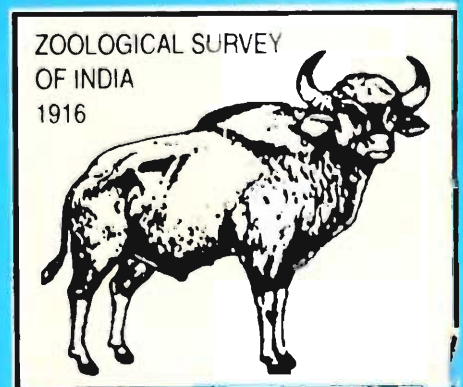


FAUNA OF CHILKA LAKE



**ZOOLOGICAL SURVEY OF INDIA
1995**



WETLAND ECOSYSTEM SERIES 1

FAUNA OF CHILKA LAKE

Edited by
The Director
Zoological Survey of India
Calcutta



ZOOLOGICAL SURVEY OF INDIA
1995

Copyright, Government of India, 1995

Published : November, 1995

Project Co-ordinator
Dr. Kaza V. Rama Rao, Scientist 'SF'
Z.S.I., Hyderabad

Price
Inland : Rs. 600.00
Foreign : £ 60.00
 \$ 40.00

Printed at PRESTECH, 39 Mahatma Gandhi Road, Calcutta - 82 and
Published by the Director, Zoological Survey of India, Calcutta

FOREWORD

The Chilka Lake in Orissa is the largest coastal Lake in the country and is well-known as an wetland of international importance. The Chilka Lake has been studied by the scientists of Zoological Survey of India during the second decade of the century and the reports published in the Memoirs of Indian Museum between 1915–1924 amply focussed on the rich faunal diversity of this ecosystem. It is reported that more than hundred thousands people are dependant on this wetland and as such the system may also be considered as one of the best example of wise use.

The Zoological Survey of India after an interval of 60 years since the last report of Chilka was published initiated an extensive survey on Chilka Lake for a period of 3 years from 1985–1987. The present volume contained the findings of the investigation and one can compare the faunal resources recorded at an interval of 60 years. In most of the cases the document reveals biodiversity at species level still appears very rich, even though the physico-chemical and limnological characteristics have significantly changed between 1925 to 1985.

It is expected that the present document will be of use to the Management Authority of this internationally recognised RAMSAR site and also to the researchers and students engaged in the area of study on wetland bio-diversity and associated fields. I would like to put on records my sincere thanks to the team leader, Dr. K. V Rama Rao and all the contributors of this volume. I would also like to extend my thanks to my colleague, Dr. J. R. B. Alfred, Additional Director and to Mr. G. Sivagurunathan, former Publication Production Officer and to the staff of Publication division for taking all efforts to bring out the volume in the present form.

NOVEMBER, 1995

DR. A. K. GHOSH
DIRECTOR

FAUNA OF CHILKA LAKE

1995

CONTENTS

APPRAISAL		
— <i>Kaza V. Rama Rao</i>	.....	1
LIMNOLOGY		
— <i>S. Z. Siddiqi and Kaza V. Rama Rao</i>	.....	11
PROTOZOA		
— <i>A. K. Das</i>	.....	137
PORIFERA		
— <i>J. G. Pattanayak</i>	.....	211
ANTHOZOA : COELENTERATA		
— <i>A. Misra</i>	.....	227
TREMATODA DIGENEA		
— <i>I. B. Dutta</i>	.....	235
NEMATODA		
— <i>S. R. Dey Sarkar</i>	.....	279
ANNELIDA : POLYCHAETA		
— <i>C. A. Nageswara Rao</i>	.....	319
CRUSTACEA : STOMATOPODA		
— <i>H. C. Ghosh</i>	.....	337
CRUSTACEA : BRACHYURA		
— <i>Maya Deb</i>	.....	345
CRUSTACEA : DECAPODA		
— <i>K. Narapu Reddy</i>	.....	367
MOLLUSCA		
— <i>N. V. Subba Rao, K. V. Surya Rao & R. N. Manna</i>	.....	391

SIPUNCULA AND ECHIURA		
— <i>Badri Prasad Haldar</i>	.....	469
ECHINODERMATA		
— <i>D. R. K. Sastry</i>	.....	477
PROTOCHORDATA		
— <i>P. Dhandapani</i>	.....	479
PISCES		
— <i>Kaza V. Rama Rao</i>	.....	483
REPTILIA AND AMPHIBIA		
— <i>T. S. N. Murthy</i>	.....	507
AVES		
— <i>S. Chattopadhyay</i>	.....	561
MAMMALIA		
— <i>Subhendu Sekhar Saha</i>	.....	601
MAMMALIA : RIVER DOLPHIN		
— <i>P. Dhandapani</i>	.....	611
PHYTO AND ZOOPLANKTON		
— <i>M. Srinivasan</i>	.....	615
ZOOPLANKTON		
— <i>M. Srinivasan and Ch. Satyanarayana</i>	.....	631
ZOOPLANKTON : In relation to Phytoplankton		
— <i>Ch. Satyanarayana and M. Srinivasan</i>	.....	649
MEROPLANKTON		
— <i>P. Dhandapani</i>	.....	655

APPRAISAL

Kaza V. Rama Rao *
Zoological Survey of India, Berhampur - 760 005

The First faunistic study on Chilka Lake, located along the east -coast of India between latitudes 19°28' and 19°54' N and longitudes 85°06' and 85°35' E was initiated by the Zoological Survey of India and the results of these studies have been published in a series of papers from 1915 to 1924 mainly in the volume V of the Memoirs of the Indian Museum. After this study, very little work on the faunal aspects were carried out except a few on the crustaceans and fishes. The Estuarine Biological Station of the Zoological Survey of India has taken up the resurvey of the Chilka Lake through the multidisciplinary team drawn from various research and academic institutions from 1985 to 1987 and the studies were carried out starting from limnology to faunal account from protozoa to mammals. The available information on the fauna of different groups of Chilka Lake is given here group-wise. The present systematic status of each group based on the expedition material is dealt in detail in the main text of the fauna of the Chilka Lake.

ACKNOWLEDGEMENTS

I am thankful to the former Directors Late Dr. B.K. Tikader, Dr.M.S. Jairajpuri, Dr.B.S.Lamba, Dr.Asket Singh, the former Jt. Directors and Dr. S.K. Bhattacharya, the former Additional Director for extending the facilities. I am also thankful to Dr. A.K.Ghosh, Director who has taken keen interest in the Chilka Lake Expedition 1985-87. Thanks are also due to officers and staff of Estuarine Biological Station, Zoological Survey of India, Berhampur as well as to the participants and collaborating agencies Headquarters, Zoological Survey of India, Calcutta, Freshwater Biological Station, Zoological Survey of India, Hyderabad, Marine Biological Station, Zoological Survey of India, Madras, Southern Regional Station, Zoological survey of India, Madras, Atomic Minerals Division, Berhampur (Gm), College of Fisheries, Orissa University of Agriculture & Technology, Berhampur (Gm), Biological & Technological Research Station, Orissa State Fisheries, Balugaon (Puri Dist.), The Marine Products Export Development Authority, Bhubaneswar, Orissa, Remote Sensing Application Centre, Bhubaneswar and Department of Zoology, Andhra University, Visakhapatnam.

I am particularly grateful to Sri Ratnakar Sabat (Motor Driver) and Sri P.Jana (Laboratory Attendent) of the Estuarine Biological Station, Zoological Survey of India, Berhampur (Gm) for their constant support throughout the Expedition.

MATERIAL & METHODS

A total of 219 stations have been established (45 during the First Chilka Lake Expedition 20-11-1985 to 22-11-1985, 74 during the Second Chilka Lake Expedition 10-6-1986 to 30-6-1986, 100 during the Third

* Freshwater Biological Station, Zoological Survey of India, 1-1-300/B, Ashoknagar, Hyderabad-500 020.

Chilka Lake Expedition 3-9-1987 to 27-9-1987) corresponding to post-monsoon (Winter), pre-monsoon (late summer) and monsoon seasons. At each station, physico-chemical parameters (surface & bottom waters), biological data pertaining to plankton (Phyto & Zoo), nekton and benthos, and soil samples were collected. The data thus collected have been analysed for faunistic as well as limnological studies and the contributions resulted are Presented chapterwise.

HISTORICAL RESUME

PROTOZOA : Annandale (1915) mentioned the presence of several fixed and free protozoa on a submerged timber in Chilka Lake along with a coelenterata. Annandale and Kemp (1915) reported Trichodina from the external surface of ctenophores. Chilton (1921) observed vorticellid protozoa on a weed from Chilka Lake.

PORIFERA : Annandale (1915) reported 7 species of sponges of which 2 are freshwater and the remaining of marine waters. Sewell and Annandale (1922) reported 3 species of sponges from Rambha bay.

COELENTERATA : 9 species of hydrozoa, 1 species of scyphozoa and 6 species of anthozoa were reported by Annandale (1915). Hamid (1931) reported *Virgularia gracillima* (Kolliker). Matthai (1924) reported a subfossil coral from the Lake. Carlgreen (1925) reported on the status of actinaria lake of Chilka Lake.

CTENOPHORA, POLYZOA, ECHIURA, SIPUNCULA, BRYOZOA AND CHAETOGNATHA : Annandale and Kemp (1915) reported a single species of ctenophora and echiura. Haldar (1985) reported 2 species of echiuroids. Annandale (1915) recorded 2 species of bryozoa (ectoprocta) and 1 species of entoprocta. Sewell and Annandale (1922) reported on the polyzoa occurring in Rambha bay. Devasundaram and Roy (1954) recorded *Sagitta* Sp. from Chilka.

PLATYHELMINTHES : Tripathy (1956, 1959 and 1977) reported a good account on the monogenean trematodes of the Lake. Chatterjee (1958), Gupta and Ahmed (1976) and Hafezullah (1984) contributed information on the digenetic trematodes of the fishes of the Lake. Southwell (1915, 1921, 1922 and 1922a) reported on the cestodes occurring in the birds and fishes of the Lake.

ANNELIDA : Southern (1921) reported 20 species of polychaetes of which 19 were new species. Fauvel (1932 and 1953) reported 23 species of polychaetes from the Lake. A detailed account on the littoral oligochaeta of the Lake was studied by Stephenson (1914). Stephenson (1915 and 1917) described 4 species of oligochaetes from the Lake. Harding (1920) reported 3 species of leeches from the Lake. Kuburaki (1921) reported five species of leeches from the Lake.

CRUSTACEA : Annandale (1915) reported on cirripedia while Chilton (1916, 1921 and 1924) dealt on isopoda amphipoda and tanaidacea of the Lake. Kemp (1915, 1915a and 1916) extensively studied the stomatopoda, decapoda and cumacean fauna. Henderson (1915) recorded hermit crabs from the Lake. Copepoda was dealt by Sewell (1919 and 1924). Tattersall (1995) reported on the fauna of mysidaceae. Sewell and Annandale (1922) reported on the Crustacean fauna of the Rambha bay. Subramanyam (1966) reported some prawns as new records from the Lake.

INSECTA : Annandale and Kemp (1915) reported on the aquatic insect fauna other than the coleoptera. Laidlaw (1915) gave an account on the odonata of the Lake. Annandale and Dover (1921 and 1921a) reported on the cicindelid beetles and butterflies. Andrewes (1921) gave an account on the carabid beetles of the Barkuda island. Dover (1921, 1921a, 1921b and 1921c) reported on the fauna of moths, wasps and bees, dipteran insects and neuropterid insects of the Barkuda island. Fraser and Dover (1922) recorded 30 species of dragonflies and damselflies from the Barkuda island of the Chilka Lake. Sewell and Annandale (1922) reported on the insect fauna of the Rambha bay. Blair (1922) reported on the heteromera of Barkuda island. Arrow (1923) reported on certain coleoptera of Barkuda island. Silvestri (1923) reported termites of Barkuda island and Annandale (1923) reported on their habits.

ARACHNIDA : Gravely (1921) described the spider and scorpion fauna of the Barkuda island.

MOLLUSCA : Preston (1914 and 1915) gave an extensive account on the molluscan fauna of the Chilka Lake. Annandale and Kemp (1916) reported on the gastropoda and lamellibranchiata of the Lake. Eliot (1916) reported on the nudibranchiata. Sewell and Annandale (1922) reported 20 species of mollusca from the Rambha bay. Hornell (1917) gave a revisionary account of the genus *Meretrix* from the Lake. Godwin-Austen (1917) reported on the mollusca collected from the Barkuda island. Annandale (1921) reported on the mollusca collected from the Gopakuda island of the Chilka Lake. Annandale (1924) gave a further account on the gastropoda of the Chilka Lake. Prasad (1939) reported 2 species of molluscs.

PISCES : Chaudhuri (1916, 1916a, 1916b) 1917 and 1923) reported on the fish fauna of the Chilka Lake. Hora (1923) reported on the fish fauna of the Lake. They recorded 118 species from the Lake. Koumans (1941) reported 1 species of gobiid from the Lake. Mitra (1946) recorded 7 species of fishes of commercial importance. Jones and Sujansinghani (1954) gave a list of fishes of which 25 were reported as new records from the Lake. Roy and Sahoo (1957) recorded 14 species as new additions to the fish fauna of the Lake. Menon (1961) listed 72 species of fishes, of which 17 species were new records. Devasundaram (1954) listed 68 species of fishes of which 40 species were found to be commonly occurring forms. Rajan, Patnaik and Basu (1968) recorded 47 additional species of fishes new to the Chilka Lake.

AMPHIBIA AND REPTILIA : Annandale (1907) reported the occurrence of 7 species of reptiles and a single species of amphibian from Gopakuda island in the Lake. Annandale (1915) recorded a single species of frog, 3 species of snakes, 2 species of crocodiles and 3 species of turtles from the Chilka Lake. Annandale (1917) reported on a new limbless skink from the Barkuda island. Annandale (1921) recorded 2 species of amphibians and 18 species of reptiles from the Barkuda island.

AVES : An account of 53 species of birds observed on the Barkuda island was reported by Annandale (1921). Recently Hussain, Mahapatra and Sahid Ali (1984) reported on the avifauna of the Chilka Lake and listed 150 species of birds.

MAMMALIA : Annandale (1915) recorded 2 species of mammals (an otter & a cetacean) from the Chilka Lake. Annandale (1921) reported a species of insectivora of the genus *Pachyura*, a rodent *Rattus rattus* and the common bat, the Indian flying fox. Hinton and Lindsay (1926) gave an account on 9 species of mammals collected from Chilka Lake by H.W. Wells.

LITERATURE CITED
(arranged groupwise/yearwise)

PROTOZOA

- Annandale, N. 1915. Fauna of the Chilka Lake : The Coelenterates with an account of the Actiniaria of brackishwater in Gangetic Delta *Mem. Indian Mus.* 5 (1): 65-114
- Annandale, N. and Kemp, S. 1915. Fauna of the Chilka Lake : Ctenophora *Mem. Indian Mus.* 5 (1): 115-118
- Chilton, C. 1921. Fauna of the Chilka Lake : Amphipoda *Mem. Indian Mus.* 5 (8): 519-558

PORIFERA

- Annandale, N. 1915. Fauna of the Chilka Lake : Sponges *Mem. Indian Mus.* 5 (1): 721-754
- Sewell, R. B. S. and Annandale, N. 1922. Fauna of the Chilka Lake : The hydrography and invertebrate fauna of Rambha bay in an abnormal year *Mem. Indian Mus.* 5 (10): 677-710

COELENTERATA

- Annandale, N. 1915. Fauna of the Chilka Lake : The Coelenterates of the Lake with an account of the Actiniaria of brackishwater in the Gangetic Delta *Mem. Indian Mus.* 5 (1): 65-114
- Matthai, G. 1924. Fauna of the Chilka Lake : On a species of sub-fossil solitary coral from the Chilka Lake *Mem. Indian Mus.* 5 (13): 897-903.
- Carlgren, O. 1925. A revision of the Actiniaria of Chilka Lake *Ark. Zool.* 17a (21): 1-21
- Hamid, A. 1931. On *Virgularia gracillima* (Kolliker) from the Chilka Lake *Rec. Indian Mus.* 33 (4): 483-487

CTENOPHORA, POLYZOA, ECHIURA, SIPUNCULA, BRYOZOA AND CHAETOGNATHA

- Annandale, N. and S. Kemp. 1915. Fauna of the Chilka Lake : Ctenophora *Mem. Indian Mus.* 5 (1): 15-118
- Annandale, N. 1915. Fauna of the Chilka Lake : The polyzoa of the Lake and of brackishwater in the Gangetic Delta. *Mem. Indian Mus.* 5 (1): 119-134
- Annandale, N. and S. Kemp. 1915. Fauna of the Chilka Lake : The Echiuroidea of the Lake and of the Gangetic Delta *Mem. Indian Mus.* 5 (1): 55-64
- Sewell, R.B.S. and N. Annandale. 1922. Fauna of the Chilka Lake : The hydrography and invertebrate fauna of Rambha bay in an abnormal year *Mem. Indian Mus.* 5 (10): 677-710

Devasundaram, M. P. and P.C.Roy. 1954. A preliminary study of the plankton of the Chilka Lake for the year 1950-52 *IPFC Symposium plankton* 48-54

Haldar, B. P. 1985. Echiura and Sipuncula Workshop on estuarine biology Berhampur 19-22 February 1985 No. 9 14 PP

PLATYHELMINTHES

Southwell, T. 1915. On some Indian Parasites of fishes *Rec. Indian Mus.* 11: 311-330

Southwell, T. 1921. Fauna of the Chilka Lake : On a larval cestode from the umbrella of a jelly-fish *Mem. Indian Mus.* 5 (8): 559-562

Southwell, T. 1922. Cestodes from Indian Birds with a note of *Lisula intestinalis* *Ann Trop. Med. Parasitol.* 16: 355-382

Southwell, T. 1922a. Cestodes in the collections of Indian Museum *Ann. Trop. Med. Parasitol.* 16: 127-152.

Tripathi, Y. R. 1956. Studies on the parasites of Indian fishes IV. Trematoda : Monogenea *Rec. Indian Mus.* 52: 231 247

Chatterjee, P. W. 1958. On a new species of the genus *Psilostomum* Loss 1899. *Proc. Nat. Acad. Sci. India.* 8(2): 96-99.

Tripathi, Y. R. 1956. Monogenetic trematodes from the fishes of India *Indian J. Helminth.* 9: 1-149

Gupta, V. and J. Ahmad. 1976. On a new Species *Skrjabinpsolus indicus* n.sp., from the intestine of marine fish *Glyphidodon bengalensis* (Gunther) from Chilka Lake, Orissa, *Indian J. Zool.* 15(1): 5-6

Tripathi, Y. R. 1977. Monogenetic Trematodes of India - reappraisal, *Indian J. Helminth.* 27: 62-105

Hafeezullah, M. 1984. On the status of some digenetic trematodes of marine fishes of India, *Bull. zool. Surv. India* 6 (1-3): 209-213

ANNELIDA

Stephenson, J. 1914. Littoral oligochaeta from the Chilka Lake on the east coast of India, *Rec. Indian Mus.* 10: 225-262.

Stephenson, J. 1915. Fauna of the Chilka Lake : Oligochaeta *Mem. Indian Mus.* 5 (1): 139-146.

Stephenson, J. 1917. Fauna of the Chilka Lake : Oligochaeta (Supplementary report) *Mem. Indian Mus.* 5(6): 483-490

Harding, W. A. 1920. Fauna of the Chilka Lake : Hirudinea *Mem. Indian Mus.* 5(7): 509-518

- Kaburaki, T. 1921. Fauna of the Chilka Lake : on some Leeches from the Chilka Lake *Mem. Indian Mus.* 5(9): 661-676
- Southern, R. 1921. Fauna of the Chilka Lake : Polychaeta of the Chilka Lake and also of fresh and brackishwaters in other parts of India, *Mem. Indian Mus.* 5 (8): 563-59
- Fauvel, P. 1932. Annelida, Polychaeta of the Indian Museum, Calcutta, *Mem. Indian Mus.* 12 (1): 1-262
- Fauvel, P. 1953. *The fauna of India Annelida Polychaeta*, The Indian Press Ltd. Allahabad 507 pp.

CRUSTACEA

- Annandale, N. 1915. Fauna of the Chilka Lake : Cirripedia, *Mem. Indian Mus.* 5 (1): 135-138
- Henderson, J. R. 1915. Hermit crabs from the Chilka Lake, *Rec. Indian Mus.* 11: 25-29.
- Kemp, S. 1915. Fauna of the Chilka Lake : Stomatopoda, *Mem. Indian Mus.* 5 (2): 191-198
- Kemp, S. 1915a. Fauna of the Chilka Lake : Crustacea Decapoda, *Mem. Indian Mus.* 5 (3): 199-322
- Tattersall, W.M. 1915. Fauna of the Chilka Lake : The Mysidacea of the Lake with the description of species from the coast of Orissa, *Mem. Indian Mus.* 5 (2):147-162.
- Chilton, C. 1916. Fauna of the Chilka Lake : Some terrestrial Isopoda from the shore of the Lake, *Mem. Indian Mus.* 5(5): 450-482
- Kemp, S. 1916. Fauna of the Chilka Lake : Cumacea, *Mem. Indian Mus.* 5(4): 393-402
- Sewell, R.B.S. 1919. A preliminary note on some new species of copepoda, *Rec. Indian Mus.* 16 (1): 11-18
- Chilton, C. 1921. Fauna of the Chilka Lake : Amphipoda, *Mem. Indian Mus.* 5(8): 519-558
- Sewell, R. B. S. and N. Annandale. 1922. Fauna of the Chilka Lake : The hydrography and invertebrate fauna of Rambha bay in a abnormal year, *Mem. Indian Mus.* 5(10): 677-710.
- Chilton, C. 1924. Fauna of the Chilka Lake : Tanaidacea and Isopoda, *Mem. Indian Mus.* 5 (12): 875-852.
- Subrahmanyam, M. 1966. New records of prawns from the Chilka Lake with a note on their distribution, *Sci. & Cult.* 32(7): 379-380.

INSECTA

- Annandale, N. and S. Kemp. 1915. Fauna of the Chilka Lake : Aquatic insects, other than Coleoptera, with notes on some marginal species, *Mem. Indian Mus.* 5(2): 177, 181-190.

- Laidlaw, F. F. 1915. Fauna of the Chilka Lake : Aquatic insects other than Coleopetra, with note on some marginal species -odonata, *Mem. Indian Mus.* 5 (2): 178-180
- Andrewes, H. E. 1921. The fauna of an island in Chilka Lake Part I Carabidae, *Rec. Indian Mus.* 22 (4): 339-348.
- Annandale, N. and C. Dover. 1921. The fauna of an Island in Chilka Lake -Part I Cicindelid beetles, *Rec.Indian Mus.* 22 (4):349-375
- Annandale. N. and C. Dover. 1921a. The fauna of an Island in Chilka lake - Part I Butterflies, *Rec. Indian Mus.* 22 (4) : 349-375
- Dover, C. 1921. The Fauna of an island in Chilka Lake-Part I Moths, *Rec. Indian Mus.* 22 (4): 377-379
- Dover , C. 1921a. The fauna of an island in Chilka Lake -Part I Wasps and Bees, *Rec. Indian Mus.* 22(4): 381-391
- Dover , C. 1921b. The fauna of an island in Chilka Lake-Part-I Dipterous insects, *Rec. Indian Mus.* 22(4): 393-396
- Dover , C. 1921c. The fauna of an island in Chilka Lake -Part I Neuropteroid insects, *Rec. Indian Mus.* 22 (4): 397-398
- Blair, K. G. 1922. The fauna of an Island in Chilka Lake Part II Heteroptera, *Rec. Indian Mus.* 24(3): 289-298.
- Dover , C. 1922. The fauna of an island in Chilka Lake- Part II Free living Thysanura, *Rec. Indian Mus.* 24(3): 303-331
- Sewell, R.B.S. and Annandale. 1922. Fauna of the Chilka Lake the hydrography and invertebrate fauna of Rambha Bay in an abnormal year *Mem. Indian Mus.* 5 (10): 677-710
- Annandale, N. 1923. The fauna of an Island in Chilka LakePart II The habits of the termites of Barkuda, *Rec. Indian Mus.* 25 (2): 233-353
- Arrow, G. J.H. 1923. The funa of an island in Chilka Lake Part II Certain Coleoptera of Barkud, *Rec. Indian Mus.* 25(2): 259-263
- Silvestri, F. 1923. The fauna of an island in Chilka Lake Part III The termites of Barkuda island, *Rec. Indian Mus.* 25 (12): 221 -232.

ARACHNIDA

- Gravely, F. H. 1921. The fauna of an island in Chilka LakePart I Spiders and Scorpions, *Rec. Indian Mus.* 22(4): 399 421

MOLLUSCA

- Preston, H. B. 1914. Mollusca from the Chilka Lake on the east coast of India, *Rec. Indian Mus.* 10 (5): 297-30
- Preston, H. B. 1915. A further report on mollusca from Lake Chilka on the east coast of India, *Rec. Indian Mus.* 11 (4): 289-310
- Annandale, N. and S. Kemp. 1916. Fauna of the Chilka Lake: Mollusca gastropoda and lamellibranchiata, *Mem. Indian Mus.* 5(4): 327-374
- Eliot, C. 1916. Fauna of the Chilka Lake : Mollusca Nudibanchiata, *Mem. Indian Mus.* 5(4): 375-380
- Godwin-Austen, W. H. 1917. The land mollusca collected on the island on Barkuda in the Chilka Lake. Ganjam, *Rec. Indian Mus.* 13 :349-351
- Hornell, J. 1917. Revision of the Indian species of *Meretrix*, *Rec. Indian Mus.* 13: 153-173
- Annandale, N. 1921. Fauna of an island in Chilka Lake-Part-I Introduction, *Rec. Indian Mus.* 22(4): 313-321
- Sewell, R.B.S. and N. Annandale. 1922. Fauna of the Chilka Lake, The Hydrography and invertebrate fauna of Rambha bay in an abnormal year, *Mem. Indian Mus.* 5(10): 677-710
- Annandale, N. 1924. Fauna of the Chilka Lake : Mollusca gastropoda (revision), *Mem. Indian Mus.* 5(12): 853-874
- Prashad, B. 1939. A note on *Meroe chilkinsis* Preston and *Meroe satparaensis* Preston from Chilka Lake. *India, J Conchyliol.* 83: 46-47.

FISHES

- Chaudhuri, B. L. 1916. Description of two new fishes from Chilka Lake, *Rec. Indian Mus.* 12 (3):105-108
- Chaudhuri, B. L. 1916a. Fauna of the Chilka Lake : Fish Part I, *Mem. Indian Mus.* 5(4): 403-440
- Chaudhuri, B. L. 1916b. Fauna of the Chilka Lake : Fish Part II , *Mem. Indian Mus.* 5(5): 441-458
- Chaudhuri, B. L. 1917. Fauna of the Chilka Lake : Fish Part III, *Mem. Indian Mus.* 5 (6): 491-508
- Chaudhuri, B. L. 1923. Fauna of the Chilka Lake : Fish Part IV, *Mem. Indian Mus.* 5(11): 711-736.
- Hora, S. L. 1923. Fauna of the Chilka Lake : Fish part V, *Mem. Indian Mus.* 5 (11): 737-770
- Koumans, F. P. 1941. Gobioid fishes of India, *Mem. Indian Mus.* 3(3): 205-313.

Mitra, G. N. 1946. Development of Chilka Lake, Orissa Govt. Press, Cuttack

Jones, S. and K.H. Sujansingani. 1954. Fish and fisheries of the Chilka Lake with statistics of fish catches for the year 1948-1950, *Indian J. Fish* 1(8): 256-344

Devasundaram, M. P. 1954. A report on the fisheries of the Chilka Lake from 1948 to 1950 Orissa Govt. publication : 1-34

Roy, J. C. and N. Saho. 1957. Additions to the fish fauna of the Chilka Lake, *J. Bombay nat. hist. soc.* 54 : 944-953

Menon, M. A. S. 1961. On a collection of fish from Lake Chilka, Orissa, *Rec. Indian Mus.* 59 (1&2): 41-69

Ranjan, S., S. Pattanaik and N. C. Basu. 1968. New records of fishes from Chilka Lake, *J. Zool. Soc. India*, 20 (1&2): 80-93

AMPHIBIA & REPTILIA

Annandale, N. 1907. Reptiles and a Batrachian from an Island in Chilka Lake, Orissa, *Rec. Indian Mus.* 1: 397-398

Annandale, N. 1915. Fauna of the Chilka Lake : Mammals, Reptiles and Batrachiana, *Mem. Indian Mus.* 5(2): 163-174

Annandale, N. 1917. A new genus of limbless skink from an island in the Chilka Lake, *Rec. Indian Mus.* 13 : 17-21

Annandale, N. 1921. The Reptiles and Batrachian of Barkuda island, Chilka Lake-part I, *Rec. Indian Mus.* 22(4): 331-333

BIRDS

Annandale, N. 1921. The Birds of Barkuda island, Chilka Lake -Part I, *Rec. Indian Mus.* 22 (4): 323-340

Hussain, S. A., K.K Mohapatra and S. Ali. 1984. Avifaunal profile of Chilka Lake & Case for Conservation, *Bombay nat. Hist. Soc. Technical Report* 4 : 1-46

MAMMALS

- Annandale, N. 1915. Fauna of the Chilka Lake : Mammals, Reptiles and Batrachians, *Mem. Indian Mus.* **5(2)**: 163-174
- Annandale, N. 1921. The fauna of an island in Chilka Lake, Part I, Introduction, *Rec. Indian Mus.* **22(4)**: 313-322
- Hinton, M. A. C. and H. M. Lindsay. 1926. Bombay Natural History Society's Mammal survey of India, Burma and Ceylon Supplement to report No. 41. *J. Bombay nat. Hist. Soc.* **31(2)**: 402-403

LIMNOLOGY

S.Z. SIDDIQI AND KAZA V. RAMA RAO

*Zoological Survey of India, Freshwater Biological Station
1-1-300/B, Ashoknagar, Hyderabad 500020*

INTRODUCTION

Chilka lake, technically a coastal or estuarine lake, is situated on the east coast of India (19°28' – 19°54'N and 85°05' – 85°38'E). It extends from the southeast corner of Puri District to Ganjam, an adjoining district in Orissa. The pear-shaped, low latitude tropical lake owes its shape to the presence of delta of the Mahanadi River in northern part, the rocky hills of the Eastern Ghat and a barrier spit separating the lake from the Bay of Bengal (Venkataratnam, 1970).

The very intrinsic nature (origin), huge size, dynamics, socio-economic potential and interesting ecology of the lake has rightly helped attract immense scientific attention and public interest. The largest of the only two lake in India, Chilka may rightly be regarded as well studied and documented lake in the world. It has, from time immemorial fascinated the researchers and lay alike chiefly for its unique physiographic attributes, dynamics and above all as a unique *biotope*.

Hydrographic studies on the vast tropical lake has long been the subject of scientific attention/ studies by previous as also contemporary workers for reasons not hard to discern. Fortunately, ZSI has been associated with not just the first ever extensive survey but also the most recent comprehensive studies on the lake during the century. The sum total studies existing on the lake to date may be broadly divided, subjectwise, as Hydrographic and Biological in nature. Further, they may be categorized as short-term and long-term studies. The long-term studies have been few and far between while a plethora of short-term studies exist. The pioneering explorative studies on the tropical brackish water lake deserve mention/review first. Interesting enough, there have been only a handful of such investigative studies to date, both classical and contemporary.

The pioneering, first ever, exploratory studies were initiated by Annandale and Kemp (1915), Sewell (1922), Roy (1954), Devasundaram and Roy (1954) and Reddy (1962), to quote few. These studies highlighted the critical hydrographic and related aspects and plankton dynamics in the unique lake ecosystem. The first thorough investigative studies on the whole gamut of physicochemical conditions prevailing in the lake (1957 – 58 to 1960 – 61) were initiated by Bannerjee and Roychaudhuri (1966). Ramanadan, Reddy and Murty (1964), studied the salinity and temperature distribution and stratification as also the water current distribution pattern in the lake between October 1965 to August 1961. Mohanty (1975), studies in detail the main physicochemical factors and their dynamics—the daily and diurnal pattern and seasonal variations—in the outer channel, an important sector of the lake interestingly neglected until then, Sarkar (1979) initiated monthly studies for seasonal and spatial

distribution of salinity in the lake, first time ever, from January 1964 to Dec. 1965. Raman *et. al.* (1990) studied the phytoplankton characteristics of the lake during the southwest monsoons (ZSI Second Multidisciplinary Expedition of Chilka Lake, 04-26 Sept. 1987).

With due regard to these group studies/efforts that should be rated as pioneering and commendable, it may be said in all earnest that situation / circumstances had imposed inherent limitations. Understandably enough, therefore often the approach was piecemeal and not holistic. The present investigation/studies may be termed as first ever, extensive, long-term multidisciplinary studies, based on first ever grid-pattern survey of the entire lake including the outer channel and mouth. Further, it attempts to beautifully blend the whole gamut of parameters in hydrography, physicochemical and biological studies through different seasons, their dynamics (*temporal variations*) and stratification (*spatial variation*) in the lake.

The ZSI's Estuarine Biological Station, Berhampur (Gm.) served as the base and provided critical infrastructural/logistics inputs with field camps/laboratories at Rambha, Balugaon and Puri for various other coordinating institutions/agencies (Appendix A). The extensive studies on these varied aspects, including meteorology, *etc.* may be humbly be regarded as the only singular attempt of its kind, nature and magnitude to date. The hydrographic, limnochemical and limnobiological aspects of studies have helped chart a meaningful ecological profile of the lake and sound evaluation of its *trophic* status. Truly therefore, the studies may be rated as *holistic* in approach. The extensive data generated on the whole gamut of physical and limnochemical factors (Appendix C) was simultaneously fed to other collaborators for help in analyses and interpretation of biological data and variations therein (faunal distribution and dynamics). The same have been liberally used extensively although by the different contributors in the present monograph and earlier technical reports notably ORSAC Interim Report on Chilka Lake (1988) and Orissa Environmental Society (1988). Further, the data also inspired parallel academic endeavours by Mahapatra (1988), Tripathy (1988), Satyanarayana (1988), Mohanty (1989), Raman *et. al.* (1990) and others.

Chilka Lake and its Environs

Stretching across two major coastal districts of Puri and Ganjam, the Chilka lake (19.28 – 19.56°N and 85.05 – 85.41°E) is situated along the Orissa coast (Figure 1). Orissa, a maritime state, has a considerably long coastline (*ca* 480 km) and is naturally blessed by extensive systems of creeks, estuaries, mangroves and brackish water lakes aggregating to an area 18,000 ha (Govt. of Orissa Publication, 1988). Orienting from North-East to South-West, parallel to the coastline, the major part of the lake lies in the Puri district while only the narrow stagnant stretch extends into the Ganjam district. The pear-shaped lake is wider in the northern than the southern region. It is bordered by Eastern Ghats, the Howrah-Madras railway line and further, the National Highway Number 5 (N.H. 5) on its western flank and the Bay of Bengal on its eastern side. Besides Rambha, Chilka, Kallikote and Balugaon towns are the important Railway stations and fish landing centre on the western edge. INS Chilka, a naval establishment, has also been set-up around. Satpara, a small village on the eastern bank, has fast emerged as a good fish landing centre and has road links with Puri, the famous temple town with an equally magnificent sea beach.

The lake is separated from the sea by a sand bar, *ca.* 60 kms in length, formed by the waves and wind in the fore-shore area. The sand bar is concave towards the sea and is irregular on the other

side having a number of small cuspidate spits. The total area of the sand bar together with its spits has been estimated to around 323.62 km² and acts as a barrier island between the lake and the sea. The lake is connected to the sea by a narrow, zig-zag channel (length widely put at between 24 – 35 kms) opening into the sea at Arakhakuda.

The outer channel is peculiar in its course, does not run directly from the sea to the lake, and infact has a course parallel to both for some distance. A narrow sand pit separates the outer channel from the sea on one side, while a series of broad peninsular islands seperate it from the main lake. Around Satpara peninsula, the channel divides into two branches. One continues along the original course and eventually merges in a network of swamps and narrow water ways. The other broader branch turns at right angles and continuing round the Satpara region reaches the main part of the lake at a point called Mugger Mukh. The opening at Mugger Mukh is extremely shallow during the summers. The chanel and its complex physiography permits limited tidal incursion of sea water into the main area and therefore flushing is poor. As a result, the lake waters remain brackish for most part of the year.

The mouth of the channel is *ca* 30 m wide. Interestingly enough, there has been significant shifting of the mouth of the lake. Thus, it is reported to have been cut once (1825) and subsequently later widened by about 200 m. The Survey of India reportedly mapped three mouths near Arakhakuda in 1930. Studies during the mid sixties revealed shifting of the mouth by about 8 kms north-east of Arakhakuda with a width of 1931 metres. Das and Samal (1988) reported further reduction in the size of the mouth to 400 m. By all accounts therefore, the location of the mouth of the Chilka, at any point of time appears to be highly variable and shows a gradual shift to the north eastern side due in part to the continuous growth of sand bar towards the north.

The freshwater inflows along the northeastern and southwestern flanks into the lake are mainly let in through the network of different tributaries of the major rivers of Ganjam and Puri districts. Thus, the lake receives, on a average reckoning, *ca* 3,75,000 cusecs of flood waters from river Daya, Nuna, Ratnachira, Bhargavi and Kania in Puri district. Malgoni, Dhanua and Salia from Rampur-Banpur block under Puri district, as also ten water channels (Jora) in Khallikote block, also discharge into the central sector of the lake. The various tributaries also carry huge load of silt (13 million tonnes/year) along with flood water thereby rendering the lake shallow and turbid as the flush out rate into the sea, through the mouth of the lake, is reduced considerably due to narrow, elevated orifice of the mouth (Sahu, 1988).

Untill few decades back, the Rambha bay in the southern end of the lake was connected to Rushikulya estuary, located *ca* 20 kms south of the lake, by a canal (Palur canal). The Palur canal was excavated primarily for navigational purposes and perhaps to help maintain the brackish water attributes of the Rambha bay for fisheries purposes. As of now, the link has been narrowed off due to heavy siltation and the water-holdings along the canal used for prawn culture.

The vast idyllic lake holds several rocky islands and hills in its fold in the central and southern sector. The Breakfask Island, and the Honeymoon Islands located in the southern sector, and the Kalijai, a hill temple resort of Goddess Kalijai, lies in the central sector are fast emerging as places of historical/ tourish interests. Few islands in the central sector, Bhasramunda and Chadyoga, for instance, also serve as perching and nesting grounds for winter-winged visitors (migratory flocks of birds). Yet another notable island, the Nalaban, in the central sector off village Balugaon, has a wide stretch of swampy

zone (ca 8 km²) and has emerged as a bird sanctuary playing host to the migratory birds from Siberia and Khajakistan (erstwhile USSR).

The swampy land area in around the periphery of the lake measures ca. 238.16 kms. The eastern edge of the lake has a complex mesh of channel following incessant silting and gradual formation of small islands in close proximity. Of late, following heavy inflows of nutrients (*external loading*) and attendant nutrient enrichment, the lake is heavily infested by aquatic weeds of different kinds. Thus, the entire stretch of lake waters along the Rambha bay (southern sector) and central region are blanketed by *Potamogeton pectinatus*, *Gracilaria lichenoides* and *G. confesoides*. Other notable macrophytes of importance are *Najas faveolata* and *Halophila ovata*. Besides, the peripheral edges show luxuriant growth of water hyacinth (*Eicchornia crassipes*). A number of grasses of different variety also grow in the shallow northern region.

The faunal diversity of the lake is impressive too on all counts. The lake plays host to ca. 212 species of fresh / brackish water fishes, 150 species of avifauna, two species of crobs dolphins, wetland wildlife, *etc.* to quote notable fauna besides migratory birds (especially water fowl) and indeed the whole gamut of aquatic/wetland fauna-Protozoa to Mammals. The diversity of crustacean zooplankton, phytoplankton and other planktonic groups is simply staggering and awespiring. Of the various aquatic ecosystem, the lakes and estuaries are not just one of the most productive area of the marine ecosystem but considerably fragile too. Historically, lake serve as sheltered sites of human habitation providing access to both land and the sea. From time immemorial, these have been put to wide variety of uses – harvesting, fisheries / aquaculture, inland water transport, exploitation of minerals, recreation, aesthetics, dumping of wastes, *etc.* The incessant anthropogene activities (man-induced changes) coupled with natural changes due to climatic, geological, physicochemical and biological factors are known to positively influence, and further, alter the natural attributes of the lake. Further, the very physicochemical *milieu* and biological profile in the vast lake are subject to *spatial* and *temporal* changes (over space and time). Lakes therefore offer innate scientific challenges in unravelling their structure and dynamics. Therefore, the upsurge of scientific interest in basic researches aimed at not just understanding but managing the critical lake ecosystem for various natural (preserving gene pools and natural resources, *etc.*) and economic reasons is understandable and natural, indeed commendable.

The past few decades have witnessed the near toll of the Chilka lake following mainly unrelenting economic exploitation and attendant anthropogene activities. The annual fish catch from the lake is ca. 6,000 tonnes. About 60,000 fishermen from around 122 villages in its vicinity earn their livelihood (Sahu, 1988). This has led to concomittant mushrooming of brackish water fish farms, fish landing and processing centres following the prospects of 'blue revolution' (boom in aquaculture), all obviously at a heavy price. The outer channel's increasing shallowness and fishing nets (overfishing by enthusiast fish farmers) obstruct the free natural movement of fish/prawn adults/larvae eventually effecting their ecology and thereby the fish production/yield. As a result the annual fish production has declined from 8,590 tonnes in 1985-86 to 4,273 tonnes in 1992-93. Weed infestation is yet another serious threat beside alarming siltation and nutrient enrichment. The idyllic beauty, the scenic landscape of islands and hills around, the breathtaking range of resident and migratory avifaunal profile, and the

island temple of Goddess Kalijai offer irresistible fare to the ever increasing number of tourists and consequent environmental problems to the fragile lake environment.

Chilka lake, the largest tropical lake in Asia, therefore has been the cause of appreciable concern of all the scientists, planners, policy makers, administrators and indeed the politicians and public alike. Endowed as a unique waterfowl habitat, it was declared a "Wetland of international importance" under Ramsar Convention in 1979, and later ratified by the United Nations Conference on Human Environment at Stockholm. Everyone seems to be genuinely concerned about the imminent environmental threats to the unique tropical lake and its ecology from the onslaught of wanton development around. Chilka lake, the undisputed natural heritage and endowment, appropriately designated as Ramsar site, needs all out efforts, on war footing, for its conservation. This humble endeavour in unravelling the structure and dynamics of critical hydrographic and chemical factors in the lake, over space and time, aims at providing all planners, decision-makers, administrators, and indeed all concerned, with necessary technical inputs to arrest the ecological degradation and help plan appropriate reclamation and conservation measures.

Climate

In general, the climate in the coastal districts of Orissa can be classified as tropical savannah type (Sinha, 1971). Generally speaking, the region experiences four different seasons, often pronounced - summer (March-May), rainy (June-September), post-rainy (October-November) and winter (December-February). However, for operational convenience and analyses of critical hydrographic data, the following seasons are considered summer (February-late June), southwest monsoon (late June-September) and winter or post-monsoons (October-January).

The rains in the region are a result of both the southwest monsoon as also the north-east monsoon. Of late, the southwest monsoon in the region plays traunt, and therefore there are scant rains and the rainfall pattern getting increasing erratic/unpredictable. During the course of second expedition (05-07 September 1986), the rains had set in timely, around mid-June but the average rainfall was inadequate. During summers, the weather remains extremely hot due to high insolation and long sunshine hours, *ca.* 13 hrs/day. The winters are sufficiently cool as the landmass as also the atmospheric conditions are influenced by flow of cold wave from north to south *i.e.*, from the plateau of Tibet and Himalayas over the Indian peninsula. Not surprisingly therefore, the intense change in the climatological profile around the area profoundly affects the hydrography of the lake in significant measure.

MATERIAL AND METHODS

The lake was surveyed first time ever on grid-system althrough its length and breadth. In all, *ca.* 500 and odd samples of lake water, and plankton, from subsurface and bottom, nekton, predominantly fishes/crustaceans and other groups, and benthos, including macroinvertebrates malacofauna, *etc.* were collected from 219 sampling stations from all sectors including outer channel and the mouth in the lake althrough the course of multidisciplinary expedition between 1985 1987 (Appendices C, D to F).

Invariably, field studies/collections were restricted to near three weeks of real-time survey for

hydrographic, limnochemical, limnobiological studies, *etc.* (Appendix B) including time spent on logistics, during each expedition, spanning the three major seasons in the region as under.

<i>Seasons</i>	<i>Calendar Months</i>
Summer	March - June
SW Monsoon	July - Sept./October
Winter	November - February

The hydrographic/limnologic measurements for critical parameters were made either *in situ* (using pocket meters/electronic probes for temperature/pH, conductivity, salinity, specific gravity, *etc.*), *onboard* (free CO₂ estimations, *etc.*) as also back in the camp laboratory for various titrimetric (color) estimations - dissolved gases, *etc.* and instrumental analyses (turbidity, *etc.*). The bottom water samples were collected using a Kemmerer-type water sampler with trip mechanism. The water samples were invariably carried/transferred in ice-box, under shade in pyrex glass and or wide-mouth PVC 1 L capacity bottles (Tarsons make), raw and or after suitable pretreatment (Winklerisation, for DO samples) and analysed in camp laboratory without loss of time. Standard methodology in vogue was followed for field collections/analyses and laboratory studies (Strickland and Parsons, 1972; FAO, 1975; APHA/WPCF and AWWA, 1979; Lind 1979; Wetzel and Likens, 1979, Barnes, 1980. UNESCO Technical papers, 1980, 1981; Grashoff *et. al.* 1983; Baker and Wolff, 1987 and others). The data gathered was analysed sectorwise (Appendices D-F for grids falling sectorwise) as also seasonwise for ease of comprehension and meaningful comparison. Further, the data was pooled for gathering study period/seasonal averages (save for pH). The minima and maxima observed as also the range of values obtained, again seasonwise and sectorwise, have been mentioned specifically while making observations parameterwise.

While the whole gamut of physicochemical parameters have been analysed, observations have been restricted to detailed treatment of few conservative parameters, say like temperature and salinity, and like. The same (conservative property) have been used as labels for identification of water type. A water-type is identified by its temperature and salinity while a water mass results from mixing between two water types in adjoining sectors. In short, therefore the observations made herein rely more on conservative parameters for meaningful evaluation of water characteristics.

SURVEY AND SAMPLING

Traditionally, the earlier workers divided the Chilka lake into four sectors – southern, central and northern sectors and the outer channel. While apparently arbitrary, the division of the lake is scientific and meaningful, inspired and reasoned from data on hydrography, bathymetry and sediment types (Figure 1).

The entire lake was surveyed on a grid-network or transect lines at intervals of 2.5 km apart. Sampling stations were located at points of intersections of the latitudes indicated by numerals (1, 2, 3, 4, *etc.*) and longitudes through alphabets (A, B, C, D, *etc.*). Consequently, the

sampling sites/stations like A₂, B₂, C₃, D₄, etc. The sampling stations were located using Brunton's Compass / sextant and other prominent land-marks around or similar comparable permanent features on shores around or islands within the lake. In all, a total of 219 sampling stations were determined/surveyed evenly dispersed over the length and breadth of the lake (Figure 2) during the course of three expeditions between 1985–1987. The sampling station-wise break up of the different sectors during the course of three expeditions have been tabulated (Appendices D to F).

A uniform format of field studies was followed for reasons of operational convenience and invariably the lake was covered from Rambha village (OTDC Hotel), Barkul village (OTDC Hotel) and Puri (Youth Hostel, etc.). The first camp, Rambha helped take care of the grid-network stations falling in the purview of southern sector (Rambha Bay) while Balugaon camp eased coverage of central and northern sectors. Puri camp, located ca. 68 kms from the lake, served as the base for daily to and fro road ways visits to the Satpara village and thence into the lake through out-board motor boats and mechanised boats.

The multidisciplinary approach to the studies implied co-operation and ready availability of inherently vast and varied group personnels/collaborating agencies (Table for details of collaborating institutions / universities) and therefore suitable time-frame for field studies. The development of infrastructural logistics facilities therefore imposed limitations on host institute (ZSI and Coordinator Dr. Rama Rao) constraining restricting of seasonal studies to the same calendar year. They were therefore extended to next seasons during the study period (1985–1987).

MORPHOLOGY AND ORIGIN

Geomorphology.

The Chilka lake, ecologically a wetland of international importance, is a pear-shaped brackish water lake located on the east coast of peninsular India. It is the largest of the two lakes on the eastern coast. Confluent with the Bay of Bengal, it extends from Bhusandpur in Puri District in the north to Palur in Ganjam District in the south. It is separated from the Bay of Bengal by a barrier spit attached at its southern end (Venkataratnam, 1970). The physiography and geology of the surrounding environs have been reviewed by Katre and Das, (1988) while Rao, Subramaniam and Sudarshana, (1988) studied morphology of the lake using remote sensing. The earlier attempts to describe the general physical and topographical features of the lake were by Annandale and Kemp (1915), Mitra (1946), Jones and Sujarsingani (1954) and Mitra and Mahapatra (1957).

Of the ca. 1055 sq. km lake area, about 223 sq. kms is covered by hillocks dotting the shoreline along the north-south side of landmass. The rocky hills are made up of hard, metamorphosed precambrian rocks (garnet sillimanate gneiss, quartzites and charnockites) and project as promontories into the lake causing the formation of bays (Venkataratnam, 1970). The distance between the northern and southern limits of the lake is 72 kms. The southern part of the lake lies in the Ganjam District and is dented and covers a distance of 5 kms landmass from east to West (Directorate of Fisheries, 1970).

Origin.

Despite the upsurge of studies on the tropical lake, the origin of the lake has not been commented upon save observations by Blanford (1872) and Venkataratnam (1970). Blanford (1872) regards the lakes as a part of sea rendered shallow primarily from deposits from the mouth of the river Mahanadi and further from silt carried up the Bay around the hills near Ganjam by violent southerly winds of the monsoon. It was then entirely cut off by a spit, formed by the same agency, of sand drifted along the coast, at a height of 20 to 30 ft. above the present flood level of the Chilka. Pascoe (1964) confirmed this observation. According to Venkataratnam (1970), the process of deposition of the spit and other sand ridges were initiated sometime during the last sea-level rise *ca.* before 3,750 + 200 years B.P. Subsequently, minor tectonic uplift led to emergence of land helping these feature rise permanently above sea level.

The earths crustal movements are known to cause depressions that can hold water. Indeed, some of the most remarkable lakes in the world owe their origin to tectonic phenomenon and therefore rightly called tectonic lakes. Based upon observations of Blanford (1872) and Venkatarathnam (1970), Chilka Lake may well be regarded as tectonic in origin. Ghosh and De (1972) considered Chilka lake as a deltaic lake.

Morphometry : Surface/Subsurface Dimensions

The lake has a surface area of 905.71 km during summer and a maximum water-spread area of 1,165 kms during the southwest monsoon season. The *maximum length* (*l*) or the wind effective length, a limnologically significant factor, is 64.3 kms. One study/estimate puts the *l* as 72 km, the distance between the northern and southern limits. The *breadth* or *maximum width* of the lake (*b*) is 20.1 kms. The *mean width* (*b*) is 14.08 kms (in summer) or 18.10 kms (in rainy season) during different times (seasons) of the year. The maximum depth (*ZZ* max), the deepest spot in the lake, recorded during the study is 3.30 m (C_3 , southern sector). Earlier records regard the central sector comprising the kalihai ganda as the deepest part of the lake (Sahu, 1988). Again, the depth too is variable during different seasons. Thus, it reportedly varies from 0.94 – 2.63 m in summers, and from 1.7 – 3.70 m during the rainy season or flood season (Jhingran and Natarajan, 1966). The range of depth recorded during the present studies varies from .40 – 3.30 m.

The bedrock is uneven and the depth of the lake varies. The entire lake has been appropriately divided, on the basis of depth, and other hydrographic features, into (1) *Southern*, (2) *Central*, (3) *Northern* sectors and the (4) *Outer Channel* including the mouth. The central part includes Kalijai ganda and incidentally is the deepest part of the lake. The outer channel is formed by landmass projected from north-east side of the lake and extending upto Satpara village. It links the main lake basin to the sea after running parallel to the sea for 24 kms. The Channel mouth is vulnerable to shifting from time to time. The topographical features and shifting nature of the outer channel has been discussed by different workers (Annandale and Kemp, 1915; Mitra, 1946; Subba Rao, 1964; Jhingran and Natarajan, 1966 and Mohanty, 1975). The mouth of the lake – Magarmatha or Muggermukh, connects the lake to the Bay of Bengal, and lies to the north east of Satpara in central sector.

The Rivers Daya, Nuna, Ratnachira, Bhargavi and Kania of Puri District discharge their flood

waters in the north-eastern sector. These discharges in turn help purge out the saline water from the area making the northern sector almost fresh or sweet in nature. The central sector too receives discharges from Malaguni, Dhanua and Salia from Ranpur – Banpur blocks of Puri districts. Further, ten water channels (Jora) from Khaliokte block of Ganjam District also discharge their waters into the central sector of the lake. *Ca.* 3,75,000 cusecs of flood waters help flush out equivalent volume of saline water of the lake through Magurmukh mouth into the Bay of Bengal. In the process, the lake is rendered sweet, following around influxes of freshwater into it and remain so through July to October each year (Sahu, 1988).

In an interesting development, the southward wind blow begins by January about the time the flow of flood water into the lake recedes. In equally an interesting reversal of events, saline water from the Bay of Bengal rushes into the lake during high tides through the Magarmukh eventually turning the lake water saline. The lake during January – July, therefore, is rendered saline following this interesting reversal of events. Nor surprisingly, therefore, the lake exhibits a cyclic change in salinity with marked seasonality. The unique process is interesting and is of biological significance.

Based upon the various published/documented accounts, a synoptic view of morphometric attributes and related limnological features of the tropical lake is attempted here under. The format followed is at variance, since the lake under investigation is not really a typical closed or open lake ecosystem, but indeed more dynamic and complex in view of its characteristic physiography.

<i>Surface/Sub-surface Dimensions</i>	<i>Km₂</i>
Total Water Spread Area	905.71
Maxi. Water Spread Area (during rainy season)	1,165.00
Maxi. length (<i>l</i>)	64.3 (72.00)
Maxi. width or breadth (<i>b</i>)	20.1
Mean width (<i>b</i>) – summers	14.08
Mean width (<i>b</i>) – rainy season	18.10
Maxi. depth (<i>z</i>) of lake	—
Water Area (Vegetation free)	726.61
Vegetation area	179.10
Lowlying land	90.17
Sand Dunes & Bland Area	322.63
Nalaban typeland	238.16
Drainage area	305.79
Agricultural land area	481.18
Area of Chilka Influence	2,346.64

(Modified after Rao, Subramaniam and Sudharshana, 1988).

LAKE ENVIRONMENT: Hydrographic & Physicochemical milieu.

Observations on the various physicochemical characteristics of the lakeal waters have been reported from time to time, beginning from Annandale and Kemp (1915), Sewel (1922) and others. But by far, the most extensive observations have emanated from the Central Inland Fisheries Research Institute (CIFRI), Barrackpore's Chilka Investigation Unit then based at Balugaon, Orissa for nearly a decade (1957-1967), Banerjee and Roychoudhuri (1966), therefore were the first to make extensive studies on the physicochemical features of the lake (April 1957 - March 1961), from six sampling stations spread over the different sectors of the lake. Further, they correlated the physicochemical characteristics to phytoplankton production, zooplankton and indeed fish production and the seasonal dynamics therein. Yet other notable works include Devasundaram and Roy (1954), Ramanadham, Reddy and Murthy (1964), Asthana (1978), Sarkar (1979), Patro (1970), Patnaik (1973), Patnaik and Sarkar (1976), and others.

The present endeavour is also the first of its kind in view of its magnitude (three expeditions spanning major seasons between November 1985 to September 1987) extent (ca. 219 sampling stations) coverage (subsurface/bottom water sampling for *horizontal/vertical* profile of the lake waters) and nature (multidisciplinary approach, data gathered on meteorologic, geologic, biologic, fisheries, remote sensing, *etc.*). The presentation and treatment here therefore of necessity is restricted to observations on the characteristics of lake waters based upon analyses and processing of basic physicochemical data for subsurface/bottom waters for all the sectors, indeed entire lake, seasonwise and yearwise.

The general range of values prevailing as also the seasonal pattern/variations, if any, have been analysed and observations made for the seasons - winter, summer and sw monsoon as also for the entire study period. The accompanying figures (contour maps) and histograms reveal prevailing contours/pattern sectorwise, in a given season as also for the study period (3 year). Thus, while the figures (maps) illustrate the prevailing contours based upon the range of values prevailing in the entire lake, say for Secchi Disc Transparency, depth, water temperature, pH, conductivity, *etc.*, the histograms additionally reveal the averages obtained seasonwise as also for the study period for a single parameter for both subsurface and bottom waters respectively in a given season/sector. The sectorwise individual values for different grids in a given sector were pooled parameterwise to compute seasonal average values for a parameter. The study period averages for a parameter was computed pooling the entire data for a year. Thus each parameter was analysed for obtaining a seasonal as also study period average and as a result the accompanying histograms each for say Zsd, or depth, help respectively reveal seasonal and study period averages. Further, the parameter under review is also analysed for its range/pattern in subsurface and bottom waters respectively again seasonwise as also for the study period.

As pointed earlier, while the physicochemical data was gathered on the whole gamut of basic hydrographic and chemical characteristics of the brackish water lake (Tables 1-12), only data on the more conservative parameters like depth, temperature, conductivity, salinity, *etc.* has been analysed for observations and evaluation of water characteristics and seasonal dynamics. Observation on other parameters, including inorganic nutrients, *etc.* have been deferred for treatment elsewhere.

VISIBILITY (Secchi Disc Transparency, Zsd,m)

Simply stated, visibility is a measure of depth to which one may see into the water. The Secchi

disc visibility is a simple, useful and reliable method of comparing the visibility of different waters (water types, in the present case) especially when measured by the same observer.

The range of Zsd values observed in different seasons as also for the entire 3 year study period have been tabulated below for easy comprehension and comparison. Figs. 3, 4 and 5 graphically represent the transparency profile during different seasons while fig. 6 and 7 illustrates the seasonal and study period averages.

Sectors	Winter		<i>Zsd,m</i>		SW Monsoon		Study Period Average
			<i>Seasons</i>				
			Summer				
Southern	.70	1.77	.20	1.8	.5	2.1	.9041
Central	.27	1.42	.10	1.7	.20	1.2	.6671
Northern	.13	.58	.10	.50	.10	.66	.4834
Outer Channel	.22	.60	.20	.90	.30	.60	.4566
Seasonal Average	0.5662		0.5821		.6079		0.5821

The extensive Zsd data gathered from *ca.* 200 sampling stations (excluding extremely shallow stations which recorded 100% visibility/transparency) revealed the following pattern of transparency or visibility in the lake. A sectorwise profile reveals the southern sector recorded for higher average Zsd values (0.9041 m) than others followed by central sector (0.6671 m) and outer channel (0.4567 m). Northern sector fared poorly in terms of Zsd values or visibility, recording an average, of 0.4834 for the study period (figs. 7). The overall average Zsd value for the entire lake for the three year study period worked out to 0.5686 m.

The average Zsd readings for different seasons revealed interesting variations with changing seasons. The present study records higher average Zsd values for southwest monsoon (.6079 m), followed by summer (0.5821 m) with winters recording marginally lower values (0.5662 m) (Fig.6). The departure from the usual seasonal pattern, low Zsd values in May-June to further lower values during August-September, is apparently unusual though not hard to reason. The southwest monsoon, and consequently rains had not only set in late but were also less vigorous/active during the period under observation (1985-1987) and therefore, the Zsd seasonal profile is at variance than the usual format of seasonal pattern, as observed by Banerjee and Roychaudhuri (1966). With inadequate rains and consequently lesser surface inflows from all around, the lake waters were less turbid and therefore more transparent (higher visibility). However, the present study strongly reinforces the widely held view of transparency/visibility profile of the lake sectorwise. Thus the southern sector exhibits higher visibility or transparency 0.9041 m (Fig.6) than the other sectors/ regions. The northern sector is poor in terms of higher water transparency/visibility (0.3138 m) mainly following higher turbidity due to influxes from silt-laden freshwaters from rivers Daya and Bhargavi. The central region recorded average transparency (0.6671 m) while in the outer channel the average Zsd was higher at 0.4567 m (Fig. 6).

The sectorwise range of Zsd values observed for the period under review are as under.

<u>1985 - 1987</u>			
	<i>Range</i>	<i>Mini.</i>	<i>Maxi.</i>
Southern sector	.20 - 2.1 m	.20 (A ₃)	2.1 (A ₄)
Central sector	.20 - 1.7	.20 (K ₁₃)	1.7 (E ₇)
Northern sector	.10 - .60	.10 (M ₁₃ , R ₁₅₋₁₆ & S ₁₃)	.60 (M ₁₂)
Outer Channel	.20 - .90	.20 (N ₁₀)	.90 (T ₁₀)

Interestingly enough, while the average Zsd values seasonwise apparently do not reflect the standard seasonal pattern (Fig. 6), the individual sectorwise Zsd values do so. Thus, while the all time seasonal low was observed in northern sector (.10 cms M₁₂, M₁₃) during summers (1986) the all time peak in Zsd values (2.1 A₃) was observed during southwest monsoons (Tables 9-12). Observations on other related physical attributes like photic depth (pd), attenuation coefficient (E), as also vertical extinction coefficient (n) have been deferred for discussion elsewhere.

In general, Secchi disc visibility or transparency largely depends on turbidity in typical estuarine ecosystems. This is also true of Chilka, a brackish water lake for the two ecosystems, fresh and estuarine, apparently different, share common ecological attributes. In highly turbid lakes, the Zsd values can be quite low. The extensive range of observations ratify this. The overall seasonal/study period Zsd average for the tropical lake was observed to be 0.5686 m (or 56 cms) while the overall Zsd range was .2 m (20 cm) to 2.1 m (210 cm) during the course of 3 year studies. Interestingly enough, secchi disc transparency show negative correlation to depth. Thus, the Zsd values are lower at deeper stations but higher at relatively shallow station. The light reflected from the bottom sediment at shallower sampling stations/ regions helps render increased visibility. In other regions of the lake, the waters are generally turbid and therefore low in visibility/transparency. M₁₃, R₁₅₋₁₆ and S₁₃ in the northern sector recorded the lowest Zsd readings (10 cms).

The transparency, visibility, of light penetration pattern, in a coastal lake is highly dependent on such critical factors like turbidity, intensity and duration of solar irradiance, presence of light absorbing particles both living - *sexton* (plankton - phyto-plankton and zoo-plankton) and non-living- *tripton*, and cloud cover over the sky. According to Tripathy, 1988 the extinction coefficient (K/m) values vary widely from .1 to 11.54 during December 1985. The mean (K/m) values in the southern sectors where higher than those recorded in other sectors. A near four-fold rise is noticed between high (K/m) values, implying the northern is relating more turbidity than other sectors of the lake. Heavy inflows of silt under turbid fresh water therefore influences the transparency/visibility and thus turbidity of the water in the lake.

DEPTH (d,m)

The depth at each sampling station was measured using a sounding line having a leadweight at one end and marked with divisions at 10 cms intervals from below upwards. Accounting for free

surface oscillations at the air water interface, the accuracy of measurement ranges within ± 5 cms. Alternately, a graduated pole with a flat plate affixed at its base as also a battery operated echosounder were also used to record the depth. Figs. 8, 9 and 10, the depth contour maps, help provide the bathymetric profile of the lake during the three seasons-winter, summer and sw monsoon. Table 1-12 provide the depth readings, gridwise. In general, the lake is quite shallow and most studies report the average depth at 1.5 m. The general range of depth of the lake, observed during the course of investigations, varied widely between .40 4.9 m.

The huge lake also show interesting sectorwise as also seasonwise variations in depth. The general average depth recorded sectorwise/seasonwise are tabulated below for quick comparison and comprehension.

Sectors	depth, $d(m)$						Study Average sectorwise
	Seasons						
	Winter		Summer		SW Monsoons		
Southern	.70	3.30	.60	2.7	.5	2.7	2.055
Central	.90	2.80	.40	2.9	.55	2.7	1.6758
Northern	.70	1.70	.70	1.6	.40	1.6	0.3138
Outer Channel	.50	1.5	.40	4.9	.40	1.8	0.4567
Seasonal Average	1.5212		1.7077		1.4517		—

Analysing depth data sectorwise, the northern sector (S_{12}) as also some parts of the outer channel (N_{10}) recorded average depths as low as .40 m (40 cms) while the outer channel (R_9) had an average sectorwise depth as high as 4.9 m (Table and). Interestingly enough, the general average depth values, sectorwise, conform the established depth profile with southern sector recording higher depth (2.055 m) and the northern sector recording the lowest average depth values (0.3138 m) in the entire lake. Like the secchi disc visibility, the average Zsd or transparency profile observed during the present study do not conform to the normal seasonal format, higher average depths during rainy season and all time low during summers (Fig. 7). Nevertheless, the higher average depth values during summers (1.7077 m) may be attributed to early onset of rains (probably premonsoon showers) during June 1986 and inadequate, less vigorous rains the following season (1987).

A close glance at the different bathymetric maps (Figs. 8, 9 and 10) reveals that there is increase in depth of the lake in a north-south direction. Katre and Das, (1988) too record higher depth in south-west section rather than the north-east section, confirming the general depth profile pattern (increase along north-south direction) in the lake. The inflows into the lake from north-east though major river located therein viz. Daya, Bhargavi, Makar, Kusum etc. and other sources, render the northern sector at lake relatively shallow.

In conclusion, the depth, an important environmental characteristic of the lake, for it in turn

influences other factors, is a highly variable feature, as most previous studies on the lake from time to time reveal. Of late, the heavy inputs (loading) of silt/sediment, through river discharges in the north-east region, have been the single important causative factor in rendering the lake shallow as previous studies corroborate (Asthana, 1976, Katre and Das, 1988 and others). The increased inputs/loading, and thus increased inflows of inorganic chemical plant nutrients (nutrient enrichment) has triggered increased growths of major types of aquatic weeds; especially macrophytes, enhancing further silting and thus influencing depth.

Temperature (°C)

Temperature not just influences thermal properties in an aquatic ecosystem but is also important in terms of ecology. The relationship between water and temperature, often significant and dramatic with changes in season (seasonal variation), is not just crucial but complex too. The close intimate nexus between ambient atmospheric and water temperature needs no emphasis and therefore crucial in any studies of physical characteristics of lake. The overall influence of temperature on thermal structure and dynamics is best observed in the annual temperature cycle of lake or estuary for that matter. In order to study the influence of temperature, the ambient atmospheric temperature profile is also considered for it facilitates meaningful evaluation.

Extensive field/*in situ* measurements (using temperature probes) of ambient atmospheric, subsurface and bottom water temperatures were made for drawing observations on the general water temperature in the tropical lake. The tables 1-12 help provide the extensive data gathered at each sampling station for ambient atmospheric, subsurface and bottom waters (save shallow grids, where bottom water temperature recordings were ignored). Figs. 13 and 14 help provide the seasonal as also study period average for ambient temperature while figs. 15, 16 and 17 graphically illustrate the subsurface water temperature profile in the lake for different seasons - winter, summer and SW monsoon. Further, Figs. 18 and 19 furnish the average subsurface water temperature profile seasonwise as also for study period. Contour maps, based upon the bottom water temperature profiles in the lake for the three seasons have not been enclosed, but the figs. 20 and 21 help provide the average bottom water profile through various seasons and study period respectively.

Ambient Atmospheric Temperature (°C)

The ambient atmospheric temperature varied widely during the course of studies, spanning over the three major seasons extending over to near two calendar years. Generalization on the range, especially sectorwise/ seasonwise, therefore, will be misleading for ambient atmospheric temperatures too depend on a number of variables. Infact, only the seasonal averages suggest some patterns. Nevertheless, the range as also the average ambient temperature profile for the study period is as under:

<i>Seasons</i>	<i>Range (°C)</i>	<i>Average (°C)</i>
Winters	24.2 -33.8	28.2031
Summers	25.5 - 34.8	29.0883
SW Monsoons	28 34.0	31.86113

The minimum and maximum ambient atmospheric temperature recorded were 24.2°C (K_{15} -Central sector) and 34.8°C (B_2 -Southern sector), incidentally during the summer seasons. However, the air temperature were considerably higher even during the southwest monsoons (Sept. 1987) when the central sector (H_9) and outer channel (R_9) recorded 34° and 33.9°C respectively (Tables 9-12). Sectorwise, variations in ambient temperature were negligible, despite the time (seasonal) lag and nearly constant although a particular season, save for marginal variations in range. The seasonal variations were insignificant too for the sw monsoons were inadequate and less vigorous (Sept. 1987). Only the winter season recorded all time low in the minima (24.2°C).

The ambient atmospheric temperature depends, among others, on the intensity of sunlight, heat exchange between atmospheric and lake, wind pattern, cloud cover, *etc.* Banerjee and Roychaudhuri (1966), made extensive monthly records of air temperature (April 1959 - May 1961) and report the following range—17° (winter - Dec. 1959 and January 1960) - 31°C (summer - June 1960 and August 1960). While no comparable studies exist, the higher ambient atmospheric temperature reported here (34°C +) agree fairly well with above studies. Banerjee and Roy Chaudhuri (1966), recorded the high (33°C) in air temperature during August (rainy season), incidentally also from the southern sector.

Surface Water Temperature (°C)

Of the various physical attributes influencing lake waters, the importance of temperature needs no emphasis. It influences parameters like evaporation, heat exchange, wind stress, vapour pressure, *etc.* which are all temperature dependent.

Surface water temperatures, as also temperature from bottom waters were measured for all sampling sites, save shallow waters where bottom water sampling had to be ignored, during the course of three expeditions. Invariably enough, these were measured around a time-frame say between 8.00 - 15.00 hrs during the day as visit to some of the distant pockets of the huge lake were time-taking, often approachable after 2-3 hours of cruising at moderate speed. As both the climatic and attendant diurnal variation in both ambient atmospheric and surface water temperatures are fairly large and varied, the water temperature data values obtained at different sites and times cannot be used for meaningful comparison. Nevertheless, the painstaking exercise of data collection from *ca.* 1165 sq. km. water spread area of the lake helps give a horizontal profile or distribution of the surface water temperature in different sectors during different seasons. The surface and bottom water temperature profile further helps provide the range of horizontal variations in the lake during a particular season as also the surface-bottom differences. Figs. 15, 16 and 17 provide the contour maps showing range of water temperature during different seasons while figs. 18 and 19 furnish average subsurface water temperatures seasonwise as also for the study period. A close study of the figure reveals that the lake plays host to atleast three water masses of different thermal properties in its southern, central and northern sectors. The salinity distribution profile in the lake strongly corroborates this observation.

The general format of analyses followed for ambient atmospheric temperature is retained for uniformity of treatment, easy comprehension and evaluation. The range of subsurface water temperature as also the seasonal averages observed, during the study period, were as under.

<i>Seasons</i>	<i>Range (°C)</i>	<i>Average (°C)</i>
Winter	23.2 -28.6	25.5586
Summer	25.2 - 35.2	29.0883
SW Monsoon	29 - 35.5	31.8611

The minima and maxima in subsurface water temperature recorded were 23.2°C (K₁₅ - Central sector) and 35.5 (E₅ - central sector) during winter and southwest monsoons (inadequate and less vigorous) respectively. Summer too recorded near high water temperature (35.2 at D₂ - southern sector). The sectorwise differences observed are southern sector - 29.7080°C, central sector - 28.72917°C, northern sector 27.4120°C and outer channel 28.02251°C respectively. Inland waters being less warmer than sea water, the northern sector records lower average water temperature (27.4120°C). The generally higher water temperature in southern sector results more from its closed topography and distant location from the lake mouth, thus causing significant hinderance to entry or mixing of cold sea water into it.

The general seasonal variations as also the few extremes of values recorded at few sampling points may be accounted as due to seasonal changes and other specific reasons. In general, the variations in surface water temperature may result due to sudden changes in prevailing weather pattern - bad weather (depression, *etc.*), overcast sky/clear skies, irradiance, *etc.* Besides biotic factors like emergent/submerged vegetation, especially macrophytes, also substantially influences the surface temperature pattern. Besides the depth of the water column, sampling site as also salinity pattern also influence water temperature regimen in shallow tropical lakes.

Other detailed studies on the surface water temperature pattern in the lake are by Annandale and Kemp (1915), Banerjee and Chaudhuri (1966) and Ramanadhan, Reddy and Murthy (1964). The sectorwise surface water temperature distribution profile as also the seasonal pattern are in general agreement with Ramanadham, Reddy and Murthy, (1964) and others.

Bottom Water Temperature (°C)

Bottom water temperature measurement studies on the Chilka lake are conspicuous by their absence and this is only natural and understandable in view of the time/efforts involved and limitations of logistics, *etc.* The present endeavour therefore is perhaps the first of its kind aimed at profiling the bottom water distribution pattern in the lake through space (water column) and time (seasons). Figs. 20 and 21 graphically illustrate the average bottom water temperature profile for different seasons as also the study period respectively.

The range of bottom water temperatures observed together with seasonal averages are as under:

<i>Seasons</i>	<i>Range (°C)</i>	<i>Average (°C)</i>
Winter	22.7 27	24.7848
Summer	25.2 34.2	28.9005
SW Monsoon	28.0 - 34.8	31.7188

The sectorwise range as also the sectorwise averages for bottom water temperature are:

<i>Sector</i>	<i>Range (°C)</i>	<i>Average (°C)</i>
Southern	25.2 34.2	29.7086
Central	22.8 34.8	28.7291
Northern	22.2 32.8	27.4120
Outer Channel	24.3 33.9	28.0225

The minimal and maximal bottom water temperature recorded during the course of three year study were 22.2°C (O₁₆, Northern sector, winter season) and 34.8°C (F₇, Central sector, southwest monsoons) respectively. Generally speaking sectorwise, the northern region recorded marginally lower temperature (27.4120°C) than others, as it receives huge discharges from inland sources - rivers, holding less warmer waters than the sea. The southern sector recorded a high average (29.7086°C) and this may be generally attributed to shallow depth and confined/enclosed nature of the sector.

Seasonwise the average difference between the minimum and maximum bottom water temperature observed worked out to 6.9340°C for the study period. Both seasonwise as also sectorwise, the average differences between the average subsurface and average bottom water temperature are only marginal - 0.2915°C and 0.5722°C respectively or less than a degree celsius. Surprisingly enough, the general range of temperature differences between subsurface and bottom waters were low of the orders of 1° ±. The difference between the average minima and average maxima for the two temperatures ranged between 1°C - 7°C during the course of studies. However, the individual variations are more pronounced often ranging as high as 2 - 4.5°C (Tables 9-12, C₂, Ss, E₅, Cs, and N₁₅, Ns, all incidentally during September 1987).

Because of the extremely shallow depth, the water column in the lake gets well mixed. Therefore the general surface-bottom surface difference in temperature are not significantly pronounced or low at most sampling sites. Indeed, the waters tend toward vertical homothermy. Not surprisingly enough, reverse gradients were also observed at few sampling sites. These may probably be accounted as resulting from cooling effect of the winter breeze in surface waters, sudden change in intensity of sunlight (quick overcast sky), *etc.* among others.

The ambient air, surface water and bottom water temperature exhibited a unimodal seasonal oscillation. High values were reported during the hot summer or premonsoon period while low values were recorded during the winter season. The temperature observations also revealed the following

pattern of temperature regime in the lake. The subsurface water temperature were significantly lower than the ambient atmospheric temperature but marginally higher than the bottom water temperature although the course of studies. During summer, the surface waters are usually warmer than the bottom waters. Significantly enough, the lake waters exhibit no *thermocline* (temperature gradient) as water temperature-depth plot at few stations revealed minimal temperature variations with depth.

The water temperature variations in subsurface and bottom waters in near closed lake ecosystems are generally significantly influenced by the following factors *viz.* bathymetry, incoming solar irradiance, tidal currents and atmospheric variations (Borrego and Borrego, 1982). Additionally, the absorption of radiant energy by water and its constituents, accumulation of heat by the exposed rocky and muddy substratum and subsequent dissipation of heat under immersed conditions, and mixing of fresh and sea water, are also known to influence the thermal properties of the water column. The Chilka lake basin also holds a number of rocks and rocky island besides muddy substratum. Therefore, the release of accumulated heat from the submerged substratum also considerably influences the thermal profile of overlying water besides other important factors.

Conductivity (umhos/cm) and Dissolved Solids (mg/L)

While measurements of electrical conductivity, umhos/cm at 25°C as also total dissolved solids (TDS) or total dissolved residues (computed using appropriate factors for highly turbid waters) have been made and incorporated in tables 1-12 of estuarine parameters, analyses and observations on the same have been deferred for detailed treatment elsewhere for limitations of space and time.

The total dissolved solids content in natural waters is a useful factor and helps evaluate not just chemical fitness but also edaphic relationships that eventually contribute to aquatic productivity (Reid and Wood, 1976). In general, the electrical conductivity values show positive correlation to total dissolved solids and salinity in the shallow, well mixed estuarine lake.

SALINITY (S‰)

In view of the critical role of salinity in influencing related estuarine parameters - density and stratification, temperature and dissolved gases, especially dissolved oxygen content, as also estuarine ecology, adequate care was ensured for measurement/estimation of salinity although the course of studies. Thus while salinity was invariably estimated using Mohr-Knudsen method, direct *in situ* measurements of salinity as *parts per thousand* (‰) and *percent* (%) (using Salinometers - makes Erma and Atago TANAKA S100) were also made. It was also estimated indirectly through measurements of density (using Nicholsons Hydrometer) as also through specific gravity (sp. gr. δ), using appropriate meters (Atago Tanaka, S100). However, for purpose of analyses and observations, only the values obtained through titrimetric (argentometric method) method and instruments (salinometer) have been used overwhelmingly, as density and sp. gr. measurements have not been made uniformly for all expeditions/seasons.

Figs. 26, 27 and 28 provide the salinity distribution pattern in subsurface waters during different seasons - winter, summer and sw monsoon. Additionally, the average subsurface salinity profile pattern seasonwise as also for the study period, is graphically illustrated (histogram) in figs. 29 and 30. Contour maps illustrating the average bottom water salinity have not been enclosed but figs. 31 and 32 help furnish the bottom water salinity profile seasonwise as also for the study period.

The range of salinity values as also the averages, sectorwise as also seasonwise, observed have been recapitulated hereunder for subsurface and bottom waters respectively.

<i>Subsurface Salinity Profile (‰)</i>			
<i>Sectors</i>	<i>Range</i>		<i>Average</i>
Southern	7	17	12.00266
Central	1.73	18	11.1453
Northern	0	14.5	5.9235
Outer Channel	1.99	34	6.7471
<i>Seasons</i>	<i>Range</i>		<i>Average</i>
Winter	1.73	9.14	4.5546
Summer	1	27	13.4071
SW Monsoon	0	05	8.9022

The range of surface water salinity recorded during the course of studies and different seasons varied widely from 0 (N₁₃/R₁₅₋₁₆, Northern sector, Southwest monsoons) to 34 (W₁₁, Outer channel, summer seasons) and indeed neatly reveals a clear seasonal pattern in line with the general seasonal variations in surface salinity in aquatic eco system. Thus the surface water salinity profile in the Chilka lake varies seasonally - higher salinity levels (hyper-haline situation) during dry summer seasons (evaporation from water surface is faster than volume of freshwater inputs) and low salinity during wet or rainy season - increased dilution through higher inflows through river systems). The average seasonal low and high in surface water salinity were 8.9022 and 13.4071‰ respectively for sw monsoon and summer. Sectorwise or gridwise, N₁₃ as also R₁₅₋₁₆ recorded 0‰ salinity while W₁₁, outerchannel recorded a high of 34‰ during the course of studies.

Analyses of salinity data for bottom waters, along similar lines revealed the following picture.

<i>Bottom Water Salinity Profile (‰)</i>			
<i>Sectors</i>	<i>Range</i>		<i>Average</i>
Southern	7.08	15	11.71101
Central	2.62	18.5	11.2902
Northern	.24	14.5	5.9670
Outer Channel	1.99	34	8.5536

Seasons	Range		Average
Winter	1.24	9.92	4.6079
Summer	1.0	34.0	14.8526
SW Monsoon	0.5	- 16	8.6815

Not unsurprisingly enough, the bottom water salinity profile revealed as much variation in range as also seasonality. The range varied widely from 0.24‰ (S_{17} , northern sector, winters) to as high as 34‰ (W_{11} , outer channel, summer) and followed the standard pattern of seasonal variations - high levels during summers and low levels during southwest monsoons/winters. The average bottom water salinity profile varied between 0.24 to 1.0 during dry seasons, and to 34.0‰ and during the wet or rainy season.

A close scrutiny of figs. 26, 27 and 28 indicates that the isohalines reveal or point towards progressive decrease in salinity profile across the main axis of the lake in the north-south direction. Further, the different sectors of the lake present different or characteristics salinity profile. Thus the waters of the central sector are banked by a water mass of high salinity towards the south and one of low salinity towards the north. The disposition of the isohalines suggest that apparently there is minimal intrusion and or mixing between the three regions, given the physiographic nature of lake. The outer channel/mouth of the lake holds water mass of appreciable salinity (often at par with sea water) indicating the strong tidal influence in regulating the salinity profile of the lake in the region (Sewell, 1922, Banerjee and Roychaudhuri, 1960 and Sarkar, 1979).

The close interdependence of critical estuarine parameters help impart to shallow, well mixing lake a complicated estuarine pattern. The Chilka lake too, influenced by its physiographic profile, may be categorized as *positive* estuary. Further, using the salinity characteristics (mean/range) the lake may be categorized as having following zonation, based upon the 1958 "Venice system" They are as under: *Mixohaline* - outer channel (1.99 - 34‰), (*Mixo-*) *mesohaline* - southern and central sector (7 - 17‰) and (*Mixo-*) *Oligohaline* - northern sector - (0-14.5‰). Generally speaking, the salinity profile in the shallow tropical lake overwhelmingly follows a unimodal oscillation format. Also, salinity values in the lake ranges from near limnetic (freshwater S_{∞} (0.5) to near sea water (around outer channel/mouth of the lake).

While Sarkar, (1979) rightly deserves consideration for initiating first-time ever comprehensive studies on seasonal and spatial variation in salinity in the tropical lake (15 sampling stations spread over major sectors/regions), the present endeavour is a step ahead in terms of magnitude of coverage (ca. 219 sampling stations) and time-scale (major seasons spanning two consecutive calendar years). The salinity profile in the lake has been charted, first time ever, in the most extensive and exhaustive manner, simultaneously for horizontal and vertical distribution of salinity in subsurface and bottom waters. The surface-bottom differences in salinity are not too pronounced at most grids/sectors and in general vertical distribution of salinity is characterised by top to bottom *homogeneity* at most places. However, the surface-bottom differences were more pronounced and noticeable in the outer channel, especially during summer and ranged between 7-13‰ at W_{11} and V_{11} respectively.

The high salinity gradient along the outer channel as also the vast differences in surface-bottom water salinity pattern may be attributed to unidirectional sea water incursions (tidal influence) in outer channel. This is not too surprising for wide fluctuation in salinity characterize lake environment. Bannerjee and Roy Chaudhuri (1966), reported a maximum fall in salinity to the extent of 19-21‰ (flood period) and a maximum rise to the extent of 15-18‰.

Hydrogen-Ion Concentration (pH)

The pH factor in lakeal environment is yet another variable characteristic that is not just primarily influenced by other parameters but regulates critical parameters-like inorganic plant nutrients, ammonia, etc. Besides the primary bicarbonate buffer system, pH is determined, among others, by currents, biological processes and chemical nature of the substrate, mixing of water masses, etc. in shallow tropical lakes. At around the normal range of pH (6-9) in lake, bicarbonate (H_2CO_3) is most abundant while only free carbon-di-oxide is not just important but abundant at low pH (< 5).

Figs. 33, 34 and 35 illustrate the range of pH values (horizontal profile) in subsurface waters during different seasons while table 1-12 furnish the subsurface and bottom water pH at different grids. The contour maps for pH profile for bottom waters have not been enclosed as detailed observations on the same deferred for treatment elsewhere. Again, coincidentally, the present study is the first ever attempt at charting the horizontal and bottom water pH profile of the lake through space (spatial) and time (major seasonal variations). The only other detailed investigations on the pH profile is by Banerjee and Roychaudhuri, 1966, in subsurface waters in the lake.

The range of pH values observed during the course of studies, sectorwise for subsurface waters have been tabulated. The inherent logarithmic nature of pH scale prohibits computing averages/mean, misleading in case of pH scale, therefore only the ranges have been furnished.

<i>Subsurface pH</i>				
<i>Sectors</i>	<i>Mini.</i>	<i>Maxi.</i>	<i>Range of values</i>	
Southern	7.0	9.87	7	9.87
Central	7.83	9.75	7.83	9.75
Northern	7.2	10.66	7.2	10.66
Outer Channel	7.2	10.3	7.2	10.3

The pH in the lake subsurface waters varied widely between 7.0 (D_5 , southern sector) to 10.66 (N_{18} , Northern sector). Horizontally, the lake waters exhibit wide variations in their pH content. In general the lake waters show pronounced alkaline nature. Generally speaking, the subsurface waters

in the southern and northern sectors as also outer channel recorded both lower as also the higher ranges of pH. While the subsurface waters in the central sector were observed to have higher range of pH values 7.83 (M_{11}) - 9.75 (S_{13} , H_{11}), the water mass in the northern sector show pronounced alkaline nature followed by the central sector. Incidentally, Bannerjee and Roychaudhuri (1966), reported similar pattern of pH (horizontal distribution) recording pH peak (9.6 from off Kaluparaghat, northern sector) and similar higher pH (9.5, off Balugaon, Central sector). The high pH content of the waters was attributed to abundance of algae (*Ibid*, 1966) and thus phytoplankton production. The wide fluctuation in the pH range may be attributed to inflows from the poorly buffered inland waters in the region.

The range of subsurface waters pH concentrations observed during different seasons are as under.

<i>Subsurface pH</i>					
<i>Seasons</i>	<i>Mini.</i>	<i>Maxi.</i>	<i>Range of values</i>		
Winter	7.2	9.36	7.2	-	9.36
Summer	7.0	9.95	7.0	-	9.95
SW Monsoon	8.36	10.66	8.36	-	10.66

Seasonwise, the southwest monsoons or the rainyseason (inadequate though) witnessed pronounced alkalinity, perhaps following higher photosynthetic production from phytoplankton and aquatic macrophytes all around. The winters recorded relatively lower range of subsurface water pH values more perhaps due to stabilization effect. Observation on the correlations between the pH and salinity profile have been deferred for treatment elsewhere.

The range of bottom water pH concentrations observed sectorwise have been tabulated as under, for easy comprehension while the grid-wise data has been presented in tables 1-12.

<i>Bottom Water pH</i>					
<i>Sectors</i>	<i>Mini.</i>	<i>Maxi.</i>	<i>Range of pH</i>		
Southern	7.5	9.65	7.5	-	9.65
Central	7	9.75	7.0	-	9.75
Northern	7.8	10.44	7.8	-	10.44
Outer Channel	7.95	10.01	7.95	-	10.01

Like the horizontal profile of subsurface water pH, the northern sector too recorded appreciably higher range of bottom pH -7.8 (at N_{18} , Q_{10}) and 10.44 (N_{18}) while the southern sector recorded relatively lower bottom water pH values -7.5 (D_5) -9.65 (D_4). The central sector (station E_5) recorded the minima (pH 7.0) while the northern sector (station N_{18}) recorded the maxima (pH 10.44) in bottom water. The high pH concentrations in the northern sector may be attributable, in part, to high macrophytes and other aquatic weed infestations, their luxuriant growth and attendant high photosynthetic activity. In short, biotic factors also appreciably influences the pH concentration regime in the shallow lake, besides chemical, physical and edaphic factors.

The bottom water pH profile, observed seasonwise, is as under:

<i>Bottom water pH</i>				
<i>Seasons</i>	<i>Mini.</i>	<i>Maxi.</i>	<i>Range of values</i>	
Winters	7.63	9.32	7.63	9.32
Summer	7.0	9.43	7.0	9.43
SW Monsoons	8.37	10.01	8.37	10.01

Seasonwise, the bottom water pH profile follows the subsurface water pH concentration pattern, showing appreciably alkaline pH range during south west monsoons and relatively lower pH ranges during winter and summer. The pH concentration profile observed shows no distinct seasonality for understandable reasons (variable nature of pH and its regulation by host of physical, chemical and biologic factors, *etc.*). Banerjee and Roychaudhuri, (1966) recorded lower pH during the rainy season while high pH values were observed during winters and early summers. E_5 in the central sector recorded the minima (pH 7.0) while station O_9 in the outer channel recorded the high or peak (10.01) in pH values during different seasons. In general, the surface-bottom water differences in pH concentrations range are not generally pronounced, save individual differences at some grids/sampling stations for various reasons. Detailed treatment of pH profile (*horizontal/vertical*) sectorwise as also its dynamics are beyond the scope of this work and therefore discussed elsewhere. As observed earlier, the pH concentration regime too, like other key estuarine parameters in coastal lakes, is under the perennial influence of poorly buffered riverine water inflows and relatively well buffered sea water influxes from time to time.

Dissolved Oxygen Content (Do mg/L) and Percent Saturation (% Cs).

The dissolved oxygen content (DO, mg/L) profile in estuaries and coastal lakes are regulated, among others by turbulence/wave action, current, biotic activities and salinity and temperature effects. In fact, a complex of estuarine parameters confer complex relationship on not just dissolved gases (DO, *etc.*) but dissolved substances too (Reid & Wood, 1976).

Figs. 36, 37 and 38 illustrate the d.o. content profile in subsurface waters in different sectors during winter, summer and southwest monsoon respectively. Figs. 39 and 40 provide stacked diagram pictures of the average d.o. content profile in subsurface waters for the three year study period as also for different seasons. Tables 1-12 furnish the individual d.o. content values for each station for

subsurface and bottom waters.

The range of d.o. concentrations for subsurface waters observed sectorwise is as under :

Sectors	Mini.	Subsurface Do		Range of values	Average
		Maxi.			
Southern	5.4	14.6		5.4 - 14.6	8.5832
Central	3.0	19.8		3.0 - 19.8	9.0279
Northern	5.9	16.2		5.9 - 16.2	9.3384
Outer channel	8.0	14.6		8.0 14.6	11.0975

The subsurface waters in the lake showed wide variations in their dissolved oxygen content (DO) varying from as low as 3.0 mg/L (I_{13} in central sector) to 19.8 mg/L (H_9 in central sector). In general, the outer channel recorded relatively higher average d.o. content values (11.09752 mg/L for subsurface waters) while the southern sector recorded lower average d.o. content (8.5832 mg/L) for subsurface waters. Bannerjee and Roychaudhuri (1966) reported similar d.o. pattern recording peak in d.o. from satpara region in the outer channel. The central sector recorded lower average d.o. values (9.0279 mg/L) while the northern sector showed appreciably higher d.o. content (9.3384 mg/L) in their subsurface waters. Asthana (1978) observed near similar pattern of d.o. content in different sectors of the lake and attributed higher d.o. content in the northern sector to phytoplankton production. The relatively lower values in the Rambha region (southern sector) may be attributed to the enclosed nature of the bay and attendant stagnant waters conditions and thick strands of submerged vegetation in the vicinity.

The range of d.o. content values for subsurface waters observed seasonwise is as under :

Seasons	Subsurface D.O (mg/L)				Average
	Mini.	Maxi.	Range		
Winter	7.0	11.2	7.0	11.2	7.7011
Summer	4.8	14.6	4.8	14.6	12.5411
SW Monsoon	3.0	14	3.0	14.0	8.2931

The winter season recorded lower range of d.o. content (average 7.0711 mg/L, minima at C_5 , maxima at O_{16} in northern sector) while the summers recorded higher d.o. content (12.5411 mg/L minima at B_4/B_5 in southern sector, maxima at O_{11} in outer channel). The higher values during summers as also southwest monsoon (inadequate rainfall during 1987) may be attributed to higher algal bloom in the lake waters during late summers and beyond. Earlier, Banerjee and Roychoudhury (1966) reported higher d.o. values for surficial waters during August, November and December. The seasonal d.o. content profile for subsurface waters observed in the lake therefore is at variance from the earlier studies. Other factors responsible for this anomalous behaviour/pattern may be the variations in the normal

weather pattern (inadequate rains, *etc.*) changes in lake environment and luxuriant growth of aquatic weeds in the lake during the course of three year studies.

Bottom water D.O. Content

The sectorwise range of d.o. concentrations values for bottom waters in different sectors of the lake are as under :

<i>Sectors</i>	<i>Bottom Water DO (mg/L)</i>				
	<i>Mini.</i>	<i>Maxi.</i>	<i>Range</i>		<i>Average</i>
Southern	2.7	14.4	7.0	14.4	8.5727
Central	3.1	15.8	3.1	15.8	9.0004
Northern	4.4	14.8	4.4	14.8	9.1977
Outer Channel	7.8	14.6	7.8	14.6	11.0065

In general, the central sector recorded the peak (15.8 mg/L K_{10} , summer season) while the southern sector recorded the minima (2.7 mg/L at B_1 , B_3 , southwest monsoons). The range of d.o. concentrations in bottom waters were higher for northern sector and outer channel, the latter (OC) recording higher average values (DO 11.0065 mg/L). The sectorwise d.o. content profile for bottom waters in the lake therefore essentially follows the d.o. concentration profile for subsurface waters.

The seasonal range of d.o. content observed for bottom waters in the lake during different seasons are as under:

<i>Seasons</i>	<i>Bottom water DO</i>				
	<i>Mini.</i>	<i>Maxi.</i>	<i>Range</i>		<i>Average</i>
Winter	7.0	12.7	7.0	12.7	7.7037
Summer	5.0	15.8	5.0	15.8	12.4504
SW Monsoon	2.7	13.8	2.7	13.8	8.1788

The seasonal profile of d.o. concentrations in bottom waters revealed the minima (2.7 mg/L at B_1 , southern sector) during the SW monsoons and an all time high (15.8 mg/L at k_{10} , central sector) during the summers. On the whole, the summer season recorded higher range of d.o. values for bottom waters (5-15.8 mg/L) as also the average (12.4504 mg/L) than winter season (7-12.7 mg/L average 7.7037 mg/L). The d.o. concentration profile for bottom waters essentially follows the pattern for subsurface waters. Further while a seasonal pattern can be discerned, it is not distinct or discreet on account of various variables involved physicochemical, biotic, *etc.*, time of sampling and other differences. Surprisingly enough, and indeed in contrast to the normally observed pattern, the d.o. concentrations in subsurface as also bottom waters closely follow the water temperature profile, varying

directly and positively with regard to atmospheric and water temperature. Mohanty, 1989 observed similar relationships between temperature and oxygen concentration.

In general, the d.o. concentrations of subsurface waters were found to be higher than bottom waters, although save minor exceptions, in all sectors as also during different major seasons. This may be attributed to higher phytoplankton production in the highly irradiated upper euphotic layer of subsurface waters than the bottom layers. On the whole, the differences in the range of d.o. values for subsurface and bottom waters are only marginal and possibly results from a combination of variables physicochemical, biotic, edaphic, *etc.* In general, the subsurface-bottom waters differences in d.o. concentrations were observed to be more pronounced in southern sector/Rambha bay, the range of observed values being 7 10.2 mg/L and 7 12.7 mg/L respectively. Further, the range of d.o. values were also observed to be relatively higher in outer channel and the surface-bottom differences nearly insignificant or negligible.

The concentration and distribution of dissolved gases, especially dissolved oxygen in lakes/estuaries is complex phenomenon on account of highly variable nature of few estuarine parameters. As pointed earlier, the whole gamut o physicochemical and biotic factors regulate the concentration and distribution pattern of d.o. in lakeal environment.

Free Carbon-di-Oxide (Free CO₂ mg/L)

While free Carbon-dioxide was estimated, on-board, without loss of time, the data on free CO₂ for subsurface and bottom waters has not been incorporated in Tables 1-12. In general free CO₂ was absent although save for presence of traces at few sampling stations although the course of investigative studies. However, the range of values of free CO₂ observed in subsurface/ bottom waters varied from as low as 1/2 mg/L 5.0 mg/L. The northern sector as also the outer channel recorded higher free CO₂ content varying from 2-3 (N₁₆/P₁₆) to 4-5 mg/L (R₁₆) in its subsurface/bottom waters during summer and southwest monsoons. Free CO₂ was absent although during the winter season. Earlier studies record 2.0 mg/L free CO₂ content in the Baradih Magarmukh zone and outer channel. The present study records appreciable presence of free CO₂ in the water masses in the adjoining lower stretches of central and northern sectors as also the outer channel.

Total Alkalinity, CaCO₃ mg/L

While titrimetric measurements involved estimations of various forms of alkalinities, data on alkalinity has been expressed as total alkalinity, and furnished in tables 1-12, for subsurface and bottom waters for uniformity, ease of reference and comparison.

The range of total alkalinity values, as also the averages observed in subsurface waters in different sectors of the lake are as under :

<i>Subsurface water TA, CaCO₃ mg/L</i>					
<i>Sectors</i>	<i>Mini.</i>	<i>Maxi.</i>	<i>Range</i>		<i>Average</i>
Southern	93	495	93	495	195.3754
Central	93	425	93	425	197.1341
Northern	75	410	75	410	183.6805
Outer Channel	51	390	51	390	155.8103

Thus, total alkalinity values mg CaCO₃/L, varied widely from 93–495 mg CaCO₃/L with the southern and central sectors recording higher averages 195.3754 and 197.1341 mg/L respectively. The average range of alkalinity values observed by earlier workers was 26.8–122 ppm (Banerjee and Roychaudhury, 1966 and 20–160 mg/L (Das and Samal, 1988) respectively for subsurface waters in the lake. Das and Samal record higher alkalinity 185–115 mg/L in the Rambha region and correlated it to salinity. Interestingly enough, the southern/central sector water masses recorded higher total alkalinity during the course of three year studies.

The range of total alkalinity values, as also the seasonal averages recorded during different seasons are as under.

<i>Subsurface TA, mg CaCO₃/L</i>					
<i>Seasons</i>	<i>Mini.</i>	<i>Maxi.</i>	<i>Range</i>		<i>Average</i>
Winter	260	495	260	495	349.3794
Summer	75	137	75	137	86.9034
SW Monsoons	51	186	51	186	112.7174

Banerjee and Roychaudhury, 1966 record higher alkalinity values during summer months and lower values during the southwest monsoons. Lower total alkalinity values (average 86.9034 mg/L CaCO₃) were also observed during the southwest monsoons but the winter season witnessed relatively higher total alkalinity values (average 349.3794 mg/L CaCO₃).

While the bottom water alkalinity was also estimated for various sectors/seasons during the

course of studies, and range of observed values furnished in tables 1 – 12, observations on the total alkalinity profile for bottom waters, the variations over different seasons, as also the differences between subsurface and bottom waters in the lake have been deferred for treatment elsewhere.

CONCLUSIONS

The present endeavour, the result of first ever multidisciplinary expedition studies on the tropical lake, spanning over three calendar years (late 1985 to 1987) attempts to present, the general morphometric and limnologic attributes, based upon first hand measurements of extensive field data from 219 sampling stations evenly distributed over the three major sectors and outer channel, during three major seasons.

Chilka lake, traditionally considered a brackish water entity, both by the public and initiated alike, has been treated technically although for observations and analyses, as a discreet coastal lake or estuarine lake, with a view to help facilitate truly scientific evaluation of this unique yet complex ecosystem. The importance of basic conservative physicochemical attributes characteristics of the lake (*viz.* depth, salinity, temperature, *etc.* have been accorded their due share for meaningful evaluation of lake environment. Further, the analyses of critical lakeal characteristics or key estuarine parameters will eventually help evaluate in proper perspectives, the biotic attributes - floral and faunal diversity, their distribution/abundance/variation in terms of the lakeal ecology. The classical as also notable contemporary exhaustive studies to date on the hydrography, physical/chemical limnology, and fauna of Chilka Lake have been highlighted to facilitate quick retrieval, comprehension and meaningful comparison. Extensive field observations were therefore made on the whole gamut of metrologic, geomorphic, hydrographic and physicochemical attributes of the lake environment complex to help chart sectorwise/seasonwise profile of basic critical parameters influencing the lake dynamics over the period of space and time. The same are graphically represented in the text. For technical constraints and other understandable limitations, only horizontal distribution/profile for critical estuarine parameters for subsurface waters have attempted and observations made. The distribution pattern/profile for these for bottom waters as also the observations on the surface-bottom differences have been deferred for treatment elsewhere.

A brief account of conservative parameters influencing the behaviour/pattern/distribution of other related parameters follows hereunder to help easy recall evaluation. The bottom of the lake is uneven. On the basis of hydrographic profile/features of the lake basin, it has been traditionally divided into (1) Northern Sector, (2) Central Sector, (3) Southern Sector and Outer Channel. The average depth of the water column in the lake during the study period, covering major seasons ranged between 1.2691 to 1.8771 m. The overall average depth, computed for the entire study period, worked out to 1.5793 m. The sectorwise averages for the entire study period as also the seasonal averages obtained (yearwise) have been furnished. The northern sector was found to be very shallow (1.2691 m) compared to central and southern sectors (1.6433 and 1.8771 m respectively). The outer channel recorded an average depth of 1.5277 m.

Depth, a highly variable lakeal character, is also influenced by active southwest monsoons, and attendant inflows, in the region, rising as high as 2 m. Further, the huge inflows, 3,75,000 cusecs of flood waters and consequent sedimentation of the lake influences depth profile transparency/visibility and above all turbidity.

Generally speaking, the subsurface water temperature showed positive correlation to ambient atmospheric temperature, being marginally lower or equal to atmospheric temperature. The difference in the range of temperature between subsurface and bottom waters in all the lake too are marginal and not generally pronounced. On the average, the bottom water temperatures are lower than the subsurface waters, being of the order of 1°C +. However, individual differences between the two temperature regimes at few stations varied widely from 2 – 4.5°C . The ambient air, subsurface and bottom water temperatures exhibit unimodal oscillation.

The study revealed that the lake plays host to different water masses of differing thermal characteristics in its different sectors/region. The southern (29.7080°C), and central sectors (28.0225°C) holds water masses that are warmer compared to the northern sector (27.4120°C). These are therefore comparatively warmer zones. The higher temperature in the southern sector has been attributed to enclosed nature of the region, among others. The huge sprawling tropical lake exhibits no marked thermal gradient (thermocline) in its water column. The shallow depth of the lake and its other physiographic attributes permit good mixing between the upper and bottom water masses. The lake waters therefore exhibit a trend towards vertical homothermy.

The salinity profile in the lake exhibits a wide range of variation from 0 to 34‰ both in its subsurface and bottom water through space (sectors) and time (seasons). In general, the southern sector recorded higher average salinity (12.0026‰) while the northern sector recorded lower average salinity (5.9235‰). The salinity profile in the northern sectors and outer channel fluctuated widely between 0 - 14.5‰ and 1.99 to 34‰ respectively.

Again, like the water temperature profile, the bottom water salinity regime closely follows the surface water salinity pattern with the southern and central sectors recording higher average salinity (11.7110 and 11.2902‰ respectively) than the northern sector and outer channel (5.9670‰ and 8.5536‰ respectively).

Interestingly enough, both surface as also bottom water salinity profiles reveal clear seasonality showing unimodal seasonal oscillation – high levels during summers (average 14.8526‰) and low levels during southwest monsoon/winter (8.6815‰ and 4.6079‰ respectively). The salinity profile therefore corroborates its annual cyclic nature.

The annual sweet-saline mix regime of the lake in turn initiates other cyclic changes in the lakeal environment triggering interesting changes in the over all biotic profile of the lake. Based upon the “Venice System”, the lake water masses have been categorized. Salinity values in the lake ranges from near limnetic (S 0.5‰) to mixohaline (S 34‰). The range of pH values observed varied widely from 7.0 – 10.66 for different seasons during the course of studies. Sectorwise, the southern and central sector, showed lower and lesser range of variation in its pH (7 – 9.87) than the northern sector which recorded higher average pH range (7.2 – 10.66) and plays host to luxuriant growth of aquatic weeds. The range of pH values for bottom waters shows similar behaviour sectorwise/seasonwise. In general, the lake water remained markedly alkaline althrough the study period and do not show marked seasonal variations. Fluctuations in the pH concentration in the lake are primarily regulated by heavy inflows of riverine (fresh) waters as also sea water influxes. Further, in shallow tropical lakes, biotic factors appreciably influence the pH concentration regime besides edaphic and physicochemical factors.

The dissolved oxygen content in the subsurface waters shows wide variations in different sections of the lake. The northern sector recorded higher average d.o. concentrations (9.3384 mg/L) coinciding with periods of high phytoplankton production and or influx of riverine inflows into the lake. The low d.o. content in the southern sector has been attributed to enclosed nature of the section and stagnant water conditions around. The sectorwise d.o. content profile for bottom waters marginally differs from that of the subsurface waters with outer channel (11.0065 mg/L) and northern sector (9.1997 mg/L) recording higher averages. Generally speaking, subsurface d.o. concentrations are higher than bottom water resulting perhaps due to higher phytoplankton production in highly irradiated upper euphotic layers.

The d.o. content profile showed no clear seasonal pattern. In fact, it was observed to be at variance than the normally observed pattern for various reasons. Thus the dissolved oxygen concentrations closely followed the ambient/water temperature profile, varying directly and positively with it. The concentration and distribution of dissolved oxygen in the shallow tropical lake is influenced by the whole gamut of physiographic, physicochemical and biologic factors.

Hopefully, the painstaking long term exhaustive studies lays bare the critical estuarine parameters influencing the physicochemical *milieu* and indeed the ecology of the important lake, a Ramsar site, and an wetlands of international importance. The extensive first-hand field data gathered painstakingly, hopefully, will serve for long time to come as critical base-line data providing all the important technical inputs to the Scientists/Administrators/Decision-makers and the public, in helping evolve judicious 'Action Plan' for the conservation and management of this critical tropical lake. Academically, the present endeavour also hopefully serves as the first Indian Manual aimed at unravelling the structure and dynamics of a coastal/estuarine lake.

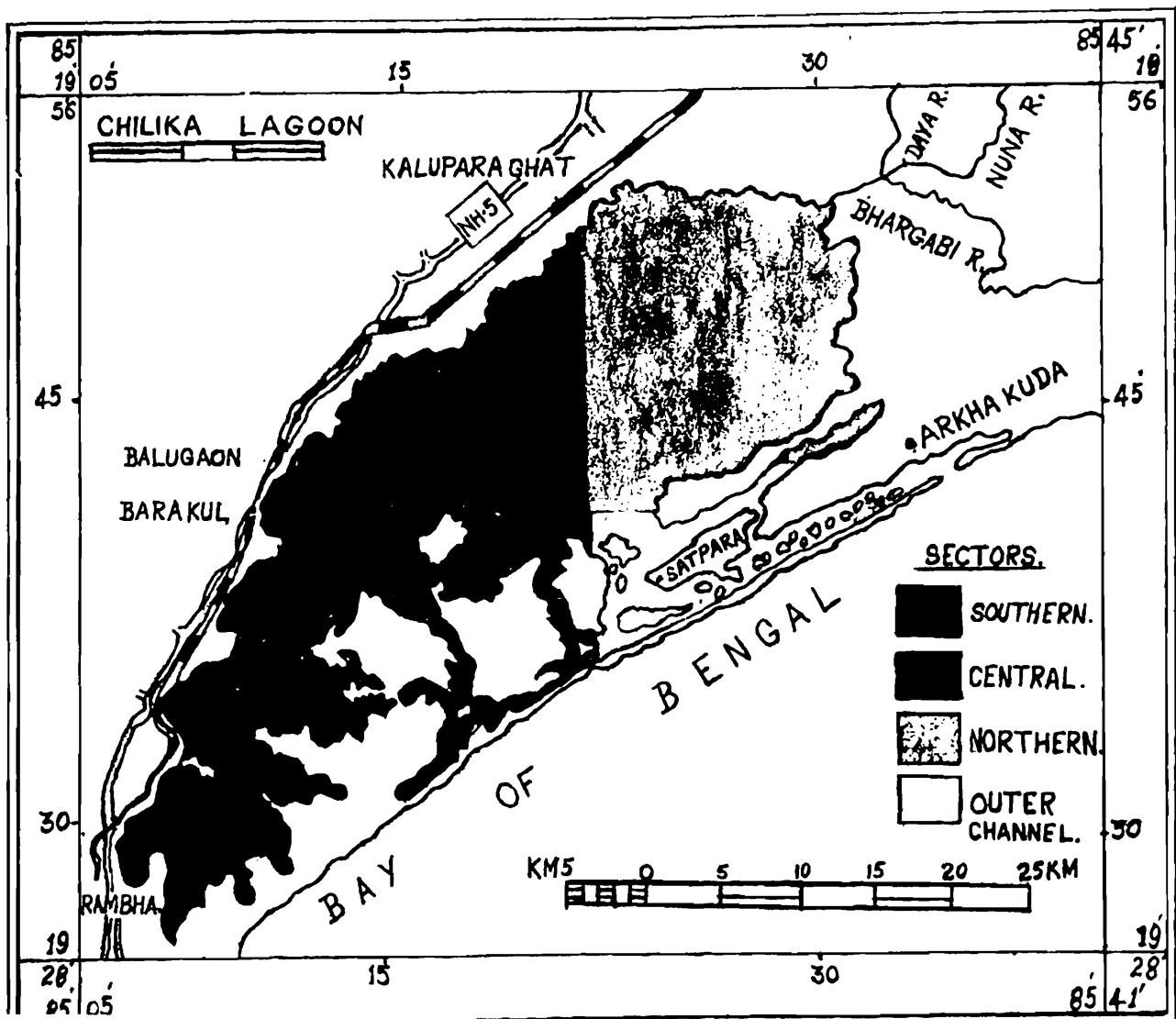


Figure 1. Showing the different sectors of the Chilika Lake, Orissa.

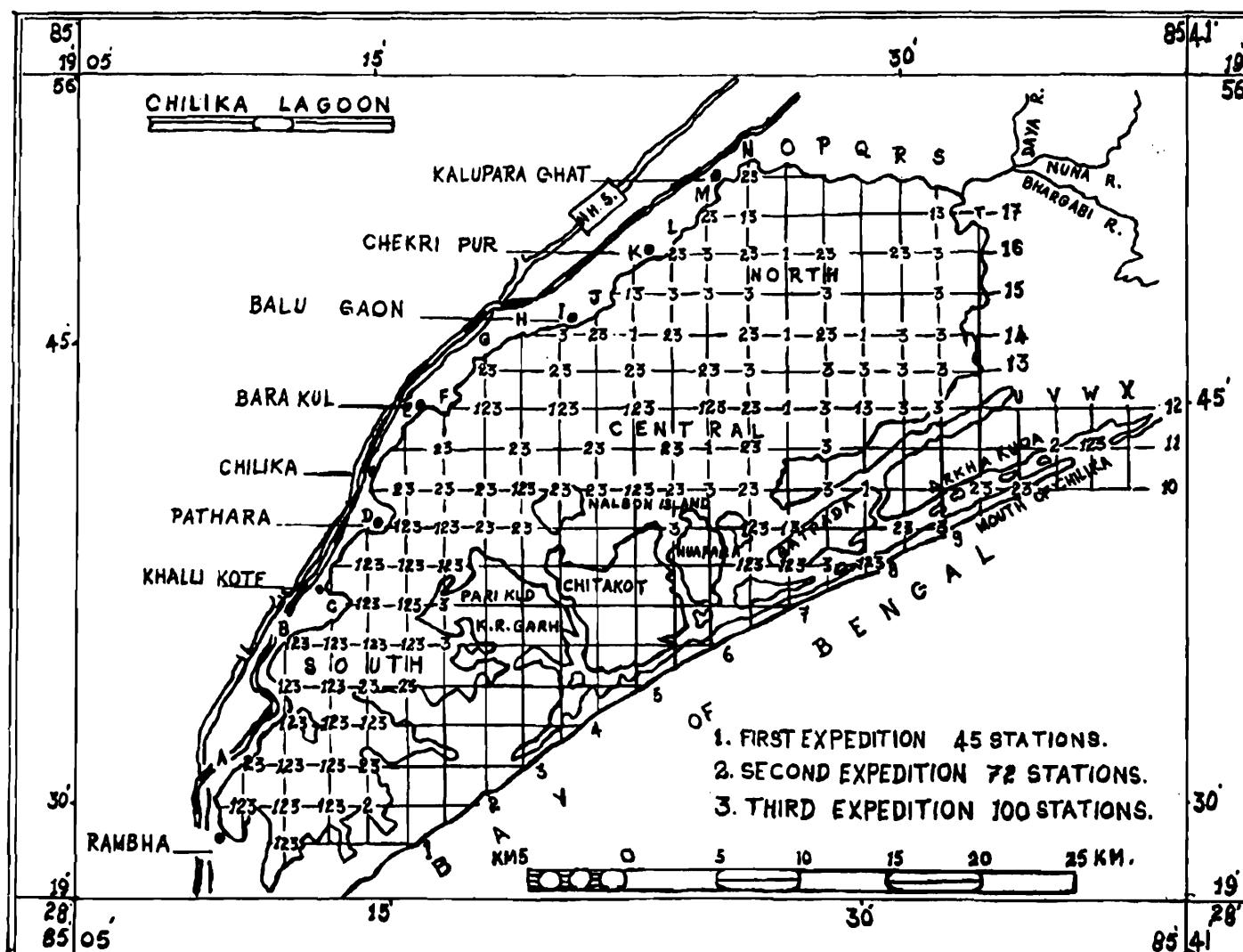


Figure 2. Showing the sampling stations surveyed (gridwise) in different sectors of Chilika Lake, Orissa during the course of Three Multidisciplinary Expeditions (seasonwise), 1985 (Winter: 21 Nov. 05 Dec.), 1986 (Summer: 10 - 30 June) and 1987 (SW Monsoon : 04 -27 Sept.). Numbers 1, 2, 3 indicate the seasonwise sampling of the grid station in 1985, 1986 and 1987 respectively. Say, A₂, B₂, C₂, etc. (grid station) has been surveyed althrough in all three expeditions and likewise.

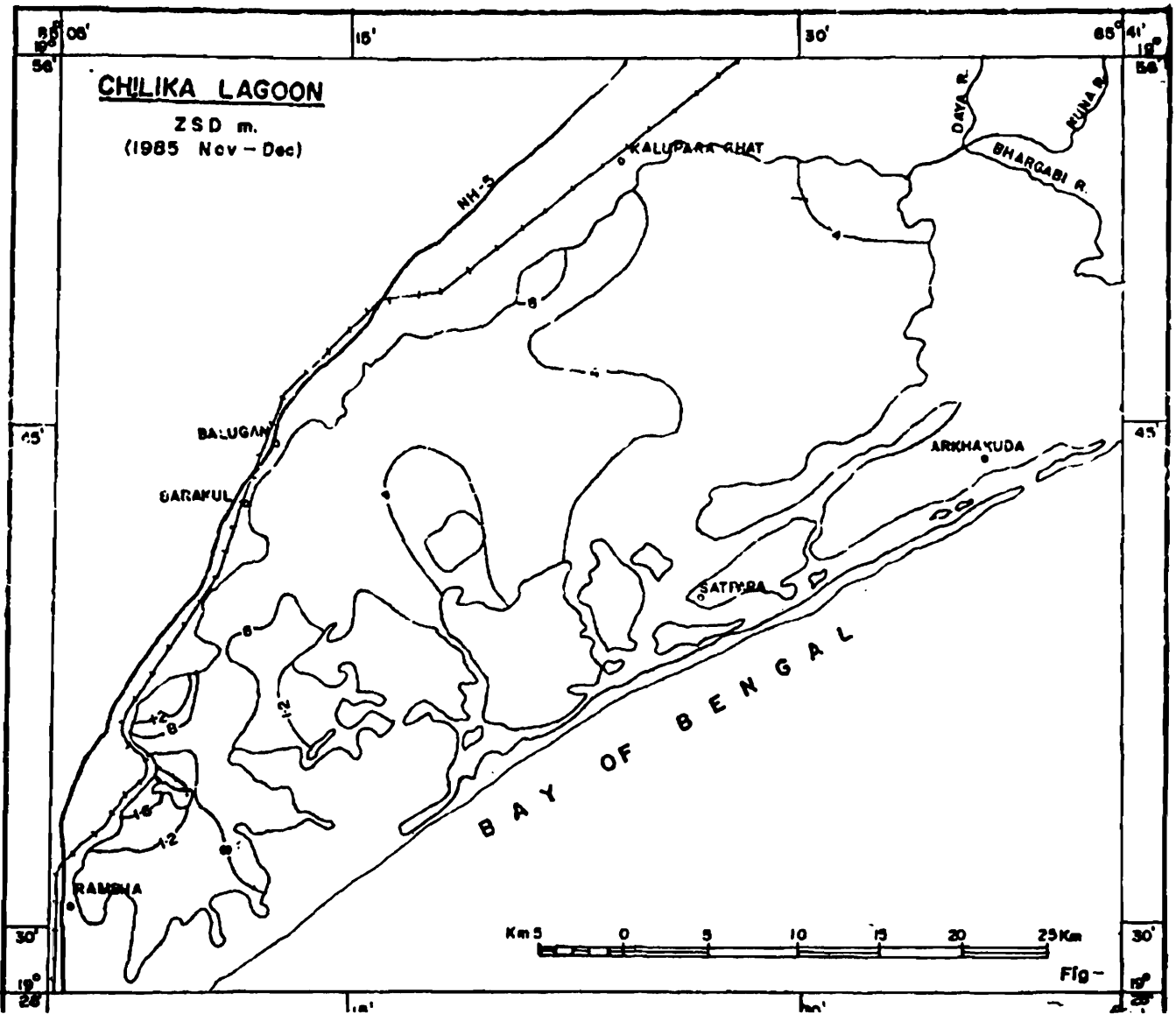


Figure 3. Showing range of transparency values (m) in different sectors of Chilika Lake during winter season (21 Nov. - 05 Dec., 1985)

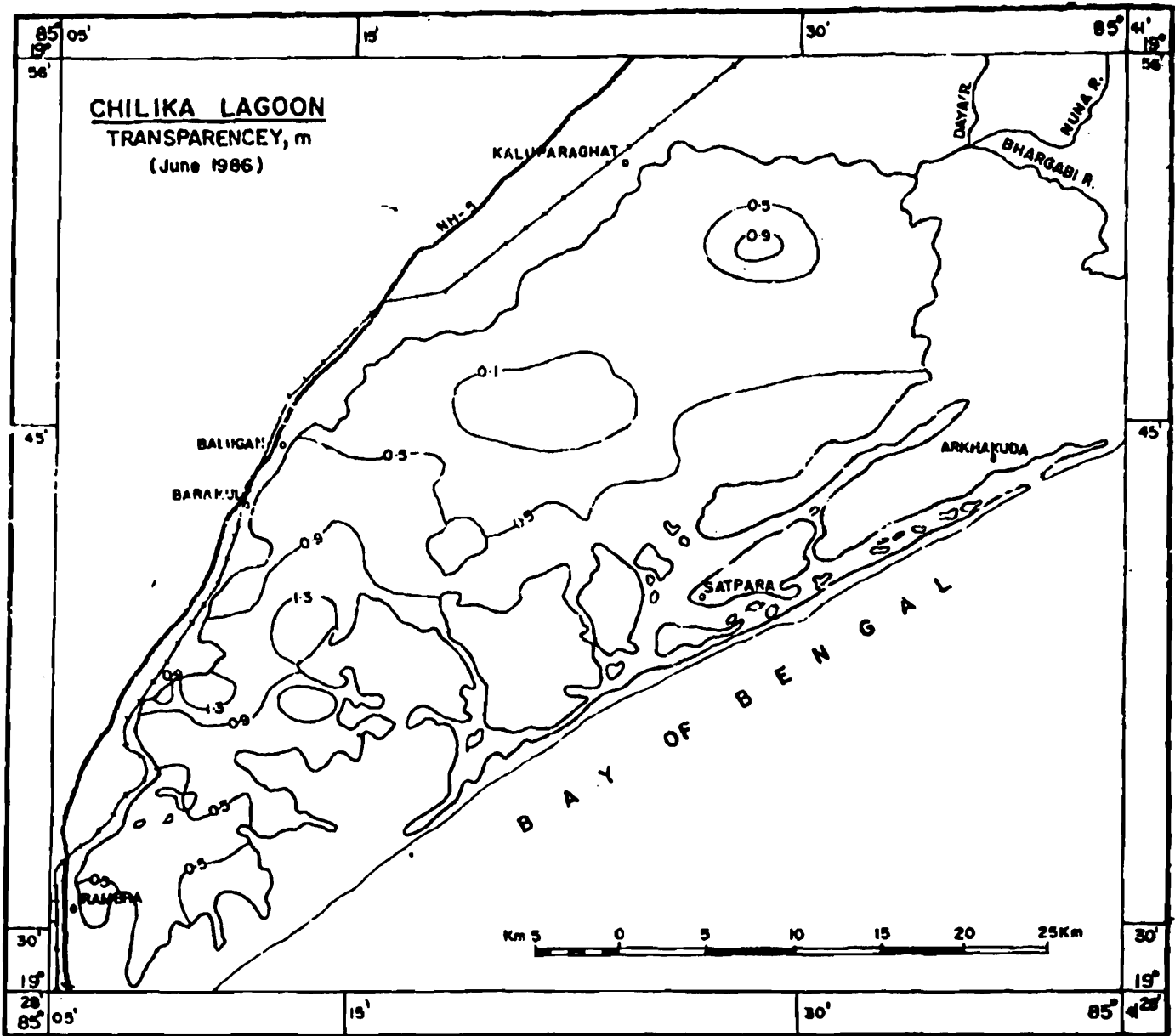


Figure 4. Showing range of transparency values (m) in different sectors of Chilika Lake, Orissa during summer season (10 - 30 June, 1986).

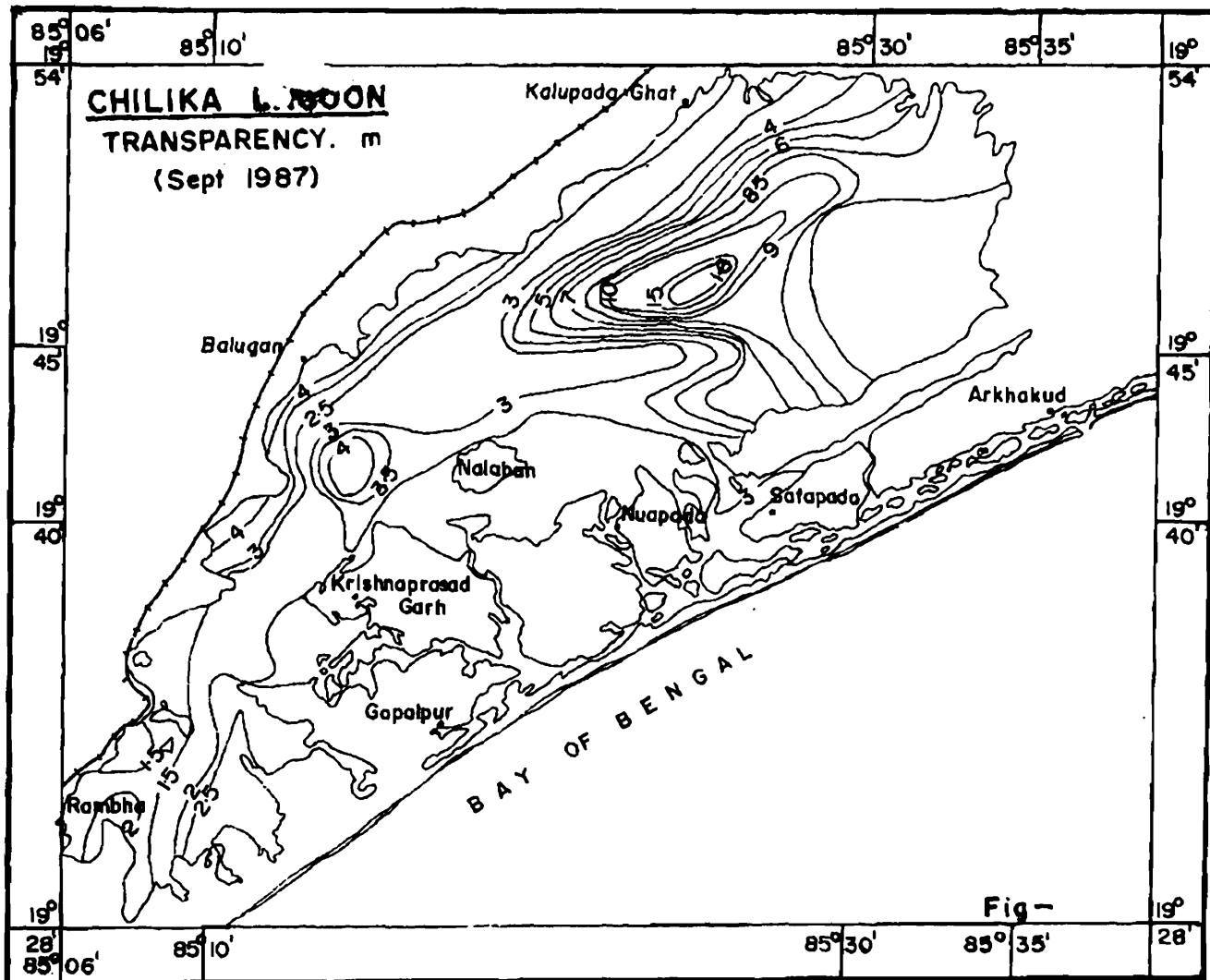


Figure 5. Showing range of transparency values (m) in different sectors of Chilika Lake, Orissa during winter season (21 Nov. – 05 Dec., 1985).

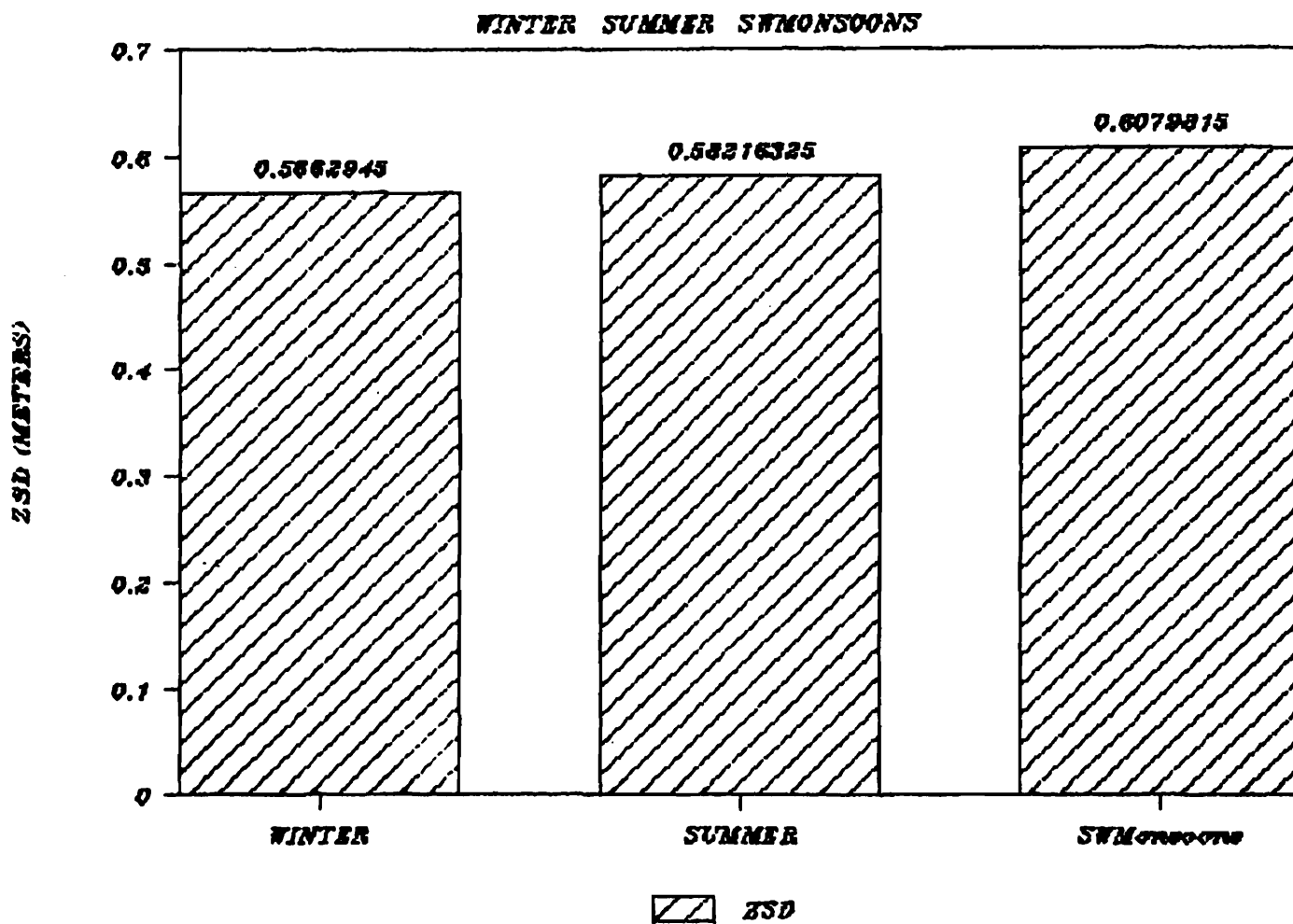


Figure 6. Showing average transparency (Zsd) profile of Chilika Lake, Orissa, seasonwise.

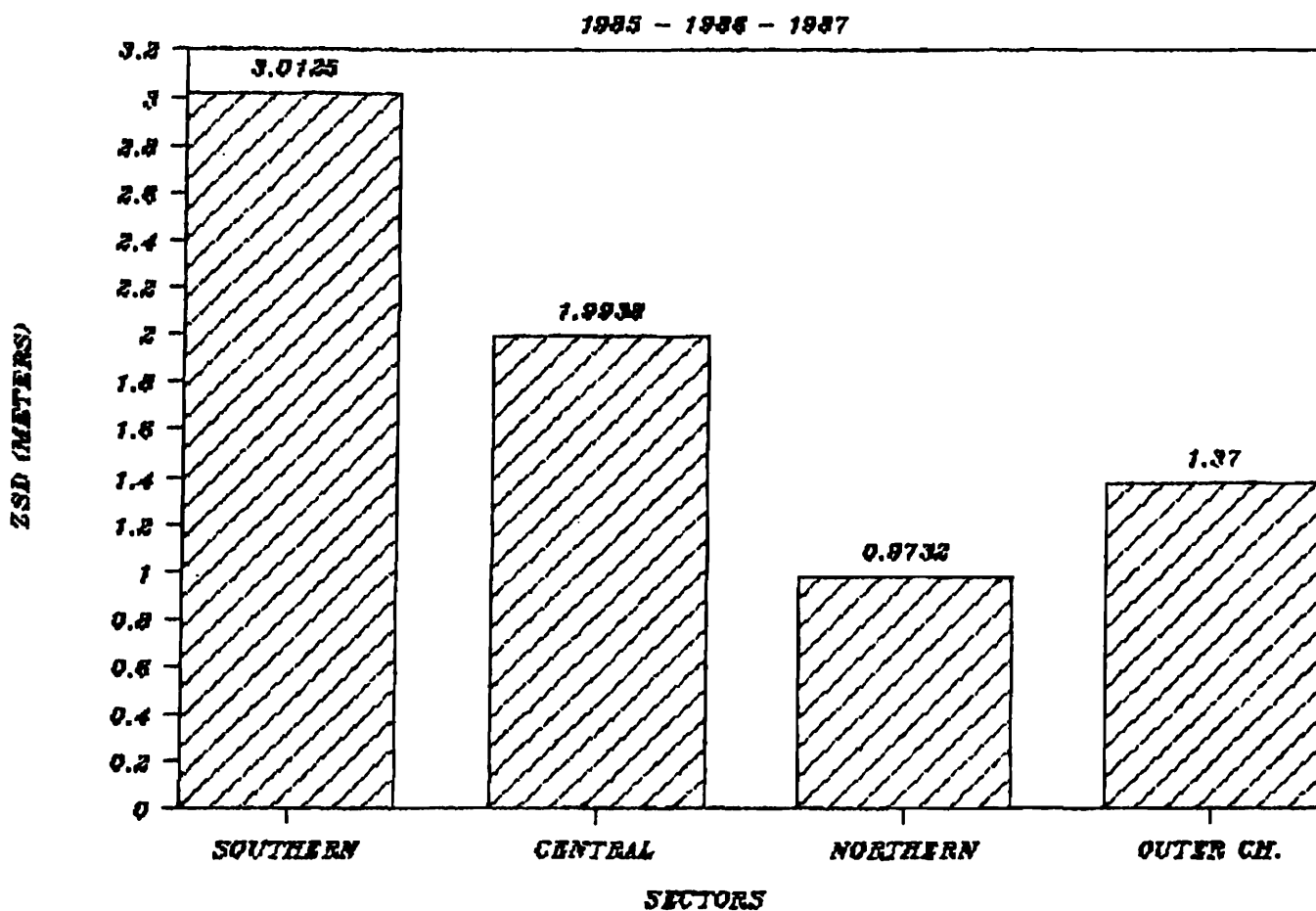


Figure 7. Showing average transparency (Zsd) profile of Chilika Lake, Orissa, for study period.

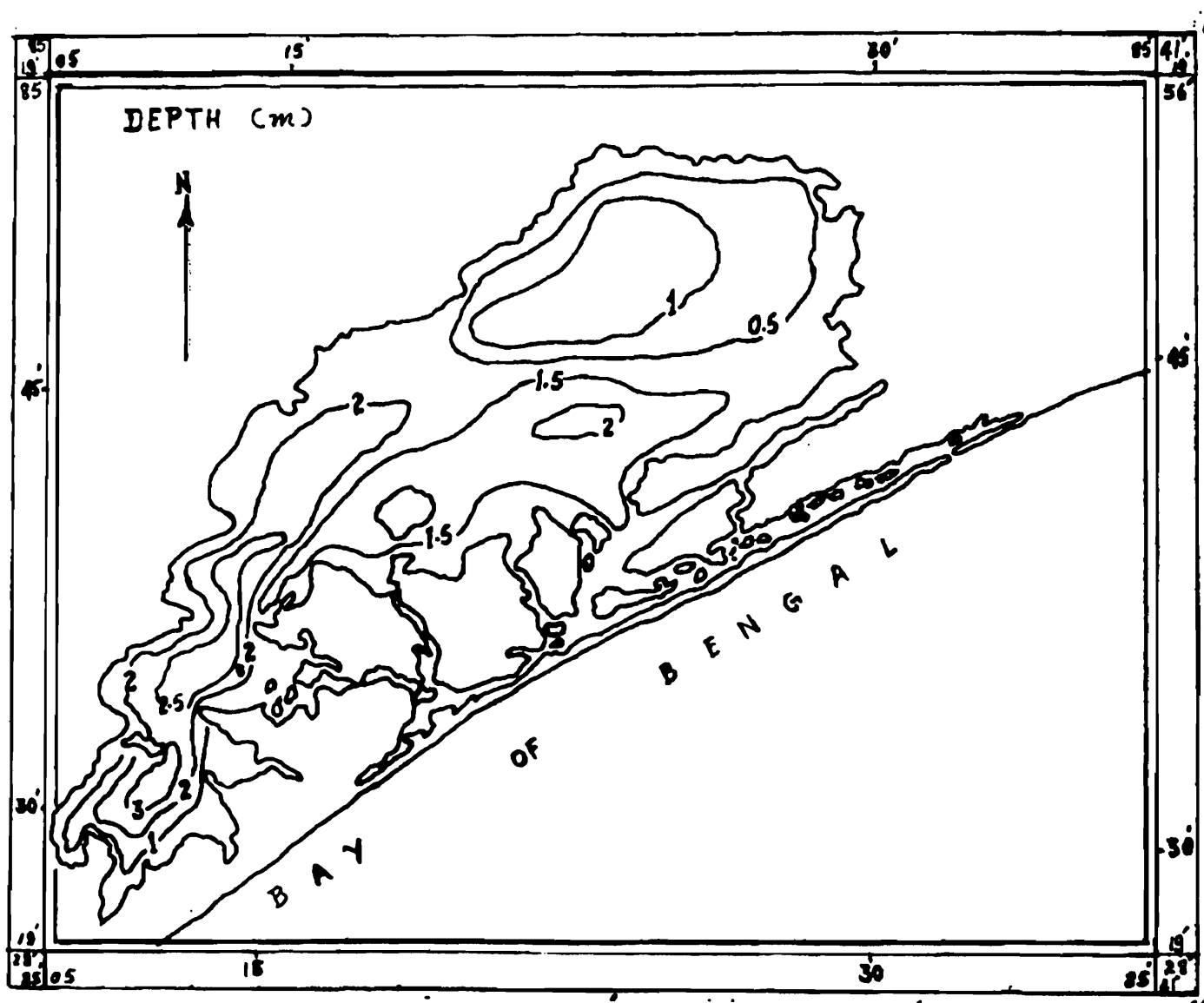


Figure 8. Showing range of depth (m) in different sectors of Chilika Lake, Orissa during winter season (21 Nov. 05 Dec., 1985).

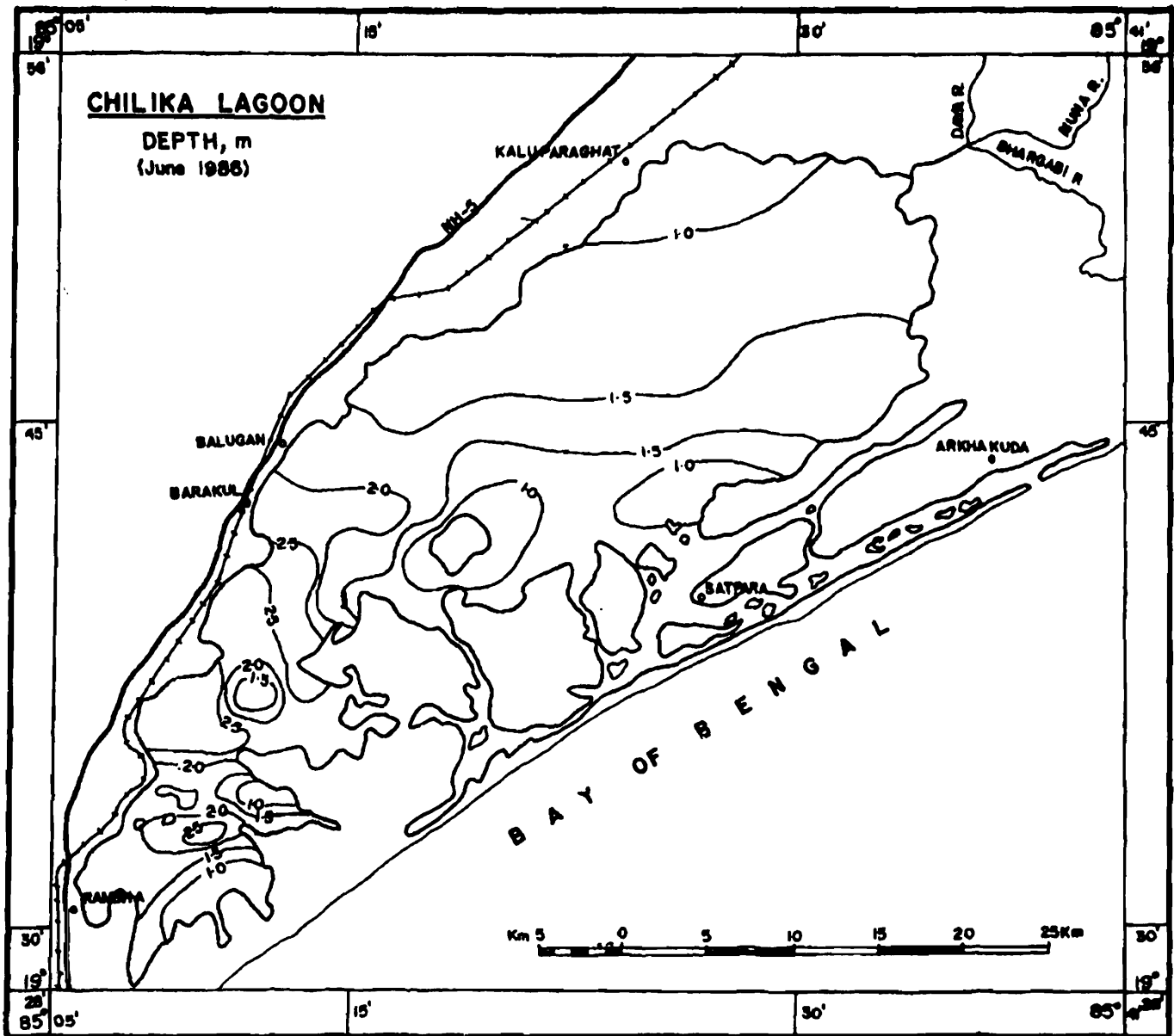


Figure 9. Showing range of depth (m) in different sectors of chilika Lake, Orissa during summer season (10 - 30 June, 1986).

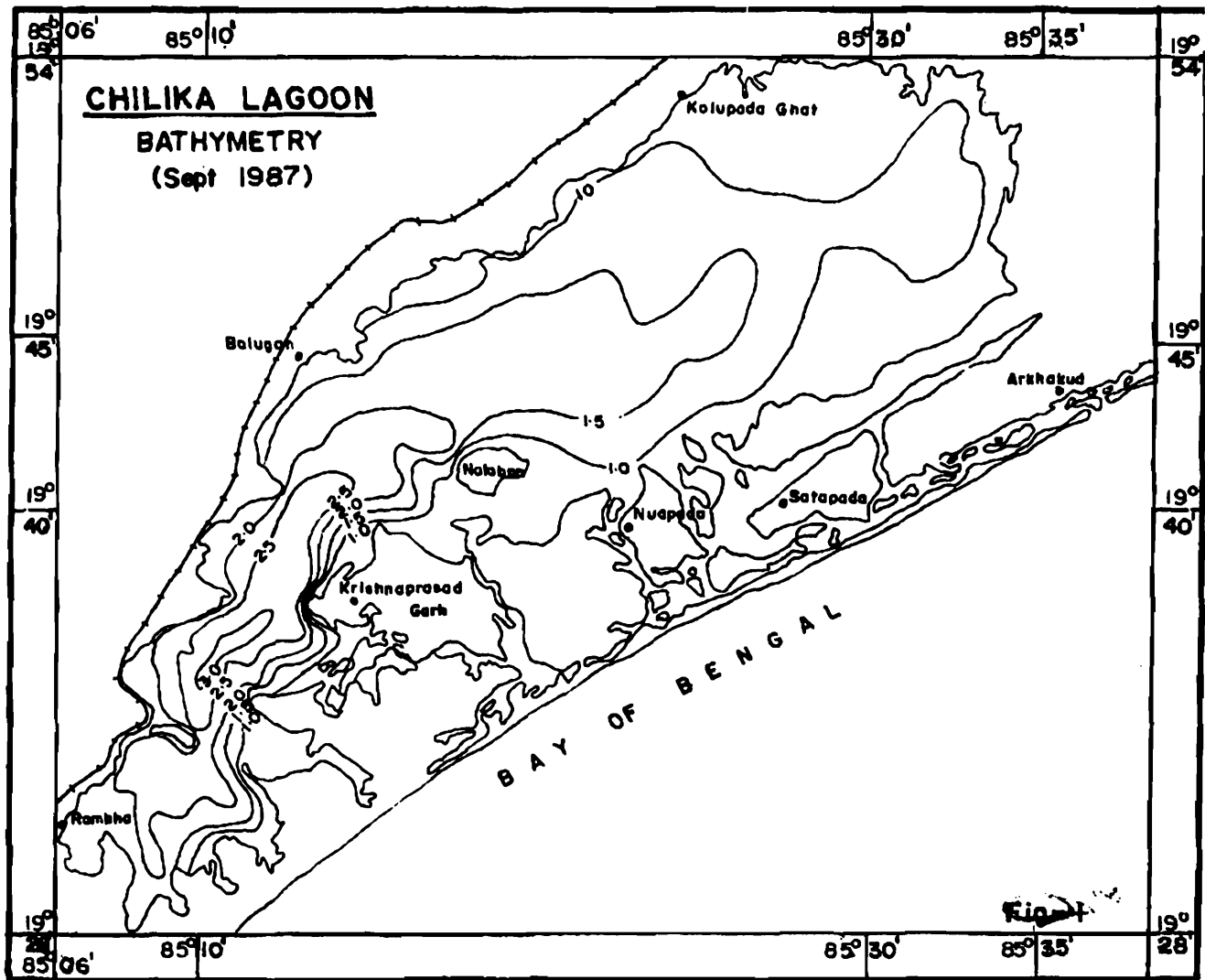


Figure 10. Showing range of depth (m) in different sectors of Chilika Lake, Orissa during SW Monsoon (04 - 27 Sept., 1987).

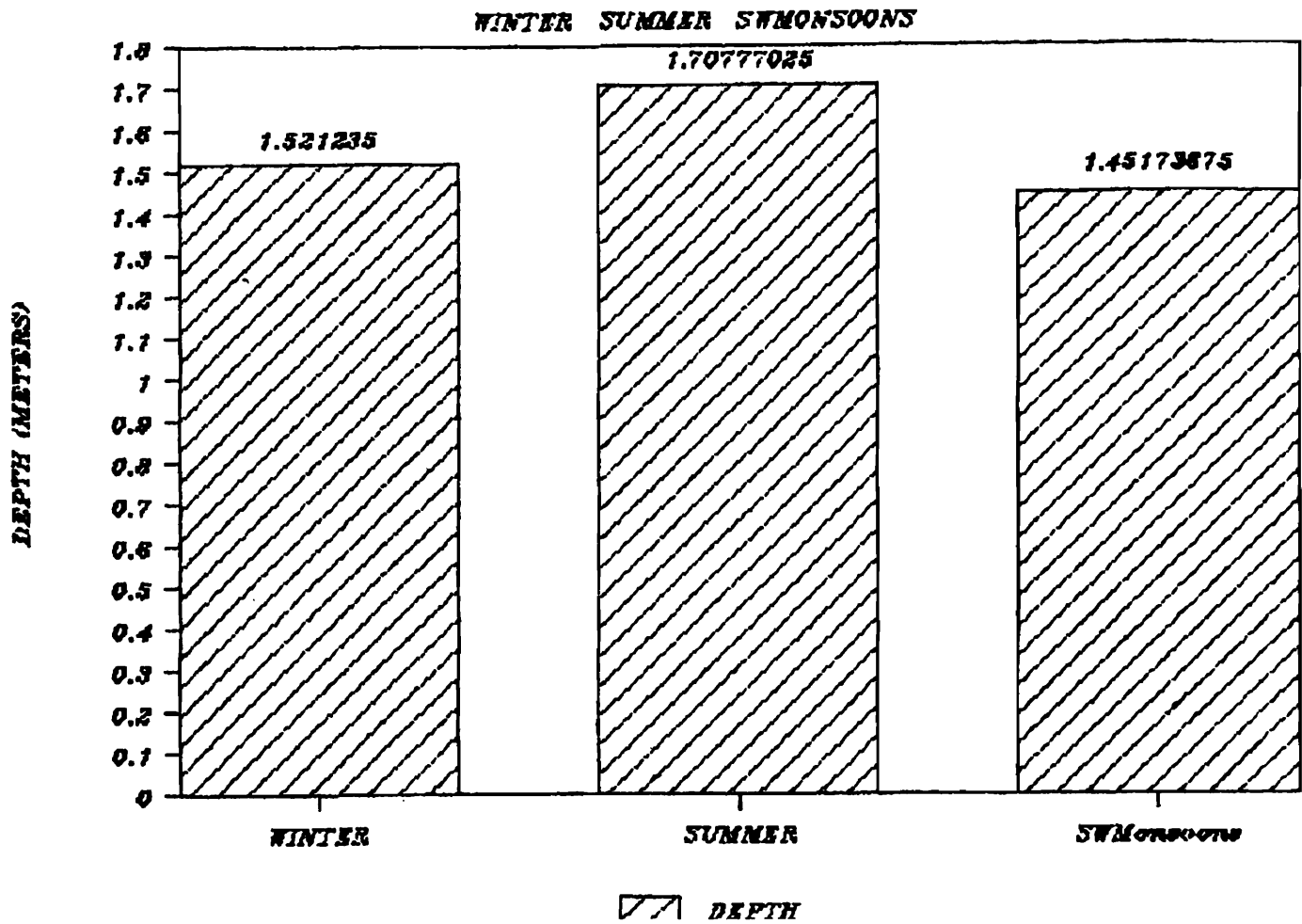


Figure 11. Showing average depth (m) profile of Chilika Lake, Orissa, season-wise (Winter, Summer and SW Monsoon).

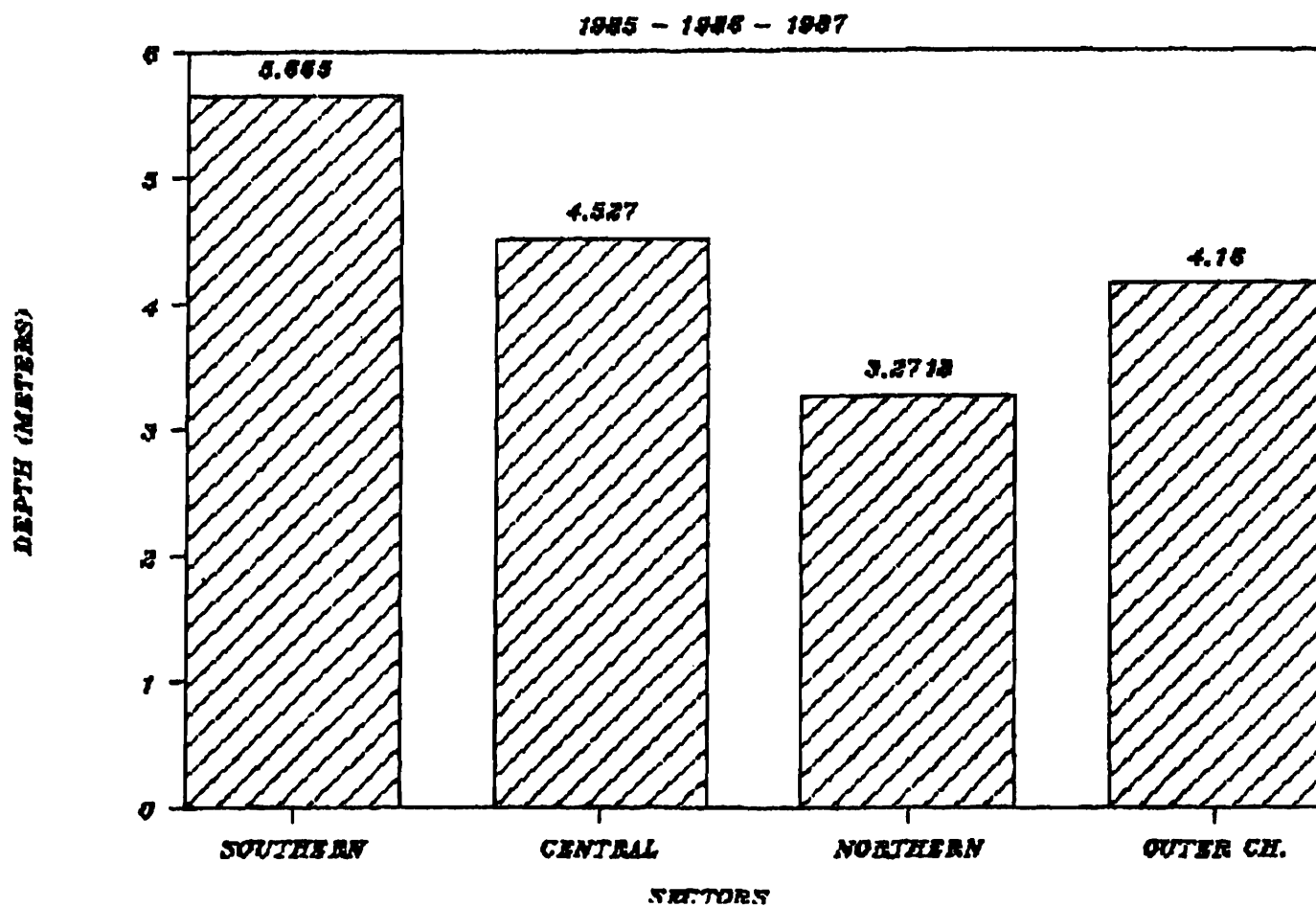


Figure 12. Showing average depth (m) profile of Chilika Lake, Orissa, for study period (1985-1986-1987).

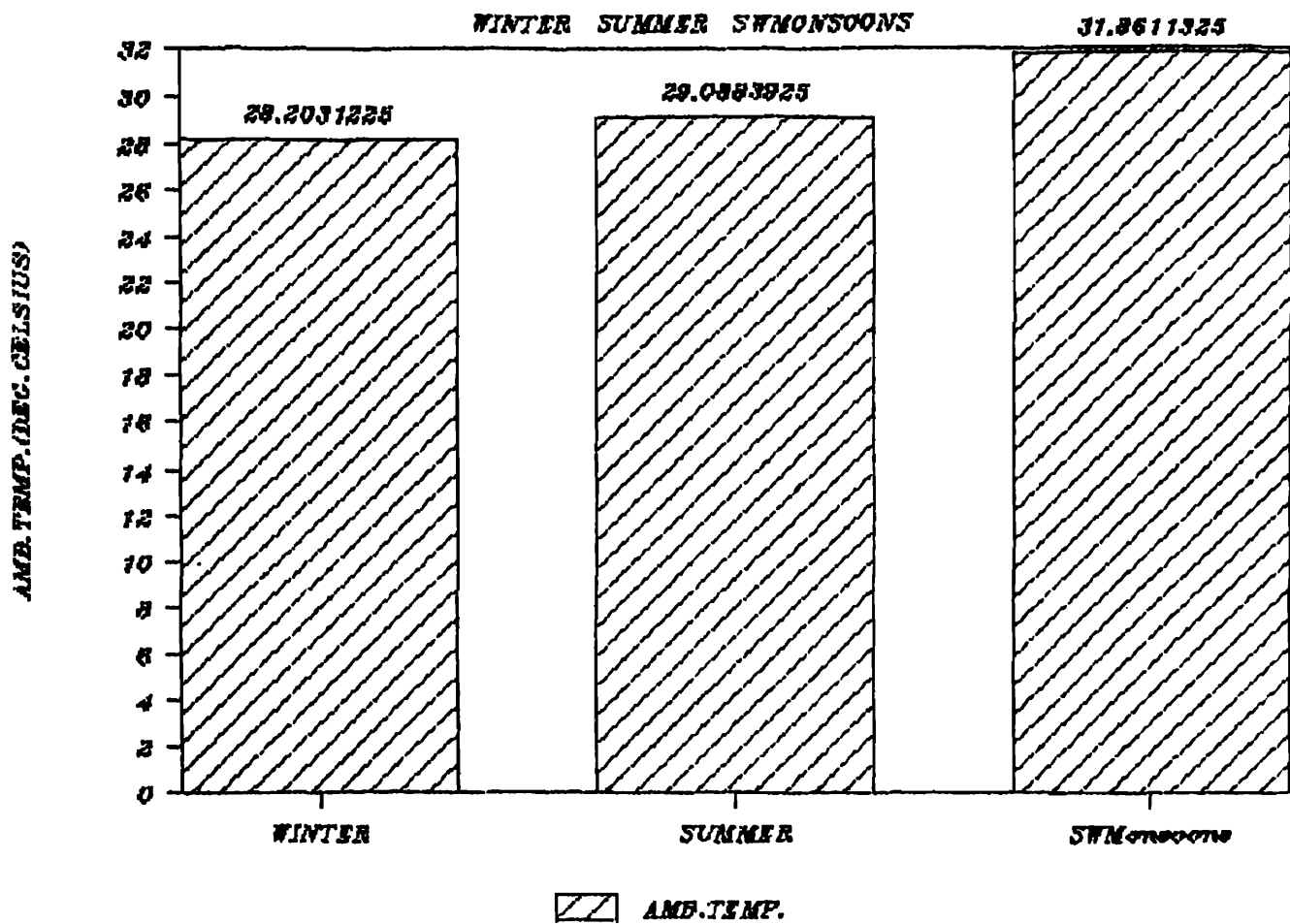


Figure 13. Showing average ambient temperature profile of Chilika Lake, Orissa, seasonwise.

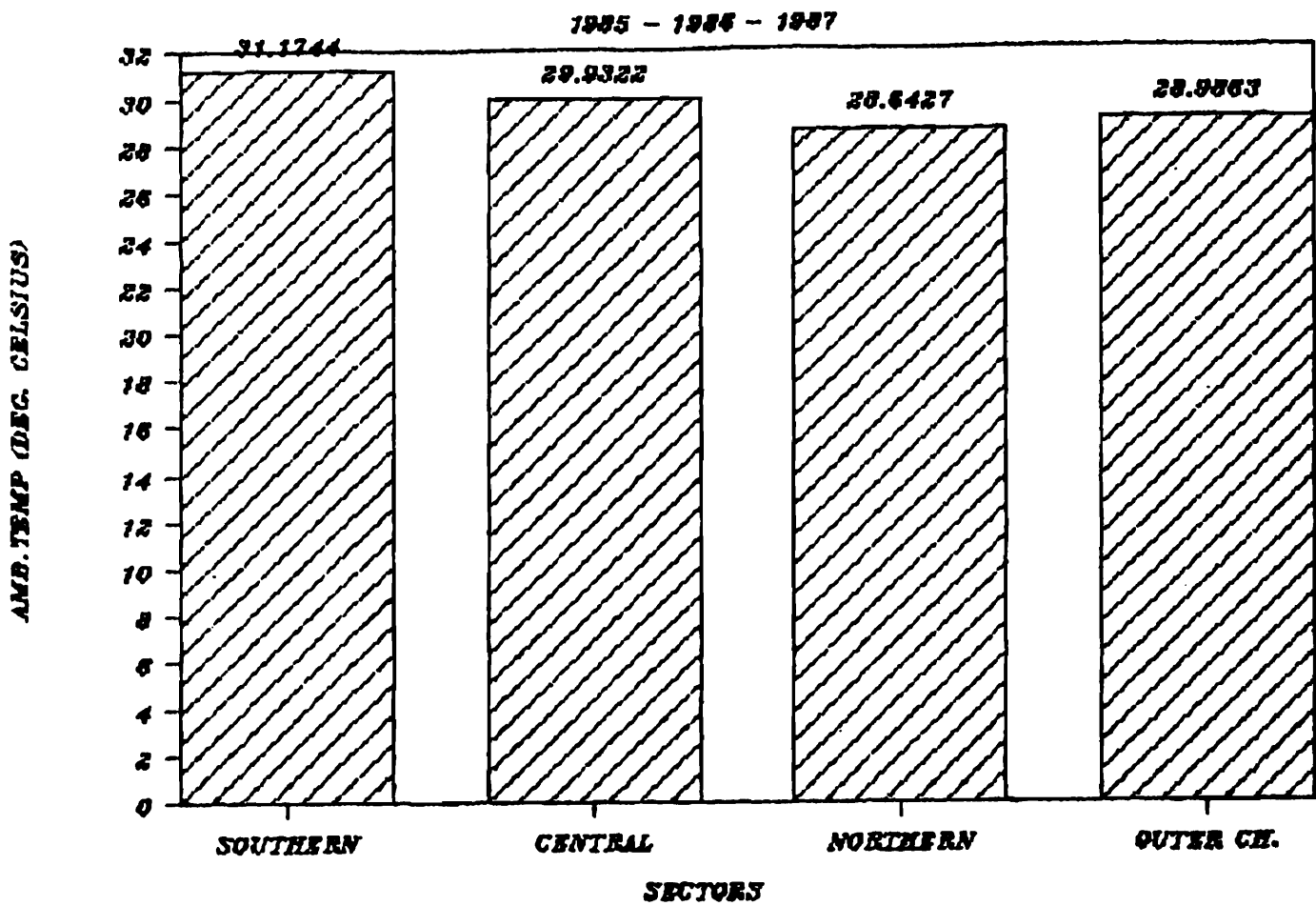


Figure 14. Showing average ambient temperature profile of Chilika Lake, Orissa, for study period.

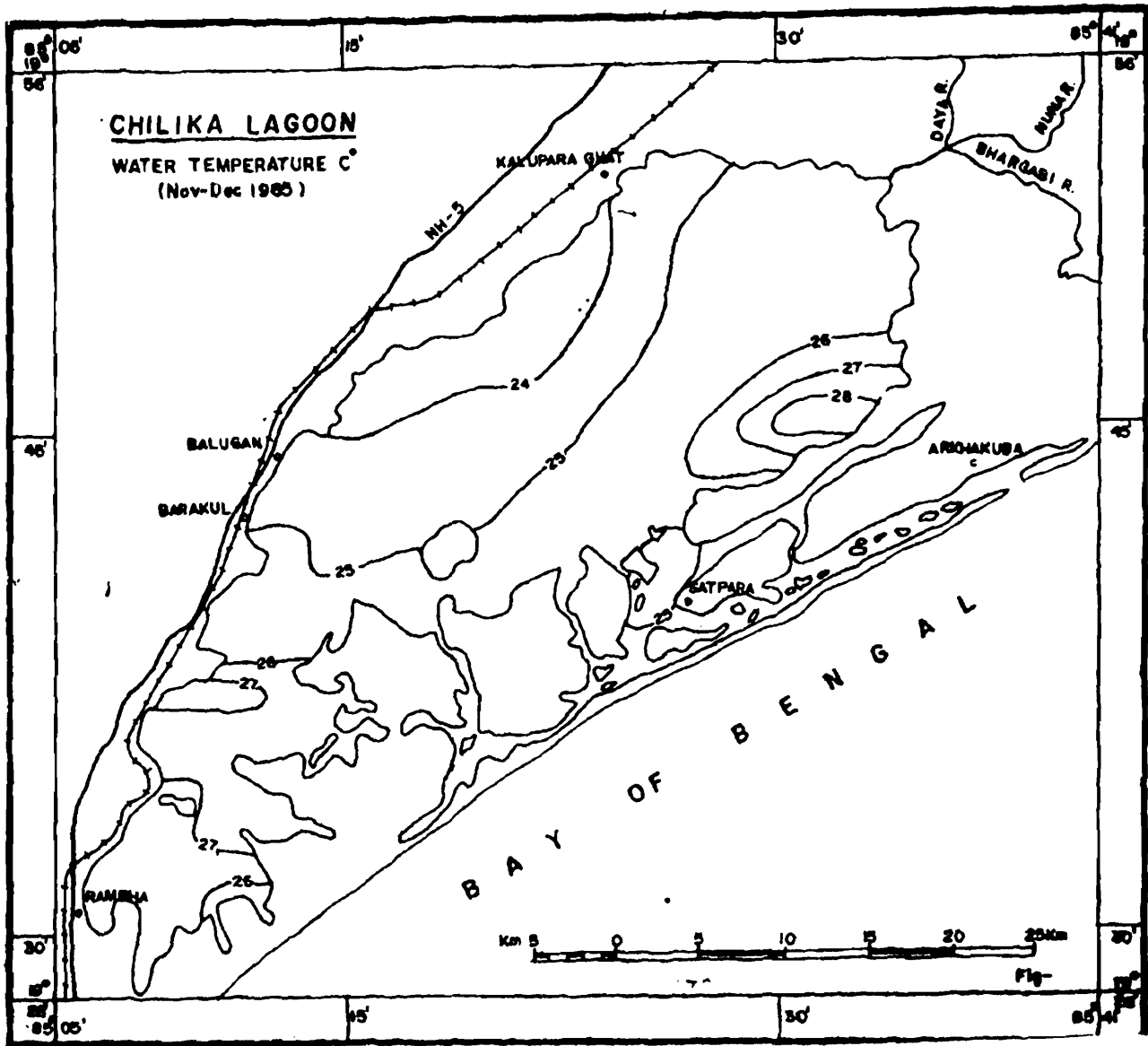


Figure 15. Showing range of subsurface water temperature (°C) (horizontal profile) during winter season (21 Nov. 05 Dec., 1985) in different sectors of Chilika Lake, Orissa.

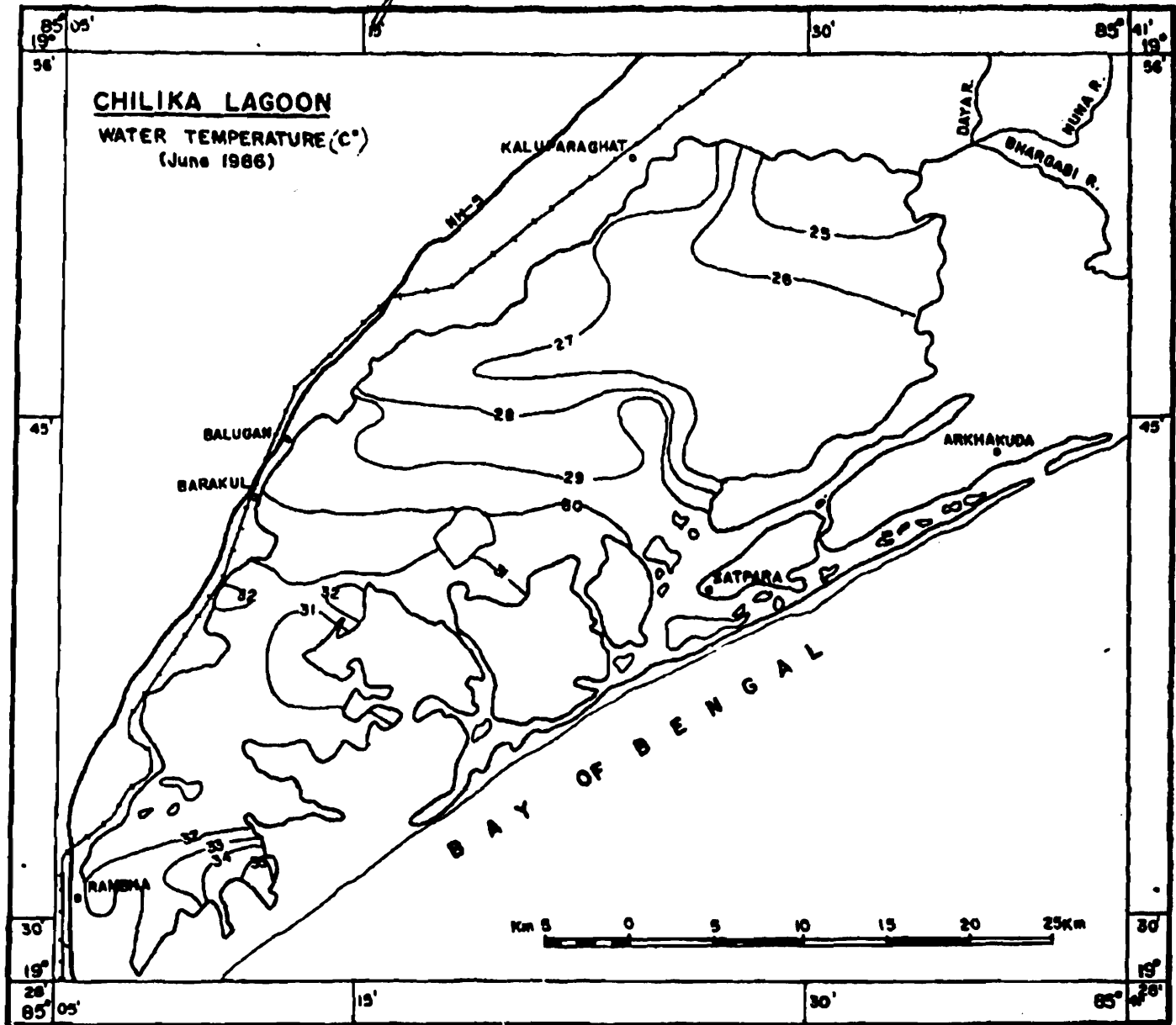


Figure 16. Showing range of subsurface water temperature ($^{\circ}\text{C}$) (horizontal profile) during summer season (10 - 30 June, 1986) in different sectors of Chilika Lake, Orissa.

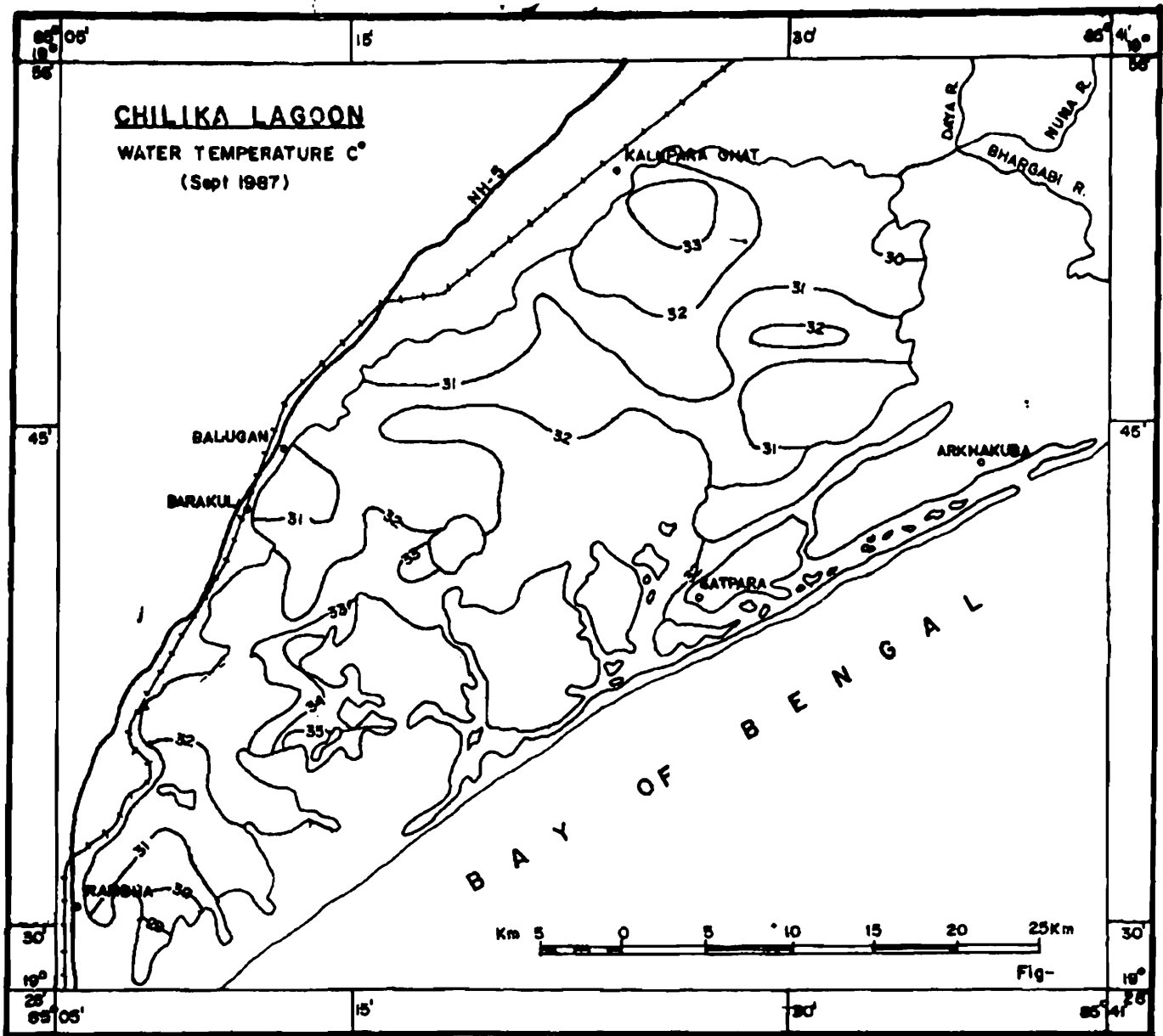


Figure 17. Showing range of subsurface water temperature (°C) (horizontal profile) during SW monsoon season (04 - 27 Sept., 1987) in different sectors of Chilika Lake, Orissa.

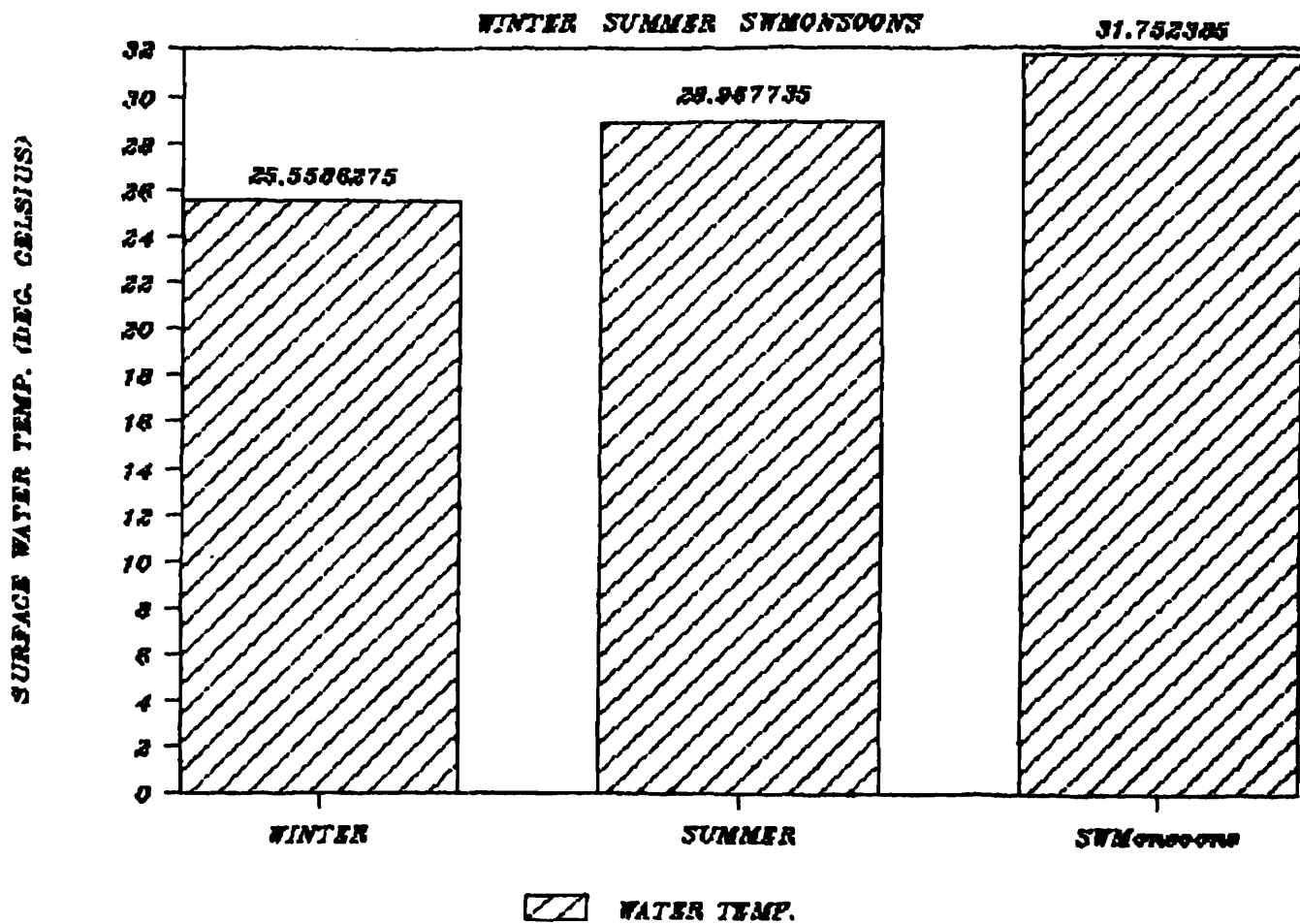


Figure 18. Showing average subsurface water temperature profile (°C) seasonwise in Chilika Lake, Orissa.

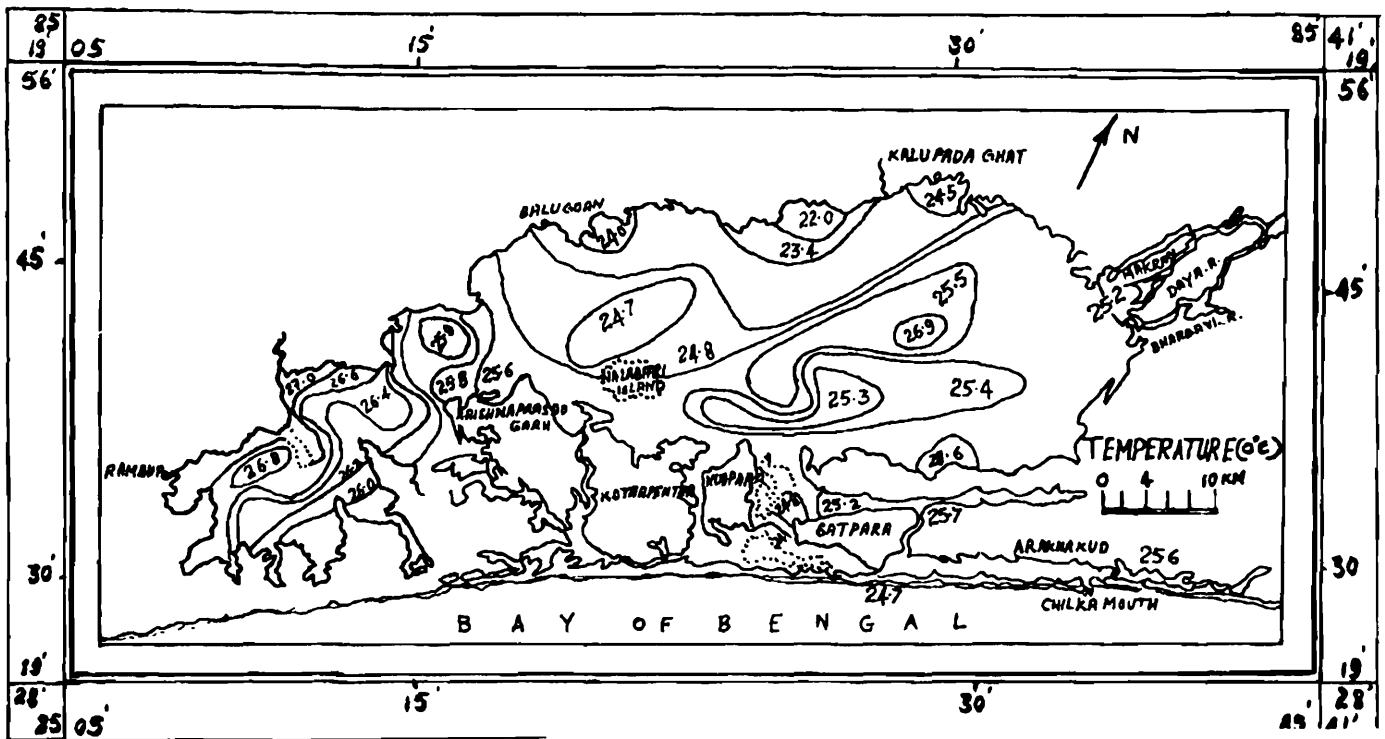


Figure 19. Showing subsurface water temperature profile ($^{\circ}\text{C}$) in Chilika Lake, Orissa, during study period.

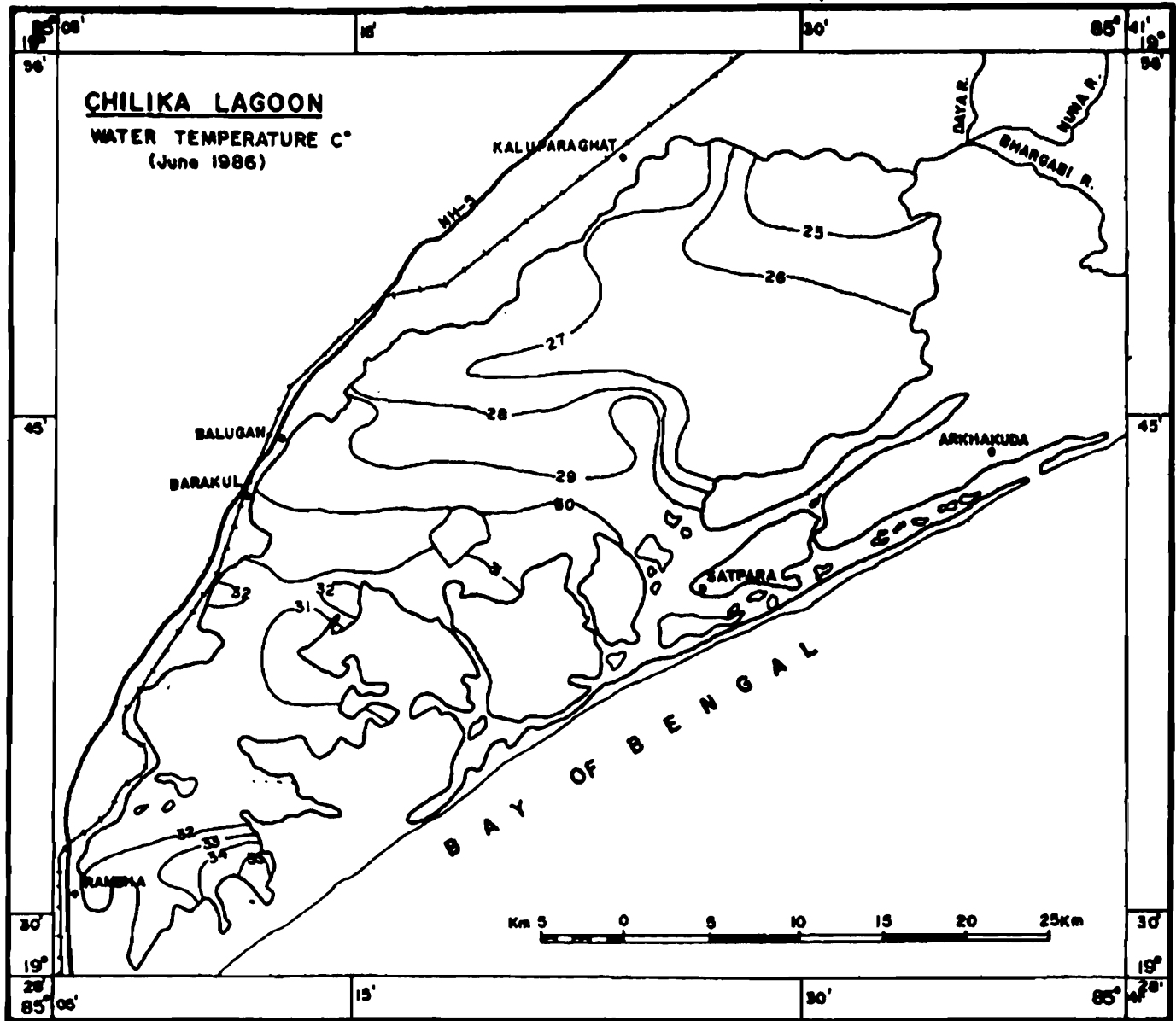


Figure 20. Showing average bottom water temperature profile (°C) in Chilika Lake, Orissa, seasonwise.

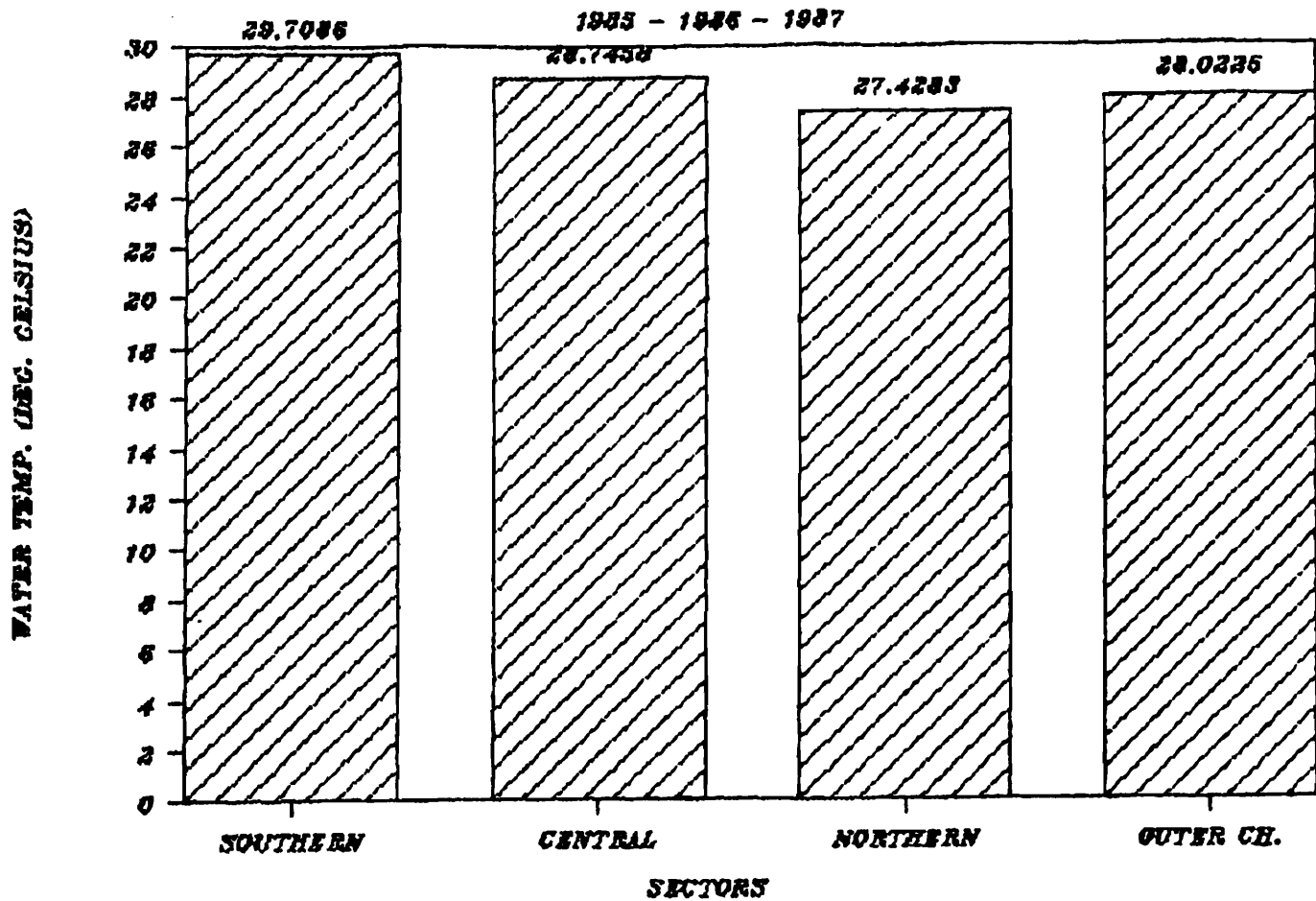


Figure 21. Showing average bottom water temperature profile (°C) in Chilika Lake, Orissa, during study period.

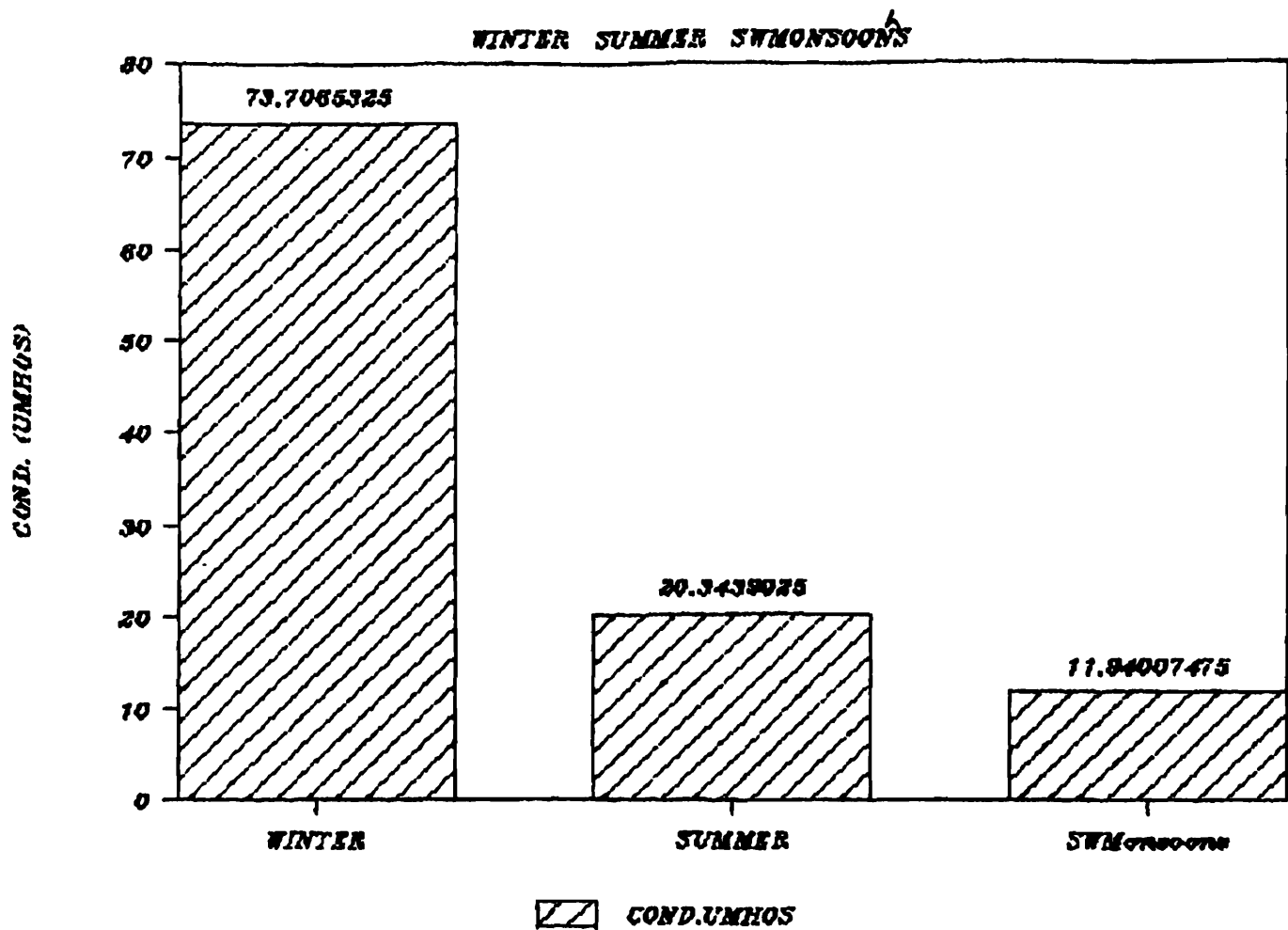


Figure 22. Showing average surface water conductivity of Chilika Lake, Orissa, seasonwise.

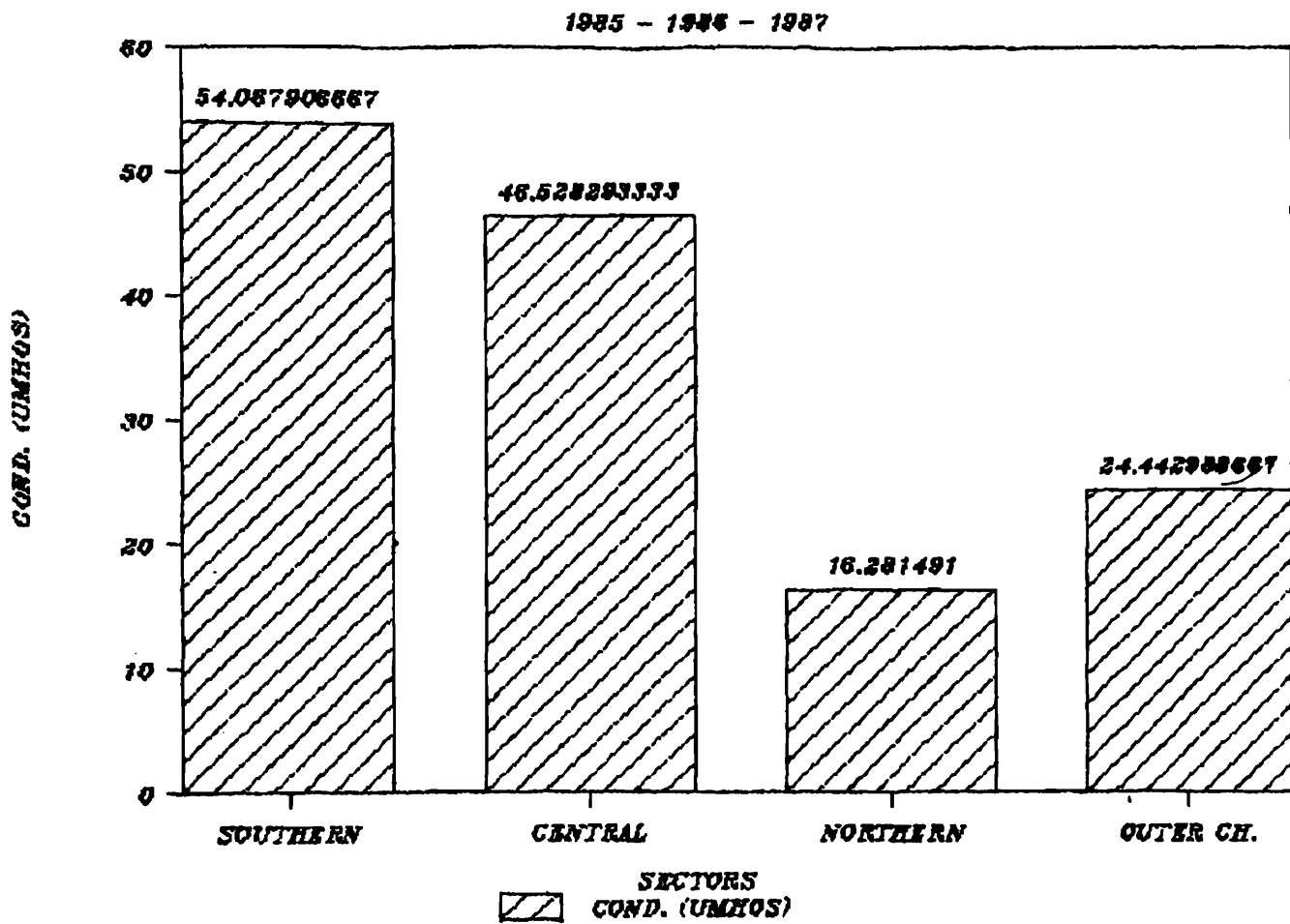


Figure 23. Showing average surface water conductivity of Chilika Lake, Orissa, for study period.

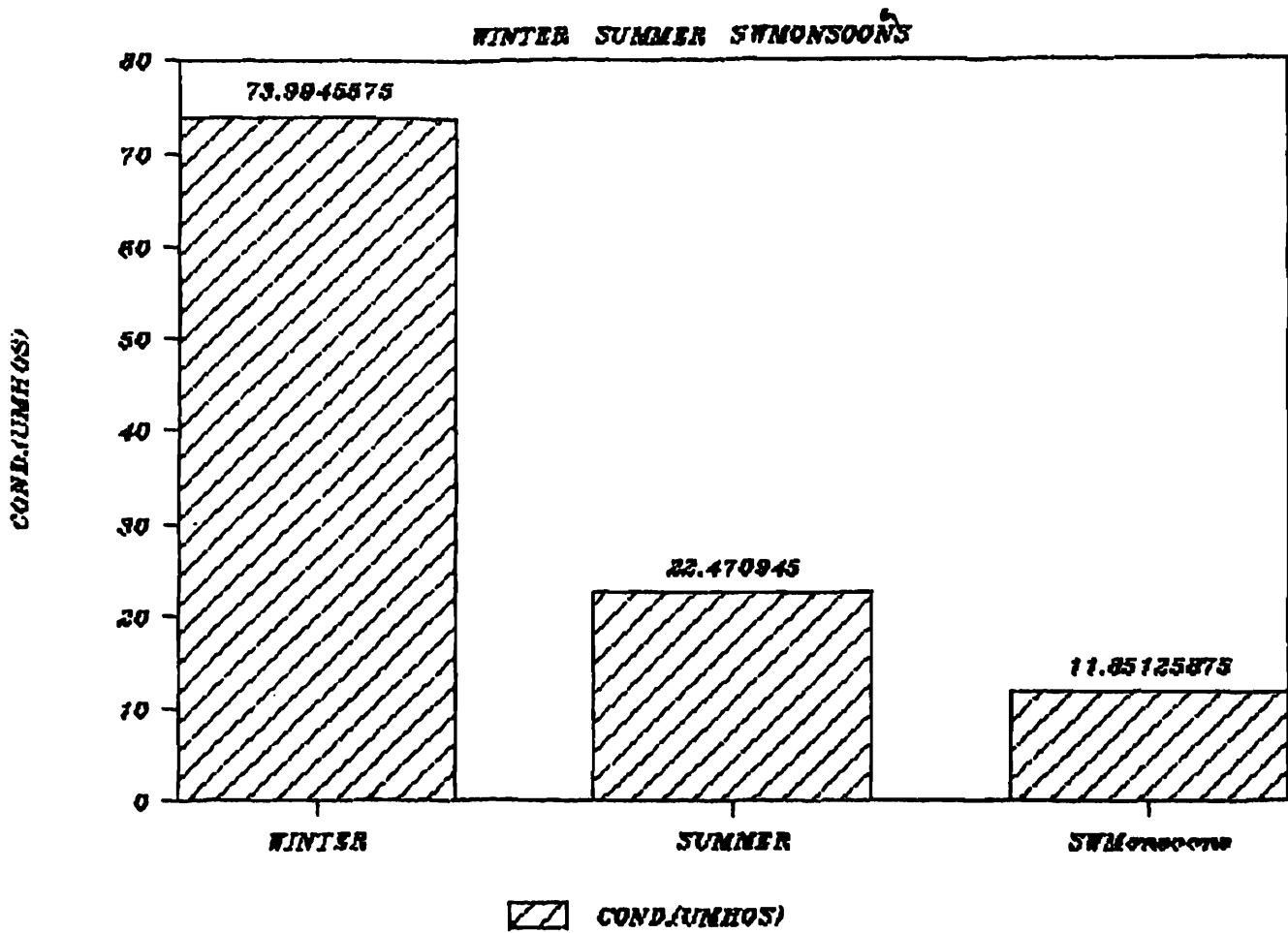


Figure 24. Showing average bottom water conductivity of Chilka Lake, Orissa, seasonwise.

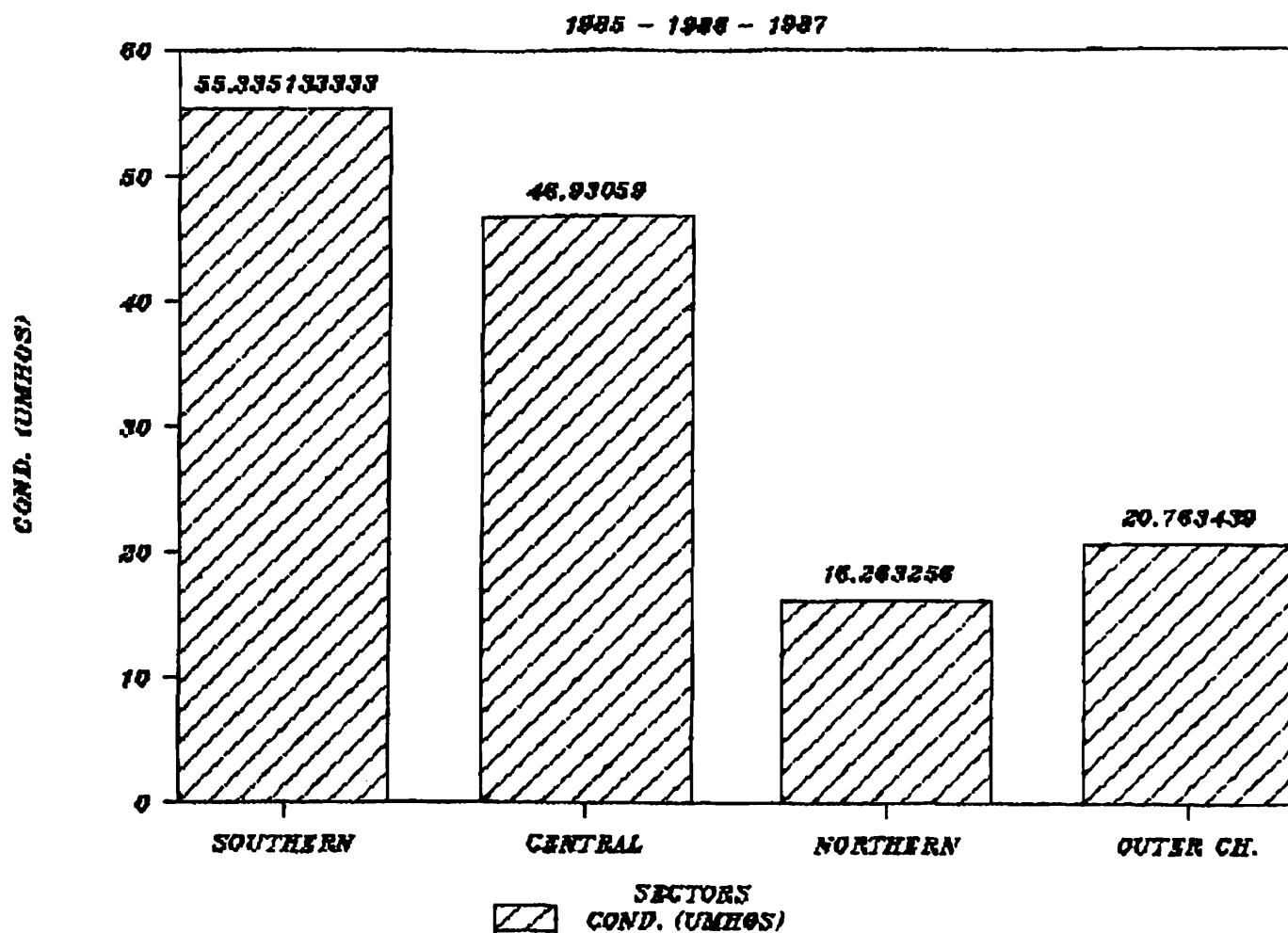


Figure 25. Showing average bottom water conductivity of Chilika lake, Orissa, for study period.

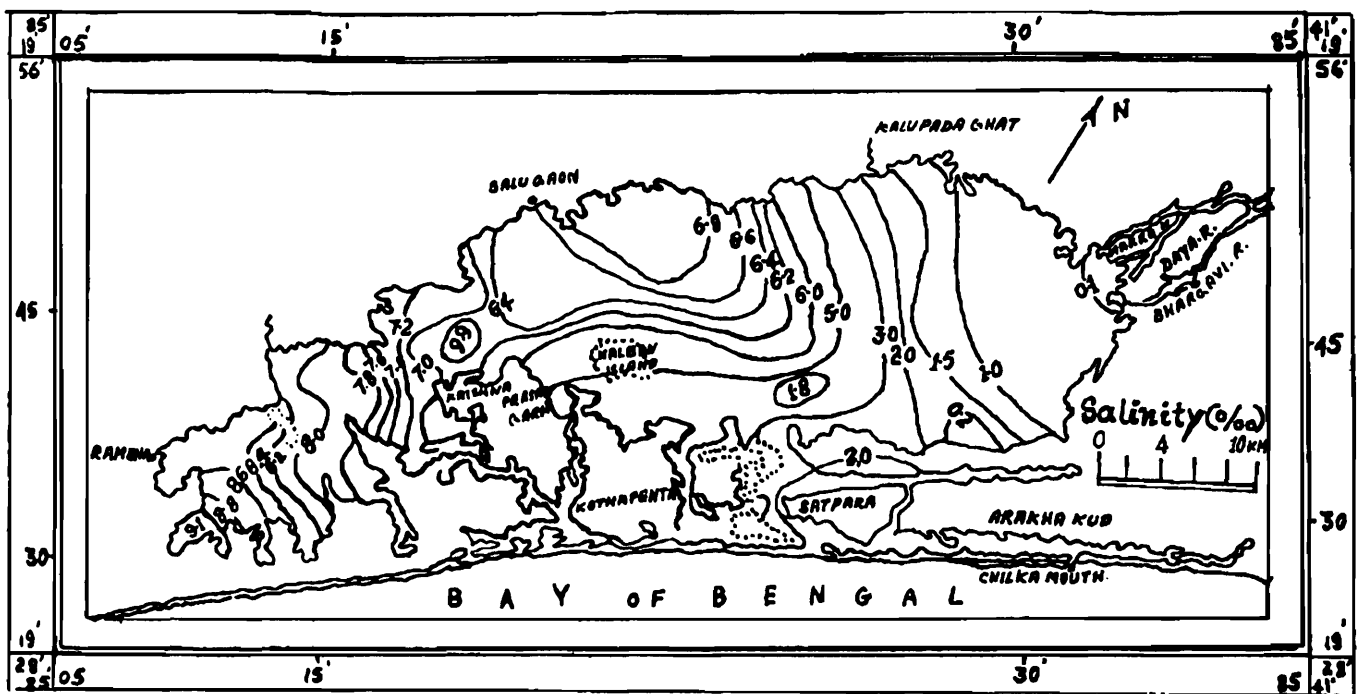


Figure 26. Showing range of salinity (S‰) (horizontal profile) in subsurface waters in Chilika Lake, Orissa, during winter season (21 Nov. 05 Dec., 1985).

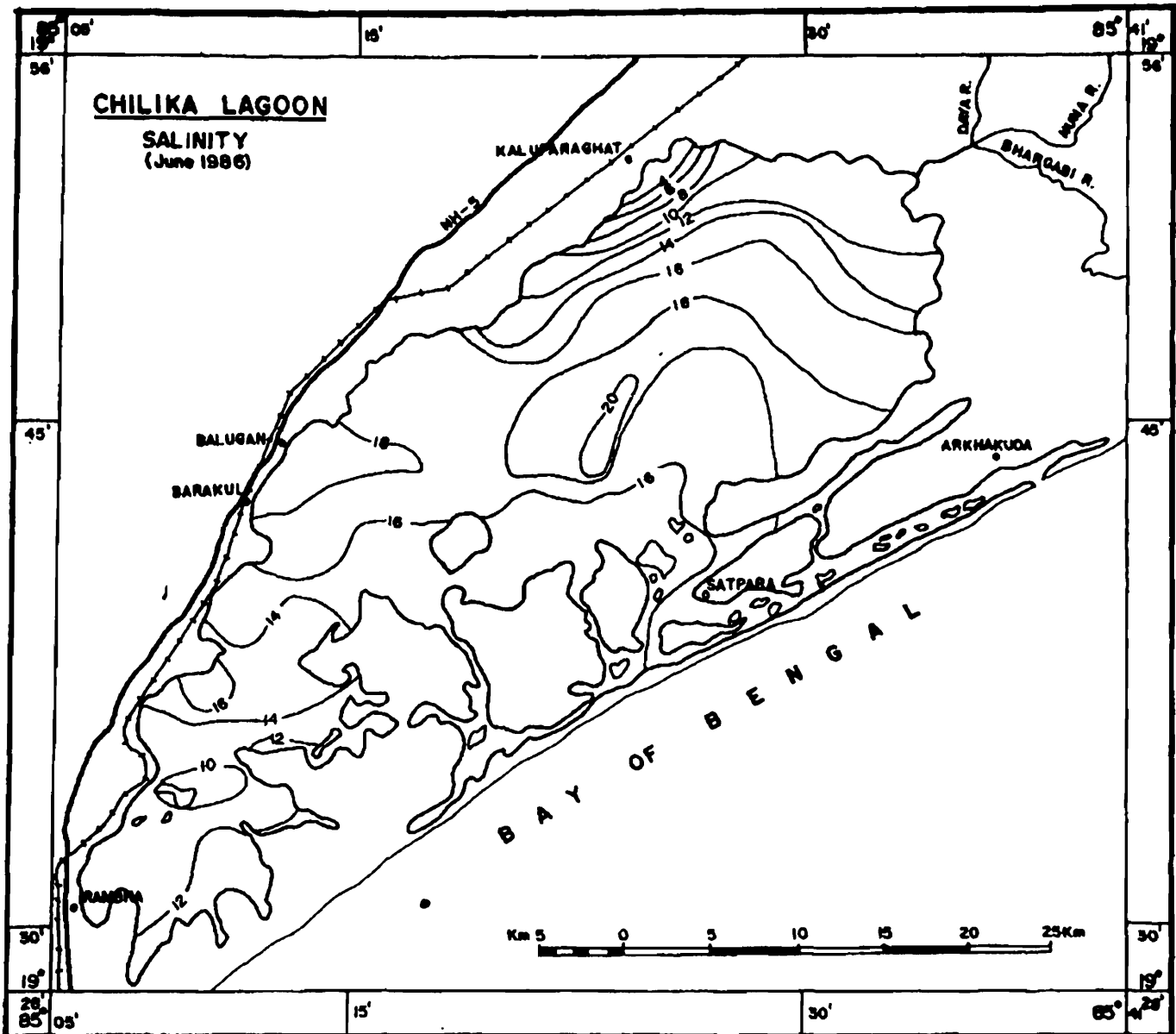


Figure 27. Showing range of salinity (‰) horizontal profile) in subsurface waters of Chilika Lake, Orissa, during summer season (10 - 30 June, 1986).

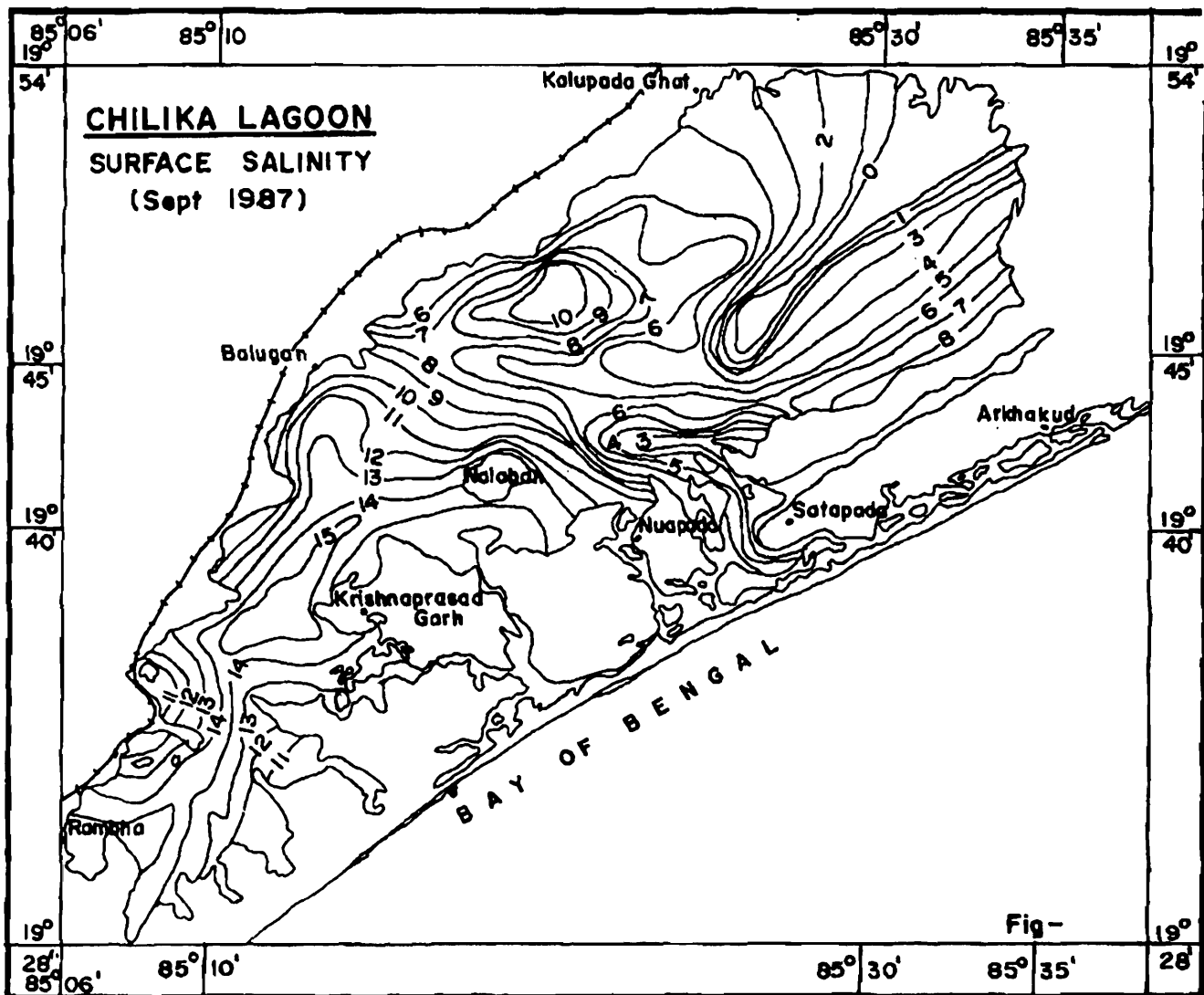


Figure 28. Showing range of salinity (‰) (horizontal profile) in subsurface waters of Chilika Lake, Orissa, during SW monsoon (04 - 27 Sept., 1987).

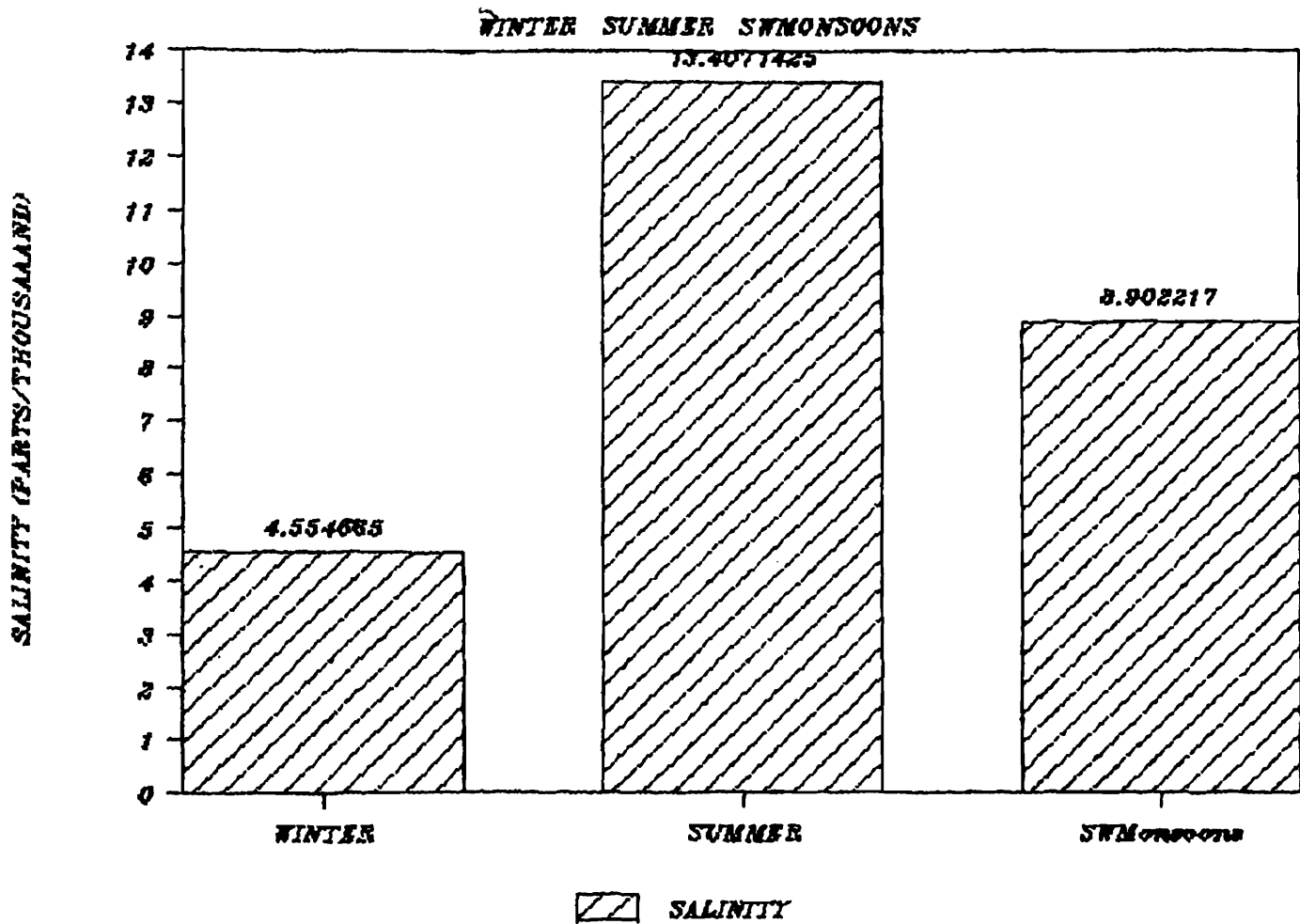


Figure 29. Showing average subsurface water salinity (S‰) (horizontal profile) in Chilika Lake, Orissa, seasonwise.

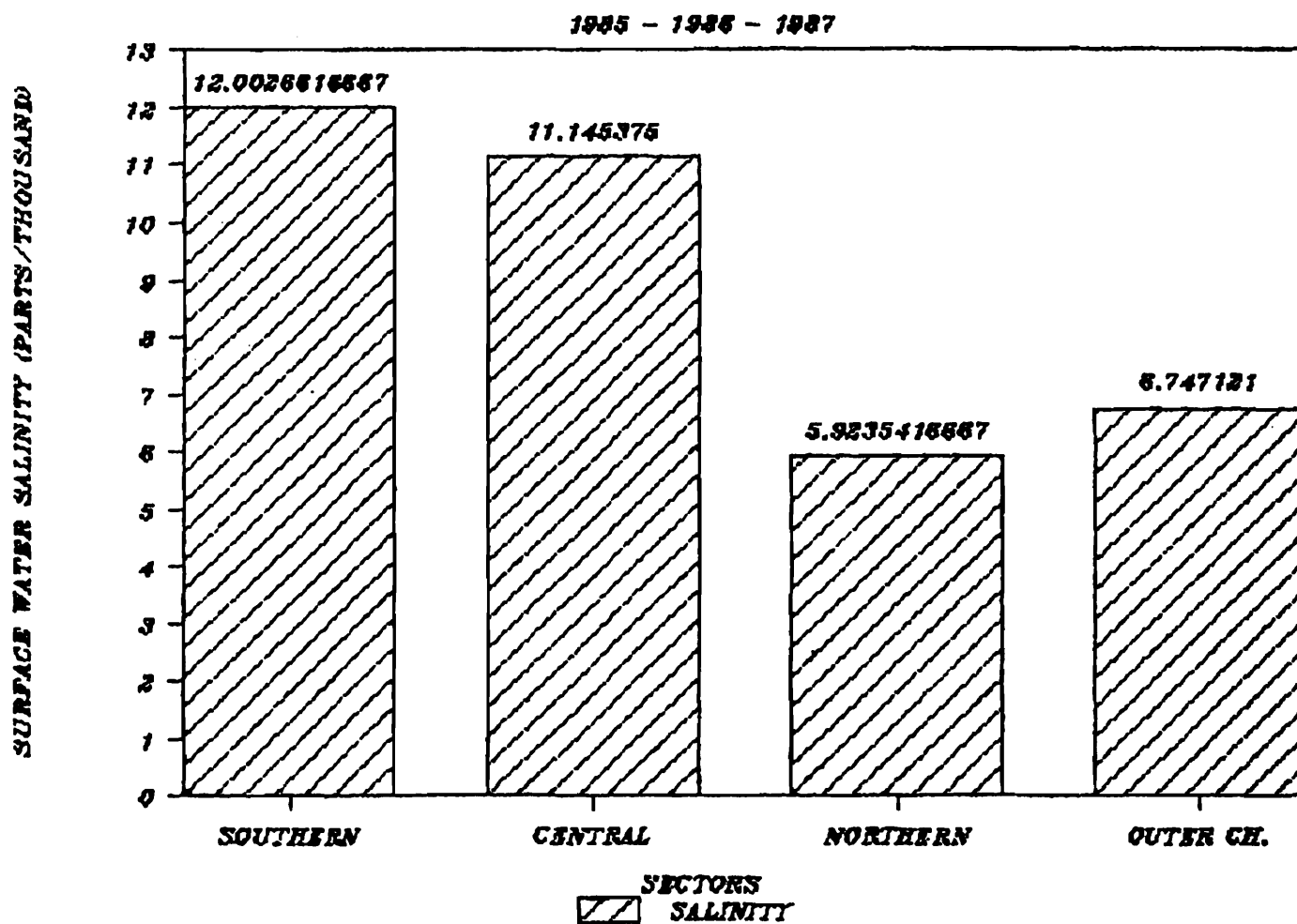


Figure 30. Showing average subsurface water salinity (‰) (horizontal profile) in Chilika Lake, Orissa, during study period.

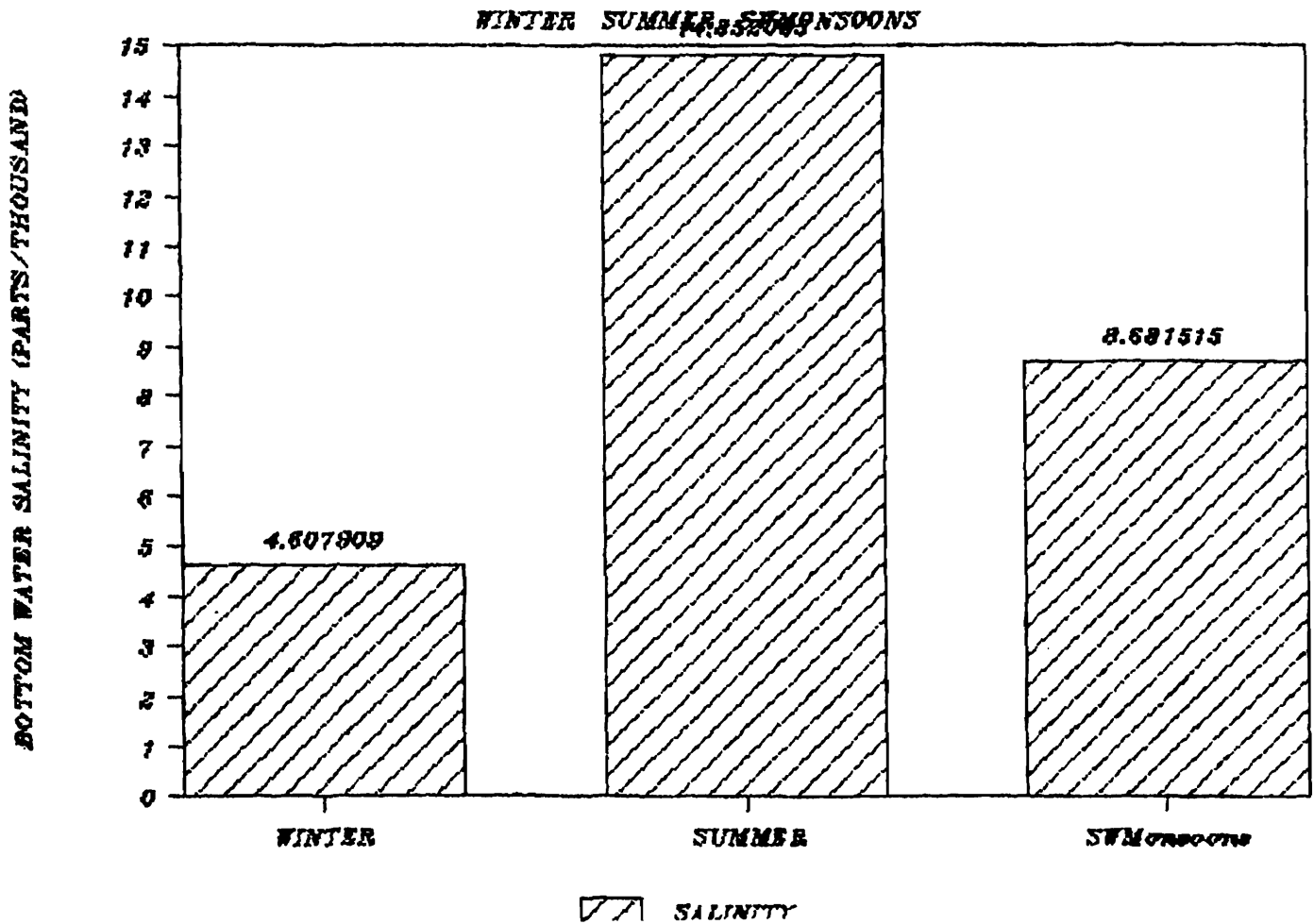


Figure 31. Showing average bottom water salinity (‰) profile in Chilika Lake, Orissa, seasonwise.

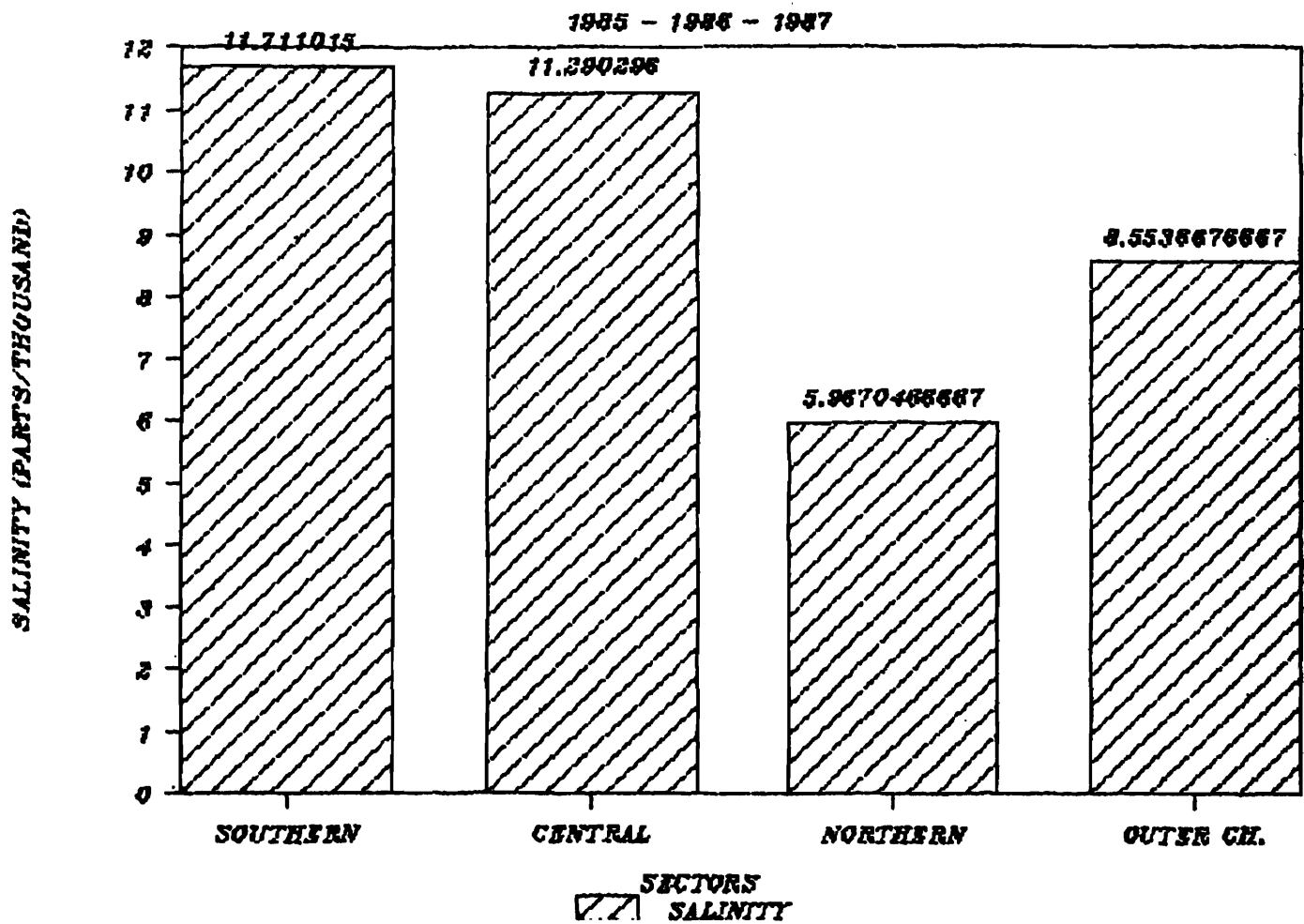


Figure 32. Showing average bottom water salinity (S‰) profile of Chilika Lake, Orissa, during study period.

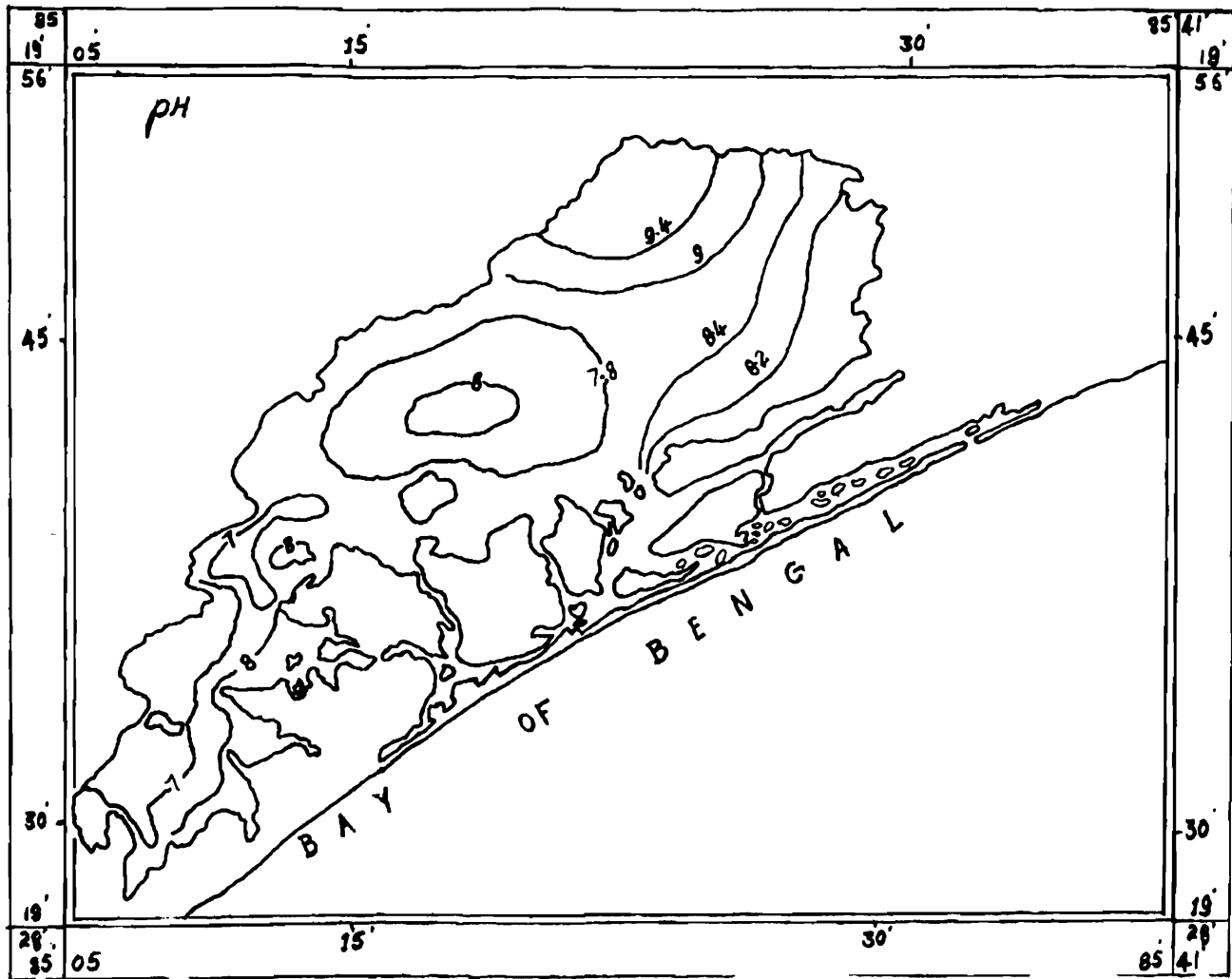


Figure 33. Showing range of pH values (horizontal profile) in different sectors in Chilika Lake, Orissa, during winter season (21 Nov. 05 Dec., 1985).

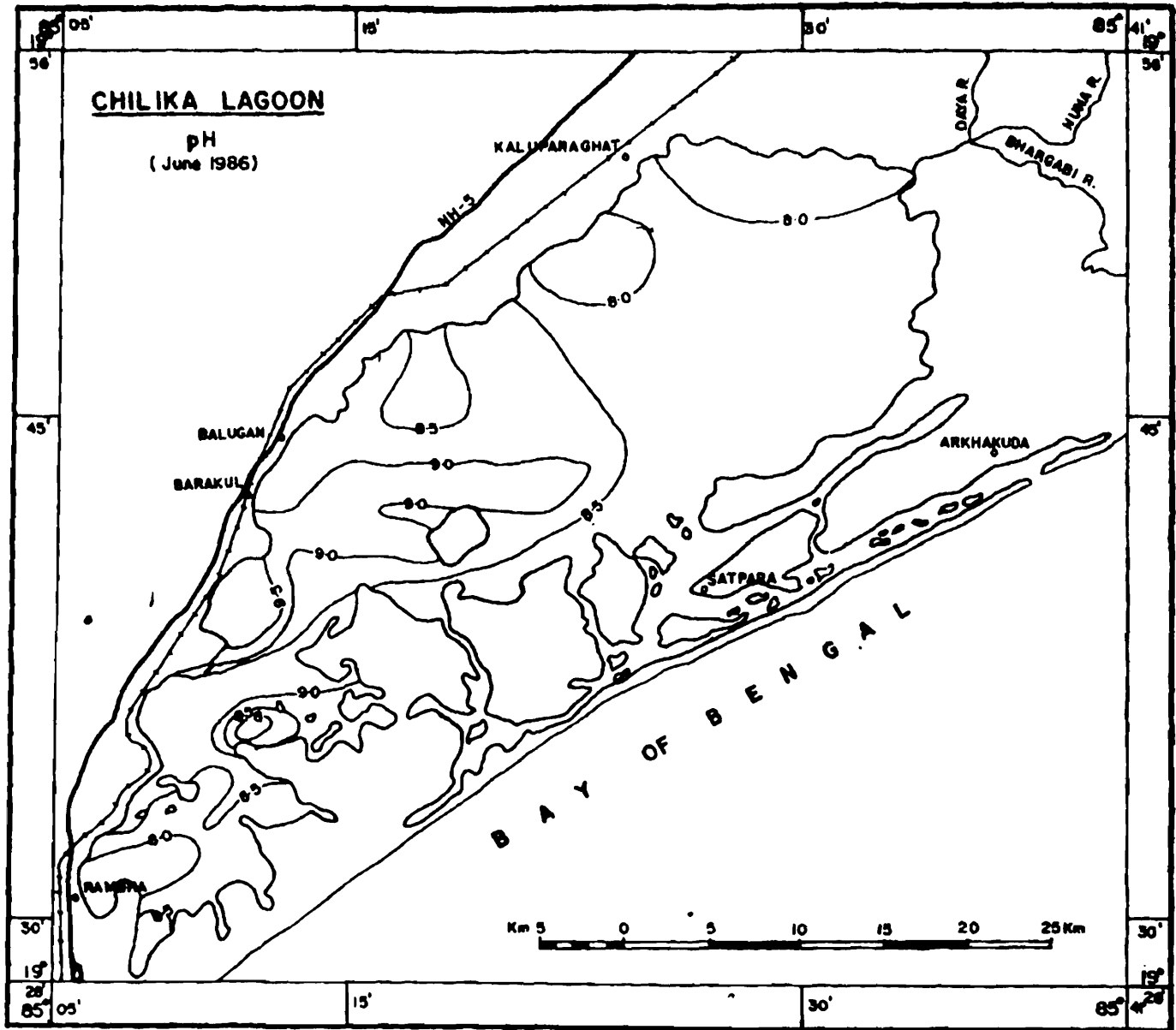


Figure 34. Showing range of pH values (horizontal profile) in subsurface waters in different sectors in Chilika Lake, Orissa, during summer season (10 - 30 June, 1986).

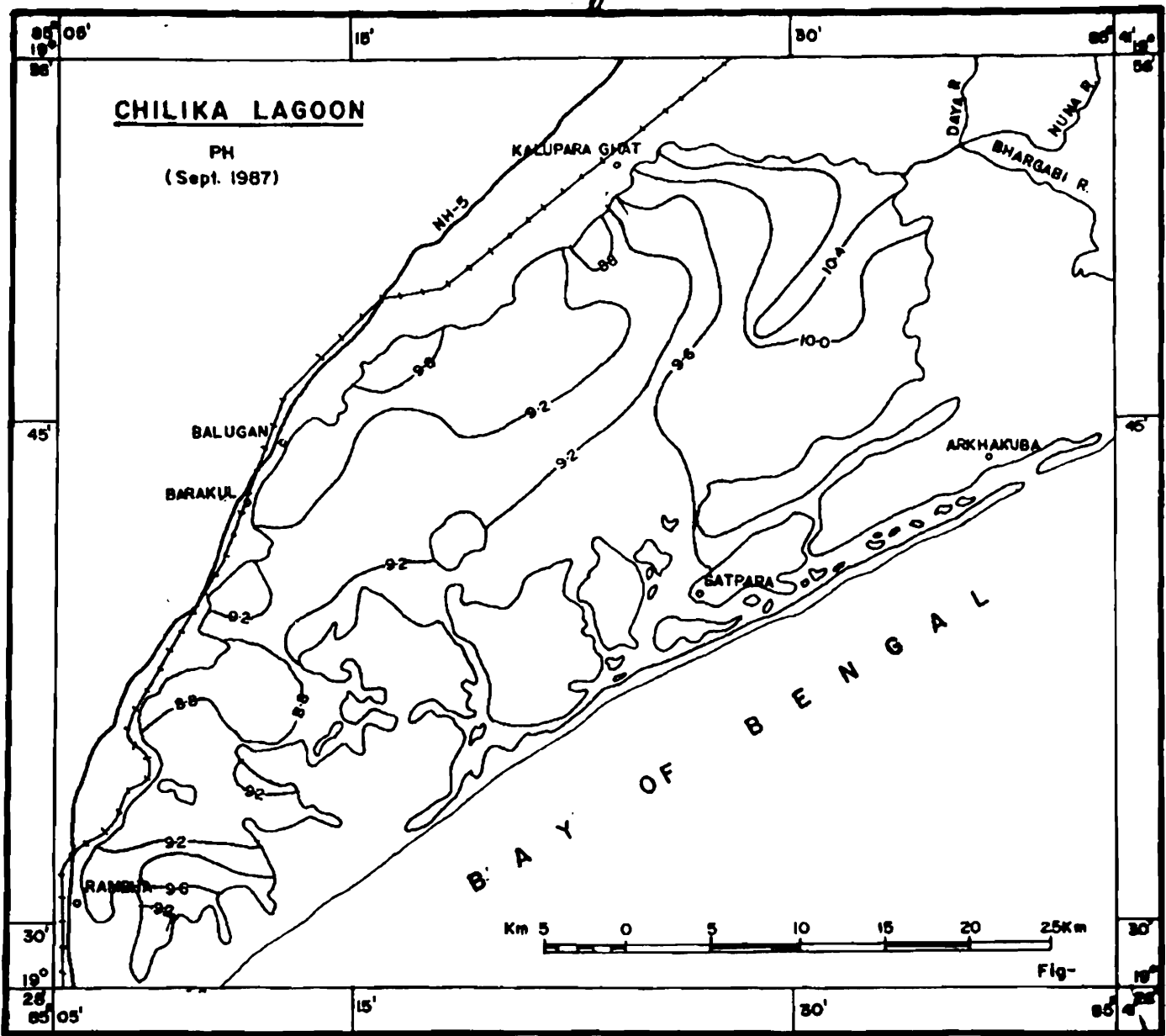


Figure 35. Showing range of pH values (horizontal profile) in subsurface waters in different sectors in Chilika Lake, Orissa, during SW monsoon (04 - 27 Sept., 1987).

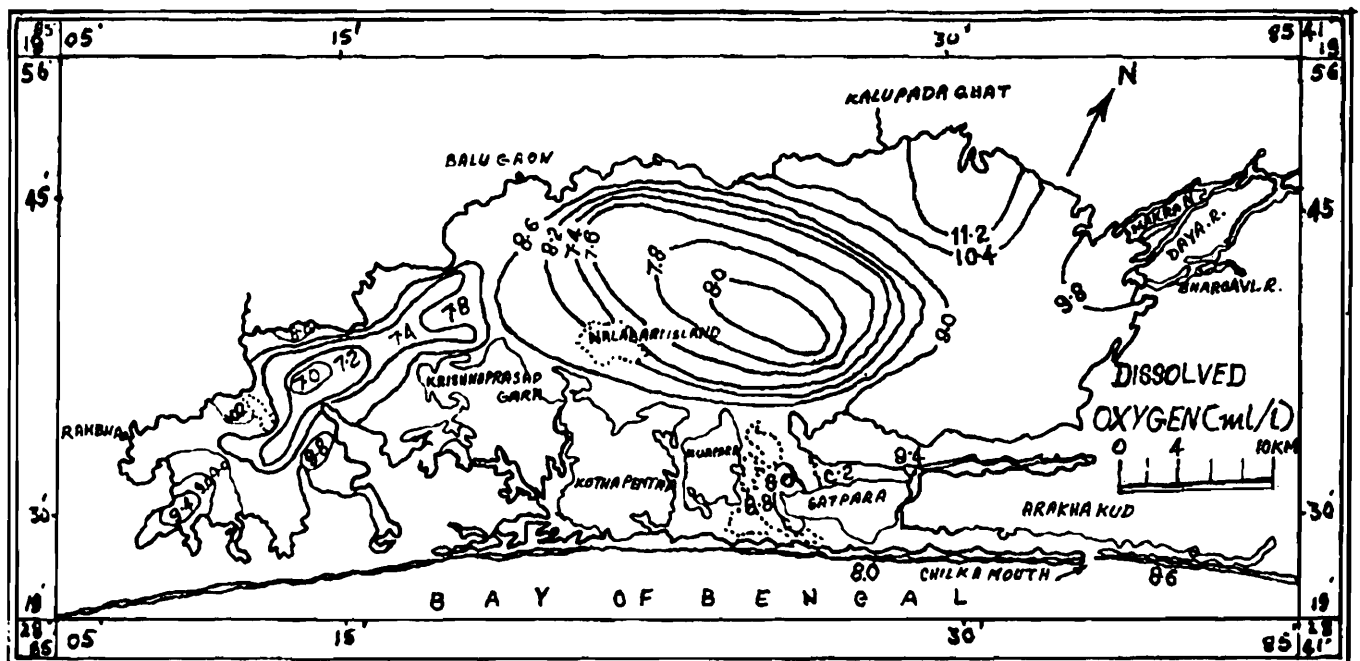


Figure 36. Showing dissolved oxygen content (DO mg/L) (horizontal profile) in subsurface waters in Chilika Lake, Orissa, during winter season (21 Nov. - 05 Dec., 1985).

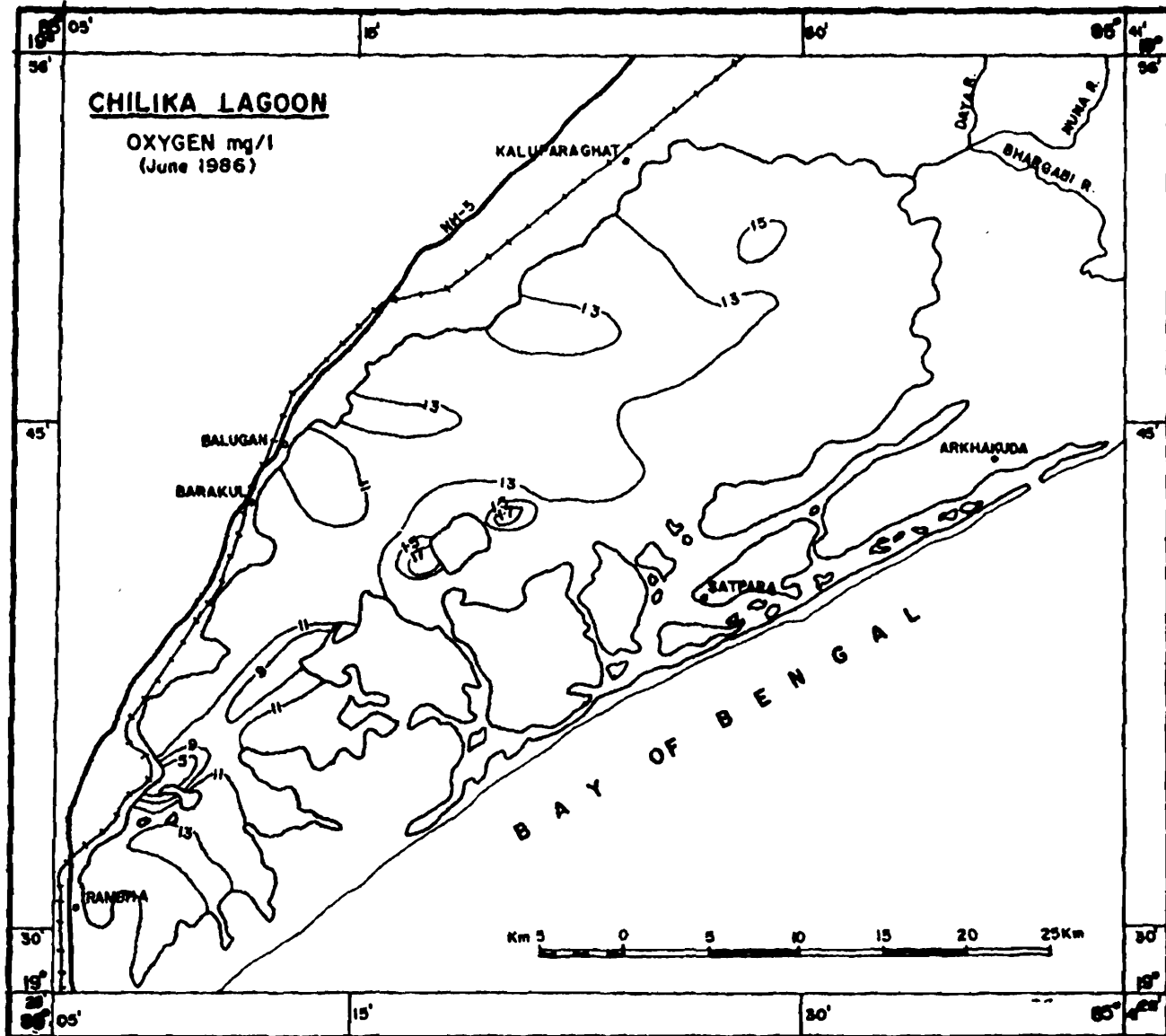


Figure 37. Showing dissolved oxygen content (DO mg/L) (horizontal profile) in subsurface waters in Chilika Lake, Orissa, during summer season (10 - 30 June, 1986).

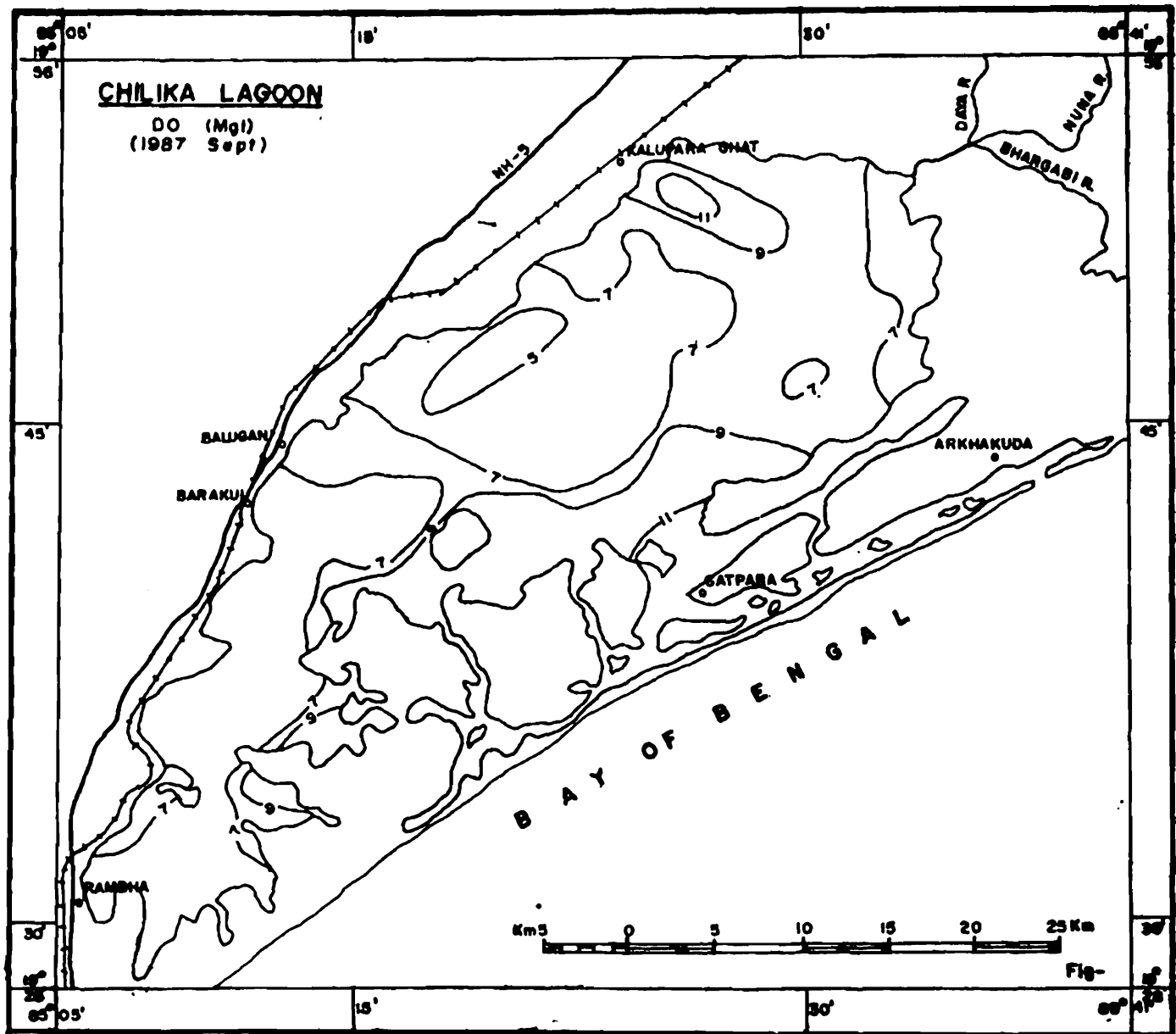


Figure 38. Showing dissolved oxygen content (DO mg/L) (horizontal profile) in subsurface waters in Chilika Lake, Orissa, during SW monsoon (04-27 Sept., 1987).

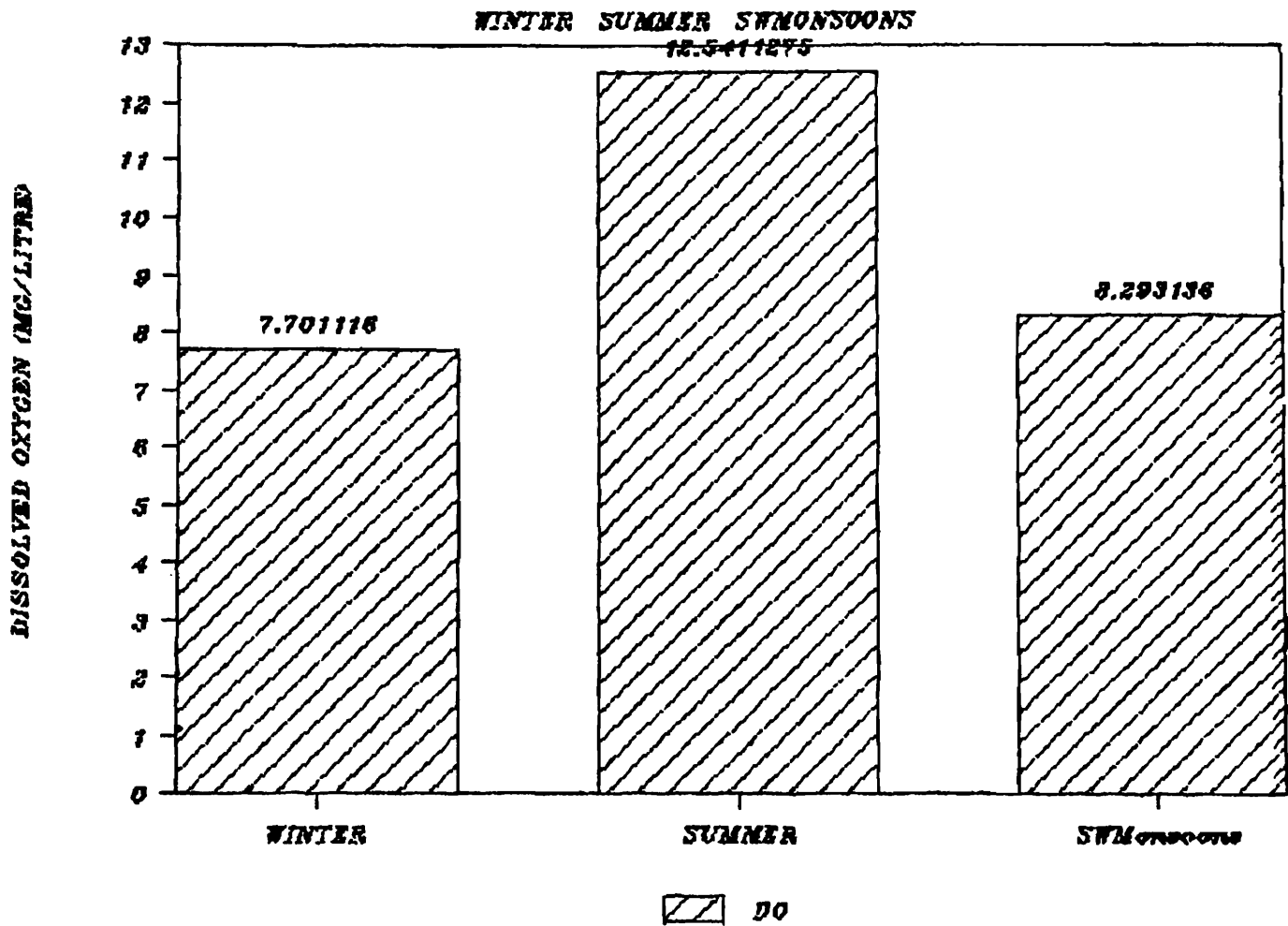


Figure 39. Showing average dissolved oxygen content (DO mg/L) profile in subsurface waters of Chilika Lake, Orissa, seasonwise.

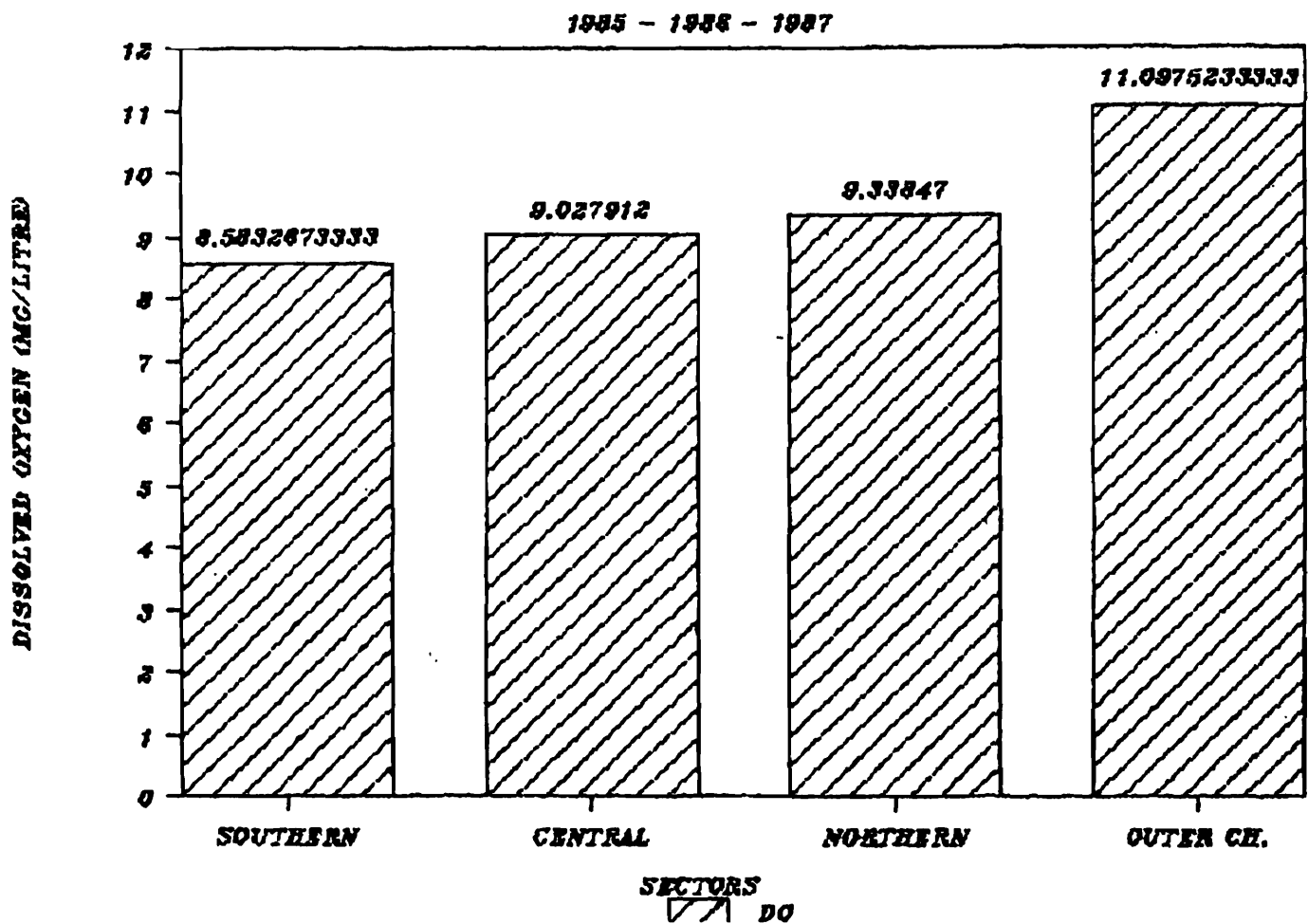


Figure 40. Showing average dissolved oxygen content (DO mg/L) profile in subsurface waters of Chilika Lake, Orissa, for study period.

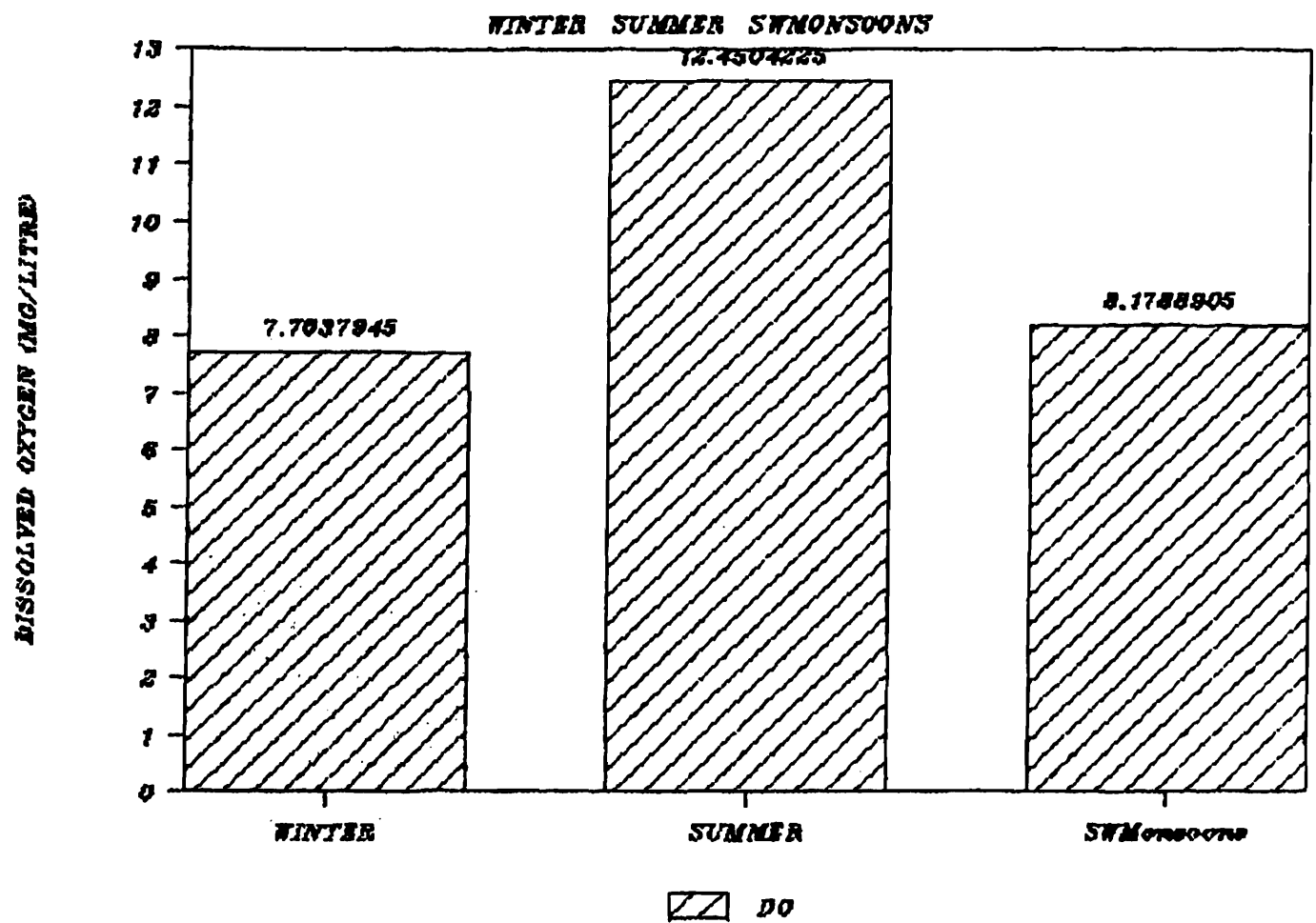


Figure 41. Showing average dissolved oxygen content (DO mg/L) profile in Chilika Lake, Orissa, seasonwise.

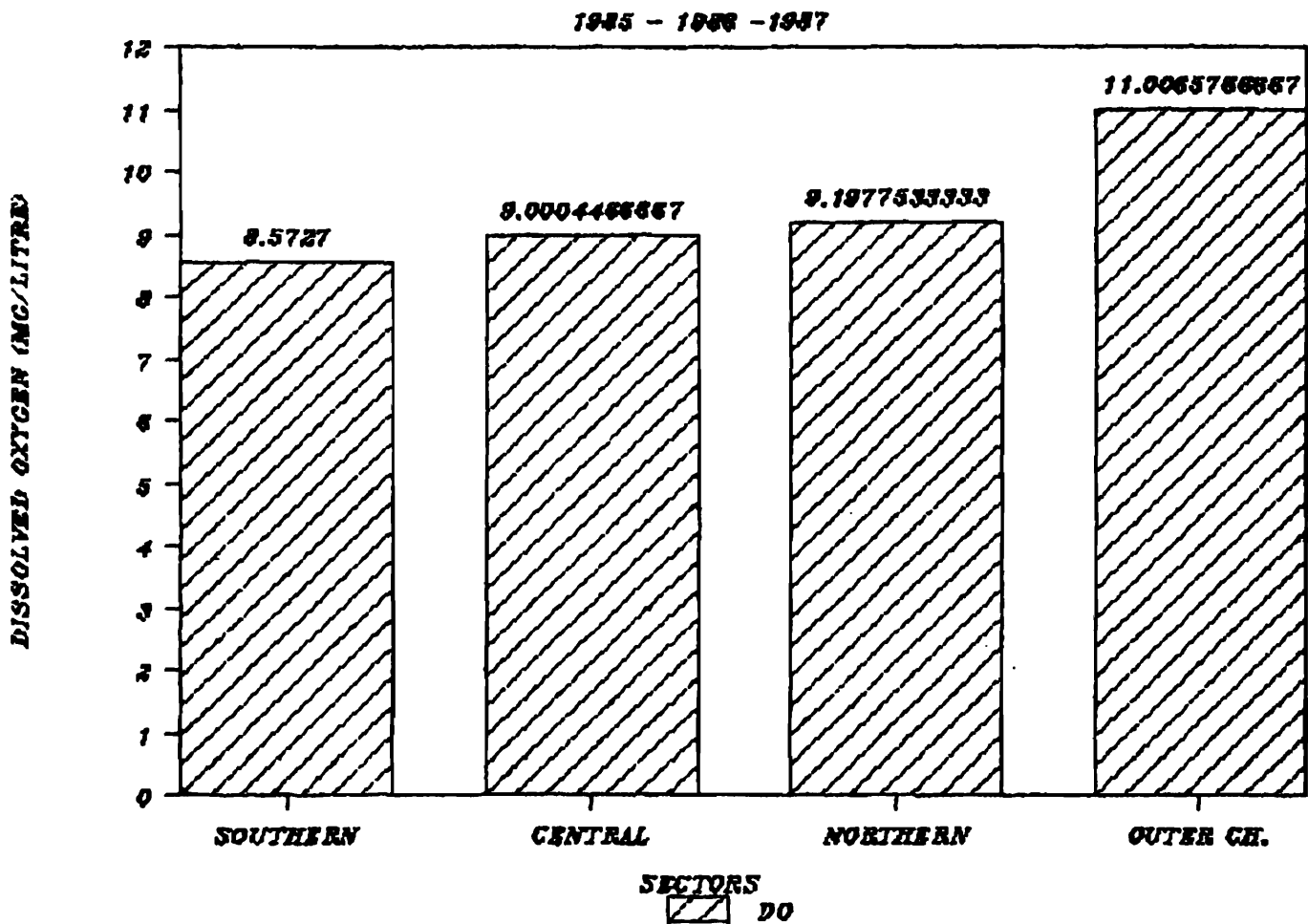


Figure 42. Showing average dissolved oxygen content (DO mg/L) profile in bottom waters in Chilika Lake, Orissa, for study period.

SUMMARY

The importance, relevance and economic potential of Chilka Lake, Orissa as a unique natural aquatic environment, a distinct biotope indeed, ecologically a wetland of international importance, has long been established, just and well. Nevertheless, its existence as a unique lake, in strict technical parlance, for that matter and the imperative need to initiate long term multidisciplinary scientific research was emphasized first time ever by the Zoological Survey of India in the early eighties (1985 – 1987). The first ever pioneering studies – biological survey of lake, was initiated by Indian Museum (1909, and late 1913) for explorative faunal studies (lake organisms). The extensive multidisciplinary studies, guided by sound strategy for location of 'sites' and 'stations' aimed at total coverage, made use of systematic location of sites or stations, along transects/grid system relying on stratified random strategy for explorative studies for understanding the environmental characteristics of the lake – its environment, biology and ecology. The extensive multidisciplinary studies, initiated between late 1985 to 1987, spanning over major seasons, painstakingly gathered and analysed (*in situ*, on board, and later field laboratory) basic physicochemical, biologic, meteorologic data on the nature of the lake environment (sediment-type, characteristics of water, and the whole gamut of lake organisms – plankton, nekton and benthos, wildlife and avifauna, through space (spatial) and time (temporal variations) including the critical seasonal variations.

Extensive critical data was gathered on key physiographic, physicochemical, biologic, meteorologic parameters, as also remote sensing in the lake from 219 sampling stations on grid-lines although the extensive expanse of the lake, using mechanised launch (Orissa Tourism Development Corporation) and other hired country boats with outboard motors. The present communication, first of the series, attempts to recapitulate the status of major extensive studies carried out on the lake to date, and hopefully serves as the state-of-the-art report on the Hydrography/Limnology of the lake. The sectorwise dynamics and seasonal variations in critical physicochemical attributes therein, distribution of inorganic chemical plant nutrients, – different forms of Phosphorous and Nitrogen have been dealt in elsewhere for technical and operational convenience.

Hopefully, the painstaking data gathered for lake water column (subsurface-horizontal profile, and depth-vertical profile) will for long time to come, serve as important reference (base-line data) for future studies on the lake. Above all, the extensive hydrographic/limnological data gathered will serve as key (technical) information input for meaningful evaluation of the lakes *trophic* status for eventual conservation and management.

ACKNOWLEDGEMENTS

We are extremely grateful to all past Directors – Late Dr. B.K. Tikadar, and Dr. B.S. Lamba, Ex-Jt. Director, Dr. M.S. Jairajpuri for all help and facilities. We are also extremely indebted to Dr. A.K. Ghosh, Sci. 'H' and Director, for his keen interest and all encouragement since the initiation of the expedition studies to its final conclusion (writing up). Last, though not the least, we also express our sincere thanks to all members of the expedition teams for making the endeavour a momentous event.

REFERENCES

Annandale, N. and S. Kemp, 1915. Introduction to the Fauna of Chilka Lake. *Mem. Indian Mus.* 5(1): 1–20.

- APHA-AWWA-WPCF, 1975. *Standard Methods For the Examination of Water and Wastewater*. Fourteenth Edition. Pp 1193.
- Asthana, V. 1978. Limnological Studies of Lake Chilka, Orissa. Final Project Report. Indian Programme on Man and Biosphere (MAB), Project No. 112, Dept. of Science and Technology, New Delhi.
- Baker, J.M. and W.J. Wolff (eds.), 1987. *Biological Surveys of estuaries and coasts*. Cambridge University Press, xx + 449 pp.
- Bannerjee, A.C. and N.C. Roychoudhury, 1966. Observations on some physicochemical features of the Chilka Lake. *Indian J. Fish.* 13 (1/2) : 395–429.
- Barnes, R.S.K. 1980. *Coastal Lakes*. Cambridge University Press, Cambridge 100 pp.
- Blanford, W.T. 1872. Sketch of the Geology of Orissa. *Rec. Geol. Surv. India* 5 : p. 56.
- Borrego, A.Z. and S.A. Borrego. 1982. Temporal and spatial variability of temperature in two coastal lakes. *Cal. Cati. Rep.* 23 : 188–197.
- Das, N.K. and R.C. Samal. 1988. Environmental Survey of Chilka in : Chilka – *The Pride of Our Wetland Heritage*. Orissa Environ. Society pp. 96–103.
- Devasundaram, M.P. and Roy, J.C. 1954. A preliminary study of the plankton of Chilka Lake for the year 1950–1951. *Proc. Symp. Mar. and Freshwat. Plankton in Indo-Paci.*, Bangkok, pp. 48–54.
- Directorate of Fisheries, Government of Orissa, Cuttack, 1970. *Chilka Lake*.
- FAO Fisheries Technical Paper No. 137, 1975. *Manual of Methods in Aquatic Environment Research*. Part I, Food and Agriculture Organisation, Rome. 238 pp.
- Ghosh, R.N. and S.K. De, 1972. Mahanadi delta, Puri and Cuttack Dists., Orissa, Govt. of Orissa, 1986.
- Grashoff, K., M. Ehrhardt, and K. Kremling, 1983. *Methods of Sea Water Analysis 2/e* Verlag Chemic, Weinheim, ixv + 419.
- Jhingran, V.G. and A.V. Natarajan, 1966. Final Report on the Fisheries of the Chilka Lake (1957-1965). *CIFRI Bull. NO. 1*, 11-121.
- Jones, S. and K.H. Sujansangini, 1954. Fish and Fisheries of the Chilka Lake with statistics of fish catches for the year 1948-50. *Indian J. Fish.*, 1: 256-344.
- Katre, D.V. and G.R. Narayan Das, 1988. Minerals and Sediments of Chilka Lake. In *CHILKA The Pride of our Wetland Heritage*, Orissa Environmental Society, Bhubaneswar. Pp. 16-30.
- Lind, O.T. 1979. *Handbook of Common Methods in Limnology*. Second edition. C.V. Mosby Pp. 199.

- Mahapatra, K. 1988. Benthic Studies in Chilka Lake A Tropical Lake. *M. Phil. Dissertation* (Marine Science), Berhampore Univeristy, Berhampore 760 007, Orissa.
- Mohanty, P. K. 1989. Some Physical Characteristics of the Chilka Lake Waters. *M.Phil Dissertation* (Oceanography), Berhampur University, Berhampur.
- Mohanty, S.K. 1975. Some observations on the physico-chemical features of the outer channel of the Chilka lake during 1971-1973. *Bull. Dept. Mar. Sci. Cochin* 7(1) : 69-89.
- Orissa Remote Sensing Application Centre, 1988. Interim Report on study of the Chilka Lake Resources and Environment. ORSAC, Bhubaneshwar. Pp. 1-95 Maps + Tables.
- Panigrahy, R.C. 1985. Phytoplankton and primary production in Chilka Lake *Ph.D. Dissertation*, Berhampur University, Berhampur, Orissa.
- Parija, P. and B. Parija. 1946. Flora, of Chilka Lake. *J. Indian Bot. Soc.* N.D.P. Iyengar Commemoration volume: 375-379.
- Pascoe, E.H. 1964. A Manual of the Geology of India and Burma, vol. III, Pp. 1897.
- Patnaik, S. 1973. Observations on the seasonal fluctuation of plankton in the Chilka Lake. *Jour. of Fish* 20 (1) : 43-56.
- Patnaik, S. and S.K. Sarkar. 1976. Observations on the distribution of phytoplankton in the Chilka Lake. *Jour. Inland Fish. Soc. India.* 8: 38-48.
- Patro, J.M. 1970. Salinity fluctuations in Chilka Lake during 1968 -69 *In : The Chilka Lake*, Publ. Dept. Fish. Orissa,
- Raman, A.V., Ch. Satyanarayana, K. Adishesu and K. Phani Prakash. 1990. Phytoplankton characteristics of Chilka Lake, a brackish water lake along east coast of India. *Indian Jour. Mar. Sciences*, 19: 274-277.
- Ramanadham, R., M.P.M. Reddy and A.V.S. Murthy. 1964. Limnology of the Chilka Lake. *J. Mar. Biol. Ass. India* 6(2) : 183-210.
- Reddy, M.P.M. 1962. Limnological studies of the Chilka Lake and wave refraction studies in relation to shore-line development. *Ph.D. Thesis*, Andhra University, Waltair, India. 175 Pp.
- Roy, J.C. 1954. Periodicity of the plankton diatoms of the Chilka Lake for the years 1950 and 1951. *J. Bombay nat. Hist. Soc.*, 52(1): 112-123.
- Sahu, B.N. 1988. Orissa Chilka Lake Degradation. *Encology* 3(3): 11-7, 1988.
- Sahu, B.N. 1988. The Chilka Lake is in danger. *In : Chilka The Pride of Our Wetland Heritage* Orissa Environmental Society. 1-8.
- Sarkar, S.K. 1979. Further studies on Seasonal and Spatial variations of Salinity in Chilka Lake. *J. Inland Fish Soc. India* 11(2) : 1-9.

- Satyanarayana, 1988. Chilka Lake Expedition, September, 1987: Studies on Hydrobiology and Phytoplankton. *M.Phil Dissertation*, Andhra University, Waltair.
- Sewell, R.B.S. 1922. Hydrography of the Rambha Bay. *Mem. Indian Mus.* 3(10) : 679-690 :
- Sinha, B.N. 1971. *Geography of Orissa*. National Book Trust, New Delhi, India. 197 Pp.
- Subba Rao, J. 1960. Unpublished Annual Report for the Field Season 1959-60, Eastern Circle, AMD/DAE.
- Subba Rao, M.V., B.M.G. Rao, B.R. Rao, and N.K. Nanda. 1981. Hydrobiological studies of the brackish water Chilka Lake, Orissa. *Jour. Environ. Biol.* 2(1) : 59-62.
- Subba Rao, M.V., K.K. Rao, P. Prabhu, I.K. Rao and K.C. Pati. 1982. Seasonal variations and stratification of the physicochemical characters in three different stations at Chilka Lake, Orissa. *J. Environ. Res.* : 3(1) : 8-10.
- Strickland, J.D.H. and T.R. Parsons. 1972. *A Practical Handbook of Seawater Analyses. Bull. Fish.Res. Board. Canada*, No. 167. 310 Pp.
- Tripathy, S.K. 1988. Hydrographical Studies in Chilika Lake - A Tropical Lake. *M.Phil. Thesis*, Dept. of Mar. Sciences, Berhampur University, Berhampur 760 007, Orissa.
- UNESCO, 1980. UNESCO Technical Papers in Marine Science. *Coastal Lakeal Survey*, Vol. 31, 1980.
- UNESCO, 1981. UNESCO Technical Papers in Marine Science. *Coastal Lake Research - Present and Future. Report and Guidelines*.
- Venkataratnam, K. 1970. Formation of the Barrier Spit and other Sand Ridges near Chilka Lake on the East Coast of India. *Marine Geol.* 9: 101-116.
- Wetzel, R. G. and G. E. Likens, 1979. *Limnological Anolyses* W.B. Saunders Company. PP. 387.

List of Abbreviations

BW	—	Bottom Water
CS/cs	—	Central Sector
°C	—	Degree Celcius
E	—	Attenuation Coefficient
Free CO ₂ mg/L	—	Free Carbon-di-oxide, mg/L
Cond.	—	Conductivity, umhos/cm

CaCO ₃ mg/L	—	Calcium Carbonate
DO mg/L	—	Dissolved Oxygen, mg/L
mg/L	—	Milligrams per litre
Cmg/L	—	Total Inorganic Carbon available
NS/ns	—	Northern Sector
n	—	Vertical Extinction Coefficient
OC	—	Outer Channel
pH	—	potentia hydrogeni
Pd	—	Photic depth, m
% Saturation	—	Percentage Saturation of Dissolved Oxygen
S ‰	—	Salinity, parts per thousand
Sp.gr.δ	—	Specific gravity
SS//ss	—	Southern Sector
SW	—	Surface/Subsurface Water
TA	—	Total Alkalinity, CaCO ₃ mg/L
Sio ₂	—	Silicon Di-oxide
TDS	—	Total Dissolved Solids, mg/L
TA, mg CaCO ₃ /L	—	Total Alkalinity
Zsd	—	Secchi Disc Transparency, m
ZSI	—	Zoological Survey of India

Table 1. Showing seasonal values of various hydrographic and physicochemical factors in subsurface (S) and bottom (B) waters at 16 different sampling stations in southern sector in winter season during the **First Multidisciplinary Expedition to Chilka Lake, Orissa (Nov. – Dec. 1985)**.

Hydrographic/ Physicochem. Parameters	Grid details															
	A ₂		B ₁			B ₂			C ₂		C ₃		B ₃		B ₄	
	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B
Zsd. m		1.05		-		0.82		-		0.98		1.27		1.77		
Depth. m		2.15		1.2		2.7		0.9		3.30		2.25		1.77		
Amb. Temp °C		33.1		29.8		29.1		28.4		30.4		30		30		
Water Temp. °C	27.1	26.3	26.6	26.1	26.3	25.8	26	25.8	27.2	25.8	26.8	26.4	27.1	27.0		
Cond. umhos	108.9	109.01	115.5	115.5	88	88	133.54	132	130.9	130.68	132	132.65	135.74	134.2		
TDS. mg/L	70.78	70.85	75.07	75.07	57.2	57.2	86.80	85.8	85.08	84.94	85.80	86.22	88.23	87.23		
T. mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
S % o	8.5	8.50	9.14	9.14	8.59	8.50	8.35	8.43	8.03	8.11	8.27	8.35	8.51	8.51		
Sp. gr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
pH	7.5	7.93	8.52	8.58	7.65	7.88	8.03	8.05	7.97	8.01	7.83	7.84	7.99	8.12		
DO, mg/L	7.5	8.0	9.4	12.7	9.0	6.8	8	7.6	7.2	6.4	7.4	8.2	10.2	10.2		
% CS	59.77	98.52	115.76	156.40	110.83	83.74	98.52	92.00	90.3	77.48	91.13	100.98	127.97	127.97		
TA mg/L	415	435	430	405	460	460	355	375	495	360	390	380	410	395		
Inorg. C mg/L	95.45	100.05	103.20	97.2	105.8	105.8	85.2	90	113.85	86.4	89.7	87.4	94.3	94.8		

TABLE 1. Contd.

Hydrographic/ Physicochem Parameters	Grid details																				
	D ₄			C ₄			B ₅			B ₆			C ₅			D ₆			C ₆		
	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B			
Zsd, m	.70			.70			.72			1.62			.75			.70			.70		
Depth, m	.70			3.25			2.40			2.0			3.0			2.8			2.6		
Amb. Temp °C	32.5			31.2			30.8			33.8			30			31.6			33.2		
Water Temp. °C	26.2	26.2	27	25.6	26.6	25.8	27.1	26.8	26.3	25.2	27.7	25.4	27.7	25.4	27.7	25.4	27.7	25.4			
Cond. umhos	123.53	124.3	132.44	130.68	129.69	137.39	129.91	127.38	127.82	125.51	125.61	125.4	129.14	120.95							
TDS, mg/L	80.29	80.79	86.08	84.94	84.29	89.30	84.29	82.79	83.08	81.51	82.29	81.51									
T, mg/L								-	-												
S ‰	7.80	7.87	8.11	8.01	7.95	8.03	7.95	8.03	7.95	8.03	7.79	7.87	7.79	7.87	7.79	7.87	7.87				
Sp. gr.																					
pH	8.10	8.15	7.76	7.89	7.81	7.96	7.96	7.98	7.55	7.83	7.84	7.63	7.76	7.73	7.76	7.63	7.73				
DO, mg/L	9.8	9.6	7.4	7.0	7.4	7.8	8.0	8.6	7.0	7.2	7.4	7.6	7.2	7.4	7.6	7.2	7.4				
% CS	120.68	118.22	92.84	84.74	91.13	94.43	100.37	104.11	86.20	87.16	92.84	92.00	90.33	89.58	92.84	90.33	89.58				
TA mg/L	340	340	350	350	355	345	340	370	355	405	370	385	400	390	370	400	390				
Inorg. C mg/L	81.6	81.6	84	84	81.65	84.96	81.6	88.8	81.65	97.2	88.8	92.4	100	101.40	88.8	100	101.40				

TABLE 1. Contd.

Hydrographic/ Physicochem Parameters	Grid details			
	D ₇		D ₈	
	S	B	S	B
Zsd, m		0.98		0.72
Depth, m		2.10		2.65
Amb. Temp °C		27.5		28.5
Water Temp. °C	25	25.5	25.9	25.6
Cond. umhos	109.23	110.88	117.92	117.28
TDS, mg/L	70.99	72.07	76.64	76.23
T, mg/L	-	-	-	-
S % o	7	7.08	7.08	7.08
Sp. gr.	-	-	-	-
pH	8.05	8.05	8.16	8.15
DO, mg/L	7.4	7.6	7.8	8.0
% CS	89.58	92.	94.43	96.85
TA mg/L	365	340	335	390
Inorg. C mg/L	87.6	81.6	80.4	93.6

Table 2. Showing seasonal values of various hydrographic and physicochemical factors in subsurface (S) and bottom (B) waters samples at 14 different sampling stations in **Central sector in winter season during the First Multidisciplinary Expedition to Chilka Lake, Orissa (Nov. – Dec. 1985)**. All values are expressed in universal units

Hydrographic/ Physicochem Parameters	Grid details													
	E ₆		E ₇		E ₈		F ₈		E ₉		F ₉		H ₁₀	
	S	B	S	B	S	B	S	B	S	B	S	B	S	B
Zsd. m		1.42		1.3		0.72		.63		Sunset		.73		.34
Depth. m		1.95		1.50		2.80		1.68		2.6		2.75		1.25
Amb. Temp °C		33.8		29.0		30.5		29.0		27.0		27.2		29.1
Water Temp. °C	26.2	25.4	25.7	25.7	25.9	25.1	25.5	24.9	25.7	25.7	24.8	24.8	24.7	24.7
Cond. umhos	114.4	112.2	114.07	114.07	116.60	116.38	104.28	102.3	117.26	117.26	108.24	108.02	105.82	105.82
TDS, mg/L	74.36	72.93	74.14	74.14	75.79	75.64	67.78	66.49	76.21	76.21	70.35	70.21	68.78	68.78
T, mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S % o	7	7	7.08	7.23	9.92	7.08	6.12	6.52	7.08	7.08	6.36	6.36	5.88	5.88
Sp. gr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	8.1	8.1	8.33	8.35	8.15	8.16	8.12	8.16	8.19	8.15	7.88	7.86	7.87	7.82
DO, mg/L	7.8	8.4	8.8	9.0	7.8	7.8	7.4	7.8	7.4	8.0	8.6	8.2	8.2	8.0
% CS	96.05	101.69	106.53	108.95	94.43	94.43	89.58	92.63	89.58	96.85	102.13	97.38	97.38	95.01
TA mg/L	423	405	355	335	325	335	380	325	325	350	355	365	385	370
Inorg. C mg/L	100.8	97.2	85.2	77.05	78	80.4	91.2	78	78	84	81.65	83.95	88.55	85.1

TABLE 2. Contd.

Hydrographic/ Physicochem Parameters	Grid details																	
	K ₁₀		M ₁₁		G ₁₂		I ₁₂		K ₁₂		K ₁₄		K ₁₅					
	S	B	S	B	S	B	S	B	S	B	S	B	S	B				
Zsd. m	0.48		.27		0.43		.60		0.53		0.33		.90					
Depth. m	1.5		1.9		1.9		1.9		1.8		1.3		.90					
Amb. Temp °C	28.6		29.9		26.4		25.6		27.7		25.5		24.2					
Water Temp. °C	25.3	24.9	25.5	25.5	24.0	24.2	24.7	25.0	24.6	24.6	23.4	22.8	23.2	23.2				
Cond. umhos	88.44	89.1	34.32	52.3	114.4	115.06	113.96	113.52	108.9	109.78	98.89	98.56	87.23	86.90				
TDS, mg/L	57.48	57.91	22.30	30.81	74.36	74.78	74.07	73.78	70.78	71.35	64.27	64.06	56.69	56.48				
T, mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
S % o	4.93	5.01	1.73	2.62	6.92	7.08	6.92	6.84	6.52	6.60	6.12	6.28	5.33	5.17				
Sp. gr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
pH	7.96	7.90	7.83	7.87	7.99	8.02	8.01	8.02	7.98	8.02	7.82	7.70	9.06	9.07				
DO, mg/L	7.6	7.6	7.6	9.0	7.6	8.0	7.8	7.8	8	8	7.4	6.4	-	-				
% CS	92.00	90.26	92.00	108.95	90.26	95.01	92.63	94.43	95.01	95.01	85.05	73.22	-	-				
TA mg/L	320	340	290	-	375	-	350	350	365	375	425	425	365	310				
Inorg. C mg/L	73.6	78.2	72.5	-	86.25	-	84	84	83.95	90	97.75	97.75	80.3	68.20				

Table 3. Showing seasonal values of various hydrographic and physicochemical factors in subsurface (S) and bottom (B) waters samples at 8 different sampling stations in Northern sector in winter season during the First Multidisciplinary Expedition to Chilka Lake, Orissa (Nov. – Dec. 1985). All values are expressed in universal units.

Hydrographic/ Physicochem Parameters	Grid details																				
	M ₁₂		N ₁₇			O ₁₆		Q ₁₀		S ₁₇		Q ₁₂		Q ₁₄		O ₁₄					
	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B					
Zsd, m	.58		.34			.25		.44		.58		.13		.24		.25					
Depth, m	1.6		0.80			1.25		.90		.70		1.70		0.70		1.20					
Amb. Temp °C	27.7		24.5			23.0		–		–		27.5		29.1		27.3		27		30.3	
Water Temp. °C	25.3	25.0	24.5	23.0	24.5	23.0	25.5	22.2	25.7	25.8	25.2	24.0	28.6	23.4	25.4	22.8	25.9	23.8			
Cond. umhos	105.82	105.82	23.43	23.43	23.21	22.44	36.63	36.19	4.18	5.17	0.638	0.717	1.790	1.838	24.97	24.33					
TDS, mg/L	68.78	68.78	15.22	15.22	15.08	14.58	23.80	23.52	2.71	3.36	0.41	0.46	1.16	1.18	16.23	15.94					
T, mg/L	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–					
S % o	6.04	6.36	1.27	1.27	1.11	1.19	1.83	1.99	.08	.24	0.16	0.32	0.95	0.95	1.35	1.35					
Sp. gr.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–					
pH	8.04	8.03	9.45	9.32	9.36	9.22	7.20	8.20	8.32	8.34	8.18	7.81	8.40	8.24	8.28	8.31					
DO, mg/L	8.0	8.4	10.4	10.2	11.2	11.0	9.4	8.6	9.8	10.0	–	–	–	–	8.6	8.0					
% CS	96.85	101.69	123.51	119.01	135.59	125.85	113.80	104.11	118.64	118.76	–	–	–	–	104.11	93.34					
TA mg/L	355	370	385	400	410	420	365	350	315	445	340	300	260	375	295	–					
Inorg. C mg/L	85.2	88.8	84.70	88	90.20	96.6	98.55	84	75.6	106.8	81.6	75.00	62.40	90	70.8	–					

Table 4. Showing seasonal values of various hydrographic and physicochemical factors in subsurface (S) and bottom (B) waters samples at 6 different sampling stations around **Satpara and outer channel** in winter season during the **First Multidisciplinary Expedition** of Chilka Lake, Orissa (Nov. – Dec. 1985). All values are expressed in universal units.

Hydrographic/ Physicochem Parameters	Grid details													
	O ₈		O ₉		N ₈		N ₉		Q ₈		Q ₁₀			
	S	B	S	B	S	B	S	B	S	B	S	B		
Zsd, m		.36		.22		.60		.36		0.42		.44		
Depth, m		1.0		0.95		.60		1.5		.50		0.90		
Amb. Temp °C		25.4		28.5		24.4		26.2		27.3		27.5		
Water Temp. °C	24.3	24.7	25.2	24.6	24.4	24.4	24.8	24.3	24.7	24.9	25.7	25.8		
Cond. umhos	36.08	36.52	36.96	37.18	56.32	57.31	44.33	47.19	42.57	42.9	36.63	36.19		
TDS, mg/L	23.45	23.73	24.02	24.16	36.60	37.25	28.81	30.67	27.67	27.88	23.80	23.52		
T, mg/L	-	-	-	-	-	-	-	-	-	-	-	-		
S % o	2.07	2.07	1.99	1.99	3.34	3.42	2.34	2.70	2.46	2.46	1.83	1.99		
Sp. gr.	-	-	-	-	-	-	-	-	-	-	-	-		
pH	7.88	7.95	8.14	8.14	8.60	8.68	7.99	8.02	8.16	8.15	7.2	8.2		
DO, mg/L	8.0	8.0	8.2	8.0	8.8	8.8	8.0	7.8	8.0	8.0	9.4	8.6		
% CS	96.91	96.91	99.27	96.91	104.51	104.51	96.91	92.63	96.91	96.91	113.80	104.11		
Free CO ₂ mg/L	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil		
TA mg/L	295	295	345	310	390	375	311	310	310	380	365	350		
Inorg. C mg/L	73.75	73.75	82.8	74.4	93.60	90.00	77.55	74.44	74.40	91.20	83.95	84		

Table 5. Showing the various seasonal values of key physicochemical parameters in subsurface (S) and bottom Water (W) samples at 20 different sampling stations in Southern Sector during late summers (June 1986) during the course of Second Multidisciplinary Expedition of Chilka Lake, Orissa. All values are expressed in appropriate units.

Physico-chemical Parameters	Grid Nos.																			
	A ₂		B ₂		C ₂		D ₂		A ₃		B ₃		C ₃							
	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B		
Zsd, m	.50		.45		.80		.60		.20		.30		.40							
Depth, m	1.9		1.7		.80		.60		1.6		2.2		2.6							
Amb. Temp °C	34.6		34.8		33.8		33.8		31.8		32		31.5							
Water Temp. °C	32.7	32.6	33	32.7	34.4	34.2	35.2	34.2	31.5	31.5	31.5	31.5	31.5	31.5						
Cond. umhos	17.86	19.55	19.99	19.69	19.03	19.43	19.48	19.37	19.01	18.94	19.51	19.31	19.30	19.33						
TDS, mg/L	116.11	127.12	129.98	127.98	123.69	126.34	126.62	125.91	163.62	123.12	126.84	125.53	125.48	125.69						
Turb. mg/L	22	28	30	49	10	20	28	37	13	136	78	78	50	76						
S % o	11	11	11	11	12	12	12	12	11	11	11	11	12	12						
Sp. gr.	8	8	8	8	9	9			8	7.5	8	8	8.5	8.5						
pH	7.7	7.9	7.76	7.66	8.31	8.36	8.2	8.4	8.6	8.58	8.48	8.53	8.5	8.58						
DO, mg/L	12.6	13.2	12.4	13.0	13.4	11.5	12.5	11.5	12.8	14.4	14.6	13.0	12.8	13						
% CS	171.89	180.08	169.16	177.35	188.99	162.20			171.81	193.28	195.97	174.49	171.81	174.49						
TA mg/L	130	120	118	120	122	125	127	127	104	117	105	105	108	108						
Inorg. C mg/L	32.5	30.0	29.5	30	29.25	30.0	30.48	30.48	24.96	28.08	25.20	25.20	25.92	25.92						

TABLE 5. Contd.

Physico-chemical Parameters	Grid Nos.																	
	S	D ₃		B ₁		B ₄		C ₄		D ₄		C ₅		B ₅		B		
		B	S	B	S	B	S	B	S	B	S	B	S	B	S	B		
Zsd, m		.5		.40		.40		.60		.50		.60		.80				
Depth, m		2.0		1.1		1.8		1.9		.50		2.7		2.0				
Amb. Temp °C		30		32		30		30		31		31.5		31				
Water Temp. °C	31.5	30	32	32	31.5	30	32	32.1	32	32.1	32	30.8	32	31.5				
Cond. umhos	18.28	18.88	18.65	18.57	17.42	17.45	18.32	19.59	18.59	18.82	19.55	21.42	19.01	20.35				
TDS, mg/L	118.23	122.76	121.26	120.70	113.25	113.47	119.11	127.34	120.83	122.33	127.12	139.28	123.62	132.27				
Turb. mg/L	25	49	68	83	ND	ND	12	52	1	1	15	55	17	45				
S % o	12	12	12	12	10	-	8	10	10	-	11	13	11	12				
Sp. gr.	8.5	8.5	8.5	8.5	7.5	-	6	7.5	7.5	-	8	9.5	8	8.5				
pH	8.38	8.36	8.58	8.62	9	8.6	8.47	8.52	8.6	8.8	8.60	8.64	8.66	8.61				
DO, mg/L	11.2	11.6	12.6	12.8	4.8	5.0	11.8	12.4	10.6	-	10	12.8	11.4	17.4				
% CS	150.33	155.70	170.89	174.62	64.42	66.0	160.98	169.16	144.61	-	136.42	169.08	155.52	233.55				
TA mg/L	107	110	108	140	112	-	103	112	112	-	95	102	99	90				
Inorg. C mg/L	25.92	26.40	25.92	33.60	25.76	-	24.38	25.96	25.76	-	21.85	24.48	23.76	22.5				

TABLE 5 Contd.

Physicochem. Parameters	Grid Nos.																	
	S	D ₅		S	B ₆		S	C ₆		S	D ₆		S	D ₇		S	D ₈	
Zsd, m		.70			.70			1.8			1.2			1.2			.90	
Depth, m		2.5			2.4			2.9			1.2			2.15			2.1	
Amb. Temp °C		32			27.6			28.2			27.8			30.5			31.3	
Water Temp. °C	32	31	32.6		32.3	31.8		33	31.5		31.8	31.7		31.8	32		31.8	
Cond. umhos	20.69	21.39	21.09		21.05	21.45		22.11	20.20		19.95	22		22.99	22.11		22.77	
TDS, mg/L	134.49	139.06	137.13		136.85	139.42		143.71	131.34		129.70	143		149.43	143.71		148.00	
T. mg/L	12	65	18		36	8		20	12		15	10		36	10		30	
S % o	12.5	14	15		16	17		18	15		16	14		15	13		15	
Sp. gr.	9	10	11		12	12		13	11		11.5	10		11	9.5		11	
pH	7.0	7.5	8		8.2	8.66		8.72	8.85		8.9	9.5		9.43	9.95		9.82	
DO, mg/L	12.6	13	12.6		12.6	12.6		13	8.4		10.8	11.8		12.0	12.2		11.2	
% CS	171.80	174.49	171.89		171.89	169.12		180.30	112.75		144.96	158.38		158.52	159.84		147.95	
TA mg/L	103.78	113	97		100	95		89	105		97	108		115	109		100	
Inorg. C mg/L	26.78	32.77	22.31		23.00	22.8		21.36	24.51		22.31	26.28		25.92	23.98		22	

Table 6. Showing the values of different physical and chemical parameters in subface (S) and bottom (B) waters of various (28) grid points sampled / surveyed in **Central Sector** during late **summers (June 1986)** — stands for no sampling following insufficient depth. All values expressed in appropriate units.

Physicochem Parameters	Grid details																	
	E ₅		E ₆		E ₇		E ₈		F ₈		E ₉		F ₉		G ₉		H ₉	
	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B
Zsd, m	.70		.40		1.7		1.4		1.3		1.0		1.1		.60		.60	
Depth, m	2.2		-		2.4		2.9		1.7		2.6		1.9		1.9		.70	
Amb. Temp °C	31		26.5		30		31.8		31.5		30.5		30.5		30.5		31.5	
Water Temp. °C	32	32	30.2	30.3	30	30.5	31.5	30.5	32.6	31.9	30.5	30.3	30.5	30.5	30.5	30.2	31	-
Cond. umhos	20.96	20.9	18.5	-	20.18	22.09	22.11	23.76	22.66	22.11	25.19	22.77	24.2	24.09	24.2	24.09	23.98	24.31
TDS, mg/L	136.27	136.4	120.8	-	131.20	143.64	143.71	154.44	147.29	143.71	163.73	148.00	157.3	156.58	157.3	156.58	155.87	158.01
Turbi, mg/L	15	42	15	42	11	15	12	20	12	20	22	45	22	28	28	37	34	ND
S % o	12.5	13.0	15	-	13	15	14	15	14	14	17	18	16.5	16.0	15	16	15	15
Sp. gr.	9	9.5	13	-	9.5	11	10	11	10	10	12.5	13.0	12	12	11	12	11	11
pH	8	7	8.8	8.9	8.5	8.5	9	9	8.5	8.5	9.0	9.0	9.0	9.0	9	8.7	9.2	9.5
DO, mg/L	12.4	12.6	10.8	9.2	8.0	12.6	13.0	13.2	12.8	13.2	12.2	13.2	12.8	12.8	13	13.4	19.8	-
% CS	169.16	171.89	142.66	121.53	105.68	166.44	174.49	177.18	174.62	177.18	161.16	177.18	174.62	174.62	174.49	177.0	161.55	-
TA mg/L CaCO ₃	109	109	136.0	-	116	106	107	106	103	122	100	104	137	115	113	116	131	-
Inorg. C mg/L	26.16	26.16	31.28	-	27.84	24.72	25.68	24.72	23.69	28.06	23.0	23.92	31.57	26.45	25.99	26.68	30.13	-

TABLE 6 Contd.

Physico-chemical Parameters	Grid details																	
	E ₁₀		F ₁₀		G ₁₀		H ₁₀		I ₁₀		J ₁₀		K ₁₀					
	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B		
Zsd, m	70		90		1		70		.25		.30		70					
Depth, m	2.1		2.2		2.1		1.9		0.90		.40		1.0					
Amb. Temp °C	29.8		30		30.2		29.8		30		30		30.2					
Water Temp. °C	30	29.5	30	29.8	30.0	29.5	30	29.8	29.5	30	30.7	30	31	30.2		30		
Cond. umhos	24.31	24.42	24.31	24.31	23.76	23.54	23.1	21	22.88	22.77	23.1	23.1	21.89		22.22			
TDS, mg/L	158.01	158.73	158.01	158.01	154.44	153.01	150.15	150.13	148.72	148.00	150.15	150.15	142.28		144.43			
T., mg/L	14	30	8	36	28	37	12	25	36	-	15	-	8		-			
S % o	18	18.5	16.5	17.5	16.5	17.5	16.5	17.0	16	16	16	16	15		15			
Sp. gr.	13	13.5	13	13	12	12.5	13	12.5	12	12	11.5	-	11		11			
pH	9	9	9.2	9.0	9	8.5	9	8.5	9	9	9	9	9.2	9.0		9.0		
DO, mg/L	11.4	11.8	10	12	12.4	12	13.2	12.4	8.6	-	17.6	-	13.6		15.8			
% CS	150.59	158.38	132.10	155.84	163.80	155.84	174.37	163.80	113.6	-	232.49	-	179.65		288.7			
TA mg/L CaCO ₃	102	104	93	104	108	101	102	96	125	-	122	-	106		106			
Inorg. C mg/L	23.46	23.92	21.39	23.92	24.84	24.26	23.46	22.08	28.75	-	28.06	-	21.2		21.2			

TABLE 6 Contd.

Physico-chemical Parameters	Grid details																			
	L ₁₀			F ₁₁			H ₁₁			J ₁₁			L ₁₁			G ₁₂			I ₁₂	
	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B		
Zsd. m		.50		.60		.45		-		-		.20		.10						
Depth. m		1.15		1.9		1.8		-		-		1.5		1.60						
Amb. Temp °C		30		26		26.5		26		26.5		29.5		29.5						
Areal Water Temp. °C	30	29.7	29	30	29	29.5	29	28	28.5	28	29.0	29	28.3	29.2						
Cond. umhos	22.33		23.76	23.87	23.43	23.65	24.2	24.31	26.29	26.4	21.67	23.21	23.76	23.43						
TDS. mg/L	145.14	145.14	154.44	155.15	152.29	153.72	157.3	158.01	170.88	171.6	140.85	150.86	154.44	152.29						
T., mg/L	12	63	14	14	34	90	55	104	130	140	70	134	92	126						
S % o	15.5	15	19.5	20	18	19	18	19	21	21.5	17.5	17.0	17	17						
Sp. gr.	11.5	11	14	14.5	13.5	14	14	14	15	16	13	12	12	12.5						
pH	8.5	8.5	9	9	9	9	9	9	9	9	8.5	8.0	8.5	9.0						
DO, mg/L	13.2	13.2	10.4	11.0	12.6	13.0	12.6	13	12.2	12.4	14.0	13.6	13	13.8						
% CS	174	174	135	142	163	168.83	163	168	158.44	158.96	181.81	176.62	168.83	176.02						
TA mg/L CaCO ₃	106	123	103	123	114	117	107	117	97	134	108	96.0	11.0	118						
Inorg. C mg/L	21.2	28.29	23.69	28.29	26.2	26.9	24.6	26.9	22.31	30.82	25.92	23.04	29.04	27.14						

TABLE 6 Contd.

Physicochem. Parameters	Grid details														
	S	G ₁₃		S	I ₁₃		S	J ₁₄		S	L ₁₄		S	N ₁₀	
Zsd, m		.30		.10		.40		.13		.20					
Depth, m		1.2		1.3		1.3		1.4		.40					
Amb. Atm. Temp °C		25.5		26.0		28		28		31.0					
Water Temp. °C	27.5	27.5	27	27	28	28	27	28	29.3	29.5					
Cond. umhos	21.45	21.78	21.74	21.83	20.32	20.69	23.1	23.1	20.93	20.88					
TDS, mg/L	139.42	141.57	141.35	141.92	132.13	134.49	150.15	150.15	136.06	135.77					
Turb, mg/L	36	90	96	110	22	15	37	102	-	-					
S % o	17	17	17	17	13	14	17	17.5	16	16					
Sp. gr.	12	12	12	12	9	10	12.5	13	12	12					
pH	9	9	8.5	8.5	8.8	8.7	8.3	8.4	8.21	8.33					
DO, mg/L	12	12.2	12.4	12.8	13.6	13.8	14	13.6	14.2	13.8					
% CS	155.84	258.44	158.16	160.60	173.46	176.02	175.65	173.46	184.41	179.22					
TA mg/L CaCO ₃	100	110	100	101	107	94	93	94	94	112					
Inorg. C mg/L	23	25.3	24	24.24	25.68	25.56	22.92	22.56	22.56	26.88					

Table 7. Showing the various seasonal values of main physicochemical parameters in subsurface (S) and bottom water (B) samples at different grid lines (12) surveyed/samples in **Northern Sector during late summers (June 1986)** during Second Multidisciplinary Expedition of Chilka Lake, Orissa. All values are expressed in appropriate universal units.

Physico-chemical Parameters	Grid details															
	M ₁₂		M ₁₃			N ₁₄			P ₁₄			L ₁₆		M ₁₇		
	S	B	S	B	S	B	S	B	S	B	S	B	S	B		
Zsd, m	.10		.10			.30			.10			.20		.10		
Depth, m	1.6		1.4			1.4			1.5			1.0		.70		
Amb. Temp °C	31		25.6			28.5			27			27.3		27.8		
Water Temp. °C	30.2	30.1	7	27.8	27	27	27	27	27	27	27.2	27.7	28			
Cond. umhos	23.65	23.8	24.09	24.2	24.53	24.53	23.1	23.1	12.91	12.70	4.98	5.19				
TDS, mg/L	153.72	155.87	156.58	157.3	159.44	159.44	150.15	150.15	83.94	82.58	32.38	33.74				
T. mg/L	130	200	140	160	76	80	80	104	-	-	-	-				
S % o	17.5	18	20	20	19	19	18	18	8	8	3	3				
Sp. gr.	12	13	14.5	14.5	14	14	13	13	6	6	2	2				
pH	8.4	8.4	8.23	8.21	8.21	8.29	8.30	8.34	7.9	8.02	8.12	8.10				
DO, mg/L	13.4	14.2	12.4	13	12.8	13.0	13.4	13.4	12.4	12.8	14.2	13.0				
% CS	173.05	190.60	155.58	163.11	160.60	163.11	168.13	168.13	155.58	160.60	178.16	165.81				
TA mg/L CaCO ₃	111	113	104	100	96	97	94	96	101	96	111	110				
Inorg. C mg/L	26.64	27.12	24.96	24	23.04	23.28	22.56	23.04	23.23	23.04	23.04	26.64				

TABLE 7 Contd.

Physico-chemical Parameters	Grid details													
	N ₁₈		N ₁₆		P ₁₆		R ₁₆		N ₁₁		N ₁₂			
	S	B	S	B	S	B	S	B	S	B	S	B		
Zsd, m		.10		.30		1.0		.30		.50		.50		
Depth, m		.70		1.10		1.1		1.3		-		1.6		
Amb. Temp °C		27.8		27.8		27		26.5		28.5		29.5		
Water Temp. °C	28.0	29.0	26.1	26.2	25.5	26.5	25.2	25.2	27	27	27.1	26.6		
Cond. umhos	1.81	1.76	19.37	19.47	19.41	19.85	15.23	20.30	19.95	20.62	13.51	13.73		
TDS, mg/L	11.79	11.44	125.91	126.55	126.19	129.05	99.02	131.98	129.70	134.06	87.87	89.30		
T. mg/L	-	-	-	-	-	-	-	-	-	-	-	-		
S % o	2	2	14	15	16	15	12	16	16	17	12	13		
Sp. gr.	1	1	10	11	11.5	11.0	8.5	12	12	12.5	8	9		
pH	7.7	7.8	8.3	8.5	8.2	8.5	8.2	8.23	8.33	8.39	8.3	8.39		
DO, mg/L	8.4	8.4	13.4	11.8	16.2	14.6	14.4	12.8	15	13.8	15.6	14.8		
% CS	107.14	109.09	165.12	145.32	196.12	174.87	174.33	147.69	191.32	176.02	195.73	182.26		
TA mg/L CaCO ₃	75	69	95	85	92	93	88	86	93	100	82	84		
Inorg. C mg/L	17.25	15.87	22.8	20.4	22.08	22.32	21.12	20.64	2.32	24.0	19.68	20.16		

Table 8. Showing the various seasonal values of important hydrographic/physicochemical factors in subsurface (S) and bottom (B) samples at 10 different sampling stations surveyed/samples in outer channel in late summers (June 1986) during Second Multidisciplinary Expedition of Chilka Lake, Orissa. All values are expressed in appropriate units.

Physico-chemical Parameters	Grid Details																			
	N ₈			N ₉			N ₁₀			O ₈			Q ₈			R ₉			T ₁₀	
	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B		
Zsd, m	.20			.25			.20			.35			.70			1.0			.90	
Depth, m	1.8			2.0			.40			2.4			3.2			4.9			1.8	
Amb. Temp °C	30.5			30.5			31			26			26			25.5			26	
Water Temp. °C	26.5	26.2	26	27.2	29.3	28.5	26.5	26.5	26.2	26.2	26.5	26.0	26.2	26.5	26.0	26.2			25.8	
Cond. umhos	21.39	21.57	20.71	20.55	20.93	20.88	21.56	22.33	22.77	22.88	24.2	24.42								
TDS, mg/L	139.06	140.21	134.63	133.57	136.04	135.77	140.14	145.14	148	148.72	157.30	158.73								
S % o	14	14	17	17	16	16	17	18	19	19	20	20	20	20			15			
Sp. gr.	10	10	12.5	12.5	12	12	13	13.5	14	14	15	15	-			-				
pH	8.55	8.44	8.43	8.5	8.21	8.33	8.3	8.5	8.3	8.4	8.29	8.28	8			8				
DO, mg/L	13.8	14.6	14.2	14.6	14.2	13.8	13.6	13.4	13.6	14.2	13.4	-	13.2			13.6				
% CS	169.95	179.80	174.87	183.18	184.41	176.02	167.48	165.02	167.48	174.87	165.02	-	162.56			164.64				
TA mg/L	123	99	101	99	86	104														
Inorg. C mg/L	29.52	23.76	24.24	23.76	20.64	24.96														

TABLE 8 Contd.

Physico-chemical Parameters	Grid details					
	U ₁₀		V ₁₁		W ₁₁	
	S	B	S	B	S	B
Zsd, m	.70		.70		.50	
Depth, m	2.1		2.9		.70	
Amb. Temp °C	28.5		28		29	
Water Temp. °C	27	27.5	27	26.5	28	28
Cond. umhos	23.87	23.98	25.74	36.96	33	39.27
TDS, mg/L	155.15	155.87	167.31	240.24	214.5	255.25
Turb. mg/L						
S % o	18	18	20	33	27	34
Sp. gr.	-	-	14.5	24.5	20	25
pH	8.35	8.39	8.2	8.28	8.4	8.3
DO, mg/L	13.8	14.6	14.6	14.2	14	13.8
% CS	173.14	183.18	183.18	174.87	178.57	176.02
TA mg/L CaCO ₃	110	110	103	110	100	121
Inorg. C mg/L	26.4	26.4	24.72	26.4	24	29.04

Table 9. The various seasonal values of different hydrographic/physicochemical parameters in subsurface (S) and bottom water (B) samples from sites in southern sector during southwest monsoons (September 1987) during the Third Multidisciplinary expedition of Chilka Lake, Orissa. All values expressed in appropriate universal units.

Hydrographic/ Physicochemical Parameters	Grid Details																				
	B ₁			C ₂			B ₂			A ₂			A ₃			B ₃			C ₃		
	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B			
Zsd, m		1.1		.60		1.0		.7		2.1		1.1		.9							
Depth, m		2.0		1.5		1.9		2.2		2.1		2.2		2.4							
Amb. Temp °C		30.5		31.5		28		29.2		32		33		33							
Water Temp. °C	29	28	32	28.5	30.5	30.5	31.0	30.2	30	30	31	30.5	31.5	30.4							
Cond. umhos	18.50	18.45	18.79	18.24	18.89	18.57	18.39	18.51	17.21	16.99	18.87	18.76	19.44	18.68							
TDS, mg/L	12.02	11.99	12.21	11.86	12.28	12.07	11.95	12.03	11.18	11.04	12.26	12.19	12.64	12.14							
S % o	14	10	13.5	9.5	15	15	15	11	13	13	14	13	14	14							
Sp. gr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
pH	9.1	9.09	9.87	9.37	9.68	9.54	9.35	9.4	9.1	9.4	9.07	8.84	8.76	8.66							
DO, mg/L	6.2	2.7	-	4.2	6.0	6.2	6.2	6.4	7.9	4.4	5.9	6.0	5.8	6.1							
% CS	80.51	34.43		53.57	79.26	81.90	83.22	84.54			79.19	79.26	77.85	80.58							
TA mg/L	112	102	132	67	113	130	130	134	127	123	105	113	126	111							
Inorg. C mg/L	25.76	46	29.04	14.74	24.86	28.6	29.48	29.48	29.21	27.06	24.15	25.99	30.24	36.64							

TABLE 9 Contd.

Hydrographic/ Physicochemical Parameters	Grids																			
	D ₃			C ₄			B ₄			B ₅			C ₅			D ₅			B ₆	
	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B		
Zsd, m				1.0				1.10				1.9			.90			1.0		2.2
Depth, m		.70			2.5			2.0			2.0				3.0			2.0		2.2
Amb. Temp °C		33.5			33.5			33.5			34				33			33		33
Water Temp. °C	32	31.8	32		31	32		32	32		31.5	32		31	33		32.5	33.5		31.5
Cond. umhos	16.79	16.58	19.16		19.05	17.83		18.20	18.60		18.55	20.54		19.55	20.36		19.81	19.45		19.09
TDS, mg/L	10.91	10.78	12.45		12.38	11.59		11.83	12.09		12.06	13.35		12.71	13.23		12.87	12.64		12.41
S % o	11	11	14		13	11		12	11		11	14		15	13		13	13		13
Sp. gr.	-	-	9		8.5	8		8.5	8		8	10		10.5	9.5		9.5	-		-
pH	8.97	9.02	8.91		8.68	9.02		9.02	8.88		8.81	8.86		8.72	8.7		8.72	8.64		8.54
DO, mg/L	8.3	7.9	6.1		5.6	7.5		6.4	6.4		6.6	5.6		6.4	5.6		5.6	5.9		5.2
% CS	113.23	106.04	83.21		75.16	102.31		87.31	87.31		88.59	76.39		72.48	77.76		76.39	81.83		69.79
TA mg/L	143	125	130		111	114		111	123		98	103		101	111		107	110		212
Inorg. C mg/L	34.32	28.75	29.9		29.64	26.22		24.42	28.29		22.54	23.69		24.24	25.64		25.68	26.40		50.88

TABLE 9 Contd.

Hydrographic/ Physicochemical Parameters	Grids									
	C ₆		D ₆		D ₇		D ₄		D ₈	
	S	B	S	B	S	B	S	B	S	B
Zsd, m		1.0		.70		1.0		.5		.5
Depth, m		2.7		2.6		2.7		.5		2.3
Amb. Temp °C		30		29		33.5		32		33
Water Temp. °C	32.5	32.0	32.5	32.0	33.0	32.0	35	35	32.8	31.8
Cond. umhos	19.52	19.14	19.26	18.90	19.72	21.47	18.17	17.99	17.90	17.75
TDS, mg/L	12.69	12.44	12.51	12.29	12.81	13.95	11.81	11.69	11.64	11.54
S % o	14	15	15	15	15	15	12	12	13	14
Sp. gr.	-	-	-	-	-	-	-	-	9.5	-
pH	8.78	8.75	8.73	8.73	8.79	9.05	9.43	9.65	9.35	9.2
DO, mg/L	5.6	5.4	5.7	5.5	5.6	5.4	10.6	-	5.4	5.4
% CS	76.39	73.66	77.76	75.03	77.66	73.66	151.86	-	73.66	73.66
TA mg/L	102	100	105	98	114	121	93	111	122	116
Inorg. C mg/L	24.48	24	25.2	23.52	27.36	27.83	20.46	24.42	26.84	26.68

Table 10. The range of seasonal values of basic hydrographic/physicochemical parameters at 29 different sampling stations in Central Sector in Southwest monsoons (Sept. 1987) during the Third Multidisciplinary Expedition of Chilka Lake, Orissa. All values expressed in standard units. – indicates no data, N.S. stands for no sampling, following shallow depth.

Hydrographic/ Physicochemical Parameters	Grids																			
	E ₅			E ₆			F ₆			E ₇			F ₇			E ₈			F ₈	
	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B		
Zsd, m		.70		.70		100%		.90		100%		.40		100%						
Depth, m		.70		2.6		.70		2.8		.7		2.9		.55						
Amb. Temp °C		31		29		31		34		33.5		33		33						
Water Temp. °C	35.5	32.5	32.5	32	34.5	34.5	34.5	32.5	34.5	34.8	31.8	32.5	33	33						
Cond. umhos	20.00	18.79	19.36	19.47		19.40		18.89	19.64	19.72	18.62	17.87	18.84	18.7						
TDS, mg/L	13.00	12.21	12.58	12.65		12.61		12.28	12.76	12.81	12.10	11.61	12.24	12.15						
S % o	13	13	15	15	14	14	15	15	13	14	15	16	14	14						
Sp. gr.	9.5	9.5		–		–		–	–		–	–	–	–						
pH	8.8	8.81	8.77	8.73	9.06	9.22	8.36	8.37	8.79	9.05	9.14	8.8	9.2	9.28						
DO, mg/L	10.8	6.1	5.9	6.1	8.4	9.7	6.0	5.8	9.0	10.6	5.6	6.0	11.1	NS						
% CS	154.72	83.21	80.49	83.21	118.47	136.81	84.62	79.12	126.93	149.50	75.16	81.85	153.95	–						
TA mg/L	95	116	109	105	100	125	128	118	109	111	136	117	130	133						
Inorg. C mg/L	21.85	26.68	26.16	25.20	23	28.79	30.72	28.32	25.07	25.53	31.28	26.91	29.9	30.59						

TABLE 10 Contd.

Hydrographic/ Physicochemical Parameters	Grids																				
	E ₉			F ₉			G ₉			H ₉			E ₁₀			F ₁₀			G ₁₀		
	S	B	S	S	B	S	S	B	S	S	B	S	S	B	S	S	B	S	S	B	S
Zsd, m		.70			.40			.60		100%				.60			.40			.50	
Depth, m		2.7			2.5			2.1			.60			1.9			2.2			2.0	
Amb. Temp °C		33			33			33			34			31.3			30.8			31.5	
Water Temp. °C	32.	31.5	32	32	32.4		32.0	34		32.5	31		31	31		31	32.2		31.0		
Cond. umhos	16.41	16.28	18.61	18.55	19.04		19.03	18.81		18.81	15.11		15.04	16.28		16.20	16.97		16.72		
TDS, mg/L	10.66	10.58	12.09	12.06	12.37		12.36	12.22		12.22	9.82		9.78	10.58		10.53	11.03		10.86		
S % o	13	14	14	14	14		14	15		15	13		13	12		13	12		12		
Sp. gr.	-	-	-	-	-		-	-		-	-		-	-		-	-		-		
pH	9.08	8.91	9.0	8.96	8.95		8.94	9.20		9.25	9.28		9.33	9.07		9.04	9.12		9.01		
DO, mg/L	5.7	5.5	7.0	6.7	6.5		6.4	9.7		-	5.5		5.8	6.2		6.3	6.2		6.1		
% CS	77.76	73.82	95.49	91.40	88.67		87.31	136.81		-	73.82		77.85	83.22		84.56	83.22		81.87		
TA mg/L	122	114	129	139	150		124	125		-	134		135	133		135	137		140		
Inorg. C mg/L	28.06	26.22	29.67	31.97	34.5		28.52	27.5			30.82		31.05	30.59		31.05	31.51		32.20		

TABLE 10 Contd.

Hydrographic/ Physicochemical Parameters	Grids																	
	H ₁₀			I ₁₀			J ₁₀			F ₁₁			H ₁₁			J ₁₁		
	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B		
Zsd, m		.5			.50			100%			.70			.80		.50		
Depth, m		2.3			1.1			.90			1.9			1.8		1.8		
Amb. Temp °C		31			33			32			32.8			32		33		
Water Temp. °C	31.8	31.2	30.5		31.2	32		32.4	31		31	31.5		31.2	32	31.5		
Cond. umhos	16.51	18.30	17.74		17.86	15.97		15.82	15.4		15.57	10.73		13.13	11.16	11.26		
TDS, mg/L	10.73	11.89	11.53		11.61	10.38		10.28	10.01		10.12	6.97		8.53	7.25	7.32		
S % o	11	13	13		13	11		11	12		12	9		10	8	9		
Sp. gr.	-	-	-		-	-		-	8		8	5		7	5	6		
pH	9.08	9.01	9.02		8.98	9.2		9.2	9.33		9.13	8.77		8.77	8.99	8.98		
DO, mg/L	6.3	6.1	10.3		10.6	10.3		10.6	7.4		7.0	7.1		7.1	6.7	6.8		
% CS	84.56	81.87	136.06		142.28	140.51		144.61	99.32		93.95	95.30		95.30	89.93	91.27		
TA mg/L	136	133	136		135	132		137	122		131	131		137	114	114		
Inorg. C mg/L	31.28	30.59	31.28		31.05	30.36		31.51	28.06		31.44	31.44		32.88	26.22	26.22		

TABLE 10 Contd.

Hydrographic/ Physicochemical Parameters	Grids																
	G ₁₂			I ₁₂			K ₁₂			I ₁₃			G ₁₃			I ₁₄	
	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	
Zsd, m		.70			.70			.60			.90			.40		.40	
Depth, m		1.7			1.5			1.6			1.5			.9		1.0	
Amb. Temp °C		32			32.4			32			30			30		31	
Water Temp. °C	32	31.8	32.5		32.0	32		32.5	31		31	31		31.5	31	30.5	
Cond. umhos	12.46	12.74	9.13		11.41	7.88		7.89	11.99		11.11	11.30		11.34	11.38	11.45	
TDS, mg/L	8.10	8.28	5.93		7.42	5.12		5.13	7.79		7.22	7.35		7.35	7.40	7.44	
S % o	8	9	6		8	5		5	10		10	5		5	6	6	
Sp. gr.	5	6	5		5	3		3	-		-	-		-	-	-	
pH	9.11	9.07	9.27		9.12	-		-	9.32		9.32	9.75		9.75	9.58	9.65	
DO, mg/L	7.1	6.6	6.7		7.2	6.8		6.7	3.0		3.1	6.5		6.3	5.8	5.9	
% CS	96.86	88.59	91.40		98.22	92.76		91.40	40.26		41.61	87.24		84.56	77.85	77.93	
TA mg/L	126	119	117		126	146		116	157		162	143		150	147	151	
Inorg. C mg/L	28.98	27.37	26.91		28.98	33.58		26.68	36.11		37.26	31.46		33.0	32.34	33.22	

TABLE 10 Contd.

Hydrographic/ Physicochemical Parameters	Grids					
	K ₁₃		J ₁₄		K ₁₅	
	S	B	S	B	S	B
Zsd, m	.20		1.2		.80	
Depth, m	1.6		1.4		1.3	
Amb. Temp °C	31		30.8		31.2	
Water Temp. °C	31	30.5	30.5	30.2	31	30.8
Cond. umhos	11.37	11.40	11.39	11.47	7.26	7.23
TDS, mg/L	7.39	7.41	7.40	7.45	4.7	4.70
S % o	9	9	10	10	5	5
Sp. gr.	-	-	-	-	-	-
pH	9.46	9.42	9.47	9.24	9.39	9.26
DO, mg/L	5.5	-	3.8	3.8	6.7	6.7
% CS	73.82	-	50.19	50.19	89.93	88.50
TA mg/L	128	124	135	133	120	119
Inorg. C mg/L	28.16	27.28	29.70	30.59	27.60	27.37

Table 11. The range of seasonal values of basic hydrographic/physicochemical parameters at 32 different sampling points in northern sector in southwest monsoons (Sept. 1987) during the Third Multidisciplinary Expedition to Chilka Lake, Orissa. All values expressed in standard units. – indicates no data.

Hydrographic/ Physicochemical Parameters	Grids																	
	M ₁₂		L ₁₄		N ₁₄		M ₁₃		L ₁₅		M ₁₅		N ₁₅					
	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B		
Zsd, m		.60		.20		6.10		.10		.70		.40		.20				
Depth, m		1.6		1.4		1.5		1.5		1.2		1.2		1.2				
Amb. Temp °C		32.8		30.5		31		30.5		31.5		31.5		33.5				
Water Temp. °C	32.5	32.5	31	31	31.2	31.5	31.2	31.5	32	31.5	32	32	34.0	32.8				
Cond. umhos	6.74	6.62	9.62	9.76	6.17	6.22	6.73	6.53	8.69	8.69	8.17	8.23	7.38	7.39				
TDS, mg/L	4.38	4.30	6.25	6.34	4.01	4.04	4.37	4.24	5.64	5.64	5.31	5.35	4.79	4.80				
S % o	5	5	6	7	6	6	5	5	6	6	5	5	5	5				
Sp. gr.	3	3	–	–	–	–	–	–	4	4	3	3	3	3				
pH	–	–	9.32	8.88	–	–	8.90	9.03	8.93	8.92	9.16	9.16	9.02	9.02				
DO, mg/L	6.2	6.3	5.9	4.4	6.7	6.7	6.6	6.5	7.5	6.6	6.0	5.3	6.8	5.8				
% CS	84.58	85.94	79.19	59.06	89.93	89.93	88.59	87.24	102.33	88.59	81.85	72.30	95.90	79.12				
TA mg/L	131	131	128	143	120	119	139	138	135	131	124	122	125	118				
Inorg. C mg/L	–	–	29.44	32.89	–	–	31.97	31.74	31.05	30.13	28.52	28.06	28.75	27.14				

TABLE 11 Contd.

Hydrographic/ Physicochemical Parameters	Grids																	
	L ₁₆		M ₁₆			N ₁₆		M ₁₇		N ₁₇		N ₁₈		N ₁₂				
	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B		
Zsd, m	100%		.75		.70		.25		100%		.30		.40					
Depth, m	.20		.90		.90		.73		.70		.90		1.5					
Amb. Temp °C	32.2		32		32		32		32.2		32.8		31					
Water Temp. °C	32.5	NS	32	32.1	33	32.1	33	32.5	33.4	32.6	32.0	33.5	32	31				
Cond. umhos	7.73	NS	10.13	10.13	9.93	9.90	0.97	1.08	3.27	3.57	.072	0.60	2.39	4.66				
TDS. mg/L	5.02	NS	6.58	6.58	6.45	6.43	0.63	0.70	2.13	2.32	0.47	0.39	1.55	3.03				
S % o	4.5	NS	7	7	6	6	0	0	1	2	0	0	0	2				
Sp. gr.	3.0	NS	-	-	-	-	-	-	0.5	1.0	-	-	0	1				
pH	8.44	NS	9.21	9.21	9.37	9.36	9.61	9.38	9.53	9.49	10.66	10.44	9.74	9.76				
DO, mg/L	12.6	NS	6.5	NS	7.9	7.5	9.0	8.3	12.5	10.6	7.2	6.0	9.0	6.0				
% CS	171.89	NS	88.67	NS	109.57	102.31	124.82	113.23	173.37	144.61	98.22	83.21	122.78	80.53				
TA mg/L	140	NS	139	120	131	134	128	135	186	145	134	151	96	105				
Inorg. C mg/L	33.60	NS	31.97	26.40	28.82	29.48	28.16	29.70	40.92	31.9	29.48	33.22	21.22	23.1				

TABLE 11 Contd.

Hydrographic/ Physicochemical Parameters	Grids															
	N ₁₃			S ₁₄			S ₁₅			S ₁₆		S ₁₇		B ₁₄		P ₁₄
	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B
Zsd, m		.30		Nil		Nil		Nil		.30		Nil		Nil		Nil
Depth, m		1.4		0.90		0.80		1.1		1.1		.90		1.0		
Amb. Temp °C		31.8		31.0		30.2		30.2		31.8		30.5		30.5		
Water Temp. °C	30.8	31.0	29.8	30.0	32	30	30	30	30.8	31.0	30	29.5	30	29.5		29.5
Cond. umhos	1.36	2.17	4.34	4.54	3.52	3.54	0.2574	0.6006	0.2299	0.0210	0.32	0.34	0.22	0.22		0.22
TDS, mg/L	0.88	1.41	2.82	2.95	2.28	2.30	0.1673	0.3903	0.1494	0.0136	0.20	0.22	0.14	0.14		0.14
S % o	0	-	2	2	2	2	1	1	-	0	1.5	1.5	2	2		2
Sp. gr.	-	-	-	-	-	-	-	-	0	0	1.0	1.0	-	-		-
pH	9.98	9.68	9.72	9.52	9.4	9.5	10.16	9.65	10.5	9.38	10.38	9.39	10.51	10.21		10.21
DO, mg/L	8.0	6.1	7.1	7.4	6.9	6.8	6.7	5.6	6.5	6.8	7.9	9.1	7.5	7.9		7.9
% CS	105.68	81.87	92.20	97.75	94.13	89.82	88.50	73.97	85.86	91.27	104.35	118.18	99.07	102.59		102.59
TA mg/L	91	92	81	85	100	89	86	108	108	91	111	103	108	106		106
Inorg. C mg/L	20.02	20.24	17.82	18.70	22.0	19.58	18.92	23.76	23.76	20.02	24.42	22.66	23.76	23.32		23.32

TABLE 11 Contd.

Hydrographic/ Physicochemical Parameters	Grids																	
	P15			P16			R15-16			S13		S12		R12		Q12		
	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B		
Zsd, m	NIL	NIL		0.18		0.10		0.10		100%		0.25		0.25				
Depth, m		1.0		.90		1.1		.70		.40		.90		1.0				
Amb. Temp °C		31.5		32		31		31		32		32		32				
Water Temp. °C	31	30.5	32	31.0	31	31	31.2	30.4	31.5	31.6	31.1	31.0	31.5	30.1				
Cond. umhos	0.1848	0.189	0.3806	0.3861	0.2134	0.2189	6.33	6.42	13.02	NS	5.74	6.02	5.66	6.41				
TDS, mg/L	0.1201	0.1229	0.2473	0.2509	0.1387	0.1422	4.11	4.17	8.46	NS	3.73	3.91	3.68	4.16				
S % o	1	1	1.5	1.0	0	.5	4	4	9	NS	4	4	4	4				
Sp. gr.	-	-	-	-	-	-	3	3	6	NS	3	3	3	3				
pH	10.23	9.85	9.98	9.89	10.5	10.24	9.27	9.13	9.15	NS	9.29	9.29	9.28	9.86				
DO, mg/L	7.4	7.8	9.6	7.4	7.5	7.4	6.8	7.2	7.1	NS	7.4	7.5	7.5	7.7				
% CS	99.32	103.03	130.96	99.32	100.67	99.32	91.27	95.11	95.30	NS	99.32	100.67	100.67	103.35				
TA mg/L	127	109	111	108	107	108	90	113	87	NS	109	101	99	105				
Inorg. C mg/L	27.94	23.98	24.42	23.76	23.54	23.76	20.70	25.99	20.01	NS	25.07	23.23	22.77	23.10				

TABLE 11 Contd.

Hydrographic/ Physicochemical Parameters	Grids							
	P ₁₂		P ₁₃		Q ₁₃		R ₁₃	
	S	B	S	B	S	B	S	B
Zsd, m		.30		.20		Nil		Nil
Depth, m		1.2		1.2		1.1		.90
Amb. Temp °C		31.8		32		32		32
Water Temp. °C	31.5	30.2	31.6	31.2	31.8	31.6	31.8	31.8
Cond. umhos	4.67	5.14	2.06	2.10	0.3685	0.3916	0.57	0.57
TDS, mg/L	3.03	3.34	1.34	1.36	0.2395	0.2545	0.37	0.37
S % o	3	4	2	2	1	1	1	1
Sp. gr.	2.5	3.0	-	-	-	-	-	-
pH	9.21	9.25	9.55	9.55	9.79	10.16	9.49	9.60
DO, mg/L	8.0	7.3	7.9	7.8	6.8	7.3	7.5	7.2
% CS	107.3	96.43	106.04	104.69	91.27	97.98	100.67	96.64
TA mg/L	115	89	80	95	101	107	112	103
Inorg. C mg/L	25.3	19.58	17.60	20.9	22.22	23.54	24.64	22.66

Table 12. Showing various seasonal values of main hydrographic and physicochemical parameters in subsurface (S) and bottom (B) water samples at 12 sampling sites in **outer channel** in late southwest monsoons (September 1987) during the course of **Third Multidisciplinary Expedition** to Chilka Lake, Orissa. All values expressed in appropriate universal units.

Physico-chemical Parameters	Grid Nos.											
	N ₈		N ₉		O ₈		O ₉		P ₈		P ₁₀	
	S	B	S	B	S	B	S	B	S	B	S	B
Zsd. m	.60		.50		.5		.40		.40		.50	
Depth, m	1.7		1.15		1.1		.60		.90		.60	
Amb. Temp °C	32		31		33.1		32		33.5		31	
Water Temp. °C	32	31.2	32.2	32.4	32.5	31.5	31.6	31.5	32.8	32.3	31.5	-
Cond. umhos	9.03	10.10	9.69	10.62	6.35	5.89	7.0	7.0	8.52	8.43	13.13	11.28
TDS, mg/L	58.70	65.70	62.99	69.06	41.32	38.32	45.5	45.5	55.41	54.84	85.37	73.35
S % o	5	4	5	7	3	4	3	3	5	5	6	7
Sp. gr.	6	4.5	4	5	1.5	2	2	2	3.5	3.5	4	5
pH	9	8.9	8.9	8.9	9.4	9.6	10.3	10.01	9.19	9.16	9.6	9.6
DO, mg/L	12.4	11.4	13.2	13.0	12	13.4	11.8	-	13.6	12.00	13.2	-
% CS	169.16	153.02			163.71	179.86	160.98		185.53	163.71	177.18	-
TA mg/L	106	100	107	109	92	97	123	-	90	97	97	-
Inorg. C mg/L	24.38	23	24.61	25.07	21.16	22.31	28.29		20.7	22.31	22.31	-

TABLE 12 Contd.

Physico-chemical Parameters	Grid Nos.													
	R ₉		S ₉			T ₁₀		O ₁₀			V ₁₁			
	S	B	S	B	S	B	S	B	S	B	S	B		
Zsd. m	.50		.50			.45		.30			.60			
Depth, m	.90		1.4			0.5		.40			1.8			
Amb. Temp °C	32.6		33			32.5		33.2			31.5			
Water Temp. °C	33.9	33.9	32.5	32.0	32.5	-	33.6	33.6	32	32				
Cond. umhos	10.02	10.06	9.92	9.94	10.37	-	10.37	-	13.0	12.67				
TDS, mg/L	65.13	65.42	64.49	64.63	67.42	-	67.42	-	84.51	82.36				
S % o	6	6	5	5	7	-	7	-	10	10				
Sp. gr.	4	4	3.5	3.5	4.5	4.5	4.5	-	7.5	7.5				
pH	9.11	9.15	9.03	9.04	9.1	-	9.24	-	9.15	9.2				
DO, mg/L	14	13.8	12.4	12.6	11.8	-	10.4	-	13.0	13.2				
% CS	194.17	191.40	169.16	171.89	160.98	-	144.24	-	177.35	180.08				
TA mg/L	93	94	93	100	99	-	62	-	51	75				
Inorg. C mg/L	21.39	21.62	21.39	23.0	22.77	-	14.26	-	11.73	17.25				

APPENDIX A

A Synoptic View of the Participating Agencies/Individuals involved in the Multidisciplinary Expedition Studies on Chilka Lake, Orissa between 1985 - 1987

	Institutions	Participants	Fields of Study
I.	Zoological Survey of India (ZSI) Estuarine Biological Station, Berhampore (Gm)	K. V. Rama Rao <i>et. al.</i> C.A.N. Rao	Fishes/Limnology Polychaecta
	Freshwater Biological Station, Hyderabad (A.P.)	E.V. Muley	Limnology
	Southern Regional Station, Madras	M. Srinivasan	Planktonology
	Ecology Divn., ZSI, Calcutta Crustacea Divn., <i>etc.</i> Malacology Divn., Calcutta	S.Z. Siddiqi, <i>et. al</i>	Hydrography/Limology Malacofauna littoral/benthic
II.	Berhampore Univeristy, Berhampur (Ganjam), Orissa		
	Dept. of Marine Sciences Dept. of Meteorology	K. Mahapatro & Das	Benthic fauna, Macrophyts, <i>etc.</i>

APPENDIX A (Cont'd)

- | | | | |
|------|--|---------------------------|--|
| III. | Fisheries Department, Govt. of Orissa, Balugaon/Bhubaneswar. | Mishra, <i>et. al.</i> | Fisheries, Limnology, <i>etc.</i> |
| IV. | Division of Marine Biology, Department of Zoology, Andhra University, Waltair - 530 003. | A.V. Raman <i>et. al.</i> | Phytoplankton Characteristics of Chilka Lake. |
| V. | Orissa Remote Sensing Application Centre (ORSAC), Bhubaneswar. | N.K. Das <i>et. al.</i> | Multithematic Studies including Monitoring in conjunction with ground data acquired through various expeditions. |
-

APPENDIX A (Cont'd)

Synoptic review of major classical/ contemporary exhaustive, long-term, comprehensive, Hydrographic and Hydrobiological Studies on Chilka Lake, Orissa during the century.

PERIOD OF STUDY/ INVESTINGATIONS	EXECUTING INSTITUTIONS /AGENCIES	THRUST AREA (S)	REPORTS/RESULTS	GENERAL REMARKS
1915 (Anandale & Kemp, 1915)	Zoological Survey of India (ZSI), Calcutta	Faunal Survey, <i>etc.</i> of the lake	<i>Mem. Indian Mus.</i> 5(1) : 1 139, 1915.	
1922 (Sewell, R.B.S., 1922)	<i>Ibid</i>	Hydrography & Invertebrate Fauna of Rambha Bay in an abnormal year.	<i>Ibid</i> 5 (10) : 677 710, 1922.	
1922 1932 (Biswas, K. 1932)	—	Algal Flora of the Lake	A <i>Mem. asiatic Slc. Bengal</i> 11(5) : 165 198, 1932	
1948 1950 (Jones & Sajansingani, 1954)	—	Fish & Fisheries incl. of fish catches in lake	<i>Indian J. Fish</i> 1 : 256 344	
1950 1951 (Devasundaram & Roy, 1954)	Chilka Biological Station, Balugaon, Orissa	Preliminary study of plankton of Chilka Lake	<i>Proc. Symp. on Marine & Freshwater plankton in Indo-pacific, Bangkok</i> 25-26 Jan. 1954 Pp. 48 -54	Fluctuation in planktonic organisms phytoplankton at 5 representative stations
1954 (Roy, 1954)	<i>Ibid</i>	Diatom flora of Chilka Lake	<i>J. Bombay nat. Hist.</i> Soc. 52(1) :	
1957 1961 Banerjee & Roychaudhuri, 1966)	Chilka Investigation Unit, Balugaon (Puri)	Some physicochemical features of Chilka Lake.	<i>Indian J. Fish.</i> 13(1/2) : 395 429	

APPENDIX A (Cont'd)

1966 1957 - 1965 (Jhingran & Natarajan, 1966)	Central Inland Fisheries Research Institute (CIFRI), Barrackpore,	Rinal Report. Fisheries of the Chilka Lake.	<i>Cent. Inland Fish. Res. Inst. Barrackpore (W.B.) Bull. 8, 1966.</i>	
1960 - 1961 (Ramanandam, Reddy & Murty, 1964)	Physical Oceanography Team, Dept. of Meteorology & Oceanography, Andhra University, Waltair.	Limnology of Chilka Lake	<i>J. mar. biol. Ass. India 6(2) : 183 - 201, 1964</i>	
1964 - 1965 (Sarkar, S.K., 1979)	Chilka Investigation Unit, CIFRI, Balugaon, Dist. Puri (Orissa)	Seasonal/spatial variations in salinity	<i>J. Inland Fish. Soc. 11(2) : 1-9, 1979.</i>	5 sections surface/ vertical distribution of salinity, temperature and surface currents.
1971 - 1973 (Mohanty, S.K., 1975)	Chilka Biological Research Station, Balugaon, Puri (Orissa)	Physicochemical features of outer channel, Chilka Lake	<i>Bull. Dept. Mar. Sci. Univ., Cochin 21(1) : 69 - 89, 1975</i>	Seasonal Annual/Daily changes in physico- chemical P outer channel
1985 - 1987 (Rama Rao, <i>et. al.</i>)	Zoological Survey of India/Estuarine Biolo- gical Research Station, Berhampur (Gm.) Orissa	Chilka Lagoon Expeditions 1985 1987. A Multidisci- plinary study.	Rama Rao <i>et. al.</i> , 1987 <i>Proc. Nat. Symp. in Aquatic Ecology</i> UGC/Andhra Univ., Waltair, May, 1987. Abstract No. 10, p. 6. <i>Natl. Sem. on Conserv. & Management of Chilka</i> Jan. 1988, Abstract, p. 4	First ever grid pattern survey of the lagoon for faunistics/limnological profile from 219 sampling stations for <i>temporal (seasonal)</i> and <i>spatial (horizontal)</i> variation studies in 3 major sections and mouth of the lagoon for 30 hydrographical/physico- chemical factors.

APPENDIX A (Cont'd)

1985 1987 (Mahapatra <i>et. al.</i> , 1988)	Biological & Techno- logical Research Station, State Fisheries Department, Balugaon,	Physicochemical observations of three stations in Chilka.	Mahapatra <i>et. al.</i> 1988. <i>National Seminar on Conserv. & Management of Chilka</i> , Jan. 1988. Abstract, p. 28.	3 Peripheral stations in Northern (Kaluparaghat), Central (Balugaon) and Southern (Rambha) sectors.
1987 (Raman <i>et. al.</i> , 1990)	Divn. of Marine Biology, Dept. of Zoology, Andhra University, Waltair.	Phytoplankton characteristics of Chilka Lake.	Raman <i>et. al.</i> 1990. <i>Indian Jour. Mar. Sci.</i> 19 : 274-277.	

APPENDIX 'B'

Showing details of the **total duration, seasons and number of sampling stations, etc.**
surveyed/sampled during the course of **Chilka Lake Expedition**, Orissa, between 1985 – 1987.

No. of Expeditions undertaken	Period	Time-frame of Field Survey/ Sampling/Studies	No. of Actual Working Days	Season(s)	No. of Sampling Stations	Remarks
First Expedition	21 Nov. 05 Dec. 1985	16 days	15 days	Winter	45	Normal
Second Expedition	10 – 30 June, 1986	22 days	18 days	Summers	74	Normal with intermittent rains
Third Expedition	04 – 27 Sept., 1987	23 days	22 days	South–West Monsoon	100	Poor rainfall save for intermittent showers

APPENDIX 'C'

Showing synoptic view of general limnological characteristics estimated for **subsurface (S)/bottom**
(B) – Waters in different sectors of the tropical lake during the three year period 1985 – 1987.

LIMNOLOGIC PROFILE

SECTORS (No. of sampling stations sectorwise per Expedition)

HYDROGRAPHIC PARAMETERS

- Depth (d), m
- Secchi Disc Transparency (Zsd, m)
- Attenuation Coefficient (Ev)

LIMNOLOGICAL PARAMETERS

- | | | | | |
|--------------------------------------|----------|---------|----------|---------|
| - Temperature 0°C | | | | |
| - Atm. Temp. 0°C | | | | |
| - Subsurface Water/Bottom Water | Southern | Central | Northern | Outer |
| - Salinity (‰) : Subsurface/Bottom | Sector | Sector | Sector | Channel |
| - Sp. gr. () : Subsurface/Bottom | | | | |
| Turbidity (mg/L) Subsurface/Bottom | (16, 20 | (13, 30 | (8, 12 | (6, 10 |
| pH : Subsurface/Bottom | & 20) | & 22) | & 32) | & 12) |
| Conductivity, umhos cm ⁻¹ | | | | |
| - Subsurface/Bottom | | | | |
| Total Dissolved Residues | | | | |
| (Total Dissolved Solids) mg/L | | | | |
| - Subsurface/Bottom | | | | |

Dissolved Gases :

Dissolved Oxygen, DO mg/L

- Subsurface/Bottom

Percentage Saturation % CS

- Subsurface/Bottom

Free CO₂, mg/L: Subsurface/Bottom

Total Alkalinity, CaCO₃ mg/L

- Subsurface/Bottom

Tot. Inorg. Carbon, mgC/L

- Subsurface/Bottom

Inorganic Plant Nutrients

- Phosphate : Surface/Bottom

- Nitrates : Surface/Bottom

- Silica : Subsurface/Bottom

Southern Sector	Central Sector	Northern Sector	Outer Channel
(16, 20 & 20)	(13, 30 & 22)	(8, 12 & 22)	(6, 10 & 12)

LIMNOBIOLOGICAL FEATURES

- Plankton Biomass (volume)

- Subsurface/Bottom

- Pigment Concentrations

Macrophytes (including large algae/mosses)

- Plant beds, visual location

APPENDIX 'D'

Details of grids, sectorwise, date, cruise, survey and sampling etc. during the course of **First Multidisciplinary Expedition** to Chilka Lake, Orissa during **Winter (late Nov. – Dec. 1985)**. In all, **45** sampling stations were surveyed along transect lines and **87** samples of lake waters collected/analysed *in situ, on-board* and camp laboratory.

Date/Cruise/ Survey/Sampling Time	Grids surveyed/ sampled	Lake region	Field Date/ Material collected	No. of water samples coll./ analysed (total in perenthesis)	No. of Stn. covered (total in perenthesis)	R e m a r k s
22.xi.85 10.00 – 14.00 hrs.	A ₂ B ₁ & B ₂	Southern sector		04	02	
23.xi.85 9.30 – 17.00 hrs	B ₂ C ₂ C ₃ B ₃ & B ₄	-do-		10 (11)	05 (07)	
24.xi.85 8.30 – 17.00 hrs.	D ₄ C ₄ B ₅ & B ₆	-do-		08 (19)	04 (11)	
25.xi.85 9.00 – 16.00 hrs.	C ₅ D ₆ C ₆ & E ₆	Southern Sector + Central		08 (27)	04 (15)	
26 Nov. 85	-	-		-	-	Shifting of camp, field gears/equipments from Rambha to Balugaon.

Appendix 'D' Contd.

Date/Cruise/ Survey/Sampling Time	Grids surveyed/ sampled	Lake region	Field Date/ Material collected	No. of water samples coll./ analysed (total in perentthesis)	No. of Stn. covered (total in perentthesis)	R e m a r k s
29.xi.85 8.00 – 17.30 hrs.	G I K M & O ₁₂	Central + Northern		10 (47)	05 (30)	
30.xi.85 8.30 – 15.10 hrs.	K ₁₄ K ₁₅ N ₁₇ O ₁₆	-do-		08 (65)	04 (34)	
01 Dec. 86	-	-		-	-	Shifting of camp etc. from Balugaon to Puri
2.xii.85 10.00 – 19.00 hrs.	Q ₁₀ O ₉ & N ₉	Northern sector + outer channel		06 (71)	03 (37)	
3.xii.85 9.00 – 17.10 hrs.	O ₈ Q ₈ & W ₁₁	Outer channel		06 (77)	03 (40)	
4.xii.85 11.00 – 10.00 hrs.	S ₁₇	Northern		02 (79)	01 (41)	
5.xii.85 8.30 – 18.00 hrs.	N ₈ Q ₁₂ Q ₁₄	Outer channel +		08 (87)	04 (45)	

APPENDIX 'E'

Details of grid network, sectorwise, date, cruise, survey and sampling time *etc.* during the course of **Second Multidisciplinary Expedition** to Chilka Lake, Orissa in late **summers (June 1986)**. In all, **74** stations were surveyed along transect lines and **123 samples** of lake water collected/analysed *in situ, on-board* and camp laboratories.

Date/Cruise/ Survey/Sampling Time	Grids surveyed/ sampled	Lake region	Field Date/ Material collected	No. of water samples coll./ analysed (total in perenthesis)	No. of Stn. covered (total in perenthesis)	R e m a r k s
11. vi. 86 8.30 – 15.00 hrs.	A ₂ B ₂ C ₂ & D ₂	Southern Sector		08	04	
12. vi. 86 8.00 – 14.00 hrs.	A ₃ B ₃ C ₃ D ₃ & B ₁	-do-		10 (18)	05 (09)	
13. vi. 86 8.23 – 15.30 hrs.	B ₄ C ₄ D ₄ C ₅ & D ₅	-do-		08 (26)	05 (14)	
14. vi. 86 8.30 – 15.10 hrs.	D ₅ & E ₅	-do-		04 (30)	02 (16)	
15. vi. 86	Camp shifting					Shifting of base camp, etc.
16. vi. 86 8.30 – 15.00 hrs.	B ₆ C ₆ D ₆ & E ₆	Southern + Central		07 (37)	04 (20)	

APPENDIX 'E' Contd.

Date/Cruise/ Survey/Sampling Time	Grids surveyed/ sampled	Lake region	Field Date/ Material collected	No. of water samples coll./ analysed (total in perenthesis)	No. of Stn. covered (total in perenthesis)	R e m a r k s
17. vi. 86 8.15 – 15.00 hrs.	D ₇ E ₇ F ₈ & E ₈	Southern + Central		08 (45)	04 (24)	
18. vi. 86 8.30 – 14.30 hrs.	D ₈ E ₉ F ₉ G ₉ & H ₉	Southern + Central		10 (55)	05 (29)	
19. vi. 86 8.13 – 16.05 hrs.	E F G H I J K & L ₁₀	Central Sector		14 (69)	08 (37)	
20. vi. 86 8.25 – 15.40 hrs.	F ₁₁ H J & L ₁₁	-do-		08 (77)	04 (41)	
21 June 1986	Break for maintenance/ repairs, etc.			-	-	Break for maintenance/ repairsof logistics vehicles, trailors, etc.
22. vi. 86 9.20 – 15.30 hrs.	G I K & M ₁₂	Central + Northern		08 (85)	04 (45)	
23. vi. 86	G I K & M ₁₃	-do-		08 (93)	04 (49)	

APPENDIX 'E' Contd.

Date/Cruise/ Survey/Sampling Time	Grids surveyed/ sampled	Lake region	Field Date/ Material collected	No. of water samples coll./ analysed (total in perenthesi)	No. of Stn. covered (total in perenthesi)	R e m a r k s
24. vi. 86 8.45 – 18.05 hrs.	J L N & P ₁₄	Central + Northern		08 (101)	03 (56)	
25. vi. 86 8.30 – 18.45 hrs.	L ₁₆ M ₁₇ & N ₁₈	Northern		06 (107)	03 (56)	
26. vi. 86 8.25 – 18.30 hrs.	N ₁₆ P ₁₆ & R ₁₆	-do-		06 (113)	03 (59)	
27. vi. 86 8.45 – 19.30 hrs.	N ₈ N ₉ N ₁₀ N ₁₁	Outer channel + Northern sector		10 (123)	05 (64)	

APPENDIX 'F'

Details of grid network sectorwise, date, cruise hours, survey and sampling time etc. during the course of **Third Multidisciplinary Expedition** to Chilka Lake, Orissa in late **South West monsoons** (Sept. 1987). In all **100 grids** were surveyed and 189 samples of lake water collected/analysed *in situ, on-board* and camp laboratory.

Date/Cruise/ Survey/Sampling Time	Grids surveyed/ sampled	Lake region	Field Date/ Material collected	No. of water samples coll./ analysed (total in perenthesis)	No. of Stn. covered (total in perenthesis)	R e m a r k s
04. ix. 87 8.30 – 15.45 hrs.	B ₁ C ₂ B ₂ & A ₂	Southern sector		08	4	
05. ix. 87 8.30 – 16.00 hrs.	A ₃ B ₃ C ₃ & D ₃ C ₄ & D ₄	-do		12 (20)	6 (10)	
06. ix. 87 8.05 – 15.58 hrs.	B ₅ C ₅ D ₅ & E ₅	Southern & Central sector			4 (14)	
07. ix. 87 8.07 – 17.25 hrs.	B ₆ C ₆ D ₆ E ₆ & F ₆	-do-		10 (30)	5 (19)	
08. ix. 87 8.10 – 18.35 hrs.	D ₇ E ₇ F ₇ & D ₄	-do-		08 (38)	4 (23)	
09. ix. 87	Camp shifting	-		-	-	Shifting of camp base/ lab./field gears from Rambha to Balugaon.

APPENDIX 'F' Contd.

Date/Cruise/ Survey/Sampling Time	Grids surveyed/ sampled	Lake region	Field Date/ Material collected	No. of water samples coll./ analysed (total in perenthesis)	No. of Stn. covered (total in perenthesis)	R e m a r k s
10. ix. 87 8.50 – 17.00 hrs.	E ₈ & F ₈	Central		4 (42)	2 (25)	Live recording (Video Film) of Field Studies/ Analyse\$, etc.
11. ix. 87 10.00 – 16.45 hrs.	D ₈ E ₉ F ₉ G ₉ & H ₉	Southern & Central		10 (52)	5 (30)	
12. ix. 87 7.12 – 17.00 hrs.	E ₁₀ F ₁₀ G ₁₀ H ₁₀ I ₁₀ J ₁₀	Central		12 (64)	6 (36)	
13. ix. 87 7.30 – 20.00 hrs.	F ₁₁ H ₁₁ J ₁₁ L ₁₁ N ₁₁ P ₁₁	Central & Northern		11 (75)	6 (42)	
14. ix. 87 8.30 – 17.30 hrs.	G ₁₂ I ₁₂ K ₁₂ & M ₁₂	Central & Norther		8 (83)	4 (46)	
15. ix. 87 8.30 – 17.00 hrs.	I ₁₃ G ₁₃ I ₁₄ & K ₁₃	Central		8 (91)	4 (50)	
16. ix. 87 7.55 – 19.40 hrs.	J ₁₄ K ₁₅ L ₁₄ N ₁₄ & M ₁₃	Central & Northern		10 (101)	05 (55)	
17. ix. 87 8.20 – 17.30 hrs.	L ₁₅ M ₁₅ & N ₁₅	-do		06 (107)	03 (58)	

APPENDIX 'F' Contd.

Date/Cruise/ Survey/Sampling Time	Grids surveyed/ sampled	Lake region	Field Date/ Material collected	No. of water samples coll./ analysed (total in perenthesis)	No. of Stn. covered (total in perenthesis)	R e m a r k s
18. ix. 87 7.25 – 22.00 hrs.	L ₁₆ M ₁₆ N ₁₆ M ₁₇ N ₁₇ & N ₁₈	Central & Northern		10 (107)	06 (64)	
19 – 20 Sept. '87	Camp shifting	–				Shifting of base camp/lab. field gears, material/ personal from balugaon to Puri.
21. ix. 87 8.20 – 18.00 hrs.	O ₈ P ₈ Q ₈ R ₉ S ₉ T ₁₀ U ₁₀ & V ₁₁	Outer channel + Mouth		17 (134)	08 (72)	
22. ix. 87 8.30 – 18.05 hrs.	N ₈ N ₉ M ₁₀ L ₁₀ K ₁₀ & L ₉	Outer channel + Central sector		12 (146)	06 (78)	
23. ix. 87 8.30 – 19.35 hrs.	O ₉ P ₁₀ N ₁₀ N ₁₂ & N ₁₃	Outer channel + Northern sector		09 (155)	05 (83)	
24. ix. 87 8.35 – 18.00 hrs.	S ₁₄ S ₁₅ S ₁₆ & S ₁₇	-do-		16 (189)	08 (100)	
25. ix. 87 7.30 – 19.00 hrs.	R ₁₄ P ₁₄ P ₁₅₋₁₆	-do-		10 (173)	05 (92)	
26. ix. 87 7.30 – 17.00 hrs.	S ₁₃ S ₁₂ R ₁₂ Q ₁₂ P ₁₂ P ₁₃ Q ₁₃ & R ₁₃	-do-		16 (189)	08 (100)	

PROTOZOA

A. K. DAS

Zoological Survey of India, Calcutta

INTRODUCTION

First published report on the freeliving ciliates of the Chilka Lake dates back to 1915 when Annandale mentioned the presence of 'numerous fixed and free protozoa' on the submerged timbers in the lagoon along with a coelenterate species, *Bimaria flumianalis*. Next report on ciliates from the Chilka was made by Chilton (1921) who had observed some 'vorticellid protozoa' attached with some drifting weeds belonging to *Potamogetum pectinatus*. Then, after a long gap and in the course of dealing with freeliving protozoa of Orissa, Das and Nair (1987) recorded 41 species of ciliates from the Chilka based on their collections made during 1969-1971.

In recent years the present author had the opportunity to participate Chilka Lake expeditions and collect water samples from 35 stations (Map 1) covering a vast stretch of the Lake. The ciliates collected from those samples as well as those already present in the Zoological Survey of India comprise 61 species under 37 genera belonging to 31 families. These are being dealt with in the present communication.

MATERIAL AND METHODS

Water samples along with some algae, water weeds, flocculent matter and bottom ooze were collected from 35 stations as mentioned earlier and kept in wide mouthed sampling jars made up of glass. These jars were then brought to the laboratory and kept for some days, keeping their lids open for considerable increase of protozoa population occurring in those samples. The samples were then thoroughly examined under light microscope from time to time. Freeliving ciliates occurring in them were isolated by micropipette and examined in living condition by keeping them in a drop of natural medium. Sometimes, Methocyl solution was used for slowing down the movement of the fast moving ciliates for the study of their internal structures *in situ* under light microscope. Sometimes, Lugol's solution was added as a killing agent and also for detecting peripheral organellae. Schaudinn's fixative and Carnoy's fluid were used for making permanent slides. The first one is very effective for keeping the exact natural shape of the specimen while the second one is good for studying nuclear structure. Heidenhain's iron haematoxylin and Delafeld's haematoxylin were used for staining the ciliates. In some cases, dry silver impregnation method was employed to study their infrastructure. Permanent slides were mounted in DPX.

Location of each station is mentioned below for the sake of convenience of future collection of ciliates in the lagoon. Stn. 1 Near Grid No. A₂ (opposite to Ghantasila and near bird island and Beacon island); Stn. 2 - Near Grid No. B₁; Stn. 3 - Near Brahmandeo (Grid No. C₂); Stn. 4 - Near Honeymoon island (between Grid Nos. A₃ & B₃); Stn. 5 Near Somolo island (between Grid Nos. C₃ & C₄); Stn. 6 Near Gopakuda and Khallikote range; Stn. 7 Near Grid No. D₅; Stn. 8 Near Khallikote; Stn. 9 Near Grid No. F₆; Stn. 10 - Between Grid Nos. D₇ & E₇; Stn. 11 - Near Grid No. E₇; Stn. 12 - Grid No. F₈ (near Parikud

and Krishnaprasadgarh); Stn. 13 Grid No. H₉ (near Nalbano island); Stn. 14 - Between Grid Nos. I₁₀ & I₁₁ (near Nalbano island); Stn. 15 Grid No. G₁₀; Stn. 16 Grid No. F₁₀; Stn. 17 - Near Barkul; Stn. 18 - Near Balugaon; Stn. 19 - Near Kalijugeswara (Grid No. G₁₂); Stn. 20 - Grid No. I₁₂; Stn. 21 - Grid No. I₁₃; Stn. 22 Grid No. J₁₄; Stn. 23 Grid No. M₁₃; Stn. 24 - Grid No. M₁₅; Stn. 25 Near Kaluparaghat; Stn. 26 - Grid No. N₁₇; Stn. 27 - Grid No. O₈ (near Satpara); Stn. 28 - Grid No. R₉; Stn. 29 - Between Grid Nos. T₁₀ & U₁₀; Stn. 30 Between Grid Nos. V₁₀ & V₁₁ (near Arakuda); Stn. 31 Grid No. L₁₀; Stn. 32 - Grid No. O₉ (between Satpara and Gambhari); Stn. 33 near Gambhari (Grid No. P₁₁); Stn. 34 - Between Grid Nos. P₁₅ & P₁₆; Stn. 35 Between Grid Nos. R₁₅ & R₁₆.

SYSTEMATIC LIST OF FREELIVING CILIATES HITHERTO
REPORTED FROM THE CHILKA LAKE

Phylum CILIOPHORA

Class KINETOFRAGMINOFOREA

Order PROSTOMATIDA

Family HOLOPHRYIDAE

1. *Holophrya nairi* sp. nov.

Family PRORODONTIDAE

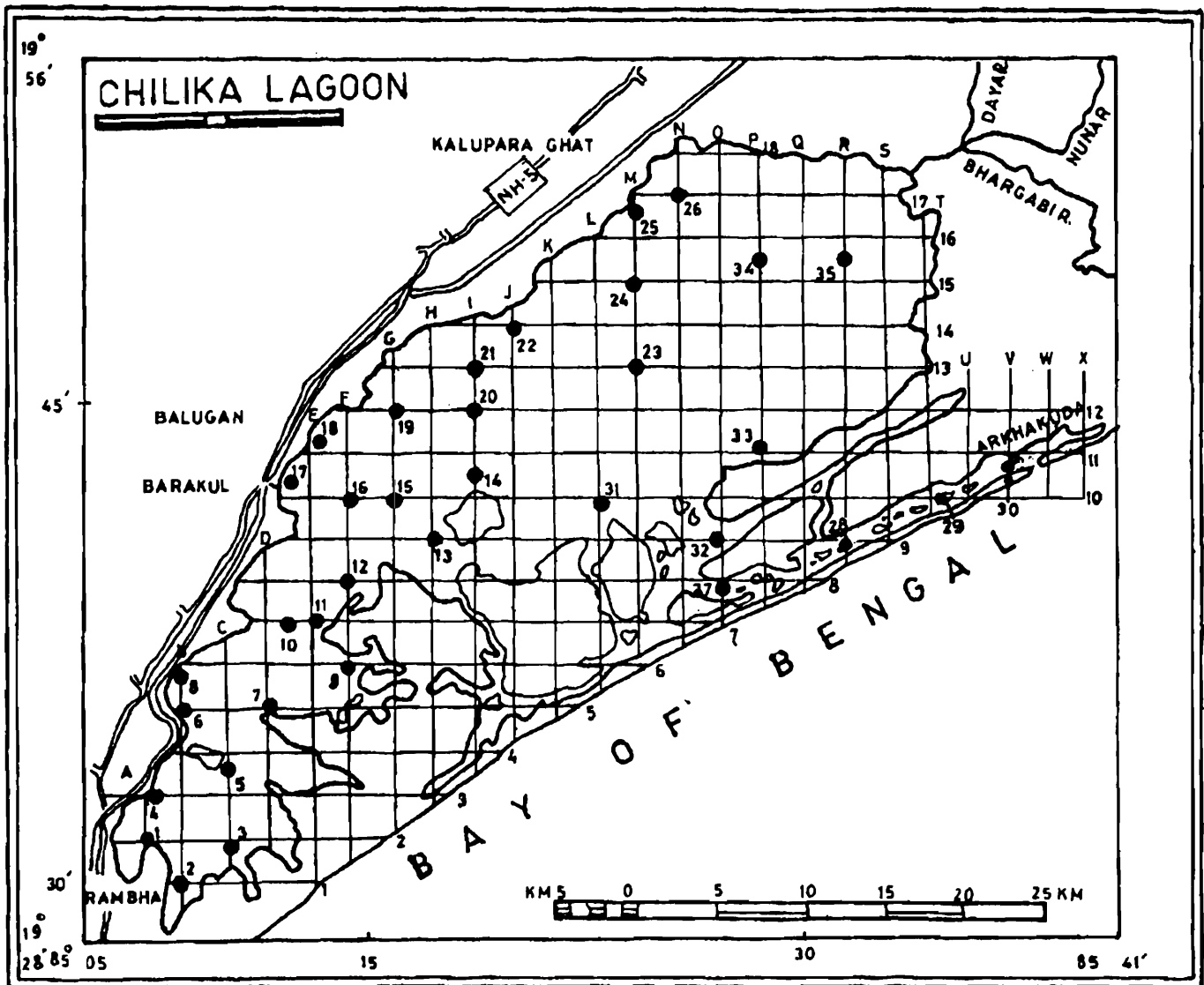
2. *Prorodon discolor* (Ehrenberg)
3. *Prorodon marinus* Claparede & Lachmann
4. *Prorodon teres* Ehrenberg
5. *Urotricha discolor* Kahl
6. *Urotricha globosa* Schewiakoff

Family COLEPIDAE

7. *Coleps tessellatus* Kahl

Family ENCHELYIDAE

8. *Lacrymaria coronata* Claparede & Lachmann
9. *Lacrymaria elegans* Engelmann
10. *Lacrymaria olor* (Muller)



Map 1. Showing collecting stations of Protozoa samples

11. *Lacrymaria salinarum* Kahl
12. *Trachelophyllum clavatum* Stokes
Family SPATHIDIIDAE
13. *Spathidium fossicola* Kahl
Order PLEUROSTOMATIDA
Family AMPHILEPTIDAE
14. *Loxophyllum grande* (Entz)
15. *Loxophyllum meleagris* Dujardin
16. *Loxophyllum setigerum* Quennerstedt
17. *Loxophyllum uninucleatum* Kahl
18. *Litonotus fasciola* (Ehrenberg)
Order KARYORELICTIDA
Family TRACHELOCERCIDAE
19. *Trachelocerca phoenicopterus* Cohn
Family GELEIIDAE
20. *Geleia nigriceps* Kahl
Order TRICHOSTOMATIDA
Family PLAGIOPYLIDAE
21. *Plagiopyla nasuta* Stein
22. *Plagiopyla ovata* Kahl
Order NASSULIDA
Family NASSULIDAE
23. *Nassula notata* (Muller)

24. *Nassula ornata* Ehrenberg
Order CYRTOPHORIDA
Family CHILODONELLIDAE
25. *Chilodonella cucullulus* (Muller)
Family CHLAMYDODONTIDAE
26. *Chlamydodon mnemosyne* Ehrenberg
Family DYSTERIIDAE
27. *Dysteria ovalis* (Gourret & Roeser)
Class OLIGOHYMENOPHOREA
Order HYMENOSTOMATIDA
Family PARAMECIIDAE
28. *Paramecium calkinsi* Woodruff
Family FRONTONIIDAE
29. *Frontonia fusca* (Quennerstedt)
30. *Frontonia leucas* (Ehrenberg)
31. *Frontonia marina* Fabre-Domergue
Order SCUTICOCILIATIDA
Family PHILASTERIDAE
32. *Philaster digitiformis* Fabre-Domergue
Family URONEMATIDAE
33. *Uronema filificum* Kahl
34. *Uronema marinum* Dujardin

Family COHNILEMBIDAE

- 35. *Cohnilembus longivelatus* (Kahl)
- 36. *Cohnilembus subulatus* (Kent)
- 37. *Cohnilembus verminus* (Muller)

Family PLEURONEMATIDAE

- 38. *Pleuronema marinum* Dujardin

Family CYCLIDIIDAE

- 39. *Cyclidium citrullus* Cohn

Order PERITRICHIDA

Family VORTICELLIDAE

- 40. *Vorticella marina* Greef

Family SCYPHIDIIDAE

- 41. *Scyphidia* sp.

Class POLYHYMENOPHOREA

Order HETEROTRICHIDA

Family SPIROSTOMATIDAE

- 42. *Gruberia calkinsi* Beltran
- 43. *Spirostomum teres* Claparede & Lachmann

Family METOPIDAE

- 44. *Metopus es* (Muller)
- 45. *Metopus fuscus* Kahl
- 46. *Metopus ovalis* Kahl

Family CONDYLOSTOMATIDAE

- 47. *Condylostoma magnum* Spiegel

48. *Condylostoma patens* (Muller)
Family CAENOMORPHIDAE
49. *Caenomorpha capucina* Kahl
50. *Caenomorpha levanderi* Kahl
Order OLIGOTRICHIDA
Family STROMBIDIIDAE
51. *Strombidium calkinsi* Kahl
Family CODONELLIDAE
52. *Tintinnopsis lohmani* Lackmann
Order HYPOTRICHIDA
Family HOLOSTICHIDAE
53. *Holosticha manca* Kahl
54. *Keronopsis rubra* (Ehrenberg)
Family OXYTRICHIDAE
55. *Oxytricha chilkaensis* sp. nov.
Family EUPLOTIDAE
56. *Diophrys appendiculata* (Ehrenberg)
57. *Euplotes charon* (Muller)
58. *Euplotes eurystomus* Wrzesniowski
59. *Euplotes patella* (Muller)
60. *Euplotes vannus* (Muller)
61. *Euplotes woodruffi* Gaw

SYSTEMATIC ACCOUNT

Phylum CILIOPHORA
 Class KINETOFRAGMINOPHOREA
 Order PROSTOMATIDA

Key to the families

- 1(2) Body barrel shaped bearing armoured plates in longitudinal rows Family COLEPIDAE
- 2(1) Body oval to elongate or flask shaped, without bearing any armoured plates
- 3(6) Cytostome round or oval, sometimes in shallow atrium, toxicysts may or may not present
- 4(5) Oral basket made up of double trichites ending deep in cytoplasm, somatic toxicysts common, unique distinctive "brush" of cilia arising from specialised short kineties on dorsal surface near anterior pole Family PRORODONTIDAE
- 5(4) Cytostome very simple without any oral basket, toxicyst lacking Family HOLOPHRYIDAE
- 6(3) Cytostome usually slit-like, toxicysts present and localised typically in or near oral area
- 7(8) Body elongated, egg shaped, with narrow drawn out and obliquely branched anterior end
 Family ENCHEYLIDAE
- 8(7) Body usually flask or sack-shaped, flattened, with truncate anterior end
Family SPATHIDIIDAE

Family HOLOPHRYIDAE

Genus *Holophrya* Ehrenberg

Body oval, globose or ellipsoidal, ciliation uniform, sometimes longer cilia at anterior or posterior end; cytostome apical, round and simple; cytopharyngeal apparatus of simple rhabdos type.

1. *Holophrya nairi* sp. nov.
 (Fig. 1)

Diagnosis : Body globose to oval, dimensions 130-148.2 μm x 95.5 - 107 μm ; ciliation uniform, disposed along longitudinal striae; cytostome small, apical and round, without any cytopharynx, macronucleus spherical, located at middle to posterior half of the body; micronucleus small, elliptical, lying lateral to macronucleus; contractile vacuole single and terminal; cytoplasm heavily laden with round or oval haematoxyphilic reserve particles.

Type material :

Holotype : 1 ex., on slide (Reg. No. Pt. 2118), locality : Chilka Lake (St. No. 32, Grid No. O₉), between Satpara and Gambhari), Orissa, India ; date of collection : 23.ix.1987; Coll. A.K. Das.

Paratypes : i) 1 ex., on slide (Reg. No. Pt. 2119); locality : Chilka Lake (Stn. No. 6 near Khallikote Range); date of collection : 13.ix.1987; Coll. A.K. Das; ii) 1 ex., on slide (Reg. No. Pt. 2120); locality: Chilka Lake (Stn. No. 13, Grid No. H₉, Nalbano island); date of collection : 11.ix.1987; Coll. A.K. Das. All the type material are deposited with the Zoological Survey of India, Calcutta.

Remarks : Amongst the congeners the present species *Holophrya nairi* sp. nov. resembles only *H. atra* in having spherical macronucleus and numerous reserve particles in the cytoplasm. But, it differs from the latter in body shape, larger body length and disposition of micronucleus. Further, *H. atra* is a freshwater species while the present one has been collected in brackishwater with salinity ranging from 4.1 to 13.8 p.p.t.

It is worth mentioning here that 4 species of *Holophrya*, viz., *H. annandalei*, *H. bengalensis*, *H. lateralis* and *H. simplex* have so far been reported from India. All of them were collected from freshwater environs. The present brackishwater inhabiting species is conveniently distinguishable from them in having large number of haematoxynophilic reserve particles in cytoplasm. The present species is also quite distinct from the above mentioned four species in general shape, dimensions and shape of the macronucleus. The specific name of the present species is given after the name of Shri K.N. Nair, ex Scientist, Zoological Survey of India, who has contributed much in the field of taxonomy of freeliving ciliates in India.

Family PRORODONTIDAE

Key to the genera

- 1(2) Uniform ciliation throughout the body, oral basket made up of double trichites, cytostome not surrounded by heavier cilia Genus *Prorodon*
- 2(1) Ciliation uniform but posterior region may be without cilia; cytostome surrounded by a ring of heavier cilia, oral basket not visible Genus *Urotricha*

Genus *Prorodon* Ehrenberg

Key to the species

- 1(2) Body oval or almost oval, with both anterior and posterior ends rounded; mouth polar followed by oral basket, extending about one-third the distance from anterior end; salt water species *P. marinus*
- 2(1) Body oval or ovoid, mouth polar to subpolar, oral basket extending about one-fourth the distance from anterior end; freshwater species
- 3(4) Body oval, narrower posteriorly, cytoplasm whitish, contractile vacuole located at posterior end *P. discolor*

- 4(3) Body ovoid, both anterior and posterior ends rounded, cytoplasm not whitish; contractile vacuole terminal *P.teres*

2. *Prorodon discolor* (Ehrenberg)

(Fig.2)

1835. *Holophrya discolor* Ehrenberg, *Abh. preuss. Akad. Wiss* (1833), p. 251.

1930. *Prorodon discolor* : Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pl. 18, p. 76.

Material examined : 4 exs., Stn. 13 & 14, around Nalbano island (Grid No. H₉ and between Grid Nos. I₁₀ & I₁₁), 12.IX. 1987. Coll. A.K. Das.

Diagnosis : Body oval, narrower posteriorly, dimensions 165.6 - 182 μm X 103.5 - 120 μm ; mouth polar, pharyngeal basket conical, straight, with distinct trichites, extending about one-fourth the distance from anterior end; cytoplasm whitish; macronucleus single, round or short-ellipsoid with hemispherical micronucleus; contractile vacuolate single and located at the posterior end.

Distribution : India : Orissa (first record); West Bengal.

Remarks : It usually occurs in freshwater. But, in the present case it has been collected from the Chilka waters having salinity ranging from 13 p.p.t. to 15 p.p.t.

3. *Prorodon marinus* Claparede & Lachmann

(Fig. 3)

1858. *Prorodon marinus* Claparede & Lachmann, *Etudes sur les Infusoires et les Rhizopodes* : Geneva.

1930. *Prorodon marinus* : Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch), Jena, pt. 18, p. 73.

Material examined : 1 ex., near Kaluparaghat, 10.VI.1967, Coll. K.N. Nair; 6 exs., Stn. No. 25, near Kaluparaghat (Grid No. M₁₇), 20.IX.1987, Coll. A.K. Das.

Diagnosis : Body more or less oval with anterior end truncate and posterior end rounded; dimensions 145 - 190.4 μm X 82.8 - 93.1 μm , mouth polar; oral basket extending about one-third the length of the body; macronucleus round with a single micronucleus.

Distribution : India : Orissa.

Remarks : It is a marine species. However, the present material has been collected from the brackish water of the Chilka with salinity 5 p.p.t.

4. *Prorodon teres* Ehrenberg

(Fig. 4)

1838. *Prorodon teres* Ehrenberg, *Die Infusionsthierchen als vollkommene Organismen*, Leipzig, p. 316.

1930. *Prorodon teres* : Kahl, *Urtiera oder Protozoa* (in Dahl's & Tierwelt Dtsch.), Jena, pt. 18, p. 80.

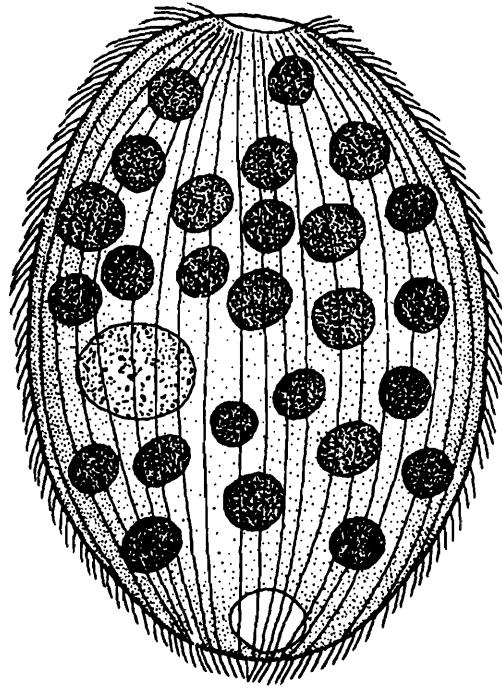


Fig. 1. *Holophrya nairi* sp. nov.

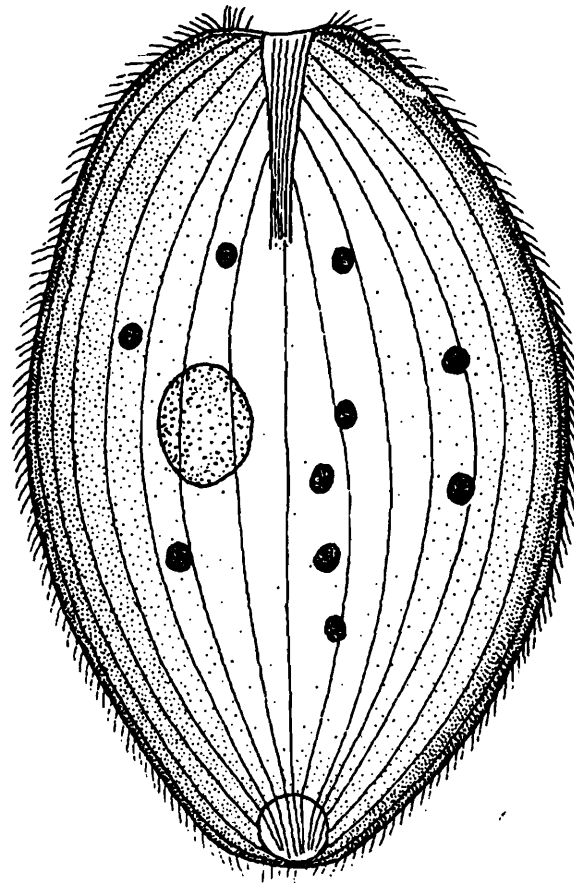


Fig. 2. *Prorodon discolor* (Ehrenberg)

Material examined : 1 ex., Stn. 25, near Kaluparaghat, 18.IX.1987, Coll. A.K. Das; 3 exs., Stn. 27, near Satpara (Grid No. 0₈), 21.IX.1987, A.K. Das; 1 ex., Stn. No. 32, between Satpara and Gambhari (Grid No. 0₉), 23.IX.1987, A.K. Das.

Diagnosis : Body ovoid, both anterior and posterior ends considerably round, dimensions 114.7-134.5 μm X 58.5-70 μm ; mouth polar, pharyngeal basket slightly conical with trichites, extending about one-fourth distance from anterior end; macronucleus spherical with single micronucleus; contractile vacuole single and terminal.

Distribution : India : Orissa (first record) and West Bengal.

Remarks : It is a freshwater species and collected from Chilka waters having salinity 0.7-3 p.p.t.

Genus *Urotricha* Claparede & Lachmann

Key to the species

- 1(2) Body slender, ovoid and somewhat asymmetrical in shape *U. discolor*
 2(1) Body symmetrical and globular in shape *U. globosa*

5. *Urotricha discolor* Kahl (Fig. 5)

1930. *Urotricha discolor* Kahl, *Urtiera oder Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 18, p. 59.

Material examined : 2 exs., Stn. 12, near Parikud and Krishnaprasad Garh (Grid No. F₈), 10.IX.1987, Coll. A.K. Das.

Diagnosis : Body slender, distinctly ovoid and somewhat asymmetrical when seen in living condition; dimensions 25-40 μm X 15-20.5 μm ; ciliation uniform excepting posterior region of the body which lacks cilia but possesses one long caudal cilium; macronucleus spherical; contractile vacuole single and posterior.

Distribution : India : Orissa (first record); also first record from India.

Remarks : This species has been collected from Chilka waters having salinity 13.3 p.p.t.

6. *Urotricha globosa* Schewiakoff (Fig. 6)

1893. *Urotricha globosa* Schewiakoff, *Bull. Soc. nat. Moskau*, 1.

1930. *Urotricha globosa*: Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 18, p. 59.

Material examined : 20 exs., Satpara (near Stn. 27), 12.IV.1969, Coll. K.N. Nair.

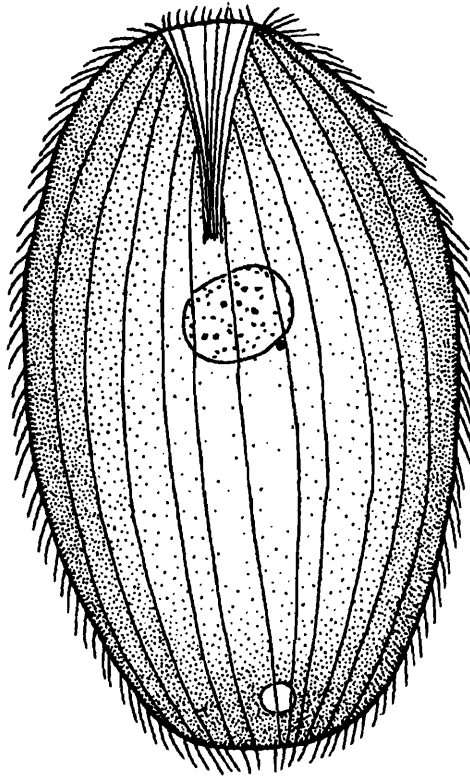


Fig. 3. *Prorodon marinus* Claparede & Lachmann

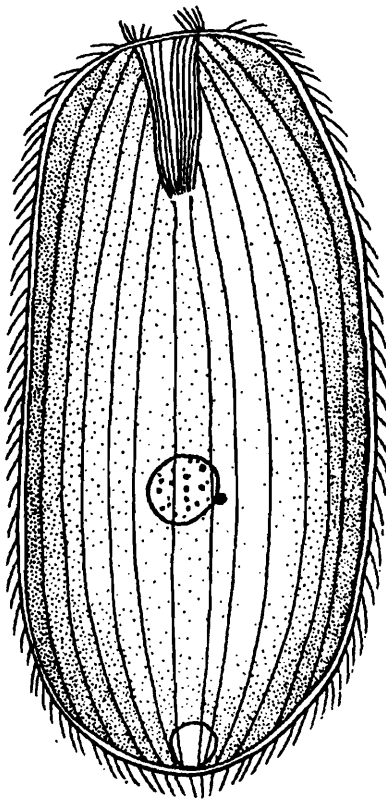


Fig. 4. *Prorodon teres* Ehrenberg

Diagnosis : Body globular, symmetrical, dimensions 24.8-29 μm X 12-21.6 μm ; other characteristic features as in *U. discolor*.

Distribution : India : Orissa and Andaman and Nicobar islands; in brackish water.

Family COLEPIDAE

Genus *Coleps* Nitzsch

Body barrel-shaped with regularly arranged ectoplasmic plate; anterior end truncate, posterior end rounded often with spinous projections; cytostome apical, surrounded with slightly larger cilia.

7. *Coleps tessellatus* Kahl (Fig. 7)

1930. *Coleps tessellatus* Kahl, *Arch. Protistenk.*, 71.

Material examined : Sev. exs., Stn. 3, near Brahmandao (Grid No. C₂), 4.IX.1987, Coll. A.K. Das.

Diagnosis : Body barrel-shaped, somewhat asymmetrical, anterior margin denticulate; dimensions 68.2-80 μm X 28.5-31 μm , armoured with 22-25 ectoplasmic plates, left margin of the posterior end provided with 3 spinous projections, one long caudal cilium present.

Distribution : India : Orissa (first record); also first record from India.

Remarks : It is a marine water species and collected from Chilka waters having salinity 13.5 p.p.t.

Family ENCHELYIDAE

Key to the genera

- 1(2) Body cylindrical, spindle or flask-shaped with a long contractile proboscis.. Genus *Lacrymaria*
 2(1) Body elongate, flattened, flexible, ribbon-like, without any contractile proboscis
 Genus *Trachelophyllum*

Genus *Lacrymaria* Ehrenberg

Key to the species

- 1(2) Neck very long and highly contractile *L. olor*
 2(1) Neck medium to short, sometimes not appreciably contractile
 ..
 3(4) Neck with 4-5 annulations *L. elegans*

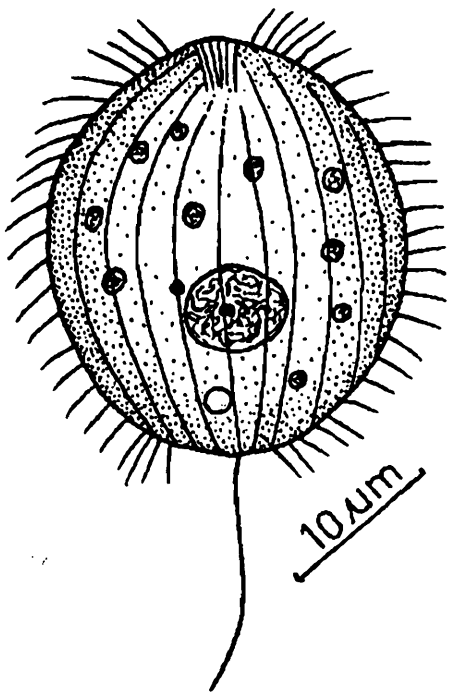


Fig. 5. *Urotricha discolor* Kahl

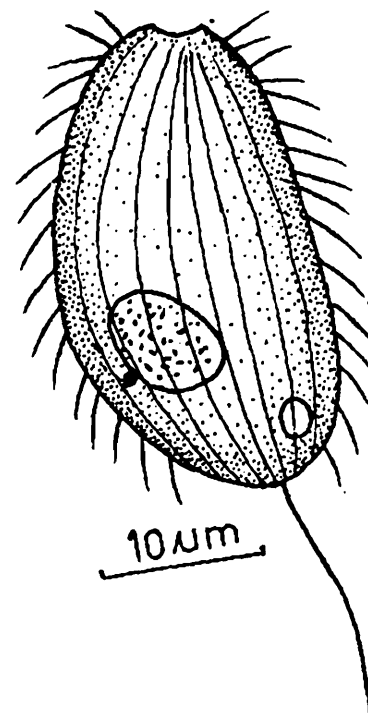


Fig. 6. *Urotricha globosa* Schewiakoff

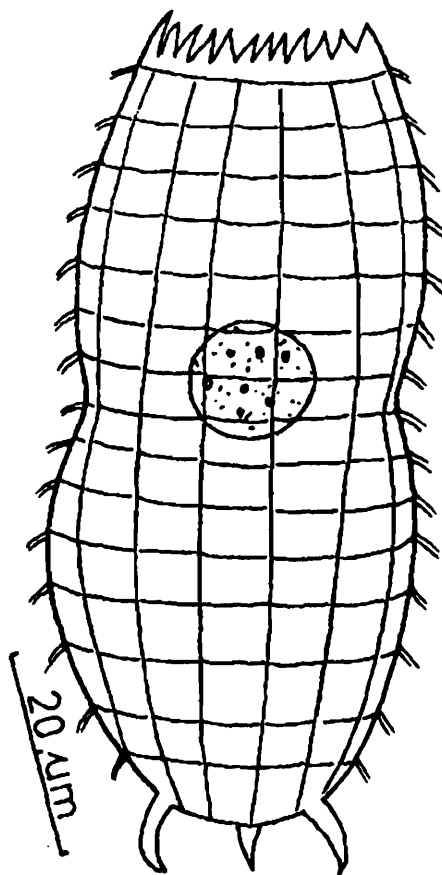


Fig. 7. *Coleps tessellatus* Kahl

- 4(3) Neck without any annulation
- 5(6) Body comparatively large 120 μm X 31 μm with bluntly rounded posterior end, neck distinctly extensible *L. coronata*
- 6(5) Body comparatively small, 99.4 μm X 32.1 μm with short and blunt posterior end, neck not appreciably contractile *L. salinarum*

8. *Lacrymaria coronata* Claparede & Lachmann

(Fig. 8)

1858. *Lacrymaria coronata* Claparede & Lachmann, *Etudes sur les Infusoires et les Rhizopodes*, Geneve.

1930. *Lacrymaria coronata* : Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch), Jena, pt. 18, p. 95.

Material examined : 1 ex., Stn. 12, near Parikud and Krishnaprasad Garh (Grid No. F₈), 27.IX.1985, Coll. A.K. Das; 2 exs., Stn. 27, near Satpara (Grid No. O₈), 21.IX.1987, Coll. A.K. Das.

Diagnosis : Body large, 120 μm x 31 μm , usually with bluntly rounded posterior end; neck short, slightly raised, distinctly extensible and separated from the body by a deep cleft; macro-nucleus elongate, contractile vacuole single and terminal.

Distribution : India : Orissa (first record); also first record from India.

Remarks : This species occurs in fresh and brackish waters and has been collected from Chilka waters with salinity ranging from 4 to 7 p.p.t.

9. *Lacrymaria elegans* Engelmann

(Fig. 9)

1862. *Lacrymaria elegans* Engelmann, *Zeitschr. f. wiss zool.*, 11.

1930. *Lacrymaria elegans* : Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.) Gena, pt. 18, p. 90.

Material examined : 3 exs., Satpara, 3.i.1971, coll. K. N. Nair; 2 exs., Stn. 27, near Satpara (Grid No. O₈), 21.IX.1987, Coll. A. K. Das.

Diagnosis : Body cylindrical measuring 70-82.8 μm X 24.8-41.4 μm in dimensions; neck contractile with 4-5 annulations; macronucleus elliptical, contractile vacuole single and terminal.

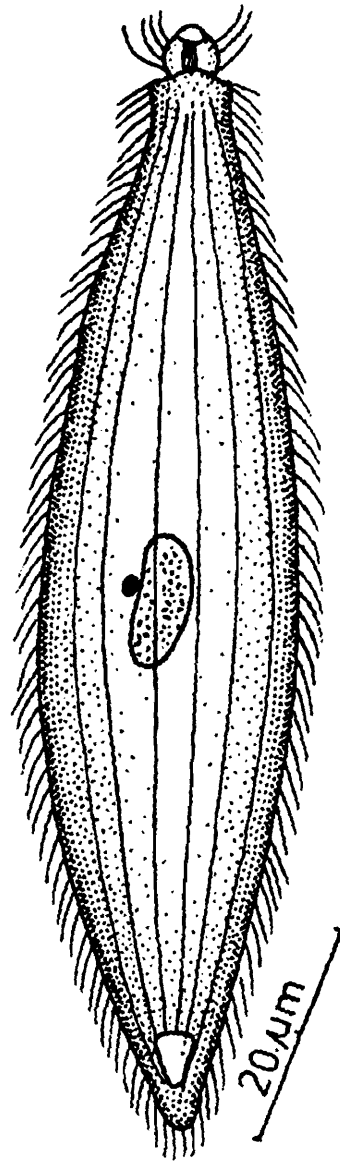


Fig. 8. *Lacrymaria coronata* Claparede & Lachmann

Distribution : India :Orissa.

Remarks : It is a freshwater species and collected from Chilka waters with salinity ranging from 2 to 4 p.p.t.

10. *Lacrymaria olor* (Muller)

(Fig.10)

1786. *Vibrio olor* Muller, *Animalc. Infusor Fluvial et Marina*, Havnae et Lipsae, p. 75.

1832. *Lacrymaria olor* Ehrenberg, *Abh. Preuss. Akad. Wiss.*, Berlin, p. 105.

Material examined : 1 ex., Satpara, 27.XII.1970, Coll. K.N. Nair.

Diagnosis : Body elongate, posterior portion cylindrical with pointed posterior end; neck very long, highly contractile; dimensions 161.5 μm X 29 μm ; oral cone well developed; macronucleus with two rounded parts united together; contractile vacuole two in number and located at either end of the cylindrical body portion.

Distribution : India : Orissa, Andhra Pradesh, Andaman and Nicobar islands, Rajasthan and West Bengal.

Remarks : This species usually occurs in freshwater.

11. *Lacrymaria salinarum* Kahl

(Fig. 11)

1928. *Lacrymaria salinarum* Kahl, *Arch. Hydrobiol.*, 19.

1930. *Lacrymaria salinarum* Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 18, p. 94.

Material examined : 1 ex., around Bird Island (Grid No. A₂), 30.V.1969, Coll. K.N. Nair.

Diagnosis : Body slender, spindle shaped with short and blunt posterior end; dimensions 99.4 μm X 32.1 μm ; neck short and not appreciably contractile; macronucleus ellipsoidal; contractile vacuole single and located near the posterior end.

Distribution : India : Orissa.

Remarks : It is a saltwater species.

Genus *Trachelophyllum* Claparede and Lachmann

12. *Trachelophyllum clavatum* Stokes

(Fig. 12)

1886. *Trachelophyllum clavatum* Stokes, *Ann. Mag. nat. Hist.* (5) 16, p. 98.

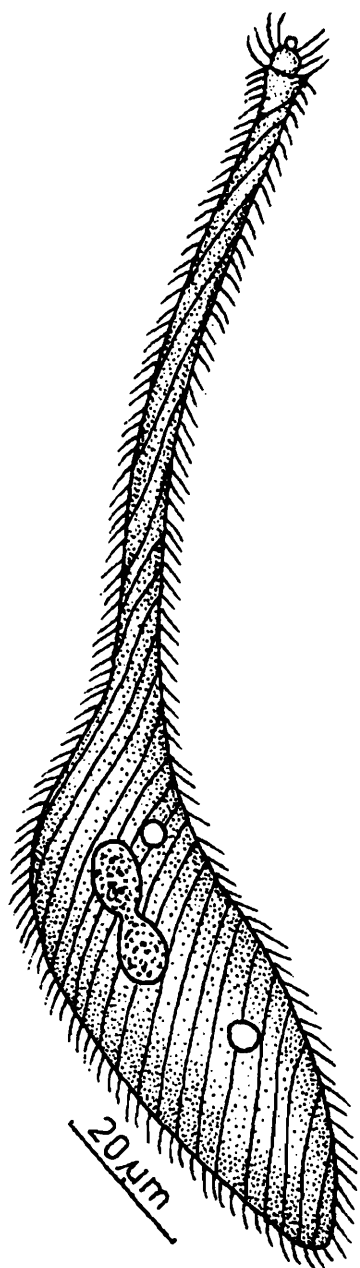


Fig. 10. *Lacrymaria olor* (Muller)

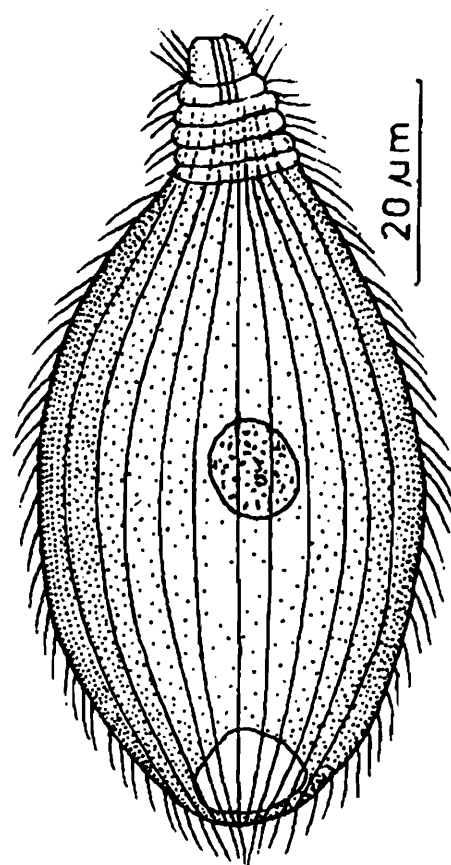


Fig. 9. *Lacrymaria elegans* Engelmann

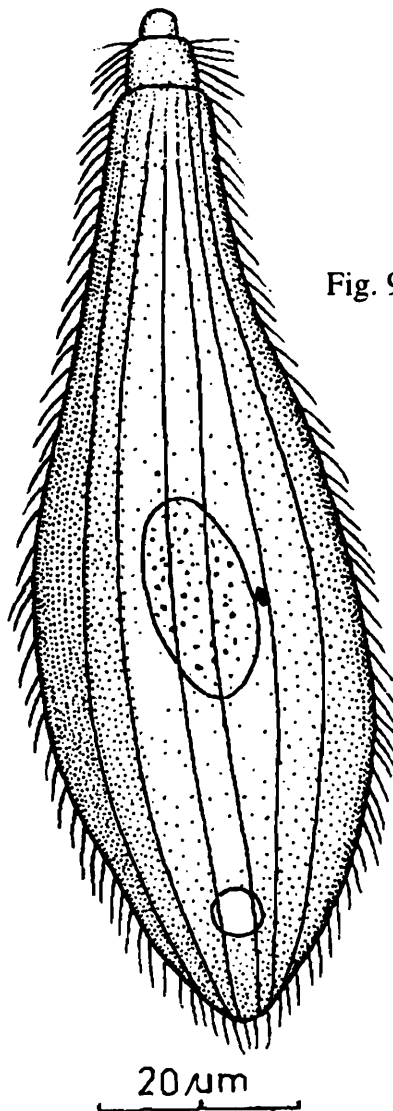


Fig. 11. *Lacrymaria salinarum* Kahl

1930. *Trachelophyllum clavatum* : Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.,) Jena, pt. 18, p. 116.

Material examined : 4 exs., Khallikote, 20.II.1960, Coll. K.N. Nair; 2 exs., Stn. 18, near Balugaon, 13.IX.1987, Coll. A.K. Das.

Diagnosis : Body flexible, ribbon-like without any gelatinous envelope; dimensions 103.5-136.6 μm X 16.6-29 μm ; cytopharynx narrow with trichocysts; macronucleus single, elongated; contractile vacuole single and terminal.

Distribution : India : Orissa.

Remarks : It is a freshwater species but collected from brackishwater of the Chilka.

Family SPATHIDIIDAE

Under this family a single genus *Spathidium* has been collected from the Chilka Lake.

Genus *Spathidium* Dujardin

Cytostome slit-like and occupying anterior end almost completely, contractile vacuole posterior.

13. *Spathidium fossicola* Kahl (Fig. 13)

1933. *Spathidium fossicola* Kahl, *Arch. Protostank.*,

Material examined : 5 exs., near Khallikote, 2.VI.1969, Coll. K.N. Nair; 5 exs., Stn. 8, near Khallikote range and Gopakuda (Grid No. B₃), 7.IX.1987, A.K. Das.

Diagnosis : Body flask-shaped and contractile, anterior end truncated, dimensions 74.5-103.5 μm X 33.1-41.4 μm ; cytostome slit-like, located apically; macronucleus horse-shoe shaped; contractile vacuole single and posteriorly located.

Distribution : India : Orissa.

Remarks : It is a salt water species and collected from the Chilka having salinity 11 p.p.t.

Order PLEUROSTOMATIDA

Under this order a single family Amphileptidae with a single genus *Loxophyllum* has been collected so far from the Chilka Lake.

Family AMPHILEPTIDAE

Body lanceolate and laterally compressed, slit-like cytostome located at the convex ventral border of the anterior part of the body.

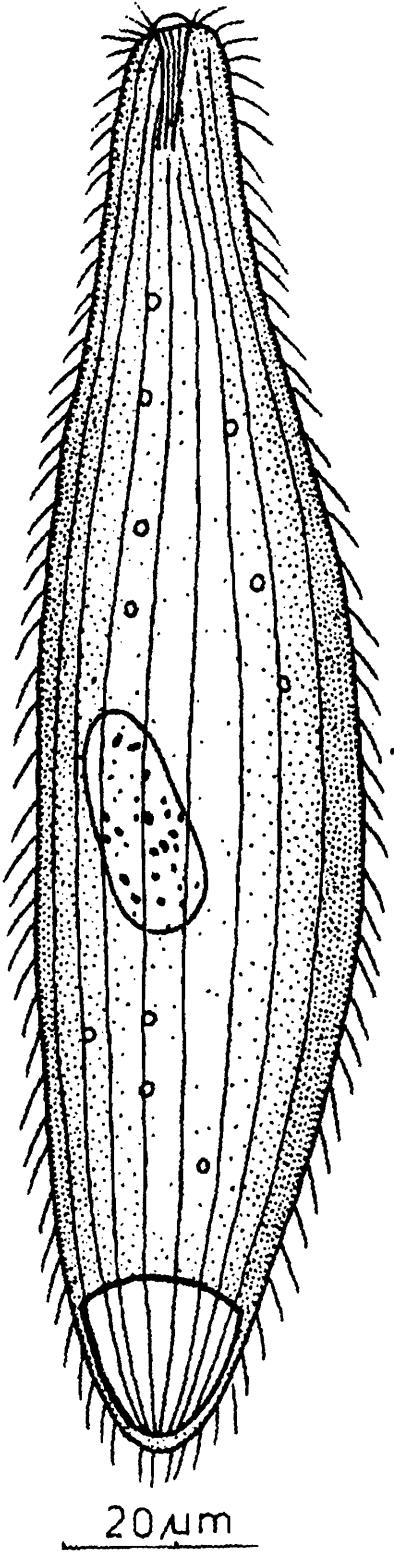


Fig. 12. *Trachelophyllum clavatum* Stokes

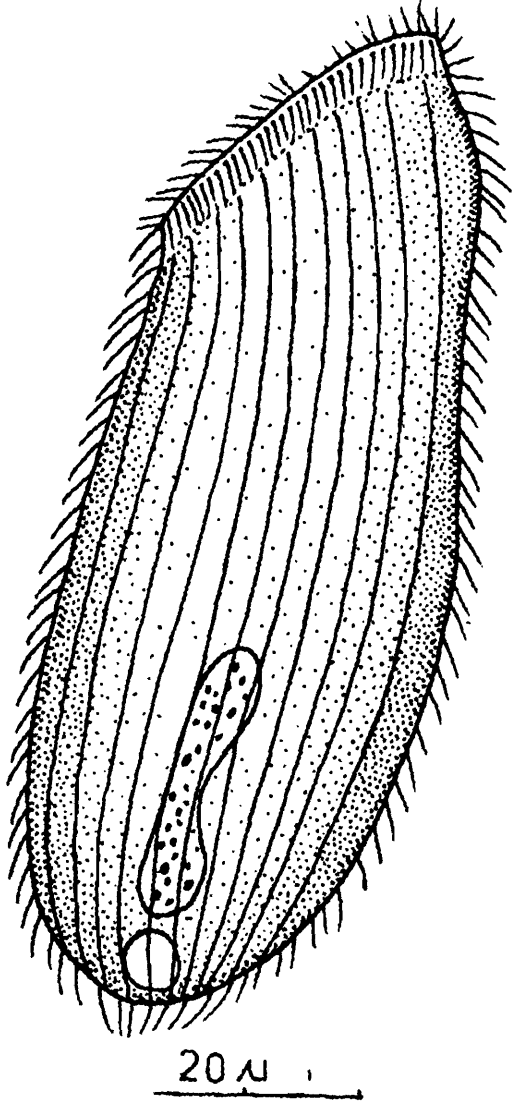


Fig. 13. *Spathidium fossicola* Kahl

Key to the genera

- 1(2) Body leaf-like, flattened, contractile and pointed at both ends; presence of hyaline border on ventral side reaching posterior end, bearing trichocysts; macronucleus single or moniliform Genus *Loxophyllum*
- 2(1) Body elongated, often curved in 'S'-shaped manner with a neck at anterior end; body without trichocyst and without any hyaline border; macronucleus bipartite Genus *Litonotus*

Genus *Loxophyllum* Dujardin

Key to the species

- 1(2) Macronucleus single *L. uninucleatum*
- 2(1) Macronucleus two to many
- 3(4) Body shape variable, large in size, macronuclei several *L. meleagris*
- 4(3) Body lanceolate, medium to small in size, macronuclei two to four in number
- 5(6) Macronuclei two in number *L. grande*
- 6(5) Macronuclei four in number *L. setigerum*

14. *Loxophyllum grande* (Entz)

(Fig. 14)

1879. *Lionotus grande* Entz, *Termeszetr. Fuz*, 3, p. 33.1931. *Loxophyllum grande* Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.), Gena, pt. 21, p. 197.

Material examined: 1 ex., Gangadharpur, 18.VI.1969, Coll. K.N. Nair; 1 ex., Stn. 6 near Khallikote (Grid No. B₅), 6.IX.1987, Coll. A.K. Das; 1 ex., Stn. 14, near Nalbano island (between Grid Nos. I₁₀ & I₁₁), 12.IX.87, Coll. A.K. Das; 3 exs., Stn. 17, near Barkul, 12.IX.1987, Coll. A.K. Das; 2 exs., Stn. 21 (Grid No. I₁₃), 15.IX.1987, Coll. A.K. Das, 4 exs., Stn. 22 (Grid No. J₁₄), 16.IX.87, Coll. A.K. Das.

Diagnosis: Body lanceolate, flattened, ventral side with hyaline border bearing trichocysts; dimensions 151-172.3 µm X 42-54.4 µm; macronuclei spherical, two in number; contractile vacuoles several and lying in the arched portion of the body.

Distribution: India: Orissa.

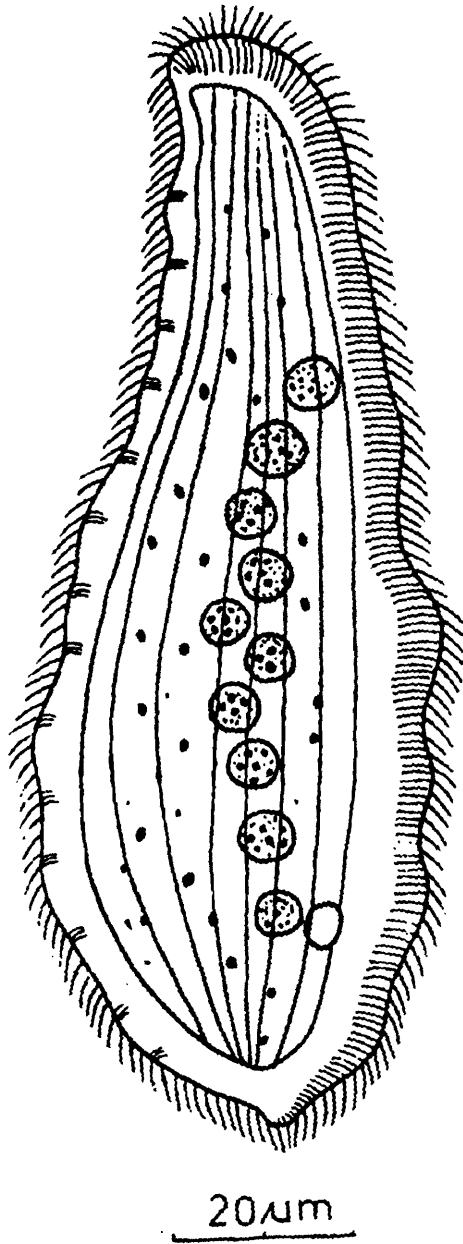


Fig. 15. *Loxophyllum meleagris* Dujardin

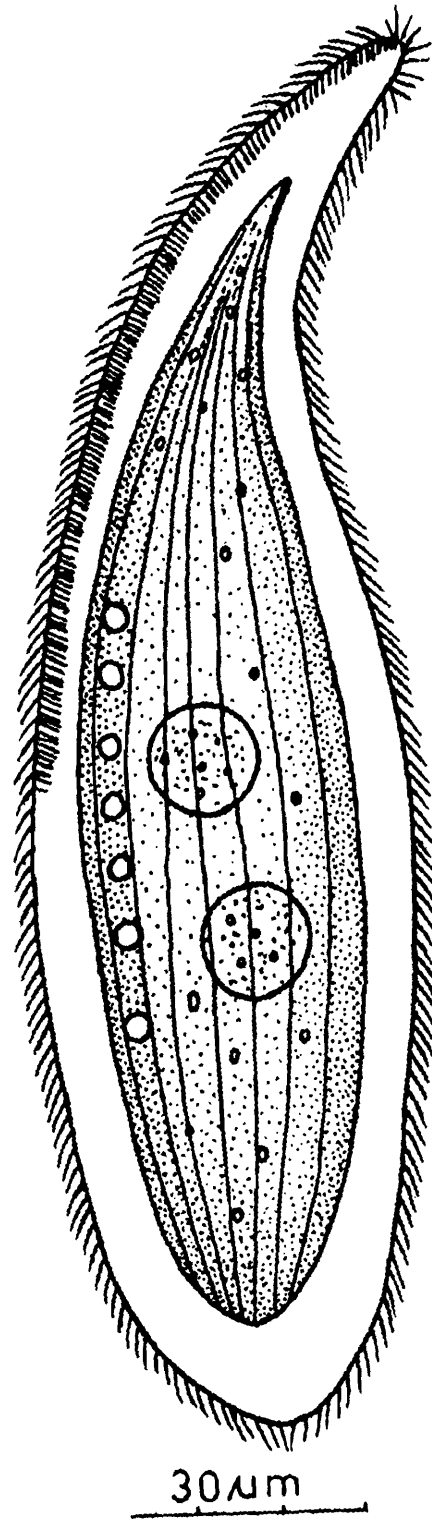


Fig. 14. *Loxophyllum grande* (Entz)

Remarks : It occurs in brackish and marine waters. The present material has been collected from the Chilka having salinity 10-13 p.p.t.

15. *Loxophyllum meleagris* Dujardin
(Fig. 15)

1841. *Loxophyllum meleagris* Durardin, *Histoire naturelle des zoophytes infusoires*, Paris.

1931. *Loxophyllum meleagris* : Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 21, p. 202.

Material examined : 1 ex., Stn. 25, near Kaluparaghat, 18.IX.87, Coll. A.K. Das.

Diagnosis : Body shape variable between lanceolate and broad lamelliform, dimensions 178 μm X 60 μm ; macronuclei several; contractile vacuole subterminal with distinct canal, adjacent to dorsal edge.

Distribution : India : Orissa (first record); also first record from India.

Remarks : This is a freshwater species, The present material is also collected from Chilka waters with salinity less than 1 p.p.t.

16. *Loxophyllum setigerum* Quennerstedt
(Fig. 16)

1867. *Loxophyllum setigerum* Quennerstedt, *Acta. Univ. lund.*, 4, p. 1.

1931. *Loxophyllum setigerum* : Kahl, *Urtiere oder Potozoa* (in Dahl's Tierwelt Dtsch), Jena, pt. 21, p. 201.

Material examined : 2 exs., Khallikote (near Stn. 6), 19. XII.1970, Coll. K.N. Nair; 1 ex., Stn. 1, Rambha Bay (near Grid No. A₂), 4.IX.1987, Coll. A.K. Das.

Diagnosis : General feature as in *L. grande* but, body leaf-shaped; dimensions 95.2-155.2 μm x 35.5 x 53.8 μm ; macronucleus 4 in number; contractile vacuoles several and arranged in a row.

Distribution : India : Orissa.

Remarks : This species inhabits brackish and marine water. In the Chilka it has been collected from brackish water having salinity 15 p.p.t.

17. *Loxophyllum uninucleatum* Kahl
(Fig. 17)

1928. *Loxophyllum uninucleatum* Kahl, *Arch. Hydrobiol.*, 19.

Material examined : 1 ex., near Bird Island, 31.V.1969, Coll. K.N. Nair; 2 exs., Stn. No. 9 (Grid No. F₆), 7.IX.1987, Coll. A.K. Das; 1 ex., Stn. No. 11 (Grid No. E₇), 8.IX.1989, Coll. A.K. Das.

Diagnosis : General feature as in *L. grande* but considerably small in size with dimensions 60-78.6 μm X 22-28.9 μm ; macronucleus round; contractile vacuole single and terminal.

Distribution : India : Orissa.

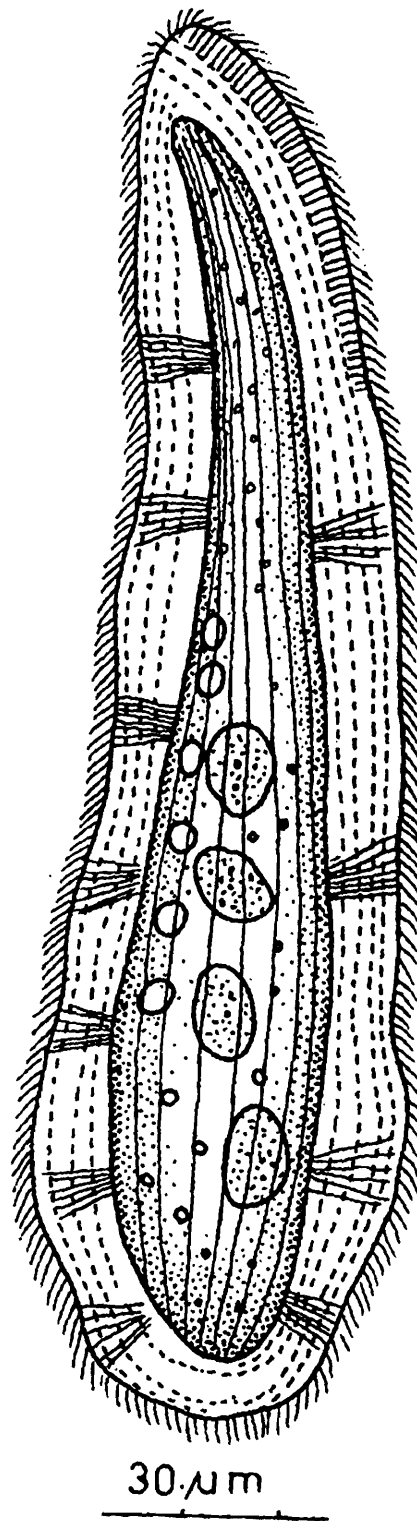


Fig. 16. *Loxophyllum setigerum* Quennerstedt

Remarks : It is a marine species and collected from Chilka waters with salinity 14-15 p.p.t.

Genus *Litonotus* Wrzesniowski

18. *Litonotus fasciola* (Ehrenberg)
(Fig. 18)

1838. *Amphileptus fasciola* Ehrenberg, *Die Infusionsthierchen als Vollkommene Organismen*, Leipzig, p. 356.
1931. *Litonotus fasciola* : Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 21, p. 194.

Material examined : 2 exs., Stn. 4, near Honeymoon island (between Grid Nos. A₃ & B₃), 5.IX.1987, Coll. A.K. Das; Sev. exs., Stn. 5, near Somolo island (between Grid Nos. C₃ & C₄), 5.IX.1987, Coll. A.K. Das.

Diagnosis : Body lanceolate, non-contractile, neck not always sharply distinguished from the body; 80-90 µm in length; macronucleus subcentral consisting of two spherical lobes united to one another by a thread; contractile vacuole single and located near the posterior end of the body.

Distribution : India : Orissa (first record); Jammu & Kashmir, Maharastra, Rajasthan and West Bengal.

Remarks : This species has earlier been reported from fresh and brackish water. The present material has been collected from Chilka water having salinity 13-14 p.p.t.

Order KARYORELICTIDA

Key to the families

- 1(2) Body fragile, usually extremely elongate, cytostome apical.... Family TRACHELOCERCIDAE
2(1) Body large, elongate, highly contractile, cytostome ventral near anterior end of the body
..... Family GELEIIDAE

Family TRACHELOCERCIDAE

Genus *Trachelocerca* Ehrenberg

Elongated, more or less extensible with drawn out anterior end; cytostome apical surrounded by a circlet of cilia; no neck or any constriction marking off anterior portion.

19. *Trachelocerca phoenicopterus* Cohn
(Fig. 19)

1866. *Trachelocerca phoenicopterus* Cohn, *Z. Wiss. Zool.*, 16, p. 253.
1930. *Trachelocerca phoenicopterus* : Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 18, p. 118.

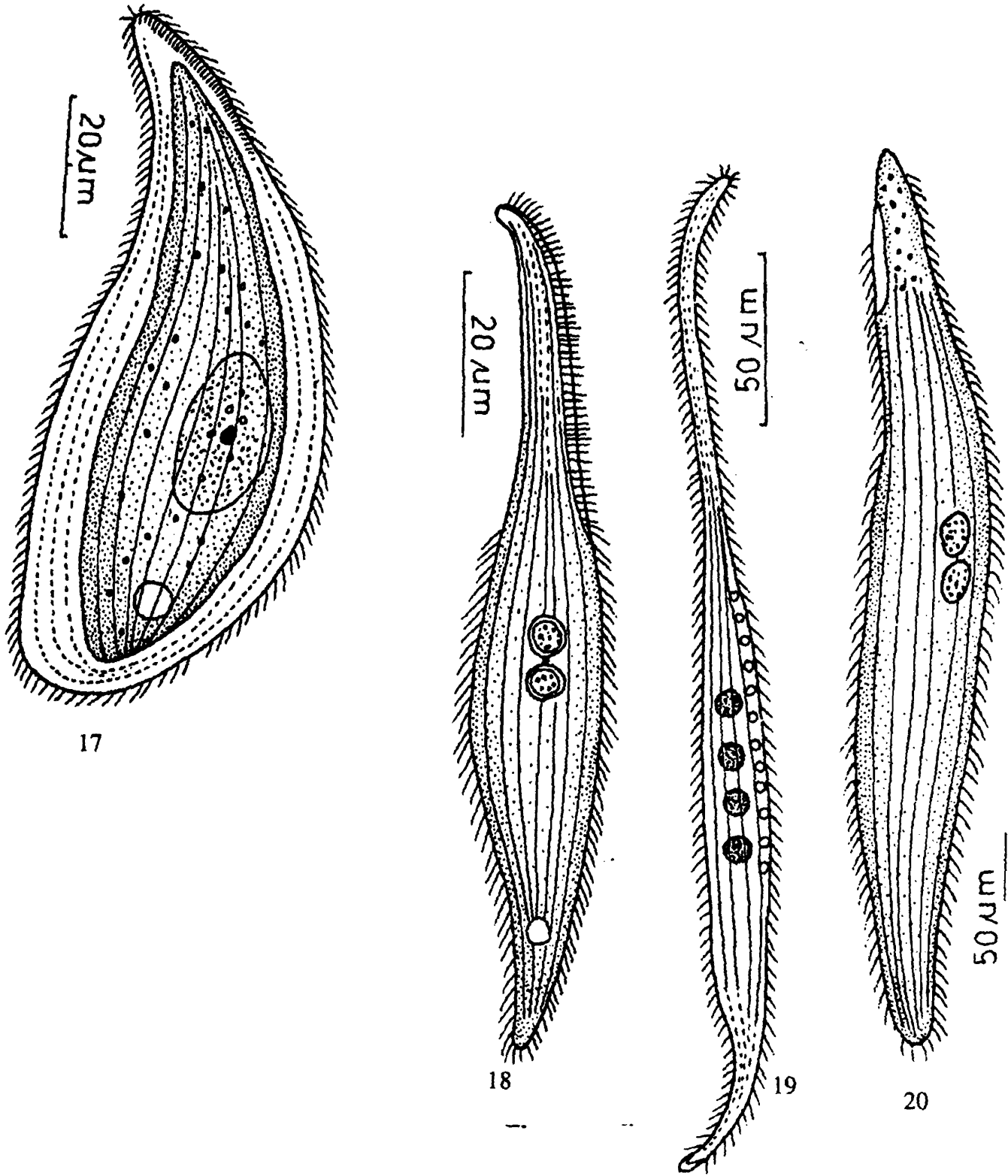


Fig. 17. *Loxophyllum uninucleatum* Kahl

Fig. 18. *Litonotus fasciola* (Ehrenberg)

Fig. 19. *Trachelocerca phoenicopterus* Cohn

Fig. 20. *Geleia nigriceps* Kahl

Material examined : 1 ex., Barkuda, 29.V.1969, Coll. K.N. Nair; 2 exs., Stn. 5, near Somolo island (between Grid Nos. C₃ & C₄), 5.IX.1987, Coll. A.K. Das.

Diagnosis : Body elongate, extensible and contractile with a distinct tail, 300-350 μm long; cytostome located at the anterior end surrounded by a ridge; both cytostome and cytopharynx with trichocysts; macronucleus four in number and arranged radially; six compact micronuclei; contractile vacuoles several and arranged in a row.

Distribution : India : Orissa, Andhra Pradesh, Andaman and Nicobar islands.

Remarks : It is a saltwater species. Present material has been collected from Chilka waters with salinity 14 p.p.t.

Family GELEIIDAE

Genus *Geleia* Kahl

Characteristic features are same as those of the family.

20. *Geleia nigriceps* Kahl
(Fig. 20)

1933. *Geleia nigriceps* Kahl, *Arch. Protistenk.*

Material examined : 1 ex., Satpara, 12.VI.1969, Coll. K.N. Nair; 2 exs., Stn. 33, Near Gambhari (Grid No. P₁₁), 23.IX.1987, Coll. A.K. Das.

Diagnosis : Body elongate, highly contractile, with uniform somatic ciliature; anterior end without any beak and anterior part filled with an aggregation of distinct black granules; dimensions 215.5-248 μm ; X 30-37.3 μm ; macronuclei two in number, more or less oval in shape and located near the middle of the body; contractile vacuole not seen.

Distribution : India : Orissa.

Remarks : This species occurs in brackish and marine water and has been collected from Chilka waters with salinity 4 p.p.t.

Order TRICHOSTOMATIDA

Family PLAGIOPYLIDAE

Cytostome located anteriorly and preceded by vestibulum, lined with distinctive ciliature, body dorsoventrally flattened with uniform ciliation.

Genus *Plagiopyla* Stein

Vestibulum a broad ventrally opened groove from which body ciliation begins; vestibular cilia

short excepting at anterior end where a tuft of longer cilia present.

Key to the species

- 1(2) Body reniform or ovoid, marginal elevation of vestibulum distinct *P. nasuta*
 2(1) Body oval, marginal elevation of vestibulum very feeble and sometimes not visible *P. ovata*

21. *Plagiopyla nasuta* Stein (Fig. 21)

1860. *Plagiopyla nasuta* Stein, *Sitz.Ber. Bohm. Ges. Wiss.*, Prague, p. 58.

1931. *Plagiopyla nasuta* : Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 21, p.264.

Material examined : 4 exs., Khallikote, 2.VI. & 4.VI.1969, Coll. K.N. Nair; 1 ex., Stn. 10 (between Grid Nos. D₇ & E₇), 8.IX.1987, Coll. A.K. Das; 1 ex., Stn. 11 (Grid No. E₇), 8.IX.1987, Coll. A.K. Das.

Diagnosis : Body reniform or ovoid, narrower anteriorly, dimensions 62.1 - 74.5 μm X 45.5 - 55.9 μm ; marginal elevation (beak) of vestibulum distinct; cytostome situated near median line at the end of peristome; macronucleus single and round; contractile vacuole single and terminal.

Distribution : India : Orissa and West Bengal.

Remarks : This species has so far been reported from both fresh and brackish water. The present material has been collected from the Chilka with salinity 15 p.p.t.

22. *Plagiopyla ovata* Kahl (Fig. 22)

1931. *Plagiopyla ovata* Kahl, *Urtiere oder Potozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 25, p. 265.

Material examined : 5 exs., Khallikote, 2.VI.1969, Coll. K.N. Nair; 3 exs., Stn. 2 (near Grid No. B₁), 4.IX.1987, Coll. A.K. Das; 2 exs., Stn. 33, near Gambhari (Grid No. P₁₁), 23.IX.1987, Coll. A.K. Das.

Diagnosis : Body oval, dimensions 80-93.1 μm X 61.2-68.3 μm ; marginal elevation of vestibulum very feeble and sometimes not visible; body margin nearly parallel; macronucleus single and oval; contractile vacuole not seen.

Distribution : India : Orissa.

Remarks : In India this species has so far been reported from the Chilka only with salinity ranging from 4 to 14 p.p.t.

Order NASSULIDA

Family NASSULIDAE

Ciliated all over the body but, body ciliation usually denser on ventral side than on dorsal one; hypostomal fringe short but multiple; cytopharyngeal apparatus prominent.

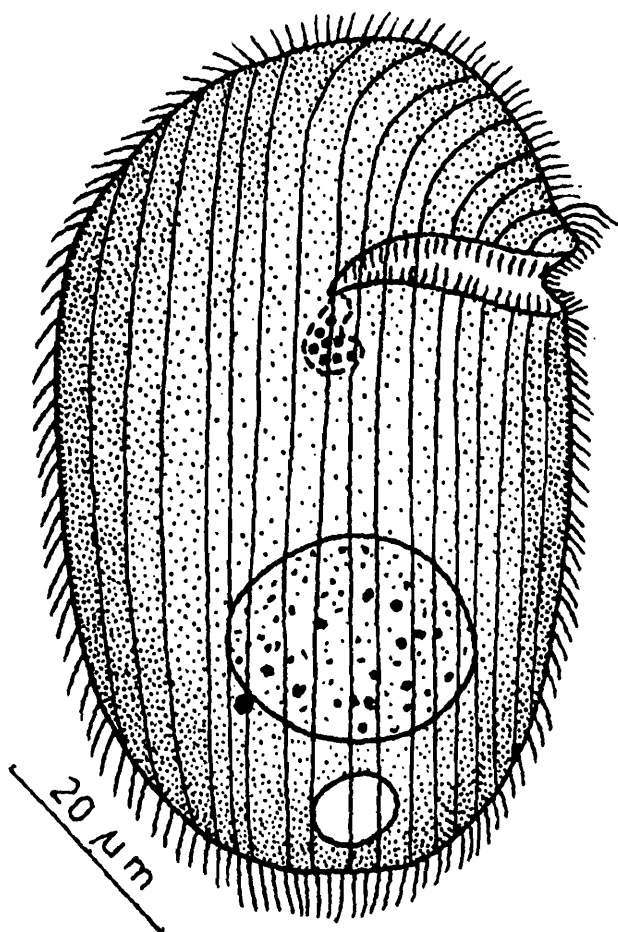


Fig. 21. *Plagiopyla nasuta* Stein

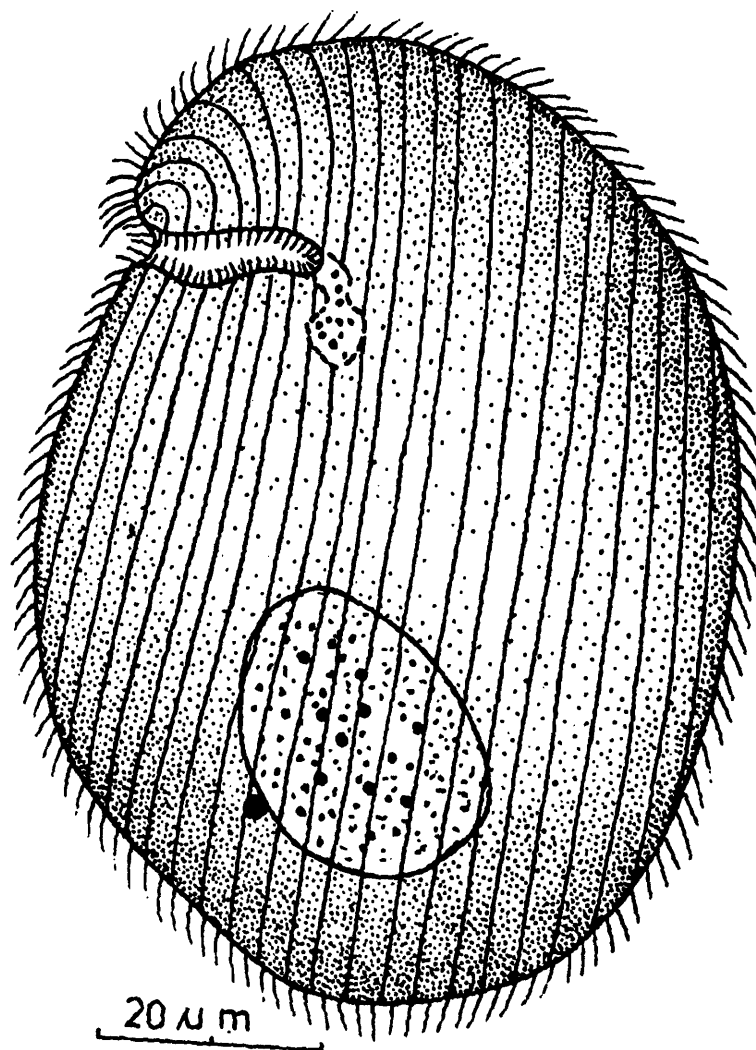


Fig. 22. *Plagiopyla ovata* Kahl

Genus *Nassula* Ehrenberg

Body oval to elongate with flat ventral surface and convex dorsal surface; cytostome provided with well developed trichites and located at about one-third to one-fourth of the length of the body from anterior end; macronucleus spherical or oval and centrally located.

Key to the species

- 1(2) Body broadly oval, a distinct curvature resembling beak present and bent to left near cytostome, anterior end somewhat broader than posterior one *N. ornata*
- 2(1) Body elongately ellipsoid and without any beak like structure, both anterior and posterior ends with more or less same width *N. notata*

23. *Nassula notata* (Muller)

(Fig. 23)

1786. *Leucophora notata* Muller, *Animalc. Infusoria fluviat. et Marina*., Havniae et Lipsiae.
 1911. *Nassula notata* Hamburger and Buddenbrock, *Nordische Ciliata* : Nord Plankton, Kiel.
 1931. *Nassula notata* : Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 21, p. 218.

Material examined : 3 exs., Stn. 25 near Kaluparaghat (Grid No. O₈), 18.IX.1987, Coll. A.K. Das; 2 exs., Stn. 26 (Grid No. N₁₇), 18.IX.1987, Coll. A.K. Das.

Diagnosis : Body elongately ellipsoid, dimensions 74.5-95.2 µm X 45.5 - 51.7 µm; both anterior and posterior ends with more or less same width; body without any bent to anterior left; cytoplasm bright red in colour; macronucleus elliptical; contractile vacuole two in number - one located near the middle of the body and the other subterminal in position.

Distribution : India : Orissa (first record); also first record from India.

Remarks : The present material closely resembles earlier descriptions of *N. notata* excepting that it possesses elliptical macronucleus (vs. round macrounclaus in earlier report). This is a brackish water species and collected from Chilka waters having salinity 3-4 p.p.t.

24. *Nassula ornata* Ehrenberg

(Fig. 24)

1833. *Nassula ornata* Ehrenberg, *Abh. Preuss. Akad. Wiss.*, Berlin, p. 169.

Material examined : 2 exs., Stn. 2 (near Grid No. B₁), 4.IX.1987, Coll. A.K. Das; 1 ex., Stn. 12, near Parikud (Grid No. F₈), 10.IX.1987, Coll. A.K. Das; 2 exs., Stn. 13 (Grid No. H₉) & Stn. 14 (between Grid Nos. I₁₀ & I₁₁), around Nalbano island, 12.IX.1987, Coll. A.K. Das; 1 ex., Stn. 18, near Balugaon, 13.IX.1987, Coll. A.K. Das; 2 exs., Stn. 28, (Grid No. R₉), 21.IX.1987, Coll. A.K. Das; Stn. 29 (between Grid Nos. T₁₀ & U₁₀), 21.IX.1987, Coll. A.K. Das.

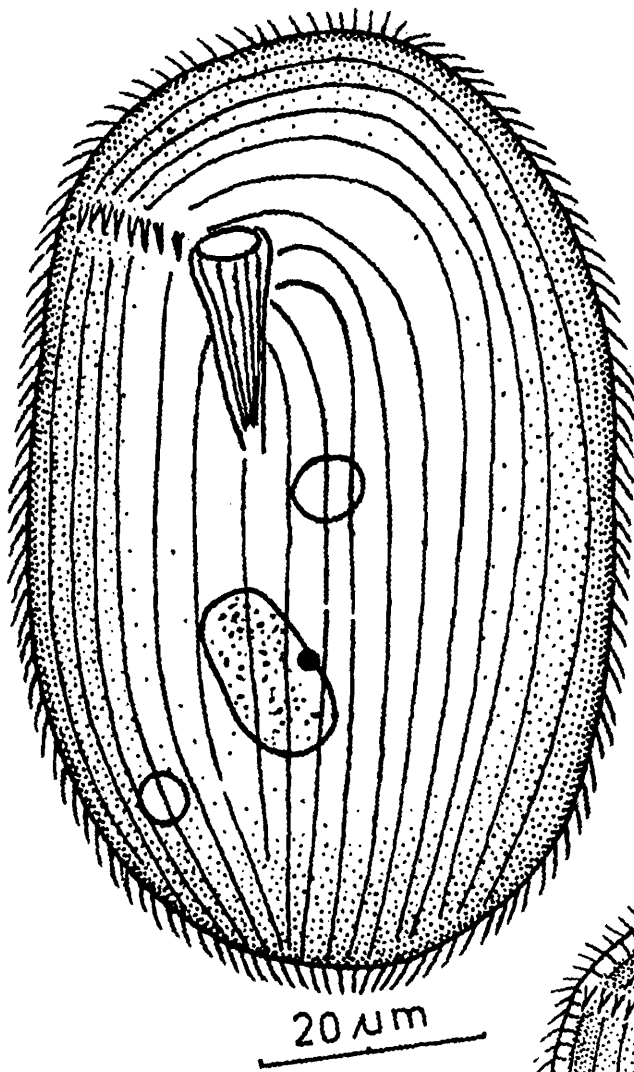


Fig. 23. *Nassula notata* (Muller)

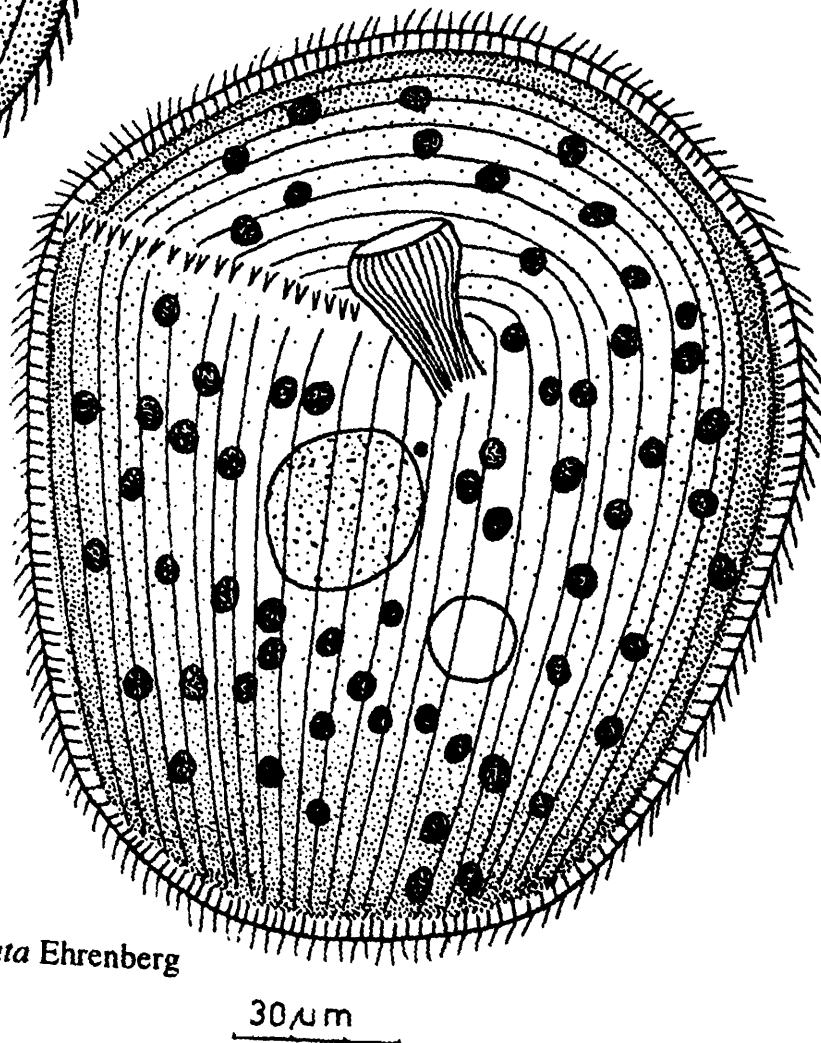


Fig. 24. *Nassula ornata* Ehrenberg

Diagnosis : Body broadly oval, anterior end broader than posterior one; demensions 155.2-194.6 μm X 118-140.8 μm ; body distinctly bent to the left near cytostome (resembling a beak) as seen in living condition; cytostome somewhat brownish green in colour; macronucleus round; contractile vacuole single and located little below the middle of the body.

Distribution : India : Orissa (first record); Rajasthan and West Bengal.

Remarks : This species has so far been reported from fresh water bodies of Rajasthan (Mahajan, 1965) and West Bengal (Das et al, 1993). But the present material has been collected from the brackish water of the Chilka with salinity ranging from 6 to 15 p.p.t.

Order CYRTOPHORIDA

Key to the families

- 1(4) Ventral ciliature thigmotactic, without any prominent specialised adhesive organellae, no style (spine) from the posterior end of the ventral surface.
- 2(3) Thigmotactic zone broad; body ovoid with a distinct anterior beak to the left.....
..... Family CHILODONELLIDAE
- 3(2) Thigmotactic zone localised, body ellipsoidal without beak
.....Family CHLAMYDODONTIDAE
- 4(1) Ventral ciliature not much specialised, definite adhesive organellae present, a style (spine) arising from posterior end of ventral surface Family DYSTERIIDAE

Family CHILODONELLIDAE

Genus *Chilodonella* Strand

25. *Chilodonella cucullulus* (Muller) (Fig. 25)

1773. *Kolpoda cucullulus* Muller, *Verminum terrest. et fluviatil s. animal infusor, etc., Havniae et Lipsiae*, p. 158.
1931 *Chilodonella cucullulus* Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.) Jena, pt.21, p.235.

Material examined : 2 exs., Kaluparaghat, 5.I.1971, Coll. K.N. Nair; 1 ex., Stn. 18, near Balugaon, 13.IX.1987, Coll. A.K. Das; 4 exs., Stn. 25, near Kaluparaghat, 18.IX.1987, Coll. A.K. Das; 2 exs., Stn. 26 (Grid No. N₁₇), 18.IV.1987, Coll. A.K. Das.

Diagnosis : Body dorso-ventrally flattened, dimensions 100-111.7 μm X 30-66.2 μm ; cytopharynx straight, 19-20 ciliary rows; macronucleus oval, contractile vacuole many and scattered.

Distribution : Orissa; Jammu & Kashmir, Maharashtra, Rajasthan and West Bengal.

Remarks : This species has been reported from both fresh and brackish water. The present material has been collected from Chilka water having salinity ranging from 0-7 p.p.t.

Family CHLAMYDODONTIDAE

Genus *Chlamydodon* Ehrenberg

A characteristic striped band present along the lateral margin of the body; oral basket made up of rods with apical process.

26. *Chlamydodon mnemosine* Ehrenberg

(Fig. 26)

1837. *Chlamydodon mnemosine* Ehrenberg, *Abhandl. d. Konigl. Akad. d. Wissensch.*, p. 145.

Material examined : 4 exs., Khallikote, 19.II. & 21.II.1969, Coll. K.N. Nair; 2 exs., Stn. 1, near Bird Island (Grid No. A₂), 4.IX.1987, Coll. A.K. Das; 1 ex., Stn. 2 (Grid No. B₁), 4.IX.1987, Coll. A.K. Das; 2 exs., Stn. 14, near Nalbano island (Grid No. between I₁₀ & I₁₁), 12.IX.87, Coll. A.K. Das; 2 exs., Stn. 18, near Balugaon, 13.IX.1987, Coll. A.K. Das; 1 ex., Stn. 19, near Kaligugeswara (Grid No. G₁₂), 14.IX.1987, Coll. A.K. Das.

Diagnosis : Body reniform, dimensions 68.3-70.4 µm X 37.3-47.6 µm; a band of trichites parallel to body outline present; oral basket with 8-10 rods; macronucleus oval; contractile vacuoles scattered and 4-5 in number.

Distribution : India :Orissa.

Remarks : The present material has been collected from brackish water of the Chilka with salinity ranging from 8 to 15 p.p.t.

Family DYSTERIIDAE

Genus *Dysteria* Huxley

Body ovate, dorsal surface convex, ventral surface flat, left ventral side with nonciliated ventral plate, cytostome located in a furrow near right side, posterior style conspicuous.

27. *Dysteria ovalis* (Gourret & Roeser)

(Fig. 27)

1886. *Aegyria angustata* var. *ovalis* Gourret sl. Roeser, *Arch. Zool. exp. zool. exp. gen.* (2)4, p. 443.

1931. *Dysteria ovalis* : Kahl, *Urtiere oder Protozoa* (In Dahl's Tierwelt Dtsch.), Jena, pt. 21, p. 256.

Material examined : 2 exs., Stn. 14, near Nalbano island (between Grid Nos. I₁₀ & I₁₁).

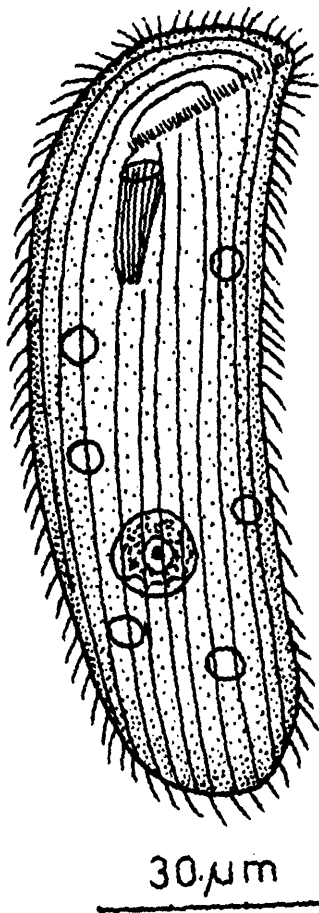


Fig. 25. *Chilodonella cucullulus* (Muller)

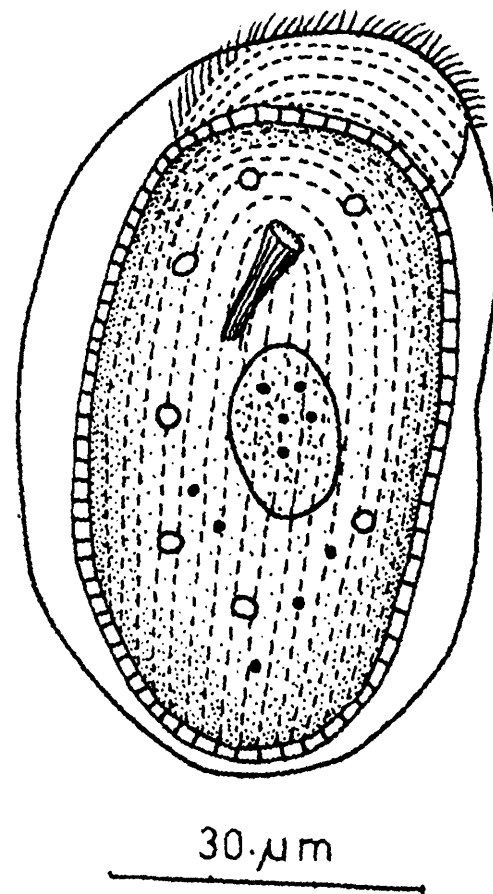


Fig. 26. *Chlamydodon mnemosyne* Ehrenberg

Diagnosis : Shape oval, posterior end rounded, left margin keel-shaped; dimensions 70.4 μm X 38 μm ; post oral ciliation continued from pre oral and extending up to right side of cytostome and parallel to right margin; macronucleus small, round and located at the middle of the body; contractile vacuole single, lying on the posterior half of the body.

Distribution : India : Orissa (first record); also first record from India.

Remarks : The present material has been collected from Chilka waters having salinity 13 p.p.t.

Class OLIGOHYMENOPHOREA

Order HYMENOSTOMATIDA

Key to the families

- 1(2) Prebuccal area of vestibulum conspicuous, leading to buccal cavity; two peniculi in buccal cavity, cytostome not expansible Family PARAMECIIDAE
- 2(1) Prebuccal area shallow or absent, three peniculi in buccal cavity, cytostome expansible Family FRONTONIIDAE

Family PARAMECIIDAE

Genus *Paramecium* Muller

Body cigar-shaped, peristome long, broad and slightly oblique, cytopharynx moderately long, with a row of fine cilia attached to its dorsal wall.

28. *Paramecium calkinsi* Woodruff (Fig. 28)

1921. *Paramecium calkinsi* Woodruff, *Biol. Bull. Wood's Hole*, 41, p. 171.

Material examined : 2 exs., around Ghantashila and Barkuda, 30.V. & 1.VI.1969, Coll. K.N. Nair; 1 ex., Stn. 1, opposite to Ghantashila and near Bird island (Grid No. A₂), 4.IX.1987, Coll. A.K. Das; 2 exs., Stn. 25, near Kaluparaghat, 18.IX.1987, Coll. A.K. Das; 2 exs., Stn. 26 (Grid No. N₁₇), 18.IX.1987, Coll. A.K. Das.

Diagnosis : Body foot-shaped with broadly rounded posterior end, dimensions 111.8-153.2 μm X 58-78.7 μm ; macronucleus single with two vesicular micronuclei; contractile vacuole two in number - one in anterior half and the other in posterior half of the body.

Distribution : Orissa.

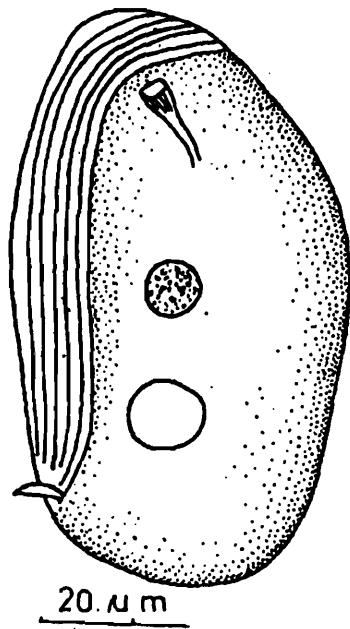


Fig. 27. *Dysteria ovalis* (Gourret & Roeser)

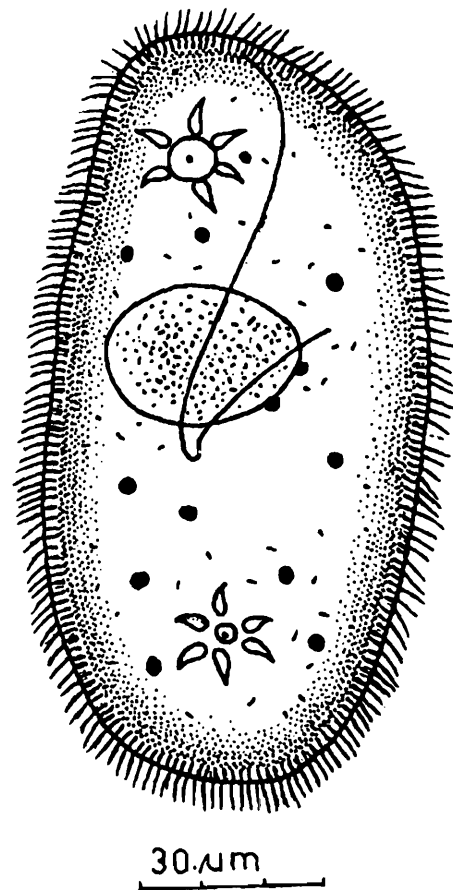


Fig. 28. *Paramecium calkinsi* Woodruff

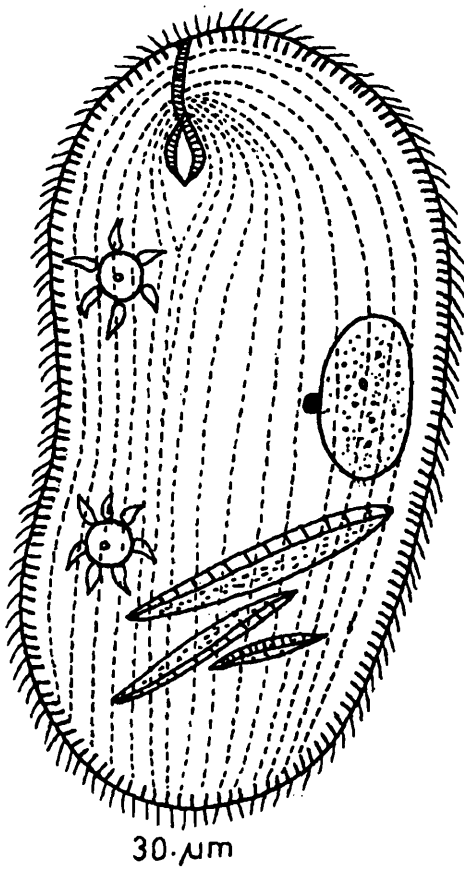


Fig. 29. *Frontonia fusca* (Quennerstedt)

Remarks : This species has been collected from Chilka waters having salinity ranging from 0-15 p.p.t.

Family FRONTONIIDAE

Genus *Frontonia* Ehrenberg

Body ovoid to ellipsoid, oral groove in anterior third of the flat ventral surface, one or two contractile vacuoles with collecting canals and external pore.

Key to the species

- 1(4) Body moderately flattened, cytopharynx 30-35 μm , contractile vacuole one, macronucleus with two or more micronuclei
- 2(3) Post oral groove extended to posterior part of the body, macronucleus with several micronuclei *F. leucas*
- 3(2) Post oral groove inconspicuous, not extending posterior part of the body, macronucleus with usually two micronuclei *F. marina*
- 4(1) Body strongly flattened, cytopharynx about 15 μm long, contractile vacuoles two, macronucleus with single micronucleus *F. fusca*

29. *Frontonia fusca* (Quennerstedt)

(Fig. 29)

1869. *Panophrys fusca* Quennerstedt, *Acta Univ. Lund*, 6, p. 1.

1931. *Frontonia fusca* : Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 21, p. .321.

Material examined : 2 exs., Stn. 12, near Parikud (Grid No. F_g), 10.IX.1987, Coll. A.K. Das.

Diagnosis : Body ovoid, strongly flattened, both anterior and posterior ends rounded; dimension 92 μm X 48.8 μm ; cytopharynx small, about 15 μm long; macronucleus with single micronucleus; contractile vacuoles two in number - one in anterior half and the other in posterior half of the body.

Distribution : India : Orissa (first record); also first record from India.

Remarks : It is a brackish water species and collected from the Chilka having salinity 13-14 p.p.t.

30. *Frontonia leucas* (Ehrenberg)

(Fig. 30)

1838. *Bursaria leucas* Ehrenberg, *Die Infusionsthierchen als Vollkommene, Organismen*, Liepzig, p. 329.

1858. *Frontonia leucas* : Claparede and Lachmann, *Mem. Inst. Nat. Genevois*.

Material examined : 2 exs., Stn. 6, near Khallikote (Grid No. B₅), 6.IX.1987, Coll. A.K. Das; 1 ex., Stn. 34 (between Grid Nos. P₁₅ & P₁₆), 25.IX.1987, Coll. A.K. Das.

Diagnosis : Body elongated or ovoid, rounded at both ends, dimensions 149 µm X 85.7 µm; cytostome carrying three rows of cilia, post oral groove extending to the posterior part of the body; macronucleus ellipsoid with several micronuclei; contractile vacuole single with long radiating canals and located at the middle of the body.

Distribution : India : Orissa (first record); Jammu & Kashmir, Rajasthan, Maharastra and West Bengal.

Remarks : It is a freshwater species but, the present material has been collected from brackish water of the Chilka with salinity ranging from 1 to 11 p.p.t.

31. *Frontonia marina* Fabre-Domergue (Fig. 31)

1891 *Frontonia marina* Fabre-Domergue, *Ann. Microgr.*, 3, pp.49209.

1931. *Frontonia marina* : Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 21, p.319.

Material examined : 4 exs., Barkuda, 30.V.1969, Coll. K.N. Nair; 2 exs., Stn. 3, near Brahmandeo (Grid No. C₂), 4.IX.1987, Coll. A.K. Das; 1 ex., Stn. 5, near Somolo island (between Grid Nos. C₃ & C₄), 5.IX.1987, Coll. A.K. Das; 1 ex., Stn. 22 (Grid No. J₁₄), 16.IX.1987, Coll. A.K. Das; 2 exs., Stn. 27, near Satpara (Grid No. O₈), 21.IX.1987, Coll. A.K. Das.

Diagnosis : Body elongate, both anterior and posterior ends rounded but, former broader than latter; dimensions 136.7-149 µm X 64.2-78.7 µm; rim as well as cytostome carrying 6-8 rows of oral cilia; post oral groove inconspicuous and not extending posterior part of the body; macronucleus oval usually with two micronuclei, contractile vacuole single and located near the middle of the body.

Distribution : India : Orissa.

Remarks : It is a marine species. The present material has been collected from Chilka waters with salinity ranging from 3-14 p.p.t.

Order SCUTICOCILIATIDA

Key to the families

- 1(6) Infraciliature of paroral membrane bipartite without 'c' segment, scuticovestige separate and posterior to paroral
- 2(3) Body elongate-ovoid, not uniformly ciliated, anterior pole conspicuously naked excepting long caudal cilium/cilia Family URONEMATIDAE

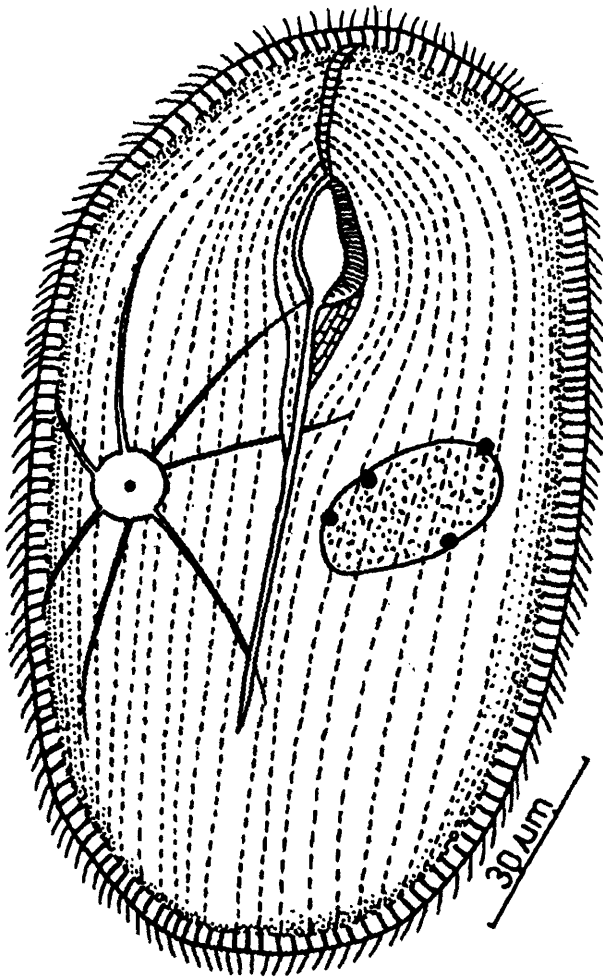


Fig. 30. *Frontonia leucas* (nonital) (Ehrenberg)

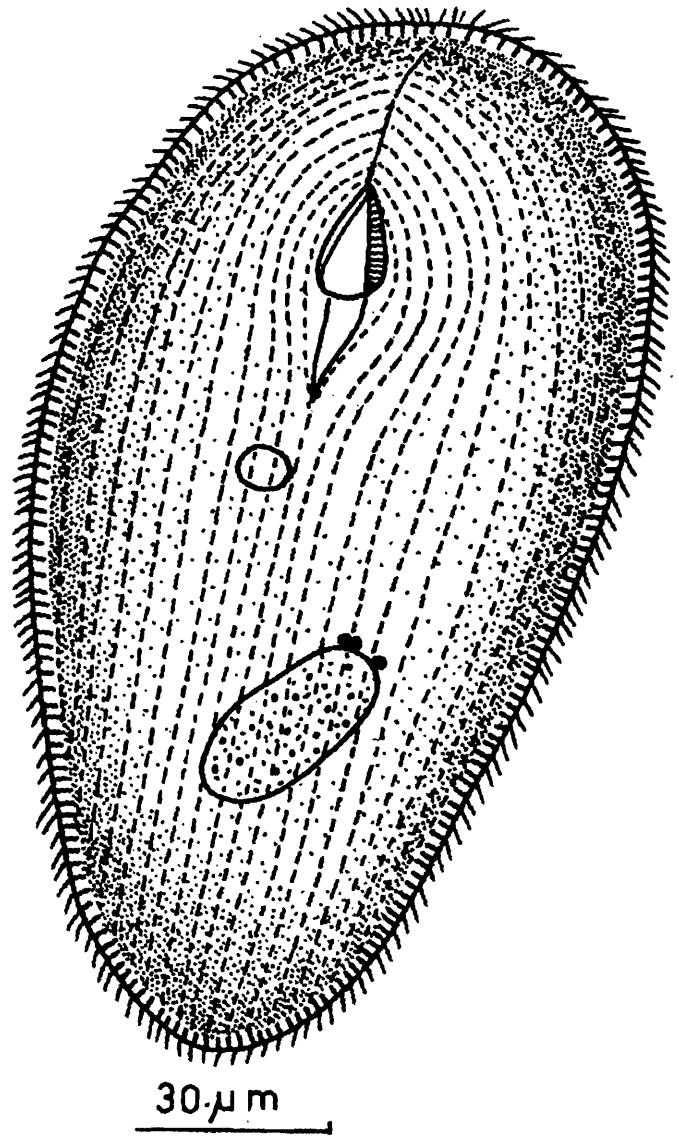


Fig. 31. *Frontonia marina* Fabre-Domergue

- 3(2) Body elongate to finger-shaped, uniformly ciliated, generally with a single caudal cilium
- 4(5) Oral depression narrow and provided with most conspicuous false "double membranellae" (*i.e.*, one membranellae plus adjacent row of somatic ciliature) Family COHNILEMBIDAE
- 5(4) Buccal cavity elongate, typically three adoral ciliary organellae Family PHILASTERIDAE
- 6(1) Infraciliature of paroral membrane tripartite including 'c' segment as a permanent scutico vestige
- 7(8) Paroral membrane prominent, sometimes present as a stiff velum and distinctly curling around cytostome Family PLEURONEMATIDAE
- 8(7) Paroral membrane less prominent, without forming any velum Family CYCLIDIIDAE

Family PHILASTERIDAE

Genus *Philaster* Fabre-Domergue

Body elongate to finger shaped with anterior end bluntly tapered; body ciliation uniform with a caudal cilium, peristome broader near cytostome and about one-third to two-fifth the body length with a series of long cilia; contractile vacuole single and terminal.

32. *Philaster digitiformis* Fabre-Domergue (Fig. 32)

1885. *Philaster digitiformis* Fabre-Domergue, Il del' An *et. Phys.*, 21.

1931. *Philaster digitiformis* : Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 21, p. 364,

Material examined : 2 exs., Stn. 24 (Grid No. M₁₅), 17.IX.1987, Coll. A.K. Das.

Diagnosis : Body shape as for the genus, anterior end bent dorsally, dimensions 98 µm X 30 µm; macronucleus oval and located in the middle of the body; micronucleus large and round.

Distribution : India: Orissa (first record), also first record from India.

Remarks : It is a salt water species. The present material has been collected from Chilka waters having salinity 5 p.p.t.

Family URONEMATIDAE

Genus *Uronema* Dujardin

Body oval to elongate, not uniformly ciliated, anterior pole conspicuously naked, peristome inconspicuous; cytostome with a small tongue like membrane; a long caudal cilium present.

Key to the species

- 1(2) Body ovoid, posterior half spindle-like, ciliated rows eight in number on each side .. *U. filificum*
- 2(1) Body slender - ovoid, broad towards posterior end, ciliated rows six in number on each side
 *U. marinum*

33. *Uronema filificum* Kahl

(Fig. 33)

1931. *Uronema filificum* Kahl, *Urtiere oder Protozoa*, (in Dahl's Tierwelt Dtsch.), Jena, pt. 21, p. 356.

Material examined : 4 exs., one each around Khallikote, Parikuda, Panaspada and Satpara, 21. X II & 27. X II.1970, 3.I. & 7.I.1971, Coll. K.N. Nair.

Diagnosis : Body ovoid, anterior end with broad plate, dimensions 28.9-37.2 μm X 14.5.-20.7 μm ; cytostome located at the ventral narrow side; ciliated rows about 8 in number, macronucleus more or less round, located at the anterior half of the body.

Distribution : India : Orissa.

Remarks : It is a saltwater species.

34. *Uronema marinum* Dujardin

(Fig. 34)

1841. *Uronema marina* Dujardin, *Histoire Naturelle. des Zoophytes, Infusoires*, Paris.

1931. *Uronema marinum* : Kahl, *Urtiere order Protozoa*, (in Dahl's Tierwelt Dtsch.), Jena pt. 21, p. 256.

Material examined : 50 exs., Khallikote, 26.II.1969 & 23.IV.1969, Coll. K.N. Nair; 7 exs., Stn. 14, near Nalbano island (between Grid Nos. I₁₀ & I₁₁), 12.IX.1987, Coll. A.K. Das; 3 exs., Stn. 19, near Kaligugeswara (Grid No. G₁₂), 14.IX. 1987, Coll. A.K. Das; Sev. exs., Stn.23 (Grid No. M₁₃), 16.IX.1987, Coll. A.K. Das; Sev. exs., Stn. 24 (Grid No. M₁₅), 17.IX.1987, Coll. A.K. Das; Sev. exs., Stn. 30, near Arakuda (between Grid Nos. V₁₀ & V₁₁), 21.IX.1987, Coll. A.K. Das.

Diagnosis : Body slender, ovoid, broad towards posterior part, distinct frontal plate present at the anterior end; dimensions 33.1-39.3 μm X 16.5-24.8 μm ; cytostome distinct shifted to right broad side; ciliary rows 6 in number on each side, macronucleus more or less round, located little above the anterior half of the body.

Distribution : India : Orissa, Karnataka.

Remarks : It is also a saltwater species and collected from Chilka waters having salinity 5-130/00.

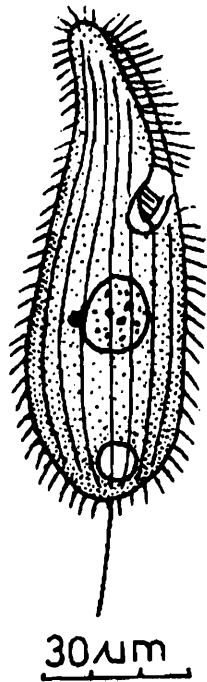


Fig. 32. *Philaster digitiformis* Fabre-Domergue

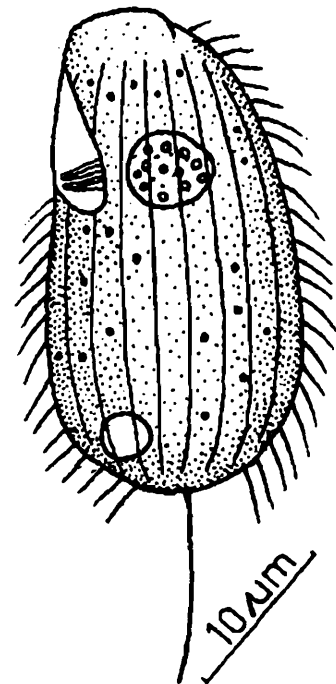


Fig. 33. *Uronema filificum* Kahl

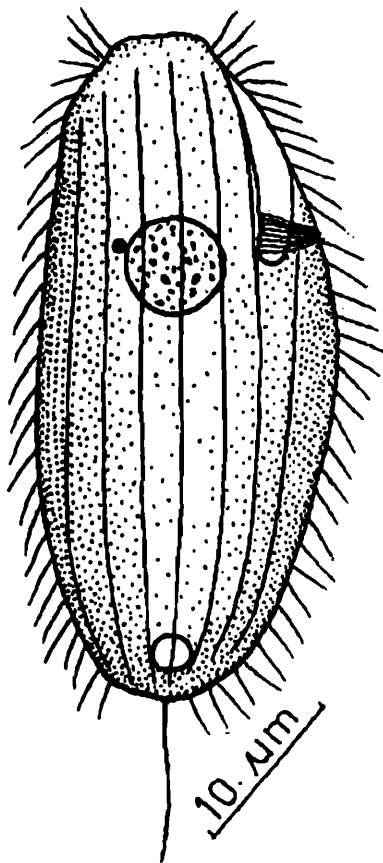


Fig. 34. *Uronema marinum* Dujardin

Family COHNILEMBIDAE

Genus *Cohnilembus* Kahl

Body flexible, slender and spindle-shaped, peristome from anterior to middle of the body or longer, curved to right; a caudal cilium or a few longer cilia at the posterior end.

Key to the species

- 1(4) Peristome extending up to the middle of the body
- 2(3) Body very slender (6.5-10:1) particularly in the anterior half, anal bristles long and fine
..... *C. verminus*
- 3(2) Body less slender (3.5-5:1), anal cilia not very distinct *C. subulatus*
- 4(1) Peristome extending about three-fourth of the length of the body, relatively fine form
..... *C. longivelatus*

35. *Cohnilembus longivelatus* (Kahl)

(Fig. 35)

1931. *Lembus longivelatus* Kahl, *Urtiere oder Protozoa* (In Dahl's Tierwelt Dtsch.), Jena, pt. 21, p.370.

1935. *Cohnilembus longivelatus* : Khal, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 30, p.835.

Material examined : 1 ex., Stn. 24 (Grid No. M₁₅), 17.IX.1987, Coll. A.K. Das.

Diagnosis : Body long, ovoid, almost flattened laterally, dorsal side stretched or concave, ventral side symmetrically arched, posterior and rounded; dimensions 85 µm X 24 µm; length-breadth ratio 3.5:1; peristome from anterior end extending about three-fourth of the length of the body; caudal cilium large and distinct; macronucleus elliptical located at the middle of the body; contractile vacuole single and terminal.

Distribution : India : Orissa (first record), also first record from India.

Remarks : It is a marine species and collected from brackish water of the Chilka with salinity 50/00.

36. *Cohnilembus subulatus* (Kent)

(Fig. 36)

1882. *Lembus subulatus* Kent, *A Manual of the Infusoria*, London.

1931. *Lembus subulatus* : Kahl, *Urtiere oder Protozoa* (In Dahl's Tierwelt Dtsch.), Jena, pt. 21, p.370.

1935. *Cohnilembus subulatus* : Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 30, p. 835.

Material examined : 2 exs., Nalbano island, 29.XII.1970, Coll. K.N. Nair.

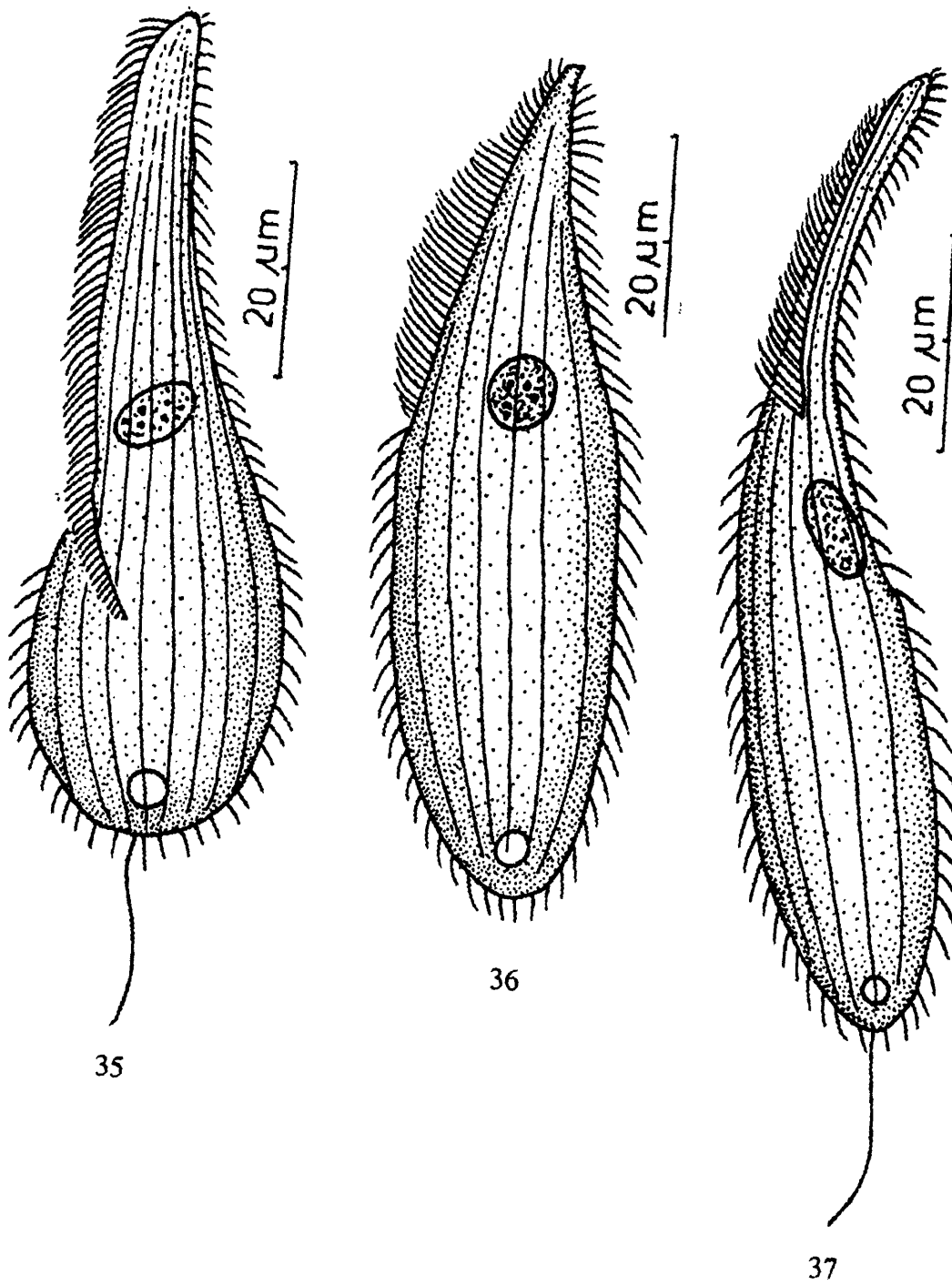


Fig. 35. *Cohnilembus longivelatus* (Kahl)

Fig. 36. *Cohnilembus subulatus* (Kent)

Fig. 37. *Cohnilembus verminus* (Muller)

Diagnosis : Body slender, lanceolate, posterior end broad ; dimensions 74.5-81 μm X 20-22 μm ; length-breadth ratio of the present material 3.6 : 1; peristome starting from the anterior and extending up to the middle of the body; anal cilia not very distinct; macronucleus oval, located at the anterior half; contractile vacuole single and terminal.

Distribution : India : Orissa and Rajasthan; in brackish water.

37. *Cohnilembus verminus* (Muller)

(Fig. 37)

1786. *Vibrio verminus* Muller, *Animalc. Infusoria Fluviat. et Marina*, etc., Havniae et Lipsiae.

1931. *Lembus verminus* : Kahl, *Urtiere oder Protozoa* (In Dahl's Tierwelt Dtsch.), Jena, pt. 21, p.369.

1935. *Cohnilembus verminus* : Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 30, p. 835.

Material examined : 6 exs., around Barkul, Nalbano island and Satpara; 21.II.1969, 10.IV.1969 & 12.VI.1969, Coll. K.N. Nair; 2 exs., Stn. 23 (Grid No. M₁₃), 16.IX.1987, Coll. A.K. Das; 1 ex., Stn. 24 (Grid No. M₁₅), 17.IX.1987, Coll. A.K. Das.

Diagnosis : Body more particularly anterior half, very slender; dimensions 45.5-93.1 μm X 8.3-12.4 μm ; length-breadth ratio of the present material 6.4 : 1; peristome almost as in *C. subulatus*; caudal cilia fine and long; macronucleus slightly elliptical and located at the anterior half of the body; contractile vacuole single and terminal.

Distribution : India : Orissa.

Remarks : It is a brackish water species and collected from Chilka waters with salinity 5 p.p.t.

Family PLEURONEMATIDAE

Genus *Pleuronema* Dujardin

Shape ovoid to ellipsoid, peristome extending from anterior end to two-third the length of the body; conspicuous membrane present at both edges, a semicircular swelling to left near oral area.

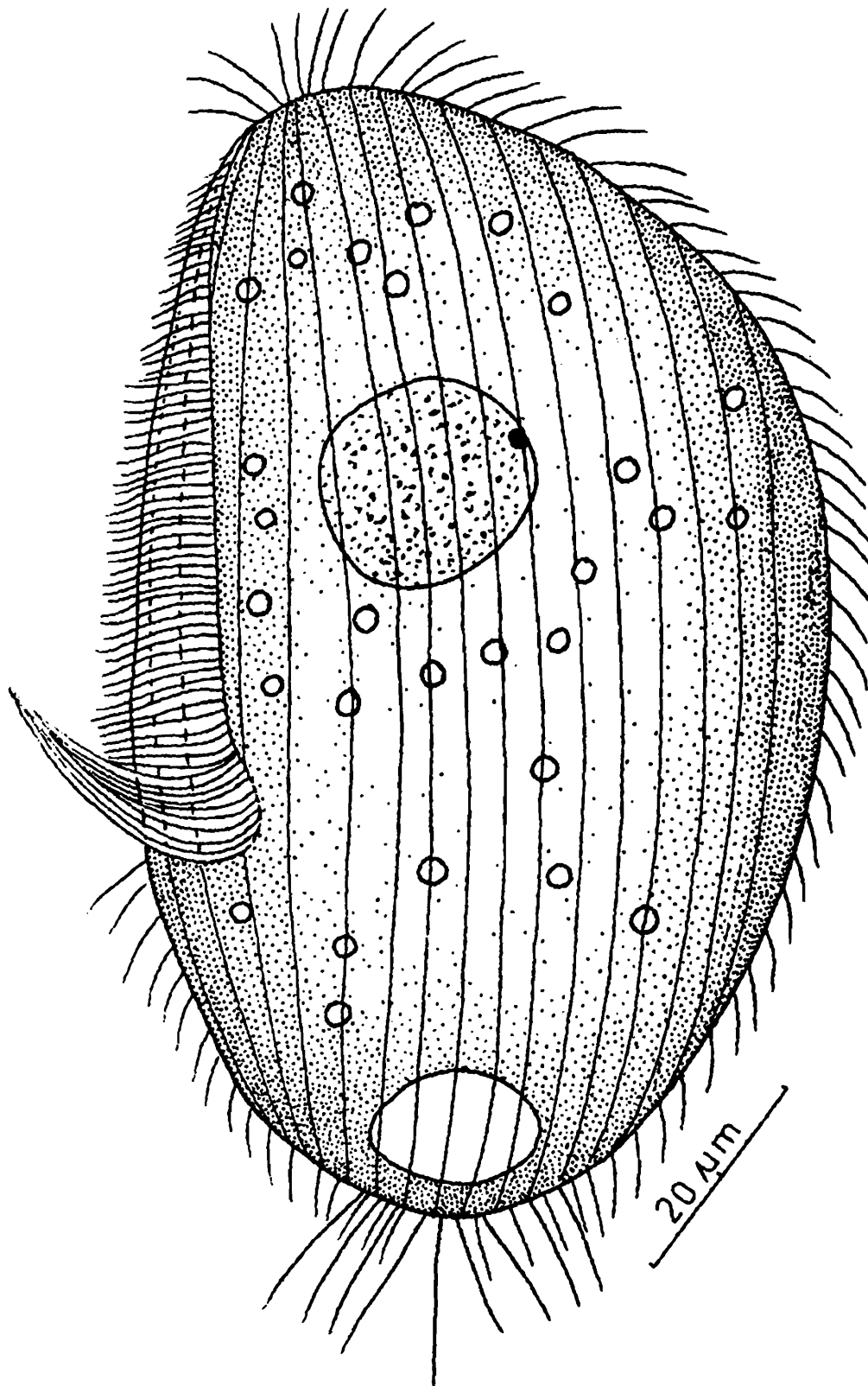
38. *Pleuronema marinum* Dujardin

(Fig. 38)

1841. *Pleuronema marinum* Dujardin, *Histoire Nat. des Zoophytes Infusoires*, Paris, pp. 678.

1931. *Pleuronema marinum* : Kahl, *Urtiere oder Protozoa* (In Dahl's Tierwelt Dtsch.), Jena, pt. 21, p. 389.

Material examined : 4 exs., Khallikote, 26.II.1969 & 23.VI.1969, Coll. K. N. Nair; 3 exs., Stn. 1, near Bird island (Grid No. A₂), 4.IX.1987, Coll. A. K. Das; 2 exs., Stn. 2 (Grid No. B₁) 4.IX.1987, Coll. A. K. Das; 2 exs., Stn. 25, near Kalupara ghat, 18.IX.1987, Coll. A. K. Das; 4 exs., Stn. 27, near Satpara (Grid No. O₃), 21.IX.1987, Coll. A. K. Das.

DAS : *Protozoa*Fig. 38. *Pleuronema marinum* Dujardin

Diagnosis : Body elongately ovoid, posterior end cuspidate; anterior half comparatively narrow; dimensions 80.7-111.8 μm x 47.6-86.9 μm ; peristome as for the genus; macronucleus round and located at the anterior half, contractile vacuole single and located at the middle of the body.

Distribution : India : Orissa.

Remarks : It is a salt water species and collected from Chilka waters having salinity ranging from 3-15 p.p.t.

Family CYCLIDIIDAE

Genus *Cyclidium* Muller

Body long, ovoid with a caudal cilium; peristome near right side; a membrane present on its right edge, forming a pocket around cytostomal groove.

39. *Cyclidium citrullus* Cohn
(Fig. 39)

1866. *Cyclidium citrullus* Cohn, *Z. wiss. Zool.*, 16, p. 253.

1931. *Cyclidium citrullus* : Kahl, *Urtiere oder Protozoa* (In Dahl's Tierwelt Dtsch.), Jena, Pt. 21, p. 376.

Material examined : 25 exs., Balugaon, 30.XII.1970, Coll. K.N. Nair; 12 exs., Stn. 35 (between Grid Nos. R₁₅ & R₁₆), 25.IX.1987 Coll. A.K. Das.

Diagnosis : Body small, ovoid, dimensions 24.9-29 μm X 12.4-16.5 μm ; peristome distinctly recognisable extending upto two-third length of the body, caudal cilium long and comes out of a distinct depression or pit; macronucleus more or less round and located at the anterior half; contractile vacuole single, lying almost at the terminal portion of the body.

Distribution : India : Orissa, in brackish water.

Order PERITRICHIDA

Key to the families

- 1(2) With contractile stalk and without any lorica, colonial (except in two genera), in colonial forms zooids not independently contractile (except in one species) Family VORTICELLIDAE
- 2(1) Solitary, stalkless, sessile, adherent to substrata by means of a flattened disc, often prominently distinct from the rest of the body Family SCYPHIDIIDAE

Family VORTICELLIDAE

Genus *Vorticella* Linnaeus

Inverted bell form, solitary, may be in cluster but not in colony.

40. *Vorticella marina* Greef
(Fig. 40)

1870. *Vorticella marina* Greef, *Wiegmann's Arch.*, 36.

1935. *Vorticella marina* : Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 30, p. 735.

Material examined : 3 exs., Stn. 4, near Honeymoon island (between Grid Nos. A₃ & B₃), 4.IX.1987, Coll. A.K. Das; Sev. exs., near Nalbano island (Grid No. H₉, 12.IX.1987, Coll. A.K. Das; 2 exs., Stn. 15 (Grid No. G₁₀), 12.IX.1987, Coll. A.K. Das; 2 exs., Stn. 16 (Grid No. F₁₀), 12.IX.1987, Coll. A.K. Das.

Diagnosis : Body conical-campanulate, bell transversely annulated; peristomal border dilated, macronucleus more or less horse-shoe shaped, contractile vacuole single.

Distribution : India : Orissa (first record); also first record from India.

Remarks : It is a marine species. The present material was found to be attached with submerged algae of the lagoon and collected from salinity ranging 12-15 p.p.t.

Family SCYPHIDIIDAE

Genus *Scyphidia* Dujardin

Cylindrical or urn-shaped, highly contractile, posterior end with specially developed acetabuliform organ for attaching with submerged objects or aquatic animals; body surface usually cross-striated.

41. *Scyphidia* sp.

Material examined : 2 exs., Stn. 21 (Grid No. I₁₃), 15.IX.1987 Coll. A.K. Das.

Distribution : India : Orissa (first record), also first record from India.

Remarks : Body urn-shaped, adherent to the substrata forming flattened disc; macronucleus single, large and band -shaped.

The present material was found to be attached with dead molluscan shell and collected from Chilka waters having salinity 6 p.p.t. Specific identification of these specimens is not possible due to ill fixation.

Class POLYHYMENOPHOREA

Order HETEROTRICHIDA

Key to the families

- 1(2) Anterior part of the body uniquely twisted to the left and posterior part sometimes tailed and/or bearing tuft of longer cilia Family METOPIDAE

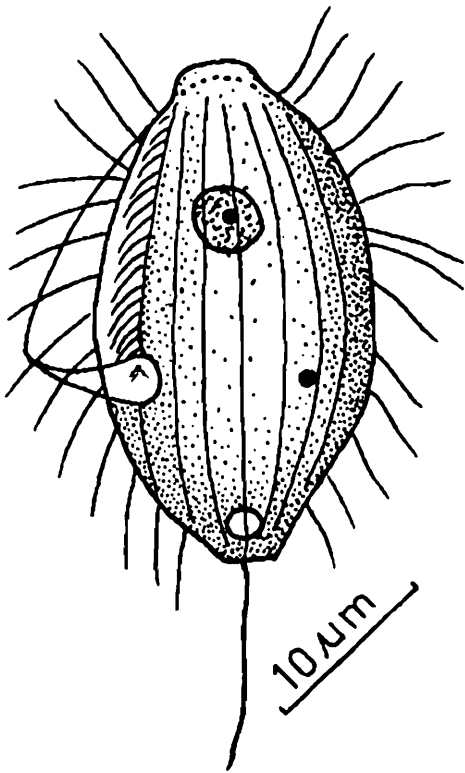


Fig. 39. *Cyclidium citrullus* Cohn

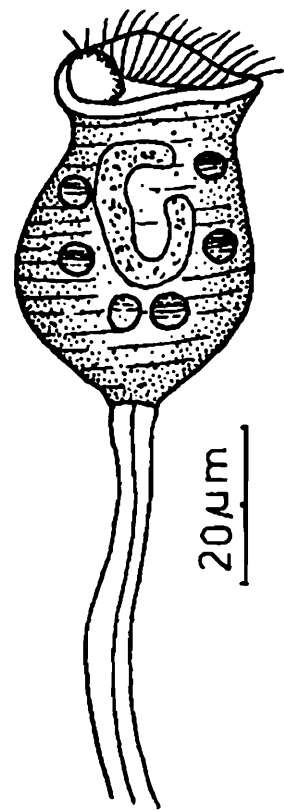


Fig. 40. *Vorticella marina* Greef

- 2(1) Anterior part of the body not twisted as above
- 3(4) Body top-shaped, pellicle rigid, cytostome near antapical pole, adoral zone of membranellae usually encircling the body, spiralling posterior Family CAENOMORPHIDAE
- 4(3) Body large, elongate, pellicle not rigid, adoral zone of membranellae not as above
- 5(6) Body large, elongate and cylindrical or pyriform, highly contractile, peristomal field long and narrow Family SPIROSTOMATIDAE
- 6(5) Body large elongate or nearly ellipsoidal but not highly contractile, peristomal field funnel like and prominent Family CONDYLOSTOMATIDAE

Family SPIROSTOMATIDAE

Key to the genera

- 1(2) Body elongate, cylindrical, highly contractile, posterior end of the body usually blunt, contractile vacuole terminal and large, with a long dorsal canal Genus *Spirostomum*
- 2(1) Body shape as above, but slightly contractile and posterior end of the body drawn out, contractile vacuole small and posterior Genus *Gruberia*

Genus *Gruberia* Kahl

42. *Gruberia calkinsi* Beltran (Fig. 41)

1933. *Gruberia calkinsi* Beltran, *Biol. Bull.*, 64, P. 23.

Material examined : 8 exs., Barkul and Satpara, 21.II.1969 & 12.VI.1969, Coll. K.N. Nair.

Diagnosis : Body elongated, slightly contractile with drawn out posterior end; dimensions 310.5-351.9 μm X 64.2-80.7 μm ; peristome extending posterior half of the body; moniliform macronucleus with many micronuclei, contractile vacuoles many and distributed all over the body.

Distribution : India : Orissa and Andhra Pradesh.

Remarks : It is a brackishwater species.

Genus *Spirostomum* Ehrenberg

43. *Spirostomum teres* Claparede and Lachmann (Fig. 42)

1858-61. *Spirostomum teres* Claparede and Lachmann, *Mem. Inst. Nat. Genevois*, p. 233.

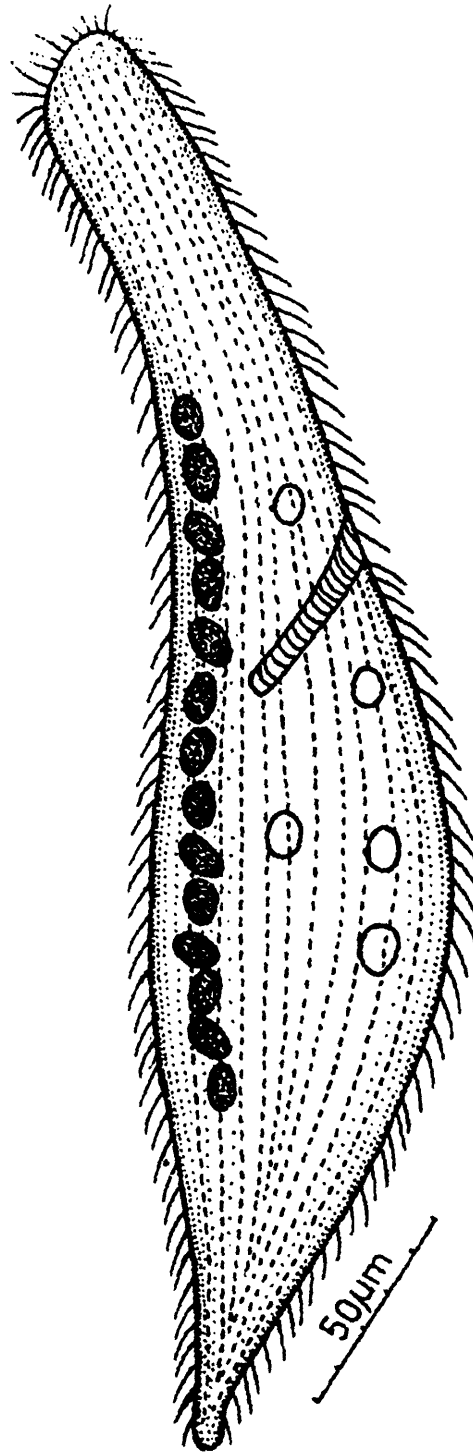


Fig. 41. *Gruberia calkinsi* Beltran

Material examined : 1 ex., Stn. 31 (Grid No. L₁₀), 22.IX.1987, Coll. A.K. Das; 1 ex., Stn. 33, near Gambhari (Grid No. P₁₁), 23.IX.1987, Coll. A.K. Das.

Diagnosis : Body elongated, highly contractile, posterior end truncated; dimensions 289.8 µm X 39.4 µm; cytostome not usually extending up to the middle of the body; macronucleus oval to spindle shaped and located at the middle of the body; contractile vacuole large and terminal with a central canal.

Distribution : India : Orissa (first record), Andhra Pradesh, Jammu and Kashmir and West Bengal.

Remarks : It usually occurs in freshwater. But, the present material has been collected from brackish water of the Chilka, having salinity ranging 3 to 4 p.p.t.

Family METOPIDAE

Genus *Metopus* Claparede and Lachmann

Body elongated, ovoid or pyriform, body torsion very strong at the left side of the anterior end; anterior part of the body shorter than or equal to posterior body part; buccal cavity not very large, peristome never spiraling; cytostome subanterior or subequatorial.

Key to the species

- 1(2) Body characteristically sigmoid, contractile vacuole comparatively small and located at posterior end of the body and without any raising edge *M. es*
- 2(1) Body not sigmoid, contractile vacuole large, posteriorly located and with raising edges
- 3(4) Body of clear brownish tint and irregular shape, posterior extremity flattened *M. fuscus*
- 4(3) Body slightly reddish, oval, both anterior and posterior ends rounded. *M. ovalis*

44. *Metopus es* (Muller) (Fig. 43)

1786. *Trichoda* Muller, O.F., *Animalc. Infusoria Fluviat. et. Marina, etc.*, Havniae et Lipsiae, p. 126.

1964. *Metopus es* : Jankowski, *Arch. Protistenk.*, 107, p. 188.

Material examined : 3 exs., Khallilota and Satpara, 4.VI.1969 & 3.I.1971, Coll. K.N. Nair; 1 ex., Stn. 2 (Grid No. B₁), 4.IX.1987, Coll. A.K. Das; 2 exs., Stn. 3, near Brahmandeo (Grid No. C₂), 4.IX.1987, Coll. A.K. Das; 1 ex., Stn. 6, near Khallikote (Grid No. B₅), 6.IX.1987, Coll. A.K. Das; 2 exs., Stn. 33, near Gambhari (Grid No. P₁₁), 23.IX.1987, Coll. A.K. Das.

Diagnosis : Body characteristically sigmoid, comparatively large and slender; dimensions 107.6-142.8 µm X 51.7 - 62.1 µm, cytoplasm colourless, pellicular striations prominent, peristome conspicuous,

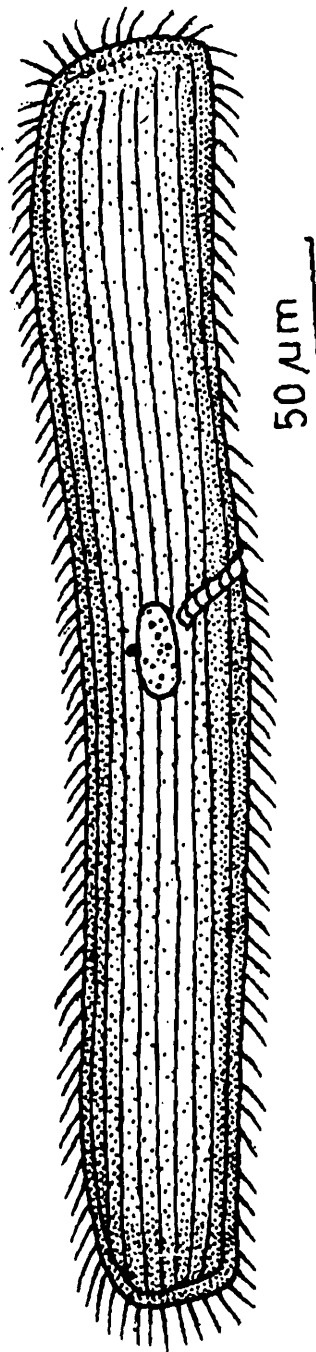


Fig. 42. *Spirostomum teres* Claparede & Lachmann

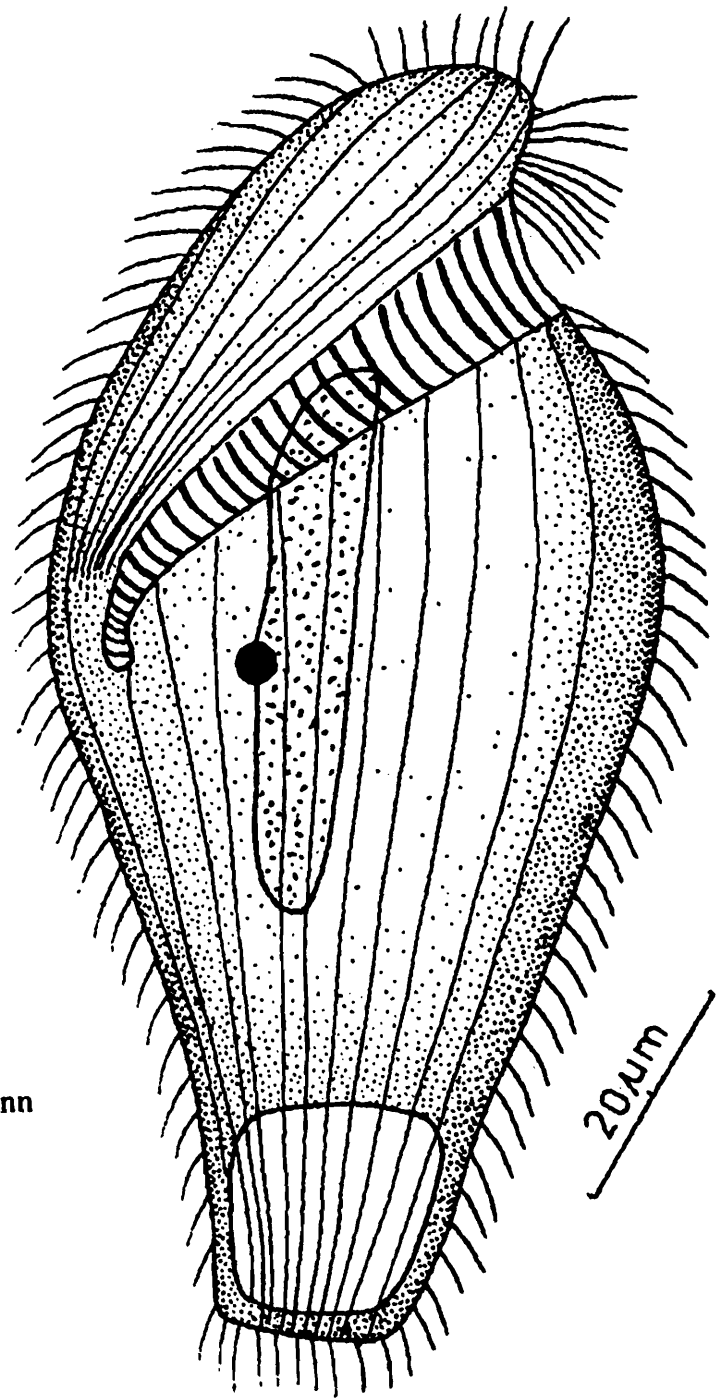


Fig. 43. *Metopus es* (Muller)

slightly spirally diagonal, extending from the anterior end to the middle of the body; macronucleus single and sausage-shaped; contractile vacuole without any raising edge and located at the posterior end.

Distribution : India : Orissa, Andhra Pradesh, Rajasthan and West Bengal.

Remarks : It is a freshwater species but, the present material has been collected from brackish water of the Chilka with salinity ranging from 4 to 14 p.p.t.

45. *Metopus fuscus* Kahl
(Fig. 44)

1927. *Metopus fuscus* Kahl, *Arch. Protistenk.*, 57, p. 147.

Material examined : 2 exs., Stn. 6, near Khallikote (Grid No. B₅), 6.IX.1987, Coll. A.K.Das; 1 ex., Stn. 12, near Parikud (Grid No. F₈), 10.IX.1987, Coll. A.K. Das; Stn. 13, near Nālbano island (Grid No. H₉), 12.IX.1987, Coll. A.K. Das; 1 ex., Stn. 15 (Grid No. G₁₀), 12.IX.1987, Coll. A.K. Das.

Diagnosis : Body of clear brownish tint and irregular shape, posterior extremity flattened, dimensions 132.5-157 μm X 62-67 μm; pellicular striations fine, torsion of anterior left side conspicuous; peristome conspicuous, both perizonal ciliary stripe (PCS) and adoral zone of buccal membranelles (AZM) longer than those of *M. es*; macronucleus oval or slightly reniform and sharply outlined, contractile vacuole large, with raising edges and located posteriorly.

Distribution : India : Orissa (first record), Rajasthan, West Bengal.

Remarks : It is also a freshwater species and collected from brackish water of the Chilka with salinity ranging from 11 to 15 p.p.t.

46. *Metopus ovalis* Kahl
(Fig. 45)

1927. *Metopus ovalis* Kahl, *Arch. Protistenk.*, 57; p. 142.

Material examined : 2 exs., Stn. 6, Khallikote (Grid No. B₅), 6.IX.1987, Coll. A.K. Das; 1 ex., Stn. 25, near Kaluparaghat, 18.IX.1987, Coll. A.K.Das; 1 ex. Stn. 34, (between Grid Nos. P₁₅ & P₁₆), 25.IX.1987, Coll. A.K. Das.

Diagnosis : Body oval, anterior and posterior ends rounded, dimensions 92 μm X 36 μm, cytoplasm reddish, pellicular striations large and wide; macronucleus ovoid and not sharply out lined, contractile vacuole as in *M. fuscus*.

Distribution : India : Orissa (first record), Rajasthan and West Bengal.

Remarks : It is a freshwater species and collected from Chilka waters having salinity 1 to 11 p.p.t.

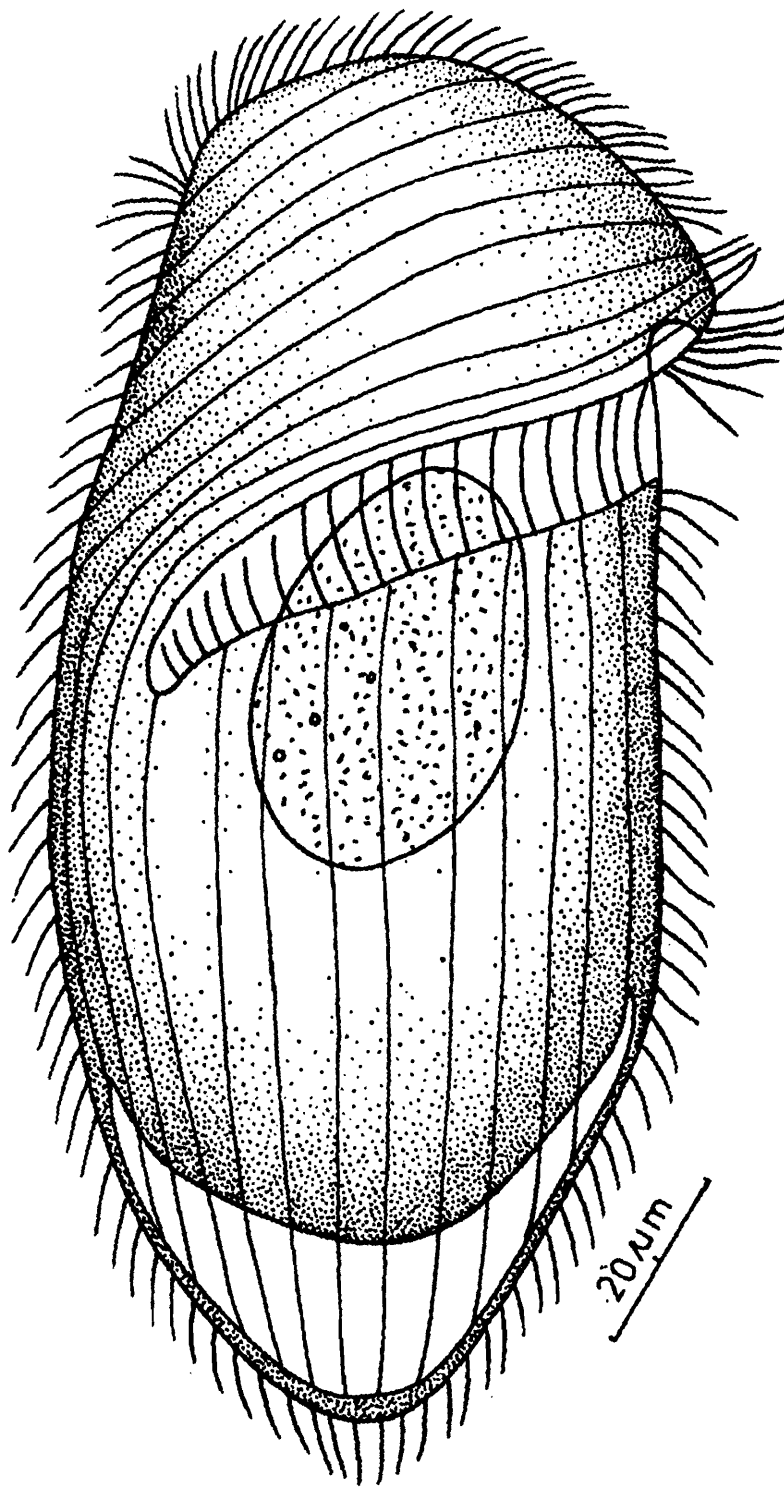


Fig. 44. *Metopus fuscus* Kahl

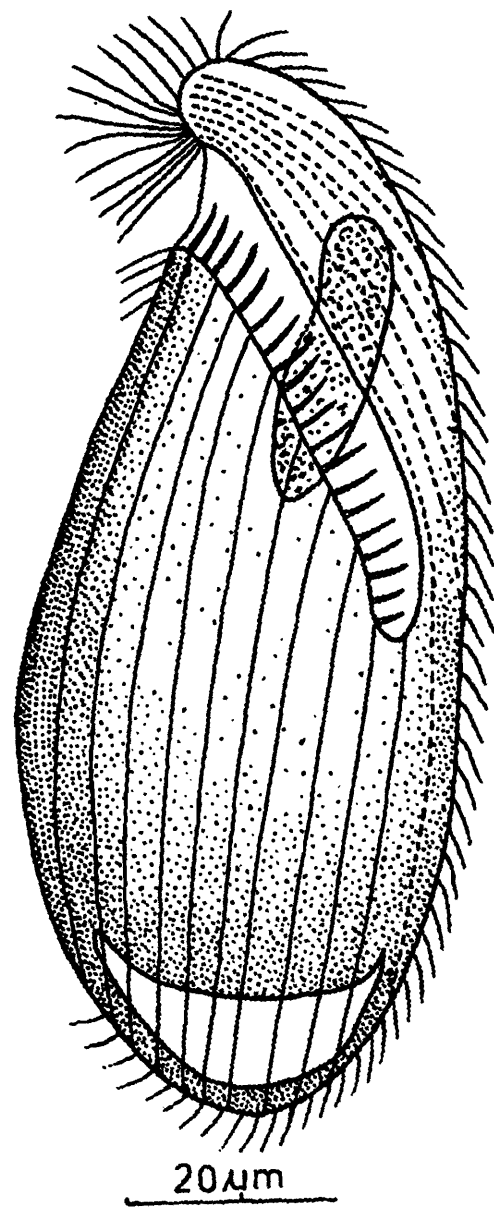


Fig. 45. *Metopus ovalis* Kahl

Family CONDYLOSTOMATIDAE

Genus *Condylostoma* Bory

Anterior end of the body truncate, posterior end rounded or bluntly pointed; peristome slightly flattened, V-shaped and wide at anterior end; peristomal field not ciliated.

Key to the species

- 1(2) Posterior half of the body oval, broad and posterior end rounded, about 20 striations on one side *C. patens*
 2 (1) Posterior half of the body narrow, and posterior end bluntly pointed, about 40 striations on one side *C. magnum*

47. *Condylostoma magnum* Spiegel

(Fig. 46)

1926. *Condylostoma magnum* Spiegel, *Arch. Protistenk*, 55, p. 186.

Material examined : 4 exs, Parikud, 9.VI.1969, Coll. K.N. Nair; 2 exs., Stn. 3, near Brahmandeo (Grid No. C₂), 4.IX.1987, Coll. A.K. Das.

Diagnosis : Body large, anterior end of the body truncate, posterior half narrow and posterior end of the body bluntly pointed; dimensions 186.3-298 µm X 51.7-68.3 µm; about 40 striations on each side; macronucleus long and moniliform.

Distribution : India : Orissa.

Remarks : It is a brackish water species and collected from the Chilka with salinity 13.5 p.p.t.

48. *Condylostoma patens* (Muller)

(Fig. 47)

1786. *Trichoda patens* Muller, *Animalc. Infusoria Fluvial. et Marina, etc.*, Havniae et Lipsiae

1932. *Condylostoma patens* : Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 25, p. 453.

Material examined : 6 exs., Khallikote, Parikud, Satpara and Kaluparaghat, 22.II & 26.II.1969, 10.VI. & 12.VI.1969, Coll. K.N. Nair; 2 exs., St. 35 (between Grid Nos. R₁₅ & R₁₆), 25.IX.1987, Coll. A.K. Das.

Diagnosis : Body large, anterior end of the body truncate, posterior half oval, broad and posterior end rounded; dimensions 213.2-322.9 µm X 58-111.8 µm; about 20 striations on each side; macronucleus elongate, moniliform, located towards the right side; contractile vacuole canal like; extending along the left border.

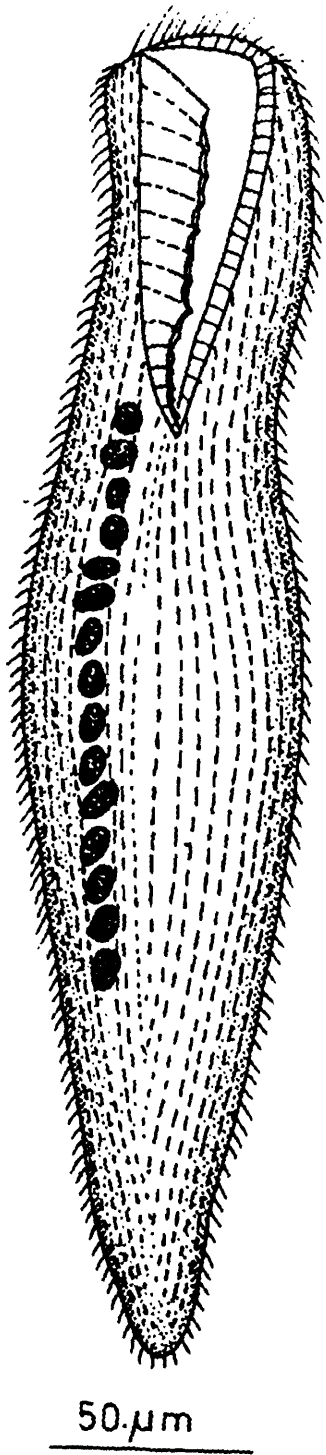


Fig. 46. *Condyllostoma magnum* Spiegel

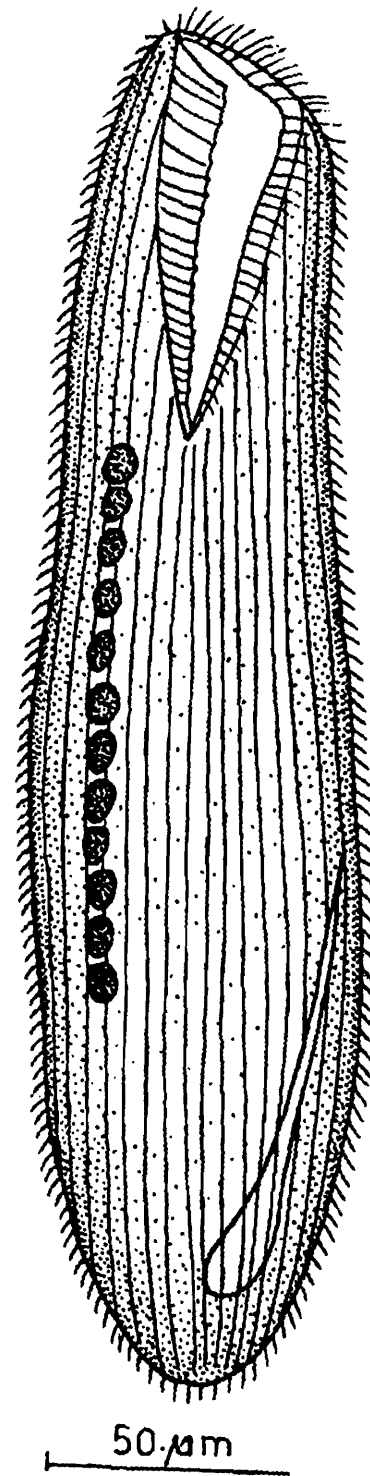


Fig. 47. *Condyllostoma patens* (Muller)

Distribution : India : Orissa, Andhra Pradesh, Andaman and Nicobar islands, Karnataka and Rajasthan.

Remarks : It is a marine species, but present material has been collected from Chilka waters with salinity 1.5 p.p.t.

Family CAENOMORPHIDAE

Genus *Caenomorphu* Perty

Body top-shaped with a long caudal spine, a dense spiral field present around the caudal prolongation; strong marginal zone of about 8 rows of cilia present.

Key to the species

- 1(2) Caudal prolongation long but secondary caudal prolongation considerably short *C. levanderi*
 2(1) Both caudal and secondary caudal prolongations considerably long *C. capusina*

49. *Caenomorphu capusina* Kahl (Fig. 48)

1932. *Caenomorphu capusina* Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 25,p.432.

Material examined : 3 exs., Satpara, 3.I.1971, Coll. K.N. Nair; 2 exs., Stn. 31 (Grid No. L₁₀), 22.IX.1987, Coll. A.K. Das

Diagnosis : Body bell-shaped, dimensions 66.2-70 μm X 37.2-42 μm ; both caudal and secondary caudal prolongations long; macronucleus sausage shaped; micronucleus single, big, round, feebly stained and located adjacent to the macronucleus.

Distribution : India : Orissa.

Remarks : It is a brackish water species and collected from Chilka waters with salinity 3 p.p.t.

50. *Caenomorphu levanderi* Kahl (Fig. 49)

1927. *Caenomorphu levanderi* Kahl, *Arch. Protistenk*, 57, p. 180.

Material examined : 2 exs., Stn. 27, near Satpara (Grid No. O₈), 21.IX.1987, Coll. A.K. Das.

Diagnosis : Body medusoid, more or less hemispherical, dimensions 76.5 μm X 39.5 μm including the length of caudal prolongation; caudal prolongation long but secondary caudal prolongations considerably short; shape of macronucleus and, shape and location of micronucleus more or less similar to those

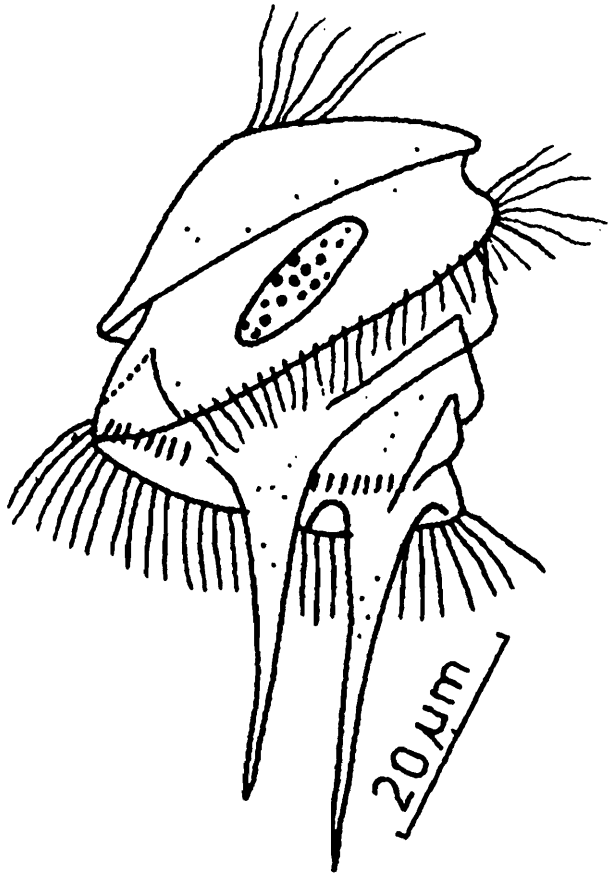


Fig. 48. *Caenomorpha capucina* Kahl

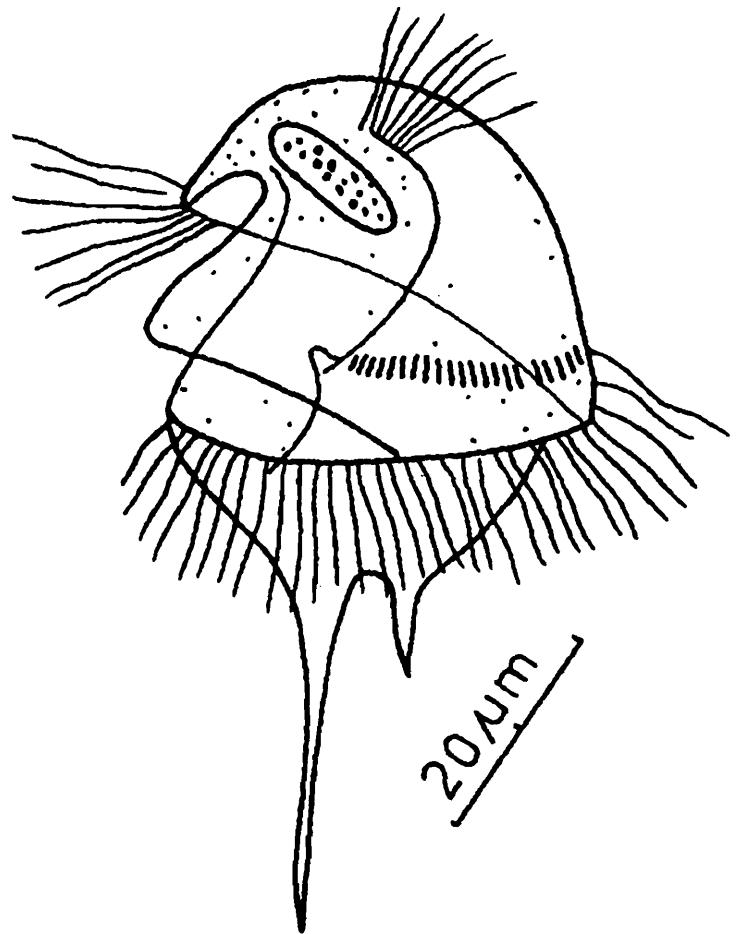


Fig. 49. *Caenomorpha levanderi* Kahl

of *C. capucina* but macronucleus of this species smaller in size.

Distribution : India : Orissa (first record), also first record from India.

Remarks : It is a brackish water species and collected from Chilka waters with salinity 3-4 p.p.t.

Order OLIGOTRICHIDA

Key to the families

- 1(2) Body small, rounded without any lorica; circlet of apical membrane open
 Family STROMBIDIIDAE
- 2(1) Body cylindrical, cone-shaped, highly contractile, loricate Family CODONELLIDAE

Family STROMBIDIIDAE

Genus *Strombidium* Claparede and Lachmann

Body ovoid to spherical; adoral zone very conspicuous, 2-4 sickle-shaped frontal membranellae extending up to cytopharynx.

51. *Strombidium calkinsi* Kahl (Fig. 50)

1932. *Strombidium calkinsi* Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 25, p. 494 & p. 840.

Material examined : 15 exs., Khallikote, Kaluparaghat and Parikud, 19.II. & 26.II.1969 & 19.VI.1969, Coll. K.N. Nair; 7 exs., Stn. 27, near Satpara (Grid No. O₈), 21.IX.1987, Coll. A.K. Das.

Diagnosis : Body ovoid, posterior end provided with a long, sharp, cytoplasmic spine; dimensions 41.4-47.6 μm X 26.9-31 μm ; macronucleus oval and located near the middle of the body.

Distribution : India : Orissa.

Remarks : It is a salt water species and collected from brackish water of Chilka having salinity 3-4 p.p.t.

Family CODONELLIDAE

Genus *Tintinnopsis* Stein

Lorica cup-shaped and always with a broad aperture; aboral end closed; wall of lorica thin and covered with foreign bodies.

52. *Tintinnopsis lohmani* Lackmann
(Fig. 51)

1856. *Tintinnopsis lohmani* Lackmann, *Archiv. fur Anat. u. Physiol.*, p. 340.

Material examined : 1 ex., Rambha, 2.II.1970, Coll. K.N. Nair.

Diagnosis : General characters as for the genus; lorica 35 µm long.

Distribution : India :Orissa.

Remarks : It is a brackish water species and recorded by Das and Nair (1987) for the first time from India, that too, from the Chilka.

Order HYPOTRICHIDA

- 1(4) Right and left marginal cirri present, transverse and frontal cirri may or may not distinctive, oral ciliature not extending more than half of the body
- 2(3) Transverse and fronto-ventral cirri not distinctive but, can be differentiated
..... Family HOLOSTICHIDAE
- 3(2) Fronto-ventral and transverse cirri typically heavy and distinctive Family OXYTRICHIDAE
- 4(1) Marginal cirri absent or greatly reduced in number, transverse and fronto-ventrals highly developed and conspicuous, oral ciliature prominent, usually extending more than half of the body
..... Family EUPLOTIDAE

Family HOLOSTICHIDAE

Key to the genera

- 1(2) Three frontals distinct along anterior margin, body elliptical, two ventral and two marginal rows of cirri present Genus *Holosticha*
- 2(1) Frontals not distinct, body slender, anterior end slightly enlarged, two ventral rows of cirri reaching frontal field Genus *Keronopsis*

Genus *Holosticha* Wrzesniowski

53. *Holosticha manca* Kahl
(Fig. 52)

1932. *Holosticha manca* Kahl, *Urtiere order Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 25, p. 579.

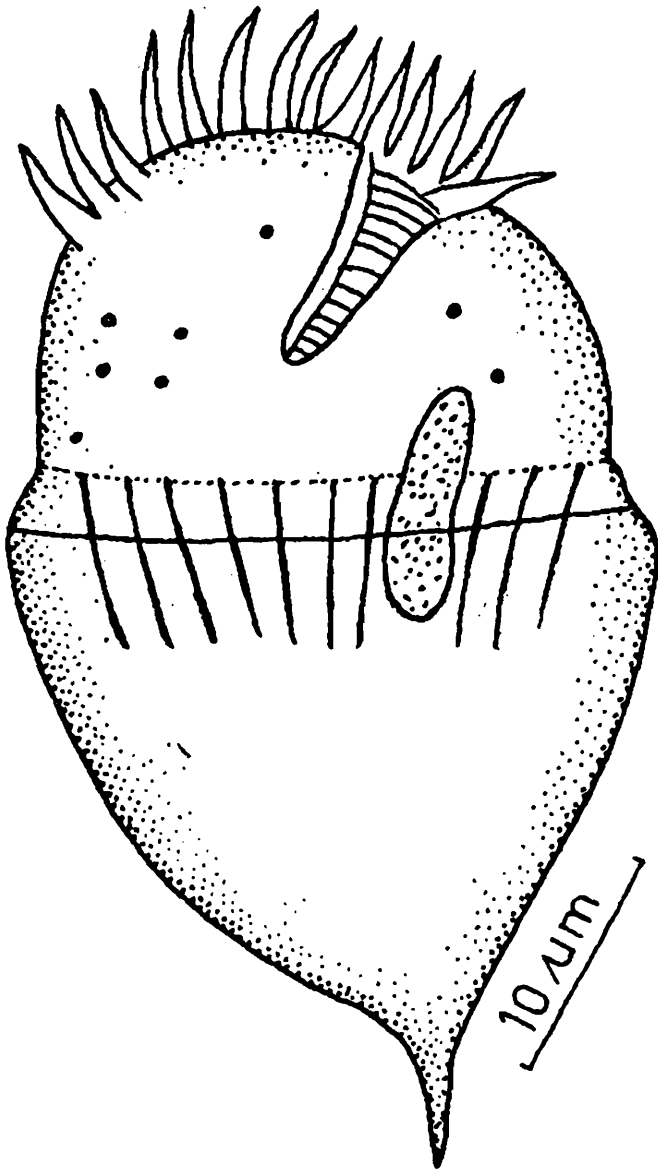


Fig. 50. *Strombidium calkinsi* Kahl

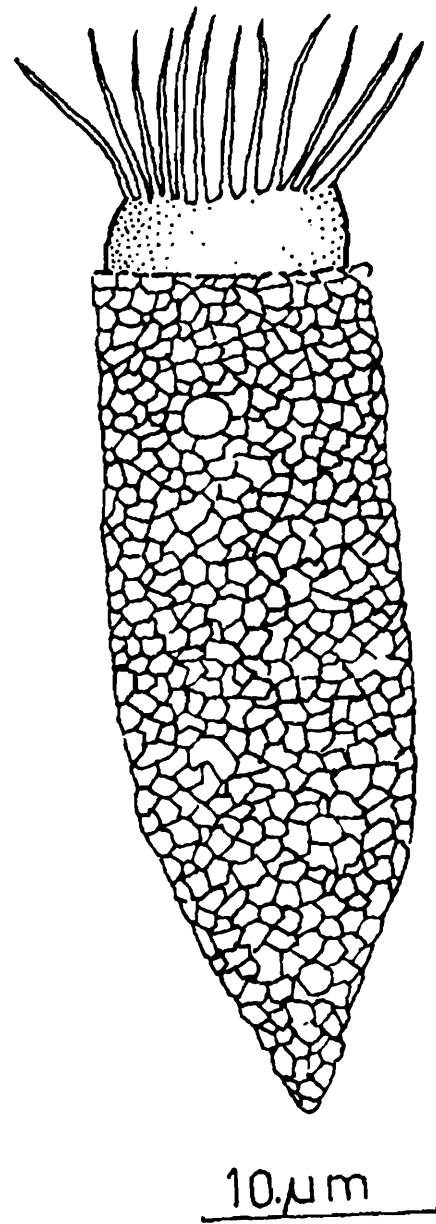


Fig. 51. *Tintinnopsis lohmani* Lackmann

Material examined : 2 exs., Barkuda, 31.v. 1969, Coll. K.N. Nair; 3 exs., Stn. 6, near Khallikote (Grid No. B₃), 6.IX.1987, Coll. A.K. Das; Stn. 7 (Grid No. D₃), 6.IX.1987, Coll. A.K. Das; 2 exs., Stn. 10 (between Grid Nos. D₇ & E₇), 8.IX.1987, Coll. A.K. Das ; 2 exs., Stn. 11 (Grid No. E₇), 8.IX.1987, Coll. A.K. Das; 4 exs., Stn. 12, near Parikud (Grid No. F₈), 10.IX.1987, Coll. .K. Das; 2 exs., Stn. 22 (Grid No. J₁₄), 16.IX.1987, Coll. A.K. Das; 2 exs., Stn. 33, near Gambhari (Grid No. P₁₁), 23.IX.1987, Coll. A.K. Das.

Diagnosis : Body slender, elliptical with thin ectoplasm; dimensions 80-97.1 μm x 31-42.3 μm ; peristome extending up to posterior third of the body; two ventral rows of cirri present and both reaching up to posterior third of the body; anals variable.

Distribution : India :Orisa and Andhra Pradesh.

Remarks : It is a brackish water species and collected from Chilka waters with salinity ranging from 4 to 15 p.p.t.

Genus *Keronopsis* Penard

54. *Keronopsis rubra* (Ehrenberg) (Fig. 53)

1838. *Oxytricha rubra* Ehrenberg, *Die Infusionsthierchen als Vollkommene Orgnismen*, Leipzig.
1932. *Keronopsis rubra* : Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 25, p. 571.

Material examined : 9 exs., Barkul and Satpara, 22.II.1969 & 12.VI.1969, Coll. K.N. Nair; 3 exs., Stn. 12, near Parikud (Grid No. F₈), 10.IX.1987, Coll. A.K. Das; 2 exs., Stn. 22 (Grid No. J₁₄), 16.IX.1987, Coll. A.K. Das.

Diagnosis : Body slender, reddish, anterior end sometimes slightly expanded; dimensions 115.9-171.8 μm X 28.9-41.4 μm ; peristome reaching one-fourth to one-fifth of the body length; frontal membranellae 8-10; frontal cirri three in number, sharp and distinct.

Distribution : India : Orissa and Andhra Pradesh.

Remarks : It is a salt water species and collected from Chilka waters having salinity 10-14 p.p.t.

Family OXYTRICHIDAE

Genus *Oxytricha* Bory

Body ellipsoid, marginal cirri may or may not continuous, 8 frontals, 5 ventrals and 5 anals present, caudal cirri short.

55. *Oxytricha chilkaensis* sp. nov. (Fig. 54)

Diagnosis : Body broadly oval, both left and right sides straight and almost parallel, both anterior

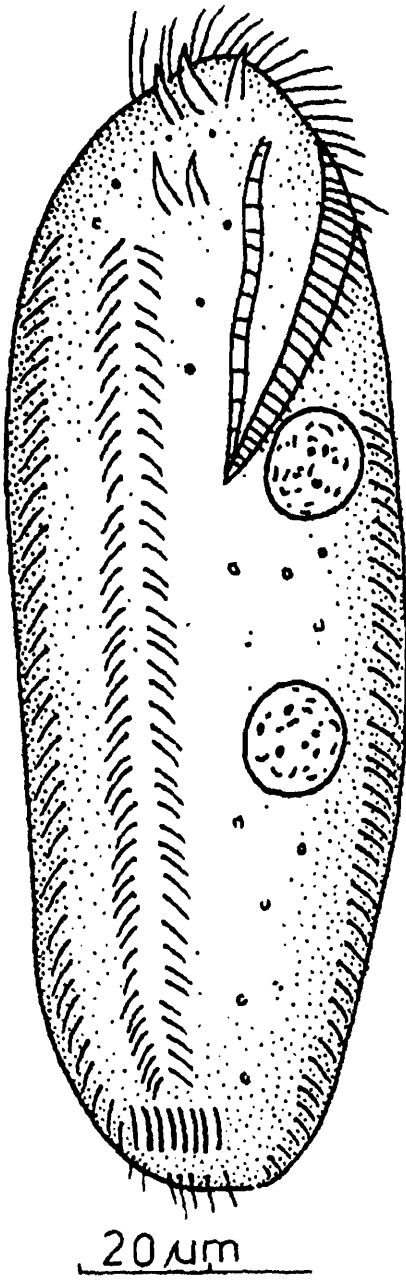


Fig. 52. *Holosticha manca* Kahl

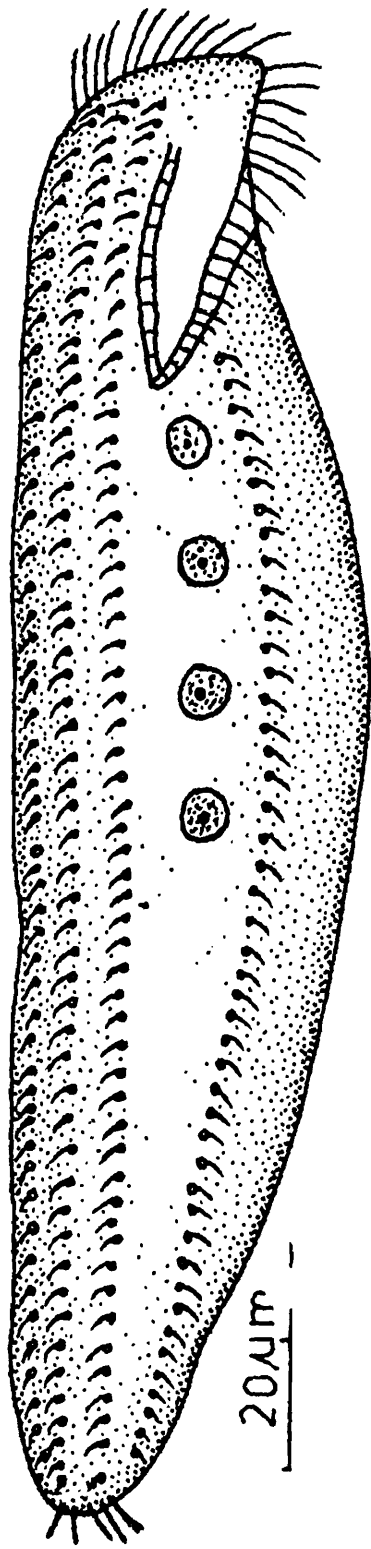


Fig. 53. *Keronopsis rubra* (Ehrenberg)

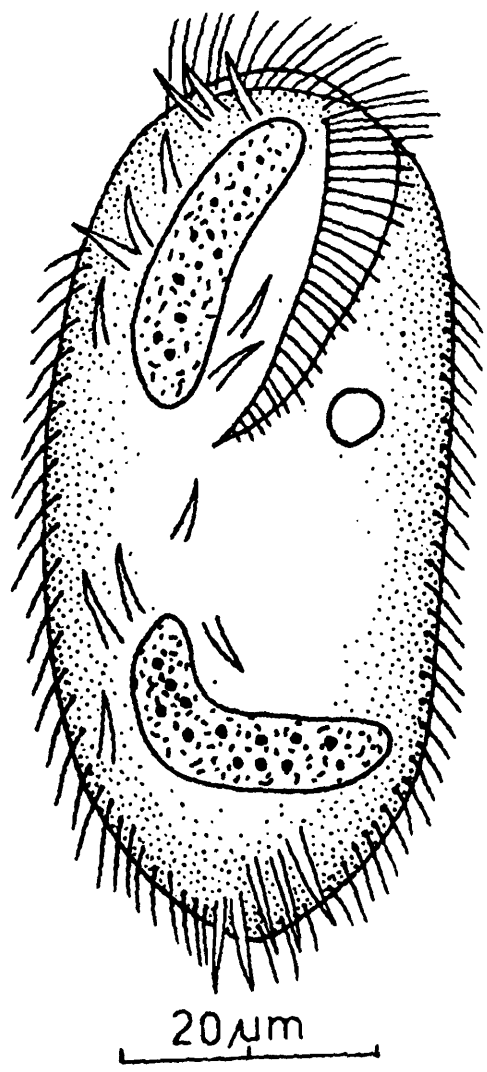


Fig. 54. *Oxytricha chilkaensis* sp. nov.

and posterior ends rounded, dimensions 50-54 μm X 25-30 μm ; frontal cirri 9, ventrals 5 and anals 5, peristome extending to almost middle of the body, macronuclei long, rod-shaped and two in number, contractile vacuole single and located at one side of the peristome.

Type material : Holotype : 1 ex., on slide (Reg. No. Pt. 2117); locality : Chilka lake (Stn. 14, near Nalbano island, between Grid Nos. I₁₀ & I₁₁), Orissa, India, 12.IX.1987, Coll. A.K. Das.

Paratype : 1 ex., on slide, Reg. No. and other data as for the holotype.

Remarks : The present species of *Oxytricha*, which has been collected from brackish water of the Chilka with salinity 13 p.p.t. resembles another congeneric salt water species, *O. ovalis* Kahl in body shape and in the arrangement of cirri. But it differs from *O. ovalis* in having : i) broadly oval-shaped body with both sides straight and almost parallel (vs. body oval but both sides convex in *O. ovalis*), ii) cytostome extending upto almost middle of the body (vs. cytostome extending upto one-third of the body length in *O. ovalis*) and iii) long and rod-shaped macronuclei (vs. more or less round macronuclei in *O. ovalis*). The other salt water species of *Oxytricha*, *O. marina* Kahl also considerably differs from *O. chilkaensis* sp. nov. in having : i) long ellipsoid body with little wider posterior part which often contains dark granules and ii) two round macronuclei.

Family EUPLLOTIDAE

Key to the genera

- 1(2) Peristome broadly triangular, frontoventrals 9 or more, 5 anals, 4 scattered caudals Genus *Euplotes*
- 2(1) Peristome relatively large, often reaching upto anals; fronto-ventrals 7-9, 5 anals and 3 strong cirri near posterior margin Genus *Diophrys*

Genus *Diophrys* Dujardin

56. *Diophrys appendiculata* (Ehrenberg) (Fig. 55)

1838. *Stylonychia appendiculata* Ehrenberg, *Die Infusionsthierchen als Vollkommens Organismen*, Leipzig.
1932. *Diophrys appendiculata* : Kahl, *Untiere oder Protozoa* (in Dahl's Tierwelt Dtsch.), Jena, pt. 25, p. 625.

Material examined : 7 exs., Barkul, Khallikote, and Nalbano island, 26.II. & 10.VI.1969, Coll. K.N. Nair.

Diagnosis : Body ellipsoid, dimensions 60-87 μm X 45.5-64.2 μm ; peristome large, reaching almost middle of the body; frontoventrals 7-8 in number; 2 marginals on the left side of the posterior part of the peristome; strong and large 5 anal and 3 caudal cirri present, latter placed deep into dorsal pit; macronucleus elongate, cylindrical and 2 in number.

Distribution: India : Orissa, Andhra Pradesh and, Andaman and Nicobar islands.

Remarks : This is a brackish water species.

Genus *Euplotes* Ehrenberg

Key to the species

- 1(2) Body irregularly oval without anterior collar, macronucleus sickle shaped *E. vannus*
- 2(1) Body oval or elliptical with anterior collar, macronucleus not sickle shaped
- 3(4) Anterior collar very prominent, peristomal lip short and arched, macronucleus similar to the figure "C" *E. eury stomus*
- 4(3) Anterior collar less or moderately prominent, peristomal lip long, shape of macronucleus not as above
- 5(6) Macronucleus 'T' or 'J' Shaped *E. woodruffi*
- 6(5) Macronucleus not as above
- 7(8) Peristomal lip large and hyaline, macronucleus in the form of open 'C' *E. patella*
- 8(7) Peristomal lip long and sinuous, macronucleus horse-shoe shaped *E. charon*

57. *Euplotes charon* (Muller)

(Fig. 56)

1786. *Trichoda charon* Muller, Havniae et Lipsiae, p. 367.

1960. *Euplotes charon* : Tuffrau, *Hydrobiologia*, 15, p. 57.

Material examined : 1 ex., Balugaon, 30.XII.1970, Coll. K. N. Nair; 2 exs., Stn. 6, near Khallikote (Grid No. B₃), 6.IX.1987, Coll. A. K. Das; 1 ex., Stn. 12 near Parikud (Grid No. F₈), 10.IX.1987, Coll. A. K. Das; 1 ex., Stn. 20 (Grid No. I₁₂), 14.IX.1987, Coll. A. K. Das; 2 exs., Stn. 22 (Grid No. J₁₄), 16.IX.1987, Coll. A. K. Das; 1 ex., Stn. 33, near Gambhari (Grid No. P₁₁), 22.IX.1987, Coll. A. K. Das.

Diagnosis : Body oval, dorsal side convex, average dimensions 72 µm x 49 µm, anterior collar moderately prominent; peristomal lip long and sinuous, 12 latero-dorsals, 10 frontoventrals, 5 transverse and 5-8 curved caudal cirri present, macronucleus horse-shoe shaped.

Distribution : India : Orissa, Maharashtra and Rajasthan.

Remarks : This species has been reported from fresh and salt water. The present material has been collected from Chilka waters with salinity 4-14 p.p.t.

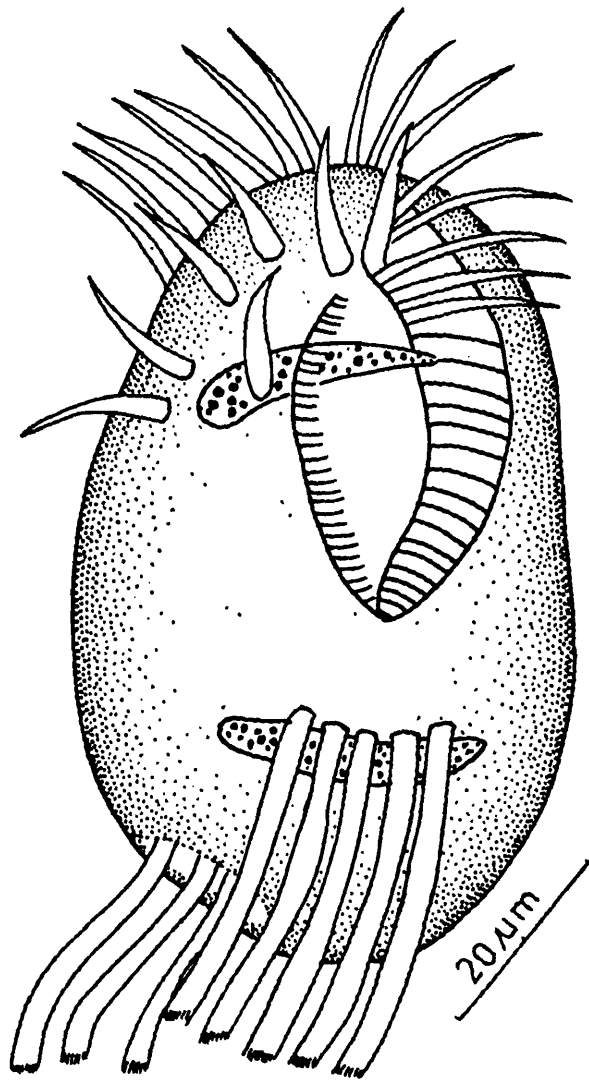


Fig. 55. *Diophrys appendiculata* (Ehrenberg)

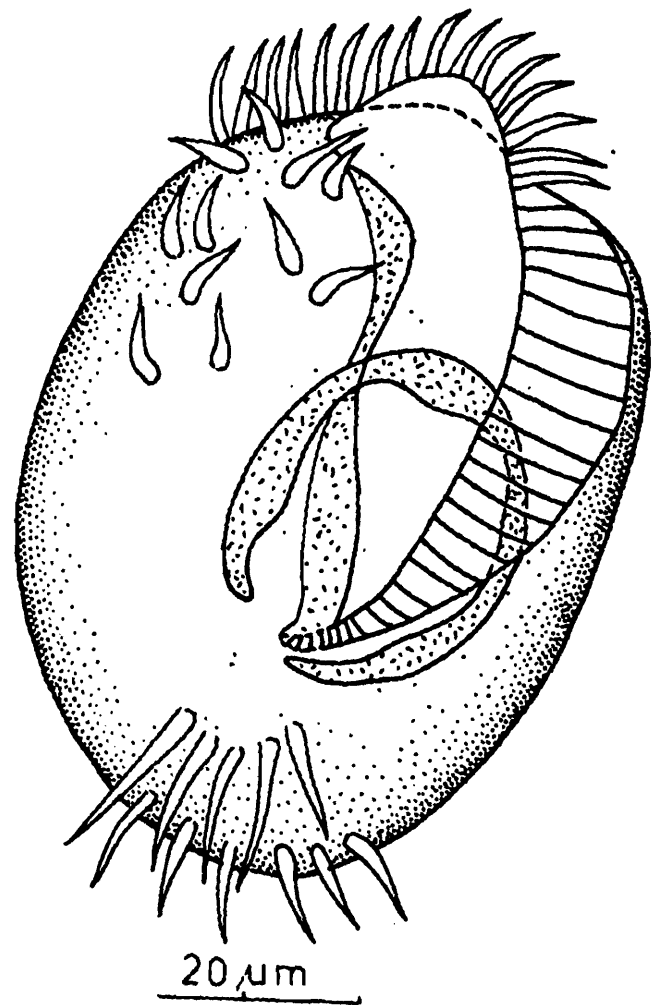


Fig. 56. *Euplotes charon* (Muller)

58. *Euplotes eury stomus* Wrzesniowski
(Fig. 57)

1870. *Euplotes eury stomus* Wrzesniowski, Z. (wiss.) zool. 20, p. 467.

1960. *Euplotes eury stomus* : Tuffrau, *Hydrobiologia*, 15, p. 33.

Material examined : 2 exs., Stn. 13, near Nalbano island (Grid No. H₉), 12.IX.1987, Coll. A. K. Das.

Diagnosis : Body elliptical, little angular, narrowing at both left and right margins; dimensions 159µm-99.3µm; anterior collar prominent and translucent; peristomal lip short and arched; 8 laterodorsals, 9 frontodorsals, 5 transverse and 4 caudal cirri present; macronucleus resembling figure '3'

Distribution : India : Orissa (first record); also first record from India.

Remarks : This species usually occurs in fresh water. But, the present material was collected from brackish water of the Chilka with salinity 15 p.p.t.

59. *Euplotes patella* (Muller)
(Fig. 58)

1773. *Trichoda patella*, Muller, Havnae et Lipsiae

1960. *Euplotes patella* : Tuffrau, *Hydrobiologia*, 15, p. 40.

Material examined : 2 exs., Stn. 27, near Satpara (Grid No. D₈), 21.IX.87, Coll. A. K. Das.

Diagnosis : Body oval to elliptical, truncate anteriorly, dimensions 86-95 µm x 66.2 - 72.3 µm; anterior collar less prominent; peristomal lip large and hyaline; 9 latero-ventral, 9 fronto ventral, 5 transverse and 4 caudal cirri present; macronucleus resembling inverted 'C'.

Distribution : India : Orissa (first record); Rajasthan and West Bengal.

Remarks : It is a fresh water species and collected from Chilka waters having salinity 3-4 p.p.t.

60. *Euplotes vannus* (Muller)
(Fig. 59)

1786. *Trichoda vannus* Muller, Hauniae et Lipsiae.

1932. *Euplotes vannus* : Kahl, *Urtiere oder Protozoa* (in Dahl's Tierwelt Dtach.), Jena, pt. 25, p. 636.

Material examined : 2 exs., Stn. 5, near Somolo island (between Grid Nos. C₃ & C₄), 5.IX.1987, Coll. A. K. Das; 1 ex., Stn. 10 (between Grid Nos. D₇ & E₇), 8.IX.1987, Coll. A. K. Das; 2 exs., Stn., 11 (Grid No. E₇), 8.IX.1987, Coll. A. K. Das.

Diagnosis : Body irregularly oval without any anterior collar, left and right margins parallel and rectilinear and, both anterior and posterior extremities uniformly rounded; dimensions 58-66.2 µm x 25-33.1 µm; peristomal lip slightly sinuous; 9 latero-dorsals, 10 frontodorsals, 5 transverse and 4 caudal cirri

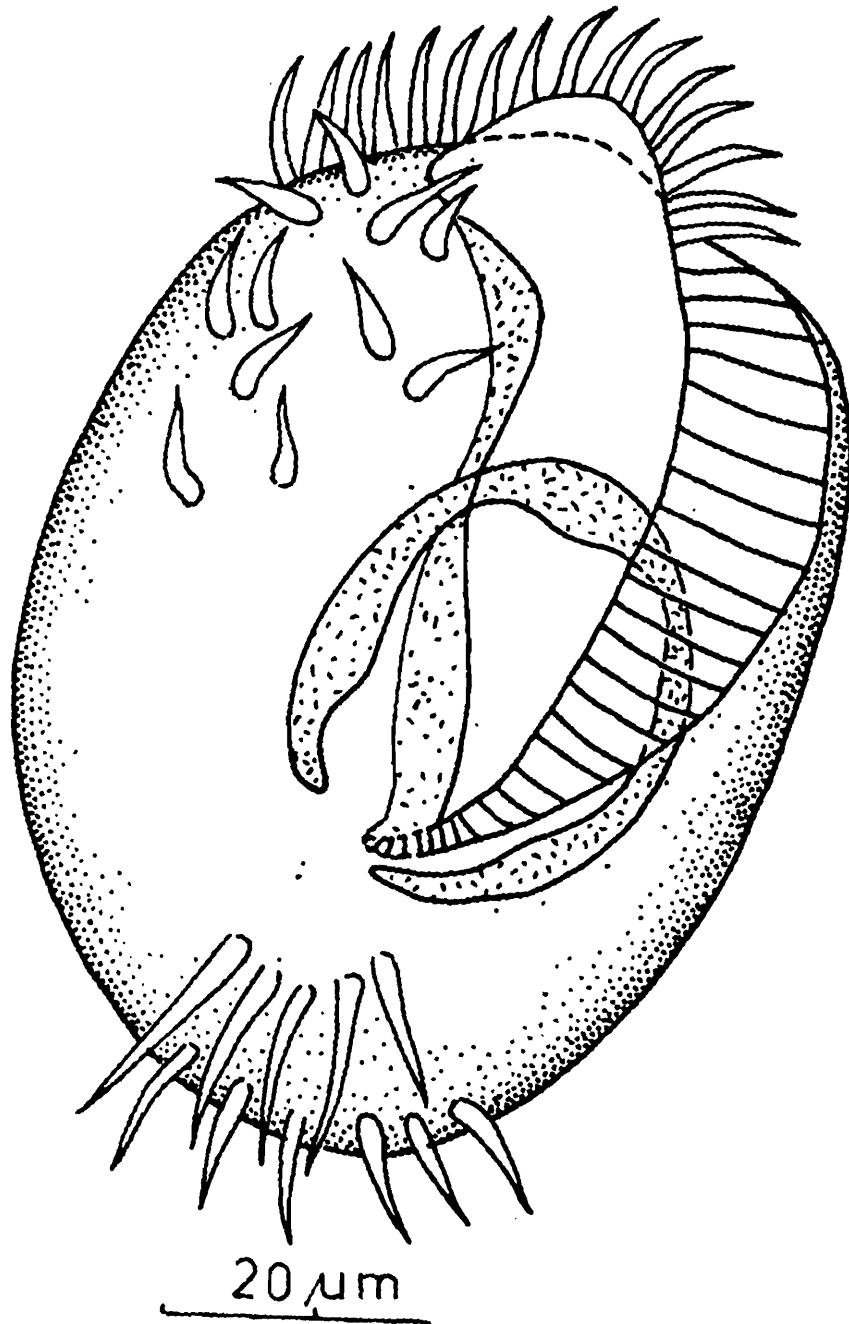


Fig. 57. *Euplotes eurystomus* Wrzesniowski

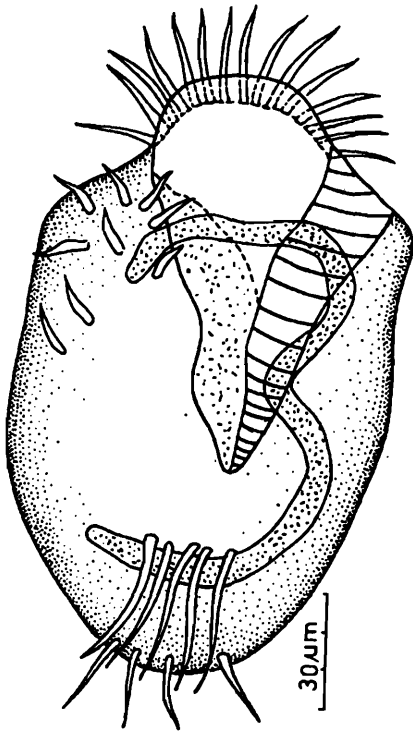


Fig. 58. *Euplotes patella* (Muller)

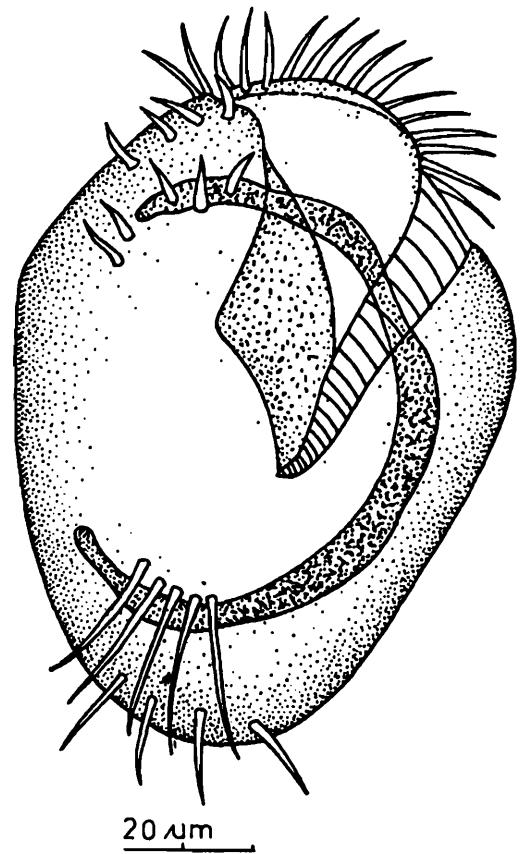


Fig. 59. *Euplotes vannus* (Muller)

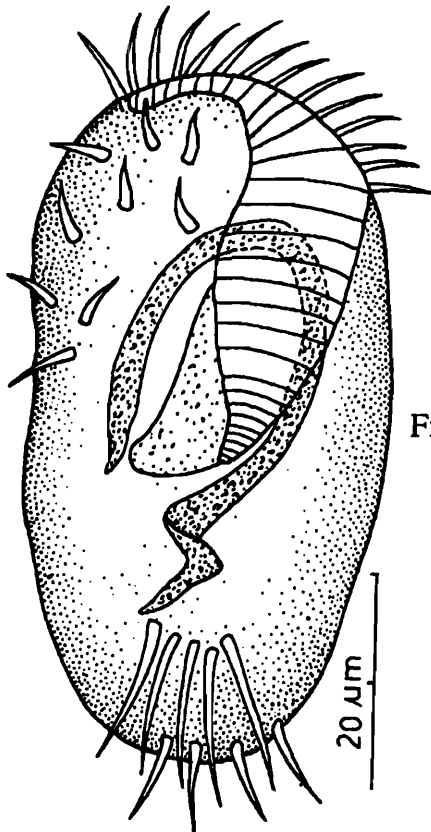


Fig. 60. *Euplotes woodruffi* Gaw

present; macronucleus sickle shaped.

Distribution : India : Orissa, Andhra Pradesh and, Andaman and Nicobar islands.

Remarks : It is a salt water species and collected from Chilka waters with salinity 14-15 p.p.t.

61. *Euplotes woodruffi* Gaw
(Fig. 60)

1940. *Euplotes woodruffi* Gaw, *Arch. Protistenk.*, 93, p. 1.

1966. *Euplotes woodruffi* : Kudo, *Protozoology.*, p. 1006.

Material examined : 8 exs., Khallikote, Parikud, Nalbano island, Balugaon and Rhambha, 19.II.1969 & 9.VI., 10.VI. & 12.VI.1969 & 17.XII.1970, Coll. K. N. Nair; 2 exs., Stn. 25, near Kaluparaghat, 18.IX.1987, Coll. A. K. Das.

Diagnosis : Body oval, with anterior end more broad than posterior end, dimensions 99.4-107.6 μm x 62.1-72 μm anterior collar prominent; peristomal plate small, 9 fronto-ventrals, 5 transverse and 4 caudal, cirri present; macronucleus 'V' shaped.

Distribution : India : Orissa and Andhra Pradesh.

Remarks : This species has so far been reported from both fresh and brackish water with salinity 2-3 p.p.t.

SUMMARY

Taxonomic account of all the freeliving ciliates reported so far from the Chilka Lake, Orissa is dealt with in the present communication along with the keys to their families, genera and species. These material comprise 61 species belonging to 37 genera under 31 families and 12 orders, out of which 2 species, viz. *Holophrya nairi* sp. nov. and *Oxytricha chilkaensis*, sp. nov. are new to science, 13 species are reported for the first time from India and 22 constitute first report from Orissa state.

ACKNOWLEDGEMENTS

The author is grateful to the Director, Zoological Survey of India, for kindly providing him the facilities in the present work and to Dr. A. K. Mandal, Ex-Scientist 'SE' for critically going through the manuscript.

REFERENCES

- Annandale, N. 1915. Fauna of the Chilka Lake : The coelenterates of the lake, with an account of the Actinaria of brackish water in the Gangetic delta. *Mem. Indian Mus.*, 5 : 65-114.
- Chilton, C. 1921. Fauna of the Chilka Lake : Amphipoda. *Mem. Indian Mus.*, 5 : 519-558.

- Das, A. K. and Nair, K. N. 1987. Fauna of Orissa. Protozoa (freeliving). State Fauna Series No.1, Pt. 1, *Zool. Surv. India* : 25-52.
- Das, A. K., Mandal, A. K. and Sarkar, N.C. 1993, Protozoa fauna of West Bengal, India. 1. Freeliving Protozoa. *State Fauna Series*, : 3, *Fauna of West Bengal*, Pt. 12, *Zool. Surv. India* : 1-134.
- Mahajan, K. K. 1965. Fauna of Rajasthan, India, Part 10. Protozoa (No. 2) *Rec. zool. surv. India*, **63** : 45-76.

PORIFERA

J. G. PATTANAYAK

*Estuarine Biological Station, Zoological Survey of India
Berhampore 760 005*

INTRODUCTION

In order to have an up to date account of the sponge fauna of Chilka Lake, Orissa, India a number of expeditions were undertaken in different seasons during the years 1985 - 1987 to cover almost all parts of the lake. As a result of above expeditions a total of 35 lots of sponges belonging to two species under two genera and two families were collected.

As per records it reveals that 7 species under 5 genera and 4 families have been recorded by Annandale (1915). After that only literature of Sarma, Rao and Satapathy (1979) is available which deals only with the faunal associates of two species of sponges of Chilka Lake and not on the taxonomy of sponges.

By thorough investigation of the specimens of Annandale and also according to world literature it is found that 7 species under 5 genera and 4 families are so far recorded as per the present status of the species from Chilka Lake which are dealt within this paper.

During this expedition only two species are found. Out of them, one mainly freshwater form having tolerance of high salinity range and are found throughout the lake, the other one is boaring on mollusc shells and is found only in the main area of the lake. The other species which were recorded by Annandale (1915) are not available during this investigation. That may be due to the decrease of salinity which is completely intolerable for exclusively marine forms. The decrease of salinity is due to more inflow of freshwater from different rivers as well as abolition of one of the two connecting channels with the sea. At present only two species prevails in this lake but as per present status and earlier records this paper is dealt with 6 species. Key to the families, genera and species and their distribution by grid maps of the lake are also included in this paper. Classification of sponges is based on Hartman, 1982.

MORPHOLOGY AND TERMINOLOGY

Amphioxea : Spicule tapering or pointed at both ends. (text fig. 1)

Basal lamina : The attachment surface of a sponge.

Body colour : Colouration of sponges depends on the presence or absence of Zoochlorellae or Zoozanthellae within the tissue of the sponge, rarely by the presence of pigments or by adventitious sediments. Except in some well established cases, the colouration seems therefore of little taxonomic significance.

Form and consistancy : Form of sponge body depends on the growth. In mature sponge, form may range from thin to thick crusts or cushions, being of bulbous or otherwise massive nature, or display branching, sub-branching or pseudo branching projections. Consistency depends on the spongin present in the skeletal meshwork, this may be hard, soft or brittle.

Foramen : An orifice of the gemmule (when present).

Foraminal tubule : A horny tube that surrounds the foramina of some gemmule.

Gemmosclere : A desiccation – resistant asexual reproductive body composed of a mass of archaeocytes charged with reserves and enclosed in a non-cellulose protective envelope.

Megasclera : A structural spicule.

Microsclere : Spicule that lies free in the symplasm.

Osculum : An aperture through which water is ejected out from the sponge.

Pneumatic coat : A horny or chitinous layer on the surface of the gemmule containing air-spaces.

Spicule : A discrete element of the sponge skeleton. Usually composed mainly of silica or calcium carbonate but spongin spicules do occur rarely.

Spirasters : Short spiny microscleric monaxons are known as steptasters, of which the principal sorts are spirally twisted are spirasters. (Text fig. 12)

Style : When growth of the spicule has occurred in one direction only and forming dissimilarity of the two ends, the spicule is called a style. (Text fig. 4).

Symplasm : The inner mass of sponge body.

Triaenes : Tetraxon spicule of the appearance of crown of three rays, the cladome, at the end of the long rhabdom. (Text fig. 14).

Tylostyles : styles in which the broad end is knobbed. (Text fig. 4).

SYSTEMATIC ACCOUNT

Phylum PORIFERA

Class DEMOSPONGIAE Sollas

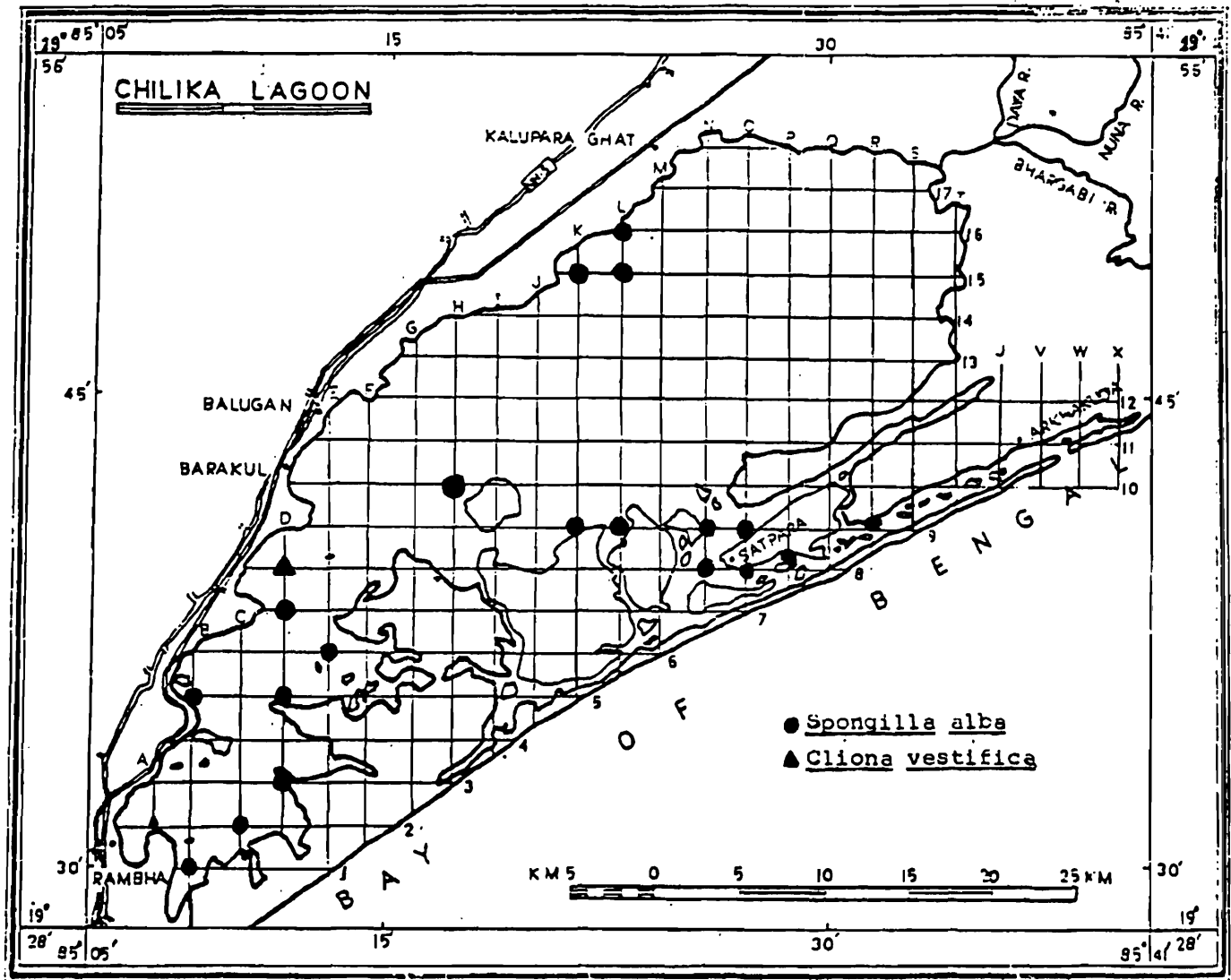
Subclass CERACTINOMORPHA Levi

Order HAPLOSCLERIDA Topsent

Family SPONGILLIDAE Gray

1. Genus *Spongilla* Lamarck

(i) *Spongilla alba* Carter



PRESENT DISTRIBUTION OF SPONGES

Map

Subclass TTRACTINOMORPHA Levi

Order HADROMERIDA Topsent

Family SUBERITIDAE Schmidt

2. Genus *Suberites* Nardo

(ii) *Suberites sericeus* Thiele

3. Genus *Laxosuberites* Topsent

(iii) *Laxosuberites aquae-dulcioris* Annandale

(iv) *Laxosuberites lacustris* Annandale

Family CLIONIDAE Gray

4. Genus *Cliona* Grant

(v) *Cliona vestifica* Hancock

Order SPIROPHORDIA Levi

Family TETILLIDAE Sollas

5. Genus *Tetilla*

(vi) *Tetilla dactyloidea* (Carter)

Subclass CERACTINOMORPHA Levi

Diagnosis : Viviparous reproduction, only monaxonid megascleres, no triaenes; only sigmoid or chelate microscleres, no astross.

Order HAPLOSCLERIDA Topsent

Diagnosis : Megascleres are diactinal (oxeas or strongyles). Microscleres, if present are sigmas, taxons, or rarely microxeas. Spongin is always present, varying in amount from an interspicular cement upto reticulations of prominent fibres enclosing spicules.

Family SPONGILLIDAE Gray

Diagnosis : freshwater form; spicules smooth or spined oxeas, or strongyles, or birotulates, organised into bundles or tracts and bound by spongin; asexual reproduction by gemmule.

1. Genus *Spongilla* Lamarck

1758. *Spongia* Linnaeus, *Systema Naturae*, 10th ed., 1, animalia : 1348.
 1816. *Spongilla* Lamarck, *Historie naturelle des animaux sans vertebres*, 2 : 98.
 1968. *Spongilla*, Penney and Racek, *Bull. U.S. natn. Mus.*, No. 272 : 7.

Type species : *Spongia lacustris* Linnaeus, 1758.

Diagnosis : Megascleres slender to stout, smooth, amphioxea.

Microscleres slender, spined, amphioxea and different from gemmoscleres.

Gemmoscleres - stout, curved, strongly spined amphioxea or amphistrongyla.

Gemmules : spherical, large, abundant and scattered throughout the sponge; pneumatic layer granulated with very small non-polygonal air-spaces, gemmoscleres embedded tangentially in it; foramen cup-shaped, never tubular.

Distribution : Cosmopolitan.

(i) *Spongilla alba* carter, 1849
 (Text figs. 1-3)

1849. *Spongilla alba* Carter, *Ann. Mag. Nat. Hist.*, 4 : 83.
 1915. *Spongilla nana* Annandale *Mem. Indian Mus.* 5 : 32.
 1968. *Spongilla alba*, Penney and Racek, *Bull. U.S. natn. Mus.*, No. 272 : 16.

Material examined : One lot, Chilka Lake B-1, 12.VI.1986; one lot, B-1, 4.IX.1987; one lot, B-5, 6.IX.1987; one lot, C-2, 11.VI.1986; two lots, C-2, 23.XI.1985; two lots, D-3, 12.VI.1986; three lots, D-5, 6.IX.1987; one lot, D-7, 27.XI.1985; one lot, K-15, 16.IX.1987; one lot, L-15, 17.IX.1987; one lot, E-6, 7.IX.1987; one lot, H-10, 27.XI.1985; one lot, L-16, 25.VI.1986; one lot, N-8, 28.XI.1985; two lots, Pariakuda Island, 16.XII.1985; two lots, Nalbano Island, 17.XII.1985; three lots, Satpara, 6.XII.1985; two lots, off Nuapara, 8.XII.1985; one lot, Barunakuda, 29.VI.1986; one lot, Nuapara Island, 29.6.1986; one lot, Gurubhai point, 29.VI.1986; one lot, Mirjapur, 27.VI.1986; one lot, Serkheda, 29.VI.1986; one lot, Alupatna, 27.VI.1986; one lot, Panchkudi point, 16.XII.1985.

Description : Sponge forming massive growth and branching of moderate thickness, surface smooth with irregular projections, oscula moderate size; dermal membrane closely adherent to symplasm, consistency hard but brittle.

Megascleres - feebly curved, slender to stout and fusiform, smooth amphioxea; length range 0.195 - 0.285 mm, width range 0.010 - 0.015 mm.

Microscleres : numerous in dermal membrane; slightly curved, slender, amphioxea with erect spines more in number and longer in central region; length range 0.055 - 0.075 mm, width range 0.001 - 0.003 mm.

Gemmoscleres feebly curved, slender, cylindrical amphistrongyla, with large recurved spines more numerous at the tip regions; length range 0.085 - 0.110 mm, width range 0.005 - 0.008 mm.

Gemmules : abundant, scattered throughout the body; large spherical; pneumatic layer moderately thick granular, gemmoscleres projecting beyond outer surface of this layer; foramen cup shaped; diameter range 0.30 - 0.60 mm.

Colour in life : whitish in live form.

Distribution : India : Andhra Pradesh, Kerala, Maharashtra, Orissa, Rajasthan and West Bengal. Outside India : Africa, Australia, South America and South East Asia.

Remarks : During this present survey this species is available throughout the Chilka Lake in huge quantity.

Subclass TTRACTINOMORPHA Levi

Diagnosis : Demospongiae with oviparous reproduction, tetraxonid, and monaxonid megascleres, astrose microscleres along with sigmas and raphides.

Order HADROMERIDA Topsent

Diagnosis : Megascleres are monaxonid, usually tylostyles, sub-tylostyles or styles but occasionally diactinal types. Microscleres, if present, are euasters or streptasters or derivatives thereof. A well formed network of spongin fibres is absent. Consistency is firm but often friable.

Reproduction oviparous with parenchymella larva and development taking place in the sea.

Family SUBERITIDAE Schmidt

Diagnosis : megascleres are tylostyles, sub-tylostyles, styles or infrequently, diactinal types. Microscleres are usually absent, when present they are spined, centrotylote, diactinal types. Papillae are absent. Skeletal architecture radiate or subradiate.

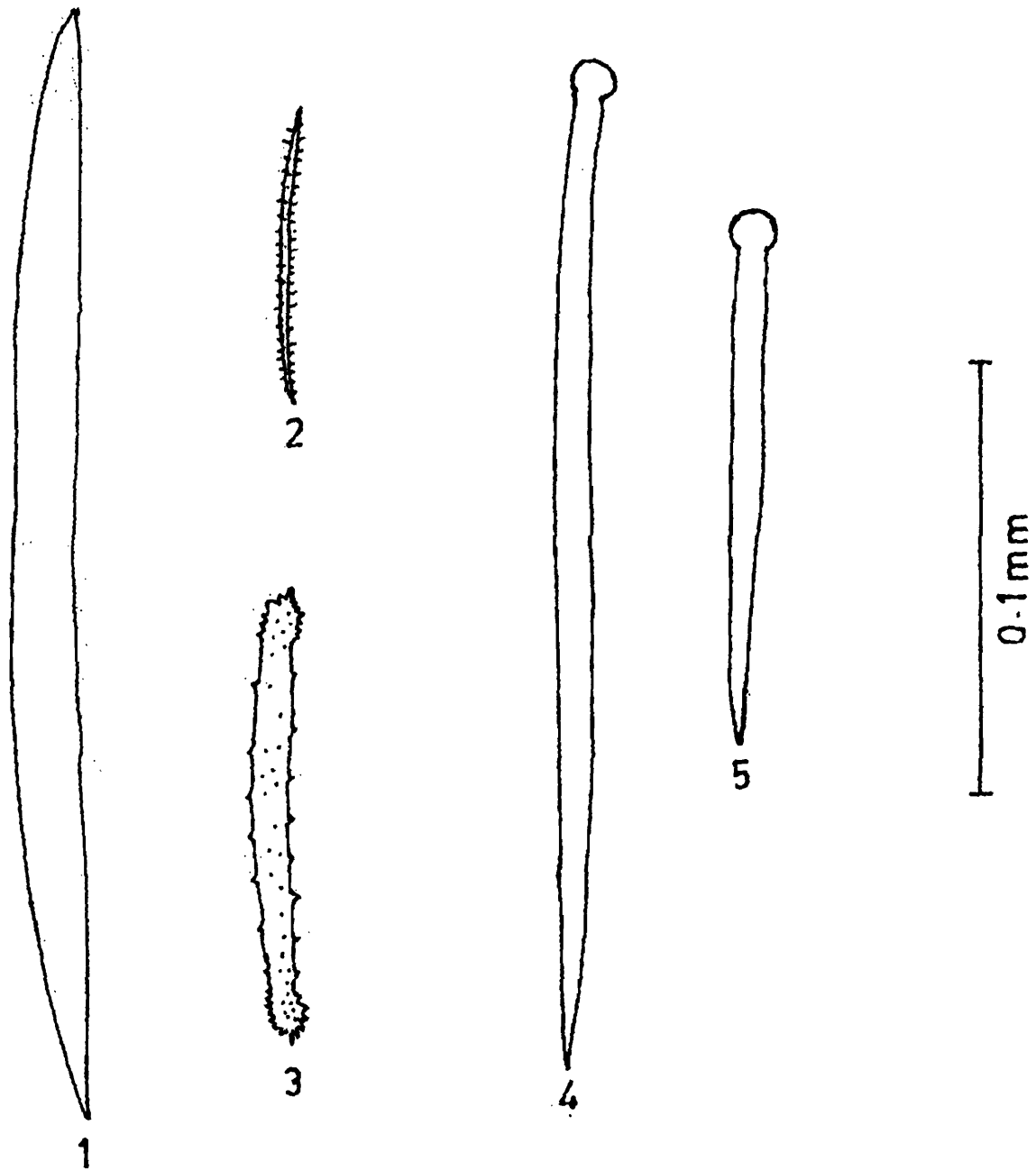
Key to the Genus

Ectosomal spicules are well differentiated from the endosomal spicules *Suberites*

Ectosomal spicules are not differentiated from the endosomal spicule *Laxosuberites*

2. Genus *Suberites* Nardo, 1833

1833. *Suberites* Nardo, "Auszug aus einem neuen system der spongiarien: 'Isis' (Oken), coll., P. 523.
 1859. *Lithumena* Lioberkuhn, Arch. Anat. Phys., p. 520.
 1867. *Ficulina* Gray, Proc. Zool. Soc. London, p. 523.
 1905. *Suberella*, Thiele, Zool. Jahrb. Jena. suppl. vi : 416.



- 1. Magaslere of *Spongilla alba*
- 2. Microsclere of *Spongilla alba*
- 3. Gemosclere of *Spongilla alba*
- 4 & 5. Megaslere of *Suberites sericeus*

Type species : *Alcyonium domuncula* Olivi

Diagnosis : Massive form; skeleton consisting of an irregularly radial main skeleton of large tylostyle, and a dermal palisade of small tylostyle set at right angles to surface; ectosomal spicules are well differentiated from the endosomal spicules.

Distribution : Range from intertidal habitats to depths of at least 3750m and are worldwide in distribution.

(ii) *Suberites sericeus* Thiele, 1898
(Text figs. 4 & 5)

1898. *Suberites sericeus*. Thiele, *Bibl. Zool.* X, 24 : 39, pl. viii, fig. 10.

1915. *Suberites sericeus*, Annandale, *Mem. Indian Mus.*, 5 : 36, pl. iv, fig. 4.

Description : Sponge forming flat crusts of moderate thickness, surface hispid with irregular projections; oscula are small and scattered, not connected by sub-dermal canals but a few irregular exhalent channels in this position sometimes open into them; pores are minute and not confined to restricted areas; consistency soft and somewhat elastic; stout horny membrane at the base of the sponge.

Skeleton composed of tylostyles of two types. Larger type have small sub-globular head and length range 0.23 mm - 0.45 mm, thickness of shaft range 0.008-0.012 mm, diameter of the head range 0.010 mm - 0.014 mm. Smaller type have length range 0.10 mm - 0.15 mm, thickness of shaft range 0.005 - 0.008 mm and diameter of the head range 0.008-0.010 mm. Spicules of larger type found in abundance throughout the sponge but smaller type occur in the central parts only.

Microscleres absent.

Colour in life - bright sulphur-yellow, disappears rapidly in spirit.

Distribution : India : Orissa. Outside India : Japan.

Remarks : Since Annandale's report of this species in 1915, it is not recorded elsewhere in India. During the present investigation also thorough search has been made in the same locality but the author is unable to collect the species.

3. Genus *Laxosuberites* Topsent, 1896

1896. *Laxosuberites* Topsent, *Mem. Soc. Zool. Fr.* IX : 126.

Type species : *Suberites rugosus* Schmidt.

Diagnosis : Suberitidae of massive form, with skeleton of tylostyle of one size arranged in radial bundles or in a confused reticulation in choanosome and forming surface brushes. Ectosomal spicules are not differentiated from the endosomal spicules.

Key to the Species

Plumose spicule fibres terminate in free brush-like branches of spicules on the surface of sponge
 *L. lacustris*

Spicule fibres do not terminate in free brush-like branches of spicules on the surface of sponge
 *L. aquae-dulcioris*

(iii) *Laxosuberites aquae-dulcioris* Annandale, 1914
 (Text. figs. 6 & 7)

1914. *Suberites aquae-dulcioris* Annandale, *Rec. Ind. Mus.*, X : 157, pl. xi, fig. I.

1915. *Laxosuberites aquae-dulcioris*, Annandale, *Mem. Indian Mus.*, 5 : 42.

Description : Sponge forming robust to flat crusts depending upon the attachment surface, surface hispid; oscula many, forming uniform layer of considerable area, protected by oscular collar formed of dermal membrane. Dermal pores minutely open directly into cylindrical channels of considerably greater diameter; consistency soft but compact.

Skeleton composed of tylostyles, most of their heads in contact with the basal membrane and their shafts projecting upwards, length of largest spicules is 0.33 mm, breadth of the thickest part of the shaft is 0.005 mm and breadth of the head is .006 mm.

Microscleres absent.

Colour in life deep orange-yellow in colour due to accumulation of food material in cells and occasionally bright green due to presence of Zoochlorelae.

Distribution : India : Orissa.

Remarks : After Annandale's report from this locality in 1915 this species is not recorded elsewhere in India. during the present investigation also this species is not found from the same locality even though thorough investigations were made.

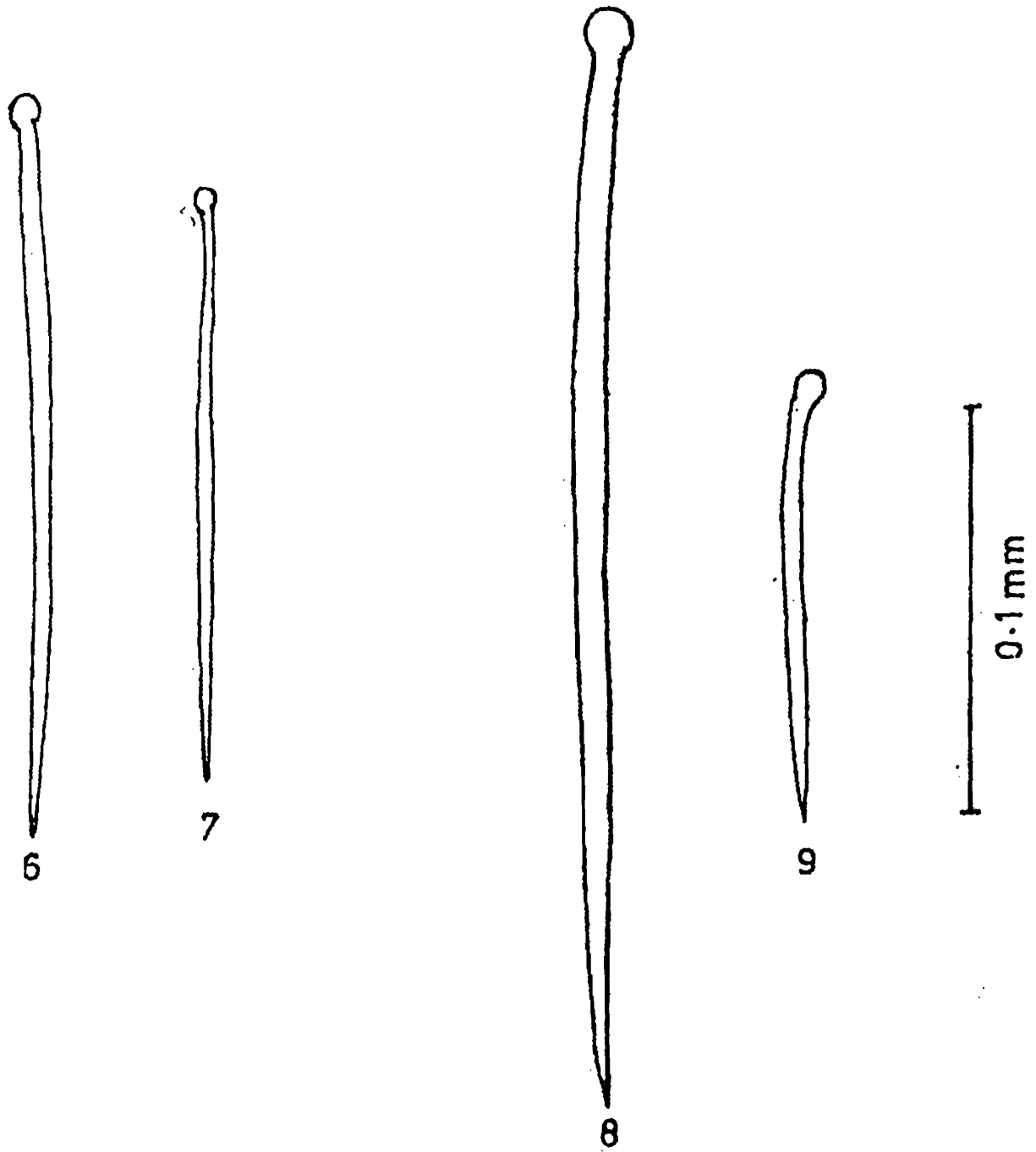
(iv) *Laxosuberites lacustris* Annandale, 1915
 (Text figs. 8 & 9)

1915. *Laxosuberites lacustris* Annandale, *Mem. Indian Mus.*, 5 : 45.

1937. *Laxosuberites lacustris*, Burton, *Bull. Madras Govt. Mus.*, 1 (2), pt. 4 : 14.

1985. *Laxosuberites lacustris*, Thomas, *Recent Advances in marine Biology* : 311.

Description : Sponge forming thin and fragile films on stones and rocks, surface smooth and minutely hispid; usually one osculum, but many frequently grow so close together as to form an apparently uniform layer of considerable area, osculum slightly raised and protected by oscular collar, small, 0.08 mm in diameter; inhale dermal pores lie scattered, minute, open directly into cylindrical channels.



6 & 7. Megaloceres of *Laxosuberites aquae-dulcioris*
8 & 9. Megaloceres of *Laxosuberites lacustris*

Skeleton consisting of plumose spicule fibres that terminate in free bush-like bunches of spicules on the surface of the sponge.

Megascleres tylostyles, length range 0.11 mm to 0.58 mm, thickness of shaft range 0.004 mm to 0.008 mm and diameter of head range 0.006 mm to 0.009 mm.

Microscleres absent.

Colour in life generally colourless but sometimes orange-yellow or bright green due to the presence of food materials of zoochlorelae.

Distribution : India : Orissa, Gulf of Mannar.

Remarks : After Annandale's report from this locality in 1915 this species is recorded from Gulf of Mannar in India. During the present investigation this species is not found from the same locality of Chilka Lake.

Family CIONIDAE Gray

Diagnosis : Escavate burrows in mollusc shells, corals, limestone or other calcareous materials by chemical etching agents secreted at the tips of pseudopodial process of special etching cells from the larval stage onwards. The spicules are siliceous which include tylosteles or sub-tylostyles, micro-spined oxeas and spirasters. Occurs in all seas, chiefly in tidal and shallow waters.

4. Genus *Cliona* Grant, 1826

1888. *Cliona*, Topsent, *Arch. Zool. experim.*, (2) V, bis, p. 76.
1915. *Cliona*, Annandale, *Rec. Ind. Mus.* XI : 1.

Type species : *Cliona celata* Grant, 1826

Diagnosis : Clionidae of massive growth in the burrows of perforated dead or living shells. Orange to sulphur yellow in colour. Tylostyles, oxeas and spirasters spicules are present.

(v) *Cliona vestifica* Hancock, 1849 (Text figs. 10-12)

1900. *Cliona vestifica*, Topsent, *Arch. Zool. experim.*, (3) VIII, p. 56, pl. ii. figs. 3-9.
1915. *Cliona vestifica*, Annandale, *Rec. Ind. Mus.*, xi : 8.
1972. *Cliona vestifica*, Thomas, *J. mar. biol. Ass. India*, p. 345, pl. 1, figs. 3, 3A, 3B.

Material examined : One lot, Chilka Lake, d-8, 18.VIII.1986.

Description : This is the commonest species of boring sponge in the coasts of India in shallow water, infesting shells and all calcareous objects alike. The openings found irregularly arranged on the surface

of the shells. Diameter openings 0.5-1 mm. Chambers found inside the shell rounded, elliptical or irregular in shape, with diameter of 1-2 mm.

Skeleton consisting of three types of spicules Tylostyles, oxeas and spirasters. Tylostyles - straight, head spherical, pointed and sharp, length range 0.15-0.22 mm, width of the shaft range 0.003-0.004 mm and diameter of head range 0.004 - 0.006 mm. Oxeas Amphioxea, smooth or microspined and sharply pointed at both ends, length range 0.09 - 0.15 mm, width range 0.003 - 0.006 mm. Spirasters - with 2 - 6 angulations, spined or smooth, length range 0.005 - 0.020 mm, width range 0.001 - 0.004 mm.

Colour in life pale yellow.

Distribution : India : Orissa, Gulf of Mannar, Palk Bay, Mandovi and Zuari Estuaries, Ennur backwaters, Adyar river near Madras. Outside India : Truly cosmopolitan.

Remarks : This species has tolerance of wide range of salinity and hence they are very common in estuaries. Annandale (1915) recorded this species from outer channel as well as from main area of Chilka Lake but during the present investigation this species is recorded from the main area only.

Order SPIROPHORDIA Levi

Diagnosis : Trianaes and oxeas are present as megascleres arranged in a radiate pattern. Microscleres are sigmaspires. Sexual reproduction is either oviparous followed by direct development or viviparous with production of young adults within the parental tissue. This order includes only single family Tetillidae.

Family TETILLIDAE Sollas

Diagnosis : Same as that of order with protriaenes always present.

5. Genus *Tetilla* Schmidt, 1862

1862. *Tetilla* Schmidt, *Spongien der Adriat, Meeres Leipzig*, p. 40.

Type species : *Tetilla polyura* Schmidt.

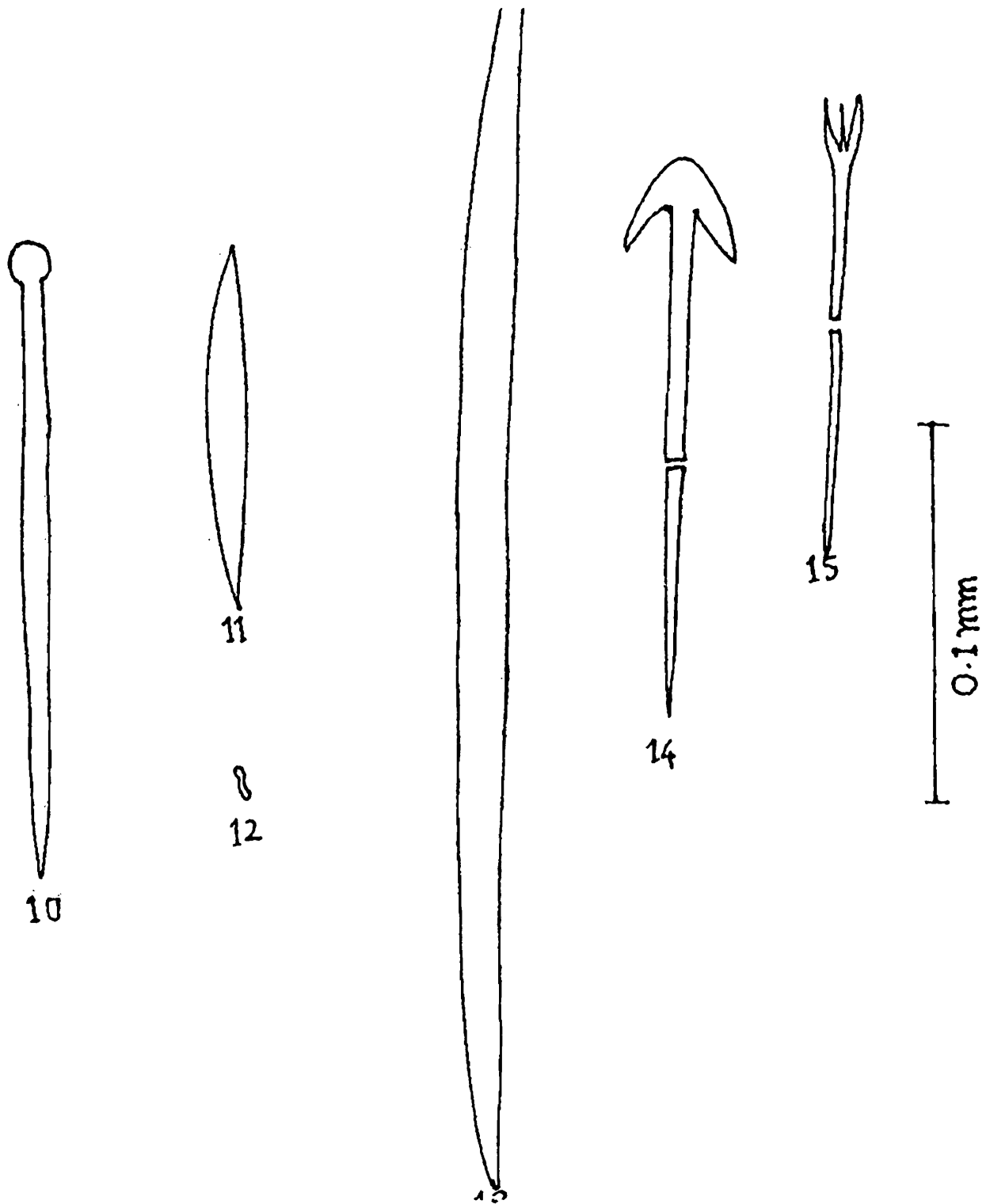
Diagnosis : Tetillidae of massive growth, basal portion of which is embedded in the sand and the upper portion growing erect on the sand. Protoriaenes, anatriaenes, tylostyles, oxeas and sigma spicules are present.

(vi) *Tetilla dactyloidea* (Carter, 1869) (Text figs. 13-15)

1869. *Tethya dactyloidea* Carter, *Ann. Mag. nat. Hist.*, ser. 4, III, p. 15.

1888. *Tetilla dactyloidea* Sollas, 'Challenger' Rep., *Zool.* XXV, p. 1.

1915. *Tetilla dactyloidea* var. *lingua* Annandale, Fauna of Chilka Lake, *Memoire of the Indian Museum*, 5 : 53, pl.v, fig. 4.



10&11. Megascleres of *Cliona vestifica*
12. Microsclere of *Cliona vestifica*
13-15. Megascleres of *Tetilla dactyliodea*

1916. *Tetilla dactyloidea*, Dendy, *Rep. Govt. Baroda mar. Zool. Okhamandal*, p. 102, pl. ii, fig. 10.

1932. *Tetilla dactyloides*, Burton and Rao, *Rec. Indian Mus.* 34 : 326.

Description : Sponge is tongue shaped and compressed, elongated, erect, fleshy, tough; surface smooth, upper extremity obtuse, round. The single osculum is very small and the central cavity into which it opens is almost obliterated. lower extremity is terminating in a bundle of loose, soft, spiculiferous, keratose filaments, which is much reduced. The ostias are confined to upper three quarters of the superficial area of the sponge.

Skeleton is composed of long oxeas, anatriaenes and protriaenes. The anchors of the anatriaenes lie in the basal region and long rays project upwards, where as small radiating rays of the protriaenes are present on the surface region of the upper zone and the long rays extend towards the base. oxeas are long and present throughout the sponge.

Megascleres are fusiform oxeas, anatriaenes and protriaenes. Oxeas amphioxea, smooth and sharply pointed at both ends, length range 0.30 - 0.85 mm, width range 0.008 - 0.012 mm. Anatriaenes - smooth, length range of the shaft 1.5 - 2.35 mm, width range 0.004 - 0.008 mm; length range of the clads 0.028 - 0.035 mm. Protriaenes - length range of the shaft 1.25 - 1.75, width range 0.002 - 0.004 mm; length of the clads range 0.016 - 0.028 mm.

Microscleres absent.

Colour in life and in spirit pale greenish gray.

Distribution : India : Chilka Lake, Orissa; Mahim estuary, off the Island of Bombay; Port Blair, Andamans; Okha Mandal, Gujarat. Outside India : South-east coast of Arabia; Mergui; Osaka Market, Japan.

Remarks : Annandale (1915) described this species as *Tetilla dactyloidea* var. *lingua* from Chilka Lake, Orissa. But the distinguishing characters described by Annandale are not so much of taxonomic value. The present study of the species reveals that the differences between *Tetilla dactyloidea* and *Tetilla dactyloidea* var. *lingua* are merely external and are of little taxonomic value. Therefore, present author has synonymised the variety *lingua* with the original species *Tetilla dactyloidea*. After Annandale's record in 1915, this species has not been recorded from Chilka Lake. During this present investigation also this species has not been found from the same locality.

SUMMARY

The paper deals with six species of sponges (Porifera : Demospongiae) which are so far known from Chilka Lake, Orissa, India. The species *Tetilla dactyloidea* var. *lingua* is synonymised with *Tetilla dactyloidea*.

ACKNOWLEDGEMENTS

The author is thankful to the Director, Zoological Survey of India, Calcutta for providing all sorts of facilities during the present investigation. Greatful thanks are also due to Dr. S. K. Mitra, Scientist 'SF' for constant encouragement and valuable suggestions. I also wish to express my deep sense of gratitude to Dr. K. V. Rama Rao, Scientist 'SF' and Chief Co-ordinator of the Project for all round help and facilities. Thanks are also due to Sri S. C. Nahar for going through the manuscript and to Shri P. Varma for helping in drawing.

REFERENCES

- Annandale, N. 1914. Fauna Symbiotica indica No. 5, Some sponges commonly associated with oysters and mussels in Madras harbour and the Chilka Lake. *Rec. Indian Mus.*, 10(2), No. 7 : 149-158.
- Annandale, N. 1915. Fauna of Chilka Lake : Sponges. *Mem. Indian Mus.*, 5 : 21-54.
- Burton, M. 1937. Supplement to the littoral fauna of Krusadai Island, *Bull. Madras Govt. Mus.*, 1 (2), pt. 4 : 1-58.
- Burton, M. and H. S. Rao, 1932. Report on the shallow water marine sponges in the collection of the Indian Musuem. *Rec. Indian Mus.*, 34 : 299-356.
- Carter, H. J. 1849. 1849. A descriptive account of the freshwater sponges (genus Spongilla) in the island of Bombay, with observations on their structure and development. *Ann. Mag. Nat. Hist.*, 4 : 81-100.
- Carter, H. J. 1869. Description of a siliceous sand-sponge found on the South-east coast of Arabia. *Ann. Mag. nat. Hist.*, 3(4) : 15-17.
- Dendy, A. 1916. Report on the non-calcareous sponges collected by Mr. James Hornell at Okhamandal in Kattiawar in 1905 1906. *Rep. Govt. Baroda Mar. Zool. Okhamandal*, ser. 2, 17 : 96-146, pls. 1-4.
- Gray, J. E. 1867. Notes on the arrangement of sponges, with description of some new genera. *Proc. Zool. Soc. Lond.*, pp. 492-558.
- Hartman, W.D. 1982. Porifera. In : *Synopsis and classification of living organisms*. Ed. in chief : S. P. Parker, Mc Graw Hill Book Company, 1 : 641-666, 4 pls.
- Lamarck, J. B. P. A. 1816. *Historie naturelle des animaux sans vertebres*, 2 : 98-100.

- Lieberkun, N. 1859. Neun Beitrag Zur anatomie der spongien. *Arch. Anat. und. Phys.*, pp. 353-382, 525-529.
- Linnaeus, C. 1758. *Systema Naturae*, 10th ed., vol. 1, animalia, p. 1348.
- Nardo, G. D. 1833. *Auszug aus Cinem neuen System der Spongiarien*. 'Isis', Coll. : 519-523.
- Penney, J.T. and Racek, A.A. 1968. Comprehensive revision of a worldwide collection of freshwater sponges (Porifera : Spongillidae). *Bull. U.S. natn. Mus.*, No. 272 : 1-184.
- Scmidt, E.D. 1862. *Die Spongien des adriatischen Meeres*. Leipzig, Wilhelm Engelmann I-VII : 1-88.
- Sharma, A.L.N., D. G. Rao and S. Satapathy, 1979. Faunal association of littoral sponges in Chilka Lake (Lagoon). *Journ. Bombay nat. Hist. Soc.* 76 (1) : 192-195, illustr.
- Thiele, J. 1898. Stud. u. pacif. Spongien, *Bibl. zool.* X : 1-39, pl. viii, fig. 10.
- Thiele, J. 1905. Die Kiesel-und Hornschwamme der sammlung Plate. *Zool. Jahrb. Jena Suppl.* 6 : 407-496.
- Thomas, P.A. 1972. Boring sponges from the reefs of Gulf of Mannar and Palk Bay. *Proc. Symp. Corals and Coral Reefs, 1969. Mar. biol. ass. India* : 333-362.
- Thomas, P.A. 1985. Demospongiae of the Gulf of Mannar and Palk Bay. In : P.S.B.R. James (Ed.), *Recent Advances in Marine Biology*. Today and Tomorrow printers, New Delhi : 205-365.
- Topsent, E. 1888. Contribution a l' edtude des Clionides. *Archs Zool. exp. gen.*, 5(2) : 1-166.
- Topsent, E. 1896. Materiause pour servir a l'etude de la Faune des Spongiaires de France, *Mem. Soc. Zool. Fr.*, 9 : 113-133.
- Topsent, E. Etude monographique des spongiaires de France III. Monaxonida (Hadromerina). *Archs Zool. Exp. gen.*, 8 : 1-331.

ANTHOZOA : COELENTERATA

A. MISRA

Zoological Survey of India, Calcutta

INTRODUCTION

Actinarians, popularly known as 'sea anemones' are recognised as an important group of marine invertebrate organisms. The members of this group belong to the order Actiniaria, Subclass Zoantharia, class Anthozoa and phylum Coelenterata. They are typically marine benthic animals preferring sandy, muddy or rocky substratum. They are very comfortable in the crevices of rocks or coral reefs. Basically being inhabitants of marine environments, the sea anemones are also common in the estuaries enjoying an ever changing brackish-water environment. In the estuary, the burrowing forms are most abundant. They are generally cryptic in habit, remains completely buried in mud or sand exposing only the tentacular crown. Most of the anemones are more or less contractile in habit, retracting the whole of the oral region with tentacles. For this reason, narcotization is recommended as a preliminary to fixing which requires some patience. The procedure varies from species to species, sometimes, specimen to specimen which demands individual's personal experience.

There are more than 800 species so far described from the world. However, this group of animal has not been studied well from India. Literature on sea anemones of India indicates that about 30 species under 22 genera and 14 families have so far been reported from India, of which 14 species inhabits the brackish water habitat. The sea anemones of Chilka Lake, Orissa, were first studied by Annandale (1915), and later revised by Carlgren (1925). These studies reveal that six species of sea anemones are available in the Chilka Lake. The present study records one additional species, *Edwardsia jonesii* Sheshaiya & Cuttress, from the area in addition to the already recorded six species.

SYSTEMATIC ACCOUNT

Order ACTINIARIA

Suborder NYNANTHEAE

Tribe ATHENARIA

Family EDWARDSIIDAE

Genus *Edwardsia* Quatrefages

1. *Edwardsia tinctorix* Annandale
2. *Edwardsia jonesii* Sheshaiya & Cuttress

Family HALIACTIIDAE

Genus *Pelocoetes* Annandale3. *Pelocoetes exul* AnnadaleGenus *Phytocoetes* Annandale4. *Phytocoetes gangeticus* Annandale

Family HALCAMPIDAE

Genus *Mena* Stephenson5. *Mena limnicola* (Annandale)6. *Mena chilkaeae* (Annandale)

Tribe BOLOCEROIDARIA

Family NEVADNEIDAE

Genus *Nevadne* Stephenson7. *Nevadne glauca* (Annandale)

Order ACTINIARIA

Diagnosis : Anthozoa with more or less well developed pedal disc, with or without basilar muscles. column smooth or provided with verrucae, tentaculi, vesicles, marginal spherules or pseudospherules or other specialisations of variable structure; often divisible into different regions. Tentacles retractile or not, usually arranged hexamerously in alternating cycles.

Suborder NYNANTHEAE

Diagnosis : Actiniaria with a rounded or flat base with or without basilar muscles. Mesenteries arranged in hexamerous cycles. Secondary mesenteries always develop in exocoels, as pairs whose longitudinal muscles face one another.

Key to the Tribe

Aboral end of the body rounded, rarely flattened, disc-like. Column rarely with ectodermal muscles and then only in its uppermost part. Muscles or mesenteries strong Athenaria

Aboral end of the body always disc-like, never rounded. Column with longitudinal muscles. Muscles of mesenteries weak Boloceroidaria

Tribe ATHENARIA

Diagnosis : Nynantheae without basilar muscles. Body as a rule very elongate, more or less vermiform, often divisible into different regions. Aboral end of the body usually rounded being a physa often used for digging. Sphincter usually absent, when present either endodermal or mesogloal. Tentacles and mesenteries usually few, rarely more than 48, cyclically arranged. Retractors of the macrocnemes usually strongly restricted, reniform or circumscribed.

Key to families

1. Acontia present..... HALIACTIIDAE
2. Acontia absent2
2. Eight macrocnemes; sphincter absent EDWARDSIIDAE
- Twelve macrocnemes; sphincter present HALCAMPIDAE

I. Family EDWARDSIIDAE

Diagnosis : Body vermiform, elongated divided into two regions, a long scapus provided with a cuticle and a short upper scapulus. Physa naked, at the aboral end. Capitulum very thin and short below the tentacles. Sphincters and acontia absent. Mesenteries divided into 8 macrocnemes and at least 4 microcnemes. Parietal muscles always distinct.

Genus *Edwardsia* Quatrefages, 1842

Diagnosis : Body divided into physa, scapus, scapulus and capitulum. Scapus long with batteries of nematocysts sunk in the mesogloea. tentacles at least 12, shorter or longer.

Key to the species of *Edwardsia*

- Tentacles 12 *E. jonesii*
- Tentacles 16 *E. tinctorix*

1. *Edwardsia tinctorix* Annandale, 1915

1915. *Edwardsia tinctorix* Annandale, *Mem. Indian Mus.*, 5 : 92, pl. 16, fig. 3; pl. 7, figs. 55 a; pl. 7a, fig. 5; text figs. 7a - c.
1968. *Edwardsia tinctorix* : Parulekar, *J. Bombay nat. Hist. Soc.* 65(1) : 140, pl. fig. 1.

Material : 2 ex., Stn. J 11, Chilka Lake, 13.9.87; 3 ex., Stn. D8, Chilka Lake, 18.6.86; Coll. J.Pattanayak.

Diagnosis : Tentacles 16, smooth and arranged in two cycles. Physa well developed at the aboral end. Nemathybomes in 8 longitudinal rows on the column.

Distribution : Endemic in India waters. West Bengal : Hugli - Matla Estuary; Orissa : Chilka Lake; Goa and Maharashtra.

2. *Edwardsia jonesii* Sheshaiya & Cuttress, 1971

1971. *Edwardsia jonesii* Sheshaiya & Cuttress, *J. Mar. biol. ass. India* **11** (1 & 2) : 73, figs. 1 & 2.

1987. *Edwardsia jonesii* : Anonymous, *Mangrove Ecosystem of Sundarbans* Dept. of Marine Science, Univ. of Calcutta, p. 71.

Material : 2 ex., Stn. C3, Chilka Lake, 12.6.1986; 1 ex., Stn. L11, Chilka Lake, 20.6.1986; 4 ex., Stn. D7, Chilka Lake, 17.6.1986; Coll. J. pattanayak.

Diagnosis : Tentacles 12, smooth and arranged in two cycles. Body distinctly divided into capitulum, scapulus, scapus and inflatable physa without cuticle. Capitulum thin-walled, almost transparent, smooth and without cuticle. Scapus thick-walled, covered with thick shaggy rusty red cuticle.

Distribution : Endemic in Indian waters. West Bengal : Hugli - Matla Estuary; Orissa : Chilka Lake; Tamil Nadu.

II. Family HALIACTIIDAE

Diagnosis : Body elongated, aboral end rounded or rarely flattened. Column smooth or provided with suckers or warts. Distinct sphincter absent. Macrocnemes 6 pairs, filamented and fertile; microcnemes, non-filamented and fertile; microcnemes variable in number, non-filamented and sterile.

Key to the genera of Haliactiidae

Oral disc divided into very distinct lobes *Pelocoetes*

Oral disc not divided into distinct lobes *Phytocoetes*

Genus *Pelocoetes* Annandale, 1915

Diagnosis : Elongated vermiform body. Column divided into capitulum, scapus and physa. Scapus with longitudinal rows of warts. distinct sphincter absent. Actinopharynx long. Upper part of capitulum and oral disc thrown out into 6 long outgrowths each bifurcating into two or three times.

3. *Pelocoetes exul* Annandale, 1915

1915. *Pelocoetes exul* Annandale, *Mem. Ind. Mus.*, **5** : 86, pi. 6, fig. 11 pl. 7, figs. 3, 3a, 3b; text fig. 5.

1987. *Pelocoetes exul*; Anonymous, *Mangrove ecosystem of Sundarbans*, Dept of Marine Science, Calcutta University, p. 71.

Material : 3 ex., Stn F9, Chilka Lake, 11.9.1987; 1 ex., Stn. F10, Chilka Lake, 19.6.1986; Coll. J. Pattanayak.

Diagnosis : Column elongated with longitudinal rows of nematocyst batteries alternating with cinclides. Oral disc lobed. Tentacles branched hexamerously arranged.

Distribution : Endemic in India waters. West Bengal - Hugli - Matla estuary; Chilka Lake; Tamil Nadu; Kerala; Goa; Maharashtra.

Genus *Phytocoetes* Annandale, 1915

Diagnosis : Long, slender body, not divisible into regions. Proximal end physa-like. Column smooth, with rows of cinclides in its upper part. Sphincter absent. Tentacles long, inner tentacles longer than the outer ones. Oral disc not divided into lobes.

4. *Phytocoetes gangeticus* Annandale, 1915

1915. *Phytocoetes gangeticus*, Annandale, *Mem. Ind. Mus.*, 5 : 79, Pl. 7a, figs. 3, 3a & 3b.

1968. *Phytocoetes gangeticus* : Parulekar, *J. Bombay nat. Hist. Soc.*, 65(1) : 141, pl. 1, Fig. 4.

Material : 5 ex., Stn E8 Chilka Lake, 10.9.1987; 2 ex., Stn. M13, 23.6.1986, Coll. J. Pattanayak.

Diagnosis : Tentacles simple, slender, 36 in number. Column narrow and slender, smooth with longitudinal rows of cinclides, sphincter not visible. Base narrow physa-like.

Distribution : Endemic in Indian waters. West Bengal : Gangetic delta; Orissa - Chilka Lake; Tamil Nadu; Kerala; Goa; Maharashtra.

III. Family HALCAMPIDAE

Diagnosis : Body elongated and cylindrical, usually divisible into three regions, physa, scapus and capitulum. Scapus often provided with tenaculi or papillae. Sphincter present. Mesenteries divisible into macro- and microcnemes.

Genus *Mena* Stephenson

Diagnosis : Aboral end rounded, physa-like. Column with longitudinal rows of stinging warts, scattered in the lower part. Two distinct sphincters, one close to the base of the tentacles, the other in the upper region of the column. Tentacles 12 or more. Macrocnemes 6 pairs, at least 8 mesenteries fertile, microcnemes weak.

Key to the species of *Mena*

Tentacles 12; stinging warts arranged in 12-16 longitudinal rows. *M. limnicola*

Tentacles 24; stinging warts arranged in 24 longitudinal rows *M. chilkaea*

5. *Mena limnicola* (Annandale, 1915)

1915. *Halianthus limnicola* Annandale, *Mem. Indian Mus.*, 5 : 89, pl. 6, Fig., 2, pl. 7, Fig., 4, 4a, 4b, text fig. 6.

1925. *Mena limnicola* : Carlgren, *Ark zool.* 17A(21) : 11, fig. 8-11.

Material : 3 ex., Stn. L II, Chilka Lake; 26.6.1986; coll. J. Pattanayak.

Diagnosis : Tentacles 12. Sphincters very weak, Stinging warts large, arranged in 12-16 longitudinal rows; more scattered and variable in size in the lower part of the column; also present in the central part of the physa. Six pairs of macrocnemes fifth and sixth pairs weaker than the others.

Distribution : endemic in Chilka Lake, Orissa.

6. *Mena chilkaeae* (Annandale, 1915)

1915. *Phytocoetes chilkaeus* Annandale, *Mem. Indian. Mus.*, 5 : 82, pl. 7, fig. 2, pl. 8a, fig. 4. tex-fig. 4.

1925. *Mena chilkaeae* : Carlgren, *Ark Zool.* 17A (21) : 9, Fig. 4-7.

Material : 2 ex., Stn L 13, Chilka Lake, 23.6.1986, Coll. J. Pattanayak.

Diagnosis : Tentacles 24, Lower sphincter more alveolar with fewer meshes. Stinging warts large and arranged in 24 longitudinal rows, more irregularly distributed in the lowermost part of the column, absent in the central part of the physa. Six pairs of strong macrocnemes.

Distribution : Endemic in Chilka Lake, Orissa.

Tribe BOLOCEROIDARIA

Diagnosis : Nynantheae without basilar muscles. Aboral end of the body not physa-like. No distinct sphincter. Longitudinal muscles and sometimes spirocysts in the ectoderm of the column. Perfect pairs of mesenteries usually few, 6 or rather more. Longitudinal muscles of mesenteries weak.

IV. Family NEVADNEIDAE

Diagnosis : Column with longitudinal muscles at least in its upper part and without spirocysts. Sphincter absent. Tentacles not deciduous, atypically arranged. Longitudinal muscles of tentacles and radial muscles of oral disc ectodermal. Perfect mesenteries more than 6 pairs. No differentiation into macro- and microcnemes.

Genus *Nevadne* Stephenson, 1915

Diagnosis : Body elongated with small pedal disc, broader distally. Column smooth, but its nematocysts arranged in small groups. Outermost exocoelic tentacles largest. Mesenteries double in the youngest cycle.

7. *Nevadne glauca* (Annandale, 1915)

1915. *Gyrostoma glaucum* Annandale, *Mem. Indian Mus.*, 5 : 70, pl, 7a, fig 1 text figs. 1a, b.

1925. *Nevadne glauca* : Carlgren, *Ark. Zool.*, 17A (21) : 3, figs. 1-3.

Material : 10 ex., Stn L14, Chilka Lake, 24.6.86, 9 ex., Stn. E8, Chilka Lake 10.9.1987; 12 ex., Stn, C5, 16.9.87; 1 ex., stn, F10, Chilka Lake 12.9.87; coll. Pattanayak.

Diagnosis : Pedal disc small. Tentacles about 144, arranged in 6 cycles; 4th and 6th cycles being exocoel tentacles. Actinopharynx well developed with weak siphonoglyphes. Mesenteries arranged in four cycles (6+6+12+48), last cycle only in uppermost part of the body. Mesenteries of the three first cycles perfect but those of second and third order perfect only in uppermost part of actinopharynx.

Distribution : Endemic in Indian waters. West Bengal - Hugli - Matla Estuary; Orissa - Chilka Lake; Tamil Nadu.

SUMMARY

The present paper deals with the diagnostic features of 7 species of sea anemones available at Chilka Lake, Orissa. *Edwardsia jonesii* is reported for the first time from the area. key to families, genera and species and also the distribution are also dealt with herein. All the species are endemic in India waters.

ACKNOWLEDGEMENT

The author is thankful to the Director, Zoological survey of India for providing all facilities and kind permission to work with the collection.

REFERENCES

Annandale, N. 1915. Fauna of the Chilka Lake. The coelenterates of the lake, with an account of actiniaria of brackish water in the Gangetic delta. *Mem. Indian Mus.*, 5 : 65-144.

Carlgren, O. 1925. A revision of the actiniaria of Chilka Lake. *Ark. Zool.*, 17a (21) : 1-21.

PLATYHELMINTHES : TREMATODA : DIGENEA

I. B. DUTTA

Zoological Survey of India, Calcutta

INTRODUCTION

Digenetic trematodes represent a group of animals in the phylum Platyhelminthes, Class Trematoda, Order Digenea. The Digenea having complex heterogeneous life cycles, involves at least one intermediate host. The trematodes are dorsoventrally flattened nonciliated endoparasites. It lives on or in another living organisms called the host. Host provides shelter and nourishment to the parasites. Trematodes reside in the intestine, blood vessels, kidney, liver, body cavity, trachea, gall bladder, urinary bladder, air sac, etc. It can cause injury by the action of muscular suckers, hooks, spines, can cause congestion in lungs and trachea, can reduce the efficiency of gaseous exchange in respiratory system, can interfere with the absorption of digested food.

MATERIAL AND METHOD

In the present work digenetic trematodes have been collected from Chilka lake, Orissa, through out the year.

Fishes were collected from the fishermen from the collection spot as well as from local fish markets. Fishes were brought to the laboratory in bucket for collecting helminth parasites from them. Fishes were dissected out, placed in normal saline and examined all the possible sites for helminth parasites. After collection the flukes are washed in 10% saline water thoroughly and allowed them to relax for some time in the same medium. Trematodes are first studied alive under field microscope specially for the study of excretory system and the condition of intestinal Caeca. The completely relaxed flukes are placed on a glass slide, covered with a cover glass, excess water removed with blotting paper and a few drops of fresh fixative given beneath on end of cover glass. The AFA Fixative gave the best result. The slide is then fully covered with a petridish to avoid dehydration of the specimens. Full cover glass or piece of cover glass is used for reasonable flattening of the worm, depending on the size of texture of its body. Care is taken so that the worm is not overpressed or overflattened. In case of thick muscular worms additional pressure with the help of the tip of a needle is also applied carefully.

The fixed flukes are removed carefully by flushing the slide or cover glass with the pipette and kept in the same fixative for sometime. After that it is washed with 70% alcohol to remove excess fixative, and finally it is stored in 70% alcohol in air tight glass vials with the necessary data of the host, place, the organ from which recovered and date of collection.

The worms from store are washed thoroughly in 70% alcohol and over stained with a dye, mostly Semichon's carmine or Harris' haematoxylin. Then the material is differentiated with acid alcohol. The specimen is washed thoroughly with 70% alcohol to remove any trace of acid in its body. The dehydration

is completed by keeping the worm in different higher grades of alcohol, in 90% for 10-15 minutes and in absolute alcohol for 15-30 minutes with two changes. The dehydrated specimen is then cleared in xylol for few seconds, and in clove oil for few minutes. Then the specimen is given a dip in xylol to remove excess clove oil from the specimen and mounted in Canada balsam or DPX. The freshly prepared slide is then dried in low temperature and observed under microscope. Drawings are made to the Scale using a camera lucida. Measurements are in millimetres unless stated otherwise.

Classified list of digenetic trematode species studied

Family : ACANTHOCOLPIDAE Luhe, 1909

Subfamily : STEPHANOSTOMINAE Yamaguti, 1958

Genus : *Stephanostomum* Looss, 1899

1. *Stephanostomum indicum* Srivastava, 1937

Family : ACANTHOSTOMIDAE Poche, 1926

Subfamily : PSEUDAOCANTHOSTOMINAE Yamaguti, 1958

Genus : *Pseudallacanthochasmus* velasquez, 1961

2. *Pseudallacanthochasmus grandispinus* Velasquez, 1961

Family : ALLOCREADIIDAE (Looss, 1902) Stossich, 1903

Subfamily : ORIENTOCREADIINAE Yamaguti, 1958

Genus : *Orientocreadium* Tubangui, 1931

3. *Orientocreadium batrachoides* Tubangui, 1931

Family : BUCEPHALIDAE Poche, 1907

Subfamily : PROSORHYNCHINAE Nicoll, 1914

Genus : *Bucephalopsis* (Dies, 1855)

4. *Bucephalopsis karvei* Bhalerao, 1937

Subfamily : BUCEPHALINAE

Genus : *Bucephalus* Baer, 1829

5. *Bucephalus tridentaculata* verma, 1936

6. *Bucephalus indicus* Srivastava, 1938

Family : CRYPTOGONIMIDAE ciurea, 1933

Subfamily : TUBANGUIINAE Yamaguti, 1958

Genus : *Haplorchoides* Chen, 1949

7. *Haplorchoides mehrai* Pande and Shukla, 1977

Family : ENENTERIDAE

Subfamily : ENENTERINAE yamaguti, 1958

Genus : *Karyakartia* Hafeezullah, 1979

8. *Karyakartia pambanense* (Karyakarte, 1968) Hafeezullah, 1979

Family : FELLODISTOMIDAE Nicoll, 1909

Subfamily : BACCIGERINAE Yamaguti, 1958

Genus : *Baccigeroides* n. gen.

9. *Baccigeroides hafeezullai* n. gen.; n. sp.

Genus : *Bacciger* Nicoll, 1914

10. *Bacciger bacciger* (Rud, 1819) Nicoll, 1914

Subfamily : FELLODISTOMINAE Nicoll, 1909

Genus : *Steringotrema* odhner, 1911

11. *Steringotrema Chauhani* n. sp.

Family : HAPLOPORIDAE Nicoll, 1914

Subfamily : HPLOPORINAE Dollfus, 1927

Genus : *Saccocoelium* Looss, 1902

12. *Saccocoelium tripathi* n. sp.

Genus : *Saccocoelioides* Szidat, 1954

13. *Saccocoelioides chilkaensis* n. sp.

14. *Saccocoelioides martini* Madhavi, 1979

Family : HEMUNRIDAE Luhe, 1901

Subfamily : LECITHASTERINAE Odhner, 1905

Genus : *Anadichadena* n. gen.

15. *Anadichadena binovi* n. gen; n. sp.

Genus : *Aphanurus* Looss, 1907

16. *Aphanurus microrchis* Chauhan, 1954

Subfamily : HEMIURINAE Looss, 1899

Genus : *Anahemiurus* Manter, 1947

17. *Anahemiurus manteri* n. sp.

Subfamily : DINURINAE Looss, 1907

Genus : *Johniophyllum* Skrjabin et Guschanskaja, 1954

18. *Johniophyllum skrjabini* n. sp.

Genus : *Uterovesiculurus* skrjabin et Guschanskaja, 1954

19. *Uterovesiculurus thrissoclesi* Gupta and Ahmad, 1979

Subfamily : LECITHOCHIRIINAE Luhe, 1901

Genus : *Lecithochirium* Luhe, 1901

20. *Lecithochirium furcolabiatum* (Jones, 1933)

Subfamily : GONOCERCINAE Skrjabin et Guschanskaja, 1955

Genus : *Hemipera* Nicoll, 1913

21. *Hemipera ovocaudata* Nicoll, 1913

Subfamily : LECITHASTERINAE Odhner, 1905

Genus : *Lecithaster* Luhe, 1901

22. *Lecithaster indicus* Srivastava, 1935

Family : ISOPARORCHIIDAE (Travassos, 1922) Poche, 1926

Genus : *Isoparorchis* Southwell, 1913

23. *Isoparorchis hypselobagri* (Biller, 1898) Ejsmont, 1932

Family : MONODHELMINTHIDAE Dollfus, 1937

Subfamily : MEHRATREMATINAE (Srivastava, 1939) Skrajabin, 1953

Genus : *Mehratrema* Srivastava, 1939

24. *Mehratrema militaris* n. sp.

25. *Mehratrema dollfusi* Srivastava, 1939

Family : MONORCHIIDAE Odhner, 1911

Subfamily : MONORCHIINAE (Odhner, 1911) Nicoll, 1915

Genus : *Monorchis* (Monticilli, 1893) Looss, 1902

26. *Monorchis minutus* Madhavi, 1977

Subfamily : ASYMPHYLODORINAE Szidat, 1943

Genus : *Asymphylogora* Looss, 1890

27. *Asymphylogora kadarai* Srivastava, 1951

Subfamily : OPISTHOMONORCHIINAE Yamaguti, 1952

Genus : *Opisthomonorchis* yamaguti, 1952

28. *Opisthomonorchis carangis* Yamaguti, 1952

Family : OPECOELIDAE Ozaki, 1925

Subfamily : OPECOELINAE Stunkard, 1931

Genus : *Opegaster* Ozaki, 1928

29. *Opegaster minima* (Tubangui, 1928) Yamaguti, 1934

HOST PARASITE LIST

HOST	PARASITE
<i>Otolithus ruber</i>	<i>Opegaster minima</i> (Tubangui, 1928) Yamaguti, 1934 <i>Stephanostomum indicum</i> Srivastava, 1937
<i>Mystus gulio</i>	<i>Orientocreadium batrachoides</i> Tubangui, 1931 <i>Haplorchoides mehrai</i> Pande and Shukla, 1977
<i>Pomadasys hasta</i>	<i>Pseudallacanthochasmus grandispinis</i> Velasquez, 1961 <i>Monorchis minutus</i> Madhavi, 1977
<i>Xenontedon cancila</i>	<i>Bucephalopsis karvel</i> Bhalerao, 1937
<i>Carana</i> Sp.	<i>Bucephalus tridentaculata</i> Verma, 1936
<i>Otolithus</i> Sp.	
<i>Polynemus</i> sp.	
<i>Therapon jarbua</i>	<i>Bucephalus indicus</i> Srivastava, 1938 <i>Opegaster minima</i> (Tubangui, 1928) Yamaguti, 1934 <i>Karyakartia pambanense</i> (Karyakarte, 1968) Hafeezullah, 1979
<i>Setipinna phasa</i>	<i>Baccigeroides hafeezullai</i> n. gen; n. sp.
<i>Athernia</i> sp.	<i>Bacciger bacciger</i> (Rud. 1819) Nicoll, 1914
<i>Blennius</i> sp.	<i>Steringotrema chauhani</i> n. sp.
<i>Mugil</i> sp.	<i>Saccocoelium tripathi</i> n. sp.
<i>Mugil</i> sp.	<i>Saccocoelioides chilkaensis</i> n. sp.
<i>Eutroplus suratensis</i>	<i>Saccocoelioides martini</i> Madhavi, 1979

<i>Hemirhamphus</i> sp.	<i>Anadichadena binoyi</i> n. gen; n. sp.
<i>Gadus</i> sp.	<i>Anahemiurus manteri</i> n. sp.
<i>Glossogobius giuris</i>	<i>Johniophyllum skrjabini</i> n. sp.
<i>Polynemus</i> sp.	<i>Lecithochirium furcolabiatum</i> (Jones, 1933)
<i>Tricirrata</i> sp.	<i>Hemipera ovocaudata</i> , Nicoll, 1913
<i>Otolithus</i> sp.	
<i>Polynemus sextarius</i>	<i>Uterovesiculurus thrissoclesi</i> Gupta & Ahmad, 1979
<i>Eleutheronema tetraductylum</i>	
<i>Hilsa</i> sp.	<i>Lecithaster indicus</i> Srivastava , 1935
<i>Mystus</i> sp.	<i>Isoparorchis hypselobagri</i> (Billet, 1898) Eymont, 1932
<i>Osteogeneiosus mililaris</i>	<i>Mehratrema militaris</i> n. sp.
<i>Arius</i> sp.	<i>Mehratrema dollfusi</i> Srivastava, 1939
<i>Mugil cephalus</i>	<i>Aphanurus microrchis</i> Chauhan, 1945
<i>Puntius sarana</i>	<i>Asymphylogora kedarai</i> Srivastava, 1951
<i>Carangoides malabaricus</i>	<i>Opisthomonorchis carangis</i> Yamaguti, 1952
<i>Gerres filamentosus</i>	<i>Opegaster minima</i> (Tubangui, 1928) Yamaguti, 1934

Family ACANTHOCOLPIDAE Luhe, 1909

Subfamily STEPHANOSTOMINAE Yamaguti, 1958

Genus *Stephanostomum* Looss, 1899

Stephanostoma Danielsen, 1880

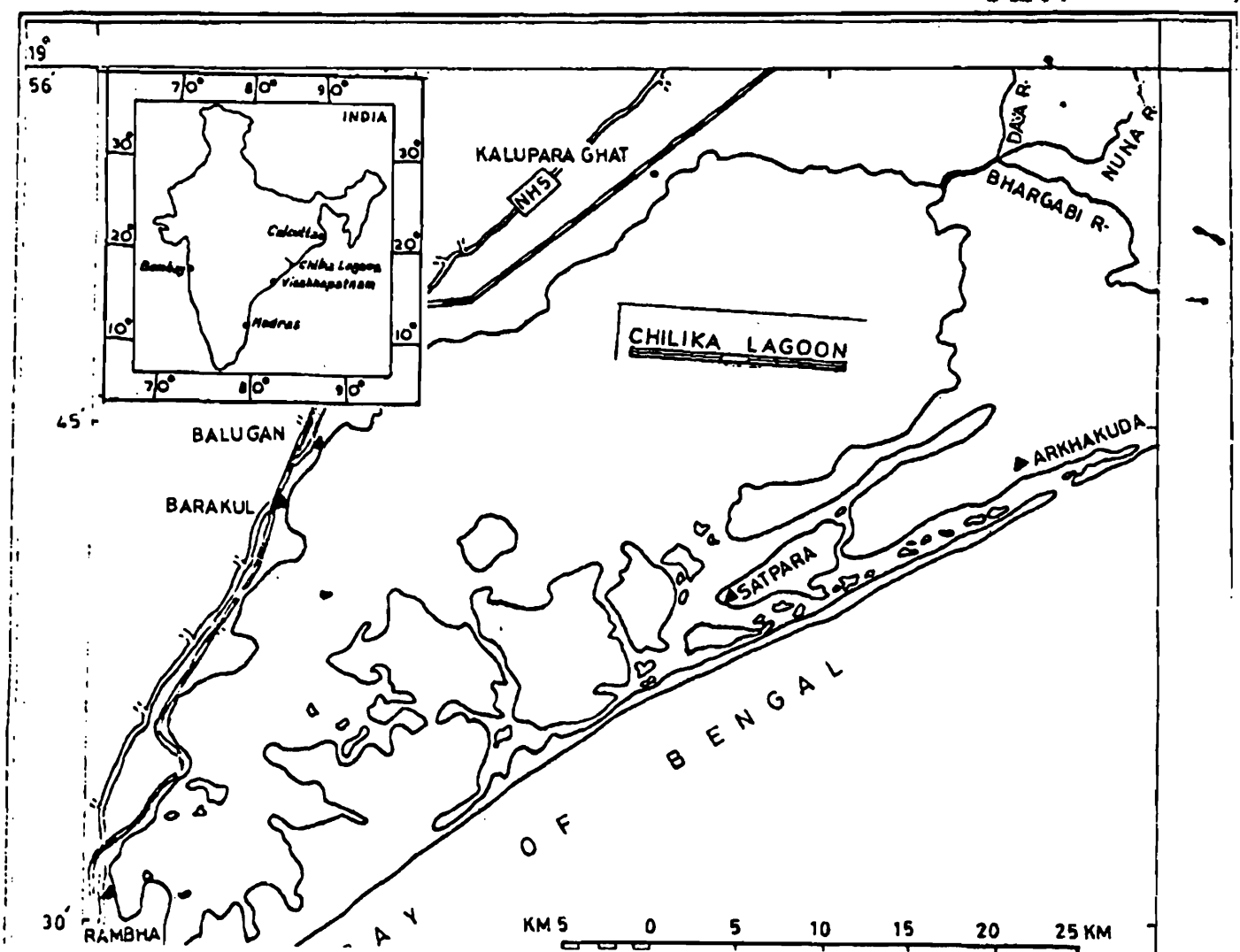
Stephanochasmus Looss, 1900

Lechradena Linton, 1910

Echinostephanus Yamaguti, 1934

Monorchistephanostomum Perez Viguera, 1942

Cricovitellarium Perez Viguera, 1955



Map

Stephanostomum indicum Srivastava, 1937

Material examined : 4 exs.; Host - *Otolithus ruber* ; Location - Intestine; Locality - Chilka lake at Satpara; 23.9.87; Coll. I. B. Dutta; Z.S.I. Reg. Nos. w 7938/1.

Distribution : India, Chilka lake (first record)

Measurements : 3.61 - 4.20 x 0.68 - 0.70, Ventral sucker 0.25 - 0.32 x 0.27 - 0.36. Oral sucker 0.09 - 0.11 x 0.16 - 0.19. Pharynx 0.22 - 0.24 in diameter. Anterior testis 0.32 - 0.43 x 0.40 - 0.41; posterior testis 0.49 - 0.51 x 0.28 - 0.40. Ovary 0.14 - 0.22 x 0.16 - 0.23; eggs 65 - 73 μ m x 32 - 45 μ m.

Remarks : Srivastava (1937) described this species collected from *Pristis cuspidatus* from India. The present record is the first report from the Indian estuarine water.

Family ACANTHOSTOMIDAE Poche, 1926

Subfamily PSEUDOACANTHOSTOMINAE Yamaguti, 1958

Genus *Pseudallacanthochasmus* Velasquez, 1961*Pseudallacanthochasmus grandispinis* Velasquez, 1961

Material examined : 2 exs; host - *Pomadasys hasta*; Location - Intestine; Locality - Chilka lake at ; Z.S.I. Reg. Nos. w 7828/1 & 7829/1.

Distribution : India, Chilka Lake (first record).

Description : Body elongate, 1.28 - 1.68 long, 0.32 - 0.43 wide, eyespot pigments present near pharynx. Tegument spinose. Ventral sucker 0.06 - 0.07 long, 0.04 - 0.07 wide, pre-equatorial, sunken in body parenchyma at 0.30 - 0.32 from anterior end of body. Oral sucker 0.15 - 0.16 long, 0.13 - 0.18 wide, bowl-shaped, larger than ventral sucker, Sucker ratio - 1 : 0.38. Circumoral spines 26-28, in a single circle. Prepharynx 0.020 - 0.024 long; pharynx muscular, 0.05 - 0.07 long, 0.04 - 0.06 wide; oesophagus 0.04 - 0.05 long; intestinal caeca extending upto posterior end of body.

Testes two, tandem, anterior testis 0.13 - 0.21 long, 0.13 - 0.23 wide, posterior testis 0.13 - 0.21 long, 0.13 - 0.26 wide, Seminal vesicle cylindrical; pars prostatica small surrounded by prostate gland cells; hermaphroditic duct opens anterior to acetabulum in short vertical wall formed by acetabular depression in body parenchyma.

Ovary 0.12 - 0.16 long, 0.10 - 0.26 wide, multilobed, pretesticular. Receptaculum seminis present near ovary. Laurer's canal present. Uterus mostly on hind body. Eggs 12 - 20 μ m x 8 - 12 μ m.

Excretory vesicle 'Y' shaped.

Discussion : Velasquez (1961) described *P. grandispinis* from *Lutjanus* sp. from, Lazon Islands,

Phillipines. Hafeezullah and Siddiqi (1970) reported it from *Pomadasys hasta* from Cochin, India. This is the second record from India from *Pomadasys hasta*. In the present specimen have circumoral spines. The genus *Pseudallacanthochasmus* has a circumoral ring of spines which is a character common to Cryptogonimidae and Acanthostomidae both. Velasquez (1961), Hafeezullah and Siddiqi (1970) kept this genus in the family Cryptogonimidae because of the acetabulum sunken in a depression of body parenchyma and the concealed location of the genital pore in the short vertical wall formed due to this depression. The placement of the genus in the family Acanthostomidae are by Yamaguti (1971) and Srivastava, (1982).

Family ALLOCIREADIIDAE (Looss, 1902) Stossich, 1903

Subfamily ORIENTOCREADIINAE Yamaguti, 1958

Genus *Orientocreadium* Tubangii, 1931

Ganada Chatterji, 1933

Neoganada Dayal, 1938

Nizamia Dayal, 1938

Ganadotrema Dayal, 1949

Partormopsolus Dubimina et Bychowsky in Skrjabin, 1954

Macroterma Gupta, 1951

Orientocreadium batrachoides Tubangui, 1931

Material examined : 1 exp. Host *Mystus gulio*; Location - Intstine ; Locality - Chilka Lake at Barkul; 22.6.86; Coll. I. B. Dutta; Z.S.I. Reg. No. w 7939/1.

Distribution : Egypt, Luzon Island (Philippines), India, Chilka lake (first record).

Measurements : Body 1.10 x 0.44. Ventral sucker 0.13 x 0.14. Oral sucker 0.14 x 0.17; pharynx 0.09 x 0.11. Testis 0.11 x 0.12 in diameter, ovary 0.12 x 0.13; eggs 12-28 µm x 8-12 µm.

Remarks : Tubangui (1931) described *O. batrachoides* from *Clarius batrachus*, *Glossogobius giuris*, from Luzon, Philippines. Agrawal (1964) redescribed this species from Lucknow recovered from *Macrones seenghala*. Kakaji (1969) reported this species from Rita rita at Varanasi. The present specimens are from *Mytus gulio* at Chilka lake, Orissa.

Family : BUCEPHALIDAE Poche, 1907

Subfamily : PROSORHYNCHINE Nicoll, 1914

Genus : *Bucephalopsis* (Dies, 1855)

Bucephaloides Hopkins, 1954

Prosorhynchoides Dollfus, 1929

***Bucephalopsis karvei* Bhalerao, 1937**

Material examined : 70 exs., Host - *Xenentodon cancila*; Location - Intestine; Locality - Chilka lake at Satpara; 15.12.85, 6.9.87, 18.9.87, 23.9.87; coll. I. B. Dutta; Z.S.I. Reg. Nos. w 7940/1.

Distribution : India (Poona), Chilka lake (first record).

Description : Body pear-shaped, 0.96 - 1.25 long, 0.51 - 0.73 wide. Tegument spinose. Mouth lies in posterior half of body, pharynx 0.06 - 0.09 long, 0.07 - 0.10 wide; oesophagus long; intestine almost round. Anterior sucker subterminal, 0.18 - 0.22 long, 0.22 - 0.32 wide.

Testes tandem, anterior testis 0.18 - 0.20 long, 0.16 - 0.17 wide, posterior testis 0.18 - 0.32 long, 0.14 - 0.22 wide. Cirrus sac encloses the seminal vesicle, longer than half length of the body. Pars prostatica surrounded by prostate gland cells; ductus ejaculatorius short opening into genital atrium. Genital pore near excretory pore at posterior end of body.

Ovary pretesticular, 0.19 - 0.22 long, 0.14 - 0.20 wide. Receptaculum seminis absent. Vitelline follicles preovarian divided into two groups on both sides of body. Uterine coils on left side of body. Eggs 16-20 μm x 12 - 16 μm .

Excretory bladder tubular, excretory pore terminal.

Discussion : Bhalerao (1937) described *B. karvei* from the host *Belone cancila* at Poona. Chauhan (1954) and Gupta (1958) redescribed the same species from the same host. With the measurements and other diagnostic characters the present specimens are identified as *B. karvei* Bhalerao, 1937. The specimens have also been collected from the same host *Xenentodon cancila*.

Subfamily BUCEPHALINAE Nicoll, 1914

Genus *Bucephalus* Baer, 1829

Gasterostomum Siebold, 1848

Eubucephalus Diesing, 1855

***Bucephalus tridentacularia* Verma, 1936**

Material examined : 7 exs., Host - *Caranx* sp., *Otolithes* sp., *Polynemus* sp.; Location - Intestine; Locality - Chilka lake, Coll. I. B. Dutta; Z.S.I. Reg. No. w 7941/1.

Distribution : India (Allahabad), Chilka lake (first record).

Description : Small, 0.76 - 0.91 long, 0.20 - 0.24 wide. Tegument spinose. Anterior sucker prominent 0.11 - 0.14 long, 0.07 - 0.08 wide, with eight arrowhead-like tentacles having two shorter lateral processes on the opposite sides of the main stem and its appearance to arise from the muscular ridges. Pharynx subglobular, 0.14 - 0.06 long, 0.05 - 0.06 wide, oesophagus short, intestinal sac anteriorly directed.

Testes two, anterior testis 0.13 - 0.14 long, 0.10 - 0.11 wide; posterior testis 0.10 - 0.11 long, 0.11

- 0.12 wide. Cirrus sac large, on left side. Pars prostatica surrounded by prostate gland cells. Genital pore ventral.

Ovary anterotesticular, entire, 0.11-0.12 long, 0.10-0.11 wide. Vitelline glands follicular, in lateral fields, near anterior end of both sides of body. Uterine coils in mid body. Eggs 20 - 24 μm x 16 - 20 μm .

Excretory bladder tubular, pore postero-terminal.

Discussion : Verma (1936) described *B. tridentaculata* from *Aoria aoria*, *Macrones aoria* and *Aoria seenghala* (= *Macrones seenghala*) from Allahabad. Chauhan (1954) redescribed the species. The present specimens collected from *Caranx* sp. and *Otolithes* sp. from Chilka lake. The specimens moreover is similar to all respect except the size of the body. The specimens are identified as *B. tridentaculata* Verma, 1936. Thus the new host record and new locality record may be extended.

Bucephalus indicus Srivastava, 1938

Material examined : 3 exs., Host - *Therapon jarbua*; Location - Intestine; Locality - Chilka lake at Satpara; 29.6.86; Coll. I. B. Dutta, Z.S.I. Reg. Nos. W 7942/1.

Distribution : India (Allahabad), Chilka lake (first record).

Description : Body 0.88 - 0.99 long, 0.25 - 0.30 wide, Tegument spinose. Mouth in the middle of the body, oesophagus short, intestine sac like. Anterior sucker 0.12 - 0.14 long, 0.09 - 0.10 wide, having with a crown of six contractile tentacles, Pharynx 0.04 - 0.05 in diameter. Testes two, anterior testis 0.14 - 0.16 long, 0.12 - 0.13 wide; Posterior testis 0.12 - 0.15 long; 0.10 - 0.12 wide. Cirrus sac elongate, seminal vesicle avoid; Pars prostatica surrounded by prostate gland cells, ductus ejaculatorius narrow. Genital pore ventral, subterminal.

Ovary pretesticular, entire, 0.12 - 0.13 long; 0.10 - 0.12 wide. Seminal receptacle posterior to ovary. Vitellaria follicular, arranged anteriorly on both sides of the body. Uterine coils extend from anterior end to posterior end of body. Eggs 16 - 24 μm x 12 - 16 μm .

Excretory vesicle tubular, excretory pore near genital pore.

Discussion : Srivastava (1938) described *B. indicus* from *Macrones seenghala*. Chauhan (1954) redescribed the species from the same host. Srivastava (1963) pointed out that *B. indicus* may be synonymised with *B. tridentaculata* Verma, 1936. The present author does not agree with this opinion. *B. tridentaculata* resembles *B. indicus* in the nature of tentacles but it differs in the position of gonads, extent of vitellaria, position of cirrus sac, shape and opening of excretory vesicle, shape of anterior sucker and number of tentacles.

Family CRYPTOZONIMIDAE (Ward, 1917) Ciurea, 1933

Subfamily TUBANGUIINAE Yamaguti, 1958

Genus *Haplorchoides* Chen, 1949
Pseudohaplorchis Dayal, 1949 nec Yamaguti, 1954

Haplorchoides mehrai Pande and Shukla, 1977.

Material examined : 60 exs., Host *Mystus gulio*; Location Intestine; Locality Chilka lake at Barkul; 19/6, 22/6, 23/6 & 26.6.86. Coll. I. B. Dutta, Z.S.I. Rg. Nos. w 7943/1.

Distribution : India, Chilka lake (first record).

Description : Body small, delicate, 0.78 - 0.86 long, 0.25 - 0.36 wide, forebody mostly attenuated. Tegument spinose. Ventral sucker absent. Oral sucker 0.05 - 0.06 long, 0.06 - 0.07 wide, Prepharynx 0.08 - 0.13 long; pharynx 0.04 - 0.05 long, 0.03 - 0.04 wide, oesophagus short, intestinal caeca terminating to posterior end of body. Testis single, post eqatorial, 0.14 - 0.16 long, 0.14 - 0.20 wide. Cirrus sac absent. Seminal vesicle bipartite, preovarian, pars prostatica poorly developed. Genital atrium complex, muscular, with gonotyl, genital opening behind intestinal bifurcation. Ovary pretesticular, 0.06 - 0.07 long, 0.05 - 0.09 wide. Seminal receptacle well developed, situated posterior to ovary. Vitellaria follicular, situated in lateral fields of the body from testis to ovary. Uterus occupying most of hind body. Eggs 24 - 32 μm \times 16-20 μm .

Excretory vesicle 'y' shaped.

Discussion : Rai and Pande (1968) mentioned that *H. attenuatus* (Srivastava, 1935) and *H. piscicola* (Srivastava, 1935) are the only valid species of the genus *Haplorchoides* Chen, 1949. Pande and Shukla (1977) not only described *Haplorchoides mehrai* but they added *H. pearsoni* also to the genus *Haplorchoides*.

Family ENENTERIDAE

Subfamily ENENTERINAE Yamaguti, 1958

Genus *Karyakartia* Hafeezullah, 1979

Karyakarita pambanense (Karyakarte, 1968), Hafeezullah, 1979

Material examined : 3 exs; Host - *Therapon jarbua*; Location Intestine; Locality Chilka lake; Coll. I. B. Dutta; Z.S.I. Reg. Nos.w 7837/1 & 7838/1.

Distribution : India, Chilka lake (first record).

Description : Body elongate, 3.05 - 3.61 long, 0.40 - 0.49 wide. Tegument spinose. Ventral sucker round, 0.15 - 0.16 in diameter, situated at 0.72 - 0.81 from anterior end of the body. Oral sucker 0.24 - 0.30 long, 0.16 - 0.19 wide, funnel-shaped, larger than ventral sucker, 20-21 anteriorly directed oral tentacles on rim of mouth. Prepharynx 0.13 - 0.17 long; pharynx 0.09 - 0.10 long, 0.08 - 0.09 wide; oesophagus 0.06 - 0.10 long; intestinal caeca extending upto posterior end of body forming a cyclocoel.

Testes two, tandem, entire, anterior testis 0.25 - 0.28 long, 0.18 - 0.20 wide, posterior testis 0.28 - 0.29 long, 0.19 - 0.20 wide. External seminal vesicle tubular, extending upto posterior end of Vitellaria. Cirrus sac present. Internal seminal vesicle bipartite, pars prostatica surrounded by prostate gland cells; cirrus muscular. Genital opening near pharynx.

Ovary 0.12 - 0.14 long, 0.11 - 0.16 wide, entire, pretesticular. Seminal receptacle present behind ovary. Vitellaria follicular, extending in between lower part of external seminal vesicle and posterior end of body. Uterus pre-ovarian; metraterm not differentiated. Eggs 57-77 μm x 45 - 65 μm .

Excretory vesicle tubular, excretory pore terminal.

Discussion : Karyakarte (1968) described *Acanthostomum (Gymnatrema) pambanense* from the intestine of *Therapon puta* examined at Pamban Island, East coast of India. Hafeezullah (1979) collected identical specimens from the intestine of *Therapon jarbua* at Visakhapatnam coast. According to him, the identification of the species *Acanthostomum (Gymnatrema) pambanense* Karyakarte, 1968 is erroneous. He (Hafeezullah, 1979) stated that the cephalic spines described by Karyakarte are actually forwardly directed cephalic or oral papillae, and intestinal caeca do not terminate blindly at the posterior end of body but they unite and form cyclocoel. He further observed that external saccular seminal vesicle is present and the internal seminal vesicle is enclosed in a cirrus sac. In *Acanthostomum* Looss, 1899 there are backwardly directed oral spines, external seminal vesicle is absent and genital pore is preacetabular. In the light of these characters Hafeezullah (1979) assigned this species to a new genus *Karyakarita* and *Karyakarita pambanense* as its type species.

The author agrees with the erection of *Karyakarita* by Hafeezullah (1979) and its placement in the family *Enenteridae*.

Family FELLODISTOMIDAE Nicoll, 1909
STERINGOPHORIDAE Odhner, 1911

Subfamily BACCIGERINAE Yamaguti, 1958
PENTAGRAMMINAE Yamaguti, 1958

Genus *Baccigeroides* N. Gen.

Baccigeroides hafeezullai n. gen., n. sp.
(Fig. 1)

Material examined : 15 exs.; Host - *Setipinna phasa*; Location - Intestine; Locality - Chilka lake; Coll. I. B. Dutta; Z.S.I. Reg. Nos. w 7839/1 - 7843/1.

Distribution : India, Chilka lake (first record).

Description : Body small, oval 0.76 - 0.81 long, 0.44 - 0.48 wide. Tegument aspinose. Ventral sucker 0.06 - 0.08 in diameter, situated at 0.19 - 0.24 from anterior end of body. Oral sucker terminal, subspherical, 0.05 - 0.06 long, 0.07 - 0.09 wide, almost equal to ventral sucker. Sucker ratio almost 1 : 1.

Prepharynx short; pharynx small, 0.03 - 0.04 long, 0.03 - 0.05 wide. Oesophagus half long, narrow, bifurcating at 0.18 - 0.20 from anterior end of body. Intestinal caeca short, reaching upto level of testes.

Testes two, entire, symmetrical, oval, post-acetabular 0.09 - 0.10 long and 0.08 - 0.09 wide. Cirrus sac ovoid, situated on right side of body near pharynx and anterodorsal to caecal bifurcation. Internal seminal vesicle saccular, unipartite; parsprostatica surrounded by prostate gland cells; ejaculatory duct short. Genital pore pharyngeal in position, submedian, dextral.

Ovary oval, entire, anterior to right testis, 0.282 - 0.084 long, 0.073 - 0.076 wide. Seminal receptacle anterodorsal to ovary. Vitellaria follicular, forming bunches, eight follicles in each bunch, symmetrical, anterodorsal to intestinal caeca in anterior one third of body. Uterus voluminous, filling most of hind body. Eggs small, 20-24 μm x 6-20 μm .

Excretory vesicle 'Y' shaped, arms reaching upto level of oesophagus.

Discussion : Nicoll (1914) named the genus *Bacciger* but did not define it. Palombi (1934) recorded *Bacciger* from the Gulf of Naples. Yamaguti (1938) described *B. harengulae* from Hamana-Ko, Japan, but due to the absence of cirrus sac in it, Nahhas and Cable (1964) transferred it under the genus *Pseudobacciger*. Margolis and Ching (1965) indicated the differences between *Bacciger* and *Pseudobacciger*. The tegument of *Bacciger* is spined, cirrus sac well developed and intercaecal, and seminal vesicle is bipartite, while in *Pseudobacciger* also the tegument is spined, but the cirrus sac and prostate gland cells are absent. Madhavi (1975) mentioned that the tegument of *Pseudobacciger* is smooth and delicate. Probably in her material the tegumental spines were lost during processing. The proposed new genus *Baccigeroides* is very much similar to *Bacciger* Nicoll, 1914 but differs from it in having unipartite seminal vesicle (Fig. 8), extra-caecal on right side, prostate gland cells surround pars prostatica, genital pore near pharynx, presence of prepharynx, half long oesophagus and ventral sucker equal to oral sucker. It differs from *Pseudobacciger* in the size of body, ratio of suckers, presence of cirrus sac, unipartite seminal vesicle, prostate gland cells surrounding the pars prostatica and position of genital pore near pharynx. It also differs from *Allobacciger* Hafeezullah and Siddiqi, 1970 in the sucker ratio, shape and position of ovary, extra-caecal cirrus sac and genital pore near pharynx. Hafeezullah and Siddiqi (1970) described a new species *Bacciger cochinchinensis* which clearly fits in the genus *Baccigeroides* as diagnosed above and therefore it becomes *Baccigeroides cochinchinensis* (Hafeezullah and Siddiqi, 1970) n. comb. The present species differs from *B. cochinchinensis* in the absence of long prepharynx, number of vitelline follicles being 7-8 instead of 6, uterine coils, being much more and in the size of eggs. The present species clearly differs from *B. cochinchinensis* Hafeezullah and Siddiqi, 1970 and author humbly suggests its name *Baccigeroides hafeezullai*.

Generic diagnosis : Fellodistomidae, baccigerinae. Body small. Tegument aspinose. Suckers well developed. Prepharynx small; oesophagus long; caeca short. Genital pore near pharynx; cirrus sac present, extra-caecal; seminal vesicle unipartite; prostate gland cells present. Testes two, symmetrical. Ovary pretesticular or testicular, entire. Seminal receptacle present. Follicular vitelline glands in symmetrical bunches in anterior one third of body. Posterior two third of the body remains filled up with uterine coils. Parasites of marine fishes.

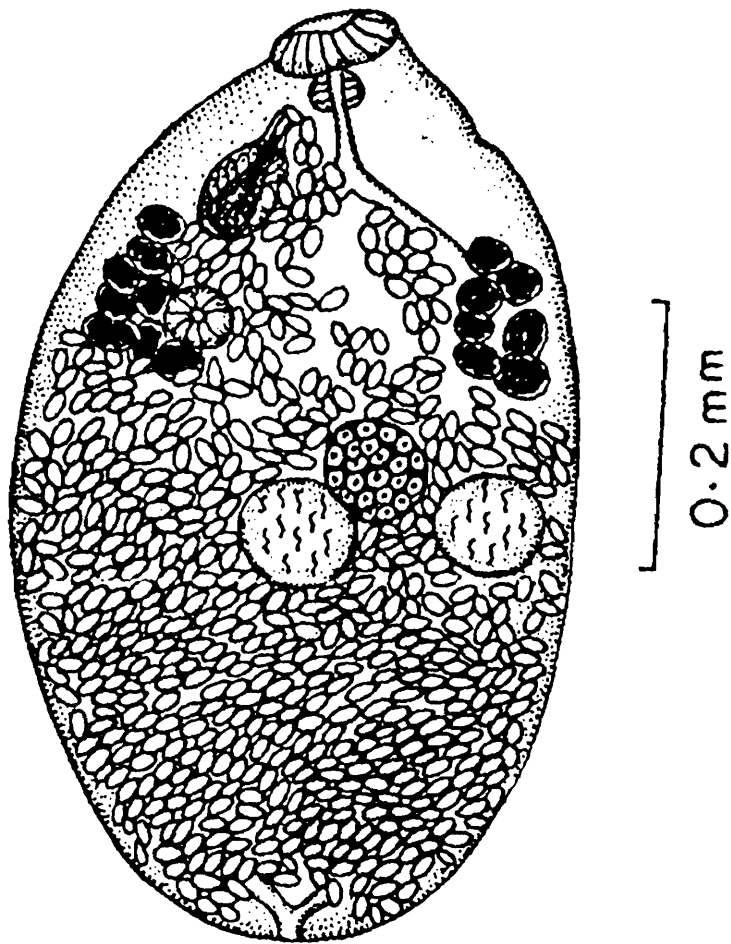


Fig.1. *Baccigeroides hafeezullai* n.gen.; n.sp. Holotype

Type species : *Baccigeroides hafeezullai*.

Other species : *B. cochinchensis* (Hafeezullah and Siddiqi, 1970) n. comb.

Key to the genera of Baccigerinae

1. Vitellaria consisting of symmetrical compact masses; testes well apart from ovary
..... *Pseudopentagramma*
- Vitellaria other wise; testes very close to ovary 2
2. Cirrus pouch absent or poorly developed; seminal vesicle bipartite vitellaria closely massed together *Pseudoibacciger*
- Cirrus pouch well developed, Preacetabular; Seminal vesicle saccular, bipartite, vitellaria not closely massed together *Bacciger*
- Cirrus pouch anterior or dorsal to acetabulum; Seminal vesicle tubular, not bipartite; vitellaria not closely massed together in extracaecal field *Faustula*
- Cirrus pouch anterodorsal to caecal bifurcation, unipartite extracaecal; vitellaria in compact bunch with 8-follicles *Baccigeroides* n. gen.

Genus *Bacciger* Nicoll, 1914

Bacciger bacciger (Rud., 1819) Nicoll, 1914.

Distoma baccigerum Rudolphi, 1819.

Distomum baccigerum (Rud.) Diesing, 1850

Dicrocoelium baccigerum (Rud.) Zernov, 1913

Bacciger bacciger of Nicoll, 1914

Material examined : 16 exs., Host - atherina sp; Location - Intestine; Locality - Chilka lake, Coll. Y.R.Tripathi, Z.S.I. Reg. No. w 7944/1.

Distribution : Mediterranean, Black Sea, India, Chilka lake (first record).

Description : Body small, oval, 0.56 - 0.94 long 0.54 - 0.64 wide. Tegument spinose. Ventral sucker 0.08 - 0.16 in diameter, situated at 0.24 - 27 from anterior end of body. Oral sucker 0.07 - 0.09 long, 0.10 - 0.12 wide, smaller than ventral sucker, terminal. Sucker's ratio - 1 : 1.29. Prepharynx absent; pharynx 0.03 - 0.06 long, 0.03 - 0.05 wide; oesophagus short; intestinal caeca short, extending upto anterior ends of testes.

Testes two, symmetrical, 0.18 - 0.26 long, 0.12 - 0.21 wide. Cirrus sac anterodorsal to acetabulum, internal seminal vesicle bipartite; pars prostatica surrounded by prostate gland cells; ejaculatory duct short.

Ovary entire, median, 0.12 - 0.17 long, 0.08 - 0.16 wide. Seminal receptacle posterior to ovary, intertesticular.

Vitellaria in two groups of follicles, one on either side of body, vitelline reservoir at posterior end of acetabulum. Uterine coils mostly in hind body. Eggs 16-24 μm x 12-16 μm .

Excretory vesicle 'V' shaped.

Discussion : The details of the present specimens largely conform to the details of *Bacciger bacciger* (Rud, 1819) Nicoll, 1914. A new locality is recorded for the species. Skrjabin and Koval (1954) stated that the tegument is smooth. Bykhovskaya-Pavlovskaya et al (1962) stated that the tegument is unarmed. Nikoleeva (1961) stated that the tegument is finely annulated, the annulations being formed of small spines. However, the tegument of the present specimens is unarmed.

Subfamily FELLODISTOMINAE Nicoll, 1909

STERINGOPHORINAE Odhner, 1911

Genus *Steringotrema* Odhner, 1911

Steringotrema chauhani n. sp.

(Fig. 2)

Material examined : 8 exs; Host - *Blennius* sp.; Location - Intestine; Locality - Chilka lake; Coll. Y.R.Tripathi; Z.S.I. Reg. No. w 7869/1.

Distribution : India, Chilka lake (first record).

Description : Body 1.60 - 1.72 long, 0.52 - 0.62 wide, oval. Tegument spinose. Ventral sucker 0.26 - 0.35 in diameter, situated at 0.43 - 0.59 from the anterior end of body. Oral sucker terminal, 0.11 - 0.13 long, 0.14 - 0.16 wide, smaller than ventral sucker. Sucker ratio 1 : 2.14. Perpharynx absent; pharynx muscular, 0.11 - 0.12 long, 0.12 - 0.15 wide; oesophagus short, followed by bifurcated intestine. Intestinal caeca extending upto the level of testes.

Testes two, symmetrical, left testis 0.18 - 0.19 long, 0.14 - 0.15 wide, right testis 0.19 - 0.21 long, 0.14 - 0.17 wide, post-acetabular. Cirrus pouch preacetabular; internal seminal vesicle bipartite; pars prostatica surrounded by prostate gland cells. Genital pore near pharynx, submedian left side of the body.

Ovary bilobed, pretesticular, 0.13 - 0.15 long, 0.10 - 0.11 wide. Seminal receptacle present, anterodorsal to ovary. Vitellaria follicular, symmetrically arranged on both sides of the body in two separate groups, anteriorly extending to level of pharynx, posterior group extending to level of testes. Coils of uterus mostly filling hind body. Eggs 36 - 49 μm x 28 - 41 μm .

Excretory vesicle 'V'; shaped; arms extending upto pharynx; pore terminal.

Discussion : The genus *Steringotrema* has the following species. *S. cluthense* (Nicoll, 1909) Odhner, 1911; *S. corpulentum* (Linton, 1905) Manter, 1931; *S. crassum* (Manter, 1934) Yamaguti, 1954;

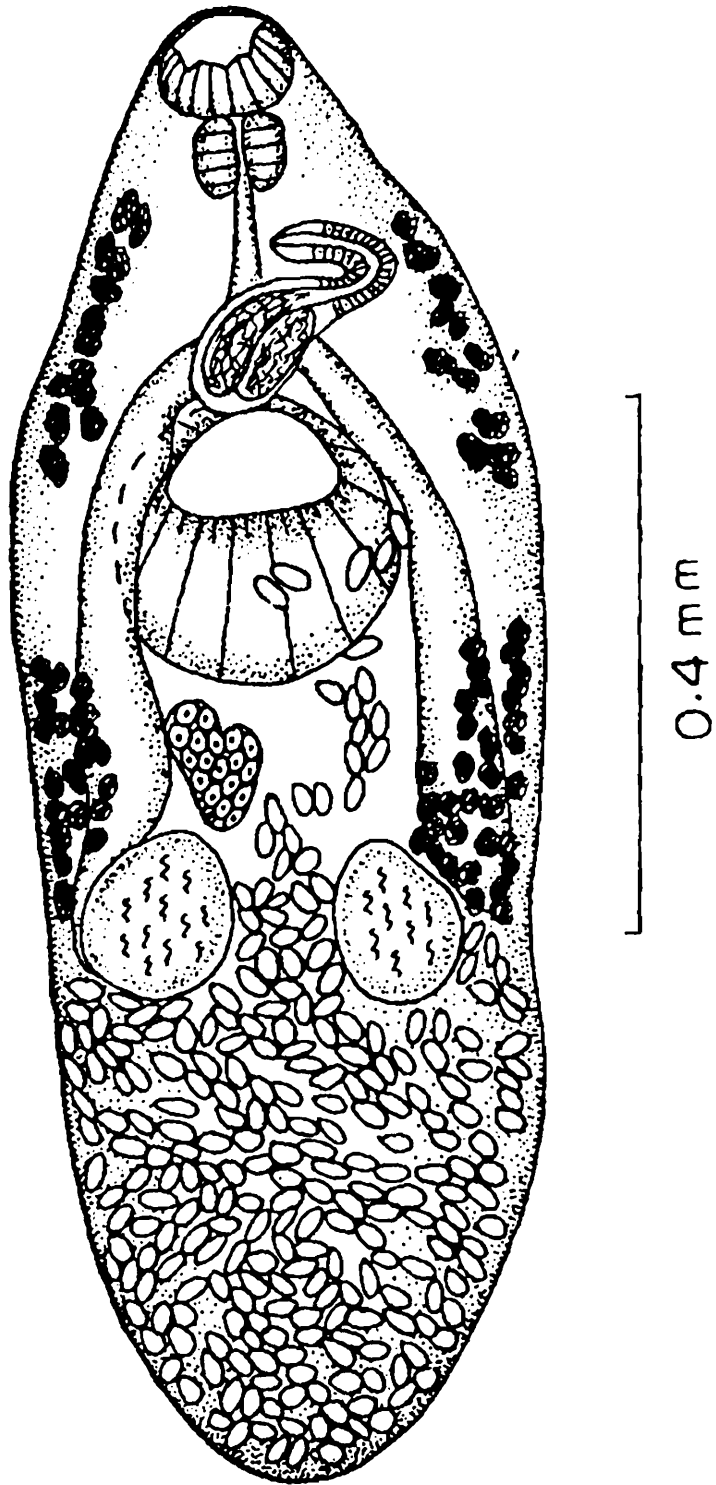


Fig.2. *Steringotrema chauhani* n.sp. Holotype

S. divergens (Rudolphi, 1809) Odhner, 1911; *S. nakazawai* Kobayashi, 1921; *S. ovacutum* (Lebour, 1908) Odhner, 1911; and *S. pagelli* (Van Beneden, 1871) Odhner, 1911.

The present form comes close to *S. divergens* but differs from it in the extent of intestinal caeca, sucker ratio, lobed ovary and egg size. The species is named after the noted helminthologist, Dr. B. S. Chauhan.

Family HAPLOPORIDAE Nicoll, 1914
Subfamily HAPLOPORINAE Dollfus, 1927
Genus *Saccocoelium* Looss, 1902
Saccocoelium tripathi n. sp.

(Fig. 3)

Material examined : Several; Host - *Mugil* sp.; Location Intestine, Locality Chilka lake; Coll. Dr. Y R. Tripathi, Z.S.I. Reg. Nos. w 7876/1 & 7877/1.

Distribution : India: Chilka lake (first record).

Description : Body small, oval, 0.76 - 1.08 long, 0.30 - 0.43 wide. Tegument spinose on anterior half of body. Ventral sucker preequatorial, 0.09 - 0.14 in diameter situated 0.22 - 0.28 from anterior end of body. Oral sucker subterminal, 0.10 - 0.13 in diameter. Sucker ratio 1 : 1.02. Prepharynx absent. Pharynx muscular, 0.06 - 0.13 long, 0.05 - 0.08 wide, oesophagus long. Intestinal caeca short, extending upto middle of body.

Testis single, 0.14 - 0.20 long, 0.16 - 0.22 wide, entire postacelabular. Seminal vesicle bipartite, Hermaphroditic pouch developed, prostate cells surround pars prostatica. Genital pore near pharynx.

Ovary entire, contiguous with testis, 0.07 - 0.12 long, 0.09 - 0.11 wide. Vitellaria a pair of lobes, symmetrical on each side. Uterus at posterior end. Eggs 30 - 50 μm x 20 - 30 μm .

Excretory vesicle saccular.

Discussion : Looss (1902) erected the genus *Saccocoelium* with *S. obesum* as its type species and added *S. tensum* to it. Hunter and Thomas (1961) described another species *S. beauforti* from *Mugil cephalus* from North California. Overstreet (1971) transferred it to the genus *Saccocoelioides* Szidat, 1954 on account of its follicular vitellaria. The author agrees with the synonymy. Dawes (1947) synonymises *Saccocoelium tensum* with *Saccocoelium obesum*. Fischthal and Kuntz (1963) and Ferreti and Paggi (1965) concurred with this synonymy. The present new form differs from *S. obesum* Looss, 1902 in the absence of prepharynx, shape and position of pharynx, the pharynx being highly muscular, position of ovary, shape of vitellaria, and egg size. The genus *Saccocoelium* is recorded for the first time from the Indian region and thus its distribution is extended. Author suggests its name *Saccocoelium tripathi* n. sp. to honour Dr. Y R. Tripathi, one of the distinguished helminthologist.

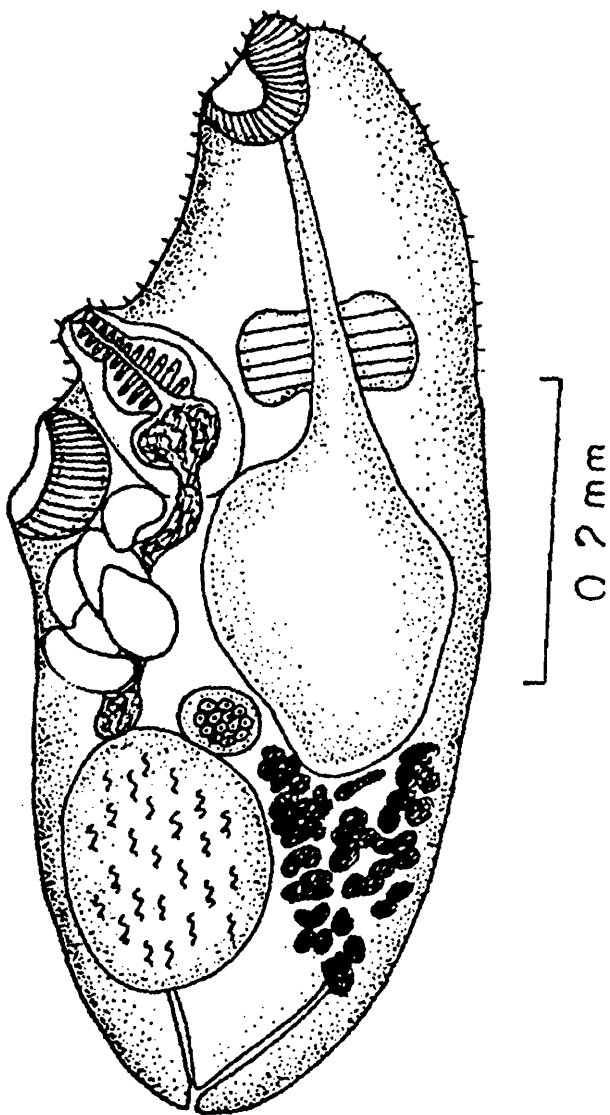


Fig.3. *Saccocoelium tripathi* n.sp. Holotype

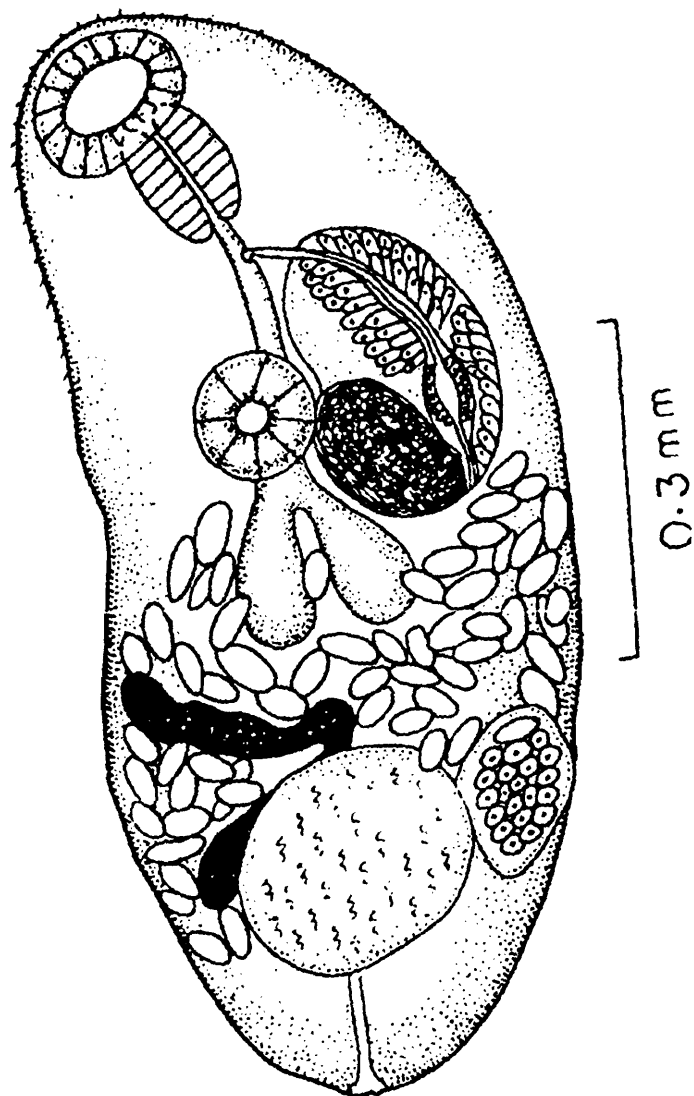


Fig.4. *Saccocoelioides chilkaensis* n.sp. Holotype

Genus *Saccocoelioides* Szidat, 1954*Saccocoelioides chilkaensis* n. sp.

(Fig. 4)

Material examined : 22 exs., Host - *Mugil* sp.; Location - Intestine, Locality - Chilka lake, Coll. Dr. Y. R. Tripathi & I. B. Dutta, Z.S.I. Reg. No. w 7878/1 – w 7881/1.

Distribution : India: Chilka lake.

Description : Body small, 0.81 - 1.07 long, 0.32 - 0.35 wide. Tegument spinose on anterior half of body. Ventral sucker equatorial, 0.07 - 0.09 in depth, 0.10 - 0.11 wide, situated at 0.32 - 0.38 from anterior end of body. Oral sucker terminal, conical, 0.07 - 0.09 long, 0.10 - 0.11 wide. Sucker ratio 1 : 1. Prepharynx 0.12 - 0.20 long; pharynx muscular, 0.08 - 0.09 long, 0.11 - 0.12 wide; oesophagus short followed by bifurcation. Intestinal caeca short, stumpy, reaching anterior level of testis.

Testis single, entire, 0.18 - 0.20 long, 0.13 - 0.14 wide, situated at posterior end of body. Hermaphroditic sac formed dorsal to ventral sucker, containing saccular internal seminal vesicle, small pars prostatica surrounded with prostate gland cells. External seminal vesicle present, extending upto testis. Genital pore lateral on right side of the body, anterior to ventral sucker.

Ovary entire, small, pretesticular 0.06 - 0.16 long, 0.07 - 0.15 wide. Receptaculum seminis absent. Vitellaria follicular, situated posterior to caecal ends. Uterus between ventral sucker and testis. Eggs 53 - 69 μm x 36 - 49 μm .

Excretory vesicle 'V' shaped.

Discussion : Szidat (1954) established the genus *Saccocoelioides* from anostomid fish from Argentina, to accommodate four species : *S. nanii* (as type species) from *Prochilodus lineatus*, *S. magnovatus* from *Leporinus obtusidens*, *S. elongatus* from *Prochilodus platensis* and *S. mangus* from *Crimata platana*. Lumsden (1963) described *S. sogandaresi* from Sailfin Molly, *Mollinesia latipinna* from Galveston Bay of Texas. Martin (1973) added *S. pearsoni* from *Mugil cephalus* and *Trachystoma peterdi* and traced its life history. He further transferred the species *S. magniovatus* Szidat, 1954 to Lecithobotrys. Lamothe - Argomedeo (1976) added another species *S. chauhani* from *Astynax fasciatus* from Veracruz, Mexico. Madhavi (1979) described a new species *S. martini* from *Mugil waigiensis* from India. The present new species is very close to *S. martini* Madhavi, 1979, but differs from it in the shape and size of the body, presence of long prepharynx, shape and position of ovary, number and position of vitelline follicles, position of genital pore, extension of external seminal vesicle and in the egg size. It differs from the type species *S. nanii* Szidat, 1954 in the presence of long, Prepharynx, position and number of vitelline follicles, shape and position of pharynx, short oesophagus, extension of external seminal vesicle and in egg size. Again it differs from all known species in the presence of long, Prepharynx, short oesophagus; extension of external seminal vesicle and number of vitelline fallicles. Author suggests its name *Saccocoelioides chilkaensis* n. sp. considering its locality. Further, it differs from *S. gohari* Ramadan *et al.*, 1989 in the absence of prepharynx; presence of muscular pharynx; shape and position of testis and ovary; shape of excretory vesicle and size of eggs.

Genus *Saccocoelioides* Szidat, 1979*Saccocoelioides martini* Madhavi, 1979

Material examined: 15 exs.; Host - *Etiopis suratensis*; Location - Intestine; Locality - Chilka lake at Rambha; 7.9.89; Coll. I.B. Dutta; Z.S.I. Reg. No. w 7945/1.

Distribution: India: Chilka lake.

Description: Body small, oval, 0.76 - 0.84 long; 0.33-0.40 wide. Tegument spinose. Ventral sucker 0.08 - 0.12 long; 0.11-0.13 wide, preaquatorial. Oral sucker 0.10 - 0.12 long; 0.10-0.11 wide, almost equal to ventral sucker. Sucker ratio - 1 : 1.03. Prepharynx long, oesophagus short; pharynx 0.09-0.11 long, 0.09-0.10 wide; intestinal caeca short, terminating at level of ovary.

Testis single, triangular, 0.18-0.27 long; 0.11-0.12 wide, situated near posterior end of body. Hermaphroditic sac cylindrical, preacetabular enclosing bipartite seminal vesicle, pars prostatica covered with prostate gland cells. Hermaphroditic duct muscular, protrusible. External seminal vesicle longer than internal seminal vesicle. Genital pore lateral on right side of the body near anterior margin of pharynx.

Ovary small, pretesticular, 0.10 - 0.16 long, 0.11-0.12 wide. Seminal receptacle absent. Vitelline glands follicular, distributed in the lateral fields near testis. Uterus between ventral sucker and testis. Eggs 69-77 μm x 36-41 μm .

Excretory bladder saccular.

Remarks: The present specimens identified as *S. martini* Madhavi, 1979, though there are some differences in measurements and shape of the body. Madhavi (1979) collected this species from mullets of Bay of Bengal. Here it is reported from the *Etiopis suratensis* from the estuary, Chilka lake.

Family HEMIURIDAE Luhe, 1901

Subfamily LECITHASTERINAE Odhner, 1905

Genus *Anadichadena* n.gen.*Anadichadena binoyi* n.gen; n.sp.

(Fig. 5)

Material examined: 12 exs., Host-*Hemiramphus* sp., Location-Intestine; Locality-Chilka lake; Coll. I.B.Dutta; Z.S.I.Reg. Nos. w 7891/1 – w 7896/1.

Distribution: India: Chilka lake (first record)

Description: Body small, 0.99-1.32 long, 0.32-0.41 wide, pointed posteriorly; ecsoma absent. Tegument smooth. Ventral sucker preaquatorial, 0.16-0.19 in diameter, globular situated at 0.30-0.38 from anterior end of body. Oral sucker terminal, 0.06-0.09 long, 0.09-0.10 wide, smaller than ventral sucker. Sucker ratio 1: 2.05. Prepharynx absent; pharynx 0.05-0.07 long, 0.05-0.06 wide; oesophagus 0.02-0.04 long followed by intestinal bifurcation. Intestinal caeca extending upto posterior end of body.

Testes two; anterior testis 0.07-0.08 long, 0.07-0.11 wide; posterior testis 0.06-0.10 long, 0.06-0.07 wide. Seminal vesicle saccular, pre-testicular; pars prostatica long, tubular, surrounded by prostate gland cells, ejaculatory duct joining metraterm to form hermaphroditic duct, enclosed in a hermaphroditic sac. Genital atrium opening laterally near intestinal bifurcation.

Ovary 0.08-0.10 long, 0.06-0.07 wide, smooth, post-testicular. Receptaculum seminis present, post-ovarian. Vitellaria compact, consisting of seven rosette-shaped lobes, post-ovarian. Uterus not reaching posterior end of body.

Eggs 12-16 μm x 8-12 μm .

Excretory vesicle 'Y'-shaped, arms united dorsal to pharynx.

Discussion : The present new genus is very much close to the genera *Dichadena*, *Neodichadena*, and *Monorchimacradena*. But it differs from *Dichadena* Linton, 1910 in the shape of body, position of testes near acetabulum, position of ovary anterior to vitellaria instead of posterior to it, receptaculum seminis anterior to vitellaria and genital opening lateral between acetabulum and oral sucker.

It differs from the genus *Neodichadena* Yamaguti, 1970 in the absence of preoral lobe, presence of 7 vitelline lobes instead of 8, extent of seminal vesicle, and less number of uterine coils.

It differs from the genus *Monorchimacradena* Nahhas et Cable, 1964 due to the absence of preoral lobe, presence of double testes instead of single, extent of seminal vesicle and limited number of uterine coils.

It is further differs from the genus *Lecithaster* Luhe, 1901 in the presence of unlobed ovary instead of lobed one, position of vitellaria and testis and in the size of egg. Considering these differences from the genera *Dichadena*, *Neodichadena*, *Monorchimacradena* and *Lecithaster*, the author suggests to establish a new genus *Anadichadena* to accommodate the present new species.

Generic diagnosis : Hemiuridae, Lecithasterinae. Body small, without ecsoma. Tegument smooth. Acetabulum larger than oral sucker and preequatorial. Oral sucker subterminal; prepharynx absent; pharynx well developed; oesophagus short; caeca reaching posterior extremity. Testes two, diagonal; seminal vesicle saccular, pretesticular; pars prostatica tubular, surrounded by prostate gland cells; ejaculatory duct joining the metraterm and forming a hermaphroditic duct, enclosed in a hermaphroditic sac. Genital pore lateral near intestinal bifurcation. Ovary pre-vitellarian, receptaculum seminis post ovarian. Vitellaria consisting of 7-rosette-shaped lobes. Uterus not reaching posterior extremity. Eggs small. Excretory arms united dorsal to pharynx. Intestinal parasites of estuarine and marine fishes.

The author named the species *Anadichadena binoyii* after the name of the eminent scientist Dr. Benoy K. Tikader, former Director of Zoological Survey of India.

Type species : Anadichadena binoyii

Key to the genera of Lecithasterinae

1. Vitellaria single lobed, compact ***Aphanurus***
 Vitellaria bilobed, compact 2
 Vitellaria divided into a number of claviform lobes; excretory arms united anteriorly 3
 Vitellaria consisting of several, rather rounded or some what digitiform 4
2. Seminal vesicle tubular, convoluted, pars prostatica very long; Pre- acetabular pit present; mouth surrounded by muscular lobes ***Mitrostoma***
 Seminal vesicle long, bipartite; pars prostatica short; preacetabular pit and circumoral lobe absent ***Aphanuroides***
3. Testes double ***Macradena***
 Testes single ***Monorchimacradena***
4. Excretory arms united anteriorly; caeca united posteriorly; vitellaria preovarian 5
 Excretory arms not united anteriorly; caeca not united posteriorly; vitellaria post ovarian 6
5. Pars prostatica not very long, enlarged posteriorly; seminal vesicle pretesticular, turned back on itself; ovary unlobed ***Dichadena***
 Pars prostatica extremely long, looped posteriorly, enclosing seminal vesicle which is posterolateral to testes; ovary lobed ***Pseudodichadena***
6. Vitellarian lobes in one group; testes diagonal or juxtaposed; pre oral lobe absent; parsprostatica short; ovary lobed ***Lecithaster***
 Peroral lobe present; pars prostatica long; ovary unlobed; uterine coils more ***Neodichadena***

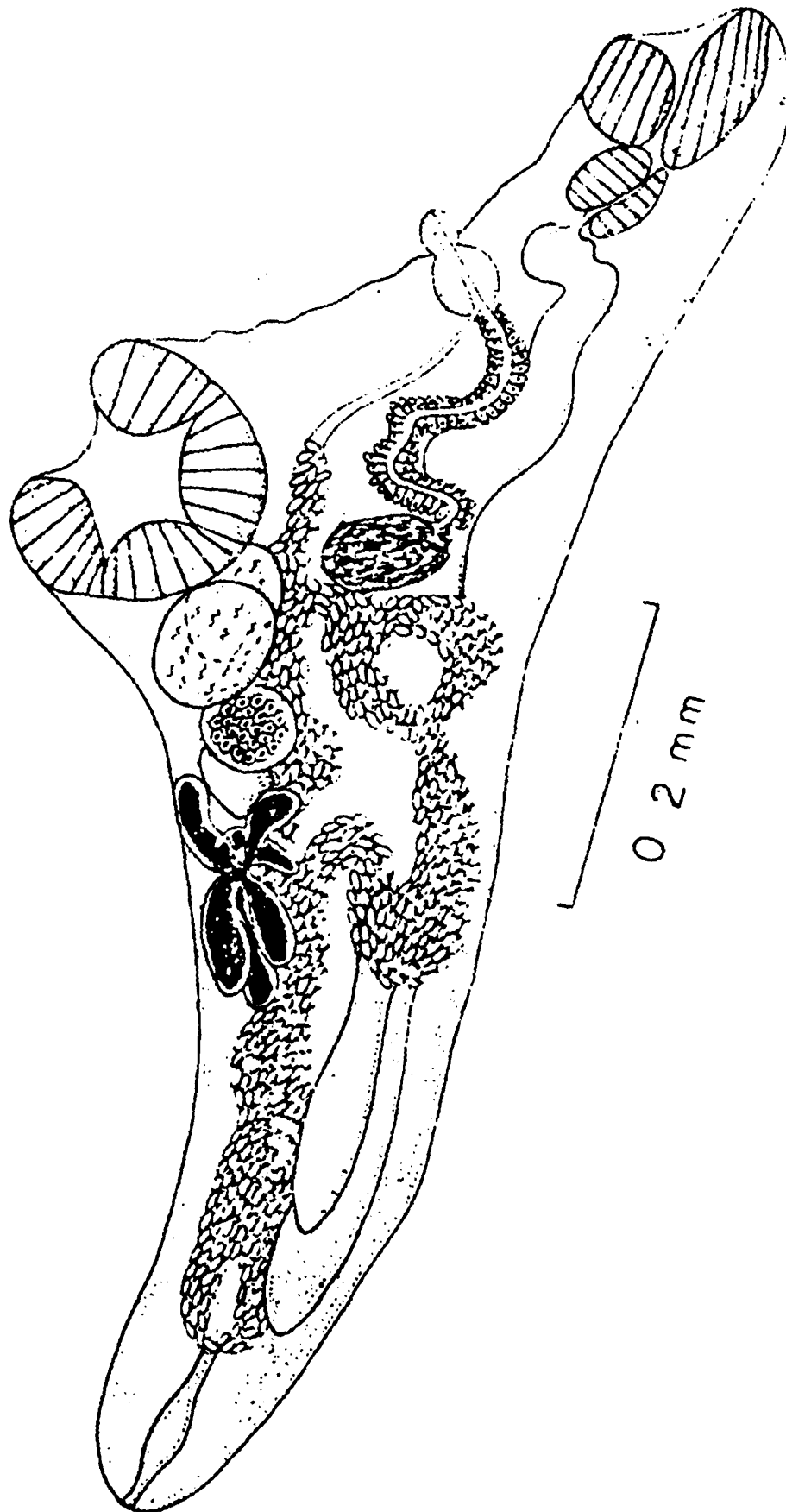


Fig.5. *Anadichadena binoyi* n.gen.; n.sp. Holotype

Pre oral lobe absent; pars prostatica long; ovary unlobed; uterine coils less
 *Anadichadena* n. gen

Vitellarian lobes divided into two (one preovarian and one postovarian) groups; testes tanded ...
 *Acanthuritrema*

Genus *Aphanurus* Looss, 1907

Chauhanurus Skrjabin et Guschanskaja, 1954

Aphanurs microrchis Chauhan, 1945

Material examined : 134 exs.; Host-*Mugil cephalus*; Location-Intestine; Locality: Chilka lake at Barkul; 15.6.86; Coll. I.B.Dutta; Z.S.I. Reg. Nos. w 7946/1.

Distribution : Chilka lake (first record), India.

Measurements : Body 0.96-1.10 X 0.17-0.19; oral sucker 0.05-0.08 X 0.06 X 0.09; Pharynx 0.03-0.04 in diameter; Ventral sucker 0.11-0.16 X 0.12-0.16; anterior and posterior testis 0.04-0.05 in diameter; ovary 0.03-0.04 X 0.04-0.06; Eggs 20-24 μm x 8-12 μm .

Remarks : This species is common parasite of marine fishes; Chauhan (1945) first recorded this species from *Mugil parsia* at Bombay Coast. This is the second locality record, therefore the distributions of the species is extended.

Subfamily HEMIURINAE looss, 1899

Genus *Anahemiurus* Manter, 1947

Anahemiurus manteri n.sp.

(Fig. 6)

Material examined : 10 exs., Host-*Gadus* sp., Location-Intestine; Locality-Chilka lake; Coll. Dr. Y.R. Tripathi; Z.S.I. Reg. Nos. w 7885.1 & 7886/1.

Distribution-India, Chilka lake (First record).

Description : Body small, 1.07-1.77 long, 0.36-0.52 wide, oval, having a small tail. Tegument scaled on anterior half of body, posterior half and tail smooth. Ventral sucker round 0.16-0.21 in diameter situated 0.23 from anterior end of body. Oral sucker subterminal, 0.08-0.11 long, 0.17-0.21 wide, almost equal to ventral suckers. Sucker ratio- 1:1.32. Prepharynx absent; pharynx small, 0.04-0.06 long, 0.04-0.05 wide, globular; oesophagus short. Intestinal caeca extending upto middle third of body.

Testes two, left testis 0.05-0.08 long, 0.14-0.18 wide, right testis 0.07-0.09 long, 0.12-0.18 wide,

symmetrical, entire, oval, post-acetabular. Seminal vesicle thick-walled, avoid, undivided, ;pars prostatica long surrounded by prostate gland cells. Tubular hermaphroditic duct. Genital opening just posterior to anterior to intestinal bifurcation.

Ovary entire, 0.06-0.12 long, 0.11-0.15 wide, post-testicular, equatorial. Seminal receptacle present. Vitellaria two compact masses, unlobed, post-ovarian. Uterus occupying most of middle of body. Eggs 16-24 μm x 12-16 μm .

Excretory vesicle 'Y'-shaped; arms united anterodorsal to pharynx.

Discussion : Manter (1974) established the genus *Anahemiurus* to accommodate the type species *A. microcercus*. Kurashvili (1958) described another species, *A. trachuri*, from *Trachurus mediterraneus ponticus* from Black Sea. The present new form is collected from *Gadus* sp. from the Chilka lake, Orissa. The form is very much identical of the two known species but differs from them in the shape and size of body, acetabulum more anteriorly situated, testes are symmetrically arranged, uterine coils are not extended upto the posterior end of body, genital pore is situated posterior to the intestinal bifurcation and in the size of eggs. Author proposes its name as *Anahemiurus manteri* to honour the eminent Scientist H.W. Manter.

Subfamily DINURINAE Looss, 1907

Genus *Johniophyllum* skrjabin et Guschanskaja, 1954

Johniophyllum skrjabini n.sp.

(Fig. 7)

Material examined : 1 ex.; Host-*Glossogobius giuris*; Location Intestine; Locality-Chilka lake; Coll. I.B. Dutta; Z.S.I. Reg. No. w 7897/1.

Distribution : India: Chilka lake (first record).

Description : Body small, 1.92 long, 0.49 wide, elongate, without ecsoma. Tegument without cuticular serration. Ventral sucker round, 0.32 in diameter, situated 0.70 from anterior end of body. Oral sucker subterminal, 0.14 in diameter, round, smaller than ventral sucker. Sucker ratio-1 : 2.28. Prepharynx absent; pharynx well developed, 0.08 long, 0.07 wide, oesophagus short. Intestinal caeca extending upto posterior end of body.

Testes two, left testis 0.16 long, 0.15 wide, right testis 0.14 long, 0.17 wide, symmetrical, oval, postacetabular. Seminal vesicle saccular, hermaphroditic duct long, muscular without pouch pars peostatica and prostate gland cells not distingly differentiated. Genital opening near pharynx.

Ovary post-testicular, 0.16 long, 0.25 wide, entire. Seminal receptacle near ovary. Vitellaria postovarian, consisting of seven tubular lobes. Uterus mostly in hind body. Eggs 8-12 μm x 8-9 μm .

Excretory arms united near oral sucker.

DUTTA : *Digenea*

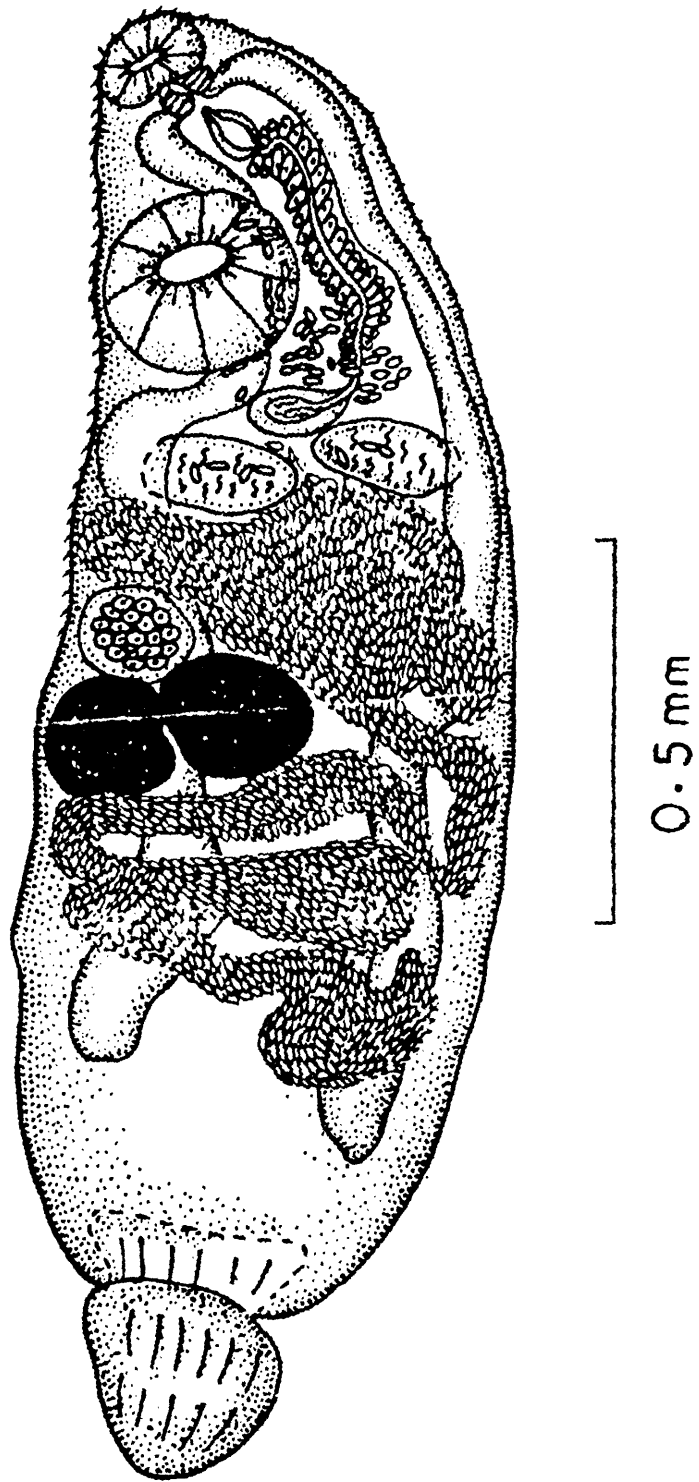


Fig.6. *Anahemiurus manteri* n.sp. Holotype

Discussion : Skrjabin et Guschanskaja (1954), while erecting the genus *Johniophyllum*, transferred *Lecithocladium johni* Yamaguti, 1938 under their genus as *Johniophyllum johnii* which was recovered from *Beryx splendens* from Japan. The new species is very close to *J. johnii* (the type species of the genus) but differs from it in the size and position of ventral sucker; pharynx not being muscular, intertinal caeca not extending more to posterior end of the body; position of genital pore, distribution of uterine coils and the eggs are smaller in size. Considering the above facts it is clear that the present species is new to science and author suggests its name *Johniophyllum skrjabini* to the honour of K.I.Skrjabin.

Genus *Uterovesiculurus* Skrjabin et Guschanskaja, 1954

Uterovesiculurus thrissocli Ahmad, 1980

Material examined : Several; Host-*Otolithes* sp; *Polynemus sextarius* and *Elutheronema tetradactylum*; Location-Intestine; Locality-Chilka lake at Balugaon; Coll. I.B.Dutta, 17.7.86; Z.S.I. Reg. No. w 7947/1.

Distribution : India: Chilka Lake (first record).

Description : Body elongate; 2.96-3.01 long, 0.64-1.07 wide; ecsoma Present. Tegument serrated. Ventral sucker 0.41-0.76 long, 0.38-0.73 wide. Oral sucker subterminal 0.16-0.22 long, 0.17-0.30 wide; pharynx 0.08- 0.14 long, 0.09-0.14 wide; oesophagus short; ceca extending into tail. Sucker ratio 1:2.70.

Testes diagonal, postacetabular, right testis 0.18-0.24 long, 0.21-0.36 wide, left testis 0.19-0.22 long, 0.22-0.27 wide. Seminal vesicle saccular, posterodorsal to acetabulum, pars prostatica surrounded by prostate gland cells near its distal portion only. Hermaphroditic duct long, narrow, enclosed in a hermaphroditic pouch, opening into tubular genital atrium. Genital pore near pharynx.

Ovary 0.17-0.22 long, 0.31-0.41 wide, submedian, Vitellaria consisting of seven tubular lobes. Uterus not extending into the tail. Eggs 16-20 μm x 8-12 μm .

Excretory sac 'Y' shaped, arms united dorsal to pharynx.

Discussion : Ahmad (1980) described five species to the genus *Uterovesiculurus* Skrjabin et Guschanskaja, 1954 from the marine fishes of Puri coast. The five species are *U. thrissocli*, *U. Gazzi*, *U. orientalis*, *U. bengalensis* and *U. yamagutii*. He differentiated this five species from one another by slight differences, mainly on the position of testes, genital pore, shape and nature of seminal vesicle and ovary and also mentioned the presence of bipartite and tripartite seminal vesicle, but the partition of seminal vesicle has not been clearly shown in the figure. These differences appear to be more specific variations. Therefore, the latter four species are considered as the synonyms of *U. thrissocli*. The present specimens are referable to *U. thrissocli*. Yamaguti (1971) and Hafeezullah (1975) discussed the validity of the genus *Uterovesiculurus* and *Erilepturus*.

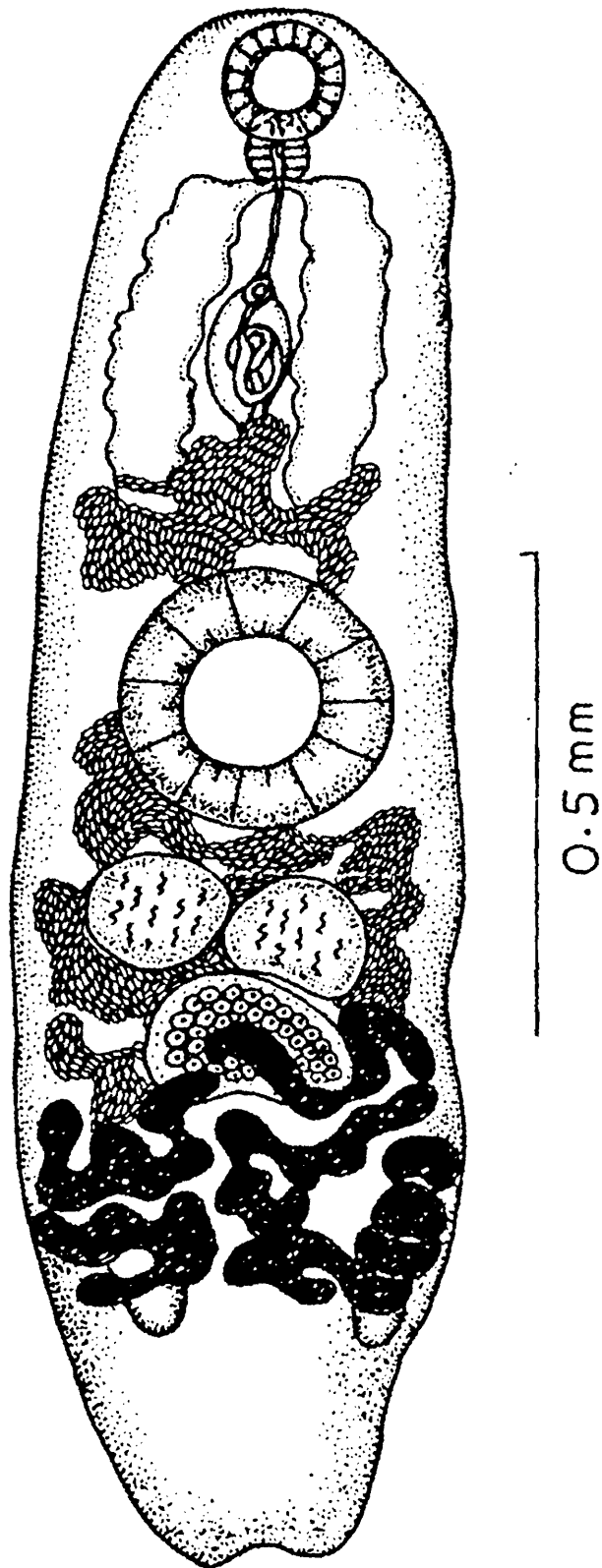


Fig.7. *Johniophyllum skrjabini* n.sp. Holotype

Subfamily LECITHOCHIRIINAE Luhe, 1901

Genus *Lecithochirium* Luhe, 1901*Ceratotrema* Jones, 1933*Jajonetta* Jones, 1933*Lecithochirium furcolabiatum* (Jones, 1933)

Material examined : 28 exs.; Host – *Polynemus* sp., Location – Intestine; Locality – Chilka lake; Coll. Dr. Y.R.Tripathi; Z.S.I. Reg. No. w 7884/1.

Distribution : India, Chilka lake (first record).

Description : Body 2.99 – 5.42 long, 1.20 – 1.70 wide, fusiform, preoral lobe formed into a bifid horn-like process; ecsoma present. Tegument scaled. Ventral sucker 0.43 – 0.65 in diameter, preequatorial, situated at 1.02 – 1.6 from anterior end of body. Oral sucker subterminal, 0.24 – 0.52 in diameter with three thickenings on inner well. Pharynx small; oesophagus short. Intestinal caeca not extending upto ecsoma. Sucker ratio – 1 : 1.32.

Testes two, symmetrical, post-acetabular, left testis 0.32 – 0.43 long, .25 – 0.33 wide, right testis 0.33 – 0.44 long, 0.22 – 0.49 wide. Seminal vesicle elongate, Preacetabular, constricted into two portions; prostatic duct surrounded by prostatic gland cells; ejaculatory duct and metraterm join to form a hermaphroditic duct opening into a genital atrium. Genital pore ventral to intestinal bifurcation.

Ovary entire, 0.40-0.52 long, 0.27-0.35 wide, submedian, post testicular. Receptaculum seminis present just posterior to ovary. Vitellaria compact into two groups, each group having three to four finger-like processes. Uterine coils separating testes, ventral sucker and ovary, not extending upto end of the body proper. Eggs numerous, 16-20 µm x 12-16 µm.

Excretory sac Y-shaped; arms uniting near pharynx dorsally.

Discussion : Chauhan (1945) described *Lecithochirium acutus* from *Arius fulcaris* and *Trichiurus* sp. from west coast of India, Bombay, which has a non-bifurcated nipple-shaped pre oral lip. Manter (1947) proposed that *Ceratotrema* Jones, 1933 is the synonym of *Lecithochirium* Luhe 1901 on the basis of presence of pre oral lobe in Chauhan's species. Yamaguti (1971) retained the genus *Ceratotrema* distinct from *Lecithochirium*. The present specimens are identified as *L. furcolabiatum* (Jones, 1933) Manter, 1974 due to the presence of bifid pre oral lobe, three elevations into the oral sucker and oral sucker smaller than ventral sucker.

Subfamily GONOCERCINAE Skrjabin et Guschanskaja, 1955

HEMIPERINAE Yamaguti, 1958

Genus *Hemipera* Nicoll, 1913*Hemiperina* Manter, 1934

Hemipera ovocaudata Nicoll, 1913

Material examined : 2 exs.; Host- *Tricirrata* sp., Location Intestine; Locality- Chilka lake; Coll. Dr. Y.R. Tripathi; Z.S.I. Reg. Nos. w 7887/1 & w 7888/1.

Distribution : English channel, British Island, India, Chilka lagoon (First record).

Description : Body small, 1.29-1.40 long 0.49-0.56 wide, oval; ecsoma absent. Tegument smooth. Ventral sucker large, 0.33-0.41 in diameter, situated at 0.64-0.68 from anterior end of body. Oral sucker subterminal, 0.14-0.20 long, 0.16-0.23 wide, almost half as large as ventral sucker. Sucker ratio-1:2. Prepharynx absent; pharynx, globular, 0.06-0.07 long, 0.06-0.09 wide; oesophagus very short; intestinal caeca reaching upto posterior end of body.

Testes two, symmetrical, irregular in shape, posterior to vitellaria, near posterior end of body, left testis 0.12-0.17 long, 0.10-0.12 wide, right testis 0.14-0.20 long, 0.13-0.14 wide. Seminal vesicle oval or pyriform; pars prostatica tubular, short, surrounded by prostate gland cells, enclosed in weak cirrus sac. Sinus organ formed, cone like. Genital opening near pharynx.

Ovary subglobular, 0.10-0.11 long, 0.08-0.10 wide, entire, median, pretesticular, postacetabular, disposed between two masses of vitellaria. Seminal receptacle weakly developed. Vitellaria compact, in two separate masses, unlobed, posterolateral to acetabulum, one on either side of ovary. Uterus entirely preovarian, largely preacetabular, intercaecal. Eggs filamented, 45-106 μm x 20-36 μm .

Excretory sac 'Y'-shaped, arms uniting dorsal to pharynx.

Discussion : Nicoll (1913) described *Hemipera ovocaudata* from *Lepadogaster gouanii*, *Onos mustelus* and *Onos tricirratus* from English channel. Nama (1979) recorded it from *Channa (Ophiocephalus) punctatus* from India. The present specimens broadly conform to Nicoll's description of his species. Therefore, the author refers them to *H. ovocaudata* Nicoll, 1913 in spite of some minor differences. However, the host record and distribution of the species is extended.

Subfamily LECITHASTERINAE Odhner, 1905

Genus *Lecithaster* Luhe, 1901*Lecithaster indicus* Srivastava, 1935

Material examined : 4 exs.; Host-*Hilsa* sp; Location-Intestine; Locality-Chilka lake at Satpara, 28.6.86, 12.9.87 & 27.6.86; Coll. I.B. Dutta; Z.S.I. Reg. No. w 7948/1.

Distribution : India: Chilka lake (first record).

Measurements : Body 0.83-1.02 X 0.28-1.44; oral sucker 0.04-1.08 X 0.06-0.10 ; Pharynx 0.04-0.05 in diameter; ventral sucker 0.10-0.18 in diameter; left testis 0.08-0.11 X 0.10-0.12; right testis 0.10-0.11 X 0.09-0.11; ovary 0.11-0.15 X 0.18-0.21; Eggs 16-20 μm x 12-16 μm .

Remarks : Srivastava (1935) described *L. indicus* from *Clupea ilisha*. The present specimens broadly conform to this species.

Family ISOPARORCHIIDAE (TRAVASSOS, 1922) Poche, 1926

Genus *Isoparorchis* Southwell, 1913

Leptolecithum Kobayashi, 1915

Isoparorchis hyselobagri (Billet, 1898) Ejsmont, 1932

Material examined -2 exs.; Host - *Mystur* sp.; Location-air bladder; Locality-Chilka lake at Barkul; Coll. I.B.Dutta, Z.S.I. Reg. No. w 7949/1.

Distribution : India, Australia, Indonesia, China, Japan, Siberia, Chilka lake (first record).

Remarks : This species is recorded mainly from the air sac of Cat fish; *Tor tor* & *Wallago attu*. As this is widely occurring and well described species, therefore detailed description is not given here.

Family MONODHELMINTHIDAE Dollfus, 1937

Subfamily MEHRATREMATINAE (Srivastava, 1939) Skrjabin, 1953

Genus *Mehratrema* Srivastava, 1939

Mehratrema militaris n.sp.

(Fig. 8)

Material examined : 5 exs.; Host-Osteogeniosus militaris. Location -Intestine; Locality- Chilka lake; Coll. Dr. Y.R. Tripathi, Z.S.I. Reg. No. w 7913/1.

Distribution : India, Chilka lake.

Description : Body elongate, small, 0.83-1.26 long, 0.19-0.36 wide. Tegument smooth. Ventral sucker preequatorial, 0.09-0.11 in diameter, situated at 0.48-0.56 from anterior end of body. Oral sucker terminal, 0.08-0.15 long, 0.09-0.11 wide, sub-equal to ventral sucker. Sucker ratio 1:0.9. Prepharynx absent, pharynx muscular, 0.04-0.06 long, 0.04-0.05 wide. Oesophagus short; intestinal caeca extending upto a little anterior to posterior end of body.

Testes two, symmetrical, right testis 0.09-0.11 long, 0.06-0.12 wide, left testis 0.09-0.12 long, 0.06-0.10 wide, entire, anterodorsal to ventral suckr. Cirrus sac well developed, enclosing vesicula seminis

interna, pars prostatica surrounded by prostate gland cells.

Ovary entire 0.07-1.28 long, 0.05-0.08 wide, equatorial, pretesticular. Seminal receptacle present. Vitellaria follicular placed laterally on both sides of body, distributed from posterior end of testes to posterior end of intestinal caeca. Uterian coils posterior to ventral sucker. Eggs 36-49 μm x 20-24 μm .

Excretory vesicle 'V' shaped.

Discussion : Srivastava (1939) established the genus *Mehratrema* to accommodate type species *M. dollfusi* recovered from the fish *Scatophagus argus*. Chauhan (1943) described *M. polynemusinis* collected from the fishes *Polynemus indicus*, *Muraenesox talabonoides* and *Sciaena* sp. from Bombay coast. Karyakarte (1969) described *M. skrjabini* collected from the fish *Therapon puta* from Pamban. Gu and Shen (1981) described another species *P. arii* from the intestine of *Arius sinensis* from Sanya. The present new form is very close to *P. skrjabini* Karyakarte (1969) in characters such as shape of body, absence of prepharynx, extent of intestinal caeca, but it differs from Karyakarte's species in size of body, ventral sucker subequal to oral sucker, testes and ventral sucker situated more posteriorly, shape and position of vitelline follicles (in the present from vitellaria starts from posterior end of testes) and size of eggs. Intestinal caeca is not so wide in the present form as they are in *P. skrjabini*. It further differs from the type species *P. dollfusi* due to absence of prepharynx, extent of vitelline glands, wide and well developed cirrus sac, positions of testes and ventral sucker. It differs from *P. polynemusinis* in the absence of prepharynx, extent of vitellaria, position of testes, ventral sucker, ratio of suckers and size of eggs.

Genus *Mehratrema* Srivastava, 1939

Mehratrema dollfusi Srivastava, 1939

Material examined : 2, exs.; Host-Arius sp.; Location-Intestine; Locality- Chilka lake at Barkul; Coll. I.B. Dutta, 17.6.86; Z.S.I. Reg. No. w 7950/1.

Distribution : India, Chilka lake.

Measurements : Body 1.24-1.55 X 0.40-0.41; oral sucker 0.13-0.15 in diameter; pharynx 0.05-0.06 X 0.06-0.07. Ventral sucker 0.12-0.015 in diameter; left testis 0.14-0.15 X 0.11-0.15; right testis 0.13-0.17 X 0.11-0.14; Ovary 0.10-0.16 X 0.10-0.11; Eggs 41-45 μm x 16-20 μm .

Remarks : Srivastava (1939) established the genus *Mehratrema* to accommodate his type species *M. dollfusi* recovered from *Scatophagus argus* from India. The present form identified as *M. dollfusi* Srivastava, 1939.

Family MONORCHIIDAE Odhner, 1911

Subfamily MONORCHIINAE (Odhner, 1911) Nicoll, 1915

Genus *Monorchis* (Monticelli, 1893) Looss, 902

Monorchis minutus Madhavi, 1977

Material examined : 75 ex., Host-*Pomadasys hasta*; Location-Intestine; Locality-Chilka lake at

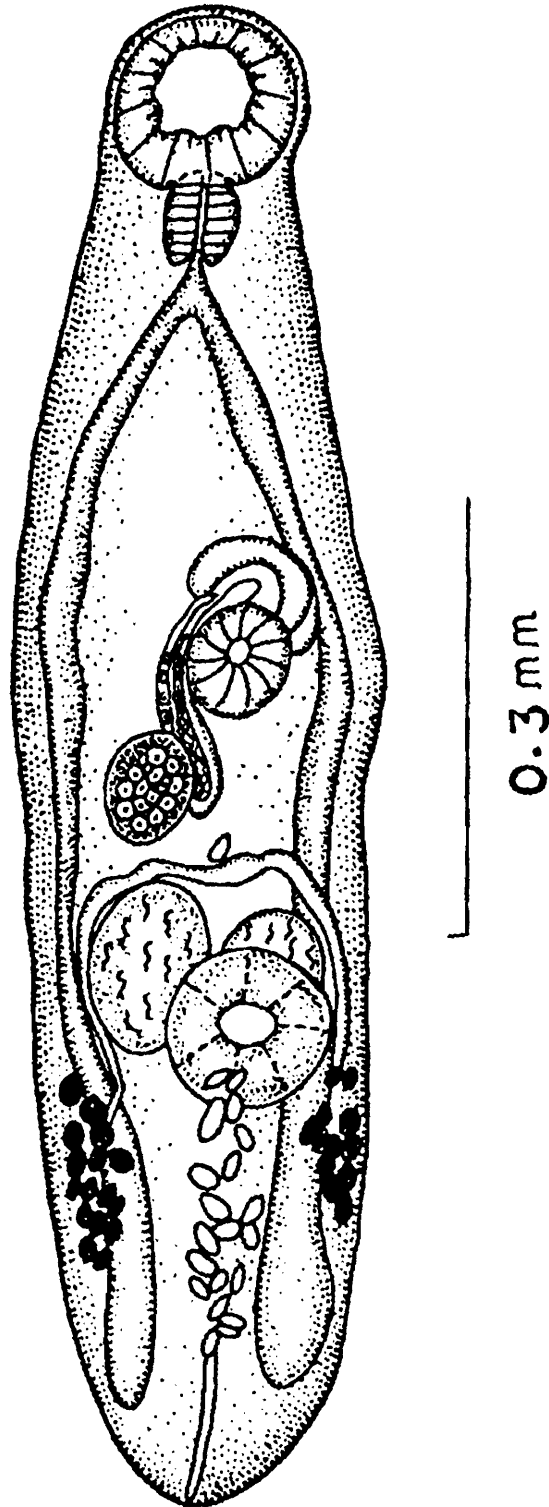


Fig.8. *Mehratrema militaris* n.sp. Holotype

Rambha; Coll. I.B. Dutta, Z.S.I. Reg. No. w 7951/1.

Distribution : India (Waltair), Chilka lake (first record).

Description : Body small, 0.06-0.78 long, 0.32-0.36 wide. Tegument spinose. Ventral sucker 0.06-0.08 in diameter. Oral sucker 0.10-0.11 long, 0.12-0.14 wide, larger than ventral sucker. Sucker ratio-1:1.6. Prepharynx present; pharynx 0.07-0.08 long 0.09-0.10 wide, Caeca long, wide terminating upto posterior end of body.

Testis single, 0.12-0.17 long; 0.09-0.11 wide, situated on left side of body. Cirrus sac long, extending posterior to acetabulum, enclosing oval seminal vesicle, long pars prostatica surrounded by prostate gland cells and cirrus armed with spines. Genital atrium small, without spines. Genital pore median, preacetabular.

Ovary single, ovate, 0.10-0.13 long, 0.07-0.08 wide, pretesticular; vitellaria follicular, forming a bunch on each side of body.

Terminal organ bipartite, anterior part armed and thick walled; uterus joining laterally at the anterior part. Eggs 16-20µm x 8-12 µm.

Excretory bladder 'I' shaped reaching near acetabulum.

Remarks : Madhavi (1977) described *M. minutus* from *Pomadasy maculatus* from Waltair coast, while the present specimens have been collected from an allied species of host *Pomadasy hasta*. The details of the anatomy and measurements of various organs conform to the description of *M. minutus*.

Subfamily ASYMPHYLADORINAE Szidat, 1943

Genus *Asymphylogora* Looss, 1890

Parasymphylogora Sziday, 1943

Asymphylogora kedarai Srivastava, 1951

Material examined : Several;; Host-*Puntius sarana*; Location-Intestine; Locality-Chilka lake at Barkul; 16.12.85 and 20.6.86; Coll. I.B.Dutta, Z.S.I. Reg. No. w 7952/1.

Distribution : India, Chilka lake (first record).

Description : Body small 1.21-1.44 long; 0.59-0.60 wide. Tegument spinose near anterior end. Ventral sucker 0.17-0.18 long; 0.19-0.20 wide, situated at 0.32-0.36 from anterior end of body. Oral sucker 0.14-0.15 long, 0.16-0.19 wide, smaller than ventral sucker. Sucker ratio 1:1.10. Prepharynx absent; pharynx well developed 0.12-0.17 long; 0.08-0.09 wide; oesophagus 0.06-0.10 long; intestinal caeca extending upto posterior end of ovary.

Testis single, triangular, 0.33-0.36 long; 0.19-0.20 wide, situated at posterior end of body. Cirrus

sac enclosing bipartite seminal vesicle, pars prostatica surrounded by prostate gland cells and unarmed cirrus.

Ovary entire anterotesticular 0.14-0.29 long; 0.14-0.020 wide. Seminal receptacle present anterior to ovary. Vitelline glands follicular, situated laterally on both sides of body. Eggs 16-24 μm x 8-12 μm .

Excretory bladder tubular, excretory pore terminal.

Discussion : Srivastava (1951) described *A. kedarai* from the intestine of *Puntius sophore* at district Hardoi, U.P. whereas the present specimens have been recovered from a closely allied species of the host..

Subfamily OPISTHOMONORCHIINAE Yamaguti, 1952

Genus *Opisthomonorchis* Yamaguti, 1952

Opisthomonorchis carangis Yamaguti, 1952

Material examined : Several; Host-*Caranx malabaricus*; Location-Intestine; Locality-Chilka lake at Barkul, 20.6.86, Coll. I.B.Dutta, Z.S.I.Reg. No. w 7953/1.

Distribution : Macassar, Celebes, India, Chilka lake (first record).

Measurements : Body 1.12-1.28 X 0.12-0.14. Oral sucker 0.03-0.04 in diameter, pharynx 0.02-0.03 in diameter, ventral sucker 0.04-0.05 X 0.03-0.04, testes 0.9-0.12 X 0.08-0.09; ovary 0.07-0.08 X 0.06-0.07; Eggs 18-30 μm x 8-12 μm ,

Remarks : Yamaguti (1952) described this species from *Caranx* sp. at Macassar, Celebes. This species is commonly found in carangid fishes and it is the first record from the India estuarine water.

Family OPECOELIDAE Ozaki, 1925

Subfamily OPECOELINAE Stunkard, 1931

Genus *Opegaster* Ozaki, 1928

Opegaster minima (Tubangui, 1928) Yamaguti, 1934

Material examined : Several; Host- *Therapon jarbua*, *Gerres filamentosus*; *Otolithus ruber*; Location-Intestine; Locality-Chilka lake at Satpara and Rambha; 29.6.86 & 23.9.87; Coll. I.B. Dutta; Z.S.I. Reg.No. w 7954/1.

Distribution : Philippines, India, Chilka lake (first record).

Measurements : Body 1.07-1.45 X 0.44-0.86. Ventral sucker 0.17-0.20 X 0.18-0.26. Oral sucker 0.11-0.14 in diameter. Pharynx 0.06-0.07 in diameter, anterior testis 0.08-0.11 X 0.17-0.28; posterior testis

0.09-0.14 X 0.18-0.25. Ovary 0.09-0.13 X 0.13-0.24; Eggs 65-73 μm x 36-57 μm .

Remarks : Tubangui(1928) described *Opecoelus minima* from Philippines. Yamaguti (1934) transferred this species to the genus *Opegaster* Ozaki, 1928.

SUMMARY

To investigate the digenetic trematodes of estuarine fishes from Chilka lake, Orissa were surveyed and examined the fishes collected from the area. The Survey indicated that the trematodes infection of estuarine fishes is considerably less in compared with the trematodes infection of marine fishes. The physical and chemical factors are mainly responsible for this reduction in the number of Parasites in the estuarine environment. The estuarine environment is the intermediate stage in between marine and freshwater environment. The hosts and parasites which are living in the estuarine water are having the composite characters of marine and fresh water environment. There are some parasites which are endemic in estuarine environment and they complete their life cycle with in the same environment. The estuarine fishes acted as a connecting bridge to transfer parasites from the fresh water to marine water to marine water and vice verca.

The present study deals with 29 species belonging to 13 families and 26 genera, out of which there are 2 new genera and 8 new species.

ACKNOWLEDGEMENTS

The author is grateful to Dr. A. K. Ghosh, Director, Zoological Survey of India for providing all necessary facilities for this work. He is thankful to Dr. M.Hafeezullah, Ex-Scientist 'SF', for going through the manuscript and giving valuable suggestions. Thanks are also due to Dr. K.V. Rama Rao, Scientist 'SF' for providing all help in the field as Co-ordinator, Chilka lake Expedition of Zoological Survey of India.

BIBLIOGRAPHY

- Ahmad, J. 1980. On five new trematodes of the genus *Uterovesiculurus* Skrjabin et Guschanskaja, 1954 (Trematoda : Hemiuridae) from marine fishes of Bay of Bengal. *Acta Parasit. Polonica*. **27**:415-422.
- Annandle, N. and Kemp, S. 1915. Fauna of Chilka lake. *Mem. Indian Mus.* **5**: 1-20.
- Bhalerao, G.D. 1937. Studies on the helminths of India; Trematoda. IV. *J. Helminth.* **15**(2):97-124.
- Bykhovskaia-Pavlovskaya, I.E. et al. 1962. [Key to the Parasites of freshwater fishes of USSR] In [Key to the fauna of USSR] No.80 (In Russian). *Akad. Nauk USSR*, Moscow-Leningrad.
- Chatterjee, P.N. 1958. ON A new species of the genus *Psilostomum* Looss, 1899. *Proc. Nat. Acad. Sc. India*. **8**(2): 96-99.
- Chauhan, B.S. 1943. Trematodes from Indian marine fishes. Part III. Description of a new species of the genus *Mehratrema* (family Monodhelminthidae). *Proc. Indian Acad. Sc.* **17**:133-137.

- Chauhan, B.S. 1945. Trematodes from Indian marine fishes Part IV. On some trematodes of the family Hemiuridae Luhe, 1901, with descriptions of six new forms. *Proc. Indian Acad. Sc.* **21**:160-173.
- Chauhan, B.S. 1954. Studies on the trematode fauna of India. Part III. Digenea, Gasterostomata. *Rec. Indian Mus.* **51**:231-287.
- Dawes, B. 1947. The trematoda of British fishes. London 364 pp.
- Ejsmont, L. 1932. Note sur le genre *Isoparorchis*. *Ann. Par.* **10**(5):453-547.
- Ferretti, G. and Paggi, L. 1965. Ridescrizione di *saccocoelium obesum* looss, 1902, trematode parassita di *Mugil Cephalus*. *Rev. parassit. Romanica.* **26**(4) : 229-239.
- Fischthal, J.H. and Kuntz, R.E. 1963. Trematode Parasites of fishes from Egypt V. Annotated record of some previously described forms. *J. Par.* **49**(1):91-98.
- Gu, C.D., Shen, J.W. 1981. Ten new species of digenetic trematodes of marine fishes. *Acta Zootax. Sinica* (1979) **4** (4) : 342-355.
- Gupta, S.P. 1958. A redescription of *Bucephalopsis magnum* (Verma, 1936) Srivastava, 1938 and *Bucephalopsis Karvei* Bhalerao, 1937. *J. Helminth.* **8**(2): 112-121.
- Gupta, V. and Ahmad, J. 1976. On a new species *Skrjabenopsolus indicus* n.sp. from the intestine of Marine fish, *Glyphidodon bengalensis* (Gunther) from Chilka lake, Orissa. *Indian J. Zoot.* **XV**(1):5-6.
- Hafeezullah, M. 1975. Two new trematodes (Digenea:Hemiuridae) of marine fishes from East Coast of India. *Dr. B.S. Chauhan Comm. Vol.*: 203-210.
- Hafeezullah, M. 1979. A new digenean genus from marine fish from East Coast of India. *Riv. Parassit* **4**(3) : 327-332.
- Hafeezullah, M. and Siddiqi, A. H. 1970. Digenetic trematodes of marine fishes of India. Part I. Bucephalidae and Cryptogonimidae. *Indian J. Helminth.* **22** (1): 1-22.
- Hunter, W.S. and Thomas, L.J. 1961. A new species of *Saccocoelium* (Trematoda : Haploporidae) from Beaufort. *N.C. Trans. American. Micr. Soc.*, **80**: 176-179.
- Jones, E.I. 1933. On *Ceratotrema furcolabiata* n.g., n. sp. and *Hemipera sharpei* n.sp., two new digenetic trematodes of British marine fishes. *Parasit.* **25**(2):248-254.
- Karyakarte, P.P. 1968. *Acanthostomum* (Gymnatrema) *Pambanense* sp.n. (Trematoda:Acanthostomatidae) from the fish, *Therapon Puta* (Cuv. and vol.) in India, *Riv. Parassit.* **29** (3): 185-189.
- Karyakarte, P. P. 1969. *Mehratrema skrjabini* n. sp., (Trematoda : Monodhelminthidae) from the fish *Therapon Puta* (Cuv. and vol.) in India, *Riv. Parassit.* **30**(1) : 27-30.

- Kurashvili, B.E. 1958. *Anahemiurus trachuri* n.sp. from *Trachurus mediterraneus ponticus*. *Soobsh. Acad. Nauk. Gruzinsk SSR*. **21** (2) : 209-211.
- Lamothe-Arumedo, R. 1976. Estudio helminthologico de los animal silvestres de la estacione de biologia tropical Los Tuxtlas; Veracruz. Trematoda I. Una especie nueva de *Saccocoelioides* Szidat, 1954 Parasita de *Astyanax fasciatus aeneus* Gunther. *Anales Inst. Biol. Univ. Nac. Aut. Mexico* **45**(1):1974 (1976) : 39-44.
- Linton, E. 1910. Helminth fauna of the Dry Tortugas. II. Trematodes. *Carneg. Inst. Wash. Publ. No.* 133, 98 pp.
- Looss, A. 1902. Die Distomen-Uterfamilie der Haploporinae. *Arch. Par.* **6** (1): 129-143.
- Luhe, M. 1901. Uber Hemiuriden. *Zool. Anz.* **24**: 394-403.
- Lumsden, R.D. 1963. *Saccocoelioides sogandaresi*, a new haploporid trematode from the Sailfin molly, *Mollienisia latipinna* La Suer in Texas. *J. Par.* **49**(2): 281-284.
- Madhavi, R. 1975. Digenetic trematodes from marine fishes of Waltair coast, Bay of Bengal. Family Fellodistomatidae. *Riv. Parassit.* **36**(4):267-278.
- Madhavi, R. 1979. Digenetic trematodes from marine fishes of Waltair coast, Bay of Bengal, families Haplosporinae and Haploporidae. *Riv. Parassit.* **40**(3): 237-248.
- Madhavi, R. 1979. Some new digenetic trematodes (Monorchhiidae) from marine fishes of Waltair coast, Bay of Bengal. *Excerta Parasitologica en memoria del doctor Eduardo Caballero y Caballero Mexico Universidad Nacional Autonoma de Mexico*. (1977):233-246.
- Manter, H.W. 1931. Some digenetic trematodes of marine fishes of Beaufort, North Carolina. *Parasit.* **23**(3):396-411.
- Manter, H.W. 1947. The digenetic trematodes of marine fishes of Tortugas, Florida. *Amer. Midl. Nat.* **38**(2):257-416.
- Margolis, L. and Ching, H.L. 1965. Review of the trematod genera *Bacciger* and *Pentagramma* (Fellodistomatidae) and description of *P. petrovi* (Layman, 1930) n.comb. from marine fishes from the pacific coast of Canada. *Canadian. J. Zool.* **34**(6): 573-577.
- Martin, W.E. 1973. Life history of *Saccocoelioides pearsoni* n.sp. and the description of *Lecithobotrys sprengi* n.sp. (Trematoda: Haploporidae). *Trans. American Micro. Soc.* 92:80-95.
- Nahas, F.M. and Cable, R.M. 1964. Digenetic and aspidogastrid trematodes from marine fishes of Curacao and Jamaica. *Tulane Stud. Zool.* **11**(5):169-228.
- Nama, H.S. 1979. On the occurrence of the trematodes *Hemipera ovocaudata*. *Current Sci* (1978)47(14):518-519.

- Nicoll, W 1913. New trematode parasites from fishes of the English channel. *Parasit.* 5(4): 238-246.
- Nicoll, W. 1914. Trematodes Parasites of North Queensland. *Parasit.* 6(4): 333-350.
- Nikolaeva, V.M. 1961 [Parasite fauna of Azov anchovy *Engraulis encrasicolus maeoticus* Pusanov and its changes at the time of migration of the host] (In Russian.) *Tr. Sevastopol'Sk. Biol. Stantsii Akad. Nauk SSSR*, 14:269-273.
- Odhner, T. 1911 Zum natuerlichen system der digenen Trematoden. III Familie Storingophoridae N.fem.*Zool. Anz.* 38:97-117.
- Overstreet, R.m.1971. Some adult digenetic trematodes in Striped mullet from the Northern Gulf of Mexico. *J. Parasit* 57: 967-974.
- Palombi, A. 1934. *Bacciger bacciger* (Rud.)trematode digenetic; familia Storingophoridae Odhner. *Anatomia, Sistematica e biologia. Publ. Stat. Zool. Napoli* 13(3): 438-478.
- Pande, B.P. and Shukla, P.P.1977. *Haplorchoides* Chen, 1949 (Haplorchinae: Heterophyidae) in fresh water fishes. *J. Helminth* 50(3): 181-192.
- Rai, P.and Pande, B.P.1968. Observations on the haplorchinae flukes hitherto known from Indian Silurid fishes *Agra Uni. J.Res. (Sci.)*16:17-24.
- Skrjabin, K.I. and Koval,V.P.1957.[Family Fellodistomatidae Nicoll, 1913] In [Trematodes of animals and man.Principles ofTrematodology] Vol.13 By K.I.Skrjabin (In Russian). *Akad. Nauk> SSSR.Moscow.*
- Srivastava, C.B. 1963. On three new species of the genus *Bucephalus* Baer, 1827 (Bucephalidae) with remarks on the systematic position of *B. indicus* Srivastava, 1938. *Indian J. Halminth* 15(1):36-44.
- Srivastava, C.B.1982. The Fauna of India and the adjacent countries. Supplement to Dr. H.R. Mehra's Vol. on Trematoda-Digenea. pp. 1-163.
- Srivastava, N.N.1951. A New trematode, *Asymphyiodora kedarai* n.sp. of the family Monorchiidae Odhner, 1911. *Indian J. Helminth* 3(1):7-12.
- Srivastava, H.D. 1935. New Hemiurids from Indian freshwater fishes. Part I, New distomes of the genus *Lecithaster* Luhe, 1901 from *Clupea ilisha*. *Proc. Indian Acad.Sc. B.*4(4): 381-387.
- Srivastava, H.D. 1937. The parasites of the family Acanthocelpidae Luhe, 1909 from Indian marine food fishes. *Proc. 24 Indian Sc. Cong.* 297-298.
- Srivastava, H.D. 1937. Studies on the gasterostomatous parasites of Indian food fishes. *Indian J.Vet.Sc. & Anim. Husb.* 8(4):317-340 (1938).

- Srivastava, H.D. 1939. The morphology and systematic relationship of a new genus of digenetic trematode belonging to the family Monodhalmidae (Dollfus, 1937). *Indian Vet. Sc. & Anim. Husb.* 9(1): 97-99.
- Strelkow, J.A. 1960. Endoparasitic worms of marine fishes of East Kamchatka. *Trudy Zool. Inst. Akad. Nauk SSSR.* 28:147-196.
- Szidat, L. 1954. Trematodes nuevos de peces de agua dulce de la republica argentina. *Rev. Inst. Nac. Inv. Cienc. Nat. Cienc. Zool.* 3(1): 1-85.
- Tubangui, M.A., 1928. Trematode parasites of Philippine vertebrates. *Philippines. J. Sc.* 36: 351-371.
- Velasquez, C.C 1961. Cryptogonimidae from Philippine food fishes. *J. Parasit.* 47(6):914-918.
- Verma, S.C. 1936. Studies on the family Bucephalidae (Gasterostomata)I. Descriptions of new forms from Indian freshwater fishes. *Proc. Nat. Acad.* 6(1):66-89.
- Yamaguti, S. 1934. Studies on the helminth fauna of Japan. 2. Trematodes of fishes *Japanese. J. Zool.* 5(3):249-541.
- Yamaguti, S. 1938. Studies on the helminth fauna of Japan. 24. Trematodes of fishes. V. *Japanese. J. Zool.* 8(1):15-74.
- Yamaguti, S. 1952. Parasitic worms mainly from Celebes. I. New digenetic trematodes of fishes. *Acta Med. Okayama* 8(2):146-198.
- Yamaguti, S. 1954. Systema Helminthum part I. Digenetic trematodes of fishes. Publ. by author Tokyo (1953)405. pp.
- Yamaguti, S. 1970. Digenetic trematodes of Hawaiiin fishes. Keigaku publishing Co. Tokyo. 436 pp.

NEMATODA

S.R.DEY SARKAR

Zoological Survey of India, Calcutta 700 053

INTRODUCTION

Our knowledge regarding nematode fauna of vertebrate hosts from the Chilka Lake and its adjoining areas is very scanty. Whatsoever little is known is from the work of Baylis and Daubney (1922, and 1923). While dealing with the unnamed collections of the Zoological Survey of India, Baylis and Daubney (op.cit) had enlisted only four species of birds nematode. Besides this work no efforts have been made to study this group from these areas, though these areas were explored by several departmental survey parties in the past.

The present work was initiated to make a systematic study of nematode parasite of vertebrate hosts of the Chilka Lake and its adjoining areas, chiefly based on the collection made by the present author and S. Chattopadhyay during the 2nd (June, 1986), 3rd (Sept. 1986) and 4th (Sept. 1987) Chilka Lake Expedition, under the supervision of Dr. K.V. Rama Rao, Scientist - 'SE', Principal co-ordinator and some named collections of this group present in the collection of the Zoological Survey of India (marked with single asterisk).

• This comprises of 37 species contained in 28 genera, 20 families and 4 orders, of which 5 species are new to science and two species are being reported for the first time from Indian faunal limits. Most of the remaining species are fairly well known and several others showing interesting variations or forming new host and locality records.

Detailed description of the species except a few is avoided in most cases. Keys for the subfamilies, genera and species are provided. To avoid repetition only original and current synonymies have been given, since most of them are available in the work of Baylis (1936 & 1939). The systematic position of the genus *Quasithelazia* Maplestone, 1932 is also discussed in this paper. The classification followed for higher taxa is more or less based on C.I.H. keys, unless otherwise stated. All measurements are in millimeters.

List of Parasitic nematode hitherto recorded from the Chilka Lake and adjoining areas.

Class NEMATODA

Subclass ADENOPHOREA

1. Order ENOPLIDA

- Superfamily TRICHINELLOIDEA
1. Family TRICHURIDAE (Ransom, 1911), Railliet, 1915
- Subfamily TRICHURINAE Ransom, 1911
- Genus 1. *Trichuris* Roederer, 1761
1. *T. discolor* (V. Linstow, 1906), Ransom, 1911
- Subfamily CAPILLARIINAE RAILLIET, 1915
- Genus 2. *Capillaria* Zeder, 1800
2. *Capillaria* sp.
- Subclass SECERNENTEA
2. Order STRONGYLIDA
- Superfamily ANCYLOSTOMATOIDEA
2. Family ANCYLOSTOMATIDAE (Looss, 1905), Lane, 1917
- Subfamily ANCYLOSTOMATINAE, Looss, 1905
- Genus 3. *Ancylostoma* (Dubini, 1843) Creplin, 1845
- Subgenus *Ancylostoma* Lane, 1916.
3. *A. (A). caninum* (Ercolani, 1859), V. Linstow, 1889
- Subgenus *Cylancylostoma* Lane, 1916
4. *A. (C). ceylanicum* Leiper, 1915
- Superfamily TRICHOSTRONGYLOIDEA
3. Family TRICHOSTRONGYLIDAE
- Subfamily TRICHOSTRONGYLINAE Leiper, 1912
- Genus 4. *Trichostrongylus* Looss, 1905
5. *T. pigmentus* (V. Linstow, 1904) Hall, 1916.

4. Family AMIDOSTOMATIDAE (Travassos, 1919, Subfam.) Baylis and Daubney, 1926.
- Subfamily AMIDOSTOMATINAE, Travassos, 1919
- Genus 5. *Amidostomum* Railliet and Henry, 1909
6. *Amidostomum* sp.
3. Order ASCARIDIDA
- Superfamily ASCARIDOIDEA
5. Family ANISAKIDAE (Railliet and Henry, 1912 Sub.fam.) Skrjabin and Karokhin, 1945
- Subfamily ANISAKINAE Railliet and Henry 1912
- Genus 6. *Contracaecum* Railliet and Henry, 1912
8. *C. haliaeti* Baylis and Daubney, 1923
9. *C. microcephalum* (Rudolphi, 1809) Baylis, 1920
10. *Contracaecum* sp.
6. Family ASCARIDIDAE Baird, 1853
- Subfamily TOXOCARIINAE (Hartwich, 1954), Osche, 1958
- Genus 7. *Taxocara* Stiles, 1905
11. *T. mystax* (Zeder, 1800)
- Genus 8. *Porrocaecum* Railliet and Henry, 1912
12. *P. anguisticolle* (Molin, 1860), Baylis and Daubney, 1922
13. *P. reticulatum* (V. Linstow, 1899) Baylis and Daubney, 1922
- Superfamily SEURATOIDEA
7. Family QUIMPERIIDAE Baylis, 1930
- Subfamily QUIMPARIINAE Gene, 1928
- Genus 9. *Paragendria* Baylis, 1928

14. *Paragendria* sp.
8. Family CUCULLANIDAE Cobbold, 1864
- Subfamily CUCULLANINAE Yorke and Maplestone, 1926
- Genus 10. *Cucullanus* Mueller, 1777
15. *Cucullanus* sp.
- Superfamily HETERAKOIDEA
9. Family HETERAKIDAE Railliet and Henry 1912
- Subfamily HETERAKINAE Railliet & Henry, 1912
- Genus 11. *Heterakis* Dujardin, 1845
16. *Heterakis* sp.
10. Family ASCARIDIIDAE Travassos, 1919
- Genus 12. *Ascaridia* Dujardin, 1845
17. *A. centropusi* n. sp.
- Superfamily SUBULUROIDEA
11. Family SUBULURIDAE (Travassos, 1914) Yorke and Maplestone, 1926
- Genus 13. *Subulura* Molin, 1860
- Subgenus *Subulura* Molin, 1860
18. *Subulura (Subulura) tulsidasi* n. sp.
19. *Subulura (Subulura)* sp.
4. Order SPIRURIDA
- Superfamily PHYSALOPTEROIDEA
- Family PHYSALOPTERIDAE (Railliet, 1893 Subfam.)
- Subfamily PHYSALOTERINAE Railliet, 1893 Leiper, 1908

- Genus 14. *Physaloptera* Rudolphi, 1819
- 20. *P. alata* Rudolphi, 1819
 - 21. *P. praeputialis* V. Linstow, 1889
 - 22. *Physaloptera* sp.
- Genus 15. *Abbreviata* Travassos, 1920
- 23. *A. varini* Schulz, 1927
- Superfamily GNATHOSTOMATOIDEA
13. Family GNATHOSTOMATIDAE Railliet, 1895
- Subfamily GNATHOSTOMATINAE (Railliet, 1895 fam.) Baylis and Lane, 1920
- Genus 16. *Echinocephalus* Molin, 1858
- 24. *E. uncinatus* Molin, 1858
- Superfamily RICTULARIOIDEA
14. Family RICTULARIIDAE (Hall, 1915 subfam.) Railliet, 1916
- Genus 17. *Pterygodermatites* Wëdl, 1861
- Subgenus *Mesopectines* Quentin, 1969
- 25. *P. (Mesopectines) cahirensis* (Jagirskiold, 1904) Quentin, 1969
- Superfamily HABRONEMATOIDEA
15. Family CYSTIDICOLIDAE (Skkrjabin, 1946 Subfam.) Chabaud, 1975
- Genus 18. *Pseudoproleplus* Khera, 1955
- 26. *P. vestibulus* Khera, 1955.
16. Family HABRONEMATIDAE (Chitwood and Wehr 1932), Ivaschkin, 1961
- Subfamily HISTOCEPHALINAE Gendre, 1922
- Genus 19. *Viguiera* Seurat, 1913.

27. *Viguiera* sp.

Genus 20. *Stellocaronema* Gilbert, 1930.

28. *Stellocaronema* sp.

Superfamily ACUARIOIDEA

17. Family ACUARIIDAE (Railliet, Henry and Sisoff 1912 subfam.) Chabaud, 1975

Subfamily ACUARIINAE Railliet, Henry and Sisoff, 1912

Genus 21. *Chevreuxia* Seurat, 1918

29. *C. revoulata* (Rudolphi, 1819) Seurat, 1918

30. *C. roonwali* n.sp.

Genus 22. *Echinuria* Soloviev, 1912

31. *Echinuria* sp.

Genus 23. *Synhimentus* Railliet, Henry and Sisoff, 1912

Subgenus *Synhimentus* Railliet, Henry and Sisoff, 1912

31. *S. (S.) coucalus* n. sp.

Subfamily SCHISTOROPHINAE Travassos, 1918

Genus 24. *Schistorophus* Railliet, 1916

33. *S. tenuis* (Maplestone, 1931), Singh, 1949

Superfamily DIPLOTRIAENOIDEA

18. Family DIPLOTRIAENIDAE (Skrjabin, 1916 Subfam.) Anderson, 1958

Subfamily DIPLOTRIAENINAE Skrjabin, 1916

Genus 25. *Diplotriaena* Railliet and Henry, 1909

34. *D. puriensis* n. sp.

Superfamily FILARIOIDEA

19. Family ONCHOCERCIDAE (Leiper, 1911) Anderson & Bain, 1976
- Subfamily DIROFILARIINAE Sandground, 1921
- Genus 26. *Dirofilaria* Railliet and Henry, 1910
35. *Dirofilaria* sp.
- Subfamily LEMDANINAE Lopez-Neyra, 1956
- Genus 27. *Lemdana* Seurat, 1917
36. *L. bengalensis* Soota and Chaturvedi, 1971
- Superfamily APROCTOIDEA
20. Family APROCTIDAE (Yorke and Maplestone, 1926, Subfam.) Skrjabin & Schikhobalova, 1945
- Subfamily APROCTINAE Yorke and Maplestone, 1926
- Genus 28. *Aprocta* Linstow, 1883
37. *Aprocta* sp.

HOST PARASITE LIST

Host	Habitat	Parasites
Fish		
1. <i>Notopterus notopterus</i>	Intestine	1. <i>Pseudoproleptus vestibulus</i> Khera, 1955 2. <i>Paragendria</i> sp.
2. <i>Aurius</i> sp.	Intestine	3. <i>Echinocephalus uncinatus</i> Molin, 1958 4. <i>Cucullanus</i> sp.
Reptilia		
3. <i>Varanus bengalensis</i>	Intestine	5. <i>Abbreviata varani</i> Schulz, 1927
Birds		
4. <i>Venellus indicus</i>	Horny layer of gizzard	6. <i>Chevreurxia roonwali</i> n. sp. 7. <i>Capillaria</i> sp.

Birds

5.	<i>Anas penelope</i>	Gizzard, Horny layer of gizzard	8.	<i>Amidostomum</i> sp.
			9.	<i>Viguiera</i> sp.
6.	<i>Phalacrocorax fuscicollis</i>	Intestine	10.	<i>Contracaecum spiculigerum</i> (Rud. 1809), Railliet & Henry, 1912.
7.	<i>Anhinja rufa</i>	Gizzard	11.	<i>Contracaecum tricuspe</i> (Geddoelst, 1916) Baylis, 1920.
8.	<i>Haliastur leucogaster</i>	Gizzard		
9.	<i>Milvas migraus</i>	Intestine	12.	<i>Contracaecum haeliaeti</i> Baylis and Daubney, 1923
10.	<i>Haliastur indus</i>			
11.	<i>Ardeola grayii</i>	Intestine	13.	<i>Contracaecum microcephalum</i> (Rudolphi, 1809), Baylis, 1920
12.	<i>Himantopus himantopus</i>	Horny layer of gizzard	14.	<i>Chivreuxia revoluta</i> (Rud.1819), Seurat, 1918.
13.	<i>Athene brama</i>	Caecum	15.	<i>Echinuria</i> sp.
14.	<i>Halcyon smyrnensis</i>	Horny layer of gizzard	16.	<i>Schistorophus tenuis</i> (Maplestone, 1932), Singh, 1949.
15.	<i>Aluda gulgula</i>	Body cavity	17.	<i>Diplotriaena puriensis</i> n. sp.
16.	<i>Lanius crstatus</i>	Subcutaneous tissue around the neck	18.	<i>Lemdana bengalensis</i> Soota & Chaturvedi, 1971
17.	<i>Pluvialis dominica</i>	Caecum	19.	<i>Heterakis</i> sp.
18.	<i>Caprimulgus maerourus</i>	Intestine	20.	<i>Subulura</i> (<i>Subulura</i>) sp.
19.	<i>Caprimulgus indicus</i>	Intestine	21.	<i>Subulura</i> (<i>Subulura</i>) <i>chilkaensis</i> n. sp.
20.	<i>Centropus sinensis</i>	Intestine, Horny layer of gizzard, Nasal cavity, Intestine	22.	<i>Ascaridia centropusi</i> n.sp.
			23.	<i>Synhimentus</i> (<i>Synhimentus</i>) <i>coucalus</i> n.sp.
			24.	<i>Aprocta</i> sp.
			25.	<i>Subulura</i> (<i>Subulura</i>) sp.

Birds

- | | | | | |
|-----|--------------------------------------|----------------|-----|---|
| 21. | A vulture and <i>Haliastur indus</i> | Intestine | 26. | <i>Porrocaecum anguisticolle</i> (Molin, 1860), Baylis & Daubney, 1922 |
| 22. | <i>Ardea cinerea</i> | Intestine | 27. | <i>Porrocaecum reticulatum</i> (V. Linstow, 1899), Baylis & Daubney, 1922 |
| | | Intestine | 28. | <i>Contracecum</i> sp. |
| 23. | <i>Accipiter badius</i> | Proventriculus | 29. | <i>Physaloptera alata</i> Rud. 1819 |
| | <i>Mammals</i> | | | |
| 24. | <i>Tatera indica</i> | Stomach | 30. | <i>Trichuris discolor</i> (V. Linstow, 1906) Ransom, 1911 |
| 25. | <i>Lepus nigricollis</i> | Stomach | 31. | <i>Trichostrongylus pigmentus</i> (V. Linstow, 1904), Hall, 1916. |
| 26. | <i>Viverricula indica</i> | Intestine | 32. | <i>Pterygodermatites (Mesopectines) cahirensis</i> (Jagerskiold 1904), Quentin, 1969. |
| | | Heart | 33. | <i>Dirofilaria</i> sp. |
| 27. | <i>Felis vinerrina</i> | Intestine | 34. | <i>Toxocara mystax</i> (Zeder, 1800) |
| | | Intestine | 35. | <i>Ancylostoma (Ceylancylostoma) celanicum</i> Leiper, 1915 |
| | | Stomach | 36. | <i>Physaloptera praeputiaatis</i> V. Linstow, 1889 |
| 28. | <i>Felis chaus</i> | Stomach | 37. | <i>Physaloptera</i> sp. |
| | | Intestine | 38. | <i>Ancylostoma (Ancylostoma) caninum</i> (ErColani, 1859), V. Linstow, 1889 |
| | | Intestine | 39. | <i>Toxocara mystax</i> (Zeder, 1800) |

SYSTEMATIC ACCOUNT

Subclass I. ADENOPHOREA

Order ENOPLIDA

Superfamily TRICHINELLOIDEA

Family TRICHURIDAE (Ransom, 1911), Railliet, 1915

Key to subfamilies

Stichocystes similar in form and arranged regularly throughout the length of oesophagus in 1-3 rows. Cloaca with thin muscular wall anterior and posterior to point of entry of spicule. Male caudal

end straight or curved ventrally. Body usually filiform but, exceptionally post-oesophageal region expanded markedly. Oesophageal region generally shorter than post-oesophageal region. Cirrus usually present, often barely cuticularized. Parasites of Skin, Viscera, spleen, respiratory and excretory system of vertebrates Capillariinae

Cloaca with thick muscular wall anterior to point of entry of spicule; wall thinner posterior to point of entry. Ventral to oesophagus a single broad bacillary band present. Stichocytes in single row. Caudal end of male curved dorsally. Post oesophageal region of the body thicker markedly. Oesophageal region longer than post-oesophageal region. Spicule well developed. Cirrus with spines or tubercles. Parasite of large intestine of mammals Trichurinae

Subfamily TRICHURINAE Ransom, 1911

Genus *Trichuris* Roederer, 1761

Trichuris discolor (V. Linstow, 1906), Ransom, 1911

1906. *Trichocephalus discolor* V. Linstow, *Spolia Zeylanica* pt. II, 3 : 163-188.

1911. *Trichuris discolor* Ransom, *U.S. Dept. Agric. Bureau Animal Industry, Bull.* 127.

Material : 5 (M) and 2 (F), Z.S.. Reg. No. WN 602; host - Indian Gerbil (*Tatera indicata*); location Stomach; locality Satpara, Chilka Lake, Puri district, Orissa ; 18.ix. 1987, coll. S.R.Dey Sarkar.

Remarks : As this species is both well known and cosmopolitan occurring in many species of rodents and ruminants, a detailed description is not necessary. However, it forms new host and locality records.

Subfamily CAPILLARIINAE Railliet, 1915

Genus *Caillaria* Zeder, 1800

Caillaria sp.

Material : 1(F) Z.S.I. Reg. No. WN.603; host-Red wattle lapwing (*Venellus indicus*); location gizzard ; locality Ganta Shila, Chilka Lake, Ganjam district, Orissa, 11.vi. 1986, coll. S.R.Dey Sarkar.

Remarks : In the absence of a male specific identification is not possible. However the genus forms new locality records.

Subclass II. SECERNENTEA

Order 1. STRONGYLIDA

Superfamily ANCYLOSTOMATOIDEA

Family (1) ANCYLOSTOMATIDAE (Looss, 1905), Lane, 1917

Key to subfamily

Mouth directed dorsally, ventral teeth directed into mouth cavity. Gebenaculum present. Dorsal ray of bursa generally with two reduced stems.

Female tail with terminal spike, vulva posterior to mid-body. Ancylostomatinae Looss, 1905

Key to genus and subgenus

Buccal capsule large and globular, one to three pairs of ventral teeth at the oral margin. Cuticle thick and unsculptured. Parasites of alimentary canal of carnivora, Primates, Edentata, Rodentia and Suidae *Ancylostoma*

Bursa with small lateral lobe and divergent lateral rays. Parasites of carnivora. Primates, Suidae; Cosmopolitan *Ancylostoma (Ancylostoma)*

Oral opening guarded by two pairs well developed ventrolateral teeth. Externolateral ray divergent from medolateral and posterolateral rays which are parallel. Externodorsal ray arises near middle of dorsal ray. Parasites of carnivora (Felidae, Viverridae, Canidae, Ursidae and Mustelidae), Primates (man, Nycticebus), Rodentia (Muridae, Sciuridae); Indo-Malayan region *Ancylostoma (Ceylancylostoma)*

Subfamily ANCYLOSTOMATINAE Looss, 1905

Genus *Ancylostoma* (Dubini, 1843) Creplin, 1845

Subgenus *Ancylostoma* Lane, 1916.

Ancylostoma (Ancylostoma) caninum (Ercolani, 1859) V. Linstow, 1889

1859. *Strongylus caninus* Ercolani, *Nuovi Elementi tearico-paratici di Medicina Veterinaria*, Bologna.
 1889. *Ankylostomum caninum* V. Linstow, *Helminthologisches. Arch. f. Naturg.* Berlin, 1 : 1-235..
 1916. *Ancylostoma (Ancylostoma) caninum* Lane, *Ind. Jour. Med. Res.*, 4 : 74-92.

Material : 1 (M) and 1(F) ; Z.S.I. Reg. No. WN 604 ; host Jungle cat. (*Felis chaus*); Location-intestine; locality - Barkul, Chilka Lake, Puri district, Orissa; 4.ix. 1987; coll - S.Chattopadhyay. 6 (M) and 20(F) ; Z.S.I. Reg. No. WN 607; host - Jacal (*Canis aureus*); location - small intestine; locality Satpara, Chilka Lake, Puri district, Orissa; 11.ix.1987; coll. S. Chattopadhyay.

Remarks : The species is well known and cosmopolitan, a detailed description is not necessary. It is recorded for the first time from Chilka Lake.

Subgenus *Ceylancylostoma* Lane, 1915

Ancylostoma (Ceylancylostoma) ceylanicum Leiper, 1915

1915. *Ancylostoma ceylanicum* Leiper, *J. Roy Army Med. Corps*, 24(6), p. 569.
 1916. *Ancylostoma (Ceylancylostoma) ceylanicum*, Lane, *Ind. Journ. Med. Res.*, 4 : 74-92.

Material : 8 (M) and 8 (F) , Z.S.I. Reg. No. WN 605 ; host - Fishing cat (*Felis viverrina*); location - small intestine; locality - Satpara, Chilka Lake, Puri district, Orissa; 19.ix 1987; coll S. Chattopadhyay.

Remarks : As the species is well known and cosmopolitan a detailed description is not necessary. It is now recorded for the first time from a new locality.

Superfamily (ii) TRICHOSTRONGYLOIDEA

Family (I) TRICHOSTRONGYLIDA (Leiper, 1908 subfam) Leiper, 1912

Key to subfamily

Ventroventral ray smaller, sharing common base with lateroventral ray; Neodont formation absent. Dorsal lobe symmetrical, not reduced. Parasite of beavers, lagomorphs and ruminants, in man, cosmopolitan. Trichostrongylinae

Key to genus

Synlophes absent. Dorsal ray bifurcate at its tip, each limb being bidigitate. Gubernaculum present. Parasites of ruminants, lagomorphs, rodents, birds and rarely in man. *Trichostrongylus*

Subfamily TRICHOSTRONGYLINAE Liper, 1912

Genus *Trichostrongylus* Looss, 1905

Trichostrongylus pigmentus (V. Linstow, 1904), Hall, 1916

1904. *Strongylus pigmentus* V. Linstow, *Spolia Zylaniica*, 1 : 91-104.

1916. *Trichostrongylus pigmentus* Hall, *Proc. U.S. Nat. Mus.* Washington, 1 : 1-258.

Material : 1 (M) and 12 (F), Z.S.I. Reg. No. WN 606; host - Black naped hare (*Lepus nigricollis*); location - Stomach; locality - Satpara, Chilka Lake, Puri district, Orissa; 18.ix. 1987.coll. S. Chattopadhyay.

Remarks : This species is the only representative from India. As the species is well known and cosmopolitan in distribution as such a detailed description is not necessary. However, the genus and the species are recorded for the first time from Chilka Lake.

Distribution : India and Srilanka

Family (2) AMIDOSTOMATIDAE (Travassos, 1919, Subfam.) Baylis & Daubney, 1926

Key to subfamily

Buccal capsule well developed, long without a corona radiata or anterior cutting organs. Cephalic sensorial papillae at extremity of long pedancles. Parasite of birds. Amidostomatinae

Subfamily AMIDOSTOMATINAE Travassos, 1919

Genus *Amidostomum* Railliet & Henry, 1909*Amidostomum* sp.

Material : 3 (M); Z.S.I. Reg. No. WN 608 ; host *Anas penelope* ; location - gizzard; locality Kalijaya island, Chilka Lake, Puri district, Orissa ; 25.vi. 1986; coll S.R.Dey Sarkar.

Remarks : This is a parasite of aquatic birds. In the absence of male specific identification is not possible. However, the genus forms new locality record.

Order 2. ASCARIDIDA

Superfamily 1. ASCARIDOIDEA

Family I. ANISAKIDAE (Railliet & Henry 1912 Subfam) Skrjabin & Karokhin, 1945

Key to subfamily

Cuticle without spines. Excretory system ribbon like. Excretory pore generally at the base of ventral interlabium or between subventral lips. Parasites of mammals, birds, reptiles and fishes.
 Anisakinae

Key to genus

Postlabial region without cuticular collar, spines absent on bases of lips. Interlabia present. Lips rounded hexagonal or semi-oval; lips indented medially, with a pair of laterally directed pointed processes on its anterior angles. Dentigerous ridges absent. Spicules equal or subequal. Parasites of fish-eating birds, and marine mammals, except sirenians. *Contracaecum*

Key to the species of the genus *Contracaecum* Railliet & Henry, 1912

- Parasite of cormorants *C. spiculigerum*
- Parasite of birds of prey *C. haliaeti*
- Parasite of herons, egrets, Stork etc :-
- Interlabia with transverse processes *C. tricuspe*
- Interlabia without transverse processes. *C. microcephalum*

Subfamily ANISAKINAE Railliet & Henry, 1912

Genus *Contracaecum* Railliet & Henry, 1912*Contracaecum spiculigerum* (Rudolphi, 1809) Railliet & Henry, 1912

1809. *Ascaris spiculigera* Rudolphi, *Entozoorum Sive Vermium intestinalium historia naturatis*, 2 : 457 pp. Amstelaedami.
1912. *Contracaecum spiculigerum* Railliet and Henry, *Bull. Soc. Path. Exot.*, 5 : 251-259.

Material : * Several (M) and (F) Z.S.I. Reg. No. W 786/1; host - Indian Shag (*Phalacrocorax fuscicollis*); location - intestine ; locality - Barkul, Chilka Lake, Puri district, Orissa ; 29.ix. 1914 ; "Chilka Survey;" 1(M) and 2(F), Z.S.I. Reg. No. WN 609 ; host - Little Cormorant (*Phalacrocorax niger*); location - intestine; Locality Barkul, Chilka Lake, Puri district, Orissa; 26.vi 1986 ; coll. S.R.Dey Sarkar; 18 (M) and 25 (F), Z.S.I. Reg. No. WN 610; host - Little Cormorant (*Phalacrocorax niger*); location - Gizzard; locality Tanda, Chilka Lake, Puri district, Orissa; 19.x. 1987; coll. S.Chattopadhyay.

Remarks : As this species is well known and cosmopolitan in distribution a detailed description is not necessary.

Contracaecum tricuspe (Gedaelst, 1916) Baylis, 1920

1916. *Kathleena tricuspe* Gedaelst, *Rev. Zool. Africaine Bruxelles.*, 5 : 1-90.
1920. *Contracaecum tricuspe* Baylis, *Parasitology*, Cambridge (Eng.), 12 : 253-264.

Material : 1 (M), Z.S.I. Reg. No. WN 611; host - Indian Darter (*Anhinga rufa*); location - gizzard; locality Satpara, Chilka Lake, Puri district, Orissa; 12.x. 1987; coll. S.Chattopadhyay.

Distribution : India : Calcutta, West Bengal; Satpara, Chilka Lake, Orissa (first report).

Remarks : The specimens agree in body measurements etc. with those of Baylis (1920).

Contracaecum haliaeti Baylis & Daubney, 1923

1923. *Contracaecum haliaeti* Baylis and Daubney, *Ann. and Mag. Nat. Hist. Sr. 9*, 11 : 333-335.

Material : * 3(F), Z.S.I. Reg. No. W 1055/1; host - white bellied Sea-eagle (*Haliaetus leucogaster*); location - upper part of intestine; locality Barkuda Island, Chilka Lake; Ganjam district, Orissa; date of coll. ? ; coll. N. Gist Gee. 5 (M) and 15(F), Z.S.I. Reg. No. WN 612 ; host - pariah Kite (*Milvus migrans*); location - gizzard and intestine; locality Barkul, Chilka Lake, Puri district, Orissa ; 20.vi. 1986; coll. S.R.Dey Sarkar. 3 (M) Z.S.I. Reg. No. WN 613 ; host - Brahmini kite (*Haliastur indus*); location - gizzard and intestine ; locality Barkul, Chilka Lake, Puri district, Orissa; 20.vi. 1986 ; coll. S.R.Dey Sarkar.

Remark : As the species is both widely distributed and well known, a detailed description is not necessary.

Contraecum microcephalum (Rudolphi, 1809) Baylis, 1920

1809. *Contraecum microcephala* Rudolphi, *Amstelaedami*, 2: 457 pp.

1920. *Contraecum microcephalum* Baylis, *Parasitology*, Cambridge [Engg.], 12 : 253-264.

Material : * Several (M) and (F), Z.S.I. Reg. No. W 1054/1 ; host - Pond heron (*Ardeola grayii*); location - Intestine ; locality Samal Island, Chilka Lake, Ganjam district, Orissa ; date of coll. ? coll. S.L.Hora.

Remark : The species being well known, a detailed description is not necessary.

***Contraecum* sp.**

Material : 1 subad. (F), Z.S.I. Reg. No. WN 614 ; host : Grey heron. Location Gizzard; locality - Kalijaya Island, Chilka Lake, Puri district, Orissa, 17.v. 1986; coll. S.R.Dey Sarkar.

Remark : In the absence of a male specific identification is not possible.

Family (ii) ASCARIDIDAE Baird, 1853

Key to subfamily

Ventriculus without appendices. Gubernaculum absent. Parasites of mammals and birds.
..... Toxocarinae

Key to genera

Interlabia absent. Cervical alae present, intestinal caecum absent. Parasites of mammals, (Carnivora, and elephants)..... ***Toxocara***

Interlabia present. Intestinal caecum present. Oesophageal appendix absent. Lips with denticulate ridges. Oesophagus with voluminous globoid to oblong ventriculus. Parasites of birds.
..... ***Porrocaecum***

Subfamily TOXOCARINAE (Hartwich, 1954 fam.) Osche, 1958

Genus ***Toxocara*** Stiles, 1905***Toxocara mystax*** (Zeder, 1800)

1800. *Fusaria mystax* Zeder, *Ester Nachtrag zur Naturgeschichte der Eingeweidewürmer*, Leipzig.

Material : 2 (F), Z.S.I. Reg. No. WN 615; host - jungle cat (*Felis chaus*); location - intestine; locality - Barkul, Chilka Lake, Puri district, Orissa; 4.ix. 1987; coll. S.Chattopadhyay. 1(M) (damaged), Z.S.I. Reg. No. WN 616; host - Fishing cat (*Felis viverrina*); location - intestine ; locality - Satpara, Chilka Lake, Puri district, Orissa; 19.ix. 1987, coll. S. Chattopadhyay.

Distribution : India : Zoological Garden, Calcutta, West Bengal; Punjab; Barkul and Satpara, Orissa (1st report); Wirawila, Sri Lanka.

Remark : As the species is well known and cosmopolitan in cat tribe, a detailed description is not necessary.

Key to the species of genus *Porrocaecum* Railliet & Henry, 1912

- Parasite of birds of prey 1
- Parasite of herons, egrets cranes etc. 2
1. Pulp of dorsal lip with two rounded anterior lobes, each bearing a flattened and expanded process *P. angusticolle*
2. Male with five pairs of preanal papillae, spicules about 0.5 long *P. reticulatum*

Genus *Porrocaecum* Railliet & Henry, 1912

***Porrocaecum angusticolle* (Molin, 1860) Baylis and Daubney, 1922**

1860. *Ascaris angusticolle* Molin, *Sitz. K. Akad. Wiss., Wein.*, **40** : 331-358.

1922. *Porrocaecum angusticolle* Baylis & Daubney, *Mem. Ind. Mus.*, Calcutta, **7** : 263-347.

Material : * Several (F), Z.S.I. Rg. No. W 776/1; host - a vulture; location intestine ; locality Satpara, Chilka Lake, Puri district, Orissa; July, 1913; coll. T. Southwell. 2 (M), Z.S.I. Reg. No. WN 617; host - Brahminy kite - *Haliastur indus* ; location - intestine ; locality - Satpara, Chilka Lake, Puri district, Orissa; 11.ix. 1987; coll. S.R.Dey Sarkar.

Distribution : India : Calcutta, West Bengal; Pune, Maharashtra; Satpara, Chilka Lake, Orissa.

Remark : As the species is well known, a detailed description is not necessary.

***Porrocaecum reticulatum* (V. Linstow, 1899) Baylis and Daubney, 1922**

1899. *Ascaris reticulata* V. Linstow, *Mitt. Zool. Mus. Berlin*, **1** : 1-28.

1922. *Porrocaecum reticulatum* Baylis and Daubney, *Mem. Ind. Mus.* Calcutta, **7** : 263-347.

Material : 1(M), 1(F), Z.S.I. Reg. No. WN 618 ; host - Grey Heron (*Ardea cineræ*); location - intestine ; locality - Samal Island, Chilka Lake, Ganjam district, Orissa; 14.vi. 1986, coll. S.R.Dey Sarkar.

Distribution : India : Zoological Garden, Calcutta, West Bengal; Samal Island, Chilka Lake, Orissa (first report).

Remark : The specimens agree in body measurements etc. with those of Baylis (1936).

Superfamily 2. SEURATOIDEA

Family (i) QUIMPERIIDAE Baylis, 1930

Key to subfamily

Intestinal caecum absent. Buccal capsule small or absent. Gubernaculum present or absent. Parasites of fish, rarely amphibians *Quimperiinae*

Key to genus

Oesophagus gradually swelling posteriorly. Buccal cavity weakly developed. Parasites of Siluriform fish in India. *Paragendria*

Subfamily QUIMPERIINAE Gendre, 1928

Genus *Paragendria* Baylis, 1939

Paragendria sp.

Material : 4 (F), Z.S.I. Reg. No. WN 619; host - *Notopterus notopterus*; location - intestine ; locality - Balugaon; Chilka Lake, Puri district, Orissa; 20.vi. 1986; coll. S.R.Dey Sarkar.

Remark : In the absence of a male, specific identification is not possible. However the genus forms new locality records.

Family (ii) CUCULLANIDAE Cobbold, 1864

Key to subfamily

Oral opening dorsoventrally elongated. Lumen of oesophagus reinforced with cuticularized rods. Parasite of fish *Cucullaninae*

Key to genus

Intestinal caecum absent. Male tail conical, caudal alae absent. Oesophagus well developed. Preanal papillae 3 pairs or more. *Cucullanus*

Genus *Cucullanus* Mueller, 1777

Cucullanus sp.

Material : 1(F), Z.S.I.Reg.No.WN 620 ; host - *Aurius* sp.; location intestine; locality Barkul, Chilka Lake, Puri district, Orissa ; 17.vi. 1986; coll. S.R.Dey Sarkar.

Remarks : In the absence of a male, specific identification is not possible. However the genus forms new locality record.

Superfamily 3. HETERAKOIDEA

Family (i) HETERAKIDAE Railliet & Henry, 1912

Key to subfamily

Interlabia present. Male caudal alae broad, Spicules, equal or unequal. Didelphic, oviparous Parasites of birds and rarely in Mammal. Heterakinae

Key to genus

Head without cordons, lateral alae well developed. Preanal sucker circular. Gubernaculum absent. Parasites of birds (mainly Galliformes) and one species in rodent. *Heterakis*

Subfamily HETERAKINAE Railliet & Henry, 1912

Genus *Heterakis* Dujardin, 1845

Heterakis sp.

Material : 3 (F), Z.S.I. Reg. No. WWN 621; host - *Pluvialis dominica*; location - Caecum; locality Barkul, Chilka Lake, Puri district, Orissa; 9.ix. 1987, coll. S. Chattopadhyay.

Remarks : In the absence of a male, specific identification is not possible. However, the genus is now recorded from a new host and from a new locality.

Family (ii) ASCARIDIIDAE Travassos, 1919

Genus *Ascaridia* Dujardin, 1845

Ascaridia centropusi n.sp.

(Text - figure I)

Material : Holotype 1(M), Z.S.I. Reg. No. WN 622; host - Crow-Pheasant (*Centropus sinensis*); location - intestine; locality-Satpara, Puri district, Orissa; 18.ix. 1987; coll. S. Chattopadhyay. Paratypes 2 (M), 3 (F), Z.S.I. Reg. No. WN 623 ; other details as for the holotype.

Description : Lips well developed; oesophagus club-shaped, without posterior bulb. Male with slight caudal alae, spicules subequal, gubernaculum absent. Vulva near middle of body.

Male : Body 33.76 to 36.5 long, 0.64 to 0.8 wide; nerve ring 0.56 from anterior end; oesophagus 2.24 to 2.4 long; spicules stout, subequal, longer being 2.78 to 2.8 and smaller 2.7 long, both, with rounded

distal end; cervical alae 0.88 long, 0.048 wide; tail 0.51 long, caudal alae slight; preanal sucker round 0.144 in diameter; caudal papillae 15 pairs, 6 preanal, 1 adana; 8 postanal (4 pairs subventral one pair ventral and one pair lateral preanal papilla; of the postanal one pair ventral and the remaining are lateral).

Female : Body 48.8 to 52.8 long, 0.88 to 0.96 wide; nerve ring 0.64 to 0.72 from anterior end; oesophagus 2.56 long; tail conical, 0.88 to 1.0 long, end with a terminal spike; annulations course : Vulva posterior to midbody, 26.4 to 29.2 from anterior end, eggs (0.048 x 0.064) in diameter.

Remarks : The present species differs markedly from all other species described so far under the genus *Ascaridea*, Dujardan, 1845 in size of spicule, number and arrangement of caudal papillae and various body measurements. However, it is some what related with *Ascaridia circularis* (V. Linstow, 1903) Railliet and Henry, 1914 and *Ascaridia trilabium* (V. Linstow, 1904) Railliet and Henry, 1914, recorded from Crow Pheasant (*Centropus sinensis*) from Saim (Thyland) and Ceylon (Sri Lanka) respectively.

A. circularis has equal spicules 1.74 long and 8 pairs of caudal papillae and *A. trilabium* has equal spicules 2.3 long and 13 pairs of caudal papillae (Baylis, 1936) or subequal 1.95 and 1.97 long, and 10 pairs of caudal papillae (V. Linstow, 1904), where the present specimens have subequal spicules 2.8 and 2.7 long and 15 pairs of caudal papillae. It is therefore, concluded that the species *Ascaridia centropusi* n.sp. is new to science.

Superfamily 4. SUBULUROIDEA

Family : SUBULURIDAE (TRAVASSOS, 1914) Yorke & Maplestone, 1926

Key to subfamily

Peripheral and radial lobes separated from body by a constriction. Anterior extremity not so. Chordal lobes helix in form. Parasite of birds and mammals. Subullurinae

Key to genus

Buccal cavity hexagonal or circular. Spicules equal or unequal. Gubernaculum present, preanal sucker fusiform. Cervical alae present. Parasite of birds and mammals. ***Subulura***

Key to Subgenus

Oral opening simple, triangular or circular. Parasites of birds and rodents ***Subulura (Subulura)***

Subfamily SUBULURINAE Travassos, 1914

Genus ***Subulura*** Molin, 1860

Subgenus *Subulura* Molin, 1860

Subulura (Subulura) tulsidasi n.sp.

(Text-figure 2)

Material : Holotype 1 (M), Z.S.I., Reg. No. WN 624; host Night jar (*Caprimulgus indicus*); location intestine; locality Barkul, Chilka Lake, Puri district, Orissa; 4.ix 1987, coll. S.R.Dey Sarkar,

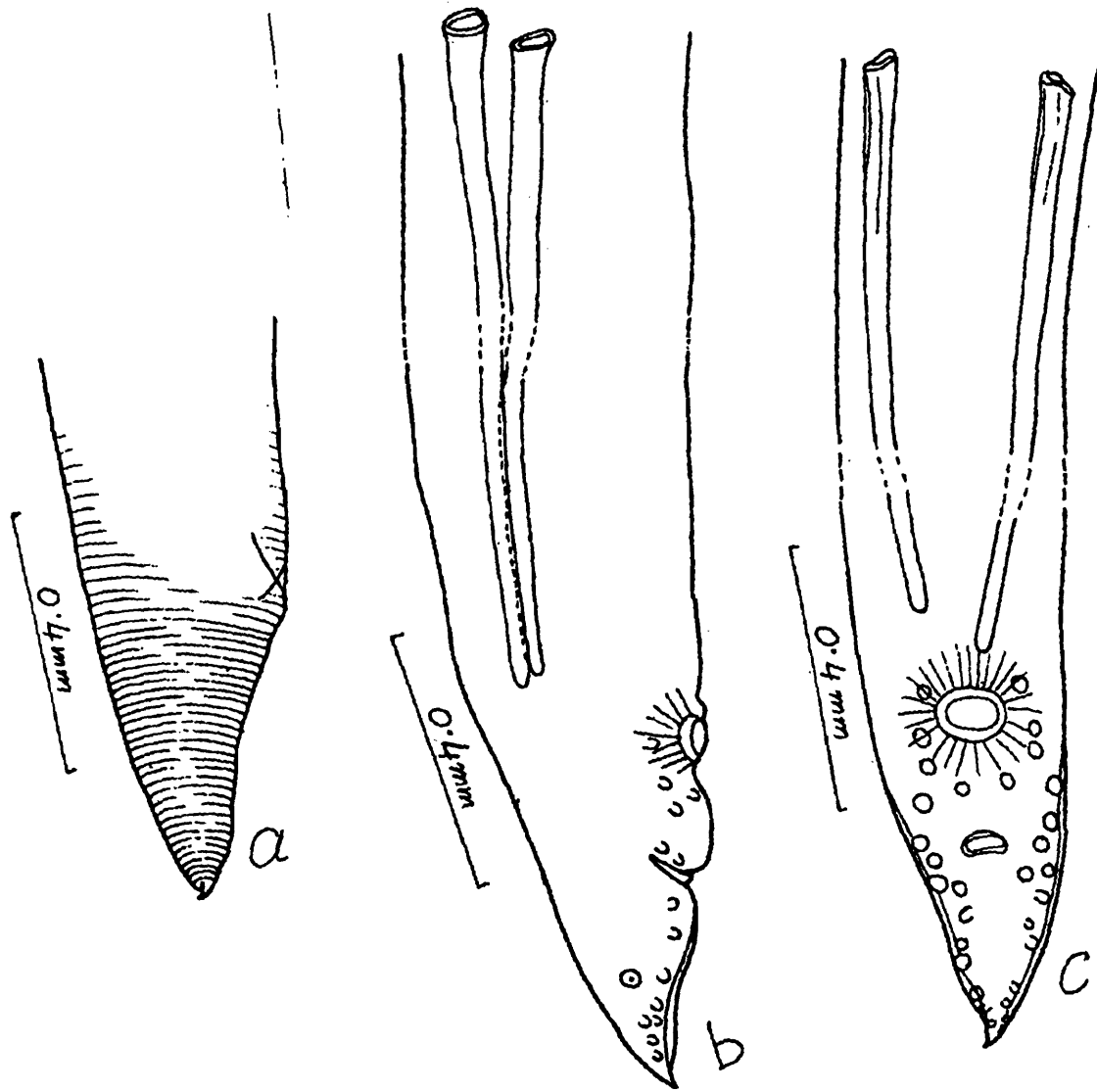


Fig. 1

Paratypes 3 (M) and 3(F) Z.S.I. Reg. No. WN 625; Other particular same as for the holotype.

Description : Body slender, anterior end curved in form of a hook and posterior end attenuated, cervical alae present. Buccal cavity thick walled, three small teeth present at base of cavity.

Male : Body 12.64 to 16.4 long, 0.32 to 0.33 wide; cervical alae 0.88 to 0.96 long, 0.064 wide; buccal capsule with chitinous walls and 0.032 to 0.048 from anterior end; sucker fan shaped and 0.4 to 0.48 from cloeca; tail curved with a terminal spike, 0.21 to 0.24 long; caudal alae narrow, spicules equal non-alate 1.04 to 0.91 long; gubernaculum 0.16 long; caudal papillae 15 pairs, 5 pairs preanal, 8 pairs postanal and two pairs adanal.

Female : Body 25.2 to 25.8 long, 0.45 to 0.46 wide; cervical alae 1.2 long; buccal capsule 0.64 long; oesophagus including bulb 1.92 to 2.00 long; bulb 0.32 to 0.35 long; nerve ring 0.38 to 0.4 from anterior end excretory pore 0.6 from anterior end; vulva preequatorial 10.35 from anterior end dividing body length in ratio 3:5; tail straight, 0.96 long, prolonged into slender point, eggs 0.048 x 0.032 in diameter.

Remarks : Of all the species of the genus *Subulura* Molin, 1860, the present species comes closer to *S. multipapillata* (Chandler, 1926) Cram, 1927, *S. albai* Agrawal, 1965 and *S. ali* Rasheeda Ilyas, 1982, in having caudal alae, equal spicules and preequatorial vulva. But it differs from all these in various body measurements, number and arrangement of caudal papillae and in length of spicules. *S. albai* has eleven pairs of caudal papillae; and *S. ali* has fourteen pairs of caudal papillae.

In number of caudal papillae, the present worm comes close to *S. multipapillata* but differs from it markedly in relative size of various organs, in having longer body, longer spicules and arrangement of caudal papillae.

It also comes closer to *S. alii* in body length, but differs from it in size of spicules and number and arrangement of caudal papillae.

It is therefore concluded that the species described above is new to science. It is proposed to name *Subulura (Subulura) tulsidasi* in honour of Dr. T.D.Soota, Ex-Deputy Director, Zoological Survey of India.

Subulura (Subulura) sp.

Material : 2(F), Z.S.I. Reg. No. WN 626; host - Crow-pheasant (*Centropus sinensis*); location Caecum, locality - Satpara, Puri district, Orissa; 15.ix. 1987, coll. S. Chattopadhyay. 1(F), Z.S.I. Reg. No. WN 627; host - Night jar (*Caprimulgus macrourus*); location - intestine; locality - Barkul, Chilka Lake, Puri district, Orissa, 4.ix. 1987, coll. S. Chattopadhyay.

Remarks : In the absence of males, specific identification is not possible.

Order : SPIRURIDA

Superfamily I : PHYSALOPTEROIDEA

Family : PHYSALOPTERIDAE (Railliet, 1893 subfam.) Leiper, 1908

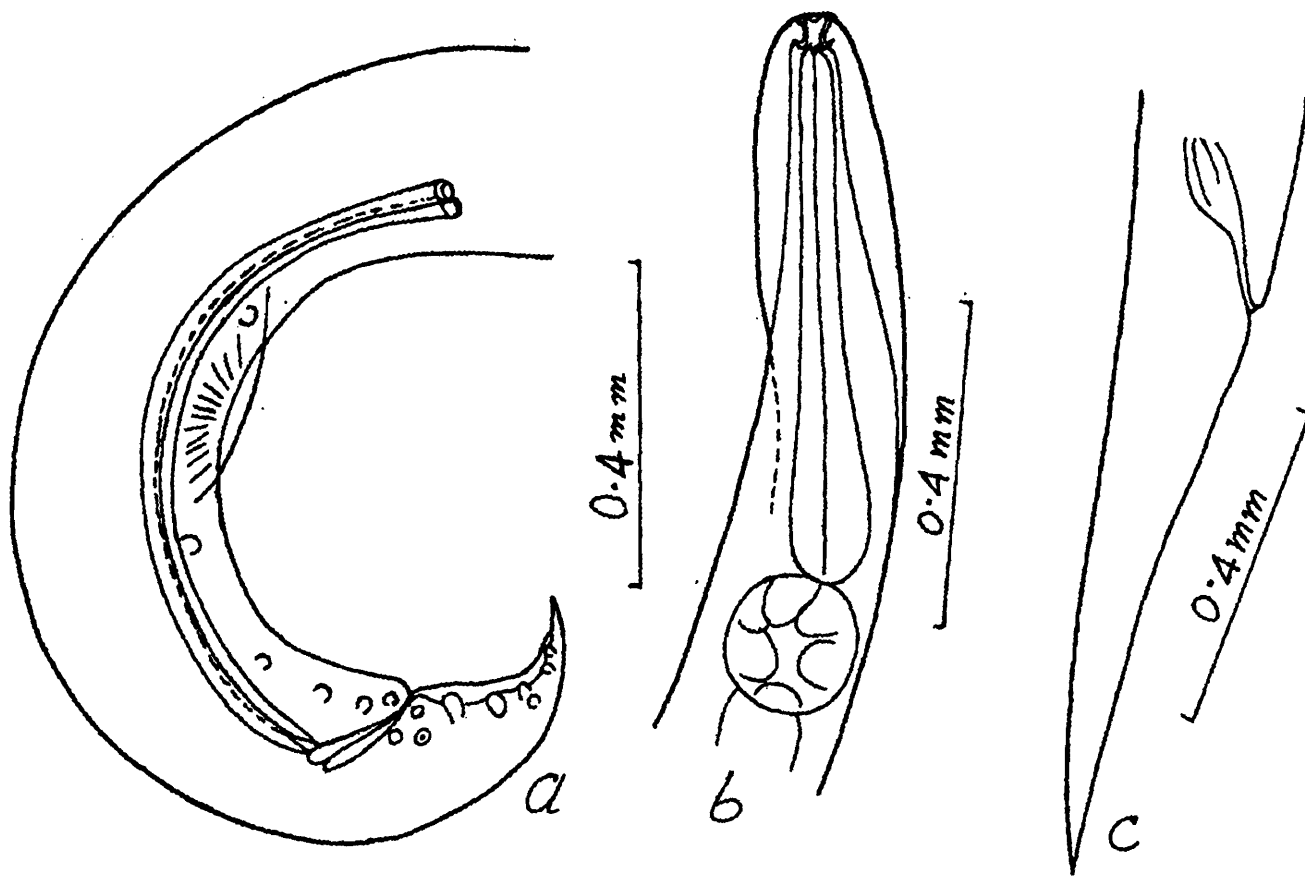


Fig. 2

Key to subfamily

Caudal alae of male ornamented and united on ventral surface of body. Parasites of vertebrates except fishes Physalopterinae

Key to genera

Dental apparatus consist of upper tooth, small denticle internal to it, and laterally pair of double teeth on each lip. Parasite of reptiles, rarely in amphibians, rodents and primates *Abbreviata*

Spicules well developed, equal, subequal or unequal. Caudal papillae well developed and of usual number. Uteri two to four. Parasites mainly of birds of prey, and carnivora and, inccidentally of snakes and various mammals which ingest flesh or insects *Physaloptera*

Key to species of the genus *Abbreviata* Travassos, 1920

Parasite of reptiles. Inner surface on each lip with a median simple tooth and two double pair of submedian tooth; uterine branches four, originate by dichotomous branching *A. varani*

Subfamily PHYSALOPTERINAE Railliet, 1893

Genus *Abbreviata* Travassos, 1920*Abbreviata varani* (Parona, 1889) Schulz, 1927

1889. *Physaloptera varani* Parona, *Ann. mus. civ. di storia nat. di Genova*, 39 : p.102.

1927. *Abbreviata (Abbreviata)varani*, Schulz, *Soborn. Rabot. Gelm. Posv. K.I. Skrjabinee*, 287-312.

Material : * Sev (M) and (F), Z.S.I. Reg. No.W 1007/1; host Indian monitor (*Varanus bengalensis*); location intestine; locality Barkuda Island, Chilka Lake, Ganjam district, Orissa; 8.vii. 1923, coll. Dr. Annandale. 76(M) 255(F), Z.S.I. Reg. No. WN 628; host : *Varanus bengalensis*; location : Stomach and intestine; locality-Satpara, Chilka Lake, Puri district, Orissa, 18.ix. 1987 coll. S. Chattopadhyay.

Distribution : India: Bhajna, 24-Parganas (South), West Bengal; Barkuda Island and Satpara, Chilka Lake, Orissa.

Remarks : It may be noted that the incidence of infection by this species appear very high as the entire stomach and intestine of the host was full of this parasite.

Key to the species of the genus *Physaloptera* Rudolphi, 1819

1. Parasite of birds *P. alata*

2. Parasite of carnivorous mammals; ventral surface of caudal region in male with longitudinal rows of tubercles in its middle portion. *P. praeputialis*

Genus *Physaloptera* Rudolphi, 1819

Physaloptera praeputialis V. Linstow, 1889

1889. *Physaloptera praeputialis* V. Linstow, *Arch. f. Naturg.*, 44(1): 235-246.

Material : 1(M) and 1(F), Z.S.I. Reg. No. WN 629; host : Fishing Cat, (*Flis viverrina*); location - Stomach; locality - Satpara; Chilka Lake, Puri district, Orissa, 19.ix. 1987; coll. S.Chattopadhyay.

Distribution : India: Calcutta, West Bengal; Satpara, Chilka Lake, Orissa (first report).

Remark : The specimens agree in body measurements etc. with those of Baylis (1936).

Physaloptera alata Rudolphi, 1819

1819. *Physaloptera alata* Rudolphi, *Entozoorum synopsis cui accedung mantissa duplex et indices locupltissimi*, x + 811 pp. Berolini.

Material : 1(M) and 1(F), Z.S.I. Reg. No. WN 630; host - Hawk (*Accipiter badius*); location - Proventriculus; locality-Barkul, Chilka Lake, Puri district, Orissa; 4.ix. 1987, coll. S. Chattopadhyay.

Distribution : India : Barkul, Chilka Lake, Orissa (first report); Calcutta, West Bengal; Lucknow, U.P.

Remark : The specimens agree in body measurements etc. with those of Baylis (1936).

Physaloptera sp.

Material : 1 (M) and 2 immature (F), Z.S.I. Reg. No. WN 631; host Jungle Cat (*Felis chaus*); location - Stomach; locality - Barkul, Chilka Lake, Puri district, Orissa, 4.ix. 1987, coll.S.Chattopadhyay.

Remark : In the absence of male specific identification is not possible.

Superfamily 2 : GNATHOSTOMATOIDEA

Family : GNATHOSTOMATIDAE Railliet, 1895

Key to subfamily

Cephalic bulb present Gnathostomatinae

Key to genus

Cephalic bulb undivided, armed with transverse rows of recurved hooks. Body unarmed. Parasites of fishes. *Echinocephalus*

Key to species

Head with 30-40 rows of hooks. *E. uncinatus*

Echinocephalus uncinatus Molin, 1858

1858. *Echinocephalus uncinatus* Molin, *Sber. Akb. Wiss. Wien.*, 30: 154.

Material : 6(F), Z.S.I. Reg. No. WN 632; host - *Arius* sp., location intestine; locality Barkul, Chilka Lake, Puri district, Orissa, 17.vi. 1986, col. S.R.Dey Sarkar.

Distribution : Adriatic; off Sri Lanka, Karachi coast (Pakistan); Gulf of Mannar, Portonova, Tamil Nadu; Hugli river, West Bengal; Chilka Lake, Orissa (first report).

Superfamily 3 : RICTULARIOIDEA

Family : RICTULARIIDAE (Hall, 1915 subfam.) Railliet, 1916

Key to genus

Oral opening apical or displaced dorsally, never totally dorsal and transverse. 3 oesophageal teeth present. Preulvar spines, 29-58 pairs. *Pterygodermatites*

Key to subgenus

Peribuccal denticles in the form of a crown, sometimes replaced on the ventral side by one or two semilunar apophyses. Preulvar spines 37-51 pairs. Caudal papillae in two subventral rows. Parasite of rodents (Gerbillidae, Muridae), Carnivores (Viverridae) and of primates in Asia, Africa *Pterygodermatites* (*Mesopectines*)

Genus *Pterygodermatites* Wedl. 1861

Subgenus *Mesopectines* Quentin, 1969

Pterygodermatites (*Mesopectines*) *cahirensis* (Jagerskiold, 1904) Quentin, 1969.

1904. *Rictularia cahirensis* Jagerskiold, *Zool. Anz.* 27 (20-21) : 660-661.

1969. *Pterygodermatites* (*Mesopectines*) *cahirensis* Quentin, *Mem. Mus. natn. Hist. nat. Ser.. A*, 54(2) : 55-115.

Material : 1(F), Z.S.I. Reg. No. WN 633; host Palm Civet (*Paradoxurus hermophroditus*); location - intestine; locality - Satpara, Chilka Lake, Puri district, Orissa; 11.ix. 1987, coll. S. Chattopadhyay. 1(M), 10(F), Z.S.I. Reg. No. WN 634; host - Civet (*Viverriculla indica*); location - intestine; locality - Satpara, Chilka Lake, Puri district, Orissa; 11.ix 1987; coll. S. Chattopadhyay.

Remark : As this species is well known and widely distributed in Asia and Africa, a detailed description is not necessary. However, this species is recorded for the first time from Chilka Lake.

Superfamily 4 : HABRONEMATOIDEA

Family (i) : CYSTIDICOLIDAE (Skrjabin, 1946 subfam.) Chabaud, 1975

Key to genus

Vestibule well developed. Each Pseudolabia with single tooth. Vulva Post-quatorial. Cephalic cuticle forming callarettee. Intestinal parasites of marine and freshwater fishes *Pseudoproleptus*

Key to species

Caudal papillae 10 pairs *P. vestibulus*

Genus *Pseudoproleptus* Khera, 1955

Pseudoproleptus vestibulus Khera, 1955

1955. *Pseudoproleptus vestibulus* Khera, *Indian J. Helminth.*, 5(1953), p.115.

Material : 2 (M) and 10 (F); Z.S.I. Reg. No. WN 635; host *Notopterus notopterus* ; location - intestine; locality Balugaon, Chilka Lake, Puri district, Orissa; 20.vi. 1986, coll. S.R.Dey Sarkar.

Distribution : India : Lucknow, U.P.; Siliguri and Calcutta, West Bengal, Ranchi, Bihar; Balugaon, Chilka Lake, Orissa (first report).

Remark : The species has already been dealt with elaborately by Margolis (1975) and Soota and Dey Sarkar (1980)

Family (2) HABRONEMATIDAE (Chitwood and Wehr, 1932) Ivaschkin, 1961.

Key to subfamily

Attachment organ leaf-like structures, simple or denticulate, sometimes with shields and various ornamentations. Parasites of birds Histioccephalinae

Key to the genera

Posterior border of pseudolabia ornamented. Dorsal and ventral lips with blades or shields. Blades or shields in a single row. Vulva anterior to anus. Preanal papillae seven to nine pairs. *Viguiera*

Vulva in first third of body. Preanal papillae three pairs. *Stellocaronema*

Subfamily HISTOCEPHALINAE Gendre, 1922

Genus *Viguiera* Seurat, 1913

Viguiera sp.

Material : 3 (F), Z.S.I. Reg. No. WN 636; host - *Anas pinelophe*; location under horny layer of gizzard; locality Kalijaya, Chilka Lake, Puri district, Orissa, 25.vi. 1986. coll. S.R.Dey Sarkar.

Remark : For want of a male specimen specific identification is not possible. However the present record is from a new host and locality.

Genus : *Stellocaronema* Gilbert, 1930

Stellocaronema sp.

Material : 2(F), Z.S.I. Reg. No. WN 637; host - Red-wattel lapwing (*Venellus indicus*); location - under horny layer of gizzard; locality - Gant Sila, Ganjam district, Chilka Lake, Orissa; 11.vi. 1986, coll. S.R.Dey Sarkar.

Description : Female : Body 21.5. to 22.16 long; 0.16 wide; Pharynx 0.032 long; nerve ring 0.35 from anterior end; vulva 6.2 to 6.24 from anterior end; tail rounded, 0.14 long.

Remark : In the absence of a male specimen specific identification is not possible. It may be noted that the genus forms new locality records from India.

Superfamily 5 : ACUARIOIDA

Family : ACUARIIDAE (Railliet, Henry and Sisoff 1912, subfam.) Chabaud, 1975

Key to subfamilies

Cephalic ornamentation containing cordons on cuticle which sometimes form cuticular collarett. Cordons extending longitudinally and expanding largely on cervical region. Acuariinae

Cephalic ornamentation containing cylindrical horns, blades, shields or a hood, apex of these structures always detached from underlying cuticle. Schistorophinae

Key to genera

1. Well developed cuticular collarete present in cervical region. Body spines absent. *Chevreuxia*
2. Cordons displaced ventrally derids dorsal to cordons..... *Echinuria*
3. Cordons anastomosing or not anastomosing but recurrent. Cervical collarete absent. Body spine absent cordons without anterior sinuosities. Dilelphic. Cordons not enlarged posteriorly. Parasites of birds *Synhimentus*

Key to subgenus of *Synhimentus* Railliet, Henry and Sisoff, 1912

Cordons anastomosing *Synhimentus (Synhimentus)*

Subfamily ACUARIINAE Railliet, Henry and Sisoff, 1912

Genus (i) *Chevreuxia* Seurat, 1918

Key to species

1. Male 6.4 long; female 13.2-18.3 long; spicule left 0.75 long, spicule right 0.095 long. Spicule ratio 7:1 Caudal papillae Pedunculated, 4 pairs preanal and 5 pairs post anal, vulva near middle of body. *C. revoluta*
2. Male 8.24 long. Spicule left 0.64 long, right 0.128 long, spicule ratio 5:1 caudal papillae pedunculated 4 preanal and 6 postanal *C. roonwali* n. sp.

***Chevreuxia roonwali* n.sp.**
(Text-figure 3)

Material : Holotype 1(M); Z.S.I. Reg. No. WN 638; host - Red wattled Lapwing (*Venellus indicus*); location-under horny layer of gizzard; locality Gant Sila, Chilka Lake, Ganjam district, Orissa; 11.v. 1986, coll. S.R.Dey Sarkar.

Description : Body thin and delicate. Buccal capsule long, narrow, oesophagus long, divided into two parts. A bell shaped cuticular collarete present in oesophageal region. Cordons running in submedian lines and uniting on each lateral surface of collarete. Male tail spirally coiled with large caudal alae.

Male : Body 8.24 long, 0.16 wide; vestibule 0.176 long; nerve ring 0.23 from anterior end; oesophagus 3.28 long; collar begins at 0.45 from head end; tail 0.176 long, caudal alae well developed; spicules unequal and dissimilar, smaller boat shaped 0.128 long and longer 0.64 long, their ratio 1:5, caudal papilla 10 pairs, pedunculate of which 4 pairs preanal and 6 pairs postanal.

Remarks : Of the 5 species so far described under the genus *Chevreuxia* Seurat, 1918, the present form comes closer to *Chevreuxia americana* Schemdit, 1968 in number and arrangement of caudal papillae, but differs from it in body size and size of spicule. It also differs markedly from the only Indian species *Chevreuxia leipperii* Singh and Ali, 1961 in all respect. It is, therefore, concluded that the worm described above, forms a new species of the genus *Chevreuxia*. It is proposed to name it *C. roonwali* in memory of Late Dr. M.L.Roonwal, Ex-Director, Zoological Survey of India.

***Chevreuxia revoluta* (Rudolphi, 1819) Surat, 1918**

1819. *Spiroptera revoluta* Rudolphi, Entozoorum Synopsis cui accedung mantissa duplex et indices locuptissimi, x+811 pp. Brolini.
 1918. *Chevreuxia revoluta* Seurat, *Bull. du-mus. d'hist. nat.* No.5: 345-351.

Material : 1(F), Z.S.I. Reg. No. WN 639; host Black Winged Stilt (*Himantopus himantopus*); location - under the horny layer of the gizzard; locality Honymoon (=Sanuguda) Island, Chilka Lake, Ganjam district, Orissa, 28.ix. 1986, coll. S. Chattopadhyay.

Remarks : The species was originally reported from Black winged Stilt (*Himantopus himantopus*) from Europe. The present worm also collected from the same host agrees in body measurements etc. with those of Craun (1927). The species has been rather rarely reported. It is now recorded for the first time from India.

Genus (2) ***Echinuria*** Soloviev, 1912

***Echinuria* sp.**

Material : 1(F), Z.S.I. Reg. No. WN 647; host - spotted owl (*Athene brauna*); location - caceum, locality Balugaon, Chilka Lake, Puri district, Orissa; 24.vi. 1986 coll. S.R.Dey Sarkar.

Remark : In the absence of males specific identification is not possible. The genus form new locality record from Chilka Lake, Orissa.

Genus (3) ***Synhimentus*** Railliet, Henry & Sisoff, 1912

Subgenus ***Synhimentus*** Railliet, Henry & Sisoff, 1912

***Synhimentus (Synhimentus) coucalus* n.sp.**
(Text-figure 4)

Material : Holotype 1(M), Z.S.I. Reg. No. WN 640; host - Crow-pheasant (*Centropus sinensis*); location - under the lining of gizzard; locality - Satpara, Chilka Lake, Puri district, Orissa; 19.ix. 1987, coll. S.R.Dey Sarkar.

Paratypes 2(F), Z.S.I. Reg. No. WN 641; other particulars same as for the holotype.

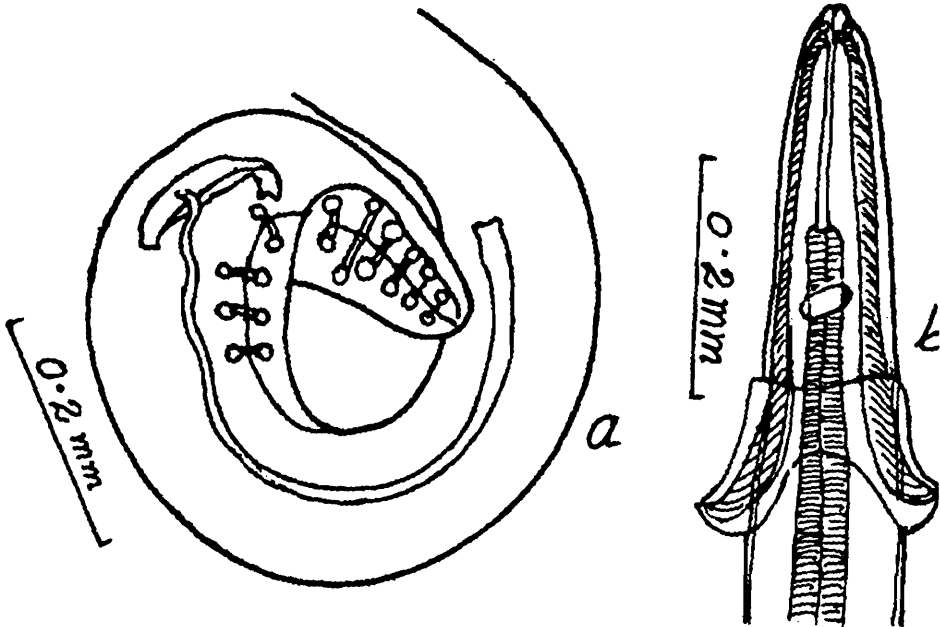


Fig. 3

Description : Mouth with two triangular conical lips. Body transversely striated, tail of male spirally coiled, cordons recurrent and anastomosed in pairs across the lateral lines.

Male : Body 6.76 long, 0.24 wide; nerve ring 0.21 from anterior end; cordons extending 0.416 from head posteriorly and anastomose, 0.272 from head end, width of cordon 0.016; tricuspid papillae 0.58 from head end; Pharynx 0.18 long; oesophagus divided into two parts, anterior muscular 0.64 long and posterior glandular 2.56 long, and deeply excavated ventrally; spicules very unequal and dissimilar; longer slender and pointed 0.704 long; smaller stout, shovel shaped, 0.176 long and their ratio 4:1; caudal papillae pedunculate, 9 pairs, of which 4 pairs preanal 5 pairs postanal.

Female : Body 7.84 to 9.96 long, 0.32 to 0.56 wide; nerve ring 0.24 to 0.32 from anterior end; cordons extendently 0.496 to 0.592 posteriorly from head and anastomose 0.28 from anterior end. Tail 0.21 to 0.22 long, bluntly conical with a pair of papillae near tip; vulva very near to anus, 0.208 to 0.224 from posterior end; eggs 0.032 x 0.016 in diameter.

Remark : The present specimens come closer to *Synhimentus (Synhimentus) inveginata* (V. Linstow, 1901) Railliet, Henry and Sisoff, 1912 and *Synhimentus (Synhimentus) sagitata* Rudolphi, (1809) Cram, 1927 in position of vulva, but differs from both of them markedly in body size, size and shape of spicules, and in presence of a pair of tail papillae in female. The present specimens also do not agree with any other species so far described under the genus. *Synhimentus (Synhimentus)* therefore, a new specific name *Synhimentus (Synhimentus) coucalus* n.sp. is proposed to accomodate them.

Subfamily SCHISTOROPHINAE Travassos, 1918

Key to genus

Anterior edge of pseudolabia free and not indented. Anterior extremity with 4 long or short cylindrical horns. *Schistorophus*

Genus *Schistorophus* Railliet, 1916

Schistorophus tenuis (Maplestone, 1932) Singh, 1949

1932. *Quasithelazia tenuis* Maplestone, *Rec. Indian Mus.* 34(3) : 229-261.

1949. *Schistorophus tenuis* Singh, *J. Helminth.*, 23(1-2): 25-38.

Material : 1(M) & 3(F); Z.S.I. Reg. No. WN 642; host white breasted Kingfisher (*Halcyon smyrnensis*); location-under horny layer of gizzard; locality-Barkul, Chilka Lake, Puri district, Orissa, 18.v. 1986; coll. S.R.Dey Sarkar.

Description : **Male** - Body 7.2 long, 0.08 wide; nerve ring 0.16 from anterior end; vestibule 0.096 long with sclerotized walls; oesophagus divided into two parts 1.09 long; caudal alae well developed; tail 0.08 long with rounded tip. The spicules are dissimilar in shape and unequal in length, the left being 4 times as long as the right, measuring 0.32 and 0.08 in length respectively. Left spicule slender and tubular and right one short, stout and traugh like. Caudal papillae pedunculated 16 pairs; 12 pairs preanal and 4 pairs postanal.

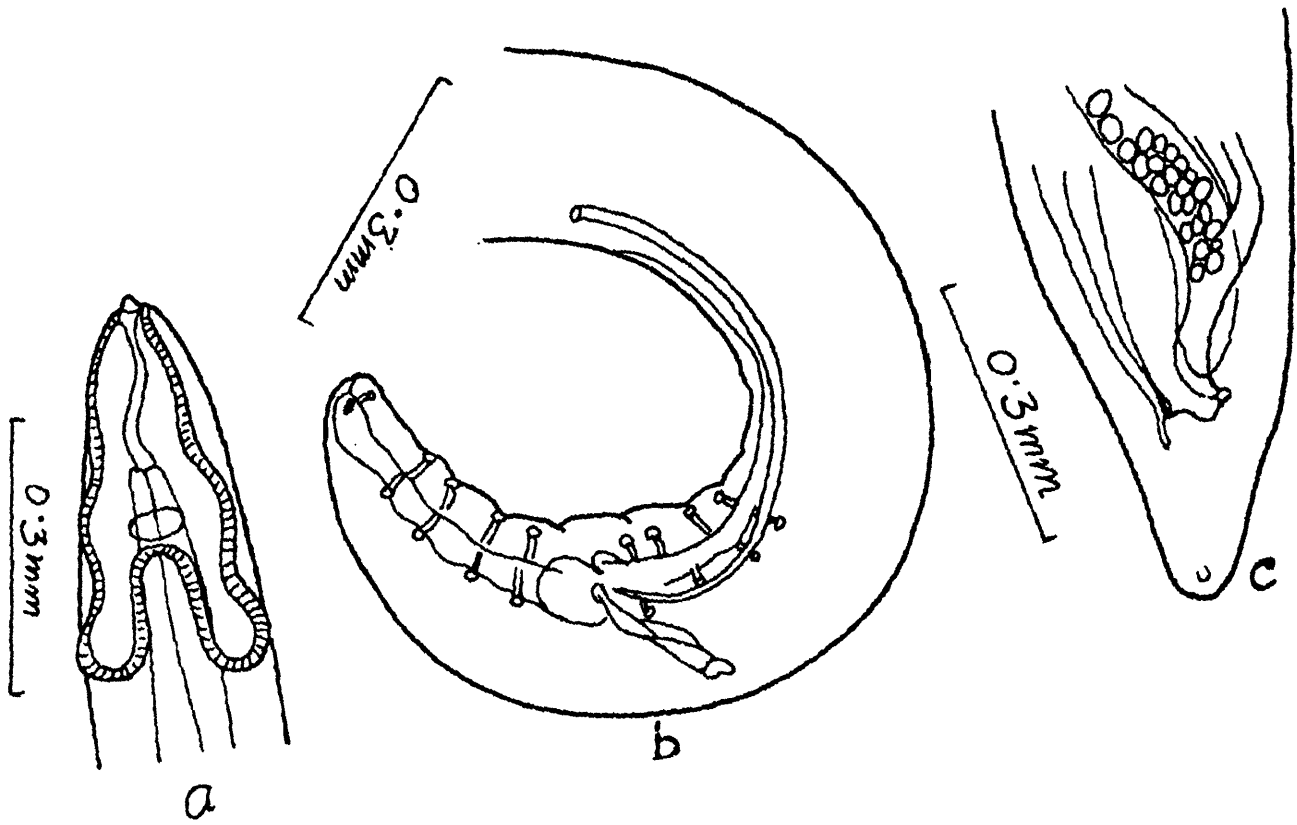


Fig. 4

Female : Body 14.6 to 15.3 long, 0.08 to 0.112 wide; nerve ring 0.16 to 0.18 from anterior end; vestibule 0.14 to 0.16 long; oesophagus 1.12 to 1.6 long; tail bluntly conical and 0.08 to 0.09 long; vulva in middle of the body and 7.2 to 7.7 from anterior end. Vagina directed posteriorly, didelphic. Eggs 0.016 x 0.032 in diameter.

Remarks : Maplestone (1932) established the genus *Quasithelazia* with *Q. tenuis* as its type species. His observation was based on a single male specimen from a white breasted King fisher (*Halcyon smyrnensis*) from the Zoological Garden, Calcutta. This was accepted by Baylis (1939). Singh (1949) had the opportunity of examining a series of specimens from the same host from Hyderabad, but unable to locate the presence of a swollen, lobulate, glandular structure in between the vestibule and oesophagus as stated by Maplestone (1932) and due to other similarities of body characters between Maplestone's specimen and his, concluded that the genus *Quasithela* is identical with *Schistorophus* and referred the species as *S. tenuis* (Maplestone, 1932). This was accepted by Chabaud and Petter (1959), English (1965) and Soota (1981). The present author also failing to locate Maplestone's key structure agrees with the above majority view assigning the specimens to *Schistorophus tenuis*. The present specimens though collected from *Haleyon smyrnensis*, show some variations in body size, size of spicules and in the number and arrangement of caudal papillae, position of vulva, and direction of vagina. According to Singh (*op.ct*) vagina is directed anteriorly. These differences may be considered just as intraspecific variations.

Distribution : India : West Bengal, Calcutta; Andhra Pradesh, Hyderabad and Orissa, Chilka Lake (first report).

Superfamily 6. DIPLOTRIAENOIDEA

Family DIPLOTRIAENIDAE (Skrjabin, 1916 subfam.) Anderson, 1958

Key to subfamily

Mouth simple without peribuccal chitinous ring or epauletts; with tridenti-like structures on each side of anterior end of oesophagus, and opening by pores on either side of oral opening, Oral opening dorsoventrally elongated. Anus subterminal. Spicule unequal; vulva in oesophageal region. Parasites of cavities of birds.....

Diplotriaeninae

Key to genus

Cephalic extremity devoid of two pairs of lateral pores and associated structures. Cephalic extremity with one pair of tridents. Parasites of insectivorous birds. *Diplotriaena*

Subfamily DIPLOTRIAENINAE Skrjabin, 1916

Genus *Diplotriaena* Railliet & Henry, 1909

Diplotriaena puriensis n.sp.

(Text-figure 5)

Material : Holotype 1(M), Z.S.I. Reg. No. WN 643; host-Eastern Skylark (*Aluda gulgula*); location - body cavity; locality Satpara, Chilka Lake, Puri district, Orissa; 12.ix. 1987; coll. S.R.Dey Sarkar.

Description: Body long, delicate, smooth and tapering at both extremities. Anterior end characterised by presence of one pair of tridents' on either side of oesophagus.

Male : Body 37.6 long; 0.4 wide; tridents two in number, equal, 0.13 long; nerve ring 0.48 from anterior end; oesophagus divided into two parts, anterior narrow, muscular, 0.32 long, posterior wide, glandular 3.30 long; spicules unequal and dissimilar left more or less straight 1.04 long, right spirally twisted with about one turn, measuring 0.64 long in straight line. Cloaca subterminal 0.08 from posterior end. Caudal papillae six pairs, of which one pair appear to be adanal and five postanal.

Remark : Though only a single male specimen is available for study, *Diplotriana puriensis* n.sp. differs from all the other species of the genus in various body measurements and number and arrangement of Caudal papillae. It shows some resemblance with *D. chandigarensis* Soota and Chaturvedi, 1967 and *D. nepalensis* Soota and Chaturvedi, 1967, but differs from them in following respects : in *D. chandigarensis* body is shorter, both spicules are shorter, ratio of the spicules is 7:5; in *D. nepalensis* body is longer, left spicule is little shorter but right spicules is longer and their ratio is 5:4; while the spicule ratio of *D. puriensis* n.sp. is 13:8. Further it is closer to *D. mukteswarensis* Singh, 1962 and *D. Chandigarensis* in number of caudal papillae but differs from them in the arrangement of caudal papillae, *D. mukteswarensis* has two pairs of preanal, two pairs of adanal and two pairs of postanal papillae, in *D. chandigarensis* caudal papillae 5-6 pairs in number, four pairs of them preanal and one to two pairs post anal in position, but in *D. puriensis* n.sp. one pair adanal and 5 pairs postanal papillae are present. It is therefore, regarded as a new species and the specific name *Diplotriana puriensis* n.sp. is proposed to accomodate it.

Superfamily 7. FILLARIOIDEA

Family ONCHOCERCIDAE (Leiper, 1911) Anderson & Bain, 1976

Key to subfamilies

Without conspicuous and salient cuticular cephalic formations. Caudal alae of male well developed, caudal papillae large and pedunculate. Tail short spicules very dissimilar. Parasites of reptiles, birds and mammals.Dirofilarinae

Cloeca subterminal in both sexes Buccal, capsule absent. Caudal papillae few in number. Spicule similar or dissimilar. Posterior extremity sometimes dilated, parasites of birds, rarely in reptiles and mammals. Lemdaninae

Subfamily DIROFILARIINAE Sandground, 1921

Key to genus

Lateral alae absent or weakly developed. Spicules very dissimilar. Oesophagus divided or undivided. Vulva postoesophageal. Caudal papillae numerous. Parasites of mammals. *Dirofilaria*

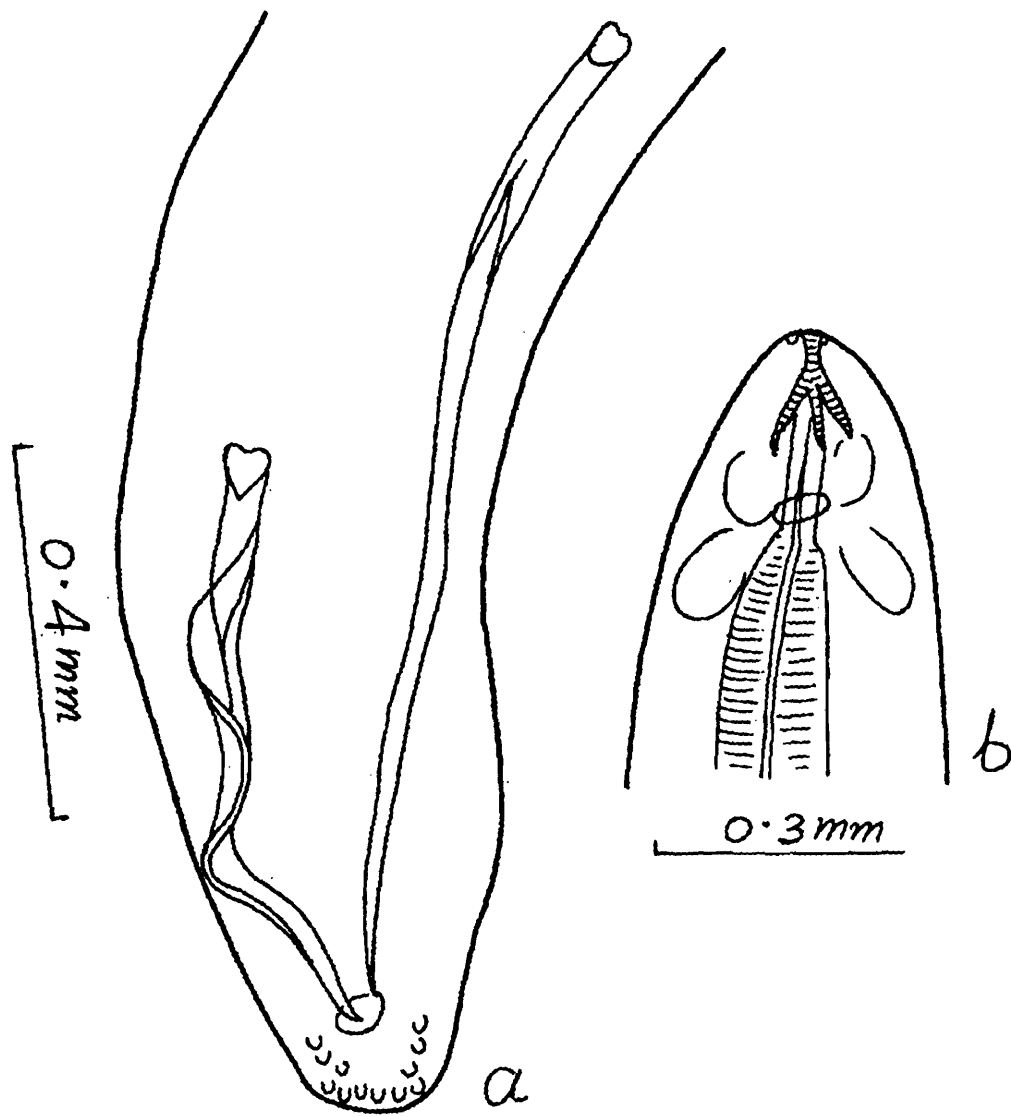


Fig. 5

Genus *Dirofilaria* Railliet & Henry, 1910*Dirofilaria* sp.

Material : 1(F), Z.S.I. Reg. No. WN 644; host *Viverricula indica*; location heart; locality - Satpara, Chilka Lake, Puri district, Orissa; 15.ix. 1987, coll. S. Chattopadhyay.

Remarks : The genus is recorded for the first time from the area. In the absence of a male specific identification is not possible.

Subfamily LEMDANINAE Lopez-Neyra, 1956

Key to genus

Left spicule tubular, very longer than right. Vulva a short distance from muscular oesophagus.
 *Lemdana*

Genus *Lemdana* Seurat, 1917*Lemdana bengalensis* Soota and Chaturvedi, 1971

(Text figure - 6)

1971. *Lemdana bengalensis* Soota and Chaturvedi, *Zool. Anz. Leipzig*, **186** (1971) 5/6, S. 359-367.

Material : 2(M), 1(F) Z.S.I. Reg. No. WN 645; host Brown Shrike (*Lanius cristatus*); location Subcutaneous tissue around the neck; locality Satpara, Chilka Lake, Puri district, Orissa, 18.ix. 1987; coll. S.R.Dey Sarkar.

Description : Male : Body 20.0 to 22.88 long; 0.49-0.56 wide; nerve ring 0.16-0.17 from anterior end; oesophagus divided into two parts - anterior smaller and muscular 0.24-0.27 long, the posterior longer and glandular 4.16-5.2 long; tail round 0.064-0.084 long; spicules very unequal, left tubular, longer, 2.8 to 2.88 in length and with a sheath 1.12 long, right smaller 0.3-0.37 in length. Gubernaculum absent. Three circumanal papillae only are traceable.

Female : 89.5 long, 0.8 wide; nerve ring 0.48 from anterior end; anterior muscular oesophagus 0.64, posterior glandular oesophagus not discernible, vulva in oesophageal region and 1.44 from anterior end. Tail 0.13 in length, short, round and bearing two small terminal subventral papillae. Eggs 0.032 x 0.048 in diameter.

Discussion : Soota and Chaturvedi (1971) described the species *Lemdana bengalensis* from *Lanius cristatus*, from Salt Lake, 24-Parganas, West Bengal, India and from *Lanius* sp. from Thankot, Nepal. The present specimens also collected from the same host *Lanius cristatus*, show some considerable variations from *L. bengalensis* in respect of body size, size of spicules, spicule sheath and number of caudal papillae.

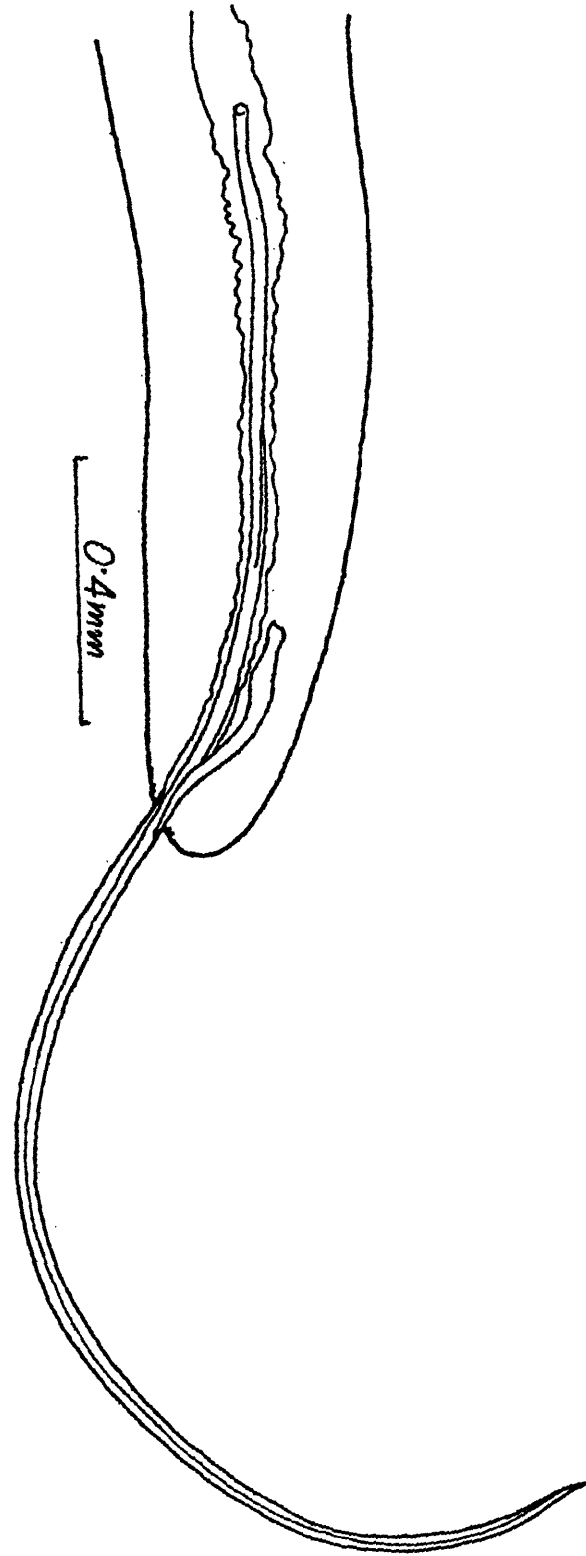


Fig. 6

However, as these differences are not uncommon, these are considered just as intra specific variations.

Distribution : India : Monghyr, Bihar; Salt Lake, Calcutta, West Bengal; Satpara, Chilka Lake, Orissa, (first report); Nepal : Thankot.

Superfamily 8. APROCTOIDEA

Family APROCTIDAE (Yourke and Maplestone, 1926 subfam.) Skrjabin & Schikhobalova, 1945

Key to subfamily

Cephalic extremity rounded. Buccal capsule absent. Oral opening more or less rounded. Oesophagus divided or undivided. Caudal alae absent or present. Parasites of orbit, nassal cavity and air sacs of birds.
..... ***Aproctinae***

Key to the genus

Cordons absent. Buccal cavity minute, lacking lips. Cephalic end rounded and smooth. Oesophagus divided or undivided. Caudal alae absent. Parasitic in orbit or nasal cavity of birds ***Aprocta***

Subfamily APROCTINAE Yourke & Maplestone, 1926

Genus *Aprocta* Linstow, 1883

Aprocta sp.

Material : 3(F), Z.S.I. Reg. No. WN 646; host-Crow Pheasant (*Centropus sineusis*); location - Nasal cavity; locality Satpara, Chilka Lake, Puri district, Orissa; 18.ix 1987, coll. S.R.Dey Sarkar.

Remarks : In the absence of a male , specific identification is not possible. However, the genus is recorded for the first time from Chilka Lake, Orissa.

SUMMARY

The paper deals with parasitic nematodes collected from vertebrates in Chilka Lake and its adjoining areas. The material contains 37 species belonging to 28 genera of 20 families of which five species are new to science and two species are reported for the first time from India, several interesting variations and new host or locality records have been given for most of the species at the appropriate place in the text. The genus *Quasithelazia* Maplestone, 1932, has been considered congeneric with *Schistorophus* Railliet, 1916.

ACKNOWLEDGEMENT

The author is highly grateful to the Director, Zoological Survey of India, Calcutta for providing laboratory facilities during this work. The author is also grateful to Dr. A.K.Mandal Ex-Scientist - SE, Dr.

K.V.Rama Rao, Scientist -SF, Dr. T.D. Soota, Ex-Deputy Director, Dr. C.B.Srivastava, Ex. Scientist -SE of this institution, for encouragement and valuable suggestions. The author is also thankful to Shri Srikumar Chattopadhyay Scientist SE, for taking pains in collecting the specimens. Finally, I wish to acknowledge Dr. Amalendu Chatterjee, Scientist SD, Incharge of the Section and to the members of Nematelminths Section, Zoological Survey of India, for their co-operation and help.

REFERENCES

- Agrawal, V. 1965. Two new species of nematodes from birds. *Proc. Nat. Acad. Sci.*, **35** : 217-222.
- Anderson, R.C. and Odile Bein, 1976. CIH keys to the nematode parasites of vertebrates. 3. keys to genera of the order Spirurida. Pt. 3. Diplotriaenoidea, Aproctoidea and Filarioidea. Edt. Anderson, Chabaud and Willmott, Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England ; 59-116.
- Baylis, H.A. 1936. Nematoda, I (Ascaroidea and Strongyloidea). Fauna Brit. India including Ceylon and Burma. Taylor and Francis, London : 408 pp.
- Baylis, H.A. 1939. Nematoda, II (Filarioidea, Dioctophymoidea and Trichinelloidea). Fauna Brit. India including Ceylon and Burma. Taylor and Francis : 273 pp.
- Baylis, H.A. and Daubney, 1922. Report on the parasitic nematodes in the collection of the Zoological Survey of India, *Mem. Ind. Mus.* **7**: 263-347.
- Baylis, H.A. and Daubney, 1923. A further report on parasitic nematodes in the collection of the Zoological Survey of India. *Rec. Indian Museum* **25**(4) : 557-578.
- Chabaud, A.G. 1974: CIH keys to the nematode parasites of vertebrates, 1. Keys to subclass, orders and superfamilies. Edt. Anderson, Chabaud and Willmott, Commonwealth Agricultural Bureau. Farnham Royal, Bucks, England : 17 pp.
- Chabaud, A.G. 1975. CIH keys to the nematode parasites of vertebrates 3. Keys to genera of the order Spirurida. Part 1. Camallanoidea, Dracunculoidea, Gnathostomatoidea, Physalopteroidea, Rictularioidea and Thelazioidea : 27 pp.
- Chabaud, A.G. 1978. CIH keys to the nematode parasites of vertebrate. 6. Keys to the genera of the Superfamilies Cosmocercoidea, Seuratoidea, Heterakoidea and Subuluroidea : 71 pp.
- Chabaud, A.G. and Petter, A.J. 1959. Essai de classification des nematodes Acuariidae. *Annl. Parasit. hum. Com.*, **34** : 331-349.
- Cram, E.B. 1927. Bird parasites of the nematode suborders strongylata, Ascaridata and Spirurata. *Bull. U.S. Nat. Mus.*, **140** : 465 pp.

- Durette-Desset, M.C. 1983. CIH. Keys to the nematode parasites of vertebrates. 10. Keys to genera of the Superfamily Trichostrongyloidea : 1-85.
- Hartwich, G. 1974. CIH. Keys to the nematode parasites of vertebrates. 2. Keys to genera of the Ascaridoidea : 1-15.
- Inglis, W.G. 1965. The nematode parasitic in the gizzard of birds : A study in morphological convergence. *J. Helminth.*, **39**(2/3) : 207-224.
- Margolis, L. 1975. Review of *Pseudopropleptus* Khera, 1955 (Nematoda : Spiruroidae) from fresh water fishes of Southern Asia and Africa with notes on related species. Dr. B.S. Chauhan Comm. vol. *Zool. Soc. India* : 21-31.
- Singh, S.N. 1949. Studies on the helminth parasites of birds in Hyderabad State, Nematoda III. *J. Helminth.*, **23**(1-2) : 25-38.
- Singh, S.N. and Ali, S.M. 1961. On a new species of the genus *Chevreuria* Seurat, 1918 from India. *J. Helminth.*, R.T. Leiper Supplement : 157-160.
- Singh, K.S. 1962. Parasitological Survey of Kumaun region. Pt. I. On three new species of the genus *Diptotriaena* Railliet and Henry, 1909. (Diptotriaeninae : Filariidae : nematoda) from birds from Mukteswar. *Indian J. Helm.*, Lucknow, **14**(1) : 16-23.
- Soota, T.D. 1981. On some nematodes from the unnamed collection of the Zoological Survey of India along with the description of a new species. *Rec. zool. Surv. India*, **79** : 55-71.
- Soota, T.D. 1983. Studies on the nematode parasites of Indian vertebrates I. Fishes. *Rec. zool. Surv. India*, Occasional paper, **54** : 352 pp.
- Soota and Chaturvedi, Y. 1967. On two new nematode species of the genus *Diptotriaena* Railliet and Henry, 1909 from Nepal and India. *J. zool. Soc. India*, **19**(1-2) : 133-136.
- Soota, T.D. and Chaturvedi, Y. 1971. Description of a new nematode of the genus *Diptotriaena* Railliet and Henry, 1909 and notes on the taxonomic status of the another nematode *Porrocaecum haliasture* Gupta, 1960. *J. zool. soc. India*, **23**(1) : 21-23.
- Soota, T.D. and Chaturvedi, Y. 1971. On some Filariid nematodes and a description of a new family Hamulofilariidae. *Zool. Anz. Leipzig* **186**. (5/6) S. 359-367.
- Soota, T.D. and Dey Sarkar, S.R. 1980. On some nematodes from Darjeeling district, West Bengal, India. *Proc. Zool. Soc.*, Calcutta, **31** : 39-46.

ANNELIDA : POLYCHAETA

C. A. NAGESWARA RAO

*Estuarine Biological Station, Zoological Survey of India,
Berhampur - 760005*

INTRODUCTION

Polychaetes are one of the important constituents among the benthic animal communities of the marine, estuarine and brackish water habitats. In view of their highly euryhaline nature, large populations of polychaetes occur in the above habitats in various niches viz. among the algal masses in the sand-mud sediments, in the crevices of rocks, and sedentary forms in tubes attached to rocks, vegetation, and in the bottom sediments.

Abundance of the polychaetes in the estuarine and brackish waters of the Indian region is evident from the reports of Southern (1921) and Fauvel (1932). Systematic studies on the Polychaetes of Gangetic delta, Mahanadi, Godavari and vellar estuaries were made by Misra *et. al.* (1983), Rao, C.A.N. (1981) Julka & Rao, (1976), Radhakrishna (1963) Rao & Sarma (1982) Balasubramanyan (1964) and Srikrishna Das *et. al.* (1987) respectively. For furthering our knowledge on the abundance and variety of the fauna of the Chilka Lake which is the biggest brackish water body in the Indian region, a detailed survey was made during 1985-87, and a large number of polychaetes were collected from different localities of the lake. Studies on them resulted in the identification of 31 species belonging to 14 families. For each species earlier records from Indian waters, diagnostic characters and distribution are given. As all the species reported here are well documented already, figures and illustrations are not given.

MATERIALS AND METHODS

Specimens of polychaetes were collected mainly by sieving the sediment samples collected from the bottom of the Chilka Lake through 0.5 mm. pore size sieve. The sediment samples from the Chilka Lake bottom were collected by grab and trawl from different stations within the lake during the expeditions conducted in November '85, June '86 and September '87 as shown in the Fig. (1). In addition, polychaete samples were collected during the expeditions and also from earlier surveys to the lake from the Inter-tidal areas at different localities of the lake. The material collected from different localities is given first mentioning the number of examples collected and the name of the locality. Then the material collected from various stations during different expeditions are given first mentioning the station number and the number of specimens collected in brackets from each station chronologically.

SYSTEMATIC ACCOUNT

Phylum ANNELIDA

Class POLYCHAETA

Family PILARGIDAE St. Joseph, 1899

1. *Ancistrosyllis constricta* Southern

Family HESIONIDAE Malmgren, 1867

2. *Ophicdromus angustifrons* (Grube)

Family NEREIDAE Johnston, 1865

3. *Namalycastis indica* (Southern)
4. *Namalycastis fauveli* Rao
5. *Nereis (Neanthes) reducta* Southern
6. *Nereis (Neanthes) glandicincta* Southern
7. *Nereis (Neanthes) chilkaensis* Southern
8. *Nereis (Nereis) persica* Fauvel
9. *Perinereis nigropunctata* Horst.

Family NEPHTYIDAE Grube, 1850

10. *Nephtys oligobranchia* Southern
11. *Nephtys polybranchia* Southern

Family GLYCERIDAE Grube, 1850

12. *Glycinde oligodon* Southern

Family EUNICIDAE Savigny, 1818

13. *Marphysa mossambica* (Peters)
14. *Marphysa fallax* Marion & Bobretzky
15. *Marphysa gravelyi* Southern
16. *Dioptra neapolitana* Delle Chiaje
17. *Lumbrineris polydesma* Southern

18. *Lumorineris simple* Southern
Family SPIONIDAE Grube, 1850
19. *Prionospio cirrifera* Wiren
Family ORBINIIDAE Hartman 1942
20. *Scoloplos marsupialis* Southern
Family PARAONIDAE Cerruti 1909
21. *Aricidea fauveli* Hartman
Family CAPITELLIDAE Grube 1862
22. *Capitella capitata* (Fabricius)
23. *Pulliella armata* Fauvel
24. *Notomastus latericeus* Sars.
25. *Heteromastus similis* Southern
26. *Barantolla sculpta* Southern
Family MALDANIDAE Malmgren 1867
27. *Euclymene annandalei* Southern
28. *Axiiothella obockensis* (Gravier)
Family TERESELLIDAE Grube, 1851
29. *Loimia medusa* (Savigny)
Family SABELLIDAE Malmgren 1867
30. *Laonome indica* Southern
Family AMPHARETIDAE Malmgren 1867
31. *Amage bioculata* (Moore)

Family PILARGIDAE St. Joseph, 1899

Ancistrotyllis constricta Southern, 1921

1921. *Ancistrotyllis constricta* Southern *Mem. Ind. Mus.*, V(8) : 573.
 1932. *Ancistrotyllis constricta* Fauvel *Mem. Ind. Mus.*, XII (1) : 64.
 1967. *Ancistrotyllis constricta* Day *Brit. Mus. Nat. Hist.* : 215.

Material 1985 : A3(2), B2(3), B5(3), C2(2), C3(1), D6(1), D7(1), D8(1), E5(2), E8(1), E9(1), E10(1), E11(2), G12(1), G13(3), H9(1), H10(1), I10(1), I12(4), J11(1), K13(5), M15(1), N11(1), O8(1), O12(1), O8(1).

1986 : B4(4), B5(1), B6(1), D6(1), D7(1), D8(1).

1987 : C3(1), C5(1), E5(1), E9(1), I10(2), L10(1).

Description : Elongated with several segmented body reaching 2-4 cm. in length : anterior part cylindrical due to thick Pharynx, the remaining part flat; Everted Proboscis with a circle of fleshy papillae at its tip. Prostomium with three antennae of which the median is longer. Bulbous Palps with pointed Palpostyles; one pair of tentacular cirri on either side. First setigerous segment uniramous with a long dorsal cirri, few capillary setae and a small ventral cirri; Dorsal rami of the anterior feet reduced as a cirri with an aciculum, neuropodia with capillary setae and ventral cirrus. Notopodia of the middle and posterior segments with a sickle-shaped stout hook projecting out from dorsal cirri, and 1-2 capillary setae; Neuropodia with long capillary setae and shorter setae with serrated edges. Ventral cirri small. A pair of anal cirri.

Distribution : Visakhapatnam harbour channel, Chilka Lake and Vellar estuary. Natal, South Africa.

Family HESIONIDAE Malmgren, 1867

Ophiodromus angustifrons (Grube 1878)

1878. *Irima angustifrons* Grube
 1932. *Podarke angustifrons* Fauvel. *Mem. Ind. Mus.* XII(1) : 63.
 1967. *Ophiodromus angustifrons* Day *Brit. Mus. Nat. Hist.* : 225.

Material 1987 : F10(1).

Description : Incomplete specimen with anterior 20 segments measuring 1.5 cm. Anterior segments cylindrical, while the remaining flat. Proboscis with no teeth or Papillae; a pair of pointed palps at each corner. Six pairs of tentacular cirri attached to cirrophores and are easily detachable. First setigerous segment with a long dorsal cirrus with a cirrophore, 1-2 setae.

Dorsal ramus reduced with a large dorsal cirri and few setae while the ventral rami lobe-like with

several setae and a small ventral cirri. Notosetae comprises many capillary setae and 1-2 forked setae with unequal limbs; Neurosetae all compound, some with long pointed end pieces, and few falcigers with bidentate tips.

Distribution : Andaman & Nicobar Islands; Tamilnadu coast. Phillipine Islands; Natal, South Africa.

Family NEREIDAE Johnston, 1865

Namalycastis indica (Southern) 1921

1921. *Lycastis indica* Southern *Mem. Ind. Mus.* V(8) : 578.
 1932. *Lycastis indica* Fauvel *Mem. Ind. Mus.*; XII(1) : 82.
 1969. *Namalycastis indica* Day *Brit. Mus. Nat. Hist.* : 301.

Material : 8 exs. Malatikuda; 25 exs. Barakudi.
 1986 : G10(1), H10(1), J11(1), L16, N16(1), M16(2).
 1987 : S12(1), S16(2).

Description : Body slender reaching 10-15 cm; Prostomium triangular with a median groove; a pair of bulbous palps, a pair of small antennae and two pairs of prominent eyes; Two pairs of tentacular cirri on each side of which postero-dorsals are elongated; Proboscis without pragnaths or fleshy Papillae; Feet uniramous, Dorsal ramus represented by big dorsal cirri with an aciculum and 1-2 spinigers, ventral ramus large with several spinigers and narrow falcigers, ventral cirri short; Dorsal cirri elongated towards the Posterior region.

Distribution : Salt Lakes, Calcutta; Gangetic delta, Chilka Lake and Andaman Islands, Natal & Mocambique, South Africa.

Namalycastis fauveli Rao, 1981

1981. *Namelycastis fauveli* Rao, *Bull. Zool. Surv. Ind.*; 3 (3) : 215.

Material : 30 exs. Harithas.

Description : Slender worms of several segments reaching 4-6 cm. in length. Proboscis plate-like with a median ridge; a pair of small knob like antennae, a pair of bulbous palps and two pairs of eyes. Two pairs of small tentacular cirri on each side. Proboscis with a pair of chitinous Jaws, Paragnaths absent. Feet uniramous; dorsal rami represented by dorsal cirri with an aciculum and 1-2 spinigers in some segments; Dorsal cirri small in the anterior segments and gradually becomes broad and enlarged in size towards the posterior region; ventral ramus triangular, lobe like with several spinigers and falcigers. One limb of the lower piece of the heterogomph falciger is very long; ventral cirri very small.

Distribution : Baitarani estuary, Orissa.

Nereis (Neanthes) reducta Southern, 1921

1921. *Nereis reducta* Southern, *Mem. Ind. Mus.* V(8) : 593.
 1953. *Nereis reducta* Fauvel, *Fau. Ind.* 190.

Material : 3 ex. Arkhakuda.

Description : Elongated body reaching 7-8 cm. Proboscis with Group I-2 Paragnaths, one above the other, II-5 or 6, III-10-14 in a group, IV-6-8 in a group; paragnaths of the basal ring very small with group V=O-1, and VI having no paragnaths, VII-VIII many small paragnaths in a continuous band and are not distinct. Prapodia with two ligules in each ramus; Dorsal lobe of the notopodia reduced in size towards the posterior region; Dorsal rami with no setae in the first few segments and only few spinigers in the rest; Neuropodia with spinigers and falcigers.

Distribution : Chilka Lake, Rushikulya estuary, Orissa.

Nereis (Neanthes) glandicineta Southern, 1921

1921. *Nereis glandicineta* Southern, *Mem. Ind. Mus.* V (8) : 539.
 1932. *Nereis glandicineta* Fauvel, *Mem. Ind. Mus.*; XII (1) : 92.

Material : 1986 M10(2);
 1987 : M15(1), P8(1).

Description : Prostomium with a pair of narrow palps. Some of the tentacular cirri reaching 5-6th segment. Proboscis with group I=4 small, II = a group of 7-10, III many in a row. IV = 7-8 long pointed paragnaths arranged closely, V=0, VI=one transparent on either side, VII-VIII = completely missing. Dorsal and ventral rami trifid; Anterior feet with only spinigers; Middle and posterior feet with dorsal spinigers; and ventral falcigers. Notopodial falcigers not seen in any segment. Brownish circular gland masses are seen near the base of the dorsal cirri in the anterior and middle segments.

Distribution : Salt water lakes of Calcutta; Visakhapatnam coast and Kerala coast. Talehsap, Thailand and Singapore.

Nereis (Neanthes) chilkaensis Southern, 1921

1921. *Nereis chilkaensis* Southern, *Mem. Ind. Mus.* V(8) : 584.
 1932. *Nereis chilkaensis* Fauvel, *Mem. Ind. Mus.* XII(1) : 94.

Material : 4 exs. Arkhakuda, 2 exs. Barkul, 23 exs. Barakudi, 11 exs. Rambha, 8 exs. Pathra, 6 exs. Gopakuda, 3 exs. Malatikuda.

1985 : B3(2), B4(1), C2(24), C4(1), D4(7), E6(3), E7(5), H10(1).
 1986 : A3(1), B2(1), b3(3), C5(35), d3(14), d5(1), E5(5), E7(4).
 1987 : B1(1), B5(1), B6(12), C3(2), C4(1), C5(3), d3(1), F9(1).

Description : Stout and elongated worms reaching 6-7 cm. Dorsal part of the anterior region dark-brown in colour. Tentacular cirri reaching upto 8-10 feet; Proboscis with group I = 4-6, II = many in a cluster, III = many, IV = several, V = o, in some specimens single small paragnath seen, VI = 2-5, VII-VIII = many in band of 2-3 rows. Feet with three ligules in each ramus; only spingers in the notopodia and Neuropodia with spingers and falcigers. Dorsal falcigers absent; Dorsal lobe of the feet enlarged and is wide apart from ventral lobe in the posterior feet.

Distribution : Chilka Lake, Ennur back-waters & Pamban, Tamil Nadu Coast.

Nereis (Nereis) persica Fauvel, 1911

1911. *Nereis zonta var persica* Fauvel. *Archiv Zool. Expre. Gen. Paris* VI : 385.
 1953. *Nereis zonta-persica* Fauvel *Fa. India*, 87
 1967. *Nereis (Nereis) persica* Day, *Brit. Mus. Nat. Hist.* : 314.

Material : 1985 N9 (1), T10(1),
 1986 : Q8 (1), S9(1).

Description : Body slender and 2-3 cms. in length. Narrow anteriorly and becomes broad in the middle and posterior region. Prostomium narrow with a pair of long palps. Eyes prominent, Tentacular cirri reaching 6-7th segment. Proboscis with I = 1, II = 5-6 in a group III = 6-7, IV = many small and big Paragnaths, V = 1, VI = 4-7 big and small, VII-VIII = several in a broad band of 4-6 rows deep. Notopodia of the anterior feet with spingers and neuropodia with spingers and falcigers, middle and posterior feet with few notosetae of which 1-2 spingers and 2 stout homogomph falcigers with short bidentate end-pieces. Dorsal cirri long.

Distribution : Panban, Tamil Nadu coast, Marmaugoa & Gujarat. Persian Gulf, Red Sea, Natal & Mocambique, South Africa.

Perinereis nigropunctata Horst, 1924

1921. *Perinereis marjorii* Southern *Mem. Ind. Mus.* V (8) : 595.
 1932. *Perinereis nigropunctata* Fauvel *Mem. Ind. Mus.* XII (1) : 107
 1967. *Perinereis nigropunctata* Day *Brit. Mus. Nat. Hist.* : 337.

Material : 5 exs. Arkhakuda.

Description : Elongated worms reaching 5-6 cm. Proboscis with group I = 4-8 big and conical Paragnaths, II = 10-18 small ones in a cluster, III-IV = Several big Pragnaths in cluster, V = 3 in a triangle, VI - one stout and transverse barlike on either side, VII VIII = several in band of two rows deep.

Both the rami of the feet bifid, with the dorsal ligule enlarged towards the posterior region; long dorsal cirri; ventral heterogomph falcigers with short and stout end-pieces.

Distribution : Gangetic delta, Chilka Lake, Madras coast, and Andaman Island. Malaysia, Red Sea

and South Africa.

Family NEPHTYIDAE Grube 1850

Nephtys oligobranhia Southern, 1921

1921. *Nephtys oligobranhia* Southern, *Mem. Ind. Mus.* V (8) : 610.

1932. *Nephtys oligobranhia* Fauvel *Mem. Ind. Mus.* XII (1) : 119.

Material : 1985 C3(2), c5(1),
1986 B5(1), J14(1), K13(4), M12(1), N8(1), R18(20),
1987 B1(2), B2(4), c3(2), C5(4), E9(3), P15(2), Q12(1), R13(1).

Description : Elongated body of 1-2 cm. with 50-60 segments. Proboscis with several rows of fleshy Papillae on its surface, and a circle of Papillae at the tip. Anterior segments closely arranged while posterior ones are broad and attached to each other with a narrow connection. Prostomium small, plate like with four antennae; First setigerous segment with setae on both rami, and without dorsal and ventral cirri. Parapodia biramous with both rami wide apart; Small knob like dorsal and ventral cirri; Setae in all feet similar. Long capillary setae with a flattened blade ending abruptly with a fine tip. Branchia appear from 5-7 segments and disappear by 30th segment; Branchial filaments curved inwards and then Projecting outwards; a single long anal cirrus.

Distribution : Salt Lakes, Calcutta, Chilka Lake, Cochin backwaters and Visakhapatnam coast. Mergui, Thailand.

Nephtys polybranchia Southern 1921

1921. *Nephtys polybranchia* Southern, *Mem. Ind. Mus.* V (8) : 607.

1932. *Nephtys polybranchia* Fauvel, *Mem. Ind. Mus.* VII (1) : 118.

Material : 3 exs. Parikud, 8 exs. Barkul;
1985 M11(2)
1986 B2(2), B4(2), C2(1), D3(1), D6(1), E9(4), F8(1), H9(1), I10 (1),
1987 D4(3).

Description : Elongated body with 45-60 segments and about 2 cm. in length. Body tetragonal in cross section. Anterior part stout and gradually becomes narrow. Prostomium square shaped with four knob like antennae. Proboscis with several rows of papillae on its surface and a circle at its tip. Branchia appear on the 2-3 segment and enlarged in the middle segments and reduced size in the posterior segments. Branchia seen in the posterior region except last 4-5 segments. Setae simple capillaries. single long anal cirri.

Distribution : Chilka Lake, India. Shanghai, China and Thailand.

Family GLYCERIDAE Grube, 1850

Glycinde oligodon Southern, 1921

1921. *Glycinde oligodon* Southern, *Mem. Ind. Mus.* V(8) : 629.
 1932. *Glycinde oligodon* Fauvel, *Mem. Ind. Mem.* XII (1) : 123.

Material : 2 exs. Parikud.

1985 B5(1), E&(1)
 1986 B2(3), B5(1), C2(3), D7(1), E8(1), H10(1), H11(1), I10(1), I13(3), M13(2),
 N11(1), N14(1), R16(1)
 1987 B1(1), B6(1), C3(2), C5(2), D7(2), D8(2), F9(2), G10(2), O9(2), P10(2).

Description : Body small, narrow, dark coloured, reaching 1-2 cm. Prostomium ringed and conical with 4 very small antennae at its tip. Proboscis square in cross section with dorsal paragnaths and ventral fleshy Papillae; Lateral 'V' shaped chevrons absent. Body divided into two parts; Anterior 20-22 segments with uniramous feet having a small dorsal cirri, setigerous lobe with spingers and ventral cirri. Feet of remaining segments biramous consisting a dorsal lobe with stout aciculum and 2-3 setae embeded inside the dorsal lobe. Ventral lobe as in the anterior feet; a pair of long anal cirri.

Distribution : Chilka Lake, 840 fms. of Bay of Bengal, off Visakhapatnam and Vellar estuary.

Family EUNICIDAE Savigny, 1818

Marphysa mossambica (Peters. 1854)

1919. *Marphysa mossambica* Fauvel, *Archiv Zool. Exper Gen. Paris.* LVIII : 380.
 1932. *Marphysa mossambica* Fauvel, *Mem. Ind. Mus.* XII(1) : 142.

Material : 1987 F7(1).

Description : Body flat and elongated 4-5 mm. in width and 5 cm. in length; dark black in colour. Branchia from 25th segment and continue to the end of the body, with 1-7 filaments; Simple capillary setae in all feet with 1-2 comb setae in the ventral side; Compound setae absent; stout acicula in yellow colour with blunt tips seen both dorsally and ventrally in several feet.

Distribution : Gangetic delta, Gulf of Mannar and Andaman & Nicobar Islands. Red Sea, South Africa Coast, Phillipines Islands, and Australia.

Marphysa fallax Marion & Bobretzky, 1875

1923. *Marphysa fallax* Fauvel, *Fau. de. France* : 410.
 1953. *Marphysa fallax* Fauvel, *Fau. India* 247.

Material : 1987 L9(1).

Description : Slender and small worms of 15mm. length. Branchia with 1-3 filaments from segments 7-8th and disappear in the last 10-15 segments; Feet with dorsal capillary setae and ventral compound setae, ventral compound setae having knife like end pieces; Feet of the middle and posterior segments consist several compound setae with knife like end pieces & 1-2 with sickle shaped end pieces ventrally. Comb setae not seen. Acicular setae with bidentate tips. Two pairs of anal cirri.

Distribution : Gulf of Mannar.

***Marphysa graveleyi* Southern, 1921**

1921. *Marphysa graveleyi* Southern, *Mem. Ind. Mus.* V(8) : 617.

1932. *Marphysa graveleyi* Fauvel, *Mem. Ind. Mus.* XII(1) : 142.

Material : 2 exs. Barakuda, 1 ex. Palur Canal;
1986 I10(2), H10(1).

Description : Elongated worms with 200-250 segments, 4-8 mm in width and 4-8 cm. in length. Branchia from 20-32 segments, with a maximum of 6-7 filaments and continue to the posterior end; Anterior and middle feet with dorsal capillary setae and ventral falcigers with knife like end pieces. In the posterior feet some of the compound setae are replaced by 1-2 capillary setae in the neuropodia thus both capillaries and falcigers are present in the posterior feet. Comb setae not seen. Stout acicular setae with bidentate tips. This species is very close to the *M. sanguinea* and its separation from *M. graveleyi* is very difficult.

Distribution : Visakhapatnam coast, Chilka Lake and Madras coast.

***Diopatra neapolitana* Delle Chiaje 1841**

1921. *Diopatra variabilis* Southern, *Mem. Ind. Mus.* V(8) : 611.

1932. *Diopatra neapolitana* Fauvel, *Mem. Ind. Mus.* XII(1) : 144.

Material : 1985 B3(1), C3(4), C6(8), F8(3), K12(2), I12(1), M11(1), O12(3)
1986 E5(1), G9(1), H10(1), I12(1), K13(1), M13(2), N9(3), R4(1),
1987 C2(1), F10(6), F11(7), H10(2), H11(31), K12(1), M13(1), N12(1), M13(2), P8(2).

Description : Elongated specimens with the anterior few segments circular and the remaining flat; size varies from 2-20 cm. in length enclosed in leathery tubes. Five long occipital tentacles arising from ringed ceratophores; a pair of small tentacular cirri; Branchia with spirally arranged filaments in the anterior 25-35 segments. Anterior 4-5 segments with winged capillaries and pseudo-compound hooks with hooded bidentate tips; Remaining segment with winged capillaries, comb setae and acicular setae with bidentate tips. Two pairs of anal cirri. Some very small specimens measuring 1-2 cm. are seen without the paired tentacular cirri with Gills in anterior 10-15 segments as in *Epidiopatra* sp. Since it is not certain whether the tentacular cirri are originally absent or detached, these are reported as *Diopatra neapolitana*.

Distribution : Widely distributed on the Indian coasts; South African coast, Persian Gulf, Red Sea, and Mediterranean Sea.

***Lumbrineris simplex* Southern, 1921**

1921. *Lumbrineris simplex* Southern, *Mem. Ind. Mus.* V(8) : 625.
 1953. *Lumbrineris simplex* Fauvel, *Fau. India* : 264.

Material : 1 ex. Barakuda, 1 ex. Rambha.

1985 B2(1), B3(1), B6(1), C2(1), D4(1), D7(1)

1986 B1(2), B2(2), B4(6), C2(1)

1987 B1(2), B2(1), B3(1), B5(1), B12(1), c4(1), G9(1).

Description : Narrow and elongated worms reaching 10 cm. in length; Branchia, Dorsal and Ventral cirri absent; only capillary setae in all segments; Post-setal lobes of the posterior feet slightly enlarged; Two pairs of anal cirri.

Distribution : Chilka Lake and Vellar estuary.

***Lumbrineris polydesma* Southern, 1921**

1921. *Lumbrineris polydesma* Southern, *Mem. Ind. Mus.* V(8) 622.
 1953. *Lumbrineris polydesma* Fauvel, *Fau. India* : 264.

Material : 1985 B6(3), C2(7), D6(1), M12(1), B6

1987 B5(1), C3(3), C4(1), C5(1), E6(2), E8(1), E9(4), G10(5), H10(5), J11(2).

Description : Elongated and cylindrical worms upto 6-7 cm. Branchia, Dorsal and Ventral cirri absent; Anterior 25-30 feet with long capillaries. From 30th feet, along with capillaries, stout simple hooded hooks are seen. Post-setal lobes of the posterior feet enlarged and slightly erect. Two pairs of small anal cirri.

Distribution : Gangetic delta, Chilka Lake, Vellar estuary and Gujarat coast.

Family SPIONIDAE Grube 1850

***Prionospio cirrifera* Wiren, 1883**

1932. *Prionospio cirrifera* Fauvel, *Mem. Ind. Mus.* XII(1) : 174.
 1953. *Prionospio cirrifera* Fauvel, *Fau. India* : 324.

Material : 2 ex. Satpara, 5 ex. Gorapur; 2 ex. Barkul;

1985 N17(10), O16(16),

1987 J10(1), L16(1)

Description : Slender worms reaching 2-4 cm. First few segments flat and remaining circular; A pair of long palps easily detachable and missing in many specimens. Prostomium rectangular with a keel like crest towards back; 2 pairs of small black eyes; Long narrow gills from 2nd segment to the 14-15th

segment; Anterior feet with long capillary setae in both rami; Hooded hooks from 9th segment ventrally and from 30th segments dorsally. Posterior segments with several hooks and few capillaries. Pygidium with a median anal cirri. Specimens enclosed in thin mud tubes.

Distribution : Gangetic delta and Visakhapatnam coast. South African coast.

Family ORBINIIDAE Hartman, 1942

Scoloplos marsupialis Southern, 1921

1921. *Scoloplos marsupialis* Southern, *Mem. Ind. Mus*; V (8) : 632.

1932. *Scoloplos marsupialis* Fauvel, *Mem. Ind. Mus*; XII (1) : 165

Material : 21 exs. Arkhakuda.

Description : Body reaching 4-8 cm. in length and divided into a flat thorax of 17-19 segments and a long cylindrical abdomen of several segments. Prostomium conical and Proboscis sac-like with several lobes; Paired lanceolate gills appear from 15-16th segment and continue till the posterior end. Serrated capillaries dorsally and capillaries & simple hooks ventrally, Dorsal cirri enlarged in the abdomen; A membranous pocket like structure in between each foot from 17th segment.

Distribution : Chilka Lake, Gulf of Mannar and Vellar estuary. South African coast.

Family PARAONIDAE Cerruti 1909

Aricidea fauveli Hartman, 1957

1957. *Aricidea fauveli* Hartman, *Allan hancock pacific Exped.* 15(3) : 318.

1969. *Aricidea fauveli* Day, *Brit. Mus. Nat. Hist.* 560.

Material : 1985 C2(1), D7(2), d8(1), H10(1).

1986 B2(8), B4(5), D8(2), E5(3), H10(1),

1987 B2(1), E7(1), F9(1).

Description : Small and narrow worms of 15-30 mm. Anterior thoracic region flat and the remaining cylindrical. Prostomium pointed with a small median antennae bent backwards, which is easily detachable; Lanceolate gills appear from 4th segment and disappear between 25-30th segment; First setigerous segment with setae in both rami. Thoracic feet with a long dorsal post setal lobe, and a pad like ventral lobe; only capillary setae in both rami; abdominal segments with their feet reduced having dorsal and ventral capillaries along with 8-9 stout unidentate hooks each with a delicate pointed structure 'arista' on its tip on the convex side.

Distribution : South African coast.

Family CAPITELLIDAE Grube, 1862

Capitella capitata (Fabricius, 1780)

1927. *Capitella capitata*, Fauvel *Fau. Fra.* 154.
1947. *Capitella capitata*, Hartman *Allan Hancock Pacif Exped.* 10 (4) 404.
1987. *Capitella capitata* Ganapati & Raman, *Ind. J. Mar. Sci.* 5 : 251.

Material : 2 ex. Satpara; 2 ex. Parikud; 1 ex. Gorapur.

Description : Narrow thread like worms upto 2.5 cm. prostomium pointed; Body divided into stout thorax of 9 setigerous segments and a narrow abdomen. Peristomium and the next seven thoracic segments with capillary setae in both rami and the 9th segment with dorsal capillaries and ventral hooks. Abdomen with hooks in both rami arranged in elevated tori, Branchia absent.

Distribution : Visakhapatnam coast and Vellar estuary; Mediterranean Sea, South Africa and Atlantic Ocean.

Pulliella armata Fauvel, 1929

1930. *Pulliella armata* Fauvel, *Bull. Madras. Govt. Mus.* 1 (2) 48.
1967. *Pulliella armata* Day, *Brit. Mus. Nat. Hist.* 595
1981. *Pulliella armata* Rao, *Proc. Ind. Accd. Sci. (Amin. Sci)* 90(3) : 324.

Material : 1 ex. Gorapur.
1987 L9(7)

Description : Small and narrow worms of 2 cm. Prostomium pointed, Peristomium achaetous; Body divided into stout thorax with 9 setigers and a narrow abdomen of several segments. Thoracic segments with capillaries in both rami and abdomen with hooded hooks. The hooks are with one large and several small teeth covered with a hood. The posterior segments of the abdomen are slightly enlarged with 1-2 stout and long spines instead of hooks dorsally and ventral hooks; Branchia absent; a pair of anal cirri.

Distribution : Gulf of Mannar and Godavari estuary; South Africa and Indo-China.

Notomastus latericeus (Sars, 1851)

1932. *Notomastus latericeus* Fauvel, *Mem. Ind. Mus.* XII(1) : 194.
1981. *Notomastus latericeus* Rao & Soota, *Rec. Zool. Surv. Ind.* 79 : 80.

Material : 1 ex. Arkhakuda.

Description : Stout and elongated specimen of about 3.5 cm. prostomium pointed and peristomium achaetous; Body divided into thorax of 11 segments and a long abdomen. Thoracic segments with capillaries on both rami; Abdomen several segmented and is stouter than thorax, with hooded hooks in both rami. Gills rudimentary and are seen as small projections at the dorsal edges of notopodia and neuropodia of the abdominal segments.

Distribution : Andaman & Nicobar Islands, Bay of Bengal and Gujarat Coast. Ceylon and South Africa.

***Heteromastus similis* Southern, 1921**

1921. *Heteromastus similis* Southern, *Mem. Ind. Mus.* V (8) : 640.
 1932. *Heteromastus similis* Fauvel, *Mem. Ind. Mus.* XII (1) : 195.
 1987. *Heteromastus similis* Srikrishna Das *et. al.*, *J. Mar. biol. Ass. India*; **29** (1 & 2) : 138.

Material : 5 ex. Satpara, 2 ex. Parikud, 3 ex. Harchandi River mouth, 1 ex. Palur canal mouth.

Description : Elongated worms upto 5-6 cm. Body divided into thorax of 11 setigerous segments and a long abdomen. Peristomium achaetous; Thoracic segments broad and the first 5 setigers with capillaries on both rami, remaining 6 setigers with long hooks; abdominal segments narrow, annulated and tetragonal in cross section with hooks situated on ridge like elevated tori. Branchia not distinct; a median anal cirrus.

Distribution : Chilka Lake, Visakhapatnam coast and Godavari estuary.

***Barantolla sculpta* Southern, 1921**

1921. *Barantolla sculpta* Southern, *Mem. Ind. Mus.* V (8) : 643.
 1932. *Barantolla sculpta* Fauvel, *Mem. Ind. Mus.* XII(1) : 196.

Material : 3 ex. Rambha, 4 exs. Barkul, 1 ex. Gorapur;
 1985 Q10 (2), 1987 P10(1).

Description : Long and Stout worms reaching 4-5 cm. Body divided into a stout thorax of 11 setigers and long abdomen of several segments; thoracic region cylindrical and its surface tessellated while abdomen is tetragonal in cross section. Prostomium pointed and peristomium achaetous; First six thoracic setigers with sharp capillaries on both rami and the remaining five with long hooks. Abdominal segments with smaller hooks arranged on long tori both dorsally and ventrally; Fine thread like dorsal branchia in the posterior region of the abdomen till the last segment. A single median anal cirrus.

Distribution : Saltwater Lake, Calcutta. Telehsap, Thailand.

Family MALDANIDAE Malmgren, 1867

***Axiothella obockensis* (Gravier 1906)**

1932. *Axiothella obockensis* Fauvel, *Mem. Ind. Mus.* XII (i) : 202.
 1953. *Axiothella obockensis* Fauvel, *Fauna of India* : 380.

Material : 1 ex. Arkhakuda; 1 ex. Parikud Island; 2 exs. Barakuda : 1986 VII (1).

Description : Slender worms reaching 2-3 cm. With a oval ceptalic plate notched at the anterior and posterior ends. All segments with dorsal capillaries and ventral stalked Uncini each with 4-5 teeth. No ventral acicular setae in the anterior feet. Two preanal segments without setae; Pygidium funnel shaped fringed with cirri of which the ventral one is long.

Distribution : Gulf of Mannar and Vellar estuary; Red Sea.

Euclymene annandalei Southern, 1921

1921. *Euclymene annandalei* Southern, *Mem. Ind. Mus.* V (8) : 648.
 1932. *Clymene (Euchlymene) annandalei* Fauvel, *Mem. Ind. Mus.* XII (1) : 199.
 1969. *Euchymene annandalei* Day, *Brit. Mus. Nat. Hist.* 641.

Material : 9 exs. Rambha, 1 ex. Barakuda;
 1985 B6(8), C2(12), D6(3), F8(4).

Description : Slender worms reaching 3-5 cm. with 21 setigerous segments and two anal segments without setae, Prostomium small with an oval cephalic plate having a central keel with nuchal groove. The cephalic plate is notched laterally and crenated posteriorly. Three anterior segments with dorsal capillaries and a single acicular hook ventrally. In the remaining segments the ventral acicular hook is replaced by several stalked uncini each with 4-5 teeth; Pygidium funnel shaped with cirri around, of which the ventro-median is long. Circular bands of pink and green colour in live specimens. Specimens enclosed in thin delicate tubes of fine sand.

Distribution : Chilka Lake, (South west) Vellar estuary and Andaman Nicobar Islands.

Family TERESELLIDAE Grube, 1851

Loimia medusa (Savigny, 1820)

1932. *Loimia medusa* Fauvel, *Mem. Ind. Mus.* XII (1) : 224.
 1953. *Loimia medusa* Fauvel, *Fau. India*, 416.

Material : 2 exs. Arkhakuda.

Description : Elongate specimens; one specimen of 22 cm. and the other 8 cm; Body divided into a stout thorax of 17 segments, and a long narrow abdomen. Several long filliform grooved tentacles with purple coloured bands and three pairs of arborescent gills; Thorax with dorsal capillaries and ventral pectinate uncini and abdomen with circular Uncinigerous Pinnules. Thorax with ventral glandular pads.

Distribution : Gangetic delta, Orissa Coast, Gulf of Mannar, Vellar estuary, Gujarat coast and Andaman and Nicobar Islands, South africa coast, Red Sea, English channel and West Indies.

Family SABELLIDAE Malmgren, 1867

Laonome indica Southern, 1921

1921. *Laonome indica* Southern, *Mem. Ind. Mus.* V (8) 652.
 1987. *Laonome indica* Srikrishna Das, et. al. *J. Mar. Bioc. Ass. India*, 29 (1 & 2) : 138.

Material : 1 ex. Satpara ;
 1985 C6(16), I12(6)
 1986 B2(3), B5(2), E7(1), G9(7), G12(1), H10(1), H11(5), K13(30), I10(1), M13(10),
 N9(1), N11(1),
 1987 B2(5), C3(1), C5(1), d6(1), D7(10), D8(1), E7(1), H11(1), I12(28), K13(1).

Description : Worms measuring 2-5 cm. Several long branchia arranged in two semi-circular lobes. Prostomial collar with two pointed lobes ventrally. Body divided into thorax of 5-9 segments and a long abdomen of many segments. Thoracic segments with dorsal capillaries and short spatulate setae; ventral uncini arranged in a single rows. Abdomen with dorsal uncini and ventral capillary setae. Specimens enclosed in thin tubes of mud.

Distribution : Chilka Lake and Vellar estuary.

Family AMPHARETIDAE Malmgren, 1867

Amage bioculata (Moore, 1906)

1932. *Amage bioculata* Fauvel, *Mem. Ind. Mus.* XII (1) : 218.

Material : 3 ex. Satpara.

Description : Very small specimens of about 8-10 mm. Prostomium with several smooth buccal tentacles and 4 pairs of subulate gills which are easily detachable. Eyes spots not seen clearly. Body divided into thorax of 11-12 segments and abdomen of about 20 segments. Thoracic feet with dorsal capillaries and ventral uncini arranged in pinnules. Abdomen with only uncini. Anal cirri absent.

Distribution : Orissa coast, India. North Pacific Ocean.

ECOLOGY AND DISTRIBUTION

Considering the salinity of the waters during the year and the type of bottom sediment., Chilka Lake can be divided broadly into three regions viz. Mouth-Channel, Southern Brackish and Northern freshwater region.

Mouth-channel region : due to its closeness to the sea, significant tidal influence is prevelant and nearly sea water conditions exist in this region during round the year except flood season. The bottom sediment is highly sandy with very less quantities of silt and clay. This region is inhabited by polychaetes

of Marine nature which are highly euryhaline viz. *N. reducata*, *N. glandicineta*, *P. nigropunctata*, *N. persica*, *N. oligobranchia*, *N. polybranchia*, *D. neapolitana*, *M. fallax*, *S. marsupialis*, *L. medusa*, *A. obockensis*, *A. bioculata* and *N. latericeus*.

Southern Brackish region : This is a closed bay like region, comprising the Lake broadly South of Balugaon. In this region the influence of the sea water due to tides is less as the mouth is far away. Further freshwater inflows into this region is also not high as no major rivers opens into this region except through land drainage during rainy season. Moderate salinities of the range 6-20‰ are noticed in this region during the year. The bottom sediment/substrata is an admixture of sand and silt at many places or rocky as many hills surround and intrude into this region at many places. Polychaetes of Brackish water nature which prefers moderate salinity are abundant in this region, viz. *A. constricta*, *O. angustifrons*, *N. indica*, *N. chilkaensis*, *G. oligoden*, *L. polydesma*, *L. simplex*, *M. gravelyi*, *M. mossambica*, *P. cirrifera*, *L. indica*, *E. annandalei*, *B. sculpta*, *C. capitata*, *H. similis* and *A. fauveli*.

Northern Freshwater region : This is roughly north of Balugaon and west of Satpara. Vast areas in its margins are reclaimed for paddy cultivation. Further large patches of aquatic vegetation is noticed in this region. Water in this region is of Freshwater nature as rivers viz. Daya, Nuna and Bhargavi opens into this region and discharge large volumes of flood waters specially during monsoon. Waters in this region are highly turbid with much suspended materials. The influence of sea water into this region is restricted by the shallow regions around Satpara. The bottom sediment is highly muddy with sandy patches near the river mouths. Very low salinity is found in this region (0-17 ppt.) This region is inhabited by very few polychaetes and only two species i.e. *N. fauveli* and *P. armata* are collected in this region.

The division of the lake into the above three region is done broadly on the quality of water, bottom sediment, seawater inflow and aquatic vegetation etc. during the year. However the boundaries of these regions are highly dynamic due to seasonal effects like rainfall and floods etc. The categorisation of polychaetes of the lake into marine, brackish and of freshwater nature is based on their abundance of occurrence at their respective regions. It is not very uncommon to find polychaetes of marine nature occurring in brackish-water zone or brackish forms in marine or freshwater zone for sometime as suitable conditions exist for sufficient time for settling them in those regions temporarily due to seasonal changes in salinity.

SUMMARY

Southern (1921) reported 20 species of polychaetes, all as new species from Chilka Lake. *Perineris majorii* and *Diopatra variabilis* described by him were synonymised by Fauvel (1932) as *P. nigropunctata* and *D. neapolitana*. In the present studies *Tylonereis fauveli*, *Dendronereis aestuarina*, *Dendronereides heteropoda*, *Polydora hornelli*, *Myriochele picta*, *Sternaspis scutata* and *Fabricia spongicola* (1921) could not be collected. However *O. angustifrons*, *N. indica*, *N. fauveli*, *N. glandicineta*, *N. persica*, *M. mossambica*, *M. fallax*, *P. cirrifera*, *A. fauveli*, *C. capitata*, *P. armata*, *N. latericeus*, *B. sculpta*, *A. obockensis*, *E. annandalei*, *L. medusa* & *A. bioculata*, a total of 18 species are reported from this studies which were not reported earlier from this region and all these are new locality records from Chilka Lake. Occurrence in large numbers of *Aricidea fauveli* in the southern part of the lake is noteworthy as this species is reported first time from Indian waters.

ACKNOWLEDGEMENTS

Thanks are due to the Director, Zoological Survey of India, Calcutta for permitting me to participate in the Chilka expedition and assigning me the studies on the polychaetes. Thanks are also due to Dr. K. V. Rama Rao, Scientist 'SE' under whose leadership the surveys to the lake were conducted and for his untiring efforts for collection of samples from as many stations as possible which ultimately resulted in collecting large numbers of polychaete examples. Acknowledgements are due to Dr. Chris Glasby of the Australian museum, Sydney, for the help in the identification of some Nereids. Thanks are also due to the Officer in-charge, E.B.S., Z.S.I. Berhampur for the facilities provided during the preparation of this paper.

REFERENCES

- Balasubramanyan, K. 1964. Studies on the ecology of the Vellar estuary, 3. Inter tidal and estuarine polychaetes. *J. Anamalai Uni.*, 25 : 101-103.
- Day, J. H. 1967. A monograph on the polychaeta of South Africa. Part I & II. *Brit. Mus. (Nat. Hist.) London*, 878 pp.
- Fauvel, P. 1932. Annelida, Polychaeta of the Indian Museum, *Mem. Ind. Mus.* XII (1) : 1-262.
- Fauvel, P. 1953. The Fauna of India, Annelida, Polychaeta.
- Hartman, O. 1969. Catalogue of the polychaetous annelids of the world. Part I & II. *Occ. Papers. Allan Hancock. Foundation publications.*, 23 : 1-628.
- Julka, J. M. & Rao, C.A.N. 1976. On a collection of polychaetes from Mahanadi estuary. *Newl. Zool. Surv. India*, II (2) : 52-53.
- Misra, A., Soota, T.D. & Chowdhury, A. 1983. On some polychaetes from Gangetic delta, West Bengal, India. *Rec. Zool. Surv. India*, 81 : 41-54.
- Nageswara Rao, C.A. 1981. On two new polychaetes (Nereidae : Annelida) from the estuarine waters of India. *Bull. Zool. Surv. India.*, III (3) : 213-217.
- Radhakrishna, Y. 1963. The systematics and ecology of the bottom fauna of the Godavari estuary, Andhra Pradesh. *Thesis submitted to Andhra University for the award of D. Sc. Degree, Waltair.*
- Southern, R. 1921. Polychaetes of the Chilka Lake and also fresh and brackish waters in other parts of India. *Mem. Ind. Mus.*, V (8) : 563-655.
- J. Srikrishna Das, B. Rama Moorthy, K. & Balasubramanian, K. 1987. Polychaetes of Portonoro waters. *mar. biol. Ass. India.*, 29 (1 & 2) : 134-139.
- Srinivasa Rao, D. & Rama Sarma, D. V. 1982. New Polychaete records from Indian waters. *J. Bombay nat. Hist. Soc.*, 79 (2) : 446-450.

CRUSTACEA: STOMATOPODA

H.C. GHOSH

Zoological Survey of India, Calcutta

INTRODUCTION

Kemp (1915) reported three species of stomatopods : *Squilla scorpio* (= *cloridopsis scorpio*) by ten specimens; *Squilla scorpio* var. *immaculata* (= *Cloridopsis immaculate*) by several specimens from the lake proper and *Squilla interrupta* (= *Oratosquilla interrupta*) by a single specimen from the outer channel of the lake.

After a gap of over 75 years, the Zoological Survey of India undertook an intensive survey of the Lake during 1985-87. A study of the stomatopod material collected during these surveys revealed only two species : *Cloridopsis immaculata* and *Oratosquilla interrupta*. The disappearance of *Cloridopsis scorpio* and reappearance of *Oratosquilla interrupta* around the outer channel are interesting and the probable reasons for the same are discussed under the column for discussion.

A brief taxonomic account of three species so far reported from the Lake are provided together with important figures and key for identification. A grid map showing pattern of distribution and a table with collection data and important body measurements are also provided.

SYSTEMATIC ACCOUNT

Order : STOMATOPODA

Family : SQUILLIDAE

Squillidae is the sole family represented in the Chilka Lake by three species under two genera as keyed below :

Key to genera and species of Stomatopoda

- Lateral processes of 5th, 6th and 7th thoracic somites single loded *Cloridopsis*
 Lateral process of 5th thoracic somite without a large black spot *C. immaculata*
 Lateral process of 5th thoracic somite with a large black spot *C. scorpio*
 Lateral processes of 5th, 6th and 7th thoracic somites bilobed *Oratosquilla*
 Median carina of carapace interrupted at base of bifurcation. Lobe on outer margin of inner spine of basal prolongation of uropod rounded, margin convex *O. interrupta*

Cloridopsis immaculata (Kemp)

1913. *Squilla scorpio* var. *immaculata* Kemp, *Mem. Indian Mus.*, 4:45, Pl. 2, fig. 31.

1986. *Cloridopsis immaculata* ; Mannig, *Bull. Mar. Sci. Gulf and Carib.*, 18:128.

Material examined : 21(M) (TL 40.00 to 81.00 mm) and 9(F) (TL 48.5 to 73.5mm). Collected from the Lake proper and the outer channel during 1985 (November), 1986 (June) and 1987 (September) by the Zoological Survey of India.

Diagnosis : Eyes small, cornea bilobed and set obliquely on stalk. Rostral plate almost as long as broad, narrowed anteriorly, median carina present on anterior half and apex broadly rounded. Carapace narrowed anteriorly, width little less than half of medium length, anterolateral spines strong, each spine with a rounded ventral lobe, median carina straight and laterals poorly marked. Dactylus of raptorial claw with 5-teeth, outer margin sinuous, with a shallow proximal notch, dorsal ridge of carpus undivided. Lateral process of 5th thoracic somite broad and produced into an anteriorly directed spine. Lateral process of 6th and 7th thoracic somites posterolaterally rounded. Abdominal carinae spined as follows : Submedian 6, intermediate 5-6, lateral 5-6, marginal 1-5. Telson almost as long as broad, three pairs of marginal teeth present; telson denticles : 2-4,4-6, 1. Outer margin of uropodal exopod with 6 movable spines. Lobe on outer margin of inner spine of basal prolongation of uropod large and rounded.

Colour : Colour markings in the female specimens inconspicuous. The males exhibit colour markings as follows: the 1st and 2nd abdominal segments each with a small and dark transverse band on the posteromedian margin. 3rd, 4th and 5th abdominal segments bear a minute dark spot medially. A dark patch is also present on the distal margin of uropodal exopod.

Distribution: India: West Bengal and Orissa. Elsewhere : Karachi, Arabian coast, Singapore and Thailand.

Remarks: *C. immaculata* is the only predominant species of stomatopod in the Chilka Lake and are very common in the brackish waters of West Bengal and Orissa. A few specimens were found attached with molluscan bivalves- *Modiolus undolatus* (Dunken) on the telson, sides of carapace and under the abdomen. The males differ in total length from 40.0-80.0 mm and the corneal index from 428-740. For other measurements and ecological data see table the grid map.

Cloridopsis scorpio (Latreille)

1825. *Squilla scorpio* Latreille, *Encyel. Method.* 10:472.

1913. *Squilla scorpio* : Kemp, *Mem. Indian Mus.* 4:42, pl. 2, fig. 30.

1968. *Cloridopsis scorpio* : Manning, *Bull. Mar. Sci. Gulf and Carib.* 18:128.10

Material examined : 2(M) (TL 75.0-82.0 mm) and 1(F) (TL 86.0 mm); Chilka Lake, 30.7.1915; Reg. No. 9243-45/10.

Diagnosis : Rostral plate is narrower and the apex truncated. Lateral process of 5th thoracic somite bears a permanent black patch. Outer margin of uropodal exopod with 7-movable spines. Transverse band on the posteromedian margin of 1st abdominal segment absent.

Distribution: India : Maharashtra, Tamil Nadu, Orissa and West Bengal. Elsewhere : scattered localities in the Indo-West Pacific region.

Remarks : *Cloridopsis scorpio* is also a brackish water species but by the number of specimens so far reported appears to be scarce in Indian Waters. Kemp (1915) reported two male and eight females from the Chilka Lake. No fresh material of *C. scorpio* could be collected during the present survey of 1985-87. Neither Kemp's (1915) material were available for study. The material of *C. scorpio* studied and reported here were collected by an unknown person in 1915. The probable reasons for disappearance of *C. scorpio* from this Lake are discussed under the column discussion. Corneal index varies from 652-759.

Oratosquilla interrupta (Kemp)

1913. *Squilla interrupta* Kemp, *Mem. Indian Mus.*, 4:72, pl. 5, figs. 60-62.

1968. *Oratosquilla interrupta* : Manning, *Bull. Mar. Sci. Gulf and Carib.*, 18:135.

Material examined : 6(M) (TL 84.5-91.6 mm) and 5(F) (TL 75.0-89.8 mm); Satpara, Chilka Lake, Puri District, K.N. Reddy, 28-6. 1986.

Diagnosis : Eyes large, cornea bilobed and set obliquely on stale, Rostral plate subquadrate, apex truncate and lateral margins upturned. Arms of anterior bifurcation of carapace distinct but interrupted at

base of bifurcation. Dactylus of raptorial claw with six teeth; dorsal ridge of carpus of claw with two tubercles. Lateral processes of 5th to 7th thoracic somites bilobed, anterior lobe of 5th produced into an anteriorly directed spine. Abdominal carinae spined as follows : submedian 5-6, intermediate 3-6, lateral 3-6, marginal 1-5. Telson slightly broader than long, denticles rounded -3, 6-8, 1. Uropodal exopod with nine movable spines on outer margin. Lobe on outer margin of inner spine of basal prolongation of uropod rounded, outer margin convex.

Distribution : India : Maharashtra, Tamil Nadu, Andhra Pradesh, Orissa and West Bengal. Elsewhere : Scattered localities in the Indo-West Pacific region.

Remarks : Presence of two tubercles on the dorsal ridge of carpus of raptorial claw and interruption at the base of anterior bifurcation of median carina of carapace will distinguish *Oratosquilla interrupta* from all other members of genus. Unlike *Cloridopsis immaculata* and *C. scorio*, *O. interrupta* is a purely marine form and occurs in good numbers along the east and west coast of India. In the Chilka Lake, this species occurs only in the high salinity zone of the outer channel. The males range in total length from 84.5-91.5 mm and females from 75.5-93.8 mm. Corneal index varies from 465-560. For other measurements, see table.

DISCUSSION

A modest comparison of Kemp's (1915) findings on the material of stomatopods and ecological conditions of the Chilka Lake with the present findings shows some interesting developments. Over the years the ecology of the Lake has undergone significant changes including (1) raising of the Lake bed by about a meter due to continuous siltation, (2) unabated growth and decomposition of weeds causing the water to stagnate at several pockets and turning it foul. These factors have brought down the salinity level of the water to bare minimum turning the lake almost into a fresh water body. Consequent to these changed ecological conditions, the faunal contents also changed.

Kemp (1915) reported 10 adult specimens of *Cloridopsis scorio* from the Lake proper and its outer channel. During the present survey spreading over three years not a single specimen of *Cloridopsis scorio* was detected. The shallowness and low salinity of water might be the main reason for its disappearance from the Lake.

Kemp (1915) also reported several adult and larval forms of *Cloridopsis immaculata* from all over the Lake. During the present survey, 30 adult individuals of the same were collected from maximum number of stations (see grid map). This shows that *Cloridopsis immaculata* is the only stomatopod which had adapted itself to the changed ecological conditions of the Lake and adapted to thrive almost in freshwater condition.

Kemp (1915) did not come across a single specimen of *Oratosquilla interrupta* in the Lake but had reported one from the outer channel by a previous survey and opined that this was a case of casual immigration and that the species does not belong to the lake system. During the present survey also, no specimen of *Oratosquilla interrupta* were encountered from the Lake proper and only once 11 adult

specimens were collected from fishermen at Satpara who had caught them with fishhaul near the outer channel. This indicates that *Oratosquilla interrupta*, a purely marine form, does not enter the Lake proper but frequent the outer channel where depth and salinity labels are much higher.

ACKNOWLEDGEMENTS

The author is thankful to Dr. K. Rai, Ex-Scientist 'SE', who had helped the author to participate in one of the trips to Chilka in 1987 and to Dr. K.V. Rama Rao, Scientist 'SF' and leader of the Chilka Lake Survey for his continuous encouragements and guidance in the field.

REFERENCES

- Kemp, S. 1913. An account of the Crustacea Stomatopoda of the Indo-Pacific region based on the collection in the Indian Museum. *Mem. Indian Mus.*, 4:1-127.
- Kemp, S. 1915. Fauna of Chilka Lake. Stomatopoda. *Mem. Indian Mus.*, 5: 191-197.
- Manning, R.B.1968. A revision of the family Squillidae (Crustacea: Stomatopoda) with description of eight new genera. *Bull. Mar. Sci. Gulf and Carib*, 18:105-142.

AVAILABLE ECOLOGICAL DATA AND MEASUREMENTS OF IMPORTANT
BODY PARTS OF STOMATOPOD CRUSTACEA OF CHILKA LAKE, ORISSA

Cloridopsis immaculata

DATE	GRID	DEPTH	SALINITY	SEX	TL	APL	CW	RPL	RPW	CAL	CAW	CL/CW	TL/W	TL/L	TLW/TLL	CL
23-11-85	B ₄	1.77	10.2/10.2	(M)	61.0	11.5	2.2	2.0	2.2	12.8	10.0	1.94	12.2	11.5	1.06	536
24-11-85	C ₄	3.25	7.4/7.0	(F)	48.5	9.5	1.7	1.8	1.8	10.0	8.0	2.0	9.0	8.0	1.25	588
															1.17	525
25-11-85	C ₅	3.0	7.0/7.2	(M)	57.5	12.2	2.0	1.8	2.0	10.5	8.5	1.87	10.0	8.5		
27-11-85	F ₈	1.5	7.4/7.8	(M)	45.0	8.5	1.8	1.5	1.5	10.6	7.5	1.33	8.5	7.5	1.13	555
29-11-85	F ₉	2.75	8.6/8.2	(M)	70.5	12.5	2.2	2.0	2.0	14.0	11.2	1.25	13.5	13.0	1.03	636
29-11-85	F ₉	2.75	8.6/8.2	(F)	57.0	7.0	2.0	1.8	1.5	9.0	7.3	1.23	11.2	10.0	1.12	450
29-11-85	F ₉	2.75	8.6/8.2	(F)	59.0	10.5	1.5	1.5	1.5	12.5	10.0	1.25	11.2	10.5	1.06	833
29-11-85	F ₉	2.75	8.6/8.2	(F)	58.5	11.0	2.0	1.5	1.5	12.0	9.0	1.33	11.0	10.5	1.04	600
11-06-86	B ₂	1.7	6.2/6.3	(M)	70.0	12.5	2.6	2.5	2.2	14.5	11.2	1.29	15.0	14.0	1.07	557
11-06-86	D ₂	0.6	12.5/11.5	(M)	68.5	11.0	2.4	2.5	2.3	15.0	8.0	1.75	14.0	12.8	1.49	625
13-06-86	B ₅	2.0	5.7/8.7	(M)	74.0	13.5	2.5	2.5	2.3	11.0	7.5	1.46	15.6	14.2	1.09	440
13-06-86	B ₅	2.0	5.7/8.7	(M)	75.0	14.5	2.5	2.6	2.2	16.5	8.0	2.06	15.0	15.5	1.03	660
13-06-86	B ₅	2.0	5.7/8.7	(M)	78.0	14.5	2.5	2.8	2.5	18.5	8.5	2.17	15.0	15.0	1.00	740
13-06-86	C ₄	1.9	5.9/6.2	(M)	80.0	13.4	2.5	2.7	2.5	13.5	13.0	1.03	16.0	15.0	1.06	540
16-06-86	B ₆	2.4	6.3/6.3	(M)	63.5	13.2	2.3	2.6	2.5	14.5	9.5	1.52	13.5	13.5	1.00	630
16-06-86	C ₆	2.9	6.3/6.3	(F)	55.5	10.0	2.5	2.0	1.5	12.0	5.5	2.18	11.5	10.0	11.5	480
16-06-86	C ₆	2.9	6.3/6.3	(M)	74.0	15.5	2.5	2.5	2.2	16.5	8.8	19.4	15.5	15.0	1.03	660
16-06-86	C ₆	2.9	6.3/6.3	(M)	76.0	10.0	2.5	2.0	2.5	16.8	8.5	1.97	15.5	15.0	1.23	672
17-06-86	E ₇	2.4	4.0/6.3	(M)	81.0	13.5	2.5	3.0	3.0	16.5	8.5	1.94	15.0	15.0	1.00	660

DATE	ST.	DEPTH	SALINITY S/B	SEX	TL	APL	CW	RPL	RPW	CAL	CAW	CL/CW	TLW	TLL	TLW/TLL	CL
17-06-86	E ₇	2.4	4.0/6.3	(M)	73.5	12.0	3.5	4.0	4.0	15.0	7.5	2.00	14.5	13.5	1.07	428
17-06-86	F ₈	1.7	6.4/6.6	(M)	76.0	12.5	2.5	2.8	2.5	16.8	8.5	1.97	16.8	16.00	1.05	672
17-06-86	F ₈	1.7	6.4/6.6	(M)	77.0	15.6	2.8	2.7	2.5	17.0	8.5	2.00	15.5	14.5	1.06	607
18-06-86	G ₉	1.9	6.5/6.7	(M)	56.0	9.0	2.2	2.1	1.8	12.5	5.0	2.50	11.5	10.5	1.09	568
18-06-86	D ₈	2.1	6.1/5.6	(M)	56.5	11.0	2.0	2.0	1.8	12.2	9.5	1.28	11.5	10.5	1.09	610
18-06-86	D ₈	2.1	6.1/5.6	(M)	56.0	8.5	2.2	1.8	1.8	12.5	10.0	1.25	11.0	10.0	1.10	568
19-06-86	H ₁₀	1.9	6.6/6.2	(M)	67.5	13.5	3.0	3.0	2.5	14.0	10.0	1.40	13.0	12.6	1.03	466
24-06-86	N ₁₄	1.4	6.4/6.5	(M)	71.5	12.5	2.5	2.6	2.5	17.0	8.0	2.12	13.5	13.4	1.00	680
04-09-87	A ₂	2.2	6.2/6.4	(M)	17.0	10.0	2.0	1.8	2.2	13.2	10.5	1.25	12.0	11.5	1.04	660
04-09-87	B ₁	2.0	6.2/7.7	(M)	14.0	8.0	1.5	1.4	1.4	8.5	6.5	1.30	7.0	6.5	1.07	566
26-09-87	Q ₁₃	1.1	6.8/7.5	(M)	74.0	12.5	2.5	1.5	2.0	15.5	11.5	1.34	14.5	13.5	1.07	620
Range :		0.6-3.0	<u>4.0-12.5</u> 5.6-11.5	(M) (F)	40.0-80.0 48.5-73.5	7.0-15.5	1.5-3.5	1.4-4.0	1.4-4.0	8.5-17.0	5.0-11.5	1.03-2.17	7.0-16.8	6.5-16.0	1.03-1.49	428-740

Cloridopsis scorpio

30-07-15				(M)	75.5	11.2	2.3	2.8	2.2	15.0	7.0	2.14	15.0	12.2	1.22	652
30-07-15				(M)	82.0	13.5	2.3	2.7	2.2	15.8	8.5	1.85	15.7	13.1	1.19	687
30-07-15				(F)	86.0	12.2	2.2	3.5	2.5	16.7	8.0	2.08	15.5	12.5	1.24	759
Range :				(M) (F)	75.0-82.0 86.0	11.2-13.5	2.2-2.3	2.7-3.5	2.2-2.5	15.0-15.8	7.0-8.5	1.85-2.14	15.0-15.7	12.2-13.1	1.19-1.24	552-759

DATE	SEX	TL	APL	CW	RPL	RPW	CAL	CAW	CL/CW	TLW	TLL	TLW/TLL	CL
Oratosquilla interrupta													
28-06-86	(M)	84.5	15.0	3.4	2.7	2.5	15.8	8.8	1.79	15.1	14.5	1.04	465
28-06-86	(M)	84.7	15.5	3.5	2.8	2.5	17.1	9.5	1.78	16.2	15.0	1.08	488
28-06-86	(M)	88.2	14.5	3.8	3.8	3.5	18.0	9.8	1.85	17.0	16.0	1.06	479
28-06-86	(M)	90.2	16.5	4.0	3.7	3.5	18.5	10.0	1.85	17.5	15.1	1.15	462
28-06-86	(M)	91.5	17.2	3.5	3.0	2.7	19.6	10.1	1.94	16.8	15.2	1.10	560
28-06-86	(M)	91.6	15.7	3.4	3.3	2.5	18.6	10.0	1.86	16.9	15.5	1.03	547
28-06-86	(M)	75.5	13.8	3.0	2.3	2.1	15.8	7.5	2.10	13.6	13.2	1.03	527
28-06-86	(M)	83.2	13.8	3.5	2.8	2.5	17.8	8.7	2.04	16.8	16.5	1.01	508
28-06-86	(M)	85.0	14.9	3.4	2.7	2.4	17.5	8.8	1.98	15.2	15.0	1.01	515
28-06-86	(M)	90.0	15.9	3.5	2.8	2.5	19.0	9.0	2.11	18.3	17.0	1.07	543
28-06-86	(M)	93.8	16.8	3.8	3.1	2.7	18.4	9.4	1.95	17.0	15.6	1.08	484
	(M)	84.5-91.5	13.8-17.2	3.0-3.8	2.3-3.8	2.1-3.5	15.8-19.6	7.5-9.8	1.78-2.10	13.6-18.3	13.2-17.0	1.01-1.10	465-560
	(F)	75.5-93.8											

- TL = Total length;
- APL = Antennular peduncle length;
- RPL = Raptorial Propodus length;
- CAL = Carapace length;
- TLL = Telson length;
- CI = Corneal Index
- CW = Corneal Width;
- RPW = Raptorial Propodus width;
- CAW = Carapace width;
- TLW = Telson width;
- CL = Carapace length

CRUSTACEA : BRACHYURA

MAYA DEB

Zoological Survey of India, Calcutta

INTRODUCTION

The earliest record of the few crabs of Chilka Lake and coastal areas of Orissa made by Alcock in his carcinological Fauna of India (1894-1910) series. Afterwards Kemp (1915) dealt thoroughly with crab fauna of Chilka Lake and reported 26 spp. five species out of these 26 spp. were described by Kemp as new. After that no attempt was made to study Chilka Lake Crustaceans by the Z.S.I. staff till 1985. Three surveys (1985-1987) were undertaken and a large amount of 100 exs. of crabs were collected for study.

The present collection yielded no new species but for two new records only. A total 28 species distributed under 22 genera 9 families from Chilka.

LIST OF CRABS FROM CHILKA LAKE

Family MAJIDAE Samouelle

Doclea hybrida (Fabr.)

Family CALAPPIDAE Dana 1852

Matuta planipes Fabr.

Family LEUCOSIIDAE Dana 1852

Ebalia malefactorix Kemp,

Philyra alcocki Kemp

Family HYMENOSOMATIDAE Macleay

Elamina (Trigonoplax) cimex Kemp

Family OCYPODIDAE Ortmann 1894

Ocypoda ceratophthalma (Pallas)

Ocypoda macrocera M. Edw.

Ocypoda platytarsis M. Edw.

Uca annulipes (Latr.)

Dotilla pertinax Kemp

Dotilla intermedia de Man

Dotilla myctiroides, M. Edw.

Macrophthalmus gastrodes Kemp.

Camptandrium sexdentatum Stimpson

Leipocten sardidulum Kemp

Family GRAPSIDAE Dana 1852

Pachygrapsus propinquus de Man

Varuna litterata (Fabr.)

Ptychognathus onyx Alcock

Sesarma plicatum (Latr.)

Sesarma tetragonum (Fabr.)

Sesarma batavicum Moreina

Plagusia depressa tuberculata Lamarck

Metopograpsus messor (Forsk.)

Family GECARCINIDAE Dana 1852.

Cardiosoma carnifex (Herbst)

Family XANTHIDAE

Heteropanope indica de Man

Family PORTUNIDAE

Portunus pelagicus (Linn.)

Scylla serrata (Forsk.)

Thalamita crenata (Latr.)

Family MAJIDAE Samouelle

1819. *Majidea* Samouella, *Entom. Campen.* P. 88
 1880. *Majidae* Richters : 141.
 1895. *Majidae* Alcock, *J. Ann. Soc. Bengal*, **64** : 160.
 1976. *Majidae*, Sakai, Crabs of Japan & adjacent seas : 153.

1. Genus *Doclea* Leach

1814. *Doclea* Leach, *Zool. Miscell.*, **11** : 41.
 1895. *Doclea* Alcock, *lit. cit.*, **64** : 225, Sakai 1976 : 230.

Doclea hybrida (Fabr.)

1798. *Inachus hybridus*, Fabricius, *Entom. Syst. Supplement* : 355
 1834. *Doclea hybrida* H. Milne Edwards, *Hist. Nat. Crust.*, **XI** : 99 Alcock 1895, *lit cit* : 231.

Material examined : One female from Chilka Lake, Coll. K. N. Reddy in 1985.

Diagnosis : Subglobular carapace, body and appendages covered with short valvety hairs except the hands and dactyli of legs. Rostrum very short, bifid. Antero-lateral sides of carapace armed with four short spines besides two denticles at outer angle of buccal cavity and at the basal antennal joint. Mid dorsal line of carapace have a line of 5 tubercles, the last one on posterior border. Between the median and lateral rows of tubercles on either branchial region there are two large tubercles, one behind the other. Each tubercle present at the centre of each region.

Chelipeds as long as the carapace and rostrum, palms enlarged, second pair of legs very long. Female abdomen four jointed but 7 distinct joints in males.

Distribution : Chilka Lake; Andamans.

Remarks : Small ball like, valvety, hairy crab with very long appendages at once separates *Doclea* specimens from others. Specimens of *Doclea muricata* (Herbst) are very near to the present species and perhaps the young stage of *hybrida* doubted by Alcock.

Family CALAPPIDAE Dana

1852. *Calappidae* and *Matutidae*, Dana : 393-394.
 1896. *Calappidae* Alcock : 137 ; Sakai 1976 : 126.

Carapace oval, elongate, convex, thick or thin, subcircular slightly convex. Either there is a single

dent or a stout spine present at the junction of the antero-lateral and postero-lateral sides or a postero-lateral vault like expansion present over the walking legs (*Calappa*). Front as wide as the orbit. Chelipeds very stout, symmetrical. Hands very enlarged in *Calappa*.

Adult male abdomen 5 jointed, 3rd, 4th and 5th joints fused together but 7 separate joints in young males and females.

2. Genus *Matuta* Weber

Matuta Weber 1795, Nomen. Entom. P. 92; Alcock 1896 : 153; Sakai 1976 : 139.

Carapace subcircular, large, thin with a stout, long spine present at the junction of antero-lateral and posterolateral sides. Walking legs flattened for swimming.

Matuta planipes Fabricius

1798. *Matuta planipes* Fabricius, *Entom. Syst. Suppl.*, : 369.

1896. *Matuta victor*, Alcock, *J. Asiat. Soc. Bengal*, **65** : 160.

1976. *Matuta planipes* Sakai, lit. cit. : 141.

Material : Seen several specimens from Chilka Lake, coll. K. N. Reddy in 1985.

Diagnosis : Carapace subcircular, slightly convex, postero lateral sides strongly convergent, with a 1/2 inch long very large horizontal epibranchial spine on either side. Carapace finely granular on epibranchial, post gastric and cardiac regions. Of the six, the anterior two tubercles on the middle of carapace are obsolete : in adults the other four tubercles also less prominent. Antero-lateral sides of carapace crenulate. The posterior and postero-lateral sides of carapace form a finely beaded slightly raised ridge which ends in rear of the lateral spine. Front distinctly bilobed. Chelipeds equal and symmetrical.

Distribution : Chilka Lake, Gangetic Delta, East to West Coast of India, Andamans. Tavoy, Penang, Australia and Japan.

Remarks : Freshly preserved specimens of *M. planipes* covered with minute red dots which are closely set.

Family LEUCOSIDAE Dana

1852. *Leucosidae* Dana, U.S. Expl. Exp. Crust. pt. 1 : 390.

1896. *Leucosidae* Alcock : 164.

1976. *Leucosidae* Sakai, lit. cit. : 67.

Key to the genera of Leucosidae

1. Small, flatish, circular crab; dorsal surface bounded by continuous beaded line at
 *Philyra*

Small, convex, subcircular or polygonal crab, no continuous beaded line bounded the dorsal surface
 *Ebalia*

Genus *Philyra* Leach

1817. *Philyra* Leach, *Zool. Miscell.*, III : 18
 1896. *Philyra*, Alcock, *J. Asia. Soc. Bengal*, 65 : 237
 1915. *Philyra*, Kemp, *Mem. India Mus.* 5 : 212.

Diagnosis : Carapace small, flatish, generally circular in shape. Front broad, low and epistome projecting below and beyond it. Dorsal surface of carapace usually bounded by a continuous beaded line. Orbits small, sunken. The branchial and hepatic regions of the carapace well defined by grooves and creases. Chelipeds stout, equal and long, Legs slender, shorter than the chelae. Abdomen of male 3 or 4 jointed, of the female four jointed.

Philyra alcocki Kemp.

1915. *Philyra alcocki* Kemp, lit cit., 5 : 212.

Material examined : 18 exs. of both males and females, coll. in 1985 by K. N. Reddy.

Diagnosis : Carapace subcircular to oblong, little longer (L - 12 mm W - 11 mm) than wide, convex in both the directions. The surface of the carapace thickly covered with microscopic granules and scattered pits. Front produced, narrow with one median triangular tooth; both the horizontal fronto orbital edge and posterior border of carapace 3 mm wide, Eyes and orbits very small. Side wall of hepatic region form an independent facet, bounded below by beaded ridge. Gastro-car-diac region of carapace separated from branchial region by shallow groove and three ill defined, separate rows of granules on branchial region. Chelipeds stouter and longer than long slender legs. Upper surface of arm of chela bears rows of granules. Male abdomen consists of 3 smooth moveable joints, the first joint fixed or fused and produced laterally.

Distribution : Chilka Lake, the type locality only.

Remarks : *P. alcocki* Kemp can be separated from other allied forms by its microscopically granular surface and by the presence of two oblique rows of granules on postero dorsal surface.

Genus *Ebalia* Leach

Ebalia malefactorix Kemp

1817. *Ebalia* Leach, *Zool. Miscell.*, III : 18
 1896. *Ebalia* Alcock, lit cit, 65 : 185
 1915. *Ebalia* Kemp, lit cit., 5 : 209.
 1915. *Ebalia malefactorix* Kemp, lit cit. 5 : 209.

Material examined : 20 exs. of both male and female (L - 9 mm, W - 8 mm, 8.5 mm)

Diagnosis : Carapace almost as long as broad, convex in both the directions, subcircular to polygonal in outline. A large separate facet present on the side wall of carapace at hepatic region. Postero-lateral sides of carapace very long, convergent and beaded. The horizontal front little concave medially. One broad median elevated granular ridge and two similar lateral ridges present on posterior half of carapace. Eyes and orbits small. Chelipeds much stouter and slightly longer than the very slender legs. Arm of chela covered with granules on its upper and lower surfaces. The outer, upper and inner surfaces of carpus and palm finely granular. Margins of the thoracic sternum including basal part of abdomen granular in both male and female.

Distribution : Chilka Lake, Ennur near Madras, Cochin, Ernakulam.

Remarks : Long postero lateral margin of male is tridentate; three tubercular, broad, elevated ridges of postero dorsal surface of carapace, its front, chelipeds etc. are unlike the other allied species.

Family HYMENOSOMATIDAE Macleay

1838. *Hymenosomidae* Macleay, *Smith, Illust. Zool. Africa Inst.* : 68.
1905. *Hymenosomatidae* Stabbing : 49; Sakai 1976 : 145.

Very small, thin leaf like crab, circular or triangular shape, smooth or hairy, regions undivided or divided, legs very long slender.

Genus *Elamena* Edw

1837. *Elamena* H. Milne Edwards, *Hist. Natur. Crust.* 11 : 33.
1900. *Elamena* Alcock, *lit. cit.*, 69 : 385.

Elamina (Trigonoplax) cimex Kemp

1915. *Elamina (Trigonoplax) cimex* Kemp, *Mem. Ind. Mus.*, 5 : 216.

Material examined : 6 exs. of male and female from outer channel of Chilka Lake coll. made from among the weeds in September 1914.

Diagnosis : Small, flat, thin, oblong, leaf like crab, broad posteriorly and much narrowed anteriorly. Rostrum flat blunt, finger like or tooth like process. Regions defined by shallow grooves, margins not upturned. Surface bare, smooth, largest female 7.9 mm. in length including front, little more than the width. Chelipeds in females less than half of the legs, males juvenile and chelipeds small. Leg joints very long, narrow. Dactylia long, curved, with hairs and 10-12 recurved spines among the hairs on their distal concave edge.

Distribution : So far known from Chilka Lake only.

Remarks : *E. (T.) cimex* differs from other allied species in having a simple rostrum not tridentate; absence of any teeth and upturned edge of carapace and in having long epistome and well-developed maxillipeds.

Family OCYPODIDAE Ortmann

1894. *Ocypodidae* Ortmann : 700, 741 ; Alcock 1900 : 283; Sakai 1976 : 597.

Amphibious, estuarine crabs of various size and shape, usually burrowing and commonly gregarious. Front narrow, orbits occupy the rest of the anterior border. Buccal cavity usually large and closed by external maxillipeds. Abdomen of male narrow.

Key to the genera of Ocypodidae

1. Large cubic crab, surface granular. Eyes large. Brush of hairs between the basis of legs present *Ocypode*
- Small cubic or broader or thinner quadrilateral or subcircular or hexagonal crab 2
2. Small cubic crab, surface and side walls of carapace grooved. Male abdomen with a brush of hairs on 4th joint merii of legs have membranous tympana *Dotilla*
- Not small cubic crab 3
3. Very broad, thick quadrilateral crab, one male cheliped very enlarged, other chela slender *Uca*
- Thin quadrilateral or circular or hexagonal crab 4
4. Carapace one and half times as broad as long quadrilateral, thin, chelae equal or so, eye stalks long *Macrophthalmus*
- Carapace subcircular or hexagonal in shape 5
5. Hexagonal shape, surface hairy, divided into granular elevated areas of various shape *Camptandrium*
- Small, subcircular, flatish crab, lateral sides arched, not markedly dentate *Leipoctan*

Genus *Dotilla* De Haan

1835. *Doto*; De Haan, *Fauna Japan. Crust.* : 24.
 1858. *Dotilla* Stimpson; *Proc. Ac. Nat. Sci.*, Philad. : 98.
 1919. *Dotilla* Kemp, lit. cit. 16 : 331.

Key to the species of *Dotilla*

1. Carapace as long as broad, thick; narrower anteriorly. Chelipeds 3-4 times as long as the crab and much longer than legs ***myctiroides***
- Carapace slightly broader than long quadrilateral in shape 2
2. Gastric, cardiac regions and lateral zigzag areolae on the carapace are very distinct ***intermedia***
- No gastric, cardiac areolae, lateral areolae straight not zigzag ***pertinax***

***Dotilla intermedia*, de Man**

1888. *Dotilla intermedia* de Man, *J. Linn. Soc. Zool.* **22** : 135.
 1900. *Dotilla clepsydrodactylus* Alcock, *J. Asia. Soc. Bengal*, **69** : 3647
 1919. *Dotilla intermedia* Kemp, *Rec. Ind. Mus.* **16** : 331.

Material examined : 30 specimens from outer channel, Chilka Lake, coll. Chilka Survey dt. March 1914.

Diagnosis : Carapace broader than long, surface sculpture faint but distinct as 5 rayed star, one groove parallel to the posterior margin present. Merus of external maxilliped large with a sculpture of single loop of groove parallel with the outer border of merus, inner half of it quite smooth. Fingers more than twice as long as the palm. The dactylus of only last pair of leg long, in other legs little longer than the propodus.

Distribution : Chilka Lake, Chandipore, Orissa; Tamilnadu, Ennur near Madras. Tavoy, Burma and Megui Archipelago.

***Dotilla myctiroides* (Edw.)**

1852. *Doto myctiroides* Milne Edwards, *Ann. Sci. Nat. Zool.* **18** fig. 24.
 1919. *Dotilla myctiroides* Kemp. *Rec. Ind. Mus.*, **16** : 326.

Material examined : One example from outer channel of Chilka Lake, coll. Chilka Survey March 1914.

Diagnosis : Crabs little oblong, bare, thick, convex, faintly grooved dorsally, antero lateral parts granular. The sidewalls of crabs grooved anteriorly. Orbits shallow, oblique and almost obsolete. Merus of external maxillipeds very large, finely granular and a faint groove runs parallel with its outer border. Chelipeds 3-4 times as long as the carapace, fingers longer than the palm and no large teeth present on their cutting edges. Legs much shorter than chela, all the broad merii of legs with large tympanum and the last four thoracic sterna with large tympana.

Distribution : Chilka Lake, Orissa; Tamilnadu, Rameswaram, Tuticorin; Goa; Andamans. Singapore, Java and Scychelles.

Remarks : Large adults are very thick, oblong, convex; antero lateral sides convergent forward and the animals are unlike crab in appearance.

Dotilla pertinax Kemp

1915. *Dotilla pertinax* Kemp, *Mem. Ind. Mus.* V : 222

1919. *Dotilla pertinax*, Kemp *Rec. Ind. Mus.* 16 : 329.

Material examined : 20 specimens from outer channel of Chilka Lake coll. Chilka Survey, March - Oct. 1914.

Diagnosis : Carapace broader than long, surface grooved and areolated, grooves always smooth, areolae tubercular or hairy. Gastric and cardiac aerolae very distinct, two lateral areolae zigzag. Outer orbital corner spine like, acute. Outer surface of wrist and palm of chela and fingers closely covered with bubble like granules; on fingers; these granules arranged in ridges. Cutting edge of dactylus of male only, with a large thin teeth. Merii of legs with tympanum, sternal tympana absent. The distal end of 4th abdominal joint fringed with thick and long bristles.

Genus *Uca* Leach

1814. *Uca* Leach, *Edin. Ency.* 7 : 430 ; Sakai 1976 : 600.

1820. *Gelasimus* Latreille, *Dict. des sciences Nat.*, 18 : 286; Alcock 1900 : 350.

1976. *Uca* Sakai, lit. cit. : 600.

Subgenus *Celuca* Crane

1975. *Celuca* Crane : 290 : Sakai 1976 : 607.

Front $\frac{1}{5}$ $\frac{1}{6}$ of the greatest width of carapace. Outer surface of palm of major cheliped of the adult make smooth, not granular or rough.

Uca (Celuca) Lactea anulipes (Edw.)

1837. *Gelasimus anulipes* H. M. Edwards; *Hist. Nat. Crust.* 11 : 55.

1922. *Uca anulipes* Balss, *Arch. F. Naturq.*, 88 : 142.

1976. *Uca (Celuca) Lactea anulipes* Sakai, *Crabs of Japan & Adj. Seas* : 608.

Material examined : Several males and female from Chilka Lake, Coll. in March 1914.

Diagnosis : Carapace $\frac{3}{5}$ th as long as wide, much broader than long, deep, subquadrilateral in shape; regions not outlines; true lateral sides of carapace moderately convergent posteriorly. Front $\frac{1}{5}$ to $\frac{1}{6}$ th of width; antero lateral angles of carapace acute, claw like. Outer surface of large palm of male

cheliped smooth, two oblique granular ridges present on inner surface; one ridge continuous with the dentry edge of fixed finger and other running to the lower edge of same finger. One enlarged tooth near the tip of fixed finger gives it a notched, truncate appearance.

Distribution : Chilka Lake, East and West Coast of India. Singapore Mergui; Philippines; Hongkong; Madagascar and East Coast of Africa.

Genus *Macrophthalmus* Latreille

1829. *Macrophthalmus* Latreille : 44, Sakai

1976. *Macrophthalmus* Sakai : Lit. cit : 610.

Macrophthalmus gastrodes Kemp

1915. *Macrophthalmus gastrodes* Kemp, *Mem. Ind. Mus.* 5 : 228.

Material examined : One male and one female from outer channel of Chilka Lake in March and Sept. 1914, L 14.8 mm, W - 17.6 of male.

Diagnosis : Subquadrilateral, little broader posteriorly than the length. Strongly convex in both directions. Regions strongly outlined, convex areas granular while the grooves smooth. Front 1/6 of the width, straight or nearly so, deflexed downwards. Orbits long, oblique, wavy, outer orbital corner obtuse angular; behind it 3 shallow, crenulate teeth on antero lateral sides; postero lateral sides divergent. Outer maxillipeds leaves a wide gap between them when closed. Chelipeds and legs profusely hairy, outer side of palm smooth but for a line of hairs in the middle of palm in both sexes. At the base of dactylus one large molariform tooth present in male, not in narrow female finger of chela. Male thoracic sterna profusely granular.

Distribution : Chilka Lake, Bay of Bengal Coast of Orissa.

Remarks : The above mentioned characters distinguished the *M. gastrodes* from the apparently allied *M. serratus*, white and *M. definitus* white.

Genus *Camptandrium* Stimpson

1858. *Camptandrium* Stimpson, *Proc. Acad. Sci. Philadelphia*, X : 106.

1915. *Camptandrium* Kemp, *Mem. Ind. Mus.* 5 : 235; Sakai 1976 : 618

1976. *Camptandrium* Sakai, lit. cit. : 618.

Camptandrium sexdentatum Stimpson

1858. *Camptandrium sexdentatum* Stimpson, lit. cit. : 107.

1915. *Camptandrium sexdentatum* Kemp, lit. cit. : 236; Sakai 1976 : 618.

1976. *Camptandrium sexdentatum* Sakai lit. cit. : 618.

Material examined : 3 specimens from outer channel of Chilka in Sept. 1914; L - 14.2 mm, W 15.6 mm.

Diagnosis : Carapace hexagonal, slightly convex, surface covered with short, stiff setae. Front 1/3 of width of carapace slightly concave in dorsal view. Anterior two third of carapace well divided into elevated symmetrical areas of tubercular or variable sizes which in turn covered with granules of minute sizes. Antero lateral sides of carapace 3 dentate. Postero lateral margin wavy, granular and double edged. Posterior margin granular and perfectly straight; forms 90° angle on either side. Supra orbital edge wavy; lower orbital border well developed and with a dent on its inner corner. Chelipeds narrow, weak and shorter than legs, fingers concave internally. Leg joints long, narrow, edges hairy. One sub terminal spinule present on the upper edge of merii of 2nd and 3rd pair of legs of young males ad absent in females.

Distribution : Outer channel, Chilka Lake; Ennur backwater near Madras. Thailand, Batavia, Hongkong, China, Korea and Japan.

Remarks : *C. sexdentatum* differs from the other known species of the genus *C. japonicum* in having 3 obtuse anterolateral teeth and slender legs.

Genus *Leipocten* Kemp.

1915. *Leipocten* Kemp. lit. cit. v : 243.

1976. *Leipocten* Sakai, lit. cit : 619.

12. *Leipocten sordidulum* Kemp

1915. *Leipocten sordidulum* Kemp, lit. cit. v : 244.

1976. *Leipocten sordidulum* Sakai, lit. cit. : 619

Material examined : Five females from outer channel. Opposite Manikpatna coll. in March, Dec. 1914. W 8 mm L 6 mm.

Diagnosis : Subquadrilateral in shape, antero lateral sides subparallel, little divergent posteriorly and then angularly bent and convergent. Surface slightly convex in both the directions, regional areolae faintly outlined. Under dense hairs small pearly granules and pits present, these granules variable in number and disposition. Some females more granular than other females and in males these granules absent except near the lateral margin. Some of these marginal, mid lateral granules and few above the base of legs, are prominent, large. In females these granules arranged to form one or two lobes or teeth. Front 1/3 of the width, slightly concave. In dorsal view, front straight. Supra orbital edge wavy, smooth or rough. lower orbital edge crenulate. True posterior border straight, as long as front. Chelipeds symmetrical; palms very large, bare in male and hairy, narrower in female; cutting edges of both the fingers bluntly dentate, only one large long dent present at the base of dactylus. Female palm narrow and bears 3-4 rows of large spines and hairs. Legs short, stout, upper edge of merii granular and its lower edge spinulate; carpus and propodus swollen, dactylus conical and gently curved. Male abdomen six jointed, (2nd & 3rd joint fused); narrower than 7 jointed female abdomen.

Distribution : Chilka Lake, Ennur backater near Madras; East coast of India. Formosa, Malay, Singapore and Queensland.

Remarks : The specimens are profusely hairy when denuded the above characters can be detectable.

Genus 11. *Ocypode* Weber

1795. *Ocypode* Weber, *Nom. Ent. Syst.* : 92.

1900. *Ocypoda* Alcock, lit. cit. : 343.

1976. *Ocypode* Sakai, lit. cit. : 598.

13. *Ocypode platytarsis* Edw.

1852. *Ocypoda platytarsis* H. M. Edwards, *Ann. Sci. Nat. Zool.* 18 : 141.

1900. *Ocypoda platytarsis* Alcock, lit. cit. 69 : 348.

Material examined : Many, from Chilka Lake, mouth of outer channel Manik Patna coll. in 914.

Diagnosis and Remarks : Length of carapace 4/5 of its width, quadrilateral, deep; just like *O. ceratophthalma* but differs in the following points. Surface of ischium of external maxillipeds quite smooth; the stridulating ridge on the inner surface of palm consists of granules, no hairs. No brushes of hairs present on the propodus of any of its legs. The dactyli of legs broadened and distinctly flattened dorso ventrally.

Distribution : Chilka Lake; East and West Coast of India. Sri Lanka.

14. *Ocypode macrocera* Edw.

1834. *Ocypoda macrocera* H. Milne Edwards, *Hist. Nat. Crust.* II : 49

1900. *Ocypoda macrocera* Alcock, *J. Asia Soc Bengal*, 69 : 347.

1986. *Ocypoda macrocera* Deb, Chakrab. & Choud. *J. Beng. Natn. Hist. Soc.* 5 : 57.

Material examined : Five males and two females from Chilka Lake Coll. on 18.12.87; Width - 27 mm, Length - 21 mm, Front - 3.5 mm.

Diagnosis : Carapace square, deep, strongly convex from before backwards and moderately so from side to side. Surface covered uniformly with bubble like small granules. Gastric and cardiac regions separated by grooves. Outer orbital corner prominent, right angular. Chelipeds markedly unequal, length of stridulating ridge on inner side of palm, more than half of the breadth of larger palm, this ridge consists of striae only, hairs scanty. Fingers of the smaller chelipeds broad, thin, tips also broad and blunt.

Distribution : From the Bay of Bengal coasts of India, Chilka Lake, Orissa.

Remarks : *O. macrocera* Edw. Specimens can be separated from its nearest allies in having broad and blunt finger tips of the smaller chelaeped.

15. *Ocypode ceratophthalma* (Pallas)

1772. *Cancer ceratophthalmus* Pallas, *Spicilegis zool.* IX : 83.
 1900. *Ocypoda ceratophthalma* Alcock, *J. Asia. Soc. Bengal*, 69 : 345.
 1986. *Ocypoda ceratophthalma* Chakraborty, Choudhury & Deb. *J. Bengal. Nat. Hist. Soc.*, 5 : 57.

Material examined : Large number of specimens from Chilka, Chandipur, Orissa, Sagar Is. and Digha coast. Width 40 mm, Length 35 mm.

Diagnosis : Carapace square and cubic; convex; surface elegantly and uniformly granular, outer orbital corner acuminate or right angular. The eye stalk prolonged beyond the eye in adult, into a long, blunt style. Chelipeds unequal, compressed, outer surface granular, rough, stridulating ridge on inner surface of hand more than half of height of palm. The propodus of first two pairs of legs profusely hairy on their anterior edge of adults only.

Distribution : Chilka Lake, Sagar Is. Lower Bengal; Chandipur, Orissa; Tamil Nadu, Tuticorin, Rameswaram; Gulf of Mannar; Nicobar Is.. Tropical Indo Pacific from Japan, Hawaii to New South Wales, Red Sea, East and South Africa.

Remarks : The stridulating ridge consists of thick strip of hairs and tubercles gradually becoming striae, which are finely regular and closely set like a comb. Palm of smaller hand compressed and fingers of both palms are pointed at tips. Profuse hairs on the first two pairs of legs may be absent in young.

VI. Family GRAPSIDAE Dana

1851. *Grapsidae* Dana, *Amer. J. Sci.*, (2) 12 : 287.
 1976. *Grapsidae*, Sakai, *Crabs of Japan & Adj. Seas* : 627.

Carapace usually quadrilateral in shape, lateral sides either straight or slightly arched. Front board and orbits occupy the antero-lateral angles. Buccal cavity square shaped, covered by external maxillipeds, when closed these leaves a large rhomboidal gap in between them.

Key to the genera of Grapsidae

- A. Front very broad, deflexed downwards, carapace thick, quadrilateral or so; deep -
- a) An oblique hairy ridge on the exposed surface of external maxillipeds; square shaped crab, side walls and under surface with reticulate close clusters of hairs *Sesarma*
- b) No oblique hairy ridge on the external maxilliped present
- i) Antennae in the orbital hiatus *Pachygrapsus*
- ii) Antennae excluded out completely from the orbital hiatus *Metopograpsus*

- B. Front broad laminar but not deflexed downwards.
- a) Carapace subcircular, flat, with a distinct facet on postero-lateral side. Three terminal leg joints compressed, hairy, broad and flattened for swimming ***Varuna***
- b) Carapace flat, small, almost as broad as long, square type. Only the dactyli of legs compressed but not broadened ***Ptychognathus***
- C. Front not broad or deflexed but deeply cleft into four teeth, dorsal surface of crab covered with tubercles; legs, specially the merus very strong, long and with a subterminal spine on its anterior edge ***Plagusia***

Genus 12. *Metopograpsus* H. M. Edwards

1853. *Metopograpsus* H. Milne Edwards, *Ann. Sci. Nat.* **20** : 164.
1976. *Metopograpsus*, Sakai, lit. cit : 633.

16. *Metopograpsus messor* (Forsk.)

1775. *Cancer messor* Forskal, *Descrip. Anim. in itim Orient* : 28.
1900. *Metopograpsus messor*, Alcock lit. cit., **69** : 397.
1976. *Metopograpsus messor*, Sakai, lit. cit. : 633

Material examined : One male from Chilka Lake, Coll. in 1985 by K. N. Reddy.

Diagnosis : Carapace thick, quadrats, little broader than long, lateral sides distinctly convergent posteriorly. Regions not defined. Fine oblique markings present on the lateral epibranchial region; the single arched transverse groove on the middle of carapace very distinct and known as branchial groove. Beside the acute outer orbital angle no teeth present on lateral sides of carapace. Front board, more than half of maximum width of carapace free edge beaded. Orbits on antero external corners. Chelipeds stout, unequal, fingers stout with tips spooned. Merii of legs broad, compressed reticulate, spiny bristles present on the edges of carpus, propodus and the dactylus.

Distribution : Chilka Lake, east and west coast of India. Indo Pacific; from Red Sea; Arabian Sea; east coast of Africa to Japan and Hawaii.

Remarks : The single arched, deep transverse groove of the middle of carapace and broad front with beaded free frontal edge separates the *M. messor* from *M. maculatus*, the other known Indian species of the genus.

Genus 13. *Pachygrapsus* Randall

1839. *Pachygrapsus* Randall, *Proc. Acad. Nat. Sc. Phil.* : 126.
1976. *Pachygrapsus* Sakai, lit. cit. : 634.

17. *Pachygrapsus propinquus* de Man

1908. *Pachygrapsus propinquus* de Man, *Rec. Ind. Mus.*, 2 : 216.

1915. *Pachygrapsus propinquus* Kemp, *Mem. Ind. Mus.*, 5 : 231.

Material examined : Large number of specimens from outer channel of Chilka Lake, coll. in March 1914. Measurements Length 23 mm, Width - 28.8 mm.

Diagnosis : Subquadrilateral, convex crab, much broader than long; lateral sides without teeth and convergent posteriorly. Front more than half of width of carapace, slightly deflexed, free edge little concave. Regions of carapace faintly outlined. Anterior part of carapace, finely tubercular and these tubercles forms transverse granular ridges posteriorly.

Chelipeds slightly unequal in adult, identical; inner edge of arm with 3-4 blunt tubercles at the base and appear as dentate crest distally. Upper outer surfaces of chelipeds and merii of legs reticulate with transverse ridges. Merii very broad, the spines at lower distal edge of merii varies from 2-4 in number. Anterior edges of carpus and propodus thickly fringed with hairs, dactylus short, claw like and spiny.

Distribution : Port canning, Gangetic delta, Chilka Lake, Orissa and Ennur backwater near Madras.

Remarks : Presence of transverse granular hairy ridges on the carapace differentiate the species from its nearest allies.

Genus 14. *Ptychognathus*. Stimpson

1858. *Ptychognathus* Stimpson : 104; Alcock 1900 : 402.

1915. *Ptychognathus* Kemp, lit. cit. 5 : 234; Sakai 1976 : 638.

18. *Ptychognathus onyx* Alcock

1900. *Ptychognathus onyx* Alcock, *J. Asia. Soc. Bengal*, 69 : 404.

1915. *Ptychognathus onyx*, Kemp, lit. cit. 5 : 234.

Material examined : 3 exs. from outer channel on mud bottom, Chilka Lake in Spet. 1914 and 2 exs in Dec. 1914 from Manik Patna.

Diagnosis : Carapace small subcircular, almost as long as broad; flat, thin, with edges sharp. Surface smooth. Regions of carapace indistinctly marked.

Front straight, prominent, laminar, 2/5th of the width of carapace. Two post frontal tubercles present. Antero lateral sides sharp and with three sharp, acute teeth including outer orbital angle. The exopodite of external maxilliped very broad, oval with smooth convex surface, in male it is more than double of ischium. Male chelipeds long, stout, smooth, inner angle of wrist produced to a long spine. Palm swollen, higher than long. A patch of thick long grey coloured hairs present on the outer surface of the male palm, near the finger cleft, and extending along the fixed finger as a tuft of hair. In female the palm not hairy or

swollen, but nude, its outer surface traversed by a fine ridge near the lower border, which runs to the tip of the fixed finger.

Distribution : Chilka Lake; Andamans; Bay of Bengal and Tavoy.

Remarks : *P. onyx* differs from the *P. dentata* the other known Indian species, in having a long spine at the inner angle of male wrist and the patch of hairs present on outer side of palm at finger cleft, instead of on the inside of hand.

Genus 15. *Varuna* Edwards 1830

19. *Varuna litterata* (Fabr.)

1798. *Cancer litteratus* Fabricius, *Ent. Syst. Suppl.* : 342.
 1900. *Varuna litterata*, Alcock, *J. asia. Soc. Bengal*, **69** : 401.
 1976. *Varuna litterata*, Sakai, *Crabs of Japan and Adj. Seas* : 644.

Material examined : are 56 exs. of males and females from Chilka Lake, Coll. at different stations during 1923-1987.

Diagnosis : Carapace subcircular, thin, flatish, borders of carapace sharp, thin, finely beaded. Surface of carapace smooth and pitted, one 'H' like groove present on the middle of the carapace. Antero-lateral sides of carapace arched, cut into three teeth including outer orbital angle. A distinct facet on each postero-lateral sides of carapace present. Size of chelae variable and surfaces not smooth. Terminal joints of legs compressed paddles for swimming.

Distribution : Chilka Lake, coasts of India to Japan; East coast of Africa and Madagascar.

Genus 16. *Plagusia* Latreille

1806. *Plagusia* Latreille, *Gen. Crust.* **1** : 33; Alcock 1900 : 436 ; Sakai 1976 : 675.

20. *Plagusia depressa tuberculata* Lamarck

1818. *Plagusia tuberculata* Lamarck, *Hist. Nat. Anim, Sans Vert.* **5** : 247.
 1900. *Plagusia depressa squamosa*, Alcock, *lit. cit.* 437.
 1976. *Plagusia depressa tuberculata* Sakai, *lit. cit.* : 676.

Material examined : One young specimen from outer channel of Chilka coll. in March 1914.

Diagnosis : Flat, subcircular crab with all the regions well defined; surface covered with tubercles of various sizes and inter spaces between the tubercles covered with hairs. Antero-lateral sides of carapace armed with four teeth including outer orbital corner. No true front; inter orbital space 1/3 of width of carapace, epistome prominent beyond the frontal edge usually cut into seven lobes. Chalipeds in adult male stout, long; in female slender and as long as the carapace. Inner angle of wrist course, dentiform; the

tubercles on upper edge of palm and moveable finger arranged in longitudinal rows, those on the outer surface of palm arranged in transverse rows. Legs very stout, meri broad, stout with only one strong subterminal spine on the anterior edge. Upper surface of carpus, propodus and dactylus traversed longitudinally by a narrow strip of long stiff hairs.

Distribution : Chilka Lake, Bay of Bengal, Andamans. Arabian Sea, Indo Pacific, widely ranges from east coast of Africa towards Japan, Hawaii and Chile.

Remarks : The tubercles on the surface of carapace are variable, sometimes obscure, or flatish or very prominent. Hairs also vary : either absent or just fringes of bristles or thickly covered the inter spaces between the tubercles.

Genus 17. *Sesarma* Say

1817. *Sesarma* Say, J. Acad. Nat. Sci. Philad. 1 : 76; Alcock 1900 : 409, Sakai 1976 : 654.

Subgenus *Parasesarma* De Man, 1895

1895. *Parasesarma*, De Man, Zool. Jahrb. Syst., 9 : 181.

Lateral sides of carapace entire, not dentate, behind the external orbital angle. Upper edge of palm of chelipeds with 2-3 pectinate crests and of moveable finger with row of large tubercles.

Key to the species of *Parasesarma*

1. One large spine present on the inner edge of arm of cheliped *plicatum*
- No such spine on inner edge of arm of cheliped *batavicum*

21. *Sesarma (Parasesarma) batavicum* Moreira

1903. *Sesarma batavica* Moreira, Arch. Mus. Rio Janeiro, XII : 117.

1915. *Sesarma batavicum*, Kemp, lit. cit. 5 : 238.

Material examined : Many specimens in the outer channel of Chilka near Manik Patna in March Dec. 914; Jan. 1915.

Diagnosis : Carapace, square, deep, broader than long; lateral sides slightly convergent posteriorly and without teeth behind the outer orbital angle. Four post frontal lobes; gastric and other regions faintly outlined. Front more than half of carapace and slightly concave in dorsal view. Small transverse rows of setae present on carapace. Chelipeds in male equal, outer sides of arm and wrist rugose. Upper edge of palm of male bears few oblique ridges, the outermost ridge well developed composed of sharp tubercles, which are very high distally, other tubercular ridges and granules present. Upper edge of moveable finger of males bears 10-12 blunt dents near its base. Patch of long thick hairs present at the finger cleft in all males. In females no dents on dactylus present and few lank hairs on finger cleft. Merii of legs very broad, few dents

on their lower distal corner present, upper surface rugose. Anterior edge of carpus and propodus densely setose.

Distribution : Chilka Lake, Ennur, near Madras and Sea shore at Batavia (de Man 1890 : 97-98).

Remarks : Oblique ridges on the upper edge of male palm and 10-12 dents on moveable finger of male chelae differentiate the species.

22. *Sesarma (Parasesarma) plicatum* (Latr.)

1806. *Ocypoda plicata* Latreille, *Hist. Nat. Crust.* 6 : 47.

1900. *Sesarma quadratum*, Alcock, *J. Asia, Soc., Bengal*, 69 : 412.

1976. *Sesarma (Parasesarma) plicatum*, Sakai, lit. cit. : 656

Material examined : Few specimens from Chilka studied by Alcock.

Diagnosis : Deep, square shaped crab, length 4/5 of width, dorsal surface slightly convex. Four equal, prominent post frontal lobes covered with rugae and tuft of hairs. Gastric region very deeply defined. Oblique striations present on lateral epibranchial regions. Front more than half of greatest width of carapace, free edge slightly concave. The chelipeds stout, outer surfaces of arm, wrist and palm granular. Inner edge of arm with a large subdistal spine and ending in a spinule. Inner surface of palm granular; upper edge of palm of male adorned with two-three pectinate and oblique crests. The upper edge of moveable finger of male milled with 11-19 transverse lamellae, but the lamellae on female incomplete. Merii of legs broad, ends in a subdistal spine, their dorsal surfaces rough. Edges of other leg joints fringed with tufts of bristles.

Distribution : Chilka Lake, East and West coasts of India; Andaman Nicobars. Malay; China; Korea; Madagascar and East coast of Africa.

Remarks : Presence of a large spine on inner edge of arm of cheliped at once separate the *S. plicatum* from other allied species.

23. *Sesarma tetragonum* (Fabr.)

1798. *Cancer tetragonum* Fabricius, *Ent. Syst. Suppl.* : 341.

1900. *Sesarma tetragonum* Alcock, lit. cit. : 420.

Material examined : One male, Chilka Lake, outer channel near Manik Patna in March 1914.

Diagnosis : Crabs nearly square shaped, deep; its length 5/6 of its width. Parallel lateral sides with one acute tooth behind outer orbital spine. Front 1/2 or so of width of carapace, deflexed, free edge concave; of the four post frontal lobes the middle pair very prominent and broader than outer ones. All the regions specially the gastric well defined, whole dorsal surface covered with tufts of hairs, longer and thicker anteriorly. In male, chelipeds more stouter and more sharply rugose on outer surface than in females. Outer surface of palm granular, on inner surface a transverse granular ridge present. Upper edge of moveable

finger of chelae adorned with 9-10 small dents, not milled lamelle.

Distribution : Chilka Lake, Mahanadi and Gangetic delta, Tamil Nadu and Andamans.

VII. Family GECARCINIDAE Dana

1851. Gecarcinidae Dana, *Amar. J. Sci.* (2) 12 : 289.

Large amphibious crab, mostly inhabit land. Dark brown to brick red colour in freshly preserved condition.

Genus 18. *Cardiosoma* Latreille

1825. *Cardiosoma* Latreille, *Encycl. Method.* x : 685.

1900. *Cardiosoma* Alcock, lit. cit. 69 : 444.

24. *Cardiosoma carnifex* (Herbst)

1794. *Cancer carnifex* Herbst, *Krabben und Krebse*, 11 : 163.

1976. *Cardiosoma carnifex*, Sakai, : 680.

Material examined : Few examples collected from outer channel, Chilka Lake, Coll. in March 1914.

Diagnosis : Carapace deep, convex, transverse; epibranchial regions very swollen and strongly arched anterolaterally, under surface of this region densely hairy. Front 1/4 or so; fronto orbital border much more than half of greatest width of carapace. Orbits deep, outer angle dent like. Buccal cavity elongate quadrate shape; external maxillipeds leaves between them a rhomboidal gap when closed. Chelipeds stout, subequal in size and varies with age and sex. Stiff bristles, not very thickly set on the end of merii of legs, anterior edge and surface of carpus and on both borders of propodus present. Four series of spines present on the dactylia of legs. Abdomen of both male and female consists of 7 separate joints.

Distribution : Chilka Lake, Waltair Andamans. Mozambique; Darban, Japan, Formosa, Cellbes to Gilbert Island; Tahiti.

Remarks : The entire edge of merii of legs of *c. hirtipes* is adorned with thick bristles is unlike *c. carnifex*.

Family VIII XANTHIDAE Alcock

1898. *Xanthidae* Alcock : 69; Sakai 1976 : 385.

1984. Super family Xanthoidea Serene, *Xanthoidea; Xanthidae* et *Trapeziidae* : 11.

Genus 19. *Pilumnopeus* A. M. Edw.

1863. *Pilumnopeus* A. milne Edwards, *Ann. Sic. Nat. Zool.* 20 : 289 ; Sakai 1976 : 500.

1898. *Heteropanope* Alcock : 207, Kemp 1915 : 242.

1976. *Pilumnopeus* Sakai, lit. cit. : 500.

25. *Pilumnopus indica* (De Man)

1887. *Heteropanope indica* De Man, *J. Linn. Soc. London* : 53; Alcock 1898 : 208; Kemp 1915 : 242.
 1976. *Pilumnopus indica* Sakai, *Crabs of Japan & adj. Seas* : 500.

Material examined : 20 exs. Manikpatna, Chilka Lake, outer channel in March and Dec. 1915.

Diagnosis : Small, deep, subcircular to hexagonal crab, surface covered with short fine hairs. More or less two thirds as long as wide, slightly convex in both the directions. Antero lateral teeth four including outer orbital corners. Two parallel series of finely granular hairy transverse, short ridges present on anterior part of carapace. Frontal two lobes convex near median notch. Orbital edge granular. Chelipeds markedly unequal, stout, larger palm smooth, smaller palm granular.

Distribution : Chilka lake, Bay of Bengal, East coast of India, Andamans; Mergui Archipelago, Sri Lanka, Japan.

Remarks : Small, thick hairy crab with short, transverse granular hairy ridges on the carapace are the main distinctive characters for the species.

IX. Family PORTUNIDAE Rafineque

1815. *Portunidae* Rafineque : 124; Alcock 1899 : 5; Sakai 1976 : 322.

Last pair of legs are typical swimming paddles and as long as the stout chelipeds. Carapace only slightly convex or flatish, the size and shape of crabs varies; regions not outlined, seldom aerolated. Antero lateral sides of carapace with 4, 5 to 9 teeth. Front broad.

Key to the genera of the family Portunidae

1. Sub quadrate crab, straight antero lateral sides with 4 or 5 spines *Thalamita*
- Very broad crab, with 9 antero lateral spines 2
2. Last antero lateral spine larger than other spines *Portunus*
- All the antero lateral spines are equal *Scylla*

Genus 20. *Portunus* Weber

1795. *Portunus* Weber : 93.
 1899. *Neptunus*, Alcock, lit. cit., 68 : 28.
 1897. *Portunus*, Rathban, *Proc. Biol. Soc. Washington*, II : 155.
 1976. *Portunus* Sakai : 339.

26. *Portunus pelagicus* (Linn)

1766. *Cancer pelagicus* Linnaeus, *Syst. Nat. ed. XII* : 1042.
 1899. *Neptunus pelagicus* : Alcock, lit. cit. 68 : 34.
 1915. *Neptunus pelagicus*, Kemp, *Fauna of Chilka Lake*, 5 : 248.
 1976. *Portunus (Portunus) pelagicus* Sakai, lit. cit. : 339.

Material examined : Few young specimens from Chilka Lake, Coll. K. N. Reddy, 1985 common edible species of Chilka.

Carapace transverse its length half of its width, slightly convex; four low frontal teeth; front low, narrow. Antero lateral sides long, cut into 9 acute teeth including outer orbital corner. Last tooth prominent 3-4 times longer than the former equal 8 teeth.

The young carapace proportionately much longer than the adult, and the frontal margin almost entire, low, only faint indications of teeth, hence the chance of wrong identification is very easy.

Distribution : Chilka Lake, Indo Pacific like that of *Scylla serrata*.

Genus 21. *Thalamita* Latreille

1829. *Thalamita* Latreille, *Cuvier Regne An., Crust.*, 4 : 33; Alcock 1899 : 72, Sakai 1976 : 367.

27. *Thalamita crenata* (Latre.)

1829. *Portunus crenatus* Latreille, *Coll. du Museum*, fide H. M. Edw. 1834.
 1834. *Thalamita crenata*, H. M. Edwards : 461; Sakai 1976, lit. cit : 369.

Material examined : Two males from Chilka Lake Survey, Coll. in 1987. Carapace subquadrilateral, slightly convex, almost smooth crossed transversely by faint granular ridges. Front broad, cut into six rounded, equal teeth except the inner supraorbital angles. Five spines on antero lateral sides. Chelipeds slightly unequal, 3 spines on arm and 5 spines on palm.

Distribution : Chilka Lake, Bay of Bengal coasts of India, Andamans, Bombay. Karachi; Persian Gulf; Singapore; Mergui; Penang; Australia and Samoa.

Genus 22. *Scylla* De Haan

1833. *Scylla* De Haan, *Fauna Japonica* : 11; Alcock 1899 : 27; Sakai 1976 : 335.

28. *Scylla serrata* (Forsk.)

1798. *Cancer serratus* Forskal : 90.
 1899. *Scylla serrata* Alcock : 27; Sakai 1976 : 335; 1986 Deb, Chakrabarty & Choudhury : 64.

Material examined : Three females and two males from Chilka Lake Coll. in 1985 by Shri K. N. Reddy.

Diagnosis : Carapace broad, oval, moderately convex in both directions, upper surface smooth. Olive green in colour when alive. In young, frontal four lobes low, broad and indistinct. Antero lateral sides of carapace comprises 9 equal sharp, spine like teeth. Chelipeds very stout, with several spines; leg joints unarmed. Abdomen of male broadly triangular.

Distribution : Chilka Lake, most common in all the estuaries and backwaters of India; from Karachi to China; Japan; Australia; East and South Africa.

Remarks : The crab grows to a large size and extremely common edible crab in all the estuaries, coasts and back waters of India, Pakistan, Bangladesh and throughout Indo Pacific areas.

SUMMARY

The paper is based on crab collections of Chilka Lake during 1985-1987, by Z.S.I. survey parties. The paper deals with 28 species under 9 families and 22 genera. Only two species recorded for the first time from Chilka Lagoon.

ACKNOWLEDGEMENT

The author is thankful to the former Director, Dr. S. M. Jairajpuri and to Dr. A. K. Ghosh, Director, Zoological Survey of India for the facilities provided for the study. She expressed her thanks to Dr. K. V. Rama Rao, Scientist - SF, Sri K. N. Reddy, Sci - SD for providing the collection at my disposal for study.

CRUSTACEA : DECAPODA

K. NARAPU REDDY

Sundarban Field Research Station, Zoological Survey of India,
Canning 743 329, Dist. 24-Parganas (S), W.B.

INTRODUCTION

During the year 1914, Chilka Lake was intensively surveyed under the leadership of Dr. N. Annandale. The Decapod crustaceans collected during these surveys were studied and the results published by S. Kemp (1915). A list of the species of prawns, shrimps and hermit crabs, as reported by S. Kemp consisting of 30 species is given below along with the current status given in parentheses.

LIST OF THE SPECIES REPORTED BY S. KEMP (1915)

Class : CRUSTACEA

Order : DECAPODA

A. PRAWNS & SHRIMPS

Sub Order : DENDROBRANCHIATA

Family : PENAEIDAE

- * 1. *Panaeus carinatus* Dana (= 1. *Penaeus monodon* Fabricius and
2. *P. semisulcatus* de Haan)
- * 2. *P. indicus* H. Milne Edwards
- * 3. *Penaeopsis monoceros* (Fabricius) (= *Metapenaeus monoceros* (Fabricius))
- 4. *P. affinis* (H. Milne Edwards) (= *M. affinis* (H. Milne Edwards))
- * 5. *P. dobsoni* (Miers) (= *M. dobsoni* (Miers))

Family : SERGESTIDAE

- 6. *Lucifer hansenii* Nobili

Sub Order : PLEOCYEMATA

Infra Order : CARIDEA

Family : CRANGONIDAE

7. *Pontophilus hendersoni* Kemp

Family : PALAEMONIDAE

Sub Family : PALAEMONINAE

- * 8. *Palaemon lamarrei* H. Milne Edwards (= *Macrobrachium lamarrei lamarrei* (H. Milne Edwards))
- * 9. *P. malcolmsoni* (H. Milne Edwards) (= *M. malcolmsonii* (H. Milne Edwards))
- * 10. *P. rudis* Heller (= *M. rude* (Heller))
11. *P. scabriculus* Heller (= *M. scabriculum* (Heller))
- * 12. *Leander styliferus* H. Milne Edwards(= *Exopalaemon styliferus* (H. Milne Edw.))

Sub Family : PONTONIINAE

13. *Urocaris indica* Kemp (= *Periclimenes (Periclimenes) indicus* (Kemp))
- * 14. *Periclimenes demani* Kemp (= *Periclimenes (Harpilius) demani* Kemp)

Family : ALPHEIDAE

15. *Ogyrides striaticauda* Kemp
16. *Athanas polymorphus* Kemp
17. *Alpheus crassimanus* Heller
18. *A. malabaricus* Fabricius
19. *A. paludicola* Kemp

Family : ATYIDAE

20. *Caridina nilotica* var. *bengalensis* de Man
- * 21. *C. propinqua* de Man

Family : PASIPHAEIDAE

22. *Leptochela aculeocaudata* Paulson

Infra Order : THALASSINIDEA

Family : CALLIANASSIDAE

- * 23. *Callianassa (Callichirus) maxima* A. Milne Edwards

Family : UPOGEBIIDAE

- * 24. *Upogebia (Upogebia) heterocheir* Kemp

B. HERMIT CRABS

Infra Order : ANOMURA

Family : : DIOGENIDAE

- * 25. *Clibanarius padavensis* de Man

- * 26. *C. longitarsus* (de Haan)

- * 27. *C. olivaceus* Henderson

- * 28. *Diogenes avarus* Heller

Family : COENOBITIDAE

29. *Coenobita rugosus* Milne Edwards

- * 30. *C. cavipes* Stimpson

- * Species dealt with in the present account.

During the period 1985-87, Zoological Survey of India conducted intensive surveys of Chilka Lake fauna. The prawn, shrimp and hermit crab material collected during these surveys (November–December, 1985; June, 1986 and September, 1987) totalling 526 specimens have been studied by the present author. In addition, 53 specimens of hermit crabs found in the earlier unnamed collections from this Lake have also been studied.

The current studies revealed the presence of 13 species of prawns and shrimps belonging to 8 genera and 5 families; and 8 species of hermit crabs belonging to 3 genera and 2 families. Of these, the following hermit crabs are found as new to the fauna of Chilka Lake.

Infra Order : ANOMURA

Family : DIOGENIDAE

1. *Clibanarius clibanarius* (Herbst)
2. *Diogenes affinis* Henderson
3. *D. investigatoris* Alcock

The present account deals with the above 21 species studied. It excludes species not studied (Alpheidae) and those not encountered in the present collections. In prawns and shrimps,

total body length is given measuring from the tip of rostrum to the tip of telson. In hermit crabs, carapace length is given measuring from the tip of rostrum to the posterior cleft of carapace.

SYSTEMATIC ACCOUNT

Class : CRUSTACEA

Order : DECAPODA

Key to Suborders

1. Gills dendrobranchiateDendrobranchiata
- Gills phyllobranchiate or trichobranchiatePleocyemata

A. PRAWNS & SHRIMPS

Sub order : DENDROBRANCHIATA

Key to the families

1. Last two pairs of walking legs well developed; gills many Penaeidae
- Last one or two pairs of walking legs reduced or absent ; gills few or wanting Sergestidae

Family : PENAEIDAE

Key to the genera

1. Rostrum with ventral teeth *Penaeus*
- Rostrum without ventral teeth; no distal fixed pair of spines on the telson; no exopod on 5th pereopod; pleurobranch on 7th thoracic somite present *Metapenaeus*

Genus : *Penaeus* Fabricius, 1798

Key to the species

1. Hepatic carina present2
- Hepatic carina absent *indicus*
2. Hepatic carina horizontally straight; 5th pereopod without exopodite *monodon*
- Hepatic carina inclined at an angle of 15° anteroventrally; 5th pereopod with small exopodite *semisulcatus*

1. *Penaeus monodon* Fabricius

1798. *Panaeus monodon* Fabricius, *Supp. Ent. Syst., Hafniae*, Copenhagen, P. 408.

1906. *Peneus semisulcatus* : Alcock, *Cat. Indian Decapod Crust.*, pt. 3 (1) : 10 (Non:de Haan, 1850).
 1915. *Penaeus carinatus* : Kemp, *Mem. Indian Mus.*, 5 : 317 (Part)
 1965. *Penaeus monodon* : Racek and Dall, *Verh. K. ned. Akad. Wet.*, 56 (3) : 10.

Material : 1(M) (250 mm), Reg. No. C-4427/2, Satpara fish landing centre, 5.xii. 1985, K. N. Reddy.

1(M) (220 mm), Reg. No. C-4428/2, Rambha fish landing centre, 15. vi. 1986, K. N. Reddy.

3(M) (117, 155 & 178 mm) 1(F) (100 mm), Reg. No. C-4429/2, Satpara fish landing centre, 27. vi. 1986, K. N. Reddy.

1(F) (100 mm) 2(M) (70–80 mm), Reg. No. C-4430/2, Satpara fish landing centre, 28.vi.1986, K. N. Reddy.

1(F) (185 mm), Reg. No. C-4431/2, Barakul fish landing centre, 13.ix.1987, H. C. Ghosh.

Diagnostic characters : Rostrum with 7–8/2–3 teeth, usually 7/3, sigmoid in shape in juveniles and adults, surpassing antennular peduncle in length. Adrostral carina reaching almost to epigastric tooth. Post rostral carina often more or less flat with feeble indications of a sulcus, carina reaching almost to the posterior edge of carapace.

Gastro-orbital carina occupying posterior one-third to half distance between post-orbital margin of carapace and hepatic spine. Hepatic carina prominent, anterior half horizontal, the posterior often diverging very slightly below horizontal axis; distinctly separated from the base of antennal carina, which ends above middle of hepatic carina. Hepatic sulcus not well defined.

Ischial spine on 1st pereopod; no exopod on 5th pereopod.

In petasma, the median anterior lobe small, separated from the laterals by a shallow notch, not projecting as far as lateral lobes. Lateral lobes without distal setae, but with distolateral irregular group of ossicles greatly variable in number.

In thelycum, the length of anterior plate twice its breadth, anterior rounded portion concave, posterior bluntly pointed portion inserted between flaps of seminal receptacle for 2/5 of their length. Seminal receptacle circular; flaps forming turgid, reflected lips on mid line; with smooth inner edges in impregnated females.

Remarks : Alcock (1906) erroneously assigned *P. semisulcatus* to *P. monodon* and vice versa which partly been responsible for confusion between these two species, as indicated by Barnard (1950). For avoiding confusion between the two species Kemp (1915) had provisionally employed the term *carinatus* Dana but did not attempt to separate them. Holthuis (1949) has shown that *P. carinatus* Dana is identical with *P. monodon* Fabricius, the latter having priority. The present material contained both the species *P. monodon* and *P. sulcatus* and has been treated accordingly. The distinguishing features separating them are dealt with under the latter species.

It contributes substantially to the prawn fishery of the Lake. The movement of post-larvae

towards the Lake occurs throughout the year, with likely peaks in January – April and June – October. The latter contributes chiefly to April–September fishery in the Lake and considered as primary (Jhingran et al, 1966), while the former incursion as secondary. They live in the Lake from 6 months to one year and by the time they are 10 months old, they start migrating to sea in large numbers for breeding purpose.

2. *Panaeus semisulcatus* de Haan

1850. *Panaeus semisulcatus* de Haan, *Fauna Japon.*, Leyden, P. 191
 1906. *Peneus monodon* : Alcock, *Cat. Indian Decapod Crust.*, Pt. 3 (1) : 8. (Non: Fabricius, 1798).
 1915. *Panaeus carinatus* : Kemp, *Mem. Indian Mus.*, 5 : 317 (part) (Non : Dana, 1852 = *monodon*).
 1965. *Panaeus Semisulcatus* : Racek and Dall, *Verh. K. ned. Akad. Wet.*, 56 (3) : 11.

Material : 1(M) (165 mm), Reg. No. C-4432/2, Opp. Honeymon Id, Near Rambha, 11. xii. 1985, K. N. Reddy

1(F) (185 mm), Reg. No. C-4433/2, Pandanasi Point, W. of Parikud Id., 16.xii. 1985, K. N. Reddy.

1(F) (95 mm), Reg. No. C-4434/2, Satpara fish landing centre, 27.vi.1986, K.N.Reddy.

6 (M) (90–110 mm), 1(F) (110 mm), Reg. No. C-4435/2, Satpara fish landing centre, 28.vi.1986, K. N. Reddy.

5(F) (90–130 mm), 4 (M) (50–110 mm), Reg. No. C-4436/2, Satpara fish landing centre, 29.vi.1986, K. N. Reddy.

Diagnostic characters : Rostrum with 6–7/2–3 teeth, almost straight, blade uniformly convex, reaching tip of antennular peduncle. Post rostral carina distinctly sulcate, the sulcus nearly one-third the length of carapace. Adrostral carina and sulcus reaching 2/5 of the length of carapace from posterior edge. Post rostral carina almost reaching posterior border of carapace.

Gastro-orbital carina occupying posterior two-third distance between cervical sulcus and anterior margin of carapace. Orbito-antennal sulcus with parallel sides, posteriorly deep. Antennal carina two-fifth of the length of the carapace, exceeding orbito-antennal sulcus posteriorly, meeting hepatic sulcus one-third of its length from posterior end. Hepatic carina inclined downwards to horizontal at an angle of 15°, one-fifth in length of carapace.

Ischial spine smaller than basial on 1st pereopod; exopods on all pereopods.

In petasma, the median projections flattened dorsoventrally, slightly overhanging lateral lobes; latter with minute apical spines; minutely tuberculate internally and externally but without distinct rows or areas of spines.

In thelycum, the anterior plate obtusely angled apically, with deep V-shaped excavation; a posterior tongue inserted between flaps of seminal receptacle for one-third their length. Width of anterior plate one-third of seminal receptacle at its widest point. Seminal receptacle as wide as long, flaps strongly reflected with transverse striae on everted lips and almost angular at their lateral extremities.

P. semisulcatus may be separated from *P. monodon* by the features as given in the table.

Character	<i>P. semisulcatus</i>	<i>P. monodon</i>
1. Post rostral carina	distinctly sulcate	feebly or partially sulcate
2. Rostrum	more or less straight with convex blade	strongly sigmoid in shape
3. Adrostral carina	reaching well beyond epigastric tooth	reaching to epigastric tooth
4. Hepatic carina	not strongly elevated, inclined at an angle of 15° to horizontal	strongly elevated, horizontal
5. Exopod of 5th pereopod	present	absent

Remarks : Full grown individuals of *P. semisulcatus* may reach body length upto 250 mm, whereas *P. monodon* will usually grow beyond 300 mm. As the two species are similar in appearance both of them go together in the commercial fishery parlance. They are economically important as they grow bigger in size and are prized for export business.

3. *Penaeus indicus* H. Milne Edwards

1837. *Panaeus indicus* H. Milne Edwards, *Hist. nat. Crust., Paris*, 2 : 415.
 1906. *Peneus indicus* : Alcock, *Cat. Indian Decapod Crust.*, pt. 3 (1) : 12.
 1965. *Penaeus indicus*: Racek and Dall, *Verh. K. ned. Akad.Wet.*, 56 (3) : 15

Material : 1 (M) (155 mm), Reg. No. C-4437/2, Satpara fish landing centre, 5.xii.1985, K. N. Reddy.

1 ex. (26 mm), Reg. No. C-4438/2, Siari golla Village, near Panasapada, 7.xii.1985, K. N. Reddy.

1 (F) (90 mm), Reg. No. C-4439/2, Balugan fish landing centre, 14.xii.1985, K. N. Reddy.

1 (M) (170 mm), Reg. No. C-4440/2, Pandanasi Point, W. of Parikud Id., 16.xii. 1985, K. N. Reddy.

2 (M) (135 140 mm), 1 (F) (135 mm) Reg. No. C-4441/2, Rambha fish landing centre, 15. vi. 1986, K.N. Reddy.

2 (M) (135 mm each), 1 (F) (153 mm), Reg. No. C-4442/2, fishing net of Barakul Panthanivas, 16. vi. 1986, K.N. Reddy.

2 (F) (133 & 138 mm), 1 (M) (122 mm) Reg No. C-4443/2, Grid H/9, W. of Nalaban Id., 18.vi.1986, K.N. Reddy.

1 (F) (132 mm), Reg. No. C-4444, near Barakul Panthanivas, 18.vi.1986, K.N. Reddy.

2 (F) (100 mm each), Reg. No. C-4445/2, Balugan fish landing centre, 20.vi.1986, K.N. Reddy.

1 (M) (110 mm), Reg. No. C-4446/2, Grid No. I/13, Near Bhasra Munda, 23.vi.1986, K.N. Reddy.

5 (F) (65-160 mm), 6 (M) 102-150 mm), Reg. No. C4447/2, Satpara fish landing centre, 27. vi. 1986, K.N. Reddy.

1 (M) (155 mm) 1 (F) (142 mm), Reg. No. C-4448/2, Satpara fish landing centre, 29.vi.1986, K.N. Reddy.

Diagnostic characters : Rostrum slender with 7-9/4-5 teeth, the proximal 5 dorsal teeth close together, penultimate and distal teeth widely separated; with distinct double curve, $1\frac{1}{2}$ to 2 times the length of carapace in juvenile stages, but becoming shorter with increasing size, extending beyond tip of antennular scale in large prawns, blade high but not forming a triangular crest.

Adrostral groove shallow, decreasing in depth backwards upto epigastric tooth. Carapace thin, glabrous, carina and sulci feebly defined. Gastro-orbital carina occupying the posterior two-third distance between hepatic spine and orbital angle. Orbito-antennal sulcus wide and ill-defined. Post antennular spine continued as an oblique ridge to the hepatic spine. Hepatic carina absent.

Spine on the merus and carpus of the first pair of pereopods and on the merus of the second pair of pereopods.

In petasma, the median lobe rounded at the tip, projecting forward upto the apex of the lateral lobe; terminal portion of the distal margin serrated with 12 well-calcified teeth.

In thelycum, the anterior median process roughly semicircular and relatively small situated on sternite between fourth pereopods and provided with minute apical spines on the anterior margin. The two large lateral plates housing seminal receptacles occupy most part of the last thoracic sternite and they meet each other in the median line where the edges of the plates up-curved to form an appearance of a valve.

Remarks : It contributes chiefly to the prawn fishery of the lake. They are captured both by traps and nets. The movement of post larvae from the sea to the lake occurs throughout the year, with likely peaks in February – May and August – September. The latter contributes to the main fishery of March – August seasons and is considered as primary, while the former incursion as secondary, (Jhingran et al, 1966). After spending about 10 to 11 months in the lake they start moving towards the sea. While the primary brood start leaving the Lake by July to August, the secondary start leaving by December to February. The former migration appears to be salinity oriented when the salinity of the Lake is suddenly lowered due to floods and the latter migration appears to be temperature oriented when the temperature of the confined waters in the Lake is lowered due to winter months. During their stay in the Lake they contribute to the prawn fishery of the Lake.

Genus : *Metapenaeus* Wood-Mason & Aloccock, 1891

Key to the species from Chilka Lake.

1. Rostrum with a marked edentate distal portion; distomedian petasml projection with vestigial apical filament; lateral thelycal plates usually with white conjoined pads *dobsoni*
- (Rostrum without a marked edentate distal portion; distomedian petasml projection without apical filament; lateral thelycal plates without white conjoined pads 2
2. Distomedian petasml projections hood shaped and directed anterolaterally; anterior thelycal plate tongue links; lateral thelycal plates with ear shaped lateral ridges *monoceros*
- Distomedian petasml projections crescent shaped; anterior theylycal plate not tongue like; lateral thelycal plates flat and transversely divided *affinis*

4. *Metapenaeus monoceros* (Fabricius)

1798. *Penaeus monoceros* Fabricius, *Suppl. Ent. Syst., Hafniae*, Copenhagen, P 409.

1906. *Metapeneus monoceros* : Aloccock, *Cat. Indian Decapod Crust.* Pt. 3(i) : 18.

1915. *Penaeopsis monoceros* : Kemp. *Mem. Indian Mus.*, 5 : 321.

1969. *Metapenaeus monoceros* : George, *Bull. Cent. Mar. Fish Res. Inst.* 14 : 30.

Material : 14 (M), 6 (F) (75 – 100 mm), Reg. No. C-4459/2, Rambha fish landing centre, 15.vi.1986, K.N. Reddy.

1(F) (90 mm), Reg. No. C-4460/2, Grid No. C/6, S.E. of Pathara, 16.vi.1986, K.N. Reddy.

1(M) (90 mm), Reg. No. C-4461/2, Grid No. E/9, E. of Chilka, 18.vi.1986, K.N. Reddy.

2(F) (90 – 104 mm), 1 (M), (72 mm) Reg. No. C-4462/2, Near Barakul Panthanivas, 18.vi.1986, K.N. Reddy.

1(M) (68 mm), Reg. No. C-4463/2, Grid No. G/10, off N.W. of Nalaban Id., 19.vi.1986, K.N. Reddy.

1(F) (75 mm), Reg. No-C-4464/2, Grid No. H/11, off Balugan, 20.vi.1986, K.N. Reddy.

2(M) (92 & 105 mm), Reg. No. C-4465/2, Balugan fish landing centre, 20.iv.1986, K.N. Reddy.

1(F) (35 mm), Reg. No. C-4466/2, Grid No. K/12, off Bhasra Munda, 22.vi.1986, K.N. Reddy.

1(M) (80 mm), 1(F) (35 mm), Reg. No. C-4467/2, Grid No. I/13. 23.vi.86, K.N. Reddy.

1(M) (40 mm) 1(F) (50 mm), Reg. No. C-4468/2, Grid No. M/13, North Central part of Lake, 23.vi.1986, K.N. Reddy.

1(M) (38 mm), Reg. No. C-4469/2, Grid No. N/14, N. Central part of Lake, 24.vi.1986. K.N. Reddy.

1(M) (70 mm), Reg. No. C-4470/2, Grid No. P/14, North Central part of Lake, 24.vi.1986, K.N. Reddy.

8(M) (45 – 95 mm), 6(F) (55 – 105 mm), Reg. No. C-4471/2, Satpara fish landing centre, 27.vi.1986, K.N. Reddy.

5(M) (75 – 95 mm), 6(F) (65 – 95 mm), Reg. No. C-4472/2, Satpara fish landing centre, 29.vi.1986, K.N. Reddy.

1(M) (95 mm), Reg. No. C-4473/2, Grid No. A/2, Near Rambha, 4.ix.1987, H.C. Ghosh.

1(M) (90 mm), Reg. No. C-4474/2, Grid No. B/2, Near Rambha, 4.ix.1987, H.C. Ghosh.

7(F) (92 – 123 mm), 2(M) (102 & 110 mm), Reg. No. C-4475/2, Barakul fish landing centre, 13.ix.1987, H.C. Ghosh.

2(F) (70 – 82 mm), Reg. No. C-4476/2, Grid No. P/10, Near Satpara, 23.ix.1987, H.C. Ghosh.

Diagnostic characters : Rostrum with 9-12 teeth, not forming a crest, nearly straight, tilted up, reaching nearly to, or a little beyond the tip of the antennular peduncle. Post rostral carina continued almost to the posterior border of the carapace.

Supra-orbital spine very small, antennal spine strong and produced as a clear ridge to the base of the hepatic spine. Gastric region defined anteriorly, on either side of the rostrum, by a short oblique post-orbital sulcus. Branchial region defined anteriorly by a deep and narrow crescentic groove, superiorly by a distinct ridge which runs from the hepatic spine almost to the posterior border of the carapace.

Strong spine on the basis of all 3 pair of chelipeds; a small blunt ischial spine on 1st pair of chelipeds. In large males, a large triangular distoventral keel on ischium of 5th pereopod followed by a deep notch on merus.

In petasma, distolateral projections spout-like with large distal opening; distomedian projections overlying distolateral projections, with the opening facing dorsolaterally; openings closed by convex flap on distoventral edge of opening, this flap sometimes flat and projecting laterally, when distomedian projections appear quadrangular, sometimes reflected back, when projections appear triangular. Apices of projections with 1 or 2 rows of minute setae.

In thelycum, anterior plate level with and bounded on either side by expanded coxal projections of 4th pereopods; with median groove deepening posteriorly, between 2 projecting carinae. Posterior plates strongly concave, middle part much above ventral surface of anterior plate, lateral edge level with it; anterior part with angular projections facing inwards under anterior plates to form ear shaped structures, enclosing 2 flat plates lying on either side of posterior tongue like extension of anterior plate; the whole having a cup-shaped appearance, but open posteriorly.

Remarks : It contributes along with its related species, *M. dobsoni* to the prawn fishery of the Lake next in quantity to that of *Penaeus* spp. During the period of floods (July – September)

they are captured in good numbers in the outer channel, indicating their migrating phase towards the sea.

5. *Metapenaeus dobsoni* (Miers)

1878. *Penaeus dobsoni* Miers, *Proc. Zool. Soc. London*, 1878 : 302.
 1906. *Metapenaeus dobsoni* : Alcock, *Cat. Indian Decapod Crust.*, pt. 3 (i) : 21.
 1915. *Penaeopsis dobsoni* : Kemp, *Mem. Indian Mus.*, 5 : 322.
 1965. *Metapenaeus dobsoni* : Racek and Dall, *Verh. K. ned. Akad Wet.* 56 (3) : 80.

Material : 4(M) (50 – 80 mm), 3 (F) (60 – 80 mm), Reg. No. C-4449/2, Satpara fish landing centre, 5.xii. 1985. K.N. Reddy.

1 ex. (15 mm), Reg. No. C-4450/2, Parahara, near Madarchua, S.W. of Gantasila, 12.xii.1985, K.N. Reddy.

1(M) (65 mm), Reg. No. C-4451/2, Grid No. D/5, 14.vi.1986, K.N. Reddy.

23(F), 17 (M) (55 – 70 mm), Reg. No. C-4452/2, Rambha fish landing Centre, 15.vi.1986, K.N. Reddy.

1(F) (60 mm), 1 (M) (53 mm), Reg. No. C-4525/2, Near Barakul Panthanivas, 18.vi.1986, K.N. Reddy.

3(F) (60 – 65 mm), Reg. No. C-4453/2, Grid No. K/13, 23.vi.1986, K.N. Reddy.

1(M) (30 mm), Reg. No. C-4454/2, Grid No. N/14, 24.vi.1986, K.N. Reddy.

19(F) (55 – 75 mm), 9 (M) (45 – 80 mm), Reg. No. C-4455/2, Satpara fish landing centre, 27.vi.1986, K.N. Reddy.

4(M)(63 – 83 mm), 6(F) (60 – 75 mm), Reg. No. C-4456/2, Satpara fish landing centre, 29.vi.1986, K.N. Reddy.

1(M) (60 mm), Reg. No. C-4457/2, Grid No. B/2, Near Rambha, 4.ix.1987, H.C. Ghosh.

2(F) (60 mm each), 2(M) (60 – 62 mm), Reg. No. 4458/2, Grid No. Q/13. N. of Satpara, 26.ix.1987, H.C. Ghosh.

Diagnostic characters : Rostrum with 8-9 proximal teeth forming a crest; a well marked uptilted distal portion devoid of teeth; surpassing the tip of the antennular peduncle. Antennal spine not very strong and not continued backward as a strong ridge: post antennular sulcus not deep.

Strong spine on the basis of all 3 pairs of chelipeds, the one on the 3rd pair in adult males long and barbed : large tooth and notch at the proximal end of merus in the 5th pereopod of large males; no exopod on the 5th pereopod.

In petasma, the pair of distomedian spouts with four short filaments at their origin. In thelycum,

the tongue like anterior lobe ensheathed posteriorly by two lateral lobes. In impregnated females the thelycum is obscured by a pair of white conjoined pads.

Remarks : This species along with its related species, *M. monoceros* contributes as the minor prawn fishery next only to *Penaeus* spp. in the outer channel between January and April and again after floods from October.

Sub Order : PLEOCYEMATA

Key to the Infra orders

1. Body laterally compressed, rostrum prominent, abdomen well developed with the first segment not much shorter than the following ones Caridea
- Body dorso-ventrally flattened, rostrum often short or absent, abdomen may be well developed or strongly reduced, but the first abdominal segment is always shorter than the following ones 2
2. Abdomen more or less intact and entire Thalassinidea
- Abodmen not entire Anomura.

Infra Order : CARIDEA

Key to the families

1. First pair of pereopods Chelate 2
- First pair of pereopods sub-chelate Crangonidae
2. Cutting edges of fingers of chelae pectinate Pasiphaeidae
- Cutting edges of fingers of chelae not pectinate 3
3. Carpus of 2nd pair of pereopods entire; first pair of chelate pereopods often smaller than the 2nd pair 4
- Carpus of 2nd pair of pereopods usually subdivided into two or more joints; first pair of chelate pereopods distinctly stronger than the second, often unequal and swollen Alpheidae
4. Fingers of chelae without terminal brushes of long hairs Palaemonidae
- Fingers of chelae with conspicuous terminal brushes of hairs Atyidae

Family : PALAEMONIDAE

Key to the sub families

1. Pleurobranchs absent from the third maxillipeds; posterior margin of the telson with three pairs of spines Pontoniinae

- A pleurobranch present at the base of the third maxilliped; posterior margin of telson with two pairsof spines and two or more setae Palaemoninae

Sub family : PALAEMONINAE

Key to the genera

1. Carapace with branchiostegal spine; hepatic spine absent.....*Exopalaemon*
 — Carapace without branchiostegal spine; hepatic spine present*Macrobrachium*

Genus : *Macrobrachium* Bate, 1868

Key to the species

1. Merus of second cheliped shorter than carpus 2
 — Merus of second cheliped as long as or longer than carpus *scabriculum*
 2. Rostrum with a distinct elevated basal crest 3
 — Rostrum without a distinct elevated basal crest *rude*
 3. Basal crest not much elevated; palm of 2nd leg not swollen, fingers shorter than palm; small sized species *lamarrei*
 — Basal crest distinctly elevated; in younger specimen palm of 2nd leg swollen; fingers longer than palm; large sized species growing beyond 200 mm in body length..... *malcolmsonii*

6. *Macrobrachium lamarrei lamarrei* (H. Milne Edwards)

1837. *Palaemon lamarrei* H. Milne Edwards, *Hist. nat. crust.*, Paris, 2 : 397.

1950. *Macrobrachium lamarrei* : Holthuis, *Siboga Exped.*, 39 a (9) : 119.

1988. *Palaemon lamarrei lamarrei* : Jalihal et al, *Rec. Zool. Surv. India, Misc. Publ., Occ. Paper*, 112 : 2.

Material : 19(F) (25 – 60 mm), Reg. No. C-4488/2. Grid No. L/16, Off Beredi, 25. vi. 1986, K. N. Reddy.

3(F) Ovigerous (45 – 55 mm) Reg. No. C-4489/2, Grid No. N/18, off Kaluparaghat, 25. vi. 1986, K. N. Reddy.

3(F), 1 (M) (45 – 50 mm) Reg. No. C-4490/2, Raghunathpur, Balugan, 14.ix. 1987, H. C. Ghosh.

Diagnostic characters : Rostrum with 7-11 dorsal teeth (1 or 2 post orbital) and 4 to 8 ventral teeth, uppermargin with a gap between proximal series of 6-9 teeth and distal 1 or 2 subterminal teeth, sometimes the gap interrupted by 1 or 2 teeth; equal to or slightly surpassing

the antennal scale, tilted up distally. Second chelipeds slender, equal or 1/3 longer than body length with chela shorter than carpus. Second pleopod of male with non-hairy, slender appendix masculina reaching the tip of endopod.

Remarks : Most of the specimens in the collection were found to be females and of them one-third were ovigerous.

7. *Macrobrachium malcolmsonii* (H. Milne Edwards)

1844. *Palaemon malcolmsonii* H. Milne Edwards, *Voy, Inde Jacquemont*, 4 (2) : 8.

1910. *Palaemon malcolmsonii* : Henderson & Mathai, *Rec. Indian Mus.*, 5 : 283.

1950. *Macrobrachium malcolmsonii* : Holthuis, *Siboga Exped.*, 39 a(9) : 121.

Material : 2 Juveniles (14-16 mm), Reg. No. C-4491/2, Badamukh, S.W. tip of Rambha Bay, 12, xii. 1985. K. N. Reddy.

2(M) (90 & 120 mm), Reg. No. C-4492/2, Barakul fish landing centre, 13.ix. 1987, H. C. Ghosh.

Diagnostic characters : Rostrum with 10-13 dorsal teeth (2 or 3 orbital) and 4-7 ventral teeth; upper margin with a toothed highly convex proximal part and a short upturned distal part carrying one or two teeth near the apex. Rostrum longer, equal to or slightly surpassing antennal scale; inner and outer margins of antennal scale subparallel. Chela of first pereopods with fingers shorter than palm; chela of second pereopods with carpus shorter than palm.

8. *Macrobrachium rude* (Heller)

1862. *Palaemon rudis* Heller, *Verh. Zool. Bot. Ges. Wien*, 12 : 527.

1910. *Palaemon rudis* : Henderson & Mathai, *Rec. Indian Mus.*, 5 : 291.

1950. *Macrobrachium rude* : Holthuis, *Siboga Exped.*, 39 a(9) : 150.

Material : 6(M) (43-90 mm), Reg. No. C-4493/2, Satpara fish landing centre, 27.vi.1986, K. N. Reddy.

50(M), 1(F) (50-100 mm) Reg. No. C-4494/2, Satpara fish landing centre, 28.vi. 1986, K. N. Reddy.

29(M) (48-97 mm), Reg. No. C-4495/2, Satpara fish landing centre, 29.vi.1986, K. N. Reddy.

4(M) (97-133 mm), Reg. No. C-4496/2, Barakul fish landing centre, 13.ix. 1987, H. C. Ghosh.

Diagnostic characters : Rostrum with 9-12 teeth (2 post orbital) and 4-5 ventral teeth, reaching very nearly to the apex of antennal scale, the distal portion sloping slightly downwards. Large chelipeds (2nd pereopods) unequal.

In adult males, the larger cheliped nearly equal to or considerably longer than the total body length with the segments clothed with a fine velvety pubescence; tubercles on fingers on either side of cutting edge.

Remarks : All the specimens in the collection were found to be males.

9. *Exopalaemon styliferus* (H. Milne Edwards)

1837. *Palaemon longirostris* H. Milne Edw., *Hist. nat. Crust.*, 2 : 394.
 1840. *Palaemon styliferus* H. Milne Edw., *Ibid.*, 3 : 638.
 1917. *Leander styliferus* : Kemp, *Rec. Indian Mus.*, 13 (4) : 214.
 1993. *Exopalaemon styliferus* : Chace & Bruce, *Smithsonian Contr. Zool.*, 543 : 5.

Material : 1(F) (88 mm), Reg. No. C-4497/2, Satpara fish landing centre, 28.vi.1986, K. N. Reddy.

Diagnostic characters : Rostrum armed with 5-7 teeth on basal crest, 1-3 dorsal subterminal teeth, and 6-10 ventral teeth; antennular peduncle with distolateral spine on basal segment barely over reaching adjacent distal margin of segment, free part of shorter branch of dorsolateral flagellum several times as long as fused part; and pereopod with carpus considerably shorter than chela; 3rd pereopod with dactylus no more than half as long as propodus. Four posterior abdominal somites not sharply carinate in dorsal mid-line.

Remarks : Rostral formula of the present specimen 1) 6 +1/6.

Sub Family : PONTONIINAE

10. *Periclimenes (Harpilius) demani* Kemp.

1915. *Periclimenes demani* Kemp, *Mem. Indian Mus.*, 5 : 279.
 1922. *Periclimenes (Ancylocaris) demani* : Kemp, *Rec. Indian Mus.*, 24 : 219.
 1952. *Periclimenes (Harpilius) demani*: Holthius, *Siboga Exped.*, 39 a(10).

Material : 1 ex. (25 mm), Reg. No. C-4498/2, Grid No. E/7, South of Kalijai, 27.xi.1985, EBS.

Diagnostic characters : Rostrum with 7-9 dorsal teeth (2 post orbital) and 1-3 ventral teeth; carapace with supra orbital spine and hepatic spine; distal spine of antennal scale projecting very slightly beyond end of lamella, a spine or tooth at the distal end of lower border of merus and carpus of 2nd pereopods; dactyli of last 3 pereopods simple; the anterior of the two pairs of spines of telson in the proximal half of the telson.

Family : ATYIDAE

11. *Caridina propinqua* de Man

1908. *Caridina propinqua* de Man, *Rec. Indian Mus.*, 2 (3): 227.
 1925. *Caridina propinqua* : Bouvier, *Encycl. Ent.*, Ser.A(4): 181.

Material : 1(F) ovigerous (16 mm), Reg. No. C-4477/2, Grid No. E/7, South of Kalijai, 27.xi.1985. EBS.

13 exs. (8-18 mm), Reg. No. C-4478/2, Siari golla Village, near Panasapada, 7.xii.1985,

K. N. Reddy.

2 exs. (13-15 mm), Reg. No. C-4479/2, Badamukh, S.W. tip of Rambha Bay, 12.xii.1985, K. N. Reddy.

5 exs. (3-ovigerous (F)), Reg. No. C-4480/2, Gaurangapatna, Rambha Bay, 12.xii. 1985, K. N. Reddy.

1 ex. Reg. No. C-4481/2, Back water between Malud and Siar, 13.xii.1985, K. N. Reddy.

30 exs. Reg. No. C-4482/2, Launchghat, Parikud Id.,16.xii.1985, K. N. Reddy.

1 ex. (14 mm), Reg. No. C-4483/2, N.W. of Nalaban Id., 17.xii. 1985, K. N. Reddy.

9 exs. Reg. No. C-4484/2, Grid No. C/2, off Rambha, 4.ix.1987, H. C. Ghosh.

13 exs. Reg. No. C-4485/2, Grid No. A/3, North of Rambha, 5.ix. 1987, H. C. Ghosh.

1(F) ovigerous (14 mm), Reg. No. C-4486/2, Barakul (from weeds along the shore), 13.ix. 1987, H. C. Ghosh.

3 exs. (2-ovigerous (F)),Reg. No. C-4487/2, Raghunathpur, Balugan, 14.ix.1987, H. C. Ghosh.

Diagnostic characters : Rostrum with 10-19 dorsal teeth (3 to 5 post orbital), 0-3 ventral teeth; surpassing the second joint of antennular peduncle in length. Antennular peduncle reaching the middle of the distal spine of the antennal scale; the stylocerite reaching the end of the first joint.

Fingers of 3 pairs of chelae with conspicuous terminal brushes of hairs. In the first pair, the carpus one-third longer than merus, chela one-fourth longer than carpus, fingers one and half to two times as long as the palm. In the 2nd pair carpus one and half times as long as merus; chela shorter than the carpus, nearly three times as long as broad; the fingers one and half to two times as long as the palm. In the 3rd pair, the dactylus one-third the length of the propodus.

Remarks : Found throughout the lake, especially amongst weeds along the shore.

Infra Order : THALASSINIDEA

Key to the families

1. Rostrum small, pointed; first pair of legs unequal; appendix interna on 3rd to 5th abdominal appendages Callianassidae.
- Rostrum large, apex broad; first pair of legs equal; no appendix interna on 3rd to 5th abdominal appendages Upogebiidae.

Family : CALLIANASSIDAE

Genus : *Callianassa*12. *Callianassa (Callichirus) maxima* A. MilneEdw.

1870. *Callianassa maxima* A. Milne Edwards, *Nouv. arch. Mus., Paris*, 6 : 97.

1915. *Callianassa (Callichirus) maxima* : Kemp, *Mem. Indian Mus.*, 5 : 252.

Material : 3 exs., Reg. No. C-4499/2, Backwaters between Malud and Siar, 13.xii. 1985, K. N. Reddy.

1 ex., Reg. No. C-4500/2, Between Siar and Badadanda, 13.xii. 1985, K. N. Reddy.

Diagnostic characters : Rostrum short, sharply pointed, no lateral teeth, reaching barely one-third the length of eyes; no tooth on the frontal margin of carapace between the eyes and antennal peduncles. Eyes slightly surpassing the joint of the first and second antennular segments; antennular peduncle reaching the middle of the terminal segment of antennal peduncle.

In the third maxilliped ischium, merus and propodus are extremely broad. First legs very unequal. In the large right cheliped, ischium slender but broader at its distal end, merus slightly longer than ischium; carpus one-third broader than long, palm as broad as carpus but one quarter longer than carpus, fingers close meeting at the tip with a large gape, the inner edge of the fixed finger without teeth but the inner edge of dactylus with a large bluntly trilobed tooth at the proximal end, large blunt tooth in the middle and a series of four smaller blunt teeth towards the tip. In the small left cheliped, merus longer than ischium, carpus longer than merus, chela shorter than carpus, fingers as long as the palm. Second and fifth pair of pereopods chelate; the propodus in the third pair with a conspicuous lobe on its interior margin.

Second abdominal segment longest, equal to the fourth and fifth combined and little longer than the sixth. The sixth somite subcircular and excavate on either side in the posterior third. First two abdominal appendagea slender but the remaining three are broadly foliaceous.

Telson sub-quadrilateral, broader than long, posterior margin slightly convex, lateral margins gently rounded. Uropods much longer than telson, the inner one triangular and the outer one ovoid in shape.

Family : UPOGEBIIDAE

13. *Upogebia (Upogebia) heterocheir* Kemp

1915. *Upogebia (Upogebia) heterocheir* Kemp, *Mem. Indian Mus.*, 5 : 257.

Material : 1 ex., Reg. No. C-4501/2, Grid No. H/10, off Northern part of Nalaban Id., 28.ix.1985, EBS.

3 exs., Reg. No. C-4502/2, Grid No. I/12, W. of Bhasra Munda, 29.xi. 1985. EBS.

1 ex. Reg. No. C-4503/2, Grid No. M/12, North Central part of Lake, 29.xi. 1985, EBS.

4 exs. (2-ovigerous (F)), Reg. No. C-4504/2, Between Bird's Dropping Id and Nalaban Id, 2.2. mt. depth, 17. xii. 1985, K. N. Reddy.

1 ex., Reg. No. C-4505/2, Grid No. B/6, N. of Khallikote, 16.vi.1986. K. N. Reddy.

Diagnostic characters : Rostrum large with round apex, surpassing the eyes by half of its length; antennular peduncle extends a little beyond rostrum.

Third maxillipeds with a rudimentary epipod. First pereopods subchelate in males but monodactylous in females, carpus much widened distally and more than half the length of merus, propodus longer than merus. In females, a small subterminal spine on the under margin of propodus; in males this spine much enlarged forming a subchela with the dactylus. In the fifth pereopods, the propodus projects a little beyond the articulation of the dactylus giving a rudimentary subchelate appearance.

The sixth abdominal somite is the longest, almost one and half times the length of the second. Telson slightly broader than long, apex noticeably emarginate.

B. HERMIT CRABS

Infra Order : ANOMURA

Key to the families

1. Antennular flagella end in a filament..... Diogenidae
- Antennular flagella end abruptly and bluntly..... Coenobitidae

Family : DIOGENIDAE

Key to the genera

1. Chelipeds sub equal; fingers of chelipeds opening and closing horizontally ... *Clibanarius*
- Chelipeds unequal, as the one on the left side vastly larger; fingers of chelipeds opening and closing obliquely or nearly vertically *Diogenes*

Genus : *Clibanarius* Dana, 1852

Key to the species

1. Eye stalks shorter than the antennular peduncles..... *clibanarius*
- Eye stalks as long as the antennular peduncles2
2. Hands rough with spinules; coloured stripes present on second and third pereopods3
- Hands comparatively smooth with less spinules; coloured stripes absent on pereopods
..... *olivaceus*
3. Red stripes distinct on eye stalks and second and third pereopods *padavensis*

- Red strips absent on eye stalks; a pale blue band bordered with red on second and third pereopods*longitarsus*

14. *Clibanarius padavensis* de Man

1888. *Clibanarius padavensis* de Man, *J. Linn. Soc. (Zool)*. 22 : 242.
1889. *Clibanarius padavensis* : Thomas, *J. mar. biol. Ass. India* 31, (1&2): 65.

Material : 1(F) (8.2 mm), Reg. No. C-4513/2, Manikpatna, Satpara Id., 11.vi.1969, ZSI.

3 exs. (15 mm each), Reg. No. C-4514/2, Mouth of Chilka Lake, near Arkakuda Village, 9.xii.1985, K. N. Reddy.

Diagnostic characters : Eye stalks as long as the antennular peduncles but about one-sixth longer than the anterior border of the carapace. Chelipeds equal and similar; merus with 1 or 2 spinules at the distal end of the outer lower border; carpus with a distinct spine at the distal end of the dorsal inner border. Distinct red longitudinal stripes on eye stalks and walking legs.

15. *Clibanarius longitarsus* (de Haan)

1849. *Pagurus longitarsus* de Haan, *Fauna Japon, Crust.*, : 211.
1950 *Clibanarius longitarsus* : Barnard, *Ann. South African Mus.* , 38 : 424.
1989. *Clibanarius longitarsus* : Thomas, *J. mar. biol. Ass. India*, 31 : 65.

Material : 1(F) (8.5 mm), Reg. No. C-4507/2, Barkuda Id., 24.ix.1920, N. Annandale.

4 exs. (7 mm largest), Reg. No. C-4508/2, Manikpatna, Satpara Id., 1.1.1955, H. C. Ray.

1(F) (6.2 mm), Reg. No. C-4509/2, Satpara Id., 1.1.1955, H. C. Ray.

22 exs., Reg. No. C-4510/2, Satpara Id., near Dak Bungalow, 1.1.1955, H. C. Ray.

16 exs. (5.5 - 17 mm), Reg. No. C-4511/2, Mouth of Chilka Lake, near Arkakuda Village, 9.xii. 1985, K. N. Reddy.

1 ex. (18 mm), Reg. No. C-4512/2, Satpara, 27.vi.1986, K. N. Reddy.

Diagnostic characters : Eye stalks as long as antennular peduncles, a little longer than anterior border of carapace; ophthalmic scales small with pointed tips. Antennal acicles reaching middle of the last segment of antennal peduncle with serrated inner margins. Chelipeds equal provided with long setae, palm and wrist with dark tipped spines, fingers with one or two rows of spines, carpus with a distinct spine on the inner side of upper distal end, merus with a spinule on the outer side of upper distal end. Dactylus of 3rd leg longer than propodus. Eye stalks without colour bands; 2nd and 3rd pereopods with a blue band bordered with red.

16. *Clibanarius olivaceus* Henderson

1915. *Clibanarius olivaceus* Henderson; *Rec. Indian Mus.*, 11: 26
1972. *Clibanarius olivaceus* : Sarojini & Nagabhusanam, *Rec. Zool. Surv. India*, 66 : 253.

Material : 10 exs. (5.5 mm largest), Reg. No. C-4515/2, Manikpatna, Satpara Id., 1.1.1955, H. C. Ray.

1 ex. (6.3 mm), Reg. No. C-4516/2, Satpara, 6.xii. 1985, K. N. Reddy.

3 exs. (5.5 mm), Reg. No. C-4517/2, Mouth of Chilka Lake, near Arkakuda Village, 9.xii, 1985, K. N. Reddy.

Diagnostic characters : Eye stalks as long as the antennular peduncles but distinctly longer than the anterior border of the carapace. Chelipeds subequal and similar. The hand with a few scattered granular tubercles and setae. No spines on the entire palmar surface. The fingers rougher becoming spinous towards the tips and more setose than the palm. The length of the hand including the fingers is almost twice its breadth.

17. *Clibanarius clibanarius* (Herbst)

1791. *Cancer clibanarius* Herbst, *Krabben*, 2 (1) : 20.

1989. *Clibanarius clibanarius* : Thomas, *J. mar. biol. Ass. India*, 31 : 62.

Material : 1(F) (11 mm), Reg. No. C-4518/2, Satpara, 28.vi. 1986, K. N. Reddy.

Diagnostic characters : Eyestalks reaching half or more than half of the last segment of the antennular peduncle but as long as the anterior border of the carapace or as the antennal peduncle.

Chelipeds equal, similar and their fingers opening and closing horizontally; the carpus and chela have the inner border serrulated and the outer surfaces including fingers with tubercles; tufts of bristles arise from the bases of these tubercles; the merus has the upper and inner borders serrulate with tubercles on its outer surface. Second and third pairs of legs with dactylus longer than propodus by one-third to half.

Genus : *Diogenes* Dana, 1852

Key to the species from Chilka Lake.

1. Rostrum is a slender non serrated spinule2
- Rostrum is a narrow lamina, with the free edge spinose distally; antennal acicle obscurely bifurcate; palm of the left cheliped higher than long*affinis*.
2. Fixed finger of left cheliped deflexed; antennular are slightly longer than antennal peduncles*avarus*.
- Fixed finger of left cheliped not deflexed; antennal and antennular peduncles of equal length*investigatoris*

18. *Diogenes avarus* Heller

1865. *Diogenes avarus* Heller, *Novara crust.*, : 183, pl. 7 fig. 2.

1905. *Diogenes avarus* : Alcock, *Cat. Indian Decapod Crust*, Pt. 2(1) : 68.

1989. *Diogenes avarus* : Thomas, *J. mar. biol. Ass. India*, 31 : 74.

Material : 2 exs., Reg. No. C-4519/2, Channel between Satpara and Manikpatna, depth 1.2 m, 16.ii. 1903, N. Annadale.

1(M) (5.4 mm), Reg. No. C-4520/2, Satpara, 1.1.1955, H. C. Ray.

8 exs. (2.5 - 4 mm), Reg. No. C-4521/2, Satpara Id., near Dak Bungalow, 1.1.1955, H. C. Ray.

60 exs. (5 mm the largest), Reg. No. C-4522/2, Mouth of Chilka Lake, near Arkakuda Village, 9.xii. 1985, K. N. Reddy.

Diagnostic characters : Eyestalks stout, reaching the middle third of the last segment of the antennular peduncles. Rostrum slender, shorter than ophthalmic scales. Antennal peduncles slightly shorter than antennular peduncles. Antennal acicle straight, barely reaching the base of the terminal joint of the peduncle.

Left cheliped stouter and vastly larger than the right, about two and half times the length of the carapace; segments granulous, more finely on hand. Carpus longer than merus or palm. Palm one and half times as long as broad, its outer surface longitudinally carinated near the middle line, the carina gradually fading away before it reached the finger cleft. The fixed finger deflexed, dactylus less than half the length of palm.

19. *Diogenes affinis* Henderson

1893. *Diogenes affinis* Henderson, *Trans. Linn. Soc.Zool.*, (2) 5 : 415.

1972. *Diogenes affinis* : Sarojini & Nagabhushanam, *Rec. Zool. Surv. India*, 66 : 259.

Material : 1 ex., Reg. No. C-4523/2, Mouth of Chilka Lake, sea side beach, 9.xii. 1985, K. N. Reddy.

Diagnostic characters : Rostrum shorter, but slightly longer than ophthalmic scales. Antennular peduncle shorter than the antennal peduncle. Antennal acicle indistinctly bifurcate and the outer prong does not reach the base of the terminal joint of the peduncle. Antennal flagellum thickly setose. In the left cheliped, the palm is broader than long.

20. *Diogenes investigatoris* Alcock

1905. *Diogenes investigatoris* Alcock, *Cat. Indian Decapod Crust.*, 2 (1) : 71.

1906. *Diogenes investigatoris* : Southwell, Rep. Pearl oyster Fisheries of the Gulf of Mannar, pt. 5 (35) : 211.

Material : 2 exs. (2.3mm each), Reg. No. C-4524/2, Satpara, 1.1.1955, H. C. Ray.

Diagnostic characters : Antennal and antennular peduncles of equal length. Ophthalmic scales spinose throughout the free edge. Eyestalks just reach the base of the terminal joint of the antennular peduncle as well as that of the antennal peduncle. Antennal flagellum thickly setose and the antennal acicle does not reach the base of the terminal joint of its peduncle.

Both the chelipeds thickly setose. Left cheliped short and stout, merus with a distinct spine at the proximal end of the lower inner border and with indistinct denticles on the lower outer border;

palm higher than long and the fixed finger not deflexed. A longitudinal row of spinules on the upper part of the outer surface of the palm.

Family : COENOBITIDAE

Genus : *Coenobita* Latreille, 1826

Key to the species

1. An oblique file of upright laminar teeth (stridulating mechanism) present on the upper part of the outer surface of the left palm. *rugosus*
- Stridulating mechanism absent on the left palm *cavipes*

21. *Coenobita cavipes* Stimpson

1859. *Coenobita cavipes*, Stimpson, *Proc. Acad. Nat. Sci. Philad.*, : 245.

1905. *Coenobita cavipes* : Alcock, *Cat. Indian Decapod Crust.*, pt. 2(1) 146.

1950. *Coenobita cavipes* : Barnard. *Ann. South African Mus.*, 38 : 470.

Material : 1(F) (18.6 mm), Reg. No. C-4506/2, Satpara Id., near Dak Bungalow, 1.1.1955, H. C. Ray.

Diagnostic characters : Eyestalks compressed, dorsally punctate, reaching the base of the terminal joint of the antennular peduncle and nearly to the middle of the last joint of the antennal peduncle. Ophthalmic scales narrow and acute. Antennal acicle fused with the second joint of the peduncle. Chelipeds and legs relatively smooth. Upper part of the outer surface of the left palm without any oblique file of upright laminar teeth (stridulating mechanism, a characteristic feature of *C. rugosus*) but studded with vesicular granules with corneous tips; the lower part quite smooth. Meri of both the chelipeds finely rugulose the carpi punctate, the upper part of their outer surface and the right palm with some vesicular corneous tipped granules. A thick brush of long hairs on the upper part of the inner surface of both palms.

In the 3rd left leg, the outer surface of the propodus nearly flat and not separated from the anterior surface by a crest, the dactylus somewhat compressed and its outer surface flat. Coxae of the 5th pair of legs slightly prominent on the left side than on the right.

ACKNOWLEDGEMENTS

The author is grateful to the Director, Zoological Survey of India, Calcutta, for allowing him to participate in the surveys conducted in the Chilka Lake and for permitting him to work out the material collected and to Dr. K.V. Rama Rao the then Officer-in-Charge, Estuarine Biological Station, Berhampur for providing all facilities during the surveys for collecting the material. Thanks are due to Dr. D. R. K. Sastry, Scientist- SD for going through the manuscript critically and making suggestions for its improvement

REFERENCES

- Alcock, A. 1906. The prawns of the *Penaeus* group. Catalogue of the Indian Decapod Crustacea in the collection of the Indian Museum. Part-III, Macrura, Fasciculus-1 : 1-55.
- Barnard, K. H. 1950. Descriptive Catalogue of South African Decapod Crustacea. *Ann. S. African Mus.*, **38** : 1-837.
- Holthuis, L.B. 1949. The identity of *Penaeus monodon* Fabr. *Proc. Acad. Sci. Amsterdam*, **52** : 1-8.
- Jhingran, V.G. and Natarajan, A.V. 1966. Final report on the Fisheries of the Chilka Lake (1957-1965). *Bull. Cent. Int. Fish. Res. Inst.*, **8** : 1-12.
- Kemp, S. 1915. Crustacea : Decapoda, Fauna of the Chilka Lake. *Mem. Indian Mus.*, **5** : 199-325, pl. 13.

MOLLUSCA

N.V.SUBBA RAO, K.V.SURYA RAO and R.N.MANNA
Zoological Survey of India, Calcutta

INTRODUCTION

The malacofauna of Chilka Lake was studied extensively by Annandale (1924, 1925), Annandale and Kemp (1916), Annandale and Prashad (1922), Eliot (1916) Ghosh (1916, 1920), Prashad (1939), Preston (1914, 1915), Sewell and Annandale (1922) who presented data on the systematics, distribution and partly their ecology. Some of the recent general studies have dealt with benthic animal communities in relation to environment (Rajan, 1971) and their seasonal abundance, which also include data on molluscs. All these reports have pointed out the richness of molluscs in the lake.

The present study is aimed at assessing the current status of the fauna of Chilka lake, as the ecological balance of the lake is under stress. Three expeditions which included specialists of different groups, were conducted in the years 1985, 1986 and 1987. It gave us an opportunity to find out the present composition of malacofauna in the lake and compare it with those of earlier studies. The systematics and distribution of molluscs were already included in the Fauna of Orissa and hence not repeated here. However, the additional material collected during the present expeditions is given separately for each species. Keys are provided for families, genera and species. A family-wise treatment of molluscs is given so as to present a broad picture of their occurrence in the lake. A total list of molluscs recorded from the lake and the source are presented in the tables so as to enable a comparison. The distribution of species in different parts of the lake are given in a separate table. For this purpose the lake has been divided into four sectors, namely outer channel, southern, northern and central.

The collections included land, freshwater, estuarine and marine molluscs. Land molluscs were collected from the island in the Chilka lake, whereas freshwater molluscs were collected from the lake where there is influx of freshwater or fall in salinity. As dead shells can be washed into the lake from its hinterland, only live specimens were considered in evaluating the fauna. However, with regard to estuarine and marine component both dead and living were taken into consideration.

ABBREVIATIONS USED

C.A.N.R	C.A.Nageswara Rao
Coll.	Collector
D.	Diameter
E.B.S.	Estuarine Biological Station, Berhampur
Ex./Exs.	Example/Examples
Is	Island
Km.	Kilometer
K.V.R	K.V.Rama Rao
K.V.S.	K.V. Surya Rao
L.	Length

mm.	Millimeter/s
N.	North
nr.	Near
N.V..S.R.	N.V.Subba Rao
R.N.M.	R.N.Manna
S.	South
S.E.	South east
Sp.	Species
Stn.	Station
S.W.	South West
V.	Valve/Valves
Vill.	Village

MATERIAL & METHODS

Collections were made both along the coast and in main area of the lake as well as its outer channel, by using dredges and grabs for the bottom fauna. Hand net was used to collect molluscs among weeds near the coast. Shells were hand-picked on the sandy coasts and exposed muddy banks. Dredge and grab samples were sieved through different sizes of mesh. Data on Hydrological and other Limnological parameters were collected as per details given in the general introduction. Samples were collected from different stations fixed on the basis of grids throughout the lake as per the map given.

The present study is mainly based on the molluscs collected by Sri R.N.Manna and the Estuarine Biological Station during the three expeditions organised by the Estuarine Biological Station, Berhampur between 4th December, 1985 to 21st December, 1985; 8th June, '86 to 3rd July, '86 and 4th September, '87 to 26th September '87.

The material studied by us and given in our earlier publication on 'Mollusca' : Marine in the Fauna of Orissa (Subba Rao *et. al.* 1991) is also included here.

SYSTEMATIC LIST OF SPECIES

A classified list of species, arranged systematically is given below. The size range (in mm), the year of collection, collecting stations, followed by the number of examples within parantheses are given under each species. A mention of the type material is also made wherever necessary.

All the material given below is available in the National Zoological Collections, Calcutta except the collections preserved in the Estuarine Biological Station, Berhampur (Ganjam) (indicated by*)

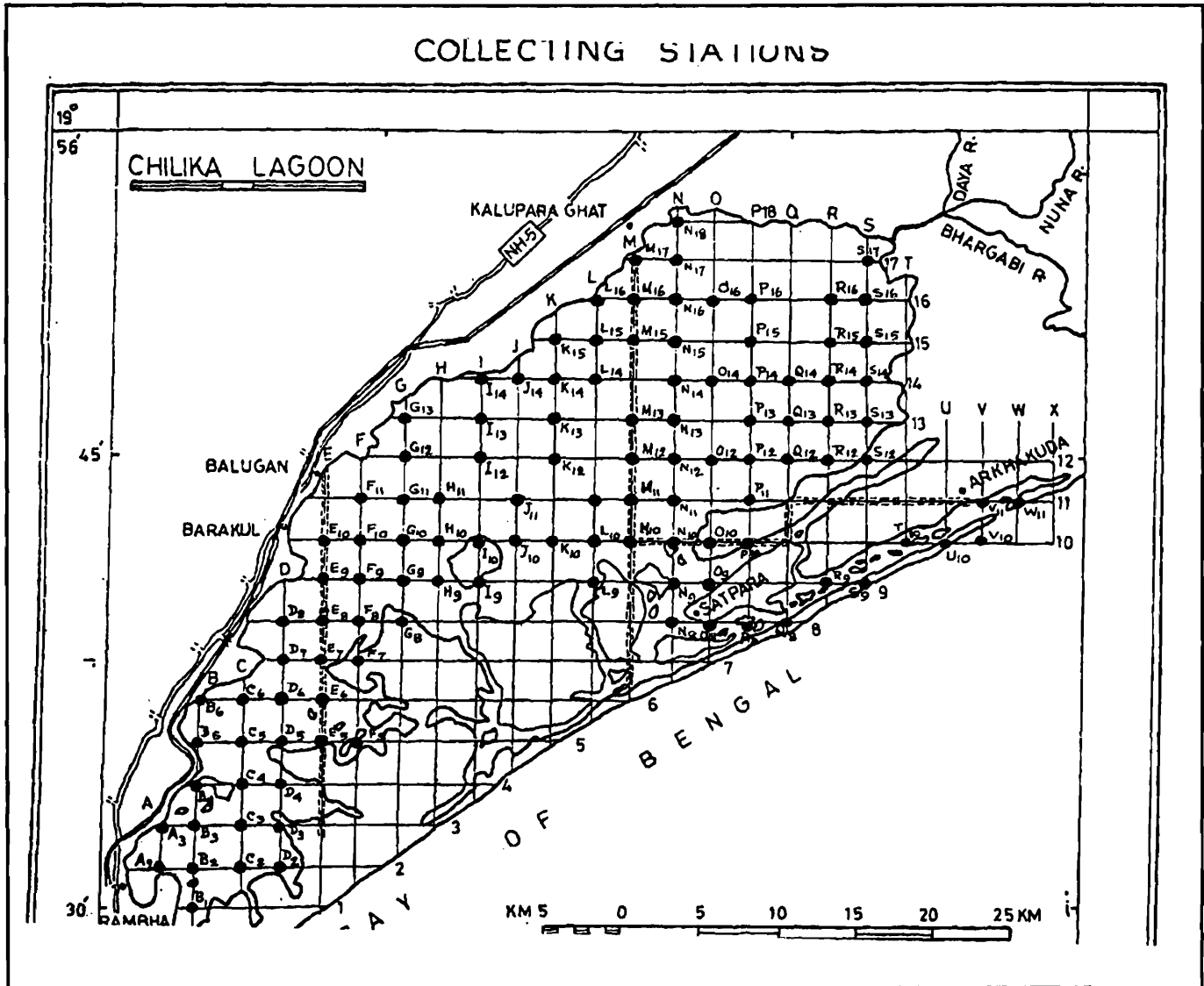
Class GASTROPODA

Subclass PROSOBRANCHIA

Order ARCHAEOGASTROPODA

Family TROCHIDAE

Marine, intertidal, from shallow beaches to a depth of 10 to 20m. About 45 species under 17 genera.



Map

Four species are recorded from Orissa coast, of which only the following two species are from the lake. *U. vestiarius* has wide distribution in the Indo-Pacific. Dead shells of this are carried into the Lake by the hermit crabs. *S. satparaensis* is endemic to the Lake.

Key to genera and species

Shell button shape, spire depressed; umbilicus closed; highly polished, brightly coloured, exhibits polymorphism *Umbonium (U. vestiarius)*

Shell turbinate, spire elevated; umbilicus deep, margined by beaded ridge; not polished, neither brightly coloured nor exhibiting polymorphism *Solariella (S. satparaensis)*

- 1) *Umbonium vestiarius* (Linnaeus) size : 3.78-10.62mm Chilka Lake (3);
1985 : South bar (22), Tip of South bar (23), Uttar bar (6), Stn. W 11 (8).
1986 : Stn. V 10 (48).
1987 : Stn. P 8 (1), Stn. Q 8 (1), V-N 11 (25).
- 2) *Solariella (Solariella) satparaensis* Preston. Size : 2.40-2.86mm.
1913 : Off Satpara (1) Holotype; (4) Cotypes.

Family CYCLOSTREMATIDAE

Marine, shallow sandy beaches. Out of 5 species known from India, three are reported from Orissa coast. The following two species are recorded from the Lake.

Key to the genera and species

Shell strongly sculptured; umbilicus open; whorls rounded *Tubiola (T. microscopica)*

Shell smooth; umbilicus partly concealed by columellar fold; whorls angulate
..... *Leucorhynchia (L. variegata)*

- 3) *Tubiola microscopica* (Nevill) Size : 0.82mm.
1913 : Seruanadi (Type) (1) (Described as *Cyclostrema (Tubiola) innocens* Preston, 1915).
- 4) *Leucorhynchia variegata* (Preston) Size : 0.75mm
1913 : Manikpatna, (1) (Type) (Described as *Tinostoma variegata* Preston).

Family NERITIDAE

Members of this family occur in marine, estuarine and freshwater habitats. Eight genera and 44 spp. are recorded from India but five genera with eight species occur in Orissa. Two species as listed below are known from the Lake. *C. oualaniensis* has Indo-Pacific in distribution while the other species is restricted to the Lake.

Key to the genera and species

- Shell obliquely ovate, without ornamentation; columella smooth; dull coloured, not exhibiting polymorphism *Smaragdia (S.mamilla)*
- Shell globose, sometimes ornamented with spines; columella finely dentate; brightly coloured, exhibiting polymorphism *Clithon (C.oualaniensis)*

- 5) *Smaragdia (Smaragdella) mamilla* Annandale size : 3.10-4.23mm
1913 : Seruanadi, (Holotype)(1) ; Chilka Lake (9).
- 6) *Clithon oualaniensis* (Lesson) Size : 4.68-7.55mm.
1977 : Arakuda vill (1160).
1984 : Brahmagiri nr. Arakuda vill. (47).
1985 : Arakuda (27), Uttar bar (1), N 8 (1).

Order MESOGASTROPODA
Family CYCLOPHORIDAE

A large family of land molluscs which include 21 genera and 400 species. Although 3 genera with 5 species are recorded from Orissa, one species has so far been reported from an island in the Lake. The species given below is known by only a few shells probably washed into the Lake.

- 7) *Cyclophorus (Cyclophorus) polynema* Pfeiffer
Size : 24.65mm.
1954 : An island 15km. East of Balugaon (6).
1986 : Rambha Bay (1).
1987 : Sidhakona N. Ghantasila Hill (1).

Family VIVIPARIDAE

It includes freshwater pond snails, which are distributed throughout India. The common and widely distributed genus *Bellamya* is represented by two species as given below at a few localities in the Lake.

Key to the species

- Shell elongately conical, body whorl rounded, suture not impressed; shell with dark bands *Bellamya (B.bengalensis f. annandalei)*
- Shell ovate, body whorl subangulate, suture impressed; shell without bands *B.dissimilis*

- 8) *Bellamya bengalensis f.annandalei* (Kobelt)
Size : 19.54-30.40mm.
1986 : Rambha Bay (2).
1987 : S 16(2), Harchandi River Mouth, Rambha (3).

- 9) *Bellamyia dissimilis* (Mueller)
 Size : 15.90-22.85mm.
 Vicinity of Chilka (4).
 1985 : Parikud Island (4), Between Birds' dropping and Nalbano islands (1).
 1986 : Nalbano (1), *Gangadharpur (11), *Rambha Bay (1).

Family PILIDAE

It includes apple snails which are distinguished into two genera in India, namely *Pila* and *Turbinicola*. The former is represented by two common species *P.virens* and *P.globosa*. The dead shells of the latter, which might have been washed into the Lake are only seen.

- 10) *Pila globosa* (Swainson)
 Size : 35.98-40.44mm.
 1985 : Gurubai Point N. of Satpara (1), Gollapara nr. Manikpatna (2), Between Malud and Siar (4).
 1986 : M 17 (1), N 18 (1), *Rambha Bay (3), *Sunamukhi (1), *Patnashi (1).
 1987 : *Harchandi River mouth (3), *Haridaspur (2), K 10 (1), N8 (1), P 14 (1), S 16 (1).

Family BITHYNIIDAE

Members of this family occur in freshwater streams, ponds and paddy fields. There are 6 genera and 17 species in India (Subba Rao, 1989), while there are records of two genera from Orissa namely, *Gabbia* and *Digoniostoma* each with one species. Only the former, namely *Gabbia orcula* was reported from the southern end of the Chilka Lake (Subba Rao *et. al.* 1989).

- 11) *Gabbia orcula* (Frauenfeld).
 Size : 5.40-5.65mm.
 : S. end of Chilka (47).

Family STENOTHYRIDAE

Shells are small in size normally not exceeding 6mm. in length, and occurring in freshwater and brackish water habitats, more abundantly near river mouths. The family includes two genera namely, *Stenothyra* and *Gangetia*, which include 11 species in all. The following three species which are also recorded from other localities in Orissa are distributed throughout the Lake except in its outer channel.

Key to the genera and species

1. Aperture proportionally larger to body; ovate; body whorl less inflated .. *Gangetia (G.miliacea)*
 Aperture proportionally smaller to body; subcircular; body whorl more inflated
 *Stenothyra*.2
2. Shell subventricose, whorls increasing irregularly, body whorl sub-angulate *S.blanfordiana*

Shell globose, whorls increasing regularly, body whorl convex *S.minima*

- 12) *Stenothyra blanfordiana* Nevill.
 Size : 2.34-2.65mm. : Chilka (63).
 1913 : Chilka (5) (Syntypes); Barkul (1) Type described as *Stenothyra chilkaensis* Preston; Manikpatna (1). (Type) described as *Stenothyra obesula* Preston.
 1985 : N.Pant Nivas, Barkul (25), Nuapara (several), Pandanashi W. Parikuda Island (3), Panchkuda (2), Q8 (1).
 1986 : B5(50), D4(2), D8(1), G12(2), G13(8), H9(8), *H10(1), I10(4), J10(1), *K10(3), *K14(20), *M12(1), M17(5), *N8(10), *N17(65), N18(3), Q8(14), *Q14(7), *R15(11); R16(4), *S16(15).
 1987 : C2(2), C3(1), D4(4), E7(13), 10(2), F8(4), H9(2), I13(3), I14(32), J10(14), J14(1), K10(4), K13(1), K15(6), L9(1), L10(1), L14(3), L15(2), L16(3), M10(2), M13(2), M15(2), M16(7), N10(2), N12(2), N16(5), N17(1), N18(4), O9(3), O12(8), P13(3), R14(2), S12(3), S15(1), Nimnashi (1).
- 13) *Stenothyra minima* (Sowerby). Size : 2.75-3.50mm. : Off Balugaon (55).
 1913 : Off Satpara (3) (Type) described as *Stenothyra orissaensis* Preston.
 1985 : Parikuda Island (1), *N17(4), *Q8(13).
 1986 : G13(65), J14(45), L16(several), N16(28), P16(49).
 1987 : E15(11), I14(55), J14(18), K10(1), K15(7), L9(5), L14(4), L15(4), M15(4), M16(3), N12(2), N15(7).
- 14) *Gangetia miliaea* (Nevill).
 Size : 2.45-2.60mm. : Chilka (38).
 1913 : Off barkul (14) (Syntypes described as *Stenothyra trigona* Preston).
 1985 : Parikuda Island (10), Panchkudi (9), Nalbano (2), Palur canal (8), Barkuda Island (4), Baramuha, Rambha (1).
 1986 : C2(1), G12(2), K10(10), K13(14), L16(2), N8(2).
 1987 : B6(2), E5(3), E10(3), H9(12), I13(5), I14(115), J14(4), K10(3), K15(7), L14(5), L15(2), L16(1), M15(1), M16(4), M17(1), N17(6), N18(1), *E15(1), *N10(2), *K14(55), *K15(15), *M12(1), *N8(20), *N17(11), *O16(65), Q8(2).

Family TURRITELLIDAE

Members occur buried in the sandy bottom of marine littoral region. A total of 9 species are recorded from Indian coasts, of which three species were reported from Orissa (Subba Rao *et.al.* 1991). The following two species which can not be considered as lake fauna are represented by dead shells collected from sand bars near the mouth of the Lake.

Key to the species

Whorls keeled in middle, strong spiral ridges, one to two, on each whorl in addition to spiral striae
 *Turritella acutangula*

Whorls without keel, spiral ridges of same size *T.columnaris*

- 15) *Turritella acutangula* (Linnaeus).

Size : 63.10-87.10mm.

1985 : Tip of South bar (2).

- 16) *Turritella columnaris* Kiener.

Size : 54.10-74.45mm.

1985 : South bar (1).

1987 : V10(1).

Family THIARIDAE

Members of this family are common in freshwater streams, ponds, lakes etc. Some of the species, especially those belonging to the genus *Thiara* show considerable salinity tolerance and occur in brackish water also. The family includes 4 genera with 44 species recorded from India (Subba Rao, 1989a). The previous records from Orissa mention only two species namely *Thiara tuberculata* and *T. lineata*. In addition to these two species, three more species as mentioned below are recorded for the first time from the Lake. One of these, namely *T. torulosa* is included here on the basis of a dead shell, but the other species occur in the northern part of the lake, where some freshwater streams are opening which lower the salinity in the area.

Key to the species

1. Spire nearly equal to body whorl; sculptured with spines, whorls angulate *Thiara scabra*
 Spire proportionally longer than body whorl; sculptured either with granules or tubercles; whorls rounded 2
2. Shell slender, spire with more than 12 whorls, attenuate, pointed, sculptured with strong spiral ridges broken into rectangular nodules *T. torulosa*
 Shell not slender, spire with less than 12 whorls, sculptured with both spiral and axial ridges or striae 3
3. Whorls granulose or with nodules; outer lip sinuate below; interior of aperture with spiral groove 4
 Whorls with axial and spiral striae giving appearance as tubercled; outer lip aperture not sinuate below, spiral groove absent *T. tuberculata*
4. Shell sculptured with distinct spiral rows of granules *T. granifera*
 Shell sculptured with dark spiral lines *T. lineata*

- 17) *Thiara (Thiara) scabra* (Mueller).
 Size ; 9.16-15.84mm.
 1986 : M17(5).
 1986 : M17(2), P16(1), S17(1).
- 18) *Thiara (Tarebia) granifera* (Lamarck).
 Size : 5.00-23.00mm
 1986 : M17 (several), N16(2), N18(165).
 1987 : L16(4), N16(2), N17(2), S17(1).
- 19) *Thiara (Tarebia) lineata* (Gray).
 Size : 11.24-19.95mm.
 1986 : N18(5), *Ghode Daube(4).
 1987 : M17(10), N16(8), N17(7), R14(1), S14(5), S17(1).
- 20) *Thiara (Stenomelania) torulosa* (Bruguiere).
 Size : *6.70mm. (*spire broken)
 1987 : S17(1).
- 21) *Thiara (Melanoides) tuberculata* (Mueller).
 Size : 3.20-5.00mm : Rambha (1).
 1985 : Gollapara nr. Manikpatna (1).
 1986 : L16(8), M17(several), N16(120), *Ghode Daube(8) *Harchandi river mouth (7), Sunamukhi nr. B.F.C.A. (1).
 1987 : L16(4), M16(3), M17(31), N18(3), P16(4), R14(1), R15(1), S16(1), S17(3), Nimnashi (5), *Stn. 23 (1), *R15(1), *S16(11).

Family POTAMIDIIDAE

The members of the family represented by three genera and eight species in India are common in brackish and estuarine waters and mangrove swamps. Although four species were reported from Orissa (Subba Rao *et.al.* 1991), two common species, namely *Cerithidea cingulata* and *Telescopium telescopium* are recorded from the Lake. The former species occurs throughout the Lake, except in its northern part, whereas the latter is collected from the outer channel. Shells of both these species are used in the manufacture of lime.

Key to the genera and species

Shell narrowly elongate, whorls sculptured with both spiral and axial ribs; body whorl with varix; columella not twisted *Cerithidea (C.cingulata)*

Shell broadly elongate; whorls sculptured with spiral ribs; body whorl without varix; columella twisted *Telescopium (T.telescopium)*

- 22) *Cerithidea (Cerithideopsis) cingulata* (Gmelin).
 Size : 12.32-23.41mm.
 1950 : Kalidai, (3) Balugaon (1).
 1954 : N.W.Barikuda (63), Satpara (43), Mahosa and Barhampur (34), Barkul point (83), Keshpur, S.W.Balugaon (27), Chiriyakuda (375), Gopakuda (923).
 1975 : Rambha (10).
 1985 : Satpara (33), S.W.Satpara (7), Siarigolla nr. Manikpatna (10), Nuapara (6), Arakuda (46), South bar (24), Uttar bar (119), Samal Island (9), Umbakona (1), Siar and Malud (16), Baradonta (16), Palur canal (14), Parikuda (7), Pandanashi (9), Panchkudi (2), Parikuda point (1), *Arakuda (several).
 1986 : D2 (1), D4(17), E6(4), M13(3), N8(17), N9(12), N10(43), N12(1), O8(11), R9(4), T10(1), U10(8), V10(49), *Rambha Bay (2), Muthupet(4).
 1987 : D3 (1), D4(6), E5(1), F11(1), J10(2), K10(5), L9(5), M10(1), N8(6), N9(9), N10(5), N11(3), N13(1), O8(4), P8(10), P10(3), P11(2), P12(1), P15(1), Q8(9), Q12(2), R12(3), S12(3), S13(1), T10(16), U10(2), V-N11(13), South bar (33), *M12(1), *N8(2), *O6(2), *Q8(10), *W11(21).
- 23) *Telescopium (Telescopium) telescopium* (Linnaeus).
 Size : 4.05-96.30mm.
 1941 : Mouth of Chilka (2).
 1954 : Barikuda (63), Barkul Island (6), Keshpur. S.W. Balugaon (27) Channel nr. mouth (2), Chiriyakuda (375).
 1955 : Barikuda (2).
 1985 : S.Satpara (2), South bar (2), *Arakuda (1).

Family EPITONIIDAE

Members of this family popularly known as wentletraps, frequent in the soft substratum with admixture of sand and mud. Three genera, namely *Epitonium*, *Acrilla* and *Eglisia* with a total of 10 species in all have been reported from India. Five species were reported from Orissa (Subba Rao *et.al.* 1991) and one of the species, namely *Epitonium hamatulae* Preston was originally described from the Lake near its outer channel. But we could not see any subsequent material of this species.

- 24) *Epitonium hamatulae* Preston.
 Size : 7.80mm.
 1913 : Canal off Barhampur Island (1) (Holotype).

Family LITIOPIDAE

It includes less known minute shells occurring in brackish and marine waters. Two genera namely *Alaba* and *Diala* each with a few species are known from Indian waters. *Alaba blanfordi* is the only species reported from Orissa (Subba Rao *et.al.* 1991). The species is recorded for the first time from the Lake. It occurs in different parts of the lake, excluding the outer channel, but more abundantly in the central part of the Lake.

25) *Alaba blanfordi* A.Adams.

Size : 4.25-16.70mm.

1985 : Honeymoon Island (1), Breakfast Island (1), Nalbano Island (4), Pandnashi (1), Parikuda (3).

1986 : A3(1), B5(1), C4(1), D7(2), D9(3), E5(2), F8(3), H9(1), I10(1), I 13(1), L10(10), N16(2).

1987 : A2(1), B3(21), B5(2), C2(1), C3(4), D4(14),E5(3), F7(1), F8(3), I 10(3), L 14(1), M15(1), N13(1), P8(1), P10(1), T10(2), *C2(1), *N8(31),*O14(7), *Q8(14), *Q14(5), *R15(1).

Family FINELLIDAE

A small family of minute shells which probably prefer brackish waters. The following single species is distributed all over the lake except its outer channel.

26) *Finella virgata* (Philippi).

Size : 3.00-8.70mm

1913 : Rambha Bay (1) Type described as *Litiopa (Alaba) kempfi* Preston; Seruanadi (1) Type described as *Litiopa (Alaba) copiosa* Preston. Sankuda Is., Nalbano, Barkuda, Mahosa, Rambha Bay, Barhampur, between Barnikuda and Satpara (Several).

1985 : Palur Canal (1).

1986 : C2(1), D2(2), D3(2), D4(51).

1987 : N9(1), *B5(2), *C2(5), *D4(33), *D7(1), *E6(5), *E7(7), *F8(2), *G11(2), *N8(5), *R15(1).

Family FOSSARIDAE

A small family with three genera known from India, namely *Fossarus*, *Couthouya* and *Chilkaia*. The last one as the name suggests is a monotypic genus described from this lake. The present one is the only subsequent record from the Lake after its original discovery in 1913.

27) *Chilkaia imitatrix* Preston.

Size : 3.05 mm.

1913 : Mahosa (1) Type; Seruanadi (2).

1987 : *Q8(1).

Family NATICIDAE

It is a large family of carnivorous snails with world wide distribution. The members are mainly marine with a few species extending into brackish and estuarine waters. Five genera with over 40 species in all are reported from India. Nine of these species falling under four genera were reported from Orissa (Subba Rao *et.al.*, 1991). The following four species are recorded from the outer channel of the Lake on the basis of washed out shells. However, we did not collect *N. tigrina* from the lake. Probably no naticid occurs in the Lake proper.

Key to the genera and species

1. Shell globular, thick, solid; umbilicus either completely or partly closed; surface smooth except for spiral striae *Natica* 2.

- Shell ovate, thin; umbilicus deep, funnel shape; surface sculptured with fine spiral ribs
 *Eunaticina (E.coarctata)*
2. Spire low; body whorl with pale broad light band in middle *N.vitellus*
 Spire high, body whorl either spotted or without band in middle 3
3. Axial striations below suture more prominent; colour grayish to light brown, base white
 *N.gualteriana*
- Axial sculpture below suture not prominent; colour white mottled with pinkish brown dots arranged
 in rows *N. tigrina*
- 28) *Natica (Natica) gualteriana* Recluz.
 Size : 8.36-14.28mm.
 1913 : Satpara (2), Chilka (5).
 1985 : Arakuda (1), South bar (1), Uttar bar (3).
 1986 : V10(3), *Palur canal (2).
 1987 : V-N11(1).
- 29) *Natica (Natica) vitellus* (Linnaeus).
 Size : 32.50mm
 1986 : South bar (1).
- 30) *Eunaticina coarctata* (Reeve).
 Size : 10.40mm.
 1986 : V10(1).

Family CASSIDAE

Only two washed out shells are its representation in the fauna. The members of the family are marine and do not occur in the Lake.

Key to the species

Shell with varix on each whorl; body whorl ovate; spire narrowly pointed; suture not canaliculate
 *Phalium areola*

Shell without varices; body whorl globose; spire broadly pointed; suture deeply channeled
 *P.canaliculatum*

- 31) *Phalium (Phalium) areola* (Linnaeus).
 Size : 22.40mm.
 1987 : South bar (1).

- 32) *Phalium (Semicassis) canaliculatum* (Bruguiere).
 Size : 28.60mm.
 1985 : South bar (1).

Order NEOGASTROPODA

Family MURICIDAE

A large family having cosmopolitan distribution. It includes carnivorous molluscs occurring commonly in the marine littoral region and a few species extending into deep waters. Ninety nine species under 28 genera were recorded from India, of which 12 species under 8 genera were from Orissa coast (Subba Rao *et al.*, 1991). A single species namely *Thais lacera* occurs in brackish and estuarine waters. The species occurs mostly in the southern part of the Lake and also in its outer channel. It lives attached to rocks, piles, poles of a jetty and other submerged objects on a muddy substratum. Another species, namely *Cronia contracta* has also been collected, but it is a marine species, which might have been probably washed into the Lake.

Key to the genera and species

Whorls sharply angulate, carinate; body whorl with two rows of spinose tubercles, surface with spiral ribs and grooves, not scabrous; aperture liriate inside on outer lip; columella smooth *Thais (T.lacera)*

Whorls not sharply angulate, not carinate; body whorl without tubercles, but with axial ribs and spiral ribs of scabrous nature; aperture denticulate inside on outer lip, columella with few pustules on anterior part *Cronia (C.contracta)*

- 33) *Thais lacera* (Born).
 Size : 21.90-30.70mm.
 1907 : Gopakuda Island (8).
 1913 : Breakfast Island (2), Off Samal Island (2).
 1914 : Barkuda Island (3), Satpara (2).
 1919 : On shore (30), Barkuda (1)
 1971 : Cheriyaakuda (86).
 1955 : Gopakuda (2), Cheriyaakuda (34), Rambha Bay (4).
 1973 : Kaliyugeswar nr. Balugaon (1).
 1978 : Kalidai (21).
 1985 : Uttarbar (1), Honeymoon Island (19), Breakfast Island (5), Samal Island (4), Sidhakona (2), Birds' Island (4), Parikuca Island (3), Kalijai Island (11), *Rambha (38).
 1986 : A2(6), B2(16), B4(17), B5(1), C4(10), D4(1), D6(3), D7(7), E7(1), E10(1), F8(7), F9(2), G9(14), *Gopakuda (21), *Malaikuda (26), *Parahara (2).
 1987 : B1(8), C3(6), E6(5), *B3(1), *B5(4), *C3(2), *C6(1), *D4(7), *D7(1), *E7(1), *E10(1), *Gopakuda (1).

- 34) *Cronia (Ergalatax) contracta* (Reeve).
 Size : 17.70mm
 1986 : V10(1).

Family MELONGENIDAE

It includes large operculate species which are found in brackish or muddy water in tropics. A total of about 30 species are known world-wide. Four species are recorded from India, of which the common Indian species is recorded from orissa coast and also from the Lake.

- 35) *Pugilina cochlidium* (Linnaeus).
 Size : 50.05-111.85mm.
 1974 : Kaliyugeswar (2).

Family NASSARIIDAE

It includes "mud snails" which occur on intertidal mud flats. Some of the species are found in brackishwaters. World-wide in distribution. Sixty species have been recorded in India under different subgenera of the genera *Nassarius*, *Bullia* and *Cyllene*. Seventeen species were reported from Orissa (Subba Rao *et.al.*, 1991) and 8 of these as given below were collected from the Lake. Three of the species namely *Nassarius jacksonianus*, *N.liviscens* and *N.vittatus* which were earlier reported from the Lake are absent from the present samples.

Some of the Preston's species which were reported by their author from Chilka Lake, have become synonymous with earlier described species. The species, namely *N.stolatus* and *N.foveolatus* which are common in the mangrove swamps are seen in the Lake. *Bullia vittata* prefers sandy beach along the coast and occurs in the sand bar near the mouth. It does not occur in the main part of the Lake.

Key to the genera and species

1. Shell turreted, spire elongate, longer than body whorl; beaded spiral cords below suture *Bullia (B.vittata)*
- *Nassarius 2.*
- Shell not turreted, ovate, spire either equal or shorter than body whorl; spiral cords not beaded.
- *Nassarius 2.*
2. Shell smaller in size, not exceeding 12mm in height; columella without callous, outer lip without denticles 3
- Shell larger in size, exceeding 12mm in height; columella usually calloused, outer lip with denticles inside 5
3. Whorls flat, mildly sculptured 4

- Whorls angulate, strongly sculptured *N.orissaensis*
4. Shell ovately conical, body whorl with a constriction below suture *N.subconstrictus*
- Shell elongately ovate, body whorl without any constriction below suture *N.vittatus*
5. Surface of the shell smooth, sculpture restricted to spiral whorls only; suture channeled
..... *N.foveolatus*
- Surface of the shell sculptured with axial ribs and spiral cords ; suture not channeled 6
6. Parietal callous well developed, posteriorly extended, prominent pre-sutural groove separates the rest of sculpture; axial ribs closely placed *N.livescens*
- Parietal callous less developed, not extending posteriorly; pre-sutural groove absent; axial ribs distantly placed 7
7. Spiral cords few below suture; body whorl with broad chestnut colour bands *N.stolatus*
- Spiral cords absent below suture; body whorl with faint bands on upper part only
..... *N.jacksonianus*
- 36) *Nassarius (Hima) stolatus* (Gmelin).
Size : 5.12-11.98mm.
1914 : Satpara (2), Stn. 107(1), Between Manikpatna and Satpara (1), Seruanadi (2).
1985 : S.Satpara (3), Arakuda (8), South bar (6), Tip of South bar (4), Uttar bar (15), Malud and Siar (3), Kalijai Island (3), Palur canal (1), Nalbano Island (1).
1986 : A2(1), D3(1), D4(1), F8(2), H11(1), V10(12).
1987 : I 10(3), M15(1), N15(1), V-N11(4), *C2(1), *Q8(1), *Q12(1), *W11(8).
- 37) *Nassarius (Zeuxis) foveolatus* (Dunker).
Size : 13.45-14.26mm.
1913 : Stn.115, Chilka Survey (1).
1985 : Uttar bar (1).
1986 : C2(1).
- 38) *Nassarius (Aciculina) subconstrictus* (Sowerby).
Size : 3.12 10.05mm.
1913 : Rambha, Manikpatna, Barnikuda, Nalbano, Satpara, Seruanadi, Balugaon, Barkuda, Barkul (Several).
1954 : Barkuda (11), Barkul(58).
1985 : S.Satpara (12), Gollapara nr. Manikpatna (18), Barkuda Island (2), South bar (2), Tip of South bar (1), Uttar bar (9), Honeymoon Island (13), Samal Island (22), Gaurangapatna nr. Rambha Bay (1), Sidhakona nr. Ghantasila (16), Baradonta and Siar, Rambha (1), N.Pant Nivas, Barçul (19), Parikuda Island (15), Panchkudi nr. parikuda (6), Pandanashi nr. Parikuda (9), Nalbano Island (2), Birds' dropping Island (6), Kalijai Island (13).

1986 : A2(1), B1(2), B2(1), B4(1), C2(7), C4(1), D2(7), D4(15), D8(7), D8(2), E6(2), H9(14), I 10(56), J10(3), K13(3), L10(4), L16(32), M12(1), M17(1), N8(8), N9(1), N10(3), N11(2), O8(3), Q8(2), R9(1), T10(2), V10(4).

1987 : C2(2), C3(1), D4(7), E5(3), E6(1), F7(3), F8(3), G8(1), G12(1), I 10(5), I 14(7), J10(6), K10(5), K15(4), L15(3), M15(3), N9(2), N11(2), N15(1), O8(1), O9(3), P8(1), P10(2), P11(1), Q8(1), S12(1), T10(8), V-N11(5), *C2(9), *D4(17), *E5(1), *E7(11), *F8(2), *H10(3), *K10(3), *K14(4), *M11(2), *M12(6), *N8(9), *N17(1), Q8(12), *Q12(1), *R15(5), *W11(1).

39) *Nassarius (Aciculina) vittatus* (A.Adams).

Size : 7.89-10.90mm.

1954 : Balugaon (1), Baradi E.Balugaon (30), Chilka (3).

40) *Nassarius (Niotha) jacksonianus* (Quoy and Gaimard).

Size : 9.95-15.56mm

1914 : Channel between Satpara and Manikpatna (4).

41) *Nassarius (Niotha) livescens* (Philippi).

Size : 8.94mm

1914 ; Chilka Lake (1).

42) *Nassarius (Pygmaeonassa) orissaensis* (Preston).

Size : 3.00-8.26mm.

1913 : N.E. of Nalbano (14), Balugaon (19), Satpara (26), Barnikuda (22), Rambha Bay (75), Stn. 4(15), Stn.12(3), Stn.21(7), Stn.50(1), Stn.55(20), Stn.84(51), Stn.111(9), Stn.112(1), Stn.134(1), Stn.135(3), Stn.124(3), Stn.127(2), Mouth of Madachuva Bay (13), of Chilka Survey.

1985 : Gollapara nr. Manikpatna (1), Between Nalbano and Birds' dropping Island (16), Birds' dropping Island (17), Kalijai Island (1).

1986 : A2(1), A3(1), B3(4), B5(1), C3(1), C4(3), C6(2), D6(1), D7(1), D8(5), E7(10), E8(9), E9(3), E10(1), F8(8), F9(19), F10(2), F11(17), G9(10), G10(1), G12(4), G13(4), H10(2), I 12(1), J 11(8), J 14(3), K10(3), K 13(1), L 10(4), L14(3), L16(3), M13(7), N8(10), N9(1), N11(3), N16(3), O8(1), Q8(7), R16(6).

1987 : A2(3), B1(1), B2(2), B5(5), B6(2), C3(11), C4(6), C5(4), C6(2), D5(2), D8(6), E7(2), E9(10), E10(7), F8(3), F9(8), F10(6), F11(9), G9(14), G10(4), H10(1), H11(5), I10(3), I13(1), I14(6), J10(3), K10(1), K15(3), L10(3), L15(2), M12(2), M16(1), N12(1), N13(1), O8(1), P13(1), P15(4), Q12(6), R12(2), S12(2), S15(3), *B2(8), *B3(1), *C3(1), *C5(1), *D6(7), *E8(5), *F8(2), *G11(9), *I12(2), *K10(2), *K12(2), *K14(1), *M11(1), *M12(7), *O12(4), *O16(2), *Q14(9).

43) *Bullia (Dorsanum) vittata* (Linnaeus).

Size : 14.75-37.08mm.

1913 : Chilka survey (1).

1985 : South bar (9).

1986 : *Prayagi Coast (6).

Family OLIVIDAE

Shells are small and glossy. Found in the sandy beaches of tropical seas. The collections include some beach washed shells of the following species. The members of this family are normally absent in the Lake.

Key to the genera and species

Shell narrowly cylindrical; columella not calloused; aperture narrow throughout *Oliva (O.oliva)*

Shell broadly cylindrical; columella heavily calloused which extends posteriorly; aperture broad anteriorly *Olivancillaria (O.gibbosa)*.

- 44) *Oliva (Oliva) oliva* (Linnaeus).
 Size : 14.56-21.30mm.
 1985 : South bar (1), Tip of South bar (2).
 1986 : Prayagi Coast (2).
- 45) *Olivancillaria gibbosa* (Born).
 Size : 43.68mm.
 1954 : Chilka Lake (1).
 1985 : Uttar bar (1).

Family CANCELLARIIDAE

A tropical marine family with shells of moderate size. About 8 species under two genera namely, *Cancellaria* and *Trigonostoma* are known from India. Three species were reported from Orissa, but only one species has been collected from the Lake.

- 46) *Cancellaria elegans* Sowerby.
 Size : 26.10mm.
 1985 : Uttar bar (1).

Family MARGINELLIDAE

The members of this large family are mostly small, sand dwellers of tropical seas and have highly polished shells. The knowledge of Indian species, so far described under two genera namely *Marginella* and *Persicula* is far from satisfactory. These genera are represented by one species each from the Orissa coast. The representatives of the family do not occur in the Lake, but included here on the basis of a washed out shell collected from near the mouth.

- 47) *Marginella elegans* (Gmelin).
 Size : 12.15mm.
 1985 : Tip of South bar (1).

Subclass OPISTHOBRANCHIA

The following six families include Opisthobranch molluscs, some of which can be located only after a very careful examination of the area concerned. The present collections included material belonging to three families, namely, Pyramidellidae, Atyidae and Cylichnidae. The rest of the families namely Stiligeridae, Elysiidae and Cuthonidae were recorded by earlier workers.

Order ENTOMOTAENIATA

Family PYRAMIDELLIDAE

Shells are minute, generally not exceeding 10mm; and have characteristic pyramidal shape. The species occur in marine, estuarine and brackish waters. Some of the species are parasitic on other molluscs, especially bivalves. About 20 species under 5 genera were reported from India. Of these, 14 species under the genera *Pyramidella*, *Pyrgulina*, *Odostomia*, *Syrnola* and *Turbonilla* were reported from Orissa. All the five species listed below were originally described from the Lake.

Key to the genera and species

1. Shell smooth; columella with tooth like fold2
Shell sculptured; columella without fold, if present concealed in it3
 2. Whorls rounded, upper part mildly angulate *Odostomia (O.chilkaensis)*
Whorls flattened, not angulate *Syrnola* Not recorded from the lake
 3. Shell pupiform, cancellate; columella with concealed plait 4. *Pyrgulina*
Shell not pupiform, slender; columella smooth *Turbonilla (T.rambhaensis)*
 4. Shell elongate, subulate, spire with more than 7 whorls, suture shallow *P.ecclesia*
Shell short, not subulate; spire with less than 7 whorls; suture deep5
 5. Shell linear, tumid; whorls angulate, rapidly increasing; spiral striae fine *P.nadiensis*
Shell broad; whorls rounded, gradually increasing; spiral striae coarse *P.humilis*
- 48) *Odostomia chilkaensis* Preston.
Size : 3.60-7.09mm. Manikpatna (2) (Type locality), Mahosa (1).
- 49) *Pyrgulina ecclesia* (Preston).
Size : 3.49.
1913 : Breakfast Island (1) (Type), Madarchua Bay (1).

- 50) *Pyrgulina humilis* (Preston).
Size : 1.75-6.34mm.
1913 : Off Barhampur Island, Mahosa, W.Satpara, Nalbano, Seruanadi, between Barnikuda and Satpara. S.Kalidai, of Barnikuda (26).
- 51) *Pyrgulina nadiensis* (Preston).
Size : 2.90-4.60mm
1913 : Seruanadi (7) Type; Mahosa (1), Satpara (1).
1987 : D3(1), I10(1), J10(2), *N8(5), *Q8(2), *Q14(7).
- 52) *Turbonilla rambhaensis* (Preston).
Size : 5.00-6.45mm.
1913 : S.E.Nalbano (1), Rambha Bay (1).
1986 : F8(2), *D4(1).

Order CEPHALASPIDEA
Family ATYIDAE

A small family of widely distributed molluscs found in marine and estuarine waters. A few species of the genera, namely *Atys* and *Haminoea* were reported from India. Each genus is represented by a single species in Orissa. The former occurs in the marine environment, whereas the latter generally prefers estuarine muddy habitats.

- 53) *Haminoea crocata* Pease.
Size : 4.10-12.80mm.
1913 : Satpara (7), Seruanadi (1).

Family CYLICHNIDAE

The members of the family are marine inhabitants and have small shells. The genera *Cylichna* and *Tornatina* were reported from India. Two species of the latter genus were described from the Lake, which however were treated later as synonyms. The following species is common in the outer channel as well as in the central part of the Lake.

- 54) *Tornatina estriata* Preston.
Size : 3.25-3.86.
1913 : Manikpatna (1) (Type described as *Tornatina soror*). Off Balugaon (1) (Type), Cheriya Is., Satpara, Seruanadi, off Barnikuda, Barhampur Is., Nalbano, Mahosa, Kaliidai (several).
1985 : Between Bird's dropping Island and Nalbano (1).
1986 : K12 (1).
1987 : E10(1), H9(1), H11(1), I10(1), I 13(1), J14(2), L10(1), N12(1), S9(2), T10(1), *G11(4), *K14(1), *O12(6), *Q8(3).

Order SACOGLOSSA
Family STILIGERIDAE

A small family of nudibranchs. The only species reported from the Lake is *Stilger pica* Annandale & Prasad, which is represented by its type material. No subsequent material was collected.

Family ELYSIIDAE

A single species *Elysia chilkaensis* Eliot was described from Mahosa in the outer channel of the lake. Only two species were reported from India.

Order NUDIBRANCHIA
Family CUTHONIDAE

The genus *Cuthona* is represented by three species from brackish or estuarine waters in India. *Cuthona henrici* Eliot was described from 'off Ghantasila' in the main part of the Lake.

Subclass PULMONATA
Order BASOMMATOPHORA
Family ELLOBIIDAE

The family includes air breathing pulmonates, which live mostly in the supra littoral marine or estuarine environment. The family is not represented in the Lake, but included here on the basis of a single washed out shell.

- 55) *Melampus ceylonicus* Petit.
Size : 10.90mm.
1987 : Muthupet (1).

Family LYMNAEIDAE and PLANORBIDAE

Both these common freshwater families of India are represented by a few dead shells, which probably might have been washed into the Lake. No live specimens were collected during the expeditions.

Family LYMNAEIDAE

- 56) *Lymnaea (Pseudosuccinea) luteola* Lamarck *f. typica* Lamark.
Size : 13.25-25.00mm. Chilka (7)
Lymnaea (Pseudosuccinea) luteola f. impura Troschel.
Size : 11.20-16.26mm.
: Barkuda Island (4).
Lymnaea (Pseudosuccinea) luteola f. ovalis Gray. Size : 12.75-19.10mm.
: Rambha (9).

Family PLANORBIDAE

- 57) *Indoplanorbis exustus* (Deshayes).
 Size : 4.05 7.75 mm.
 1986 : *Rambha Bay (3), *Ghode Daubi (2).

Order STYLOMMATOPHORA

Land molluscs are represented by five families namely, Enidae, Succineidae, Subulinidae, Streptaxidae and Ariophantidae. All these families have a wide distribution and do not show any characteristic feature as far as the islands in the Lake are concerned. All the collections have originated from Barkuda Island. The following species were collected by the recent expeditions. *Rachistia praetermissus* was reported to be abundant on the leaves of shrubs on Barkuda Island (Godwin-Austen, 1877). But only an empty shell was collected during the present expeditions. *Euplecta infausta* (Blanford) was collected by Annandale (1916). *Gulella rambhaensis* Ray was described from Rambha on the basis of a partly damaged shell. It may however, be mentioned that no serious effort was made to collect land molluscs during the recent expeditions.

Family ENIDAE

- 58) *Rachistia praetermissus* (Blanford).
 Size : 20.60mm.
 1985 : Umbakona, N.Ghantasila, Rambha (1).

Family SUCCINEIDAE

- 59) *Succinea daucina* Pfeiffer f. *hraswasikhara* Rao
 Size : 2.35-5.60mm.
 1985 : Siddhakona, N.Gantasila Hill (23).

Family SUBULINIDAE

- 60) *Lamellaxis gracile* (Hutton)
 Size : 4.40-11.25 Barkuda Island (2).

Family STREPTAXIDAE

- 61) *Huttonella bicolor* (Hutton)
 Size : 3.9-7.0.
 1920 : Barkuda Island (5), incl. Type described as *Ennea bicolor* race *barkudensis* Annandale & Prashad.
- 62) *Huttonella rambhaensis* Ray.
 Size : 2.50mm.
 1985 : Beach of Rambha Bay (1).

Family ARIOPHANTIDAE

- 63) *Euplecta infausta* (Blanford).
 Size : 10.7-13.5mm.
 1916 : Barkuda Island (2).

Class BIVALVIA
 Order ARCOIDA
 Family ARCIDAE

It is a large family with a tropical distribution. Majority of the species live in marine waters, while a few occur in estuarine and freshwaters. Some burrow into the substratum and some live as epifauna and secrete byssus threads for anchor. Shells are heavy and solid with numerous taxodont teeth on the hinge. The family includes about 200 species, of which 32 species under 6 genera are reported from India. Seven species under 3 genera were recorded from Orissa. The following species are available in the Lake.

Key to the genera and species

1. Shell thick, equivalve; surface sculptured with nodulose radial ribs *Anadara* 2
 Shell thin, inequivalve; surface sculptured with flat radial ribs *Scapharca* (*S.deyrollei*)
2. Shell rhomboidal in shape, higher than long; ligamental area broad; prominent keel at posterior part; ribs on posterior slope not nodulose *A.rhombea*
 Shell not rhomboidal, more elongate; keel on posterior part absent; ribs nodulose *A.granosa*

- 64) *Anadara granosa* (Linnaeus).
 Size : 20.08-52.60mm
 1913 : Barkuda, Cheriya kuda, Samal Island (19 ex., 12v.), Rambha (11).
 1985 : Arakuda (1v), South bar (2v), Tip of South bar (1v), Uttar bar (1v), *Rambha (2v).
 1986 : B3 (2v), South bar (3v), *Palur canal (1v).
 1987 : B4 (1v), C6(1v), E9(1v), South bar (1v).

- 65) *Anadara rhombea* (Born).
 Size : 13.61-35.72mm.
 1985 : Arakuda (1v), *Arakuda (1v).
 1986 : South bar (1v), *Palur canal (1v).
 1987 : South bar (1v).

- 66) *Scapharca deyrollei* Jousseume.
 Size : 27.05-49.65mm.
 1985 : Tip of South bar (2v).
 1986 : South bar (3v).

Family NOETIIDAE

Shells bear some resemblance to those of Arcidae. A single genus with two species is known from India, but only the following species seems to occur in the crevices of mud covered rocks and oyster beds in the outer channel.

- 67) *Striarca lactea* (Linnaeus).
Size : 9.60-30.35mm.
1913 : Satpara, Barhampur (3).

Family GLYCYMERIDIDAE

Shells bear resemblance to those of Arcidae. These live buried in the shallow sandy bottoms of Indo-Pacific region. About 150 species are known of which 3 species under the genus *Glycymeris* are reported from India. The following species, which may not be treated as occurring in the Lake is included on the basis of an empty shell collected from the sand bar near its mouth.

- 68) *Glycymeris tenuicostatus* (Reeve).
Size : 13.00-31.52mm.
1985 : South bar (1v), Tip of South bar (1v).

Order MYTILOIDA
Family MYTILIDAE

These are true mussels, which are abundant in estuarine and marine waters, generally attached to the substratum or any other structure by byssus. About 16 species under 8 genera are reported from India. Of these, 6 species under 4 genera are recorded from Orissa (Subba Rao, *et.al.* 1991). There are 4 species in the Lake as given below. Except *M.phlippinarum* the other three species are common in the Lake. Annandale and Kemp (1916) mentioned that *Perna viridis* the common green mussel of India, would not survive in the Lake. But the collection of a few live specimens during recent expeditions suggest that the species is actually living in the Lake. Indirectly it points out the hydrological changes in the Lake.

Key to the genera and species

- 1. Shell thick, large, exceeds 30mm in length; umbo situated at anterior end; surface covered with brown periostracum; green in colour; concentrically striated *Perna (P.viridis)*

Shell thin, sometimes transparent; small, not exceeding 30mm in length; umbo situated behind anterior end; surface not covered with periostracum, radially striated *Modiolus 2*
- 2. Ventral margin concave in middle, dorsal margin evenly arched; surface with out undulating markings *M.striatulus*

Ventral margin straight; dorsal margin not arched; surface with pinkish brown undulating markings *M.undulatus*

- 69) *Perna viridis* (Linnaeus).
Size : 09.15 mm.
1913 : Manikpatna (1)
1985 : Specimens damaged
- 70) *Modiolus (Modiolus) striatulus* Hanley.
Size : 12.05-25.48mm.
1913 : Barkul, Barkuda, Breakfast Island, Satpara, Barnikuda, Malidaikuda, Kalidai, Manikpatna, Rambha (Several) Kalijai (includes types described as *Modiola jenkinsi* Preston, *M. annandalei* Preston, *M. celator* Preston and *M. emarginata* Preston).
1975 : Balipatam (1).
1984 : Barkul (7).
1985 : Barkul (57), Tip of South bar (16), Parahara (2), Birds' dropping Island (22), *C2(2), *D7(1), *E7(2), *I9(1), *K10(2), *K12(1), *N8(1), *O12(2).
1986 ; B5(20), M17(1),, *Gopakuda (8).
1987 : D5(1), G13(2), K15(8v), L16(5v), O9(2).
- 71) *Modiolus undulatus* (Dunker).
Size : 7.45-19.10.
1913 : Nalbano, Cherriya Is., Seruanadi, Balugaon, Rambha, Off Samal Is. (Several) (Including Types described as *Modiola chilkaensis* Preston and *M. undulata* var. *crassicostata* Preston).
1954 : Kalidai Is. (1), Balugaon (13), Off Kankarpara Is. (19).
1955 : Balugaon (Several).
1973 : Kaliyugeswar nr. Balugaon (Several).
1984 : Brahmaguri, Barakudi (6).
1985 : Satpara (59), Gollapara nr. Pansapara (1), Nuapara (23), Breakfast Island(24), Honeymoon Island (45), Samal Island(6), Birds' dropping Island (10), Sidhakkona (1), Between Malud and Siar (1), Palur Canal (2), Baradonta and Siar (3), N.Panth Nivas, Barkul (13), Panchkudi (5), Parikuda (23), Pandanashi (6), Kalijai (2), Nalbano (7).
1986 : A2(12), A3(6), B2(20),, B3(30), B4(54), B5(16), C2(9), C4(6), D2(6), D3(25), D4(4), D6(22), E8(2), E10(1), F8(1), F11(1), G13(30), H10(4), I10(20), J11(Iv), J14(40), K10(1), K12(5), L11(35), L14(32), L16(96), N8(1), N10(15), N14(25), P14(2), Nalbano (6).
1987 : A2(15), B1(2), B3(1v), B4(1), b5(7), B6(1), C3(45), C4(21), C5(14), C6(1), D5(7), D8(28), E7(27), E8(8), E9(13), E10(16), F9(24), F10(7), F11(12), G9(13), G10(12), G12(1), H10(46), H11(10), I10(9), J10(2), J11(10), J14(2), K10(1), K13(9), L10(2), L11(20), L14(9), L15(25), M12(8), M13(12), M15(14), M16(10), M17(5), N8(22), N9(5), N11(11), N12(16), N14(25), N16(8), O8(50), P10(2), P11(6), P12(6), P13(8), P14(4), Q12(10), Q13(14), R12(21), R13(5), R14(9), S12(6), S16(12), Nimnashi (3), *Gopakuda (30), *Malatikuda (6), *C2(1), *D6(1v), *E7(1), H10(1), *I9(2), *K10(4), *K15(2), *M11(1), *M12(1), *N8(8), *N9(1), *N17(1), *O16(2), *Q8(1), *R15(1), *No data (6).
- 72) *Modiolus philippinarum* Hanley.
Size : 39.32mm.
1913 : Between Satpara and Barnikuda (1v).

Order PTERIOIDA
Family ANOMIDAE

Shells are thin, semitranslucent and live attached to rocks, other shells and mangroves. Majority of the Indian records of this family are either from estuaries or mangroves. Three genera, namely *Anomia*, *Enigmonia* and *Placenta* and four species were recorded from India. The last mentioned is represented by a single species *Placenta placenta*, which is common in certain lagoons and estuaries of India. It occurs in the southern sector and outer channel of the Lake, but does not support any fishery.

Key to the genera and species

Shell orbicular, large, exceeding 40mm in length, compressed, upper valve slightly inflated, lower valve flat; without hole *Placuna (P.placenta)*

Shell irregular in shape, small, not exceeding 40mm in length, upper valve more inflated, lower valve flat with hole through which byssus passes *Anomia (A.achaeus)*

73) *Anomia achaeus* Gray.
Size : 20.90-26.45mm.
1986 : South bar (2v).
1987 : N8(1v), 59(2).

74) *Placuna placenta* (Linnaeus).
Size : 18.06-90.38mm.
1986 : O8(2), B3(Several pieces may be 5).
1987 : B4(2), C6(1), N8(3).

Family LIMIDAE

Members of this family are found in marine waters and there are no records from the Lake. Empty valves of the species given below may have been washed into the Lake.

75) *Ctenoides annulata* (Lamarck).
Size : 7.06mm.
Chilka Lake (1).

Family OSTREIDAE

'True oysters' are well known in many parts of the world due to their edible value. The shells are solid and live attached by one valve to the substratum or any other structures, like rocks, jetty piles other shells etc. in estuarine, brackish and marine waters. Besides the edible value of its flesh, oyster shells are used in the preparation of poultry feed. A large number of these oyster shells are collected from the nearby Bahuda estuary. The systematics of the family is still in a confused state. About 12 species under three genera, namely *Crassostrea*, *Saccostrea* and *Lopha* were reported from Indian waters. Seven species of these genera were reported from Orissa. The following two species, which are also common in other Indian estuaries occur in the outer Channel near Manikpatna and rocks near the mouth of the Lake.

Key to the genera and species

Shell large exceeding 50mm in length, lower valve concave, margin not crenulate, no tubercles on either side of umbonal groove *Crassostrea (C.cuttackensis)*

Shell small not exceeding 50mm in length; lower valve with its margin crenulate; rows of tubercles present on either side of the umbonal grove *Saccostrea (S.cucullata)*

- 76) *Crassostrea cuttackensis* (Newton and Smith).
 Size : 19.25-66.62mm.
 1913-1914 : Manikpatna (7, 11v.), Outer Channel (6v).
 1985 ; Uttar bar (12v), * Arakuda (2v).
 1986 : R9(2).
 1987 : South bar (6v).

- 77) *Saccostrea cucullata* (Born).
 Size : 22.65-27.82mm.
 1913-1914 : Chilka Lake (2).
 1986 : South bar (10).

Family GRYPHAEIDAE

These are commonly known as honeycomb oysters, and occur in shallow water to 30m in the Indo-Pacific region. Annandale and Kemp (1916) recorded *Hytotissa hyotis* (Linnaeus) at Manikpatna in the outer channel, probably based on empty valves. There is less likelihood of its occurrence in the Lake.

- 78) *Hytotissa hyotis* (Linnaeus).
 Size : 17.65 mm.
 1913 : Manikpatna (1).

Order UNIONOIDA
 Family UNIONIDAE

It includes freshwater mussels, which normally occur in stagnant water ponds or lakes. One empty shell was collected as given below, which suggests that the species has not established itself in the Lake.

- 79) *Lamellidens marginalis* (Lamarck).
 Size : 66.30mm.
 1986 : *Kentakuda nr. Satpara (1).

Order VENEROIDA
 Family UNGULINIDAE

A small obscure family with two genera, namely *Diplodonta* and *Felania* in Indian waters. Shells are thin and rounded and occur from shallow to deep waters. Eight species are reported from India, of which

majority (6 species) are from Orissa. The family has a good representation in the Lake. The following five species are described from the Lake. Only three species could be collected during the recent expeditions. *Diplodonta annandalei* was found to be abundant during October-March in the Southern sector and Outer channel (Patnaik, 1971).

Key to the genera and species

1. Anterior muscle scar sinuate, less elongate, narrower than posterior *Diplodonta* 2
 Anterior muscle scar not sinuate, more elongate than posterior *Felania* 3
2. Shell trigonal; umbo large; dorsal margin angularly arched, anterior margin not produced
 *D. barhampurensis*
 Shell rhomboidal; umbo small, depressed; dorsal margin not arched, anterior margin produced ..
 *D. satparaensis*
3. Shell small, not exceeding 5mm in length, obliquely ovate *F. ovalis*
 Shell large exceeding 5mm in length, rounded 4
4. Umbo elevated, posterior margin suddenly slopes, rounded; umbonal area light brown; outer surface olive brown *F. chilkaensis*
 Umbo not elevated; posterior margin gradually slopes, making angle with ventral margin; outer surface as well as interior white *F. annandalei*

80) *Diplodonta barhampurensis* Preston.

Size : 14.50mm.

1913 : Channel of Barhampur Island (1) (Type).

81) *Diplodonta satparaensis* Preston.

Size : 9.56-23.72mm.

1913 : Channel between Satpara and Barhampur (2) (Type & Cotype) Barhampur Island, Satpara, Kalidai, (28).

1986 : I 10(1v), L 10(1v), O8(1v), Q8(1), R9(2v), U10(11v).

1987 : O8(4v), L10(1), *M11(2), *W11(1v).

82) *Felania annandalei* Preston. Size : 2.70-12.76mm.

1913 : Between Barnikuda and Nalbano (1v) (Type), Malidaikuda, Barnikuda, Satpara Bay, Kalidai, Patsahanipur (several).

83) *Felania chilkaensis* Preston. Size ; 9.90-13.94 mm.

1913 : S. Satpara, Manikpatna, Barkul, Outer bar (31).

1985 : South bar (1).

84) *Felania ovalis* Preston.

Size : 2.70-12.76mm.

1913 : Manikpatna, (Type locality), Channel between Satpara and Barhampur, outer bar S.W. mouth (1, 3v).

1986 : G9(1v), T10(8v), V10(4v).

1987 : P8(1), U10(1v), T10(1), *W11(1v).

Family KELLIIDAE

Members of this family generally occurs in marine substrate. Of the four genera, namely *Kellia*, *Bornia*, *Nesobornia* and *Scintillula* recorded in the Indian ocean, only first mentioned was recorded from Chilka Lake. *Kellia chilkaensis* Preston and *K.mahosaensis* Preston were originally described from the Lake, but there are no subsequent collections of the latter and it is not possible to ascertain its present status.

Key to the species

Shell equilateral, transversely oblong; ventral margin evenly curved; umbo less prominent
 *Kellia chilkaensis*

Shell inequilateral, trigonally oblong; ventral margin contracted in middle; umbo more prominent
 *K. mahosaensis*

85) *Kellia chilkaensis* Preston.

Size : 3.70-4.10mm.

1913 : Channel between Satpara and Barhampur Island (4) S. Kalidai, Mahosa, Patsahanipur.

Family GALEOMMATIDAE

It is a small family having two genera *Galeomma* & *Scintilla* and 10 species in Indian waters. The species normally occur in sandy and muddy bottoms in marine environment. *Scintilla chilkaensis* Preston was described from Mahosa, in the outer Channel of the Lake. As the type itself was based on an empty shell and as no subsequent collections were made, it is not possible to confirm the existence of this species in the Lake.

86) *Scintilla chilkaensis* Preston.

Size : 5.75-7.00mm

1913 : Mahosa (Type Locality), Satpara (3).

Family CARDITIDAE

The members of the family, commonly known as 'False cockles' are shallow water inhabitants of the sea. Shells are thick with strong radial ribs and crenulate margins. These cockles do not occur in the Lake, but dead shells are cast ashore on the sand bars near the mouth.

- 87) *Cardites antiquata* (Linnaeus).
 Size : 17.85-36.35mm.
 1954 : Tonda nr. Satpara (14v).
 1955 : Manikpatna (11v).
 1985 : South bar (4v).
 1986 : South bar (4v), *W11(1v).

Family CARDIIDAE

It is one of the largest family with several species, which are commonly known as cockles. The systematics of Indian cockles are not precisely known. About 30 species under 6 genera were reported from India. Four species under 3 genera were recorded from Orissa coast. Shells of three species washed on to the sand bar in the outer Channel near the Lake's mouth were collected. These do not occur in the Lake.

Key to the genera and species

1. Ribs faintly developed; umbonal area smooth; shell ventricose, gaping posteriorly *Laevicardium (L. apertum)*
 *Laevicardium (L. apertum)*
- Ribs well developed, either nodose or spinose; umbonal area ribbed; shell either rounded or oblong
 *Acanthocardia 2*
2. Shell thick, oblong, longer than high; ribs flat; valves less inflated *A. lata*
 Shell thin, height is almost equal to length; rounded in shape; ribs rounded; valves more inflated
 *A. coronata*

- 88) *Acanthocardia coronata* (Schroeter).
 Size : 7.62-33.52mm.
 1986 : South bar (1v).
 1987 : N8(1).
- 89) *Acanthocardia lata* (Born). Size : 42.09mm.
 1954 : Satpara and Manikpatna (1v).
 1955 : Satpara (1v).
 1987 : South bar (1v).
- 90) *Laevicardium (Fulvia) apertum* (Bruguiere).
 Size : 7.20-9.45mm.
 1939 : Outer bar close to mouth (1).

Family MACTRIDAE

These are commonly known as trough or 'surf' clams and have cosmopolitan distribution. There

are over 100 species in all. About 20 species under two genera, namely *Mactra* and *Spisula* were recorded from India. Eleven species were reported from Orissa coast, but 5 species, all dead shells, were known from the Lake. *Spisula annandalei* Preston, which was originally described from the Lake, is not known by subsequent collections. It is not possible to comment on its present status.

Key to the genera and species

1. Shell with resilium and ligament separated by lamella; dorsal part not gaping; pallial sinus small ***Mactra* 2**
 Shell with resilium and ligament not separated by lamella; dorsal part gaping; pallial sinus large ***Spisula (S.annandalei)***
 2. Lunule and escutcheon separated by a groove ***M. turgida***
 Lunule and escutcheon not separated by a groove 3
 3. Dorsal margin on either side of umbo concentrically grooved; rest of the shell surface smooth, with vertical brown bands ***M. grandis***
 Dorsal margin without concentric grooves; surface without bands 4
 4. Shell transversely triangular, thick, straw in colour; interior violet; pallial sinus deep ***M. luzonica***
 Shell ovately triangular, thin, white or light cream in colour, interior white except in umbonal area; pallial sinus shallow ***M. mera***
- 91) *Mactra (Mactra). grandis* Gmelin
 Size : 21.50-44.36 mm.
 1955 : Kalupara ghat (2v).
- 92) *Mactra (Mactra) luzonica* Deshayes.
 Size : 20.95-44.40 mm.
 1955 : Kaluparaghat (1v).
 1985 : South bar (10v).
 1986 : South bar (3v).
 1987 : South bar (3v).
- 93) *Mactra (Mactra) mera* Deshayes.
 Size : 32.05-38.92 mm.
 1987 : South bar (2v).

- 94) *Mactra (Coelomacra) turgida* Gmelin.
Size : 70.25 mm.
1987 : South bar (1v).
- 95) *Spisula (Standella) annandalei* Preston.
Size : 13.20-24.05 mm.
1913 : Chilka Lake, Nalbano (Type) etc. (3 & 1v).

Family SOLENIDAE

A large family of burrowing forms with a world wide distribution. The genus *Solen* with 6 species are recorded from India. These were recorded from intertidal mudflats or sandy beaches. Two species namely, *Solen annandalei* Preston and *S. kempi* Preston were originally described from the lake. The former species coexists with *Neosolen aquaedulcioris*. It occurs in the sandy bottom at Nalbano and Satpara. The species of *Solen* are generally rare.

Key to the species

Shell linear, narrow, posterior part narrower than anterior; posterodorsal margin angular .. *Solen kempi*
Shell broader, posterior part equal to anterior; posterodorsal margin rounded*S.annandalei*

- 96) *Solen annandalei* Preston.
Size : 48.42 mm.
1913 : Satpara Bay (Type), (2).
- 97) *Solen kempi* Preston
Size : 22.45-24.92 mm.
1913 : Patsahanipur (Type) (1), Satpara (1).
1987 : N8 (1, 1v).

Family CULTELLIDAE

A moderate family with world wide distribution. Majority of the species prefer marine muddy substrate with admixture of sand. Five genera namely, *Cultellus*, *Pharella*, *Siliqua*, *Tanysiphon* and *Neosolen* with a total of 10 species were reported from India. The species of the last mentioned two genera occur in brackish or estuarine waters. Three genera, namely *Pharella*, *Siliqua* and *Neosolen* and 5 species were reported from Orissa coast. Among the following three species given below only *N.aquaedulcioris* occurs throughout the Lake except in the Northern Sector. The other two species are marine and their shells are washed into the Lake.

Key to the genera and species

1. Shell subcylindrical, transparent; anterior margin truncate, followed by deep groove, posterior end rounded; pallial sinus small, shallow *Neosolen (N.aquaedulcioris)*

- Shell oblong, compressed not translucent; both anterior and posterior ends rounded; pallial sinus deep 2
2. Shell with internal rib extending from umbo to ventral margin; outer surface light violet with four white radiating bands *Siliqua (S.radiata)*
- Shell with small internal rib above anterior muscle scar; outer surface white without radiating bands *Cultellus (C.subellipticus)*
- 98) *Cultellus subellipticus* Dunker.
Size : 97.80-29.95 mm.
1986 : N8(1).
1987 ; N8(1), N12(1), T10(1).
- 99) *Neosolen aquaedulcioris* Ghosh.
Size : 9.40-26.05 mm..
1913 : Off Samal Island (50), (Syntype), off Balugaon, of Barkuda (40), Rambha (12).
1985 : Samal Island (4), Gourangaapatna (13), Siddhakona (3), Umbakona (3), Pandanashi (2), Birds' dropping Island (15), 1 km. Birds' dropping Island (13), Kalijai Island (4).
1986 : A2(12), B2(2), B3(20), B4(24), B5(14), B6(2), C3(17), D6(1), D7(1), D8(4), E5(1), E7(1), E8(2), E9(8), E10(17), F8(4), F9(2v), F11(1), G10(1v), H10(4), H11(36), I12(1v), K10(1), K12(12), L11(10), M12(15), N8(1).
1987 : E10(1), F11(1v), K10(1v), N8(1), N9(2), P8(3), Q8(1), *B2(29), *B5(1), *C3(2), *C4(6), *C5(4), *C6(4), *D6(2,2v), *D7(2), *D8(6), *E9(6), *F8(5), *F9(18), *T12(11), *K12(6), *M12(2).
- 100) *Siliqua (Siliqua) radiata* (Linnaeus).
Size : 32.95-48.10 mm.
1954 : Mouth of Chilka (1), Tonda Sand hills, nr. Satpara (4v).
1985 : Uttar bar (1).
1987 : U 10(2).

Family TELLINIDAE

It is a large family with several species distributed world-wide in muddy or sandy mud substrate. Five genera which include about 48 species were reported from India. The genera *Tellina*, *Macoma*, *Strigilla* and *Apolymetis* and 13 species were reported from Orissa. The following five species are recorded in the Lake. Three of these are known by their type collections only. As no subsequent collections were made it is not possible to comment on their present status. Of the two species of *Macoma*, *M. birmanica* is common in the Lake and collections have been made from a number of stations whereas the occurrence of *M. truncata* in the lake is doubtful.

Key to the genera and species

1. Shell with one lateral teeth at least in each valve; posterior end normal *Tellina* ..2

- Shell without lateral teeth; posterior end twisted *Macoma*..3
2. Shell ovately oblong; umbonal region pink in colour; surface shining *T. iridescence*
- Shell elongately ovate; umbonal region white; surface not shining *T. texturata*
3. Shell elongately ovate; pallial sinus large occupies entire shell reaching anterior muscle scar
..... *M. birmanica*
- Shell ovately trigonal; pallial sinus occupies half the area, not reaching anterior muscle scar
..... *M. truncata*
101. *Tellina (Pharaonella) iridescens* (Benson).
Size : 6.75-15.40mm.
1913 : Channel off Barhampur (1)*, Chilka Lake (1), *(Type described as *T. chilkaensis* Preston).
- 102) *Tellina (Omala) texturata* Sowerby.
Size : 7.00-9.70mm.
: Chilka Lake (1, 2v) (Type described as *Tellina confusa* Preston).
- 103) *Tellina barhampurensis* Preston.
1913 : Chanel between Satpara and Barhampur (1v) (Type).
- Remarks* : May belongs to Semelidae
- 104) *Macoma (Psammacoma) birmanica* (Philippi).
Size : 5.90-27.82.
1985 : Nuapara (14), Birds' dropping Island (1), Kalijai Island (9).
- 1986 : B4(1), D7(1), D8(7), E8(2), E9(2), E10(2), F9(5), F11(1), G9(2), G10(10), H10(25), H11(11), I 10(1), I 12(2), I 13(1), J 11(10), K 12(10), L10(1), L 11(19), L 14(1), M 12(6), M13(12, 1v), N 10(2v) N11(73), N12(11), N14(3v), O8(1), P 14(2, 1v), R 16(1, 3v).
- 1987 : D8(1), E8(2), F9(3), G 10(3), H 10(2, 1v), G 12(1v), H 11(2), J 10(1), J11 (1), K 10(14, 1v), K 12(2), L 10(13), L 11(7), L 16(1), M 10(11), M 12(1, 1v), M13(1), N 8 (1), N11(2v), N 12(13, 1v), N 13 (4, 2v), O 8(1), P 8(1), P 10(1v), P 12(9, 1v), Q 12 (5, 1v), R 12(9), R 13(3), R 14(1v), S 12(1, 1v), S 14 (2, 1v).
- *F 9(1), *I 12(7), *K 10(2), *K 12(3), *M 11(2), *M 12(34), *O 12(18), *Q 12(1).
- 105) *Macoma (Psammacoma) truncata* (Jonas).
Size : 44.48-48.46mm.
1955 : Kaluparaghat (1v).

Family DONACIDAE

The members of this family occur in intertidal sandy beaches. There are about 60 species with brightly coloured polymorphic shells. A few shore washed valves were collected and no species occurs in the Lake.

Key to the species

Shell thick, trigonal, inflated; umbo nearly in middle; surface strongly sculptured; prominent keel extends from umbo to posteroventral margin, truncate *Donax scortum*

Shell thin, elongately ovate, umbo shifted far beyond posterior part; keel absent; posteroventral margin rounded *D. pulchellus*

106) *Donax (Donax) pulchella* Hanley.

Size : 4.46-11.82mm.

1913 : Outer channel (1v).

107) *Donax (Hecuba) scortum* (Linnaeus),.

Size : 41.28-73.30mm.

1985 : Tip of South bar (1v), *Arakuda (1v).

1986 : South bar (5v).

Family PSAMMOBIIDAE

The members commonly known as 'sunset clams', prefer admixture of sand and mud in the marine environment. A few species may occur in mudflats in brackish water. The family with a cosmopolitan distribution has 12 species and four genera in India. Four species occur along the Orissa coast. One of these species, namely, *Gari (Psammobia) mahosaensis* Preston has its type locality in the Lake. But there are no subsequent collections after its original discovery. Empty valves of *Sanguinolaria (Soletellina) acuminata* were collected from the sand bars near the mouth of the Lake.

Key to the genera and species

Shell inflated, gap on posterior end narrow; posterior end broader than anterior
..... *Gari (G. mahosaensis)*

Shell much compressed; gap on posterior end broad; posterior end narrower than anterior
..... *Sanguinolaria (S. acuminata)*

108) *Gari (Psammobia) mahosaensis* Preston.

Size : 3.35-8.90.

1913 : Southwards Mahosa (1) (Type), Mahosa, Barhampur, Satpara, Barnikuda (7, 3v).

- 109) *Sanguinolaria (Soletellina) acuminata* Deshayes.
 Size : 63.95-138.05mm.
 1985 : Uttar bar (6, 4v).

Family SEMELIDAE

It includes about 70 species, majority of which live in sandy mud or sandy substrate of the sea. A few species live buried in the muddy substratum of estuary or brackish water. Four genera namely *Abra*, *Cumingia*, *Semele* and *Theora* with a total of 13 species were recorded from Indian coast. Two species namely, *Theora opalina* and *Cumingia hinduorum* are recorded from the Chilka Lake. The former occurs throughout the Lake and the latter is known from its type material.

Key to the genera and species

Shell oval in shape, thin, translucent, compressed, smooth; posterior part without keel; pallial sinus deep *Theora (T. opalina)*.

Shell rhomboidal in shape, thick concentrically striated, infalated; posterior part with mild keel; pallial sinus confluent *Cumingia (C.hinduorum)*

- 110) *Cumingia hinduorum* Preston.
 Size : 4.85-10.72mm.

1913 : Mahosa, Satpara, Patsahanipur (5), Main Channel W. Satpara (1) (Type).

- 111) *Theora (Theora) opalina* (Hinds).
 Size : 4.87-20.12mm.

1913 : Balugaon, Kaluparaghat, Barkuda, Nalbano (Several).

1985 : Samal Island (5), Baramuha nr. Rambha (5), Gaurangapatna (3), Siddhakona (1), Umbakona (5), Barkul (1) Between Birds' dropping Island and Nalbano (2), 1 km. Birds; dropping Island (1), 2 kms. Birds' dropping Island (1).

1986 : A2 (3), A3 (1), B1(2), B3(1), C3(3), D2(6), E7(16), E8(1), E9(2), F 11(7), G 13(2), H 11(4), I 10(8), I 12(1), I 13 (30), J 11(9), J 14(2, 3v), K 10(13), K 13(14), L 14(4v), L 16 (1, 1v), M 12(2, 1v), M 13(1v), N 8(2, 1v).

1987 : F 11(1, 1v), G 10(1), H 11(1), I 12(3), K 12(1v), K 13(1, 1v), L 14(2v), M 10(1), N 8(7), N 9(8), N 12(1, 1v), N 13 (1), P 10(2), P 12(2v).

*D 6(1v), *K 12(1), *K 14(3v).

Family TRAPEZIIDAE

A small family consisting of two genera and a few species which live in the crevices of rocks, coral reefs etc. Of the four species known from India only one species is found to occur in estuary. Preston (1914)

described *Petricola esculpturata* from oyster beds in Manikpatna, which is now synonymized with *Trapezium sublaevigata*, a species reported from mangroves and estuaries of India. Although no subsequent collections were made after its original discovery it may be presumed that the species may be able to survive in the Lake.

112) *Trapezium (Neotrapezium) sublaevigatum* (Lamarck).

Size : 8.40-47.05mm.

1913 :Manikpatna Oyster beds (6) (Type described as *Petricola esculpturata* Preston) Chilka Lake (2).

Family CORBICULIDAE

It is a small family of clams which live in freshwaters and estuaries. The Indian species of about 15 are recognised into four genera namely *Corbicula*, *Batissa*, *Geloina* and *Villorita*. The first mentioned includes all freshwater species where as the other three genera include brackishwater or estuarine species. Empty valves of *Corbicula striatella*, the common Indian freshwater species were collected from the Lake where there was more freshwater influence than at other places.

113) *Corbicula striatella* Deshayes.

Size : 8.15-12.15mm.

1987 : R 14(1v), S 15(2, 1v), S 16(2), S 17(5, 4v).

Family VENERIDAE

A large and well known family with numerous genera and species having world-wide distribution. About 20 genera and 52 species were reported from India. As many as 24 species under 13 genera were reported from the Orissa coast, of which 13 species and 8 genera were from the Chilka Lake. A list of species based on the collections is given below; of these *Meretrix meretrix*, *M. casta*, *Tivela dillwyni* and *Clementia vatheleti* were collected with animals while all others were empty valves. *C. vatheleti* was found to occur throughout the Lake along with *Macoma birmanica*. Species of *Meretrix* occur in Outer Channel near the mouth where the substratum is more sandy than at other places. There are no recent collections of *Tivela dillwyni*.

Key to the genera and species

1. Ligament deeply excavated; shell compressed or mildly inflated *Sunetta*..2
Ligament not excavated; shell inflated 4
2. Surface smooth, except for concentric striae *S. scripta*
Surface sculptured with concentric ribs, either part or complete 3
3. Surface partly sculptured, anterior part smooth, ribs rounded *S. donacina*
Surface completely sculptured, ribs flat *S. meroe*
4. Shell orbicular, as high as broad; lunule heart shape, deep; surface concentrically ribbed
..... *Dosinia* ..5

- Shell oval, oblong or trigonal; lunule may be present or absent, when present shallow; surface smooth or sculptured with radial or concentric ribs or both 6
5. Surface sculptured with fine concentric ribs, ribs very close *D. fibula*
 Surface sculptured with coarse concentric ribs, ribs distant *D. tumida*
6. Shell small not exceeding 5 mm in length; hinge minutely denticulate *Tivela (T. dillwyni)*
 Shell large exceeding 5 mm in length; hinge smooth 7
7. Pallial sinus shallow; lateral teeth on left valve and corresponding groove in right valve finely denticulate *Meretrix*..8
 Pallial sinus deep; lateral teeth and corresponding groove not denticulate 9
8. Hinge narrow; shell longer than high; posterior end with dark band, valve thin, less inflated
 *Meretrix meretrix*
 Hinge broad, shell higher than long; valves thick, more inflated, posterior end without band
 *M. casta*
9. Shell thin, fragile; lunule indistinct, depressed; laterals absent; surface with irregular concentric ribs *Clementia (C. vatheleti)*
 Shell thick, not fragile; lunule distinct, not depressed; laterals present; surface either smooth or sculptured 10
10. Shell trigonal in shape; surface sculptured with either concentric or radial ribs or both; margin crenulate *Timoclea*.11
 Shell either elongate or oval in shape; surface smooth or concentrically ribbed 12
11. Ribs strong, distant; concentric ribs thin, crested *Timoclea imbricata*
 Both radial and concentric ribs strong; ribs not crested; radial ribs divaricate *T.scabra*
12. Shell compressed, elongately oblong; lunule narrow; surface with irregular sculpture at antero-ventral part and with undulating markings *Paphia (P. undulata)*
 Shell inflated; oval; lunule broad; surface smooth except for concentric striae; without markings *Marcia (M. pinguis)*

- 114) *Sunetta (Sunetta) donacina* (Gmelin).
Size : 24.64-42.50mm.
1954 : Balugaon (8v).
1955 : Kalluparaghat (2v).
- 115) *Sunetta (Sunetta) meroe* (Linnaeus).
Size : 17.50-42.60mm.
1913 : Satpara (1v), (described as *Meroe chilkaensis* Preston) Barkuda (2v).
1954 & 1955 : Arakuda nr. Manikpatna, Tonda (122 v).
1985 : South bar & Tip of South bar (8v), Uttar bar (2v).
1986 : South bar (7).
1987 : South bar (1v), * W 11 (7v).
- 116) *Sunetta (Sunetta) scripta* (Linnaeus)
Size : 12.10-34.12mm.
1913 : Satpara (1v), (Type described as *Meroe satparaensis* Preston (Part), Outer channel Barkuda (2v).
1954 & 1955 : Arakuda (122v).
1985 : Satpara (14, 8v), South bar & Tip (16v), *Arakuda (1v).
1986 : (South bar 91, 16v).
1987 : (South bar (14, 3v).
- 117) *Meretrix meretrix* (Linnaeus).
Size : 15.05-60.05mm.
1913 : Outer channel, Satpara, oyster Is. (24, 7v), Satpara Is., (11, 1v).
1954 : Satpara Is., (11, 1v).
1955 : Arakuda (4, 1v).
1985 : Satpara (1v), Arakuda (1v), South bar & Tip (20, 9v) Uttar bar (4, 9v).
1986 : N8(15), N11(19), N12(15), O8(3), Q8(2v), R9(1v), T10(17), V10(4, 5v), *Stn. No. 53 (3v),
* Palur canal (3v), * Arakuda (3v).
1987 : N 9(1), N 11(3), O 8(2v), O 9(1v), P 8(2v), S 13(3, 2v), *Satpara (2v), *W 11(3v).
- 118) *Meretrix casta* (Gmelin)
Size : 3.00-54.70mm.
1913 : Outer channel (2, 5v), Barhampur Island (2), Rambha (11v).
1919 : Samal Island (27), Cheriya Island (1).
1954 & 1955 : Kaluparaghat 92v), Tonda, Balugaon, Manikpatna, Arakuda (3, 24v).
1985 : Satpara (3, 2v), S. Satpara (6v).
1986 : N 9 (30, 1v), N 10(2, 1v), Q 8(24), R 9(11, 3v), U 10(7, 1v), South bar (1v), * Palur canal (16, 3v), * S. No. 53 (15, 5v).
1987 : B 1(1v), N 8(2), N 11(1, 1v), O 8(1), O 9(3, 6v), P 8(6), Q 8(18), S 9(3, 6v), S 12(1, 2v), T 10 (1), U 10(4), V 10(2v), * Satpara (9), * Muthupet (1), *E 5 (2), * Q 12 (1).

- 119) *Tivela dillwyni* (Deshayes).
Size : 3.30mm.
1913 : Seruanadi (1).
- 120) *Dosinia (Asa) fibula* (Reeve).
Size : 14.75 mm.
1955 : Kaluparaghat (2v), Manikpatna (1v).
1985 : Uttar bar (1).
- 121) *Dosinia (Asa) tumida* (Gray).
Size : 21.00-39.35 mm.
1913 : Satpara Bay (1).
1955 : Manikpatna (1v).
- 122) *Clementia vatheleti* Mabilie.
Size : 10.91-19.34 mm.
1913 : Off Balugaon (1) (Type described as *Clementia annandalei* Preston). Balugaon, Nalbano, Barnikuda (Several).
1985 : Baramuha nr. Rambha (1), Gourangapatna (1), Parahare (1), Birds' dropping Island (1v).
1986 : F 11(2, 5v), G 12(10, 9v), H 11(9, 1v), I 10(1v), I 12(18), I 13(20), J 10(1, 1v), J 11(10), J 14(1v), K 12(6), K 13(4, 1v), L 11 (22, 16v), L 14(14v), L 16 (1v), M 12(3), M 13(7), N 14(4), N 16(2v), P 14(3, 1v), R 16(2).
1987 : B 5(1), F 10(4v), F 11(7), G 12(7), H 10(1v), H 11(3), I 12(6), I 13(2v), J 11(1v), K 12 (1v), K 13(14), K 15(2v), L 10(1), L 14(1v), L 15 (2), M 12(1), M 13(16), M 15 (2, 1v), N 13(1v), N 15(10), N 16 (3v), P 8(1), P 12(1,1v), R 14 (5v), * D 6 (14), *G 11(2v), * I 12(15), * K 12(20), * K 14(4v), * O 12(8v).
- 123) *Marcia (Marcia) pinguis* (Schroeter).
Size : 7.58-55.35mm.
1913 : Satpara, Outer channel, Mahosa (17, 4v).
1954 & 1955 : Manikpatna, Arakuda, Tonda (36, 9v).
1985 : Arakuda (2v), Uttar bar (1v), *Arakuda (4v).
1986 : R 9(1), V 10(4v), *Palur canal (1v).
1987 : *W 11(1).
- 124) *Paphia undulata* (Born).
Size : 46.05-47.15 mm..
1986 : B 3(1v), *Palur canal (1).
- 125) *Timoclea imbricata* (Sowerby).
Size : 16.18mm.
1987 : W 11(1v).

- 126) *Timoclea scabra* (Hanley).
 Size : 2.78mm.
 1987 : T 10(1v).

Order MYOIDA,

Family LATERNULIDAE

It is a small family of mud-dwellers of tropical seas. A total of about a dozen species are known. The genus *Laternula*, with its three species was reported from India. *Laternula navicula* is recorded from the Southern Sector of the Lake. Four species of *Anatina* and one species of *Lyonsia* described from the Lake during the century are found to be synonyms of *L. navicula*.

- 127) *Laternula navicula* (Reeve).
 Size : 4.70-21.85mm.
 1913 : Chilka lake (1) Type described as *Anatina granulosa* Preston, Barkul point (1). Type described as *Anatina barkulensis* Preston, Barkuda Island (1), Type described as *Anatina barkudaensis* Preston, Off Samal Island (1) Type described as *Lyonsia samalinsulae* Preston, Rambha, Mahosa, Cheriya Island, Barhampur Island, Satpara and Barkuda Island (30).
 1985 : Honeymoon Island (4), Breakfast Island (2), Samal Island (6), Baramuha near Rambha (1), Gaurangapatna (3), Parahara (2), Sidhakona (8), Umbakona (1), Between Malud and Siar (5), Baradonta and Siar (1), Palur canal (2).

Family CUSPIDARIIDAE

A small family with a number of species in which the shell is small and rostrate posteriorly. These clams inhabit mud flats and backwaters, while a few survive in deep sea. The genus *Cuspidaria* with its four species is known from India. Preston (1913) described three different species from the lake, which are found to be conspecific on examination. *C. chilkaensis* is distributed throughout the Lake.

- 128) *Cuspidaria chilkaensis* Preston.
 Size : 3.30-10.80.
 1910 : Rambha (1) (Type described as *Corbula chilkaensis* Preston).
 1913 : Patsahanipur (1) (Type described as *Cuspidaria annandalei* Preston), Kalidai, Kaluparaghat, Seruanadi, Barkul(34).
 1975 : *Busandipur (8).
 1985 : Satpara (2), Siragolla nr. Pansapara (8), Nauapara (14), 2 km. Birds' dropping Island (1), Birds' dropping Island (2).
 1986 : F 11(3), H 10(1), I 10(1), J 14(1v), L 10(1), L 11(1), L 16(75), M 17(1), N 14(38), N 16(4v), P 14(1), R 16(32).
 1987 : B 3(1), C 3(3, 1v), C 5(1,1v), E 10(1v), G 10(1v), K 12(2), K 15(2), L 10(1), M 15(3v), M 16(1), M 17(1), N 9(7), N 10(1), N 12(3), N 13(29), N 15(6, 1v), P 10(6), P 11(1), P 12(1), P 14(4), P 15(1v), Q 13(2), R 12(1), R 14(14), S 12(7), S 16(24), S 17(1). *D 6(1), *K 10(1), *N 8(3), *N 17(1, 1v), *O 10(1), *O 12(1, 25v), *Q (2), * R 15(16), * S 16(1).

Order PHOLADOMYOIDA

Family PHOLADIDAE

Members of this family bore into submerged wooden structures, soft rocks and some times into corals. These are distributed in the tropical and subtropical waters. About 7 species under 5 genera, namely *Martesia*, *Pholas*, *Lignopholas*, *Barnea* and *Jounnetia* are known from India. The first mentioned is the well known genus and has three species in India. *M. striata* is the most common species occurring in estuaries of India. Judged from its habitat requirement, the species may be able to survive in the Lake, especially in its outer channel. But no collections were made during the expeditions as it involves a special effort and technique for the extraction of these wood borers.

- 129) *Martesia (Martesia) striata* (Linnaeus).
 Size : 10.10-16.00.
 Chilka Lake (4).

Family TEREDINIDAE

The animals are elongated and worm-like with a world-wide distribution. These bore into wooden structures along the coast and estuaries. About 30 species are known from India. A total of 12 species under 7 genera were reported from Orissa. Although there were a few earlier references to the existence of teredinids in the lake, no recent collections were made. In the absence of any recent authentic data it may not be proper to comment on their existence in the Lake.

Class CEPHALOPODA

Order SEPIOIDA

Family SEPIIDAE

These are popularly known as 'Cuttle fishes' and inhabit off shore waters. As these are free-swimming pelagic forms, stray individuals may enter the Lake. The single example of *Sepiella inermis* (Ferussac et d' Orbigny) (Size 43.00 to 62.00mm) was collected by the Investigator in 1890. No further collection was made from the Lake. Salinity and depth of the Lake may act as deterrents for the species to survive.

The following species are first records from the lake and hence the details for each species are given.

Class GASTROPODA

Order MESOGASTROPODA

Family THIARIDAE

Genus *Thiara* Roeding, 1798

Subgenus *Tarebia* H. & A. Adams, 1854

Thiara (Tarebia) granifera (Lamarck)

1822 : *Melania granifera* Lamarck, *Hist. Nat. Anim. Sans Vert.*, 6(2) : 167.

1989 : *Thiara (Tarebia) granifera* : Subba Rao, *Hand Book Freshwater Molluscs of India* : 101, figs. 212, 213.

Diagnosis : Shell elongately conical, spire longer than body whorl, sculptured with prominent granules below suture.

Distribution : West Bengal, Orissa, Bihar, Madhya Pradesh. Elsewhere - Madagascar, Philippines, Malaysia, Formosa, Pacific Islands, United States. It is recorded for the first time from Orissa.

Remarks : It inhabits freshwater bodies and closely resembles *T. lineata* with which it is often confused, It differs from *lineata* in having granules below suture. Shells dark brown, sometimes with dark bands. Some of the material dredged from the bottom of the lake are in live condition and recorded for the first time from the lake.

Family LITIOPIDAE

Genus *Alaba* H. & A. ADAMS, 1853

Alaba blanfordi A. Adams

1862 : *Alaba blanfordi* A. Adams *Ann. Mag. nat. Hist.* (3) 10 : 296.

1991 : *Alaba blanfordi* : Subba Rao, *et. al.*, *Fauna of Orissa* pt. 3, *Marine, State Fauna ser.*, 1(3) : 47.

Diagnosis : Shell small, not exceeding 20mm., acuminate conical, whorls sculptured with spiral sulcations and axial plications; suture deep, aperture squarose.

Distribution : India : Orissa, Coromandal coast, Maharashtra and Andamans. Elsewhere - Mayanmar, Cambodia (= Siam, Type locality) and Japan.

Remarks : It is recorded for the first time from Chilka. Its previous record in Orissa was from Puri (Ray, 1968). Collections included mostly dead shells with a few live specimens. It resembles *Finella virgata* but differs from it in being dwarf and in having angulate body whorl and distant axial plications on the body.

Family NATICIDAE

Genus *Eunaticina* Fischer, 1885

Eunaticina coarctata (Reeve)

1864 : *Sigaretus coarctatus* Reeve, *Conch. Icon.*, 5, *Sigaretus* sp. 17, pl. 4, fig. 17a-b.

1942 : *Eunaticina coarctata* : Gravely, *Bull. Madras Govt. Mus. new Ser.*, 5(2) : 38.

1985 : *Eunaticina coarctata* : Mookherjee, *Rec. zool. Surv. India Occ. Paper*, 75 : 58, pl. 10, fig. 40a-b.

Diagnosis : Shell oblong, aperture semi-ovate, spire low, conical; columella straight, slight fold towards posterior side, suture deep, canaliculate; sculptured with spiral grooves; umbilicus open, deep, funnel shape, partly covered with callous, operculum corneous.

Distribution : India : Ennur backwaters nr. Madras, Andamans. Elsewhere Singapore (Type locality).

Remarks : It closely resembles *E. tener* Smith recorded from deeper waters off Gopalpur in Ganjam district. It differs from it in shell being thick, sculptured with spiral grooves. It is rare species found in deeper waters (Mookherjee, 1985).

The identification is based on a single shell washed ashore near the mouth of the lake. There was no previous record of its occurrence in the lake and the species should not be included in the lake fauna.

Family CASSIDAE

Genus *Phalium* Link, 1807

Subgenus *Semicassis* Moerch, 1852

Phalium (Semicassis) canaliculatum (Bruguiere)

1792 : *Cassidea canaliculata* Bruguiere, *Ency. Meth. vers.*, 1(2) : 423.

1968 : *Phalium (Semicassis) canaliculatum* : Abbott, *Indo-Pacif. Mollusca*, 2(9) : 132, pl. 8, figs 5,6.

1985 : *Phalium (Semicassis) canaliculatum* : Mookherjee, *Rec. zool. Surv. India Occ. Paper*, 75 : 64, pl. 11, figs. 45a-b.

Diagnosis : Shell ovately globose, spire elevated, whorl rounded, sutures deep, canaliculate; aperture ovate, anteriorly broad, posteriorly narrow, parietal shield present, columella plicated, canal short, wide, outer lip folded; sculptured with spiral grooves; colour white with orange brown squarose blotches arranged in rows.

Distribution : India : Coasts of Tamil Nadu, Andhra Pradesh. Elsewhere - Sri Lanka, Philippines, Hong Kong, Japan, Present record from Chilka mouth extends its distribution towards north.

Remarks : It is a marine species, found in littoral zone ranging from low tide to 100 metres. It closely resembles *P. bisulcatum* another species which occurs on Indian coast, but differs in having deep subsutural channel in the last two whorls.

Order NEOGASTROPODA

Family MARGINELLIDAE

Genus *Marginella* Lamarck, 1801

Marginella elegans (Gmelin)

1791 : *Voluta elegans* Gmelin, *Syst. nat.*, ed., 13 : 3448.

1982 : *Marginella elegans* : Abbott and Dance, *Compendium of Sea Shells* : 236, fig.

Diagnosis : Shell pyriform, solid, glossy, smooth, spire short, obtuse, some times concealed into body; body whorl wider towards posterior, narrow anteriorly; aperture narrowly elongate, outer lip margin thick with denticulate interior; columella with five strong plaits; colour ash some times with brown markings.

Distribution : India : Orissa, Andaman and Nicobar Islands. Elsewhere - East Indies, Malacca Strait. It is recorded for the first time from Indian waters.

Remarks : It is a marine species which occurs in sandy bed from off shore to deeper waters. The specimen has a broken spire and white colour. A depression on the posterior part of shell made by an epizoic animal is present.

Subclass PULMONATA

Order BASOMMATOPHORA

Family ELLOBIIDAE

Genus *Melampus* Montfort, 1810

Melampus ceylonicus Petit

1841-42 : *Auricula ceylonica* Petit (De La, Saussaye, M) *Proc. zool. Soc. Lond.*, pt. 9 & 10 : 202.

1887 : *Melampus ceilonicus* Martens, *J. Linn. Soc. Lond.*, 21 : 167.

Diagnosis : Shell ovate, spire conical, acute, body whorl large, smooth; suture lineate, aperture narrowly elongate, oblique, outer lip margin thin, interior denticulate with both short and long teeth; columella obliquely rounded, with three plaits; colour light brown, occasionally with bands.

Distribution : India : Andhra pradesh, Orissa, Bombay. *Elsewhere* Sri Lanka, Mergui Archipelago.

Remarks : The specimen is a partly eroded shell which has lost its original colour. The snails are air breathers and occur in clusters under the crevices of bark and roots of the vegetation near river mouths and mangroove swamps. It is recorded for the first time from Chilka.

Order STYLOMMATOPHORA

Family SUCCINEIDAE

Genus *Succinea* Draparnaud, 1801

Succinea daucina Pfeiffer f. *hraswasikhara* Rao

1924 : *Succinea daucina* f. *hraswasikhara* Rao, *Rec. Indian Mus.*, 26 : 397 pl. 28, fig.12.

1977 : *Succinea daucina* f. *hraswasikhara* : Mitra *et. al. Newsl. zool. Surv. India* , 3(2) : 99.

Diagnosis : Shell ovate, thin, spire short semi-transparent; aperture large, columella straight.

Distribution : India : West Bengal, Orissa, Tamil Nadu, It is recorded for the first time from Orissa.

Remarks : It is terrestrial in its habitat found under bark and roots of trees and under litter in shady damp areas.

It closely resembles the typical form but differs from it in having distinct short spire, papillate apical whorl and tumid penultimate whorl. Apparently it looks like *Lymnaea* of freshwater genus but differs from it in having tumid spire and columella without fold.

Class BIVALVIA

Order PTERIOIDA

Family ANOMIIDAE

Genus *Anomia* Linnaeus, 1758

Anomia achaeus Gray

1849 : *Anomia achaeus* Gray, *Proc. zool. Soc. Lond.*, : 116.

1859 : *Anomia achaeus* : Reeve, *Conch. Icon.*, 11, *Anomia*, sp. 12, pl. 3, fig. 12.

1965 : *Anomia achaeus* : Kundu, *J. Bombay nat. Hist. Soc.*, 65 : fig.

Diagnosis : Shell irregular, thin, fragile, translucent, usually attached to substratum, inaequivalve, right valve flat and attached to substratum, left valve arched, infalced, surface sculptured with radial striae, interior nacreous, with muscle scar, one of them long, oval shape.

Distribution : India : West Bengal, Maharastra and Gujarat. Elsewhere Karachi. It is the first record from Orissa.

Remarks : Specimens collected are from outer part of the lake near mouth which has marine influence. Shells found attached to oyster, *Saccostrea cucullata* (Born).

Order VENEROIDA

Family CULTELLIDAE

Genus *Cultellus* Schumacher, 1817

Cultellus subellipticus Dunker

1861. *Cultellus subellipticus* Dunker, *Proc. zool. Soc. Lond.*, : 421.

1874. *Cultellus subellipticus* : Reeve, *Conch. Icon.*, **12**, *Cultellus*, sp., 9, pl. 2, fig. 2.

1916. *Cultellus subellipticus* : Preston, *Rec. Indian Mus.*, **12** : 37.

Diagnosis : Shell transversely elongate, inequal, thin, semi-transparent, white, anterior part short, narrow, posterior part longer, broad, ends rounded ; compressed, hinge with single cardinal in right valve, two in left valve, posterior bifid; surface smooth except for fine growth striae, interior with small ridge extending from umbo to above anterior muscle scar, muscle scar rounded ; pallial sinus small.

Distribution : India : Post Canning, Chilka, Ennur backwaters. Elsewhere : Singapore, Malacca, Mergui Archipelago.

Remarks : Animals occur in soft muddy bottom. Material was collected by grab in the outer channel of the lake. So far no live material available is in the National Zoological Collections. Present material is an addition and is recorded for the first time from Chilka as well as Orissa.

5. Key to Families

Class GASTROPODA

- | | | |
|-----|---|--|
| 1. | Animals terrestrial | 2 |
| | Animals aquatic | 7 |
| 2. | Shell elongate, higher than broad | 3 |
| | Shell depressedly coiled, broader than high | 6 |
| 3. | Surface sculptured; aperture denticulate | Streptaxidae |
| | Surface smooth; aperture simple | 4 |
| 4. | Umbilicus open; shell surface with dark bands | Enidae (<i>Rachistia praetermissus</i>) |
| | Umbilicus closed; shell surface without bands | 5 |
| 5. | Shell transparent; body whorl larger than spire; aperture broadly ovate | Succineidae (<i>Succinea daucina f. hraswasikhara</i>) |
| 6. | Shell large, more than 30mm in diameter; operculum present | Cyclophoridae (<i>Cyclophorus polynema</i>) |
| | Shell small, not more than 30mm in diameter; operculum absent | Ariophantidae (<i>Euplecta infausta</i>) |
| 7.- | Shell absent | 8 |

- Animal covered with an external shell 10
- 8. Animal without rhinophores and cephalic tentacles; pair of natatory parapodia present; dorsal part of body without cerata Elysiidae (*Elysia chilensis*)
- Animal with pair of rhinophores and cephalic tentacles; dorsal part of body with cerata 9
- 9. Cerata on body divided into four groups, last group clumped together Cuthonidae (*Cuthona henrici*)
- Cerata on body not divided, but continuous in two rows Stiligeridae (*Stiliger pica*)
- 10. Shell minute, small, not more than 5 mm in height 11
- Shell large, more than 5 mm in height 14
- 11. Shell cylindrical; aperture elongate, narrow Cylichnidae (*Tornatina estriata*)
- Shell either ovate or turbinate; aperture either rounded or ovate 12
- 12. Shell turbinate, porcellaneous; umbilicus wide Cyclostrematidae
- Shell ovate, not porcellaneous; umbilicus narrow or closed 13
- 13. Spire elevated, surface smooth; aperture small when compared to body whorl Stenothyridae
- Spire depressed; surface sculptured; aperture large when compared to body whorl Fossaridae (*Chilkaia imitatrix*)
- 14. Shell elongate; spire high, many whorled 15
- Shell not elongate; spire either depressed, concealed or sunken 21
- 15. Shell large, more than 50 mm in height whorls some times keeled in middle, spirally striated; aperture rounded Turritellidae
- Shell small, not more than 50 mm in height (except in *Telescopium*); whorls without keel; aperture either ovate, elongate or horizontal 16
- 16. Whorls with transpiral ribs; outer lip margin thickened Epitoniidae
- Whorls without transpiral ribs; outer lip margin simple 17
- 17. Aperture with anterior canal Puzosinidae

- Aperture without anterior canal 18
18. Shell large, more than 15 mm in height; sculptured with granules, beads or axial ribs Thiariidae
.....
- Shell small, not more than 15 mm in height; smooth or spirally striated 19
19. Body whorl with varix; columella without fold 20
Body whorl without varix; columella with fold Pyramidellidae
20. Shell imperforate; aperture anteriorly produced Litiopidae
Shell perforated; aperture not produced anteriorly Finellidae (*Finella virgata*)
21. Spire not prominent, either concealed or sunken 22
Spire prominent, either elevated or depressed 24
22. Shell thin, fragile; spire sunken; animal cannot be withdrawn completely inside
..... Atyidae (*Haminoea crocata*)
Shell thick; spire concealed in body whorl or very short, animal can be withdrawn completely inside
the shell 23
23. Shell sculptured; columella wide and flat, ornamented; aperture semicircle, dentate inside;
operculum calcareous Neritidae
Shell smooth, polished; columella narrow, with folds/plicae; aperture narrow elongate; operculum
absent Marginellidae (*Marginella elegans*)
24. Inner layer nacreous, shell either lenticular or conical; operculum corneous Trochidae
Inner layer not nacreous; operculum if present not corneous; shell either globose, conical or
cylindrical 25
25. Shell without operculum in live condition; animals sometimes adopted for air breathing, gills
replaced by lungs 26
Shell with operculum; animals not adopted for air breathing 30
26. Shell thin, transparent, fragile; spire small and acute; aperture wide; columella twisted
..... Lymnaeidae

- Shell thick; spire either large or depressed; aperture not wide; columella with folds or simple ...
27
27. Shell discoidal, spire depressed, not raised above the plane of body Planorbidae
- Shell globose or fusiform or cylindrical, spire elevated and high.....28
28. Shell sculptured with longitudinal ribs and spiral threads; outer lip ribbed inside
 Cancellariidae (*Cancellaria elegans*)
- Shell smooth; outer lip smooth inside 29
29. Shell cylindrical in shape, highly polished, brightly coloured; aperture elongate, narrow, columella
 with folds; outer lip smooth inside Olividae
- Shell ovate, not polished, dull coloured; aperture not elongate, narrow, with teeth inside; animals
 adopted for air breathing, gills replaced by lungs Ellobiidae (*Melampus ceylanicus*)
30. Shell very small, not more than 8 mm in height; columellar fold ridge like
 Bithyniidae (*Gabbia orcula*)
- Shell large, 8 mm; columella either simple or ornamented31
31. Spire low, body whorl very large, globose; operculum paucispiral, calcareous
 Piliidae (*Pila globosa*)
- Spire high; body whorl medium to large but not globose; operculum horny32
32. Shell sculptured, usually ribbed or tuberculate; umbilicus closed33
- Shell smooth or finely striated; umbilicus open36
33. Shell large, exceeds 40 mm in height, pear shaped; anterior canal long, widely open, shoulder with
 pointed tubercles Melongenidae (*Pugilina cochlidium*)
- Shell small, not pear shaped; anterior canal small, narrowly open34
34. Body whorl much inflated, two rounded varices on body; columellar shield well developed;
 aperture longitudinal Cassidae
- Body whorl less inflated, without varices, if present more than two, columellar shield absent;
 aperture not longitudinal35
35. Shell sculptured with axial ribs, atleast some part prominent; canal short, twisted; columella
 smooth, sometimes with denticles Nassariidae

Shell either tuberculate or axially ribbed, ribs scabrous; columella with few tubercles anteriorly, outer lip either lirate or denticulate inside Muricidae

36. Shell thin, translucent, dull coloured, usually with dark bands, sometimes bands absent; umbilicus closed; operculum horny Viviparidae

Shell thick, not translucent, coloured or white; umbilicus open, semicircular, sometimes filled with callous ; operculum calcareous Naticidae

Key to families of Bivalvia

1. Shell greatly reduced, covering anterior tip of animal, body worm-like, posterior end with two calcareous pallets Teredinidae

Shell covering entire animal, body laterally compressed with wedge-shaped foot, pallets absent 2

2. Hinge with numerous teeth arranged either in straight line or arched; muscle scars two, well developed 3

Hinge with teeth, not more than five, sometimes reduced or even absent; muscle scars usually two, sometimes reduced or absent 5

3. Shell orbicular, hinge teeth arranged in arch, teeth of equal size; outer surface with fine radial ribs Glycymerididae (*Glycymeris tenuicostatus*)

Shell not orbicular; hinge teeth arranged in straight line; teeth in middle smaller; byssal gape sometimes present on ventral margin 4

4. Muscle scars without shelf on its inner margin; byssal gape present Arcidae

Muscle scars with shelf on its inner margin; byssal gape absent Noetiidae(*Striarca lactea*)

5. Anterior muscle scar reduced or even absent; hinge scarcely developed, when developed bear tubercles or tooth like process; mantle open, without siphons, animals attached either by byssus or by its valve 6

Anterior muscle scar and hinge well developed, teeth present but few in number or reduced to single tooth or even absent; mantle with two siphons; animals free 10

6. Umbo terminal or subterminal; ligament simple, without nodules; interior nacreous; shell elongate, modioliform, anterior muscle scar present; animals attached by byssus Mytilidae

Umbo centrally placed; ligament with nodules; interior not nacreous; shell not modioliform, either irregular or rounded in shape; anterior muscle scar absent; animals attached by either valve or some times free in adults stage 7

7. Shell irregular in shape; attached by left valve or byssus; umbo without wing like extension ... 8
- Shell regular in shape, higher than long, compressed; animals free; umbo with wing-like extensions on either side, gaping extends downwards along margin *Limidae (Ctenoides annualata)*
8. Shell thin lower valve flat, with hole through which byssus passes for attachment; upper valve inflated; nacreous; byssus disappear in adult stage *Anomiidae*
- Shell strong, lower valve concave, without hole; byssus absent; attachment by valve only; shell not nacreous 9
9. Muscle scar reniform, away from hinge; umbonal groove deep; surface without radial plications, concentrically wrinkled *Ostreidae*
- Muscle scar rounded, close to hinge; umbonal groove shallow; surface with radial plications
..... *Graphaeidae (Hyotissa hyotis)*
10. Hinge with three cardinals in each valve, laterals if present either elongate or sometimes feeble
..... 11
- Hinge with less than three cardinals in each valve, laterals present, sometimes reduced to a single tooth, rarely absent 12
11. Laterals prominent, elongate and serrated; pallial sinus absent; interior violet in colour
..... *Corbiculidae (Corbicula striatella)*
- Laterals short, not serrated, pallial sinus either shallow or deep; interior either white or light blue
..... *Veneridae*
12. Shell strongly sculptured with radial ribs; not gaping 13
- Shell either smooth or sculptured variously; gaping 14
13. Shell equilateral, ovate or oblong or trigonal in shape; hinge with distant laterals, cardinals small, not grooved; margin smooth *Cardiidae*
- Shell inequilateral, either cordiform or mytiliform; hinge with laterals rudimentary, not distant; cardinals, large, grooved; margin crenulate *Carditidae (Cardites antiquata)*
14. Hinge with internal ligament in a socket behind cardinal 15
- Hinge normal, ligament external 16
15. Shell trigonally ovate, inflated, ligamental socket triangular; left valve with 'V' shaped cardinal, right valve with two cardinals; pallial sinus broadly open *Mactridae*

- Shell either rounded or ovate, compressed; ligamental socket elongate, oblique; cardinal teeth normal; pallial sinus narrowly open Semelidae
16. Umbonal cavity deep; left valve with two cardinals and two laterals, teeth lamellar, right valve with single cardinal and lateral; interior nacreous, outer surface covered with thick periostracum
..... Unionidae (*Lamellidens marginalis*)
- Umbonal cavity shallow; cardinals and laterals not lamellose; interior not nacreous, surface sometimes covered with periostracum 17
17. Valves equal in size, not fitting into other valve 18
- Valves unequal in size, sometimes fits into other 27
18. Valves cylindrical to flattened umbo either terminal or subterminal; gaping on both ends 19
- Valves neither subcylindrical nor flattened; umbo either terminal or subterminal; gaping either anterior or posterior 20
19. Shell cylindrical, straight; umbo at anterior end; anterior and posterior ends truncate; hinge with single tooth in each valve Solenidae
- Shell flattened, sometimes curved, umbo subterminal; anterior and posterior ends rounded; hinge with more than one tooth Cultellidae
20. Shell wedge shape; prominent keel or angulation on posterior part extending from umbo to ventral margin Donacidae
- Shell either ovate or oblong; keel or angulation on posterior part absent 21
21. Shell with accessory plates, oblong in shape, sub-cylindrical, anterior part widely gaped, surface either fully or partly sculptured with radial ribs Pholadidae (*Martesia striata*)
- Shell without accessory plates, ovate, trigonal or orbicular in shape; either compressed or inflated anterior part not widely gaping; surface generally smooth or mildly sculptured with concentric ribs or striae 22
22. Valves compressed; posterior end gaping, surface smooth except for concentric growth lines, covered with thick brown periostracum; hinge without laterals Psammobiidae
- Valves inflated; posterior end either fully gaping or not; surface either smooth or concentrically sculptured, without periostracum; hinge with laterals, occasionally edentate 23
23. Shell oblong, thin, fragile, both anterior and posterior margins truncate; ligament supported by thin oblique ridge interiorly Laternulidae (*Laternula navicula*)

- Shell either ovate or orbicular; margins rounded; ligament without ridge interiorly 24
24. Shell transversely ovate, umbo nearer to anterior end; pallial sinus absent; hinge narrow with two cardinals in each valve Trapeziidae (*Trapezium sublaevigatum*)
- Shell either orbicular or oblong; umbo either middle or near to posterior end; hinge with either two cardinals or less in each valve 25
25. Shell oblong, muscle scars regular Galeommatidae
- Shell ovate or orbicular; muscle scars irregular 26
26. Shell orbicular, valves equal in size; muscle scars unequal, anterior scar elongate; posterior large; median cardinal teeth bifid and incomplete Ungulinidae
- Shell ovate in shape; some times beaked posteriorly; valves of unequal size; anterior muscle scar not elongate; median cardinal simple 27
27. Shell smaller in size, not exceeding 15mm; posterior end beaked, margin truncate, prominent keel present, valves inflated, one valve fits into the other; pallial sinus small Cuspidariidae (*Cuspidaria chilkaensis*)
- Shell large exceeding 15 mm; posterior end some times twisted, keel absent; valves compressed, some times one valve less inflated than the other; pallial sinus large, unequal in size . Tellinidae

6. DISCUSSION

The collection of molluscs, either living or dead studied by us are identified into 136 species under 96 genera and 66 families. A total of 60 species under 37 genera and 33 families were originally described from the lake. Preston (1910-1915) described 51 species as new to science. Later authors added 9 more species to this list (Annandale 2, Annandale & Prashad 2, Eliot 2, Ghose 1, Nevill 1, Ray 1, See Table 1). A large proportion of Preston's identifications were revised by Annandale (1924) and he retained only 12 out of 31 names of gastropods and a few bivalves proposed by Preston. Later studies have also revealed that majority of species described earlier from the lake are synonyms of already known species. Thus the species of gastropods have come down from 28 (26 + 2 land) to 16 + 1 and bivalves from 32 to 17. Among these, 26 species were already known from other places. Thus 34 species may be considered as endemic to the Lake; one of these species is a land mollusc.

Annandale (1924) in his revisionary studies included fifteen families with twenty two genera and 28 species. He has rightly omitted dead shells which might have been carried into the lake by hermit crabs or passively through current or by man. From the present study it is seen that the living molluscs of the lake fall into 19 families with 25 genera and 36 species.

Dead shells of seven species of land molluscs were collected from the Islands in the Lake. As no

special effort was made for terrestrial collections these are excluded while considering the lake fauna.

Annandale and Kemp (1916) found only dead shells of freshwater gastropods. But the present study has revealed that some of the species have made their way into the lake. Although the common pond snail, *Bellamya bengalensis* was represented by dead shells, live specimens of another species *B. dissimilis* were collected in areas where there was an influx of freshwater. Two other species, namely *Thiara granifera* and *T. tuberculata* were also collected live. These species are salt tolerant and these occur in the salt water of Hugli river. The occurrence of these freshwater species in the lake indicates a change in the ecology of Lake after 1924. These species may slowly get acclimitized and develop into permanent residents of the Lake.

By far the marine and estuarine species numbering about 117, are major constituents of the lake molluscs. But majority of them are represented by dead shells, which might have been carried into the lake from the nearby sea. The families are not distributed uniformly throughout the lake. Some of the families like Trochidae, Cyclostrematidae, Neritidae, Fossaridae, Epitoniidae, Bullidae, Elysiidae, Arcidae, Ungulinidae, Cultellidae and majority of Veneridae occur only in the outer channel. The other families Stenothyridae, Potamididae, Pyramidellidae, Nassariidae, Muricidae, Cylichnidae, Stiligeridae and Cuthonidae occur in the main part of the Lake.

Annandale (1924) recognized the following eight genera as representing the true lacustrine fauna of the Chilka. *Stenothyra*, *Gangetia*, *Turbonilla*, *Cerithidea*, *Pygmaeonassa*, *Cuma*, *Didontoglossa*, *Cuthona* and *Stiliger*.

As pointed out by him some of the characteristic genera and families of brackish water such as Littornidae, Assimineidae and Ellobiidae are absent in the lake. The substratum and the vegetation available are not able to attract these molluscs. Annandale (1924) cited two families namely Nassariidae and Pyramidellidae as best represented in the lake, each with five species. Our study also confirms his observations and in fact adds 3 species to the former and one species to the latter. The members of the former are predaceous or carrion feeders while that of the latter are mud-dwellers. The former occurs throughout the lake while the latter in the outer channel. Two bivalve families namely Ungulinidae and Veneridae are also best represented, the former with 5 species and the latter with 12 species.

Molluscan fauna is very rich in the Lake. The studies on seasonal abundance and bottom fauna of the lake revealed that molluscs were the dominant constituents of the biomass and contribute 83% to 92% in the total biomass production (Rajan, 1971, Patnaik, 1972). Molluscs are also important dietary components of lake fishes and play an effective part in the food chain. These studies had concluded that maximum number of gastropods were observed during April-June in the northern and central sectors where as in May-August molluscs were comparatively higher in southern sector (Patnaik, 1972). According to the studies by Rajan (1971) northern sector had highest production of gastropods, while the southern sector had highest biomass of bivalves. It was followed by southern for gastropods and central sector for bivalves respectively. The earlier studies had concluded that outer channel had comparatively less number of molluscs when compared to the main part of the lake. Production-wise main part of the lake may be richer than the outer channel, but with regard to species composition as seen from our studies, (Table III) it is the other way round. In the outer channel there are 92 species followed by southern, central

and northern in that order. The factors responsible for this can only be assumed. The depth of water is not likely to influence the distribution of benthos. Salinity variation has some impact on the distribution of molluscs. It was seen that areas with vegetation are distinctly rich in fauna. Majority of molluscs are substratum dwellers and its nature may have some influence. Depending on their habitat preferences several species of molluscs had localised distribution in the lake. For example *Thais lacera* occurs only on the submerged rocks, poles etc. Although it was reported from central and southern sectors, the availability of suitable structures may restrict its distribution. Patnaik (1972) reported *Cerithidea cingulata* from southern sector only. But we have collections from central and southern sectors and outer channel. It is a common brackish water species and can occur wherever there is a suitable substratum. Species of *Stenothyra* and *Gangetia miliacea* occur in the main part of the lake, where as *Pygmaeonassa orissaensis* occurs in the main part of the lake and also outer channel.

When we consider the abundance, a comparatively small number of species predominate in numbers. There may be about 10 species and half a dozen genera which are common with numerous individuals in the lake. As remarked by Annandale (1924) and also corroborated by us *Tornatina estriata* is the commonest gastropod at all seasons of the year. Among bivalves *Modiolus undulatus*, *M. striatulus*, *Clementia vatheleti*, *Theora opalina*, *Macoma birmanica*, *Neosolen aquaedulcioris*, *Meretrix casta*, *M. meretrix* are the commonest and abundant in the Lake.

Annandale and Kemp (1916) had brought out the special characteristics of lake molluscs. In general shell is small, thin, and lacks bright pigment. Majority of the shells in the main lake area have shells less than 5 mm length. The exceptions to this are a few species of Nassariidae, Potamididae and Muricidae, which are more than 1 cm and attain a maximum of 96.30 cms. Among bivalves large sized forms like, *Crassostrea*, *Meretrix*, *Standella* etc. occur in the outer channel or in northern sector. Dwarfing has been noticed and is attributed to salinity or periodic desiccation or confined position.

Molluscs in the main area of the lake are dull, but certain species like *Clithon oualaniensis*, *Umbonium vestiarium*, *Leucorhynchia variegata*, which occur in the outer channel are brightly coloured and highly polymorphic. Strangely the occurrence of *Clithon oualaniensis* in Chilka Lake was not mentioned by the earlier workers. But the senior author (NVS) collected samples from eelgrass on the mud flat and also on the algae from near Arakuda village in the outer channel. The substratum was muddy mixed with sand (Grueneberg, 1979).

As given in the Table II Annandale & Kemp (1916) recorded a total of 75 species, Subba Rao *et al.* (in 1989, 1991) 90 species and the present data included a total of 87 species. Of these the following 39 species are recorded for the first time from the Lake :

Bellamyia dissimilis

Turritella acutangula

T. columnaris

Thiara scabra

T. lineata

T. granifera
T. torulosa
T. tuberculata
Alaba blanfordi
Natica vitellus
Eunaticina coarctata
Phalium areola
P. canaliculatum
Cronia contracta
Oliva oliva
Cancellaria elegans
Marginella elegans
Melampus ceylonicus
Indoplanorbis exustus
Succinea daucina hraswasikhara
Anadara rhombea
Scapharca deyrollei
Glycymeris tenuicostatus
Anomia achaeus
Lamellidens marginalis
Cardites antiquatus
Acanthocardia coronata
Mactra luzonica
M. mera
M. turgida
Sanguinolaria acuminata
Cultellus subellipticus
Siliqua radiata
Macoma birmanica

Donax scortum

Corbicula striatella

Paphia undulata

Timoclea scabra

T. imbricata

The following species are distributed throughout the lake including the outer channel as evidenced by the collections :

Nassarius stolatus

Macoma birmanica

N. subconstrictus

Theora opalina

N. orissaensis

Clementia vatheleti

Modiolus striatulus

Cuspidaria chilkaensis

M. undulatus

Only a few species occur in the main area of the Lake.

Stenothyra blanfordiana

Gangetia miliacea

S. minima

Alaba blanfordi

The following species are mainly inhabitants of the outer channel, but occur in some parts of the lake.

Outer channel & Southern sector

Outer channel & Central sector

Thais lacera

Tornatina estriata

Placuna placenta

Outer channel, South & Central Sector

Neosolen aquaedulcioris

Species like *Bullia vittata*, *Anomia achaeus*, *Diplodonta satparaensis*, *Cultellus subellipticus* and *Meretrix meretrix* are restricted in their distribution to the outer channel only. The First one occurs buried in the sandy beach near the mouth and the second one attached to rocks in the mouth. These two are purely marine and should not be taken as components of the lake fauna. The other species mentioned above prefer substrata with an admixture of sand and mud and salinity slightly less than in the open sea.

The status of some of the species originally described from the lake is difficult to ascertain. The species were described on the basis of either one or very few dead shells. There were no subsequent reports of these species either from Chilka lake or from elsewhere. The following species were not collected during the recent expeditions.

Gastropoda

*Tubiola microscopica**Leucorhynchia variegata**Smaragdia mamilla**Epitonium hamatulae**Pyrgulina ecclesia**P. humilis chilkaensis**Odostomia chilkaensis**Stiliger pica**Elysia chilkaensis**Cuthona henrici*

Bivalvia

*Diplodonta barhampurensis**Diplodonta annandalei**Scintella chilkaensis**Spisula (Standella) annandalei**Gari (Psammobia) mahosaensis**Cumingia hinduorum**Solen annandalei**Tellina iridescens**Kellia chilkaensis**K. mahosaensis**Petricola esculpturata (=Trapezium
subllaevigatum)*

TABLE - I

Species described from Chilka Lake with their current scientific names.

Sl.No.	Name of the Species	Current scientific name
1	2	3
Class GASTROPODA		
Subclass PROSOBRANCHIA		
Order ARCHAEOGASTROPODA		
1. Family TROCHIDAE		
1.	<i>Solariella satparaensis</i> Preston, 1914	Same
2. Family CYCLOSTREMATIDAE		
2.	<i>Cyclostrema (Tubiola) innocens</i> Preston, 1915	<i>Tubiola microscopica</i> (Nevill, 1877)
3.	<i>Teinostoma variegata</i> Preston, 1914	<i>Leucorhynchia variegata</i> (Preston, 1914)
3. Family NERITIDAE		
4.	<i>Smaragdia mamilla</i> Annandale, 1924	<i>Smaragdia (Smaragdella) mamilla</i> Annandale, 1924
Order MESOGASTROPODA		
4. Family STENOTHYRIDAE		
5.	<i>Stenothyra blanfordiana</i> Nevill, 1880	Same
6.	<i>S. chilkaensis</i> Preston, 1914	<i>Stenothyra blanfordiana</i> Nevill, 1880
7.	<i>S. orissaensis</i> Preston, 1914	<i>S. minima</i> (Sowerby, 1837)
8.	<i>S. obesula</i> Preston, 1915	<i>S. blanfordiana</i> Nevill, 1880
9.	<i>S. trigona</i> Preston, 1915	<i>Gangetia miliacea</i> Nevill, 1880
5. Family EPITONIIDAE		
10.	<i>Epitonium hamatulae</i> Preston, 1915	Same
6. Family LITIOPIDAE		
11.	<i>Litiopa (Alaba) copiosa</i> Preston, 1915	<i>Finella virgata</i> (Philippi, 1849)
12.	<i>L. (A.) Kempfi</i> Preston, 1915	do
7. Family FOSSARIDAE		
13.	<i>Chilkaia imitatrix</i> Preston, 1915	Same

Order NEOGASTROPODA

8. Family MURICIDAE

14. *Cuma disjuncta* var. *obliterata* Annandale, 1924 *Thais lacera* (Born, 1778)

9. Family NASSARIIDAE

15. *Nassa denegabilis* Preston, 1914 *Nassarius (Aciculina) subconstrictus* (Sowerby, 1899)
16. *N. orissaensis* Preston, 1914 *N. (Pygmaeonassa) orissaensis* (Preston, 1914)

Subclass OPISTHOBRANCHIA

Order ENTOMOTAENIATA

10. Family PYRAMIDELLIDAE

17. *Chrysallida (Mormula) ecclesia* Preston, 1915 *Pyrgulina ecclesia* (Preston, 1915)
18. *C. (M.) humilis* var. *chilkaensis* Preston, 1915 *P. humilis* (Preston, 1905)
19. *C. (M.) nadiensis* Preston, 1915 *P. nadiensis* (Preston, 1915)
20. *Odostomia chilkaensis* Preston, 1914 Same
11. Family TEREBRIDAE Family PYRAMIDELLIDAE
21. *Terebra rambhaensis* Preston, 1914 *Turbonilla rambhaensis* (Preston, 1914)

Order CEPHALASPIDEA

12. Family CYLICHNIDAE

22. *Tornatina estriata* Preston, 1914 Same
23. *T. soror* Preston, 1914 *T. estriata* Preston, 1914

Order SACCOGLOSSA

13. Family STILIGERIDAE

24. *Stiliger pica* Annandale & Prashad, 1922 Same

14. Family ELYSIIDAE

25. *Elysia chilkaensis* Eliot, 1916 Same

Order NUDIBRANCHIA

15. Family CUTHONIDAE

26. *Cuthona henrici* Eliot, 1916 Same

Subclass PULMONATA

Order STYLOMMATOPHORA

16. Family STREPTAXIDAE

27. *Ennea bicolor* (Hutton) race *barkudensis* Annandale & Prashad, 1920 *Huttonella bicolor* (Hutton, 1834)
28. *Gulella* (*Huttonella*) *rambhaensis* Ray, 1960 *Huttonella rambhaensis* Ray, 1960
 Class BIVALVIA
 Order MYTILOIDA
 17. Family MYTILIDAE
29. *Modiola annandalei* Preston, 1911 *Modiolus* (*Modiolus*) *striatulus* Hanley, 1843
30. *M. chilkaensis* Preston, 1911 *M. (M.) undulatus* (Dunker, 1856)
31. *M. jenkinsi* Preston, 1910 *M. (M.) striatulus* Hanley, 1843
32. *M. undulata* var. *crassicostata* Preston, 1914 *M. (M.) undulatus* (Dunker, 1856)
 Order VENEROIDA
 18. Family UNGULINIDAE
33. *Diplodonta* (*Felania*) *Annandalei* Preston, 1914 *Felania annandalei* Preston, 1914
34. *D. (F.) chilkaensis* Preston, 1914 *F. chilkaensis* Preston, 1914
35. *D. (F.) ovalis* Preston, 1914 *F. ovalis* Preston, 1914
36. *D. barhampurensis* Preston, 1915 Same
37. *D. satparaensis* Preston, 1915 Same
 19. Family KELLIDAE
38. *Kellia chilkaensis* Preston, 1915 Same
39. *K. mahosaensis* Preston, 1915 Same
 20. Family GALEOMMATIDAE
40. *Scintilla chilkaensis* Preston, 1915 Same
 21. Family MACTRIDAE
41. *Standella annandalei* Preston, 1915 *Spisula* (*Standella*) *annandalei* Preston, 1915
 22. Family SOLENIDAE
42. *Solen annandalei* preston, 1915 Same
43. *S. kempi* Preston, 1915 Same
 23. Family CULTELLIDAE
44. *Neosolen aquaedulcioris* Ghosh, 1920 Same
 24. Family PSAMMOBIIDAE

- | | |
|--|---|
| 45. <i>Psammodia mahosaensis</i> Preston, 1915
25. Family SEMELIDAE | <i>Gari (Psammodia) mahosaensis</i> Preston, 1915 |
| 46. <i>Cumingia hinduorum</i> Preston, 1915
26. Family TELLINIDAE | Same |
| 47. <i>Tellina barhampurensis</i> Preston, 1915 | May be Semelidae |
| 48. <i>T. chilkaensis</i> Preston, 1915 | <i>Tellina (Pharaonella) iridescens</i> (Benson, 1842). |
| 49. <i>T. confusa</i> Preston, 1914
27. Family CYRENIDAE | <i>T. (Omala) texturata</i> Sowerby, 1867
Family VENERIDAE |
| 50. <i>Corbicula (Velorita) satparaensis</i> Preston, 1914
28. Family VENERIDAE | <i>Meretrix casta</i> (Gmelin, 1791) |
| 51. <i>Clementia annandalei</i> Preston, 1914 | <i>Clementia vatheleti</i> Mabilie, 1901 |
| 52. <i>Meroe chilkaensis</i> Preston, 1914 | <i>Sunetta scripta</i> (Linnaeus, 1758) (Part)
<i>S. meroe</i> Linnaeus, 1758 (Part) |
| 53. <i>M. satparaensis</i> Preston, 1914
29. Family PETRICOLIDAE | <i>S. scripta</i> (Linnaeus, 1758)
Family TRAPEZIIDAE |
| 54. <i>Petricola esculpturata</i> Preston, 1915
Order MYOIDA
30. Family CORBULIDAE | <i>Trapezium (Neotrapezium) sublaevigatum</i> (Lamarck, 1819)
Family CUSPIDARIIDAE |
| 55. <i>Corbula chilkaensis</i> Preston, 1911
31. Family LYONSIIDAE | <i>Cuspidaria chilkaensis</i> (Preston, 1911)
Family LATERNULIDAE |
| 56. <i>Lyonsia samalinsulae</i> Preston, 1915
32. Family LATERNULIDAE | <i>Laternula navicula</i> (Reeve, 1863) |
| 57. <i>Anatina barkudaensis</i> Preston, 1915 | do |
| 58. <i>A. barkulenss</i> Preston, 1915 | do |
| 59. <i>A. granulosa</i> Preston, 1914
33. Family CUSPIDARIIDAE | do |
| 60. <i>Cuspidaria annandalei</i> Preston, 1915 | <i>Cuspidaria chilkaensis</i> (Preston, 1911) |

Table II
Species recorded in the Chilka Lake.

Sl.No.	Name of the species	Recorded earlier by		Present Record	Remarks
		Annandale & Kemp (1916)	N.V.S.R. <i>et.al</i> (1989 & 1991)		
1	2	3	4	5	6
Class GASTROPODA					
Subclass PROSOBRANCHIA					
Order ARCHAEOGASTROPODA					
I. Family TROCHIDAE					
1.	<i>Umbonium vestiarius</i> (Linnaeus)	+	+	+	Dead, inhabited by hermit crabs.
2.	<i>Solariella satparaensis</i> Preston	+	+	+	Dead
II. Family CYCLOSTREMATIDAE					
3.	<i>Tubiola microscopica</i> (Nevill)	+	+		
4.	<i>Leucorhynchia variegata</i> (Preston)	+	+		
III. Family NERITIDAE					
5.	<i>Clithon oualaniensis</i> (Lesson)		+	+	Live
6.	<i>Smaragdia (Smaragdella) mamilla</i> Annandale	+	+		
Order MESOGASTROPODA					
IV. Family CYCLOPHORIDAE					
7.	<i>Cyclophorus (Cyclophorus) polynema</i> Pfeiffer			+	Terrestrial, Dead
V. Family VIVIPARIDAE					
8.	<i>Bellamyia bengalensis f. annandalei</i> (Kobelt)	+		+	Freshwater, Dead
9.	<i>B. dissimilis</i> (Mueller)			+	Freshwater, Live
VI. Family PILIDAE					
10.	<i>Pila globosa</i> (Swainson)	+		+	Freshwater, Dead
VII. Family BITHYNIIDAE					

11.	<i>Gabbia orcula</i> (Frauenfeld)					+
	VIII. Family STENOTHYRIDAE					
12.	<i>Stenothyra blanfordiana</i> Nevill	+	+	+		Live
13.	<i>S. minima</i> (Sowerby)	+	+	+		Live
14.	<i>Gangetia miliacca</i> (Nevill)	+	+	+		Live
	IX. Family TURRITELLIDAE					
15.	<i>Turritella acutangula</i> (Linnaeus)					+ Dead
16.	<i>T. columnaris</i> Kiener					+ Dead
	X. Family THIARIDAE					
17.	<i>Thiara (Thiara) scabra</i> (Mueller)					+ Freshwater, Dead
18.	<i>T. (Tarebia) granifera</i> (Lamarck)					+ Freshwater, Live
19.	<i>T. (Tarebia) lineata</i> (Gray)					+ Freshwater, Dead
20.	<i>T. (Stenomelania) torulosa</i> (Bruguiere)				-	+ Freshwater, Dead
21.	<i>T. (Melanoides) tuberculata</i> (Mueller)				-	+ Freshwater, Live
	XI. Family POTAMIDIDAE					
22.	<i>Cerithidia (Cerithideopsis) cingulata</i> (Gmelin)	+	+	+		Live
23.	<i>Telescopium (Telescopium) telescopium</i> (Linnaeus)	+	+	+		Dead
	XII. Family EPITONIIDAE					
24.	<i>Epitonium hamatulae</i> Preston	+	+			-
	XIII. Family LITIOPIIDAE					
25.	<i>Alaba blanfordi</i> A. Adams					+ Live
	XIV. Family FINELLIDAE					
26.	<i>Finella virgata</i> (Philippi)	+	+	+		Dead
	XV. Family FOSSARIDAE					
27.	<i>Chilkaia imitatrix</i> Preston	+	+	+		Dead
	XVI. Family NATICIDAE					
28.	<i>Natica (Natica) gualteriana</i> Recluz	+	+	+		Dead
29.	<i>N. (N.) vitellus</i> (Linnaeus)					+ Dead
30.	<i>N. (N.) tigrina</i> (Roeding)	+				(= <i>N. maculosa</i>)
31.	<i>Eunaticina coarctata</i> (Reeve)					+ Dead

XVII. Family CASSIDAE

- | | | | | | | |
|-----|--|--|--|--|---|------|
| 32. | <i>Phalium (Phalium) areola</i> (Linnaeus) | | | | + | Dead |
| 33. | <i>P. (Semicassis) canaliculatum</i> (Bruguiere) | | | | + | Dead |

Order NEOGASTROPODA

XVIII. Family MURICIDAE

- | | | | | | | |
|-----|---|---|---|--|---|------|
| 34. | <i>Thais lacera</i> (Born) | + | + | | + | Live |
| 35. | <i>Cronia (Ergalatax) contracta</i> (Reeve) | | | | + | Dead |

XIX. Family MELONGENIDAE

- | | | | | | | |
|-----|---------------------------------------|--|--|--|---|--|
| 36. | <i>Pugilina cochlidium</i> (Linnaeus) | | | | + | |
|-----|---------------------------------------|--|--|--|---|--|

XX. Family NASSARIIDAE

- | | | | | | | | |
|-----|--|---|---|--|---|---|------|
| 37. | <i>Nassarius (Hima) stolatus</i> (Gmelin) | | | | + | + | Live |
| 38. | <i>N. (Zeuxis) foveolatus</i> (Dunker) | + | + | | + | + | Dead |
| 39. | <i>N. (Aciculina) subconstrictus</i> (Sowerby) | + | + | | + | + | Live |
| 40. | <i>N. (A.) vittatus</i> A. Adams | | | | | + | |
| 41. | <i>N. (Niotha) jacksonianus</i> (Quoy & Gaimard) | + | + | | | | |
| 42. | <i>N. (Niotha) livescens</i> Philippi | | | | | + | |
| 43. | <i>N. (Pygmaeonassa) orissaensis</i> (Preston) | + | + | | + | + | Live |
| 44. | <i>Bullia (Dorsanum) vittata</i> (Linnaeus) | + | + | | + | + | Live |

XXI. Family OLIVIDAE

- | | | | | | | | |
|-----|---------------------------------------|--|--|--|---|---|------|
| 45. | <i>Oliva (Oliva) oliva</i> (Linnaeus) | | | | | + | Dead |
| 46. | <i>Olivancillaria gibbosa</i> (Born) | | | | + | + | Dead |

XXII. Family CANCELLARIIDAE

- | | | | | | | | |
|-----|------------------------------------|--|--|--|--|---|------|
| 47. | <i>Cancellaria elegans</i> Sowerby | | | | | + | Dead |
|-----|------------------------------------|--|--|--|--|---|------|

XXIII. Family MARGINELLIDAE

- | | | | | | | | |
|-----|------------------------------------|--|--|--|--|---|------|
| 48. | <i>Marginella elegans</i> (Gmelin) | | | | | + | Dead |
|-----|------------------------------------|--|--|--|--|---|------|

Subclass OPSTHOBRANCHIA

Order ENTOMOTAENIATA

XXIV. Family PYRAMIDELLIDAE

- | | | | | | | | |
|-----|--------------------------------------|---|---|--|--|--|--|
| 49. | <i>Odostomia chilkaensis</i> Preston | + | + | | | | |
| 50. | <i>Pyrgulina ecclesia</i> (Preston) | + | + | | | | |

51.	<i>P. humilis</i> (Preston)	+	+	-	
52.	<i>P. nadiensis</i> (Preston)	+	+	+	Dead
53.	<i>Turbonilla rambhaensis</i> (Preston)	+	+	+	Dead
	Order CEPHALASPIDEA				
	XXV. Family ATYIDAE				
54.	<i>Haminoea crocata</i> Pease	+	+	-	
	XXVI. Family CYLICHNIDAE				
55.	<i>Tornatina estriata</i> Preston	+	+	+	Live
	Order SACOGLOSSA				
	XXVII. Family STILIGERIDAE				
56.	<i>Stiliger pica</i> Annandale and Prashad	+		-	
	XXVIII. Family ELYSIIDAE				
57.	<i>Elysia chilkaensis</i> Eliot	+		-	
	Order NUDIBRANCHIA				
	XXIX. Family CUTHONIDAE				
58.	<i>Cuthona henrici</i> Elliot	+			
	Subclass PULMONATA				
	Order BASOMMATOPHORA				
	XXX. Family ELLOBIIDAE				
59.	<i>Melampus ceylanicus</i> Petit			+	Dead
	XXXI. Family LYMNAEIDAE				
60.	<i>Lymnaea (Pseudosuccinea) luteola</i> f. <i>typica</i> Lamarck		+		Freshwater, Dead
	<i>L. (P.) luteola</i> f. <i>impura</i> Troschel		+		Freshwater, Dead
	<i>L. (P.) luteola</i> f. <i>ovalis</i> Gray		+		Freshwater, Dead
	XXXII. Family PLANORBIIDAE				
61.	<i>Indoplanorbis exustus</i> Deshayes			+	Freshwater, Dead
	Order STYLOMMATOPHORA				
	XXXIII. Family ENIDAE				
62.	<i>Rachistia praetermissus</i> (Blanford)	+	+	+	Terrestrial, Dead

XXXIV. Family SUCCINEIDAE

63. *Succinea daucina* Pfeiffer f. *hrawasikhara* Rao + Terrestrial, Live

XXXV. Family SUBULINIDAE

64. *Lamellaxis gracile* (Hutton) + + + Terrestrial, Dead

XXXVI. Family STREPTAXIDAE

65. *Hutonella bicolor* (Hutton) + +

66. *H. rambhaensis* Ray +

XXXVII. Family ARIOPHANTIDAE

67. *Euplecta infausta* (Blanford) + +

Class BIVALVIA

Order ARCOIDA

XXXVIII. Family ARCIDAE

68. *Anadara granosa* (Linnaeus) + + + Dead

69. *A. rhombea* (Born) + Dead

70. *Scapharca deyrollei* Jousseume + Dead

XXXIX. Family NOETIIDAE

71. *Striarca lactea* (Linnaeus) + +

XL. Family GLYCYMERIDIDAE

72. *Glycymeris tenuicostatus* (Reeve) + Dead

Order MYTILOIDA

XLI. Family MYTILIDAE

73. *Perna viridis* (Linnaeus) + + + Dead

74. *Modiolus (Modiolus) striatulus* Hanley + + + Live

75. *M. undulatus* (Dunker) + + + Live

76. *M. philippinarum* Hanley +

Order PTERIOIDA

XLII. Family ANOMIIDAE

77. *Anomia achaeus* Gray + Dead

78. *Placuna placenta* (Linnaeus) + + Live

XLIII. Family LIMIDAE

79.	<i>Ctenoides annulata</i> (Lamarck)				+	
	XLIV. Family OSTREIDAE					
80.	<i>Crassostrea cuttackensis</i> (Newton & Smith)	+	+	+		Dead
81.	<i>Saccostrea cucullata</i> (Born)	+	+	+		Dead
	XLV. Family GRYPHAEIDAE					
82.	<i>Hyotissa hyotis</i> (Linnaeus)				+	
	Order UNIONOIDA					
	XLVI. Family UNIONIDAE					
83.	<i>Lamellidens marginalis</i> (Lamarck)				+	Freshwater, Dead
	Order VENEROIDA					
	XLVII. Family UNGULINIDAE					
84.	<i>Diplodonta barhampurensis</i> Preston	+	+			
85.	<i>D. satparaensis</i> Preston	+	+	+		Live
86.	<i>Felania annandalei</i> Preston	+	+	-		
87.	<i>F. chilkaensis</i> Preston	+	+	+		Dead
88.	<i>F. ovalis</i> Preston	+	+	+		Dead
	XLVIII. Family KELLIIDAE					
89.	<i>Kellia chilkaensis</i> Preston	+	+			
90.	<i>K. mahosaensis</i> Preston	+	+			
	XLIX. Family GALEOMMATIDAE					
91.	<i>Scintilla chilkaensis</i> Preston	+	+			
	L. Family CARDITIDAE					
92.	<i>Cardites antiquata</i> (Linnaeus)				+	Dead
	LI. Family CARDIIDAE					
93.	<i>Acanthocardia coronata</i> (Schroeter)				+	Dead
94.	<i>A. lata</i> (Born)				+	Dead
95.	<i>Laevicardium (Fulvia) apertum</i> (Bruguiere)				+	
	LII. Family MACTRIDAE					
96.	<i>Mactra (Mactra) grandis</i> Gmelin				+	
97.	<i>M. (M.) luzonica</i> Deshayes				+	Dead

98. <i>M. (M.) mera</i> Deshayes			+	Dead
99. <i>M. (Coelomactra) turgida</i> Gmelin			+	Dead
100. <i>Spisula (Standella) annandalei</i> Preston	+	+		
LIII. Family SOLENIDAE				
101. <i>Solen annandalei</i> Preston	+	+		
102. <i>S. kempfi</i> Preston	+	+	+	Dead
LIV. Family CULTELLIDAE				
103. <i>Cultellus subellipticus</i> Dunker			+	Dead
104. <i>Neosolen aquaedulcioris</i> Ghosh	+	+	+	Live
105. <i>Siliqua (Siliqua) radiata</i> (Linnaeus)			+	Dead
LV. Family TELLINIDAE				
106. <i>Tellina (Pharaonella) iridescens</i> (Benson)	+	+		
107. <i>T. (Omala) texturata</i> Sowwerby			+	
108. <i>T. barhampurensis</i> Preston	+	+		
109. <i>Macoma (Psammacoma) birmanica</i> (Philippi)			+	Live
110. <i>M. (P.) truncata</i> (Janas)			+	
LVI. Family DONACIDAE				
111. <i>Donax (Donax) pulchella</i> Hanley			+	
112. <i>D. (Hecuba) scortum</i> (Linnaeus)			+	Dead
LVII. Family PSAMMOBIIDAE				
113. <i>Gari (Psammobia) mahosaensis</i> Preston	+	+		
114. <i>Sanguinolaria (Soletellina) acuminata</i> Deshayes			+	Dead
LVIII. Family SEMELIDAE				
115. <i>Cumingia hinduorum</i> Preston	+	+		
116. <i>Theora (Theora) opalina</i> (Hinds)	+	+	+	Live
LIX. Family TRAPEZIIDAE				
117. <i>Trapezium (Neotrapezium) sublaevigatum</i> (Lamarck)	+	+		
LX. Family CORBICULIDAE				
118. <i>Corbicula striatella</i> Deshayes			+	Freshwater, Dead

LXI. Family VENERIDAE

119. <i>Sunetta (Sunetta) donacina</i> (Gmelin)		+	-	
120. <i>S. (S.) meroe</i> (Linnaeus)	+	+	+	Dead
121. <i>S. (S.) scripta</i> (Linnaeus)	+	+	+	Dead
122. <i>Meretrix meretrix</i> (Linnaeus)	+	+	+	Live
123. <i>M. casta</i> (Gmelin)	+	+	+	Live
124. <i>Tivela dillwyni</i> (Deshayes)	+	+	-	
125. <i>Dosinia (Asa) fibula</i> (Reeve)		+	+	Dead
126. <i>D. (A.) tumida</i> Gray		+	-	
127. <i>Clementia vatheleti</i> Mebille	+	+	+	Live
128. <i>Marcia pinguis</i> (Schroeter)	+	+	+	Dead
129. <i>Paphia undulata</i> (Born)			+	Dead
130. <i>Timoclea imbricata</i> (Sowerby)			+	Dead
131. <i>T. scabra</i> (Hanley)			+	Dead

Order MYOIDA

LXII. Family LATERNULIDAE

132. <i>Laternula navicula</i> (Reeve)	+	+	+	Live
--	---	---	---	------

LXIII. Family CUSPIDARIIDAE

133. <i>Cuspidaria chilkaensis</i> Preston	+	+	+	Live
--	---	---	---	------

Order PHOLADOMYOIDA

LXIV. Family PHOLADIDAE

134. <i>Martesia (Martesia) striatula</i> (Linnaeus)	+	+		
--	---	---	--	--

LXV. Family TEREDENIDAE

135. <i>Bankia carinata</i> Gray	+	+		
----------------------------------	---	---	--	--

Class CEPHALOPODA

Order SEPIOIDA

LXVI. Family SEPIIDAE

136. <i>Sepiella inermis</i> (Ferussac d' Orbigny)		+		
--	--	---	--	--

Table III

Distribution of species in the Chilka Lake.

(* Indicates dead shells only)

Sl.No.	Name of the species	Outer Channel	Main area		
			Southern	Central	Northern
1	2	3	4	5	6
1.	<i>Umbonium vestiarium</i>	x			
2.	<i>Solariella satparaensis</i>	x			
3.*	<i>Tubiola microscopica</i>	x			
4.	<i>Leucorhynchia variegata</i>	x			
5.	<i>Clithon oualaniensis</i>	x			
6.	<i>Smaragdia manilla</i>	x			
7.*	<i>Bellamya bengalensis f. annandalei</i>		x		x
8.	<i>B. dissimilis</i>		x	x	x
9.*	<i>Pila globosa</i>				x
10.*	<i>Gabbia orcula</i>		x		
11.	<i>Stenothyra blanfordiana</i>		x	x	x
12.	<i>S. minima</i>		x	x	x
13.	<i>Gangetia miliacea</i>		x	x	x
14.*	<i>Turritella acutangula</i>	x			
15.*	<i>T. columnaris</i>	x			
16.*	<i>Thiara (Thiara) scabra</i>				x
17.	<i>T. (Tarebia) granifera</i>				x
18.*	<i>T. (Tarebia) lineata</i>				x
19.*	<i>T. (Stenomelania) torulosa</i>				x
20.	<i>T. (Melanoides) tuberculata</i>		x		x
21.	<i>Cerithidea (Cerithideopsis) cingulata</i>	x	x	x	
22.	<i>Telescopium (Telescopium) telescopium</i>	x	x	x	
23.*	<i>Epitonium hamatulae</i>	x			

24.	<i>Alaba blanfordi</i>	x	x	x	x
25.	<i>Finella virgata</i>		x	x	x
26.	<i>Chilkaia imitatrix</i>	x			
27.*	<i>Natica (Natica) gualteriana</i>	x			
28.*	<i>N. (N.) vitellus</i>	x			
29.*	<i>Eunaticina coarctata</i>	x			
30.*	<i>Phalium (Phalium) areola</i>	x			
31.*	<i>P. (Semicassis) canaliculatum</i>	x			
32.	<i>Thais lacera</i>	x	x	x	
33.*	<i>Cronia (Ergalatax) contracta</i>	x			
34.	<i>Pugilina cochlidium</i>			x	
35.	<i>Nassarius (Hima) stolatus</i>	x	x	x	x
36.*	<i>N. (Zeuxis) foveolatus</i>	x	x		-
37.	<i>N. (Aciculina) subconstrictus</i>	x	x	x	x
38.*	<i>N. (A.) vittatus</i>			x	
39.*	<i>N. (Niotha) jacksonianus</i>	x			
40.	<i>N. (Pygmaeonassa) orissaenss</i>	x	x	x	x
41.	<i>Bullia (Dorsanum) vittata</i>	x	x		
42.*	<i>Oliva (Oliva) oliva</i>	x			
43.*	<i>Olivancillaria gibbosa</i>	x			
44.*	<i>Cancellaria elegans</i>	x			
45.*	<i>Marginella elegans</i>	x			
46.	<i>Odostomia chilkaensis</i>	x			
47.	<i>Pyrgulina ecclesia</i>		x		
48.	<i>P. humilis</i>	x	x	x	
49.	<i>P. nadiensis</i>	x	x	x	x
50.	<i>Turbonilla rambhaensis</i>		x	x	
51.	<i>Haminoea crocata</i>	x			
52.	<i>Tornatina estriata</i>	x	x	x	
53.*	<i>Melampus ceylanicus</i>		x		

54.* <i>Lymnaea (Pseudosuccinea) luteola f. impura</i>		x		
55.* <i>L.(P.) luteola f. ovalis</i>		x		
56.* <i>Indoplanorbis exustus</i>		x		
<i>Class BIVALVIA</i>				
57. <i>Anadara granosa</i>	x		x	
58.* <i>A. rhombea</i>	x		x	
59.* <i>Scapharca deyrollei</i>	x			
60. <i>Striarca lactea</i>	x			
61.* <i>Glycymeris tenuicostatus</i>	x			
62. <i>Perna viridis</i>	x		-	
63. <i>Modiolus (Modiolus) striatulus</i>	x	x	x	x
64. <i>M. undulatus</i>	x	x	x	x
65. <i>Anomia achaeus</i>	x			
66. <i>Placuna placenta</i>	x	x		
67.* <i>Crassostrea cuttackensis</i>	x			
68.* <i>Saccostrea cucullata</i>	x			
69.* <i>Hyotissa hyotis</i>	x			
70.* <i>Lamellidens marginalis</i>	x			
71.* <i>Diplodonta barhampurensis</i>	x			
72. <i>D. satparaensis</i>	x		x	
73. <i>Felania annandalei</i>	x		x	
74. <i>F. chilkaensis</i>	x		x	
75. <i>F. ovaliis</i>	x		x	
76. <i>Kellia chilkaensis</i>	x		x	
77. <i>K. mahosaensis</i>	+			
78. <i>Scintilla chilkaensis</i>	x			
79.* <i>Cardites antiquata</i>	x			
80.* <i>Acanthocardia coronata</i>	x			
81.* <i>A. lata</i>	x			
82.* <i>Laevicardium (Fulvia) apertum</i>	x			

83.* <i>Mactra (Mactra) grandis</i>				x
84.* <i>M. (M.) luzonica</i>	x		-	x
85.* <i>M. (M.) mera</i>	x			-
86.* <i>M. (Coelomactra) turgida</i>	x	-		-
87. <i>Spisula (Standella) annandalei</i>	x		x	
88.* <i>Solen annandalei</i>	x			
89.* <i>S. kempi</i>	x		x	
90. <i>Cultellus subellipticus</i>	x			
91. <i>Neosolen aquaedulcioris</i>	x	x	x	x
92.* <i>Siliqua radiata</i>	x			
93.* <i>Tellina (Pharaonella) iridescens</i>	x			
94.* <i>T. barahampurènsis</i>	x			
95.* <i>Macoma (Psammacoma) birmanica</i>	x	x	x	x
96.* <i>M. (P.) truncata</i>			x	
97.* <i>Donax (Donax) pulchella</i>	x			
98.* <i>D. scortum</i>	x			
99. <i>Gari (Psammobia) mahosaensis</i>	x			
100.* <i>Sanguinolaria (Soletellina) acuminata</i>	x			
101. <i>Cumingia hinduorum</i>	x		x	
102. <i>Theora opalina</i>	x	x	x	x
103. <i>Trapezium (Neotrapezium) sublaevigatum</i>	x			
104.* <i>Corbicula striatella</i>				x
105.* <i>Sunetta (Sunetta) donacina</i>			x	x
106.* <i>S. (S.) meroe</i>	x			
107.* <i>S. (S.) scripta</i>	x			
108. <i>Meretrix meretrix</i>	x	x		
109. <i>M. casta</i>	x	x	x	x
110. <i>Tivela dillwyni</i>	x			
111.* <i>Dosinia (Asa) fibula</i>	x			
112.* <i>D. (A.) tumida</i>	x			

113. <i>Clementia vatheleti</i>	x	x	x	x
114. <i>Marcia pinguis</i>	x	x		
115. * <i>Paphia undulata</i>		x		
116. * <i>Timoclea imbricata</i>	x			
117. * <i>T. scabra</i>	x			
118. <i>Laternula navicula</i>	x	x		
119. <i>Cuspidaria chilkaensis</i>	x	x	x	x

The distribution of the following species in the lake is not known as the collections are not available for study nor the exact locality is given and hence not included in the table.

1. *Natica tigrina* (= *N. maculosa*)
2. *Strombus isabella*
3. *Nassarius (Niotha) livescens*
4. *Stiliger pica*
5. *Elysia chilkaensis*
6. *Cuthona henricii*
7. *Lymnaea (Pseudosuccinea) luteola f. typica*
8. *Ctenoides anulata*
9. *Kellia mahosaensis*
10. *Tellina texturata* (*T. confusa*)
11. *Martesia striatula*
12. *Sepiella inermis*

SUMMARY

From the studies made so far a total of 136 species under 66 families were reported from the Chilka lake. Annandale (1916), who pioneered the molluscan studies had recorded 74 species and the recent studies on the fauna of Orissa had added 22 species (Subba Rao *et.al.*, 1991). The present collections have brought to light 39 species more, thus enhancing the species number of molluscs occurring in the lake. This number includes 7 species of land molluscs and 13 species of freshwater molluscs. The rest of the species are either marine or estuarine. Of the total species recorded, 62 only are collected live while the rest are represented by dead shells. Majority of the shells were washed ashore near the outer channel, while only a few dead shells were collected from the lake. It is, however, interesting to point out that of the 74 species reported from the lake by Annandale and Kemp (1916) only 24 species were collected during the present expeditions. The absence of so many species is difficult to understand. It may be due to difference in the collection technique or the species may not exist in the lake at present. But overall there is a definite increase in the number of species.

The collection of live specimens of three species of freshwater molluscs points to the change in the lake ecology as there were no such earlier reports.

The Chilka lake is the type locality for about 60 species (with subspecies, varieties and races). Of these 53 species are still considered valid. But the recent collections included only 15 of the species described from the lake and for the rest we had to study the old original collections. It is not possible to comment on the status of these species. For example of the three opisthobranch species, described from the lake none have been collected afterwards.

A family-wise treatment of the malacofauna is given so as to present a comprehensive idea and comparison of the fauna in general. An up-dated list of species reported from the lake and their distribution in the lake is provided. Keys to the families and genera were given to facilitate easy identification.

ACKNOWLEDGEMENTS

The authors are grateful to the Director, Zoological Survey of India, Calcutta for providing facilities to undertake the present work and to Dr. K.V. Rama Rao, ex-Officer-in charge of Estuarine Biological Station, Berhampur for his cooperation and making all arrangements during various expeditions.

REFERENCES

- Annandale, N. 1924. Fauna of Chilka Lake, Mollusca, Gastropoda (Revision). *Mem. Indian Mus.*, 5 : 853-873, figs. 1-16.
- Annandale, N. 1925. Introduction to the study of the fauna of an Island in the Chilka Lake. *Mem. Asiat. Soc. Beng.*, 7 : (Mollusca) 265-274.
- Annandale, N. and Kemp. S. 1916. Fauna of Chilka Lake, Mollusca Gastropoda and Lamellibranchiata (with an account of the anatomy of the Common *Solen* by E. Ghosh). *Mem. Indian Mus.*, 5 : 328-374, pls. 14-16.

- Annandale, N. and Prashad B., 1920. Observation on a carnivorous land snail. *Rec. Indian Mus.*, **19** : 189-194, figs. 1-3.
- Annandale, N. and Prashad, B. 1921. The Indian molluscs of the estuarine subfamily : Stenothyriinae. *Rec. Indian Mus.*, **22** : 121-136, text figs. 1-3, pl. 16.
- Annandale, N. and Prashad B., 1922. In : "Fauna of Chilka Lake" - *Mem. Indian Mus.*, **5** : (Mollusca) : 700-702.
- Eliot, C. 1916. Fauna of Chilka Lake, Mollusca, Nudibranchiata, *Mem. Indian Mus.*, **5** : 377-379, text-fig.
- Ghosh, E. 1916. Appendix. Fauna of Chilka Lake, Mollusca, Gastropoda and Lamellibranchiata. The anatomy of the common *Solen* of the Chilka Lake ? A dwarf form of *Solen fonesi* Dunker. *Mem. Indian Mus.*, **5** : 367-374, figs. 1-3.
- Ghosh, E. 1920. Taxonomic studies on the soft parts of the Solenidae. *Rec. Indian Mus.*, **19** : 47-78, pls. II. & III.
- Godwin-Austen, H.H. 1917. The land mollusca collected on the Island of Barkuda in the Chilka Lake, Ganjam. *Rec. Indian Mus.*, **13** : 349-351.
- Grueneberg, H. 1979. A search for causes of Polymorphism in *Clithon oualaniensis* (Lesson) (Gastropoda, Prosobranchia). *Proc. R. Soc. Lond., B* **203** : 379-386.
- Nevill, G. 1864. *Handlist of Mollusca in the Indian Museum, Calcutta*, pt.2, Gastropoda, Prosobranchia Neurobranchia cont., Indian Museum, Calcutta : 306 pp.
- Patnaik, S. 1972. Seasonal abundance and distribution of bottom fauna of the Chilka Lake. *J. mar. biol. Ass. India*, **13**(1) (1971) : 106-125.
- Prashad, B. 1939. A note on *Meroe chilkaensis* Preston and *Meroe satparaensis* Preston from the Chilka Lake, India. *J. Conch. Paris*, **83**(1), : 46--47.
- Preston, H.B. 1912. Descriptions of six new species of shells from Bengal and Madras. *Rec. Indian Mus.*, **6** : 39-42, figs. 1-6.
- Preston, H.B. 1914. Mollusca from the Chilka Lake on the east coast of India. *ibid.*, **10** : 297-310, 22 figs.
- Preston, H.B. 1915. A further report on mollusca from Lake Chilka on the east coast of India. *ibid.*, **11** : 289-310, 25 figs.
- Rajan, S. 1971. Environmental studies of the Chilka Lake - 2. Benthic animal communities. *Indian J. Fish.*, **12**(2) (1965) : 492-499, 2 figs.
- Ray, H.C. 1960. A new species of Mollusca, *Gulella rambhaensis* from Rambha in Orissa (Gastropoda : Family, Streptaxidae), *J. Bombay nat. Hist. Soc.* **57**(3) : 691-693, text fig. 1.

- Sewell, R.B.S. and Annandale N., 1922. Fauna of Chilka Lake. The hydrography and invertebrate fauna of Rambha Bay in the abnormal year. *Mem. Indian Mus.*, **5** : 679-710 (Mollusca : 697-720), pls. 31-43, tab. 1-4 (Fauna by Annandale, N.).
- Subba Rao, N.V., Thakur, D. K. and Mitra, S.C., 1989. Mollusca (Terrestrial). *Fauna of Orissa, State Fauna Ser.*, **1(2)** : 253-275, figs. 1-6.
- Subba Rao, N.V., Mitra, S. C. and Manna, R. N., 1989. Molluscs (Freshwater) *Fauna of Orissa, State Fauna Ser.*, **1(2)** : 277-318, figs. 1-15.
- Subba Rao, N.V., Surya Rao, K. V. and Maitra, S. 1991. Mollusca, Marine *Fauna of Orissa, State Fauna Ser.*, **1(3)** : 1-175, 30 pls.

SIPUNCULA AND ECHIURA

BADRI PRASAD HALDAR
Zoological Survey of India, Calcutta

INTRODUCTION

The couple of non-chordate phyla Sipuncula and Echiura comprises sedentary members dwelling in burrowed substrata from the temporarily exposed intertidal limits to the abyssal depths of vast seas and also certain tropical estuaries of the globe. Though they are typically of marine origin, a few like those under study apparently well adapt themselves to the estuarine environment. Noteworthy, the members eliciting the estuarine habits and distribution in different belts of the globe are exclusively restricted to a single family of Echiura and, two of Sipuncula. Of the two sipunculan families only one is, for the first time, recorded from the study area.

Nearly eight decades back faunistic survey was made at Chilka lake when Annandale and Kemp (1915) described only a single species of Echiura. In the intervening period two specimens belonging to two species of Echiura collected from Barkuda are being reported for the first time here along with the earlier known and presently collected echiuran species and one species of sipunculan, hitherto unknown, collected during the present expedition. It may be mentioned here that 37 species of Sipuncula and 29 species of Echiura are so far recorded from the Indian Coast (Haldar, 1991; Haldar & Dattagupta, 1991).

The paper deals with the systematic account of all the aforesaid four species alongwith the key to genera and species of echiurans together with their geographical distribution.

SYSTEMATIC ACCOUNT

List of Species

- Sipuncula : * *Siphonosoma australe* (Keferstein)
- Echiura : 1. *Anelassorhynchus dendrorhynchus* (Annandale & Kemp)
- 2.* *Anelassorhynchus sabinus* (Lanchester)
- 3.* *Ochetostoma australiense* Edmonds

* denotes new record

Phylum SIPUNCULA

Class SIPUNCULIDEA

Order SIPUNCULIFORMES

Family SIPUNCULIDAE

Diagnosis : Tentacles in clusters or arranged in meridional rows; retractor muscles two pairs.

Genus *Siphonosoma* Spengel

Diagnosis : Introvert shorter than trunk and with papillae and hooks arranged in rings; tentacles numerous, arranged round the mouth; coelomic canals present in the body wall; circular and longitudinal muscle layers divided into anastomosing bands; contractile vessel without villi; spindle muscle attached both anteriorly and posteriorly.

Siphonosoma australe (Keferstein)

1865. *Phascolosoma australe* Keferstein, *Nachr. Ges. Wiss. Gottingen*, No. 7 : 197-198.
Siphonosoma australe : Haldar, *Mem. zool. Surv. India*, 1991, 17 (4) : 39-42, figs. 21, 64-70.

Material examined : 1 ex., Lake mouth, Chilka Lake Expedition, 21.ix.1987.

Description : Trunk is 135 mm long, posteriorly tapering, thick and opaque-skinned, brown in colour. Introvert is 70 mm long 32 rows of hooks with large, slightly curved, more or less pointed, dark-brown in colour, and 0.22 mm long and 0.07 mm wide at base. Tentacles are about 80 in number, long, slender and measuring 0.5 - 0.7 mm in length. Papillae are uniformly distributed all over the body, smaller in size and circular in surface view in midtrunk region whereas more prominent and dome shaped at posterior end. Papillae are more or less flat and circular in between hook rows.

Longitudinal muscle layer is separated in 15-17 bands, anastomosing occasionally. Circular muscle layer is also divided into a number of anastomosing bands. Retractor muscles are two pairs (dorsal and ventral) and originate from different level of the anterior part of trunk. Contractile vessel is simple and running along dorsal surface of oesophagus up to first intestinal coil. Intestinal tract consists of 78 coils and anterior part of rectum is provided with a small caecum, while its anal part is attached to the body wall by wing muscles. Anal aperture lies in between the muscles 7-8 about 5 mm behind the nephridiopores. Spindle muscle arises anteriorly by three roots and anchors intestinal coil posteriorly. Nephridia are light brown, one-fourth as long as trunk and partially attached anteriorly. Coelomic papillae and 'Keferstein bodies' are found in front of nephrostomes and anterior trunk region respectively. Transverse dissepiments are not observed.

Remarks : Four species under this genus are so far known from the Indian coast but none of them is ever reported from estuarine zone. In this context the present report is interesting as the animal is collected for the first time from an area where salinity is 20‰.

Distribution : This is a warm and generally shallow water species occurring in the Indo-West Pacific region.

In India : Krusadai Island, Gulf of Mannar (Gravelly, 1927; Prashad, 1936); Rameswaram (Haldar, 1991); Visakhapatnam Harbour, Andhra Pradesh (Ganapati & Subba Rao, 1970); Long Island, Middle Andamans (Haldar, 1976).

Phylum ECHIURA

Class ECHIURIDA

Order ECHIUROINEA

Family THALASSEMATIDAE

Diagnosis : Trunk sac-like to cylindrical in shape and usually covered with papillae; proboscis well developed; hooks paired and antero-ventral in position; posterior setae absent; nephridia paired; nephrostomes with spirally coiled lips; gonoducts with lateral gonostome; anal vesicles long and tubular.

Key to the subfamilies and genera

1. Longitudinal muscles of the body wall continuous without gathering into longitudinal muscle bands *Thalassematinae* 2
- Longitudinal muscles of the body wall gather at intervals forming distinct longitudinal muscle bands *Ochetostomatinae* 3
2. Gonoducts 1-3 pairs; gonostomal lip drawn into a pair of spirally coiled filaments *Anelassorhynchus*
3. Gonoducts 1-7 pairs; gonosomal lip elongate and spirally coiled *Ochetostoma*

Genus *Anelassorhynchus* Annandale

1922. *Anelassorhynchus* Annandale, *Bijdr. Dierk.*, 22 : 148.
 1946. *Anelassorhynchus* : Fisher, *Proc. U.S. natn. Mus.*, 96 : 222.

Diagnosis : Echiurida resembling the genus *Thalassema* in having the longitudinal muscle layer of the body wall of uniform thickness and without specialized bands but differing in having prolonged and spirally coiled lips to nephrostome.

Key to the species of *Anelassorhynchus*

- Proboscis with dendritic or gill-like outgrowths *A. dendrorhynchus*
 Proboscis without dendritic outgrowths *A. sabinus*

Anelassorhynchus dendrorhynchus (Annandale & Kemp)

1915. *Thalassema dendrorhynchus* Annandale and Kemp, *Mem. Indian Mus.*, 5 : 55-63.
 1978. *Anelassorhynchus dendrorhynchus* : Haldar, *Bull. zool. Surv. India*, 1 (3) : 316.

Material examined : 1 ex., Stn. 11, Leg C₄, "grayish black clay devoid of vegetation", 13.vi.1986; 2 exs., Stn. 13, Leg C₅, "black sandy mud without vegetation", 13.vi.1986; 1 ex., Stn. 15, Leg D₅, "soft gray clay with little sand", 14.vi.1986; 1 ex., Stn. 17, Leg B6, "grayish clay devoid of vegetation", 16.vi.1986 Chilka Lake Expedition.

Description : The measurement of the largest specimen is 130 mm in total length with proboscis 20 mm and that of the smallest one is 70 mm in total length with proboscis 12 mm. The proboscis is shovel-shaped with its margin distinctly serrated, the serrations near the proximal end being developed into dendritic outgrowths. The proboscis and the posterior end of the body is white, while the rest is pink in colour. Skin is thin and transparent except at the posterior end of the body. The body is covered with papillae which are numerous at both the extremities and apparently arranged in concentric rings. Papillae at the posterior end are larger than the anterior ones. Circum-anal region is conical in shape and devoid of papillae, being encircled by concentric folds. Ventral hooks are golden yellow in colour and placed close to the proboscis base.

Internally, the longitudinal muscle layer is not separated into bands. The alimentary canal is very long, irregularly coiled and attached to the body wall by numerous mesenterial strands from the latter. The animal appears to be a soft mud dweller as the intestine is filled with mud and mud pellets with no trace of sand or shingle. Nephridia are two pairs in number and post-setal in position; nephrostomal lips are very long and spirally coiled. Anal vesicles are short, brownish, being provided with minute ciliated funnels and opening close to anus.

Remarks : The animal is very sluggish in habit. When it is left on a bowl containing mud simulating its natural habitat, it shows only a rhythmic movement due to contraction and expansion of longitudinal and transverse muscle layers.

The specimens are collected exclusively with the help of small dredge from certain localised parts of the vast Chilka lake where salinity is very less.

The specimens conform with the type specimens available with the author. The species can be readily distinguished from its nearest ally, viz., *A. branchiorhynchus* where the proboscis is relatively longer and more slender and the dendritic outgrowths of its margin are much more highly developed, having a gill-like appearance.

Distribution : The species is endemic to the east coast of India.

In India : Sagar Island, West Bengal (Haldar, 1978); Chilka Lake (Type locality), Orissa (Annandale & Kemp, 1915); Pamban, Tamil Nadu (Haldar, 1978).

Anelassorhynchus sabinus (Lanchester)

1905. *Thalassema sabinum* Lanchester, *Proc. zool. soc. Lond.*, 1 : 40-41.

1978. *Anelassorhynchus sabinus* : Haldar, *Bull. zool. Surv. India.*, 1 (3) : 316.

Material examined : 1 ex., Barkuda Island, Chilka Lake, Coll. Prof. M. Mohanti, 7.x.1972.

Description : The animal is small, measuring 12 mm in total length with proboscis being one-third of the entire body. The proboscis shows the beginning of the formation of gill-like outgrowths. The skin covering the trunk is appreciably thin being transparent in places so as to make most of the internal organs except the nerve cord visible from outside. The body is covered with minute papillae. Ventral setae are two in number and placed just behind the proboscis and anterior to the nephridiopores.

Internally, the longitudinal muscle layer is not separated into bands. The intestine is found decomposed, nevertheless, the body cavity is filled with mud and mud pellets which indicates that the animal is a soft mud dweller. The nephridia are two pairs and small in size. Each nephridium is provided with a pair of long coiled filaments and its body is marked with constriction. The anal vesicles are short saccular structures which open laterally in the posterior limit of the rectum. There are minute sessile funnels on the vesicles.

Remarks : Perusal of literature shows that the length of the proboscis varies from one-fourth to one-sixth of the trunk length. In the present specimen, the proboscis is comparatively longer than so far reported. Three pairs of sac-like structures on either side of the nerve cord as mentioned by Dattagupta *et al.* (1963), are not observed in the present specimen. Re-examination of Prashad's (1919) specimen from the Andamans reveals the presence of caecum which is absent in the present material.

The specimen in general appearance looks like an immature *A. dendrorhynchus* (Annandale & Kemp) but the difference lies in the structure of proboscis. In view of Fisher (1946) the modifications of proboscis are adaptations to an ecology in several ways abnormal but according to Prashad (1919) *A. branchiorhynchus* is the most highly evolved with respect to the gills, *A. dendrorhynchus* intermediate while *A. sabinus* shows the beginning of the formation of these structures. The author is in possession of all the aforesaid three species which confirm Prashad's statement. Further, *A. sabinus* differs from *A. microrhynchus* described from Chandipur, Orissa, where the proboscis is reduced to a small collar.

The species is so far known from the marine habitat. The present record from the estuarine zone is somewhat interesting.

Distribution : *In India :* Pirotan Island, Gujarat (Dattagupta *et al.* 1963); Pamban and Porto Novo, Tamil Nadu (Haldar, 1978); Andamans (Prashad, 1919). *Elsewhere :* Indonesia (Lanchester, 1905); Japan (Sato, 1934, 1939)

Genus *Ochetostoma* Leuckart and Ruppell

Diagnosis : Proboscis long, simple and ribbon-like; longitudinal muscle layer with a varying number of well defined bands through the interspaces of which fascicles of innermost oblique musculature are visible; nephridia 1-7 pairs; nephrostomes with elongated spirally coiled lips; vascular ring present at the beginning of mid-gut; rectal caecum present.

Ochetostoma australiense Edmonds

1960. *Ochetostoma australiense* Edmonds, *Trans. R. Soc. S. Aust.* **83** : 93-94, pl. 2b, fig. 4.

1971. *Ochetostoma australiense* : Dattagupta, *Rec. zool. Surv. India*, **65** (1-4) : 177-178, text-figs. 2 C & E.

Material examined : 1 ex., Barkuda Island, Chilka Lake, 7.x.1972, Coll. Prof. M. Mohanti.

Description : The specimen is of medium size, measuring 70 mm in length with the proboscis 26 mm. The proboscis is almost flat, smooth with slightly wavy margin. The skin in preserved state is dirty gray, somewhat translucent as compared to thicker and opaque extremities of the body. The surface of the body is covered with minute and irregularly distributed papillae. Two ventral setae, provided with interbasal muscles, are situated a little behind the proboscis base.

Internally, the longitudinal muscle layer of the body wall is separated into 14 bands. Small bundles of inner oblique musculature between longitudinal muscle bands are prominent. The coils of intestine are held in position by what appear to be innumerable strands from the body wall. Rectal caecum is present. Nephridia are three pairs, the first pair being presetal and the other two pairs postsetal in position; nephrostomal lips are spirally coiled. The anal vesicles are long, tubular and provided with numerous short funnels. The vascular system consists of one each ventral, ring sinus, heart and dorsal, and also two neurointestinals.

Remarks : This species is closely related to *O. erythrogrammon* Leuckart and Ruppell, also from the Andamans, but differs by number of neurointestinals. (2 vs. 1) and number of longitudinal muscle bands (12-13 or 11-14 vs. 14-18). It may be mentioned that Dattagupta (1971) separated these two species on the basis of much more stable character i.e. neurointestinals than the variable feature i.e. longitudinal muscle band as followed by Stephen and Edmonds (1972).

This species was described by Edmonds (1960) from the river mouth in New South Wales, Australia. Subsequently, it was reported from the marine habitat of the Andamans (Dattagupta, 1971). Presently, the species is, however, recorded from the estuarine water with minimum salinity of the Chilka Lake.

Distribution : This is a shallow water species found in the tropical belt of the Indo-west Pacific region.

In India : Octavia Bay, Andaman Islands (Dattagupta, 1971); Barkuda Island, Chilka Lake.

Elsewhere : Eastern coast of Australia (Edmonds, 1960).

GENERAL OBSERVATIONS

Both the Chilka Lake and the Hooghly-Matla estuarine region have been thoroughly studied by the author and 3 species of echiurans and 1 species of sipunculan each have been encountered at each of these areas. Of the four species only the echiuran, *Anelassorhynchus dendrorhynchus* is common at both the places and the other species of Chilka Lake have been replaced at Hooghly-Matla estuarine region by *A. branchiorhynchus* and *A. microrhynchus* (Halder, in press) and *Phascolosoma arcuatum* (Halder, 1989). There have been records of *Anelassorhynchus dendrorhynchus*, *Ochetostoma australiense* from both estuarine and marine environs (Halder, 1978; Edmonds, 1960; Dattagupta, 1971) and *Anelassorhynchus sabinus* is so far known only from the marine habitats (Lanchester, 1905; Prashad, 1919; Sato, 1934 & 1939; Dattagupta *et al.*, 1963; Halder, 1978). The otherwise marine inhabitant *Siphonosoma australe*, a

sipunculan, has been earlier reported from the harbour area of Visakhapatnam where the salinity ranged from 5.85‰ to 33.43‰ (Ganapati and Subba Rao, 1970).

ACKNOWLEDGEMENTS

The author extends his grateful thanks to Prof. M. S. Jairajpuri, the former Director, Zoological Survey of India, Calcutta, for providing laboratory facilities, to Dr. K. V. Rama Rao, Scientist 'SF' for providing all the necessary facilities during the Chilka Lake Expeditions and to Dr. A. K. Ghosh, Director Zoological Survey of India, Calcutta, for his constant encouragement. Thanks are also due to Shri D. K. Mandal, Scientist 'SE' for valuable help in the preparation of this manuscript.

SUMMARY

The paper deals with the taxonomic account of 1 species of sipunculan and 3 species of echiurans from the Chilka Lake. It also provides keys to subfamilies, genera and species (for echiurans) along with geographical distribution and discussion on their habits and habitats. Except *Anelassorhynchus dendrorhynchus*, other two echiurans, *Anelassorhynchus sabinus* and *Ochetostoma australiense*, and the sipunculan, *Siphonosoma australe*, are recorded for the first time from this Lake.

REFERENCES

- Annandale, N. & Kemp, S. 1915. Fauna of the Chilka Lake. The Echiuroidea of the Lake and Gangetic Delta. *Mem. Indian Mus.*, **5** : 55-63.
- Dattagupta, A. K. 1971. Anatomical notes on four species of *Ochetostoma* Leuckart & Ruppell (Echiura) together with a list of species on the genus. *Rec. zool. Surv. India*, **65** : 173-182.
- Dattagupta, A. K., Menon, P.K.B. & Johnson, P. 1963. Echiurids from Indian waters with the description of two new species. *Ann. Mag. nat. Hist.*, (13) **6** : 57-63, 2 text-figs.
- Edmonds, S. J. 1960. Some Australian echiuroids (Echiuroidea). *Trans. R. Soc. S. Aust.*, **83** : 89-96, 2 pls. 5 text-figs.
- Fisher, W.K. 1946. Echiuroid worms of the north Pacific Ocean. *Proc. U.S. natn. Mus.*, **96** : 215-292, pls. 2-37.
- Ganapati, P. N. & Subba Rao, B.V.S.S.R. 1970. On the occurrence of *Siphonosoma australe* (Keferstein) at Visakhapatnam harbour. *Curr. Sci.*, **39** (1) : 12-13.
- Gravely, F.H. 1927. The littoral fauna of Krusadai Islands in the Gulf of Manaar. Gephyrea and Phoronis. *Bull. Madras Govt. Mus.*, n. ser. 1 : 87-88, figs. a, b.
- Haldar, B. P. 1976. Sipuncula from the Andaman and Nicobar Islands. *Rec. zool. Surv. India*, **70** (1) : 1-9.

- Haldar, B. P. 1978. Notes on some Echiura from the east coast of India. *Bull. zool. Surv. India*, **1** (3) : 315-316.
- Haldar, B. P. 1989. A note on *Phascolosoma arcuatum* (Gray) (Sipuncula : Phascolosomatidae) in the Hooghly-Matla estuary, West Bengal, India. *Rec. zool. Surv. India*, **85**(4) : 533-538.
- Haldar, B. P. 1991. Sipunculans of the Indian coast. *Mem. zool. Surv. India*, **17** (4) : 1-169, 206 figs., 2 tabs.
- Haldar, B. P. & Dattagupta, A. K. 1991. Echiura. *State Fauna Series 2 : Fauna of Lakshadweep* : 185-197, 2 text-figs.
- Haldar, B.P. (in press). Echiura and Sipuncula. *State Fauna Series 4 : Fauna of Hugli-Matla estuary*, 8 pp.
- Lanchester, W.F. 1905. On the sipunculids and echiurids collected during the 'Skeat' expedition to the Malay Peninsula. *Proc. zool. Soc. Lond.*, **1** : 35-41, pl. II, fig. 5.
- Prashad, B. 1919. Echiuroids from brackish water, with description of a new species from the Andamans. *Mem. Asiatic Soc. Bengal*, **6** : 323-338, pl. 11.
- Prashad, B. 1936. On the Sipunculoidea from Indian waters in the Indian Museum, Calcutta. *Rec. Indian Mus.*, **38** : 231-238, pl. 9.
- Sato, H. 1934. Report on the Sipunculoidea, Echiuroidea and Priapuloida collected by the Soyo-Maru Expedition. 1922-1930. *Sci. Rep. Tohoku Univ.*, ser. 4, **9** : 1-32, 31 figs., 1 pl.

ECHINODERMATA

D. R. K. SASTRY

Zoological Survey of India

27 Jawaharlal Nehru Road, Calcutta 700 016

Members of the Phylum Echinodermata are exclusively marine inhabitants, occurring in all seas from the intertidal region to depths exceeding 7,000 m. They are chiefly 'osmoconformers' with little or no capacity to regulate the ionic-concentration or the osmotic pressure of their body fluids. Only a few species are known to be able to graduate their volume and/or weight to a limited extent. Even these cannot withstand wide fluctuations in salinity or prolonged exposure to dilute conditions, which seem to limit their establishment in estuarine and brackish water habitats. Thus, no member of Echinodermata is known to occur exclusively or chiefly in the estuarine or brackish water regions. However, a few species were reported as had been collected from such localities as Chilka Lake, Hughli Rivermouth etc. Hence an attempt is made here to present the available information on the echinoderms reported as from the Chilka Lake and clarify the possibility of their occurrence in the Chilka Lake and other estuarine and brackish water regions.

Based on the intensive collections made for the first time from the Chilka Lake, Annandale and Kemp (1915) reported that Echinodermata appeared to be one of the most conspicuous groups absent from both the Outer Channel and main area of the Lagoon. However, Koehler (1898, 1910) and Koehler and Vaney (1908) already reported by that time, the following species of Echinodermata as from the Chilka Lake.

ASTEROIDEA

1910. *Astropecten bengalensis* Doederlein Koehler, 32 (as *A. mauritianus*)
1910. *Astropecten indicus* Doederlein Koehler, 27

OPHIUROIDEA

1898. *Ophiactis savignyi* (Mueller and Troschel) Koehler, 72 (as *O. affinis*)
1898. *Ophiothela danae* Verrill Koehler, 89 (as *O. danae* var. nov. *involuta*)

HOLOTHUROIDEA

1908. *Acaudina molpadioides* (Semper) Koehler and Vaney, 44 (as *Haplodactyla molpadioides*)

Their localities were variously mentioned as 'Lac Chilka, Lac de Chilka, and Crique de Chilka' and their depths varying between 7 and 9 fms (13-16.5 m.).

Certainly, it cannot be assumed that Annandale and Kemp (1915) were not aware of these reports.

In the case of cephalopod molluscs reported as from the 'Chilka Lake; they clearly stated that they were probably collected outside the mouth of the Lake as they were from the *INVESTIGATOR'S* collections. As the above echinoderms were also from the *INVESTIGATOR'S* collections, the same might be true in their case too, since *INVESTIGATOR* did not make any collectings in the Chilka Lake proper. Moreover, the depths from where the above echinoderms were collected, were mentioned as 13 to 16.5 m., whereas, Annandale and Kemp (1915) reported that their deepest sounding did not exceed 6m. (20 ft.) which might increase during the flood season by not more than 2 m. (5-6 ft.) Thus the echinoderms were probably collected off Chilka Lake in the Bay of Bengal, rather than in the Chilka Lake proper.

The unpublished information with the present author indicates that a few echinoderms no doubt extend into the estuarine and brackish water areas, but only during the summer months when the salinity of the ambient water would not be much lower than that of the open sea water. The salinity distribution in the Chilka Lake reported by Annandale and Kemp (1915; figs 1 and 2) shows that it was only during the lean period that the salinity in the Outer Channel was anywhere near that of the open waters, while the lagoon proper remained brackish throughout most part of the year. Hence, it may be presumed that the nearby open coast echinoderms, if at all extend into at least the Outer Channel, they would do so only during summer months, and of the mouth of the Outer Channel is not closed by a sand bar, as it would sometimes happen. Recent collections brought only *Astropecten* specimens in a much damaged condition from the beach on open coast near the mouth of the Outer Channel.

In conclusion, as the available information is not complete, we might expect that an intensive round the year faunistic survey of the Outer Channel and the nearby open coast along with observations on the salinity would greatly add to our present knowledge on the possible extension of echinoderms into the estuarine regions in general and into the Chilka Lake in particular.

REFERENCES

- Annandale, N. and Kemp, S. 1915. Fauna of the Chilka Lake : Introduction. *Mem. Indian Mus.*, V : 1-20.
- Koehler, R. 1898. Echinodermes recueillis par l' *Investigator* dans l' Ocean Indien. II. Les Ophiures Littorales. *Bull. scient. Fr. belg.*, 33 : 55 - 125.
- Koehler, R. 1910. Asteries Du Musee De Calcutta. II. Les Asteries Littorales. *Echinoderma of the Indian Museum*, part VI : 1 - 191.
- Koehler, R. and Vaney, C. 1908. Holothuries recueillies par " *Investigator* dans l'Ocean Indien. II. Les Holothuries Littorales. *Echinoderma of the Indian Museum*, Part II : 1 - 54.

PROTOCHORDATA

P. DHANDAPANI
Zoological Survey of India, Madras

INTRODUCTION

Chilka, the largest brackishwater lake of Asia, lies in Orissa State of India; and is connected to the Bay of Bengal by a narrow mouth. Ecologically, this lake holds three salinity zones, i.e. The Northern Sector which gets diluted by rivers and undergoes drastic changes in salinity (0-10‰); the Central sector that is influenced by eastward flowing nallahs and westward flowing tidal currents from the sea to hold highly fluctuating saline waters (5-20‰); and the land locked Southern sector where the salinity is almost constant (10-15‰). It is hardly possible for any Protochordata to exist in a brackishwater lake since almost all are stenohaline. But, among Larvacea there are few species that are euryhaline, and one among them collected from the border of Southern sector of the lake is described here. This is the first time that a Protochordate is collected from Chilka lake.

Oikopleura dioica Fol, 1872

Oikopleura dioica Fol, 1872; Longerhans, 1880; Lohmann, 1892 : Lohmann and Buckmann, 1926; Aida, 1907; Kruger, 1912; Essenberg, 1926a; Vernieres, 1933; Yamada, 1933; Thompson, 1948; Bjornberg & Forneris, 1955.

Oikopleura (Vexillaria) dioica Lohmann, 1933; Tokioka, 1940.

Material : Only one male specimen was present out of 199 plankton samples sorted out; and the specimen was collected from st.D8 located at the border of Southern and Central sector just below Barkul at the mouth of Saliya Nallah on 27.11.85, around 1600 hrs. The depth of the station was 2.6m.; the salinity was 7.08‰; the dissolved oxygen content was 7.8 to 8 ml./l; and the surface temperature of water was 25.9°C.

Body : About 0.4mm long and stout; from the rear, the dorsal contour runs straight, but with a depression just in front of the dorsal tip of gonad; anteriorly the body drops suddenly near the mouth. The ventral contour also runs straight, but suddenly ascends near the mouth, giving an impression of a cleft.

The mouth area is slightly drawn out into a tube, with a long underlip. The buccal glands are small, followed by a short endostyle. The stomach looks trilobate in the sense that the intestine is bulb shaped.

The specimen is a male. A well developed mature testis bulges out of the dorsal contour; posteriorly.

Tail : About 2.3mm long. The musculature is narrow, pointed at the tip and ends just in front of the tip of the tail.

Remarks : *Oikopleura dioica* Fol, 1872, has always been collected in the coastal regions (Thompson, 1948; Ganapathy and Bhavanarayana, 1958; Toioka, 1955; Fenaux, 1969; and Dhandapani, 1977). This species is highly eurythermal and euryhaline hence recorded in Chilka Lake.

The range of salinity tolerance of *O. dioica* is from 11.4 to 36.7‰ as recorded from Australian waters (Thompson, 1948); and has been recorded from the very low saline southerly currents of coastal Bay of Bengal (Ganapathy and Bhavanarayana, 1958). Likewise, the tolerance for temperature recorded from Australian waters is 3.2 to 29.5°C.

The present recording of *O. dioica* from an environment of 7.08‰ of salinity and 25.9°C is only supporting evidence in confirmity of the high eurythermal and euryhaline nature of the species.

SUMMARY

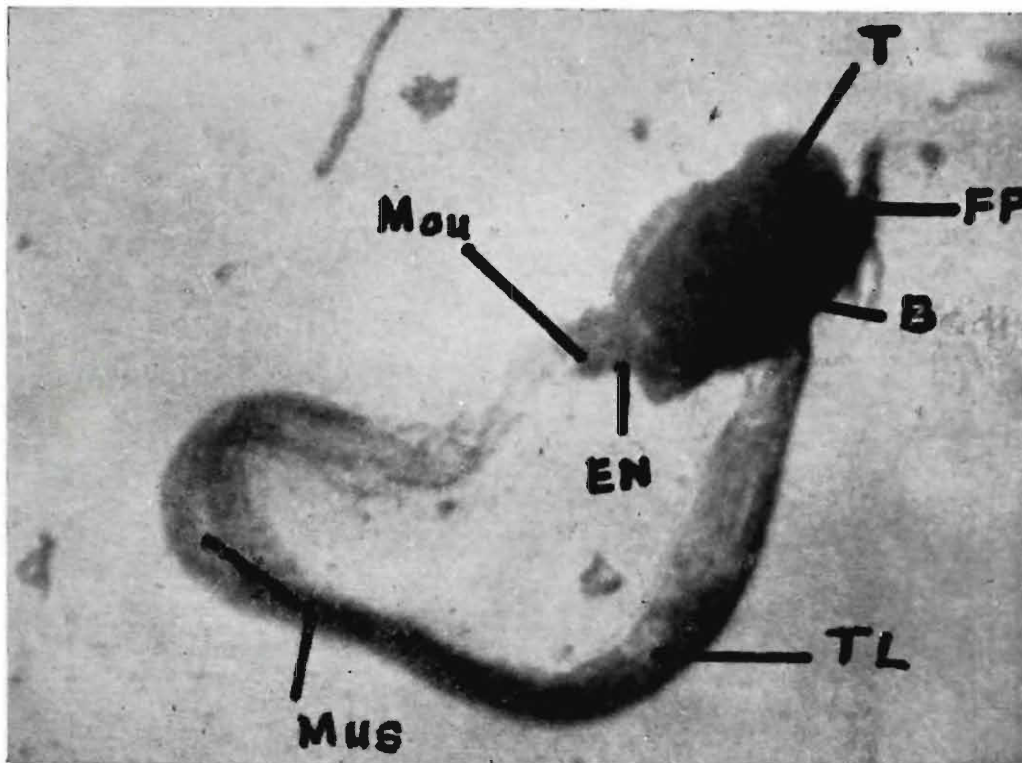
The only specimen of Protochordata, *Oikopleura dioica*, Fol, 1872 (Tunicata : Larvacea) collected from Chilka Lake is described. The eurythermal and euryhaline nature of the species is discussed.

ACKNOWLEDGMENT

The author is thankful to the Director, Zoological Survey of India; the Officer-in-charge, Estuarine Biological Station, ZSI, Berhampur; and the Officer-in-charge, Marine Biological Station, ZSI, Madras, for all the encouragement and facilities provided for the study. Thanks are also due to all the participants for having made the Expedition a success.

REFERENCES

- Aida, T. 1907. Appendicularia of Japanese waters. *Imp. Univ. Tokyo J. Coll. Sci.* **23**(5) : 1-25. pl. i-iv.
- Bjonberg, T.K.S. and L. Forneris, 1955. Resultados Cientificos do cruzeiro do "BAEPENDI" e do "VEGA" a ilha de Trindade, Coprlata 1. *Contribuicos avulsas do Instituto Oceanographico, Universidade de Sao Paula, Oceanografia Biologica, No.1*, pp. 1-68, Plt. XVII.
- Dhandapani, P. 1977. Descriptions of two new species of Larvacea with a list of other species collected from the Bay of Bengal. *Proc. Symp. Warm Water Zoopl. Spl. Publ. UNESCO/NIO*, pp. 60-64.
- Essenberg, C.E. 1926a. Copelata from the San Diego Region. *Univ. Calif. Publ. Zool.* **28**(22) : 399-521.
- Fenaux, R. 1969. Les Appendiculaires du Golfe de Bengale. *Marine Biology* **2** (3) : 252-263.
- Fol, H. 1872. Etudes sur les Appendiculaires du detroit de Messine. *Mem. Soc. phys. et d'hist. nat. d. Geneve*, **21**(2) : 445-499, pl. i-xi.
- Ganapati, P.N. and P.V. Bhavanarayana, 1958. Pelagic Tunicates as indicators of water movements off Waltair coast. *Curr. Sci.* **27** : 57-58.



Oikopleura dioica Fol, 1872 : Male specimen B = Body ; EN = Endostyle ;
FP = Foreign particle ; MOU = Mouth ; MUS = Musculature ;
T = Testis ; TL = Tail.

- Kruger, P. 1912. Pyrosomes et Appendiculaires provenant des campagnes de l'Hirondelle et de la Princes Alice (1885-1910). *Result. Camp. Sci. Albert I.* **39** : 1-38, pls. i-ii.
- Langerhans, P. 1880. Uber Madeiras Appendicularien. *Z. wiss. Zool.* **34** : 144-146, pl. vi
- Lohmann, H. 1892. Vorberichte uber die Appendicularien der Plankton-Expedition. *Ergebn. Plankt.-Exped.* **1 (A)** : 139-140.
- Lohmann, H. 1933. Appendicularia In : Kukentak u. Krumbach. *Handb. d. zool.* **5(2)** : 3-192.
- Lohmann, H. & Ad. Buckmann, 1926. Die Appendicularien der Deutschen Sudpolar-Expedition 1901 bis 1903. *Ergebn. Deutsch. Sudp. Exped.* **18 (zool. 10)** : 63-231.
- Thompson, H. 1948. Pelagic Tunicates of Australia. *Commonwealth Council for Scientific and Industrial Research, Australia.* pp. 1-196, pls. 1-75.
- Tokioka, T. 1940. Some additional notes on Japanese Appendicularian fauna. *Rec. Oceanogr. Works Japan*, **11(1)** : 1-26.
- Tokioka, T. 1955. A small collection of Chaetognatha and pelagic tunicates from the north-eastern part of the Indian Ocean. *Publ. Seto mar. biol. Lab.*, **5** : 74-78.
- Vernieres, P. 1933. Essai sur l'histoire naturelle des Appendiculaires de Banyuls et Sete. *Bull. Inst. Oceanogr. Monaco*, **617** : 1-60, Pl. i-ii.
- Yamada, T. 1933. Report on the distributions of the plankton in the neighbouring seas of Tyosen in June, 1932. Appendix to Ann. Rept. Hydrogr. Observ., No. 7.

PISCES

KAZA V. RAMA RAO *

*Freshwater Biological Station, Zoological Survey of India,
1-1-300/B, Ashoknagar, Hyderabad 500 020, Andhra Pradesh, India.*

INTRODUCTION

The rich and varied fish fauna of Chilka lake comprising fresh, brackish and marine element has been studied mainly by Chaudhuri (1916a, 1916b, 1916c, 1917, 1923), Hora (1923), Koumans (1941), Jones and Sujansinghani (1945), Mitra (1946), Devasundaram (1954), Roy and Sahoo (1967), Menon (1961) and Rajan, Patnaik and Basu (1968).

MATERIAL AND METHODS

All the collections collected during the Chilka Lake Expedition (1985-87) have been identified following the standard keys. No attempt has been made in the text to give keys, descriptions and fishery notes as they are dealt by Misra (1962, 1969, 1976a, 1976b), Jhingran and Natarajan (1966, 1969), Jayaram (1981), Talwar (1984, 1985), Jhingram (1991) and Talwar and Jhingran (1991).

SYNOPTIC LIST

A total number of 217 species comprising 147 genera, 71 families and 15 orders so far known from the Chilka Lake have been listed below. Fishes recorded during the expedition are marked by single asterisk and all the new records by double asterisk. The genera and species are arranged alphabetically.

Grade : PISCES

Class : CHONDRICHTHYES

Subclass : ELASMOBRANCHII

Order : CARCHARHINIFORMES

Family : CARCHARHINIDAE

Genus : *Carcharhinus* BAINVILLE

Carcharhinus limbatus (Valenciennes)

Carcharhinus melanopterus (Quoy & Gaimard)

Genus : ***Glyphis*** Agassiz

Glyphis gangeticus (Muller & Henle)

Genus : ***Scoliodon*** Muller & Henle

Scoliodon laticaudus Muller & Henle

Order : RAJIFORMES

Family : PRISTIDAE

Genus : ***Pristis*** Linck

Pristis pectinata Latham

Family : DASYATIDAE

Genus : ***Himantura*** Muller & Henle

* *Himantura imbricata* (Bloch & Schneider)

* *Himantura uarnak* (Forsskal)

Genus : ***Hypolophus*** Muller & Henle

Hypolophus sephen (Forsskal)

Family : MYLIOBATIDIDAE

Genus : ***Aetobatus*** Blainville

Aetobatus flagellum (Bloch & Schneider)

Aetobatus narinari (Euphrasen)

Genus : ***Aetomylaeus*** Garman

Aetomylaeus nichofii (Bloch & Schneider)

Class : OSTEICHTHYES

Subclass : ACTINOPTERYGII

Order : OSTEOGLOSSIFORMES

Family : NOTOPTERIDAE

Genus : *Notopterus* Lacepede

* *Notopterus notopterus* (Pallas)

Order : ELOPIFORMES

Family : ELOPIDAE

Genus : *Elops* Linnaeus

* *Elops machnata* (Forsskal)

Family : MEGALOPIDAE

Genus : *Megalops* Lacepede

* *Megalops cyprinoides* (Broussonet)

Order : ANGUILLIFORMES

Family : ANGUILLIDAE

Genus : *Anguilla* Schrank

Anguilla bengalensis bengalensis (Gray)

Anguilla bicolor bicolor McClelland

Family : MURAENIDAE

Genus : *Thyrsoidea* Kaup

* *Thyrsoidea macrura* (Bleeker)

Family : OPHICHTHIDAE

Genus : *Pisodonophis* Kaup

* *Pisodonophis boro* (Hamilton-Buchanan)

Pisodonophis cancrivorus (Richardson)

Family : MURAENESOCIDAE

Genus : *Congresox* Gill

Congresox talabonoides (Bleeker)

Genus : *Muraenesox* McClelland

* *Muraenesox cinereus* (Forsskal)

Order : CLUPEIFORMES

Family : CLUPEIDAE

Genus : *Anodontosoma* Bleeker

* *Anodontosoma chacunda* (Hamilton-Buchanan)

Genus : *Corica* (Hamilton Buchanan)

Corcia soborna Hamilton Buchanan

Genus : *Escualosa* Whitley

Escualosa thoracata (Valenciennes)

Genus : *Gonialosa* Regan

Gonialosa manmina (Hamilton-Buchanan)

Genus : *Gudusia* Fowler

Gudusia chapra (Hamilton-Buchanan)

Genus : *Hilsa* Regan

Hilsa (Tenualosa) ilisha (Hamilton Buchanan)

Hilsa (Hilsa) kelee (Cuvier)

Genus : *Nematalosa* Regan

* *Nematalosa nasus* (Bloch)

Genus : *Sardinella* valenciennes

Sardinella melanura (Cuvier)

Sardinella sirm (Walbaum)

Family : PRISTIGASTERIDAE

Genus : *Ilisha* Richardson

Ilisha elongata (Bennett)

Ilisha melastoma (Schneider)

Family : ENGRAULIDIDAE

Genus : *Stolephorus* Lacepede

Stolephorus bagenensis Hardenberg

Stolephorus commersonii Lacepede

Stolephorus dubiosus Wongratania

* *Stolephorus indicus* (van Hasselt)

Genus : *Thryssa* Cuvier

Thryssa hamiltonii (Gray)

Thryssa kammalensis (Bleeker)

Thryssa malabarica (Bloch)

Thryssa mystax (Schneider)

* *Thryssa purava* (Hamilton-Buchanan)

Order : GONORHYNCHIFORMES

Family : CHANIDAE

Genus : *Chanos* Lacepede

Chanos chanos (Forsskal)

Order : CYPRINIFORMES

Family : CYPRINIDAE

Genus : ***Brachydanio*** Weber & de Beaufort

Brachydanio rerio (Hamilton-Buchanan)

Genus : ***Catla*** valenciennes

Catla catla (Hamilton-Buchanan)

Genus : ***Chela*** Hamilton-Buchanan

Chela cachius (Hamilton-Buchanan)

Chela laubuca (Hamilton-Buchanan)

Genus : ***Cirrhinius*** Cuvier

Cirrhinus mrigala (Hamilton-Buchanan)

Cirrhinus reba (Hamilton Buchanan)

Genus : ***Crossocheilus*** Kuhl & van Hasselt

Crossocheilus latius latius (Hamilton-Buchanan)

Genus : ***Esomus*** Swainson

Esomus danricus (Hamilton-Buchanan)

Genus : ***Labeo*** Cuvier

Labeo calbasu (Hamilton-Buchanan)

Labeo rohita (Hamilton-Buchanan)

Genus : ***Osteobrama*** Heckel

Osteobrama vigorsii (Skyles)

Genus : ***Parluciosoma*** Howes

Parluciosoma daniconius (Hamilton-Buchanan)

Genus : ***Puntius*** Hamilton-Buchanan

Puntius sarana sarana (Hamilton-Buchanan)

Puntius sophore (Hamilton-Buchanan)

Puntius ticto (Hamilton-Buchanan)

Puntius vittatus Day

Genus : *Rasbora* Bleeker

Rasbora rasbora (Hamilton-Buchanan)

Genus : *Salmostoma* Swainson

Salmostoma bacaila (Hamilton - Buchanan)

Family : COBITIDAE

Genus : *Lepidocephalus* Bleeker

Lepidocephalus guntea (Hamilton-Buchanan)

Order : SILURIFORMES

Family : BAGRIDAE

Genus : *Aorichthys* Wu

** *Aorichthys seenghala* (Skyles)

Genus : *Mystus* Scopoli

* *Mystus cavasius* (Hamilton-Buchanan)

* *Mystus gulio* (Hamilton-Buchanan)

Mystus vittatus (Bloch)

Family : SILURIDAE

Genus : *Ompok* Lacepede

* *Ompok bimaculatus* (Bloch)

Genus : *Wallago* Bleeker

Wallago attu (Schneider)

Family : SCHILBEIDAE

Genus : *Ailia* Gray

Ailia coila (Hamilton Buchanan)

Genus : *Eutropiichthys* Bleeker

Eutropiichthys vacha (Hamilton-Buchanan)

Genus : *Silonia* Swainson

Silonia silondia (Hamilton-Buchanan)

Family : PANGASIIDAE

Genus : *Pangasius* Valenciennes

Pangasius pangasius (Hamilton-Buchanan)

Family : SISORIDAE

Genus : *Bagarius* Bleeker

Bagarius bagarius (Hamilton-Buchanan)

Family : CLARIIDAE

Genus : *Clarias* Scopoli

* *Clarias batrachus* (Linnaeus)

Family : HETEROPNEUSTIDAE

Genus : *Heteropneustes* Muller

Heteropneustes fossilis (Bloch)

Family : ARIIDAE

Genus : *Arius* Valenciennes

* *Arius arius* (Hamilton-Buchanan)

Arius caelatus Valenciennes

Arius maculatus (Thunberg)

* *Arius tenuispinis* Day

Genus : *Osteogeneiosus* Bleeker

* *Osteogeneiosus militaris* (Linnaeus)

Family : PLOTOSIDAE

Genus : *Plotosus* Lacepede

* *Plotosus canius* Hamilton-Buchanan

Plotosus lineatus (Thunberg)

Order : CYPRINODONTIFORMES

Family : HEMIRAMPHIDAE

Genus : *Hyporhamphus* Gill

* *Hyporhamphus limbatus* (Valenciennes)

Family : BELONIDAE

Genus : *Strongylura* van Hasselt

Strongylura leiura (Bleeker)

* *Strongylura strongylura* (van Hasselt)

Genus : *Xenentodon* Regan

* *Xenentodon cancila* (Hamilton-Buchanan)

Family : ORYZIIDAE

Genus : *Oryzias* Jordan & Synder

Oryzias melastigma (McClelland)

Family : APLOCHEILIDAE

Genus : *Aptocheilus* McClelland

Aptocheilus panchaz (Hamilton-Buchanan)

Order : SYNGNATHIFORMES

Family : SYNGNATHIDAE

Genus : *Hippocampus* Rafinesque

* *Hippocampus brachyrhynchus* Duncker

Genus : *Ichthyocampus* Kaup

* *Ichthyocampus carce* (Hamilton-Buchanan)

Order : SCORPAENIFORMES

Family : SCORPAENIDAE

Pteropterus radiata (Cuvier)

Family : PLATYCEPHALIDAE

Genus : *Platycephalus* Bloch

* *Platycephalus indicus* (Linnaeus)

Order : PERCIFORMES

Family : CENTROPOMIDAE

Genus : *Lates* Cuvier

* *Lates calcarifer* (Bloch)

Family : AMBASSIDAE

Genus : *Ambassis* Cuvier

Ambassis commersoni Cuvier

Ambassis gymnocephalus (Lacepede)

Genus : *Chanda* Hamilton-Buchanan

Chanda nama Hamilton-Buchanan

Genus : *Pseudambassis* Bleeker

Pseudambassis ranga (Hamilton-Buchanan)

Family : SERRANIDAE

Genus : *Epinephalus* Bloch

Epinephalus tauvina (Forsskal)

Genus : *Promicrops* Gill

Promicrops lanceolatus (Bloch)

Family : TERAPONIDAE

Genus : *Pelates* Cuvier

Pelates quadrilineatus (Bloch)

Genus : *Terapon* Cuvier

* *Terapon jarbua* (Forsskal)

* *Terapon puta* (Cuvier)

Family : SILLAGINIDAE

Genus : *Sillaginopsis* Gill

Sillaginopsis panijus (Hamilton-Buchanan)

Genus : *Sillago* Cuvier

* *Sillago sihama* (Forsskal)

Family : RACHYCENTRIDAE

Genus : *Rachycentron* Kaup

Rachycentron canadus (Linnaeus)

Family : ECHENEIDIDAE

Genus : *Echeneis*

Echeneis naucratus (Linnaeus)

Family : CARARGIDAE

Genus : *Alectis* Rafinesque

Alectis indicus (Ruppell)

Genus : *Alepes* Swai

Alepes djedaba (Forsskal)

Genus : *Atule* Jordan & Jrdan

Atule mate (Cuvier)

Genus : *Carangoides* Bleeker

Carangoides praeustus (Bennett)

Genus : *Caranx* Lacepede

Caranx carangus (Bloch)

Caranx ignobilis (Forsskal)

Caranx melampygus Cuvier

Caranx sexfasciatus Quoy & Gaiwnard

Genus : *Megalaspis* Bleeker

* *Megalaspis cordyla* (Linnaeus)

Genus : *Scomberoides* Lacepede

* *Scomberoides lysan* (Forsskal)

Scomberoides tala (Cuvier)

Genus : *Trachinotus* lacepede

Trachinotus blochii (Lacepede)

Family : APOLECTIDAE

Genus : *Apolectus* Cuvier

Apolectus niger (Bloch)

Family : LEIOGNATHIDAE

Genus : *Gazza* Ruppell

Gazza minuta (Bloch)

Genus : *Leigonathus* Lacepede

Leigonathus blochii (Valenciennes)

Leigonathus daura (Cuvier)

Leigonathus dussumieri (Valenciennes)

* *Leiognathus equulus* (Forsskal)

Genus : *Secutor* Gistel

Secutor insidiator (Bloch)

Family : LUTJANIDAE

Genus : *Lutjanus* Bloch

Lutjanus argentimaculatus (Forsskal)

* *Lutjanus johni* (Bloch)

Lutjanus kasmira (Forsskal)

Lutjanus russelli (Bleeker)

Family : LOBOTIDAE

Genus : *Datnioides* Bleeker

* *Datnioides quadrifasciatus* (Sevastianov)

Family : GERREIDAE

Genus : *Gerreomorpha* Alleyne & Macleay

* *Gerreomorpha setifer* (Hamilton-Buchanan)

Genus : ***Gerres*** Cuvier

* *Gerres filamentosus* Cuvier

Gerres limbatus Cuvier

* *Gerres oyena* (Forsskal)

* *Gerres poieti* Cuvier

Family : HAEMULIDAE

Genus : ***Acanthopagrus*** Peters

* *Acanthopagrus latus* (Houttuyn)

Genus : ***Plectorhynchus*** Lacepede

Plectorhynchus niger (Cuvier)

Genus : ***Pomadasys*** Lacepede

Pomadasys argenteus (Forsskal)

Family : SPARIDAE

Genus : ***Crenidens*** Valenciennes

* *Crenidens crenidens* (Forsskal)

Genus : ***Rhabdosargus*** Fowler

Rhabdosargus sarba (Forsskal)

Family : SCIAENIDAE

Genus : ***Daysciaena*** Talwar

Daysciaena albida (Cuvier)

Genus : ***Dendrophysa*** Trewavas

* *Dendrophysa russelli* (Cuvier)

Genus : ***Johnius*** Bloch

Johnius amblycephalus (Bleeker)

Johnius belangerii (Cuvier)

Johnius macropterus (Bleeker)

Genus : *Otolithoides* Folwer

Otolithoides biauritus (Cantor)

Genus : *Pama* Fowler

Pama pama (Hamilton-Buchanan)

Genus : *Paranibea* Trewavas

Paranibea semiluctuosa (Cuvier)

Genus : *Protonibea* Trewavas

Protonibea diacanthus (Lacepede)

Family : MONODACTYLIDAE

Genus : *Monodactylus* Lacepede

Monodactylus argenteus (Linnaeus)

Family : DREPANIDAE

Genus : *Drepane* Cuvier

Drepane punctatus (Linnaeus)

Family : SCATOPHAGIDAE

Genus : *Scatophagus* Cuvier

* *Scatophagus argus* (Linnaeus)

Family : CICHLIDAE

Genus : *Etroplus* Cuvier

* *Etroplus suratensis* (Bloch)

Family : MUGILIDAE

Genus : *Liza* Jordan & Swain

* *Liza macrolepis* (Smith)

Liza melinoptera (Valenciennes)

Liza parsia (Hamilton-Buchanan)

Liza subviridis (Valenciennes)

Liza tade (Forsskal)

Liza vaigiensis (Quoy & Gaimard)

Genus : *Mugil* Linnaeus

* *Mugil cephalus* Linnaeus

Genus : *Rhinomugil* Gill

* *Rhinomugil corsula* (Hamilton-Buchanan)

Genus : *Valamugil* Smith

Valamugil cunnesius (Valenciennes)

Valamugil seheli (Forsskal)

Valamugil speigleri (Bleeker)

Family : SPHYRAENIDAE

Genus : *Sphyraena* Rose

Sphyraena putnamiae Jordan & Seale

Family : POLYNEMIDAE

Genus : *Eleutheronema* Bleeker

* *Eleutheronema tetradactylus* (Shaw)

Genus : *Polydactylus* Lacepede

Polydactylus indicus (Shaw)

Polydactylus sextarius (Bloch)

Family : SIGANIDAE

Genus : *Siganus* Forsskal

Siganus vermiculatus (Valenciennes)

Family : SCOMBRIDAE

Genus : *Scomberomorus*

Scomberomorus lineolatus (Cuvier)

Family : BLENNIIDAE

Genus : *Omobranchus* Ehrenberg

Omobranchus zebra (Bleeker)

Family : GOBIIDAE

Genus : *Acentrogobius* Bleeker

* *Acentrogobius cyanomos* (Bleeker)

* *Acentrogobius globiceps* (Hora)

Acentrogobius griseus (Day)

Acentrogobius madraspatensis (Day)

Acentrogobius masoni (Day)

Acentrogobius viridipunctatus (Valenciennes)

Genus : *Bathygobius* Bleeker

Bathygobius fuscus (Ruppell)

Bathygobius ostreicola (Chaudhuri)

Genus : *Brachygobius* Bleeker

Brachygobius nunus (Hamilton-Buchanan)

Genus : ***Glossogobius*** Gill

* *Glossogobius biocellatus* (Valenciennes)

* *Glossogobius giuris* (Hamilton-Buchanan)

Glossogobius mas Hora

Genus : ***Gobiopterus*** Bleeker

Gobiopterus chuno (Hamilton-Buchanan)

Genus : ***Oligolepis*** Bleeker

Oligolepis acutipennis (Valenciennes)

* *Oligolepis cylindriceps* (Hora)

Genus : ***Oxyurichthys*** Bleeker

Oxyurichthys microlepis (Bleeker)

* *Oxyurichthys tentacularis* (Valenciennes)

Genus : ***Parapocryptes*** Bleeker

Parapocryptes rictuosus (Valenciennes)

Genus : ***Periophthalmus*** Bloch & Scheider

Periophthalmus koelreuteri (Pallas)

Genus : ***Pseudapocryptes*** Bleeker

Pseudapocryptes lanceolatus (Bloch & Schneider)

Genus : ***Stigmatogobius*** Bleeker

Stigmatogobius javanicus (Bleeker)

Stigmatogobius minima (Hora)

Family : ELEOTRIDIDAE

Genus : *Butis* Bleeker

Butis butis (Hamilton-Buchanan)

Genus : *Eleotris* Schneider

Eleotris fusca (Schneider)

Genus : *Taenioides* Lacepede

Taenioides buchanani (Day)

Family : TRYPACHENIDAE

Genus : *Trypauchen* Valenciennes

Trypauchen vagina (Bloch & Scheider)

Family : ANABANTIDAE

Genus : *Anabas* Cuvier & Cloquet

** *Anabas cobojius* (Hamilton-Buchanan)

* *Anabas testudinus* (Bloch)

Family : BELONTIIDAE

Genus : *Colisa* Cuvier

Colisa lalia (Hamilton-Buchanan)

Family : CHANNIDAE

Genus : *Channa* Scopoli

* *Channa punctatus* (Bloch)

* *Channa striatus* (Bloch)

Family : MASTACEMBELIDAE

Genus : *Macrogathus* Lacepede

Macrogathus aral (Bloch & Schneider)

* *Macrogathus pancalus* Hamilton-Buchanan

Genus : *Mastacembelus* Scopoli

* *Mastacembelus armatus* (Lacepede)

Order : PLEURONECTIFORMES

Family : BOTHIDAE

Genus : *Pseudorhombus* Bleeker

* *Pseudorhombus arius* (Hamilton-Buchanan)

Family : CYNOGLOSSIDAE

Genus : *Cynoglossus* Hamilton-Buchanan

Cynoglossus lingua Hamilton-Buchanan

* *Cynoglossus puncticeps* (Richardson)

Family : SOLEIDAE

Genus : *Euryglossa* Kaup

* *Euryglossa orientalis* (Bloch & Schneider)

Genus : *Solea* Quensel

Solea ovata Richardson

Order : TETRAODONTIFORMES

Family : TRIACANTHIDAE

Genus : *Triacanthus* Cuvier

* *Triacanthus biaculeatus* (Bloch)

Family : TETRAODONTIDAE

Genus : *Arothron* Muller

Arothron reticularis (Bloch & Schneider)

Genus : *Chelonodon* Muller

* *Chelonodon fluviatilis* (Hamilton-Buchanan)

* *Chelonodon patoca* (Hamilton-Buchanan)

Genus : *Lagocephalus* swainson

** *Lagocephalus lunaris* (Bloch & Schneider)

Genus : *Takifugu* Abe

Takifugu oblongus (Bloch)

Genus : *Tetraodon* Linnaeus

** *Tetraodon cutcutia* Hamilton-Buchanan

Table I. Current identification of new fishes described from Chilka Lake

Name	Present Status
1. <i>Engraulis annandalei</i> Chaudhuri, 1916	= <i>Thryssa purava</i> (Hamilton-Buchanan) 1822
2. <i>Engraulis kempii</i> Chaudhuri, 1916	= <i>Thryssa purava</i> (Hamilton-Buchanan) 1822
3. <i>Engraulis rambhae</i> Chaudhuri, 1916	= <i>Thryssa purava</i> (Hamilton-Buchanan) 1822
4. <i>Stolephorus dubiosus</i> Wongratana, 1983	= <i>Stolephorus dubiosus</i> Wongratana, 1983
5. <i>Ophichthys chilkenis</i> Chaudhuri, 1916	= ? <i>Pisodonophis cancrivorus</i> (Richardson) 1844
6. <i>Arius satparanus</i> Chaudhuri, 1916	= <i>Arius tenuispinis</i> (Day) 1877
7. <i>Hippocampus brachyrhynchus</i> Duncker, 1914	= <i>Hippocampus brachyrhynchus</i> Duncker, 1914
8. <i>Sphyaena raghava</i> Chaudhuri, 1917	= <i>Sphyaena putnamiae</i> (Jordan & Seale) 1905
9. <i>Petroscirtes bhattacharyae</i> Chaudhuri, 1916	= <i>Omobranchus zebra</i> (Bleeker) 1868
10. <i>Ctenogobius cylindriceps</i> Hora, 1923	= <i>Oliogolepis cylindriceps</i> (Hora) 1923
11. <i>Ctenogobius dentifer</i> Hora, 1923	= <i>Acentrogobius cyanomos</i> (Bleeker) 1841
12. <i>Ctenogobius globiceps</i> Hora, 1923	= <i>Acentrogobius globiceps</i> (Hora) 1923

13. *Ctenogobius minima* Hora, 1923 = *Stigmatogobius minima* (Hora) 1923
14. *Gobius alcocki* Annandale, 1906 = *Brachygobius nunus* (Hamilton-Buchanan) 1822
15. *Gobius chilkenis* Jenkins, 1910 = *Stigmatogobius javanicus* (Bleeker) 1856
16. *Gobius ostreicola* Chaudhuri, 1916 = *Bathygobius ostreicola* (Chaudhuri) 1916
17. *Glossogobius mas* Hora, 1923 = ? *Glossogobius mas* (Hora) 1923
18. *Micrapocryptes fragilis* Hora, 1923 = *Gobiopterus chuno* (Hamilton-Buchanan) 1822
19. *Taenioides chilkenis* Hora, 1923 = ? *Taenioides buchani* (Day) 1873

SUMMARY

The fish collections made during the Chilka Lake expedition, 1985-87 contain 69 species comprising 57 genera, 40 families and 12 orders including 4 new records.

ACKNOWLEDGEMENTS

I am thankful to former Directors Late Dr. B. K. Tikader, Former Jt. Directors B. S. Lamba, Dr. Asket Singh, Dr. M. S. Jairajpuri and Former Additional Director S. K. Bhattacharya for extending facilities. I am also thankful to Dr. A. K. Ghosh, Director, who has taken keen interest in the Chilka Lake Expedition. Thanks are also due to officers and staff of the Estuarine Biological Station (Berhampur) and Freshwater Biological Station (Hyderabad), Zoological Survey of India as well as to the participants of the Chilka Lake Expedition (1985-1987).

REFERENCES

- Chaudhuri, B.L. 1916a. Description of two new fishes from Chilka lake. *Rec. Indian Mus.*, 12(3) : 105-108.
- Chaudhuri, B.L. 1916b. Fauna of the Chilka lake : Fish Part I. *Mem. Indian Mus.*, 5(4) : 403-440.
- Chaudhuri, B.L. 1916c. Fauna of the Chilka Lake : Fish part II. *Mem. Indian Mus.*, 5(5) : 441-458.
- Chaudhuri, B.L. 1917. Fauna of the Chilka lake : Fish Part III. *Mem. Indian Mus.*, 5(6) : 491-508.
- Chaudhuri, B.L. 1923. Fauna of the Chilka lake : Fish Part IV. *Mem. Indian Mus.*, 5(11) : 711-736.
- Devasundaram, M.P. 1954. *A report on the fisheries of the Chilka lake from 1948 to 1950*. Orissa Govt. publication, 1-34.

- Hora, S.L. 1923. Fauna of the Chilka lake : Fish Part V. *Mem. Indian Mus.*, 5(11) : 737-770.
- Jayaram, K.C. 1981. *The Freshwater Fishes of India, Pakistan, Bangladesh, Purma and Sri Lanka* A Hand book - Zoological Survey of India, Calcutta, No.2, xxii + 475 pp.
- Jhingran, V.G. and A.V. Natarajan, 1966. Final report on the fisheries of the Chilka lake (1957-65). *Bull. Cent. Inland Fish. Res. Inst.*, Barrackpore, (8) : Page Var.
- Jhingran, V.G. and A.V. Natarajan, 1969. A study of the fisheries and fish populations of the Chilka lake during the period 1957-65. *J. Inland Fish. Soc. India*, 1 : 49-126.
- Jhingran, V.G. 1991. *Fish and fisheries of India* (revised and enlarged third edition) Hindustan Publishing Corporation, New Delhi, xxiii + 327 pp.
- Jones, S. and K.H. Sujansingani, 1954. Fish and Fisheries of the Chilka lake with statistics of fish catches for the years 1948-1950. *Indian J. Fish.*, 1 (1&2) : 256-344.
- Koumans, F.P. 1941. Gobioid fishes of India. *Mem. Indian Mus.* 13(3) : 205-313.
- Menon, M.A.S. 1961. On a collection of fish from lake Chilka, Orissa. *Rec. Indian Mus.*, 59(1&2) : 41-69.
- Mitra, G.N. 1946. Development of Chilka lake, Orissa. Govt. Press, Cuttack.
- Misra, K.S. 1962. An aid to the identification of the common commercial fishes of India and Pakistan. *Rec. Indian Mus.*, 57 (1-4) : 1-320.
- Misra, K.S. 1969. *Pisces. The Fauna of India and adjacent countries*. Vol. I (2nd ed.) Manager Publications, New Delhi, xvii + 276 pp.
- Misra K.S., 1976a. *Pisces. The Fauna of India and adjacent countries*. Vol. II. (2nd ed.). Manager of Publications, New Delhi, xxvii + 438 pp.
- Misra, K.S. 1976b. *Pisces. The Fauna of India and adjacent countries*. Vol. III (2nd ed.) Manager of Publications, New Delhi, xxi + 367 pp.
- Rajan, S. S. Pattanaik and N.C. Basu, 1968. New records of fishes from Chilka Lake. *J. Zool. Soc. India*, 20(1&2) : 80-93.
- Roy, J.C. and N. Sahoo, 1957. Additions to the fish fauna of the Chilka lake. *J. Bombay nat. Hist. soc.*, 54: 944-953.
- Talwar, P.K. and R.K. Kacker, 1984. *Commercial Sea Fishes of India*. Handbook. Zoological Survey of India, Calcutta, No.4, Lii + 997 pp.

- Talwar, P.K. 1985. Estuarine Fishes. IN : *State-of-Art-Report : Estuarine Biology*. Workshop on Estuarine Biology, Berhampur (Orissa) 19-22 February, 1985. Zoological Survey of India, Calcutta. 76 pp.
- Talwar, P.K. and A.G. Jhingran, 1991. *Inland Fishes of India and adjacent countries*. Vol. 1 (17 + 541 pp) & Vol. 2 (543 - 1158 pp). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

REPTILIA AND AMPHIBIA

T.S.N. MURTHY

Zoological Survey of India, Madras

INTRODUCTION

The present paper summarises our knowledge of the systematics, distribution, and ecology of 37 species of amphibians and reptiles known from the Chilka lake, Orissa and is based on approximately 210 examples taken from the waters, islands, hills, and the shore of the lagoon during a period of three years from 1985 to 1987.

History of Herpetology : The earliest attempt to conduct a zoological exploration of the Chilka lake must be credited, appropriately enough, to the pioneer investigator, Dr Nelson Annandale. To start with, he published (1907) brief notes on the reptiles inhabiting the Gopkuda Island and followed it up with a major account of the fauna (1915) of the entire lake. Shortly afterwards he described (1917, 1921) a limbless skink found on the Barkuda Island, as new to science. Thereafter, there has been a pause in the herpetofaunal study of the lagoon until Ganapati *et.al.* (1952, 1955) extended the range of the burrowing skink of Barkudia to the sandy coasts of Waltair in Andhra Pradesh.

As was expected, the Chilka lake's exploration, inaugurated by Annandale, the former Director of the Zoological Survey of India (ZSI), in early 1900s, has now paved for a multidisciplinary expedition after a lapse of 75 years, thanks again to the ZSI.

MATERIAL AND METHODS

Diurnal species were most frequently taken between midday and shortly before sunset. Many of the large snakes found in the lake and the adult monitors sighted on the islands were merely observed. Specimens, found dead on the margin of the lake or cast up ashore, were picked up and preserved if in tolerably good condition, but material obtained this way was little. Local fishermen greatly assisted in augmenting the collections, especially the snakes including the venomous varieties.

SYSTEMATIC LIST

All of the genera and species of frogs and reptiles currently recorded from the Chilka lake, with their scientific names are listed below, with page references to where they appear in the text.

AMPHIBIA

TOADS AND FROGS

Family BUFONIDAE

Genus *Bufo* Laurenti

1. *Bufo melanostictus* Scheinder–Common Toad

Family MICROHYLIDAE

Genus *Microhyla* Tschudi

2. *Microhyla ornata* (Dumeril and Bibron)–Ornate Toad

Family RANIDAE

Genus *Rana* Linnaeus

3. *Rana cyanophlyctis* Sch.–Skittering Toad
4. *Rana tigrina* Daudin–Indian Bull Frog
5. *Rana limnocharis limnocharis* Weigmann–Paddy Field Toad
6. *Rana breviceps* Sch.

Family RHACOPHORIDAE

Genus *Polypedates* Gunther

7. *Polypedates maculatus* (Gray)

REPTILIA

LIZARDS

Family GEKKONIDAE

Genus *Hemidactylus* Oken

8. *Hemidactylus brooki* Gray
9. *Hemidactylus frenatus* Schlegel

10. *Hemidactylus leschenaulti* Dumeril and Bibron

Family AGAMIDAE

Genus *Sitana* Cuvier

11. *Sitana ponticeriana* Cuvier

Genus *Calotes* Cuvier

12. *Calotes versicolor* (Daudin)

Genus *Psammophilus* Fitzinger

13. *Psammophilus lanfordanus* (Stoliczka)

Family SCINCIDAE

Genus *Mabuya* Fitzinger

14. *Mabuya macularia* (Blyth)

15. *Mabuya carinata* (Schneider)

Genus *Riopa* Gray

16. *Riopa albopunctata* (Gray)

17. *Riopa punctata* (Gmelin)

Genus *Barkudia* Annandale

18. *Barkudia insularis* Annandale

Family VARANIDAE

Genus *Varanus* Merrem

19. *Varanus bengalensis* (Daudin)

SNAKES

Family TYPHLOPIDAE

Genus *Ramphotyphlops* Fitzinger

20. *Ramphotyphlops braminus* (Daudin)

Genus *Typhlops* Opperl

21. *Typhlops acutus* Dumeril and Bibron

Family BOIDAE

Genus *Eryx* Daudin

22. *Eryx conicus* (Schneider)

Family ACROCHORDIDAE

Genus *Chersydrus* Cuvier

23. *Chersydrus granulatus* (Sch.)

Family COLUBRIDAE

Genus *Elaphe* Fitzinger

24. *Elaphe helena* (Daudin)

Genus *Ptyas* Fitzinger

25. *Ptyas mucosus* (Linnaeus)

Genus *Oligodon* Boie

26. *Oligodon arnensis* Shaw

Genus *Dendrelaphis* Boulenger

27. *Dendrelaphis tristis* (Daudin)

Genus *Xenochrophis* Gunther

28. *Xenochrophis piscator* (Schneider)

Genus *Amphiesma* Dumeril and Bibron

29. *Amphiesma stolata* (Linnaeus)

Genus *Boiga* Fitzinger

30. *Boiga trigonata trigonata* (Schneider)

Genus *Enhydris* Sonnini and Latreille

31. *Enhydris enhydris* (Schneider)

Genus *Cerberus* Cuvier

32. *Cerberus rhynchops* (Schneider)

Family ELAPIDAE

Genus *Bungarus* Daudin

33. *Bungarus caeruleus* (Schneider)

Genus *Naja* Laurenti

34. *Naja naja naja* (Linnaeus)

Family HYDROPHIIDAE

Genus *Enhydrina* Gray

35. *Enhydrina schistosa* (Daudin)

Genus *Hydrophis* Latreille

36. *Hydrophis obscurus* Daudin

Family VIPERIDAE

Genus *Vipera* Laurenti

37. *Vipera russelli russelli* (Shaw)

KEYS TO THE AMPHIBIANS AND REPTILES OF THE CHILKA LAKE

Note : The following identification keys are based upon characters that are mostly external, which can be determined by simple inspection of the specimen without dissection or the use of a lens. The colour characters, whenever possible, are also used for the benefit of the laymen and the naturalists in the field. The families represented by a single species in the lagoon are indicated by an asterisk and the respective species are bracketed.

TOADS AND FROGS

Key to the families

1. Shoulder with elevated parotid glands; skin with tubercles and spiny warts
..... Bufonidae* (*Bufo melanostictus*)
- Shoulder without elevated parotid glands; skin smooth with small tubercles; no spiny warts 2
2. Fingers and toes with discs. Tree living Rhacophoridae (*Polypedates maculatus*)
- Fingers and toes without discs. Generally living on land or in or near water 3
3. Snout pointed; tympanum hidden; back with a distinct pattern; adult not more than 30 mm long
..... Microhylidae (*Microhyla ornata*)
- Snout blunt; tympanum prominent; back without a distinct pattern; adult more than 30 mm long
..... Ranidae

Key to the species of the family RANIDAE

1. Toes completely webbed 2
- Toes half to two-thirds webbed 3
2. Skin of back thrown into longitudinal folds; inner metatarsal tubercle large, compressed, and crescentic; dorsum with a yellow stripe *Rana tigerina*
- Skin of back not thrown into longitudinal folds; inner matatarsal tubercle small, digitiform
..... *Rana cyanophylctis*
3. Body stout and tending to be toad-like; inner matatarsal tubercle large, compressed, and shovel-like
..... *Rana breviceps*
- Body not stout nor tending to be toad-like; inner matatarsal tubercle small, oval or rounded
..... *Rana limnocharis*

LIZARDS

Key to the families

1. Top of head with small scales; tongue long, slender, and deeply forked as in snakes
..... Varanidae* (*Varanus bengalensis*)
- Without the above combination of characters 2

- 2. Top of head with symmetrical shields Scincidae
- Top of head without symmetrical shields 3
- 3. Eyes without movable eyelids; above with granules or tubercles; digits dilated Gekkonidae
- Eyes with movable eyelids; skin with imbricated scales above; digits not dilated Agamidae

Key to the species of the family Gekkonidae

- 1. Back with strongly keeled and regularly arranged tubercles; nine to 15 lamellae under fourth toe *Hemidactylus brooki*
- Back with feebly keeled and irregularly arranged tubercles; nine to 15 lamellae under fourth toe 2
- 2. Inner toe less than half of second toe; male with a continuous series of preano-femoral pores *Hemidactylus frenatus*
- Inner toe more than half of second toe; male with a discontinuous series of preanofemoral pores *Hemidactylus leschenaulti*

Key to the species of the family Agamidae

- Body or more less depressed *Psanmophilus blanfordanus*
- Body compressed 2
- Back with a crest of spine-like scales; hind foot with five toes *Calotes versicolor*
- Back without a crest; hind foot with four toes only *Sitana ponticeriana*

Key to the species of the family Scincidae

- 1. Body elongated; limbless *Barkudia insularis*
- Body not elongated; limbs present 2
- 2. Limbs robust, long 3
- Limbs feeble, short 4
- 3. A postnasal present or absent; 28 to 30 scales round the body; neck and flanks spotted with white *Mabuya macularia*

No postnassal; 30 to 34 scales round the body; neck and flanks with or without white spots
 *Mabuya carinata*

4. Lower eyelid scaly; 26 to 28 scales round the body *Riopa albopunctata*

Lower eyelid with an undivided transparent disc; 24 to 26 scales round the body
 *Riopa punctata*

SNAKES

Key to the families

1. Eyes rudimentary and covered over by head shields; body worm-like Typhlopidae

Eyes exposed and well developed; body not worm-like 2

2. Vestiges of pelvis present as evidenced by claw-like spurs on each side of the vent
 Boidae* (*Eryx conicus*)

No vestiges of pelvis 3

3. Ventrals distinct and enlarged transversely 4

No transversely enlarged ventrals Acrochordidae * (*Chersydrus granulatus*)

4. Tail vertically compressed and paddle-like Hydrophiidae

Tail not so 5

5. No poison fangs in front of the mouth Colubridae

Poison fangs found in front of the mouth 6

6. Head distinctly triangular, covered with numerous small irregularly arranged scales; pupil vertical
 Viperidae* (*Vipera russelli*)

Head oval or round but not triangular, covered with well defined large symmetrical shields; pupil
 round Elapidae

Key to the species of the family Typhlopidae

Snout rounded; nostrils directed laterally; 20 scales round the body *Ramphotyphlops braminus*

Snout pointed and hooked, projecting like a beak; nostrils inferior; 28-34 scales round the body
 *Typhlops acutus*

Key to the species of the family Colubridae

1. Nostrils valvular, situated on the upper surface of the snout; ventrals rather narrow 2
 Nostrils not valvular; usually directed laterally; ventrals large 3
2. Scales smooth; a dorsal pattern of longitudinal stripes *Enhydryis enhydryis*
 Scales keeled; a dorsal pattern of dark spots or cross-bars *Cerberus rhynchops*
3. Ventral and caudal shields notched and with lateral keels; vertebral scale rows much enlarged ..
 *Dendrelaphis tristis*
 Ventrals and caudals not as above; vertebral scale rows feebly enlarged 4
4. Head much broader than neck; pupil vertical *Boiga trigonata*
 Head but alightly broader than neck; pupil round 5
5. Head and neck with a distinct pattern of dark chevrons *Oligodon arnensis*
 Head and neck without any pattern as above 6
6. Scale rows at midbody 21 or more; a dorsal pattern of black cross-bars enclosing white ocelli ...
 *Elaphe helena*
 Scale rows at midbody 19; no pattern as above 7
7. Ventrals 190 or more; 2-4 loreal shields *Ptyas mucosus*
 Ventrals 187 or fewer; one loreal shield 8
8. Two oblique black streaks from eye to edge of mouth; a dorsal pattern of black spots arranged like
 a chessboard; caudals 90 or more *Xenochrophis piscator*
 No oblique streaks from eye to edge of mouth; a pattern of dorso-lateral yellow or buff stripes;
 caudals fewer than 90 *Amphiesma stolata*

Key to the species of the family Elapidae

- Vertebral scale row distinctly enlarged; subcaudals undivided; neck not dilatible to form a hood (in life)
 *Bungarus caeruleus*
- Vertebral scale row not enlarged; subcaudals divided; neck dilatible to form a hood (in life)
 *Naja naja naja*

Key to the species of the family Hydrophiidae

- Rostral shield decurved and pointed; mental shield elongated and hidden between first infralabials
 *Enhydriana schistosa*
- Rostral and mental shields not as above *Hydrophis obscurus*

SPECIES ACCOUNTS

Included herein are most of the species of amphibians and reptiles believed to occur in the Chilka lake. Treated in detail are 37 species, a majority of which are contained in the material collected by me and a few species not in the collections but recorded by Annandale (1907-1921) and others and deposited in the herpetological collections of the Zoological Survey of India, Calcutta. The material under report includes several new records, which include three lizards and five snakes.

The taxonomic arrangement in respect of the amphibians follows the recent overview presented by Inger and Datta (1987), but with one exception; I retained *Rana breviceps* in the genus *Rana*, pending further studies to prove to what extent the subgenera *Rana* and *Tomopterna* to which *Rana breviceps* is assigned now, differ among themselves. The classification of reptiles is the same as that followed by Smith (1935, 1943), with minor nomenclatural modifications suggested by Mittlemah (1952), Malnate (1960), and Stimson *et. al.*, (1977). Besides providing the diagnostic characters for the genus, I present the following information for each taxon : (1) Current name, (2) Common name, (3) Synonymy that includes : (i) a reference to the original description (ii) a reference to the nomenclatural combination (iii) a reference to the taxon in the "Fauna of British India" series (iv) synonyms based on material collected in the Chilka lake, (4) Description, (5) Colour and pattern, (6) Size, (7) Habitat and habits, and (8) Distribution. Trinomials are used for those species under study which are clearly assignable to the well-defined subspecies.

Measurements, scale counts, colouration, and other descriptive data are from specimens examined personally. The dimensions given are those of the adult or near-adult specimen unless otherwise stated. The head and body length (snout to vent length) as well as of the tail are given for the lizards, while the size given for a snake indicates its total length. Accounts of habitat and habits are based largely on my observations and the summaries provided in the published literature. The distribution given in respect of the area under study is largely based on the material collected and/or examined by me and this reflects our knowledge of the range at the time of writing, and it is possible that the animal might be found outside the given range.

AMPHIBIA

Family BUFONIDAE

Genus *Bufo* Laurenti

TRUE TOADS

General diagnosis : Skin dry and spiny; jaws toothless, no vomerine teeth; pupil horizontal; tongue entire and free behind; fingers free, toes half webbed; parotid glands distinct.

There are about sixteen species in India. One species occurs in the Chilka lake.

1. *Bufo melanostictus* Schneider 1799

COMMON TOAD

Bufo melanostictus Schneider, 1799, P. 216; Boulenger, 1890 P. 505; Annandale, 1921, P. 352.

Description : Head with well developed and cornified cranial ridges; tympanum distinct and three-fourths that of the eye in diameter. Fingers free, first finger a little longer than the second. Toes nearly half-webbed. Skin with a double series of large spinous warts along the back; parotid glands large, reniform, and prominent.

Colour and Pattern : Very variable; it is usually olive or brown with or without brown markings on the throat and the breast. The cranial ridges, spiny warts, and the digits are tipped with black. The throat, in males, assumes an orange or brick-red hue during the breeding season. The breeding male can also be recognised by its dark, subgular vocal sac and the presence of the dark nuptial excrescences on the upper surface of the two inner fingers.

Size : Snout-ventlength of adults vary from 100 m 150 mm.

Habitat and Habits : The commonest toad of India. It is strictly terrestrial in its habits and is found near the water only during the breeding season. It hides under logs, stones or inside the burrows and in the shaded areas during the day and emerges at night. The adults are mostly nocturnal, but the juveniles are found abroad during the day also.

The common toad prefers live food and bees, ants, snails, and earthworms constitute its main diet. It utters a rather feeble cry when handled for the first time. The milky secretion of the parotid glands, which causes irritation on contact with the human skin, protects the toad from its enemies such as dogs, cats, and some other predators. However, it is preyed upon by many species of snakes and monitor lizards.

The breeding season usually commences with the onset of the monsoon, but it may breed any time when it rains heavily following a spell of heat. Schmidt (1951) noted that the common toad breeds in brackish water and his statement confirms my observations. I found this toad often under the culverts not far from the brackish waters of the Chilka Lake and also among the stones on the edge of the lake.

Distribution : Throughout India; Sri Lanka, Burma; South China, and Malaysia.

Family MICROHYLIDAE

Genus *Microhyla* Tschudi

NARROW-MOUTHED FROGS

Generic diagnosis : Small and slender frogs. Head triangular; mouth narrow; upper jaw toothless; no vomerine teeth; tympanum hidden or absent; pupil round; tongue oval, entire and free behind. Fingers

free; toes slightly webbed at the base. Tips of the digits more or less dilated. Colouration distinctive. Five species are known. One species occurs in the lake.

2. *Microhyla ornata* (Dumeril and Bibron) 1841

ORNATE FROG

Engystoma ornatum Dumeril and Bibron, 1841, P. 745.

Microhyla ornata, Boulenger, 1882, P. 165; Parker, 1934, P. 139.

Description : In addition to the generic diagnosis given above, the following additional characters supplement the description of the species.

Form stout and tending to be toad-like. Snout pointed, prominent; tympanum hidden. First finger shorter than the second. Toes less than one-third webbed; sub articular tubercles distinct; two large, oval, compressed metatarsal tubercles, of which the outer is larger. Skin above smooth, usually with small warts. Male with a subgular vocal sac.

Colour and Pattern : Usually light-brown or dark above, with a characteristic, median sepia-like dark marking; this pattern begins at about the mid-level of the eyes, narrows slightly on the occiput, then widens a little, finally extending onto the sacral region; limbs with dark crossbars. Underside white; throat and chest stippled greyish or brownish, with white spots; throat of male pigmented with black.

Size : Length from snout to vent upto 25 mm.

Habitat and Habits : The Ornate frog is a secretive species, found only in the moist places and the areas under cover. It is strictly nocturnal in habits although it may be found under the stones or among the leaves near the water during the day also, if carefully searched for. Despite its tiny size, it can jump well and cover considerable distances. It appears to be common during the monsoon when it gets attracted by the night lamps and enters the houses. It feeds mostly on small insects such as Coleoptera and ants. The call of the male, which is rather weak and uttered at regular intervals, is like a rasping note.

Distribution : Throughout India, Sri Lanka, Burma, South China, southeast Asia and Taiwan.

Annandale (1915) recorded this frog from the edge of the lake at Barkul. The recent collectors found it in the rice fields along the shore of the lake at Balugaon and Khallikote.

Family RANIDAE

Genus *Rana* Linnaeus

TRUE FROGS

Generic diagnosis : Skin smooth; upper jaw toothed; vomerine teeth present; tympanum distinct; pupil horizontal; tongue free and bifid behind; fingers free, toes webbed; tips of digits pointed or slightly dilated but without discs.

Of the fifty species so far reported from India, four species are found in the Chilka lake.

3. *Rana cyanophlyctis* Schneider 1799

SKITTERING FROG

Rana cyanophlyctis Schneider, 1799, P. 137; Boulenger, 1890, P. 442, and 1920, P. 12.

Rana cyanophlyctis, Annandale, 1915, P. 173.

Description : Head broader than long, depressed; snout blunt; nostrils dorsal. Tympanum distinct, nearly half of diameter of eye. Fingers free, first finger longer than the second. Toes completely webbed; innermetatarsal tubercle short and pointed; no outermetatarsal tubercle. Skin of upper surface and the underside smooth; back with numerous small, scattered warts; sides of body rugose. Males with paired, greyish vocal sacs.

Colour and Pattern : Dorsally brown, olive, or completely black with darker spots which sometimes join to form thick blotches; limbs dark spotted; a yellow or whitish line on the flanks and the thigh; no vertebral line; underside usually immaculate; throat and breast dusky.

Size : Adults average in snout-vent length from 35 mm to 60 mm. Females are larger than males.

Habitat and Habits : This frog is the most widespread of all the Indian frogs, being found in all aquatic situations. It is never found far from water and spends most of its time, floating motionless with the limbs partly extended and with the eyes and a part of the snout exposed. When alarmed, it skips over the surface for some distance before it dives and hides on the bottom. It is the only Indian frog which tolerates salinity and hence it is not uncommon in or near the salt creeks, and lagoons. Its presence in the drains and sewers is apparently indicative of its tolerance to the organic pollution also. It aestivates during the summer and reappears on the onset of the monsoon.

The common water frog feeds mostly on aquatic insects such as beetles and odonates, crustaceans, and snails captured and water, but also eats terrestrial insects.

The usual breeding season of this species is during the rains, but it may breed round the year in permanent water. The male is more vocal during the monsoon. Its call is sonorous, and sounds somewhat as "creek-creek"

Distribution : The general distribution of this species is Southwest Asia, Sri Lanka, India, Nepal, Thailand and Malay Peninsula. It is found throughout the Chilka lake, in all situations where the margin is swampy and also in the stagnant pools of the islands. It is found in close association with the estuarine fish, mudskipper (*Periophthalmus sp*) which is common in the lake.

4. *Rana tigerina* Daudin 1803

INDIAN BULL FROG

Rana tigerina Daudin, 1803, P.64, Pl.20; Boulenger, 1920, pp. 17-20.

Description : Body robust, tending to be toad-like. Head broader than long; snout bluntly pointed; upper jaw projecting beyond the lower; nostrils dorsal; tympanum distinct and two-thirds of the eye in diameter. Toes moderate, almost completely webbed; outer toe bordered by a prominent cutaneous fringe; inner metatarsal tubercle strongly compressed and crescentic; no outer metatarsal tubercle. Skin of back thrown into prominent longitudinal folds; flanks with warts; lower surfaces smooth; a distinct fold from above tympanum of eye, which extends to the shoulder.

Colour and Pattern : The Indian bullfrog's colouration and markings are distinctive. The adult is dark olive in colour above, with irregular dark blotches while the young are paler or grass-green above, with a pair of black patches behind the eyes and a dark W-shaped marking on the back; a distinct, narrow vertebral line is often present; upper surfaces of limbs with scattered dark spots which tend to give the appearance of crossbars; lips cream, with alternating dark and light areas; throat and breast dusky; belly and remainder of lower parts immaculate white. Male with two external vocal sacs.

During the breeding season the thumb of the male is swollen and dark. The breeding male turns bright yellow-lemon in colour and the vocal sacs assume a bluish hue.

Size : The largest of the Indian amphibians. Adults range in snout-vent length from 10 cm to 15 cm. Females are much larger, with recorded lengths upto and slightly over 16 cm.

Habitat and Habits : The Indian bullfrog is essentially an aquatic amphibian and is rarely found far from water. It can be found anytime of the year in the wells, tanks, ponds, and lakes. It generally hides during the day inside the burrows and in the weed-choked ditches along the water edge and gets active at night. Generally speaking, it is diurnal during the winter and is more nocturnal during the warm season. It is a strong jumper and swimmer. It is a shy and solitary frog, collecting together only at the time of breeding. During the summer it digs down deep into the earth where it buries itself to escape the adverse conditions and reappears at the break of the monsoon.

The Indian bullfrog is very voracious and will eat almost anything that it can overcome or gets into its mouth. Besides the insects, it is observed to feed upon snails, worms, crustaceans, and scorpions, but sometimes some frogs, lizards, snakes, birds, and mice also are eaten.

It is appropriately named 'bullfrog' because of its strength, size, and the ear-splitting call of the male which is a loud "quonk, quonk". It is one of the edible frogs of India, much sought after for its hind legs which are considered a great delicacy and has been till recently much exploited for export to U.S.A., France, Belgium, and West Germany. After having realised the disastrous consequences following the indiscriminate killing of the edible frogs, the Government of India has clamped a ban on the trade in frog meat.

Distribution : Throughout India, Sri Lanka, Burma to Indo-China, South China, and Taiwan. The bullfrog is not uncommon in the cultivated areas of the lake, but is also found in the wells dug out for agricultural use.

5. *Rana limnocharis limnocharis* Weigmann 1835

PADDY-FIELD FROG

Rana limnocharis Weigmann, 1835, P. 255; Boulenger, 1920, pp. 28-35.

Description : Form slender. Head moderate, snout rather pointed; tympanum distinct, about three-fourths that of the eye in diameter. Fingers free, first finger slightly longer than the second. Toes usually half webbed; inner metatarsal tubercle oval; a minute outer metatarsal tubercle present. Skin rather warty above, with numerous short, oblique folds. Male with a subgular vocal sac.

Colour and Pattern : Dorsally olive or brown, with or without a reddish tinge, and whitish below; lips and limbs barred with dark; a dark V-shaped mark between the eyes followed by a W-shaped mark on the shoulder; a yellow vertebral line is often present; lower jaw and lower surface of thigh dusky, the remainder of the underside being whitish. The area surrounding the vocal sac of the male turns purplish-black at the time of breeding and a strong pad appears on its thumb.

Size : Snout-vent length of adults range from 30 mm to 65 mm.

Habitat and Habits : This frog is generally found in the shallow marshes, flooded paddy fields, and also among the grassy areas in the vicinity of the tanks and the streams. It is a very agile creature and is a good jumper. When approached, it either leaps into the water or escapes into the vegetation. The call of the male is described as resembling that a series of staccato notes often delivered in bursts.

Distribution : The general distribution of this species is : India, Sri Lanka, Malay Peninsula and Archipelago, Philippines, Borneo (Indonesia), China and Japan. It is common throughout India.

In the Chilka lake it was collected from the paddies and the marshy edge of the shallow waters of the lake near Bulugaon. Probably it is more widespread than my collections indicate.

6. *Rana breviceps* Schneider 1799

INDIAN BURROWING FROG

Rana breviceps Schneider, 1799. P 140; Boulenger, 1920, P. 101.

Description : Form snout, tending to be toad-like. Head short and broader than long; snout obtuse; nostrils dorso-lateral; tympanum distinct and is about half of the eye in diameter. Fingers free, first finger longer than the second. Toes about half-webbed; inner metatarsal tubercle large, heavy, and crescentic; no outer metatarsal tubercle. Skin of upper parts with some not so prominent small warts and short longitudinal folds; flanks and the lower half of the body granular; chest and throat smooth.

Male with a vocal sac, forming folds on sides of the throat.

This species is distinguished from *Rana limnocharis* its closest ally, by the presence of large and shovel-shaped inner metatarsal tubercle.

Colour and Pattern : Upper side mostly light brown or olive, with black spots on the dorsum and a white or yellowish vertebral band. The tip of the snout and the edge of the upper jaw are stippled with black. The limbs may have dark crossbars. Underside white, the throat being brownish (in females) or blackish (inmales).

Size : The adult ranges from 35 mm to 57 mm in snout-vent length.

Habitat and Habits : The Indian burrowing frog is rather a rare species which is chiefly encountered in the semi-arid tracts and the grass lands situated close to the water.

The frog's superficial resemblance to the toad is largely due to its fossorial habits. It is said to be capable of burying itself in loose soil upto a depth of nearly 30 cm below the ground. It is so thoroughly adapted to a life on land that should it ever fall into water, it will be hard put to help itself out of it. It is entirely a nocturnal frog and this is the reason why it is so scarce even during the monsoon. It leads a solitary life, congregating only during the monsoon.

It feeds mostly on beetles, but other insects like Crickets comprise its diet. Unlike other ranids, it is not a concert-giving frog. The calling note of the male is a loud, nasal "quonk" repeated in quick succession.

Distribution : India, Nepal, Sri Lanka, and Upper Burma. Mostly found in the plains of Peninsular India. In the Chilka lake it is collected only from the paddies on the edge of the lake at Barkul.

Family RHACOPHORIDAE

Genus *Polypedates* Gunther

OLD WORLD TREE FROGS

Generic diagnosis : Pupil horizontal; tongue free and deeply notched behind; tympanum distinct; fingers free, with rudimentary web between the first and the second fingers; tips of fingers and toes dilated into regular horseshoe-shaped discs. Tree-living frogs, mostly nocturnal in habits.

The genus contains two species of which one is found in the lake.

7. *Polypedates maculatus* (Gray) 1834

TREE FROG

Hyla maculata Gray, 1834, pl. 82

Polypedates maculatus, (Part) Gunther, 1858, P. 78.

Polypedates maculatus, Liem, 1970.

Description : Head generally bony, with ridges in adults; snout subtriangular and obtusely pointed. Tympanum is usually as large as the eye. Fingers and toes with sucking discs, the former slightly webbed, the latter for nearly two-thirds of their length; subarticular tubercles moderate; a single small, inner metatarsal tubercle. Skin of back smooth, of belly granular. Male with an internal vocal sac.

Colour and Pattern : Upperside usually brownish, but is much variable as the colouration is affected by age, locality and lighting, and it may be yellow, white or greyish, with scattered dark spots and a W-

shaped mark between the eyes. The edge of the upper lip is constantly white. The limbs are marked with dark which may form transverse crossbars. Underside of body white or greyish, with a marbled throat; thighs spotted behind with yellow.

Size : Adults vary from 31 mm 65 mm in snout-vent length.

Habitat and Habits : This species is the most familiar of Indian tree frogs of the family Rhacophoridae. Although it is an arboreal species, it enters the houses at night and can be found adhering to the walls, window-glasses and the floors. As one might expect of this nocturnal frog, it prefers dark and secluded areas such as the kitchen and the bathroom where it can be noticed during the rains, hiding in a corner. During the day it rests under the bark of the fruit-yielding trees like the Plantain and the Pine and also in the thatched roofs of the huts of villages. It feeds mostly on insects which should be alive, but seems to avoid certain insects such as the Cantharids, Carabids, garden bugs, fireflies and certain aquatic beetles. It deposits its frothy mass-like spawn on leaves above pools, into which it soon slips.

The common tree frog is usually detested because of its unpleasant habit of exuding a large quantity of urine, when first caught.

Distribution : India and Sri Lanka. The only example contained in the collection was picked up from the bushes on the edge of the lake at Barkul.

REPTILES

LIZARDS

Genus *Hemidactylus* Oken

GECKOS

Generic diagnosis : Head broad and is devoid of enlarged scales. Body covered with granules or tubercles. Digits ovoid and dilated, with transverse rows of plate-like scales (Lamellae) on their underside; toes clawed. Eyes immovable, pupil vertical. Males with preanal and/or femoral pores. Tail diminutive and stumpy which can be shed easily and regrown later. Mostly nocturnal. Reptiles with a true voice.

There are 51 species in India, of which three are found in the lake.

8. *Hemidactylus brooki* Gray 1845

SPOTTED HOUSE GECKO

Hemidactylus brookii Gray, 1845, P. 153; Annandale, 1907, P.397 and 1921, P. 332; Smith, 1935, P.89.

Description : Scales on the body granular, with 14-19 rows of trihedral tubercles. Upper labials 8-11, lower labials 7-0. Lamellae on the fourth toe 6-10. Femoral and preanal pores vary from 15 to 27.

Colour and Pattern : Usually light grey to dark brown above, with a series of black spots more or less regularly arranged somewhat like broken transverse bands on the back; snout with two dark lines. Underside whitish.

Size : Snout to vent 60 mm; tail 85 mm.

Habitat and Habits : Despite the common name, this gecko is often found far away from the human dwellings and is met in a variety of habitats on trees and under stones in both the plains and hills. It is nocturnal in its habits and is inactive during the winter. While hunting its prey it comes down and moves quickly on the ground too. Its call, which is a loud "tik, tik, tik" commences soon after the sun sets and is continued till dawn. The common house gecko frequents the kitchens where its presence is beneficial in controlling the undesirable insect pests. The female house-gecko lays two eggs in secluded spots.

Distribution : The common Indian house-gecko is a widespread species having been recorded from Borneo and South China through most of tropical Asia and the northern half of Africa.

This species is plentiful in the man-made structures and the surrounding areas of the lake and on the islands.

9. *Hemidactylus frenatus* Schlegel 1836

SOUTHERN HOUSE GECKO

Hemidactylus frenatus Schlegel, 1836, P. 366; Annandale, 1907, P.397 and 1921, P.332; Smith, 1935, P.95.

Description : Body smooth. Upper labials 10-11, lower labials 8-10. First toe less than half of the second in length; lamellae under the fourth toe 9-11. Male with a continuous series of 23 or more preano-femoral pores.

Colour and Pattern : The smooth gecko is dark brownish dorsally, with distinct darker markings often arranged as longitudinal stripes on the back and is whitish below. The head bears dark and light lines. The flanks are spotted with black. The tail is sometimes coral red in life. The pattern, which is conspicuous in the young, fades with age.

Size : Snout to vent 60 mm; tail 65 mm.

Habitat and Habits : Although this gecko is supposed to be partial to the human dwellings, it is frequently found in the bark of coconut trees, axils of palm fronds and even in the debris on the outskirts. The call of this gecko is a series of loud, staccato notes. It is found to live in association with the other house-gecko, *H. brooki* with which it competes successfully.

Distribution : The widespread occurrence of this gecko is due to its introduction by the human agency which probably is the source of its other name 'Walf Gecko'. In India it is common in Bengal, Orissa, South India, Maharashtra, and the Andaman and Nicobar Islands. I collected it from the walls of the tourist lodges on the edge of the lake. It was seen frequently on the coconut trees along the shore line.

10. *Hemidactylus leschenaulti* Dumeril and Bibron 1836

BARK GECKO

Hemidactylus leschenaulti Dumeril and Bibron, 1836, P. 364; Smith, 1935, P.97.

Description : Body scales granular, minute, and intermixed with small tubercles irregularly scattered; scales on the belly small and imbricate. Lamellae on the fourth toe 10-11. Male with 10-17 femoral pores on each side.

Colour and Pattern : Usually grey above, with conspicuous dark brown wavy crossbars or rhomboidal spots and is whitish below. A dark streak commencing from behind the eye extends to the flanks. The overall colouration of the gecko matches so well with the greyish-brown bark of the Banyan and Tamarind trees that the lizard is rendered invisible and hence the common name.

Size : Snout to vent 85 mm; tail 85 mm.

Habitat and Habits : This gecko seems to prefer a life on the trees rather than in the houses. It spends most of the day under the bark of giant trees situated several metres above the ground. At night it runs about on tree trunks but seldom comes down. It enters the houses in big cities.

Distribution : Most of India; Pakistan; Sri Lanka. In the Chilka lake the bark gecko has been recorded for the first time from the Banyan trees on the edge of the lake at Rambha and in the surroundings of the tourist lodges.

Family AGAMIDAE

Genus *Sitana* Cuvier

Generic diagnosis : Body compressed, covered with regular scales, smallest on the sides; no dorsal crest. Limbs long; four toes instead of the normal five toes on the hind feet. Tympanum naked. No preanal or femoral pores. Tail very long. Male with a gular pouch.

Represented by one species which occurs in the lake.

11. *Sitana ponticeriana* Cuvier 1829

FAN-THROATED LIZARD

Sitana ponticeriana Cuvier, 1829, P.43; Smith, 1935, P. 144.

Description : As given for the generic diagnosis.

Colour and Pattern : Dorsally dark brown, with a series of black-edged rhomboidal spots down the middle of the back; a light line running down the flanks to which is added another light vertebral line; belly whitish. The gular pouch of the male turns brilliant red, black, and blue during the breeding season.

Size : Snout to vent 40-50 mm; tail 80 mm - 150 mm.

Habitat and Habits : The four-toed lizard is partial to the bushy places in the open country and dry areas.

It is a fast runner that can escape on approach into a hole or a crack in the ground or into a bush. While running, it adopts a bipedal mode of locomotion. It folds and unfolds its gular pouch when excited. The male attracts the female by a gorgeous display of its throat-fan which assumes a brilliant hue of red, black, and blue during the breeding season. The female lays 6-8 eggs which are buried in the soil.

Distribution : India; Sri Lanka. In the Chilka lake this lizard has been recorded for the first time from Kavutakuda near Satpara. Probably this lizard is more widespread in the study area than the collections indicate.

Genus *Calotes* Cuvier

GARDEN LIZARDS

Generic diagnosis : Body compressed, covered with regular, uniform scales; dorsinuchal crest present; gular sac normally present; an oblique fold or pit in front of the shoulder present or absent. Tail long and slender, usually swollen and rounded at the base in the adult male. No femoral or preanal pores.

Known by 41 species in India. One species occurs in the lagoon.

12. *Calotes versicolor* (Daudin) 1802

INDIAN GARDEN LIZARD

Agama versicolor Daudin, 1802, P.395.

Calotes versicolor, Jerdon, 1853, P.470; Annandale, 1907, P. 398 and 1921, P. 332.

Description : Head and eye large. Upper head scales unequal; two well-separated spines on each side of the head above the ear. Limbs well developed, with long, slender digits ending in powerful claws. Body scales keeled, imbricate, and arranged in 37-47 rows at midbody; dorsinuchal crest composed of 41-49 lanceolate spines extending onto the tail. Adult males with swollen cheeks.

Colour and Pattern : Dorsally light sandy brown or olive depending on metachoric changes and whitish below, with dark streaks; tail with dark and light annuli; throat of an adult male with a black bar. Young and females with light transverse bars and yellowish dorso-lateral stripes. During the breeding season the male assumes a brilliant crimson or scarlet hue which is the source of the misappropriate name 'Blood sucker' given to this harmless lizard. The breeding dress of the male may primarily be confined to the head and shoulders, but sometimes covers most of the body. The males are pugnacious in nature and long drawn combats among them are not uncommon at the time of courting the females.

Size : Snout to vent 96 mm; tail 300 mm 350 mm.

Habitat and Habits : The common garden lizard is a typical animal of the forests and the plains of India. It is essentially an arboreal species, but is frequently found in the open fields, hedges and the gardens. Taking advantage of its prehensile toes and the long tail which supports its weight, the lizard conceals itself among the stems and camouflages nicely. It is an expert climber and the adults may climb up to 9 m or so in which position they rest on tall tree-tops. It is very common during the warm months and the monsoon, but is encountered irregularly in the winter when it spends most of the time in decaying vegetation, hollow logs, and under stones. On sunny days, however, the young, and the adults emerge about midday to bask in the sun for a couple of hours. This lizard's habit of repeatedly nodding its head indicates excitement of any nature, sexual or other. It can inflict a painful bite if picked up. It is an active creature with a voracious appetite. It feeds chiefly upon spiders and various kinds of large diurnal insects such as the crickets, Cockroaches, Grasshoppers, and ants and is also known to devour young birds and even distasteful butterflies avoided by the birds. The garden lizard, in turn, is preyed upon by the snakes, birds, cats, and the monitor lizards.

It courts the female by displaying its breeding dress (see colour and pattern), vanquishing other males by acts of intimidation that consists of inflating the dewlap and bobbing the head up and down. The female lays a clutch of 10-20 eggs and buries them in the soil and the hatchlings emerge after a month or so.

Distribution : From Sumatra to South China and West through most of India and Sri Lanka. It is abundant in the lake area. Annandale's (1921) specimen from the Barkuda (Breakfast Island) was no doubt wrongly identified as *Calotes versicolor major*, Blyth.

Genus *Psammophilus* Fitzinger

ROCK-LIZARDS

Generic diagnosis : Body dorsoventrally compressed, covered with uniform dorsal scales; no dorsal crest. Tympanum distinct. Eyes movable. No gular sac; no preanal or femoral pores. Tail long and slender. A genus of hill lizards.

13. *Psammophilus blanfordanus* (Stoliczka) 1871

ROCK LIZARD

Charasia blanfordana Stoliczka, 1871, P. 194.

Psammophilus blanfordanus, Smith, 1935, P. 210.

Description : Dorsal scales slightly larger, keeled and imbricate, arranged in 80-100 rows round the midbody; flanks with a few scattered and little larger series of scales.

Colour and Pattern : Young and females olive-brown marbled or with flecks of brown; a series of large, lozenge-shaped dark brown spots on the back and the tail. Adult males pale brownish above and yellowish below, with a yellowish-brown stripe commencing near the lips and extending onto and beyond the ear; a second stripe, dark brownish or blackish in colour, starts behind the eye and broadens as it covers

the lower half of the flank. At the time of courtship the male is an extremely beautiful object when its head and foreparts assume a brilliant crimson hue while the rest of the body becomes jet black in colour.

Size : Snout to vent 100 mm; tail 200 mm. Females are smaller than males.

Habitat and Habits : The rock-lizard spends most of the day basking on bare boulders with which its colour harmonises and where there is an abundance of sunshine and plenty of insects, the principal food of the reptile. It takes shelter at night in the crevices of rocks. Despite the stout body, the rocklizard is always alert and darts into the crack of a rock at the least sign of danger. The female lays about eight eggs. This lizard, recorded for the first time from the Bird Island and the Ghantasila Hills in the Rambha Bay, is an interesting addition to the lizard fauna of the Chilka lake.

Distribution : Bihar; Orissa; Madhya Pradesh; Eastern Ghats; South Kerala upto Trivandrum.

Family SCINCIDAE

Genus *Mabuya* Fitzinger

Generic diagnosis : Small-sized lizards, with long and cylindrical bodies and short; pentadactyle limbs. Dorsal and ventral scales similar in size and shape, imbricate, polished, smooth or keeled; body, limbs, and tail protected by osteoderms; head covered with symmetrical shields. Nostril in the nasal shield; supranasals separate. Tongue moderately long, covered with imbricate scale-like papillae, feebly nicked anteriorly. Tail fragile and can be quickly reproduced, if damaged.

There are 11 species, of which one occurs in the lagoon.

14. *Mabuya macularia* (Blyth)

BRONZE GRASS SKINK

Euprepes macularius Blyth, 1853, P. 652.

Mabuya macularia, Boulenger, 1887, P. 182; Smith, 1935, P. 264.

Description : From 28-30 scales round the body, the dorsals and laterals with 5 or 7 strong keels. Digits moderately long, with obtusely keeled lamellae, 12-17 beneath the fourth toe. Tail not twice the length of the head and body.

Colour and Pattern : Dark bronze above, with or without small black spots; back with a light dorso-lateral stripe; sides of neck and flank dark brown, usually with white spots; belly white. A light line starting from the upper lip extends backward or to the anterior part of the flank. The lips and flanks of the breeding males are coloured bright red. Smith (1935) distinguishes as many as five forms based on the colouration of this skink.

Size : Snout to vent 58 mm 61 mm; tail 65 mm 75 mm.

Habitat and Habits : This skink is a shy lizard, usually noticed among low vegetation and rotting leaves. It is easily glimpsed on the grassland and the cultivated fields during the monsoon. It is diurnal in habits and seems to be active throughout the year. The female lays 3 to 4 eggs.

Distribution : From Laos and Cambodia to northern Malaya and west through most of Burma, India, Sri Lanka, and Pakistan. This species is represented by a solitary example taken from the edge of the Chilka at Rambha.

15. *Mabuya carinata* (Schneider) 1801

COMMON SKINK

Scincus carinatus Schneider, 1801, P. 183.

Mabuya carinata, Boulenger, 1887, P. 181; Smith 1935, P. 266.

Description : Dorsal and lateral scales subequal, with 3 or 5 distinct keels, the three median keels are always strongly marked, the outer two are often absent in the young; from 30 to 34 scales round the midbody. Digits moderately long, with smooth or obtusely keeled lamellae, from 14 to 18 under the fourth toe.

Colour and Pattern : Dorsum olive or bronzy, sides darker. Back with two prominent dorso-lateral stripes - one starting from above the eye and extending to the tail and second stripe starting from the upper lip and extending to the groin. Underside white or yellow. The flanks of the male assume a brilliant scarlet hue at the time of breeding.

Size : Snout to vent 125 mm; tail 165 mm.

Habitat and Habits : The common skink is found both in the plains and low hills, where it is seen as it glides fast through low shrubs and fallen leaves. It is a diurnal lizard, found throughout the year except during the cold months. This is probably the most urbane of our skinks; it is not uncommon in the City parks, nurseries and gardens. In addition to insects which constitutes its exclusive food, the common skink is known to eat small vertebrates. The female lays from 11 to 23 eggs in the loose soil under decaying grass in a small hole she has dug, or in a rotting log or under rock. I have noticed it frequently in the gardens of the tourist lodges on the lakes and on the islands.

Distribution : The whole of India except the extreme North-West. Sharma (1982) recorded it from Gujarat.

Genus *Riopa* Gray

GARDEN SKINKS

Generic diagnosis : Eyelids well-developed, the lower scaly or with an undivided transparent disc; nostril in nasal shield; supranasals present; ear-opening distinct, tympanum deeply sunk. Limbs short or vestigial.

There are six species, of which two occur in the lake.

16. *Riopa albopunctata* Gray 1846

WHITE-SPOTTED GARDEN SKINK

Riopa albopunctata Gray, 1846, P. 430; Smith, 1935, P. 316.

Lygosoma albopunctatum, Boulenger, 1887, P. 309; Annandale, 1921, P. 332.

Description : Body very elongate. Lower eyelid scaly. Midbody scales 26 to 28, smooth. Digits shorter; 12 to 15 lamellae under the fourth toe. Tail thick at the tip.

Colour and Pattern : Brown above, with longitudinal rows of dark spots and yellowish-white on the underside. Sides of neck and forebody black, heavily flecked with white.

Size : Snout to vent 60 mm.

Distribution : Andhra Pradesh, Madhya Pradesh, Bihar, Uttar Pradesh, Orissa, West Bengal, and Assam. One specimen from Kerala. Annandale (1921) found it under dead weeds at the edge of the Chilka on Barkuda Island.

17. *Riopa punctata* (Gmelin) 1799

DOTTED GARDEN SKINK

Scincus punctatus Gmelin, 1799, P. 197.

Riopa punctata, Gray, 1845, P. 96; Smith, 1935, P. 318.

Description : Ear-opening round. Body robust; 72 scales along midline from nape to above vent. Tail round, thick at base.

Colour and Pattern : Mid region of body brassy white with four rows of black dots; three rows of small black dots from axilla to groin and on to tail; belly whitish.

Size : Snout to vent 85 mm.

Distribution : India and Sri Lanka. Annandale (1921) recorded this skink from several places in the Chilka lagoon, but without specific locality. Recent collectors have failed to obtain fresh material despite the widespread occurrence of the skink.

Genus *Barkudia* Annandale

BURROWING SKINKS

Generic diagnosis : Snout blunt. Eyes tiny. Body much elongate, without limbs. Fossorial species.

Known by a single species, which occurs in the lagoon area. The genus derives its name from the Barkuda Island from where the first specimen was taken.

18. *Barkudia insularis* Annandale 1917

BARKUDIA BURROWING SKINK

Barkudia insularis Annandale, 1917, P. 20; 1921, P. 332; Ganapathy and Nayar, 1952, P. 105; Ganapathy and Rajalakshmi, 1955, P. 279; Biswas, 1980, P. 524.

Description : Head small, dorso-ventrally flattened, covered with shields; snout blunt, wedge-shaped. Eyes small but functional; the upper eyelid is vestigial and the lower, scaly and movable. Ear-opening minute. Tongue long, slender, and bifid. Body elongate, slender, worm-like; midbody scales 20, smooth. Tail cylindrical, rounded at the tip.

The blunt snout and the rounded tail-tip of the skink are the source of the Oriya name "Deemundia" which means double-headed.

Colour and Pattern : Variable; it is usually glossy-brown above, with a black spot on each scale which fuse to form from 8 to 14 longitudinal rows down the back and the tail. The belly is creamy white.

Size : Adults are about 115 mm in snout-vent length and the tail is nearly 60 mm long.

Habitat and Habits : This skink, which has adapted to a mostly fossorial existence, is a highly specialised lizard for living in the subsurface substrata. The type specimen was dug up from loose earth among the roots of a Banyan tree on the Barkuda (Breakfast Island) of the Chilka lake. The limbless skink burrows with great rapidity in loose earth and disappears from sight in a trice if released on the ground. It seems to be a night-active reptile which is why it is rarely seen. It feeds on a variety of small, mostly soil-living arthropods such as the termites and the beetle larvae. Apart from the meagre knowledge that it is oviparous, little is known of the breeding habits of this skink.

Distribution : Since its discovery in 1921, this skink has been reported in 1950s from Waltair (Andhra), and the Nandankanan Biological Park (Orissa, but the identity of the specimens from the latter has been questioned. The skink has, of course, become scarce on the type-locality. I failed to secure a specimen despite rigorous attempts.

Family VARANIDAE

Genus *Varanus* Merrem

MONITOR LIZARDS

Generic diagnosis : Head mobile, neck elongate. Eyes very prominent. Ear-opening distinct. Tongue snake-like. Body flattened. Limbs strong, with sharp claws. Tail long, not fragile. Head covered with small scales and body with minute juxtaposed scales and tubercles. Preanal pores present. Size large.

There are four species in India. One species occurs in the lake.

19. *Varanus bengalensis* (Daudin) 1802

COMMON INDIAN MONITOR

Tupinambis bengalensis Daudin, 1802, P. 67.

Varanus bengalensis, Boulenger, 1885, P. 310; Annandale, 1921, P. 331.

Varanus monitor, Smith, 1935, P. 402.

Description : In addition to the generic diagnosis : Nostril an oblique slit, nearer to the orbit than to the tip of the snout. Scales on the crown of the head larger than the maxillaries; supraoculars small. Tail laterally compressed. Abdominal scales 132-176; no femoral pores.

Colour and Pattern : The young, which are rather brightly coloured, are dull orange to light brown above, with whitish ocelli and often alternating with blackish crossbars and whitish below, alternating with blackish crossbars and whitish below, with transversely arranged dark bars. The adult is usually olive, yellowish, or brownish above, with darker spots and yellowish below, uniform or spotted with dark, more prominent on the throat. The common monitor escapes easy detection by taking advantage of its colouration which harmonises well with the surroundings.

Size : Snout to vent 775 mm; tail 1,110 mm.

Habitat and Habits : The common monitor, as its name indicates, is found throughout India. It usually lives in burrows, dense clefts of vegetation and crevices around old buildings. Though it is partial to the drier areas, it is also seen along the sea coast, particularly in the neighbourhood of estuaries. It is diurnal in its habits and usually emerges from its hideouts two hours after sunrise and remains active till midday. It hibernates from November through March and becomes active during and after the monsoon. Despite the size, the monitor is a surprisingly agile lizard; it is a good climber, runner and swimmer, too. It is a difficult task to extract a monitor lodged in its burrow or wedged in between rock-cliffs.

The monitor is carnivorous, eating a wide variety of prey as well as carrion; it eats fish, crabs, birds, eggs, and rats. It is a notorious poultry raider, taking eggs and young birds. It is adept at cracking the swallowed eggs and allowing the discharge of the contents smoothly down the throat. The long, pointed and recurved teeth of a monitor are only used for gripping, not for crushing or chewing as is the case with other lizards. It, therefore, has to swallow its prey whole, sometimes alive. The flesh of a large prey like a rat or a bird is first torn to pieces with teeth and claws and is then eaten.

A monitor, if prevented from escaping, rises high on its legs, hisses loudly, sways its body and lashes its tail in readiness to defend itself. Besides delivering severe blows with its muscular tail, a monitor can also claw and bite.

The female lays about 25-30 oval, white, soft-shelled eggs, deposits them in a hole dug by it, or in ant hills and covers them with leaves and debris before departing. It takes about 8-9 months for the eggs to hatch. The young are very secretive and are known as biscobras in north India although the monitors

lack a venom apparatus. The common monitor and the other kinds, which are much hunted for their delicious flesh and eggs, are now declared as endangered and strictly protected.

Distribution : The whole of India, Burma, Sri Lanka, and Pakistan. The common monitor has been frequently sighted in the neighbourhood of the dense vegetation along the margin of the lake as well as on several islands dotting the lake. A juvenile was picked up from the crevices of a rock on Samal Island near Barkul.

SNAKES

NONVENOMOUS SNAKES

Family TYPHLOPIDAE

BLIND SNAKES

Genus *Ramphotyphlops* Fitzinger

Generic diagnosis : Head not distinct from neck; rostral smooth and rounded; nasal suture touching the preocular and rostral above; scales highly glossy and arranged in 20 rows at midbody; eyes invisible. Body cylindrical and of uniform diameter throughout. Tail very short, terminating in a stiff spike.

Represented by one species in India which occurs in the Chilka lake.

20. *Ramphotyphlops braminus* (Daudin) 1803

COMMON BLIND SNAKE

Eryx braminus Daudin, 1803, P. 279.

Typhlops braminus, Cuvier, 1829, P. 73; Smith, 1943, P. 46.

Ramphotyphlops braminus, Stimson et al., 1977, P. 204.

Description : Snout rounded; rostral large; nasals lateral; nasal suture passing to preocular. Scales in 20 rows round body; transverse rows of scales 290-320. Tail short, ending in a spine.

Colour and Pattern : Black or chestnut brown above and paler below; snout, chin and anal region creamy.

Size : Usually grows to 170 mm. Maximum recorded size : 185 mm.

Habitat and Habits : The common blind snake is a burrowing snake of the plains, forests, and the hills upto 1000 m. It lives by choice in the loose soil and is noticed only when the stones, logs or debris covering it are turned over. Smetimes it is flushed out of its underground burrow during the rains.

Its favourite hideouts are the nests of termites and the ants but is occasionally found in the gutters and water taps of large cities. It often gets into the flower pots that are left unattended for long periods inside

the houses and hence the name 'Flower-pot Snake'. It crawls about among the roots and leaves of the flower pots and feeds on the insect larvae and other creatures that are found there. It chiefly preys on the soft bodied larvae and eggs of soil-living arthropods such as the ants and the termites. It is in turn preyed upon by a variety of snakes.

The common blind snake seems to be active during the cool and monsoon months when it can be seen on the surface wandering in search of food. When handled, it wriggles vigorously and tries to poke with the spike of its tail. It is parthenogenetic and lays 2-8 eggs.

Distribution : The common blind snake is probably the most widely distributed ophidian in the world because of its accidental introduction by human agency in all parts of the globe. It occurs in most of southeastern Asia, the Malay Archipelago, Papua New Guinea, and northern Australia. It also occurs in many islands in the South Pacific, parts of Africa, Madagascar, and islands of the Indian Ocean. In the New World this species has been recorded from Mexico.

Majority of the specimens reported from the Chilka lake are from the Breakfast Island.

Genus *Typhlops* Opperl

Generic diagnosis : Closely allied to the preceding genus, differing as follows : nasal cleft in the contact with the second labial; snout pointed in *T. acutus*. Represented by thirteen species in India; one species is recorded from the Chilka lake.

21. *Typhlops acutus* (Dum. & Bibr.) 1844

BEAKED BLIND SNAKE

Onychocephalus acutus Dum. & Bibr. 1844, P. 333.

Typhlops acutus, Boulenger, 1890, P. 241; Annandale, 1907, P. 398, Smith, 1943, P. 56.

Description : Snout pointed and hooked; nostrils inferior; rostral very large. Scales round the body 28-34; transverse rows of scales 450-500. Tail ending in a small spine.

Colouration : Brownish or blackish above, with pale yellow centres on dorsal and lateral scales; underside paler.

Size : 600 mm. Largest of the Oriental blind snakes.

Habitat and Habits : The beaked blind snake is generally found beneath the ground or under stones, dead logs or other objects. It frequently strays into houses. When first picked up, it presses the beak into the skin of its captor much in the same way that the common blind snake does with the spine at the tip of the tail. However, it is restless on the surface where it endeavours to bury itself as quickly as possible. The single adult specimen caught by me at the Kalijugeswar Hill in the lagoon entwined my hand vigorously, but made no attempt to bite. Nothing is known of its breeding habits.

Distribution : Smith (1943) gives the range of this species as "India, South of the Ganges Basin and south of Rajputana, west to Baroda and east to Calcutta. Rare south of lat. 16°" which seems to be rather vague. A check up of the available collections has revealed the fact that the snake has been reported with certainty from the States of Gujarat, Madhya Pradesh, Maharashtra, West Bengal, Bihar and Orissa, and in the south from the States of Andhra Pradesh, Tamil Nadu, and Kerala. It has also been reported from the Anaimalais and Palghat Hills in the Western Ghats. The material deposited in the ophidian collections of the Zoological Survey of India, Calcutta indicates that Annadale (1915) recorded this species from the Gopkuda and Barkuda Islands and Rambha in the Chilka lake. My specimen has been taken from the hilly terrain of Kalijugeswar off Barkul.

Family BOIDAE

BOAS AND PYTHONS

Genus *Eryx* Daudin

Generic diagnosis : Head not distinct from neck, covered with small scales except the nasal and internasals which are only enlarged. Eye small, with vertically elliptic pupil. Body stout, cylindrical and covered with small scales; ventrals not as wide as the venter; caudals undivided. Tail short and stumpy.

Of the two species occurring in India, one species is recorded from the Chilka lake.

22. *Eryx conicus* (Schneider) 1801

COMMON SAND BOA

Boa conica Schneider, 1801, P. 268.

Gonglyophis conicus, Boulenger, 1890, P. 247.

Eryx conicus, Boulenger, 1893, P. 124; Smith, 1943, P. 112.

Description : Nostril slit-like, between enlarged nasals and internasal; no mental groove. Eye small, with vertically elliptic pupil and surrounded by 10-14 small scales. Body robust, cylindrical and covered with small scales which are keeled heavily on the hinder part, arranged in 40-55 rows. Ventrals 162-196, not as wide as the belly; caudals 16-24, small, and undivided; males with undivided anal spurs. Tail short, stumpy, and ending in a point.

Colour and Pattern : Yellow, brown or grey above, with a dorsal series of large, irregular dark-brown to sooty blotches which fuse with one another to form a zigzag and another lateral series of scattered spots of the same colour; belly whitish sometimes mottled with brown on the outer scale rows.

Size : 500 mm - 1 m. Females are longer, with proportionately longer tails.

Habitats and Habits : The common sand boa is mainly a snake of the plains, showing a marked preference for sandy or loose soil where it can burrow easily and rapidly. It is also found in the moist terrain with luxuriant vegetation and in the low hills.

It is a sluggish snake and as one might expect, its movements are laboured and slow. It lies with just a portion of the snout and body projecting out of the soil and becomes active only on seeing a passing prey. It is not strictly nocturnal as it sometimes is seen abroad during the day. It feeds mainly on small mammals, birds, snakes, and frogs. The female gives birth from 6 to 8 young at a time.

The common sand boa is timid in disposition and hides its head beneath the coils of the body. However, its temper is unpredictable because it sometimes coils and flinches violently and delivers nasty bites if touched.

Distribution : Throughout India barring parts of Bengal and Assam where it is rare or absent, Pakistan, and northern Sri Lanka. Although regarded as a snake of the plains, the common sand boa is common even in the areas that record heavy rainfall and in the hills as well.

Annandale (1915) recorded this species from the lagoon, but with no exact locality. A dead specimen was brought to me by the inhabitants of the Honeymoon Island off Rambha.

Family ACROCHORDIDAE

Genus *Chersydrus* Cuvier

FILE SNAKES

Generic diagnosis : Head flat, not distinct from neck, small, covered with granular and tuberculate scales instead of enlarged shields; nostrils close together and directed upwards; eyes tiny, bat-type, situated on top of head, with vertically sub-elliptic pupil. Body compressed, covered with very small rhomboidal scales, with blunt edges which roughen the skin so that it feels like a file to the human touch; skin loose and baggy; no enlarged ventrals or subcaudals; skin of the belly raised into a low median fin-like ridge, which increases lateral resistance and improves swimming efficiency. Tail short, compressed, prehensile, scaled like the body. thoroughly aquatic (marine/estuarine) species of snakes.

Known by one species which occurs in the Chilka lake.

23. *Chersydrus granulatus* Schneider 1799

ASIATIC FILE SNAKE

Hydrus granulatus Schneider, 1799, I, P. 243.

Chersydrus granulatus, Boulenger, 1890, P. 395; Annandale, 1915, P. 169; Smith, 1943, P. 134.

Description : As given for the genus.

Colour and Pattern : Dark grey to black above, with narrow, white crossbars many of which tend to fuse near the midbody and disappear or become indistinct in the adult; the underside is dirty white or yellowish; head blackish with a few, small, whitish spots on the crown, and a larger spot on the temporal region.

Size : Adults range from 600 mm to 850 mm in average length. Maximum length : 1.2 m.

Habitat and Habits : The Asiatic file snake is found in the coastal waters and river mouths, and is partial to the salty or brackish water. It is a swift, graceful swimmer in its element and gets into deeper water, often travelling well out to sea. As might be expected of such an obese and sluggish creature, the file snake is quite helpless on land where it is unable to progress except for twitching its loose-skinned body. It is more active at night than by day. It feeds principally on fish and is of a quiet and inoffensive disposition. The female produces from 6 to 8 young at a time.

The Asiatic file snake is so exceedingly common in the Chilka Lake that with every haul, fishermen picked up no fewer than two or three specimens at Rambha, Barkul, and Satpara. In the course of cruising the lake around the Maltikuda Island near Barkul I had the opportunity to watch the sea eagle (*Haliaeetus leucogaster*) beating a large sized file snake to death on a rock and tearing its flesh with the beak. The bird presumably preys upon the file snakes and other species as is indicated by the scattered dead snakes all over the island.

Distribution : From the east and west coasts of India and Sri Lanka through Indonesia to Solomon Islands; also recorded from the north and south coasts of New Guinea, and in northern Australia. Smith (1943) quoting Wall states that this snake is fairly abundant round the coasts of India but omits the Chilka Lake from its range although Annadale (1915) has confirmed the snake's widespread occurrence in the lake. Murthy (1974) says that the records of this species are few and far in between probably because the occasional specimens caught by the fishermen escape the notice of the herpetologists.

Family COLUBRIDAE

COLUBRIDS

Genus *Elaphe* Fitzinger

RACERS

Generic diagnosis : Head elongate, neck well defined. Eye rather large, pupil round. Body cylindrical, slightly compressed. Scales smooth, with paired apical pits, in 19-27 rows. Ventrals angulate laterally, caudals paired. Tail long.

There are nine species in India, of which one occurs in the Chilka lake.

24. *Elaphe helene* (Daudin) 1803

TRINKET SNAKE

Coluber helena Daudin, 1803, P. 277.

Elaphe helena, Shaw *et al.* 1939, P. 78; Smith, 1943, P. 149.

Description : Snout small, rounded, nostrils large; nasals divided; loreal single, not very small; 9 or 10 supralabials, 5th to 7th or 5th and 6th touching the eye; last labial beneath the eye in contact with the

temporals. Scales in 25-27 rows at midbody, distinctly keeled on the posterior and tail regions. Ventrals 217-265, obtusely carinate laterally, caudals 73-100. Anal undivided.

Colour and Pattern : Darkbrown above and pearly white or yellowish below. The distinctive dorsal pattern consists of black crossbars which enclose three or more white islets resembling trinkets, the ornaments of a lady; this pattern is most conspicuous anteriorly and on the flanks but disappears on the hinder part which is flanked by a thick dark stripe on each side. There are two dark streaks on the neck which may join to form an inverted 'V'; eye with two black streaks - one below it and another oblique one behind.

Size : 900 mm 1400 mm. Males are larger.

Habitat and Habits : The trinklet snake is partial to the jungles, low country and hills, but is occasionally found in the agricultural areas and human settlements.

It is an extremely active creature both during the day and at night. It retires to the termite mounds and rock crevices during the summer. It frequently enters and human dwellings. It feeds on small mammals, birds, lizards and frogs but shows a marked preference for rats, mice and other rodents. It is a bold snake with vicious temper and bites savagely, if cornered. The female lays 6-8 eggs and the hatchlings are very much like the parents.

Distribution : Throughout India; Sri Lanka; Pakistan. The solitary example under study, which was picked up from the bushes of the lake at Barkul, is an interesting addition to the ophiofauna of the Chilka lake.

Genus *Ptyas* Fitzinger

RAT SNAKES

Generic diagnosis : Head rather pointed, elongate and clearly defined from the neck; nostrils large; between nasals. Eyes prominent, with round pupils. Body long, robust, streamlined with a even taper. Scales shiny, keeled dorsally and with paired apical pits; caudals paired. Tail fairly long.

Known by a single species which occurs in the lagoon.

25. *Ptyas mucosus* (Linn.) 1758

RAT SNAKE; DHAMAN

Coluber mucosus, Linn., 1758, P. 226.

Ptyas mucosus, Gunther, 1864, P. 249; Smith, 1943, P. 159.

Description : Head long, neck thin and constricted; snout bluntly pointed; eyes large; loreals 3 (rarely two); upper labials 8, fourth and fifth touching the eye; 9 (or 10) lower labials. Body streamlined. Scales shiny, smooth, keeled posteriorly, with paired apical pits. Ventrals 190-213, caudals 100-146. Anal divided.

Colour and Pattern : Variable; usually greenish or yellowish-brown above, with black irregular crossbars which sometimes tend to fuse to form a reticulate pattern at least on the posterior half of the body including the tail; yellowish or whitish below, the yellowish tinge being more pronounced near the throat. The upper and lower lips, sides of the throat, and the underside of tail are stippled with black. Young olivaceous yellow, with bright markings and crossbars.

Size : 1200 mm 1350 mm. Males are larger.

Habitat and Habits : The rat snake is one of the commonest snakes of India. It is principally a plains snake and is never far from the vicinity of man and his surroundings. It usually prefers damp grasslands and cultivated areas, often straying into the hilly and desert terrain. Some of its favourite haunts are the rice-fields, grain stores, rat dens, termite hills, old masonry, crevices of brick/mud walls, roofs of thatched huts. It is easily the most versatile of Indian land snakes which can adapt itself to any situation.

It is diurnal in its habits and is an active, alert, and bold creature. It climbs well and is often noticed on trees at considerable heights. It takes to water easily and is adept at swimming. It is but seldom seen during the summer. It emits an offensive smell on touch and its anal glands secrete a black liquid. Despite the common name, the rat snake does not subsist on a meal of rats alone because it is found to eat frogs, lizards (of all kinds), birds, and even snakes. It does not constrict the prey but overcomes such prey as a bird or a rat by pressing them down. It has been found to take advantage of its long tail to tie a knot and exert a pull on the prey.

The males perform a "combat dance" which is but an act of display of strength. The female lays 6-14 eggs in a clutch.

Despite its fearsome length, the rat snake's first concern is to escape, if suddenly encountered. However, if it is cornered and held at bay, it turns very aggressive, arches the neck and distends it vertically, aiming high up at the face of its tormentor. At this time, it emits a deep resonant hiss, almost something like the sound emitted by a cat at bay.

Distribution : Found throughout the Indian subcontinent, Sri Lanka and Burma; Afghanistan, Turkestan, south China and Java & Sumatra (Indonesia).

Annandale (1915) recorded this species from the Breakfast Island at Rambha. Although the recent collectors have failed to obtain additional specimens, the settlers on the islands and the locals reported of its widespread occurrence in the Chilka lake.

Genus *Oligodon* Boie

KUKRI SNAKES

Generic diagnosis : Head short, not distinct from neck; snout subtruncate; rostral large; nostril small; loreal present or absent. Eye moderate, pupil round. Body short, stout, and cylindrical. Scales smooth, in 15 or 17 rows. Ventrals round or angulate laterally, caudals paired. Head pattern distinct.

There are eighteen species in India, of which one occurs in the Chilka lake.

26. *Oligodon arnensis* (Shaw)

BANDED KUKRI SNAKE

Coluber arnensis Shaw, 1802, P.526

Oligodon arnensis, Wall, 1907, P.115; Smith, 1943, P.225.

Description : Supralabials 7, 3rd and 4th touching the eye; loreal usually absent or united with the prefrontal; 1 anterior temporal. Scales in 17 rows, ventrals 164-202, angulate laterally, caudals 41-59. Anals 2.

The common name 'Kukri snake' is derived from some of the posterior maxillary teeth which are rather flattened and somewhat resemble the blade of a Gurkha's knife, called Kukri in Hindi.

Colour and Pattern : Head with 3 chevron-shaped marks. Pale brown or orange above and uniform yellowish below or with indistinct brown spots. The dorsal pattern consists of well defined black crossbars 18 to 30 on the back and 4 to 16 on the tail; these bands, however, vary in number and width and may be edged with white.

Size : 660mm.

Habitat and Habits : The common Kukri snake is mostly found in the plains and occasionally in the wooded districts throughout India. It is an active, slender snake, chiefly diurnal in its habits. It is frequently encountered in masonry, bungalows and outhouses. It is quick to conceal itself at the slightest disturbance. It appears to climb low trees with ease. It chiefly feeds upon the eggs of reptiles, mice and other small rodents. It will readily bite when molested and can inflate its body when excited. The female lays about 9 eggs.

Distribution : India, Pakistan, and Sri Lanka.

The single specimen, caught on the edge of the lake at Barkul, is a significant addition to the snake fauna of the Chilka lagoon.

Genus *Dendrelaphis* Boulenger

BRONZE-BACK TREE SNAKES

Generic diagnosis : Head elongate, ovate, somewhat depressed, and is distinct from the neck. Eye large, pupil round. Body elongate, cylindrical. Scales smooth, obliquely disposed, in 13-15 rows, vertebrae enlarged. Ventrals notched; caudals paired, keeled. Tail long and tapering.

Represented by seven species in India, of which one occurs in the Chilka lake.

27. *Dendrelaphis tristis* (Daudin) 1803

COMMON INDIAN BRONZE-BACK

Coluber tristis Daudin, 1803, P.430

Dendrelaphis tristis, Boulenger, 1894, P.88

Ahaetulla tristis, Smith, 1943, P.248.

Dendrelaphis tristis, Savage, 1952, P.203.

Description : Snout broadly rounded; temporals 2 + 2; 9 supralabials, 5th and 6th touching the eye. Scales in 15 rows, vertebrals feebly enlarged. Ventrals 163-197; caudals 108-145; Anals 2.

Colour and Pattern : Dorsally bronze-brown or purplish-brown, with a buff lateral stripe, edged with black that extends from the head to the vent; scales on the neck and the forebody yellowish. Head with a dark temporal band extending onto the neck, where it may break up into vertical bars. Belly greyish to light green or whitish.

Size : 1000mm 1500mm.

Habitat and Habits : The common bronze-back entirely lives among the bushes and on the trees, rarely descending to the ground in search of food. In the plains it usually is met with in the low bushes, thorny and Palmyra trees near the cultivated areas. It is diurnal in its habits and is active even during the hottest part of the day. It is one of the few snakes which is found in the open. When at rest, it almost looks like a twig of a tree and escapes easy detection. It is an agile snake and can move with amazing speed in its favourite haunts. It has a peculiar habit of constantly swaying its slender neck and forebody in a wavering fashion. Like the so called 'Flying' Snake, and certain other tree snakes, the common bronze-back can jump among the branches of a tree and fall to the ground from considerable heights. It chiefly feeds on frogs, lizards and birds which it hunts during the day, but is also known to eat insects and toads. It normally is a shy and timid snake and does not bite freely if picked up. However, temperaments vary as some individuals may turn plucky and vicious. The female lays about 6 eggs in the hollow of a tree or a disbanded birds's nest.

Distribution : Throughout India; Sri Lanka. Annandale (1915) collected this snake on the Breakfast island near Rambha and it has since been not collected from the lake area until I picked up the sloughed skin of the snake during the third phase of the Chilka expedition (September 1986) from the same island nearly after a lapse of seven decades.

Genus *Xenochrophis* Gunther

KEELBACK WATER SNAKES

Generic diagnosis : Head fairly distinct from neck; internasals narrowed anteriorly; nostrils dorsolateral. Eye moderate, pupil round. Body elongate, cylindrical. Scales strongly keeled, without apical pits. Ventrals rounded; caudals paired. Tail long. The popular name "Keelback" is derived from the keeled scales on the back of these water snakes.

28. *Xenochrophis piscator* (Schneider) 1799

CHECKERED KEELBACK

Hydrus piscator Schneider, 1799, P.247.

Natrix piscator, Pope, 1935, P.120; Smith 1943, P.293.

Xenochrophis piscator, Malnate and Minton, 1965, P.19.

Description : Two internasals; one preocular; nine supralabials, 4th and 5th touch the eye. Eye large, directed upwards. Scales in 19 rows, keeled. Ventrals rounded; caudals paired. Anal undivided. Tail fairly long.

Colour and Pattern : Generally olive, yellow or brown above and whitish or yellow on the underside. The dorsal pattern consists of five series - one vertebral, two dorso-lateral and two lateral - of black spots arranged in the fashion of a chessboard. Head olive-brown with two black lines behind the eyes and a dark streak on the nape.

Size : 990 mm 1210 mm. Females are longer, but with shorter tails.

Habitat and Habits : The checkered keelback is one of the commonest water snakes of India. It is mainly a snake of the plains but is also found in the hills upto 2100m. It is plentiful in the paddy fields, pools and rivers.

It is an extremely active snake and is a consummate swimmer and a good diver, too. It is chiefly diurnal and feeds principally on fishes and frogs. In the summer months when the water level goes down, the checkered keelback feeds voraciously on the exposed fish. It aestivates during the summer and reappears after the rains.

It is decidedly a plucky and vicious snake as it bites viciously when cornered. It rears up and flattens the body before it strikes.

It is a prolific breeder among the Indian snakes. The female lays from 8 to 90 eggs in a clutch in holes near water.

Distribution : This widespread species occurs from Borneo and Taiwan across the mainland and the islands of south Asia to the Indus drainage.

In the Chilka lake I collected this snake from the pools on the islands and the midwaters of the lake. It is surprising to note that Annandale (1915), who had so thoroughly surveyed the lake, failed to record this species.

Genus *Amphiesma* Dumeril & Bibron

Generic diagnosis : Closely allied to the genus *Xenochrophis* from which it differs as follows : Internasals broad anteriorly, nostrils lateral. Eye moderate or large. Body elongate. Scales in 19 rows,

distinctly keeled, usually with apical pits. Tail moderate or long.

Of the eight species found in India, one species occurs in the lake.

29. *Amphiesma stolata* (Linn.) 1758

BUFF-STRIPED KEELBACK

Coluber stolatus (Linn.) 1758, P.219.

Natrix stolata, Pope, 1935, P.128.

Amphiesma stolata, Dumeril and Bibron, 1854, P.724.

Description : Nostrils directed slightly upwards; 1 preocular; 3 postoculars; temporals 1 + 1 or 1 + 2; supralabials 8, 3rd, 4th and 5th touching the eye. Body slender. Scales in 19 rows; keeled except the outer row which is smooth. Ventrals 118-158; caudals 50-89. Anals 2.

Colour and Pattern : Olive-greenish or brown above, with dark brown spots or crossbars on the back and two lateral buff or yellowish stripes best marked on the hinder part. Head olive or uniform; sides of the head, lips and the area surrounding the chin white or yellowish; neck with a dark coloured 'V' shaped mark. Belly whitish, speckled with brown on the side of each ventral scale. In the hatchlings, the dorso-lateral stripes are replaced by a series of black spots in the posterior region.

Size : 400 mm - 850 mm.

Habitat and Habits : The striped keelback is a common snake, inhabiting both the plains and the hills. It frequents the cultivated areas, grasslands and the water edge.

It is diurnal in its habits. During the summer it hides in holes in the ground or in the crevices of brickwalls and appears after the rains. It frequently enters the human dwellings and the City gardens in search of its favourite prey consisting of frogs and toads.

It is a timid snake and does not bite when handled. The female lays from 3 to 10 eggs in a clutch.

Distribution : Laos; Thailand; south China; India; Sri Lanka; Pakistan.

Despite the few numerical records of this snake made in the lake, it is not an uncommon species.

Genus *Boiga* Fitzinger

CAT SNAKES

Generic diagnosis : Head broad, distinct from neck, and triangular; neck markedly narrow. Eye large, pupil vertically elliptical. Body slender, somewhat compressed. Scales smooth, with apical pits, obliquely disposed and arranged in 19-29 rows; the vertebral series more or less enlarged. Ventrals rounded or abruptly angulate laterally; caudals paired. Tail long.

There are eleven species in India, of which one species occurs in the lagoon.

30. *Boiga trigonata trigonata* (Schneider) 1802

COMMON CAT SNAKE

Coluber trigonatus Schneider, 1802, P.256.

Boiga trigonatum Nikalovsky, 1916, P.187.

Boiga trigonata Smith, 1943, P.349.

Description : Rostral distinctly concave below; nostrils large; loreal present; preocular 1, not reaching upper surface of head; postoculars 2; temporals 2 + 3; supralabials 8 (rarely 9), 3rd, 4th, and 5th touching eye; lower labials 10 or 11. Scales in 21 rows, vertebrals feebly enlarged - Ventrals 206-256; caudals 75-96.

Colour and Pattern : Light brown or tan above and white below, with brown spots on the sides. The dorsal pattern consists of a vertebral series of 40-50 irregular, transverse white bars edged with black, more prominent anteriorly and fading towards tail. Head with a distinct 'Y' mark above; a dark stripe from behind eye to gape of mouth.

Size : 650 mm 1275 mm. Females are longer than males.

Habitat and Habits : Although the common cat snake is essentially an arboreal species, it prefers bushes and shrubs near the ground to high trees. It is strictly nocturnal in its habits and spends most of the day coiled up on the bushes or in the hollows of trees. When at rest, it coils itself into a ball rather than stretching the entire body as is the case with other tree-living snakes. Its food comprises mainly of the tree-living lizards, in particular of the genus *Calotes*, small birds and mammals which are killed by constriction. The female lays from 3 to 11 eggs.

The common cat snake is extremely fierce in disposition and bites with least provocation. It adopts a characteristic posture at the time of striking by erecting the head and the forebody and positioning the former in the loops of its body. It also sways the tail briskly when annoyed. The mild venom secreted by this rear-fanged snake is toxic to its prey only.

Distribution : Throughout India; Sri Lanka, Pakistan; Transcaspia. The only specimen examined was caught by Annandale (1915) on the Breakfast Island near Rambha. A rare species in the lake area.

Genus *Enhydris* Sonnini and Latreille

FRESHWATER SNAKES

Generic diagnosis : Head depressed, small, slightly distinct from neck; nostrils dorsal; valvular. Eye small, situated high on the face, with a vertically elliptic pupil; loreal shield present. Body stout and cylindrical; skin smooth and glossy, rather loose. Anal and subcaudals divided. Tail moderate. Thoroughly aquatic. There are two species in India, of which one species occurs in the lake.

31. *Enhydris enhydris* (Schneider) 1799

SCHNEIDER'S SMOOTH SNAKE

Hydrus enhydris Schneider, 1799, P.245.

Enhydris enhydris, Pope, 1935, P.314; Smith, 1943, P.383.

Description : In addition to the generic diagnosis: Scale-rows at midbody 21; Ventrals 141-174, narrow; and divided into two or three small plates; subcaudals 46-70, paired.

Colour and pattern : This snake is usually olivaceous-green or brown above and lemon yellow below, with or without a dark line in the middle of belly; head dark.

Size : Adults attain a maximum length upto 900 mm. Femals are much longer than males.

Habitat and Habits : The smooth water snake is usually found in rivers, estuaries, and the lakes, but it seems to prefer the sluggish and brackish waters. It is diurnal in its habits, spending most of the day on the water edge with only the tip of the snout sticking out, while the remainder of the body lies in water. It avoids the severe winter by burying itself in burrows in mud on the water edge. It swims well and on land, its movements are quick and rather jerky. It feeds exclusively on fish but occasionally frogs and tadpoles are also eaten. It is a timid, inoffensive snake, refusing to bite when handled. The female produces 6-18 young at a time.

Distribution : In India this snake is found in the fresh as well as the brackish waters of northeastern India, Andhra Pradesh, eastern Uttar Pradesh, and Orissa. Elsewhere it has been recorded from south China, Indochina, and Malaya.

Genus *Cerberus* Cuvier

Generic diagnosis : Head pear-shaped, rather broad at the occiput, slightly distinct from neck; nostrils valvular, directed upwards; eyes small, beady, pupil vertical. Lower jaw prominent like that of a bulldog's; rear-fanged, with a mild venom. Body stout, cylindrical, with strongly keeled scales; ventrals well-developed. Tail short, compressed at base, tapering to a point.

Represented by one species which occurs in the lake.

32. *Cerberus rhynchops* (Schneider) 1799

DOG-FACED WATER SNAKE

Hydrus rhynchops Schneider, 1799, P.246.

Cerberus rhynchops, Gunther, 1864, P.279.

Annandale, 1915, P.169; Smith, P.393.

Description : In addition to the generic diagnosis : Nasals in contact ; internasals absent. Frontal

shields partly and parietal shields entirely broken up into small scales. Scales in 23-25 rows at midbody; ventrals 140-160. Anal plate divided; caudals paired, 45-60. The prominent lower jaw, like that of a bulldog's, gives the snake a forbidding appearance and the popular name as well.

Colour and Pattern : The dog-faced water snake is usually grey, brown, olive or blackish above, with more or less distinct black spots or a series of irregular darker crossbars and is greenish or yellowish below, with regular dark crossbars and lateral blotches. There is a dark streak through the eye.

Size : 600 mm 1.2 m.

Habitat and Habits : This snake is usually found in the brackish waters of tidal rivers, creeks and estuaries. It is a heavily built snake which is adept at swimming as well as climbing. It moves on land somewhat like a 'sidewinder'. In shallow water it flicks its tail to lure the fish towards its head. It often climbs on to the low vegetation of the mud flats and easily slips into the water, if disturbed. It feeds exclusively on fish but occasionally small crabs are also eaten. It is a lethargic and inoffensive reptile, biting only under serious provocation. Despite the enlarged rear fangs and the functional venom glands, the dog-faced snake is not regarded as dangerous to humans. It is a live-bearing species, the female producing from 8 to 26 young at a time.

Distribution : Found from India, Sri Lanka, Burma, Malaya, the Philippines, and Indonesia to northern Australia. This snake, which is abundant both on the west and east coasts, in the estuaries, tidal rivers and creeks of India, has strangely been considered by Smith (1943) as "rare on the coasts of India" However, Whitaker (1969) and Murthy (1971) confirmed its abundance.

In the Chilka Lake I found it in all portions of the lake, but it is especially abundant in the swamps and marshy regions of the lake which are subjected to heavy fishing.

VENOMOUS SNAKES

Family ELAPIDAE

COBRAS AND KRAITS

Genus *Bungarus* Daudin

KRAITS

Generic diagnosis : Head not distinct from neck; head shields normal; loreal absent. Eye moderate to small, pupil round. Scales in 13-19 rows; vertebrals strongly enlarged, hexagonal; caudals single or in pairs. Body cylindrical. Tail short. Fangs fixed. Bluish or jet black in colour, with a distinct pattern of white lines on the body.

One species occurs in the lake area.

33. *Bungarus caeruleus* (Schneider) 1801

COMMON INDIAN KRAIT

Pseudoboa caerulea Schneider, 1801, P.284.

Bungarus caeruleus, Fayrer, 1874, P.11; Smith, 1943, P.413.

Description : Head flat. Neck hardly evident. Body rather cylindrical, tapering towards the tail. Tail short, rounded. Eye rather small, with a rounded pupil, indistinguishable in life. Head shields normal, no loreal; four shields along the margin of the lower lip; 3rd and 4th supraoculars touching the eye. Scales highly polished, in 15-17 rows; the vertebral row distinctly enlarged and hexagonal. Ventrals 185-225, caudals 37-50, entire.

Colour and pattern : Generally black or bluish-black, with about 40 thin, white crossbars which may be indistinct or absent anteriorly. The pattern however, is complete and well defined in the young which are marked with conspicuous crossbars even anteriorly; in old individuals the narrow white lines may be found as a series of connected spots, with a prominent spot on the vertebral region. A white preocular spot may be present; upper lip and the belly white.

Size : Adults range in length from 1 m to 1.75 m. Males are longer with proportionately longer tails.

Habitat and Habits : The common krait is essentially a plains snake and is usually found in the open country, cultivated areas, and scrub jungles at low altitudes. It seems to avoid a very rocky and sandy terrain. Its favourite dwelling places are the termite mounds, rat holes and bushes of other rodents, heaps of rubbish, manure or brick in the open country and the gardens, roofs of houses and forsaken buildings and other secluded or cool spots in or near the human buildings. It is fond of water. Like the common cobra, it enters the human dwellings frequently.

The krait is strictly nocturnal in its habits and is not seen abroad during the day. It becomes active at night when it moves quickly. It sometimes turns cannibalistic and feeds exclusively on snakes including its own kind. It also feeds on small mammals, lizards, frogs and toads. The krait is remarkably quiet and inoffensive in disposition, biting only under severe provocation. When alarmed in the wild, it makes no attempt to escape or defend, but lies quietly and conceals the head in the coils of its body. The female krait lays from 6 to 12 eggs which are deposited in holes in the ground, or under leaves and it stays with the clutch till the young emerge.

May be confused with : The harmless wolf snake *Lycodon aulicus*, with the crossbars on the back superficially resembles the common krait. Not only does the wolf snake prefer human habitations but it also is nocturnal in its habits. But the snakes can be easily told apart by a close examination of the colour pattern; the white lines across the back appear very near the head in the wolf snake whereas they appear beyond the neck and extend upto the end of the tail in the krait.

Distribution : India, Pakistan, and Sri Lanka.

Venom and Toxicity : The krait is the most toxic of all venomous snakes of India because of its

virulent venom, which is considered to be four to five times powerful than that of the cobra and the lethal venom dose for a human is only a few milligrams.

The symptoms may be delayed for several hours; then their onset may be sudden and the victim complains of severe stomach and joint pains.

Genus *Naja* Laurenti

COBRAS

Generic diagnosis : Snout rounded, short. Head depressed, not very distinct from neck; neck wide, dilatable to form a hood (in life) : nostril large, between the nasals; one preocular in contact with the internals; loreal absent; supralabials 7, 3rd largest, 3rd and 4th touching the eye; a tiny, angular shield called 'cuneate' present between the fourth and fifth infralabials. Eye moderate, pupil round. Body dorsoventrally flattened in front and subcylindrical behind. Scales smooth, strongly oblique, in 21-25 rows. Ventrals 176-200, caudals 48-75, paired.

Three varieties, based mainly on the hood pattern, are recognised; the well-known "spectacled" form, which is found throughout India, occurs in the lagoon region.

34. *Naja naja naja* (Linnaeus) 1758

COMMON COBRA

Coluber naja, Linn., 1758, P.221.

Naja naja naja, Smith 1943, P.427.

Description : As given for the genus.

Colour and pattern : The usual colouration is dark brown or black to yellowish-white above, and white or yellowish below. Apart from the well-defined "spectacle" mark on the expanded hood, a cobra can be distinguished from other land snakes by the presence of a dark spot on either side of the underside of the hood and two or more broad black cross bands further below.

Size : Adults average from 1 m to 2 m in length. Males are longer.

Habitat and Habits : The most distinctive and impressive characteristic is the hood, which is formed by raising the anterior portion of the body and spreading some of the ribs in the neck region when the snake is annoyed or frightened. While displaying the hood, the common cobra can erect itself from one quarter to more than two-thirds of its total length. We are so familiar with the pictures of cobras displaying their hoods that some of us do not realise that the cobra looks like any other snake without its hood.

Cobras are remarkably adaptable snakes and found in all types of country; plains, jungles, open fields, and even in the regions heavily populated by man. Their favourite haunts are the holes in the embankments, hollows of trees, old termite mounds, ruined buildings, rock-piles, and dens of small

mammals. They are fond of water and prefer the late afternoon and early evening hours for moving about and seeking the food. It is said that their vision is quite good and that they can see moving objects situated at a distance upto 3 m.

Cobras feed chiefly on rats, mice, toads and frogs but birds, eggs, and snakes are also taken. Females lay usually from 10 to 30 eggs in rat holes or termite mounds and the young when born are exact replicas of the parents. Cobras have strong parental instincts as the parents tend to remain together from the time of mating till the young are born.

Cobras are not aggressive snakes and tend to escape when encountered in the wild. They strike only when accidentally stepped on or are under extreme provocation. When cornered, they spread the hood, hiss, sway the body from side to side, and strike repeatedly. The cobra's strike is said to be ineffective during the day but is considered much more severe and a determined one at night when the snake sees better. Young cobras are much more aggressive than adults. The young, less than 30 cm long, are capable of rearing up, spreading their hoods and are ready to follow up the intimidatory gesture with a venomous bite. It is on record that the bite of 5 day old cobra caused the death of a guinea pig 22 minutes later.

Other varieties : Two varieties are recognised; the one with a white circle round a black spot on the hood (*Naja naja kaouthia*) is found in Bengal and Orissa and the other with a plain hood (*Naja naja oxiana*) is common in parts of Gujarat, Rajasthan, Punjab, and Kashmir.

Maybe confused with : The common cobra is often confused with the large sized (3 m) and equally aggressive rat snake (*Ptyas mucosus*), but the narrow neck and the thin head of a rat snake establishes its identity.

Distribution : Throughout the Indian subcontinent and Sri Lanka.

Venom and Toxicity : The common cobra is the most feared snake in India because of its neurotoxic venom which works so fast that the victim often dies before any proper medical aid is called in. The average discharge of venom at bite is about 21 mg. A person bitten by the cobra may develop a feeling of weakness and paralysis that may extend to the muscles used in breathing and those of the heart resulting in death mainly by suffocation. In cobra venom, there are also substances that break down red corpuscles in the blood and work to stop blood coagulating.

Family HYDROPHIIDAE

SEA SNAKES

Generic diagnosis : The members of the genera *Enhydrina* and *Hydrophis*, inhabiting the brackish waters of the Chilka lagoon, can be recognised by the following combination of characters : Body more or less compressed posteriorly; tail paddle-like, vertically compressed; nostrils directed upwards; eye small, with round pupil; no loreal scale, ventrals small but distinct. Poison fangs short and fixed. Marine or estuarine snakes.

Of the nearly 20 species contained in six genera that inhabit the Indian waters, two species referable to two genera, as mentioned above, are found in the lake.

Genus *Enhydrina* Gray35. *Enhydrina schistosa* (Daudin) 1803

BEAKED SEA SNAKE

Hydrophis schistosus Daudin, 1803, P.386.

Enhydrina schistosa, Stoliczka, 1870, P.213; Smith, 1926, P.36 and 1943, P.449.

Description : Head moderate, slightly distinct from neck; end of snout extends over lower jaw giving a beak-like profile which accounts for the common names 'Beaked or Hook-nosed Sea Snake'; mental shield elongate, partly hidden between first infralabials. Body elongate, covered with keeled and overlapping scales, in 49 rows. Ventrals 314, poorly differentiated.

Colour and Pattern : The young are olive grey, with dark bands that encircle the body; these bands disappear with age, the adults then being of a uniform greyish in colour, with or without faint dark bars; belly whitish. The head is greenish, without markings; chin and throat white.

Size : Adults average in length from 850 mm to 1000 mm, but occasional individuals grow to 1.2 m.

Habitat and Habits : This sea snake is generally found in shallow waters with a muddy bottom. It is also frequently noticed in the streams to about the limits of tidal flow. On days when the sea is calm, this snake is seen hiding under the surface. It centers the tidal creeks during the monsoon. It principally feeds on fish. It is very aggressive in disposition and its venom is found to be much more powerful than that of the cobra.

Distribution : This is one of the most widely distributed sea snakes as is shown by its wide range from the Persian Gulf to North Australia and Cochin China.

Although this species is common in the tidal waters of the Bay of Bengal, Smith (1943) has made no mention of its possible occurrence in the estuaries. Murthy (1977) has recorded this snake from the estuaries of Ennore, Adyar, and Kovelong, near Madras.

I captured six examples off Rambha and Barkul, which are additional and interesting records for the Chilka lake. The material included individuals of at least two age groups, suggesting that the population was an established one.

Genus *Hydrophis* Latreille36. *Hydrophis obscurus* Daudin 1803

ESTUARINE SEA SNAKE

Hydrophis obscura Daudin, 1803, P.375.

Hydrophis obscurus, Annandale, 1915, P.171; Smith, 1926, P.66 and 1943, P.457.

Description : Extremely eccentric in form; head small; neck long, whip-like; body stout, long, slender anteriorly and much compressed posteriorly. Scales imbricate, in 35 rows; ventrals 319, distinct throughout and feebly enlarged.

Colour and Pattern : Variable; the young are more brightly coloured than the adults. The young are bluish, with 45 bright yellowish dorsal bars which encircle the body as rings on the hinder part; a curved yellow mark on the nape. The markings fade with age and the adult is more or less uniform greyish or bluish above and yellowish below.

Size : Adults average in length from 1 m to 1.3 m.

Distribution : East coast of India, the coasts of Burma, Malay Peninsula, and strait of Malacca. It is exceedingly common in the Chilka Lake. Annandale's (1915) contention that this species is more an inhabitant of the brackish water than the sea seems to be correct because the snake can be expected with each haul of the fishing nets operated in the Chilka. Besides the Chilka Lake, this snake is reported to be common at the mouth of the Hooghly River, India.

Local fishermen have no apparent fear for this snake which is certainly docile than the beaked sea snake.

Family VIPERIDAE

VIPER

Genus *Vipera* Laurenti

Generic diagnosis : Head broad, flat, and triangular, covered above with small scales; neck narrow; nostrils lateral, in large nasal shields. Eye with vertically elliptic pupil. Body robust. Tail short. Fangs very long and tucked in a folding device when not in use.

Represented by two species in India; one species occurs in the Chilka lake.

37. *Vipera russelli russelli* (Shaw) 1797

RUSSELL'S VIPER

Coluber russelli Shaw, 1797, P.291.

Vipera russelli, Boulenger, 1890, P.420; Smith, 1943, P.482.

Description : Head flat, triangular, and covered with small scales; snout short and bluntly pointed; nostril large, crescent shaped. Eye large, with vertical pupil. Body stout, short, and flattened dorsoventrally. Scales strongly keeled and arranged in 17-23 rows. Ventrals 153-180, caudals 41-64 paired. Tail short.

Colour and Pattern : Light-brown above, with a bold and distinct pattern consisting of three series of large, dark oval spots; head with two large black spots at base and a light V-shaped mark with its apex on top of snout; lower parts yellowish-white or marbled with brown.

Size : 1m 1.85m.

Habitat and Habits : The Russell's viper is found both in the plains and the hills even at elevations upto 3000 m. It is partial to open country, where it is found in the bushy areas, grasslands, farm lands, cultivated fields, and rocky situations. It avoids the hot weather during the summer by hiding in the termite mounds and the rat holes.

The Russell's viper is a sluggish and quiet snake during most of the day although it remains alert always. It becomes active in the evening and at night when it wanders about in a slow, crawling motion. It does not move away quickly when disturbed but holds the ground and emits a loud hiss to indicate its annoyance. Although it does not strike readily, the Russell's viper can bite with force and determination if injured or provoked. The young are more aggressive than the adults.

The Russell's viper feeds chiefly upon small mammals, but lizards, birds and frogs are also taken occasionally.

May be confused with : Three harmless snakes namely, the Indian Python (*Python molurus*), the Common Sand Boa (*Eryx conicus*), and the Royal Snake (*Sparelosophis diadema*) resemble the Russell's viper superficially. But they all lack the broad belly-plates, the minute scales on the head, the chain-like black spots on the body and the divided subcaudals which are characteristic of the Russell's viper.

Distribution : Throughout the Indian subcontinent and Thailand, Indo-China, Taiwan, Indo-Australian Archipelago.

Though the Russell's viper is a widely distributed species of Thailand snakes of India, it is abundant in Punjab, Maharastra, and South India generally but is rare in Uttar Pradesh, Bihar, north Bengal, and is nearly absent in Assam.

In the Chilka lake this viper is recorded from the Breakfast (Barkuda) Island.

Venom and Toxicity : The venom discharged by this viper at a bite may be about 145 mg and about 45 mg may be the lethal dose for a human adult.

The symptoms of a viper-bitten victim are painful, involving burning sensation at the bite, swelling that may double the size of a limb, and discoloration of the tissues when they are attacked by venom to blues, reds, or even black and/or green. The main danger comes from internal bleeding or from weakening of the heart, which usually develops a fast but feeble pulse.

REFERENCES

Annandale, N. 1907. Reptiles and a batrachian from an island in the Chilka Lake, Orissa. *Rec. Indian Mus.* 1 : 197-198.

Annandale, N. 1915. Fauna of the Chilka Lake. *Mem. Ind. Mus.* 5 : 167-174.

- Annandale, N. 1917. A new genus of limbless skinks from an island in the Chilka Lake. *Rec. Indian Mus.* 13 : 17-21.
- Annandale, N. 1921. The reptiles and batrachia of Barkuda Island. *Ibid*, 22 : 331-333.
- Biswas, S. and Acharjyo, L.N. 1980. A note on the distribution of *Barkudia insularis* Annandale, a rare limbless lizard from Orissa. *J. Bombay nat. Hist. Soc.* 76(3) : 524-525.
- Blyth, E. 1853. In Jerdon, T.C., Catalogue of reptiles inhabiting the peninsula of India. *J. Asiat. Soc. Bengal*, 22 : 652.
- Boulenger, G.A. 1887. Catalogue of the lizards in the British Museum (Natural History). Vol. III (Lacertidae, Scincidae, Dibamida, Chamaeleontidae), 476 PP. Addenda and Corrigenda, PP. 477-512, Pls.
- Boulenger, G.A. 1890. *The fauna of British India, including Ceylon and Burma. Reptilia and Batrachia.* London. Taylor and Francis, i xviii + 1-541.
- Boulenger, G.A. 1920. A monograph of the south Asian, Papuan, Melanesian and Australian Frogs of the genus *Rana*. *Rec. Indian Mus.* 20 : 1-226.
- Cuvier, G. 1829. Le regne animal. Nouvelle edition, revue et augmentee. Paris, Vol. 2, XV + 406 PP.
- Daudin, F.M. 1802-1803. Histoire naturelle generale et particuliere des reptiles. Paris, 8 Vols.
- Daudin, F.M. 1803. Histoire naturelle des rainettes, des grenouilles et des crapauds, Paris, PP.(1), 8-108, Pls. 1-38.
- Dumeril, A. And Gabriel Bibron. 1834-1854. Erpetologie generale. Paris, 9 Vols. in 10 and atlas.
- Fayrer, J. 1874. *The thantophidia of India, being a description of the venomous snakes of the Indian Peninsula, with an account of the influence of their poison on life and a series of experiments.* Second enlarged edition. London, PP. 178, Pls. (1st ed., 1872)
- Ganapati, P.N. and K.K. Nayar. 1952. Occurrence of the limbless lizard belonging to the genue *Barkudia* Annandale in the Andhra University Campus, Waltair. *Curr. Sci.* 21 : 105-106.
- Ganapati, P.N. and K. Rajyalakshmi. 1955. Binomics and some anatomical peculiarities of the limbless lizard, *Barkudia insularis* Annandale. *Rec. Indian Mus.* 52 (1 & 2) : 279-291.
- Gmelin, J. 1799. Systema naturae. Editio decima tertia, sucta reformata. Stockholm, Vol. 1, Pt. 3, PP. 1033-1516.
- Gray, J.E. 1830-1835. Illustrations of Indian Zoology; chiefly selected from the collections of Major-General Hardwicke. 2 Vols. London.

- Gray, J.E. 1845. Catalogue of lizards in the British Museum. London, viii + 289 PP.
- Gray, J.E. 1846. Descriptions of some new species of Indian lizards. *Ann. Mag. Nat. Hist.* 18 : 429-430.
- Gunther, A. 1864. *The reptiles of British India*. London, xxvii + 444 PP., 26 Pls.
- Inger, R.F. and Sushil K. Datta. 1987. An overview of the amphibian fauna of India. *J. Bombay nat. Hist. Soc.* 83 (Centenary Supplement) : 135-146.
- Jerdon, T.C. 1853. Catalogue of the reptiles inhabiting the peninsula of India. *J. Asiat. Soc. Bengal*, 22 : 462-479, 532-534.
- Liem, 1970. The morphology, systematics, and evolution of the Old World treefrogs. (Rhacophoridae) *Fieldiana Zoology*, 57 : 1-145.
- Linnaeus, C. 1758. *Systema naturae*. Editio decima, reformata. Stockholm, Vol. 1, iv + 823 PP.
- Malnate, E.V. 1960. Systematic division and evolution of the colubriid snake genus *Natrix* with comments on the subfamily Natricinae. *Proc. Acad. Nat. Sci. Philadelphia*, 112 : 41-71, fig., maps.
- Mittleman, M.B. 1952. A generic synopsis of the lizards of the subfamily Lygosominae. *Smithson. misc. Collns.*, 117(17) : 1-35.
- Murthy, T.S.N. 1971. The occurrence of the dog-faced water snake, *Cerberus rhynchops* (Schneider) (Serpentes : colubridae) around Madras. *J. Bombay nat. Hist. Soc.*, 67(3) : 574-575.
- Murthy, T.S.N. 1974. On a recent record of the rare Indian wart snake, *Chersydrus granulatus* (Schneider) (Serpentes : Acrochordidae) from Tamil Nadu Coast. *J. mar. biol. Ass. India*, 16(3) : 834-836.
- Murthy, T.S.N. 1977. On sea snakes occurring in Madras waters. *Ibid*, 19(1) : 68-72, Pls.
- Nikolsky, A.M. 1916. Faune de la Russie. Reptiles. Petrograd, Vol. 2, 349 PP., Pls. 1-8.
- Pope, C.H. 1935. *The Reptiles of China. Turtles, Crocodilians, Snakes. Lizards*. New York, x + 604 PP., text-figs & Pls.
- Savage, J.M. 1952. Two centuries of confusion : the history of the snake name *Ahaetulla*. *Bull. Chicago Acad. Sci.*, 9 : 203-216.
- Schlegel, H. 1836. In Dumeril, Andre, and Gabrel Bibron (and Auguste Dumeril), *Erpetologie generale*. Paris, Vol.3, PP. 366-368.
- Schmidt, K.P. 1951. Annotated bibliography of marine ecological relations of living amphibians and reptiles (except turtles). *Marine Life* 1 : 9.

- Schneider, J.C. 1799. *Historia amphibiorum naturalis et literariae*. Jena. Vol. 1, xiii + 264 PP., Pls. 1-2.
- Schneider, J.C. 1801. (Same title). Jena, Vol. 2, VI + 374 PP., Pls. 1-2.
- Shaw, G. 1796-1797. *Vivarium naturae or the naturalist's miscellany*. London, Vol.8.
- Stoliczka, F. 1871. Notes on some Indian and Burmese Ophidians. *J.Asiat. Soc. Bengal*, 11 : 421-445, Pls. 25 & 26.
- Smith, M.A. 1935. *The fauna of British India including Ceylong and Burma. Reptilia and Amphibia*, Vol.2, Sauria. London, Taylor and Francs, i-xiii + 1 40 PP., Figs, Pl, and a map.
- Smith, M.A. 1943. (Same title). London, Taylor and Francis, Vol.3 - Serpentes. xii + 1 - 583 PP., figs., and a map.
- Stimson, A.F. *et. al.* 1977. *Leptotyphlops* and *Ramphotyphlops* Fitzinger, 1943 (Reptilia, Serepentes) : proposed conservation under the plenary powers. Z.N. (S) 2155. *Bull. Zool. Nom.*, 33(3/4) : 204-207.
- Wiegmann, A.F.A. 1835. Beitrage Zur Zoologie gesammelt auf einer Reise die Erde von Dr. F.J.F. Meyer. Amphibien. *N. Acta. Ac. Leop.* 17, 1.
- Whitaker, R. 1969. The dog-faced water snake (*Cerberus rhynchops*) in the Bombay area and notes on its habits. *J. Bombay nat. Hist. Soc.*, 66(2) : 386.

APPENDIX

MATERIAL EXAMINED

The specimens that are listed below comprise the material which is examined personally and on which the descriptions of the species under discussion are largely based.

The following abbreviations are used to indicate the code and facilitate the location of the place of deposition of the specimens.

AF. Amphibia - Frog; AT. Amphibia - Toad;
 EBS. Estuarine Biological Station, Berhampore;
 RL. Reptilia - Lizard; RS. Reptilia - Snake;
 ZSI. Zoological Survey of India, Calcutta.

AMPHIBIANS

Bufo melanostictus

EBS. AT. Nos.1-3, Samal Island, Off Rambha, 23.XI. 1985;
 EBS. AT. Nos.4-5, Shore of the lake, Barkul, 18.VI. 1985;

EBS. AT. No.6, Chatragarh Village near Rambha, 17, XII, 1986;
EBS. AT. Nos.7-8, Pathara near Barkul, 13. IX. 1987.

Microhyla ornata

EBS. AF. No.32, shore of the Lake, Barkul, 19, VI. 86;
ZSI. AF. Nos.4373-4374, Balugoan;
ZSI. AF. No.4375, Khalikote.

Rana tigerina

EBS. AF. No.1, Pantha Nivas, Rambha, 24. XI. 1985;
EBS. AF. No.2, shore of the lake near Rambha, 10. VI. 1986;
EBS. AF. No.3, shore of the lake near Rambha, 22. VI. 1986;
EBS. AF. No.6, Pathara near Barkul, 13. IX. 1987;
EBS. AF. No.7, Satpara, 22. IX. 1987.

Rana limnocharis

ZSI. AF. No. 4360, freshwater ditch, Chilka, 24. II. 1969;
EBS. AF. No.8, Ambakone near Rambha, 5. XII. 1986;
EBS. AF. Nos.9-10, Gourangapatna, 5. XII. 1986.

Rana cyanophlyctis

EBS. AF. No.11, from the ditch on the shore of the lake near Rambha, 25. XI. 1985;
EBS. AF. No.12, edge of the lake on Ghantasila Hill, 22. VI. 1986;
EBS. AF. Nos.15-16, Mirza, 3. XII. 1986;
EBS. AF. Nos.17-20, Gourangapatna, 5. XII. 1986;
EBS. AF. Nos. 26-30, Pathara, 13. IX. 1987;
ZSI. AF. No.17367, Barkul, 21. VII. 13;
ZSI. AF. No.18470, Barkuda, 25. VII. 17;
ZSI. AF. No.4359, Parikuda, 23. II. 69.

Rana breviceps

EBS. AF. No.31, Chatragarh, 17. XII. 86;
ZSI. AF. No.17367, Barkul, 21. VII. 13.

Polypedates maculatus

EBS. AF. No.31, shore of the lake, Barkul, 18. VI.86;
ZSI. AF. No.15986, Gopkuda, 7-15. VIII. 1907.

REPTILES

Hemidactylus brooki

EBS. RL. No.1, stony beach, Rambha, 21. XI.85.

Hemidactylus frenatus

EBS. RL. No.2, Pantha Nivas, Rambha, 21. XI. 85;

EBS. RL. Nos.3-5, shore of the lake, Barkul, 18. VI. 86;
ZSI. RL. Nos.19507, 19568-69, and 19571, 6. IX. 23.

Hemidactylus leschenaulti

EBS. RL. No.6, Pantha Nivas, Barkul, 30. XI. 85.

Sitana ponticeriana

EBS. RL. Nos. 7-10, Kavutakuda, Satpara, 18. XII. 86.

Calotes versicolor

EBS. RL. No.11, Honeymoon Island, Off Rambha, 22. XI. 85;
EBS. RL. No.12, Breakfast Island, Off Rambha, 12. VI. 86;
EBS. RL. Nos.13-15, Honeymoon Island, 13. VI. 86;
EBS. RL. No.16, shore of the lake, Rambha, 18. VI. 86;
EBS. RL. No.17, Ghantasila, 22. V. 86;
EBS. RL. No.14, Dhairi, Rambha, 3. XII. 86;
EBS. RL. No.18, Bird Island, 6. XII. 86;
EBS. RL. No.19, Honeymoon Island Off Rambha, 6. IX. 87;
ZSI. RL. No.19720, Breakfast Island, 10. VIII. 1907;
ZSI. RL. Nos.22433-22438, bushes around Chilka, 17. II. 69.

Psammophilus blanfordanus

EBS. RL. No.20, Ambakone, off Rambha, 5. XII. 86;
EBS. RL. No.21, Bird island, 6. XII. 86.

Mabuya macularia

ZSI. RL. No.19745, Rambha, 12. VIII. 19.

Riopa albopunctata

ZSI. RL. No.19840, Barkuda Island, 3. VI.22;
ZSI. RL. No.19841, Barkul, I. VIII. 1914
ZSI. RL. No.22472, Barkuda Island, 9. VII. 61;
ZSI. RL. No.22623, Satpara Island, 23. IX. 50.

Barkudia insularis

ZSI. RL. No.22540, Barkuda Island, 5. VII. 61.

Varanus bengalensis

EBS. RL. No.22, Samal Island, 15. VI. 86.

Ramphotyphlops braminus

EBS. RS. No.1, shore of the lake, Rambha, 21. XI. 85;
ZSI. RS. No.22476, Barkuda Island, 21. IX. 23;
ZSI. RS. Nos.18730-32, Barkuda island, 25. VII. 17-4. VIII. 17;

ZSI. RS. Nos. 19061-62 & 19164, Barkuda Island, 1917;
ZSI. RS. Nos.19467-71, Barkuda Island , Nov. 1922;
ZSI. RS. No.17458, Satpara (No date).

Typhlops acutus

ZSI. RS. No.15985, Gopkuda Island (No date);
ZSI. RS. No.18163, Barkuda Island (No date);
ZSI. RS. No.18720, Rambha, Ganjam (No. date).

Chersydrus granulatus

EBS. RS. Nos.2-5, Chlka, Rambha, 24. XI.85;
EBS. RS. No.6, Chilka, Rambha, 25. XI. 85;
EBS. RS. Nos.7-9, Rambha, 10-15. VI. 86;
EBS. RS. Nos.10-15, Barkul, 15-26. VI. 86;
EBS. RS. Nos.16-23, Chilka at Barkul, 3-19. XII. 86;
EBS. RS. No.20, Chilka at Ghantasila, 6. IX. 87;
EBS. RS. Nos.21-22, Chilka at Samal Island, 7. IX. 87;
EBS. RS. No.23, Chilka at Kalijugeswar Hill, 11. IX. 87;
EBS. RS. Nos.24-25, Chilka at Raghunathpur, 14. IX. 87;
EBS. RS. Nos.26-27, Maltikuda Island, 15. IX. 87;
EBS. RS. Nos.28-29, Alupatna, Satpara, 21. IX. 87;
EBS. RS. Nos. 30-31, Satpara, 22. IX. 87;
ZSI. RS. Nos.17331-35, Barkul (No date).

Elaphe helena

EBS. RS. No.32, Pantha Nivas, Barkul, 19.IX. 87.

Ptyas mucosus

ZSI. RS. No.19441, Barkuda Island (No date);
ZSI. RS. No.22661, Rambha, 6. XI. 71.

Oligodon arnensis

EBS. RS. No.33, Pantha Nivas, Barkul, 10. IX. 87.

Dendrelaphis tristis

ZSI. RS. No.18119, Barkuda (No date);
ZSI. RS. No.18614, Rambha (No date);
ZSI. RS. No.19168, Barkuda (No date).

Xenochrophis piscator

EBS. RS. No.34, Chilka at Raghunathpur, 24. XII. 86;
EBS. RS. Nos.35, Chilka at Barkul, 9-18, XII. 1986;
EBS. RS. No.37, Chilka at Rambha, 6. IX. 87;
ZSI. RS. No.21993, Deepa Mundia, Balugoan, 21. II. 69;
ZSI. RS. No.22474, Deepa Mundia, Balugoan, 21. II. 69.

Amphiesma stolata

ZSI. RS. No.17336, Barkul, July 1913.

ZSI. RS. Nos.22439-40, Rambha, 31. V. 1969.

Boiga trigonata

ZSI. RS. No.19170, Barkuda Island (No. date).

Enhydris enhydris

EBS. RS. No.38, Chilka at Ghodadowda, 18. XII. 86;

EBS. RS. No.39, Chilka at Ghodadowda, 17. IX. 87.

Erberus rhynchops

EBS. RS. Nos.40-42, Chilka at Rambha, 25. XI. 1985;

EBS. RS. Nos.43-44, Chilka at Keshipur, 23. VI. 86;

EBS, RS. No.45, Chilka at Raghunathpur, 24. VI. 86;

EBS. RS. No.46, Chilka at Kalijugeshwar, 9. XII. 86;

EBS. RS. No.47, Chowdhehagy, Barkul, 18. IX. 87;

ZSI. RS. No.18733, Chiriya Island, Rambha, 22. VII. 19;

ZSI. RS. No.15987, Gopkuda Island, Rambha, (No. date);

ZSI. RS. No.22443, Keshipur, balugoan, 3. II. 54.

Bungarus caeruleus

ZSI. RS. No.19156, Barkuda, Island, Rambha.

Naja naja naja

EBS. RS. No.48, Honeymoon Island, Rambha, 4. IX. 87.

Hydrophis obscurus

EBS. RS. No.49, Rambha, 21. XI. 85;

EBS. RS. Nos.50-51, Rambha, 25. XI. 85;

EBS. RS. No.52, Chowdheyhagy, Barkul, 29. XI. 85;

EBS. RS. No.53, Rambha, 3. XII. 86;

EBS. RS. Nos.54-55, Rambha, 6. XII. 86;

ZSI. RS. Nos.17345 and 17348, Chilka;

ZSI. RS. No.17531, Rambha, Chilka, 1914

ZSI. RS. Nos.17341-44, Chilka, 21-31.7.13;

ZSI. RS. No.17532, Rambha, 21-31.7.13;

ZSI. RS. Nos.18003-11, Chilka, 21-31..7.13;

ZSI. RS. No.19169, Barkuda (Rambha), Oct. 1919.

Enhydrina schistosa

EBS. RS. No.56, Barkul, 28. XI. 85;

EBS. RS. No.57, Rambha, 6. XII. 86;

EBS. RS. No.58, Samal Island, 7. IX. 87;

EBS. RS. No.59, Raghunathpur, 14. IX. 87.

Vipera russelli russelli

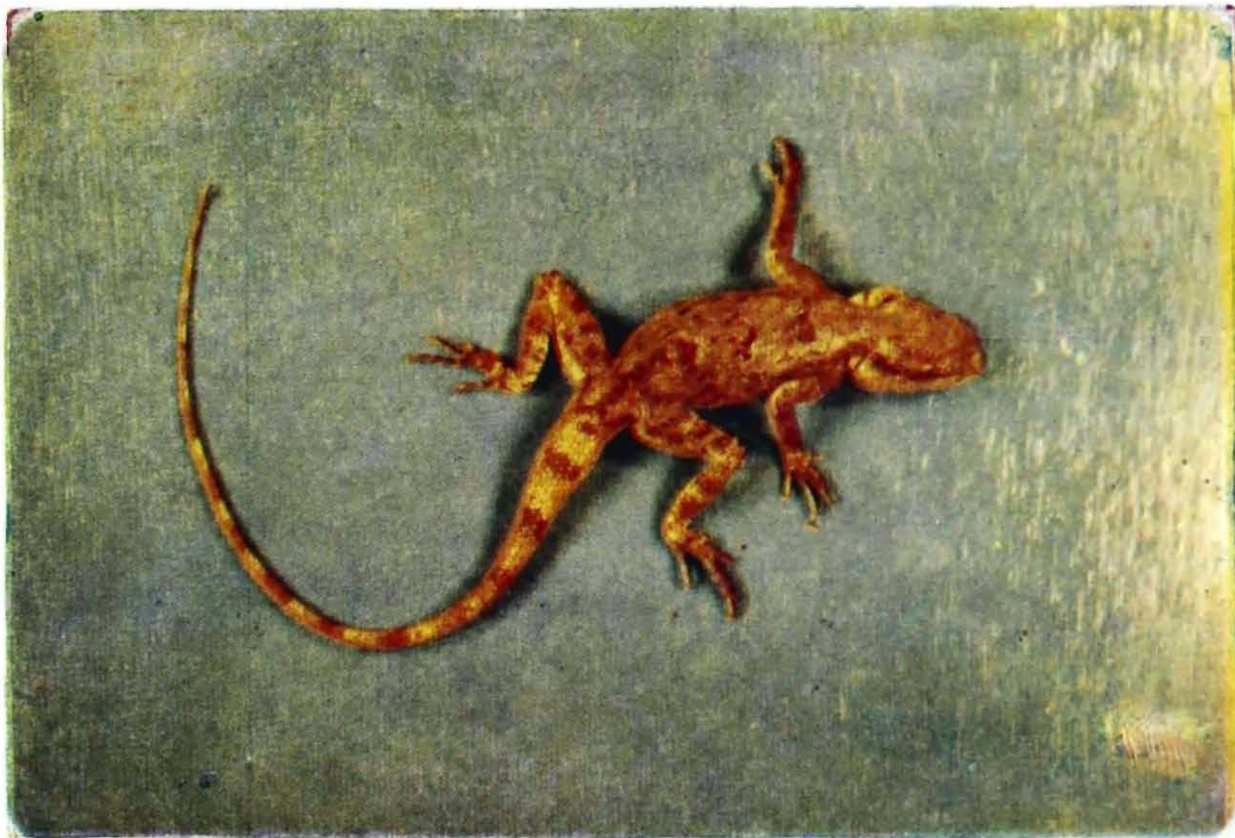
ZSI. RS. No.19140, Barkuda Island (No date).

ACKNOWLEDGEMENTS

It is largely my deep involvement, as a participant-in-charge of herpetology of the Chilka expedition, coupled with my abiding interest in the herpetology of India that have greatly motivated me to present this paper. I will remain grateful to the Director, Zoological Survey of India (ZSI), and Dr. K. V. Rama Rao, Co-ordinator of the Chilka expedition for having reposed confidence in me. I hope that I have not failed them nor the ZSI if the number of papers including a pocket book concerning the herpetology of the Chilka, submitted by me for publication are any indication. I want to thank Mr. P. Verma, Photographer of the EBS, ZSI for accompanying me in the field and taking photographs of the animals under my supervision. During the course of accumulating photographs for this work, I have been fortunate to receive and use some taken by Mr. Romulus Whitaker and Dr. H. V. Ghate.

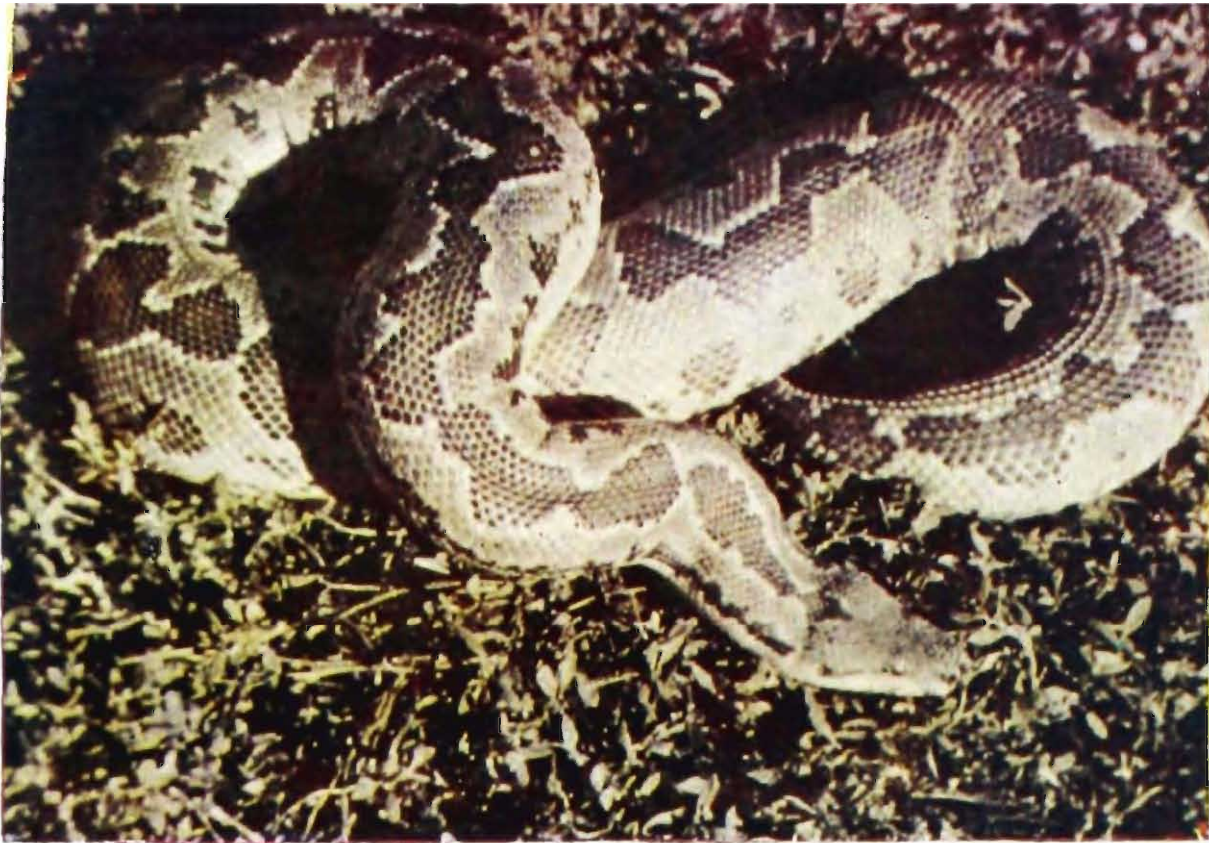
The credit for conceiving the idea of the multidisciplinary exploration of the Chilka Lake should, however, be given to Dr. K. V. Rama Rao, Scientist 'D' and Officer-in-Charge, Estuarine Biological Station (EBS), ZSI, Berhampore, who was not only the administrative head of the expedition but also was an active and enthusiastic companion for me during the several cruises conducted by me in and around the lake. His intimate knowledge of the fauna and flora of the lagoon permitted my rapid orientation to a strange and complex environment. Furthermore, I have profited on countless occasions by his abounding zeal and enthusiasm in exploring the herpetofaunal wealth of the lagoon. I, therefore, think that this would have not been possible without his constant help and encouragement.

Thanks are also due to the fishermen, a majority of whom have been very co-operative in the course of my cruising the vast lake and searching for reptiles on the islands.



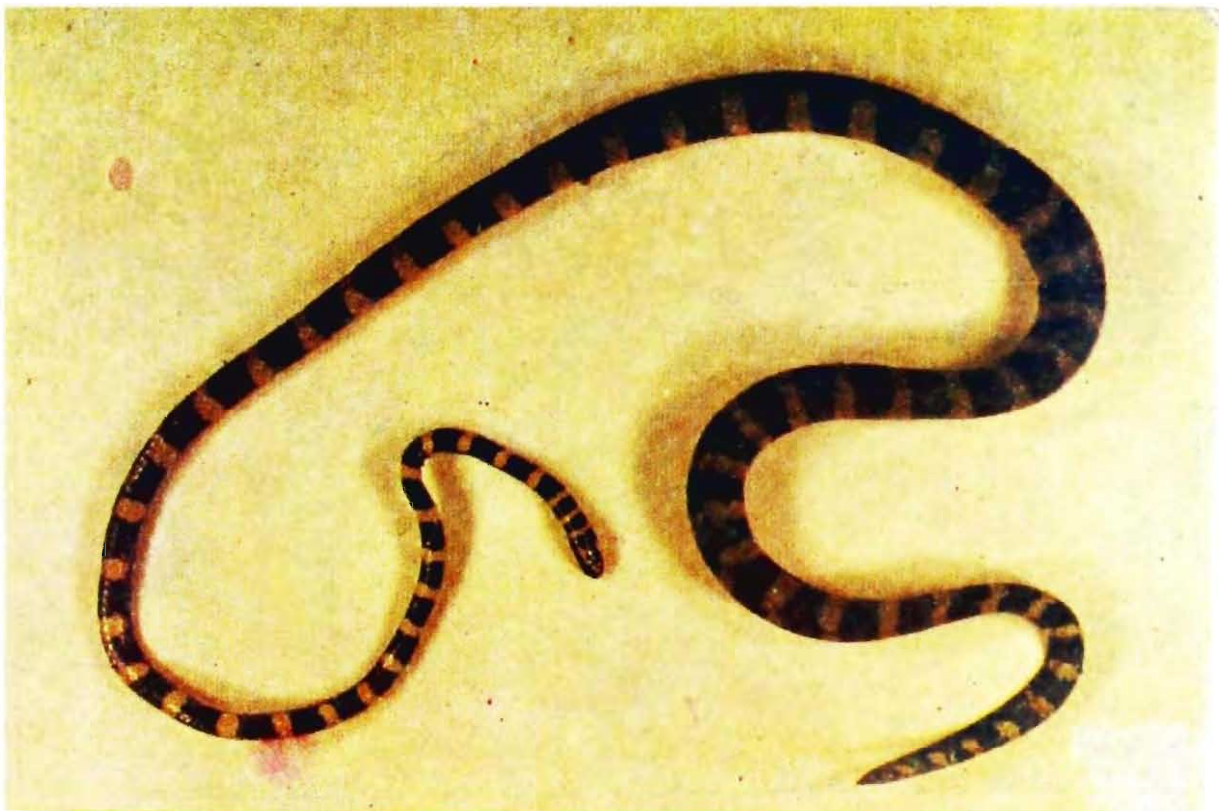
(Top) The Bird Island-a rocky hill. the habitat of the rocky lizard.

(Bottom) The rock lizard *Psammophilus blanfordanus*.



(Top) The Common Sand Boa, *Eryx conicus*.

(Bottom) Dorsal View of the dogfaced water Snake.



(Top) The Asiatic File Snake, *Chersydrus granulatus*.

(Bottom) The Eccentire Sea Snake, *Hydrophis Obscurus*.



(Top) The Indian Bullfrog, *Rana tigerina*.

(Bottom) The Common toad, *Bufo melanostictus*.

AVES

S. CHATTOPADHYAY
Zoological survey of India, Calcutta

INTRODUCTION

Present paper primarily deals with the results of three expeditions, that had been undertaken in Chilka lake during June '86 to October 1987. The present author was associated with two such expedition undertaken during post-monsoon and winter surveys (i.e. on Nov-December '86 and Sept – Oct. '87) while one of the expedition that has been undertaken during late summer was participated by Shri S. R. Dey Sarkar and Shri C. K. Misra during June 1986.

This paper also incorporates findings from earlier surveys of the lagoon by scientists of this department.

MATERIALS AND METHODS

During the course of expeditions standard avifaunistic survey techniques were followed. Whenever possible, mistnets were also used. To record those specimens, which could not be collected due to Indian wildlife Act provision and/or due to inaccessibility, 300 mm/400 mm telephoto lens with 35 mm format S.L.R. Cameras were used. For general observation 8x40 Binocular and 20-25 telescopes were used.

If not otherwise mentioned; (1) material examined are collected by the present author, hence no collector name was given (2) in assorted material, mention of only other collector was made.

All the measurements were given in millimetre. While describing moulting, pin feathers and recently discarded pin shells were taken into account.

The classification followed as per Ripley (1982).

ABBREVIATION

- 'W/M' — *Migratory* – avian elements that occur in and around Chilka lake during winter i.e. during the period of late September to the middle of April.
- 'R' — *Resident* – avian elements that occur throughout the year.
- 'R & B' — *Resident and Breeding* – avian elements that breed in and around the lagoon and occur throughout the year in the year.
- "R & N" — *Resident and nomadic* – elements those are resident forms of lagoon but are subject to sudden disappearance from the lagoon especially during drier periods and post-monsoon seasons.

'MM' — *Monsoon migrant* – elements that are known to occur during monsoon and postmonsoon seasons.

SYSTEMATIC ACCOUNT

Order – PODICIPEDIFORMES

Family -- PODICIPEDIDAE

Great Crested Grebe

'M'

Podiceps cristatus cristatus (Linnaeus)

This bird was first recorded from the adjacent area of the lake by H.G. Alexander near Puri (Ali & Ripley, 1968). Later on, in recent years one solitary specimen was collected from a large weedy tank at Kathpal c – 8 Km southeast of Baripada (21°53' N : 86°48'E) by Dasgupta *et. al.* (1977). But, the occurrence of this species inside Chilka lake was recorded by the present author during October 1982 around the Nalbani Island (Photograph 2). During the expedition. The bird was observed only once, again around Nalbani which confirms the rarity of this species.

Mostly solitary, avoids other foraging flocks and prefer clear water areas-devoid of aquatic vegetations.

Blacknecked Grebe

'M'

Podiceps migricollis nigricollis Brehm

(*Podiceps nigricollis* Brehm, 1831)

A pair was observed in the Serua River, north of Satpara Island on September 15, 1987, during the IIIrd expedition.

A pair was located in clear water area. They avoided foraging with other aquatic birds, tried to keep close together. They were very fast swimmers and unlike other grebes, they took to the wing on the slightest disturbance.

As per the extent literature, the present report is the first one regarding their occurrence in Chilka lake. This is also eastwards extension of the range of this form.

Little Grebe

'R'

Podiceps ruficollis capensis Salvadori
[*Podiceps capensis* Salvadori 1884]

Status : Very Common

Material examined :

	Wing	Tail	Bill
1 (M)	98	28	20

Very common inside the lagoon as well as in the aquatic vegetation covered waterbodies around it. Inside the lagoon, they prefer areas covered with aquatic vegetation. Keep close to the shores in pairs and in family parties. Very efficient fliers but depend more on diving ability rather than flying unless disturbed.

PELECANIFORMS

PELECANIDAE

GREY PELICAN

R/RB/NM

Pelecanus philippensis philippensis Gmelin
[*Pelecanus philippensis* Gmelin, 1789]

Status : Not so common

Found mostly in the deeper water areas of the park. Reported to occur in School. But mostly solitary ones were observed by the present author (photo-3a). Breeding colonies were reported from Bird and Brakefast islands. Loose flocks congregating towards the part of Satpara islands was noted by the author but exact locations could not be identified. Though the bird is included in Schedule I of the Wildlife Protection Act, and its subsequent amendments but ample poaching was noted in the lake.

Phalacrocoracidae

Large Cormorant

'WM'

Phalacrocorax carbo sinensis (Shaw)
[*Pelecanus sinensis* Shaw, 1801]

Status : Fairly common during winter.

Groups of more than 15 birds were often observed during the surveys to perch on the poles of fishing traps.

Concentration of 15 birds or more in the South eastern part of the lake i.e. Perch and fish in company with cormorants and darters, in Satpara island and mouza Behrampur where they were observed being mobbed frequently by the common House Crow and Jungle Crows.

Indian Shag

Phalacrocorax fuscicollis Stephens
(*Phalacrocorax fuscicollis* Stephens, 1826)

R & B

Fairly common. Found almost throughout the lake, but more concentration can be located at the

northern most part of the lake. Mixed foraging flocks may be seen in association with little cormorant and Dasters in and around fishing areas.

ANHINGIDAE

Darter or Snaklbird

R & B

Anhinga rufa melanogaster Pennant
(*Anhinga melanogaster* Pennant, 1769)

Material examined :

	Wing	Tail	Bill	Tarsus
1 (M)	202	221	80	38

The specimen was collected from Satpara island on Sept. 12, 1987, with abraded plumage and granular overy.

Fairly common, but less numerous than Little Cormorant. Found mostly in the deep water areas in the lake as around Nalbani, Satpara, Barkuda, Bhusundipur areas etc. Occur solitary or in pair or in loose flocks, forage in associations with other cormorants. Surface after catching its prey, mostly fish, to be flipped in the air before swallowing it. During middays and afternoon, bird drying their wings by spreading while sitting on a perch, mostly fishing poles, is fairly a common sight. Breeding colonies and roost in mixed heronries were located in Bird Island and Rambha area. They prefer broad leaf treeslike *Ficus* spp. for roosting.

CICONIFORMES

CICONIDAE

Grey Heron

R & B

Ardea cinerea rectirostris Gould
(*Ardea rectirostris* Gould, 1843)

R & B

Material Examined :

	Wing	Tail	Bill	Tarsus
2 (F)	419-429	142-154	114-119	146-147

The specimens were collected from Satpara on December 9 and 11, 1986. Both the specimens had fresh plumage with nonbreeding gonad.

Common. Found throughout the region in well watered areas. Occurs also in the inland

waterbodies adjacent to Chilka lake. Occurs singly or in loose flocks. Forage in association with Purple Heron, Large egrets etc. Increased number during winter seasons may be due to invasion of exotic population. Sought after by the local poachers due to alleged table quality of its flesh.

Ardeidae
Purple Heron

R & B

Ardea purpurea manilensis Meyen
(*Ardea purpurea* var *manilensis* Meyen, 1834)

Material examined :

	Wing	Tail	Bill	Tarsus
1 (M)	360	131	129	131

The specimen was collected from Barkul island on 7th December 1986, with fresh plumage and non breeding gonad.

Found almost throughout the park. Forage while wading in shallow water areas in the park, and also frequents floating islands of *Potamogetons* sp. mainly crepuscular but diurnal activities noted in association with Grey Herons and other egrets. Possibility of an exodus population can be predicted as numerous of individuals increase substantially during winter.

Little Egret

r & b

Egretta garzetta garzetta (Linnaeus)
(*Ardea garzetta* Linne, 1766)

Material examined :

	Wing	Tail	Bill
1 (M)	268	moult	84

The specimen was collected from Barkul, collector S.R. Dey Sarkar on June 20, 1986. It had central tail feathers in pin and had nonbreeding gonad.

Very common, found throughout the lagoon and adjacent areas. Occurs singly, in pairs or in loose groups following cattle amidst meadow and also in association with other egrets and herons wading in shallow waters. Nesting in mixed heronries were reported from Bird island, Barkul, Rambha, Sambal island, Satpara and Mouza Behrampur.

Indian Pond Heron or Paddy bird

R & B

Ardeolagravii gravii (Sykes)
(*Ardea gravii* Sykes, 1832)

Material examined :

	Wing	Bill	Tarsus
2 (F)	208-212	61-63	60-61
1 (M)	198	58	60

Commonest among herons in Chilka, found throughout the Lake. Large flocks although isolated can be seen foraging along the water edges and also on floating aquatic vegetation. Found to forage with other egrets and other aquatic birds. Breeding colonies during postmonsoon periods dotted all along the lake.

Eastern Large Egret

Ardeaalba modesta J. E. Grey
(*Ardea modesta* J.E. Grey, 1931)

R & B

Material examined :

	Wing	Bill	Tarsus
1 (M)	364	124	109

The specimen was collected from Balugaon on Nov. 18, 1972 by C.B. Srivastava with freshly moulted plumage and non breeding gonad.

Fairly common. Found almost throughout the lake including inland waterbodies along with edges of Chilka as well as inside the islands. While foraging along the outer edges in deeper water. In a dispersed mixed flocks of egrets, this form leads the group. Postmonsoon breeding of the species in mixed heronries were seen in Satpara and Brakefast islands.

Chestnut Bittern

'R' & 'B'

Ixobrychus cinnamomeus Gmelin
(*Ardea cinnamomeus* Gmelin, 1789)

Fairly common. A crepuscular bittern, found almost throughout the lake except the seafacing areas. Mostly solitary, occasionally occur in pairs. Prefer emergent and floating vegetation like *Phragmites* sp and *Eichormia crassipes*. Occasional movements were also observed during the day especially in winter.

Black Bittern

'R' & 'B'

Dupetor flavicollis favicollis (Latham)
(*Ardea flavicollis* Latham, 1790)

Scarce. Found patchily in some parts of the lake. Prefer waterhyacinth and other emergent

vegetation covered areas. Solitary, crepuscular, leave the roosting site at the day brake and return early in the morning. Highly evasive and avoid foraging with other birds. The bird could be encountered more frequently during winter than other times.

White Ibis

'R'

Threskiornis aethiopica melanocephala (Latham)
(*Tentalus melanocephalus* Latham, 1759)

Fairly common but having restricted distribution inside the lake. Major groups were located in Nalbani, Barkuda, northern part of Satpara and Bhusudipur areas. Mixed foraging flocks in association with the Spoonbills and Large Egrets were observed. Breeding records in mixed heronries in Bird island could not be confirmed. (Fig. 9).

.Anatidae

Shoveller

'M'

Anas clypeata Linnaeus
(*Anas clypeata* Linnaeus, 1758)

Material examined :

	Wing	Tail	Bill	Tarsus
1 (M)	231	71	69	34
1 (F)	226	—	62	34

The (M) specimen was collected from Honeymon Island, c 7 km SE of Rambhaon June 13, 1986 by S.R. Dey Sarkar. The (F) specimen was collected from Balugaon on November 15, 1972 by C.B. Srivastava, with fresh plumage, retrices in pin and upper tail covert in moulting stage. The June (M) specimen had wornout plumage and developed gonad. Occurrence of the o bird in June in the lake might be due to either some injury or some physiological disorder for which the bird could not leave its wintering place. Actually, some shotgun pellets were found embedded in its body. Even during early September some such isolated birds can seen in various parts of the lake.

Fairly common dabbling duck. Found almost throughout the lake in well watered areas. Found in flocks, sometimes more than 100 birds could be seen foraging on the surface, in association with others ducks. Their low profile above the water and heavy outside bill is very distinctive. Predominantly diurnal and crepuscular. They were generally seen along the outside edges in a mixed flocks of either foraging or resting ducks.

Wigeon

Anas penelope Linnaeus

Material examined :

	Wing	Tail	Bill	Tarsus
2 (M)	227 +–258+	92+–100	34	35–36

Both the specimens were collected near Kalijai Island on June 25, 1986. Both specimens had abraded plumage with wing feathers nearly wornout leaving the rachis only. Both of them had developed gonads. Occurrence of these specimens in the month of June is very unusual. Most of the wintering ducks usually leave the lagoon by middle of may. Previous injury in any form may be the reason of such an overstay.

Fairly common. Occurs in pairs or in small group crepuscular and nocturnal. Prefer well watered areas in the lake. Forage in association with other ducks.

ACCIPITRIDAE

Shikra

'R' & 'B'

Accipiter badius dussumeri (Temminck)
(*Falco dussumeri* Temminck, 1824)

Material examined :

	Wing	Tail	Bill	Tarsus
2 (M)	162-194	142	20-23	50

One of the specimen was collected from Bambha on Nov. 29, 1986 while the other from Barkul on Sept. 4, '87. The November specimen had wornout and old plumage devoid of any trace of moult with enlarged testes. While the September specimen had freshly moulted plumage with outer tail feathers in pin and had non breeding gonad.

Scarce. Found almost throughout the park in small number, but prefer areas with adequate vegetation cover. Highly efficient killer especially of smaller birds. Typical midday dove like soarings could be observed during winter. *Borassus flavilliver* trees are commoly used for nesting.

Brahminy Kite

'r' & 'b'

Haliastur indusindus (Bddaert)
(*Falco indus* Boddaert, 1783)

Material examined :

	Wing	Tail	Bill	Tarsus
1 (M)	378	198	35	59
2 (F)	381-409	199-inpind	36	50-56

The (M) specimen was collected from Satpara on December 11, 1986, having fresh plumage and breeding gonad. One of the two (F) specimen was collected from Barkul Island on 20 June 1986 by S.R. Dey Sarkar having wornout plumage and rectrices in pin, while the other was collected from Satpara on September 18, 1987 having fresh plumage and nonbreeding gonad.

Common. Found throughout the lake. Occur singly, in pairs or family parties upto four individuals. The characteristic call can be heard almost throughout the area. Interaction with its ecocompetitor the Pariah Kite, *Milvus migrans* were noted. Nests were located in Barkul, Rambha, Nuapara, Balugaon, Satpara and Kalijai island. Predominantly fish-eater but also prey upon wounded and disabled birds.

Whitebellied Sea-Eagle

'R' & 'B'

Haliaeetus leucogaster (Gmelin)
(*Falco leucogaster* Gmelin, 1788)

Material examined :

	Wing	Tail	Bill	Tarsus
1 (M)	430	256	57	97

The specimen was collected from Rambha, on 26 Nov. '86, having fresh plumage and non breeding gonad.

Fairly common, found almost throughout the lake. This magnificent grey and white birds of prey appeared to be thriving well in and around the lagoon. Mostly solitary but during monsoon season found in pairs or in family parties. As per the estimate of the present author there will be 50 odd pairs in the lake areas. Nests were located in large trees mainly *Ficus* sp. in Rambha, Barkul, Krisnapada island and Satpara island. In Satpara nests were also located on *Borassus flavellifer* and casuarina trees. Rollercoaster courtship display and aerial transfer of morsels from male to female was also observed during September – October 1987. Though they thrive mainly on snake but many fishes were seen lying near the nest.

This species is included in the schedule I of the Wildlife Protection Act, 1972 and its subsequent amendments, but stray killings were noted during the expedition as its flesh is being considered a delicacy to the local inhabitants.

CHARADRIDIDAE

Common Red Shank

M.

Tringa totanus
[*Scolopax Fotanus*, Linne, 1758]

Material examined :

	Wing	Tail	Bill
5 (M)	130–160	51–71.5	35.5–50
2 (F)	130–158	55.5–58.5	30.5–54

All five (M) specimens were collected from Satpara island on 9 December 1986. One of the two (F) specimens was collected from Satpara on December, 9, 1986 while the other was collected from Barkul on September 5, 1987. All the specimens except the September (M) one, had fresh plumage

and non breeding gonad. The September (M) specimens had worn out plumage with granular overy.

Common winter visitor, found throughout the lake. Also affect fresh water bodies adjacent to the lake. Found solitary or in small flocks. Forage in association with other waders.

Little Stint
Calidris minuta (Leisler) M.
(*Tringa minuta* Leisler, 1812)

Material examined :

	Wing	Tail	Bill
1 (M)	93	40	23

The specimens was collected from Satpara on December 9, 1986, with fresh plumage and non-breeding gonad.

Common winter visitor found throughout the lake and its adjacent areas. Occur singly or in pairs. Congregation in flocks mainly during roosting time. Found along the edges of waterbodies, shallow water regions and on the mudflats. Forage in association with other waders. It also affects even the smallest waterbodies situated adjacent to the lake.

Eastern Golden Plover M'
Pluvialis dominica fulva (gmelin)
[*Charadrius fulvus* Gmelin, 1780]

Material examined :

	Wing	Tail	Bill
3 (M)	160–168	65.2–70	26–30.6
2 (F)	152–168	62–65	25–30.5

Two (F) specimens were collected at Samuguda island (Honymon island) and Bhusundipus on Nov. 28, '86 and December 6, '86 respectively. And the other (M) species was from Sambal Island on Sept. 6, 1987. White, one of the (F) specimen was collected at Barkuda island on 28, Nov. '86 and the other on Sept. 9, '87 from Barkul island.

Common winter visitor in the lake. Found throughout the lake and its adjacent areas. Found in flocks upto 100 birds. Confined mostly to shallow water areas but also found in inland areas adjacent to the lagoon. Less amount of interspecific or intergeneric interactions was noted. Roosting sites were observed both in the tidal mudflats and in the inland and embankments. (fig.).

Turnstone 'M'
Arenaria interpres interpres (Linne)
 (*Tringa Interpres* Linne, 1758)

Material examined :

	Wing	Tail	Bill
2 (M)	148	55	27
2 (F)	146-149	55-60	26-28.5

One of the (M) specimens was collected from Barkul on 7 Dec. '86 and rest two (F) specimens and the (M) specimen were collected from Sambal island on 6 Sept. '87. The December (M) specimen had winter plumage and non breeding gonad. Two September (F) specimens had partial summer 'tortoise-shell' plumage and granular ovary. The (M) specimen collected during September had summer plumage but non breeding gonad. None of the specimen had any trace of moult. It is evident from the specimens that there is sexual dimorphism. The male specimen had conspicuous and well marked moustachial stripes and the pale chestnut marking on the primary wing coverts is very well defined.

Common winter visitor to the lake. Found in flocks of even 40-50 birds. Diurnal and partly crepuscular. Found mostly along the edges of the water but observed to invade inland for foraging away from waterbody in meadows and fallowlands. Less amount of interspecific or intergeneric interaction was noted. Gregarious roosting was observed on 'chaurs' (mudflats) in the mouth of Chilka.

Temmincks Stint 'M'
Calidris temmincki (Leisler)
 (*Tringa Temminckie* Leisler, 1812)

Common winter visitor in the lake. Occur singly or in groups. Prefer moist areas like the edge of water or mudflats. Roosting groups were seen to be of more than 100 birds. This species was also observed in the adjacent paddy fields and fallowlands. Its uniform grey upperparts and greenish-yellow leg as opposed to black leg is the identifying characters than that of the Little Stint.

RECURVIROSTRIDAE

Indian Blackwinged Stilt 'R' & 'N'
Hamantopus himantopus himantopus (Linnaeus)
 (*Charadrius himantopus* Linne, 1758)

Material examined :

	Wing	Tail	Bill	Tarsus
1 (M)	242	84	62	122
2 (F)	219-227	77-76	58-63	111-116

The (M) specimen was collected from Kalijay Island on June 17, 1986 by S.R. Dey Sarkar, while then two (F) specimens were collected from Samuguda, Honeymoon Island on 28 Nov '86 and from

Bhusundipur on December 6, 1986. All three specimens had fresh plumage and nonbreeding gonad.

Common, during winter large flocks were seen wading in shallow water almost throughout the lake. No breeding record was made. Though known to be a resident bird but are difintely subject to local movement.

Fantail Snipe

'M'

Gallinago gallinago gallinago (Linnaeus)
(*Capella gallinago* Linnaeus, 1758)

Material examined :

	Wing	Tail	Bill	Tarsus
1 (M)	133	55	72	31

The specimens was collected from Bhusundipur in the northern part of the lake. The specimen had freshly moulted plumage with non breeding gonad.

A common wintering wader in the lake. Found in the shallow water areas, mud flats and adjacent waterlegged paddyfields in and around the park. Due its highly camouflaging plumage, it is very difficult to locate but its harsh nasal call mostly produced in typical flight normal given away its identity. Due to its reputation as excellent table bird, it is very much sought after by the poachers.

Redwattled Lapwing

'R & B'

Hoplopterus indicus indicus (Boddaert)
(*Tringa indica* Boddaert, 1783)

Material examined :

	Wing	Tail	Bill	Tarsus
1 (M)	214	111	58	70
2 (F)	214-225	110	36-42	71

The (M) specimen was collected from Barkul on Sept 5, 1987 while one of two (F) specimen was collected from Rambha on June 11, '86 by S.R. Dey Sarkar, while theother one was collected from Barkul on Sept. 5, 1987. The June (M)specimen had breeding gonad while the other two had non breeding gonads. All three specimen had fresh plumage, with no trace of moult.

Very common resident wades. Found throughout the lake. Found in pairs or in loose flock. During winter they were observed amidst other lapwings like yellow wattled and grey headed Lapwings. Mostly durnal, but active foraging was noted during dwan and dusk. They even found active in middle of night especially moonlit ones when their characterstic call *Did-he-do-it* could be heard.

Yellow-wattled Lapwing

Vanellus malabaricus (Boddaert) 'M'
 (*Charadrius malabaricus* Boddaert, 1783)

Material examined :

	Wing	Tail	Bill	Tarsus
1 (M)	187	80	29	56

The specimen was collected from Satpara on 16 September '87, with fresh plumage and nonbreeding gonad.

Fairly common winter visitor in the lake. Prefer mudflats and shallow water regions, also venture in the adjacent meadows and fallow land. Solitary or in loose flocks. Mainly diurnal but crepuscular activities were also observed.

DROMADIDAE

Great Stone Plover 'R & 'LM'
Esacus magnirostris recurvirostris (Cuvier)
 (*Oedicnemus recurvirostris* Cuvier, 1829)

Material examined :

	Wing	Tail	Bill	Tarsus
1 (M)	260	15	71	85

The specimen was collected from Sambal island on Nov. 28, 1986, had freshly moulted plumage and nonbreeding gonad.

Scarce. Found in pairs. During the course of survey observed in Sambal, Barkuda and Kalijai Island. Shy and evasive bird. Forage along the water edges. Though resident this bird is also subject to local movement.

(Eastern Curlew) 'M'
Numenius arquata (Linnaeus)
 (*Scolopax Arquata*, Linne 1758)

Fairly common, found almost throughout the park but avoid in general the northern part of the park. Found mostly singly or in pairs. An interesting associations with the dolphin and this bird was noted in Satpara, Mouze Behrampur and in the Magarmukh areas. In these areas it was apparent to the another that the curlew followed the dolphin school fishing close to shore in almost in hot pursuit. But the reason for such behaviour is not possible to predict.

Whimbrel

'M'

Numenius phaeopus (Linnaeus)
(*Scolopax phaeopus*, Linnaeus 1758)

Scarce. Found in small number during winter, mostly in southern part of the lagoon and seafacing areas like Magarmukh. Forages mostly on the mudflats and along the water edges. Generally occur in association with curlew and other waders but remain isolated. Some individuals were observed during early September. Shy and evasive. Due to its alleged good quality of meat, this bird is very much sought after by poachers.

Lesser Crested Tern

'R & LM'

Sterna bengalensis Lesson
(*Stema bengalensis*, Lesson 1831)

Material examined :

	Wing	Tail	Bill	Tarsus
1 (M)	347	167	79	32

Specimen was collected at Satpara on 14 September 1987, with postbreeding gonad and worn out plumage.

Uncommon. Present specimen has not so far been recorded from this area. Found in loose flocks of more than 10 birds frequent seafacing parts of the lagoon. Though the specimen was collected during inland-dian-invasion during late after-noon, not roost could not belocated during the survey.

The large crested Tern, *Sterna brgii* a not so common tern was located only in the part of the lake in the Magarmukh and area of the lagoon. They occur in pairs or in loose flocks. The highpitched parakut like call

COLUMBIFORMES
COLUMBIDAE

Little Brown Dove

R & B

Streptopelia senegalensis cambayensis (Gmelin)
(*Columba cambayensis*, Gmelin, 1789)

Material examined :

	Wing	Tail	Bill
1 (M)	120	99	17

The specimen was collected from Barkul on September 9, 1987, with freshly maulted plumage and nonbreeding gonad.

Not so common, resident dove of the lagoon area. Found almost throughout the region but in small number. Occurs mostly singly, sometimes in pairs. Being secretive and shy, this bird was observed to forage in isolation.

CUCULIEORMES

CUCULIDAE

Pied Crested Cuckoo

'M'/M'

Clamator jacobinus (Boddaert)*(Cuculus jacobinus, Boddaert, 1783)*

Scarce monsoon migrant in the lagoon areas. No specimens could be collected, but this conspicuous pied species was observed more than one occasions amidst the *Pandanus* sp. groves and *Accacia* plantations along the fringes of the lake in Barkul and Rambha areas during September/October 1987. Mostly solitary, often observed to be chased by assorted covies of the Jungle Babblers, Black Drongo, Tailor bird and etc.

STRIGIFORMES

STRIGIDAE

Dusky Horned Owl

'R' & 'B'

Bubocoromandus (Latham)*(Strix coromanda Latham, 1790)**Material examined :*

	Wing	Tail	Bill	Tarsus
1 (F)	603	213	47	78

The specimen was collected from Patharguda, near Barkul on 30 November '86 with abraded plumage with non breeding gonad.

Rare. Found in the northern well wooded parts of the lagoon. Found in pair. Forage at the edge of the plantation and fallow lands. Purely nocturnal.

Spotted Owlet

'R' & 'B'

Athene brama brama (Temminck)*(Strix brama, 1821)**Material examined :*

	Wing	Tail	Bill	Tarsus
2 (F)	155-160	76-77	21-22	30-32
1 (M)	160	80	22	33

All three specimens were collected from Rambha, on November 25, '86 having fresh plumage and non breeding gonads.

Very common, found throughout the lake except the islands devoid of trees like Nalbani. Occurs singly or in pairs, occasion assemblage of loose flocks were noticed especially near electric lights and flood lamps. Nocturnal and crepuscular. But movements were observed during day as well and typical

screaching cacophony were also heard during the day. A very common target of mobbing by smaller passerines during the day. Breeds in crevices and holes of trees as well as in the walls.

Collared Scops Owl

R & B

Ottus backkamoena marathae Ticehurst
(*Ottus backkamoena marathae* Ticehurst, 1922)

Material examined :

	Wing	Tail	Bill	Tarsus
2 (M)	156-157	73	23-26	37-40
1 (F)	157	78	25	40

All three specimens were collected from Satpara Island. One (M) and one (F) specimen were collected on September '87 while the other (M) was collected on September 18 '87.

Fairly common, but not so numerous like the spotted owlet. Found singly or in pairs. Observed mostly in Rambha, Barkul and Satpara area. Purely nocturnal and less daring than the owlet.

CORACIDAE

Indian Roller

'R' & 'B'

Coracias benghalensis (Linne)
(*Corvus benghalensis* Linne 1758)

Common. Found throughout the part of the lake. Solitary or in pairs.

UPDPIFORMES

UPUPIDAE

Hoopoe

Upupa epops Linne'
(*Upupa Epops* Linne 1758)

'M'

Fairly common. Found almost throughout the lake. Affects both inland and along the water edges. Found solitary, in pairs or in family parties mostly comprising of four numbers. Typical probing foraging practice, similar to that of the snipes.

PICIFORMES

CAPITOMIDAE

Ceylon Green Barbet

R & B

Megalaima zeylanica zeylanica (Gmelin)
(*Bucco zeylanicus*, Gmelin, 1788)

Material examined :

	Wing	Tail	Bill	Tarsus
1 (M)	117	71	34	27
1 (F)	110	64	33	28

The (M) specimens was collected from Satpara on September 19, 1987 with fresh plumage and nonbreeding gonad. The (F) specimen was also collected from the same place on September 11, 1987 with fresh plumage and non breeding gonad.

Fairly common. Affects well wooded islands and along the edges of the lagoon. Occurs singly or in pairs. Loose group formation was noted during December and January when fig trees like *Ficus bryhalemis* were in fruits. Basically frugivorous but observed to feed on termite which they caught in flight during a 'termite swarming' in Satpara island during December 1986.

Capionidae

Crimson breasted Barbet or Coppersmith 'R'
Megalaima haemocephala indica Latham
(*Bucco indicus* Latham, 1788)

Material examined :

	Wing	Tail	Bill	Tarsus
1 (M)	80	31	28.5	20

The specimen was collected from Barkul on September 1987, with fresh plumage and nonbreeding gonad.

Common. Found almost throughout the except the islands devoid of trees and on the seafaces. Occur singly or in pairs. Large groups collected for foraging in fruiting trees like Banyan, *Ficus bengalensis* etc. Generally difficult to locate this bird amidst thick foliage due to its cryptic colouration but its distinct call in notable key for identification. It also breeds in this area.

PICIDAE

Northern Goldenbacked Woodpecker 'B' & 'R'
Dinopium benghalensis benghalensis (Linnaeus)
(*Picus benghalensis* Linnaeus, 1758)

Material examined :

	Wing	Tail	Bill	Tarsus
1 (M)	141	—	40	28

The specimens was collected on September 16, '87 from Satpara island, with freshly moulted plumage. Rectrices were in pin and gonads were in nonbreeding stage which indicates post-nuptial mault.

Fairly common. Found almost throughout the park except central portion of lake and islands devoid of large trees like Nalbani, bird island. Occur singly or in pair. Often hard than seen.

PASSERIFORMES

ALAUDIDAE

Bergal Bushlark

'R' & 'B'

Mirafra assamica assamica Horsefield
[*Mirafra assamica* Horsefield, 1840 (1839)]

Material examined :

	Wing	Tail	Bill	Tarsus
1 (F)	—	—	—	16.5

Collected from Barkul Island on 4 Sept., '87. The specimen had nonbreeding gona with worn out plumage.

Fairly common, ground dwelling bird. Found throughout the lake in the islands and along the edges of the lake. In comparison to its other congeners like *M. erythroptera* and related *Alauda gulgula* it prefers moist areas except seafacing areas. Often hard by its melodius triling song which is produced in the air than seen.

Eastern Skylark

'R' & 'B'

Alauda gulgula gulgula Franklin
(*Alauda gulgula*, Franklin)

Material examined :

3 (M) 28 Nov, 1986, 12 September '87, one from Barkuda Island and two from Satpara island.

	Wing	Tail	Bill
3 (M)	89-90	50-51	16-17

The specimen collected during November '86 has wornout plumage and less bill length, probably from breeding activities.

Fairly common, found in the drier grass covered partsof the island and along the edges of the lake. Keep in pairs or in loose flocks. Sporadic aerial displayswere observed during the post monsoon season. Used nests were located on the mouza Bihrampur and Satpara islands.

LANIDAE

Brown shrike

'M'

Lanias cristatus cristatus Linnaeus
(*Lanias cristatus* Linne, 1758)

Material examined :

	Wing	Tail	Bill
1 (M)	86	82	26

The specimen was collected from Satpara island on Sept. 18, '87, with nonbreeding gonad and abraded plumage.

Common winter visitor in and around the lake. Solitary, prefer groves both occurring along the edges of the water as well as in the inland areas. Territorial, frequents the same bush/groves as roost. Feeding territory was also observed to be more or less confined to the same area. As conceived, during the course of expeditions, they arrive in the lagoon area during the end of September and leave the place around the first week of April.

The Blackheaded Shrike, *Lanias sach tricolor* is the resident congener of the Brown Shrike in and around the lake. They are also reported to breed in the northern edges of the lake.

DICURIDAE

Black Drongo or King Crow 'R' & 'B'
Dicrurus adsimilis macrocercus Vieillot
 (*Dicrurus macrocercus* Vieillot, 1817)

Material examined :

	Wing	Tail	Bill
1(F)	—	10.2	25

The specimen was collected from on Sept. 9, '87 with freshly moulted feather and had wing feathers in 'pin' and with non breeding gonad.

Common. Found throughout the park, even amidst Casuarina sp. plantation on the southern seafacing areas of the lagoon. Occur singly or in pairs. It is the most dominant element which often actively engaged in dispersal of avian predator. Even the large birds of prey like the whitebellied Sea - Eagle also can not avoid its worth. Mostly diurnal but occasionally crepuscular even nocturnal as evidenced by its active foraging and other interactions as observed long after day brake, near electric street lamps etc.

Whitebellied Drongo 'M'
Dicrurus caerulescens caerulescens (Linne)
 (*Lanias caerulescens* Linne, 1758)

Material examined :

	Wing	Tail	Bill	Tail (outer rectrices)	Tarsus
1(M)	121	86	25	110	20

The specimen was collected from Barkul on 3rd December '86, having fresh plumage and non breeding gonad.

Uncommon. Probably a winter visitor. Prefer well wooded country. But nothing can be added as the species were uncounted only twice during the expeditions, and on both the occasions they were found in *Accacia* plants sitting idly during the mid day.

The Bronze Drongo, *Dicrurus aeneus* was also observed during the survey in the lake, in the Satpara island. They occur in pairs, prefer well wooded parts especially amidst the 'Toon' or Sultan Champa plantation (*Callophyllum inophyllum*). But, no specimen could be procured. They are supposed to be resident/breeding species of the lake.

CORVIDAE

R&B

Jungle Crow

Corvus macrorhynchus culminatus Sykes
(*Corvus culminatus* Skyes)

Material examined :

	Wing	Tail	Bill	Tarsus
1(M)	300	170	65	51

Collected from Rambha on 25 Nov. '86. The specimen has nonbreeding gonad and fresh plumage.

Common scavenging bird. Though less in number than the House crow but found throughout the lagoon. Preference of wet areas of the lagoon was noted during foraging. *Pila* sp. constitute a major part of the diet as noted during monsoon in undated areas of the area. Take active part in mobbing of birds of prey and other fish-eating birds like Darter and Cormorants in association with the House Crow.

IRENIDAE

'R & B'

Goldfronted Chloropsis

Chloropsis aurifrons aurifrons (Temminck)
**Phylornis aurifrons* Temminck, 1829)

Material examined :

	Wing	Tail	Bill	Tarsus
1(M)	83	71	21	19

The specimen was collected at Satpara on September 11, 1987, had freshly moulted plumage and nonbreeding gonad.

Not so common resident bird. Found along with its congeners in the same area. Occurs singly or in pairs. Very active and restless leafbird very likely to also breed in and around the lake.

Jerdon's Chloropsis
Chloropsis chochinclinensis jerdoni Blyth
 (*Pyllyornis jerdoni* Blyth, 1844)

'R' & 'B'

Material examined :

	Wing	Tail	Bill	Tarsus
1(M)	91	71	24	18
1(F)		-	25	19

Both the specimens were collected from Salpar island on September 18, 1987. Both the specimens were having their tail converts in moulting stage. The M specimen had its wing and tail feathers in pin, suggesting post nuptial moult and probability of the breeding in the lagoon especially in the northeastern and north-central portion.

A not so common passerine. Found in pairs generally affects canopy and upper story of the tree. Excellent mimic.

PYCNONOTIDAE

'R,B&LM'

Redvented Bulbul
Pycnonotus cafer wetmorei Diegnan
 (*Pycnonotus cafer wetmorei* nom. nov. Diegnan, 1960)

A common resident and breeding birds in and around the lake. But, they are subject to local movement as evidenced by their absence during late monsoon (Dey Sirkar, perscomm) and sudden arrival during middle of September 1987 as experienced by the present author. This garrulous form mostly keep in pairs and often indulge in anti-avian predator display. This particular species was mostly observed along the edge of lake as well as in the Satpara island.

'R&B'

White browed Bulbul
Pycnonotus luteolus luteolus (Lesson)
 (*Haematornis luteolus* Lesson, 1841)

Material examined :

	Wing	Tail	Bill	Tarsus
1(F)	90	77	20	23

Collected at Barkul - 1(M) (Sept. 4, '87). The specimen had fresh plumage and receding gonad an indicator of its probable breeding in the vicinity.

Rare. A loose flocks of about 4 birds were observed in the bushes adjacent to a Pandanus sp. patch. Present report is the first record of its occurrence in the lake areas. As per extant literature this form is

recorded to occur in Peninsular India, South of a line from Ahmedabad (Gujarat) through southern Madhya Pradesh to Midnapur (West Bengal). Contrary to the informations available as per extent literature, which restricts its occurrence in dry, open scrub country and gardens in hills and hills locally to c 1200 m (Ripley, 1982), the specimen was collected from a well watered areas of the lake in close proximity of waterbody.

MUSCICAPIDAE

'M'

Greenish or Dull Green Leaf Warbler

Phylloscopus trochilloides viridiunus Blyth[*Ph. (yelloscopus) viridianus* Blyth, 1843]*Material examined :*

	Wing	Tail	Bill
1(F)	62	17	11

The specimen was collected from Satpara island on September 12, 1987, having fresh plumage and nonbreeding gonad.

A very common wintering leafwarbler found almost throughout the lake and along the edges the Nalbani Islands and areas without trees. The long drawn 'Chiseep' note confirms its identity. A restless bird found to forage in the canopy and first stories. Occur mostly singly occasionally in pairs.

Jungle Babbler

R&B

Turdoides striatus orissae Jerdon(*Turdoides striatus orisae* Jerdon, 1847)*Material examined :*

	Wing	Tail	Bill	Tarsus
2(M)	104-105	100-105	25	34.5-35

Both the specimens were collected from Satpara on September 17, 1987, with fresh plumage and breeding gonads.

Comon. Found almost throughout the parks except the northern and central parks. This garrulous bird always found in flocks of 6 to 10 birds. Known for co-operative nest but no breeding activity was recorded during the expeditions.

MOTACILLIDAE

R&B

Large Pied Wagtail

Motacilla madraspatensis Gmelin[(*Motacilla) madraspatensis* Gmelin, 1789]

Scarce. Only resident wagtail in India. Frequents water edged especially the fringes of the lake. Avoid high saline parts of the lake. Mostly solitary, occasionally in pairs. Its high pitched note can be heard both on the ground as well as on wing long before one actually observe its pied plumage. One nest at the focal point of a grounded country boat was noted at Barkul during September '87. Though, already deserted by the young, the site was often seen visited by one of parents, might be the male as evidenced by its territory marking displays.

Forest Wagtail

'M'

Motacilla indica Gmelin
(*Motacilla indica* Gmelin, 1789)

Material examined :

	Wing	Tail	Bill
2(M)	76	63	17

Both specimens were collected from Satpara island on 18 Sept. '87. Both the specimens had nonbreeding gonad and fresh plumage.

Scarce. This particular passerine migrant are subject to circular migration. hence, probability of encounter of this species during April/May in this area is quite likely. Prefer, well wooded areas in the islands and along the edges of the lake. they were also observed in the forest floor of *Casuarina* sp. plantations along the seafacing sides of the lake at Magar Mukhrea. Forage in loose flocks of 4 to 6 birds and can be easily identified by the monosyllabic 'Hawfinch' like note and took to the wing when disturbed and fly to nearest tree. The sidewise tail wagging is also a feature.

Indian Paddyfield Pipit

R&B

Anthus novaeselandiae rufulus Vieillot
(*Anthus rufulus* Vieillot, 1818)

Material examined :

	Wing	Tail	Bill
1(M)	92	70	17.8

TIME & SPACE DISTRIBUTION OF AVEFAUNA IN CHILKALAGOON

Sl.	EAST (Mainly Waterbody and along its edges)	WEST		CENTRAL Nalbani	NORTH	S O U T H										REMARKS	
		Rambha (1)	Barudi (2)														
Name				BHUSUNDIPUR	BALUGAON	BARKUL	GAMBHORI	SATPARA	MOUZA BEHRAMPUR	MAGARMUKH	SEA FACE	NUAPARA	PARIKUD	KRISHNAPADA	SAMBAL	HONDY MOON ISLAND	
	1	2	3	1	2	3	1	2	3	4	5	6	7	8	9	10	

1.	Great Crested Grebe, <i>Podiceps Cristatus</i>	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	Rare, W.
2.	Little Grebe, <i>P. ruficollis</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Common R & B
3.	Black necked Grebe, <i>P. nigricollis</i>	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	Rare, W.
4.	Gery Pelican, <i>Pelecanus Philippensis</i>	+	-	-	+	-	-	-	+	-	+	-	-	+	-	+	Fairly common R & N & B.
5.	Darter, <i>Ahinga rufa</i>	+	-	-	+	+	-	-	+	+	+	+	-	-	-	-	Common, R & B.
6.	Little cormorant <i>Phalacrocorax niger</i>	+	+	+	+	+	-	-	+	+	+	+	-	-	-	+	Common R & B.

NAME	EAST		WEST		CENTRAL	NORTH			SOUTH										REMARKS
	1		1	2	1	1	2	3	1	2	3	4	5	6	7	8	9	10	
7. Cormorant, <i>P. carbo</i>	+		-	-	+	+	-	-	-	+	-	-	-	-	-	-	-	-	Fairly common W
8. Shag, <i>P. fuscicollis</i>	+		-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	Fairly common R & B
9. Grey Heron, <i>Ardea cinerea</i>	+		+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	Common R & B.
10. Purple Heron, <i>Ardea purpurea</i>	+		+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	Common R & B.
11. Large Egret, <i>Ardea alba</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Common R & B.
12. Pond Heron, <i>Ardeola gravii</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Very common R & B.
13. Intermediate Egret, <i>Ardeola gravii</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Common R & B.
14. Little Egret, <i>E. garzetta</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Very common R & B.
15. Cattle Egret, <i>Bubuleus ibis</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Very common R&B.
16. Night Heron, <i>Nycticorax nycticorax</i>	+		-	+	+	-	-	+	+	+	+	-	-	+	+	+	-	+	Very common R&B

NAME	EAST	W	CENTRAL	NORTH			SOUTH										REMARKS	
	1	1		2	1	2	3	1	2	3	4	5	6	7	8	9		10
17. Black necked stork, <i>Eppiphiorhynchus asiaticus</i>	+		-	+	+	-	-	-	+	-	-	+	-	-	-	-	-	Scarce, R.
18. White Ibis, <i>Threskiornis aethiopica</i>	-	-	-	+	+	-	-	+	-	+	-	-	-	-	+	+	-	Common, R.
19. Spoon bill, <i>Platelea leucorodia</i>	+	-	+	+	+	-	-	-	+	+	-	-	-	-	-	+	-	Common, R.
20. Flammingo, <i>Phoenicopterus roseus</i>	-	-	-	+	+	-	-	-	+	+	-	-	-	-	+	-	-	Common, W.
21. Lesser Flamingo, <i>Phoeniconaias minor</i>	-	-	-	+	-	-	-	-	+	+	-	-	-	-	-	-	-	Fairly common W.
22. Greylag Goose, <i>Anser anser</i>	+	-	-	+	+	+	-	-	-	+	-	+	-	-	+	+	+	Common, W.
23. Barheaded Goose, <i>A. indicus</i>	+	-	+	+	+	-	-	+	+	+	+	+	-	-	-	-	-	Common, W.
24. Lesser whistling Teal, <i>Dendrocyone javanica</i>	+	+	-	+	+	+	+	+	+	+	+	+	-	+	-	-	-	Common, R.
25. Brahminy Duck, <i>Tadorna ferrugines</i>	+	-	-	+	+	-	-	-	-	+	+	-	-	-	-	+	+	Common, W.
26. Pin-tail, <i>Anas acuta</i>	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	Common, W.
27. Common Teal, <i>A. cracca</i>	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	-	-	Common, W.

NAME	EAST		WEST		CENTRAL	NORTH			SOUTH										REMARKS	
	1		1	2	1	1	2	3	1	2	3	4	5	6	7	8	9	10		
28. Spot bill duck, <i>A. poecilorhyncha</i>	+		-	+	-	-	-	-	-	+	+	-	-	-	-	+	+	+	Fairly common R & B.	
29. Gadwal, <i>A. strepera</i>	+		-	-	+	+	-	-	+	+	-	-	-	-	-	-	+	+	Common, W.	
30. Wigeon, <i>A. penelope</i>	+		+	+	+				-	+	+	-	-	-	-	+	-	+	Fairly Common W.	
31. Gargany, <i>A. guerquadula</i>	+		+	+	+	+	-	+	+	+	-	+	-	-	-	+	-	-	Common, W.	
32. Shoveller, <i>A. clypeata</i>	+				+	+	-	+	+	+	-	+	-	+	+	+	+	-	+	Common, W.
33. Red Crested Pochard, <i>Netta rufina</i>	+		+	+	+	+	-	+	-	+	+	+	+	+	-	+	+	+	Common, W.	
34. Common Pochard, <i>Aythya ferina</i>	+		+	+	+	-	+	+	-	+	+	-	-	+	-	+	-	+	Common, W.	
35. White-eyed Pochard, <i>A. nyroca</i>	+		-	+	+	-	-	-	-	+	-	-	+	+	+	+	+	-	+	Common, W.
36. Tufted Pochard, <i>A. fuligula</i>	+		-	+	+	-	-	+	+	+	-	-	-	+	-	+	+	+	Common, W.	
37. Cotton Teal, <i>Nettapus coromandelianus</i>	+		+	+	+	+	+	+	-	+	+	-	-	+	+	+	+	+	Common, R & B.	
38. Comb Duck, <i>Sarkidiornismelanotos</i>	+		-	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	Scarce, W.	

NAME	EAST		WEST		CENTRAL	NORTH			SOUTH										REMARKS
	1		1	2	1	1	2	3	1	2	3	4	5	6	7	8	9	10	
39. Shikra, <i>Accipiter badius</i>	-		+	-	-	-	-	+	-	+	-	-	-	-	-	+	-	-	Fairly Common R.
40. Blackwinged Kite, <i>Elanus caeruleus</i>	-		+	-	-	-	+	+	-	+	-	-	-	-		+	-	-	Common
41. Crested Honey Buzzard, <i>Pernis ptilorhynchus</i>	-		+		-	-	-	+	-	+	-	-	-	-	-	-	-	-	Scarce, R.
42. Pariah Kite, <i>Milvus migrans</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Very common R.
43. Brahminy Kite, <i>Haliastur indus</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Very common R.
44. Serpent Eagle, <i>Spilornis cheela</i>	-		+	-	-	-		+	-	-	-	-	-	-	-	-	-	-	Common, R.
45. White bellied Sea Eagle, <i>Haliaeetus leucogaster</i> Pallas's Fishing Eagle, <i>H. leucoryphus</i>	+ ?		-	-	+	-	-	-	-	+	+	-	-	-	-	-	-	-	Common R & B.
46. Whitebacked or Bengal Vulture, <i>Gyps bengalensis</i>	+		+		-	+	+	+	+	+	-	-	-	-	+	-	-	-	Common R & B.
47. Indian Longbilled Vulture, <i>Gyps indicus</i>	-		+	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	Common R & B.
48. Pale Harrier, <i>Circus macrourus</i>	+		-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	+	Scarce, W.
49. Pied Harrier, <i>C. melanoleucos</i>	+		-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	+	Scarce, W.

NAME	EAST		WEST		CENTRAL	NORTH			SOUTH										REMARKS	
	1		1	2	1	1	2	3	1	2	3	4	5	6	7	8	9	10		
50. Marsh Harrier, <i>C. aeruginosus</i>	+		-	+	+	+	-	+	-	+	+	-	-	-	-	-	-	-	-	Common, W.
51. Kestrel, <i>Falco tinnunculus</i>	+		+	-	-	-	+	+	+	-	-	-	-	-	-	-	-	-	-	Common, W.
52. Grey Partridge <i>Francolinus pondicerianus</i>	-		+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Common, R & B.
53. Bush Quail <i>Perdicula asiatica</i>	-		+	+																Fairly common R & B.
54. Bustard Quail <i>Turnix suscitator</i>	-		+	+	-	-	-	+	-	+	+	-	-	-	-	-	-	-	-	Common, R & B.
55. White breasted Water Hen <i>Amauornis phoenicurus</i>	+		+	-	-	-	+	+	-	+	-	-	-	-	-	-	-	-	-	Common, R & B.
56. Coot, <i>Fulica atra</i>	+		-	+	+	-	-	+	+	-	+	-	-	-	-	-	+	+	+	Common, W.
57. Bronze winged Jacana, <i>Metopidius indicus</i>	+		+	-	+	+	+	+	+	+	-	-	-	-	+	+	+	+	+	Common R & B.
58. Pheasant tailed Jacana, <i>Hydrophasianus chirurgus</i>	-		-	+	+	+	-	-	-	+	-	-	-	-	-	-	-	-	-	Common PM & N.
59. Blackwinged Stilt, <i>Himantopus himantopus</i>	+		+	+	+	+	+	+	+	+	+	-	-	-	+	+	+	+	+	Common PM & N.
60. Collared Praticole, <i>Glareole pratincola</i>	-		-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	Common

NAME	EAST		WEST		CENTRAL	NORTH			SOUTH										REMARKS
	1		1	2	1	1	2	3	1	2	3	4	5	6	7	8	9	10	
61. Redwattled Lapwing, <i>Hoplopterus indicus</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Very Common R & B
62. Grey Plover, <i>Pluvialis squatarola</i>	-		+	-	+	+	-	+	+	+	+	+	+	-	-	-	-	+	Common, M
63. Eastern Golden Plover, <i>Pluvialis dominica</i>	+		+	+	+				+	+	+	+	+	+	+	+	+	+	Common, M
64. Large Sand Plover, <i>Charadrius leschenaulti</i>	-		-	-	-	+	-	+	+	-	-	+	+	-	-	-	-	-	Common, W.
65. Ringed Plover, <i>C. hiaticula</i>	+		+	-	+	+	-	+	+	+	+	+	+	+	+	+	+	+	Common, W.
66. Little Ringed Plover, <i>C. dubius</i>	-		+	+	-	+	+	+	+	+	-	+	+	-	-	-	-	-	Common R&N&B.
67. Kentish Plover, <i>C. alexandrinus</i>	-		-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	Common, W.
68. Lesser Sand Plover, <i>C. mongolus</i>	-		-	+	-	+	-	+	+	+	+	+	-	-	-	-	-	-	Common, W.
69. Whimbrel, <i>Numenius phaeopus</i>	-		-	-	+	+	-	-	+	+	+	+	-	-	-	-	+	-	Scarce, W.
70. Eastern Curlew, <i>N. arquata</i>	-		-	-	+	+	-	-	-	+	+	+	+	+	+	+	+	+	Common, W.
71. Bartailed Godwit, <i>Limosa lapponica</i>	-		+	-	+	+	-	-	+	+	+	+	+	+	+	+	+	+	Common, W.

NAME	EAST		WEST		CENTRAL	NORTH			SOUTH										REMARKS
	1		1	2	1	1	2	3	1	2	3	4	5	6	7	8	9	10	
72. Spotted Redshank, <i>Tringa erythropus</i>	+		+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	Common, W.
73. Common Redshank, <i>T. totanus</i>	+		+	+	+	+	+	+	+	+	+	-	-	-		+	+	+	Common, W.
74. Marsh Sandpiper, <i>T. stagnatilis</i>	+		+	-	+	-	-	+	-	+	-	-	-	-	-	-	-	+	Common, W.
75. Green Sandpiper, <i>T. ochropus</i>	+		+	+	+	-	+	+	+	+	+	-	-	-	-	+	+	+	Common, W.
76. Wood Sandpiper, <i>T. glareola</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Common, W.
77. Terek Sandpiper, <i>T. terek</i>	-		-	+	+	+	-	+	+	+	+	+	+	+	+	+	-	-	Common, W.
78. Common Sandpiper, <i>T. hypoleucos</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Common, W.
79. Turnstone, <i>Arenaria interpres</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Common, W.
80. Pintail Snipe, <i>Gallinago stenura</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Common, W.
81. Fantail Snipe, <i>G. gallinago</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Fairly Common, W.
82. Longtoed Stint, <i>Calidris subminutus</i>	-		+	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	Scarce, W.

NAME	EAST		WEST		CENTRAL	NORTH			SOUTH							REMARKS			
	1		1	2	1	1	2	3	1	2	3	4	5	6	7		8	9	10
83. Temminck's Stint, <i>Calidris temminckii</i>	+		+	+	+	+	-	+	-	+	+	+	-	-	+	+	-	-	Common, W.
84. Dunlin, <i>Callidris alpinus</i>	+		-	+	+	+	-	-	-	-	+	+	-	-	-	-	-	-	Scarce, W.
85. Curlew Sandpiper, <i>Calidris testaceu</i>	-		+	-	+	+	-		-	-	+	-	-	-	-	-	+	+	Rare, W.
86. Ruff & Reeve, <i>Philomachus pugnax</i>	+		+	+	+	+	-	+	-	+	+	-	-	-	-	+	+	+	Common, R.
87. Avocet, <i>R. avocetta</i>	-		-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	Rare, M.
88. Stone Curlew, <i>Burhinus oediceus</i>	-		-	+	-	+	-	+	+	-	-	-	-	-	-	-	-	+	Common, R.
89. Great Blackheaded Gull, <i>Larus ichthyaeus</i>	+		-	+	+	+	+	+	+	+	+	+	+	+	-	-	+	+	Fairly common M.
90. Lesser Blackbackea Gull, <i>Larus fuscus</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Fairly common M.
91. Brownheaded Gull, <i>Larus brunicephalus</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Common R.
92. Blackheaded Gull, <i>Larus ridibundus</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Common R.
93. Whiskered Tern, <i>Chlidonias bybrida</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Common R.



(Top) Orange headed ground Thrush.

(Bottom) Pond Heron.



(Top) Purplerumped Sunbird.

(Bottom) Indian Paddyfield Pipit.



(Top) White bellied Sea Eagle.

(Bottom) Brahminy Kite.



(Top) Spotted Dove.

(Bottom) Little Cormorants.

NAME	EAST		WEST		CENTRAL	NORTH			SOUTH							REMARKS			
	1		1	2	1	1	2	3	1	2	3	4	5	6	7		8	9	10
94. White winged Black Tern, <i>Chlidonias leucoptera</i>	+		-	-	+	-	-	+	+	+	+	+	+	+	-	-	-	-	Common R.
95. Gullbilled Tern, <i>Gelocheilidon nilotica</i>	+		+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	+	Common R.
96. Caspian Tern, <i>Hydroproone caspia</i>	-		-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	Scarce, M.
97. River Tern, <i>Sterna aurantia</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Common R.
98. Common Tern, <i>S. hirundo</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Common R.
99. Black bellied Tern, <i>S. acuticauda</i>	-		-	-	+	+	+	+	-	+	-	-	+	+	-	-	-	+	Common R.
100. Lesser Created Tern, <i>S. bengalensis</i>	-		-	-	-	-	-	-	-	+	+	+	+	-	-	-	-	-	Common R.
101. Longtailed Nightjar, <i>Caprimulous macrurus</i>	-		+	+	+	+	+	+	+	+	+	+	+	-	-	+	+	+	Common R.
102. Jungle Nightjar, <i>C. indicus</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Common R.
103. Little or Indian Nightjar, <i>C. asiaticus</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Common R.
104. Common Hawk-Cuckoo, <i>Cuculus varius</i>	-		-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Fairly common R & N.

NAME	EAST		WEST		CENTRAL	NORTH			SOUTH							REMARKS			
	1		1	2	1	1	2	3	1	2	3	4	5	6	7		8	9	10
105. Spotted Owlet, <i>Athene brama</i>	-		+	-	-	-	+	+	+	+	-	-	-	-	-	+	-	-	Very common R.
106. Scops Owl, <i>Otus scops</i>	-		+	+	-	-	+	+	-	+	-	-	-	-	-	-	-	-	Common R.
107. Collared Scops Owl, <i>Otus backkamoena</i>	-		+	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	Fairly common R.
108. Dusky Horned Owl, <i>Bubo coromandus</i>	-		+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	Scarce R.
109. Palm swift, <i>Cypsiurus parvus</i>	+		+	-	-	+	+	+	+	+	-	-	-	-	-	+	-	-	Common R.
110. Lesser Pied Kingfisher, <i>Ceryl rudis</i>	+		+	+	+	+	+	+	+	+	-	+	+	+	-	+	+	+	Common R.
111. Small Blue Kingfisher, <i>Alcedo atthis</i>	+		+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	Common R.
112. White breasted Kingfisher, <i>Halcyon smyrnensis</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Common R.
113. Storkbilled Kingfisher, <i>Pelargopsis capensis</i>	+		+	-	-	+	-	+	+	+	+	-	-	-	+	+	+	+	Common R.
114. Green Bee-eater, <i>Merops orientalis</i>	+		+	-	-	-	+	+	-	+	-	-	-	-	-	-	-	-	Common R & N.
115. Indian Roller, <i>Coracias benghalensis</i>	-		+	+	-	-	+	+	-	+	+	-	-	-	-	-	-	-	Common R.

NAME	EAST		WEST		CENTRAL	NORTH			SOUTH										REMARKS
	1		1	2	1	1	2	3	1	2	3	4	5	6	7	8	9	10	
116. Hoopoe, <i>Upupa epops</i>	-		+	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	Common R.
117. Coppersmith, <i>Megalaima haemacephala</i>	-		+	-	-	-	+	+	-	+	-	-	-	-	-	-	-	-	Common R.
118. Large Green Barbet, <i>M. zeylanica</i>	-		+	+	-	-	+	+											Common R & N.
119. Blue throated Barbet, <i>M. asiatica</i>	-		+	-	-	-	+	-	+										Common R.
120. Eastern Skylark, <i>Alauda gulgula</i>	-		+		-	-	+	-	+										Common R.
121. Redwinged Bushlark, <i>Mirafra erythroptere</i>	-		-	-	-	-	-	-											Common R.
122. Bengal Bushlark, <i>M. assamica</i>	-		+	-	-	-	-	-	+										Common R.
123. Common Swallow, <i>Hirundo rustica</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Common M.
124. riated or Redrumped Swallow, <i>Hirundo daurica</i>	+				+														Common M.
125. Blackheaded Oriole, <i>Oriolus xanthornus</i>	-		+	-	-	-	-	+	-	+	-	-	-	-	-	-	-	+	Common R.
126. Golden Oriole, <i>Oriolus oriolus</i>	-		+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Scarce M.

NAME	EAST		WEST		CENTRAL	NORTH			SOUTH										REMARKS
	1		1	2	1	1	2	3	1	2	3	4	5	6	7	8	9	10	
127. Black Drongo, <i>Dicrurus adsimilis</i>	-		+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Common R.
128. Whitebellied Drongo, <i>D. caerulescens</i>	-		+	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	Common R.
129. Redvented Bulbu, <i>Pycnonotus cafer</i>	+		+	+	-	-	+	+	+	+	-	-	-	-	-	+	+	+	Common R.
130. White-browed Bulbul, <i>P. luteolus</i>	-		-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	Common, R.
131. Pied Myna, <i>Sturnus contra</i>	+		+	+	-	+	+	+	+	+	+	-	-	+	-	-	-	-	Common, R.
132. Common Myna, <i>Acridotheres tristis</i>	+		+	+	-	+	+	+	+	+	+	-	-	+	+	+	-	-	Common, R.
133. Jungle Myna, <i>Acridotheres fuscus</i>	-																		Common R.
134. House Crow, <i>Coryus splendens</i>	+		+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	Common R.
135. Jungle Crow, <i>C. macrorhynchos</i>	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Common R.
136. Yellow eyed Babbler, <i>Chrysomma sinensis</i>	-		+	+	-	-	-	+	-	-	-	-	-	-	-	-	+	-	Scarce R.
137 Large Grey Babbler, <i>Turdoides malcolmi</i>	-		-	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	Fairly common R.

NAME	EAST		WEST		CENTRAL	NORTH			SOUTH										REMARKS
	1		1	2	1	1	2	3	1	2	3	4	5	6	7	8	9	10	
138. Jungle Babbler, <i>T. striatus</i>	+		-	-	-	+	+	+	+	+	+	-	-	-	+	+	+	-	Common R.
139. Streaked Fantail Warbler, <i>Cisticola juncidis</i>	-		-	-	+	+	-	+	-	-	-	-	-	-	-	-	-	-	Common R.
140. Blacknaped Blue Flycatcher, <i>Monarcha azurea</i>	-		-	-	-	-	-	+											Scarce R.
141. Indian Wren Warbler, <i>Prinia subflava</i>	+		+	+	-	+	-	+	-	+	-	-	-	-	-	-	-	-	Common R.
142. Greenish Leaf Warbler, <i>Phylloscopus trochiloides</i>	-		+	+	-	+	+	+	-	+	-	-	-	-	-	-	-	-	Common M.
143. Chiff-chaff, <i>P. collybita</i>	+		+	-	-	-	-	+	+	+	-	-	-	-	-	-	+	+	Common M.
144. Dusky Leaf Warbler, <i>P. fuscatus</i>	-		+	+	-	-	+	+	+	+	-	-	-	-	-	-	-	-	Common M.
145. Indian Great Reed Warbler, <i>Acrocephalus stentoreus</i>	-		-	-	+	+	-	+	-	-	-	+	-	-	-	-	-	-	Common R & N.
150. Indian Paddyfield Pipit, <i>Anthus novaeseelandiae</i>	-		+	+	-	+	+	+	+	+	+	-	-	-	-	-	+	-	Common R.
151. Richards Pipit, <i>A. richardii</i>	-		+	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	Scarce, R.
152. Blue headed Yellow Wagtail, <i>Motacilla</i>	+		+	+	+	+	-	+	+	+	+	-	-	-	-	+	-	-	Common M.

NAME	EAST		WEST		CENTRAL	NORTH			SOUTH										REMARKS
	1		1	2	1	1	2	3	1	2	3	4	5	6	7	8	9	10	
153. Yellow headed Wagtail, <i>Motacilla citreola</i>	+		+	+	+	+	+	+	+	+	+	-	-	-	+	+	+	+	Common M.
154. Large Pied Wagtail, <i>M. madecaspatis</i>	+		+	+	-	+	+	+	-	+	-	-	-	-	-	-	-	-	Fairly common R.
155. House Sparrow, <i>Passer domesticus</i>	-		+	+	-	+	+	+	-	+	-	-	-	-	-	+	-	-	Common R.
156. Common weaverbird <i>Ploceus philippinus</i>	-		+	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	Common R & N.

Collected from Barodi, c 12 km West of Rambha. The specimens had worn plumage and nonbreeding gonad.

Common resident ground dwelling birds. Found almost throughout the park except the seafacing sides of the lake. Found singly or in pairs. Antivian predator aerial display was observed on the face of the Shikara and the Blackwinged kite even during September and October. Territory maintaining displays were also observed during that period at the day brake. Many a nest were also located on the ground along the edges of the lake amidst grassland and agricultural fields.

There were other 3 congeners of the Pipit observed in the lake areas which are the Richards Pipit, *Anthus novaesulandiae richandii* Vieillot, the Blyths Pipit, *A. n. godlewski* and the Pipit and all of them are winter visitor in the lake areas.

SUMMARY

During the course of surveys in one of the richest and prime bird habitat in India, Zoological Survey of India had encountered more than 175 species and sub-species of birds belonging to 35 families and 13 order. Present paper includes results primarily from 4 major Chilka Lake Expeditions and results of previous surveys conducted by Zoological Survey of India there. From the avifaunistic surveys it can be summarily concluded that this unique lake in Indian panorama should be conserved to help sustain the avian fauna in ever-depleting, retreating and shrinking arena.

ACKNOWLEDGEMENTS

I am grateful for the unrelentless support that had been bestowed on me by the expedition teammembers : Shri S.S. Saha, Assistant Zoologist, Sri S. R. Dey Sarkar, Sr. Zool. Assistant and Shri C. K. Mishra, Jr. Taxidermist, during the entire course of expeditions. I wish to extend my deepest sense of gratitude to Dr. A. K. Ghosh, Director, and Dr. K. V. Rama Rao, our team leader for their keenest support and constant inspirations, without which the present project would have been a failure. I also wish to extend my thanks to my divisional staffs Shri K. K. Biswas, Zool. Asstt. and Shri P. C. Soren, Lab. Asstt. for their help in every possible way or other to finalize the manuscript.

MAMMALIA

SUBHENDU SEKHAR SAHA
Zoological Survey of India, Calcutta

INTRODUCTION

Some seventyfive years ago Dr. Nelson Annandale, the then Superintendent of the Indian Museum, and his associate celebrated scientists carried out faunistic explorations during 1910 to 1919 in the Chilka Lake with a special emphasis on the Barkuda Island. The scientific results of those explorations were published in the Records of the Indian Museum in a series of papers. In 1916, when Zoological Survey of India was separated out of the Indian Museum, Dr. Annandale became its first Director. The next few years the new department kept itself busy with the Chilka Lake Survey works and the success of its first ever official endeavour was acclaimed with those series of papers in the tomes of the Records of the Indian Museum Journal.

Seventyfive years later, Zoological Survey of India conceived yet another attempt to make a resurvey of the Chilka Lake specially when the Orissa State Fauna work was nearing completion and a permanent station of the Survey being available at Berhampore, close to the lake. Furthermore, the latest survey work reasonably commemorates the 75 years of existence of the Zoological Survey of India by repeating its first ever endeavour in faunal survey work.

The faunal exploration in the Chilka Lake by ZSI was sporadic during the last few decades but, in the present phase began in 1985. It was only during 1986 and 1987, in course of the III & IV Chilka Lake Expeditions, integrated exploratory drive was taken for surveying the mammalian fauna.

MATERIAL & METHODS

Particular emphasis were driven towards the small and medium sized mammals for collection of specimens. Nylon Mist Nets, rat and mice traps, fire were other method, used for the purpose. Surrounding areas were scanned at random on foot as well as on vehicle particularly in the night hours. Besides specimen collection visual records were made during the survey work and informations from reliable local sources were also gathered.

In all 18 species of mammals spread into 103 examples were collected. The list of collected species provided in the following pages, for obvious reasons, is not complete and exhaustive for the total account of the mammal fauna.

SYSTEMATIC ACCOUNT

Taxonomy here has been largely adopted from Ellerman & Morrison-Scott (1966) unless otherwise stated.

All the measurements are in millimetre and external measurements were taken in field while preparing the study skin by the collector.

Class MAMMALIA

Order CHIROPTERA

Family PTEROPODIDAE

1. *Rousettus leschenaulti* (Desmarest)
Fulvous Fruit Bat.

Pteropus leschenaulti Desmarest, 1820. Encycol. Meth. Mamm., 1 : 110.

Type locality : Pondicherry, India.

Material : 8(M), 2(F)

Measurements :

	<u>Male</u>	<u>Female</u>
H&B	110-114	104.8
TI	12-14	11
Fa	82.9-86.5	80.6
E	19.8-20	18.5
Fu	23-	23

Locality : Satpara, Puri District, Orissa : 15 Sep, 18 Sep 1987.

Notes : Feeds on Ficus fruits along with Pteropus and Cynopterus after dusk.

2. *Pteropus giganteus giganteus* (Brunnich)
Flying Fox.

Vespertillo gigantea Brunnich, 1782. Dyrenes Historie, 1 : 45.

Type locality : Bengal, India.

Material : 2(M), 2(F).

Measurements :

	<u>Male</u>	<u>Female</u>
H&B	210, 275	220, 255
Fa	157, 170	155, 165
E	38, 40	39(2)
Fu	47, 48	48(2)

Locality : Rambha, Ganjam District, Orissa : 26 Nov 1986; Barkul, Puri District, Orissa : 4 Sep 1987.

3. *Cynopterus sphinx sphinx* (Vahl)
Short nosed Fruit Bat

Vespertilio sphinx Vahl, 1797. Shr. Nat. Selok Copenhegen, 4, 1 : 123.

Type locality : Tranqueber, India.

Material : 14(M), 20(F)

Measurements :

	<u>Male & Female</u>
H&B	78-84.6
Tl	7.5-9
Fa	66-71
E	18-21
F&cl	15.5-16

Locality : Satpara, Puri District, Orissa : 15 Sep, 18 Sep, 19 Sep, 1987.

Note : Colony of 30 to 50 animals were roosting in the crevices of Ficus and Callophylum trees.

Family EMBALLONURIDAE

4. *Taphozous longimanus* Hardwicke

Taphozous longimanus Hardwicke, 1825. Trans. Linn. Soc.

Type locality : Calcutta, West Bengal, India.

Material : 1(M).

Measurements : H&B 77, Tl 27.5, Fa 60, E 17, Tb 24.8, F&cl 13.2

Locality : Satpara, Puri District, 17 Sep 1987.

Family MEGADERMATIDAE

5. *Megaderma lyra lyra* Geoffroy

Megaderma lyra E. Geoffroy, 1810. Ann. Mus. H. N. Paris. 15 : 190.

Type locality : India (Madras?)

Material : 1(F)

Measurements : H&B 95, Fa 66, E 38, Facl 18

Locality : Satpara, Puri District, Orissa : 11 Sep 1987.

Note : Colony of 6 to 12 animals were roosting in deserted houses.

Family VESPERTILIONIDAE

6. *Scotophilus heathi* (Horsfield)

Nycticejus heathi (Horsfield), 1832. Proc. zool. Soc. London. 113.

Type locality : Madras, India.

Material : 3 (M)

Measurements : H&B 70-72, Tl 58-63, Fa 595-61, E 12.5(3), F&cl 15-15.5

Locality : Satpara, Puri District : 17 Sep, 18 Sep, 1987.

7. *Pepistrellus mimus mimus* Wroughton

Pepistrellus mimus mimus Wroughton, 1879. J. Bombay nat. Hist. Soc., 12 : 722.

Type locality : Maheskatri Dangs, Surat District, Maharashtra, India.

Material : 1 (M)

Measurements : H&B 36.5, Tl 28.5, Fa 28.1, E 7.5, Tb 11.4, F&cl 5.3

Locality : Rambha, Ganjam District, Orissa : 26 Nov 1986.

Order CARNIVORA

Family CANIDAE

8. *Canis aureus indicus* Hodgson
Indian Jackal

Canis aureus indicus Hodgson, 1833. Asiat. Res. 18, 2 : 237.

Type locality : Nepal.

Material : 1(M), 5 (F)

Measurements : H&B 650-780, Tl 220-230, E 68-71, Hf 140-155

Locality : Barkul, Ganjam District : 4 Dec, 7 Dec 1986; Satapra, Puri District : 9 Dec 1986; 11 Sep, 15 Sep, 19 Sep 1987.

Note : Common all around, specially in and around villages.

9. *Vulpes bengalensis* (Shaw)
Bengal Fox.

Canis bengalensis Shaw, 1800. Gen. Zool. 1,2 : 330.

Type locality : Bengal

Material : 2(M), 3(F)

Measurements : H&B 485-520, Tl 260-290, E 106-115, Hf 70-76

Locality : Rambha, Ganjam District : 26 Nov, 30 Nov 1986; Barkul, Ganjam District : 3 Dec 1986; Satpara, Puri District : 12 Sep 1987.

Note : Common all around

Family VIVERRIDAE

10. *Viverra zibetha zibetha* Linnaeus
Large Indian Civet

Viverra zibetha Linnaeus, 1758. Syst. Nat. ed. 10, p. 44.

Type locality : Bengal

Material : 1 (M)

Measurements : H&B 825, Tl 400, E 56, Hf 128

Locality : Satpara, Puri district : 9 Dec 1986.

Note : Not uncommon, specially near thicker jungles.

Remarks : Ellerman & Morrison-Scott (1966) provided its range in India from Nepal eastwards to South Kamrup in Assam. Pocock (1939) provided its distribution as Nepal, Sikkim, Bhutan, Upper Bengal and apparently S. Kamrup in Assam. In the foot-note : "... it must be very rare in Peninsular India. Since

no specimen was secured any where south west of the Ganges by the collectors of the Bombay Mammal Survey" However, he mentioned "Blandford included Orissa" and Chutia Nagpur. Danber Brander saw at Pachmari:"

11. *Viverricula indica indica* (Geoffroy)
Small Indian civet.

Civetta indica Geoffroy, 1803. Cat. Mamm. p. 113.

Type locality : Bengal

Material : 3(M), 2 (F)

Measurements : H&B 540-565, Tl 320-370 E 33-36 Hf 85-95

Locality : Barkul, Ganjam District : 2 Dec, 3 Dec 1986; Satpara, Puri District : 9 Dec 1986, 15 Sep 1987.

Note : Common all around. Retires in Screw-pine-thickets. Two males from Barkul and a female from Satpara are collected in December have the indistinct pattern, obscured by ochraceous tinge. One male and a female from Satpara collected in September have the pattern very distinct and unobliterated though the ground colour has the intensity of ochraceous tinge similar to December specimens.

12. *Paradoxurus harmaphroditus harmaphroditus* (Pallas)
Palm Civet.

Viverra harmaphroditus Pallas, in Schreber, 1777. Säugeth 3 : 426.

Type locality : ? India

Material : 5(M), 3(F)

Measurements : H&B 487-550, Tl 430-530, E 41-50, Hf 70-78

Locality : Satpara, Puri District : 10 Dec 1986, 11 Sep, 13 Sep, 15 Sep 1987.

Note : Profile of the skull changes considerably with the age. Old adult specimens appear robust and muzzle apparently shorter due to strongly developed zygomatic arch.

Remarks : Taylor (1891) described *P. nictitans* from Kondamals in Orissa. Ellerman & Morrison Scott (1965), Pocock (1939) treated it as *P. harmaphroditus nictitans* Taylor. Ali *et al* (1988) described *P. joradensis* from Simlipal in Orissa. But, both of them do not seem to have any subspecific distinction except the peculiar partial albinistic pattern in them. Albinism in this species has been widely marked, even one of the young female from Satpara has its tail tip white.

13. *Harpestes auropunctatus auropunctatus* (Hodgson)
Small Indian Mongoose.

Mangusta auropunctata Hodgson, 1836. J. Asiat. Soc. Bengal, 5 : 235.

Type locality : Nepal

Material : 2(M), 2(F).

Measurements : H&B 298-330, TI 217-245, E 16-24, Hf 52-58

Locality : Barkul, Ganjam District : 18 Jan 1986. Satpara, Puri District : 9 dec 1986; 13 Sep, 16 Sep 1987.

Note : One Satpara female is much paler and buffy; its narial skin is fleshy instead of blackish.

Family FELIDAE

14. *Felis chaus kutas* Pearson
Jungle Cat.

Felis kutas Pearson, 1832. J. Asiat. Soc. Bengal, 1 : 75.

Type locality : Midnapur, West Bengal.

Material : 3(M), 2(F)

Measurements : H&B 445-630, TI 248-278, E 64-70, Hf 135-145.

Locality : Rambha; Ganjam District : 29 Nov 1986. Ghantasita, Ganjam District : 26 Nov 1986. Barkul, Ganjam District : 7 Dec 1986; 4 Sep 1987.

Note : Fairly common all around.

15. *Felis viverrina* Bennett.
Fishing Cat.

Felis viverrinus Bennett, 1833. P.Z.S. London. 68.

Type locality : India

Material : 1(M)

Measurements : H&B 775, TI 220, E 45, Hf 160

Locality : Satpara, Puri District : 19 Sep 1987

Note : Occasionally moves in pair and active foraging during midnight near waterfront.

Remarks : Ellerman & Morrison-Scott (1965) mentioned ranging in Western Ghats, Western Sind and Kumaon in India. Pocock (1939) stated that precise range of the species from Ceylon, India and east of the Bay of Bengal to Cochin China and Java.

Order LAGOMORPHA

Family LEPORIDAE

16. *Lepus rigricollis ruficaudatus* Geoffroy
Common Indian Hare

Lepus ruficaudatus Geoffroy, 1826. Dist. Class H.N., 9 : 381.

Type locality : Bengal.

Material : 5(M), 4(F)

Measurements : H&B 422-460, Tl 45-85, E 85-94, Hf 96-115.

Locality : Rambha, Ganjam District : 1 Dec 1986, Barkul, Ganjam District : 3 Dec, 4 Dec 1986, 9 Sep 1987. Satpara, Puri District : 8 Dec, 9 Dec, 10 Dec 1986, 18 Dec 1987.

Note : Common all around.

Order RODENTIA

Family MURIDAE

17. *Mus booduga* (Gray)
Field Mouse

Leggada booduga Gray, 1837. Charlsworth Mag. N.H., 1 : 586.

Type locality : S. Maharashtra.

Material : 1(M)

Measurements : H&B 70, Tl 61, E 12, Hf 165

Locality : Breakfast Island (=Barkuda Island) : 27 Nov 1986.

Note : Captured at early night when it was feeding on dead fish near waterline.

18. *Tatera indica indica* (Hardwicke)
Indian Jerbil

Dipus indicus Hardwicke, 1807. Trans. Linn. Soc. London, 8 : 279.

Type locality : Near Benaras, Uttar Pradesh.

Material : 2(M), 2(F)

Measurements : H&B 148-162, Tl 181-204, E 20-24, Hf 37-42

Locality : Satpara, Puri District : 11 Sep, 18 Sep, 19 Sep 1987.

Note : Fairly common all around, especially on sandy soil.

Order CETACEA

Family DELPHINIDAE

19. *Orcaella brevirostris* (Owen)
Irrawadi Dolphin

Phocaena (Orca) brevirostris Owen, 1866. Trans. Zool. Soc. London.

Material : 1 unsexed.

Measurements : Not taken.

Locality : Satpara, Puri District.

Note : Fairly common in deep waters. A specimen netted by fishermen was left dead and putrified.

DISCUSSION

Field surveys carried out during 1910 to 1919 in the Chilka Lake area by the team of Dr. Annandale could procure 18 species (= 17 species according to current taxonomy) of mammals. Annandale (1921) remarked that the Mammalian fauna is chiefly remarkable for its deficiencies.

Bombay Natural Society's Mammal Survey during 1920's could procure 9 species as reported by Hinton & Lindsay (1926).

The current Faunistic Expeditions by Zoological Survey of India produced 18 species of

mammals. Of them, *Cynopterus sphinx*, *Rousettus leschenaulti*, *Taphozous longimanus*, *Felis chaus*, *Vulpes bengalensis*, *Viverra zibetha*, *Paradoxurus harmaphroditus* and *Tatera indica* were not taken before, with the exception of *Vulpes bengalensis*, which was taken in 1956 by ZSI team headed by Dr. A. K. Datta. The present expedition also observed occurrence of the following species, namely *Macaca mulatta*, *Presbytis entellus*, *Hyaena hyaena*, *Tragulus meminna* and *Hystrix cristatus*.

The quality of the mammal fauna suggests that they are at a depauperated condition which is a general trend throughout the Eastern Ghat complex. However, much can be improved by habitat management and extending new areas for suitable home for the mammalian species in the terrestrial as well as in the aquatic system, particularly when many forest dwelling species like Tiger, Leopard and Sloth Bear do occur in the vicinity of the Lake area.

REFERENCES

- Ali, S. M., Chattaopadhyay, S., Kankane, P.L. & Gayen, N.C. 1988. A new species of Palm Civet from Simlipal, Orissa *Rec. zool. Surv. India*. 85 : 45-58.
- Annandale, N. 1921. The Fauna of an Island in Chilka Lake. Pt. I. *Rec. Ind. Mus.* 22 (IV) : 313-421.
- Ellerman, J. R. & Morrison-Scott, T.C.S. 1966. Checklist of Palaearctic and Indian Mammals. 2nd Ed. Brit. Mus. (N.H.), London.
- Hindton, M.A.C. & Lindsay, H.M. 1926. Bombay Natural History Society's Mammal Survey of India, Burma and Ceylon. Supplement to Report No. 41. *J. Bombay nat. Hist. Soc.* 31(2) : 402-403.
- Pocock, R.I. 1939. The Fauna of British India including Ceylon and Burma. Vol. 1. Taylor & Francis, London. 1941. Vol 2.

MAMMALIA : RIVER DOLPHIN

P. DHANDAPANI

Zoological Survey of India, Madras

INTRODUCTION

River dolphins are a rarity all over the world; and when present are restricted to limited areas of distribution within the ecosystem due to various reasons. From India, the Gangetic River Dolphin, *Platinesta gangetica* (Roxburgh 1801), was familiar until Annandale (1915) discovered the Irrawady River Dolphin, *Orcaella brevirostris* Gray (1866) from Chilka Lake. But, mysteriously his record remained unknown till Dhandapani (1992), to the great surprise of the cetacean Specialists of the world, brought to notice the existence of Annandale's literature and also the presence and present status of this dolphin in Chilka Lake (William F. Perrin, Chairman, IUCN Cetacean specialists Group, *pers. comm.*).

Orcaella brevirostris Gray (1866), in India, inhabits perennial river-estuaries, brackishwater lakes and mangrove creeks that are connected with the Bay of Bengal (Anderson, 1878; Annandale, 1915; James, Rajagopal, Dan, Bastian Fernando and Selvaraj, 1989; and Dhandapani, 1992). The present account deals with a population of Irrawady River Dolphin from Chilka Lake which was dwindled very much in number.

STUDY AREA AND MATERIAL

Chilka lake is the largest brackishwater body in Asia; and lies in Orissa State, India. It is connected to the Bay of Bengal by a small mouth. The Zoological Survey of India has conducted a multidisciplinary faunistic survey from 1985-88. The present description and the study deals with the material that was seen dead and afloat in the Northern sector of the lake on the 3rd of December, 1985. A week earlier to this a dead and decomposed body of another dolphin which was beyond handling stage, was sighted at the shore of Breakfast island.

DESCRIPTION

The body is torpedo shaped. Length from tail cleft to melon, 1.4m; each flipper is 21 cms; the length of each fluke from notch base to fluke tip, 22 cms.; notch base to cleft of tail, 17 cms.; distance between the tips of flukes, 37 cms.; maximum height in front of dorsal fin, 32 cms.; and the height of dorsal fin, 7 cms.

Orcaella brevirostris Gray (1866) in bluish grey above, and paler below. It is easily distinguishable by the melon on the forehead, and the blunt dorsal fin (hence Snubfin dolphin, Lyall Watson, 1985), that is situated behind the midpoint of the body. A middorsal keel extends between the dorsal fin and the notch of the tail. The tail is typical of cetaceans with the cleft pointing towards the notch. A demarcating

constriction resembling a groove runs vertically at the junction of the neck and body. The blowhole is placed just adjoining to the left of midventral line between the eyes. The flippers are elipsoid shaped with ovate tips.

During the present survey, the author noticed only three live specimens. These were observed surfacing for a moment and immediately dipping down to dive. While surfacing, the melon alone was visible above water surface; then the animal blows and disappears.

DISCUSSION

This article is thus entitled only to forewarn the possibility of Irrawady River Dolphin turning from 'Vulnerable' to 'Endangered' Category due to deteriorating environmental conditions in Chilka lake. Obviously, such a serious warning of this type needs to be supported with evidence and calls for discussion over the status of this dolphin as follows :

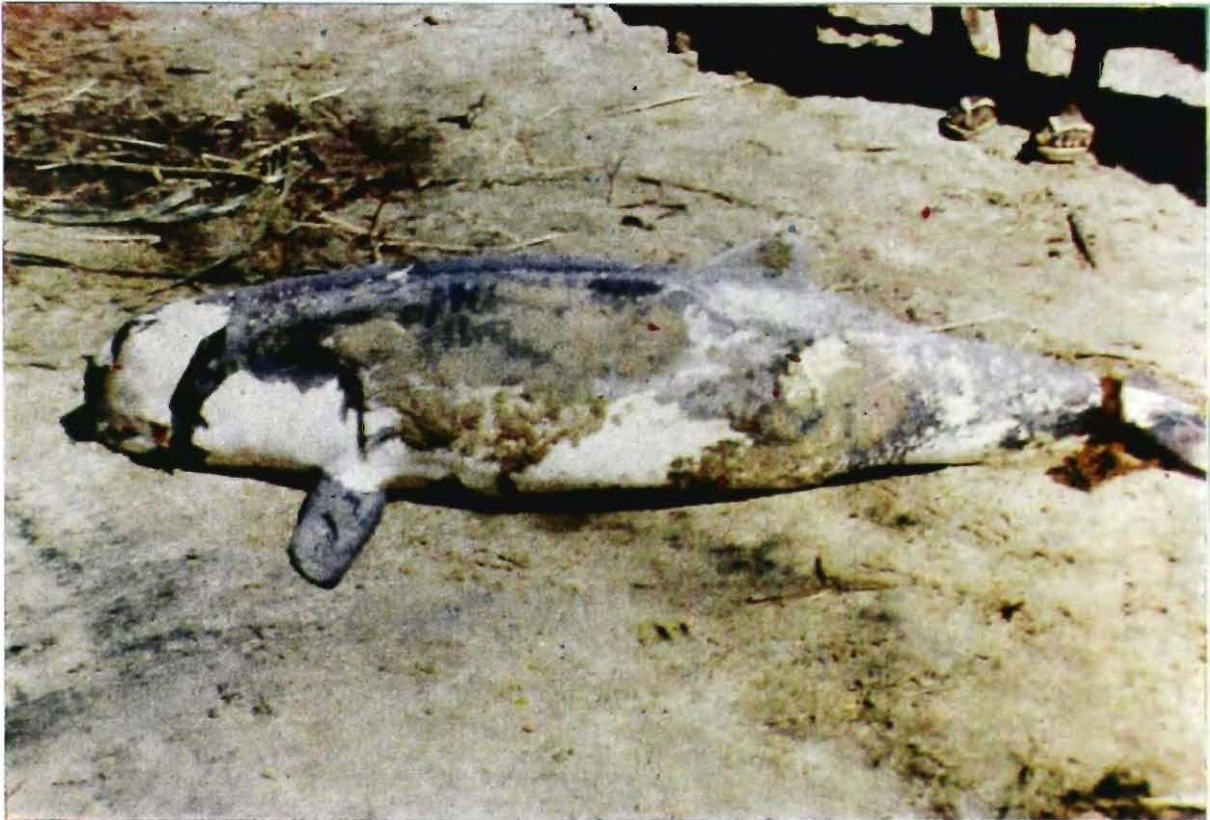
Annandale (1915) was the first to record *O. brevirostris* in Chilka Lake. Commenting on the presence of these dolphins in the channel area of the lake he says, "In this part of the lake system it was usually seen in parties of three or four. When the lake was full the parties kept to the middle of the channel" "At Satpara, individuals were frequently observed rolling over and over on the shelf of sand at the margin of the lake". He further observed at Ghantasila and Barkul points 'the cetacean would often rush in straight towards the rocks as if about to land upon them..... the forepart of the body practically out of water'.

Such a pleasing sight which Annandale has enjoyed is a dream today. The author, as mentioned above, has sighted only three live dolphins during a six month survey period conducted intermittently.

The very fact that no other published descriptions on these dolphins of Chilka lake is available for the past seventy years until Dhandapani (1992) brought it to the notice of the scientific community and also to the International Union for Conservation of Nature and Natural Resources (IUCN) only indicates the rarity of spotting of these dolphins. It is time to realise and analyse the reasons for such a turn out of events; and also to assess the present status of this species in Chilka lake and take a decision to protect and perpetuate the species.

The following could be the reasons for the depletion of Irrawady Dolphin in Chilka lake, Orissa.

- (1) As Annandale (1915) has observed, the dolphins were being exploited by spearing them for the sake of oil, believed to be a cure for rheumatism.
- (2) Enormous amount of silt deposited by the flooding rivers during monsoon for the past seven decades resulting in the increase of the shallowness of the lake. This is evidenced by the records of Annandale & Kemp (1915) and the latest recording in the log book of the Chilka lake Expedition, when compared, thus leading to the deterioration of the living space.
- (3) The possibility of the dolphins getting entangled in the dragnets and gill nets and being drowned also cannot be ruled out as it happens in the sea (James *et al*, 1989).



Orcaella brevirostris Gray (1866) A victim of accidental entangling in fishing nets.

Ultimately, the Irrawady River Dolphins fall under the Category of 'Vulnerable' species as defined by the IUCN Red List of Threatened Animals (1988) since 'most or all the populations are decreasing because of over-exploitation, extensive destruction of habitat or other environmental disturbance'. Therefore, as feared by the author that, if timely action is not taken by the concerned authorities of State and Central administration, this dolphin would become an 'Endangered' species due to 'continuous operation of the above stated factors'.

CONCLUSION

Orcaella brevirostris (Gray, 1866), is a rare dolphin that is restricted to the rivers and coasts from Bay of Bengal to North Australia. The Chilka lake population of this dolphin is 'Vulnerable' and needs to be watched and protected as it might turn 'Endangered' due to deteriorating environmental conditions.

SUMMARY

About seven decades ago, *Orcaella brevirostris* Gray (1866), otherwise known as Irrawady River Dolphin, was present in innumerable numbers in Chilka Lake. Presently its number has dwindled to a few due to paucity of favourable environmental conditions in the lake. Classified as 'vulnerable' by the IUCN Cetacean Specialists Group, this species, if not cared for in time, would soon become 'endangered' in Chilka Lake.

ACKNOWLEDGEMENT

The author is highly thankful to Shri Samantha Singh, Asst. Director of Fisheries, Balugaon Division, Govt. of Orissa, for having helped to tow the carcass of the specimen to the shore for study.

REFERENCES

- Anderson, J. 1878. Anatomical and Zoological Researches comprising an account of the Zoological Results of the two Expeditions to Western Yunnan in 1868 and 1875, and a monograph of the two Cetacean Genera *Platinesta* and *Orcaella*. Vol. I Text, Vol. II plates, London.
- Annandale, N. 1915. Fauna of Chilka lake. Mammals, Reptiles and Betrachians. *Mem. Indian Mus.* 5(1) : 166-167.
- Annandale, N. and S. Kemp. 1915. Fauna of Chilka lake : Introduction. *Mem. Indian Mus.* 5(1) : 1-20.
- Dhandapani, P. (1992), Status of Irrawady River Dolphin, *Orcaella brevirostris* Gray (1866), in Chilka lake. *J. mar. biol. Ass. India*, 34.(1&2) : 90-93, plt. I.
- James, P.S.B.R., M. Rajagopalan, S. S. Dan, A. Bastian Fernando and V. Selvaraj, 1984. On the mortality and stranding of marine mammals and turtles at Ghahirmatha, Orissa from 1983 to 1987. *J. mar. biol. Ass. India* 31 (1 & 2) : 28-35.
- Lyll Watson, 1985. Whales of the World. *Hutchinson*.

PHYTO AND ZOOPLANKTON

M. SRINIVASAN

Zoological Survey of India, Madras

INTRODUCTION

The phyto- and zooplankton play a vital role in the food cycle of any aquatic environment, as they are the primary and secondary producers and the remaining organisms are entirely depending on them for their survival. So the studies on the planktonic organisms have become important to know the fluctuation in abundance of other higher herbivores and carnivores. With this ultimate view, this study on the plankton of the Chilka lake was carried out.

Chilka lake, located in the Orissa State, along the east coast of India, is an estuarine lake or brackish water lake, with connections to the sea Bay of Bengal. The studies on the 'Fauna of Chilka Lake' was initiated by Anandale and Kemp (1915) and a few groups such as Sponges, Coelenterata, Polyzoa, Cirripedia (Anandale, 1915), Oligochaeta (Stephenson, 1915), Decapoda (Kemp, 1915), Gastropoda and Lamellibranchiata (Anandale and Kemp, 1916), Nudibranchiata (Eliot, 1916), Cumacea (Kemp, 1916), Amphipoda (Chilton, 1921), Polychaeta (Southern, 1921) and Copepoda (Sewell, 1924) from the Chilka lake were already reported. Further the fishes of the Chilka lake (Jones and Sajansingan, 1954; Jhingran, 1963; Jhingran and Natarajan, 1969, 1973), benthic organisms (Patanaik, 1971; Rajan, 1965) and hydrographic features (Ramandham et al, 1964; Banerjee and Roychoudhry, 1966; Mohanty, 1975) are well known. Recently, Pattanaik (1986) reported the spatial distribution of the zooplankton in the Chilka Lake.

But, so far very little is known about the phyto- and zooplankton of the Chilka lake, based on the samples collected during three different seasons (pre-monsoon, monsoon and post-monsoon). The three expeditions conducted by the Zoological Survey of India under the leadership of Dr K. V. Rama Rao, in the Chilka lake during the three seasons for exploring the plankton, hydrography and benthos have given the author an opportunity to participate, collect, analyse and report the results in this account.

MATERIAL AND METHODS

The Chilka lake is situated between 19°28' and 19°54' N latitudes and 85°06' and 85°35' E longitudes. Its area is about 900 square Kilometres in the summer and extends upto 1160 square Kms in the rainy season. The lake has a 29 Km long and 365 metre wide outer channel that opens into the sea, Bay of Bengal near the village Arakhudha and a main area which is about 65 Kms long and 20 Kms wide. For the purpose of convenient study, the lake is arbitrarily divided into four sectors, based on the salinity conditions such as, the southern sector, where the salinity variations from one season to another is minimum, the central sector, where the salinity fluctuates to some extent, the northern sector, where the salinity fluctuation is very high from one season to another as it receives the flood water from the branches of the river Mahanadhi during the rainy season and the outer channel that connects the sea and lagoon is much affected by the flood waters and sea water (Jhingran, 1963). The bottom of the main area is muddy and that of the outer channel is sandy. The other details of the origin and topography of the Chilka lake

are well reported in the Introduction chapter of the Fauna of the Chilka Lake by Anandale and Kemp (1915).

For the present investigation, the samples were collected from the stations fixed at 2.5 Kms interval, on a grid pattern in the main area and outer channel. The first expedition was conducted during the post-monsoon period between 22.11.1985 and 5.12.1985 and the plankton samples were collected from 45 hydrographic stations. The second expedition was conducted during the pre-monsoon period from 11.6.1986 to 29.6.1986 and the plankton samples were collected from 71 hydrographic stations and the third one was during the monsoon season, between 4.9.1987 to 26.9.1987 and the samples were collected from 100 hydrographic stations.

The phytoplankton samples were collected with 30 cm diameter ring net made of bolting silk, with the mesh size of 0.069 mm and the zooplankton samples were collected with 50 cm diameter ring net made of bolting silk with the mesh size of 0.33 mm. All the samples were collected by dragging the nets horizontally for five minutes, at the lateral sides of the boat, while the boat fitted with an outboard motor was in operation at one Km speed. The samples were preserved in 4% formaldehyde solution buffered with hexamine. Displacement volume of the plankton was estimated in the laboratory and the volume was utilized for the spatial and temporal distribution maps, as the samples were collected with the same type of craft, gear, time duration and the speed of the craft was also same during the collection of samples.

SPATIAL DISTRIBUTION

Displacement volume of the 45 phytoplankton samples collected during the first expedition (post-monsoon period) varied from 0.2 ml to 27.0 ml. The minimum volume was from the sample collected at the station B-4 located in the southern sector of the lagoon, where the salinity was 8.51‰. The maximum volume was from the station O-9, located in the central sector (Fig.1) near Satpara, where where the salinity was 1.99‰. Both the samples were collected in the afternoon at about 1515 hrs.

Among the 45 zooplankton samples collected during the first expedition, the minimum volume (0.4 ml) was from the station C-3 located in the southern sector, where the salinity was 8.03‰ and the maximum volume (52.0 ml) was from the station Q-10, located in the northern sector near Satpara (Fig.1), where the salinity was 1.83‰.

The general pattern of distribution of phyto- and zooplankton volumes from the samples collected during the first expedition revealed that it was definitely more in the central sector (Fig.2,3) near the Satpara region and the volume was less in the southern sector (less than 10.0 ml) and was moderate in the northern sector (less than 36.0 ml).

In the same manner the displacement volume from the samples collected during the second expedition (pre-monsoon period) was determined and out of the 71 phytoplankton samples collected, minimum displacement volume (0.5 ml) was from the stations, F-11, J-14 and O-8. All these three stations are located in the central sector (Fig.4) of the lagoon where the salinity was 15.5‰ and 13.0‰ and 17.0‰ respectively and the maximum volume was (23.7 ml) at the station L-16 located in the northern sector, where the salinity was 8‰ (Fig.4).

Among the zooplankton samples, the maximum volume (26.5 ml) was from the station L-16,

located in the northern sector and the minimum volume (0.2 ml) was from the station D-5 located in the southern sector (Fig .4), where the salinity was 12.5‰.

The general pattern of distribution of both the phyto and zooplankton collected during the second expedition showed that it was uniformly more in the central sector than in the southern and northern sectors, except from the two samples collected at the stations L-16 and N-17 located in the northern sector (Fig .5,6), where the salinity was less than 3‰.

The third expedition was conducted during the monsoon period and among the 100 samples of phytoplankton, the maximum volume was (34.0 ml) at the station G-9 (Fig .7), located in the central sector, where the salinity was 14.0‰ and the minimum volume was (0.2 ml) from the station N-9 located in the central sector (Fig .7), where the salinity was 5‰.

Among the 100 zooplankton samples collected, the maximum volume (37.0 ml) was from the station S-15, located in the northern sector (Fig .8), where the salinity was 2.0‰ and the minimum volume (0.1 ml) was from the stations A-2 and H-10, located in the southern and central sectors respectively, where the salinity was 15.0‰ and 11.0‰.

The general distribution pattern of the phytoplankton during the monsoon season revealed that the volume was more in the central sector (Fig .9) than in the southern and northern sectors and the zooplankton also showed the same trend of abundance (Fig .10), except a stray increase at one station, S-15.

TEMPORAL DISTRIBUTION

The analyses of the displacement volume of the phytoplankton samples collected during the pre-monsoon, monsoon and post-monsoon periods revealed that it was more abundant in the central sector near the Satpara region, southern side of the northern sector adjacent to the central sector. and in the outer channel during the post-monsoon period (Fig .2). During the pre-monsoon period also, the volume was more in the central sector and in the outer channel (Fig .5), whereas, during the monsoon period, the volume was more only in the central sector, than in the southern sector, northern sector and outer channel (fig .9). So, not much variation was noticed in the fluctuation of the plankton in the southern sector of the lake, irrespective of the seasons. Further, in the central sector of the lake also, the fluctuation of the phytoplankton volume during the pre-monsoon and post-monsoon periods was not marked. Whereas, in the outer channel area, the volume of the phytoplankton was more during the pre-monsoon and post-monsoon seasons than during the monsoon season. In the northern sector of the lake, the volume of the phytoplankton was generally less than 5.0 ml during all the three seasons, except some stray increase in the volume in one or two stations.

The analyses of the zooplankton samples collected during the post-monsoon season revealed that the displacement volume was more in the central sector near the Satpara region, in the outer channel and in the southern side of the northern sector adjacent to the central sector than in the southern sector of the lagoon. Whereas during the pre-monsoon period the volume was more in the northern sector than in the southern and central sectors and during the monsoon season, the volume was more in the central and northern sectors than in the southern sector and in the outer channel.

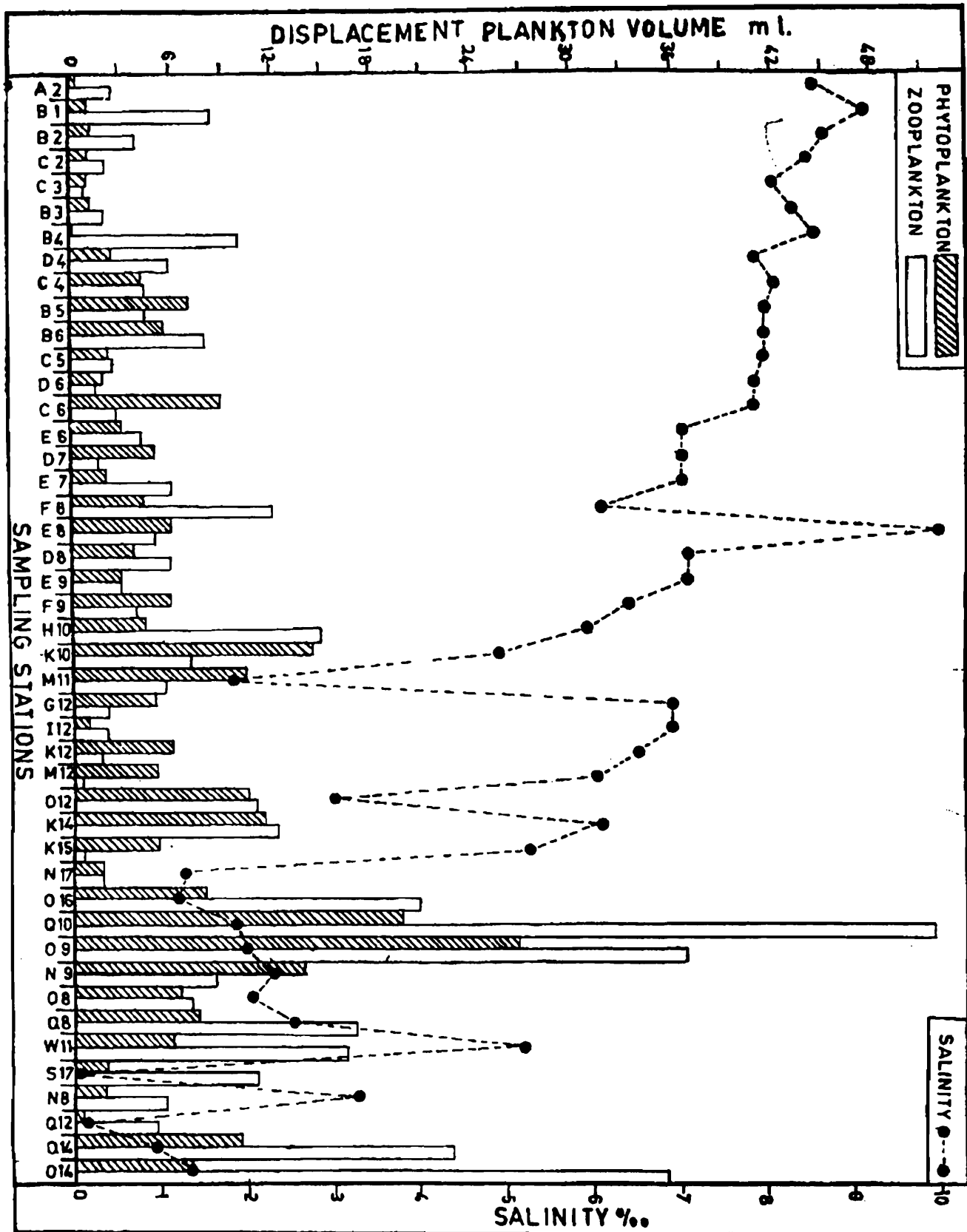


Fig. 1. Fluctuation of phyto - and zooplankton volumes in relation to salinity from the 45 sampling stations, during the post-monsoon period in Chilka lake.

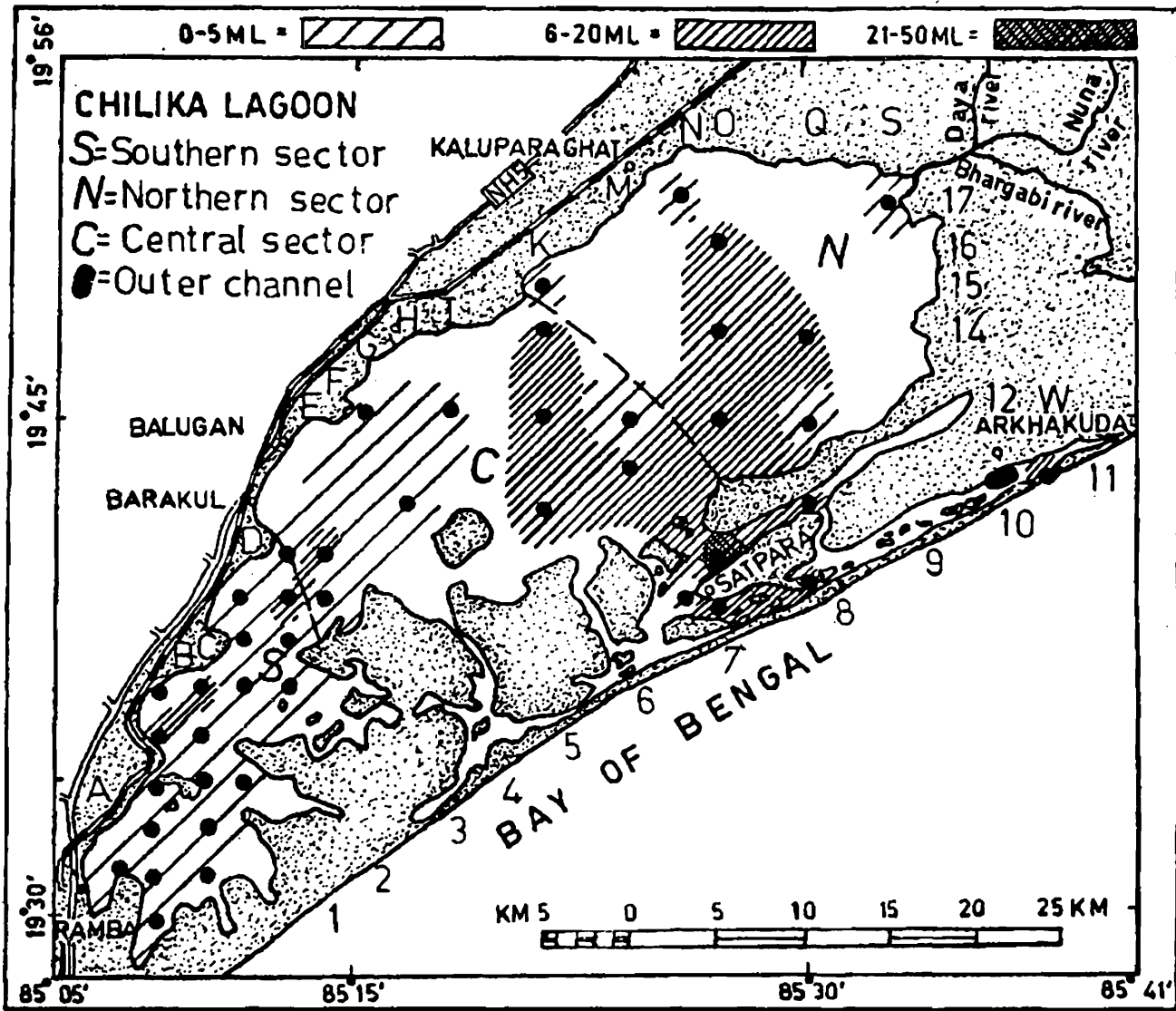


Fig. 2. Distribution of phytoplankton in the Chilika lake during the post-monsoon period.

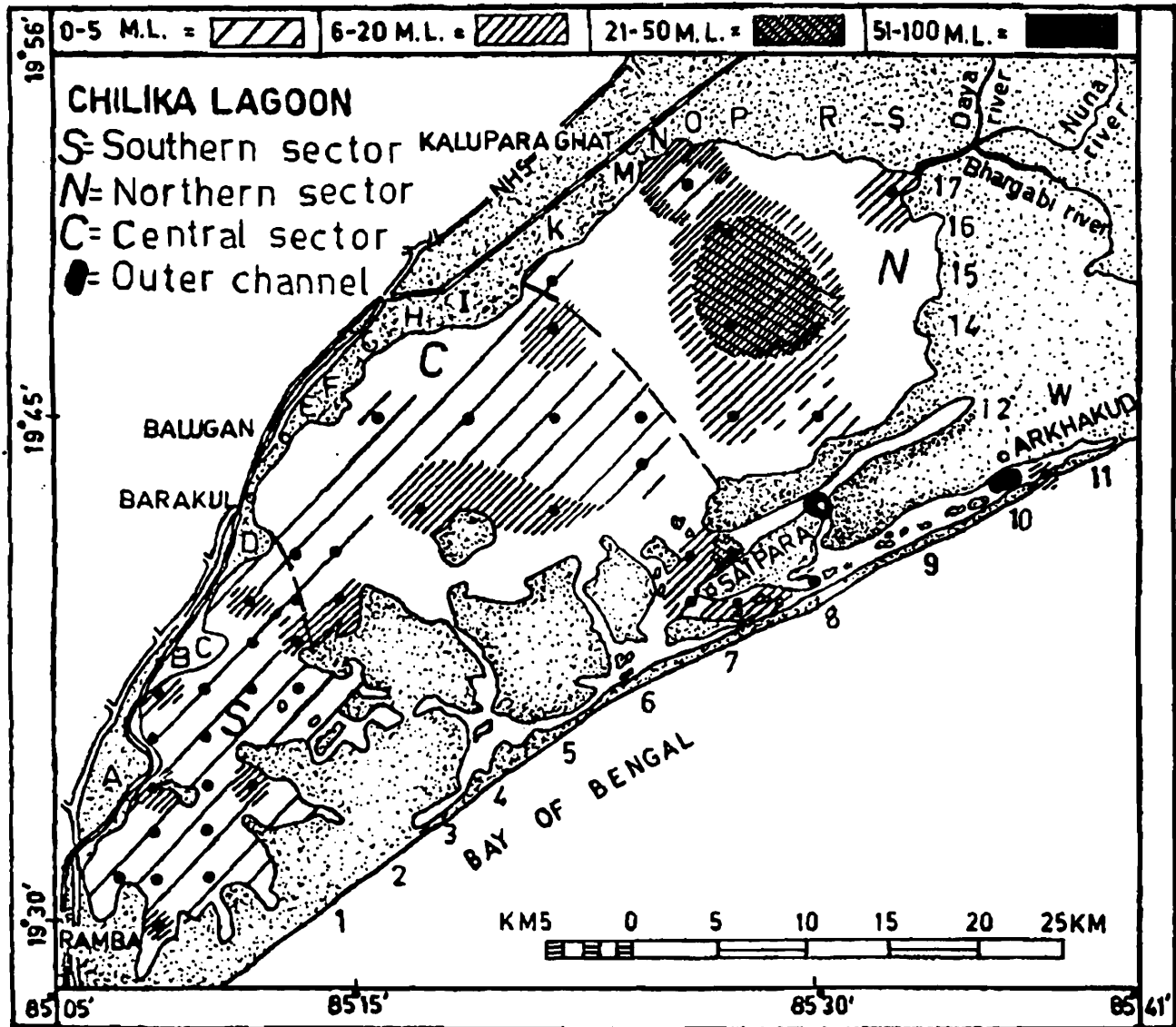


Fig. 3. Distribution of Zooplankton in the Chilka lake during the post-monsoon period.

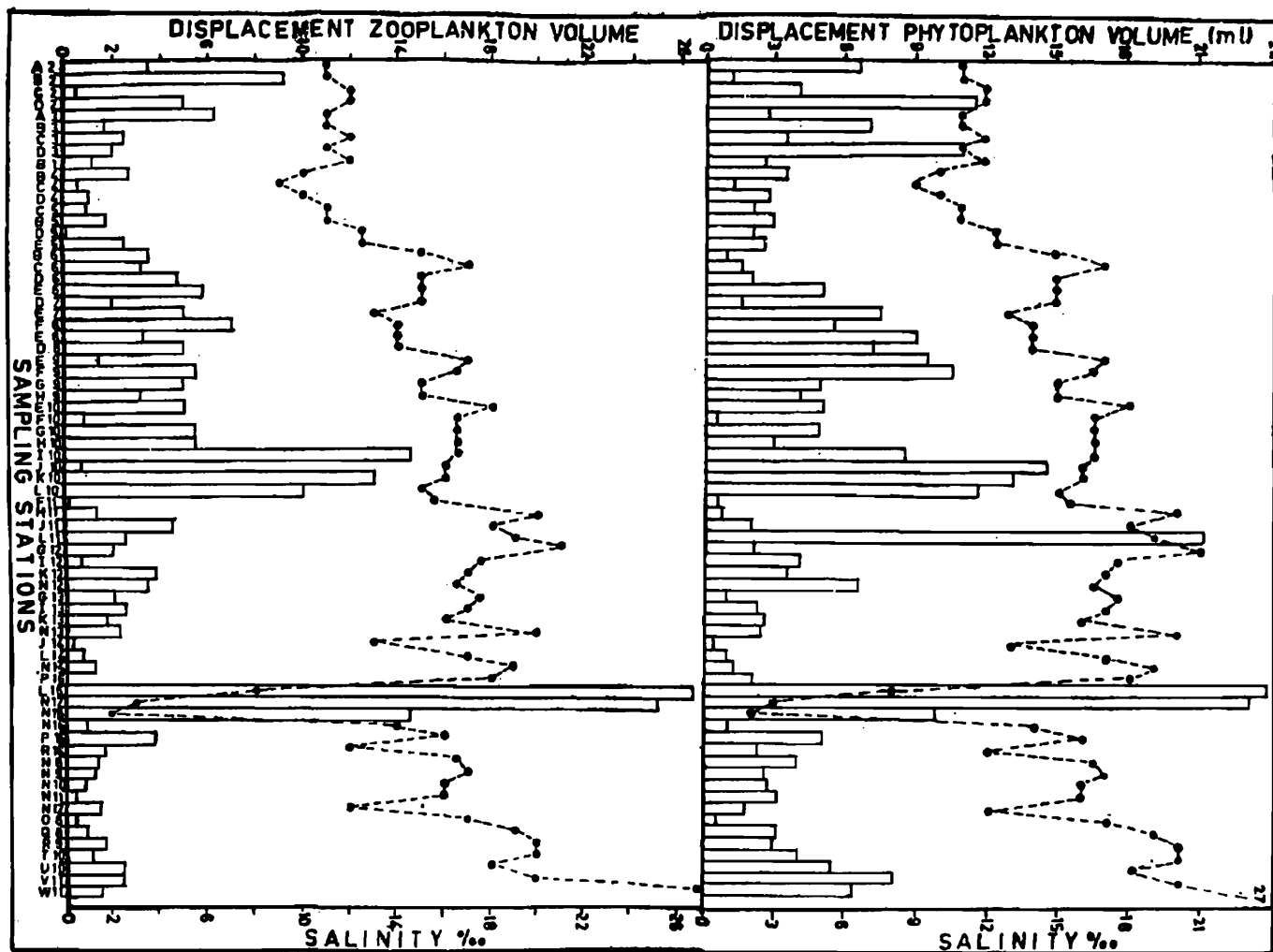


Fig. 4. Fluctuation of phyto - and zooplankton volumes in relation to salinity from the 71 sampling stations, during the pre-monsoon period in Chilka lake.

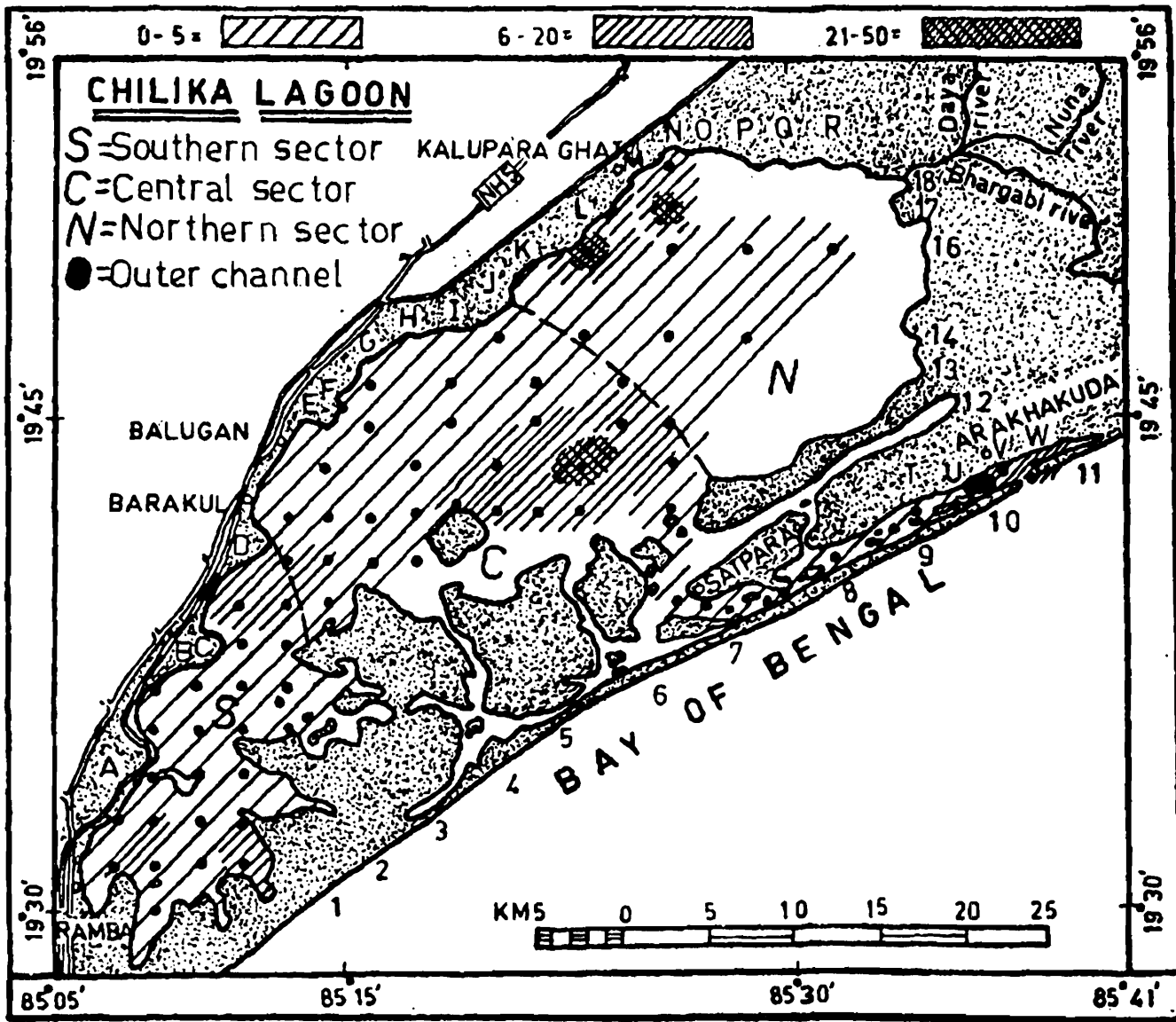


Fig. 5. Distribution of phytoplankton in the Chilka lake during the pre-monsoon period.

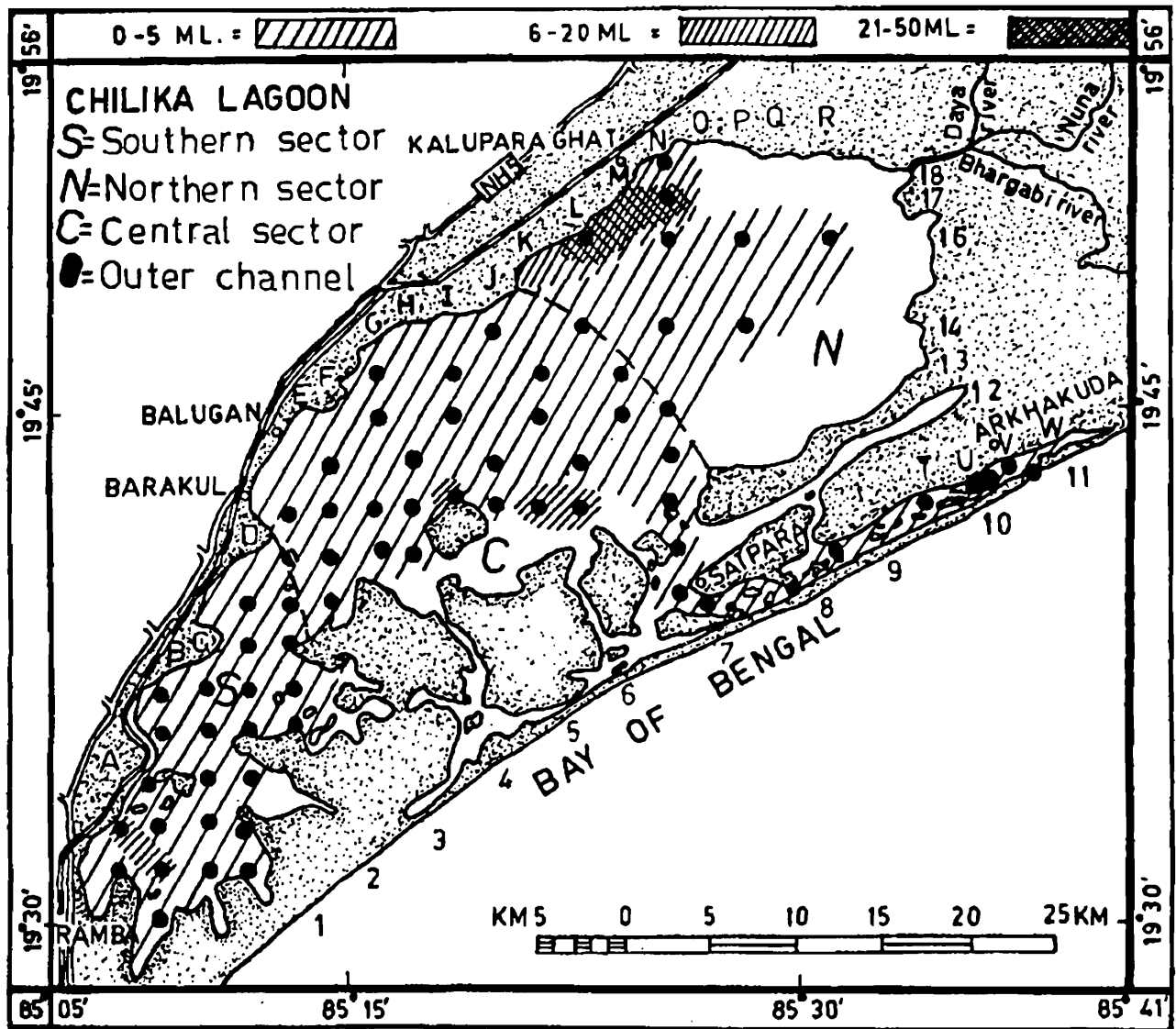


Fig. 6. Distribution of zooplankton in the Chilika lake during the pre-monsoon period.

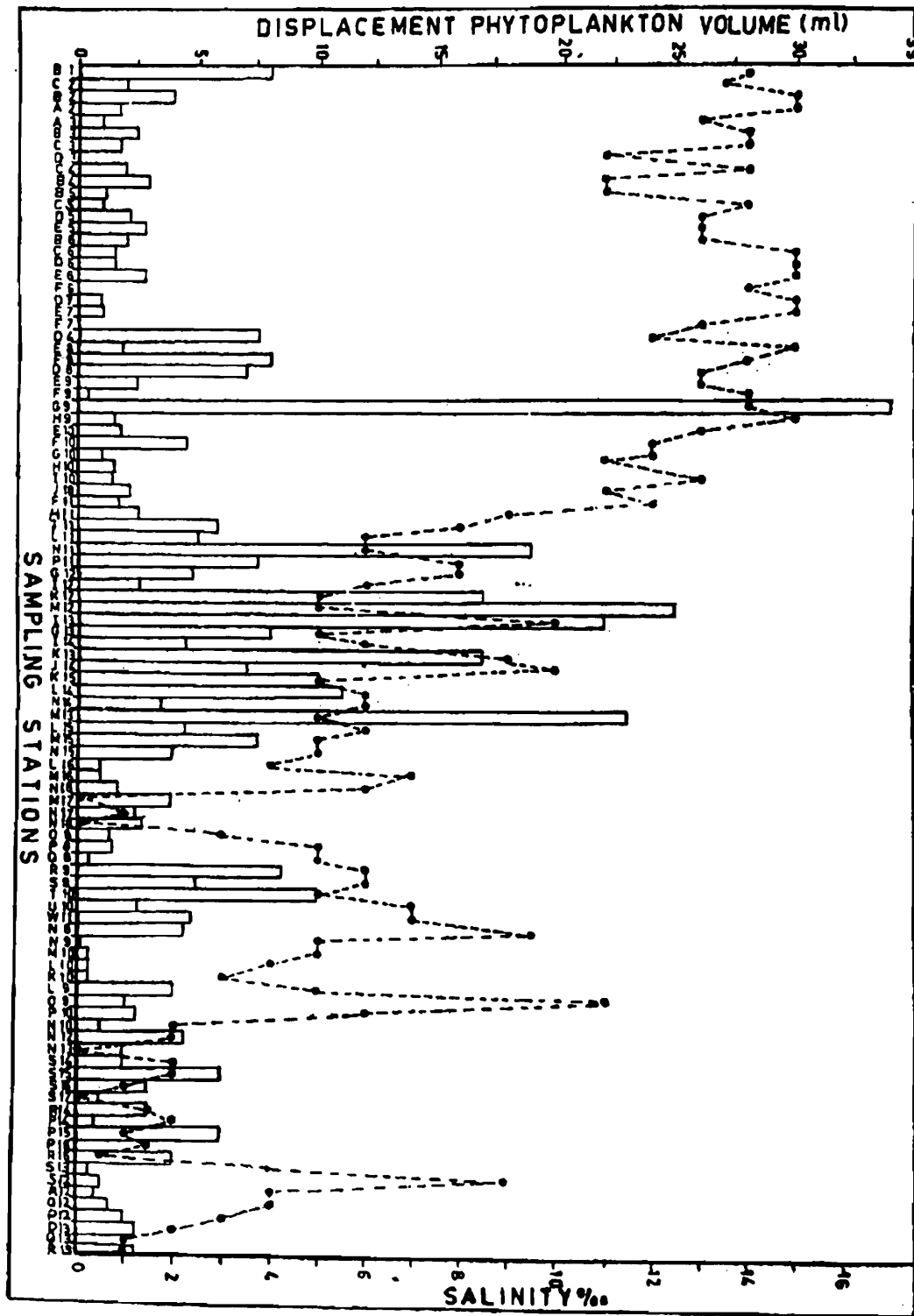


Fig. 7. Fluctuation of phyto-plankton volumes in relation to salinity from the 100 sampling stations, during the monsoon period in Chilka lake.

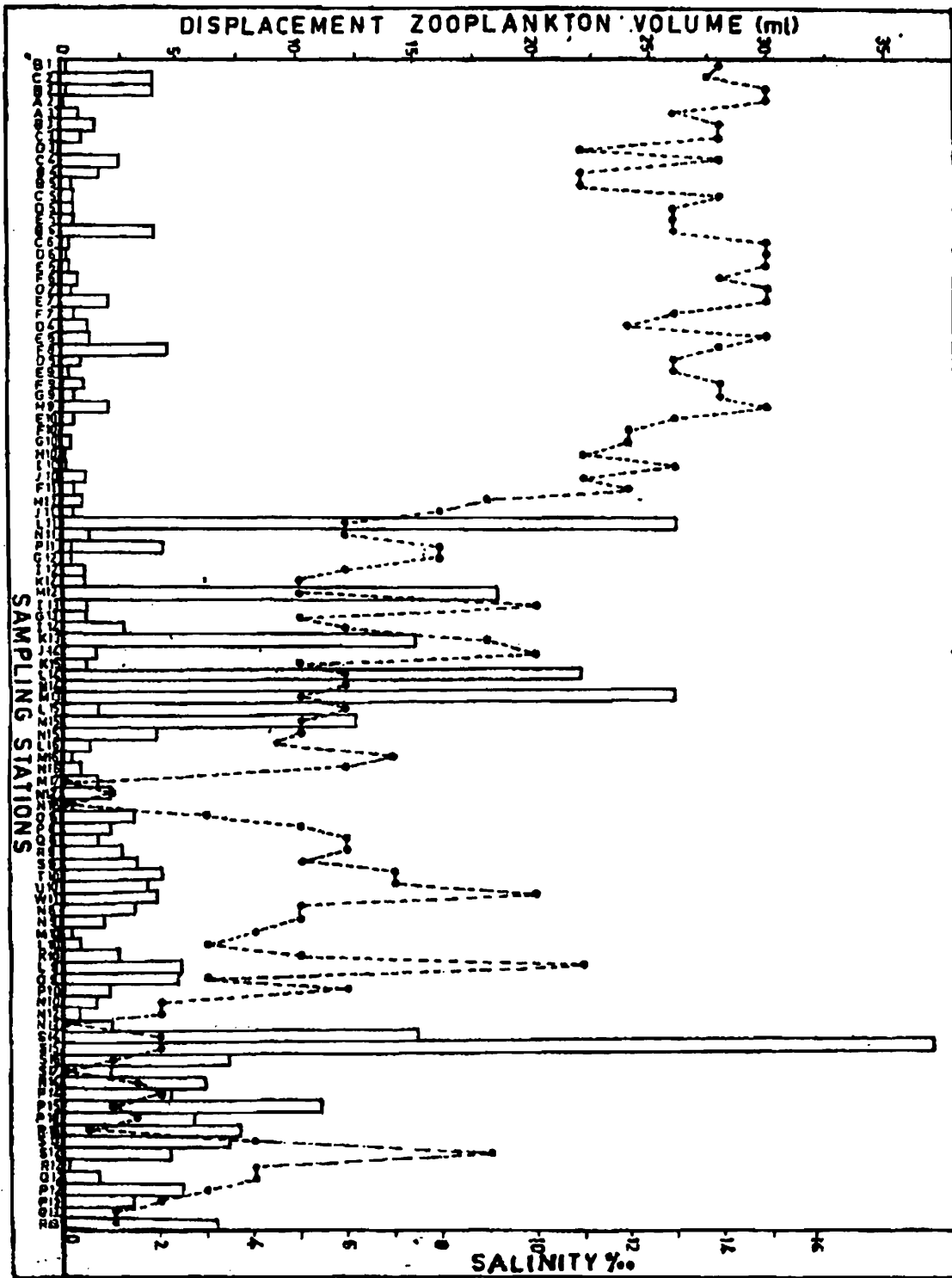


Fig. 8. Fluctuation of zoo-plankton volumes in relation to salinity from the 100 sampling stations, during the monsoon period in Chilka lake.

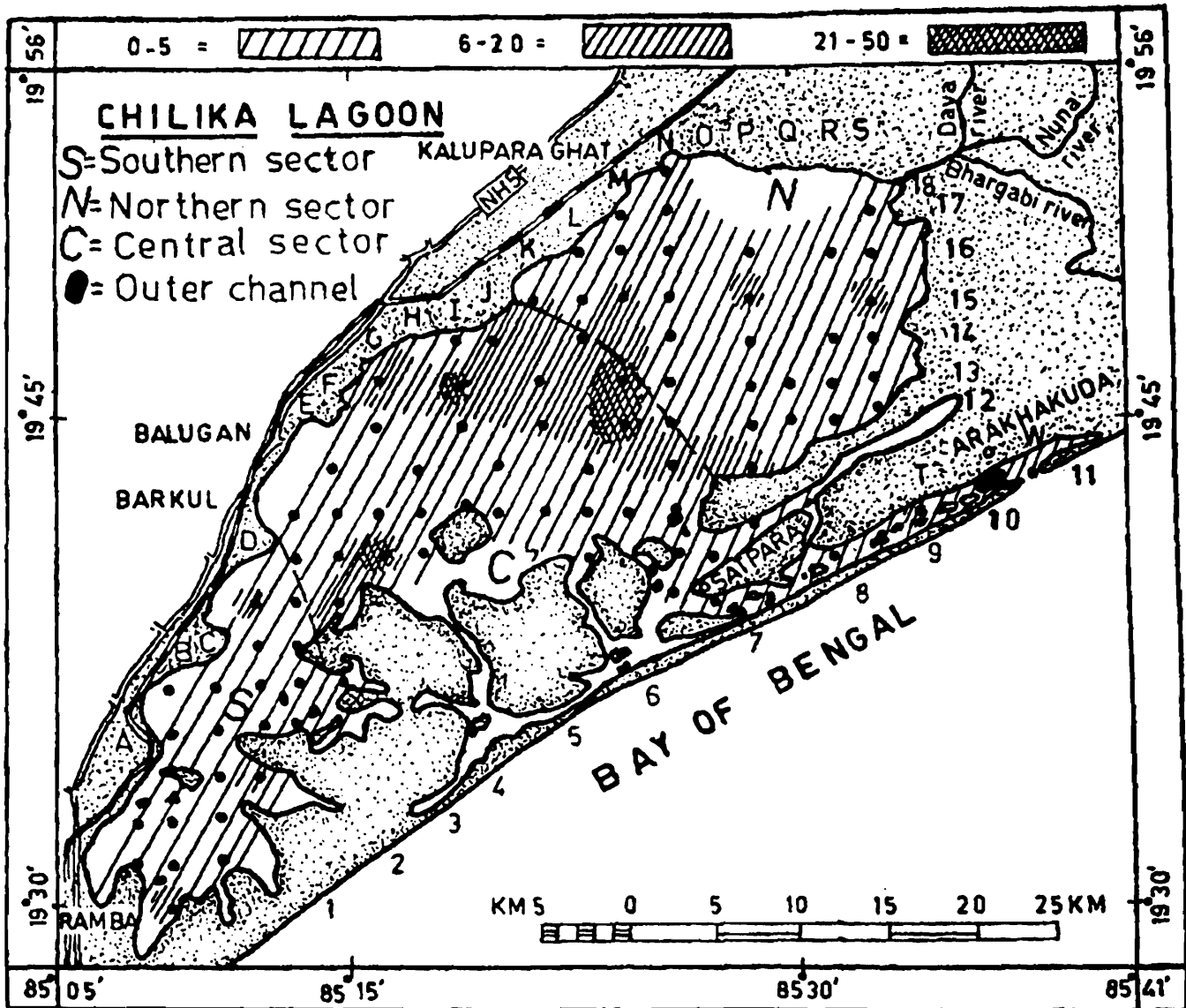


Fig. 9. Distribution of phyto-plankton in the Chilka lake during the monsoon period.

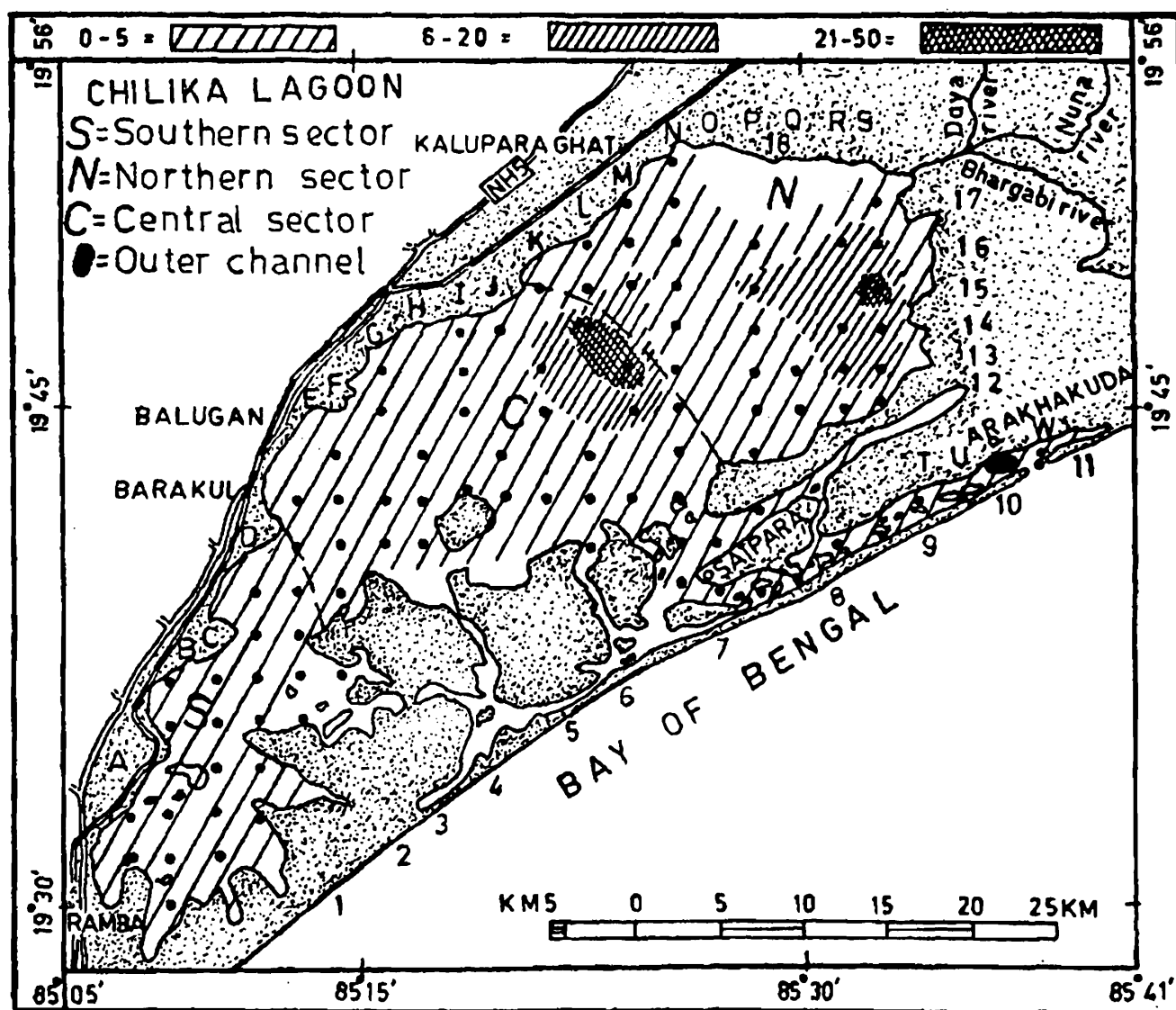


Fig. 10. Distribution of zoo-plankton in the Chilika lake during the monsoon period.

DISCUSSION

This investigation revealed that the fluctuation of salinity conditions did not seem to affect much the distribution of phyto and zooplankton in the Chilka lake during the post-monsoon period. The maximum volume of the phyto and zooplankton was from the station, where the salinity was less than 2.0‰ (Fig .1). The same trend was noticed during the pre-monsoon period (Fig .4). But, during the monsoon period, the phytoplankton volume was at its peak, when the salinity was also maximum (Fig .7), whereas the zooplankton volume was more, when the salinity was less than 2.0‰. So, it is clear that the fluctuation in the salinity did not have much direct impact on the distribution of planktonic forms. Whereas, other environmental factors such as, the discharge of flood waters from the branches of the river Mahanadhi during the monsoon season, tidal influx of the sea water into the outer channel and the evaporation of water in the lake during the summer, are also responsible in controlling the fluctuation of the planktonic organisms in this lake.

In the southern sector of the lake, the variation in the volume of the plankton during the three seasons was negligible and this may be due to the fact that the water in this sector is almost stagnant and there are no current and no inflow of fresh water from the rivulets. Whereas the northern sector and the outer channel are subjected to sudden change of water quality due to the inflow of flood waters during the rainy season and influx of sea water. As the central sector is also not much affected either by the flood or by the seawater, the phyto and zooplankton volume of this sector did not show much variation from one season to another.

Further studies on the individual groups of the plankton involved in the samples are being studied and will be published elsewhere.

SUMMARY

The phyto- and zooplankton samples collected during the three expeditions in 1985, 1986 and 1987 were studied for their distribution, fluctuation and seasonal abundance during the pre-monsoon, monsoon, and post-monsoon periods and reported in this account. Further, the hydrographic features and other environmental factors that affect the distribution of planktonic organisms in the lake were discussed.

ACKNOWLEDGEMENTS

My sincere thanks are due to the Director, Zoological Survey of India, Calcutta, Dr A. N. T. Joseph, the Former Joint Director and Officer in Charge, Marine Biological Station, Madras and Dr K. V. Rama Rao, Scientist S-E, Estuarine Biological Station, Berhampur for the facilities provided to participate in the expeditions and collect samples for this study. The help rendered by the staff members of the Estuarine Biological Station, Berhampur in collecting the samples is gratefully acknowledged.

REFERENCES

- Anandale, N. 1915. Fauna of Chilka Lake, Sponges. *Mem. Indian Mus.*, 5 (1) : 23-53.
- Anandale, N. 1915. Fauna of Chilka Lake. The Coelenterata of the Lake. *Ibid*, 5 (1) : 67-111.

- Anandale, N. 1915. Fauna of Chilka Lake. The Polyzoa of the Lake and of Brackish waters in Gangetic delta. *Ibid.*, **5** (1) : 121-132.
- Anandale, N. 1915. Fauna of Chilka Lake, Cirripedia. *Ibid.*, **5** (1) : 137-138.
- Anandale, N. and Kemp, S. 1915. Fauna of Chilka Lake, Introduction. *Ibid.*, **5** (1) : 1-20.
- Anandale, N. and Kemp, S. 1916. Fauna of Chilka Lake, Echiuroidea of the lake and Gangetic delta. *Ibid.*, **5** (1) : 57-61.
- Anandale, N. and Kemp, S. 1916. Fauna of Chilka Lake, Mollusca : Gastropoda and Lamellibranchiata, *Ibid.*, **5** (1) : 329-367.
- Banerjee, A. C. and Roychoudhry, N. C. 1966. Observations on some physico-chemical features of the Chilka lake. *Indian J. Fish.*, **13** : 395-429.
- Chilton, C. 1921. Fauna of Chilka Lake, Amphipoda. *Mem. Indian Mus.*, **5** (1) : 521-558.
- Eliot, C. 1916. Fauna of Chilka Lake, Mollusca; Nudibranchiata. *Ibid.*, **5** (1) : 377-379.
- Jhingran, V. G. 1963. Report on the fisheries of the Chilka Lake, 1957-1960. *Bull. Cent. Inl. Fish. Res. Inst.*, **1** : 1-113.
- Jhingran, V. G. and Natrajan, A. V. 1969. A study on the Fish and Fisheries populations of the Chilka Lake during the period 1957-1965. *J. Inland Fish. Soc. India*, **1** : 49-126.
- Jhingran, V. G. and Natarajan, A. V. 1973. Fishery resources of the Chilka Lake and its bearing on fisheries in adjacent areas of Bay of Bengal. *Proc. Symp. Living Resources of the seas around India, Spl. Publ. CMFRI, Cochin*, 365-72.
- Jones, S. and Sajansingan, K. H. 1954. Fish and Fisheries of the Chilka Lake with statistics of fish catches for the years 1948-1950. *Indian J. Fish.*, **1** : 256-344.
- Kemp, S. 1915. Fauna of Chilka Lake, Crustacea : Decapoda. *Mem. Indian Mus.* **5** (1) 201-325
- Kemp, S. 1916. Fauna of Chilka Lake, Cumacea, *Ibid.*, **5** (1) : 521-558.
- Mohanty, S. K. 1975. Some observations on the physico-chemical features of the outer channel of the Chilka Lake during 1971-1973. *Bull. Dept. Mar. Sci. Univ. Cochin*, **7** (1) : 69-89.
- Patnaik, S. 1971. Seasonal abundance and distribution of bottom fauna of Chilka Lake. *J. mar. biol. Ass. India*, **13** : 106-125.
- Pattanaik, P. K. 1986. On the spatial distribution of zooplankton in Chilka Lake. *Geiobios New Rep.*, **5** (1) : 31-34.

- Rajan, S. 1965. Environmental studies of the Chilka Lake, 2. Benthic animal communities. *Indian J. Fish.*, **12** (2) : 492-499.
- Ramandham, R. Reddy, M. P. M. and Murty, A. V. S. 1964. Limnology of the Chilka Lake. *J. mar. biol. Ass. India*, **6** (2) : 183-201.
- Sewell, S. 1924. Fauna of Chilka Lake, Crustacea : Copepoda. *Mem. Indian Mus.*, **5** (1) : 773-851.
- Southern, R. 1921. Fauna of Chilka Lake, Polychaeta. *Ibid.*, **5** (1) : 565-659.
- Stephenson, J. 1915. Fauna of Chilka Lake, Oligochaeta, *Ibid.*, **5**(1) : 141-45.

ZOOPLANKTON

M. SRINIVASAN AND CH. SATYANARAYANA
Zoological Survey of India, Madras

INTRODUCTION

Studies on the estuarine habitat have become important, as they play an important role in the biology and fishery of aquatic forms. Further, the estuaries form the nearest available biological habitat for human beings. Among the brackish water lakes of India, Chilka lake is the biggest, as the area extends upto 1160 square kilometres in rainy season. It has a 29 kms long and 365 metre wide outer channel that opens into the sea Bay of Bengal, near the village Arkhakhuda. The main area of the lake is about 65 kms long and 20 kms wide.

The lake exhibits fresh water, estuarine and marine environments at different zones. For the purpose of convenient study, the lake is arbitrarily divided into four sectors, such as the southern sector, where the salinity variations is minimum, the central sector, where the salinity fluctuates to some extent, the northern sector, where the salinity variations is very high and the outer channel that is much affected by the flood waters and entry of sea water.

The zooplanktonic organisms play a key role in the food cycle of the aquatic organisms as they are the secondary producers, the phytoplankton being the primary producers. Hence, the knowledge on the availability and fluctuation of these organisms will be of significant importance in understanding the fluctuation and abundance of other higher organisms, which feed on these forms. As little information is available on the various groups of zooplankton from the Chilka lake, this study was undertaken based on the samples collected during the three expeditions.

The hydrographic features and topography of the Chilka lake are well known (Annandale and Kemp, 1915; Sewell and Annandale, 1922; Ramanandam, Reddy and Murty, 1964; Banerjee and Roychoudhury, 1966; Patro, 1970; Mohanty, 1975a). Besides the hydrographic features, the fishes of the Chilka lake (Choudhuri, 1916a, b, c, 1917, 1923; Devasundaram, 1954; Jones and Sujansinghani, 1951, 1954; Jhingran *et. al.* 1963; Jhingran and Natarajan, 1966, 1969), fish eggs, larvae, juveniles and biology of some fishes (Jones and Sujansinghani, 1954; Rajan, 1964; Patnaik, 1970; Kowtal 1969; Mohanty, 1975 a, b) are also reported. Further the bottom fauna of the Chilka lake was studied by Rajan, (1965) and Patnaik (1971).

Among the zooplankton forms, certain groups such as copepods (Sewell, 1924), decapods (Kemp, 1915), Mysidacea (Tattersall, 1915), Cumacea (Kemp, 1916), Amphipoda and Isopoda (Chilton, 1921, 1924) are already reported. Distribution and seasonal fluctuation of the various planktonic groups of the Chilka lake was studied by Devasundaram and Roy (1954), Patnaik (1973) and Patnaik (1986). A perusal of the literature on the studies of the Chilka lake reveals that very little is known about the various

zooplanktonic groups. So, this study will help to some extent in enriching our knowledge on the various zooplanktonic forms of Chilka lake.

MATERIAL AND METHODS

Material for the present study was collected during the three expeditions conducted in 1985, 1986 and 1987. The first one was during the post-monsoon season from 21.11.1985 to 15.12.85 and zooplankton samples were collected from 45 hydrographic stations. The second one was during the pre-monsoon period from 11.6.1986 to 29.6.1986 and samples were collected from 71 hydrographic stations and the third was during the monsoon season from 4.9.1987 to 26.9.1987 and the samples were collected from 100 hydrographic stations. All the samples were collected from the stations fixed at 2.5 kms interval on grid basis in the main area of the lake and in the outer channel.

The zooplankton samples were collected with 50 cm diameter ring net made of bolting silk with a mesh size of 0.33 mm. Samples were collected by hauling the net horizontally for five minutes at the lateral side of the country boat fitted with an outboard motor, while the boat was in operation at 1 km. speed. Collected samples were preserved in 4% neutralised formaldehyde solution and the displacement volume was determined. Then the samples were diluted to 100 ml and after mixing well a sample of 1 ml was pipetted out with Stempel's pipette in a Sedgewick's rafter counting cell for enumeration of various planktonic organisms. The counting cell with the sample was examined under a stereoscopic binocular microscope and the organisms of the various zooplanktonic groups found in the graduated squares were counted and noted. The number of examples found in the 1 ml of the sample was utilised for the distribution maps, as the samples were collected with the same type of craft, gear, time duration and the speed of the craft was also same during the collection. For certain groups such as bivalve larvae, veliger larvae, Amphipoda, *Lucifer*, crustacean nauplii, Mysidacea, fish eggs and larvae, the samples collected during the post-monsoon (I expedition) were not utilised for distribution maps as the samples were from only 45 stations.

RESULTS

The analyses of the samples revealed that the following 18 groups are found and they are listed in the order of abundance : 1. Copepoda, 2. Crustacean nauplii, 3. Bivalve larvae, 4. Veliger larvae, 5. *Lucifer*, 6. Amphipoda, 7. Mysidaceae, 8. Medusae, 9. Cladocera, 10. Rotifera, 11. Polychaete larvae, 12. Fish eggs, 13. Fish larvae, 14. Foraminifera, 15. Decapod larvae, 16. Alima larvae of Squilla, 17. Ostracoda and 18. Chaetognatha.

Seasonal and Spatial Distribution : The estimation of displaced volume of the zooplankton revealed that during the pre-monsoon period, the volume was more in the central sector where the salinity varied from 10.01 to 20.00 ‰ (Fig. 1). During the monsoon season the volume was more in the central sector and northern sector than in the southern sector and in the outer channel and during the post-monsoon period, the volume was more in the central sector, in the outer channel and in the southern side of the northern sector than in the southern sector.

1. Copepoda : Among the 18 groups of the zooplankton found in the samples, copepods are the most abundant forms and this study has revealed that during the pre-monsoon season, their distribution was

more or less uniform in the lake. At certain pockets in the central sector, their concentration was more than in the remaining areas (Fig.2).

Whereas during the monsoon period, their abundance was definitely more in the central sector than in the remaining areas of the lake and during the post monsoon also their concentration was more in the central sector and in the outer channel than in the southern and northern sectors. During the pre-monsoon and post monsoon periods, the copepods were found in the outer channel, whereas they were totally absent in the outer channel area during the monsoon season.

Distribution of copepods in the lake during the monsoon season in relation to the salinity revealed that an average of 407 specimens per station were found in the stations (19) where the salinity ranged from 00.01‰ to 03.00 ‰; 1064 per station were found in the areas, where the salinity varied from 03.01‰ to 05.00‰; 653 per station in the areas where the salinity ranged from 05.01 ‰ to 10.00‰ and 58 per station in the areas where the salinity ranged from 10.01‰ to 20.00‰. So it is clear from these results that the copepods were seen in more numbers in low saline areas (less than 05.00‰) than in the high saline areas. The same trend was noticed during the pre-monsoon season : 2752 specimens per station were found in the areas where the salinity varied from 01.00 to 03.00‰; 780 per station in the areas where the salinity varied from 05.01 to 10.00‰; 596 per station in the areas where the salinity ranged from 10.01 to 20.00‰ and 121 per station in the areas, where the salinity was above 20.00‰.

2. Crustacean nauplii : Distribution of crustacean nauplii in the lake showed that their concentration was more in the outer channel, southern part of the central sector than in the remaining areas during the pre-monsoon period. During the monsoon season they were found in more numbers in the central sector. The interesting point of observation is that they were totally absent in the southern sector during the monsoon period (Fig. 3). Like copepods, these organisms were also found to occur in more numbers in low saline areas than in the high saline areas. During the monsoon season an average of 41 examples per station were found in the areas where the salinity varied from 00.01‰ to 03.00‰; 29 per station in the areas where the salinity ranged from 03.01 to 05.00‰; 36 per station in the areas, where the salinity was from 05.01‰ to 10.00‰ and 5 per station, in the areas where the salinity was between 10.01 and 20.00‰.

However, during the pre-monsoon season more numbers (82) per station were noted in the areas, where the salinity varied from 10.01 to 20.00‰, followed by 58 examples per station in the areas, where the salinity was above 20.00‰. 28 and 25 specimens per stations were found in areas, where the salinity was from 00.01 to 03.00‰ and 05.01 to 10.00‰. So during the pre-monsoon season, the crustacean nauplii were seen in more numbers in the high saline areas than in the low saline areas of the Chilka lake. During the post-monsoon period, these forms were found in 30 of the 45 samples collected, and they were noted in more numbers in the stations located in the northern sector near Satpara (N-9, O-9, 12, 14).

3. Bivalve larvae : The distribution of bivalve larvae during the pre-monsoon period did not show any marked variation from one sector to another (Fig. 4). More or less they were uniformly distributed. Whereas during the monsoon season, it was totally absent in the southern sector and northern region of the northern sector. It was found to occur only in the central sector and in the outer channel area (Fig. 4). The concentration of these larvae in the central sector was more at few stations located near Barkul and Balugaon. As in the case of copepods and crustacean nauplii these forms were also found to occur in more numbers in the low saline areas than in the high saline areas during the monsoon period. An average of 22

examples per station was found in the areas, where the salinity varied from 03.01 to 05.00‰; 20 examples per station was found in the areas, where the salinity was from 05.01 to 10.00‰ and 12 examples per station was noted in the areas where the salinity varied from 00.01 to 03.00‰ and 10.01 and 20.0‰.

Whereas during the pre-monsoon period, as in the case of crustacean nauplii, these forms were also found to occur in more numbers (15) in the areas, where the salinity was from 10.01 to 20.00‰ and found in less numbers (4) in the areas, where the salinity was more than 20.00‰.

4. **Veliger larvae** : The distribution of veliger larvae showed that during the pre-monsoon, it was more or less absent in the northern part of the northern sector and southern part of the southern sector. It was found only in the central sector (Fig. 5) and in the outer channel. Whereas during the monsoon season, it was totally absent in the samples collected from the southern sector and major part of the central sector. It was found only in the northern sector and in the outer channel of the lake. During the post-monsoon period, it was found to occur only in 17 of the 45 samples collected and their concentration was more in the stations located in the northern sector. These forms were found to be absent in the low saline areas (00.01 to 05.00‰) during the monsoon season, whereas during the pre-monsoon, more numbers were from the stations located in the low saline areas where the salinity ranged from 00.01 to 03.00‰.

5. **Lucifer** : The distribution of *Lucifer* in the lake during the pre-monsoon period showed that they were totally absent in major part of the northern sector, central sector and outer channel. Whereas, during the monsoon period, it was present only in the central sector and outer channel and totally absent in the southern sector and major part of the northern sector (Fig. 6). During the post-monsoon season, it was found to occur in 22 of the 45 stations and the maximum numbers were noted (420) at station H-10. Further, it was found to occur in more numbers in the low saline areas during the monsoon period. (9 examples per station where the salinity was from 03.01 to 05.00‰ and 3 per station where the salinity was from 05.01 to 10.00‰).

6. **Amphipoda** : The distribution of amphipods in the Chilka lake during the premonsoon and monsoon seasons did not show any distinct pattern of distribution. It was totally absent during these two seasons in the outer channel area. It was found at certain pockets of the southern sector, central sector and northern sector (Fig. 7). During the post-monsoon period, it was present only in 5 of the 45 samples collected and maximum number (15) was found at the station O-16, where the D.O. was at its maximum (11.2 mg/l). Further amphipods were also found to occur in more numbers in the low saline areas during the pre-monsoon and monsoon seasons, when the growth of the weeds was seen in abundance.

7. **Fish eggs (Fig. 8)** : The distribution pattern of the fish eggs showed that it was present in major part of the southern and central sector during the pre-monsoon period and during the monsoon season, it was totally absent in the northern sector, outer channel and in major part of the central sector. Even in the central and southern sectors, it was found only in certain pockets. During the post-monsoon period, it was found only in one station (F-8). Fish eggs were found to prefer the relatively high saline areas during the monsoon season (10.01 to 20.00‰) and pre-monsoon season (more than 20.00‰)

8. **Mysidaceae** : During the pre-monsoon period these forms were found to occur only in 3 of the 71 stations and the maximum number (112) was at the station L-16 and during the monsoon period, it was found in 15 of the 100 stations and the maximum number (14) was at the station K-15. During the post-monsoon

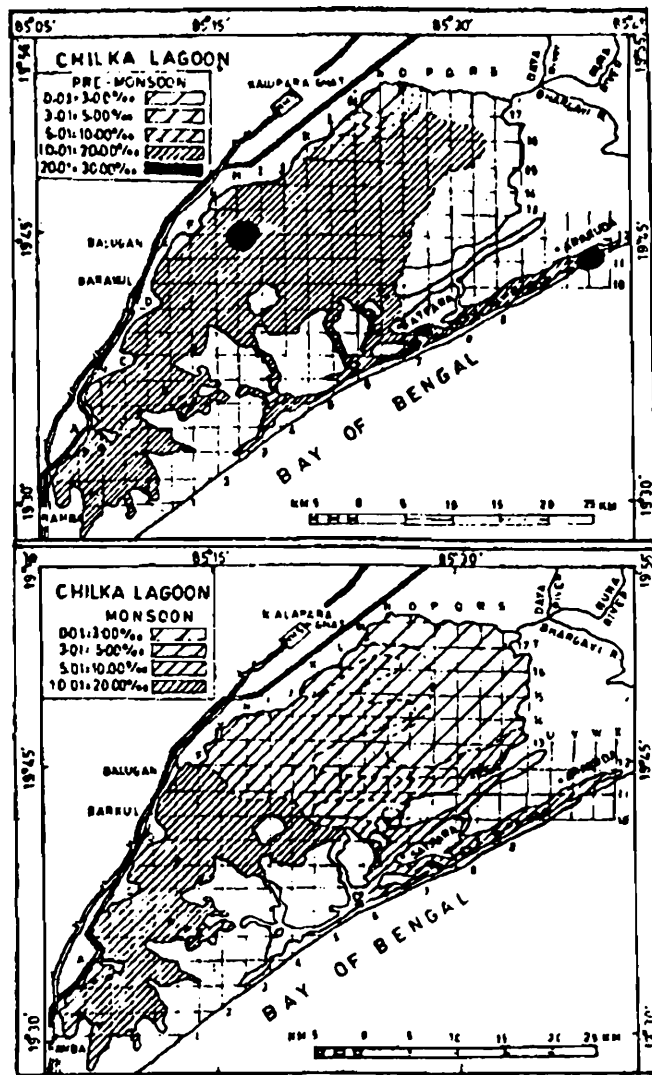


Fig. 1. Fluctuation of Salinity in the Chilka lake during the pre-monsoon, monsoon and post-monsoon seasons.

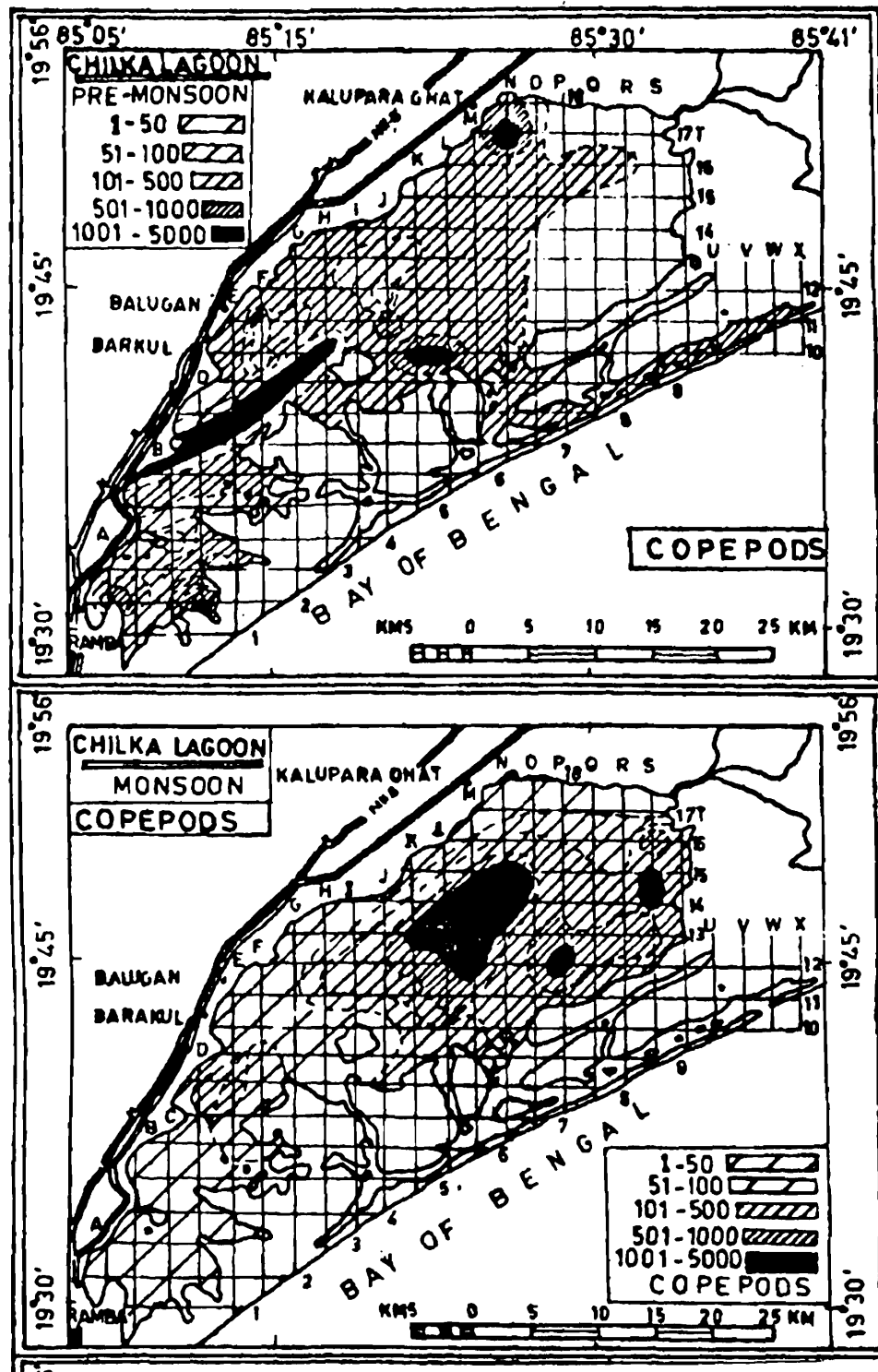


Fig. 2. Distribution of Copepoda in the Chilka lake during pre-monsoon, monsoon and post-monsoon seasons.

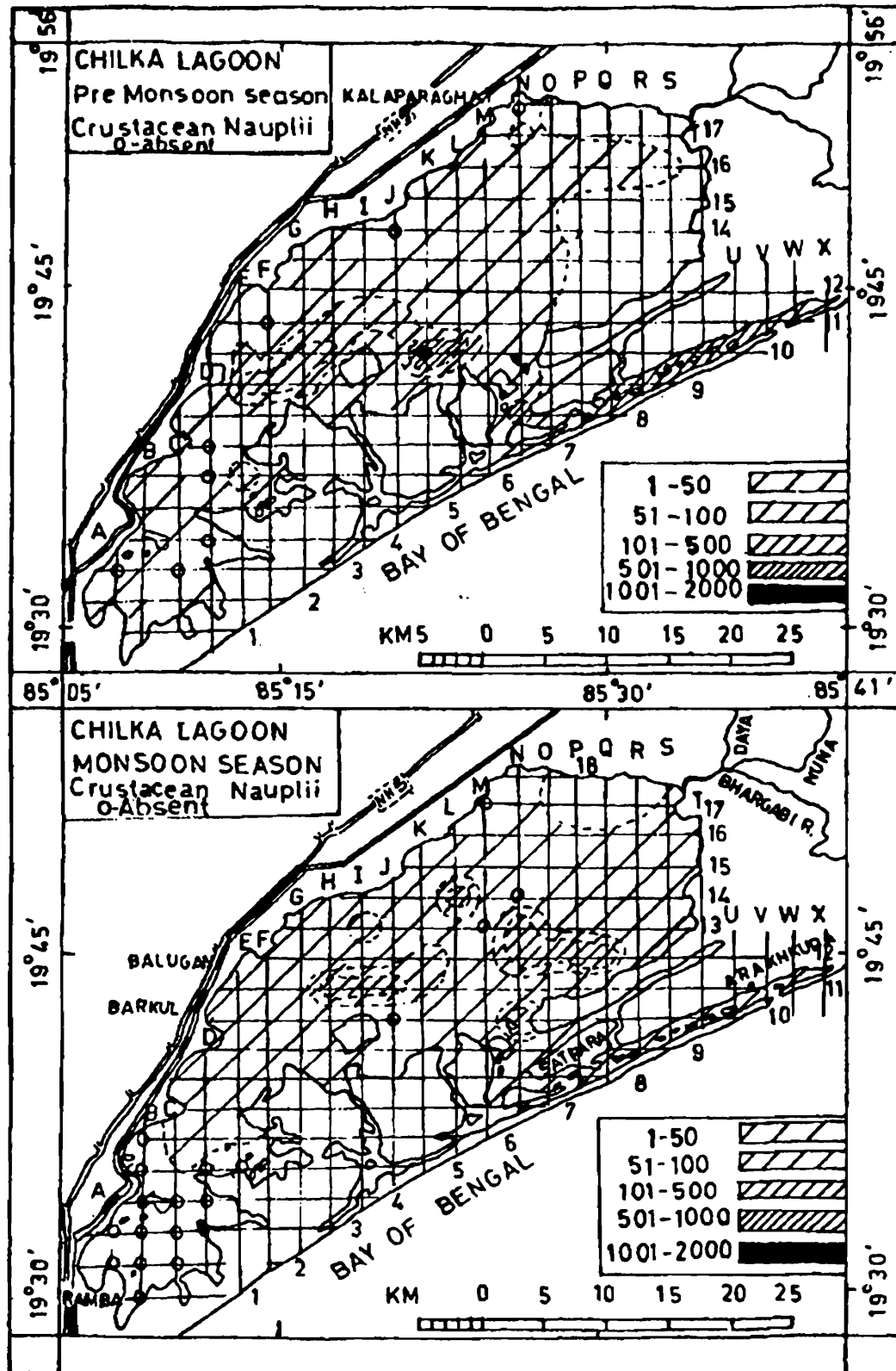


Fig. 3. Distribution of crustacean nauplii in the Chilka lake during the pre-monsoon and monsoon seasons.

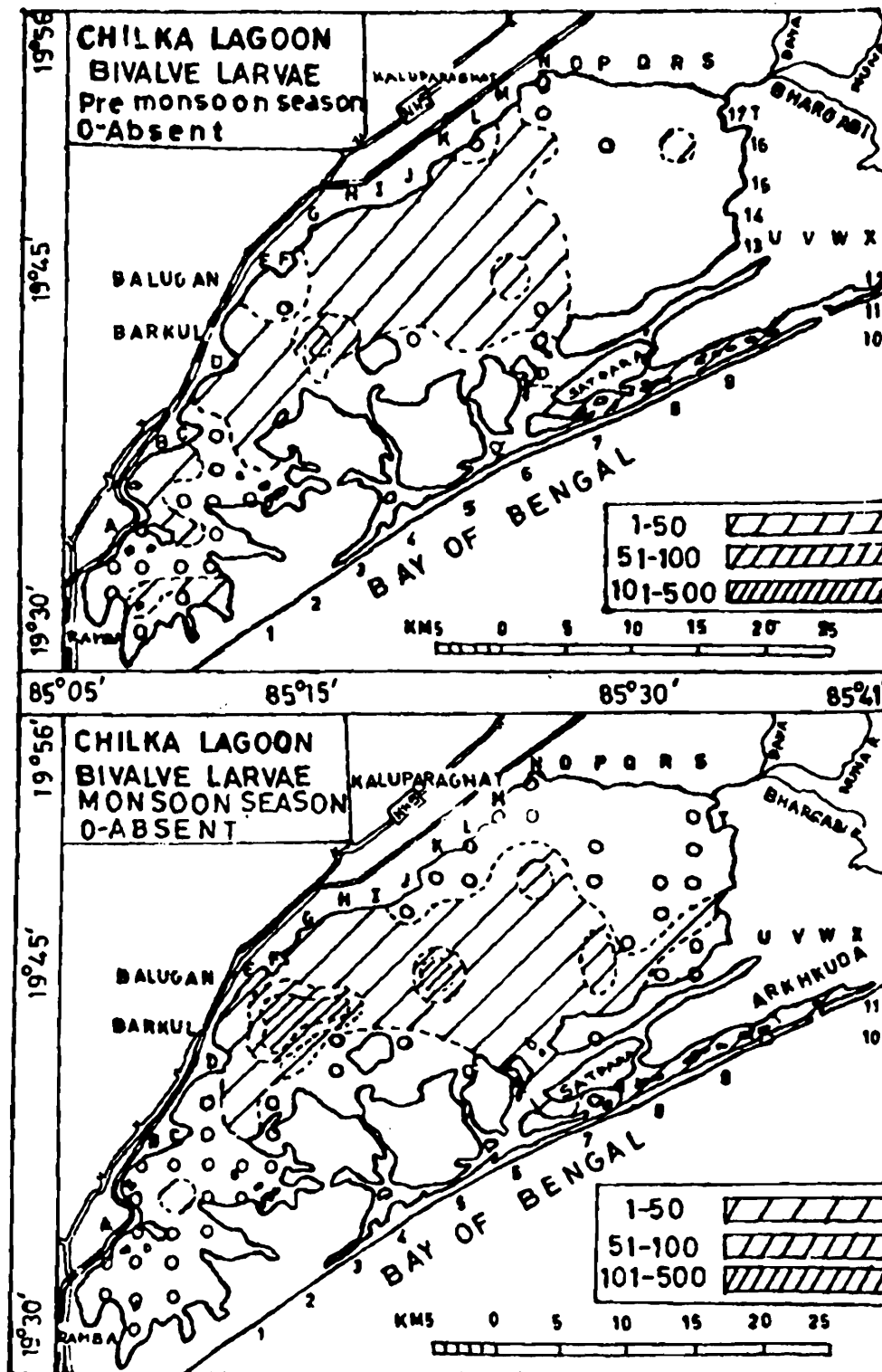


Fig. 4. Distribution of Bivalve larvae in the Chilka lake during the pre-monsoon and monsoon seasons.

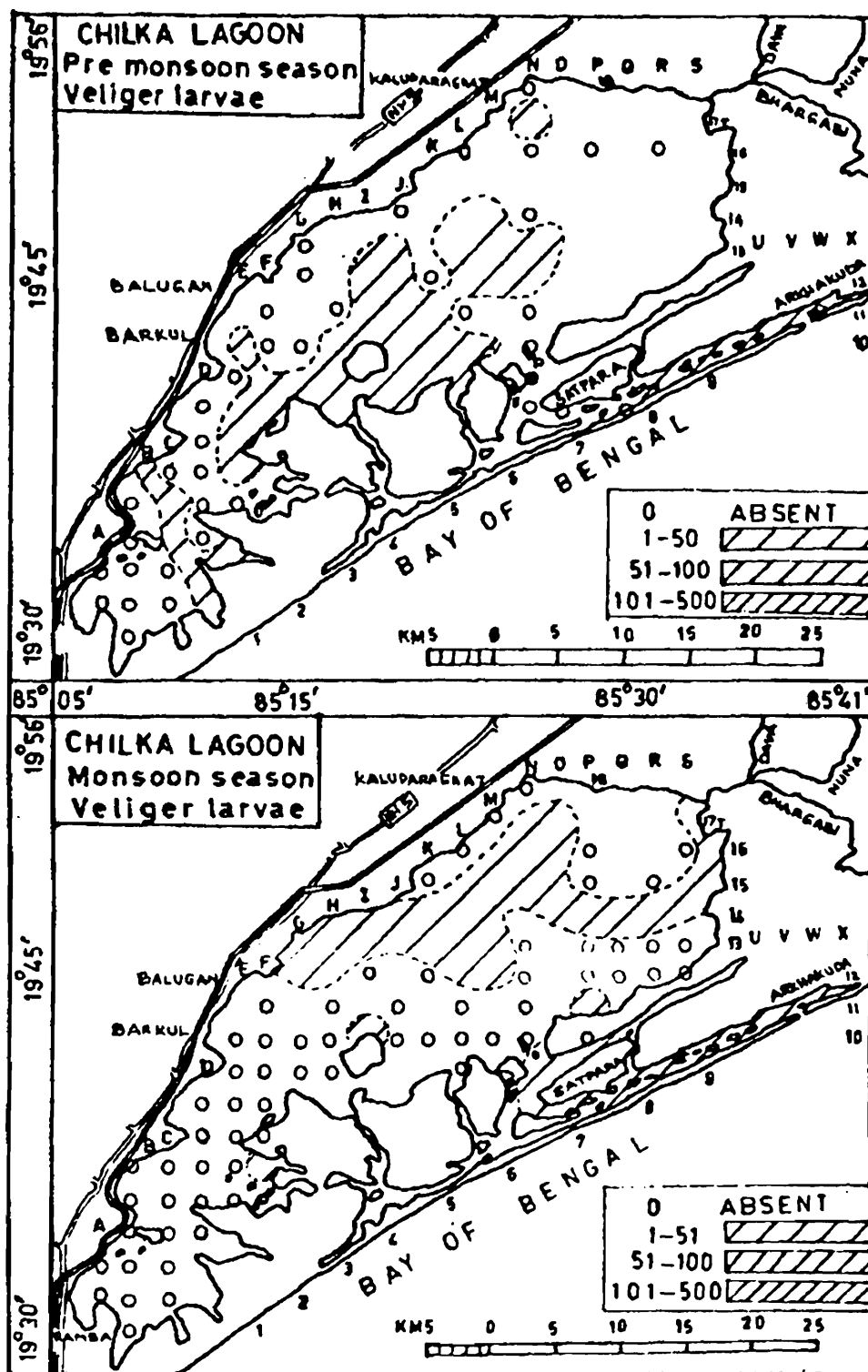


Fig. 5. Distribution of veliger larvae in the Chilka lake during the pre-monsoon and monsoon seasons.

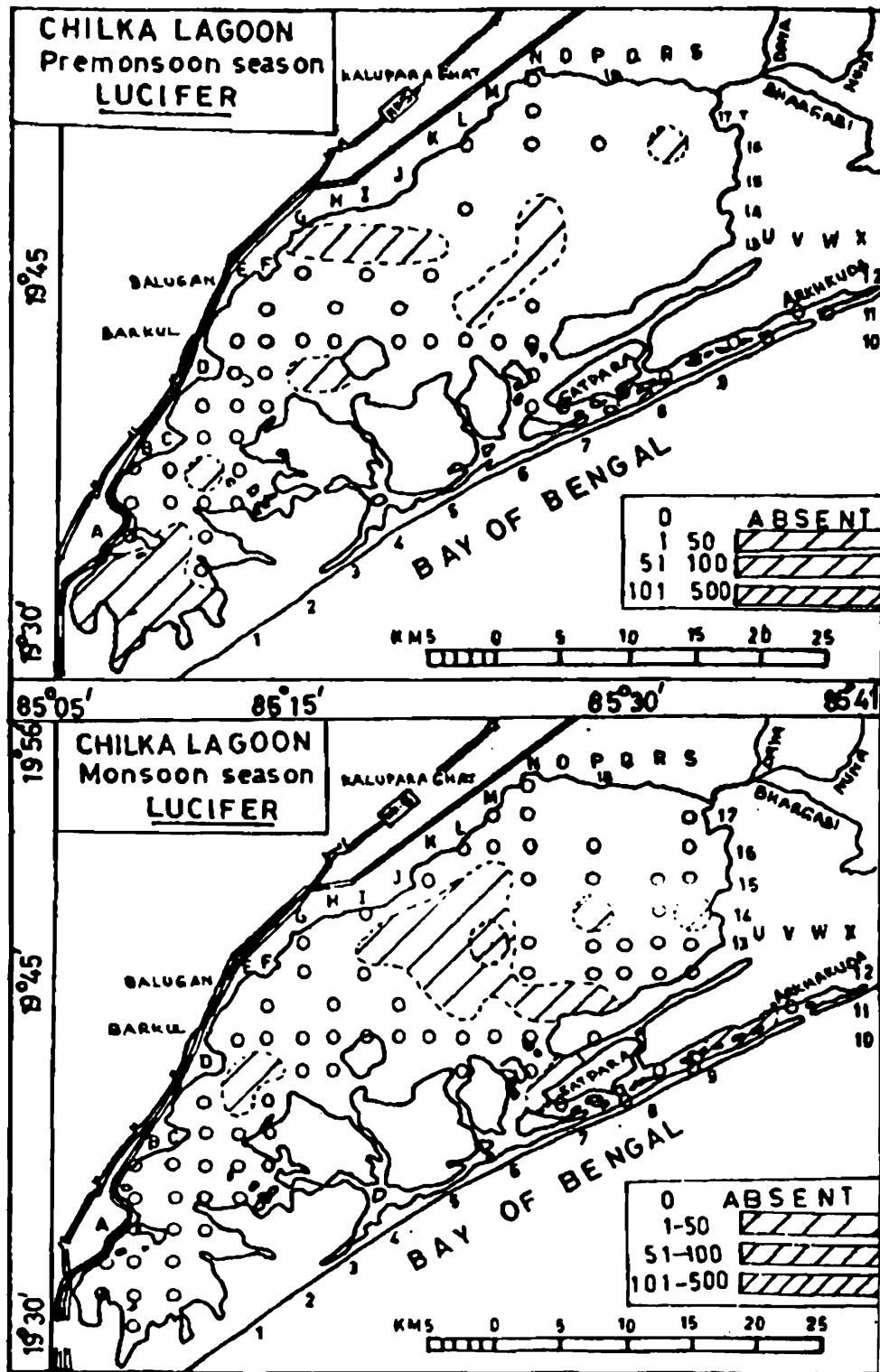


Fig. 6. Distribution of *Lucifer* in the Chilka lake during the pre-monsoon and monsoon seasons.

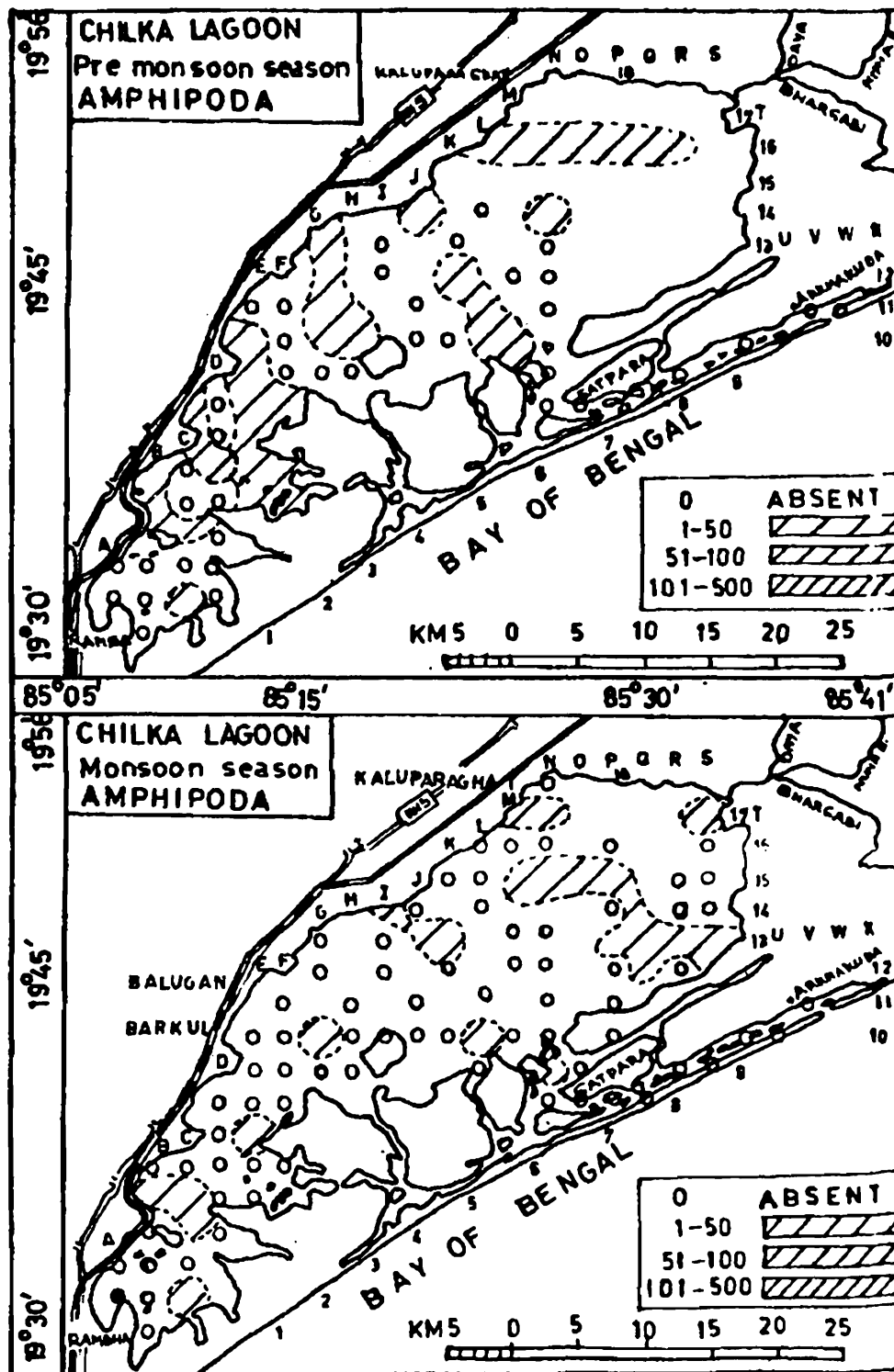


Fig. 7. Distribution of Amphipoda in the Chilka lake during the pre-monsoon and monsoon seasons.

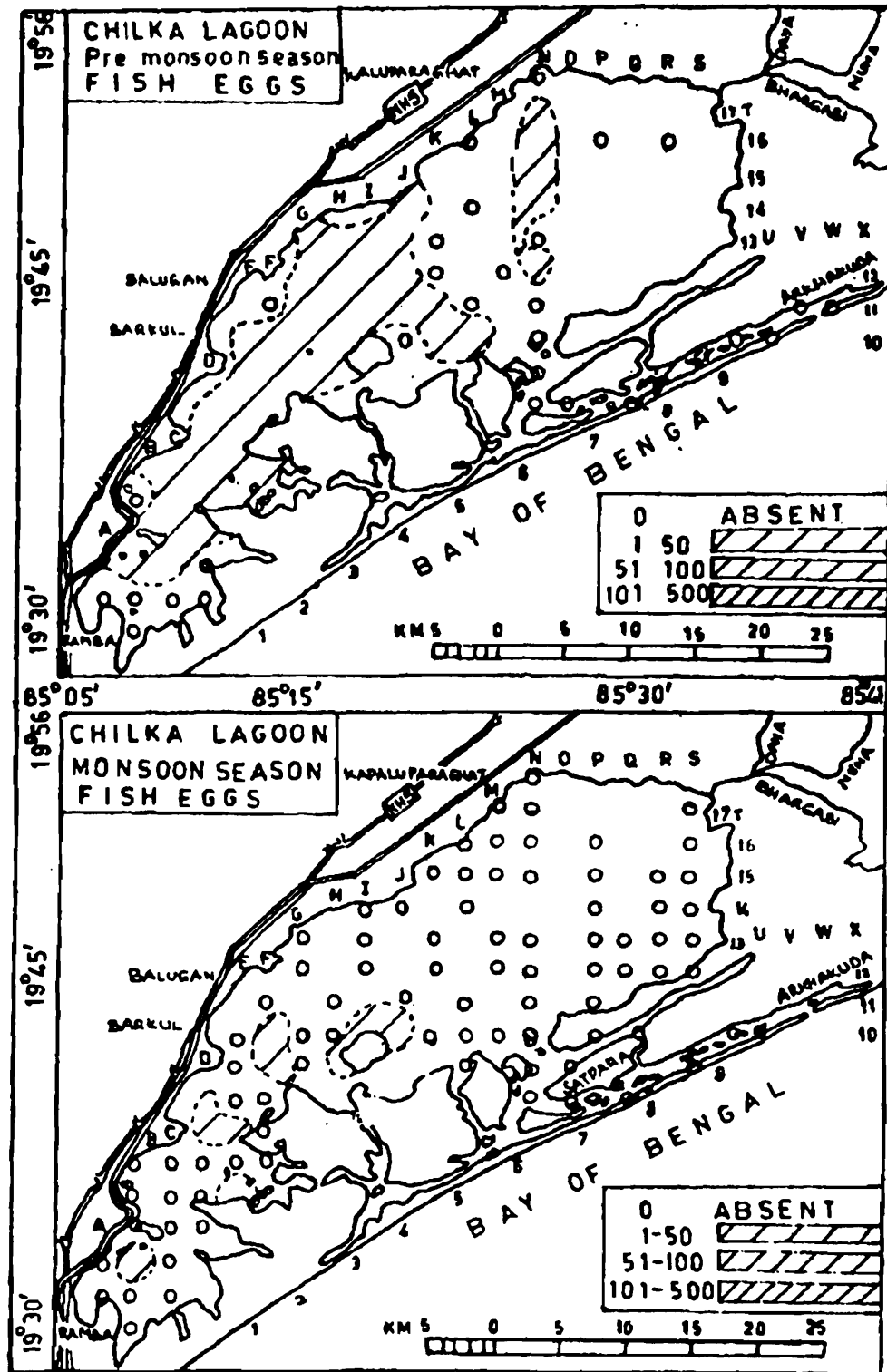


Fig. 8. Distribution of fish eggs in the Chilka lake during the pre-monsoon and monsoon seasons.

season, it was found only in 4 of the 45 stations and the maximum number (73) was noted at the station O-16. It was interesting to note that during all the three seasons, it was found in more numbers at the stations located in the northern sector (K-15, L-16, O-16). These forms were found to prefer the low saline areas (00.01 to 05.00‰).

9. Medusae : During the pre-monsoon season, it was found only in one station (R-9) located in the outer channel near the mouth of the channel and during the monsoon season, it was found in 5 of the 100 stations. Maximum number was noted at the station J-14 (25 nos.) It was totally absent in all the 45 samples collected during the post-monsoon period. These forms were found in large numbers in the relatively high saline areas (05.01 to 10.00‰ and 10.01 to 20.00‰).

10. Cladocera : These forms were found to occur in 7 of the 71 stations during the pre-monsoon season and the maximum number (10) was noted at the station K-10. During the monsoon season it was found only at two stations (M-17, R-15) and during the post-monsoon season it was found in 2 stations (B4, S-17). During the monsoon season, it was found in more numbers in the low saline (00.01 to 03.00‰) areas and during the pre-monsoon period, it was more in the relatively high saline areas (10.01 to 20.00‰).

Rotifers : This was found only in two stations (N-11, 12) during the pre-monsoon period and during the monsoon it occurred in 6 stations and the maximum number was at the station N-12. During the post-monsoon season, it was noticed in 4 samples and the maximum number (174) was at the station Q-12. Rotifers were found to prefer the low saline areas.

12. Polychaete larvae : This was noted in 3 of the 71 stations during the pre-monsoon period (E-5, N-14, V-11) and in 6 stations during the monsoon season. During the post-monsoon period, it occurred only in one station (S-17). These forms were found to prefer the relatively less saline waters.

13. Fish larvae : This was found in two samples (B-2, N-17) during the pre-monsoon period, in 9 stations during the monsoon period and in one station (K-12) during the post-monsoon period. Fish larvae were found to prefer the low saline areas (00.01 to 03.00‰).

14. Foraminifera : These forms were found to be absent in the samples collected during the pre-monsoon period and noted in 3 stations (N-16, R-14, S-16) during the monsoon period and during the post-monsoon this was found only at the station Q-14. These were found to prefer the low saline areas.

15. Decapod larvae : This was found in 12 of the 71 stations during the pre-monsoon period and in 3 stations (E-7, P-16, T-10) during the monsoon season and in one station (B-6) during the post-monsoon period. These forms were found to prefer the relatively low saline areas.

16. Alima larvae of *Squilla* : This was found to occur during the pre-monsoon period in 4 samples collected at the stations, I-13, K-13, M-12 and N-11. (For this macroplanktonic form, the entire sample was analysed). During the monsoon season this was found in 5 stations. These larvae were found to prefer relatively high saline areas (10.01 to 20.00‰).

17. Ostracoda : These organisms were found only in 2 of the 71 stations during the pre-monsoon season (V-11, W-11). Both these stations were located in the outer channel near the sea mouth. Whereas these

forms were totally absent in the samples collected during the monsoon and post-monsoon seasons. These organisms were found to occur in the areas where the salinity was above 20.00‰

18. Chaetognatha : During the pre-monsoon period this was found in 12 of the 71 stations and out of these 12 stations, 10 were in the southern sector of the lake. These forms were not found in the samples collected during the monsoon season. During the post-monsoon season, this was found in 20 of the 45 stations and all the stations were in the southern sector and in the southern part of the central sector of the lake. These forms tend to prefer the relatively high saline waters (10.01 to 20.00‰).

DISCUSSION

This investigation on the distribution of zooplankton groups revealed that certain groups tend to occur in large numbers in the high saline or relatively high saline waters and some others preferred the low saline or relatively low saline waters. It is interesting to note that the most abundant group copepods are found in more numbers in the low saline areas than in the high saline areas. During the pre-monsoon and monsoon periods an average of 2753 and 41 examples per station were found in the areas, where the salinity fluctuated from 00.01 to 03.00‰. The abundance of copepods in the low saline areas of the Chilka lake, coincides with the earlier findings by Esterly (1928) at La Jolla, California. Further, this study revealed that the copepods were uniformly distributed during the pre-monsoon period, whereas during the monsoon season, they were found in greater numbers in the central sector (Fig. 2) of the lake and during the post-monsoon period, they were found in more numbers in the outer channel area and in the northern sector of the lake.

This investigation has brought to light the abundance of fish eggs only in the southern sector of the lake and this may probably be due to the drifting of the eggs along with the inflow of water from the northern part of the lake during the monsoon period and inflow of the sea water from the outer channel into the southern sector through the central sector. Further the distribution of amphipods in the lake has shown that they are more abundant in the areas, where the dissolved oxygen concentration was at its maximum and in addition to this, in these areas weed growth was more.

Further, this study has revealed that among the 18 zooplankton groups found in the samples collected, the following 13 groups were found to prefer either the low saline areas (00.01 to 05.00‰) or relatively low saline areas (05.01 to 10.00‰) of the Chilka lake : 1. Copepoda, 2. Crustacean nauplii, 3. Bivalve larvae, 4. Veliger larvae, 5. *Lucifer*, 6. Amphipoda, 7. Mysidaceae, 8. Cladocera, 9. Rotifers, 10. Polychaete larvae, 11. Fish larvae, 12. Foraminifera and 13. Decapod larvae. The remaining 5 groups, 1. medusae, 2. Alima larvae of *Squilla*, 3. Ostracoda, 4. Chaetognatha and 5. Fish eggs were found to prefer the areas of the Chilka lake, where the salinity was more than 10.01‰.

In the Chilka lake, the southern sector and the central sectors are not much affected by the monsoon as there is no inflow of fresh water from the rivulets. Whereas the northern sector and the outer channel of the lake are highly affected during the monsoon season due to influx of fresh water from the branches of river Mahanadhi and influx of sea water into the outer channel. Chilka lake is the wonderful gift of the nature to the people of Orissa State and if it is managed carefully without the influx of industrial effluents, it will take care of the people of Orissa State.

SUMMARY

This investigation on the zooplankton groups of the Chilka lake collected during the pre-monsoon season in 1986, monsoon season in 1987 and post-monsoon season in 1985 has revealed that 18 groups of zooplankton are found in the samples. The copepods are the most dominant group and it tops the list in the order of abundance. This study of these zooplankton groups in relation to the hydrographic features have showed that certain groups such as copepods, crustacean nauplii, bivalve larvae, veliger larvae, *Lucifer*, Amphipoda, Mysidaceae, Cladocera, Rotifera, polychaete larvae, fish larvae, foraminifers and decapod larvae are found to prefer the low saline areas of the Chilka lake, whereas the groups like, Chaetognatha, medusae, ostracods, alima larvae and fish eggs are found to occur in more numbers in the high saline areas.

ACKNOWLEDGEMENTS

Our sincere thanks are due to Dr. A. K. Ghosh, Director, Zoological Survey of India, Calcutta, Dr. A.N.T. Joseph, the former Joint Director, Marine Biological station, Madras and Dr. K. V. Rama Rao, Joint Director, Fresh Water Biological Station, Hyderabad for the facilities provided to participate in the expeditions and collect samples for this study. The help rendered by the staff members of the Estuarine Biological Station, Berhampur in collecting the samples is gratefully acknowledged.

REFERENCES

- Annandale, N. and S. Kemp, 1915. Fauna of the Chilka Lake. *Mem. Indian Mus.*, 5(1) : 1-118.
- Banerjee, A.C. and N. C. Roychoudhury, 1966. Observations on some physico-chemical features of the Chilka lake. *Indian J. Fish.*, 13 (1, 2) : 395-429.
- Chaudhuri, B. L. 1916a. Descriptions of two new fishes from Chilka Lake. *Rec. Indian Mus.*, 12 : 105-109.
- Chaudhuri, B. L. 1916 b. Fauna of the Chilka lake : Fish, part-1, *Mem. Indian Mus.*, 5(4) : 403-439.
- Chaudhuri, B. L. 1916 c. Fauna of the Chilka lake : Fish, part-2. *Mem. Indian Mus.*, 5(5) : 441-458.
- Chaudhuri, B. L. 1917. Fauna of the Chilka Lake : Fish, part 3. *Mem. Indian Mus.*, 5(6) : 491-508.
- Chaudhuri, B. L. 1923. Fauna of the Chilka lake : Fish, Part-4. *Mem. Indian Mus.* 5 (11) : 711-736.
- Chilton, C. 1921. Fauna of the Chilka lake : Amphipoda. *Mem. Indian Mus.*, 5(8) : 519-558.
- Chilton, C. 1924. Fauna of the Chilka lake : Tanaidacea and Isopoda. *Mem. Indian Mus.*, 5(12) : 875-895.
- Devasundaram, M. P. 1954. A Report on the fisheries of the Chilka lake. *Orissa Govt. press*, Cuttack : 1-34.
- Devasundaram, M. P. and Roy, J. C. 1954. A preliminary study of the plankton of the Chilka lake for the year 1950 and 1951. *IPFC Proceed symp Waustracshwater plankton in Indo-pacific Bangkok* 25 & 26 January : 48-54.

- Esterly, C.O. 1928. The periodic occurrence of Copepods in the marine plankton of two successive years at La Jolla, California. *Bull. scripps. Inst. Ocenogr.*, Techn. ser. I : 14.
- Jhingran, V. G. and A. V. Natarajan, 1966. Final Report on the fisheries of the Chilka lake (1957-1965). *Bull. Cent. Int. Fish. Res. Inst.*, 8 : 1-12.
- Jhingran, V. G. and A. V. Natarajan, 1969. A study of the fisheries and fish populations of the Chilka lake during the period 1957-1965. *J. in. Fish. Soc. India*, 1 : 49-126.
- Jhingran, V. G. et. al. 1963. Report on the fisheries of the Chilka lake (1957-1960). *Bull. Cent. Int. Fish. Res. Inst.* 1 : 130 pp.
- Jones, S. and K. H. Sujansinghani, 1951. The *Hilsa* fishery of the Chilka lake. *J. Bombay nat. Hist. Soc.*, 50 (2) : 264-280.
- Jones, S. and K. H. Sujansinghani, 1954. Fish and fisheries of the Chilka lake with statistics of fish catches for the years 1948-1950. *Indian J. Fish.*, 1 : 256-344.
- Kemp, S. 1915. Fauna of the Chilka lake Crustacea : Decapoda. *Mem. Indian Mus.* 5 (3) : 199-326.
- Kemp, S. 1916. Fauna of the Chilka lake : Cumacea. *Mem. Indian Mus.*, 5 (4) : 393-402.
- Kowtal, G. V. 1969. Occurrence and distribution of pelagic fish eggs and larvae in the Chilka lake during the years 1964 & 1965. *Indian J. Fish.*, 14 : 198-214.
- Mohanty, S. K. 1975a. Some observations on the physico-chemical features of the outer channel of the Chilka during 1971-1973. *Bull. Dept. Mar. Sci. Uni. Cochin*, 7 : 69-89.
- Mohanty, S. K. 1975b. Breeding of economic fishes of the Chilka lake - A Review. *Bull. Dept. Mar. Sci. Univ. Cochin*, 7 : 543-559.
- Patnaik, P. K. 1986. On the spatial distribution of zooplankton in Chilka lake (brackish water lake). *Geobios News Reports*, 5 : 31-34.
- Patnaik, S. A contribution to the fishery and biology of the Chilka 'Sahal' (*E. tetradactylum*) *Proc. Indian Nat. Sci. Acad.*, 1970, 36B (1) : 33-61.
- Patnaik, S. 1971. Seasonal abundance and distribution of bottom fauna of the Chilka lake. *J. mar. biol. ass. India*, 13 (1) : 106-125.
- Patnaik, S. 1973. Observation of the seasonal fluctuations of plankton in the Chilka lake. *Indian J. Fish.*, 20 : 43-45.
- Patro, J. N. 1970. Salinity fluctuations in Chilka lake during 1968-69. *The Chilka lake* : 92-94. (Ed). Directorate of Fisheries, Govt. of Orissa, Cuttack (India).

- Rajan, S. 1964. Environmental studies of the Chilka lake : Feeding, spectrum of fishes. *Indian J. Fish.*, **11** : 521-532.
- Rajan, S. 1965 Environmental studies of the Chilka lake - 2. Benthic animal communities. *Indian J. Fish.*, **12** : 492-499.
- Ramanandam, R. M.P.M. Reddy and A.V.S. Murty, 1964. Limnology of the Chilka lake. *J. mar. Biol. ass. India*, **6** : 163-201.
- Sewell, R.B.S. 1924. Fauna of the Chilka lake Crustacea : Copepoda. *Mem. Indian Mus.*, **5** (12) : 771-852.
- Sewell, R.B.S. and N. Annandale, 1922. Fauna of the Chilka lake : The Hydrography and invertebrate fauna of Rambha Bay in an abnormal year. *Mem. Indian Mus.*, **5**(10) : 677-710.
- Tattersall, W.M. 1915. Fauna of the Chilka lake : The Mysidaceae of the lake with the descriptions of a new species from the coast of Orissa. *Mem. Indian Mus.*, **5** (2) : 147-161.

ZOOPLANKTON : PHYTOPLANKTON

CH. SATYANARAYANA AND M. SRINIVASAN

Zoological Survey of India, Madras

INTRODUCTION

This investigation has been carried out to find out the inter relationship between the phyto and zooplankton organisms of the Chilka lake in relation to the hydrographic features during the monsoon season in 1987. Though the Chilka lake is the biggest among the Indian brackish water lakes, meagre information is available on the planktonic forms. A perusal of literature shows the availability of few publications on the phytoplankton (Biswas, 1932; Roy, 1954; Devasundaram & Roy, 1954; Patnaik, 1973, 1978; Patnaik and Sarkar, 1976; Rao, *et al*, 1981, Satyanarayana, 1988 and Raman, *et al*, 1990).

Whereas among the zooplanktonic forms, certain groups like copepods (Sewell, 1924), Decapoda (Kemp, 1915), Mysidacea (Tattersall, 1915), Cumacea (Kemp, 1916), Amphipoda and Isopoda (Chilton, 1921, 1924), from the Chilka lake are already reported. Most of the earlier reports are either on the phytoplankton or on the zooplankton or on the phyto and zooplanktonic forms and no one has attempted to study the interrelationship of these organisms in relation to hydrographic features. The availability of the phyto and zooplankton samples and hydrographic data collected during the monsoon season from the Chilka lake has enabled the authors to undertake this study.

MATERIAL AND METHODS

Material for this study was collected during 1987 from 4.9.1987 to 26.9.1987. Plankton samples were collected from 100 hydrographic stations located at 2.5 kms interval. The details of the collection methods of the plankton samples and the method of analyses of the samples are given elsewhere (Satyanarayanan, 1988; Srinivasan, 1993; Srinivasan and Satyanarayana).

RESULTS AND CONCLUSION

The examination of 98 zooplankton samples collected during the monsoon season revealed the presence of 15 groups and they are listed here in the order of abundance : 1. Copepoda, 2. Crustacean nauplii, 3. Bivalve larvae, 4. Veliger larvae, 5. *Lucifer*, 6. Amphipoda, 7. Mysidacea, 8. Medusae, 9. Cladocera, 10. Rotifera, 11. Polychaete larvae, 12. Fish eggs, 13. Fish larvae, 14. Foraminifera, and 15. Decapod larvae. Among these 15 groups, copepods (90.0%), Crustacean nauplii (4.7%) and Bivalve larvae (3.0%) form more than 97.0% of the total number.

For the purpose of convenient study, the entire Chilka lake is divided into four zones, based on the salinity conditions, which play a dominant role in controlling the distribution of planktonic organisms. Zone-I, Low Salinity area, where the salinity fluctuates from 00.01‰ to 03.00‰; Relatively low salinity

zone-II (03.00% to 05.00%); Relatively high salinity zone-III (05.01‰ to 10.00‰) and high salinity zone-IV (10.01‰ to 20.00‰).

Among the 100 sampling stations, 19 hydrographic stations are located in the low salinity zone-I (M-17, N-10, 12, 13, 17, 18; P-12, 13, 14, 15, 16; Q-13; R-13, 14, 15; S-14, 15, 16 and 17).

More or less all these stations are in the northern sector of the lake, which is subjected to heavy influx of freshwater during the rainy seasons from the branches of river Mahanadi. Among the total number of copepods (44,705) in 1 Ml of the sample examined from 98 stations, 17.00% are found in the low saline zone; 43.00% are from the relatively low saline zone which has 18 sampling stations (K-10, 12, 15; L-10, 16; M-10, 12, 13, 15; N-8, 9, 15; O-8, 9; P-8; Q-12; R-12 and S-13). These stations are found in the central sector and in the western side of the northern sector; 35% of the copepods are from the relatively high saline zone, which has 24 stations (G-12, 13, H-11; I-12, 13, 14; J-11, 14; K-13, L-11, 14, 15; M-16; N-11, 16; P-10, 11; Q-8; R-9; S-9, 12; T-10; U-10, V-W-11). These stations are found in the outer channel area and in the central and western side of the central sector; Only 5% of the copepods are found in the high saline zone that has maximum number (37) of sampling stations (A-2, 3; B-1, 2, 3, 4, 5, 6; C-2, 3, 4, 5, 6; D-4, 5, 6, 7, 8; E-5, 6, 7, 8, 9, 10; F-6, 7, 8, 9, 10, 11; G-9, 10; H-9, 10; I-10, J-10; L-9). Most of these stations are found in the southern sector and in the southern side of the central sector. So this study clearly shows that the copepods, the most dominant group in the samples are found in abundance in the low saline, relatively low saline and relatively high saline zones of the lake than in the high saline area.

The crustacean nauplii that forms 4.7% of the plankton and occupies the second place in the order of abundance are also found in abundance in the low saline areas (33%), relatively low saline areas (22%) and relatively high saline zones (37%) than in the high saline zones (8%).

Whereas the bivalve larvae that occupies the third place in the order of abundance and constitutes 3% of the total plankton are found to prefer the relatively low saline zones (26%), relatively high saline zones (31%) and high saline zones (28%), than the low saline zone. Only 15% of the bivalve larvae are found in the low saline zone. As the remaining 12 groups form only 2.2% of the total plankton, their distribution in different zones are not individually dealt with in this account. However, it is found that the groups like, veliger larvae, fish larvae, foraminifers, *Lucifer*, Amphipoda, Mysidacea, Cladocera, Rotifers Polychaete larvae and Decapod larvae are found in greater numbers in the low saline and relatively low saline areas than in the high saline and relatively high saline zones. Whereas, the remaining groups, medusae and fish-eggs are found in abundance in the high saline and relatively high saline areas than in the remaining areas.

The analyses of the phytoplankton samples show that the Bacillariophyta, Cyanophyta and Dinophyta are the major forms abundantly found in the samples. This study has shown that in the southern sector of the Chilka lake, where the salinity was high, dinoflagellates were found in abundance (Fig. 1). In most of the stations of the southern sector only dinoflagellates were found to occur. It is interesting to note that in this region of the lake, the zooplankton were found in less numbers (Fig. 1). This may be due to the fact, that dinoflagellates produce anoxic conditions in the water column and are slightly poisonous forms and they do not form the palatable food of the zooplankton and this might have resulted in the occurrence of lesser number of zooplankton in the southern sector. Sellner and Brownlee (1990) stated that: dinoflagellate blooms provide a large and labile carbon reservoir for the 'microbial loop' and indirectly

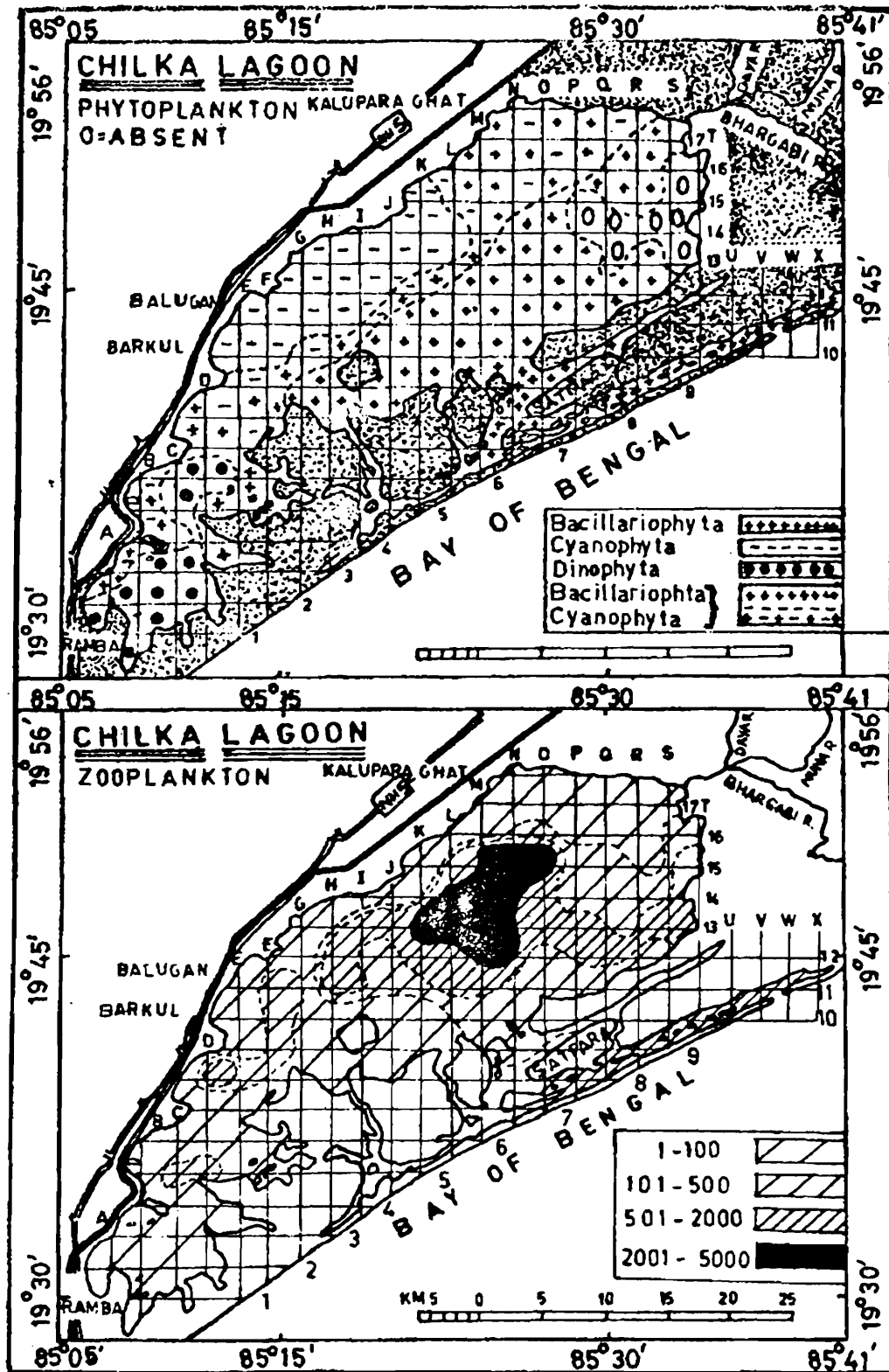


Fig. 1. Phytoplankton and Zooplankton abundance in Chilka Lake during the Monsoon Season, 1987.

high water column oxygen demand that may lead to water column hypoxic/anoxic condition.

In the outer channel and in the eastern part of the central and northern sector, exclusively Bacillariophyta are found in all the stations, whereas in the western side of the central sector the Cyanophyta are the dominant forms in all the stations. In the north-western part of the northern sector and in the middle region between the eastern and western part of the central sector, both the Bacillariophyta and Cyanophyta are found; but the Bacillariophyta are found in greater numbers than the Cyanophyta (Fig. 1) The presence of maximum number of zooplankton at the central sector may probably be due to the abundance of Bacillariophyta and Cyanophyta, which form the basic food of the zooplankton. As this conclusion is based on the results of only one expedition material, this interrelationship between the phyto and zooplankton can be ascertained only after studying these groups continuously for several seasons. However the abundance of zooplankton after the phytoplankton peaks in Agniar estuary (Mohamed and Rehman, 1988), in Vellar estuary (Ramadhas, 1977) and in Asthamudi lake (Divakaran *et al*, 1982), has already been reported.

Another interesting point of observation is that at certain stations near the river mouth (Fig. 1) of the northern sector, the phytoplankton was totally absent in the collected samples. This may be due to the high turbidity and sudden change of salinity due to the influx of fresh water from the rivers during the monsoon season.

SUMMARY

From this investigation, it was possible to conclude that certain zooplankton forms like copepods and crustacean nauplii are found to prefer the low saline areas of the Chilka lake than the high saline areas. The abundance of Bacillariophyta and Cyanophyta in the low saline areas may be responsible for the occurrence of zooplankton in greater numbers in the central sector as the former forms the food of the latter. Further the presence of dinoflagellates in huge numbers in the southern sector, which are toxic and lead to water column hypoxic may be the possible reason for the presence of zooplankton in less numbers. Phytoplankton was totally absent in certain stations near the river mouth in the northern sector. This may be due to the sudden change in salinity conditions and high turbidity.

ACKNOWLEDGEMENTS

The authors are thankful to Dr. A. K. Ghosh, Director, Zoological Survey of India, Calcutta, Dr. A. N. T. Joseph, the former Joint Director, Marine Biological Station, Madras and Dr. K. V. Rama Rao, Joint Director, Fresh Water Biological Station, Hyderabad for the facilities provided to undertake this study. The help rendered by the staff members of the Estuarine Biological Station, Berhampur in collecting the materials is gratefully acknowledged.

REFERENCES

- Biswas, K. 1932. Algal flora of the Chilka lake. *Mem. Asiat. Soc. Bengal*, **11**(5) : 65-198.
- Chilton, C. 1921. Fauna of the Chilka lake : Amphipoda. *Mem. Indian Mus.*, **5**(8) : 519-558.

- Chilton, C. 1924. Fauna of the Chilka lake : Tanaidanacea and Isopoda. *Mem. Indian Mus.*, **5** (12) : 875-895.
- Devasundaram, M.P. and Roy, J. C. 1954. A preliminary study of the plankton of the Chilka lake for the year 1950 and 1951. IPFC. Proceed Cymp Waustrechwater plankton in Indo-pacific Bangkok, 25 & 26 January : 48-54.
- Divakaran, O, M. Arunachalam, N. B. Nair and N. K. Balasubramaniam, 1982. Distribution and seasonal variation of the zooplankton of the Asthamudi lake, Southwest coast of India. *Mahasagar, Bull. Natn. Inst. Oceanogr.* 15-43.
- Habib Mohamed, T.A.M. and A. Abdul Rahman, 1987. Seasonal distribution of plankton in Agniar estuary. *J. mar. biol. Ass. India*, **29** (1, 2) : 273-279.
- Kemp, S. 1915. Fauna of the Chilka lake : Crustacea. Decapoda. *Mem. Indian Mus.*, **5**(3) : 199-326.
- Kemp, S. 1916. Fauna of the Chilka lake : Cumacea. *Mem. Indian Mus.*, **5**(4) : 393-402.
- Patnaik, S. 1973. Observation on the seasonal fluctuations of plankton in the Chilka lake. *Indian J. Fish.*, **20**(1) : 43-45.
- Patnaik, S. 1978. Distribution and seasonal abundance of some algal forms in Chilka lake. *J. Intl. Fish. Soc. India*, **10** : 56-67.
- Patnaik, S. and S. K. Sarkar, 1976. Observation on the distribution of phytoplankton in Chilka lake. *Ibid.*, **8** : 38-48.
- Ramadhas, V. 1977. Studies on phytoplankton, nutrients and some trace elements in Porto Novo waters. Ph.D. Thesis, Annamalai University, 135 pp.
- Raman, A.V., Ch. Satyanarayana, K. Adishesasai and K. Phani prakash, 1990 Phytoplankton characteristics of Chilka lake, a brackish water lake along East coast of India. *Indian J. Mar. Sci.*, **19** : 274-277.
- Rao, M.V.S., B.M.G. Rao, B.R. Rao and N. K. Nanda, 1981. Hydrological studies of the brackishwater Chilka lake, *Orissa. J. Environ. Biol.* **2**(1) : 59-62.
- Roy, J. C. 1954. Periodicity of the plankton diatoms of the Chilka lake for the years 1950 and 1951. *J. Bombay Nat. Hist. Soc.*, **52**(1) : 112-123.
- Satyanarayana, Ch. 1988. Chilka lake expedition, September, 1987 : Studies on Hydrobiology and phytoplankton. 72 pp. M. Phil. thesis, Andhra University.
- Sellner, K. G. and D. C. Brownlee, 1990. Dinoflagellate microzooplankton interactions in Chesapeake Bay in *Toxic Marine Phytoplankton* (ed) Graneli, E., B. Sundstroem, L. Edler and D. M. Anderson. Published by : Elsevier, New York (USA) : 221-226.

Sewell, R.B.S., 1924. Fauna of the Chilka lake : Crustacea. copepoda. *Mem. Indian Mus.*, 5(12) : 771-852.

Srinivasan, M. Distribution and seasonal abundance of phyto and zooplankton of the Chilka lake, Orissa State, India. Mss. 9 pages with 10 text figures. *Rec. Zool. Surv. India* (in press).

Srinivasan, M. and Ch. Satyanarayana. Seasonal and spatial distribution of zooplankton in relation to hydrographic features of Chilka lake, Orissa state. Mss. 16 pages (In press) *Ibid.*

Tattersall, W.M. 1915. Fauna of the Chilka lake : The Mysidacea of the Chilka with the description of a species from the coast of Orissa. *Mem. Indian Mus.*, 5(2) : 147-161.

MEROPLANKTON

P. DHANDAPANI

Zoological Survey of India, Madras

INTRODUCTION

Chilka, the largest brackishwater lake of Asia, is situated on the East coast of India, in Orissa State, between 19°28' to 19°54' Lat., and 85°6' 85°35' Long., and is connected to the Bay of Bengal. Its magnitude and water capacity is so large that it bears an unending potentiality for brackishwater fishery and aquaculture.

A review of literature pertaining to Chilka lake reveals as to how a galaxy of scientists have unfolded its secrets from various angles to expose its fauna, flora and environmental parameters that govern the ecology of the lake. The faunistic studies pertain to Porifera and Coelentrata (Annandale, 1915;), Annelida (Stephenson, 1915; and Southern, 1921;), Minorphyla (Annandale and Kemp, 1915;), Crustacea (Annandale, 1915; Kemp, 1915 & 1916; Chilten, 1921; Sewell, 1924; Jones and Sujasingani, 1952; Ray and Sahoo, 1956; and Subramaniam, 1966;), Mollusca (Annandale and Kemp, 1915; and Elliot, 1916;), Fishes (Jones and Sujasingani, 1954; Pillay, 1957; Jhingaran, 1963; Jhingaran and Natarajan, 1969 & 1973; Kowtal, 1969; Ramakrishniah, 1972; and Mohanty, 1976;), Benthic organisms (Rajan, 1965; and Patnaik, 1971;), Meiofauna (Sarma and Rao, 1980;), Phytofauna (Sarma and Satpathy, 1978;), Faunal association (Sarma, Rao and Satpathy, 1979;) and Aquatic mammal (Annandale, 1915; Dhandapani, 1992).

While phytoplankton was covered by Roy (1954), Patnaik & Sarkar, (1976) and Raman *et al.* (1992), only Devasondaram & Roy, 1954, and Pattnaik (1986) studied zooplankton as a whole, although tow net collections were made previously by Zoological Survey of India during the First Chilka Lake Expedition in which " copepodes and larval molluscs greatly predominated" (Annandale and Kemp, 1915, p.15).

The environmental parameters of Chilka lake were previously described by Annandale & Kemp (1915), Roy (1954), Ramanadham *et al.* (1964), Rajan (1964), Banerjee & Roychoudhury (1971), Mohanty (1975), Patnaik & Sarkar (1976), Patnaik (1978), Sarma & Rao (1980), Subha Rao *et al.*, (1981) and Pattanaik (1986).

But, so far, no account is available exclusively on the meroplankton of Chilka lake which form the main recruitment body of major faunistic composition of nekton and benthos of this lake. Keeping in mind the growing demand for fishery products both for local consumption and export; and also the need for propagating aquaculture to meet such a demand, the author initiated this study as an essential aspect to support cultivable fish farming through collection of fish seeds at the right season and at the right part of the lake. This work is expected to bring out additional information to the already available sporadic literature on various fish seed collections from Chilka lake (Kowtal, 1967; Madanagopal Rao, 1970; Natarajan & patnaik, 1970; Parida, 1970; and Ramakrishniah, 1979).

MATERIAL AND METHODS

The present work embodies the results obtained after analysing one hundred and ninety nine plankton samples collected during the Second Chilka Lake Expedition conducted by the Estuarine Biological Station, Z. S. I., Berhampur. The collections cover the North-east monsoon period, the pre-monsoon and post-monsoon periods of the east coast of India. Since the environmental factors play a major role on the development and survival of the eggs and larvae that constitute the meroplankters, and also since salinity being the most important parameter, the distribution pattern of meroplankters has been projected in this report with salinity as playing the concurrent role. It should be noted here that the number of stations analysed during the present study for the post-monsoon period (32) is not sufficient enough for a perfect comparison with the pre-monsoon period (70 stations) and monsoon period (97 stations).

RESULTS

The results presented here is based on the data collected during the three expeditions for environmental parameters, plankton, benthos and core samples of the Chilka lake; and pertains only for a short period of a particular season. This study of meroplankters and salinity is expected to through light on the meroplankton ecology of Chilka lake.

Salinity structure of Chilka lake : The distribution of major water bodies of varying salinity covering different parts of Chilka lake differs during premonsoon, monsoon and postmonsoon seasons as follows:

Premonsoon period : The Southern sector which is bordered by Rħamba on the south, Barkul on the west, Nalabhan Island on the north and Tippo Island on the east, shows salinity range of 10 to 15‰. From Barkul to Sonanari on the north, from Sonanari to 80°30' towards east and down south upto Naupada forms the Central sector that reaches the highest salinity level in Chilka lake, i.e. 15 to 20‰. Low salinity pockets are observed on the northern sector near the mouth of Kusumi Nallah. No data was collected either from Daya or Nuna river mouths during the premonsoon periods.

Monsoon period : The data on salinity for this period was collected in September. It reveals the presence of three large water bodies of decreasing salinity from north to south. The salinity remains to be almost constant in the southern sector due to mixing. The Central sector which has been holding the highest salinity level prior to monsoon gets diluted to 5-10‰; and the salinity of the entire northern sector gets reduced even to the tune of Oligosaline level (0-5‰).

Post monsoon period : The salinity distribution pattern during this period once again shows three water bodies of 0-5‰, 5-10‰ and 10-15‰ which is similar to the monsoon period but shows a tendency to increasing salinity level as evidenced by the reduced area of distribution of low saline waters. It is unfortune that no data was collected by this expedition between February and June which could have brought to light the period and process of transition from low saline to high saline conditions between postmonsoon and premonsoon periods.

Distribution of Meroplankters :

Porifera : Sponge gemmules were collected from three stations during the postmonsoon period. While two collections were from the southern sector (salinity 10-15‰), the third collection was from very close to the channel area (salinity approx. 12‰). (Fig. 1).

Annelida : Polychaete larvae were collected during all the seasons from the southern sector where salinity remains stable between 10-15‰. Two more collections contained polychaete larvae, of which one was from the Central sector and the other was from near the mouth area. (Fig. 2)

Crustacea : These were represented by Cirripede, Stomatopod, prawn and crab larvae.

a. Cirripede larvae were present mostly in the Southern sector (10-15‰) and there was one collection from the mouth region. Invariably Cypris larvae were present. (Fig. 3)

b. Stomatopod larvae were represented by Alima and Erycthis larvae. These were abundant both in the Central and Southern sector particularly during premonsoon period when the salinity was very high for Chilka lake. Scarce representation was observed in the Central sector and channel area during monsoon; and was a meagre representation of one station during postmonsoon period in the southern sector. (Fig. 4).

c. The prawn larvae were more dominantly distributed during the monsoon period in all the three sectors. During premonsoon and postmonsoon periods there is a considerable reduction in their population; and their representation is more on the southern sector (10-15‰) than in the other two sectors. (Fig. 5).

d. Crab larvae represented by megalopa stages; and were present more during premonsoon period when the salinity level in the lagoon was high. The northern sector, with its oligosaline condition, represents crab larvae only in two stations. During the post monsoon period, the megalopa larvae were present only in the southern sector. Surprisingly, the collections contained crab larvae only in few stations despite the fact that the Chilka lake is popular for its mudcrab fishery. (Fig. 7).

Mollusca : This was represented by bivalve and gastropod larvae only.

a. Bivalve larvae were represented very well in all the three seasons; and were particularly well distributed in the northern half of southern sector during monsoon. The premonsoon collection indicates more concentration of larvae in the southern sector and the post monsoon period shows sparse distribution. (Fig. 6).

b. Gastropod larvae occupy the third position after fish eggs & larvae and bivalves, in their distribution among meroplankters. The premonsoon plankton collections show a dense occurrence of gastropod larvae in the high saline (15-20‰) Central sector, while during monsoon periods they are found more in the mesosaline area of the northern sector. The postmonsoon period shows very sparse distribution all over the lake. (Fig. 8).

Fish eggs and larvae : This is the only group of meroplankter that is very well represented all over the lake both during premonsoon and monsoon periods. The picture of distribution during post monsoon period shows comparatively a very low figure, but the distribution was uniform (Fig. 9).

The Rhamba Bay or the Southern sector is filled with fish eggs and larvae both during premonsoon and monsoon periods; but during the postmonsoon, the distribution was in the northern half of the southern sector.

The pattern of distribution in the Central sector is less in density than in the Southern sector but is uniformly good during premonsoon period. It is restricted to the northern half during monsoon.

The Northern sector shows a good representation of fish eggs and larvae particularly on the eastern half during the monsoon; but, its representation is rare both during premonsoon and postmonsoon periods in the entire area.

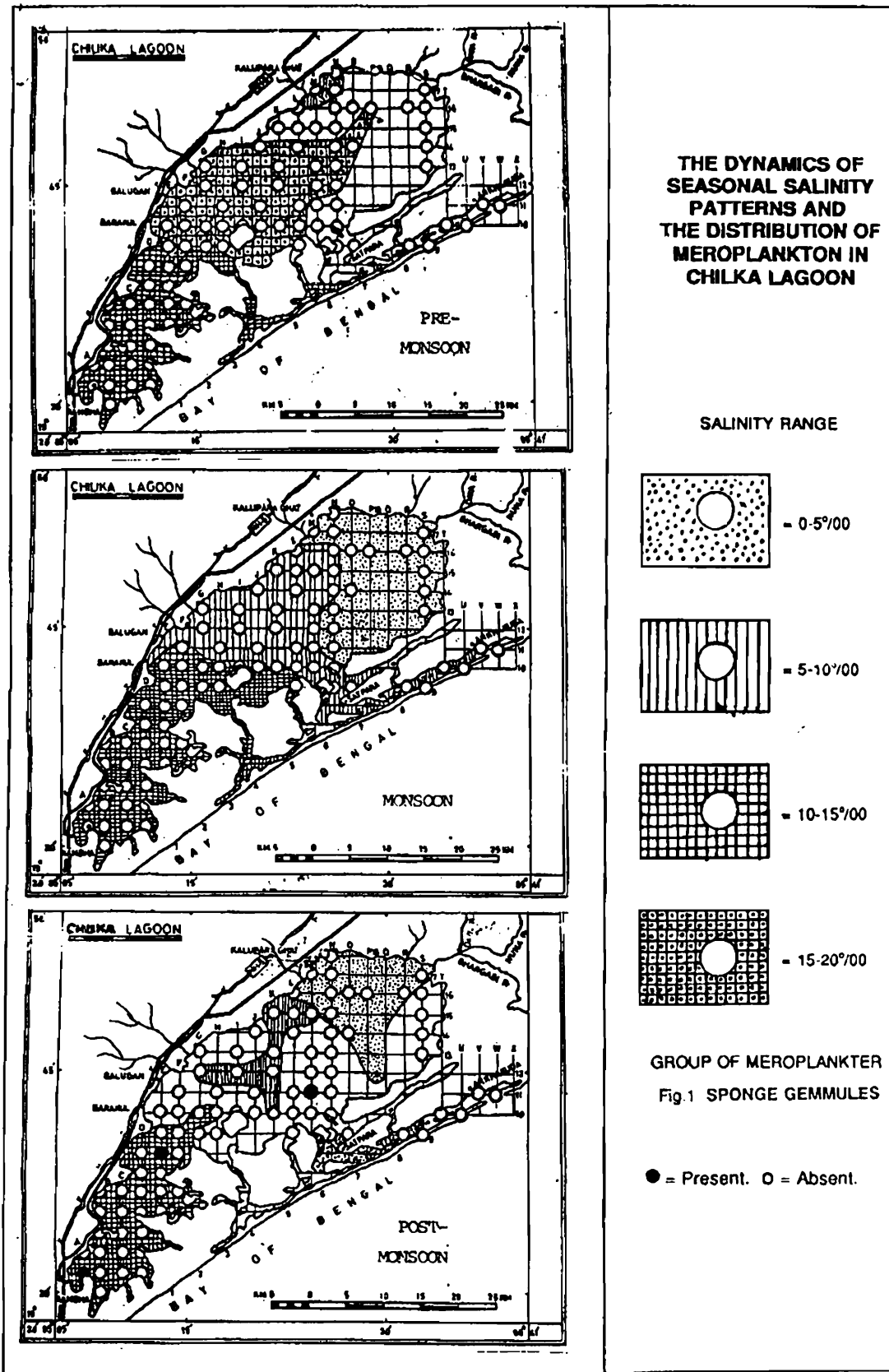
DISCUSSION

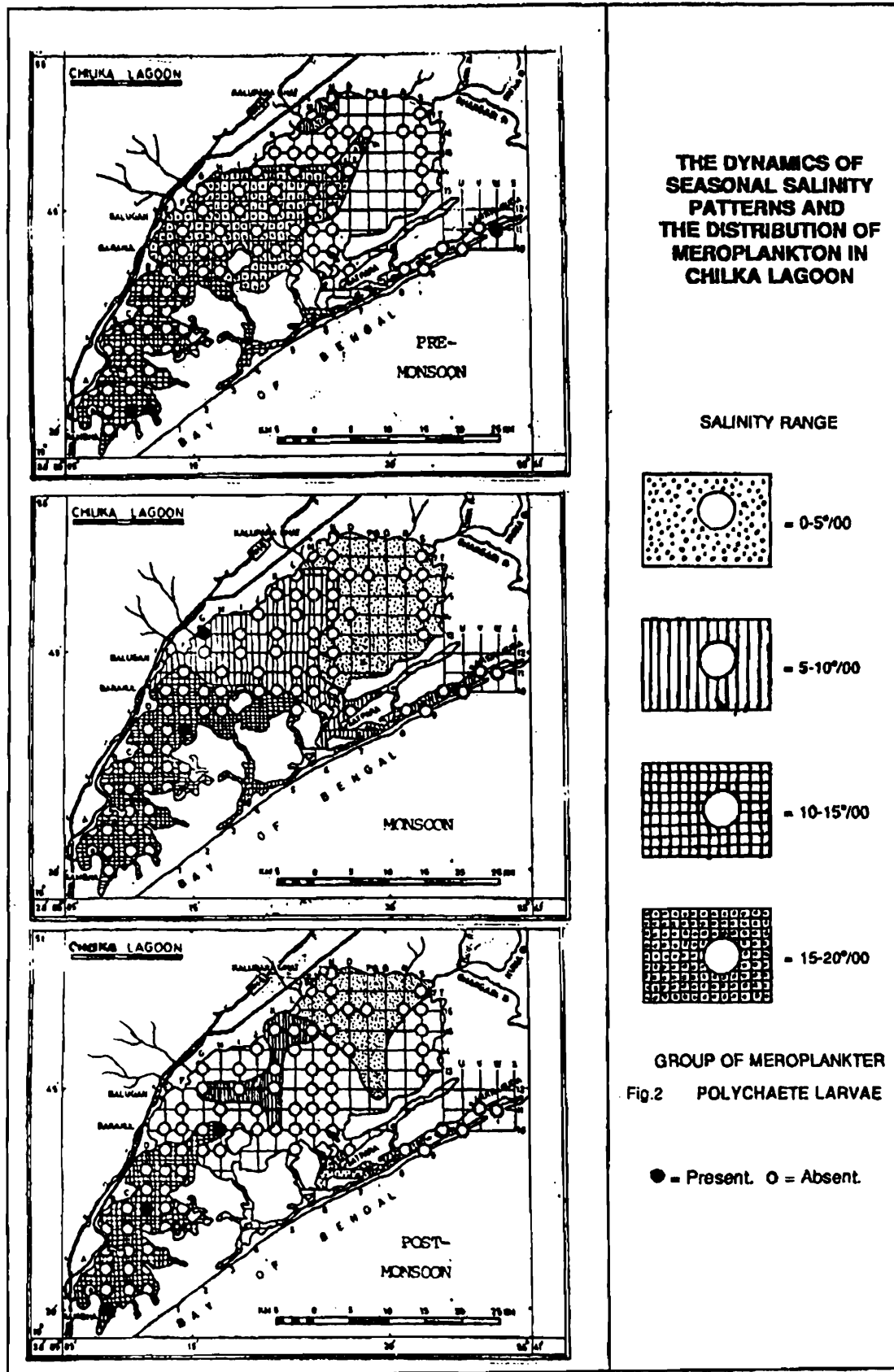
Salinity is the most important environmental parameter that governs the physiological activity of an aquatic organism. Temperature and pH play additional supporting role in an ecological niche. Even when the adult organisms with all their well developed integuments prefer suitable salinity for their very existence, it is but natural that their larval forms which spend this stage of life as plankters are depending mainly on favourable salinity for their survival and also to transform into adults. Apart from the larvae, the adult organisms also reach maturity and spawn only under favourable environmental conditions. Therefore, in Chilka lake, which shows an extreme change of salinity pattern as influenced by seasonal changes, the study of meroplankton distribution in relation to salinity would help to understand its ecology, and the same is discussed as follows :

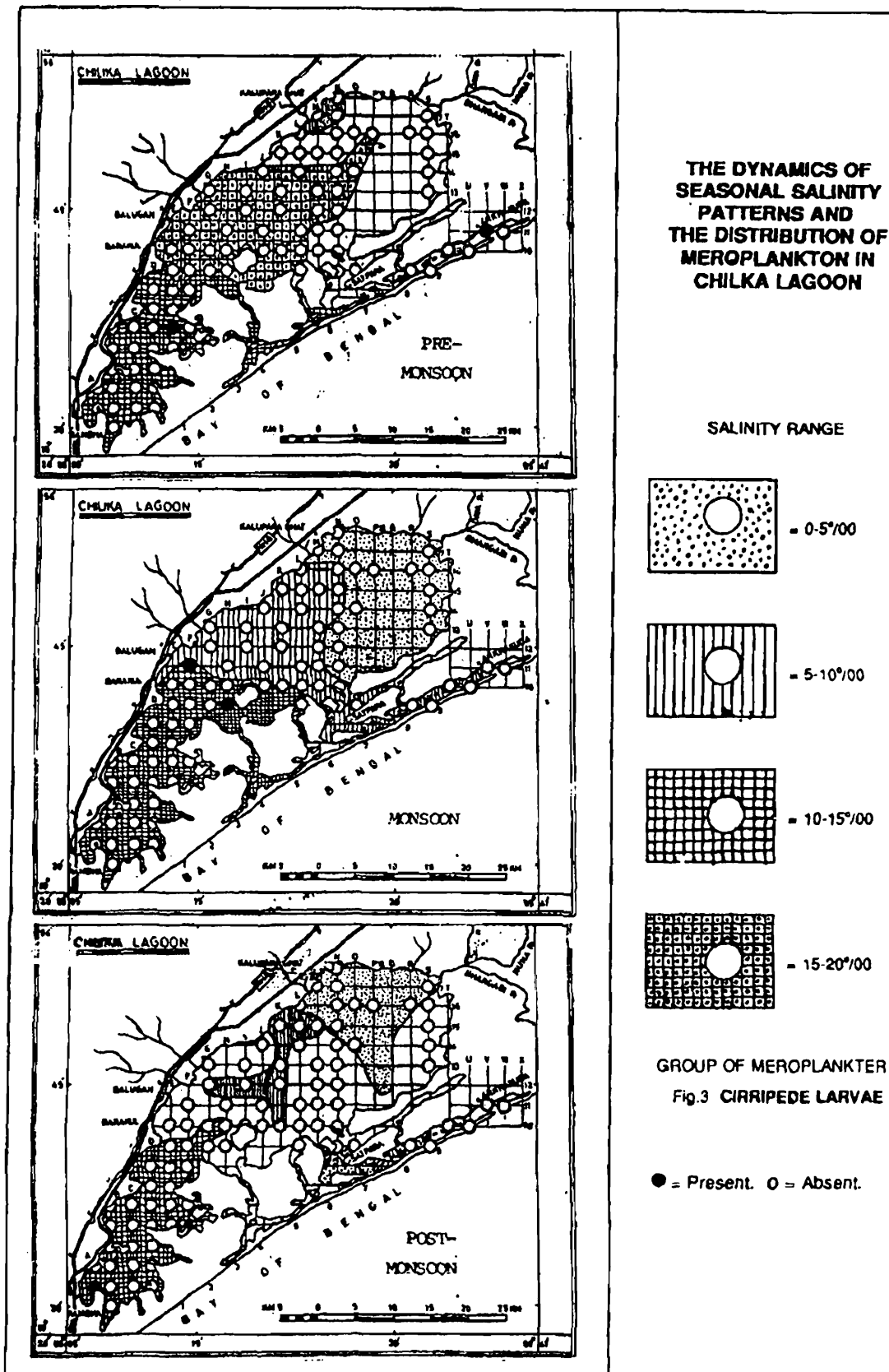
Earlier workers on environmental parameters (*loc. cit.*) attribute the heavy floodwater influx during monsoon and post monsoon period; evaporation of surface waters during summer; and the huge quantity of water entering through the narrow mouth into the channel area as reasons for the drastic changes that occur in the salinity pattern of the Chilka lake. Though, the present study is in confirmity with the observations made by earlier workers for the Northern and Southern sectors; additional casuative factors governing the pattern of salinity distribution in the Central sector were derieved from the three maps projected here which depict the premonsoon and postmonsoon period.

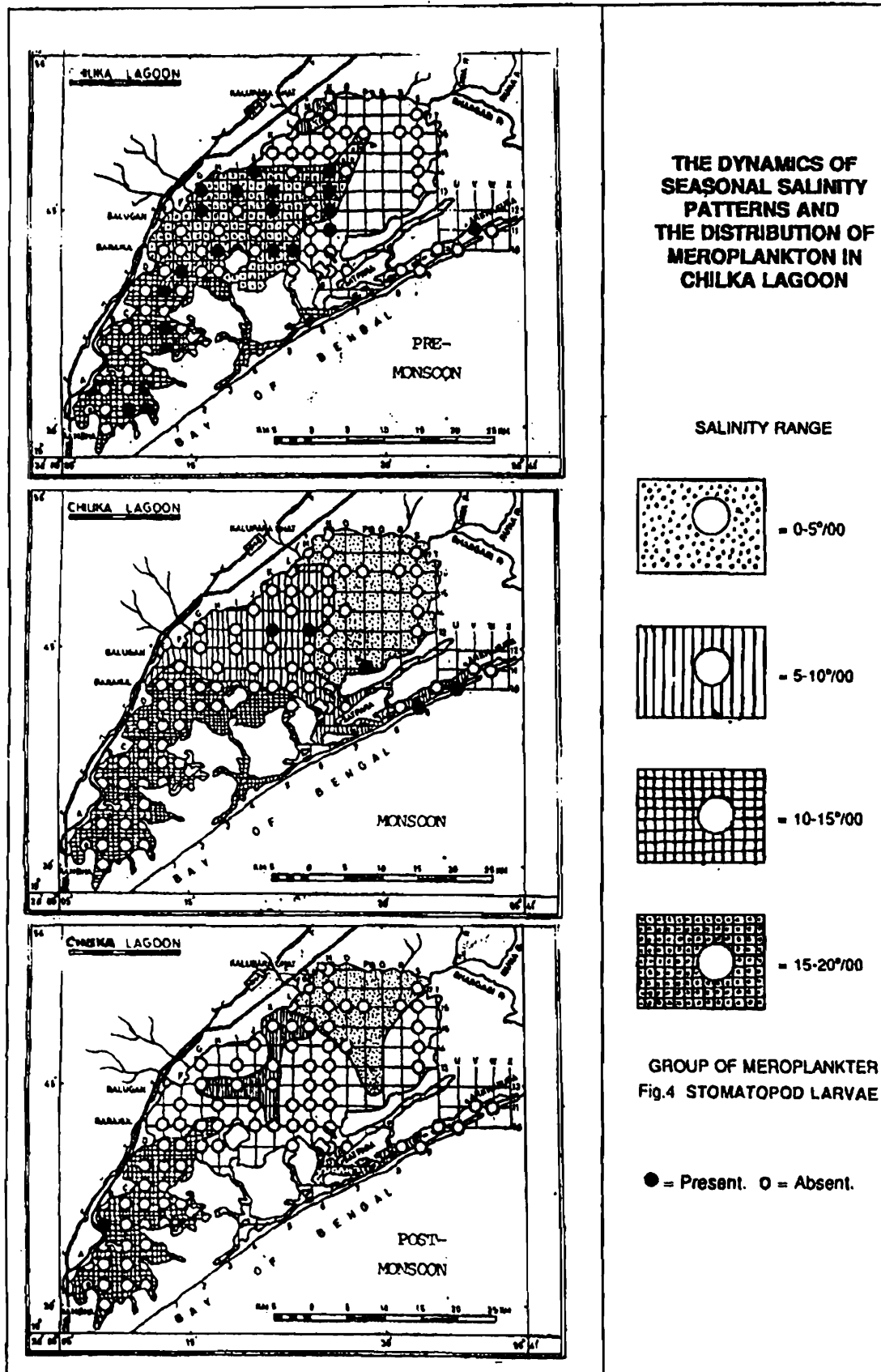
During the monsoon, the Northern sector is heavily diluted by Daya, Bhargave and Nuna rivers and also by Makhra Nallah almost to Oligosaline level (0-5‰). The force of the flood waters is so powerful that it prevents the seawaters mixing with the waters of the eastern half of Northern sector. During the postmonsoon period, while the western half and northern peripheral regions remain diluted, the eastern half of the Northern sector shows a change towards increase in salinity due to incursion of seawater through the narrow mouth of the lagoon which overpowers the the reducing force of the northern rivers and Nallah. In the Southern sector both during monsoon and postmonsoon period, the Rhamba Bay shows negligible variation in salinity due to the fact of the landwashed waters draining into the Bay; and also, neither rivers nor Nallahs open into this land locked Southern sector. Here the salinity remains to be 10-15‰ throughout the year.

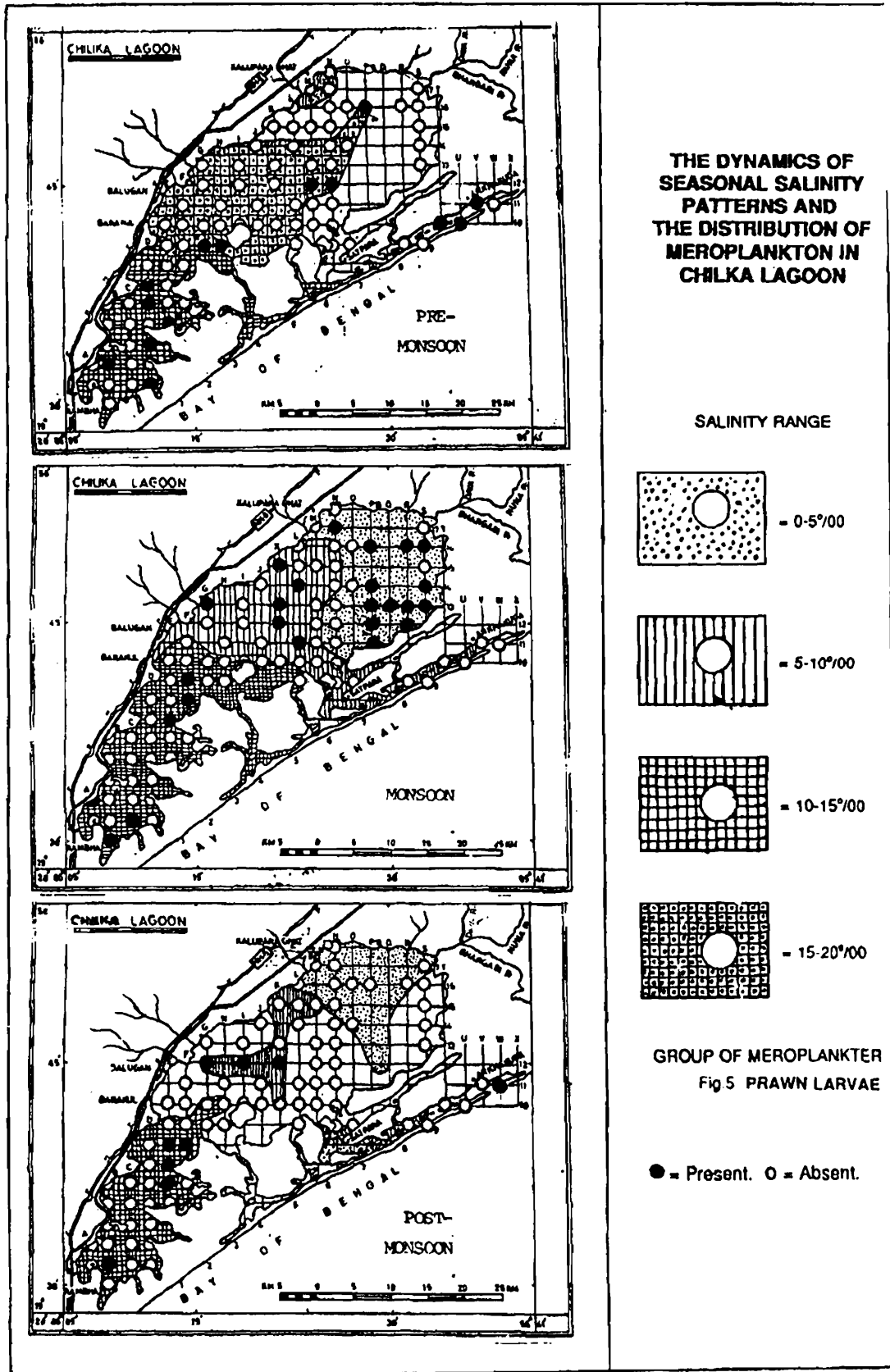
It is the Central sector of the Chilka lake that is highly influenced by the seasonal changes; and the phenomena which contributes to such changes in the pattern of salinity distribution between 5 and 20‰ are explained as follows :

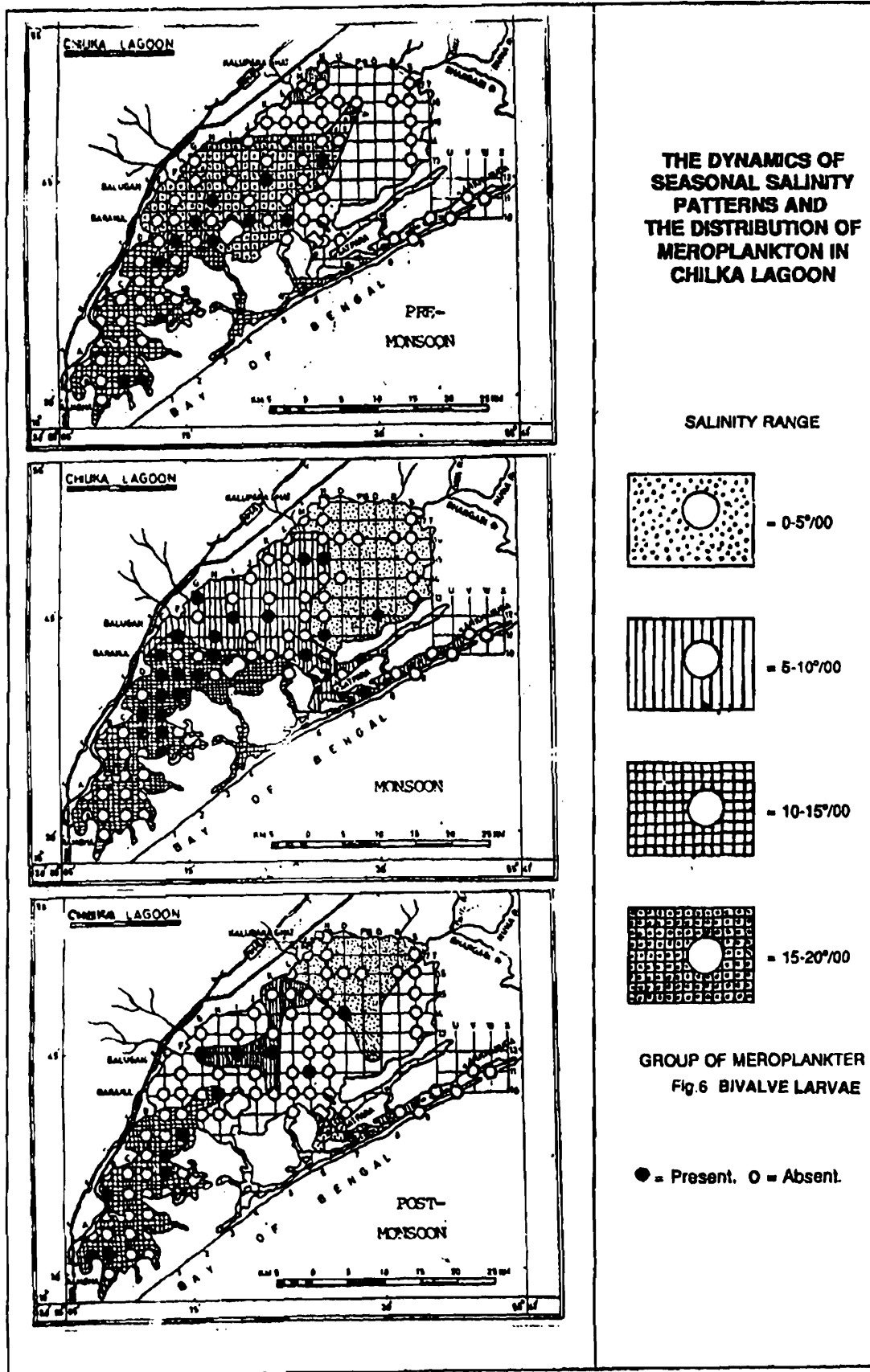


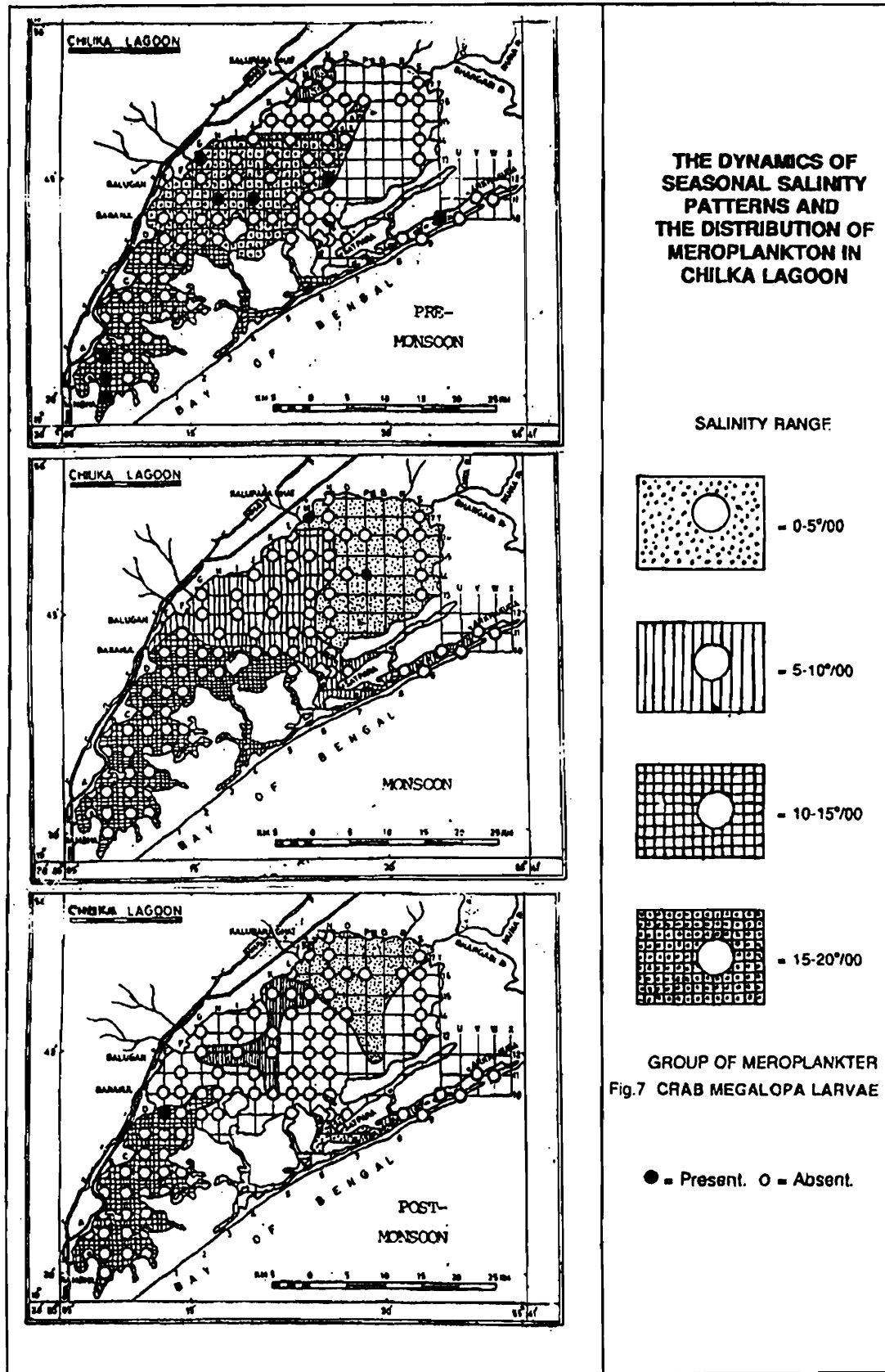


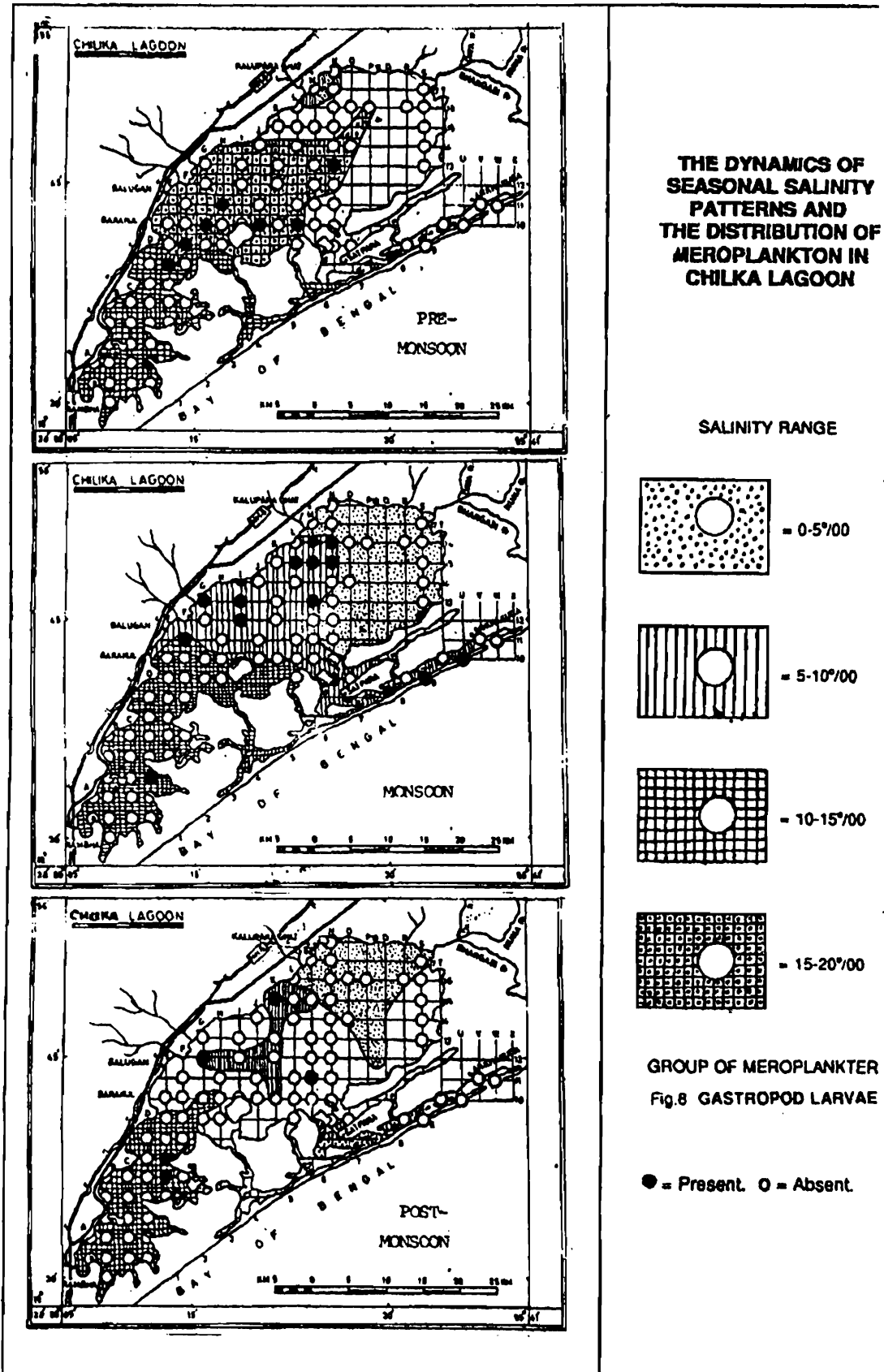


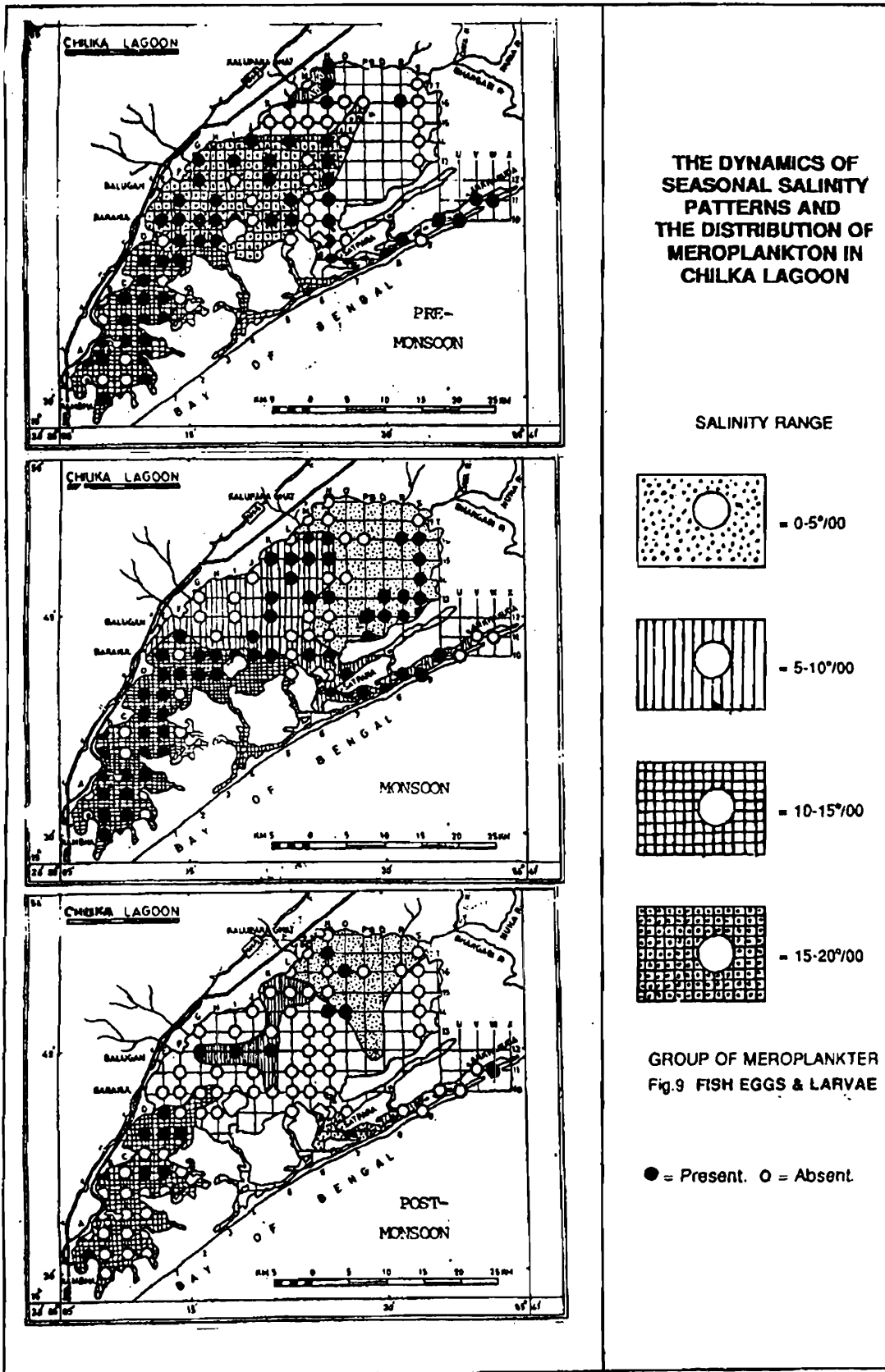












1. The force and quantum of flood waters from the northern direction from Daya, Nuna and Bhargavi rivers and the Makhra Nallah is so heavy that it dilutes not only the entire Northern sector but also contributes to the dilution of Central sector. Simultaneously, the three Nallahs on the western bank of the Central sector; i.e. Kusumi, Khalia and Saliya, also drain their floodwaters into the lake. Thus the quantum of fresh water reaching the Central sector gradually reduces the salinity from the premonsoon level of 15-20‰ to 5-10‰. This gradation of gradual dilution is well depicted by Satyanarayana (1988) who in turn based his classification of salinity zones as suggested by Remane (1971) into two oligohaline and two mesohaline zones.

2. During the post monsoon period, flood waters of the northern rivers and nallahs are reduced in quantum, thus setting a trend towards gradual increase in salinity. The reduced force of these receding floodwaters results in seawater incursion into the lake to increase the salinity value to 10-15‰ in the Central sector.

3. Soon after summer, during premonsoon period, the three Nallahs get either dried up or there is hardly any flow of freshwater into the lagoon. The heavy vegetation of the Northern sector, a result of nutrients brought in by floods, becomes a barrier to prevent any mixing of Northern sector waters with the Central sector. Thus, the almost nil flow of freshwater into the central sector; the evaporation of surface waters during summer; and the heavy influx of seawater through the narrow mouth of the lagoon contribute to the highest level of salinity observed during premonsoon period.

It may be observed from the charts No. 1-9 presented here, that, consequent of the drastic changes in salinity, the distribution pattern of meroplankters in Chilka lagoon could be classified into three groups.

Group I : Sponges, Cirripedes, Polychaetes, decapod crabs and Stomatopods, which are usually residents of the lake, reproduce only when the salinity level of the lagoon increased favourably. These are Stenohaline species and the larvae were present only in the high saline region (10-20‰).

Group II : Bivalves, Gastropods, Prawns and Fishes, which are also residents of the lagoon, reproduce throughout the year uniformly all over the lake. Their fecundity appears to be induced by the change of salinity, thus proving that this group is more Euryhaline.

Group III : These are larvae of fin fish and crustaceans which migrate from the open ocean into the lagoon whose adults are residents of the sea. The larvae migrate from the open ocean into the lagoon through the narrow mouth of the channel (Ramakrishniah, 1979).

CONCLUSION

The dynamics of salinity pattern in Chilka lagoon is due, exclusively, to the monsoon floods, evaporation of surface water and incursion of seawater. Consequently, three major salinity zones of varying levels can be demarcated at any time of the year as Northern sector, Central sector and Southern sector.

The Stenohaline species reproduce in the southern sector and channel area. The Euryhaline species reproduce all over the lake in all seasons, but their larvae are more abundant in the Northern and

Central sectors during premonsoon and monsoon periods; and these larvae belong to economically important seed community that could be harvested for aquaculture.

SUMMARY

Plankton samples collected during the Second Chilka Lake Expedition of Zoological Survey of India were analysed for meroplankters. Based on the pattern of salinity distribution, three major water zones have been identified in the lake. The distribution of meroplankters in relation to these salinity based water zones is discussed.

ACKNOWLEDGEMENT

The author is highly thankful to Late Dr. B. K. Tikader, the then Director, Zoological Survey of India, Dr. A. K. Ghosh, Director, ZSI; and to Dr. K. V. Rama Rao, Scientist-SF & the then Officer-in-charge, Estuarine Biological Station, Berhampur, without whose enthusiastic schemes this piece of work would not have been a possibility. Thanks are also due to Dr. A. N. T. Joseph, Ex-Scientist-SF & Officer-in-charge, Marine Biological Station, Madras, for his encouragement and facilities in the laboratory. Last, but not the least, the author would ever remember all the staff members of EBS /Berhampur; the fellow participants in the Expedition; and the Officers of Tourism and Fisheries Departments of Govt. of Orissa, for all the co-operation they rendered to make the Expedition a success.

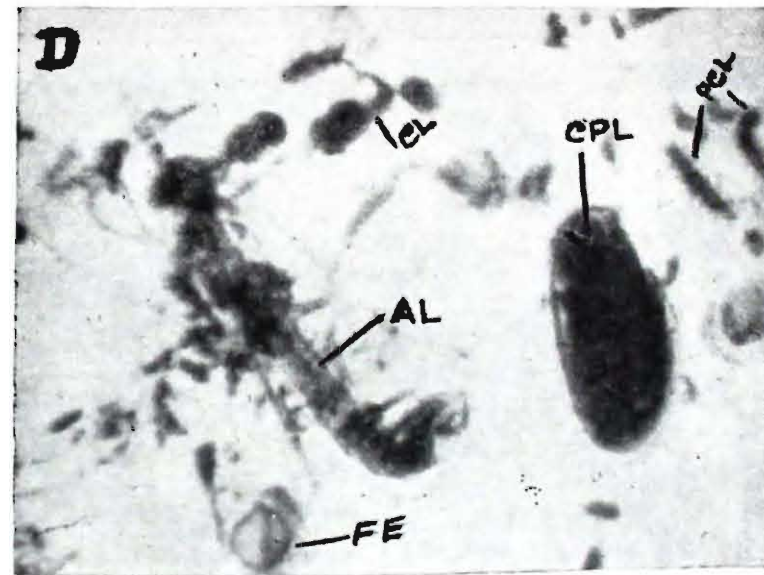
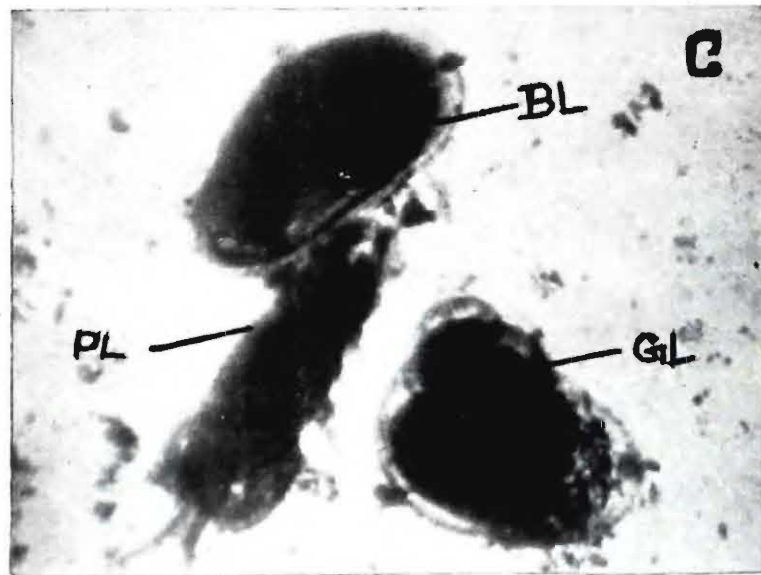
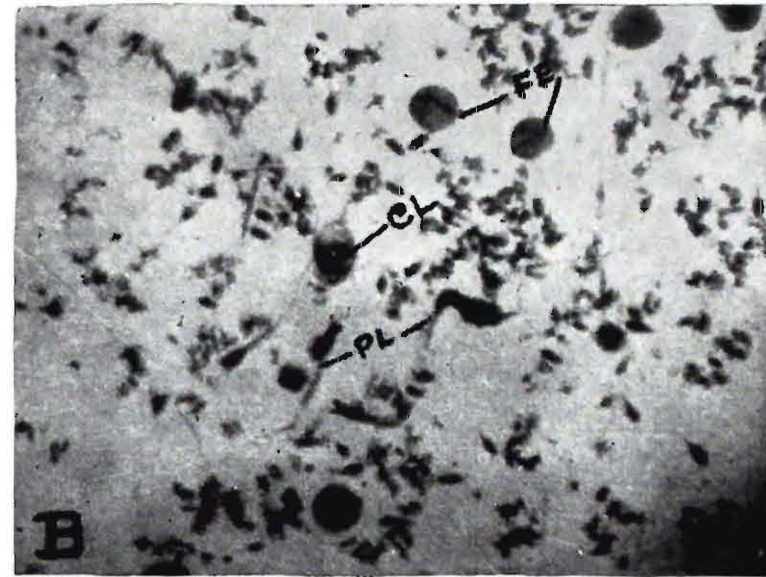
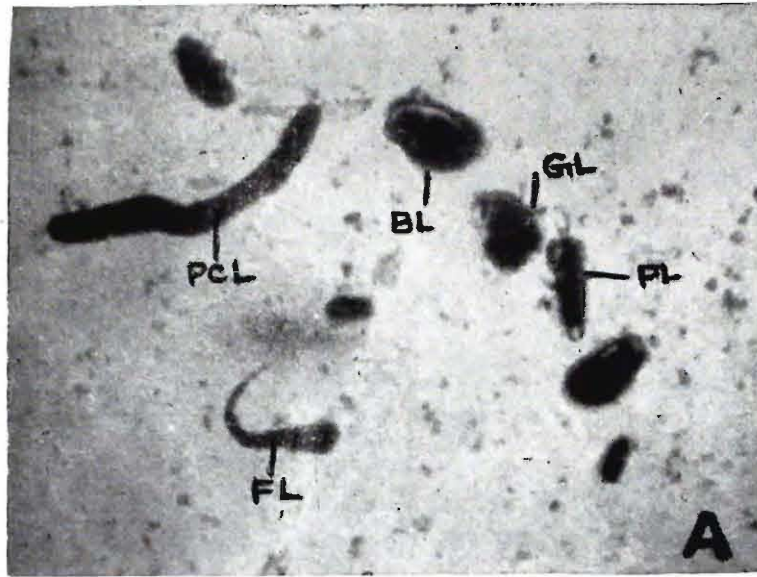
REFERENCES

- Annandale, N. 1915. Fauna of Chilka Lake, Sponges. *Mem. Indian Mus.* 5 (1) : 23-53.
- Annandale, N. 1915. Fauna of Chilka Lake, Coelenterata. *Ibid.* 5 (1) : 67-111.
- Annandale, N. 1915. Fauna of Chilka Lake, Polyzoa. *Ibid.* 5 (1) :
- Annandale, N. 1915. Fauna of Chilka Lake, Mammals, Reptiles and Betrachians. *Ibid.* 5 (1) : 166-167.
- Annandale, N. and S. Kemp, 1915. Fauna of Chilka Lake : Echiuroidea of the Lake and Gangetic Delta. *Ibid.* 5 (1) : 57-61.
- Annandale, N. and S. Kemp, 1915. Fauna of Chilka Lake : Mollusca : Gastropoda and Lamellibranchiata. *Ibid.* 5 (1) : 329-367.
- Banerjee, A. C. and N. C. Roy Choudhury, 1966. Obervationa on some physico-chemical features of the Chilka klake. *Indian J. Fish.* 13 : 395-429.
- Chilten, C. 1921. Fauna of Chilka Lake, Amphipoda. *Mem. Indian Mus.* 5 (1) : 521-558.
- Devasundaram, M. P. sand J. C. Roy, 1954. A preliminary study of the plankton of Chilka Lake for the year 1950 and '51. *Symp. Marine and Fresh. Wat. Plankton in the Indo-Pacific. Indo-Pacific Fish. Counc. Pupl.* 1-7 : 48-58.

- Dhandapani, P. 1992. Status of Irrawady River Dolphin, *Orcaella brevirostris* Gray (1866), in Chilka Lake. *J. Mar. Biol. Ass. India*. **34**. (1 & 2) : 90-93
- Elliot, C. 1916. Fauna of Chilka Lake, Mollusca : Nudibranchiata. *Mem. Indian Mus.* **5** (1) : 377-379.
- Jhingaran, V. G., 1963. Report on the fisheries of Chilka Lake, 1957-'60. *Bull, Cent. Inst. Fish. Res. Inst.*, **1** : 1-113.
- Jhingaran, V. G. and A. V. Natarajan, 1969. A study on the fish and fisheries population of the Chilka lake during the period 1957-65. *J. Inland Fish. Soc. India*, **1** (1) : 49-126.
- Jhingaran, V. G. and A. V. Natarajan, 1973. Fishery resources of the Chilka lake and its bearing on the fisheries of the adjacent areas of Bay of Bengal. *Proc. Symp. Living Resources of the seas around India, Spl. Publication CMFRI, Cochin* : 365-372.
- Jones, S. and K. H. Sujansingani, 1952. Notes on the crab fishery of the Chilka Lake. *J. Bombay Nat. Hist. Soc.* **51** : 128-134.
- Jones, S. and K. H. Sujansingani, 1954. Fish and fisheries of Chilka Lake with statistics of fish catches for the years 1948-'50. *Ind. J. Fish.* **1** : 256-344.
- Kemp, S. 1915. Fauna of Chilka Lake, Crustacea : Decapodas. *Mem. India Mus.* **5** (1) : 201-225.
- Kemp, S. 1916. Fauna of Chilka Lake, *Cumacea. Ibid.*, **5** (1) : 521-558.
- Kowtal, G. V., 1967. Occurrence and distribution of pelagic fish eggs and larvae in the Chilka Lake during the years 1964 and 1965. *Ind. J. Fish.* **14** (1-2) : 198-214.
- Kowtal, G. V., 1969. Studies of the juvenile fish stock of Chilka Lake. *Indian J. Fish.* **23** : 31-40.
- Madanagopal Rao, 1970. Breeding habits and embryonic development of the mullet *Liza trochelli* (Bleeker) in Chilka Lake. *The Chilka Lake*. Directorate of Fisheries, Govt. of Orissa, Cuttack, India : 47-55.
- Mohanty, S. K. 1975. Some observations on the physico-chemical features of the outer channel of the Chilka Lake during 1971-'73. *Bull. Dept. Mar. Sci. Univ. Cochin*, **7** (1) : 69-89.
- Mohanty, S. K. 1976. Further additions to the fish fauna of Chilka Lake. *J. Bombay Nat. Hist. Soc.* **72** (3) : 863-865.
- Natarajan, A. V. and S. Patnaik., 1970. Observations on the breeding grounds and development of the Chilka mullet *Liza macrolepis* Smith. *J. Bombay Nat. Hist. Soc.* **67** (3) : 577-78.
- Parida, N. C. 1970. A note on the Chilka crab *Scylla serrata*. *Chilka Lake*. Directorate of Fisheries, Govt. of Orissa, Cuttack, India : 66-69.

- Patnaik, S. 1970. Seasonal abundance and distribution of bottom fauna of the Lake. *J. mar. biol. Ass. India*, **13** (1) : 106-125.
- Patnaik, S. 1978. Distribution and seasonal abundance of some algal forms in Chilka Lake. *J. Inland Fish. Soc. India*, **10** : 56-67.
- Pattanaik, P. K. 1986. On the spatial distribution of zooplankton in Chilka lake. *Geobios news Rep.* **5** (1) : 31-33.
- Patnaik, S. and S. K. Sarkar, 1976. Observations on the distribution of phyto-plankton in Chilka Lake, *J. Inland Fish Soc. India*, **8** : 38-48.
- Pillay, T. V. R., 1957. A morphometric study of the populations of Hilsa *Hilsa ilisha* (Hamilton) of the river Hoogly and of the Chilka lake. *Indian J. Fish.* **4** (2) : 344-386.
- Rajan, S. 1964. Environmental studies of the Chilka lake. *Indian J. Fish.* **11** (2) : 521-532.
- Rajan, S. 1965. Environmental studies of the Chilka Lake : Benthic animal communities. *Indian J. Fish.* **12** (2) : 492-499.
- Ramakrishnaiah, M. 1972. Biology of *Hilsa ilisha* (Hamilton) from the Chilka lake with an account on its racial status. *Indian J. Fish.* **19** (1 & 2) : 35-53.
- Ramakrishnaiah, M. 1979. Observations on the post-larval incursions and fishery of the penaeid prawns in Chilka lake. *J. Inland Fish. Soc. India* **11** (2) : 31-40.
- Raman, A. V., CH. Satyanarayana, K. Adhisheshasai, and K. Phaniprakash, 1990. Phytoplankton characteristics of Chilka lake : A brackish water lagoon on the east coast of India. *Indian J. Mar. Sci.* **19** : 274-277.
- Ramanadham R., M. P. M. Reddy and A. V. S. Murthy. 1964. Limnology of the Chilka lake. *J. mar. biol. Ass. India*, **6** (2) : 183-201.
- Roy, J. C. and N. Sahoo, 1956. Additions to the fish fauna of Chilka Lake. *J. Bombay Nat. Hist. Soc.* **54** (4) : 949-953.
- Roy, J. C. 1954. Periodicity of the plankton diatoms of the Chilka lake. *J. Bombay Nat. Hist. Soc.* **52** (1) : 112-123.
- Sarma, A. L. N. and D. G. Rao, 1980. The meiofauna of Childa lake (Brackish water lagoon). *Curr. Sci.* **49** (22) : 870-872.
- Sarma, A. L. N. and S. Satpathy, 1978. A note on the phytal fauna in and around Balugaon in Chilka lake. *Curr. Sci.* **47** (7) : 242.

- Sarma, A. L. N., D. G. Rao and S. Satpathy, 1979. Faunal association of littoral sponges in and around Balugaon in Chilka lake (lagoon). *J. Bombay Nat. Hist. Soc.* **76** (1) : 192-195.
- Satyanarayana, CH., 1988. Chilka lagoon Expedition, September, 1987 : Studies on hydrobiology and phytoplankton. Desertation presented to the Andhra University for the award of Master of Philosophy (Unpublished).
- Sewell, R. B. S. 1924. Fauna of Chilka Lake, Crustacea : Copepoda. *Mem. Indian Mus.* **5** (1) : 773-851.
- Southern, R. 1921. Fauna of Chilka lake, Polychaeta. *Ibid.* **5** (1) : 565-659.
- Stephenson, J. 1915. Fauna of Chilka lake, Oligochaeta. *Ibid.* **5** (1) : 141-145.
- Subha Rao, M. V., B. M. G. Rao, B. R. Rao and N. K. Nanda, .1981. Hydrobiological studies of brackishwater Chilka lagoon, Orissa. *J. Environ. Biol.* **2**(1) : 59-62.
- Subramaniam, M. 1966. New records of prawn from the Chilka lake with notes on their distribution. *Science & Culture*, 32(7) : 379-380.



A. A comparative view of polychate larva (PCL), bivalve larva (BL), Gastropod larva (GL), Fish larva (FL) and Prawn larva (PL). B. Prawn larva (PL), Crab larva (CL) and Fish Eggs (FE). C. Enlarged view of Prawn (PL), bivalve (BL), and Gastropod larvae (GL). D. Cypris larva (CPL) and Alima larva (AL).