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Large Indian Civet *Viverra zibetha* (Photo: Jeremy Holden/FFI Cambodia)

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EDITORIAL

Small carnivores, red listing, and *Small Carnivore Conservation*

The IUCN Global Mammal Assessment is evaluating the global extinction risk of all mammal species against the IUCN Red List Categories and Criteria. The Red List status of over ¾ of the world's mammals was last evaluated in 1996, and the 2008 Red List will contain a systematic reassessment of all mammals. The July 2006 Hanoi Small Carnivores workshop and subsequent follow-up reveal the challenges for doing this with 'our animals'. Accurate Red List assessments underpin conservation prioritisation, and their supporting documentation reveals the interventions, if any, needed for each species. This documentation collates the 'state of knowledge' of each species across its range, particularly about threats and conservation measures. This is a challenge at two extremes. Whereas well-studied species like elephants, some whales and big cats may have massive amounts of relevant data, from a huge geographical area, to be synthesised into manageable form, for all but a few small carnivores there is a dearth of such information. Many species' Red List assessment can use only fragmentary data, inference and suspicion, instead of the more desirable quantification of population and distribution trends.

The Red List assessment process includes consultation and external review. This revealed differing conclusions, sometimes strongly at variance, for some small carnivore species. At any given point in time, the one 'correct' global Red List assessment for each species is the one that would reflect complete understanding of its conservation status. There never is such perfect knowledge, but it should be possible to reach a close consensus through consistent interpretation of Red List Categories and Criteria in relation to available information. The review process exposed three chief challenges with red-listing the small carnivores. First, and simplest, was the complexity of the Categories and Criteria: it takes some practice to use them effectively, and this was many people's first experience.

Second, the genuine paucity of information is an obvious challenge for species known only by a handful of records, e.g. Indonesian Mountain Weasel *Mustela lutreolina*. But it may also bedevil species recorded frequently. To give a single example, even for a species frequent in degraded habitats, there is rarely even one scientifically credible study (let alone multiple investigations from across the species's range!) of whether it can survive in such habitats indefinitely, or whether animals are simply dispersing into them from adjacent better quality habitats. In the latter case, serious reduction in the extent of good quality habitat would doom populations in degraded habitats. Therefore, the long-term impact of the rapid and spatially widespread habitat changes occurring across some tropical areas, notably most of forested Asia, is difficult to evaluate for such species. While there is some scope for more critical assessment of existing information, this deficiency can be addressed only by a great expansion of applied research.

Third, many data that do exist are not in the public domain. Surveys specifically of small carnivores are rare in most of those countries where they are most needed, where habitat is changing rapidly and hunting is barely restrained. Nonetheless, broader biological surveys, for conservation system planning, for Environmental Impact Assessment (EIA) and for 'flagship' species, and naturalists' leisure-time observations, may be far from absent. Even though some 'data' are best ignored (e.g. EIA surveys not obviously unbiased), there is still a large, dispersed, trove of reliable information about small carnivores. Some data appear in reports to governments and/or donors, many remain in surveyors' field notes, photographs and memories. Camera-trapping projects routinely yield more photographs of small carnivores than of target species (e.g. bears or big cats). This issue of *Small Carnivore Conservation* reviews such 'by-catch' data for one of the least biologically-known countries on earth. Some may question the merit of extensive data upon 'common' species, yet many of today's rarities were formerly numerous. Most of the world lacks mammalian biodiversity monitoring programmes, so the best must be made of any information that comes up. "Common Palm Civet *Paradoxurus hermaphroditus* still common in X national park" is certainly not headline news, but it is news of a sort. And combining such results from multiple places allows much more authoritative Red List status assessment for a species than does reference to the 'standard' sources, many of which are recycling a portrayal of the situation of decades ago.

The better the publicly available information base, the more likely that the Red List category assigned will be the correct one. All specialist group members and other readers of *Small Carnivore Conservation* can assist in this. We must place our own unpublished information on record, and support colleagues to do likewise. Often, the first step is to help the 'wider world' understand that even incidental data may have great conservation value. *Small Carnivore Conservation* exists to further the conservation of small carnivores, and will continue to be the predominant journal of long-term record for reliable information on field status of species, through regional review (e.g. the small carnivores of a country or protected area), species 'state of knowledge' synthesis (a single species across all or part of its world range) or simply incidental records. The revised Red List assessments for all small carnivores will soon be finalised, but this is *not* the end of the process! The Red List process is an iterative one, based on tracking and review of emerging data. So, good data, with good public access to them, on field status are an eternal need.

THE EDITORS

Status and distribution of small carnivores in Myanmar

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Abstract

There is very little published information on the recent status of small carnivores in Myanmar, even though three species identified as global conservation priorities by the 1989 IUCN/SSC *Action plan for the conservation of mustelids and viverrids* inhabit the country (Stripe-backed Weasel *Mustela strigidorsa*, Spotted Linsang *Prionodon pardicolor* and Large-spotted Civet *Viverra megaspila*). A better understanding of small carnivore present status would help assess national conservation priorities. This review is based on 'by-catch' data from camera-trap surveys, mostly for Tigers *Panthera tigris*, between 1999 and 2005, supplemented by examination of wild animal remains in hunting camps, villages and markets and other incidental information. The 19 survey areas were inside habitat-blocks potentially able to support Tiger and/or other threatened large mammals, located across most of Myanmar. They were mainly within evergreen forest. Historical species records were assembled from published sources. In total, 25 small carnivore species are known from Myanmar. Of these, 18 were confirmed by these surveys; few of the recent records of otters and none of ferret badgers could be identified to species but at least two and one species, respectively, persist. Small Asian Mongoose *Herpestes javanicus*, Small-toothed Palm Civet *Arctogalidia trivirgata* and Siberian Weasel *Mustela sibirica* have other recent information, but no recent Myanmar records were traced for Banded Civet *Hemigalus derbyanus*. Yellow-throated Marten *Martes flavigula*, Large Indian Civet *Viverra zibetha* and Common Palm Civet *Paradoxurus hermaphroditus* remain widespread and at least locally common. Red Panda *Ailurus fulgens*, Yellow-bellied Weasel *Mustela kathiah* and Banded Linsang *Prionodon linsang* were reconfirmed in their limited historical range. All species of otter are evidently much depleted, as may be Large-spotted Civet. Each of the other 8–9 species found had records from rather few sites and few conclusions can be drawn: survey was insufficient within the known national geographical and/or habitat range, and/or the species is partly or largely arboreal and so may have been much under-recorded by the camera-trapping style used. The priority need for most species is a better understanding of their status, specifically species-by-species response to the heavy hunting and habitat conversion widespread in Myanmar. Most importantly, otters merit immediate conservation management of remaining populations. Other specific needs are securing the Hkakaborazi National Park for the population of Red Panda (global interest) and Beech Marten *Martes foina* (regional interest), and the Hukaung Tiger Reserve for its population of Large-spotted Civet, and work to establish effectively protected areas incorporating lowland forest elsewhere in the country, particularly in southern Tanintharyi.
Keywords: activity patterns, camera-trapping, geographical range, historical review, hunting, lowland forest

အကျဉ်းချုပ်

၁၉၈၉ ခုနှစ် ကမ္ဘာ့ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးအဖွဲ့၏ အသားစားသတ္တဝါငယ်များဖြစ်သော မင်္ဂတ်(စ်)တဲလစ်(ဒ်) နှင့် ဗိုက်ဗဲရစ်(ဒ်) များ ထိန်းသိမ်းရေးလုပ်ငန်းစီမံချက်အရ မြန်မာနိုင်ငံတွင်နေထိုင်သော မျိုးစိတ်သုံးမျိုး (ကြောဖြူစင်းဝီဇယ်၊ လင်းဆိုင်ပြောက် နှင့် ကြောင်မြင်းကြွက်) များမှာ ကမ္ဘာ့ထိန်းသိမ်းရေး ဦးစားပေးအဆင့်များတွင်ပါဝင်သော်လည်း အသားစားသတ္တဝါငယ်များ လက်ရှိအနေအထားအကြောင်း ရေးသားထုတ်ဝေသည့် စာပေဆောင်းပါးနှင့် သတင်းအချက်အလက်များမှာ အလွန်နည်းပါးပါသည်။ အသားစားသတ္တဝါငယ်များ၏ လက်ရှိအခြေအနေကို ကောင်းစွာနားလည်သဘောပေါက်ခြင်းဖြင့် နိုင်ငံ၏ ထိန်းသိမ်းရေး ဦးစားပေးအဆင့်များ ဆန်းစစ်အကဲဖြတ်ရာတွင် များစွာအထောက်အကူပြုနိုင်ပါသည်။ ဤသုံးသပ်ချက်များသည် ၁၉၉၉ မှ ၂၀၀၅ ခုနှစ်အထိ ကင်မရာထောင်ချောက်အသုံးပြု၍ ဆောင်ရွက် ခဲ့သော အထူးသဖြင့် ကျား မျိုးစိတ်များကို လေ့လာသည့် သုတေသနလုပ်ငန်းများမှ ပူးတွဲရရှိသော သတင်းအချက်အလက်များကို အခြေခံထားပါသည်။ လေ့လာသုတေသနလုပ်ငန်းများ ဆောင်ရွက်ခဲ့သော ဧရိယာ ၁၉ ခုမှာ မြန်မာနိုင်ငံတစ်ဝန်းရှိ ကျားနှင့် မျိုးသုဉ်းရန်အန္တရာယ်ကျရောက်နေသော နို့တိုက်သတ္တဝါကြီးများ ကျက်စားနေထိုင်နိုင်သည့် ကျယ်ပြန့်သော နေရင်းဒေသများဖြစ်ပါသည်။ အများစု မှာ အမြဲစိမ်းတောများအတွင်း ဖြစ်ကြပါသည်။ မျိုးစိတ်များ၏ မှတ်တမ်းသမိုင်းများကို ပုံနှိပ်ထုတ်ဝေ ထားသည့် စာပေအရင်းအမြစ်များမှ စုဆောင်းထားပါသည်။ မြန်မာနိုင်ငံတွင် စုစုပေါင်း အသားစား သတ္တဝါငယ် မျိုးစိတ် ၂၅ မျိုးရှိသည်ဟု သတ်မှတ်ထားပါသည်။ လေ့လာသုတေသနလုပ်ငန်းများမှ ၁၈ မျိုးကို မှတ်တမ်းတင် အတည်ပြုနိုင်ခဲ့ပါသည်။ မကြာသေးမီက ရရှိသော ဖျံများ၏ မှတ်တမ်းအချို့ကိုသာ မျိုးစိတ် ခွဲခြားခြင်းပြုနိုင်ခဲ့သော်လည်း အနည်းဆုံးမျိုးစိတ် နှစ်မျိုးရှိနိုင်ပါသည်။ ထိုနည်းတူစွာ ကြောင်ပျံမျိုးစိတ်များ၏ လောလောဆယ် မှတ်တမ်းများကို မျိုးစိတ်ခွဲခြားခြင်းမပြုနိုင်သော်လည်း အနည်းဆုံး မျိုးစိတ်တစ်မျိုးရှိနိုင်ပါသည်။ မြွေပါ၊ ကြောင်ဝံနားရွက်ဖြူ နှင့် ဆိုက်ဗေးရီးယားဝီဇယ် များအတွက် မကြာသေးမီကမှတ်တမ်းများရရှိခဲ့သော်လည်း ကြောင်ဝံစင်းကြား အတွက် လောလောဆယ် မှတ်တမ်းများမရရှိပေ။ ဆတ်ခလောက်၊ ကြောင်မြင်း နှင့် ကြောင်ဝံပိုက် တို့မှာ ကျယ်ပြန့်စွာနေထိုင်ကျက်စားပြီး ဒေသအလိုက်ပေါများသောအနေအထား တွေ့ရပါသည်။ ပန်ဒါနီ၊ ဗိုက်ဝါဝီဇယ် နှင့် လင်းဆိုင် တို့မှာ မှတ်တမ်းသမိုင်းများအရကျက်စားသော ဒေသများတွင်သာ တွေ့ရှိရကြောင်း ထပ်မံအတည်ပြုနိုင်ခဲ့ပါသည်။ ဖျံမျိုးစိတ်အားလုံး၏ ဦးရေမှာ များစွာ ပြုန်းတီးနေကြောင်း အထောက်အထားများအရ တွေ့ရှိရပါသည်။ ထိုနည်းတူစွာ ကြောင်မြင်းကြွက် မျိုးစိတ်၏ဦးရေမှာ အလားတူအခြေအနေ ဖြစ်နိုင်ပါသည်။ အခြား မျိုးစိတ် ၈–၉ မျိုးကို နေရာအနည်းငယ်တွင်သာ တွေ့ရှိရ၍ ကောက်ချက်အနည်းငယ်သာ ဆွဲနိုင်ပါသည်။ သုတေသန စာရင်းကောက်လုပ်ငန်းများမှာ ပထဝီဝင်ဒေသအားလုံးနှင့် ကျက်စားရာဒေသအားလုံးကို မခြုံငုံမိချေ။ ကင်မရာထောင်ချောက်သုံး သုတေသနလုပ်ငန်းများမှာ အပင်များပေါတွင် အများပိုင်းကျက်စားသော မျိုးစိတ်များကို အနည်းငယ်သာ မှတ်တမ်းတင်နိုင်ပုံရသည်။ မျိုးစိတ်အများစုအတွက် ဦးစားပေးလိုအပ်ချက်မှာ မျိုးစိတ်များ၏အခြေအနေကို ကောင်းစွာနားလည်ရန်ဖြစ်ပြီး အထူးသဖြင့် မြန်မာတစ်နိုင်ငံလုံးတွင် ပြန့်နှံ့ဖြစ်ပေါနေသော အလွန်အကျွံအမဲလိုက်ခြင်းနှင့် နေရင်းဒေသများကို အခြားမြေအသုံးချမှုများသို့ ပြောင်းလဲပစ်ခြင်းများအား မျိုးစိတ်တစ်ခုချင်းစီမှ တုံ့ပြန်မှုများကို ကောင်းစွာနားလည်သဘောပေါက်ရန်လိုအပ်ပါသည်။ အရေးအကြီးဆုံးအချက်မှာ အနည်းငယ်မျှသာ ကျန်ရှိတော့သော ဖျံဦးရေများအတွက် ထိရောက်သော ထိန်းသိမ်းရေးနှင့် စီမံအုပ်ချုပ်မှုများ အလျှင်အမြန် လိုအပ်နေပါသည်။ အခြား သီးသန့်လိုအပ်ချက်များမှာ နိုင်ငံတကာ စိတ်ဝင်စားမှုရှိသော ပန်ဒါနီ နှင့် ဒေသတွင်းစိတ်ဝင်စားမှုရှိသော ဆတ်ခလောက်ငယ် များ ကျက်စားရာ ဓါကာဘိုရာဇီအမျိုးသားဥယျာဉ်ကိုလည်းကောင်း၊ ကြောင်မြင်းကြွက် များကျက်စားရာ ဟူးကောင်းကျားထိန်းသိမ်းရေးနယ်မြေကိုလည်းကောင်း ကောင်းစွာထိန်းသိမ်းရန်လိုအပ်ပါသည်။ နိုင်ငံအနှံ့ရှိ မြေနိမ့်ပိုင်း သစ်တောများတည်ရှိသောဧရိယာများ အထူးသဖြင့် တနင်္သာရီတောင်ပိုင်းကဲ့သို့သော ဒေသများတွင် ထိန်းသိမ်းကာကွယ်ရေးနယ်မြေများ တည်ထောင်ပြီး ထိရောက်စွာ ကာကွယ် ထိန်းသိမ်းသင့်ပါသည်။

Introduction

Myanmar (formerly known as Burma) is situated in South-east Asia, covering a total area of 676,581 km² (261,228 sq. miles) 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. The land elevation varies from sea level in parts of the south to 5,881 m (19,296′) in the northern mountain ranges bordering China, with distinctly different lowland and upland regions. 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. The sub-regions are further divided into subunits, of which Myanmar has ten, reflecting differences in topography, plant and animal distribution. The varied forest and other natural vegetation types of Myanmar and the rich fauna reflect these many ecological zones.

Myanmar retains some very large tracts of old-growth forest, with about 65% of the country's land area being forested: among the highest proportion of forest cover of any Southeast Asian country (Leimgruber *et al*. 2005, Stibig *et al*. in press). The human population was estimated in 2001 to number 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 remaining largely natural habitats (e.g. Leimgruber *et al*. 2005, Tordoff *et al*. 2005). Many rural people eat and trade wildlife (e.g. Martin 1997, Rao *et al*. 2002, 2005, Tordoff *et al*. 2005), and the country's common border with China (itself a large sink for traded wildlife, including many small carnivores; e.g. Li Yi-ming & Dianmo 1998, Li Yi-ming *et al*. 2000, Bell *et al*. 2004) must be a powerful driver of wildlife hunting. In sum, logging, barely-restricted hunting, and destructive agricultural practices have spurred significant declines in wildlife and natural habitats (Rao *et al*. 2002).

Information on even the basic occurrence of small carnivores in Myanmar has not been synthesised since Pocock (1939, 1941) and Tun Yin (1967, 1993). This is problematic because three species (Stripe-backed Weasel *Mustela strigidorsa*, Spotted Linsang *Prionodon pardicolor* and Large-spotted Civet *Viverra megaspila*) identified as global conservation priorities by the IUCN/SSC *Action plan for the conservation of mustelids and viverrids* (Schreiber *et al*. 1989) occur in Myanmar. A better understanding of the status and ecology of all species would help evaluate the priorities for conservation action and, where necessary, in formulating appropriate management recommendations. According to Myanmar's *Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law*, 1994 (in Myanmar Forest Department 2003), seven species of small carnivore are "Completely Protected" (i.e. with special protection, and severe punishment) and ten are "Normally Protected" (for which protection is also complete, unless a specific license is issued), but eight species, all of them mustelids, are unprotected (except when covered by area-specific regulations, e.g. inside declared protected areas). A third protection category, that of "Seasonally Protected Species", contains no small carnivores (Table 1).

This compilation on small carnivores in Myanmar discusses distribution range, natural history and conservation status of all 25 species recorded for the country, based largely on previously unpublished data gathered between 1999 and 2005 by camera-trap surveys, supplemented by 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 carnivores has barely been conducted in the country, with the notable exception of Su Su (2005) and Su Su & Sale (2007).

Survey areas

Surveys covered northern, western, central and southern Myanmar selecting habitat-blocks potentially able (based mainly on large extent of natural habitat) to support Tiger *Panthera tigris* (the main aim of survey at all sites excepting Hkakaborazi, Hponkanrazi and Naungmung; see Lynam *et al*. 2006, in prep.) and/or other threatened large mammals (Fig. 1). In total, 19 areas were surveyed in

Table 1. Legal protection of small carnivores in Myanmar by the Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law, 1994 *(in Myanmar Forest Department 2003).*

Species	Protection
Red Panda *Ailurus fulgens*	Complete
Beech Marten *Martes foina*	Unprotected[1]
Yellow-throated Marten *Martes flavigula*	Normal
Yellow-bellied Weasel *Mustela kathiah*	Unprotected
Siberian Weasel *Mustela sibirica*	Unprotected
Stripe-backed Weasel *Mustela strigidorsa*	Unprotected
Small-toothed Ferret Badger *Melogale moschata*	Unprotected
Large-toothed Ferret Badger *Melogale personata*	Unprotected
Hog Badger *Arctonyx collaris*	Unprotected
Eurasian Otter *Lutra lutra*	Complete
Hairy-nosed Otter *Lutra sumatrana*	Unprotected[2]
Smooth-coated Otter *Lutrogale perspicillata*	Complete
Oriental Small-clawed Otter *Aonyx cinerea*	Complete
Spotted Linsang *Prionodon pardicolor*	Complete
Banded Linsang *Prionodon linsang*	Complete
Large Indian Civet *Viverra zibetha*	Normal[3]
Large-spotted Civet *Viverra megaspila*	Normal[3]
Small Indian Civet *Viverricula indica*	Complete
Common Palm Civet *Paradoxurus hermaphroditus*	Normal[3]
Masked Palm Civet *Paguma larvata*	Normal[3]
Binturong *Arctictis binturong*	Normal[3]
Small-toothed Palm Civet *Arctogalidia trivirgata*	Normal[3]
Banded Civet *Hemigalus derbyanus*	Normal[3]
Small Asian Mongoose *Herpestes javanicus*	Normal[3]
Crab-eating Mongoose *Herpestes urva*	Normal[3]

[1]discovered in Myanmar after the 1994 law was passed; [2]not widely recognised to occur in Myanmar; see Duckworth & Hills (in press); [3]all species of Viverridae (except linsangs and Small Indian Civet) and Herpestidae are provided with normally protected status through family-level listings. Comprehensive listing of each species's name could be considered, because the current pattern of a family-level listing is confusing for many lay-people.

a roughly comparable manner. (Two further areas were visited, Thaung Dut Reserved Forest and Nankamu Reserved Forest; however, no camera-trapping took place at either, nor was any other method used appropriate to species-level small carnivore survey.) Some large regions of Myanmar were not surveyed, notably most of the east, e.g. eastern Shan State, Kayin State, Kayar State and Mon State, and hence some areas important to threatened large mammals may not have been 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 is entirely deciduous, while Momeik & Mabein, Panlaung & Padalin and Bago Yoma Swa Chaung all had (semi-)evergreen forest restricted mostly to riverine strips. Some other survey areas were adjacent to large stands of deciduous forest, e.g. Mahamyaing and Alaungdaw Kathapa. Hukaung Valley (grasslands/wetlands) and Hkakaborazi National Park (montane scrub/rock) have large areas of natural non-forest habitat. Smaller parts of several other areas are also non-forest: Paunglaung catchment (hill grass), Tanintharyi (seasonally flooded grasslands) and Saramati Taung (montane scrub/rock). The Paletwa (Mayu river catchment) survey area has such extensive Khayin-wa *Melocanna bambusoides* patches that bamboo represents 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. They are identified here under their current management status.

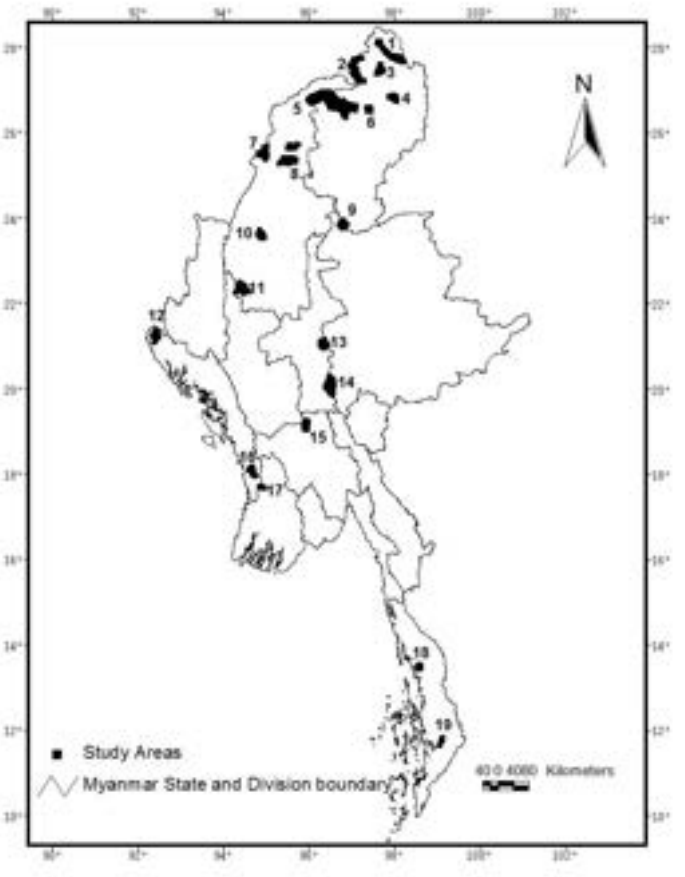

Fig. 1. Myanmar, showing survey locations. The numbers refer to survey areas as in Table 2. The marked areas are not those of the protected area, where one exists, but of the actual camera-trap survey area.

Methods

Camera-trapping

Camera-trapping was the primary technique, using heat-and-motion-sensitive CamTrakker units. These were mounted in 19 survey areas between 23 June 1999 and 24 May 2005; some survey areas were visited more than once (Table 2). Each survey area 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 by a GPS. Altitude was 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. Microhabitat is revealed in the photographs, but because cameras were often selectively set along stream-beds and trails, and at saltlicks, pools and other areas of good visibility, it is not highly informative on overall habitat usage. Date of exposure was imprinted on most images, determined by the camera's clock, but erratic functioning, particularly with older cameras, meant that many photographs lacked this information.

Camera-traps amass efficiently the high observational effort needed to survey low-density, shy and/or nocturnal ground-dwelling mammals. The photographs provide objective and verifiable evidence of presence, a consideration particularly pertinent with small carnivores, where some species are difficult to identify. Most camera-traps were set in relatively remote areas, where mammal communities are likely to be least disrupted. Concentration on evergreen forest meant that species of deciduous forest and non-forest habitats were not well sampled. Camera-traps were set at 18–20″ (45–50 cm), a height ideal for Tigers, but the lowest-slung small carnivores (e.g. weasels) will sometimes have passed without triggering a photograph. Arboreal species could only be sampled if on or very close to the ground. Camera-traps were set to record both day and night, allowing strong inferences to be made on day–night activity patterns for frequently-photographed species (van Schaik & Griffiths 1996). Such conclusions are difficult to draw from direct field observations, which usually show a great imbalance of survey effort between day and night, and from radio-tracking studies, which usually have small independent sample sizes (only a handful of animals). Camera-trapping covered all seasons, but no individual site was surveyed around the year.

Most areas received several hundred to several thousand trap-nights of survey effort (Table 2). The number of trap-nights for each camera location represents the time between mounting the camera and its retrieval. A reduction was made if the device was known to be not operative (film filled, one or more components broken) on collection, but rarely was it known exactly when a unit stopped recording.

The surveys were not designed to survey small carnivores, so

Table 2. Camera-trapping survey effort.

N°	Survey area[1]	Study period code	Set up	Retrieval	Low	High	Effort
1	Hkakaborazi National Park	HK(First Trip)	17 Oct 2003	22 Jan 2004	1,540	3,750	825
1	Hkakaborazi National Park	HK(Second Trip)	26 Mar 2004	24 Jun 2004	1,320	3,150	986
2	Hponkanrazi Wildlife Sanctuary	HP(2001)	25 Dec 2001	7 Feb 2002	2,110	3,360	391
2	Hponkanrazi Wildlife Sanctuary	HP(First Trip)	8 Dec 2004	20 Feb 2005	1,230	2,760	754
2	Hponkanrazi Wildlife Sanctuary	HP(Second Trip)	5 Feb 2005	31 May 2005	730	2,930	442
3	Naungmung township (Barbalonhtan)	BBL(2002-03)	9 May 2002	4 Apr 2003	800	1,660	1,605
4	Khaunglanhpu township	KLP(2001)	28 Mar 2001	16 May 2001	840	1,870	896
5	Hukaung Valley	HKV(2001)	1 Feb 2001	18 Mar 2001	220	300	881
5	Hukaung Valley	HKV(Phase1_Trip1)	1 Dec 2002	22 Jan 2003	240	320	1,469
5	Hukaung Valley	HKV(Phase1_Trip2)	17 Feb 2003	26 Mar 2003	210	740	991
5	Hukaung Valley	HKV(Phase2_Trip1)	15 Dec 2003	10 Feb 2004	220	340	2,037
5	Hukaung Valley	HKV(Phase2_Trip2)	2 Apr 2004	2 Jun 2004	560	1,670	1,981
5	Hukaung Valley	HKV(Phase3_Trip1)	18 Mar 2005	21 Apr 2005	220	340	937
5	Hukaung Valley	HKV(Phase3_Trip2)	24 May 2005	17 Jul 2005	210	940	540
6	Bumphabum Wildlife Sanctuary	SPB(2001)	17 Apr 2001	1 Jun 2001	570	980	980
7	Saramati Taung	SRMT(1999)	16 Feb 2000	26 Mar 2000	400	2,580	548
8	Htamanthi Wildlife Sanctuary	TMT(1999)	1 Sep 1999	31 Oct 1999	170	320	1,875
9	Momeik & Mabein townships	MB(2001)	28 Aug 2001	15 Oct 2001	200	720	618
10	Mahamyaing Reserved Forest & adjacent area	MHM(1999)	7 Dec 1999	11 Jan 2000	360	580	496
11	Alaungdaw Kathapa National Park	AKNP(1999)	23 Jun 1999	9 Aug 1999	300	980	1,621
12	Rakhine Yoma (north Paletwa township)	RN(2000)	6 Nov 2000	19 Dec 2000	20	740	991
13	Panlaung catchment & Padalin Cave Wildlife Sanctuary	PPDL(2000)	22 Aug 2000	28 Sep 2000	240	1,190	856
14	Paunglaung catchment	PLG(1999)	26 May 2000	18 Jul 2000	500	1,760	1,241
15	Bago Yoma (Swa Chaung catchment)	BGY(2000)	11 Oct 2000	26 Nov 2000	260	520	949
16	Rakhine Yoma Elephant Range	RER(2000)	14 Dec 2000	28 Jan 2001	90	920	895
17	Lemyathna & Ingabu townships	LMN(2002)	28 Feb 2002	7 Apr 2002	120	490	124
18	Myinmoletkat Taung foothills	MMLK(2001)	28 Sep 2001	13 Nov 2001	40	430	959
19	Tanintharyi (Htaung Pru Reserved Forest)	TNTY(2001)	17 Jan 2002	27 Feb 2002	20	160	786

Columns: N°, number on Fig. 1; Set up, date that earliest camera-trap was set; Retrieval, date that last camera-trap was retrieved; Low, lowest altitude (meters) at which a camera-trap was set; High, highest altitude (meters) at which a camera-trap was set; Effort, approximate number of functional camera-trap-nights; [1]Sign records of otters are included from an additional survey area, Thaung Dut Reserved Forest, where no camera-trapping took place; it was surveyed in November 1999 and lies at 24°17–30′N, 94°30–34′E, close to the historical collecting locality of the Kabaw Valley.

the results need subjective interpretation. The surveys took place over several years and no doubt camera-setting skills evolved somewhat as people became more experienced. Several different people ran surveys, separating out the sites between them, making it possible that individual methodological differences could influence patterns in results between sites. This is not felt to be a significant factor. All teams were trained by the same trainer (AJL) at first- or second-hand, and camera setting was similar in obvious parameters that might strongly affect number of small carnivores photographed: day/night operation regime (always 24-hr); intended height of cameras above the ground (but see below); use of baits/lures (never any); and rationale for siting (along animal trails with signs of large carnivores or ungulates where possible; small carnivore signs not used in siting cameras at any survey area). The only clear difference is that in sites with a good network of streams (notably the Hukaung Valley) these were often used as camera sites, whereas in some other areas (e.g. Hkakaborazi and Hponkanrazi) few streams were available.

Quantitative comparisons would be inappropriate between sites: because the surveys were not designed primarily to assess small carnivore communities, various factors may affect what small carnivores were actually recorded in addition to their true status. To assist qualitative inference, wildlife photographs were categorised into independent or non-independent events. The latter were cases 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.

Some small carnivores (e.g. those with wide intraspecific variation in pelage) are difficult to identify to species without extensive previous experience. No surveyor had access to a suitably large skin collection to make reliable identifications. Hence, original identifications of all mammal photographs were reviewed by the team including JWD, with additional input from A. V. Abramov, D. Mudappa, C. M. Poole (otters) and R. J. Timmins for the more difficult photographs of small carnivores. Species presence in most of these camera-trapping survey areas were listed in Lynam (2003: Appendix IX) before this identification review: in all discrepancies between this document and Lynam (2003), the present listing is definitive. A few small carnivore photographs

listed at time of development cannot now be located. All have been deleted from the species totals, because their identification is not now independently verifiable.

Historical collecting of mammals in Myanmar was patchy and erratic, meaning that many species still have only few preserved, internationally accessible, specimens from the country. Hence, each record is here detailed individually (except for the most-recorded species, Large Indian Civet), in partial substitution for the ongoing lack of physical specimens. All photographs are archived at the Wildlife Conservation Society's Yangon office.

Other sources of recent records

The following comments are in the context that the surveys were not targeted towards small carnivores and were not even general mammal inventories: all information on small carnivores gathered was incidental to the surveys' aims. Supplementary information came mostly through non-systematic search for dead or live animals in villages, hunting camps, rural markets etc. Such records were used only when photographed and the identifications validated as with camera-trap photographs. For these records, the actual site of the capture is not known: it is an assumption that it was near where the remains were seen. Very old relicts could have come from anywhere, so are not presented here. This method was particularly used in Hkakaborazi, Hponkanrazi and Naungmung. In other sites, the little time in villages gave only low opportunity to find such animals.

Other potential non-invasive methods widely used with other mammal groups have major drawbacks with small carnivores. Signs are difficult to identify to species in such a species-rich group. The potential for their use in species-level surveys has never been critically assessed in mainland Southeast Asia, excepting cases of restricted species coverage, e.g. otters in continental Thailand (Kruuk *et al*. 1993) and civets in the highly depauperate fauna of Hlawga Wildlife Park (Su Su 2005). Use of signs in a natural species assemblage would require documenting and analysing large samples of signs made by multiple individual animals of known species, covering all species potentially to be found in the survey area. Although many people believe that they can identify carnivore signs to species, objective testing invariably shows that they are overconfident (e.g. Davison *et al*. 2002). Hence, the only species for which sign records are listed, and only provisionally, is Red Panda, to which was attributed a distinctive form of faeces (see below). At the group level (given very low numbers of otter records), signs believed to be those of otters are also included. As with signs, there is no objective evidence that local reports of small carnivores to the species level can be reliable, so they are not used here. Direct field observation of live animals generates reliable data from experienced observers, but the lack of such people on the survey teams means that sight records are only used routinely for the distinctive Yellow-throated Marten.

A search for other published recent records of small carnivores from Myanmar located only Su Su (2003, 2005), Su Su & Sale (2007) and a few grey literature records. Unpublished records were sought from experienced colleagues, to extend the information base for the country.

Historical records

Historical records were assembled from published sources, starting with the listings in Van Rompaey & Colyn (1996). Blyth (1863) was not available to search and other sources may have been overlooked. Resource limitations prevented collation of the vitally important records held as unpublished museum specimens. Localities of historical records were often not given precisely. Both 1940s and modern maps were examined for sites of similar name in a place consistent with information in the primary source. Some ethnic groups move village at intervals and retain their village name when doing so. This may be why, for example, a 'Yado' can be located in the Kayin hills, but it is only 20 miles north-east of Toungoo, not the 60 miles given in the comments of Smith *et al*. (1940) on the itinerary of the 1880s collector, L. Fea.

Results and discussion

Most camera-trap surveys recorded small carnivores at rates of 6–22 photograph-events per 1,000 camera-trap-nights; but four surveys provided no records, four found small carnivores at a lower rate, and two found them at much higher rates: about 32 and about 42 events per 1,000 camera-trap-nights. This variation is unlikely to reflect genuinely the small carnivore numbers. Of the sites with no records, Lemyathna & Ingabu had only 124 trap-nights, but Khaunglanhpu had a more typical effort (Table 2). The latter's 220 wildlife photographs included only a handful of animals smaller than a muntjac *Muntiacus* or Clouded Leopard *Pardofelis nebulosa*: one East Asian Porcupine *Hystrix brachyura*, one Leopard Cat *Prionailurus bengalensis*, one Asian Golden Cat *Catopuma temminckii* and one Grey Peacock Pheasant *Polyplectron bicalcaratum*. On this specific survey, camera-traps were evidently set in a way that generated few pictures of lower-slung animals and the lack of small carnivore pictures is biologically uninformative. Two surveys of Hponkanrazi generated no small carnivore photographs, but a third gave a more typical result; the three surveys differed little in altitudinal coverage, and the 'successful' survey had less than twice the effort of the other two (Table 2). The four surveys with low photograph rates of small carnivores shared no obvious feature. That low-yielding surveys took place in areas (e.g. Hponkanrazi and Hukaung Valley) which hosted other, much higher yielding, surveys suggests that animal numbers were not the main determinant of capture rate. Camera-trapping was spread across the year and capture rate may have been influenced by seasonal factors (notably: two of the three surveys with much of the surveyed area under snow recorded no small carnivores). As indicated above, capture effort (number of trap-nights) could only be calculated approximately, and this may affect apparent yield of a site, as would evolution of skills of the survey teams. Where searches for remains were most complete, Hkakaborazi and Hponkanrazi, six and three species, respectively, were found by remains but not by camera-trapping. These two sites had greater than average camera-trapping effort, so equivalent searches for remains in other survey areas would presumably also have found species additional to those camera-trapped.

Table 3 shows small carnivores recorded in each area through camera-trapping. Records from other sources are given within the species accounts.

Red Panda *Ailurus fulgens*

Geographical distribution

Red Panda was found in the northernmost sites, Hkakaborazi National Park and Hponkanrazi Wildlife Sanctuary (Table 4). No animals were camera-trapped, despite high effort at Hkakaborazi. Faeces provisionally identified as Red Panda were found twice

in Hkakaborazi within dwarf bamboo–pine forest (28°08′17″N, 97°38′14″E, 3,890 m; 28°05′26″N, 97°37′53″E; 3,080 m) in late October 2003. These were confidently assigned to the species by experienced local hunters, and comprised, largely, bamboo leaves, Their appearance seemed identical to faeces produced by a captive panda caught at Zalahtu (3,390 m), by staff of the Nature and Wildlife Conservation Division (NWCD), Hkakaborazi National Park, which was sent to Yangon Zoological Gardens. Three other live Red Pandas caught in 2002–2003 by staff of the same unit were sent to the head office of Hkakaborazi National Park, in Putao, but died along the way (Table 4). There are previous records from this area. Dollman (1932) and Pocock (1941) listed 150 miles north of Myitkyina, near the Yunnan, China, border; two sites on the Nam Tamai (one at 27˚50′N, 97˚55′E); and the Taron Valley. Subsequently, two were collected on Janraung Bum at 8,000′ in February 1962 (Tun Yin 1967). Red Pandas also inhabit north-east Kachin state: two skins reputedly came from Sakkauk, on the north flank of Emaw Bum (Anthony 1941), four different individuals were seen during a bird-surveying visit to Mount Majed in early 2005 (Eames 2005), and a freshly-hunted animal was seen on Emaw Bum in early 2007 (Eames 2007).

Habitat and altitude

Signs were recorded only at high altitudes (over 3,000 m; Table 4), above the timber line, among dwarf bamboo (5–8′ tall). Pocock (1941) reported Myanmar specimens from the range 3,500–7,000′ (1,070–2,130 m; Nam Tamai Valley) and at 9,000′ (2,740 m; Taron Valley). Local people reported that pandas in Hkakaborazi move down-slope in winter (Rabinowitz & Saw Tun Khaing 1998).

Behaviour

Assuming the identification of faeces is correct, the animals make latrines, where there are multiple piles of faeces of different ages.

Threats and conservation status

The lack of camera-trap records suggests that Red Pandas might be scarce in Hkakaborazi, because there was significant survey effort over 3,000 m (nine camera positions totalling about 340 trap-nights) and effort was high within 2,000–3,000 m, but it could simply be that by chance none was photographed. However, Red

Table 3. Small carnivore records from camera-trapping.

Survey area/period	YtM	Fb	HB[1]	SL	BL	LIC	LsC	SIC	CPC	MPC	B	CeM	Total	Rate
Hkakaborazi 2003	2												2	2.4
Hkakaborazi 2004	4	1		1									6	6.1
Hponkanrazi 2001													0	0
Hponkanrazi 2004	4			1									5	6.6
Hponkanrazi 2005													0	0
Naungmung	12			1						6	1		20	13
Khaunglanhpu													0	0
Hukaung Valley 2001						11		2		1	2	13	29	33
Hukaung Valley 2002	7					6	1	2	2			13	31	21
Hukaung Valley 2003i	1					1						2	4	4.0
Hukaung Valley 2003ii	2			2				1	6			6	17	8.4
Hukaung Valley 2004	7		1	1					6			2	19	9.6
Hukaung Valley 2005i	1					2			10			2	15	16
Hukaung Valley 2005ii			1						1		4		6	11
Bumphabum	5			1					1	2	3	2	14	14
Saramati Taung	1		1	1		1			1				5	9.1
Htamanthi			6			18			2	1	1		28	15
Momeik & Mabein			1										1	1.6
Mahamyaing	1					3		1					5	10
Alaungdaw Kathapa	1		3			22		2	3			1	32	20
Rakhine Yoma (Paletwa)		2	11			27			1		1		42	42
Panlaung & Padalin		2							3			1	6	7.0
Paunglaung	2		9			13							24	20
Bago Yoma	1					16						2	19	20
Rakhine Yoma ER						4							4	4.5
Lemyathna & Ingabu													0	0
Myinmoletkat Taung	1				1	1			1			2	6	6.3
Tanintharyi	2				4	3	1		1		1		12	15

Columns: Survey area/period, see Table 2 for full area name and period dates; YtM, Yellow-throated Marten; Fb, ferret badger sp(p).; HB, Hog Badger; SL, Spotted Linsang; BL, Banded Linsang; LIC, Large Indian Civet; LsC, Large-spotted Civet; SIC, Small Indian Civet; CPC, Common Palm Civet; MPC, Masked Palm Civet; B, Binturong; CeM, Crab-eating Mongoose; Total, Total number of small carnivore photo-events; Rate, Small carnivore photos per 1000 trap-nights; [1]Rao *et al*. (2005: 296) listed a camera-trapped Hog Badger from Naungmung, but re-examination of the photograph showed the animal was actually a Masked Palm Civet.

Table 4. Remains records of small carnivores in Myanmar.

Survey area	Site	Latitude (N)	Longitude (E)	Date	State
Red Panda					
Hkakaborazi	Zalahtu, near Madein	28°08′	97°24′	March 2003	Live[@]
Hkakaborazi	near Tahundam	28°11′	97°38′	Jan 2002	Live[#]
Hkakaborazi	near Tahundam	28°14′	97°37′	Feb 2003	Live[#]
Hkakaborazi	Tahundam	28°10′	97°40′	13 Feb 2004	Dead
Hkakaborazi	Tazundam	28°02′	97°34′	2 Nov 2003	Dead
Hkakaborazi	Gushin-1	27°38′	98°13′	Apr 2004	Dead
Hponkanrazi	Ziadam	27°34′	97°06′	9 Feb 2002	Skin
Yellow-throated Marten					
Hkakaborazi	Karaung	28°07′	97°42′	15 Nov 2003	
Hponkanrazi	Wanglingdam	27°28′	97°10′	28 Dec 2005	
Hponkanrazi	Ziadam	27°34′	97°06′	28 Jan 2005	
Hponkanrazi	Karlan	27°32′	97°07′	11 Mar 2005	
Hponkanrazi	Namru-1	27°29′	97°11′	Dec 2005	
Naungmung	Khuhti	27°37′	97°41′	14 Dec 2002	
Naungmung	Htonladam	27°37′	97°42′	26 Feb 2003	
Stripe-backed Weasel					
Hkakaborazi	Gushin-1	27°38′	98°13′	May 2004	Skin
Hkakaborazi	Makhungam	27°39′	98°14′	April 2004	Skin
Hponkanrazi	Awaddam-2	27°31′	97°09′	26 Feb 2005	Dead body
Hponkanrazi	Awaddam-2	27°31′	97°09′	1 Mar 2005	Skin
Masked Palm Civet					
Hkakaborazi	Aliaung	27°42′	98°08′	Jan 2002	Live juvenile
Hkakaborazi	Gushin-1	27°38′	98°13′	May 2004	Dead
Hkakaborazi	Gushin-1	27°38′	98°13′	2004	Dead
Hponkanrazi	Warsandam	27°29′	97°12′	26 Feb 2005	Dead
Hponkanrazi	Wanglingdam	27°28′	97°10′	21 Mar 2005	Dead
Hponkanrazi	Awaddam-2	27°31′	97°09′	17 Jan 2005	Dead
Hponkanrazi	Awaddam-2	27°31′	97°09′	20 Jan 2005	Dead
Hponkanrazi	Awaddam-2	27°31′	97°09′	31 Jan 2005	Dead
Hponkanrazi	Awaddam-2	27°31′	97°09′	2 Feb 2005	Dead
Hponkanrazi	Karlan	27°32′	97°07′	4 Feb 2005	Dead
Hponkanrazi	Karlan	27°32′	97°07′	28 Dec 2004	Dead
Naungmung	Langnaipan	27°36′	97°45′	17 Oct 2002	Dead

[@]In dwarf bamboos and rhododendrons habitat; [#]In dwarf bamboos habitat; all identifications were confirmed to species. Records of species found by this technique only a few times are given in the species accounts.

Pandas, which forage primarily on the ground (Roberts & Gittleman 1984), are surely vulnerable to snaring (for, e.g., musk deer *Moschus*), which is widespread in the area. Rabinowitz & Saw Tun Khaing (1998, undated) found that in Hkakaborazi, local people did not actively target pandas, but did kill or collect them opportunistically, and sold the skins. Red Panda skins were seen for sale in markets on the Thai–Myanmar border at Tachilek in 1998 (AJL own data), an area far from likely wild pandas and a known trading point (e.g. Davidson 1999). The threat of harvest for the international captive animal trade is difficult to assess: there is ample opportunity through the markets along the Hkakaborazi–China border. Choudhury (2001) identified habitat degradation as the chief threat in India to Red Panda. Hence, it is noteworthy that habitat in Hkakaborazi and Hponkanrazi, especially at mid and high altitudes, is relatively stable (Renner *et al*. 2007). In some other areas, e.g. Emaw Bum, forests are much degraded (Eames 2007), and some populations within the species's small Myanmar range are no doubt in decline.

Beech Marten *Martes foina*

Beech Marten was not recorded by these surveys. A skin collected in early 1997 by Rabinowitz & Saw Tun Khaing (1998) in the village of Karaung, Hkakaborazi National Park, was the first Myanmar record. Given its ecological range in adjoining areas ("rocky, open areas...above 1,500 m"; Corbet & Hill 1992) Beech Marten may have a small range in Myanmar, and it may be rare even where it occurs: local people (including the captor) did not recognise the Karaung skin as a species with which they were familiar. There is little information on threats the species might face: it is not known to be targeted by hunters, and habitat change is not currently significant in its known Myanmar range (Renner *et al*. 2007).

Yellow-throated Marten *Martes flavigula*

Geographical distribution

Yellow-throated Marten was camera-trapped in 12 survey areas and there were several sightings and remains records (Tables 4 – 6). With Large Indian Civet, it was the most widely recorded small carnivore, occurring from the southernmost to the northernmost survey areas (Fig. 2); the gap in records in west Myanmar from 17° to 22°N (three survey areas) may simply reflect chance. It was noted by Saw Moses (*per* Su Su *in litt*. 2007) to be "quite common in several locations in Chin, Kachin and Shan states", with "many more sightings" additional to those in Table 6. Peacock (1933) considered that it lived "throughout" Myanmar; there are specific records from: Nam Tamai; Homalin; Myitkyina; Linpa; Suikin; the Chin Taung, 50 miles west of Kindat; Thandaung; 35 miles north-west of Toungoo; the Kabaw Valley, 20 miles west of Kindat; Nwalabo Taung; and Bankachun (Wroughton 1916a, 1916b, Fry 1929, Pocock 1941, Carter 1943). In August 1961 one was collected at Paungdaw Power Station, Dawei (Tun Yin 1967). No historical sites fall in the western gap in current records; the Chin Taung lie at the north of it. It seems unlikely that this really is a gap in the species's distribution, but this cannot be excluded.

Habitat and altitude

Photographs came from the altitudinal range of 30–2,680 m, supporting the wide altitudinal distribution demonstrated by Pocock (1941), and suggested by Choudhury (1997) in the adjoining Indian state of Arunachal Pradesh.

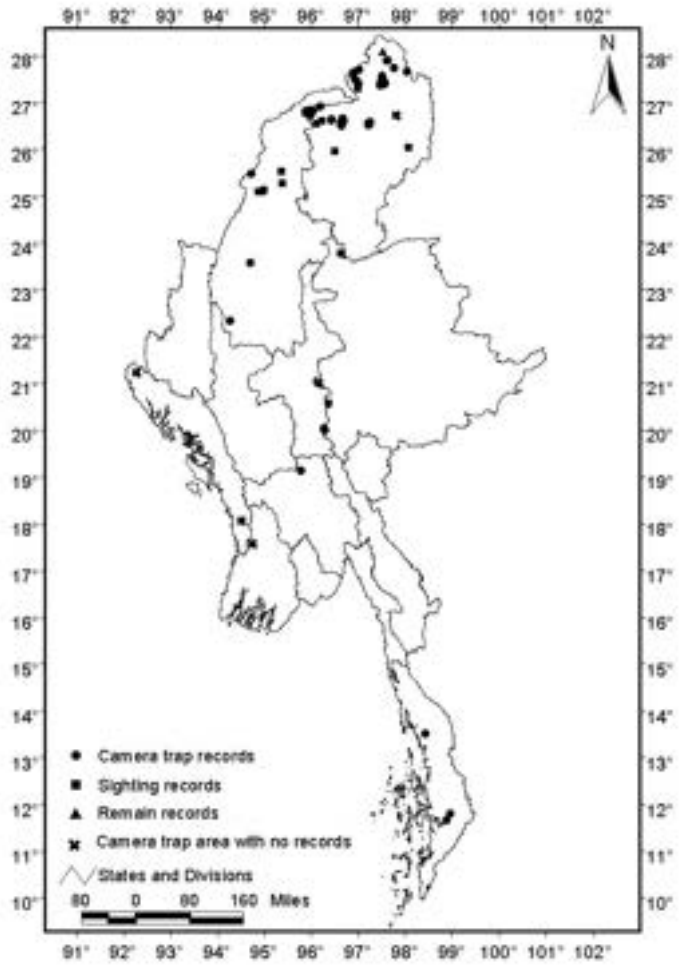

Fig. 2. Recent locality records of Yellow-throated Marten.

Behaviour

Of 55 independent photograph events, two were deep in the night (22h27 and 04h34), but all others were in daylight, including six in the evening (17h00–18h32). Two camera-trap records and several sight records were of groups of 2–3 animals. These results agree with the literature statements that Yellow-throated Martens are often in small groups (reviewed in Parr & Duckworth 2007), and are primarily diurnal, with some nocturnal activity during moonlit nights (G. C. Shortridge in Wroughton 1916a, J. M. D. Mackenzie in Wroughton 1916b, Duckworth 1997, Grassman *et al*. 2005). Although this marten is sometimes stated to live mainly singly and to be mostly nocturnal (e.g. Choudhury 1997), there seems to be no study that has presented primary data supporting these assertions.

Threats and conservation status

Yellow-throated Marten remains widespread and at least locally common in Myanmar. While undoubtedly taken opportunistically and as by-catch in traps set for other animals, there is no suggestion that it is at risk in the country.

Yellow-bellied Weasel *Mustela kathiah*

A Yellow-bellied Weasel skin was photographed in the village of Makhungam (1,100 m, but terrain within a mile or two of the village rises to 3,000 m), Hkakaborazi, in April 2004. Although not listed for Myanmar by Tun Yin (1967, 1993) or Parr & Tin Than (2005), there are previous northern highlands records: Naungmung; Machanbaw; the Nam Tamai; Gangfang; Gawlam (Anthony 1941, Pocock 1941, Duckworth & Robichaud 2005). The hilly terrain around Makhungam reflects the species's montane distribution in adjoining areas (Choudhury 1997, Duckworth & Robichaud 2005). Yellow-bellied Weasel's status in Myanmar is unclear: other tropical weasels are only rarely recorded through standard camera-trapping (see Duckworth *et al*. 2006, Abramov *et al*. in press). There is no evidence of specific threats to weasels in Hkakaborazi, although some certainly die as by-catch in traps set for other species.

Siberian Weasel *Mustela sibirica*

No Siberian Weasels were recorded during these surveys, but two skins, one with skull, seen for sale at Mong La market in February 2006 (Shepherd & Nijman 2007) surely came from within Myanmar (C. R. Shepherd *in litt*. 2007). Past specimens came from: the Kachin hills, east of Bamaw; Meteleo; Cobapo; Adung Valley; the left flank of Emaw Bum (where said to be not uncommon); the Thanlwin–Ayeyarwady divide; Mogoke; Taron Valley; Dihpu Lakha; Gangfang; and Nyetmaw Kyaung (Thomas 1891, Pocock 1941, Anthony 1941). The Emaw Bum specimen was in an "open valley" at 9,000′ (2,750 m), the Taron Valley one from "dense hill jungle" at 3,500′ (1,070 m), that from Dihpu Lakha was in "snow-covered rhododendron scrub" at 13,500′ (4,120 m), and the Mogoke specimen came from 4,400′. These are rugged, high-altitude massifs. The highest areas were not well covered on recent surveys, but there was plenty of work at 1,000–2,500 m. As with all weasels, its national conservation status is unclear.

Stripe-backed Weasel *Mustela strigidorsa*

No Stripe-backed Weasels were camera-trapped, but four remains were recorded from three villages in the far north (Table 4). The many previous records from northern Myanmar go south to 26°N,

Table 5. Camera-trap records of small carnivores in Myanmar.

Species / Survey area	Lat (N)	Long (E)	Alt./m	Date	Time	Notes
Yellow-throated Marten						
Hkakaborazi	27°55′13″	97°47′06″	2,140	19 Dec 2003	17h00	
Hkakaborazi	27°55′33″	97°47′13″	2,400	20 Dec 2003	10h51	
Hkakaborazi	27°46′12″	97°55′54″	1,730	14 Jun 2004	17h25	
Hkakaborazi	27°41′21″	98°12′05″	2,680	21 May 2004	12h55	
Hkakaborazi	27°41′21″	98°12′05″	2,680	23 May 2004	13h44	
Hkakaborazi	27°41′21″	98°12′05″	2,680	9 Jun 2004	12h16	
Hponkanrazi	27°35′11″	97°04′30″	1,290	28 Jan 2005	09h07	
Hponkanrazi	27°39′48″	97°04′12″	2,010	Dec 2004	Daylight	
Hponkanrazi	27°39′48″	97°04′12″	2,010	Dec 2004	Daylight	
Hponkanrazi	27°43′35″	97°10′51″	2,200	2 Jan 2005	13h14	
Naungmung	27°25′21″	97°38′44″	840	11 Mar 2003	22h27	Two animals
Naungmung	27°23′11″	97°37′56″	1,260	14 Mar 2003	11h28	
Naungmung	27°35′09″	97°40′56″	1,370	26 Dec 2002	09h58	
Naungmung	27°35′09″	97°40′56″	1,370	1 Jan 2003	06h58	
Naungmung	27°35′09″	97°40′56″	1,370	4 Jan 2003	16h33	
Naungmung	27°35′09″	97°40′56″	1,370	9 Jan 2003	09h25	
Naungmung	27°25′00″	97°42′32″	1,440	2 Dec 2002	13h49-53	Two photos
Naungmung	27°25′00″	97°42′32″	1,440	21 Dec 2002	14h45	
Naungmung	27°27′04″	97°39′45″	1,460	3 Dec 2002	13h50	
Naungmung	27°27′07″	97°44′19″	1,530	16 Dec 2002	11h44	
Naungmung	27°26′25″	97°44′16″	1,600	30 Dec 2002	11h28	
Naungmung	27°26′25″	97°44′16″	1,600	1 Jan 2003	13h35	
Hukaung Valley	26°31′06″	96°48′29″	240	Jan 2003	Daylight	
Hukaung Valley	26°31′06″	96°48′29″	240	7 Jan 2003	14h48	
Hukaung Valley	26°34′20″	96°48′03″	250	21 Dec 2002	04h34	Two animals
Hukaung Valley	26°34′20″	96°48′03″	250	21 Dec 2002	09h36	
Hukaung Valley	26°34′20″	96°48′03″	250	23 Dec 2002	06h46	Standing
Hukaung Valley	26°36′00″	96°47′50″	260	Dec 2002	Daylight	Standing
Hukaung Valley	26°36′49″	96°50′44″	280	Dec 2002	Daylight	
Hukaung Valley	26°56′18″	96°21′28″	400	11 Mar 2003	14h51	
Hukaung Valley	26°39′44″	96°35′39″	230	3 Jan 2004	12h37	
Hukaung Valley	26°38′44″	96°36′02″	230	23 Dec 2003	14h06	
Hukaung Valley	26°47′56″	96°03′05″	950	20 Apr 2004	12h03	
Hukaung Valley	26°51′21″	96°07′09″	1,080	16 May 2004	13h22	
Hukaung Valley	26°49′39″	96°09′51″	1,130	11 May 2004	13h52	
Hukaung Valley	26°49′39″	96°09′51″	1,130	19 May 2004	17h24	
Hukaung Valley	26°51′33″	96°10′19″	1,130	16 May 2004	16h42	
Hukaung Valley	26°44′04″	96°08′09″	1,260	8 May 2004	14h13	
Hukaung Valley	26°49′53″	96°02′40″	1,630	26 Apr 2004	06h50	
Hukaung Valley	26°39′39″	96°50′47″	290	29 Mar 2005	18h32	Standing
Bumphabum	26°35′39″	97°24′54″	830	24 Apr 2001	18h17	
Bumphabum	26°34′57″	97°22′56″	850	18 May 2001	14h05	
Bumphabum*	26°32′33″	97°24′15″	890	26 Apr 2001	07h50	
Bumphabum	26°32′09″	97°22′28″	930	9 May 2001	14h29	
Bumphabum	26°34′55″	97°24′39″	980	29 May 2001	14h26	
Saramati Taung	25°30′33″	94°52′29″	1,150	Mar 2000	14h15	
Mahamyaing	23°35′43″	94°51′53″	430	Dec 1999	07h55	
Alaungdaw Kathapa	22°21′05″	94°25′17″	490	Jun 1999	Daylight	
Paunglaung	20°00′20″	96°27′52″	1,150	25 Jun 2000	17h36	
Paunglaung*	20°02′55″	96°26′48″	1,350	7 Jun 2000	17h31	
Bago Yoma	19°08′27″	95°56′45″	350	Oct 2000	12h52	
Myinmoletkat Taung	13°30′29″	98°35′53″	80	Oct 2001	13h58	
Tanintharyi	11°39′05″	99°04′02″	30	13 Feb 2002	14h30	
Tanintharyi	11°46′49″	99°07′48″	80	11 Feb 2002	17h29	
Ferret badgers						
Hkakaborazi	27°41′59″	98°06′48″	1,320	April 2004	Night	
Rakhine Yoma (Paletwa)	21°21′59″	92°26′23″	540	18 Nov 2000	01h51	

Species / Survey area	Lat (N)	Long (E)	Alt./m	Date	Time	Notes
Rakhine Yoma (Paletwa)	21°21′59″	92°26′23″	540	28 Nov 2000	04h09	
Panlaung & Padalin	21°05′00″	96°16′21″	650	14 Sep 2000	04h14	
Panlaung & Padalin	21°05′00″	96°16′21″	650	24 Sep 2000	18h39	
Hog Badger						
Hukaung Valley	26°44′38″	96°09′08″	1,290	16 May 2004	15h38	
Hukaung Valley	26°25′34″	96°23′45″	270	18 Jun 2005	08h40	
Saramati Taung	25°22′13″	94°58′48″	1,280	17 Mar 2000	08h26	
Htamanthi	25°40′29″	95°31′45″	200	Sep 1999	Night	
Htamanthi	25°19′07″	95°32′26″	210	10 Sep 1999	02h21	
Htamanthi	25°17′59″	95°41′20″	260	Sep 1999	Daylight	
Htamanthi	25°18′35″	95°30′42″	280	Sep 1999	Night	
Htamanthi	25°18′35″	95°30′42″	280	Sep 1999	Night	
Htamanthi	25°16′38″	95°31′46″	280	Sep 1999	Night	
Momeik & Mabein	23°46′59″	96°51′22″	690	15 Sep 2001	00h29	
Alaungdaw Kathapa	22°21′29″	94°29′01″	350	17 Jul 1999	05h57	
Alaungdaw Kathapa	22°21′05″	94°25′17″	490	Jun 1999	Daylight	
Alaungdaw Kathapa	22°14′12″	94°28′38″	730	Jun 1999	04h30	
Rakhine Yoma (Paletwa)	21°17′04″	92°27′09″	640	17 Nov 2000	22h42	
Rakhine Yoma (Paletwa)	21°17′04″	92°27′09″	640	24 Nov 2000	02h20	
Rakhine Yoma (Paletwa)*	21°17′04″	92°27′09″	640	9 Dec 2000	05h05	
Rakhine Yoma (Paletwa)	21°19′24″	92°26′37″	650	15 Nov 2000	Night	
Rakhine Yoma (Paletwa)	21°19′24″	92°26′37″	650	19 Nov 2000	Night	
Rakhine Yoma (Paletwa)	21°19′24″	92°26′37″	650	20 Nov 2000	Night	
Rakhine Yoma (Paletwa)	21°19′24″	92°26′37″	650	20 Nov 2000	Night	
Rakhine Yoma (Paletwa)	21°19′24″	92°26′37″	650	20 Nov 2000	Night	
Rakhine Yoma (Paletwa)	21°19′24″	92°26′37″	650	23 Nov 2000	Night	
Rakhine Yoma (Paletwa)	21°19′24″	92°26′37″	650	28 Nov 2000	Night	
Rakhine Yoma (Paletwa)	21°14′28″	92°28′07″	680	19 Nov 2000	02h17	
Paunglaung	20°04′14″	96°28′30″	1,230	2 Jul 2000	22h08	
Paunglaung	20°04′14″	96°28′30″	1,230	7 Jul 2000	17h47	
Paunglaung	20°04′14″	96°28′30″	1,230	10 Jul 2000	15h13	
Paunglaung	19°58′34″	96°27′50″	1,350	5 Jul 2000	02h33	
Paunglaung	19°59′18″	96°27′19″	1,380	3 Jun 2000	00h53	
Paunglaung	19°59′18″	96°27′19″	1,380	13 Jun 2000	07h47	
Paunglaung	19°59′18″	96°27′19″	1,380	4 Jul 2000	07h43	
Paunglaung	20°01′47″	96°26′42″	1,440	28 Jun 2000	14h26	
Paunglaung	20°00′30″	96°26′59″	1,500	Jul 2000	Daylight	
Spotted Linsang						
Hkakaborazi	27°41′21″	98°12′05″	2,680	31 May 2004	20h40	
Hponkanrazi	27°35′20″	97°03′38″	1,350	Jan 2005	Night	
Naungmung	27°25′21″	97°38′44″	840	1 Mar 2003	03h00	
Hukaung Valley	26°43′20″	96°41′35″	250	31 Dec 2003	04h02	
Hukaung Valley	26°43′20″	96°41′35″	250	31 Dec 2003	04h41	
Hukaung Valley	26°41′57″	96°04′33″	930	11 May 2004	21h56	
Bumphabum	26°32′33″	97°24′15″	890	26 May 2001	22h01	
Saramati Taung	25°35′11″	94°57′23″	1,970	13 Mar 2000	23h23	
Banded Linsang						
Myinmoletkat Taung	13°29′50″	98°36′26″	70	18 Oct 2001	04h13	
Tanintharyi	11°39′05″	99°04′02″	30	14 Feb 2002	04h55	
Tanintharyi	11°37′16″	99°04′29″	30	1 Feb 2002	19h48	
Tanintharyi	11°37′16″	99°04′29″	30	5 Feb 2002	19h24	
Tanintharyi	11°37′16″	99°04′29″	30	19 Feb 2002	22h19	
Large Indian Civet						
Hukaung Valley	26°36′14″ –41′44″	96°34′00″ –52′53″	220–300	2 Feb–14 Mar 2001	18h57–04h33	10 + 1* photos
Hukaung Valley	26°35′29″ –42′36″	96°43′10″ –49′39″	250–290	8 Dec 2002–27 Feb 2003	18h28–03h36	5 + 2* photos
Hukaung Valley	26°31′26″	96°48′48″	250	31 Mar 2005	19h56	

Species / Survey area	Lat (N)	Long (E)	Alt./m	Date	Time	Notes
Hukaung Valley	26°36′10″	96°49′27″	260	18 Apr 2005	21h25	
Saramati Taung	25°41′46″	95°01′05″	1,570	Mar 2000	19h00	
Htamanthi	25°16′44″ –40′17″	95°30′42″ –44′14″	200–280	Sep 1999	Night	17 + 1* photos
Mahamyaing	23°31′17″ –33′36″	94°54′52″ –56′07″	470–560	27 Dec 1999–Jan 2000	Night	3 photos
Alaungdaw Kathapa	22°14′12″ –21′45″	94°17′28″ –35′44″	380–880	Jun–7 Aug 1999	Night (21); Daylight	20 + 2* photos
Rakhine Yoma (Paletwa)	21°05′28″ –21′59″	92°23′40″ –29′21″	180–720	13 Nov–21 Dec 2000	18h11–05h00; 06h01	27 + 1* photos
Paunglaung	19°58′34″ –20°08′01″	96°23′42″ –27′50″	740(1); 1,350 –1,510	9 Jun–4 Jul 2000	18h50–04h44	13 photos
Bago Yoma	19°02′25″ –12′18″	95°53′45″ –58′35″	350–420	21 Oct–16 Nov 2000	19h21–05h20; 09h02	13 + 3* photos
Rakhine Yoma ER	18°04′29″	94°41′01″	190	1, 6 & 9 Jan 2001	06h39, 09h22, 05h00	3 photos
Rakhine Yoma ER	17°59′08″	94°40′49″	630	26 Dec 2000	17h49	
Myinmoletkat Taung	13°29′50″	98°36′26″	70	30 Oct 2001	20h20	
Tanintharyi	11°48′46″	99°08′10″	30	24 Feb 2002	19h12	
Tanintharyi	11°45′03″	99°07′42″	60	19 Jan 2002	Daylight	
Tanintharyi	11°44′32″	99°06′45″	90	20 Jan 2002	11h08	
Small Indian Civet						
Hukaung Valley	26°38′53″	96°51′34″	280	8 Feb 2001	22h45	
Hukaung Valley	26°38′53″	96°51′34″	280	15 Feb 2001	20h41	
Hukaung Valley	26°36′00″	96°47′50″	260	19 Dec 2002	03h30	
Hukaung Valley	26°36′00″	96°47′50″	260	22 Dec 2002	21h01-02	Two photos
Hukaung Valley	26°41′17″	96°35′43″	240	22 Dec 2003	05h46	
Mahamyaing	23°35′43″	94°51′53″	430	14 Dec 1999	00h21	
Alaungdaw Kathapa	22°21′05″	94°25′31″	430	Jun 1999	Night	
Alaungdaw Kathapa	22°16′46″	94°35′44″	580	13 Jul 1999	04h22	
Common Palm Civet						
Hukaung Valley	26°31′37″	96°50′11″	250	28 Dec 2002	03h45	
Hukaung Valley	26°32′21″	96°48′44″	260	3 Jan 2003	Night	
Hukaung Valley	26°39′44″	96°35′39″	230	16 Dec 2003	23h23	
Hukaung Valley	26°39′44″	96°35′39″	230	28 Dec 2003	00h58	
Hukaung Valley	26°42′01″	96°32′50″	230	26 Jan 2004	19h17	
Hukaung Valley	26°40′31″	96°34′04″	240	24 Dec 2003	23h00	
Hukaung Valley	26°44′42″	96°34′27″	250	17 Jan 2004	20h57	
Hukaung Valley	26°44′42″	96°34′27″	250	1 Feb 2004	22h23	
Hukaung Valley	26°41′57″	96°04′33″	930	7 May 2004	04h19	
Hukaung Valley	26°41′57″	96°04′33″	930	7 May 2004	19h33-34	Two photos
Hukaung Valley	26°47′41″	96°11′19″	980	24 May 2004	00h15	
Hukaung Valley	26°45′36″	96°03′32″	1,090	19 Apr 2004	00h07	
Hukaung Valley	26°49′04″	96°05′01″	1,130	14 Apr 2004	20h46	
Hukaung Valley	26°44′38″	96°09′08″	1,290	26 May 2004	23h03-05	Two photos
Hukaung Valley	26°38′58″	96°35′08″	230	9 Apr 2005	20h21	
Hukaung Valley	26°40′57″	96°32′44″	250	1 Apr 2005	18h36	
Hukaung Valley	26°40′57″	96°32′44″	250	2 Apr 2005	19h59	
Hukaung Valley	26°43′11″	96°34′20″	290	5 Apr 2005	04h16	
Hukaung Valley	26°43′11″	96°34′20″	290	7 Apr 2005	01h02	
Hukaung Valley	26°43′11″	96°34′20″	290	8 Apr 2005	19h21-22	Two photos
Hukaung Valley*	26°40′48″	96°49′45″	290	10 Apr 2005	05h41	
Hukaung Valley	26°43′31″	96°38′19″	300	15 Apr 2005	02h38	
Hukaung Valley	26°44′21″	96°40′35″	330	5 Apr 2005	04h07	
Hukaung Valley	26°45′27″	96°39′27″	340	6 Apr 2005	00h42	
Hukaung Valley	26°25′53″	96°21′55″	400	7 May 2005	21h53	
Bumphabum	26°34′24″	97°25′58″	610	13 May 2001	19h09	
Saramati Taung	25°30′33″	94°52′29″	1,150	1 Mar 2000	19h29	
Htamanthi	25°17′59″	95°41′20″	270	Sep 1999	Night	

Species / Survey area	Lat (N)	Long (E)	Alt./m	Date	Time	Notes
Htamanthi	25°20′48″	95°32′45″	270	Sep 1999	Night	
Alaungdaw Kathapa	22°21′45″	94°27′58″	530	Jul 1999	Night	
Alaungdaw Kathapa	22°19′47″	94°27′54″	540	Jul 1999	Night	
Alaungdaw Kathapa	22°14′58″	94°27′59″	570	Jul 1999	Night	
Rakhine Yoma (Paletwa)	21°18′11″	92°27′37″	200	25 Nov 2000	20h08	
Panlaung & Padalin*	20°58′01″	96°22′16″	580	Sep 2000	02h54	
Panlaung & Padalin	20°58′01″	96°22′16″	580	22 Sep 2000	00h37	
Panlaung & Padalin	21°05′00″	96°16′21″	650	22 Sep 2000	19h16	
Myinmoletkat Taung	13°29′50″	98°36′26″	70	10 Oct 2001	03h09	
Tanintharyi	11°48′09″	99°08′01″	40	Feb 2002	Night	
Masked Palm Civet						
Naungmung	27°24′46″	97°41′45″	1,100	14 Dec 2002	21h03	
Naungmung	27°25′56″	97°38′23″	1,260	26 Feb 2003	20h15	
Naungmung	27°25′56″	97°38′23″	1,260	3 Mar 2003	23h24-37	Two photos
Naungmung	27°25′56″	97°38′23″	1,260	10 Mar 2003	02h19	
Naungmung	27°35′11″	97°41′06″	1,350	17 Jun 2002	14h37	
Naungmung	27°25′00″	97°42′32″	1,440	4 Dec 2002	23h00	
Hukaung Valley	26°39′53″	96°47′39″	280	11 Feb 2001	19h32	
Bumphabum *	26°29′28″	97°22′57″	810	6 May 2001	22h57	
Bumphabum	26°34′57″	97°22′56″	850	31 May 2001	00h48	
Htamanthi	25°17′59″	95°41′20″	270	Oct 1999	Night	
Binturong						
Naungmung	27°25′57″	97°41′00″	1,190	24 Aug 2002	18h52	
Hukaung Valley	26°38′44″	96°34′00″	220	12 Feb 2001	04h12	
Hukaung Valley*	26°39′53″	96°47′39″	280	26 Feb 2001	03h01	
Hukaung Valley	26°22′59″	96°26′15″	270	5 Jun 2005	07h24	
Hukaung Valley	26°22′59″	96°26′15″	270	5 Jun 2005	09h37	
Hukaung Valley	26°22′59″	96°26′15″	270	6 Jun 2005	23h44	
Hukaung Valley	26°22′59″	96°26′15″	270	8 Jun 2005	03h54	
Bumphabum	26°34′04″	97°23′47″	800	7 May 2001	00h50	
Bumphabum	26°32′09″	97°22′28″	930	6 May 2001	03h20	
Bumphabum	26°30′21″	97°23′55″	980	20 May 2001	08h41-09h03	Two photos
Htamanthi	25°16′38″	95°31′46″	280	Sep 1999	Night	
Rakhine Yoma ER*	18°00′	94°43′	580	5 Jan 2001	07h10	
Tanintharyi*	11°45′03″	99°07′42″	60	20 Jan 2002	16h13	
Crab-eating Mongoose						
Hukaung Valley	26°36′54″	96°48′15″	260	15 Mar 2001	14h21	Beside stream
Hukaung Valley	26°41′44″	96°48′54″	290	4 Feb 2001	12h18	
Hukaung Valley	26°41′44″	96°48′54″	290	8 Feb 2001	10h30	
Hukaung Valley	26°41′44″	96°48′54″	290	10 Feb 2001	11h42	Among grass
Hukaung Valley	26°41′44″	96°48′54″	290	10 Feb 2001	17h31	Two animals among grass
Hukaung Valley	26°41′44″	96°48′54″	290	11 Feb 2001	09h42	Two animals among grass
Hukaung Valley	26°41′44″	96°48′54″	290	15 Feb 2001	15h09	Among grass
Hukaung Valley	26°41′44″	96°48′54″	290	17 Feb 2001	13h46	Among grass
Hukaung Valley	26°41′44″	96°48′54″	290	19 Feb 2001	15h48	
Hukaung Valley	26°41′44″	96°48′54″	290	25 Feb 2001	13h10-18	Among grass; two photos
Hukaung Valley	26°41′44″	96°48′54″	290	28 Feb 2001	17h31	Among grass
Hukaung Valley	26°41′44″	96°48′54″	290	1 Mar 2001	09h20	Among grass
Hukaung Valley	26°41′44″	96°48′54″	290	2 Mar 2001	17h14	Among grass
Hukaung Valley	26°33′10″	96°44′40″	240	Dec 2002	08h33-34	Beside stream; two photos
Hukaung Valley	26°33′10″	96°44′40″	240	20 Dec 2002	08h22	Beside stream
Hukaung Valley	26°33′10″	96°44′40″	240	21 Dec 2002	16h35	Beside stream
Hukaung Valley	26°33′10″	96°44′40″	240	25 Dec 2002	14h43	Beside stream
Hukaung Valley	26°33′10″	96°44′40″	240	25 Dec 2002	18h18	Beside stream
Hukaung Valley	26°33′10″	96°44′40″	240	27 Dec 2002	08h47-48	Beside stream; two photos
Hukaung Valley	26°33′10″	96°44′40″	240	28 Dec 2002	14h50	Beside stream
Hukaung Valley*	26°33′10″	96°44′40″	240	29 Dec 2002	16h20	Beside stream
Hukaung Valley	26°33′10″	96°44′40″	240	30 Dec 2002	Daylight	Beside stream

Species / Survey area	Lat (N)	Long (E)	Alt./m	Date	Time	Notes
Hukaung Valley	26°34′20″	96°48′03″	250	24 Dec 2002	Daylight	Grassland
Hukaung Valley	26°36′00″	96°47′50″	260	24 Dec 2002	04h32	Beside stream among grass
Hukaung Valley	26°36′00″	96°47′50″	260	25 Dec 2002	07h18	Beside stream among grass
Hukaung Valley	26°31′51″	96°49′38″	260	9 Jan 2003	11h53	Beside stream
Hukaung Valley*	26°56′16″	96°25′52″	360	March 2003	Daylight	Grassland
Hukaung Valley	26°56′16″	96°25′52″	360	March 2003	Daylight	Grassland
Hukaung Valley	26°39′58″	96°30′22″	220	1 Feb 2004	15h13	
Hukaung Valley	26°42′39″	96°31′04″	220	31 Jan 2004	15h42	Beside stream
Hukaung Valley	26°42′01″	96°32′50″	230	29 Jan 2004	12h56	Two animals, beside stream
Hukaung Valley	26°42′01″	96°32′50″	230	5 Feb 2004	14h04	Beside stream
Hukaung Valley	26°38′54″	96°37′15″	230	5 Jan 2004	08h43	Beside stream
Hukaung Valley	26°45′57″	96°34′25″	260	22 Jan 2004	12h10	Beside stream
Hukaung Valley	26°44′13″	96°10′55″	750	16 May 2004	11h04	Beside stream
Hukaung Valley	26°49′36″	96°08′17″	900	5 May 2004	08h25-28	Under bamboo; two photos
Hukaung Valley	26°40′38″	96°38′54″	250	7 Apr 2005	18h03-04	Two animals beside stream; two photos
Hukaung Valley	26°40′38″	96°38′54″	250	15 Apr 2005	09h09	Beside stream
Bumphabum	26°32′33″	97°24′15″	890	28 May 2001	09h14	
Bumphabum*	26°32′09″	97°22′28″	930	28 Apr 2001	07h16	
Alaungdaw Kathapa	22°21′29″	94°29′01″	350	15 Jul 1999	10h18	Near bamboos
Panlaung & Padalin*	20°58′01″	96°22′16″	580	Sep 2000	Daylight	
Bago Yoma	19°07′57″	95°55′09″	400	26 Oct 2000	11h29	
Bago Yoma	19°11′04″	95°53′47″	420	Nov 2000	06h32	Under bamboos
Myinmoletkat Taung	13°29′50″	98°36′26″	70	29 Sep 2001	09h18	Under bamboos
Myinmoletkat Taung	13°29′50″	98°36′26″	70	27 Oct 2001	09h18	Under bamboos

All identifications were confirmed to species, except those marked*. Records of species found by this technique only a few times are given in text.

with a few to 21°18′N, and one (south-east of Mt Mooleyit) at 16°05'N, 98°30'E (Thomas 1891, Pocock 1941, Rabinowitz & Saw Tun Khaing 1998, Abramov *et al*. in press). All the present specimens came from rugged hill terrain, as did the historical records from Myanmar (Abramov *et al*. in press). One animal was caught while reportedly raiding village chickens. R. Kaulback and associates collected 12 specimens in northern Kachin state in the 1930s, implying that it was at least locally common. The lack of camera-trap records does not imply a decrease: across its range, photographs during general camera-trap surveys are very rare (Abramov *et al*. in press). Although typically considered a rare species of great conservation priority, it has probably been simply overlooked (Abramov *et al*. in press).

Ferret badgers *Melogale* spp.

Geographical distribution

Ferret badgers were camera-trapped south to about 21°N (Table 5); the low total of records prevents absence being inferred from further south. As with weasels, it is possible that the animals are rather low-slung to have been camera-trapped regularly, so these records may greatly under-estimate the current distribution. The three remains records all came from within the camera-trapped area (Gushin-1, Hkakaborazi, May 2004; Wanglingdam, Hponkanrazi, December 2005; and Naungmung town, 1 May 1998).

Myanmar supports two species of ferret badger. All historical records of Small-toothed Ferret Badger *M. moschata* were from north of 26˚45´N, from the Nam Tamai Valley (many); Gam Majaw; Akhe; and Putao (Pocock 1941), while all historical records of Large-toothed Ferret Badger *M. personata* were from south of 22˚N, from Yangon; Bago; Pyay; Thayet Myo; Rakhine; Popa Taung; Toungoo; Yado; Meteleo; and up the Ayeyarwady to Legyi, Sagaing (Thomas 1891, Wroughton 1915, Wroughton & Davidson 1918, Fry 1929, Pocock 1941). Recent records should not be assigned to species solely on locality, because specimens remain too few to define distributions with certainty. Datta (1999) confirmed Large-toothed Ferret Badger at about 27°N in adjoining India: hence it may well range further north in Myanmar than is yet documented.

Habitat and altitude

Ferret badgers were photographed at 500–1,300 m, similar to the known Myanmar range: Pocock (1941) listed specimens of Small-toothed Ferret Badger from 3,000′ (910 m) to 5,000′ (1,530 m) and of Large-toothed Ferret Badger from 4,960′ (1,520 m). G. C. Shortridge (in Wroughton 1915) considered Large-toothed Ferret Badger to be widespread, but nowhere plentiful, in the dry zone; there is no recent information from this area.

Behaviour

All five camera-trap records were at night, reflecting Pocock's (1941) description as nocturnal and crepuscular. The 14 September photograph was of two animals, similar in body-size, the others of singles.

Threats and conservation status

The threats ferret badgers face in Myanmar are unclear, reflecting a dearth of recent status information across Southeast Asia. All further records are needed: identifications to species should only be made through examination of the teeth (which allows ready separation, in contrast to pelage).

Hog Badger *Arctonyx collaris*

Geographical distribution

Hog Badgers were camera-trapped in seven survey areas (Table

Table 6. Direct sighting records of Yellow-throated Marten.

Survey area	Lat (N)	Long (E)	Alt./m	Date	Time	Habitat	Note
Hponkanrazi	27°20′16″	97°10′27″	750	30 May 2005	08h35	Beside stream	Two animals
Naungmung	27°28′01″	97°43′27″	940	6 Jan 2003	16h06	Semi-evergreen forest	Two animals
Naungmung	27°27′35″	97°43′03″	1,230	11 Jun 2002	08h32		Two animals
Hukaung Valley: Taket	26°38′	96°24′	210	23 Nov 2006	13h30	Ran across road	1–2 animal(s)
Hukaung Valley: Longastin	26°35'13″	96°17'39″	180	25 Dec 2005	12h50	River sandbank	Three foraging animals
Hukaung Valley: Jambu[1]	26°00′	96°41′	200	19 Mar 2005	16h00	On a road	Two animals
Hukaung Valley: Hla Mg Inn[2]	26°28′	96°34′	200	20 Nov 2003	daytime		Two groups of two
Lawngmaw Hka (Hsaw Lor)[2]	26°04′	98°15′	830	Mar 2005	14h00	–	Four animals
Htamanthi: Nam E-me stream[2]	25°34′	95°32′	180	21 Sep 2006	daytime	–	Two animals
Htamanthi: Nam Tanbauk stream[2]	25°18′	95°33′	220	16 Sep 2006	daytime	–	Two animals
Htamanthi: Tonmalaw[2]	25°10′	95°09′	150	4 Sep 2006	daytime	–	Two animals
Htamanthi: Nam Tonmaw stream[2]	25°07′	95°07′	180	8 Sep 2006	daytime	–	Two animals
Tason[2]	25°07′	95°02′	170	2-3 Sep 2006	daytime	–	Four animals
Ye-E Reserved Forest (YeAyeGan; Kalaw township)[2]	20°36′	96°32′	1,380	2 Mar 2007	daytime	–	Four animals

[1]Khin Myo Myo verbally, with photograph (2006); [2]Saw Moses per Su Su *in litt*. (2007).

5) south to about 20°N, and a live animal, snared by a hunter, was photographed in Naungmung on 8 March 2003. Hog Badgers cannot be considered absent from the several areas further south with high camera-trapping effort, because camera-trap capture rate varied widely between confirmed areas. The Hukaung Valley (with by far the highest survey effort of any site) produced only two photographs, but nearby Htamanthi WS generated six photographs; two sites, both with only average trapping effort (Paletwa and Paunglaung), between them generated nearly two-thirds of the species's photographs. This suggests low densities over large areas but high numbers in a few. Hog Badgers were recorded earlier from localities across Myanmar south to about 16°30′N, i.e. well south of recent records. Specific localities are: Thandaung; Lockaw; Ruby mines, Mogoke; 30 miles north-west of Kindat; Mawlamyine; and Falam (Wroughton 1916b, Pocock 1941). Peacock (1933) considered it rare.

Habitat and altitude

Photographs came from 200 to 1,500 m; there was little camera-trapping much above 1,500 m in the areas where Hog Badgers were found, so they may range higher. This wide altitudinal distribution is not universal: in Sumatra it is a higher montane species (Holden 2006). In Lao PDR records with accurate locality come only from hills and mountains (Duckworth 1997, Duckworth *et al*. 1999), but this may be a recent restriction through very heavy hunting having severely reduced populations in the more accessible plains (R. J. Timmins verbally 2006).

Behaviour

Hog Badgers are cathemeral: as well as a few round dawn and dusk, eight accurately-timed records were at night (22h08–02h33) and seven were in broad daylight (07h43–15h38). Peacock (1933), Pocock (1941: 447), Lekagul & McNeely (1977) and many other sources considered Hog Badger nocturnal, but no field study has demonstrated this, and in Lao PDR most records available to Duckworth (1997) were of animals active by day. Pocock (1941) conceded that there were very few original observations of wild animals on which he based his judgement, most information coming from captives. These factors seem to have led to an erroneous conclusion, unless activity patterns vary across range. All photographs were of single animals.

Threats and conservation status

It is unclear whether variation in capture frequency between sites reflects a natural pattern or effects of human activity: Hog Badgers must be vulnerable to both snaring and opportunistic day-time killing (Duckworth *et al*. 1999, Timmins *et al*. 1999). Although the lack of records from several large blocks of little-degraded habitat within a large area of Myanmar that historically held the species may reflect only chance, clarification of Hog Badger status is important. It is currently one of very few mammals larger than a squirrel that is not nationally protected (Table 1). These survey results coupled with concern for its status in Lao PDR (Duckworth *et al*. 1999), Vietnam (Timmins & Trinh Viet Cuong 2001, Long & Minh Hoang 2006, S. Roberton verbally 2006) and south China (M. W. N. Lau verbally 2006) urge that the species receive full protection in Myanmar.

Otters (Lutrinae)

Geographical distribution

There were few records of otters. A captive Oriental Small-clawed Otter *Aonyx cinerea* was photographed in the single village on the island of Pulo Baleih (Lampi Marine National Park) on 1 August 1996 (Myint Shwe verbally 2007). A live otter was seen in a tributary of the Tayomu Chaung, which flows into the Swa Chaung (Bago Yoma; 240 m), on 14 October 2000 at 10h24. Two live otters were seen in rugged terrain along the Gedu Hka (Hukaung Valley) on 21 February 2003 at 12h45. Two skins of large otters (i.e. not Small-clawed Otter) confiscated in Hukaung Valley on 3 September 2005 reportedly came from the Naga hills. They are rather dark for Eurasian Otter *Lutra lutra* or Smooth-coated Otter *Lutrogale perspicillata*, a peculiarity noted by Pocock (1941) for a skin of *L. lutra* from nearby Sumprabum. Provisional records of otter signs came from nine sites, with Thaung Dut Reserved Forest and Bago Yoma providing the most (Table 7). Several other recent records were traced. A group of about five otters swimming in

Table 7. Sign records (all provisional) of otters.

Survey area	Site	Alt./m	Date
Khaunglanhpu	not traced	unknown	Mar–May 2001
Hukaung Valley	26°39′N, 96°44′E	250	4 Feb 2001
Hukaung Valley	26°26′27″N, 96°51′14″E	240	27 Feb 2003
Hukaung Valley	26°26′28″N, 96°51′10″E	240	27 Feb 2003
Hukaung Valley	26°28′27″N, 96°52′18″E	240	14 Mar 2003
Bumphabum	Sinan Hka	460–610	20 Apr 2001
Htamanthi	Nam Tanbauk	180–300	8 Sep 1999
Htamanthi	Nam Pagan	180–300	4 Sep 1999
Htamanthi	Nam Pagan	180	7 Sep 1999
Thaung Dut	Nanthanyit Chaung	240–270	20 Nov 1999 (x2)
Thaung Dut	Nanthanyit Chaung	240–270	21 Nov 1999
Thaung Dut	Nanthanyit Chaung	240–270	22 Nov 1999
Thaung Dut	Ngadauk	210–400	27 Nov 1999
Thaung Dut	Nanthanyit Chaung	270	24 Nov 1999
Rakhine Yoma (Paletwa)	Pairwan Chuang	80–160	12 Nov 2000
Rakhine Yoma (Paletwa)	Pyarai Chaung	210	11 Nov 2000
Bago Yoma	Thayet Myaung[1]	150–300	14 Oct 2000
Bago Yoma	Kyetsha Chaung[2]	150–300	15 Oct 2000 (x2)
Bago Yoma:	Tayomu Chuang	150–300	12 Oct 2000 (x4)
Rakhine Yoma ER	Salu Chaung	80–150	14 Dec 2000 (x2)
Myinmoletkat Taung	Yebu Chaung[3]	80–240	30 Sep 2001

[1]a tributary of the Swa Chaung via the Aukchindu Chaung
[2]a tributary of the Swa Chaung via the Shaukpin Chaung
[3]a tributary of the Pe Chaung.

the Meelaung Chaung, tributary of Kyeintali Chaung in Rakhine Yoma Elephant Range was photographed by Aung Maung, Park Warden, in December 2003. Thet Zaw Naing and J. van der Ven (verbally 2007) saw two otters in daylight swimming across a side-stream of the Nam Eisu in Htamanthi Wildlife Sanctuary in early 2005, the only direct sighting of otters that either has had in a total of many months surveying river and wetland birds in much of Myanmar over the last decade. Mya Than Tun photographed a group of four large otters, probably Smooth-coated Otters, on the rocky coast of Pyinzabu island, Myeik archipelago, in January 2007, and Aung Myo Chit (verbally 2007) found many footprints of otters on the shores of nearby Bawai island in February 2002. A recently killed Oriental Small-clawed Otter found in Tanintharyi division was reported to have been hunted near Lenya proposed National Park (Su Su *in litt*. 2007). Two skins and a tail were seen for sale at Mong La in February 2006 (Shepherd & Nijman 2007).

Eurasian, Smooth-coated and Oriental Small-clawed Otters were all historically recorded in Myanmar (Pocock 1941, Tun Yin 1967). Tun Yin (1993) described the distribution of Eurasian Otter as Myitkyina district, but the only specific localities seem to be Taungbyo Reserve (Pyin Oo Lwin) and Sumprabum (Pocock 1941); see below for a record listed from Gam Majaw. Smooth-coated Otter was recorded from Bago; 20 and 40 miles west of Toungoo; upstream of Kindat; 6 miles west of Kindat; Kabaw Valley; Sagaing; Mashaw Tingra; and Sumprabum (Wroughton 1916b, Pocock 1941). Oriental Small-clawed Otter was recorded from Sumprabum; Htingnan; Nchangyang; Nauhkang; upper Chindwin; and Pwepi in the Chin Taung (Wroughton 1915, 1916b, Pocock 1941). Peacock (1933) considered that both large and Small-clawed Otters occurred throughout Myanmar. Two large otters were recorded by Anthony (1941) along the river Mai Hka (= N'mai Kha) near Tanga Rest House, Chipwi Township, unidentified large otters were reported from Thayaw–Thadangyi Kyun by Lindsay (1926), and unidentified otters from the Toungoo area by Fry (1929). A specimen of "*Lutra vulgaris*" was collected at Taho, Kayin hills, by Fea (Thomas 1891); given historical confusion over otter nomenclature (Pocock 1941), the specimen would need re-examining for a positive identification today. Otters may be historically under-recorded because of the difficulties in collecting them. The Vernay–Hopwood Chindwin Expedition several times encountered otters in early 1935: near Tumri Hka on 4 February, four seen swimming in the Chindwin could not be collected; downstream of Sai Taung on 4 March, an otter was shot but sank before recovery, and, also, two otters were seen eating a young turtle; and upstream of Htamanthi on 17 March an otter was shot but again sank before recovery (Morris 1936). The formal account of the expedition's mammals (Carter 1943) makes no mention of otters and it is rare to have a Morris-style commentary on what 'got away'.

In addition, a skin at the Natural History Museum, London (BMNH 50.587), collected at Gam Majaw (altitude 3,000′) on 6 April 1939 is a Hairy-nosed Otter *L. sumatrana* (Duckworth & Hills in press), a species not previously formally recorded for Myanmar.

Habitat and altitude

Otter sightings and signs were recorded at altitude of 80–610 m, mostly 180–300 m (Table 7). Given heavy survey effort in highlands, this probably indicates genuinely greater numbers in the lowlands. However, all mainland records were from hilly areas, a pattern most obvious in the Hukaung Valley where the plains were also well surveyed. No records came from agricultural landscapes, which were barely surveyed; such habitats support many otters elsewhere in South-east Asia (e.g. Shariff 1985).

Threats and conservation status

Otter populations are very low in the survey areas: many camera-traps were set beside streams, yet no otters were photographed. The rarity of sightings from bird surveyors along the Chindwin and Ayeyarwady rivers suggests that otters are now very rare across Myanmar's lowlands. Repeated sign searches in Hukaung Valley (extensive ideal habitat for otters) invested much effort along waterbodies, but signs were found only four times, indicating very low populations, although a few apparently persist in the more remote Naga Hills sector. A few years earlier, a reconnaissance survey of Htamanthi encountered itinerant hunters with six dead Small-clawed Otter skins, and otter gall bladders and penes, and the steel traps with which otters were caught. Otter signs were still 'patchy' with 'complete absence' noted in some waterways (Rab-

inowitz *et al*. 1995). There is no evidence that otters were previously rare in Myanmar; indeed J. M. D. Mackenzie (in Wroughton 1916b) stated that Smooth-coated Otter was "common" in the Chindwin, and this is echoed by Morris (1936); hence, the paucity of recent records in that river system reveals a major decline. It is possible that the Myeik archipelago supports better populations of otters than have remained on the mainland, with recent incidental records of at least two species.

Skins and penes of otters were listed as among the priciest wildlife commodities for sale in Putao, and were reported in the late 1990s to be already very rare in the region (Rabinowitz & Saw Tun Khaing undated). Otters are thus the highest priority small carnivores for conservation action in Myanmar.

The present occurrence of otters in protected areas in Myanmar is unclear. Although Htamanthi supports them, most suitable otter habitat is scheduled soon to be inundated by a large hydroelectric power dam. The lack of a clear understanding of where, if anywhere, important otter populations remain is a handicap to designing effective conservation interventions, yet these are an urgent need.

Spotted Linsang *Prionodon pardicolor*

Geographical distribution

Spotted Linsang was camera-trapped in six survey areas (Table 5) and a skin was found in the village of Lonnadam, Hponkanrazi, on 4 November 2005. Additionally, a skin was seen for sale at Mong La in February 2006 (Shepherd & Nijman 2007). All records were from north of 25˚30′N, but historical records ranged south to Magway, at 20˚08′N (Van Rompaey 1995). Other previous records come from: Meteleo; Kakhyen hills; Hpawshi; Nam Tamai Valley; Taron Valley; Myitkyina; Ratnampti; and the Chin Taung, 50 miles west of Kindat (Thomas 1891, Wroughton 1916b, Anthony 1941, Pocock 1941, Tun Yin 1967, Van Rompaey 1995). At five of the six survey areas, Spotted Linsang was camera-trapped at only one trap location. Moreover, within the area of known records, eight survey areas with significant camera-trapping effort found no linsangs. This suggests low population densities and/or limited efficacy of camera-trapping in detecting the species.

Habitat and altitude

Photographs came from 250–2,680 m, corroborating the wide altitudinal range, 150–2,700 m, established by Van Rompaey (1995).

Behaviour

All eight camera-trap records were in darkness; the species is universally considered nocturnal (Pocock 1939, Van Rompaey 1995), although Tizard (2002) and Long & Minh Hoang (2006) each observed single animals by daylight. All photographs were of single animals, on the floor.

Threats and conservation status

The low number of records does not imply rarity in Myanmar. Although Spotted Linsang has sometimes been considered rare and of conservation priority (e.g. Schreiber *et al*. 1989, Choudhury 1997), recent records come from across its known world range and into new areas (e.g. Walston 2001). Even in heavily surveyed areas of remote near-pristine habitat known to hold the species it is not found readily (e.g. interior Nakai–Nam Theun National Protected Area, Lao PDR; Duckworth 1997). Moreover, some records come from encroached habitat, and indeed it is one of the more regularly recorded small carnivores in the very depauperate mammal communities in south-east China (M. W. N. Lau verbally 2006). Overall it seems that the species is elusive and/or lives at naturally low density, and has thereby been much overlooked (GMA Small Carnivore Workshop, Vietnam, July 2006). This is likely to be true in Myanmar, with ground-level camera-trapping being not best suited for an animal that is a good climber (Hodgson 1842) and probably lives mainly in the shrub layer (Kuznetzov & Baranauskas 1993).

Banded Linsang *Prionodon linsang*

Geographical distribution

Banded Linsang was camera-trapped in only two survey areas, both south of 13˚30′N (Table 5). The northernmost record across its world range is from 15˚29′N, perhaps 16˚30′N (Steinmetz & Simcharoen 2006); the present survey camera-trapped nowhere within 13˚30′–16˚30′N. The only previous published Myanmar records are from Bankachun, and, apparently, around Mawlamyine (Pocock 1939).

Habitat and altitude

The highest-altitude record in these surveys was at 70 m, but with so few records its real upper limit cannot be suggested; it occurs up to at least 1,000 m in adjacent Thailand (Steinmetz & Simcharoen 2006).

Behaviour

Five independent photographs were taken, all by night; the species is universally considered nocturnal (Van Rompaey 1993, Steinmetz & Simcharoen 2006). All photographs were of single animals, all on the ground; the placement of cameras gave little chance to detect animals up trees.

Threats and conservation status

Steinmetz & Simcharoen (2006) considered the paucity of Banded Linsang records to indicate genuine scarcity. South Myanmar is seeing major lowland forest loss to plantations (Eames *et al*. 2005, Leimgruber *et al*. 2005), but this linsang uses plantations (Lim Boo Liat 1973, Payne *et al*. 1985) and hill forest (much more secure than adjacent lowland areas) so may not be particularly threatened in Myanmar.

Other notes

As pointed out by Steinmetz & Simcharoen (2006), Spotted Linsang has longitudinal band-like markings on the hind-neck, shoulders and upper back (see back cover of issue 34&35 of *Small Carnivore Conservation*), not the small round spots shown in Parr & Tin Than (2005) and some other drawings available: inexperienced people might thereby identify a Spotted Linsang as a Banded. This needs to be bourne in mind when assessing the likely validity of future reports of linsangs in Myanmar.

Large Indian Civet *Viverra zibetha*

Geographical distribution

Large Indian Civet was the most commonly recorded small carnivore, with about 130 independent photograph events coming from 11 survey areas (Table 5). Three skins were found in Naungmung, despite the lack of camera-trap records there (Kuhti on 1 December 2002 and two in Naungmung itself on 8 March and 2 May 1998). Together, the records span the latitudinal range sur-

veyed, except for the two sites furthest north, and no holes in distribution are apparent (Fig. 3). Historical records came from Gote Hteik and Pyaunggaung, both in the North Shan States; Hkamti; Lonkin; Dalu; Manpang; Homalin; Yin; Bankachun; Thaget; the Toungoo area; 25 miles west of Kindat; Ngapun; 2 km northeast of Bamaw; Yado; and Htingnan (Thomas 1891, Ryley 1914, Wroughton 1916a, 1916b, 1916c, Fry 1928, 1929, Pocock 1939, 1941, Carter 1943), and Peacock (1933) surmised that it inhabited the whole of Myanmar. More recently, three were collected from Kawapang (Tun Yin 1967).

Habitat and altitude

Records came from 30–1,570 m, mostly 200–900 m. Pocock (1939) gave a range from the foothills to 7,000′ (2,130 m), with highest abundance around 3,000′ (910 m). The many records below 400 m (70 from eight survey areas) are noteworthy: in Lao PDR, there are few recent records from below 400 m (Duckworth *et al*. 1999). There were even 11 records from five areas at or below 200 m.

Behaviour

Animals were active through the night, perhaps less so during 21h00–02h00 (Fig. 4). Seven independent photographs were recorded in broad daylight (06h01–11h08; two with time not recorded). Large Indian Civet is generally considered nocturnal (Pocock 1939, Lekagul & McNeely 1977, Rabinowitz 1991, Duckworth 1997), but activity by day, even many hours from darkness, is clearly not that exceptional, at least in Myanmar. All photographs were of single animals on the ground.

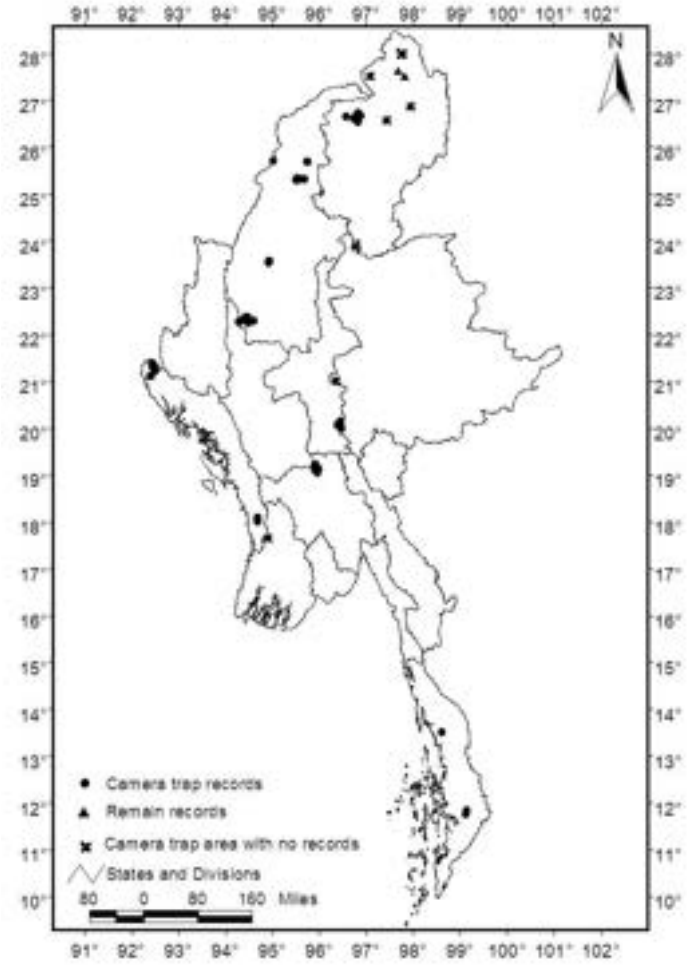

Fig. 3. Recent locality records of Large Indian Civet.

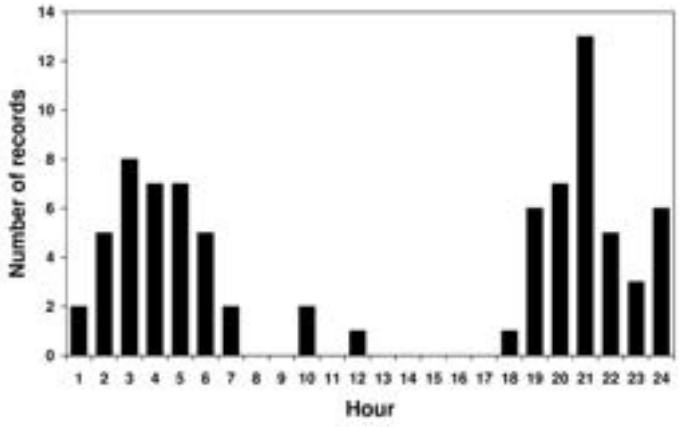

Fig. 4. Records by hour of Large Indian Civet. The given hour is the end, e.g., 5=04h00–05h00. Besides the records shown, there were 46 by'night' and two by'day' records, lacking precise time (or date).

Threats and conservation status

The species is widespread in Myanmar, and evidently at least locally common, as was earlier reported by Tun Yin (1967) and, for the Chin Taung, by J. M. D. Mackenzie (in Wroughton 1916b). It has a similar status in the neighbouring Indian state of Arunachal Pradesh (Choudhury 1997). Although it must be susceptible to snaring, there is no evidence that this or any other factor threatens Myanmar populations.

Other notes

Many photographed animals showed the semi-lunar spots on the flanks purportedly characteristic of 'Taynguyen Civet *V. tainguensis*', supporting Walston & Veron (2001) that such animals occur across the range of Large Indian Civet and that '*V. tainguensis*' is not a diagnosable taxon.

Large-spotted Civet *Viverra megaspila*

Geographical distribution

Large-spotted Civet was camera-trapped only twice, in the Hukaung Valley and in Tanintharyi (Lynam *et al*. 2005). Subsequently, a fresh hunters' kill was photographed in Tanai (Hukaung Valley) in June 2006. Historical records came only from central and southern Myanmar: Allagappa, 30 miles west of Sagaing; the holotype, from Pyay; Ba Yint Naung point; and Tanintharyi (village of Tenasserim) (Wroughton 1915, 1916a, 1916c, Pocock 1939). Peacock (1933) stated that the species was (with Large Indian Civet) "frequently seen on Tiger 'kills'" and that it lived in "many parts" of Myanmar. This suggests the species was quite common and this might still be so: few surveys below 300 m (see below) used techniques appropriate to find it (camera-trapping and spot-lighting).

Habitat and altitude

Camera-trap photographs came from 30 and 280 m and the dead animal was in a lowland plain, fitting the lowland pattern of recent records (Lynam *et al*. 2005). The records were from evergreen forest, including forest-grassland edge.

Behaviour
Both photographs were of single animals active by night, as the fragmentary information to date suggests is typical of the species (Duckworth 1997, Austin 1999).

Threats and conservation status
The very few records indicate extreme rarity in the surveyed areas. Where common, Large-spotted Civet is camera-trapped often (Austin 1999) and the many Large Indian Civet photographs prove that the cameras were being set in a way suitable for detecting *Viverra* spp. In Myanmar, much lowland forest is being converted to plantations (oil palm, sugar cane and others), particularly in Tanintharyi, and increasingly in Hukaung Valley. Active hunting is still rife in Hukaung Valley, and presumably in Htaung Pru Reserved Forest (Lynam *et al*. 2005). There is no published information whether the species uses the deciduous forests in Myanmar, although it apparently does so in Vietnam (Roberton *et al.* in prep.) and Cambodia (J. L. Walston verbally 2007); such forests are extensive below 300 m in Myanmar's dry zone, but were not camera-trapped during the present work. Pending surveys of deciduous lowlands in Myanmar, the species seems to be much reduced and under continued threat in the country. It may be the small carnivore most threatened in the country after otters (all species) and perhaps Banded Civet. Myanmar has a great international opportunity to conserve this species, given massive, irreversible, lowland forest loss in most other range states.

Small Indian Civet *Viverricula indica*
Geographical distribution
Small Indian Civet was camera-trapped in only three survey areas (Table 5); and two live juveniles (caught by hunters) were found in the village of Koneshine, Paunglaung. All sites were within 22°16′–26°41′N, but it was also found recently in Alaungdaw Kathapa (Thaint Thaint Myo, West Yangon University, verbally 2007) and at Hlawga Wildlife Park at 17°02′N (Su Su 2005), where it was the second-most common small carnivore. The camera-trapping does not give a meaningful picture of current range: it focussed on evergreen forest rather than the main habitats of this species (see below). Additionally, a skin was seen for sale at Mong La in February 2006 (Shepherd & Nijman 2007). Historical records come from a much wider range: Chin Taung, 50 miles west of Kindat; Kindat; Tawmaw; Homalin; Upper Chindwin; Yin, Lower Chindwin; Pakokku; Popa Taung; the Allagappa Valley, 30 miles west of Sagaing; Yangon; the valley of the Sittaung; the Sittaung Delta, 40 miles south of Bago town; Meteleo; Bamaw; and 30 miles north of Toungoo (Thomas 1891, Wroughton 1915, 1916b, Wroughton & Davidson 1918, Fry 1929, Pocock 1939, Carter 1943), with Peacock (1933) considering that it lived "throughout" Myanmar.

Habitat and altitude
Photographs came from 240–580 m, while Pocock (1939) mentioned specimens from 4,000′ (1,220 m) and 4,061′ (1,240 m). At Hlawga Wildlife Park the species was associated with scrub (Su Su & Sale 2007), in the neighbouring Indian state of Arunachal Pradesh, it occurs mainly around human habitation, commonly even in towns (Choudhury 1997), and in Lao PDR in deciduous and/or degraded areas (Duckworth 1997); none of these habitats was extensively camera-trapped. Forest edges and broken-forest areas were covered best at Hukaung, hence the predominance of records at that site. Conformation that the siting of camera-traps primarily in closed tall forest reduced the numbers of records of this species comes from Alaungdaw Kathapa, where Thaint Thaint Myo (verbally 2007), by setting cameras in all habitats in the protected area and surroundings, captured more photographs of this species than of any other carnivore. By contrast, the present surveys recorded it only twice there, and at one-tenth the rate at which Large Indian Civet was photographed (Table 3).

Behaviour
All eight independent photographs were taken at night and were of single animals; this species is nocturnal (Pocock 1939, Balakrishnan & Sreedevi 2007, Su Su & Sale 2007).

Threats and conservation status
Small Indian Civet attacks domestic poultry (Su Su 2005), and this may stimulate hunting in retribution. That it is still common in Hlawga (a degraded isolate of 6.24 km², in the outskirts of the large city of Yangon) shows great tolerance of human activity. Its abundance at Alaungdaw Kathapa (Thaint Thaint Myo verbally 2007) in the encroached areas around the good forest further suggests that this species, despite the low total of records on these camera-trap surveys, is of secure national conservation status.

Common Palm Civet *Paradoxurus hermaphroditus*
Geographical distribution
Common Palm Civet was camera-trapped in nine survey areas (Table 5), and also near Lampi island (on the south-west side of the small island of Wa-ale Kyunn, adjacent to north-west Lampi, in late January 2004 within 01h00–04h00; J. La Valette *in litt*. 2007). It was also recorded through a live juvenile (caught by hunters) of the village of Namsabum (Naungmung), a dead adult (hunted) in the village of Gushin-1 (Hkakaborazi) and, in March 1994, a hunter's kill in Htamanthi (Rabinowitz *et al*. 1995). These 11 survey areas cover the latitudinal range surveyed (Fig. 5). The apparent gap in records from 14° to 20°N is probably a chance effect of relatively low sampling there. It was also recorded recently from Hlawga Wildlife Park, where it was the most common small carnivore (Su Su 2005). There were many historical records, from: Pumsin; Dalu; Linpa; Kaunghein; Uyu forest, 60 miles east of Homalin (upper Chindwin); Mingun; Tharyargone, Chindwin; Kindat; Kin, lower Chindwin; Nan; Popa Taung; 6 miles east of, 30 miles north-west of, and 40 miles north-west of Toungoo; Bago; Thaton, north-west of Mawlamyine; Tanintharyi (village of Tenasserim); Bankachun; Myeik; Thaget; Katha; northern Zamayi Reserve, 80 miles north of Bago town; Kokareet; Meteleo; Taho, Kayin hills; Paddaung; Yado; Meetan (Thomas 1891, Wroughton 1915, 1916a, Wroughton & Davidson 1918, Fry 1928, 1929, Pocock 1939, Carter 1943); and various islands in the Myeik archipelago (Miller 1913, Pocock 1935, Tun Yin 1967). Peacock (1933) considered that it lived "throughout" Myanmar.

Habitat and altitude
Photographs came from 40–1,290 m, with most photographs from 200–300 m; Pocock (1939) mentioned a specimen from 4,960′ (1,510 m). G. C. Shortridge (in Wroughton 1915) considered it very common in the dry zone; this area was not surveyed recently. It inhabits the city of Yangon (Tun Yin 1979), where recently recorded by Aung Myo Chit (verbally 2006).

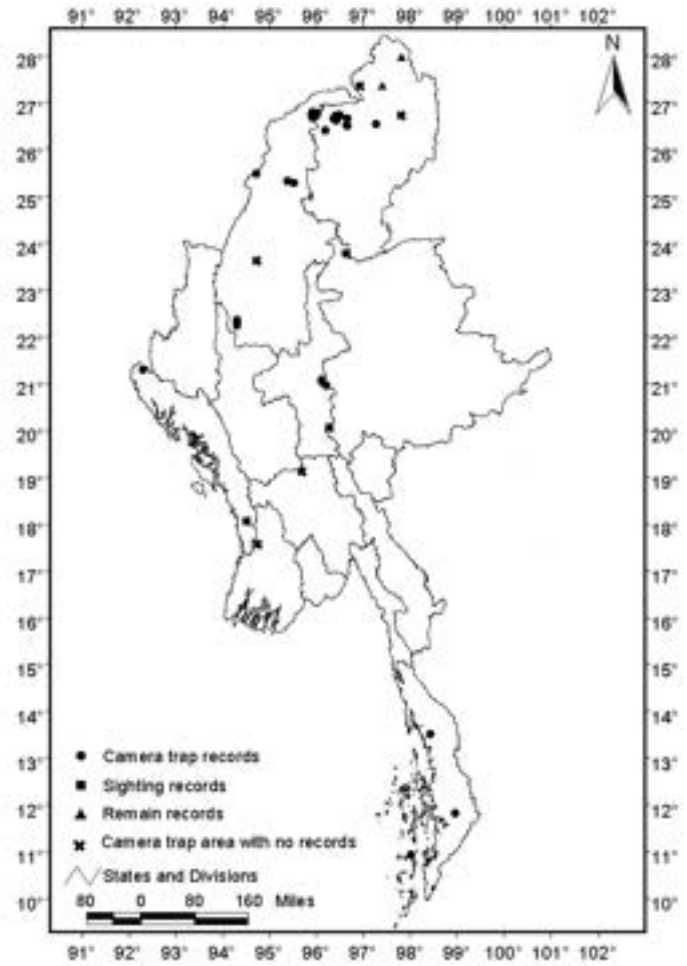

Fig. 5. Recent locality records of Common Palm Civet.

Behaviour
Of 38 independent photograph events, all were by night except one around dusk (18h36). Common Palm Civet's nocturnal activity pattern is well established (Pocock 1939, Dhungel & Edge 1985, Rabinowitz 1991, van Schaik & Griffiths 1996, Duckworth 1997, Azlan 2005, Su Su & Sale 2007). All photographs were of single animals, agreeing with Duckworth's (1997) field observations in adjacent Lao PDR. Records probably underestimate its abundance, because it is partly arboreal (e.g. Payne *et al*. 1985, Duckworth 1997) and so will have been less well camera-trapped than are the more ground-living species.

Threats and conservation status
This civet is caught in snares and other non-selective traps, and because it reputedly attacks domestic poultry (Choudhury 1997, Su Su 2005) it presumably is sometimes killed in response and pre-emptively. That it is still abundant in Hlawga (a degraded isolate of 6.24 km², in the outskirts of Yangon) shows its tolerance of high levels of human activity. It remains widespread, evidently at least locally common, in Myanmar, as it does in the neighbouring areas of Arunachal Pradesh, India, and Lao PDR (Choudhury 1997, Duckworth 1997).

Masked Palm Civet *Paguma larvata*
Geographical distribution
Masked Palm Civet was camera-trapped in four survey areas (Table 5). Also, a live juvenile (caught by hunters) from the village of Aliaung (Hkakaborazi), and 11 animals killed by hunters, from three sites, were recorded (Table 4). Although all the current survey's records came only from north of 25°17′N, historical records included the country's entire latitudinal range (Ryley 1914, Wroughton 1916a, 1916b, Pocock 1939, 1941, Anthony 1941): Nam Tamai; Adung Long; Gam Majaw; Chin Taung, 50–60 miles west of Kindat; Rakhine; Sima; Pyaunggaung; Or Gyi; Bankachun; and Gangfang. The relatively few camera-trap records reflect its partly arboreal behaviour (e.g. Duckworth 1997). Camera-trapping may have overlooked it at many sites (the many hunted animals from Hponkanrazi contrast with the lack of camera-trap photographs, despite fairly high camera-trap effort), hindering speculation on the significance of the lack of modern records south of 25°17′N.

Habitat and altitude
Camera-trap photographs came from 270–1,440 m, exceeding altitudinal records from Myanmar in Pocock (1939): 4,000′ (1,220 m) and 2,794′ (850 m). Duckworth (1997) suggested that this is a hill species in Lao PDR (all records were from over 500 m), but in Myanmar there were two records under 300 m.

Behaviour
Nine of the ten independent photographs were taken by night, and one in broad daylight (14h37). All records were of single individuals. Masked Palm Civets are generally considered to be nocturnal with only occasional daylight activity (Pocock 1939, Duckworth 1997, Grassman 1998).

Threats and conservation status
The lack of recent records from south of 25°17′N raises questions over this species's current national conservation status. Given its semi-arboreal nature, spotlight surveys and/or perhaps baited camera-trapping would generate better baseline understanding than has conventional camera-trapping. The species is surely overlooked (see above); in neighbouring Arunachal Pradesh (India), it is still common (Choudhury 1997).

Binturong *Arctictis binturong*
Geographical distribution
Binturongs were camera-trapped in six survey areas (Table 5), with all confirmed records from north of 21°N. The poorly-lit photograph from 11°45′N is within the historical range, which included Tanintharyi (village of Tenasserim) and Indawgyi Lake (Wroughton 1916a, Pocock 1939); "Province Amherst"; Meteleo (Thomas 1891), Paungdaw; and Kanang, Sumprabum (Tun Yin 1967). Peacock (1933) considered that it lived "throughout" Myanmar but considered it "rarely seen". As a predominantly arboreal species, camera-trap records may not give a full current distribution (see Masked Palm Civet): the chance nature of photographs is shown by Hukaung, where the six records came from only two camera-trap sites. There were no remains records from any sites, but Su Su (*in litt*. 2007) saw one being kept as a pet in Myeik in 2007 and Shepherd & Nijman (2007) recorded one in international trade to China at Mong La.

Habitat and altitude
Binturongs were photographed at altitudes from nearly sea level (60 m) to 1,190 m.

Behaviour

The 13 photograph events involved one around dusk (18h52), seven in full night and five (six images) in broad daylight (Table 5). These observations and others of wild animals (e.g. Lambert 1990, Nettelbeck 1997, Datta 1999, Grassman *et al*. 2005) and of captives in Vietnam (S. I. Roberton *in litt*. 2007) indicate that Binturongs are regularly active by day, although they were formerly believed to be mostly or even solely nocturnal (e.g. Pocock 1939, Lekagul & McNeely 1977, Rozhnov 1994).

All photographs were of single animals, and all were on the ground. Although generally taken to be arboreal, with most direct field sightings being of animals up trees (e.g. Lambert 1990, Nettelbeck 1997, Datta 1999), because the animal is heavily-built and not very nimble, it may have to descend to the ground relatively frequently when moving between trees.

Threats and conservation status

The low number of camera-trap records and the lack of any records of hunted animals suggests current national rarity, at least in Kachin state. In spots where there is no significant hunting of low-value wildlife, e.g. directly around the headquarters of Khao Yai National Park, Thailand, Binturongs are readily found by direct observation (Nettelbeck 1997). A better picture of national status, perhaps through direct searching by day and night, is needed, because Binturong is now rare in Lao PDR (Duckworth *et al*. 1999) and has been proposed for listing as Globally Threatened: Vulnerable (GMA Small Carnivores workshop, Vietnam, July 2006). Potentially, Myanmar could be an important country for the survival of this species given the large proportion of forest remaining.

Small-toothed Palm Civet *Arctogalidia trivirgata*

No Small-toothed Palm Civets were recorded. The only recent Myanmar record traced, from Hlawga Wildlife Park, involved an animal apparently released from captivity (Su Su 2005). Previous records are widely spread across Myanmar: Rakhine; Kadan Kyun island and Pan Daung Kyun, Myeik archipelago; Red Point, Tanintharyi; Tanintharyi (village of Tenasserim); southern Zamayi Reserve, 60 miles north of Bago town; 20 miles east of Toungoo; Tawmaw; Kokareet; and Sumtsangtap (Thomas 1891, Wroughton 1916a, Wroughton & Davidson 1918, Lindsay 1926, Pocock 1939, 1941, Carter 1943, Meiri 2005). Peacock (1933) considered that it lived "throughout" Myanmar. The lack of recent records does not imply current rarity: Walston & Duckworth (2003), Borissenko *et al*. (2004) and Duckworth & Nettelbeck (2008) all pointed out that the species's strictly arboreal habits mean that conventional camera-trapping is not an effective survey method, although baited camera traps or those set in the canopy (see Schipper 2007) might be useful. Active spotlighting, a method barely used in Myanmar to date, is needed. By analogy, the strongly arboreal gibbons *Hylobates*, very common in some survey areas (e.g. Hukaung; WCS Myanmar Programme unpublished data, W. Y. Brockelman *in litt*. 2006), were never camera-trapped. It is most unlikely that Small-toothed Palm Civet is rare in Myanmar: suitable habitat remains widespread and the same features as make it difficult for surveyors to record also insulate it from the effects of most hunting methods. It is demonstrably common in adjoining Lao PDR (Duckworth 1997) and may well be so in Arunachal Pradesh, India (Choudhury 1997).

Banded Civet *Hemigalus derbyanus*

No Banded Civets were recorded, and the only known Myanmar record is of two animals (including the type of *H. d. incursor*), from Bankachun, right at the southern tip of Myanmar (Pocock 1939, Tun Yin 1967). The lack of records probably indicates a truly localised distribution and/or scarcity, because no reason is obvious why this species would be overlooked by camera-traps. The southernmost camera-trap was at 11°37′N, some way north of the sole Myanmar record. When it was originally discovered in Myanmar, G. C. Shortridge (in Wroughton 1916a) considered it scarce, pointing out that local villagers had no name for it, despite its distinctive looks. It may be at high risk of national extinction: far-southern Myanmar is undergoing widespread forest conversion to plantations (Eames *et al*. 2005, Leimgruber *et al*. 2005). No protected area has yet been declared within its known Myanmar range.

Small Asian Mongoose *Herpestes javanicus*

No Small Asian Mongooses were found during these surveys, and the only recent Myanmar records traced were from Hlawga and the Yangon Crocodile Farm; at both, the species is so common it is trapped as a pest by park staff (Su Su 2005, *in litt*. 2007). Published Myanmar records come from only few localities: Bamaw; Toungoo; 40 miles north of Toungoo; Bago; and the Sittaung delta, 40 miles south of Bago (Thomas 1891, Wroughton & Davidson 1918, Fry 1929, Pocock 1941, Tun Yin 1967), but Peacock (1933) considered that it inhabited all Myanmar, and it surely occurs more widely than the verified localities might suggest: it inhabits north-east India (Pocock 1941), southern China (Allen 1938), most of Thailand (Lekagul & McNeely 1977), and remains "very common all over Arunachal Pradesh", a neighbouring part of India (Choudhury 1997). The current survey's lack of camera-trap records reflects the focus on tall forest habitat (see Small Indian Civet): in mainland Southeast Asia it lives mainly in deciduous forests and secondary, semi-open, habitats, with few, if any, records from closed evergreen or semi-evergreen forest (Wells 1989, Duckworth 1997, R. J. Timmins verbally 2006); e.g., in Khao Yai National Park, Thailand, which is predominantly evergreen forest, Austin & Tewes (1999) found it only in grassland. The species is readily seen where present, e.g. in the riverine and deciduous forests of north-east Cambodia (C. M. Poole verbally

Table 8. Direct sighting records of Crab-eating Mongoose from Hukaung Valley.

Observation site	Lat (N)	Long (E)	Alt./m	Date	Time	Habitat	Note
Tanai Hka	26°31′	96°25′	200	26 Dec 2005	13h50	Large sandbar	Certainly single
Upper Shipha Hka	26°39′	96°51′	280	9 Jan 2006	15h00	Streamside grass	Probably single
Shinlonga	26°31′	96°37′	220	17 Jan 2006	10h15	Marsh pasture on old ox-bow	Two animals
Tarung Hka	26°43′	96°28′	230	18 Jan 2006	14h15	Hard mud riverbank	Four animals
Fresh oxbow of Sekse Hka	26°38′	96°32′	210	23 Jan 2006	10h45	Sparsely-vegetated sandbar	Certainly single

Records came from waterbird surveys in December 2005–January 2006.

2006), so the lack of sightings in Hukaung Valley, which contains much superficially suitable open and edge habitat, suggests that it is rare or absent there. This mongoose is usually considered ecologically tolerant (Lekagul & McNeely 1977, Wells 1989, Corbet & Hill 1992), and it probably benefits from forest encroachment. Hence it is unlikely to be under national threat, especially as it survives around Yangon despite targeted trapping as a pest.

Tun Yin (1967) considered the taxon in Myanmar, *birmanicus*, a part of *H. auropunctatus*. Most authors, from Pocock (1941) to Corbet & Hill (1992), considered *auropunctatus* and allied forms as part of *H. javanicus* (see Wells 1989). Recent morphological and genetic analysis suggests that in fact two species may be involved and both may occur in Myanmar (Taylor & Matheson 1999, Veron *et al*. 2006b). Good-quality camera-trap photographs, and, particularly, skin/skull specimens could help resolve taxonomic understanding.

Crab-eating Mongoose *Herpestes urva*

Geographical distribution

Crab-eating Mongoose was camera-trapped in six survey areas (Table 5), and in the Hukaung Valley there were several field sightings (Table 8), and one dead animal was found (along the Namparaw Hka on 5 February 2001). Also, one was recently seen at Hlawga (Su Su 2005). The most southerly recent record was at 13°29′N, but this may not be a real southern limit, because camera-trapping took place in only one area further to the south. Historical records came from most of Myanmar south to Yangon: Rakhine; Meteleo; Ruby mines; 160 km from Myitkyina; Tamu, Chin Taung; Thandaung, near Toungoo; Mogaung, 20 miles north-west of Kindat; Tharyarwady; Yangon; Lonkin; Manthe; Da1u; and Nauswa (Thomas 1891, Fry 1929, Pocock 1941, Carter 1943, Van Rompaey 2001, Wroughton 1916b). The species was recorded from secondary evergreen forest at Kaeng Krachan National Park, Thailand (within 12°26′–13°19′N, 99°04–39′E; AJL own data), which lies almost as far south as the Tanintharyi survey area, but it may be very scarce, or even absent, in southernmost Myanmar, as it has only recently been confirmed to occur at all in nearby Malaysia (Wells & Francis 1988).

Habitat and altitude

Twenty-one camera-trap records were near streams; although doubtless an artefact of camera position, many records in Lao PDR were from close to surface water (Duckworth 1997) and when in forest and scrub, it is mainly near water (Van Rompaey 2001).

Records came from nearly sea level (70 m) to 930 m, mostly within 200–300 m; but this does not prove that the species is particularly tied to lowlands, because 38 of the 46 records were from one site, Hukaung Valley, where most camera-trapping was in the lowlands. However, it does seem to be rare on high mountains (Van Rompaey 2001), notwithstanding records at 1,650 m (Kurseong, Bengal, India; Pocock 1941) and 1,200 m (central Lao PDR; Duckworth 1997).

Behaviour

The 46 independent photographs involved two around dusk (18h18, 18h03–04) and 44 during daylight; by contrast, Su Su's (2005; *in litt*. 2007) sole observation at Hlawga was spotlit at about 19h00 (fully dark) on 24 October 2000 (at this site, camera-traps were operating only by night, no doubt explaining the lack of photo-records of mongooses). Diurnal activity accords with recent surveys throughout its range (Pham Trong Anh 1992, Duckworth 1997, Van Rompaey 2001, Duckworth & Robichaud 2005, Long & Minh Hoang 2006), although it was considered nocturnal by Pocock (1941), Lekagul & McNeely (1977) and Corbet & Hill (1992). Only Pocock gave a basis for his categorisation, which was presented only as a provisional suggestion; it is difficult to believe that the species is truly predominantly nocturnal anywhere in its range.

Four camera-trap records involved duos; the species is often in small groups (Pham Trong Anh 1992, Duckworth 1997, Van Rompaey 2001).

Threats and conservation status

The prime habitat in the central Hukaung Valley has been heavily camera-trapped, hence the many records from there. Evidence from other sites indicate a wide distribution, and there is no suggestion that the species is under threat in Myanmar; if the Hlawga record is of a truly wild individual (and there is no reason to doubt this: Su Su *in litt*. 2007), the species must be very tolerant of human encroachment.

Concluding discussion

Overview of national small carnivore status

In total, 25 small carnivore species are known from Myanmar. Of these, 18 were confirmed by these surveys; few of the recent records of otters and none of ferret badgers could be identified to species but at least two and one species, respectively, persist in the country. Small Asian Mongoose, Small-toothed Palm Civet and Siberian Weasel are known by recent records from other sources, but no recent Myanmar records were traced for Banded Civet. During the period of these surveys, one species (Beech Marten), found in the far north, was new to Myanmar (Rabinowitz & Saw Tun Khaing 1998). Various other Sundaic small carnivores may await discovery in southern Tanintharyi, e.g. Malay Weasel *Mustela nudipes* and Sunda Otter Civet *Cynogale bennettii* (Duckworth *et al*. 2006, Veron *et al*. 2006a). (A listing of Malay Weasel from the Hukaung Valley in Lynam [2003: 57] must be in error: it is 16° north of any acceptable record of the species, and, moreover, a photograph held in the WCS Myanmar office of a dead Crab-eating Mongoose from Hukaung has 'Malay Weasel' written on the back and is presumably the source of the error.)

Three species, Yellow-throated Marten, Large Indian Civet and Common Palm Civet, certainly remain widespread and at least locally common in Myanmar. Three others, Red Panda, Yellow-bellied Weasel and Banded Linsang, were reconfirmed in their limited historical range. All species of otter are evidently much depleted, as may be Large-spotted Civet. Each of the other 8–9 species found, Stripe-backed Weasel, 1–2 species of ferret badgers, Hog Badger, Spotted Linsang, Small Indian Civet, Masked Palm Civet, Binturong and Crab-eating Mongoose, had records from rather few sites. It is difficult to be sure of each one's national conservation status, because survey was insufficient within the known national geographical and/or habitat range, and/or the species is partly or largely arboreal and so may have been much overlooked by the main method used here, ground-level camera-trapping. In the context that these records came incidentally to other conservation work, collation and analysis of them is a cost-effective way to improve understanding of current distribution and status of a group often ignored by biologists, in a country of

outstanding international biodiversity conservation significance with, however, little available information on its wildlife for several decades.

Ramifications for replication of opportunistic use of 'by-catch' camera trap photographs

Relatively little additional effort was needed to collate and present these 'by-catch' data. However, species identification abilities probably will limit extracting information from (the many) analogous studies across the world where camera-trapping for some specific reason has generated large numbers of images of small carnivores. The external review revealed that, reflecting an absence of training in small carnivore identification and lack of opportunity for the project teams to compare their photographs with extensive series of museum skins, identification errors were frequent. Firstly, identifications of poor-quality images were often over-confident, with identifications listing no caveat of the uncertainty of actual identity. Even with good images, however, two common classes of error were those (1) involving linsangs, Small Indian Civet and Leopard Cat, and (2) the three palm civets (including listing of Small-toothed Palm Civet, actually not represented in the images at all). Maximising the potential of the many photographs already generated across the world must confront this issue: the world-wide decline in specimen collection correspondingly lifts the importance of non-invasive records (field sightings, camera-trap and other photographs). If these are genuinely to expand understanding of status and distribution, rather than sow confusion, mechanisms for reliable identification are essential. The identification advisors for these photographs have spent hundreds of hours studying museum skin collections; picture guide-books cannot substitute for this, because even the best ones cannot show the full range of variation—individual, seasonal, by sex and age, and geographic—that many species of small carnivores show.

Conservation needs of small carnivores in Myanmar

Some conservation needs for small carnivores in Myanmar are already apparent. Most importantly, otters merit immediate intervention. It is not certain that any other species is under serious decline nationally, although Large-spotted Civet and Banded Civet may be. Small carnivores' conservation needs mostly relate to turning the already declared network of protected areas into a functional reality. Some of the other specific needs may most pragmatically be undertaken as part of other conservation activities:

- Immediate clarification of otter status and preservation of remaining populations in Myanmar.
- Consolidation of the Hkakaborazi National Park in conserving biodiversity through effective management to secure the population of Red Panda (global interest) and Beech Marten (regional interest).
- Consolidation of the Hukaung Tiger Reserve in conserving biodiversity through effective management to secure the population of Large-spotted Civet, and work to establish effectively protected areas incorporating lowland forest elsewhere in the country.
- Clarification, through further survey, of the national status of Hog Badger, Large-spotted Civet (notably its status in deciduous forests in Myanmar), Binturong and Banded Civet, which may well be found to merit conservation action in their own right.
- Clarification, through further survey, of the current status in Tanintharyi division of the two Sundaic species (and potentially others), Banded Linsang and Banded Civet, the importance for which is enhanced over other little-known species in the country because of their predicted small distributions and the rapid deforestation in southern Tanintharyi division (Leimgruber *et al*. 2005).
- Clarification, through further survey, of the national status of all weasels, both ferret badgers, Spotted Linsang, Small Indian Civet, Masked Palm Civet, Small-toothed Palm Civet and both mongoose species; all are known in rather few recent localities, but may simply be overlooked.
- Baseline surveys in areas not covered under the current programme, notably eastern Shan State, Kayin State, Kayar State, Mon State, the Chin Taung, and the remainder of Tanintharyi.
- Baseline trade surveys. There is huge trade in small carnivores to Chinese markets from Vietnam (e.g. Bell *et al*. 2004), but little information on the magnitude of such trade from Myanmar (e.g. Davidson 1999, Martin & Redford 2000, Shepherd 2001, Shepherd & Nijman 2007). The most important specific investigations are to characterise Red Panda and otter trade involving Myanmar.
- Assignment of completely protected status to Hog Badger and to 'all otters' to cover the possibility that Hairy-nosed Otter persists in Myanmar. The need, if any, for the remaining species currently not protected (weasels, ferret badgers and Beech Marten) to receive protected status is unclear; habitat measures are more likely what is needed.
- Staff training in survey techniques for small carnivores including spot-lighting, live-trapping and specific forms of camera-trapping, and of paramount importance, species identification and pathways for assistance in it.

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Appendix. Gazetteer of localities of sites mentioned in the text, including historical records.

Current name (if known)	Old name	Locator	Source
Adung Long	Adung Valley	28°05–10′N, 97°45′E	Pocock 1941: 367
	Akhe	26˚55´N, 98˚12´E	Pocock 1941: 400
Aliaung	–	27˚42′N, 98˚08′E	GPS (TZ own data)
	Allagappa	21°51′N, 95°32′E	via Pocock 1939: 373
	Amherst town	16°05′N, 97°35′E	Lowe 1933: plate 13
Ba Yint Naung point	Victoria point	9°58′N, 98°33′E	BirdLife International 2001
Bankachun	Bankachon	10˚09´N, 98˚36´E	BirdLife International 2001
Bago	Pegu	17°20′N, 96°29′E	BirdLife International 2001
Bamaw	Bhamo	24°16′N, 97°14′E	BirdLife International 2001
Bawai island	–	10˚22´N, 97˚56´E	Aung Myo Chit verbally
Chin Taung	Chin hills	northwest of Sagaing	Pocock 1941
	Cobapo	Kayin hills, NE of Toungoo	Thomas 1891
	Dalu	26°20′N, 96°10′E	Carter 1943
Dihpu Lakha	Diphuk La	28˚09′N, 97˚21′E	via Pocock 1941: 369
Emaw Bum	Imaw Bum	26˚10′N, 98˚30′E	Pocock 1941: 368
Falam	–	22°55′N, 93°41′E	BirdLife International 2001
	Gam Majaw	26°43–45′N, 97°56–58′E	Pocock 1941: 400
	Gangfang	26°05′N, 98°35′E	Anthony 1941
	Gawlam	26°00′N, 98°35′E	Anthony 1941
Gedu Hka	–	26°56'N, 96°19'E	SHTP own data
Gote Hteik	Gokteik	22°20′N 96°52′E	via Ryley 1914
Gushin-1	–	27°38′N, 98°13′E	GPS (TZ own data)
Hkamti	–	26°00′N, 95°48′E	Carter 1943
Homalin	–	24°54′N, 94°58′E	Carter 1943
	Hpawshi	26°04′N, 98°36′E	Anthony 1941
Htamanthi	Tamanthi	25°18′N, 95°14′E	Carter 1943
	Htingnan	26°36′N, 97°52′E	Pocock 1941: 310
Indawgyi lake	–	25°08′N, 96°20′E	BirdLife International 2001
	Janraung Bum	26°42′N, 97°12′E	via Tun Yin 1967: 57
Kabaw Valley	–	23°40′N, 94°01′E	via Wroughton 1916b
Kadan Kyun island	King's island	12˚30´N, 98˚22´E	Meiri 2005
Kachin hills	Kakhyen hills	not precisely located	Anthony 1941
	Kanang	26°33′N, 97°26′E	via Tun Yin 1967: 89
Karaung	Arondam	28°07′N, 97°42′E	GPS (TZ own data)
	Karenni	19°15′N, 97°30′E	BirdLife International 2001
	Katha	24°21′N, 96°18′E	via Fry 1929: 642
	Kaunghein	25°40′N, 95°25′E	Carter 1943
	Kawapang	26°11′N, 97°31′E	via Tun Yin 1967: 71
Kawkareik	Kokareet	16°03′N, 98°15′E	Thomas 1891
	Kin	22°46′N, 94°41′E	Brandon-Jones *et al*. 2004
	Kindat	23°40′N, 94°20′E	Carter 1943
Koneshine	–	20°02′N, 96°33′E	SHTP own data
Khuhti	–	27°37′N, 97°41′E	
Lampi island	–	10°55′N, 98°12′E	standard maps
	Legyi, Sagaing	on the Irrawaddy, just S of 22°N	Pocock 1941: 408
Linpa	Limpa	25°50′N, 95°30′E	Carter 1943
	Lockaw	in Karenni	Pocock 1941: 437
Lonkin	–	25°35′N, 96°20′E	Carter 1943
Lonnadam	–	27°30′N, 97°10′E	GPS (TZ own data)
Machanbaw	–	27º30′N, 97º30′E	GPS (TZ own data)
Magway	–	20˚08′N, 94˚55′E	Van Rompaey 1995
Makhungam	–	27°39′N, 98°14′E	GPS (TZ own data)
	Manpang	26°00′N, 95°52′E	Carter 1943
	Manthe	25°18′N, 95°16′E	Carter 1943
	Mashaw Tingra	26°48′N, 98°00′E	Pocock 1941: 297
Mawlamyine	Moulmein	16˚30′N, 97˚38′E	BirdLife International 2001
Meelaung Chaung		17°57′N, 94°33′E	U Aung Maung verbally
	Meetan	valley of Houngdaraw, E of Mawlamyine	Thomas 1891
	Meteleo	not located; Kayin hills, hence S of 20°N	Van Rompaey 2001
Mingun	–	22°05′N, 96°00′E	via Wroughton 1915
Mogaung	–	25˚20′N, 96˚54′E	Carter 1943
Mogoke	Mogok	22°55′N, 96°30′E	BirdLife International 2001
	Mt Majed	north-east Kachin state	Eames 2005
Myeik	Mergui	12°26′N, 98°36′E	Wroughton 1916a

Current name (if known)	Old name	Locator	Source
Myitkyina	–	25˚23′N, 97˚24′E	BirdLife International 2001
Namparaw Hka	–	26°38′N, 96°35′E	U Myint Maung verbally
Namsabum	–	27°23′N, 97°34′E	GPS (TZ own data)
Nam Tamai valley	–	27˚30–54′N, 97˚30–98°02′E	Abramov *et al*. in press
	Nan	lower Chindwin	Pocock 1939: 405
	Nauhkang	26°33′N, 97°55′E	Pocock 1941: 310
Naungmung	Nogmung	27°42′N, 97°54′E	GPS (TZ own data)
	Nauswa	25°38′N, 95°22′E	Carter 1943
	Nchangyang	25°50′N, 97°48′E	Pocock 1941: 310
	Ngapun	23°58′N, 94°10′E	Wroughton 1916b
Nwalabo Taung	Mount Nwalaboo	14°05′N, 98°24′E	BirdLife International 2001
Nyetmaw Kyaung	Nyetmaw river	26°07′N, 98°33′E	Anthony 1941
Or Gyi	Telok Besar, Taninthayi	10°23′N, 98°33′E	BirdLife International 2001
	Paddaung	no directions	Thomas 1891
Pakokku	–	21°17′N, 95°08′E	Wroughton 1915
Pan Daung Kyun	Domel island	11°38′N, 98°17′E	Pocock 1939: 446
	Paungdaw	Dawei district	Tun Yin 1967: 60
Popa Taung	Mount Popa	20°56′N, 95°16′E	Wroughton 1915
Pulo Baleih	–	10°27′N, 98°29′E	U Myint Shwe verbally
	Pumsin	25°55′N, 96°15′E	Carter 1943
Putao	Fort Hertz	27°21′N, 97°24′E	BirdLife International 2001
	Pwepi	in the Chin Taung	Pocock 1941: 310
Pyaunggaung	–	22°28′N, 96°58′E	via Ryley 1914
Pyay	Prome	18°47′N, 95°15′E	standard maps
Pyin Oo Lwin	Maymyo	22°02′N, 96°28′E	BirdLife International 2001
Pyinzabu Kyun	Bentink island	11°40′N, 98°05′E	Mya Than Tun verbally
Rakhine	Arakan	19°00′N, 94°15′E	BirdLife International 2001
	Ratnampti	27°25′N, 97°47′E	Pocock 1941: 481
	Red Point	in Tanintharyi division	Pocock 1939: 448
	Ruby Mines, Mogoke	22°55′N, 96°35′E	BirdLife International 2001
Sagaing	–	21°51′N, 96°00′E	standard maps
Sai Taung	Sailung	upper Chindwin	Morris 1936
	Sakkauk stream	26°12′N, 98°26′E	per Anthony 1941: 85
	Sima	near Myitkyina	Pocock 1939: 426
Sittaung delta, 40 miles S of Bago	Sittang delta, 40 miles south of Pegu town	17°10′N, 96°58′E	BirdLife International 2001
Sittaung Valley	Sittang Valley	north of Sittaung delta	standard maps
	Suikin	near Bamaw	Pocock 1941: 332
Sumprabum	–	26°33′N, 97°54′E	Pocock 1941: 310
	Sumtsangtap	27˚40´N, 97˚54´E	Pocock 1941: 484
	Taho	Kayin hills, 8 miles N of Yado	Thomas 1891; Smith *et al*. 1940
Tamu	–	24°11′N, 94°28′E	via Wroughton 1916b
Tanai	Tanaing	26°21′N, 96°44′E	GPS (KTL own data)
	Tanga Rest House	25°46′N, 98°04′E	Anthony 1941
Taron valley	–	27˚42′N, 98˚12′E	Pocock 1941: 259
	Taungbyo reserve	22˚06′N, 96˚27′E	Pocock 1941: 285
Tawmaw	–	25°37′N, 96°18′E	Carter 1943
Tanintharyi village	Tenasserim village	12°06′N, 99°03′E	Wroughton 1916a
	Thaget	13°18′N, 98°42′E	Wroughton 1916a
Thanlwin–Ayeyarwady divide	Salween–Irrawaddy divide	near Emaw Bum	Anthony 1941
Tharyarwady	Tharawaddy	18°00′N, 95°30′E	BirdLife International 2001
	Thaton	16°55′N, 97°22′E	BirdLife International 2001
Thandaung	–	18°54′N, 96°43′E	via Fry 1929: 638
Tharyargone	Thayagon	25°57′N, 95°37′E	via Pocock 1939: 405
Thayaw-Thadangyi Kyun	Elphinstone island	12°20′N, 98°05′E	Lindsay 1926
Thayet Myo	Thayetmyo	19°19′N, 95°11′E	BirdLife International 2001
Toungoo	–	18°56′N, 96°26′E	BirdLife International 2001
Tumri Hka	–	26°19′N, 96°11′E	via Morris 1936
	Uyu forest	24°51′N, 96°00′E	via Pocock 1939: 401
Wanglingdam	–	27°28′N, 97°10′E	
	Yado	60 miles NE of Toungoo	Smith *et al*. 1940
Yangon	Rangoon	16˚47′N, 96˚10″E	BirdLife International 2001
	Yin, Rani township	22°47′N, 94°42′E	Brandon-Jones *et al*. 2004
	Zamayi Reserve	c.o. 18°08′N, 96°04′E	BirdLife International 2001

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Scent-marking by the African Civet *Civettictis civetta* in the Menagesha–Suba State Forest, Ethiopia

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Abstract

Scent-marking by African Civet *Civettictis civetta* was investigated in the Menagesha–Suba State Forest, Ethiopia, during August 2005–March 2006. A total of 77 scent-marked environmental sign-posts were located in a 300 ha area of natural forest, anthropogenic forest plantations and human settlement areas. Sign-posts such as tree stems, shrubs, herbs, grass, rocks, fences and wooden and metallic poles were scent-marked. The secretion had a species-specific odour, and was whitish yellow in colour when fresh, changing to brownish black after a couple of weeks. A large proportion of scent-markings was at 31–39 cm above ground. Most sign-posts were repeatedly marked. The frequency of marking was higher during the dry season. It seems possible to collect a good part of the secretion from the marked sites without affecting African Civets in their natural habitats, and hence to formulate methods to collect this natural renewable resource on a sustainable basis for the welfare of the local communities.

Keywords: civet musk, communication, perineal gland secretion, seasonality, sustainable harvest

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Introduction

The African Civet *Civettictis civetta* (Schreber, 1776) is well known for its perineal gland secretion, a waxy substance known as 'civet' or 'civet musk' that is used commercially as a basic ingredient in perfume industry as a fixative. The 'civet' is characterised by a pleasant odour when diluted, which is responsible for its extensive use in perfumery (Dannenfeldt 1985, cited in Ray 1995). Some mammals have highly efficient olfactory systems, enabling them to perceive signals even in low concentration (Kingdon 1977). Until the end of 1980s, African Civets were kept in large numbers in captivity for collection of 'civet' in Ethiopia and Zanzibar, which constituted major export sources into the international market (Ray 1995). Recently, synthetic musk has been developed, but has not fully replaced the natural 'civet'; most is exported from Ethiopia (Ray 1995). As the demand for civet musk in the perfume industry is growing, production can enhance the economic development of the local communities involved in African Civet farming (EWCO 1999).

Both sexes of African Civet possess perineal glands (slightly larger in males than in females), the secretion of which is used for scent-marking through pressing and rubbing the perineal glandular region against environmental sign-posts such as tree-bases, shrubs, herbs and stones (see Sreedevi 2001). Civets defaecate in special dung piles called 'civetries'. Civetries are normally less than 0.5 m² in area, and are located at territorial boundaries, serving as contact zone between neighbours (Nowak 1999).

'Civet' is used in traditional medicinal practices in Ethiopia, especially for ailments such as headaches, skin discoloration and skin infections, by topical application. In addition to these, a small amount of the musk is taken with coffee as a traditional treatment for cancer (Jemal Mohammed 1999, Yilma Delelegn 2000, Bultuma Qenno & Bekele Tsegaye 2004). Similarly, some of the indigenous communities in India use the perineal gland secretion of the Small Indian Civet *Viverricula indica* in tribal medicine (Sreedevi 2001), particularly to treat respiratory ailments and skin infections (Balakrishnan & Sreedevi 2007a), in addition to its constant use in Ayurveda drugs, a traditional Indian system of medicine (Balakrishnan 2000). It is also used in traditional incense stick preparations, for flavouring tobacco and as an aphrodisiac (Xavier 1994).

The present investigation was to study the behaviour of the African Civet with special reference to the scent-marking in the Menagesha–Suba State Forest, Oromia region, Ethiopia.

Study Area and Methods

The Menagesha–Suba Man-made and Natural Forest Conservation and Development Centre is located 45 km west of Addis Ababa. The centre extends along the range of the north-western and south-western escarpments of Wachacha Mountain, within 08°54′–09°04′N, 38°30′–39′E (Fig. 1). The forest area is part of the central plateau comprising natural forests of about 2,500 ha and a plantation area of 3,350 ha. The natural forest is undifferentiated Afromontane forest, mainly *Juniperus–Podocarpus–Olea*.

The annual rainfall is around 1,500 mm with the major pre-

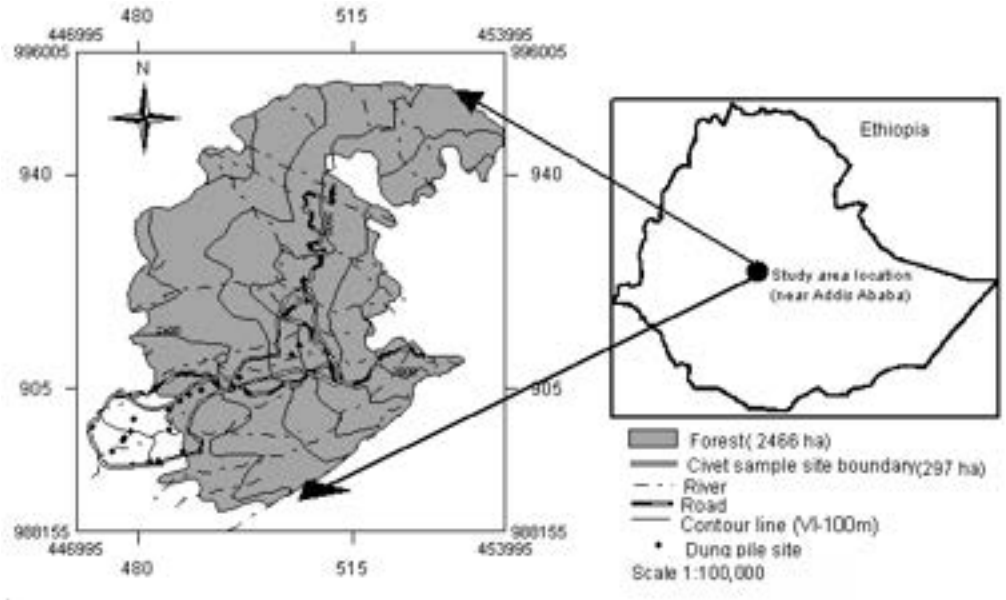

Fig. 1. Map of the Menagesha–Suba State Forest in Ethiopia and the sites of the present investigation.

cipitation during June–September. However, this area may get rain in any month. The mean temperature is 16°C with a maximum of 22.5°C and minimum of 9.5°C. In the forest, the average temperature is 11°C in the upper parts. Frost is common on the mountain outside the forest. The hottest months are May and June, while the coldest months are December and January.

The vegetation of the area was characterised by Elisabeth (1970). The natural forest is dominated by the African Pencil-cedar (African Juniper) *Juniperus procera*, with an open canopy. The biggest trees are over 50 m tall with a single trunk having diameter up to 2 m at breast height. Other big trees are African Podo *Podocarpus falcatus* and Red Stinkwood or Ironwood *Prunus africana*. Big trees of these species are few in number, but many seedlings and saplings are found in the lower parts of the forest, particularly in the plantation area. Young trees of *Hagenia abyssinica* with its soft leaves and hanging bunches of small red flowers are found around the state forest office, and in the higher altitudinal areas. The smaller trees of the main forest include *Olea europaea* subsp. *cuspidata*, *Allophylus abyssinicus*, *Euphorbia ampliphylla*, *Teclea nobilis*, *Nuxia congesta*, *Bersama abyssinica*, *Measa lanceolata*, *Myrsine africana*, *Rhus ruspolii*, *Rubus apetalus*, *Calpurina aurea*, *Carissa spinarum* and *Dovyalis abyssinica.* There are also many shrubs. Two giant herbs of the forest, *Lobelia gibberoa* and *Solanecio gigas* are found on the steep slopes of the valley. In March and April, the forest floor becomes carpeted with balls of red flowers of *Scadoxus multiflorus*.

At higher altitude, where the soil is thin, the *Juniperus* trees are short, mixed with several other small trees and bushes. Some of the more common species are *Erica arborea*, *Rosa abyssinica*, *Hypericum revolutum*, the endemic *Jasminum stans*, and the small trees *Myrsine melanophloeos*, *Ilex mitis* and *Maytenus gracilipes.* The herbs include *Helichrysum* spp. The closely grazed turf is mixed with *Trifolium* spp., *Thymus* spp. and other small herbs. Forest plantations at various altitudes consist mainly of *Juniperus procera*, *Cupressus lusitanica*, *Pinus patula*, *Pinus radiata* and *Eucalyptus* spp.

Methods

Menagesha–Suba State Forest was selected as the study area after a preliminary study carried out in February 2005 using indirect and direct methods (see Sutherland 1996). As stated by Estes (1991) and Kingdon (1997), African Civets have civetries, where they defaecate. According to Randall (1979) and Hutchings & White (2000), African Civets scent-mark their territories and objects around civetries and movement routes.

Civetries and scent-marked environmental sign-posts were searched and located in a 300 ha intensive study area. The observed civetries were numbered from 1 to 34. Each site was visited on alternate days. Direct observations at civetries were made during night using a night-vision scope. Each site was visited daily at least for 15 days per month. Detailed observations were made during August, September and October (2005) (wet season) and November and December (2005) and January and March (2006) (dry season). The objects that were scent-marked, the nature of marking, path of marking and the colour change of the musk were recorded. Data collection also included the girth and height of the objects at which scent marks were laid. In case of plants, the species were identified. The glandular secretion was removed from some of the sign-posts to examine whether the Civets scent-mark such sites again or abandon such sign-posts.

Results

Scent markings were recorded mainly around civetries, forest tracks and roads, and around human settlements. They were located in several places on sign-posts such as tree stems (Fig. 2), shrubs, herbs, grass, stones (rocks), fences (Fig. 3) and on wooden and metallic poles. They preferred to mark on smooth-surfaced vertically standing objects (Table 1). Scent marking on environmental sign-posts was more concentrated on road-sides especially around the Suba village. Thorny stems were not scent-marked in the present study area; however, *Juniperus procera* was frequently marked. Most objects were scent-marked repeatedly, a few only occasionally. Fresh markings were whitish in colour, changing to brownish black in a couple of weeks. They were butter-like in the beginning, but became stiffer in texture. The glandular secretion collected from the scent-marked sites had a species-specific odour detectable by the human nose.

The girth of plants at the marking height ranged from 0.1 to 98 cm with the mean of 70 cm (Table 1). The height from the ground at which scent-markings were seen ranged from 26 to 42

Fig. 2. Perineal gland secretion of African Civet at the base of a Pinus patula *tree in the study area. Note the thick and rough nature of the bark on which the animal has scent-marked.*

Fig. 3. Scent-marking site on a fencing stump with smooth surface in human settlement area in Suba village. The secretion adhered on the surface of the sign-post is shown with a pointer.

cm with a mean of 35 cm. A large proportion of scent-markings was at 31–39 cm high. Scent-markings were observed more in areas near human settlements and around civetries. During the dry season, scent-marking sites were observed frequently on several plants around the dung piles as well as in village areas and roadsides. More fresh scent-markings were observed during the dry season than during the wet season (Table 2), with a significant seasonal difference ($\chi^2 = 8.12$, df = 1, $P < 0.10$). Scent-marking sites in the forest area also seemed more during the dry than the wet season.

Civets were observed to re-mark the sites from where the glandular secretion was removed. It was not established whether removing the civet musk stimulated an increase in the frequency of scent-marking (re-marking). No obvious difference was observed in the frequency of marking sites from where the secretion was removed and from where it was not, but this was not tested specifically.

Discussion

African Civets are known to scent-mark environmental sign-posts along established routes with perineal gland secretions (Kingdon 1977). Trees and shrubs that bear fruits eaten by Civets are frequently scent-marked. Grasses, dry logs and rocks are also used as sign-posts for scent-marking by African and Small Indian Civets (Randall 1979, Hutchings & White 2000, Sreedevi 2001). Scents are often overlaid by others passing through the same way, indicating that the scent may provide olfactory information such as

Table 1. Details of plant species and other environmental sign-posts that African Civets used for scent marking in the Menagesha–Suba State Forest and nearby areas (N – number of observations).

Scent-marked plants/objects	*N*	Percentage	Height (cm) of marking	Girth (cm) at the height of marking
Acacia abyssinica	3	3.9	41, 31, 32	97, 43, 60
Acacia decurrens	2	2.6	33, 39	11, 26
Brucea antidysentrica	3	3.9	39, 32, 30	6, 7, 4
Carissa spinarum	3	3.9	31, 34, 37	7, 3, 5
Casuarina cunninghamiana	7	3.9	40, 39, 27, 31, 38, 41, 37	63, 85, 98, 21, 10, 66, 93
Cupressus lusitanica	9	11.7	39, 41, 37, 31, 30, 40, 37, 33, 35	17, 37, 20, 90, 87, 76, 63, 85, 77
Eucalyptus spp.	6	7.8	28, 39, 33, 36, 40, 38	38, 70, 83, 15, 11, 14
Juniperus procera	11	14.3	40, 37, 38, 42, 41, 35, 34, 35, 38, 40, 39	94, 82, 40, 59, 67, 71, 88, 69, 56, 80, 81
Maytenus spp.	2	2.6	31, 36	3, 7
Myrsine melanophloeos	7	9.1	33, 36, 31, 36, 30, 36, 36	4, 7, 4, 5, 6, 3, 7
Olea europaea subsp. *cuspidata*	2	2.6	29, 37	8, 5
Pennisetum schimperi	2	2.6	28, 36	0.1, 0.1
Podocarpus falcatus	2	2.6	39, 35	85, 16
Pinus radiata	4	5.2	35, 31, 38, 41	20, 37, 80, 66
Pinus patula	3	3.9	41, 36, 37	97, 40, 56
Prunus africana	4	5.2	32, 36, 35, 34	6, 16, 9, 8
Metallic pole	3	3.9	39, 35, 35	32, 32, 32
Stump	3	3.9	38, 37, 34	77, 60, 76
Rock or stone	1	1.3	26	20

Table 2. Number of scent marks of African Civets observed during wet and dry seasons in the Menagesha–Suba State Forest and nearby areas (N – number of markings observed).

Season	Month	*N*	Mean/month
Wet	August	3	5.3
	September	5	
	October	8	
Dry	November	10	15.2
	December	15	
	January	17	
	February	19	

sexual and individual status (Kingdon 1977). Sign-posts are repeatedly marked by pressing and rubbing the glandular area. An earlier study revealed that African Civet markings were almost exclusively along roads (Randall 1979). The present investigation revealed that the sign-posts close to civetries were marked more frequently than were similar objects away from civetries. Scent marking along roads and near civetries could be attributed to the efficient transmission of communication signals related to territorial and reproductive activities, because these are places where Civets are likely to traverse or visit. Most scent marks of African Civets faced along the road, with none being orientated more than 90° away (Randall 1979). Olfactory signals would be more effective at higher rate of diffusion (although this would require more frequent re-marking by the animal) and at closer range. When the signals are laid facing pathways, they would be more efficiently perceived by individuals of the same species during transit (Alberts 1992).

It was not easy to collect all the glandular secretion from the marked sites. Hence, the amount of musk used for scent-marking at a time was difficult to determine. Results of the present study have also revealed that African Civets reinforce scent-markings by repeated markings at the same site, as reported earlier (Randall 1979). The effectiveness of the scent to persist for long duration makes it unnecessary to mark repeatedly at short intervals. This would help Civets to scent-mark on more environmental sign-posts within their areas of movement.

The primary environmental factors, which affect spatial and temporal parameters of chemical signals in terrestrial habitats are temperature, humidity and wind (Alberts 1992). There were more sites of scent-marking during the dry season than during the wet season. This can be associated with the effect of temperature on the secretary output of the gland. Because the molecular weight of highly volatile compounds is low, the rates of evaporation and diffusion are fast, particularly during the summer months. This also makes it necessary for Civets to mark the sites repeatedly during the summer months, to maintain sign-posts.

There are various plant species and types that are found to be scent-marked by the African Civets. More marking on *Juniperus procera* may not be due to specificity for that species, but could simply reflect the high density of this tree in the forest plantation. Civets have no preference to the size of the plant for scent-marking. Scent-marking was seen on a variety of large trees, shrubs, herbs and grasses, as observed by Randall (1979). Use of smooth-surfaced objects may avoid injury to glandular areas whilst they press and rub the sign-posts during scent-marking, but during the present observations, hairy stems and hard rough-barked stems were also found marked.

The marking height might allow inference of the height of the Civet, to allow rough estimation of the age. Lower markings could be of young and sub-adults, but there is no direct evidence of this. A signalling animal can influence the signal's range by varying the height at which signals are emitted (Alberts 1992). The highest and lowest heights may also be due to the bending of slender stems while the Civets press to mark the plant.

Ethiopia is known for extraction and export of African Civets' perineal gland secretion since time immemorial. Such activities are common in the western, south-western and southern parts of the country. However, the local community around the Menagesha–Suba State Forest has no experience of keeping Civets in captivity and collecting the 'civet', despite the presence of good number of them locally. 'Civet' is a natural wildlife resource, but for it to provide long-term benefit, it is the responsibility of the government and of concerned institutions to introduce sustainable systems without affecting the natural Civet populations. With no Civet farms in this study area, the glandular secretion can be collected by establishing a scientifically oriented model farm in the area, and/or by collection of the secretion from the natural markings of Civets in the habitat.

Sustainable use of the African Civet could be a good foreign exchange earner for Ethiopia and support the livelihood of the surrounding community. The government and the concerned institutions and NGOs can initiate this activity and train suitable individuals among the local community. Use of modern traps and cages, health care services, proper feeding, extraction of musk without disturbing the animal and captive breeding are essential components under such a model Civet farm.

The observation that the Civets re-mark the sign-posts from where the glandular secretion was experimentally removed shows that they do not abandon their scent-marking sites in response to human intrusion and activities. It might therefore be possible to extract the Civet musk constantly from such marked sites. However, the increased frequency of re-marking may be problematic for the Civet, if production of 'civet' is energetically or otherwise demanding. Hence, further studies are needed before assuming that wild collection of 'civet' could be carried out without detrimental effects to Civets.

WSPA (2000) urged consumers not to buy products containing natural Civet musk, given the deplorable conditions of the captive Civets in Ethiopia. Balakrishnan & Sreedevi (2007a) suggested that alternative means be developed by which this excellent resource, renewable if managed on a scientific basis, can support rural livelihoods in the poorer regions of the world. In response to the criticism against Civet farming practice (Pugh 1998, WSPA 2000), the Ethiopian Wildlife Conservation Department has initiated programmes to revive Civet farming by permitting trapping only of male Civets from the wild and by providing nominal incentives to the farmers through the supply of cages at a subsidised rate. The decision to issue permits to trap only male Civets shows that the government agency is yet to consider developing breeding colonies for sustainable 'civet' production in Ethiopia. In the absence of captive breeding colonies, the free ranging wild populations of the African Civets will continue to be under stress. Farming and handling methods can be improved through awareness creation. The biological and socio-economic dimensions of this practice need to be assessed. Improving the well-being of the local people and ecosystems are logical goals in this regard. The Civet industry should sustain, without depleting or negatively af-

fecting, the animal and the ecosystem. Another potential way of Civet use is harbouring Civets in large semi-natural enclosures and collecting musk from the marked sign-posts in the habitat (see Balakrishnan & Sreedevi 2007b). The findings of the present investigation suggest that Civet musk could be collected with minimal trouble to Civets in their natural habitat and without keeping them in captivity.

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ANNOUNCEMENT

Electronic archive of *Small Carnivore Conservation*

In keeping with modern trends in publishing and access to international journals on the internet, papers published in *Small Carnivore Conservation* will soon be made available electronically on a dedicated website. Papers from back issues will soon be available for free download at the website address: *http://journal.smallcarnivores.org* as Adobe PDF files. We believe that this will make the information available more widely and hence have a greater impact on conservation.

The files may be freely used for reference and to further research and conservation of small carnivores by all interested individuals and institutions. Except for the addition of a citation on the first page, all files are exactly as printed and can therefore be cited to the correct year, volume and page numbers of the paper edition. This is necessarily a slow process and we are very grateful to Guido Smit of X-oc, Borgerhout, Belgium, who undertook the layout when the journal was printed in Belgium, for his assistance.

Civets in trade in Medan, North Sumatra, Indonesia (1997–2001) with notes on legal protection

Chris R. SHEPHERD

Abstract

During wildlife market surveys carried out in North Sumatra, Indonesia, between 1997 and 2001, three species of civets were observed in trade, including Common Palm Civet *Paradoxurus hermaphroditus*, Masked Palm Civet *Paguma larvata* and Small-toothed Palm Civet *Arctogalidia trivirgata*. No harvest quotas are allotted to the latter two species in Indonesia and therefore trade of these is considered illegal. Very little is known of the extent of the trade in civets in Indonesia, or of the impact trade may have on wild populations. This report calls for increased monitoring of the wildlife trade and increased enforcement of wildlife trade regulations. Further research to be carried out on civets and their status in Indonesia is also recommended.

Keywords: CITES, harvest quotas, legal protection, Viverridae, wildlife trade

Abstrak

Selama survei-survei pasar perdagangan satwa liar di Sumatra Utara yang dilakukan dari tahun 1997 sampai tahun 2001, ditemukan tiga jenis musang yang diperdagangkan, yaitu Musang Luwak *Paradoxurus hermaphroditus*, Musang Galing *Paguma larvata* and Musang Akar *Arctogalidia trivirgata.* Kuota penangkapan belum ditetapkan untuk kedua jenis terakhir. Oleh karena itu perdagangan jenis ini merupakan kegiatan illegal. Belum ada banyak informasi mengenai perdagangan jenis-jenis musang di Indonesia dan belum diketahui dampak dari perdagangan ini terhadap populasi liar. Melalui laporan/kajian ini kami mengusulkan peningkatan pemantauan terhadap perdagangan satwa liar dan peningkatan penerapan aturan-aturan yang mengatur perdagangan satwa liar. Dianjurkan pula penelitian yang lebih mendalam terhadap jenis-jenis musang dan statusnya di Indonesia.

Kata kunci: CITES, musang, Indonesia, Viverridae, perdagangan satwa liar

Introduction

Indonesia is home to 11 species of civets (family Viverridae *sensu lato*), ten of which are found on the island of Sumatra and its associated outlying islands (Corbet & Hill 1992). During surveys carried out in wildlife markets (usually referred to locally as 'bird markets' due to the predominance of caged birds on sale) in Sumatra's largest city, Medan, between 1997 and 2001, civets were frequently observed for sale. Very little is known of the status of civets in Indonesia (Schreiber *et al*. 1989, Holden 2006), or of the impact trade has on these species.

Civets are generally regarded as pests in Indonesia, because they are seen as a threat to orchard fruits and poultry and are often killed on sight, or captured (e.g. Schneider 1905, Van Strien 1982: 104–106, Melisch *et al*. 1993). Captured civets, like many small species of vertebrates in Indonesia, are often taken to local bird markets for sale. Young civets are popular as novelty pets, and are more frequently observed in the markets than are adults.

Only three species of civets are totally protected by national legislation in Indonesia: the Binturong *Arctictis binturong*, Otter Civet *Cynogale bennettii* and Sulawesi Palm Civet *Macrogalidia musschenbroekii*. The remaining eight species are not totally protected, and therefore may be traded domestically or internationally, following a harvest and export quota system. According to Indonesian regulations, only 10% of the entire legal harvest quota may be used domestically, with the remainder of the harvested volume permitted to be exported (Shepherd *et al.* 2004, Shepherd 2006).

The Decree of the Ministry of Forestry No. 447/Kpts-11/2003 (revised from Decree of the Ministry of Forestry No. 62/Ktps-II/1998) requires any harvest or capture and distribution of wild plant and animal specimens to be done under a licence. Sending or transporting wildlife from one location to another within Indonesia must be covered by legal documents, according to Article 42, Chapter X of the Regulations of the Government of the Republic of Indonesia Number 8 (1999), whether the species is protected by law or not. Collectors and suppliers (or middlemen) must be registered with regional offices for the Natural Resources Conservation Agency (BKSDA), the agency under the Directorate General of Forest Protection and Nature Conservation (PHKA, the Indonesian Management Authority of the Convention on International Trade in Endangered Species of Wild Fauna and Flora [CITES]) responsible for the regulation of wildlife trade at the provincial level (Siswomartono 1998).

Quotas are set on an annual basis for all non-protected species, including species listed in the Appendices of CITES and those not there listed. Only two of Indonesia's viverrid species are listed in the Appendices of CITES, Banded Civet *Hemigalus derbyanus* and Banded Linsang *Prionodon linsang*, both in Appendix II (see Table 1). The quota-setting process is conducted annually, via a meeting of various stakeholders including PHKA, and the Indonesian Institute of Sciences (LIPI, the CITES Scientific Authority), relevant non-government organisations and licensed wildlife traders. The quotas are reported by PHKA to the CITES Secretariat at the beginning of each year. CITES requires science-based assessments, known as 'non-detriment findings', to be carried out prior to the export of a CITES-listed species. These can be undertaken by the authorities themselves, which sometimes rely on collaboration with non-governmental organisations and research institutions. However, such studies are currently not being carried out in any robust fashion prior to the quotas being set and therefore there is no accurate baseline information from which to gauge levels of

Table 1. Status of viverrid species in Indonesia.

Species	Presence on Sumatra	IUCN Red List status 2007	Totally Protected in Indonesia	CITES Appendices	Annual national harvest quota	Legal export quota
Arctictis binturong	Yes	LC	Yes	NA	0	0
Arctogalidia trivirgata	Yes	LC	No	NA	0	0
Cynogale bennettii	Yes	EN	Yes	NA	0	0
Hemigalus derbyanus	Yes	LC	No	II	0	0
Macrogalidia musschenbroekii	No	VU	Yes	NA	0	0
Paguma larvata	Yes	LC	No	NA	0	0
Paradoxurus hermaphroditus	Yes	LC	No	NA	200	180
*Paradoxurus lignicolor**	Yes (Mentawai Islands only)	Not assessed	No	NA	0	0
Prionodon linsang	Yes	LC	No	II	0	0
Viverra tangalunga	Yes	LC	No	NA	100	90
Viverricula indica	Unclear	LC	No	NA	100	90

*Sometimes treated as a subspecies *P. hermaphroditus lignicolor;* IUCN Red List Categories: LC – Least Concern, VU – Vulnerable, EN – Endangered; CITES Appendices: NA – Not listed.

sustainable off-take. Furthermore, the harvest and export limits are not adequately monitored or enforced (Shepherd 2006).

All wildlife traders in Indonesia must be registered with PHKA. Anyone not registered is not permitted to harvest and trade wildlife. National harvest quotas are divided by province, with a limited amount being allowed from each designated area (Table 2). Wildlife cannot be harvested legally from a province that has no allotted quota. If an exporter does not finish the allotted quota in a calendar year, it is forfeited; and the remaining volume that was not realised cannot normally be added to the following year's quota.

Only three civet species, Common Palm Civet *Paradoxurus hermaphroditus*, Small Indian Civet *Viverricula indica* (sometimes referred to by its former name *V. malaccensis*, as in the 2007 quota) and Malay Civet *Viverra tangalunga* have allotted quotas in Indonesia (Table 2), meaning that it is prohibited to capture or trade in any of the other species. Furthermore, the capture of those species that are permitted in trade outside the designated localities is also illegal. Table 2 gives all allotted localities where harvest of civets may take place and the total numbers allowed for harvest and export each year (the Ministry of Forestry, Republic of Indonesia: http://www.dephut.go.id).

Very little is known of the trade in civets and other small carnivores in Indonesia. The purpose of this paper it to provide some insight into the trade of these species in bird markets in Indonesia, but more importantly to highlight the fact that the trade in these species is very often carried out in violation of wildlife trade and conservation regulations.

Table 2. Annual harvest and export quotas for civets from designated locations in Indonesia (2006).

Species	Harvest quota Location	Total	Annual export quota
Malay Civet	South Sumatra	100	90
Small Indian Civet	South Sumatra	100	90
Common Palm Civet	West Java	50	180
	Central Java	50	
	Lampung	50	
	North Sumatra	50	
Total		400	360

Source: Ministry of Forestry, Republic of Indonesia, 2007

Methods

The three largest bird markets in Medan, Jalan Bintang, Petisah and Sembahe, were surveyed on a monthly basis over a five-year period (1997–2001), with species present and the quantities of each recorded. Information was gathered from dealers regarding the origins of the species and purposes for trade. Because surveys were carried out only once a month, it is impossible to gauge the rate of turnover in the markets, and the numbers recorded should be considered a conservative estimate. Additional information was compiled from published and unpublished literature, and from government regulations and laws.

Observations

During monthly surveys in 1997–2001, three species of civets were observed (Table 3), including Common Palm Civet, Masked Palm Civet *Paguma larvata* and Small-toothed Palm Civet *Arctogalidia trivirgata*. Assuming that none of the civets were in the market for more than a month (dealers claimed that turnover was rapid), a total of 270 civets was observed in the three main bird markets of Medan during this study. Common Palm Civet was the most frequently available species, with a total of 264 individuals observed over this five-year period. Fewer of the other species were observed: only nine Masked Palm Civets and six Small-toothed Palm Civets.

Discussion

While none of these three civets is listed as protected species in Indonesia, there are no harvest quotas for Masked Palm Civet or Small-toothed Palm Civet, and therefore there should be no trade. Of the protected species, dealers stated that Binturong was sometimes available, but had no knowledge of Otter Civet or Sulawesi Palm Civet, which last is endemic to Sulawesi. Dealers acknowledged that they did not have permits to trade in civets, and transit permits were not used. Furthermore, dealers were not aware that quotas were in place and should be adhered to for Common Palm Civet. As a result, all observed trade in civets from the markets of Medan was illegal. These observations highlight the lack of effort regarding monitoring, regulation, and enforcement by the authorities in North Sumatra, and often an ignorance of or a bla-

Table 3. Observations of civets in trade in Medan, North Sumatra, 1997-2001.

Year	Common Palm Civet	Masked Palm Civet	Small-toothed Palm Civet	Total
1997	60	2	0	62
1998	33	5	2	40
1999	66	1	2	69
2000	52	0	2	54
2001	53	1	0	54
Total	264	9	6	279

tant disregard for legislation by the dealers. The Government of Indonesia should be encouraged to ensure that the wildlife traders are aware of the annual quotas and to take action against wildlife traders failing to abide by legislation pertaining to harvest, possession, and trade by carrying out arrests and prosecutions which entail sufficient penalties to establish deterrents against future or repeat offences. While none of the three species observed in trade during this study is immediately threatened with extinction, it is clear that little is known of the trade and the potential impacts on wild populations. Further research is required to assess the impact of trade on the conservation status of Indonesia's civets.

Of further concern is the fact that Indonesia has allotted a quota for Small Indian Civet in South Sumatra, whereas the status of this species in Sumatra is uncertain. It is known on the island only from a few records from North Sumatra and there are no published records from southern Sumatra (W. Duckworth *in litt*. 2007), although the harvest and export quota restricts harvest in Indonesia to South Sumatra. Because the status of this species on Sumatra is vague, a zero quota for this species should be implemented immediately until further studies have been carried out.

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ANNOUNCEMENT

Fourth Brazilian Mammal Congress

18 – 22 August 2008, São Lourenço, Minas Gerais

The organizing committee of the Fourth Brazilian Mammal Congress would like to announce that, owing to logistical reasons, the date and venue of the Congress have changed. The Congress will be held during 18-22 August 2008, in Hotel Guanabara in the city of São Lourenço, Minas Gerais. Registration forms and more information may be found at the congress website: http://www.sbmz.org/cbmz2008. Owing to the increase in the number of participants in recent congresses of the SBMz, this year the congress registration will be limited to 900 participants. The prior congress, held in 2005 in Aracruz, Espírito Santo, had 723 participants, and the 1st South American Congress, held in 2007 in Gramado, Rio Grande do Sul, had nearly 900. An equal or greater number of participants are expected for the Fourth Congress in São Lourenço in 2008. Participants who are current members of the SBMz will receive a discount on registration for the congress.

Organizing Committee: Dr. Marcus Vinicius Vieira (SBMz President), Dr. Helena Bergallo (Vice-President), Dr. Carlos Eduardo de Viveiros Grelle, Dr. Leonardo dos Santos Avilla, Ms. Natalie Olifiers.

Behavioural notes on mongoose species from Central India

Kolipaka S. SHEKHAR

Foraging and vigilance of Ruddy Mongooses

Two Ruddy Mongooses *Herpestes smithii* were spotted at a distance of about 50 m at 16h05 on 29 November 2007 in a dry, rocky, open patch of forest at Panna National Park, Madhya Pradesh (24°47′N, 80°08′E). They were very close to a troop of Hanuman Langurs *Semnopithecus entellus* that sat in the shadows of acacia trees. The mongooses were looking under rocks, around the trunks of trees and on the forest floor for things of interest. Their presence did not seem to bother the monkeys. One mongoose discovered a moth lying on a rock and chased the insect while it flew. It jumped into the air to reach the airborne insect and ran after it in quick bursts of speed, but the moth managed to raise itself out of reach of the mongoose. The two mongooses split up and foraged in different areas 15–25 feet apart, but did not let the distance between them grow. They communicated constantly with each other while searching the forest floor. One mongoose used its muzzle as a probe to inspect under rocks and its front feet to turn the rocks over for inspection. This search disturbed a cricket which jumped into the air. The mongoose quickly ran after it, keeping its tail above the ground. It caught the insect with its mouth as it landed on the ground, with the aid of its forefeet it bit the cricket quickly and swallowed it. It then immediately moved towards the second mongoose ,looking for other potential prey. At about 16h35 the langurs uttered a single warning call, a low note which sounded more like a spit. Both mongooses assumed an attentive position on their hind feet, scanning the areas for potential danger. A Golden Jackal *Canis aureus* trotted into the area and the mongooses immediately fled into an area of thick vegetation and rocks.

Meeting of Grey Mongoose and Golden Jackal

While walking through a thickly vegetated forest path in Panna National Park on 12 August 2007 at 15h00 I heard a rustle in the vegetation. A Golden Jackal *Canis aureus* emerged and stood by a termite mound about 15 m from me. It looked around, into the canopy, and steadily explored the mound using its long muzzle and front paws. Another small rustle then startled both the jackal and me. The jackal froze and kept looking towards the sound. An adult Grey Mongoose *Herpestes edwardsii* walked out of the vegetation and appeared exactly in front of, and three feet from, the jackal. Neither jackal nor mongoose seemed surprised by the other's presence. The mongoose inched towards a fallen tree, climbed up a branch to the jackal's eye level. The jackal slowly moved to within a foot of the mongoose. Each sniffed the other's muzzle, without physical contact. The mongoose then descended and disappeared into the vegetation, followed after a few seconds by the jackal. Neither animal appeared in any way defensive towards the other.

Excellent swimming ability of Grey Mongoose

Bare rock islands form in the Ken River (Panna district, Madhya Pradesh; 24°44′N, 80°00′E) when water recedes after the monsoon. Mongoose tracks have been noted in the soft sands around the islands. Mongooses are known to eat river invertebrates like crabs and snails and were also seen feeding on the abundant dung beetles (Scarabaeidae). On 12 October 2007 at 15h50 a Grey Mongoose was sighted, foraging among rocks of a small island. The mongoose then checked around the rocks for a place to exit. It then dived into the water and, to our surprise, swam nearly 200 m to the shore. The mongoose moved swiftly and swam along the current. It kept its head high above the water throughout the swim and its tail moved in synchrony with its body. At the shore it moved towards cover instantly and while in motion wriggled its body a couple of times, apparently an attempt to shed water from its soaked body.

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Grey Mongoose swimming in Ken River, Central India (Photos courtesy: Karan Rana).

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Indian Grey Mongoose *Herpestes edwardsii* (Photo: Kalyan Varma)

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