

Special
Issue

N° 8 | SPRING 2014

CAT JOURNAL

Non-*Panthera* cats in South-east Asia



SPECIES SURVIVAL COMMISSION

CAT SPECIALIST GROUP



CATnews is the newsletter of the Cat Specialist Group, a component of the Species Survival Commission SSC of the International Union for Conservation of Nature (IUCN). It is published twice a year, and is available to members and the Friends of the Cat Group.

For joining the Friends of the Cat Group please contact Christine Breitenmoser at ch.breitenmoser@kora.ch

Original contributions and short notes about wild cats are welcome **Send contributions and observations to ch.breitenmoser@kora.ch.**

Guidelines for authors are available at www.catsg.org/catnews

This **Special Issue of CATnews** has been produced with support from the Taiwan Council of Agriculture's Forestry Bureau, Zoo Leipzig and the Wild Cat Club.

Design: barbara surber, werk'sdesign gmbh
Layout: Christine Breitenmoser, Jonas Bach
Print: Stämpfli Publikationen AG, Bern, Switzerland

ISSN 1027-2992 © IUCN/SSC Cat Specialist Group

Editors: Christine & Urs Breitenmoser
Co-chairs IUCN/SSC
Cat Specialist Group
KORA, Thunstrasse 31, 3074 Muri,
Switzerland
Tel ++41(31) 951 90 20
Fax ++41(31) 951 90 40
<u.breitenmoser@vetsuisse.unibe.ch>
<ch.breitenmoser@kora.ch>

Guest Editors: J. W. Duckworth
Antony Lynam

Cover Photo: Non-*Panthera* cats of South-east Asia:
From top centre clock-wise
jungle cat (Photo K. Shekhar)
clouded leopard (WCS Thailand Prg)
fishing cat (P. Cutter)
leopard cat (WCS Malaysia Prg)
Asiatic golden cat (WCS Malaysia Prg)
marbled cat (K. Jenks)

The designation of the geographical entities in this publication, and the representation of the material, do not imply the expression of any opinion whatsoever on the part of the IUCN concerning the legal status of any country, territory, or area, or its authorities, or concerning the delimitation of its frontiers or boundaries.

THAN ZAW^{1*}, THAN MYINT¹, SAW HTUN¹, SAW HTOO THA PO¹, KYAW THINN LATT¹, MYINT MAUNG² AND ANTONY J. LYNAM³

Status and distribution of smaller cats in Myanmar

Camera-trapping in many areas across Myanmar shows that of six smaller cat species, leopard cat *Prionailurus bengalensis*, mainland clouded leopard *Neofelis nebulosa* and Asiatic golden cat *Catopuma temminckii* remain widespread in the larger remaining forested landscapes. Marbled cat *Pardofelis marmorata* is somewhat less widely distributed or not so well documented by this survey method. Landscape-scale threats such as habitat fragmentation by mega-development projects may be significant threats to these four species. The remaining two species - fishing cat *Prionailurus viverrinus* and jungle cat *Felis chaus* - may need specific conservation actions to ensure their national survival. Most cats are completely protected by existing wildlife law in Myanmar, but the legal status of fishing cat, leopard cat and jungle cat should be clarified.

Myanmar (formerly known as Burma) in South-east Asia covers 676,581 km² within 9°53'–28°25' N/92°10'–101°10' E. It is 2,195 km from north to south and 948 km wide in the central part. Elevation varies from sea level to 5,881 m in the northern mountain ranges bordering China. As classified by MacKinnon & MacKinnon (1986), it contains parts of three sub-regions of the Indo-Malayan Realm: the Indian sub-region (6% of the country) bordering Bangladesh in the west and India in the north-west; the Indochinese sub-region (91%), with a long common border with China, Lao PDR and Thailand, and the Sundaic sub-region (3%), bordering Thailand. Myanmar retains large tracts of old forest, with 46–48% of the country's land area being for-

ested (Harris et al. 2012), among the highest proportion of forest cover of any South-east Asian country (Leimgruber et al. 2005, Stibig et al. 2007). The human population in 2001 was estimated to be 51.14 million, increasing at about 2% per year (Central Statistical Organization 2001). This high growth rate and the export of timber as a source of hard currency are causing rapid encroachment of some remaining natural habitats (Leimgruber et al. 2005, Tordoff et al. 2005). Many rural people in Myanmar trade and eat wildlife (Martin 1997, Rao et al. 2002, 2005, Tordoff et al. 2005). The country's common borders with China (itself a large sink for traded wildlife, including many small cat species; Li Yiming & Li Dianmo 1998, Li Yiming et al. 2000,

Bell et al. 2004) and Thailand (Martin 1997, Martin & Redford 2000, Shepherd & Nijman 2008) must be a powerful driver for wildlife hunting. Logging, overhunting, and destructive agricultural practices have spurred significant declines in wildlife and natural habitats (Rao et al. 2002). Eight species of wild cats (tiger *Panthera tigris*, leopard *Panthera pardus*, clouded leopard, marbled cat, Asiatic golden cat, fishing cat, leopard cat and jungle cat) are confirmed to occur in Myanmar. According to Myanmar's *Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law*, 1994 (Myanmar Forest Department 2003), five species of cats (tiger, leopard, clouded leopard, marbled cat and Asiatic golden cat) are "Completely Protected" (i.e. with penalties for illegally killing involving fines of up to 50,000 kyats, i.e. ca. 50 US\$, and up to seven years in prison). The second and third protection categories, that of "Normally Protected" and "Seasonally Protected Species", contain no cat species, leaving fishing cats, leopard cats and jungle cats unprotected. Reports or suggestions of occurrence of snow leopards *Panthera uncia* and flat-headed cats *Prionailurus planiceps* in Myanmar, while plausible, have not been confirmed (Rabinowitz & Saw Tun Khaing 1998, Wilting et al. 2010). This compilation of records from Myanmar discusses distribution range, natural history and conservation status of the six small cat species recorded in the country, based largely on previously unpublished data gathered between 1999 and 2011 by camera-trap surveys. It is supplemented by the examination of wild animal remains in hunting camps, villages and markets and other incidental information. Structured research on distribution, habitat preferences, ecological attributes and population status of small cat species has barely been conducted in the country.

Survey areas

The surveys covered areas in northern, western, central and southern Myanmar selecting habitat-blocks potentially able (based mainly on large extent of natural habitat) to support tigers (the main aim of survey at all sites excepting Hkakaborazi, Hponkanrazi and Naungmung; Lynam et al. 2006, 2009) and/or other threatened large mammals (Fig. 1). In total, 19 areas were surveyed in a roughly comparable manner. Two further areas were visited but not camera-trapped, Thauung Dut Reserved Forest and Nankamu Reserved Forest. Some large regions of Myanmar were

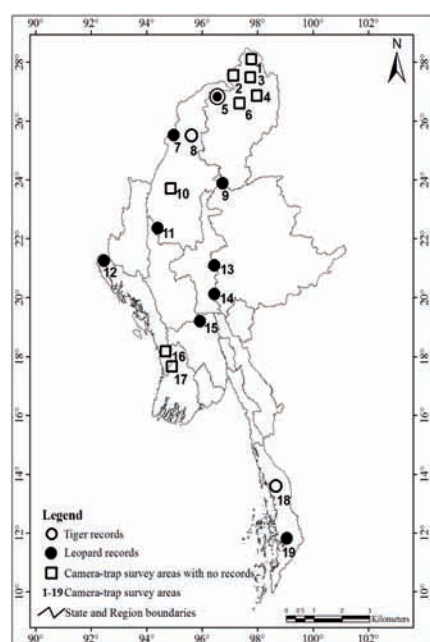


Fig. 1a. Recent locality records of tiger and leopard, based on camera-trap records.

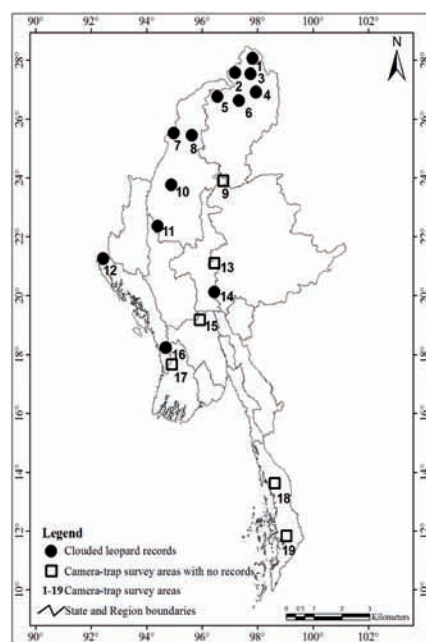


Fig. 1b. Recent locality records of clouded leopard, based on surveys in SOM T5.

not surveyed due to their inaccessibility at the time, notably most of the east, e.g. eastern Shan State, Kayah State, Kayah State and Mon State, and hence some regions potentially important to threatened large mammals were not covered. The wide altitudinal range of 20–3,750 m was surveyed. All survey areas were within large (at least several hundred square kilometers) tracts of evergreen or semi-evergreen forest except Lemyathna & Ingabu which are entirely deciduous, while Momeik & Mabein, Panlaung & Padalin and Bago Yoma Swa Chaung consist of (semi-) evergreen forest mostly restricted to riverine strips. Other survey areas were adjacent to large stands of deciduous forests, e.g. Mahamyang and Alaungdaw Kathapa. Large areas of grasslands and wetlands occur only in Hukaung Valley and montane scrub/rock habitats in Hkakaborazi National Park. Smaller parts of several other areas include hill grass in Paunglaung catchment, seasonally flooded grasslands in Tanintharyi and montane scrub/rock in Saramati Taung. The Paletwa (Mayu river catchment) survey area has such extensive bamboo (khayin-wa *Melocanna bambusoides*) patches that bamboo covers nearly 60% of the total area; semi-evergreen forest occurs mostly in ravines. The Myinmoletkat Taung survey area (Pe Chaung Catchment) has only 30% evergreen forest, amid secondary growth from shifting cultivation (30%) and *Areca* palm plantation (40%). Even so, in all these areas except Lemyathna & Ingabu (which had a very low survey effort) and Panlaung & Padalin, camera-trapping was predominantly in the evergreen forest. Most areas held a mix of old-growth and recently disturbed vegetation, but Lemyathna & Ingabu and Tanintharyi both lacked extensive old-growth forest. Survey areas were under various land designations and, consistent with the purpose of the surveys, some sites were declared as protected areas as a result of the information generated. All are identified here under their current management status.

Methods

Camera-trapping

Camera-trapping was the primary survey technique, using heat-and-motion-sensitive CamTrakker™ units (Camtrak South Inc., Watkinsville, GA, U.S.A.). These were deployed in 19 survey areas between 23 June 1999 and 16 June 2011; some survey areas were visited more than once (Supporting Online Material SOM Table T1). Each survey area

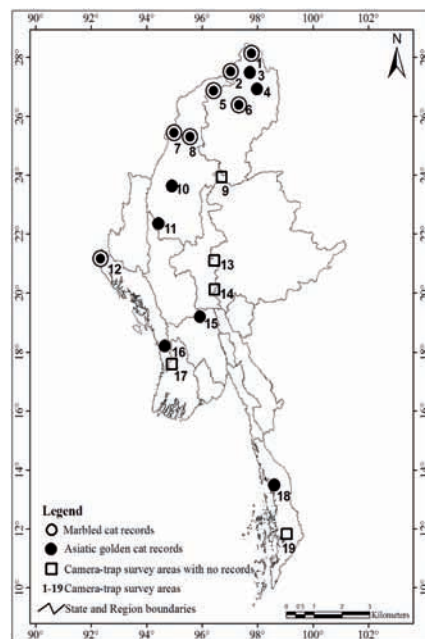


Fig. 1c. Recent locality records of marbled cat and Asiatic golden cat, based on surveys in SOM T6 and T8, excluding camera-trap records from Tanintharyi NR.

was so extensive, and, in many cases difficult of access, that only parts of it could be camera-trapped. Traps were deployed 1–3 km apart, with the co-ordinates of each recorded with, in the worst cases ± 100 m accuracy, using Global Positioning System (GPS) devices. Altitudes were calculated from these co-ordinates using the United States Geological Survey's SRTM 90 digital elevation model and should be regarded as indicative only. No habitat information relevant to the home-range scale was recorded specific to the camera-trap site. Microhabitats are revealed in the photographs, but because cameras were often selectively set along streambeds, trails and ridges, and at saltlicks, pools and other areas of good visibility, they are not highly informative on overall habitat usage. The date and time of exposure were imprinted on most images. Most camera-traps were set in relatively remote areas, in many cases at least several days' walk from the nearest road. Concentration in evergreen forest resulted in a low sampling of species from deciduous forest and non-forest habitats. Camera-traps were set at 45–50 cm above ground, an ideal height for tigers, and probably suitable for all cat species of Myanmar. They were set to function by day and night. Camera-trapping covered all seasons, but no individual site was surveyed around the year. The survey effort in most areas was from several hundred to several thousand

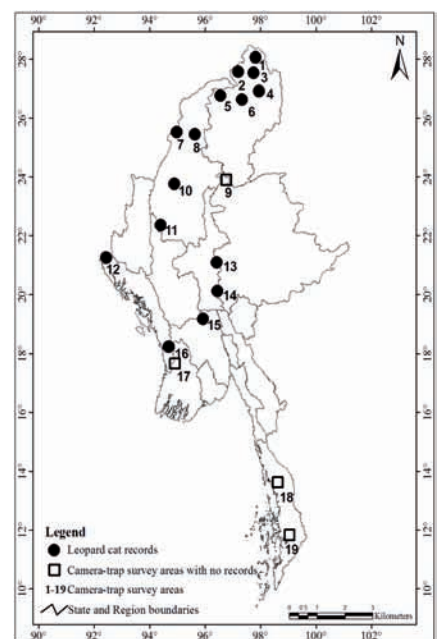


Fig. 1d. Recent locality records of leopard cat, based on surveys in SOM T10, excluding additional camera-trap records from Tanintharyi NR.

trap-nights (SOM T1). The surveys were not designed for small cats, so the results need to be interpreted with caution (Than Zaw et al. 2008). No baits/lures were used. Non-independent events were those where a given camera-site recorded what may have been the same individual animal on multiple frames with successive images separated by, arbitrarily, half-an-hour or less. All statistics of number of photographs refer to number of independent events, not the actual number of images. Any number of animals on a frame constituted only one event.

No surveyor had access to a suitably large skin collection to make reliable identifications. Hence, original identifications of all cat photographs were reviewed by the team supported by J. W. Duckworth, S. I. Robertson and R. J. Tizard. Species presence in most of these camera-trapping survey areas was listed in Lynam (2003: Appendix IX) before this identification review. In case of discrepancies between this document and Lynam (2003), the present listing should prevail. All photographs are archived at the Wildlife Conservation Society's Yangon office.

Other sources of recent records

Additional information resulted from a non-systematic search for dead or live animals in villages, hunting camps, rural markets etc. Such records were used only when photographed, and with the identifications



Fig. 2. Asiatic golden cat, grey form recorded in Ali-aung village.



Fig. 3. Asiatic golden cat, tristis form recorded in Tahundam.

reviewed as with camera-trap photographs. Very old relicts that could have come from anywhere are mostly not presented here. This method was particularly used in Hkakaborazi, Hponkanrazi and Naungmung. In other sites, the little time spent by survey teams in villages gave few opportunities to find such animals. Other potential non-invasive methods widely used with other mammal groups have major drawbacks with small cats. Signs are difficult to identify to species level in such a species-rich group. As with signs, there is no objective evidence that local reports of small cats to the species level are generally reliable (and abundant anecdotal evidence that gross errors are frequent), therefore such reports are not used here. Direct field observation of live animals by experienced observers could generate reliable data. However, small cats are very rarely encountered, limiting the suitability of such method. A search for other recent records of small cat species from Myanmar located only Su Su (2005), Thaint Thaint Myo (2007), Shepherd & Nijman (2008), Myint Maung (2011) and incidental mention in a few grey literature sources (Nay Myo Shwe 2011). Unpublished records were sought from experienced colleagues, to extend the information base for the country.

Historical records

Historical records were assembled from published sources mindful of the cautions discussed in Than Zaw et al. (2008), which source contains a gazetteer of coordinates of the historical localities. Localities not in-

cluded in Than Zaw et al. (2008) are provided in the supplementary gazetteer (SOM T2).

Results and discussion

Species accounts

Clouded leopard

Geographical distribution

Clouded leopard was the second-most commonly recorded cat with 111 independent events (SOM T3) from 13 survey areas (Fig. 1b). Additionally, there were two skins from Hkakaborazi, a skin from Hponkanrazi, three skins from Naungmung survey area (SOM T4) as well as previous records of skins and bones from this area (Rabinowitz & Saw Tun Khaing 1999). There are historical records from many places: Ya-ma-doung mountains (between Pegu and Arakan), Bhamo, locations eight miles west of Toungoo and Htingnan in the Triangle, Upper Myanmar (Pocock 1939, 1941), near Maingyaung, lower Chindwin (Wroughton 1916a), Tavoy, Tenasserim, on the bank of Kawkwe Chaung (Tun Yin 1967), and the Carin Hills (Thomas 1891). Pocock (1933: 188) reported the species to be "very thinly distributed, and generally located in dense evergreen forests in the north and south of Burma".

Habitat and altitude

Photographs were taken in the altitudinal range of 20-2,650 m (SOM T5), supporting the wide altitudinal distribution reported by Rabinowitz et al. (1987) and Nowak & Paradiso (1983), with most images between 200 and 300 m. Given the intensive survey effort

in highlands, this may indicate genuinely greater numbers in the lowlands.

Behaviour

Of 111 independent events, 39 (35%) occurred in daylight (06:01 h - 18:00 h) including six (5%) in the early morning (06:01 h - 09:00 h), 72 (65%) at night (18:01 h - 06:00 h) including 15 (14%) in the late evening (18:01 h - 21:00 h; SOM Figure F1). All camera-trap records were of single animals on the ground. Diurnal and nocturnal activity with some increase at night is consistent with past statements on activity patterns at single sites (Austin et al. 2007a, Grassman et al. 2005, Azlan & Sharma 2006). This behaviour is also consistent with recent data from 14 sites across Thailand (Lynam et al. 2013, Tantipisanuh et al. 2014, this issue), despite other statements that this species is strictly nocturnal (Pocock 1939, Tun Yin 1967, Lekagul & McNeely 1977, Prater 1980, Kanchanasakha et al. 1998, Christiansen 2006), or much more diurnal (Guggisberg 1975). As suggested by Grassman et al. (2005), Rabinowitz et al. (1987) and Rabinowitz (1988), the many records on the ground questions generalised past statements that this species is highly arboreal (Selous & Banks 1935, Gonyea 1976, Taylor 1989). However, in the absence of any arboreal survey effort, it is not possible to speculate on just how arboreal the species truly is.

Asiatic golden cat

Geographical distribution

Asiatic golden cat was camera-trapped in 12 survey areas with 55 independent events (SOM T3, T6), occurring from the southernmost to the northernmost survey areas (Fig. 1c). It was the second-most widely recorded species, with clouded leopard, which is consistent with historical reports that it occurs throughout the country (Pocock 1933). Although no camera-trap photographs were recorded in Hponkanrazi or Hkakaborazi, skins were photographed in both places (SOM T7). Of these, a skin from Ali-aung village was grey (Fig. 2) and a skin from the village of Tahundam was of the 'tristis' form (Fig. 3): silver-grey in colour, with buff-speckled black spots on the back. Lord Cranbrook secured a similar skin from the Nam Tamai (Dollman 1932), as did Pocock (1941) referring to one, suggesting that this morph may be restricted to the far North Myanmar. Several other remains were recorded (SOM T7). Six independent photographs of black Asiatic golden cat were obtained in five survey areas (Fig.



Fig. 4. Asiatic golden cat, black form recorded in Bumphabum survey area.



Fig. 5. Asiatic golden cat, dark grey form recorded in Htamanthi survey area.

4), and a dark grey one was photographed in Htamanthi (Fig. 5). These support previous records of black animals from the Nam Tamai Valley, dark grey skins from Myitkyina and the upper Chindwin River, a brown pelt from Sumprabum and an ochreous tawny one from Maymyo (Ryley 1914, Pocock 1939). Myint Maung (2011) camera-trapped one individual (two photographs) in Tanintharyi Nature Reserve at 14°32' N/ 98°15' E on 7 December 2010. Previous records were found from Htingnan, Shilingkhet and near Goletu village of Naungmung survey area (Pocock 1941), Victoria Point, Mergui and Taho, Carin State (Thomas 1891, Pocock 1939, Tun Yin 1967), and Pinyinmana (Wroughton 1915), the latter being two skulls.

Habitat and altitude

Photographs came from 170–1,950 m, commonly across 300–1,200 m (SOM T6).

Previous records from Myanmar were in thick or moderately thick forest at altitudes between 760 m (Tun Yin 1967) and 1,300 m (Thomas 1891).

Behaviour

Of 55 independent events (including one record in Tanintharyi Nature Reserve), 19 (35%) were in daylight (09:01 h – 18:00 h) and 21 (38%) were at night (21:01 h – 06:00 h), excluding nine (16%) in the early morning (06:01 h – 09:00 h) and six (11%) in the late evening (18:01 h – 21:00 h); this species is cathemeral.

Although Pocock (1939) and many subsequent sources reported it as nocturnal, most other primary reports also indicate a generally high activity level during daylight (Grassman et al. 2005, Azlan & Sharma 2006, Lynam et al. 2013, Tantipisanuh et al. this volume). By contrast, Kawanishi & Sunquist (2008) found it to be predominantly nocturnal (69%). One camera-trap record from Hukaung Valley was of a duo while all other photographs were of single animals on the ground.

Marbled cat

Geographical distribution

Marbled cats were camera-trapped in seven survey areas with 25 independent events (SOM T1, T8), occurring from the far north to the southernmost records at about 21°N (Fig. 1c). Additionally, two skins and three fresh hunter's kills were recorded in this latitudinal range (SOM T9). Although Corbet & Hill (1992) mapped the distribution range of marbled cat in Myanmar only in the northern part and three previous records were indeed from the north, near the village of Ngawar, in the Nam Tamai Valley and at Naungmung (Pocock 1939, Tun Yin 1967, Rabinowitz & Saw Tun Khaing 1999), there are several recent records from much further south, in Tanintharyi Nature Reserve. Myint Maung (2011) camera-trapped one at 14°21' N/98°17' E on 19 February 2011 and Nay Myo Shwe (2011) photographed one crossing a forest road at 14°43' N/98°15' E in Aug 2008. Historically two skins were recorded from Toungoo (18°56' N/96°26' E), however they were already prepared when collected and their origin is not clear (Fry 1929).

Habitat and Altitude

Photographs were taken in the altitudinal range of 110–2,620 m, predominantly between 120–600 m (SOM T8); historical records in Myanmar were at 1,070–1,830 m (Tun Yin 1967).

Behaviour

Of 27 independent events (including two in Tanintharyi Nature Reserve), only three (11%) were late at night (21:00 h – 06:00 h) and two (7%) in the late evening (18:00 h – 21:00 h); the other 22 (81%) were in daylight (06:00 h – 18:00 h) including six (22%) in the early morning (06:00 h – 09:00 h). All camera-trap records were of single animals. This shows marbled cats to be predominantly diurnal, at least in ground-level activity, which is consistent with the findings of some other recent

studies (Lynam et al. 2013), although Pocock (1939), and after him, many other derivative sources such as Tun Yin (1967), described them as nocturnal animals.

Fishing cat

No fishing cats were recorded during these surveys. Five fishing cats were held in the Yangon Zoological Garden as of late 2011 (Fig. 6). These are reported to have been bred in captivity from animals collected in the Ayeyarwady delta more than ten years ago. A mount of unknown origin was found in a souvenir shop in Yangon in August 2011 (Fig. 7). A report of fishing cat (BANCA 2009) later proved to be a misidentified leopard cat skin. One of a duo of fishing cats was collected on the west bank of the Chindwin at Dawazup near Dalu (Taro), in 1935 (Morris 1936, Carter 1943). Pocock (1939), overlooking this record, considered that there were no Myanmar records. A recent intensive camera-trap effort in Dawazup which lies within the Hukaung valley did not record fishing cats. Deployments took place close to Dawazup (ca. 12 km) and to the Chindwin river (ca. 1.4 km). The lack of camera-trap records, however, does not necessarily suggest that the species has declined; habitat use of fishing cats in South-east Asia is poorly known (Duckworth et al.



Fig. 6. Fishing cat, held in the Yangon Zoological Garden (photographed by Robert Tizard on 4 September 2011).



Fig. 7. Fishing cat, a taxidermy mount of unknown origin found in a souvenir shop in Yangon (photographed by Aung Myo Chit on 19 August 2011).

2010, Rainey & Kong 2010) and the cameras may have been set outside suitable habitat, given the survey focus on tall forest.

Leopard cat

Geographical distribution

Leopard cat was the most commonly and widely recorded species (Fig. 1d), occurring from the southernmost to the northernmost survey areas, with 151 independent events coming from 15 survey areas (SOM T1, T10). There were 11 records of remains (SOM T11) and two sightings (SOM T12). On one occasion, Su Su (2005) spotlighted a leopard cat during extensive studies on small carnivores in Hlawga Park during 2000-2003. Thaint Thaint Myo (2007) camera-trapped eight in Alaungdaw Kathapa National Park during 2004-2006, and Myint Maung (2011) had three independent camera-trap records in Tanintharyi Nature Reserve, one at 14°32' N/98°15' E in December 2010 and two at 14°03' N/98°14' E in January 2011. Previous records include: six skins from



Fig. 8. Jungle cat recorded in the village of Hpu Lum, Khaunglanhpu area (photo taken by Aung Soe Than on 9 April 2009).



Fig. 9. Asiatic golden cat, leopard cat and jungle cat skins in the market of Mandalay (photo taken by Su Su Naing in 2008).

the region of Kindat, an unknown number of skins from Toungoo (Pocock 1939), a specimen from Pakokku, four from Bankachon, two from Huangyan and Pwepi (Wroughton 1915, 1916a,b,c), and a specimen from Htawgaw (Anthony 1941). Other specimens originated from Dalu (1) and Gora (1). Gam Majaw, Mantum, Nam Tamai, Goletu, Tasa Hku, Adung Long collectively had eight (Dollman 1932, Pocock 1941). Single specimens were recorded from Ruby Mines and Maymyo, Northern Shan state, (Ryley 1914). Further documentation showed specimens from Htamanthi, Naungmung, Hkakaborzai (Rabinowitz et al. 1995, Rabinowitz & Saw Tun Khaing 1999) and sightings on the river bank at Kindat as well as single males sighted in two locations 20 and 40 miles NE and NW of Toungoo (Fry 1929).

Altitude

Leopard cats were recently recorded at altitudes between 150 and 2,010 m (SOM T10), mostly within 200-400 m (58%). Previous records from Myanmar were in moderately thick forest, pine and rhododendron forest between 760 m and 1,830 m in altitude (Pocock 1941).

Behaviour

The 155 independent events (including four records in Tanintharyi Nature Reserve) comprised 131 (85%) at night (18:01 h - 06:00 h) including 24 (15%) in the late evening (18:01 h - 21:00 h) and only 24 (15%) in daylight (06:01 h - 18:00 h) including 10 (6%) taken early in the morning (06:01 h - 09:00 h; SOM F2). All records were of single individuals. Leopard cats are nocturnal with significant crepuscular activity, consistent with most reports (Duckworth 1997, Azlan & Sharma 2006, Lynam et al. 2013). However, Austin et al. (2007b) found uniform activity patterns during the day and night with crepuscular peaks.

Jungle cat

No jungle cats were recorded during these surveys. Single skins were photographed in the village of Hpu Lum, Khaunglanhpu area in April 2009 (Fig. 8; Aung Soe Than *in litt.* 2009), in the market of Mandalay in August 2008 (Fig. 9; Su Su Naing *in litt.* 2008), and (freshly hunted) in the Nawng Ya market in Loikaw in May 2008 (Ohn Mar Ohn *in litt.* 2008; all photographs stored at the WCS Myanmar Program office, Yangon). Su Su (2005) spotlighted a jungle cat only once during extensive studies on small carnivores in Hlawga park during 2000-2003; park staff reported the species had previously been

more common there. Thaint Thaint Myo (2007) recorded two skins in Alaungdaw Kathapa National Park during 2004-2006 and she also reported it to be common there but the basis for this assessment was not provided. Past specimen records came from: the Chin hills (thought to be common); Mt. Popa; Thayetmyo; Tagyigin and Yin in the Lower Chindwin; and Toungoo (Wroughton 1915, 1916c, Fry 1929). Elsewhere in Southeast Asia, jungle cats are strongly associated with open deciduous habitats (Duckworth et al. 2005, Gray et al. 2014, this issue). The lack of camera-trap and sighting records during these surveys reflects, at least to some extent, the focus of camera-trapping on tall forest habitats and a minimal effort in habitats suitable for jungle cats. This is consistent with findings by Than Zaw et al. (2008) for two other carnivore species which use similar habitats: small Indian civet *Viverricula indica* and small Asian mongoose *Herpestes javanicus*. However, clarification of this species' status in Myanmar is important. The low number of recent records across Lao PDR, Cambodia and Vietnam was interpreted by Duckworth et al. (2005) to indicate a genuine current rarity of the animal in these countries. It is possible that the same would be found to be true for Myanmar.

Concluding remarks

Conservation needs of cat species in Myanmar

Leopard cats, clouded leopards and Asiatic golden cats all seem to remain common and widespread within the larger (>1,000 km²) protected areas. Provided the protected areas do not suffer major habitat conversion or other challenges to their integrity, they may have no specific in-country conservation needs. However, as Myanmar develops, loss and fragmentation of some large intact forests is guaranteed and indeed has already begun with projects such as the Dawei - Kanchanaburi deep sea port and transportation corridor. Therefore, the status of these species and their habitats will need to be reassessed periodically. Fewer marbled cats were recorded in protected areas. Neither jungle cats nor fishing cats were recorded (with no recent records of the latter from any protected area), and it is plausible that these species are seriously threatened in Myanmar. Surveys in suitable habitat for these species are therefore important to understand their conservation needs. If snow leopards and/or flat-headed cats do occur in Myanmar, they are also likely to be highly threatened.

National cat species legal status

The legal status of fishing cats, leopard cats and jungle cats should be clarified in the Protection of Wild Life and Wild Plants and Conservation of Natural Areas Law (*State Law and Order Restoration Council Law No.583/94.1994*), as Shepherd & Nijman (2008) pointed out. Leopard cats remain common and probably do not need any species-specific legal protection (bearing in mind that all hunting is legally forbidden in large parts of the country, including the core zones of protected areas). Fishing cats and jungle cats warrant the highest level of legal protection given the rarity of recent records.

Acknowledgements

We are grateful to many people and institutions whose support was critical. We express our gratitude to U Soe Win Hlaing and U Aye Myint Maung, successive Director Generals, Forest Department of Myanmar for permission to conduct field surveys. We also acknowledge the enthusiastic support of U Khin Maung Zaw, U Tun Nyo, U Tun Paw Oo, U Tin Tun and U Win Naing Thaw, successive Directors of the Nature and Wildlife Conservation Division, Forest Department, for collaborative activities between NWCD and the WCS Myanmar Program. We specially acknowledge the efforts of survey team members consisting of NWCD staff and WCS Myanmar Program staff for their commitment and enthusiasm in conducting field surveys. We are thankful to George Schaller, Alan Rabinowitz, Joshua Ginsburg, Colin Poole, Robert Tizard, Madhu Rao (all of WCS) and Will Duckworth for their technical and operational support of the surveys of the WCS Myanmar Program. We thank U Saw Tun Khaing, the former Director for his logistical and moral support throughout the survey period. We are grateful for financial support from the Foreign and Commonwealth Office via the British Embassy, Yangon; the U.S. Fish and Wildlife Service; "Save the Tiger Fund" (a joint project of the National Fish and Wildlife Foundation and Exxonmobil); Blue Moon Fund; and the Wildlife Conservation Society.

References

Anthony H. E. 1941. Mammals collected by the Vernay-Cutting Burma expedition. Publications of the Field Museum of Natural History, Zoology Series 27, 37-123.

Austin S. C., Tewes M. E., Grassman Jr. L. I. & Silvy N. J. 2007a. Ecology and conservation of the leopard cat *Prionailurus bengalensis* and clouded leopard *Neofelis nebulosa* in Khao Yai National Park, Thailand. *Acta Zoologica Sinica* 53, 1-14.

Austin S. C., Tewes M. E., Grassman Jr. L. I. & Silvy N. J. 2007b. Road ecology of the leopard cat *Prionailurus bengalensis* in Khao Yai National Park, Thailand. *Acta Zoologica Sinica* 53, 373-377.

Azlan J. M. & Sharma D. S. K. 2006. The diversity and activity patterns of wild felids in a secondary forest in peninsular Malaysia. *Oryx* 40, 1-6.

BANCA 2009. Environmental Impact Assessment (Special Investigation) on Hydropower Development of Ayeyawady River Basin above Myitkyina, Kachin State, Myanmar, Biodiversity And Nature Conservation Association, October 2009, Yangon, Myanmar.

Bell D., Robertson S. & Hunter P. R. 2004. Animal origins of SARS coronavirus: possible links with the international trade in small carnivores. *Philosophical Transactions of the Royal Society of London*, B 359, 1107-1114.

Carter T. D. 1943. The mammals of the Vernay-Hopwood Chindwin expedition, northern Burma. *Bulletin of the American Museum of Natural History* 82, 99-113.

Central Statistical Organization 2001. Statistical Yearbook 2001. Ministry of National Planning and Economic Development, Yangon, Myanmar.

Christiansen P. 2006. Sabertooth characters in the clouded leopard (*Neofelis nebulosa* Griffiths 1821). *Journal of Morphology* 267, 1186-1198.

Corbet G. B. & Hill J. E. 1992. The mammals of the Indomalayan region. Natural History Museum Publications. Oxford University Press, Oxford, UK.

Dollman G. 1932. Mammals collected by Lord Cranbrook and Captain F. Kingdon Ward in upper Burma. *Proceedings of the Linnean Society of London* 145, 9-11.

Duckworth J. W. 1997. Small carnivores in Laos: a status review with notes on ecology, behaviour and conservation. *Small Carnivore Conservation* 16, 1-21.

Duckworth J. W., Poole C. M., Tizard R. J., Walston J. L. & Timmins R. J. 2005. The jungle cat *Felis chaus* in Indochina: a threatened population of a widespread and adaptable species. *Biodiversity and Conservation* 14, 1263-1280.

Duckworth J. W., Stones T., Tizard R., Watson S. & Wolstencroft J. 2010. Does the fishing cat inhabit Laos? *Cat News* 52, 4-7.

Fry T. B. 1929. Report No. 46 (supplementary) on the second, third and fourth collections from Toungoo, Burmah, made by Mr. J. M. D. Mackenzie, I. F. S., between dates 9 February 1927 to 2 March 1928. Bombay Natural History Society's Mammal Survey of India, Burmah and Ceylon. *Journal of the Bombay Natural History Society* 33, 636-652.

Gonyea W. J. 1976. Adaptive differences in the body proportions of large felids. *Acta Anatomica* 96, 81-96.

Grassman Jr. L. I., Tewes M. E., Silvy N. J. & Kreetiyutanont K. 2005. Ecology of three sympatric felids in a mixed evergreen forest in north-central Thailand. *Journal of Mammalogy* 86, 29-38.

Gray T. N. E., Phan C., Pin C. & Prum S. 2014. The status of jungle cat and sympatric small cats in Cambodia's Eastern Plains Landscape. *Cat News Special Issue* 8, 19-23.

Guggisberg C. A. W. 1975. *Wild Cats of the World*. Taplinger, New York.

Harris N. L., Brown S., Hagen S. C., Saatchi S. S., Petrova S., Salas W., Hansen M. C., Potapov P. V. & Lotsch A. 2012. Baseline Map of Carbon Emissions from Deforestation in Tropical Regions. *Science* 336, 1573-1576.

Kanchanasakha B., Simcharoen S. & Tin Than 1998. *Carnivores of Mainland Southeast Asia*. Siam Tong Kit Printing, Bangkok.

Kawanishi K. & Sunquist M. E. 2008. Food habits and activity patterns of the Asiatic golden cat (*Catopuma temminckii*) and dhole (*Cuon alpinus*) in a primary rainforest of peninsular Malaysia. *Mammal Study* 33, 173-177.

Leimgruber P., Kelly D. S., Steininger M., Brunner J., Müller T. & Songer M. A. 2005. Forest cover change patterns in Myanmar (Burma) 1990-2000. *Environmental Conservation* 32, 356-364.

Lekagul B. & McNeely J. A. 1977. *Mammals of Thailand*. Association for the Conservation of Wildlife, Bangkok (revised 1988 printing).

Li Yiming and Li Dianmo 1998. The dynamics of trade in live wildlife across the Guangxi border between China and Vietnam during 1993-1996 and its control strategies. *Biodiversity and Conservation* 9, 901-918.

Li Yiming, Gao Zhenxiang, Li Xinhai, Wang Sung & Niemelä, J. 2000. Illegal wildlife trade in the Himalayan region of China. *Biodiversity and Conservation* 9, 901-918.

Lynam A. J. 2003. A National Tiger Action Plan for the Union of Myanmar. Myanmar Forest Department, Ministry of Forestry. Yangon, Myanmar.

Lynam A. J., Saw Tun Khaing & Khin Maung Zaw 2006. Developing a national tiger action plan for the Union of Myanmar. *Environmental Management* 37, 30-39.

Lynam A. J., Rabinowitz A., Than Myint, Myint Maung, Kyaw Thinn Latt & Saw Htoo Tha Po 2009. Estimating abundance with sparse data: tigers in northern Myanmar. *Population Ecology* 51, 115-121.

Lynam A. J., Jenks K. E., Tantipisanuh N., Chutipong W., Ngoprasert D., Steinmetz R., Sukmasuang R., Grassman Jr. L. I., Cutter P., Kita-

- mura S., Bhumpakphan N., Gale G. A., Reed D. H., Baker M. C., McShea W., Songsasen N. & Leimgruber P. 2013. Terrestrial activity patterns of wild cats from camera-trapping. *Raffles Bulletin of Zoology* 61, 407-415.
- MacKinnon J. & MacKinnon K. 1986. Review of the Protected Areas System of the Indo-Malayan Realm. IUCN. Gland, Switzerland and Cambridge, UK.
- Martin E. B. 1997. Wildlife products for sale in Myanmar. *TRAFFIC Bulletin* 17, 33-44.
- Martin E. B. & Redford T. 2000. Wildlife for sale. *Biologist* 47, 27-30.
- Morris R. C. 1936. The Vernay-Hopwood Upper Chindwin Expedition. *Journal of the Bombay Natural History Society* 38, 647-671.
- Myanmar Forest Department 2003. Policy, Laws, Regulations and Departmental Instructions. Myanmar Forest Department, Ministry of Forestry. Yangon, Myanmar.
- Myint Maung 2011. Survey Report on Evaluating the Status of Tigers (*Panthera tigris*) and their Prey in Taninthayi Nature Reserve, Forest Department, Ministry of Environmental Conservation and Forestry. Nay Pyi Taw, Myanmar.
- Nay Myo Shwe 2011. A Report on Malayan Tapir (*Tapirus indicus*) surveyed in Taninthayi Nature Reserve, Forest Department, Ministry of Environmental Conservation and Forestry. Nay Pyi Taw, Myanmar.
- Nowak R. M. & Paradiso J. L. 1983. Walker's Mammals of the World. 4th Edition. The Johns Hopkins University Press. Baltimore and London.
- Peacock E. H. 1933. A Game Book for Burma and Adjoining Territories. H. F. and G. Witherby, London.
- Pocock R. I. 1939. The Fauna of British India, including Ceylon and Burma. Mammalia Volume I, 2nd Edition. Taylor & Francis, London.
- Pocock R. I. 1941. The Fauna of British India, including Ceylon and Burma. Mammalia Volume II, 2nd Edition. Taylor & Francis, London.
- Prater S. H. 1980. The Book of Indian Animals. Bombay Natural History Society, Bombay.
- Rabinowitz A. 1988. The clouded leopard in Taiwan. *Oryx* 22, 46-47.
- Rabinowitz A. & Saw Tun Khaing 1998. Status of mammal species in North Myanmar. *Oryx* 32, 201-208.
- Rabinowitz A. & Saw Tun Khaing 1999. Current status and threats to the survival of large mammals in north Myanmar. Unpublished typescript of Wildlife Conservation Society Myanmar Program. Yangon, Myanmar.
- Rabinowitz A., Andau, P. & Chai, P. P. K. 1987. The clouded leopard in Malaysian Borneo. *Oryx* 21, 107-111.
- Rabinowitz A., Schaller G. B. & Uga 1995. A survey to assess the status of Sumatran Rhinoceros and other large mammal species in Tamanthi Wildlife Sanctuary, Myanmar. *Oryx* 29, 123-128.
- Rainey H. & Kong K. 2010. A fishing cat observation from Northern Cambodia. *Cat News* 52, 8-9.
- Rao M., Rabinowitz A. & Saw Tun Khaing 2002. Status of protected areas in Myanmar, with recommendations for conservation planning. *Conservation Biology* 16, 360-368.
- Rao M., Than Myint, Than Zaw & Saw Htun 2005. Hunting patterns in tropical forests adjoining the Hkakaborazi national park, north Myanmar. *Oryx* 39, 292-300.
- Ryley K. V. 1914. Report No. 14. N Shan States, Burma. Bombay Natural History Society's Mammal Survey of India, Burma and Ceylon. *Journal of the Bombay Natural History Society* 22, 710-725.
- Selous E. M. & Banks E. 1935. The clouded leopard in Sarawak. *Journal of Sarawak Museum* 4, 263-266.
- Shepherd C. R. & Nijman V. 2008. The Wild Cat Trade in Myanmar. *TRAFFIC Southeast Asia*. Selangor, Malaysia.
- Stibig H. J., Belward A. S., Roy P. S., Rosalina-Wasrin U., Agrawal S., Joshi P. K., Hildanus Beuchle R., Fritz S., Mubareka S. & Giri C. 2007. A land-cover map for South and Southeast Asia derived from SPOT-VEGETATION data. *Journal of Biogeography* 34, 625-637.
- Su Su 2005. Small carnivores and their threats in Hlawga wildlife park, Myanmar. *Small Carnivore Conservation* 33, 6-13.
- Tantipisanuh N., Chutipong W., Ngoprasert D., Lynam A. J., Steinmetz R., Sukmasuang R., Jenks K. E., Grassman Jr. L. I., Cutter P., Kitamura S., Baker M. C., McShea W., Bhumpakphan N., Gale G. A. & Reed D. H. 2014. Recent distribution records, threats and conservation priorities of small cats in Thailand. *Cat News Special Issue* 8, 31-35.
- Taylor M. E. 1989. Locomotor Adaptations by Carnivores. In *Carnivore Behavior, Ecology, and Evolution* Volume I. Giuleman J. L. (Ed.). Comstock, Ithaca, New York, pp. 382-409.
- Thaint Thaint Myo. 2007. The Status of Small Carnivores in Some Forest Types of Alaungdaw Kathapa National Park. Ph.D., Department of Zoology, University of Yangon, Yangon, Myanmar.
- Than Zaw, Saw Htun, Saw Htoo Tha Po, Myint Maung, Lynam A. J., Kyaw Thinn Latt & Duckworth J. W. 2008. Status and distribution of small carnivores in Myanmar. *Small Carnivore Conservation* 38, 2-28.
- Thomas O. 1891. On the mammals collected by Signor Leonardo Fea in Burma and Tenasserim. *Annali del Museo Civico di Storia Naturale di Genova* 2a, 913-949.
- Tordoff A. W., Eames J. C., Eberhardt K., Baltzer M. C., Davidson P., Leimgruber P., Uga & Aung Than. 2005. Myanmar: Investment Opportunities in Biodiversity Conservation. Birdlife International. Yangon, Myanmar.
- Tun Yin 1967. Wild animals of Burma. Rangoon Gazette. Rangoon, Burma.
- Wiltling A., Cord A., Hearn A. J., Hesse D., Mohamed A., Traeholdt C., Cheyne S. M., Sunarto S., Jayasilan M. A., Ross J., Shapiro A. C., Sebastian A., Dech S., Breitenmoser C., Sanderson J., Duckworth J. W. & Hofer H. 2010. Modelling the species distribution of Flat-headed Cats (*Prionailurus planiceps*), an Endangered South-East Asian Small Felid. *PLoS One* 5 (e9612), 1-18.
- Wroughton R. C. 1915. Report No. 16. Dry zone, central Burma and Mt. Popa. Bombay Natural History Society's Mammal Survey of India, Burma and Ceylon. *Journal of the Bombay Natural History Society* 23, 460-480.
- Wroughton R. C. 1916a. Report No. 17. S. Tenasserim. Bombay Natural History Society's Mammal Survey of India, Burma and Ceylon. *Journal of the Bombay Natural History Society* 23, 695-720.
- Wroughton R. C. 1916b. Report No 20. Chindwin River. Bombay Natural History Society's Mammal Survey of India, Burma and Ceylon. *Journal of the Bombay Natural History Society* 24, 291-300.
- Wroughton R. C. 1916c. Report No. 25. Chin Hills. Bombay Natural History Society's Mammal Survey of India, Burma and Ceylon. *Journal of the Bombay Natural History Society* 24, 758-773.
- Supporting Online Material SOM Tables T1-T12 and Figures F1-F2 are available at www.catsg.org/catnews

¹ Wildlife Conservation Society, Myanmar Programme, Bld: C1, Aye-Yeik-Mon 1st Street, Ward-3, Hlaing Township, Yangon, Myanmar *wcsmp@myanmar.com.mm and wcsadmin@myanmar.com.mm

² Warden of Hukaung Tiger Reserve, Directors' Office, Nature and Wildlife Conservation Division, Forest Department, Ministry of Environmental Conservation and Forestry, Nay Pyi Taw, Myanmar

³ Wildlife Conservation Society – Global Conservation Programs, 18th and Southern Blvd, New York 10460, USA