Small Carnivore Conservation

The Journal of the IUCN/SSC
Small Carnivore Specialist Group

Volume 45 December 2011

Juvenile Eastern Falanouc *Eupleres goudotii* (Photo: A. Ravoahangy)

EDITORIAL

Recent changes in *Small Carnivore Conservation*

We have made a couple of recent changes in the dissemination of *Small Carnivore Conservation*. The first is that beginning with this issue (Volume 45), we will make *Small Carnivore Conservation* available online immediately after publication. You will find on our website (see http://www.smallcarnivoreconservation.org/scc/Recent_issues) that articles from Volumes 36 to 44 (i.e. the most recent issue, of June 2011) are available as individual pdf files for download. This volume, and subsequent ones, will be added there at the same time as the printed copies are sent by post. This change is to make the journal freely and fully accessible to all who share interest in small carnivores. As before, Volumes 1–35 remain available online as pdf documents.

The second change is that printed copies of future volumes of *Small Carnivore Conservation* will be sent only to individuals and institutions with paid subscriptions and others who have made arrangements with the Editorial Board. A secondary purpose of our decision for rapid online publication was to address the continually increasing costs of printing and mailing the journal. We have received generous support for publication of *Small Carnivore Conservation* from several organisations over the last few years, most notably Columbus Zoo, Conservation International, Newquay Zoo and Smithsonian Institution. However, with financial markets and economies as they are, we cannot expect this generosity to continue indefinitely. The end result is we can no longer afford to send complimentary copies of the journal to many members of the Small Carnivore Specialist Group (SCSG) and various institutions as we have done previously. Each SCSG member and institution sent Volume 44 of *Small Carnivore Conservation* also received a letter to this effect. Current subscriptions costs are €33 (US$45) for one year or €90 (US$135) for three years. We would welcome members to sponsor subscriptions of people you know who would be interested to receive a copy of this journal.

As you will have noted from recent volumes, the number of contributions to *Small Carnivore Conservation* has increased considerably. Overall, the number of pages printed annually has increased about 60% since 2008, relative to pages printed during 2005–2007. The increased interest in publishing in *Small Carnivore Conservation* is strongly beneficial to understanding conservation status and needs, so we encourage you to submit additional manuscripts on any and all aspects of the study of small carnivores. As always, we thank the reviewers and the members of the editorial board for their contributions in making *Small Carnivore Conservation* possible.

— *The editors*

Notes on the carnivores of Tsitongambarika Forest, Madagascar, including the behaviour of a juvenile Eastern Falanouc *Eupleres goudotii*

Andriamandranto RAVOAHANGY[1], Bruno Andriandraotomalaza RAVELOSON[1], Voninavoko Maminandrasana RAMINOARISOA[1], and Roger SAFFORD[2]

Abstract

A juvenile Eastern Falanouc *Eupleres goudotii* found resting 2 m up a tree in Tsitongambarika Forest Protected Area, southeast Madagascar, is the first observation of the species climbing in the wild, corroborating behaviour previously known only in captivity. The record, with photographs, also provides new documentation on what is presumed to be the undescribed appearance of the juvenile of this species. The little-known Broad-striped Vontsira *Galidictis fasciata,* as well as Ring-tailed Vontsira *Galidia elegans*, Spotted Fanaloka *Fossa fossana* and Small Indian Civet *Viverricula indica*, were also recorded from this area; Fossa *Cryptoprocta ferox* was reported by local people.

Keywords: *Cryptoprocta ferox*, *Fossa fossana*, *Galidia elegans*, *Galidictis fasciata*, lowland forest, *Viverricula indica*

Fanamarihana momba ny Carnivora-n'ny Tsitongambarika, Madagasikara, mampiseho fitondrantenan'ny zanaka *Eupleres goudotii*

Famintinana

Zanaka *Eupleres goudotii* iray no hita natory tambony hazo sahabo ho 2 m tao anaty alan'i Tsitongambarika, Faritra Arovana Vaovao ao Atsimo Atsinanan'i Madagasikara. Ity no fotoana nahamarihana voalohany fa mihanika hazo ity karazana Carnivora ity. Ny fihetsiny sy ny sariny dia maneho fomba amampanao mbola tsy fahita mikasika ny maha-tanora ilay biby. Voamarika nandritra ny fitsirihana natao koa ny fisian'ny Vontsira fotsy *Galidictis fasciata*, Vontsira *Galidia elegans, Fossa fossana* ary Jaboady *Viverricula indica*; Ny olona any an-toerana dia manamafy fisian'ny Fosa *Cryptoprocta fero*x.

Teny fanalahidy: Ala mando ambanin'ny 800 m, *Cryptoprocta ferox*, *Fossa fossana*, *Galidia elegans*, *Galidictis fasciata*, *Viverricula indica*

Introduction

Madagascar was ranked as the most important priority area in the world for the conservation of small carnivores by Schreiber *et al*. (1989), but the conservation status of most of its species (all native ones are endemic) remains poorly known. Tsitongambarika Forest is a newly created protected area in extreme southeastern Madagascar (Fig. 1). Situated on the Vohimena mountain ridge, it includes one of the biggest areas of surviving lowland humid forest in Madagascar; in the southern half of the island, this forest-type is particularly rare. The protected area covers 605 km^2, within 24°45'–25°00'S and 46°57'–47°22'E. Major threats to the forest are slash-and-burn agriculture, illegal logging and uncontrolled fire, resulting in a deforestation rate of around 1.74% between 2000 and 2005 (Andriamasimanana 2008). All small carnivoran mammals (that is, excluding the relatively large Fosa *Cryptoprocta ferox*) are hunted using traps made locally with tree trunks and rope, a practice that appears to have declined significantly since protection of this area.

Survey of Tsitongambarika's flora and fauna is so far limited, although BirdLife International (2011) summarised information on flora, reptiles, amphibians, lemurs, birds and ants collected since 2005. Other taxa remain to be surveyed thoroughly, but some information on them was collected incidentally during recent fieldwork. These include reports of six carnivore species described here. Four were seen and photographed by team members from Asity Madagascar, a national non-governmental organisation working for conservation, one was seen but not photographed and a sixth was reported by a local informant who we consider a credible observer. The information was gathered during ecological monitoring for a 'direct payments' programme for biodiversity conservation (within which the monitoring is done by the communities but validated by Asity Madagascar) active in Tsitongambarika Forest since 2006. Twice a year, multidisciplinary teams survey for at least five days and five nights per site. Surveys began at two sites (2006), extended to four sites in 2007 and to six in 2008. All altitudes were measured by GPS and the readings as provided are given here; the true precision is not to the nearest meter.

Species accounts

Eastern Falanouc Eupleres goudotii

The only observation of *Eupleres* was in forest near the village of Enato (24°53'23"S, 46°58'22"E; 538 m), where a single was seen at 18h55 on 10 November 2010. It was found asleep on a horizontal branch-fork in a shrub about 2 m above ground, where it remained motionless for some time allowing close observation and photography. It appeared to have difficulty gripping the trunk, and when it finally descended, it jumped rather than climbed down; on the ground, it moved towards an unseen calling animal about 10 m away, before being lost to sight. The call was unfortunately not transcribed. Local guides shared the sighting and said that they were not familiar with the species.

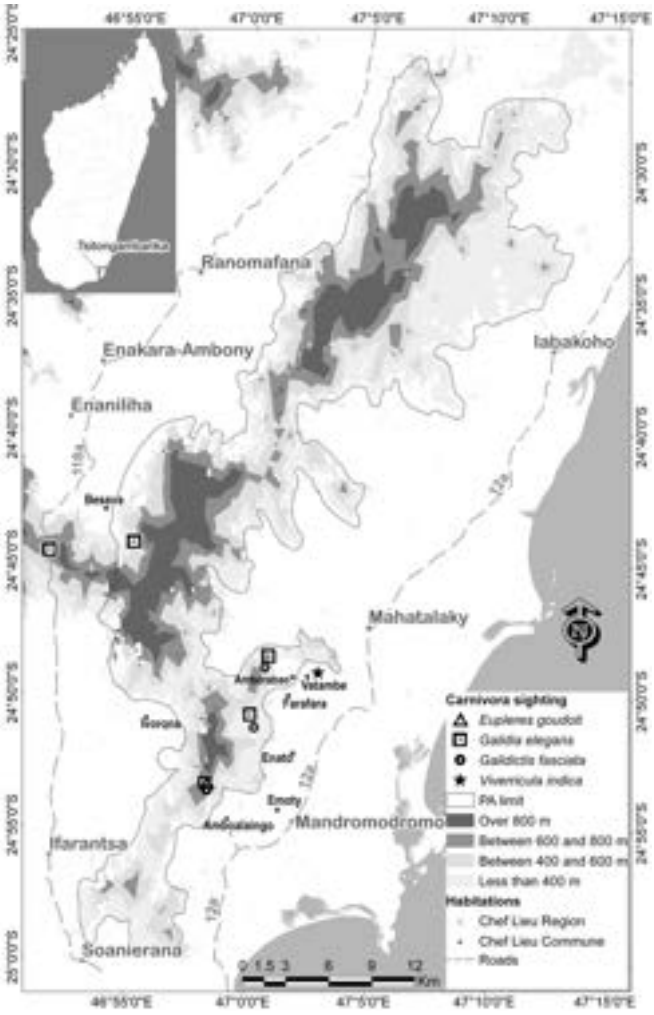

Fig. 1. Tsitongambarika Forest Protected Area, extreme southeast Madagascar. Records of *Fossa fossana* not in map; see text.

Fig. 2. *Eupleres goudotii*, Enato forest, Madagascar, 10 November 2010 (Photo: A. Ravoahangy).

The most striking characters are shown well in the photographs (Fig. 2 and front cover picture). The muzzle was black and rather short. The claws seemed rather long. The tail was short, round and thick. The dorsal surface was covered with long hairs, with brown bases, becoming black distally. The ventral side was lighter in colour.

The animal differed in shape from the adults in our field experience of *Eupleres* and all illustrations that we have seen: its rostrum is notably short, giving the animal a facial expression quite different from the normally long- and narrow-faced look of *Eupleres*, and the feet and ears seem unusually large. However, K. M. Helgen and S. M. Goodman (*in litt*. 2011, independently) agree that the animal is a juvenile *Eupleres*, its unusual appearance reflecting only its youth; they add the following observations: elongation of the rostrum is a common part of the ontogeny of carnivores from juveniles and sub-adults, and could be expected to be particularly impressive in such a long-faced species. Other physical aspects, such as the fur texture, unique tail, claws and foot-pads are typical of *Eupleres*. In colour, *Eupleres* may often appear more grey-brown and less rufous than the Tsitongambarika animal; however, this appears to be variable, and the strong rufous tones in the photograph may have been accentuated by flash photography highlighting basal rufous colours and contrast with blackish tipping.

The presence of the animal up a tree, seemingly comfortable there (not apparently having taken refuge in extreme alarm), is noteworthy, because *Eupleres* is generally considered a ground-dweller. However, Albignac (1974) found captive young to climb trees, up to 1.6 m above ground, regularly in the evening, to rest after eating. Such behaviour may not have been previously documented in the wild. The smaller size and different proportions of young *Eupleres* may make them much more ready climbers than are adults (K. M. Helgen *in litt*. 2011).

Fossa Cryptoprocta ferox

Cryptoprocta was not recorded in our surveys, but Benaina, a farmer, reported seeing an individual on 5 December 2009 near his cassava (manioc) field at Amborabao.

Broad-striped Vontsira Galidictis fasciata

Galidictis was found at two sites, Amborabao (24°48'56.18"S, 47°0'42.35"E; 715 m) and Enato (24°53'37.3"S, 46°58'19.73"E; 312 m). At Enato, a group of three was seen by day (at 12h32) and a duo during the night. A group of two individuals was observed in Amborabao by day (at 07h04). Generally, the species was seen seeking food along forest trails. Circumstances did not allow prolonged behavioural observations, but photo-

Fig. 3. *Galidictis fasciata*, Enato forest, Madagascar 2 August 2008 (Photo: B. A. Raveloson).

Fig. 4. *Galidia elegans*, Beseva, Madagascar, 20 October 2010 (Photo: B. A. Raveloson).

Fig. 5. Spotted Fanaloka *Fossa fossana*, Madagascar, October 2011 (Photo: B. A. Raveloson).

graphs were taken once (Fig. 3). As this text was finalised the species was also recorded near Farafara.

Ring-tailed Vontsira Galidia elegans
Galidia was observed at Amborabao, Enato, Farafara, Beseva (Fig. 4) and the Col de Manangotry; it seems likely that it is present throughout the forest. At Farafara, up to three individuals visited the camp inside forest (24°50'43.45"S, 47°00'27.48"E; 468 m), probably attracted by food waste (chicken feathers and bones).

Spotted Fanaloka Fossa fossana
Two single Spotted Fanalokas *Fossa fossana* were seen (one photographed, Fig. 5) in October–November 2011: one at the camp near Enato at 22h02, the other at nearby Mahialambo, c. 525 m altitude, at 20h38.

Small Indian Civet Viverricula indica
This species, introduced to Madagascar, was seen once at Vatambe (24°49'05.55"S, 47°02'47.11"E; 135 m): a singleton in paddy fields outside forest at 00h25 on 12 June 2009.

Concluding notes

The only other carnivore endemic to Malagasy rainforest that was not found, Brown-tailed Vontsira *Salanoia concolor*, is only known far from Tsitongambarika Forest, from central- and north-east Madagascar (Durbin *et al*. 2010). All the endemic species reported at Tsitongambarika are known from the nearby forest of parcel 1 of the Parc National d'Andohahela (Goodman & Pidgeon 1999, Goodman 2009, Goodman & Helgen 2010) and so these records do not represent major range extensions. However, sightings of *Eupleres* and *Galidictis* remain so rare that all deserve documentation; furthermore, the distinctive appearance of the juvenile *Eupleres* and its arboreal behaviour, are not widely known.

Acknowledgements
The surveys that produced these sightings were implemented by Asity Madagascar, and funded by Rio Tinto, the Wetland Trust, and the Waterloo Foundation. We thank Kris Helgen and Steven Goodman for commenting in detail on the photographs, and Géraldine Veron for supplying a reference from the Harry Van Rompaey library.

References
Albignac, R. 1974. Observations éco-éthologiques sur le genre *Eupleres*, viverridé de Madagascar. *Revue d'Ecologie (Terre et Vie)* 28: 321–351.

Andriamasimanana, R. H. 2008. *Appui à l'élaboration du schema d'aménagement de la Forêt de Tsitongambarika, Tolagnaro par des outils d'observation de la terre. Rapport final*. Birdlife International Madagascar Programme, Antananarivo, Madagascar.

BirdLife International 2011. *Tsitongambarika Forest, Madagascar: biological and socio-economic surveys with conservation recommendations*. Birdlife International, Cambridge, U.K.

Durbin, J., Funk, S. M., Hawkins, F., Hills, D. M., Jenkins, P. D., Moncrieff, C. B. & Ralainasolo, F. B. 2010. Investigations into the status of a new taxon of *Salanoia* (Mammalia: Carnivora: Eupleridae) from the marshes of Lac Alaotra, Madagascar. *Systematics and Biodiversity* 8: 341–355.

Goodman, S. M. 2009. Family Eupleridae (Madagascar carnivores). Pp. 330–351 in Wilson, D. E. & Mittermeier, R. A. (eds) *Handbook of mammals of the world. Vol. 1, Carnivores*. Lynx Edicions, Barcelona, Spain.

Goodman, S. M. & Helgen, K. M. 2010. Species limits and distribution of the Malagasy carnivoran genus *Eupleres* (family Eupleridae). *Mammalia* 74: 177–185.

Goodman, S. M. & Pidgeon, M. 1999. Carnivora of the Reserve Naturelle Integrale d'Andohahela, Madagascar. *Fieldiana, Zoology* N.S. 94: 259–268.

Schreiber, A., Wirth, R., Riffel, M. & Van Rompaey, H. 1989. *Weasels, civets, mongooses, and their relatives: an action plan for the conservation of mustelids and viverrids*. IUCN, Gland, Switzerland.

[1]Asity Madagascar, PO Box 1074, Antananarivo (101), Madagascar.
Emails: aravoahangy@birdlife-mada.org, rab_voronamlg@yahoo.fr, vonyr@birdlife-mada.org
[2]BirdLife International, Wellbrook Court, Girton Road, Cambridge CB3 0NA, U.K.
Email roger.safford@birdlife.org

Taxonomic impediment to conservation: the case of the Moroccan 'ferret' *Mustela putorius* ssp.

Spartaco GIPPOLITI

Abstract

The origin of the Ferret *Mustela furo*, which is presently known only in captivity and as wild-living populations descended from captive stock, is not fully understood. Generally, the population of polecat-/ferret-like animals in the Moroccan Rif is considered the result of ancient introduction, but molecular and palaeontological evidence contests this hypothesis. Therefore, more research is needed to understand the origin and taxonomic significance, and thus conservation significance, of Moroccan *Mustela*. Taxonomic and nomenclatorial confusion with domestic Ferrets, an introduced pest in several world ecosystems, plays a role in overlooking the perhaps serious conservation needs of a potential Maghrebian endemic. Given lack of recent records for wild ferrets in Morocco, a survey in the historical range of the species is urgently needed.

Keywords: fossil records, Maghreb, polecat, uncertain native/introduced status

Résumé

L'origine du Furet *Mustela furo*, à présent seulement représenté en captivité et dans des populations sauvages provenant de souches captives, n'est pas complètement connue. Généralement la population d'animaux représentant la famille des putois / furets dans le Rif marocain est considérée comme étant le résultat d'une introduction ancestrale, cependant l'analyse moléculaire et les preuves paléontologiques réfutent cette hypothèse. Par conséquent, de plus amples recherches sont nécessaires afin de comprendre l'origine et l'importance taxonomique, ainsi que l'importance de conservation du genre *Mustela* marocain. La confusion au niveau de la taxonomie et de la nomenclature avec le furet domestique, un animal nuisible introduit dans plusieurs écosystèmes mondiaux, joue un rôle crucial dans le manque d'actions entrepris face à l'important besoin de conservation de la potentielle souche endémique magrébine. Suite au manque de données récentes pour le furet sauvage au Maroc, une enquête sur la répartition historique de cette espèce est nécessaire de toute urgence.

Mots-clés: Maghreb, origine indigène/introduite incertaine, putois, vestiges fossiles

Recognition of taxa is a necessary prerequisite for meaningful conservation of biodiversity. The ancient transport by humans of wild and domestic mammals to new lands has caused more than one problem to taxonomy. In particular, insular endemic taxa have often been taxonomically recognised despite their recent, human-mediated origin, and so Gippoliti & Amori (2002) argued that they attract more conservation attention than they really deserve. The opposite problem also arises, where conservation attention has sometimes been delayed for populations assumed to have been introduced by human agency, as with Central American Squirrel Monkey *Saimiri oerstedii* and the Bornean race of Asian Elephant *Elephas maximus borneensis* (Cropp & Boinski 2000, Fernando *et al*. 2003). Molecular investigations have often been powerful tools in elucidating the origin and establishing the true autochthony of such populations.

The Mediterranean Region is particularly prone to these problems, owing to a long history of human-mediated transportation of animals. Especially on islands, anthropochorous taxa have often distracted from the study of native endemic ones (Gippoliti & Amori 2006). A further complication is represented by the movement and release of domestic animals at different stages of domestication (Groves 1989).

Mustelids of the genus *Mustela*, subgenus *Putorius* include four closely related Holarctic taxa: Black-footed Ferret *Mustela nigripes* from North America, Steppe Polecat *M. eversmanii* and Western Polecat *M. putorius* from Eurasia and the domesticated Ferret *M. furo*. Hybridisation occurs among all these taxa (Davison *et al*. 1999) and their conspecificity has been inferred by some authors (Marmi *et al*. 2004), but genetic introgression is suggested by the mitochondrial (mt) DNA of European Mink *M. lutreola* (Davison *et al*. 2000).

The Ferret is generally regarded as the domestic form of Western Polecat, but also (considering the distinctiveness of its skull from that of *M. putorius*) as a possible hybrid between *M. putorius* and the taxonomically very close *M. eversmanii*, or even a derivate of the latter (e.g. Miller 1912). The diploid chromosome number is 2n=40 for *M. putorius* and *M. furo*, but 2n=38 for *M. eversmanii*. The former two species have morphologically identical chromosome sets, but the karyotype of *M. eversmanii* differs by a single Robertsonian rearrangement (Volobuev *et al*. 1974). Molecular data derived from the nucleotide sequences of the nuclear interphotoreceptor retinoid binding protein (IRBP) and mitochondrial cytochrome b genes ally *furo* to *putorius* rather than to *eversmanii* (Sato *et al*. 2003), but mitochondrial data may not be considered conclusive at present (Kurose *et al*. 2008) and further studies of nuclear DNA are needed to clarify this situation.

The Greek geographer Strabo claimed an African origin of the Ferret when recounting its importation from 'Libya' (then used for much wider area than the country of today) to the Balearic islands to control European Rabbits *Oryctolagus cuniculatus* around 20 AD (Davison *et al*. 1999). Traditionally, a wild population referred to as *Mustela putorius furo* has been

reported from the Moroccan Rif, a compact mountain range in Northern Morocco (Cabrera 1930, Halternorth & Diller 1980, Kingdon 1997) and possibly in the isolated Beni Snassen massif (Griffiths & Cuzin in press). According to these latter authors, these areas are comparatively wooded and rainy (400–1,100 mm or more annual rainfall), compared with neighbouring areas in Morocco. While Morocco is listed in the range of *M. putorius* in compilations such as Wozencraft (2005) and the current version of *The IUCN Red List of Threatened Species* (Fernandes *et al*. 2008), these do not flag the potential taxonomic distinctiveness of this population, the sole African representative of *Mustela*, subgenus *Putorius*. Moreover, the population is not mentioned (text or map) in Corbet's (1978) review of Palaearctic mammals and several authors considered this population to be of feral origin, owing to uncertainty concerning the African origin of the Ferret (e.g. Aulagnier & Thévenot 1986). This population's perceived descent from domestic animals is borne out by the current wide nomenclatural usage of *furo* for both.

The view of an autochthonous Moroccan population seems to have received scant attention, despite important positive evidence in the last decade. Late Pleistocene (300,000 years onwards) remains of *M. putorius* (*sensu lato*) were discovered in the d'El Harhoura cave 1 at Rabat-Temara, less than 200 km south of current range. Although no precise dating of *Mustela* remains is available, these records are consistent with the natural presence of the species in North Africa (Aouraghe 2000). Furthermore, a phylogenetic study of mustelids dated the split between the *putorius* and *furo* lineages as 340,000 year before present (Sato *et al*. 2003), an estimate agreeing with the high divergence within other Palaearctic lineages that occur in the Maghrebian Region (a well-defined biogeographic province of the Palaearctic, encompassing Morocco, Algeria and Tunisia), such as the garden dormouse *Eliomys melanurus* and Red Deer *Cervus elaphus barbarus* (Filippucci *et al*. 1988, Pitra *et al*. 2004). A recent investigation of ancient mt DNA of the extinct North African Brown Bear *Ursus arctos* revealed the presence of a clearly distinct lineage not found in Europe (Calvignac *et al*. 2008).

These new data lead some support to the origin of the domestic Ferret being a highly divergent African lineage of *M. putorius*. If its autochthony can be confirmed, a formal description and naming of the North African polecat, even at subspecific level, is needed. In agreement with Opinion 2027, March 2003, by the International Commission on Zoological Nomenclature, the name *furo* is not available for a wild taxon (Gentry *et al*. 2006): it was introduced by Linnaeus specifically for domestic Ferrets. Thévenot & Aulagnier (2006), believing that Ferret is descended from the population native to Morocco and distinct from *M. putorius*, listed '*M. furo*' as extinct in the wild owing to a total lack of recent records (S. Aulagnier *in litt*. 2008), while Griffiths & Cuzin (in press), on the contrary, authored a profile of the Maghrebian taxon under the name '*M. putorius*' for the handbook *Mammals of Africa*. According to these latter authors, the last reported observations of wild animals were from two localities in the area of Chefchaouen (western Rif) in 1986 and 1987. Formal nomenclatorial recognition of the Moroccan population should also have beneficial effects for its conservation. In contrast, domestic Ferret does not require conservation, having been responsible for major ecological damage since it was released in New Zealand and other oceanic islands (e.g. Medina & Martín 2009).

Molecular investigation of tissues of historical and more recent specimens should provide fundamental insight, albeit perhaps not definitive, concerning the origin of the Moroccan population and its relationship with domestic Ferrets. Meanwhile, the present conservation status of the species in Morocco needs clarification before it is too late. Hopefully, the absence of recent records is only the result of the scarcity of interest for a perceived 'feral' species not included among protected species by Moroccan law (Griffiths & Cuzin, in press), but the danger is real to lose a unique member of Maghrebian biodiversity. The Barbary race of Lion *Panthera leo leo* is extinct in the wild and the captive diaspora is heavily genetically polluted by Lions of sub-Saharan races (Burger & Hemmer 2006, Schnitzler 2011). The low conservation interest in the taxonomic ambiguity that is the Maghrebian polecat contrasts with that of the closely related Black-footed Ferret, which has received considerable attention and financial funds in the United States of America, becoming one of the most successful cases in modern conservation biology (Seal *et al*. 1989, Jachowski & Lockhart 2009).

Acknowledgements

I wish to thank A. Kitchener (Edinburgh) for comments on an earlier draft, while F. Cuzin (Marrakesh), M. Wolsan (Warszawa) and S. Aulagnier (Castanet Tolosan) provided key literature sources and information. A. Abramov, C. P. Groves and J. W. Duckworth greatly improved the final text with their suggestions. Anouchka Jacquier provided the French translation.

References

Aouraghe, H. 2000. Les carnivores fossiles d'El Harhoura 1, Témara, Maroc. *Anthropologie, Paris* 104: 147–171.

Aulagnier, S. & Thévenot, M. 1986. *Catalogue des mammifères sauvages du Maroc*. Institut Scientifique, Rabat, Morocco.

Aulagnier, S., Haffner, P., Mitchell-Jones, A. J., Moutou, F. & Zima, J. 2008. *Guides des mammifères d'Europe, d'Afrique du Nord et du Moyen Orient*. Delachaux et Niestlé, Paris, France.

Burger, J. & Hemmer, H. 2006. Urgent call for further breeding of the relic zoo population of the Critically Endangered Barbary Lion (*Panthera leo leo* Linnaeus, 1758). *European Journal of Wildlife Research* 52: 54–58.

Cabrera, A. 1930. La patria del *Putorius furo*. *Boletín de la Reale Sociedad Española de Historia Naturale* 30: 477–480.

Calvignac, S., Hughes, S., Tougard, C., Michaux, J., Thévenot, M., Philippe, M., Hamdine, W. & Hänni, C. 2008. Ancient DNA evidence for the loss of a highly divergent Brown Bear clade during historical times. *Molecular Ecology* 17: 1962–1970.

Corbet, G. B. 1978. *The mammals of the Palaearctic region: a taxonomic review*. British Museum (Natural History) and Cornell University Press, London, U.K., and Ithaca, U.S.A.

Cropp, S. & Boinski, S. 2000. The Central American Squirrel Monkey (*Saimiri oerstedi*): introduced hybrids or endemic species? *Molecular Phylogeny and Evolution* 16: 350–356.

Davison, A., Birks, J. D. S., Griffiths, H. I., Kitchener, A. C., Biggins, D. & Butlin, R. K. 1999. Hybridization and the phylogenetic relationship between Polecats and domestic Ferrets in Britain. *Biological Conservation* 87: 155–161.

Davison, A., Griffiths, H. I., Brookes, A., Maran, T., MacDonald, D. W., Sidorowich, V. E., Kitchener, A. C., Irizar, I., Villate, I., González-Esteban, J., Ceña, J. C., Ceña, A., Moya, I. & Palazon Miñanos, S.

2000. Mitochondrial DNA and paleontological evidence for the origins of endangered European Mink, *Mustela lutreola*. *Animal Conservation* 4: 345–355.

Fernandes, M., Maran, T., Tikhonov, A., Conroy, J., Cavallini, P., Kranz, A., Herrero, J., Stubbe, M., Abramov, A. & Wozencraft, C. 2008. *Mustela putorius*. In: IUCN 2011. *IUCN Red List of Threatened Species*. Version 2011.1. www.iucnredlist.org. Downloaded on 17 August 2011.

Fernando, P., Vidya, T. N. C., Payne, J., Stuewe, M., Davison, G., Alfred, R. J., Andau, P., Bosi, E., Kilbourn, A. & Melnick, D. J. 2003. DNA analysis indicates that Asian Elephants are native to Borneo and are therefore a high priority for conservation. *PloS Biology* 1: 110–115.

Filippucci, M. G., Rodinò, E., Nevo, E. & Capanna, E. 1988. Evolutionary genetics and systematics of the garden dormouse, *Eliomys* Wagner, 1840. 2 – Allozyme diversity and differentiation of chromosomal races. *Bollettino di Zoologia* 55: 47–54.

Gentry, A., Clutton-Brock, J. & Groves, C. P. 2006. The naming of wild animal species and their domestic derivatives. *Journal of Archaeological Science* 31: 645–651.

Gippoliti, S. & Amori, G. 2002. Anthropochorous mammal taxa and conservation lists. *Conservation Biology* 16: 1162–1164.

Gippoliti, S. & Amori, G. 2006. Ancient introductions of mammals in the Mediterranean Basin and their implications for conservation. *Mammal Review* 36: 37–48.

Griffiths, H. I. & Cuzin, F. in press. *Mustela putorius*. In Kingdon, J. & Hoffmann, M. (eds) *The mammals of Africa, vol. 5. Carnivores, equids and rhinos*. Academic Press, Amsterdam, Netherlands.

Groves, C. P. 1989. Feral mammals of the Mediterranean islands: documents of early domestication. Pp. 46–58 in Clutton-Brock, J. (ed.) *The walking larder*. Unwin Hyman, London, U.K.

Halternorth, T. & Diller, H. 1980. *A field guide to the mammals of Africa including Madagascar*. Collins, London, U.K.

Jachowski, D. S. & Lockhart, J. M. 2009. Reintroducing the Black-footed Ferret *Mustela nigripes* to the Great Plains of North America. *Small Carnivore Conservation* 41: 58–64.

Kingdon, J. 1997. *The Kingdon field guide to African mammals*. Academic Press, London, U.K.

Kurose, N., Abramov, A. V. & Masuda, R. 2008. Molecular phylogeny and taxonomy of the genus *Mustela* (Mustelidae, Carnivora), inferred from mitochondrial DNA sequences: new perspectives on phylogenetic status of the Back-striped Weasel and American Mink. *Mammal Study* 33: 25–33.

Marmi, J., López-Giráldez, J. F. & Domingo-Roura, X. 2004. Phylogeny, evolutionary history and taxonomy of the Mustelidae based on sequence of the cytochrome b gene and a complex repetitive flanking region. *Zoologica Scripta* 33: 481–499.

Medina, F. M. & Martín, A. 2009. A new invasive species in the Canary Islands: a naturalized population of Ferrets *Mustela furo* in La Palma Biosphere Reserve. *Oryx* 44: 41–44.

Miller, G. S. 1912. *Catalogue of mammals of western Europe in the British Museum*. British Museum, London, U.K.

Pitra, C., Fickel, J., Meijaard, E. & Groves P. C. [*sic*] 2004. Evolution and phylogeny of Old World deer. *Molecular Phylogenetics and Evolution* 333: 880–895.

Sato, J. J., Hosoda, T., Wonsan, M., Tsuchiya, K., Yamamoto, Y. & Suzuki, H. 2003. Phylogenetic relationships and divergence times among mustelids (Mammalia: Carnivora) based on nucleotide sequences of the nuclear interphotoreceptor retinoid binding protein and mitochondrial cytochrome *b* genes. *Zoological Scence* 20: 243–264.

Schnitzler, A. E. 2011. Past and present distribution of the North African–Asian Lion subgroup: a review. *Mammal Review* 41: 220–243.

Seal, U., Thorne, E. T., Bogan, M. A. & Anderson, S. H. (eds) 1989. *Conservation biology and the Black-footed Ferret*. Yale University Press, New Haven, CT, U.S.A.

Thévenot, M. & Aulagnier, S. 2006. Mise à jour de la liste des mammifères sauvages du Maroc. Janvier 2006. *Go-South Bulletin* 3: 6–9.

Volobuev, V. T., Ternovsky, D. V. & Graphodatsky, A. S. 1974. [Taxonomic status of Ferret based on karyological data]. *Zoologicheskii Zhurnal* 53: 1738–1739. (In Russian.)

Wozencraft, W. C. 2005. Order Carnivora. Pp. 532–628 in Wilson, D. E. & Reeder, D. M. (eds) *Mammal species of the world. A taxonomic and geographic reference*, 3rd edn. Johns Hopkins University Press, Baltimore, U.S.A.

Viale Liegi 48A, 00198 Roma, Italy
Email: spartacolobus@hotmail.com

Observations of civets, linsangs, mongooses and non-lutrine mustelids from Peninsular Malaysia

Celine H. S. LOW

Abstract

Eighty-two observations of thirteen small carnivore species made in Peninsular Malaysia from 1987 to the present are extracted from the Singapore Vertebrate Study Group records database and *The Pangolin*.

Keywords: Herpestidae, Mustelidae, Prionodontidae, *The Pangolin*, Viverridae, VSG records database

Pemerhatian musang, linsang dan bumbum dari Semenanjung Malaysia

Abstrak

Tigabelas spesis haiwan kanivor kecil telah diperhatikan sebanyak 82 kali sejak tahun 1987 sehingga kini. Rekod telah diperolehi dari pengkalan data Kumpulan Kajian Vertebrata Singapura serta penerbitan "*The Pangolin*".

Kata-kata kunci: Herpestidae, Mustelidae, penerbitan "*The Pangolin*", pengkalan data VSG, Prionodontidae, Viverridae

Peninsular Malaysia is located in the tropical belt just above the equator. This political region covers the southern half of the Thai–Malay Peninsula and includes adjacent islands such as Penang, Langkawi and Tioman. The Thai–Malay Peninsula is the strip of land at the southeastern corner of the Asian continent that stretches from the Isthmus of Kra in the north, in southern Thailand, to Singapore Island in the south. The fauna of the area is a mixture of elements from the Asian mainland, the Greater Sunda Islands and some endemic taxa. In total 224 mammal species are known in Peninsular Malaysia, excluding marine mammals, 101 of which are bats (Chiroptera; Francis 2008). Currently, seven are listed as endemic, four of which are bats, the other three being rodents (Francis 2008). Ten species of civet (family Viverridae), one of linsang (family Prionodontidae), four of mongoose (family Herpestidae) and three of mustelid (family Mustelidae; excluding otters) have been recorded from Peninsular Malaysia (Medway 1983, Francis 2008, Wilson & Mittermeier 2009).

The Viverridae is represented by the Large Indian Civet *Viverra zibetha*, Large-spotted Civet *V. megaspila*, Malay Civet *V. tangalunga*, Small Indian Civet *Viverricula indica*, Common Palm Civet *Paradoxurus hermaphroditus*, Masked Palm Civet *Paguma larvata*, Binturong *Arctictis binturong*, Small-toothed Palm Civet *Arctogalidia trivirgata*, Banded Civet *Hemigalus derbyanus* and Otter Civet *Cynogale bennettii*; the Prionodontidae by the Banded Linsang *Prionodon linsang*; and the Herpestidae by the Short-tailed Mongoose *Herpestes brachyurus*, Small Asian Mongoose *H. javanicus* and Crab-eating Mongoose *H. urva*. The introduced Indian Grey Mongoose *H. edwardsii* may have been extirpated from Malaysia (Francis 2008). The non-lutrine Mustelidae is represented by the Yellow-throated Marten *Martes flavigula* and Malay Weasel *Mustela nudipes*; the Hog Badger *Arctonyx collaris* has been reported to occur in Upper Perak along the Thai border, but remains unconfirmed from the country (Chasen 1940, Medway 1983).

In contrast to the few formally published recent sightings or other detailed distribution records of small carnivores in peninsular Malaysia, many are buried in grey literature. The following is not an exhaustive literature review for the country, but contains all observations of civets, linsangs, mongooses and mustelids (excluding otters) from Peninsular Malaysia contributed to the Vertebrate Study Group (VSG) of the Nature Society (Singapore); (formerly, The Malayan Nature Society, Singapore Branch) by various individuals up to September 2011. They were extracted from VSG's records database (which began in 1993) and include citations from their local publication, *The Pangolin*, which ran from 1988 to 2000. The single record from the *Malayan Naturalist* in the VSG database is included. These records are chance sightings (including road-kills) obtained on recreational outings, not the result of any consistent survey effort.

A total of 13 species comprising 97 individuals were observed across eight states since 1987 (Appendix). Although the records reflect the general perceptions of abundance of small carnivore species, with the Common Palm Civet, Masked Palm Civet, Small-toothed Palm Civet and Malay Civet being most often observed by the contributors, this compilation alone should not be used to make assumptions about the status of small carnivores throughout Peninsular Malaysia. The high incidence of records from Fraser's Hill is the result of frequent visits by the contributors to this popular hill station, some of whom often deliberately seek out nocturnal mammals (e.g. Low 2010). It does not imply that small carnivores are more common there than in other parts of Peninsular Malaysia. The sites, habitats and behaviour recorded are mostly consistent with past records for most of the species. Although Medway (1983) stated that the Short-tailed Mongoose is primarily nocturnal, more current records show it to be mainly diurnal (Francis 2008, Wilson & Mittermeier 2009), consistent with these records.

The Banded Civet is largely restricted to lowland forest in Peninsular Malaysia (Lim 1973, Francis 2008) where its elevation range so far recorded is between 150 and 800 m. However, in Borneo it has been found up to 1,200 m (Payne *et al*.

1985). The recent sighting at Fraser's Hill was at an elevation of between 1,078 and 1,133 m (the range is the level of imprecision, as the readings were taken on a slope; it is not the range the civet moved over), evidently the highest known elevation recorded in Peninsular Malaysia to date.

The larger ground-dwelling civets of the genus *Viverra*—Large Indian Civet, Large-spotted Civet and Malay Civet—have similar colour markings (Francis 2008), and can be difficult to identify with certainty, especially in dim light conditions and from a distance. The identity of the animals in sightings not supported by photographs should be regarded as unconfirmed unless the observer had a good enough look at the subject to note diagnostic characters.

The status of most small carnivores in Peninsular Malaysia is not well known. While researchers and students of biology play the major role of studying this group of fauna and their ecology, recreational visitors to nature areas can contribute substantially by submitting records of their sightings, to enable a better understanding of the ecology and status of a poorly studied group of animals. It is also of considerable value for compilations of such data to be made readily available so that reviews of such compilations can provide more conclusive answers for conservation strategies.

Acknowledgements

I thank: Kelvin Lim for providing records from the VSG database and for access to some publications; Kelvin Lim, Marcus Chua, Will Duckworth, Chris Shepherd and Reuben Clements for their suggestions to improve the manuscript; Gary Lim for help with translation; Marcus Chua, Nick Baker, Norman Lim, Chan Kwok Wai and Alan Yeo for contributing their photographs; R. Subaraj for additional information on his sightings; and Yeo Suay Hwee, Yong Ding Li, Timothy Pwee, Andrew Tay and Gan Cheong Weei for their additional records.

References

Anonymous 1988a. Across the causeway. *Pangolin* 1(2): 31–35.

Anonymous 1988b. Across the causeway. *Pangolin* 1(4): 80–84.

Anonymous 1989. Recent reports. *Pangolin* 2(2): 17–26.

Anonymous 1990. Peninsular Malaysian records for the year (1990). *Pangolin* 3(1–4): 16–20.

Anonymous 1993. Current records. *Pangolin* 6(1–2): 1–4.

Chasen, F. N. 1940. A handlist of Malaysian mammals: a systematic list of the mammals of the Malay Peninsula, Sumatra, Borneo and Java, including adjacent small islands. *Bulletin of the Raffles Museum* 15: i–xx, 1–209.

Francis, C. M. 2008. *A field guide to the mammals of South-east Asia*. New Holland, London, U.K.

Lim B. L. 1973. The Banded Linsang and the Banded Musang of West Malaysia. *Malayan Nature Journal* 26: 105–111.

Lim, K. K. P. 1991. The Crab-eating Mongoose, *Herpestes urva* at Fraser's Hill, Pahang, Peninsular Malaysia. *Malayan Naturalist* 44 (2&3): 20–21.

Lim, K. K. P., Subaraj, R. & Sivasothi, N. 1996. Recent records. *Pangolin* 7(1–4): 1–15.

Lim, K., Subaraj, R. & Teo, R. 2000. Records for 1995. *Pangolin* 8(1–4): 10–30.

Low, C. H. S. 2010. Observations of civets on Fraser's Hill, Peninsular Malaysia. *Small Carnivore Conservation* 43: 8–11.

Medway, Lord 1983. *The wild mammals of Malaya (Peninsular Malaysia) and Singapore*, 2nd edn. Oxford University Press, Kuala Lumpur, Malaysia.

Payne, J., Francis, C. M. & Phillipps, K. 1985. *A field guide to the mammals of Borneo*. The Sabah Society, Kota Kinabalu, Malaysia.

Subharaj R. 1991. Some noteworthy mammals in Malaysia recorded by Jim Chance. *Pangolin* 4(1): 8–9.

Wilson, D. E. & Mittermeier, R. A. (eds) 2009. *Handbook of the mammals of the world*, *vol. 1. Carnivores*. Lynx Edicions, Barcelona, Spain.

Yeo, S. H. 1991a. Records for the second quarter, 1991. Mammals. *Pangolin* 4(2): 1–4.

Yeo, S. H. 1991b. Records for the third quarter, 1991. Mammals. *Pangolin* 4(3): 1–3.

Yeo, S. H. & Lim, K. K. P. 1992. Current records: mammals. *Pangolin* 5(1–4): 1–5.

Vertebrate Study Group, Nature Society (Singapore), 510 Geylang Road, #02-05 The Sunflower, Singapore 398466.
Email: leopardcat@pacific.net.sg

Appendix. Small carnivore records from peninsula Malaysia held in the Vertebrate Study Group's records database and/or published in *The Pangolin* (Photographs 1–5 on back cover).

Location	Date	Time	Notes	Observer
Yellow-throated Marten *Martes flavigula*				
Selangor: Fraser's Hill (3°43' N, 101°44' E), rubbish tip along road to Jeriau Waterfall	4 Dec 1988	N.A.	Two seen	C. Briffett *et al*. in Anon. 1988b: 80
Johor: highway between Kota Tinggi and Kuantan, about 20 km from Kota Tinggi (1°44' N, 103°53' E)	29 Jun 1990	N.A.	Two along road; 'tails lifted high off ground'	M. Strange in Anon. 1990: 19
Selangor: Fraser's Hill, road to Jeriau Waterfall	12 Jul 2008	18h50 (dusk)	Two at 'rubbish dump'	G. C. Tan
Pahang–Selangor: Fraser's Hill	2008	16h30	Behind a bungalow; stood on its hind legs when it saw the observer, then went back into vegetation	C. W. Gan
Pahang–Selangor: Fraser's Hill	28 Dec 2008	16h00	Two around bungalows, one of which on the rubbish bin grabbed a white plastic bag and ran off	T. Pwee
Pahang–Selangor: Fraser's Hill	17 Jul 2009	Day	At roadside	Y. Zhang, photo
Pahang–Selangor: Fraser's Hill	28 Apr 2011	Day	On ground	N. Baker, photo (Photo 1)
Kelantan: Taman Negara, Merapoh (4°41' N, 102°04' E)	16 May 2011	15h00	Two seen	A. Tay
Malay Weasel *Mustela nudipes*				
Pahang: Fraser's Hill	Feb 1990	N.A.	Provisional identification[1]	J. Chance in Subharaj 1991: 9
Banded Linsang *Prionodon linsang*				
Negeri Sembilan: Pasoh Forest Reserve	Jan 1991	N.A.	Provisional identification[1]	J. Chance in Subharaj 1991: 9
Large Indian Civet *Viverra zibetha*				
Johor: road between Kota Tinggi and Kluang (1°44'N, 103°53'E)	18 May 1989	N.A.	Road-kill	H. C. Ho in Anon. 1989: 23
Selangor: Kuala Selangor Nature Park (3°20'N, 101°15'E), south bund of main pond	17 Jun 1991	N.A.	Provisional identification[2], size of a small dog	N. Sivasothi in Yeo 1991a: 3, as *Viverra* spp.
Kedah: Kedah trunk road	27 Jan 1993	N.A.	Road-kill	R. Subaraj in Anon. 1993: 2
Malay Civet *Viverra tangalunga*				
Pahang: Taman Negara (4°56'N, 102°00'E), Yong Hide near Kuala Tahan	18 Feb 1988	Night	Eating chicken bones	S. Sutari *et al*. in Anon. 1988a: 32
Pahang: Taman Negara, Yong Hide near Kuala Tahan	13 Jul 1990	Night	Seen from observation hide	R. Subaraj in Anon. 1990: 18
Pahang: Taman Negara, Cegar Anjing Hide near Kuala Tahan	8 Jun 1991	Night	Two seen from observation hide	R. Subaraj in Yeo 1991a: 3
Johor: Kota Tinggi (1°44'N, 103°53'E), Muntahak Trail	9 Aug 1991	N.A.	Seen	K. S. Lim *et al*. in Yeo 1991b: 2
Johor: near Ayer Hitam on road from Johor Bahru	21 Jun 1992	N.A.	Road-kill	S. Sutari in Yeo & Lim 1992: 4
Selangor: Kuala Selangor Nature Park	15 Jan 1993	19h10	Seen from coastal bund at about 10 m away on mangrove boardwalk	N. Sivasothi in Lim *et al*. 1996: 4
Johor: Kota Tinggi, Panti Bunker Trail	4 Jan 2003	Night	Seen	A. Tay
Johor: Kota Tinggi, Panti foothills	23 Sep 2006	Night	Making off with bait (of *char siew pau* or pork bun) for scavengers	A. Yeo, photo (Photo 2)

(continued)

Appendix. (continued)

Location	Date	Time	Notes	Observer
Pahang: Taman Negara, Kuala Tahan	1 May 2007	Night	Scavenging on bait (of burger bun)	N. Lim & K. W. Chan photo
Kelantan: Taman Negara, Merapoh	14 May 2011	Night	On ground at oil palm plantation outside park	A. Tay *et al*.
Common Palm Civet *Paradoxurus hermaphroditus*				
Johor: road between Kota Tinggi and Kluang	18 & 20 May 1989	N.A.	One road-kill on each date	H. C. Ho in Anon. 1989: 23
Kedah: Pulau Langkawi (6°25'N, 99°45'E)	27 Jan 1993	N.A.	A road-kill seen in eastern part, and one observed crossing a road at the outskirts of Kuah	R. Subaraj *et al*. in Anon. 1993: 2
Johor: Sungai Renggit	10 Jan 1997	N.A.	Killed by hunter	S. H. Yeo
Johor: Endau-Rompin Park, Kuala Jasin	22 Feb 2006	Night	Seen	N. Lim, photo
Pahang: Pulau Tioman, Kampung Paya, coastal track	27 Sep 2007	Night	Seen	H. H. Tan, photo
Pahang: Fraser's Hill, Bishop's Trail	11 Sep 2009	Night	Seen	K. W. Chan, photo
Pahang: Pulau Tioman, Kampung Paya	18 Apr 2010	Night	Seen	M. Chua, photo
Pahang–Selangor: Fraser's Hill	9 May 2010	22h17	In *Piper aduncum*	C. Low & B. C. Ng in Low 2010, photo
Pahang–Selangor: Fraser's Hill	28 Dec 2010	21h53	In *P. aduncum*	C. Low *et al*., photo
Johor: Kluang, Gunung Belumut Forest Reserve	4 Feb 2011	23h09	In oil palm, at oil palm plantation outside reserve	C. Low *et al*., photo
Pahang: Pulau Tioman, Kampung Paya	24 Apr 2011	Night	Seen	M. Chua, photo
Kelantan: Taman Negara, Merapoh	14 May 2011	22h13	Adult with two juveniles in oil palm at oil palm plantation outside park	C. Low *et al*., photo (Photo 3)
Pahang: Fraser's Hill, at town centre	7 Aug 2011	Night	Walking on overhead electrical wires	K. Lim *et al*.
Pahang: Fraser's Hill, at gate of Johor Bungalow	8 Aug 2011	23h41	In tree	C. Low *et al*., photo
Masked Palm Civet *Paguma larvata*				
Pahang–Selangor: Fraser's Hill	Jul 1990	N.A.	Seen	J. Chance in Subharaj 1991: 9
Johor: Ulu Endau, Gunung Arong forest	22 Jun 1991	N.A.	Two possible individuals[3] on logging trail in deep forest	S. Sutari *et al*. in Yeo 1991a: 3 as *Arctogalidia trivirgata*
Pahang: Fraser's Hill, outside Aubyn House	3 Sep 1995	07h00	Dark-brown individual seen	A. Wong in Lim *et al*. 2000: 25
Johor: Labi, Bekok (at south-west corner of Endau-Rompin Park), above Sungai Bantang (2°20'N, 103°07'E)	28 Nov 2002	Day	Glimpsed[4] falling from the forest canopy	T. M. Leong & K. Lim
Negeri Sembilan: Gunung Telapak Buruk	31 Jan 2004	22h00	Provisional identification; along side of road near base of hill	N. Baker *et al*.
Pahang–Selangor: Fraser's Hill	24 Apr 2009	23h06, 23h36, 00h24	Same individual in *Ficus vasculosa* tree	C. Low *et al*. in Low 2010, photo
Pahang–Selangor: Fraser's Hill	30 Jun 2009	23h27	In fig tree with ripe orange figs	C. Low *et al*. in Low 2010, photo
Pahang–Selangor: Fraser's Hill	1 Jul 2009	02h15	On ground eating boiled rice	C. Low *et al*. in Low 2010
Selangor: Fraser's Hill, road to Jeriau Waterfall	12 Sep 2009	Night	In tree	K. W. Chan, photo
Perak: Pulau Banding, Belum-Temengor Rainforest, outside Belum Rainforest Resort (4°00'N, 100°50'E)	14 Feb 2010	23h29	In tree	C. Low *et al*., photo

Location	Date	Time	Notes	Observer
Pahang–Selangor: Fraser's Hill	9 May 2010	Night	Walking on a concrete-covered slope	C. Low & B. C. Ng in Low 2010, photo
Pahang–Selangor: Fraser's Hill	30 Dec 2010	23h27	In tree	C. Low *et al*., photo
Binturong *Arctictis binturong*				
Selangor: Gombak Field Studies Centre	14 May 1993	16h00	Crossed a grass lawn and entered a bamboo clump	A. Wong in Anon. 1993: 2
Pahang: Fraser's Hill, new road	30 Dec 2009	22h34	In tree with figs	C. Low in Low 2010, photo
Pahang–Selangor: Fraser's Hill	20 Dec 2010	Day	In fruiting tree	G. Francis, photo
Small-toothed Palm Civet *Arctogalidia trivirgata*				
Selangor: Old Genting Road about 3½ km from Gombak Field Studies Centre	11 Jun 1992	N.A.	Two along the road	K. Yong in Yeo & Lim 1992: 4
Perak: Kuala Gula	26 Jan 1993	Night	In oil palm, within oil palm estate, not far from coastal mangrove belt many miles long	R. Subaraj in Anon. 1993: 2
Perlis: Perlis trunk road	27 Jan 1993	N.A.	Along road	K. S. Lim & R. Subaraj in Anon. 1993: 2
Negeri Sembilan: Pasoh Forest Reserve headquarters compound	30 Jan 1995	Night	Feeding on fruits of *Eugenia tumida*	R. Teo & B. C. Ng in Lim *et al*. 2000: 25
Johor: Kota Tinggi, Panti Bunker Trail	29 Nov 2004	Dusk	At red-stem fig by first stream	R. Subaraj
Pahang–Selangor: Fraser's Hill	1 Jul 2009	01h52	In tree near *P. aduncum*	C. Low *et al*. in Low 2010, photo (Photo 4)
Pahang–Selangor: Fraser's Hill	9 May 2010	20h47, 23h20	First eating inflorescence of *P. aduncum*; second in tree.	C. Low & B. C. Ng in Low 2010, photo
Pahang–Selangor: Fraser's Hill	10 May 2010	20h40	In *P. aduncum*	C. Low & B. C. Ng in Low 2010, photo
Pahang–Selangor: Fraser's Hill	11 May 2010	22h51	In *P. aduncum*	C. Low & B. C. Ng in Low 2010, photo
Pahang–Selangor: Fraser's Hill	28 Dec 2010	23h16	In *P. aduncum*	C. Low *et al*., photo
Pahang–Selangor: Fraser's Hill	29 Dec 2010	21h46	In *P. aduncum*	C. Low *et al*., photo
Selangor: Fraser's Hill, road to Jeriau Waterfall	30 Dec 2010	22h02	In tree	C. Low *et al*., photo
Pahang–Selangor: Fraser's Hill	31 Dec 2010	23h54	In fruiting tree	C. Low *et al*., photo
Pahang: Fraser's Hill, new road	7 Aug 2011	22h10	Two on tree ferns next to a concrete-covered slope	C. Low *et al*., photo
Banded Civet *Hemigalus derbyanus*				
Johor: Kota Tinggi, Panti Bunker Trail	1991 or 1992	Night (22h00)	On trunk of tree 2 m above ground	S. H. Yeo, R. Subaraj & R. Teo
Selangor: Fraser's Hill, about 1 km on road uphill from Jeriau Waterfall	8 Aug 2011	Night (21h45)	Female on a steep slope above a seepage area	M. Chua *et al*., photo (Photo 5)
Short-tailed Mongoose *Herpestes brachyurus*				
Selangor: Kuala Selangor	28 Jun & 23 Aug 1987	Day	On coastal bund[5] north of what is now Kuala Selangor Nature Park	R. Subaraj *et al*. in Anon. 1988b: 84
Selangor: Kuala Selangor Nature Park	16 Jan 1993	07h00, 16h30	First: brown mongoose seen on trail to observation huts; second: along coastal trail at the south	N. Sivasothi in Lim *et al*. 1996: 4 as ?*H. brachyurus*
Perak: between Sungai Labu and Sungai Betul Bawah near Tanjung Piandang	Jan 1993	N.A.	brown mongoose observed on dirt track	N. Sivasothi & K. S. Tan in Lim *et al*. 1996: 4 as ?*H. brachyurus*
Johor: Kota Tinggi, Panti Bunker Trail	29 Nov 2004	Morning	Two seen within first 500 m of highway	R. Subaraj

(continued)

Appendix. (continued)

Location	Date	Time	Notes	Observer
Johor: Kota Tinggi, Panti Bunker Trail	Aug 2006	Day	Provisional identification, crossing dirt track	K. S. Lioe, photo
Johor: Kota Tinggi, Panti Temple Trail	May 2011	Day	Seen	D. L. Yong
Johor: Kota Tinggi, Panti Trail 270	17 Jul 2011	09h00	Two foraging beside trail for a while	D. L. Yong
Johor: Kota Tinggi, Panti Trail 270	25 Sep 2011	09h00	Two[6] crossing track near the old logging camp	S. H. Yeo & R. Subaraj
Small Asian Mongoose *Herpestes javanicus*				
Perak: Belum, East-West Highway, between Pulau Banding and town of Gerik (5°50'N, 101°15'E)	15 Feb 2010	Day	Ran across road, towards scrubby vegetation	C. Low *et al*.
Crab-eating Mongoose *Herpestes urva*				
Pahang: Fraser's Hill, Telecoms Loop	2 Jun 1990	Day	Seen	K. Lim *et al*., in Anon. 1990: 19; Lim 1991: 20

Sightings were of single animals except where stated.

Malay words are used in locality names with Malay–English translations: Gunung – Mount; Kampung – Village; Pulau – Island; Sungai – River.

[1]Unconfirmed: neither photographic evidence nor detailed description given.

[2]Diagnostic pattern on tail not noted.

[3]Described as 'rufous creamy around front part of body'.

[4]A civet with a russet-brown body and long black tail (possibly this species).

[5]The habitat on the coastal side was good mangrove, on the inland side was scrubland.

[6]One slightly larger than the other.

Diet of the Common Palm Civet *Paradoxurus hermaphroditus* in a rural habitat in Kerala, India, and its possible role in seed dispersal

P. S. JOTHISH

Abstract

Common Palm Civet *Paradoxurus hermaphroditus* diet in a rural habitat in India was studied by faecal analysis. Observations were made from January 2008 to May 2010, although no faeces were found after January 2010. In total 94 faeces were collected. Of these, vegetable matter alone was found in 82% and animal matter alone in 4%; 14% held both plant and animal matter. Fruits were the predominant vegetable matter in the faeces. Papaya *Carica papaya* was the most common fruit of which remains were found and was eaten year round. No seasonal change in proportion or dietary shift between vegetable and animal matter was observed. Seeds from faeces were viable and a high percentage of defecated seeds germinated. Considering the movement pattern of Common Palm Civets studied elsewhere and the high seed germination rate, Common Palm Civet is plausibly an effective seed disperser of fleshy-fruited plants in the study area. Common Palm Civet often attacks poultry and is perceived as a threat by the poultry farmers.

Keywords: Balaramapuram, faecal analysis, frugivory, poultry raiding, seed germination

Introduction

Order Carnivora includes a wide range of animals characterised by a diversity of diets. Studying diet in carnivores helps understand their influence on distribution and abundance of other species including plants, and their population dynamics, habitat use and social organisation (Rabinowitz 1991, Chuang & Lee 1997). Despite extensive literature on diet of large carnivores, information on the diet of tropical Asian small carnivores is limited (e.g. Joshi *et al*. 1995, Grassman 1998, Zhou *et al*. 2008, Mudappa *et al*. 2010). Diets of small carnivores, especially civets, in India have been studied few times (Krishnakumar & Balakrishnan 2003, Mudappa *et al*. 2010).

The palm civets (subfamily Paradoxurinae, family Viverridae) occur across southern and some of eastern Asia in a wide variety of habitats (Pocock 1933, Lekagul & McNeely 1977). The Common Palm Civet *Paradoxurus hermaphroditus* lives in tropical forests, plantations, fruit orchards and human-settled areas (Prater 1971), often residing in eaves of houses or outbuildings, across the Indian subcontinent and southern China to Southeast Asia including the Philippines and east to New Guinea, in part by introduction (Patou *et al*. 2010). In Kerala, a coastal state of peninsular India, Common Palm Civets are usually found in well-wooded areas and in open places including areas adjacent to human habitations (Balakrishnan 1997).

Common Palm Civet is an omnivore that feeds on fruits and flesh (Joshi *et al*. 1995, Grassman 1998, Krishnakumar & Balakrishanan 2003). In forested areas, it is primarily frugivorous, feeding on berries and pulpy fruits including those of figs and palms and is an effective seed disperser (Rabinowitz 1991, Corlett 1998, Nakashima *et al*. 2010). It is often considered a pest because of its raiding of coffee plantations, other fruit crops and poultry, even though the coffee beans recovered from its faeces are used to make a high-value speciality coffee (Prater 1971). The present paper reports the diet of Common Palm Civet in a rural area of Kerala, India, and the animal's possible role in seed dispersal.

Methods

Food composition was studied by analysing faeces, a technique widely used to study small carnivore diet (Corbett 1989, Rabinowitz 1991, Grassman 1998). Faeces were collected from a rural house terrace in Balaramapuram (8°42'N, 77°04'E) of Thiruvananthapuram, Kerala, India. The terrace was near a house where civets were observed to roost. According to the owner, up to three animals were present, although it was not confirmed that more than one provided the faeces analysed here. Observations were made every week from January 2008 to May 2010, although no faeces were found after 24 January 2010, and it was not possible to confirm whether the civets still slept at the same place.

Faeces were identified as from Common Palm Civet based on their occurrence in more-or-less the same location as the roosting animal(s), shape (including elongated nature) and composition of undigested plant or animal matter. Collected faeces were examined by naked eye and with a hand lens—seeking seeds, pericarps, hairs, bones, feathers, insect exoskeleton, insect wings etc. Seeds of Papaya *Carica papaya*, Common Jack *Artocarpus heterophyllus*, Jungle Jack *A. hirsutus*, Custard-apple *Annona reticulata* and Fishtail Palm *Caryota urens* collected from the civet faeces were sown directly and without any treatment in backyard soil to test viability of defecated seeds; no anti-seed-predator enclosures were used. Seeds were checked daily for germination and predation.

Results are presented as percentage frequency of occurrence (number of faeces with the particular item/total number of faeces x 100) of a particular matter in the faeces. A chi-square test was done to investigate the dietary preference (fruits vs. animal matter).

Results

In total, 94 faeces were collected. Most faeces (81) contained either plant or animal matter, but 13 contained both (Table 1). Vegetable matter predominated: more than 95% of the faeces contained vegetable matter, alone or with animal matter. Only

Table 1. Vegetable and animal matter composition of the faeces of Common Palm Civet *Paradoxurus hermaphroditus*, collected from a rural site in Kerala, India, during 2008–2010.

Item description	Number of faeces	Percentage of occurrence
Vegetable matter alone	77	81.91
Animal matter alone	4	4.25
Vegetable and animal matter	13	13.83
Vegetable matter with or without animal matter	90	95.74
Animal matter and with or without vegetable matter	17	18.10

4.3% of faeces contained only animal matter. Fruit materials were the dominant remains (90.1% of the faeces) year round. Intake of animal prey was low. The faeces held fruits much more frequently than they did animal matter ($\chi^2 = 23.62$, $df = 1$, $P < 0.001$). Grass plugs, i.e. partly chewed grass leaves (mostly with animal matter) and cooked rice were also found in the faeces. A single food item was recovered from 76 (80.8%) faeces, 17 (18.1%) contained two food items and one contained three food items (1.1%). There was no evidence of a seasonal shift in relative importance of animal material in the diet. Faeces composed entirely of animal matter were found in July 2008 (13 and 18 July; rodent skull and hairs and millipede remains), February 2009 (frog skin and bones) and November 2009 (millipede remains). Faeces containing both animal and plant matter were obtained in February (twice), May, June and November 2008; January, March (twice), July, September (twice) and October 2009; and January 2010.

Eighteen species of fruits and/or seeds were collected, with *Carica papaya* the most frequent fruit recovered (Table 2). In most cases, the civet(s) ingested fruit pulp along with seeds and defecated undamaged seeds. Although remains of *Artocarpus heterophyllus* were observed 13 times in faeces, seeds were found on only four occasions, probably reflecting their large size. The five predominant fruits found were *C. papaya*, *A. heterophyllus*, *A. hirsutus*, *Caryota urens* and *Annona squamosa*. Vertebrate matter, including rodents, birds, reptiles and amphibians was found in seven faeces. Invertebrate remains (insects, millipedes, beetles and snail shell) were found in 11 faeces. Cooked rice was found in four faeces of which two contained chilli *Capsicum annuum* pericarp and seeds. Excepting *Annona squamosa* (62.2%), all plant species showed high rates of germination (Table 3).

During the study period, seven incidents (one a direct sighting) of animals assumed to be Common Palm Civets taking live chickens from unattended poultry sheds were recorded. All incidents occurred between 18h15 and 19h30. In the direct sighting (18h25), the fowl escaped when the civet was threatened. In all other incidents, the animal killed the fowl and only the carcass of the fowl was found, without head and neck portion. These were identified as Common Palm Civet kills because this mode of attacking poultry on its head is believed by local poultry farmers to be peculiar to the species. According to the farmers, domestic dogs *Canis familiaris* and stray cats *Felis catus* usually tear the bird at the site itself and carry the carcass away, while mongooses *Herpestes* apparently attack only chicks and not adult birds. The local farmers felt that they never see Small Indian Civet *Viverricula indica* in the area. Thus, attribution of these kills to Common Palm Civet requires confirmation.

Table 2. Fruits and seeds present in Common Palm Civet *Paradoxurus hermaphroditus* faeces collected from a rural site in Kerala, India, during 2008–2010.

Plant type	Frequency of occurrence	Percent occurrence	Total number of seeds recovered
Carica papaya Papaya (Caricaceae)	24	25.53	346
Artocarpus heterophyllus Common Jack (Moraceae)	13	13.82	19
A. hirsutus Jungle Jack (Moraceae)	10	10.63	107
Caryota urens Fishtail Palm (Arecaceae)	6	6.38	42
Musa spp. Plantain (Musaceae)	3	3.19	0
Mangifera indica Mango (Anacardiaceae)	2	2.12	0
Capsicum annuum Chilli (Solanaceae)	2	2.12	14
Annona squamosa Custard-apple (Annonaceae)	5	5.31	68
Annona reticulata Bullock's heart (Annonaceae)	2	2.12	11
Annona muricata (Annonaceae)	1	1.06	2
Passiflora edulis a passion fruit (Passifloraceae)	2	2.12	56
Flacourtia jangomas (Flacourtiaceae)	3	3.19	47
Ananas comosus Pineapple (Bromeliaceae)	2	2.12	0
Syzigium cuminii Jamun (Myrtaceae)	1	1.06	18
Psidium guajava Guava (Myrtaceae)	2	2.12	92
Ficus bengalensis Fig (Moraceae)	2	2.12	148
Cucurbitaceae fruit	2	2.12	35
Unidentified	1	1.06	17

Discussion

Common Palm Civet is among the more frugivorous viverrids (Corlett 1998). No systematic studies on its diet have been carried out in India (Singh 1982, Krishnakumar & Balakrishanan 2003) but fruits have been recorded as its major food

Table 3. Germination percentage of seeds collected from Common Palm Civet *Paradoxurus hermaphroditus* faeces collected from a rural site in Kerala, India, during 2008–2010.

Species	Number of seeds sowed	Number of seeds germinated	Percentage of germination
Carica papaya	78	69	88.46
Artocarpus heterophyllus	10	10	100.0
Artocarpus hirsutus	40	36	90.00
Annona squamosa	45	28	62.22
Caryota urens	30	22	73.33

English names and botanical families for each species are given in Table 2.

in countries such as Nepal (Joshi *et al*. 1995), Thailand (Rabinowitz 1991, Grassman 1998) and Myanmar (Su Su & Sale 2007). A recent investigation of Common Palm Civet feeding ecology in semi-urban habitats in Trivandrum revealed fruit as the predominant (about 82%) component (Krishnakumar & Balakrishnan 2003). Joshi *et al*. (1995) observed that fruits constituted about 84.5% of the total faeces, with only 15.5% animal matter in Nepal. The present observations corroborate the earlier studies. Balaramapuram being a rural area, every home yard has one or more fruit plants. Excepting *A. hirsutus*, *Ficus* and *Mangifera indica*, these fruit plants have no specific time of fruiting, so fruits were available all year.

Most faeces contained a single fruit species/food item, showing that the civet(s) ate a single source in bulk at a particular feeding time. The frequent occurrence of grass leaves in the faeces (10.6% of total faeces) is consistent with other studies, mostly concluding a possible role of grass leaves in scouring the intestine and in the digestion process (Grassman 1998, Krishnakumar & Balakrishnan 2003, Balakrishnan & Sreedevi 2007, Mudappa *et al*. 2010).

Common Palm Civet(s) ate at least 18 fruit species in the present study, mostly from non-native plants (Nayar *et al*. 2006). Krishnakumar & Balakrishnan (2003) identified only 10 fruit species from Common Palm Civet faeces in two semi-urban habitats in Trivandrum, Grassman (1998) 13 fruit species in faeces pooled from Common and Masked Palm Civet *Paguma larvata* in Kaeng Krachan National Park (Thailand) and Su Su & Sale (2007) about 31 types of fruits in Common Palm Civet faeces analysed from Hlawga, Myanmar, with little seasonal fluctuation in total intake. *Carica papaya* was the predominant fruit found in the present study, as by Krishnakumar & Balakrishnan (2003). *Carica papaya* is a common fruit tree found in almost every home yard in Kerala, which fruits year round; and civets have easy access to these fruits. Most faeces containing papaya remains also had viable seeds. Similarly, seeds of *Artocarpus heterophyllus*, *A. hirsutus*, *Annona squamosa* and *Caryota urens* showed high seed germination rate (see Table 3). Both *Artocarpus* species are abundant across rural and forested parts of Kerala. Besides providing fruits, they are important timber species. By defecating viable seeds, Common Palm Civets may help the effective dispersal of these economically important trees.

Faeces with vertebrate and invertebrate remains showed that the animal supplements its carbohydrate-rich fruit diet with protein-rich animal matter. Su Su & Sale (2007), in Myanmar, found only very few vertebrate and invertebrate remains in the diet of *P. hermaphroditus*. Cooked rice in the faeces showed the scavenging nature of the Common Palm Civet. Bekele *et al*. (2008) observed high rate of scavenging in human habitats by the African Civet *Civettictis civetta* in Ethiopia and Balakrishnan & Sreedevi (2007) observed that faeces of Small Indian Civet collected near human habitats often containing cooked rice and fish bone.

In the present study, no seasonal dietary shift between fruits and animals was observed, in contrast to studies in Nepal and Thailand (Rabinowitz 1991, Joshi *et al*. 1995). The year-round availability of one or more types of fruits in the study area might explain the absence of seasonal dietary shift in this part of Kerala.

All seven poultry-raiding incidents during the two-year period occurred between 18h15 and 19h30, the time that civets leave their day roost. The civet may have drunk the blood by removing the head, as there were no signs of blood on the incident site or neighbouring areas. A recent observation of Balakrishnan & Sreedevi (2007) on the stomach content of Small Indian Civets showed that only the head region of a babbler *Turdoides* (a bird) was chewed and feathers and body were left intact. Similarly, in all these attacks apparently by Common Palm Civet, the headless carcass of the bird was found. The animal perhaps leaves the body of poultry because of its weight. Common Palm Civets become active around 18h00 and activity decreases later in the night (Rabinowitz 1991, Joshi *et al*. 1995, Su Su & Sale 2007): thus, in the present study, the civet raided poultry in its peak activity time. Although the species responsible for this raiding behaviour are not confirmed, the local belief that Common Palm Civet is the culprit means that the poultry farmers consider the species a menace.

Frugivorous carnivores may disperse seeds (Herrera 1989, Nakashima *et al*. 2010). When an animal ingests fruits, the successful dispersal of the seeds depends on feeding behaviour of the frugivores, the seed viability after consumption and gut passage and the movement of animals. The seeds collected from the faeces were undamaged and did not lose their viability after the gut passage. Daily movement patterns of civets in the present study area were not studied, but elsewhere (Rabinowitz 1991, Joshi *et al*. 1995, Su Su & Sale 2007, Koike *et al*. 2008) Common Palm Civets move long distances so may transport seeds equivalently. Carnivores may produce seed shadows differing qualitatively and quantitatively from those produced by other dispersers such as birds and primates (Nakashima *et al*. 2010). Even though faeces collected in this study were from a terrace and thus have low chance of germination in situ, other sites that the animal(s) defecated at may well have been more suitable for germination. It is plausible to assume that Common Palm Civets in the study area may be acting as a disperser of fruit plants in the locality.

In this study the faeces were collected from only a single locality and may have all come from only one animal, forestalling firm generalisation to the regional diet. Moreover, although faecal analysis proved the consumption of some species, some dietary components may have been overlooked if they are well

digested or otherwise leave no readily identifiable remains. Nonetheless, the present study provides a clue about the diet of *P. hermaphroditus* in rural India and its role in seed dispersal of economically important plants.

Acknowledgements

The author thanks the reviewers and the editor for their critical and useful comments and suggestions that helped a lot to revise this paper.

References

Balakrishnan, M. 1997**.** Mammalian diversity in Kerala: a sustainable resource for human welfare. Pp. 454–459 in Iyenkar, P. K., Nair, K. S. S. & Pushpangadan, P. (eds) *Proceedings of the ninth Kerala Science Congress*. Kerala State Science, Technology and Environment Committee, Thiruvananthapuram, India.

Balakrishnan, M. & Sreedevi, M. B. 2007. Husbandry and management of the Small Indian Civet *Viverricula indica* (E. Geoffroy Saint-Hillaire, 1803) in Kerala, India. *Small Carnivore Conservation* 36: 9–13.

Bekele, T., Afework, B. & Balakrishnan, M. 2008. Feeding ecology of the African Civet *Civettictis civetta* in the Menagesha-Suba State forest, Ethiopia. *Small Carnivore Conservation* 39: 19–24.

Chuang, S.-A. & Lee, L.-L. 1997. Food habits of three carnivore species (*Viverricula indica, Herpestes urva* and *Melogale moschata*) in Fushan Forest, northern Taiwan. *Journal of Zoology, London* 243: 71–79.

Corbett, L. K. 1989. Assessing the diet of Dingoes from feces: a comparison of 3 methods. *Journal of Wildlife Management* 53: 343–346.

Corlett, R. T. 1998. Frugivory and seed dispersal by the vertebrates in the Oriental (Indomalayan) region. *Biological Reviews* 73: 414–448.

Grassman, L. I. 1998. Movements and fruit selection of two Paradoxurinae species in a dry evergreen forest in southern Thailand. *Small Carnivore Conservation* 19: 25–29.

Herrera, C. M. 1989. Frugivory and seed dispersal by carnivorous mammals and associated fruit characteristics in undisturbed Mediterranean habitats. *Oikos* 55: 250–262.

Joshi, A. R., Smith, J. L. D. & Cuthbert, F. J. 1995. Influence of food distribution and predation pressure on spacing behaviour in palm civets. *Journal of Mammalogy* 76: 1205–1212.

Koike, S., Morimoto, H., Goto, Y., Kozakai, C. & Yamazaki, K. 2008. Frugivory of carnivores and seed dispersal of fleshy fruits in cool-temperate deciduous forests. *Journal of Forest Research* 13: 215–212.

Krishnakumar, H. & Balakrishnan, M. 2003. Feeding ecology of the Common Palm Civet *Paradoxurus hermaphroditus* (Pallas) in semi-urban habitats of Trivandrum, India. *Small Carnivore Conservation* 28: 10–11.

Lekagul, B. & McNeely, J. A. 1977. *Mammals of Thailand*. Association for the Conservation of Wildlife, Bangkok, Thailand.

Mudappa, D., Kumar, A. & Chellam, R. 2010. Diet and fruit choice of the Brown Palm Civet *Paradoxurus jerdoni*, a viverrid endemic to the Western Ghats rainforest, India. *Tropical Conservation Science* 3: 282–300.

Nakashima, Y., Inoue, E., Inoue-Murayam, M. & Abd. Sukor, J. R. 2010. Functional uniqueness of a small carnivore as seed dispersal agents: a case study of the Common Palm Civets in the Tabin Wildlife Reserve, Sabah, Malaysia. *Oecologia* 164: 721–730.

Nayar, T. S., Rasiya Beegam, A., Mohanan, N. & Rajkumar, G. 2006. *Flowering plants of Kerala – a handbook*. Tropical Botanic Garden and Research Institute, Thiruvananthapuram, India.

Patou, M.-L., Wilting, A., Gaubert, P., Esselstyn, J. A., Cruaud, C., Jennings, A. P., Fickel, J. & Veron, G. 2010. Evolutionary history of the *Paradoxurus* palm civets – a new model for Asian biogeography. *Journal of Biogeography* 37: 2077–2097.

Pocock, R. I. 1933. The palm civets or toddy cats of the genera *Paradoxurus* and *Paguma* inhabiting British India. *Journal of Bombay Natural History Society* 36: 855–877.

Prater, S. 1971. *The book of Indian animals*, 3rd edn. Bombay Natural History Society and Oxford University Press, Bombay, India.

Rabinowitz, A. R. 1991. Behaviour and movements of sympatric civet species in Huai Kha Khaeng wildlife sanctuary, Thailand. *Journal of Zoology, London* 223: 281–298.

Singh, L. A. K. 1982. Stomach contents of a Common Palm Civet *Paradoxurus hermaphroditus* (Pallas). *Journal of Bombay Natural History Society* 79: 403–404.

Su Su & Sale, J. 2007. Niche differentiation between Common Palm Civet *Paradoxurus hermaphroditus* and Small Indian Civet *Viverricula indica* in regenerating degraded forest, Myanmar. *Small Carnivore Conservation* 36: 30–34.

Zhou, Y. B., Zhang, J., Slade, E., Zhang, L., Palomares, F., Chen, J., Wang, X. & Zhang, S. 2008. Dietary shifts in relation to fruit availability among Masked Palm Civets (*Paguma larvata*) in Central China. *Journal of Mammalogy* 89: 43–437.

Tropical Botanic Garden and Research Institute, Palode, Thiruvananthapuram – 695 562, Kerala, India.
Email: psjothish@gmail.com

Small carnivores of the Imbak Canyon, Sabah, Malaysia, Borneo, including a new locality for the Hose's Civet *Diplogale hosei*

Hisashi MATSUBAYASHI, Henry BERNARD and Abdul Hamid AHMAD

Abstract

Mammals were surveyed with camera-traps in Imbak Canyon Conservation Area, Sabah, Malaysia, over 14–19 June 2011. In 75 camera-trap-nights, forty-nine pictures of 12 species were taken, including five small carnivores: Hose's Civet *Diplogale hosei*, Banded Civet *Hemigalus derbyanus*, Masked Palm Civet *Paguma larvata*, Malay Civet *Viverra tangalunga* and Short-tailed Mongoose *Herpestes brachyurus*. Hose's Civet and Banded Civet are regarded as Vulnerable under *The IUCN Red List of Threatened Species*. Of particular importance is Hose's Civet, endemic to Borneo, and one of the world's least known civets: Imbak is only the fifth site where the species has been confirmed in Sabah.

Keywords: camera-trapping, civet, mongoose, tropical rainforest

Abstrak

Tinjauan terhadap haiwan mamalia dengan menggunakan kaedah perangkap-kamera telah dilaksanakan di Kawasan Pemuliharaan Imbak Kanyon, Sabah, Malaysia pada 14–19 Jun 2011. Dengan pemerangkapan selama 75 malam-perangkap-kamera, sebanyak empat puluh sembilan gambar yang terdiri daripada 12 spesies telah berjaya dirakamkan iaitu termasuk Musang Hitam Pudar *Diplogale hosei*, Musang Belang *Hemigalus derbyanus*, Musang Lamri *Paguma larvata*, Tenggalong *Viverra tangalunga*, dan Bambun ekor-pendek *Herpestes brachyurus*. Musang Hitam Pudar dan Musang Belang merupakan spesies terdedah kepada ancaman mengikut senarai merah spesies terancam secara global IUCN. Musang Hitam Pudar merupakan satu dapatan yang penting kerana spesies ini endemik di Borneo dan merupakan salah satu spesies musang yang paling sedikit diketahui dalam dunia: Imbak adalah lokasi ke-lima dimana spesies ini telah disahkan boleh ditemui di Sabah.

Kata kunci: Bambun, hutan hujan tropika, Musang, Perangkap-kamera

Introduction

Eight species of civet (Viverridae), one of linsang (Prionodontidae) and two of mongoose (Herpestidae), inhabit Borneo, with various diets and using habitats from lowland to mountain forests (IUCN 2011). All 11 species exist in Sabah, in the northern part of Borneo. Small carnivores have some irreplaceable ecological functions (e.g. seed dispersers, predators) in tropical forest ecosystems (Payne *et al*. 1985, Nakashima *et al.* 2010), so their conservation is particularly important. At present, species distributions in Sabah are being accumulated (e.g. Yasuma & Andau 2000, Wells *et al*. 2005, Wilting *et al*. 2010), but compared with the speed of habitat degradation and loss (Hardiono & Alfred 2005), the amount of information is still poor and distributions of many small carnivores in most of Sabah remain poorly known. This brief note reports on the small carnivore species (excluding cats) detected in Imbak Canyon, from where no data were available so far, and includes a record of the Hose's Civet *Diplogale hosei*, a Bornean endemic of which very little is known.

Imbak Canyon Conservation Area, of 30,000 ha, is a primary tropical rainforest, located in central Sabah (Fig. 1). The canyon itself has a depth of about 750 m and is about 3 km wide. Its floor lies at 250 m altitude, while its rim perches at 1,000 m. This area was gazetted as a Class I Forest Reserve by the state government of Sabah in 2009, totally protecting it from logging activities. Gunung Kuli Research Station (5°01'35.9"N, 117°02'41.8"E; 309 m elevation measured by GPS [Garmin etrex Vista HCx]) was established in Imbak Canyon Conservation Area in 2010. Yayasan Sabah, a statutory body of the Sabah state government, manages the area for conservation, research, training, education and nature recreation. Around this research station are various habitats over 300–1,400 m: primary lowland and upper mixed dipterocarp forest (300–900 m), lower montane forest (900–1,200 m) and rocky ultrabasic lower montane forest (1,200–1,400 m; J. Kulip, Universiti Malaysia Sabah, *in litt*. 2011). Hunting pressure around the station is low, although outsiders sometimes seek an aromatic wood, Gaharu *Aquilaria malaccensis*, in the area.

Materials and methods

Camera-trapping was carried out by the Institute for Tropical Biology and Conservation of Universiti Malaysia Sabah and Yayasan Sabah over 14–19 June 2011, around the Gunung Kuli Research Station. Fifteen camera-traps, comprising nine digital cameras (eight Capture, Cuddeback, CA, U.S.A.; one FieldNote Duo, Marif, Yamaguchi, Japan) and six analogue cameras (FieldNote II, Marif, Yamaguchi, Japan) were set along the Ridge Trail. This trail follows the main ridge west of the Gunung Kuli Research Station, looping approximately 10 km through steep slopes; it is around 1 m wide and does not break the canopy. During this survey, 4–8 people used this trail, but usually few people pass the trail. The camera-traps were placed around 30 cm above the ground and at every 150 m along the Ridge Trail itself in an otherwise undisturbed forest, covering elevations between 300 and 600 m (Table 1).

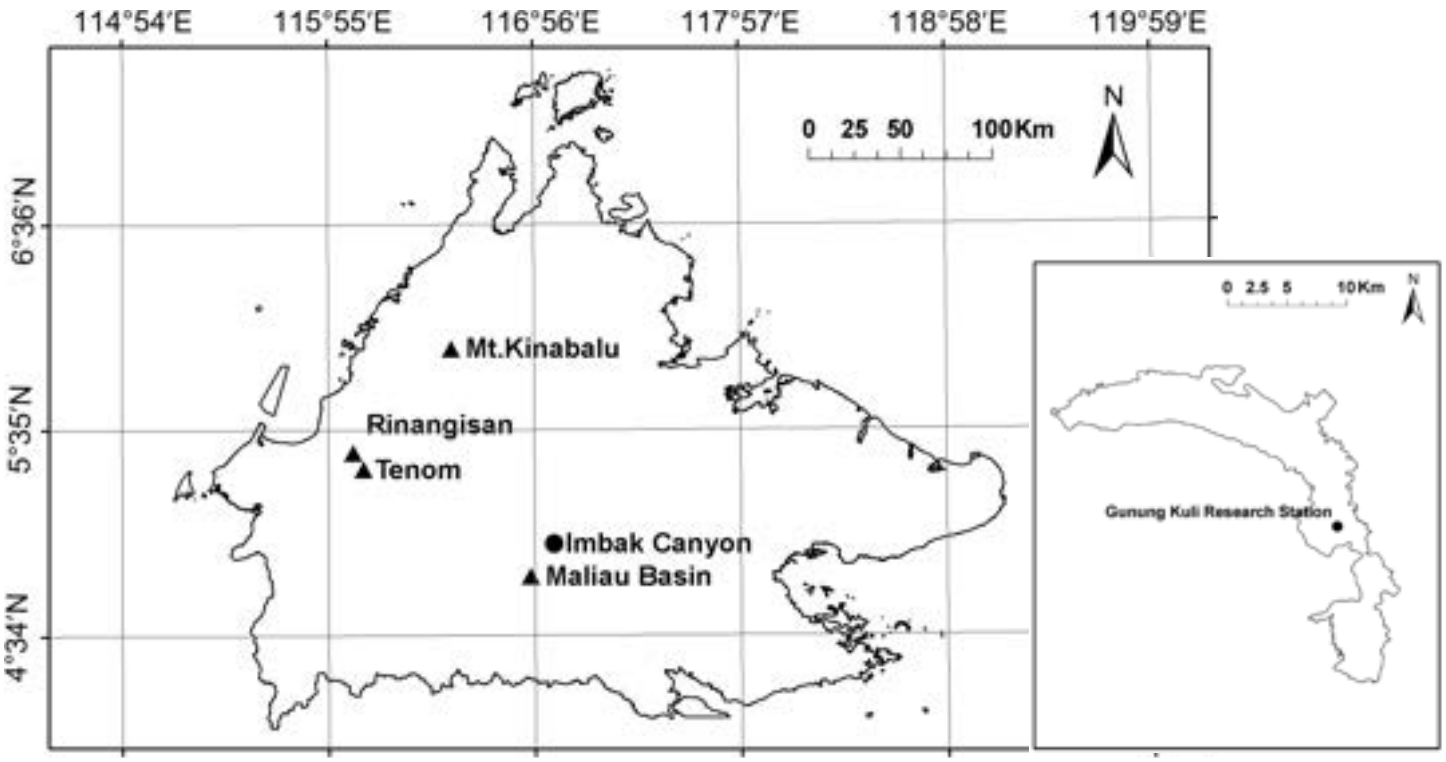

Fig. 1. Known locations of Hose's Civet *Diplogale hosei* in Sabah (top) and location of Gunung Kuli Research Station in Imbak Canyon Conservation Area (right).

All camera-traps were baited with a local variety of banana (freshly each day) suspended about 1 m above ground level in front of the camera-trap's detection zone. After completion of the field study, the numbers of each species photographed were counted by H. Matsubayashi, with external validation of identification by M. Yasuda of Forestry and Forest Products Research Institute, Japan; multiple photographs of the same species within 1 hour were counted only once. This study focuses on animals of >1 kg body weight. Nomenclature follows IUCN (2011).

Table 1. Locations of camera-trapping stations.

Camera-trapping station	Latitude North	Longitude East	Measured elevation (m)
C01	5°01'34.8"	117°02'35.5"	314
C02	5°01'35.4"	117°02'30.4"	324
C03	5°01'34.4"	117°02'25.5"	352
C04	5°01'34.5"	117°02'21.0"	385
C05	5° 01'34.1"	117° 02'16.8"	453
C06	5°01'34.0"	117°02'13.6"	460
C07	5°01'32.3"	117°02'09.8"	503
C08	5°01'31.8"	117°02'05.2"	545
C09	5°01'33.1"	117°02'02.4"	532
C10	5°01'33.3"	117°01'58.5"	572
C11	5°01'31.0"	117°01'54.9"	592
C12	5°01'29.3"	117°01'51.0"	619
C13	5°01'27.9"	117°01'46.5"	625
C14	5°01'25.4"	117°01'42.5"	626
C15	5°01'23.6"	117°01'38.8"	645

Results and discussion

A total of 75 camera-trap-nights gave 49 pictures of 12 species (Table 2). Five species of small carnivore, Hose's Civet *Diplogale hosei*, Banded Civet *Hemigalus derbyanus*, Masked Palm Civet *Paguma larvata*, Malay Civet *Viverra tangalunga* and Short-tailed Mongoose *Herpestes brachyurus,* were identified (Fig. 2). Hose's Civet and Banded Civet are categorised as Vulnerable by *The IUCN Red List of Threatened Species* (Hon & Azlan 2008, Hon *et al*. 2008).

Hose's Civet, endemic to Borneo, was detected at 20h08 on 14 June 2011 at 592 m measured elevation, amid lowland mixed dipterocarp forest. Imbak is the fifth and, marginally, the most eastern site where this species has been confirmed in Sabah, following Mt Kinabalu, Tenom, Rinangisan (in the Crocker Range) and Maliau Basin (Fig. 1; Van Rompaey & Azlan 2004, Wells *et al.* 2005, Brodie & Giordano 2011). In addition, Van Rompaey & Azlan (2004) located 'Mt Salekan' in Sabah, although the museum tag (no field tag survives) of the specimen in question (National Museum of Natural History—Naturalis—Leiden, Netherlands, collection number 'schedel a'; A. Wilting *in litt.* 2011) says it is from Sarawak. The nearest previous Hose's Civet recorded to Imbak was in the Maliau Basin, around 25 km distant. The detected elevation of this species in Imbak, about 600 m, is within the known range of 450–1,700 m above sea level (Francis 2002, Dinets 2003).

Banded Civet was detected once, at 00h12 on 16 June 2011 at 460 m elevation. Hose's Civet and Banded Civet were recorded within 1 km of each other and only 140 m different in altitude. Generally, Hose's Civet records are from higher areas, Banded Civets from lower (e.g. Payne *et al*. 1985) and the extent of microgeographic overlap in their distributions is un-

Fig. 2. The five species of small carnivore camera-trapped in Imbak Canyon Conservation Area, Sabah, during June 2011: Hose's Civet *Diplogale hosei* (left top); Banded Civet *Hemigalus derbyanus* (left middle); Masked Palm Civet *Paguma larvata* (left bottom); Malay Civet *Viverra tangalunga* (top); and Short-tailed Mongoose *Herpestes brachyurus* (bottom).

known. Moreover, Hose's Civet and Banded Civet are not frugivorous (Payne *et al*. 1985); whether they reacted to the scent of the banana bait, or were simply passing the cameras, is unclear.

Masked Palm Civet was the most photographed (25 times) and widely distributed species (12 camera stations across measured elevations of 352–645 m). It was photographed at night and during the crepuscular period, over 18h00–07h00. Malay Civet was detected at five camera stations across most of the surveyed elevational range, only at night. The multiple detections of Masked Palm Civet and Malay Civet might reflect their abundance. Equally it is possible that only one or two individuals of each species were detected at all camera-traps combined, because of closeness of the camera-traps to each other and, perhaps, their attraction to the banana bait.

Short-tailed Mongoose *Herpestes brachyurus* was detected at 08h32, consistent with its mainly diurnal nature (Mathai *et al*. 2010, Wilting *et al.* 2010). An unidentified mongoose was photographed at 06h10.

That five small carnivore species were confirmed, despite the relatively few camera-trap-nights, suggests that camera-trapping with banana bait is a useful method to detect these species. The behaviour of Hose's Civet was reported for a captive individual but is still largely unknown in the wild (Yasuma 2004). Longer-term survey over a larger part of the conservation area, using multiple methods (see, e.g., Wilting *et al*. 2010) will enhance understanding of small carnivore status and conservation needs.

Table 2. Mammal species detected at each camera-trapping station.

Detected species (total number of photographs)	IUCN Red List category[1]	Camera-trapping stations and elevation range (m)														
		C01	C02	C03	C04	C05	C06	C07	C08	C09	C10	C11	C12	C13	C14	C15
		314–385				453–460		503–592					619–645			
Southern Pig-tailed Macaque *Macaca nemestrina* (1)	VU									1						
Malayan Porcupine *Hystrix brachyura* (2)	LC				1		1									
Long-tailed Porcupine *Trichys fasciculata* (6)	LC		1										5			
Malay Civet *Viverra tangalunga* (5)	LC			1			1				1				1	1
Masked Palm Civet *Paguma larvata* (25)	LC			1	2	2	2	5	3		1	2	1	3	2	1
Hose's Civet *Diplogale hosei* (1)	VU											1				
Banded Civet *Hemigalus derbyanus* (1)	VU						1									
Short-tailed Mongoose *Herpestes brachyurus*[2] (1)	LC											1				
Leopard Cat *Prionailurus bengalensis* (1)	LC										1					
Chevrotain *Tragulus* sp(p).[3] (2)	LC			1	1											
Southern Red Muntjac *Muntiacus muntjak* (2)	LC	1														1
Bornean Yellow Muntjac *M. atherodes* (1)	LC		1													

[1]From *The IUCN Red List of Threatened Species* Version 2011.1. LC = Least Concern; VU = Vulnerable.

[2]One additional photograph identifiable only as mongoose *Herpestes* sp. was taken at C08; the other possible species is Collared Mongoose *H. semitorquatus*.

[3]It was not possible to distinguish between Lesser and Greater Chevrotains *Tragulus kancil* and *T. napu* on the photographs.

Acknowledgements

We thank the staff of Institute for Tropical Biology and Conservation of the Universiti Malaysia Sabah for assisting with the fieldwork. We also thank the staff of Yayasan Sabah, especially Waidi Sinun and the forest rangers based at Gunung Kuli Research Station, for their kind support during the survey. The manuscript was improved by comments from Will Duckworth, John Mathai and Andreas Wilting; Steven van der Mije of Naturalis provided additional information on the 'Mount Salekan' specimen.

References

Brodie, J. & Giordano, A. 2011. Small carnivores of the Maliau Basin, Sabah, Borneo, including a new locality for Hose's Civet *Diplogale hosei*. *Small Carnivore Conservation* 44: 1–6.

Dinets, V. 2003. Records of small carnivores from Mount Kinabalu, Sabah, Borneo. *Small Carnivore Conservation* 28: 9.

Francis, C. M. 2002. An observation of Hose's Civet in Brunei. *Small Carnivore Conservation* 26: 16.

Hardiono, M. & Alfred, J. R. 2005. *Borneo: treasure island at risk*. WWF, Frankfurt am Main, Germany.

Hon, J. & Azlan, M. J. 2008. *Diplogale hosei*. In: IUCN 2011. *IUCN Red List of Threatened Species*. Version 2011.1. <www.iucnredlist.org>. Downloaded on 26 June 2011.

Hon, J., Azlan, M. J. & Duckworth, J. W. 2008. *Hemigalus derbyanus*. In: IUCN 2011. *IUCN Red List of Threatened Species*. Version 2011.1. <www.iucnredlist.org>. Downloaded on 26 June 2011.

IUCN 2011. *IUCN Red List of Threatened Species*. Version 2011.1. <http://www.iucnredlist.org.> Downloaded on 23 August 2011.

Mathai, J., Hon, J., Juat, N., Peter, A. & Gumal, M. 2010. Small carnivores in a logging concession in the upper Baram, Sarawak. *Small Carnivore Conservation* 42: 1–9.

Nakashima, Y., Inoue, E., Inoue-Murayama, M. & Sukor, J. R. A. 2010. Functional uniqueness of a small carnivore as seed dispersal agents: a case study of the Common Palm Civets in the Tabin Wildlife Reserve, Sabah, Malaysia. *Oecologia* 164: 721–730.

Payne, J., Francis, C. M. & Phillipps, K. 1985. *A field guide to the mammals of Borneo*. The Sabah Society, Kota Kinabalu, Malaysia.

Van Rompaey, H. & Azlan J., M. 2004. Hose's Civet, *Diplogale hosei*. *Small Carnivore Conservation* 30: 18–19.

Wells, K., Biun, A. & Gabin, M. 2005. Viverrid and herpestid observations by camera and small mammal cage trapping in the lowland rainforests on Borneo including a record of the Hose's Civet, *Diplogale hosei*. *Small Carnivore Conservation* 32: 12–14.

Wilting, A., Samejima, H. & Azlan, M. 2010. Diversity of Bornean viver-

rids and other small carnivores in Deramakot Forest Reserve, Sabah, Malaysia. *Small Carnivore Conservation* 42: 10–13.
Yasuma, S. 2004. Observation of a live Hose's Civet *Diplogale hosei*. *Small Carnivore Conservation* 31: 3–5.
Yasuma, S. & Andau, M. 2000. *Mammals of Sabah, part 2: habitat and ecology*. Japanese International Cooperation Agency & Sabah Wildlife Department, Kota Kinabalu, Malaysia.

Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah, Jalan UMS, 88400, Kota Kinabalu, Sabah, Malaysia.
Emails: matsubayashi.hisashi@gmail.com (Hisashi Matsubayashi), hbtiandun@yahoo.com (Henry Bernard), midahmad@gmail.com (Abdul Hamid Ahmad)

New discovery!

A new species of ferret badger *Melogale* has been named from Vietnam

Ferret badgers *Melogale* are distributed in the Indochinese region (southern China, the eastern Himalayas and non-Sundaic South-east Asia), Java, Bali and north-east Borneo. Typically four species are recognised, all very similar in external morphology. In March 2005 a living ferret badger of different phenotype was confiscated by rangers from Cuc Phuong National Park, Vietnam (see photograph). It died and the carcass was not preserved. In January 2006 a freshly dead individual of the same phenotype was found at the Endangered Primate Rescue Center, Cuc Phuong National Park (20°45'N, 105°43'E). These animals differ from the known species in several characteristics, and are named Cuc Phuong Ferret Badger *Melogale cucphuongensis* Nadler, Streicher, Stefen, Schwierz & Roos, 2011. The new species is sympatric with Small-toothed Ferret Badger *M. moschata* and Large-toothed Ferret Badger *M. personata* but differs clearly from both species in skull morphology and other features. It is smaller than the other ferret badger species, dorsally dark and ventrally buff in colour and has only very few very small white markings on the head and hindneck. Characteristic for the species is the elongated nose with a rhinarium that extends to the upper side of the nose and forms a small naked wedge. The snout is long, narrow and bends slightly upwards, and the mouth is set back a clear distance from the nose. Based on a 423 base-pair-long fragment of the mitochondrial cytochrome b gene, *M. cucphuongensis* is obviously within *Melogale* and represents a sister lineage to a clade containing at least *M. personata* and *M. moschata* (Bornean Ferret Badger *M. everetti* and Javan Ferret Badger *M. orientalis* were not included in the analysis). Whilst *M. personata* and *M. moschata* are very difficult to distinguish on external morphology, the new species is clearly different looking. Quite surprisingly the new species was found in Cuc Phuong National Park, a location, where fauna and flora have been studied for many years by many researchers. The finding clearly demonstrates the need to always remain alert and open for new discoveries.

Freshly-dead Cuc Phuong Ferret Badger *Melogale cucphuongensis* Nadler, Streicher, Stefen, Schwierz & Roos, 2011. Cuc Phuong National Park, Vietnam, March 2005. (Photo: Elke Schwierz)

Reference

Nadler, T., Streicher, U., Stefen, C., Schwierz, E. & Roos, C. 2011. A new species of ferret-badger, genus *Melogale*, from Vietnam. *Der Zoologische Garten* N. F. 80: 271–286.

rids and other small carnivores in Deramakot Forest Reserve, Sabah, Malaysia. *Small Carnivore Conservation* 42: 10–13.
Yasuma, S. 2004. Observation of a live Hose's Civet *Diplogale hosei*. *Small Carnivore Conservation* 31: 3–5.
Yasuma, S. & Andau, M. 2000. *Mammals of Sabah, part 2: habitat and ecology*. Japanese International Cooperation Agency & Sabah Wildlife Department, Kota Kinabalu, Malaysia.

Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah, Jalan UMS, 88400, Kota Kinabalu, Sabah, Malaysia.
Emails: matsubayashi.hisashi@gmail.com (Hisashi Matsubayashi), hbtiandun@yahoo.com (Henry Bernard), midahmad@gmail.com (Abdul Hamid Ahmad)

New discovery!

A new species of ferret badger *Melogale* has been named from Vietnam

Ferret badgers *Melogale* are distributed in the Indochinese region (southern China, the eastern Himalayas and non-Sundaic South-east Asia), Java, Bali and north-east Borneo. Typically four species are recognised, all very similar in external morphology. In March 2005 a living ferret badger of different phenotype was confiscated by rangers from Cuc Phuong National Park, Vietnam (see photograph). It died and the carcass was not preserved. In January 2006 a freshly dead individual of the same phenotype was found at the Endangered Primate Rescue Center, Cuc Phuong National Park (20°45'N, 105°43'E). These animals differ from the known species in several characteristics, and are named Cuc Phuong Ferret Badger *Melogale cucphuongensis* Nadler, Streicher, Stefen, Schwierz & Roos, 2011. The new species is sympatric with Small-toothed Ferret Badger *M. moschata* and Large-toothed Ferret Badger *M. personata* but differs clearly from both species in skull morphology and other features. It is smaller than the other ferret badger species, dorsally dark and ventrally buff in colour and has only very few very small white markings on the head and hindneck. Characteristic for the species is the elongated nose with a rhinarium that extends to the upper side of the nose and forms a small naked wedge. The snout is long, narrow and bends slightly upwards, and the mouth is set back a clear distance from the nose. Based on a 423 base-pair-long fragment of the mitochondrial cytochrome b gene, *M. cucphuongensis* is obviously within *Melogale* and represents a sister lineage to a clade containing at least *M. personata* and *M. moschata* (Bornean Ferret Badger *M. everetti* and Javan Ferret Badger *M. orientalis* were not included in the analysis). Whilst *M. personata* and *M. moschata* are very difficult to distinguish on external morphology, the new species is clearly different looking. Quite surprisingly the new species was found in Cuc Phuong National Park, a location, where fauna and flora have been studied for many years by many researchers. The finding clearly demonstrates the need to always remain alert and open for new discoveries.

Freshly-dead Cuc Phuong Ferret Badger *Melogale cucphuongensis* Nadler, Streicher, Stefen, Schwierz & Roos, 2011. Cuc Phuong National Park, Vietnam, March 2005. (Photo: Elke Schwierz)

Reference

Nadler, T., Streicher, U., Stefen, C., Schwierz, E. & Roos, C. 2011. A new species of ferret-badger, genus *Melogale*, from Vietnam. *Der Zoologische Garten* N. F. 80: 271–286.

A record of the little-known Bornean Ferret Badger *Melogale everetti* at Gunung Alab, Sabah, Malaysia

Anna WONG[1*], Nurul Saadah MOHAMED[2], Fred Yit Yu TUH[3] and Andreas WILTING[4]

Abstract

The Bornean Ferret Badger *Melogale everetti* is one of the least known Bornean carnivores, currently classified as Data Deficient on *The IUCN Red List of Threatened Species*. No Southeast Asian carnivore has a smaller known distribution. Few confirmed records from the last decade exist. One was captured in a wire mesh live-trap baited with banana, at Gunung (Mount) Alab, Crocker Range Park, Sabah, Malaysia, in October 2010.

Keywords: Carnivora, Crocker Range Park, Mustelidae, wire-mesh live trap

Abstrak

Borneo Ferret Badger *Melogale everetti* merupakan salah satu spesies haiwan Borneo karnivora yang paling kurang dikenali, dan kini diklasifikasi sebagai Tak Cukup Data (*Data Deficient*) di dalam Senarai Merah Spesies Terancam IUCN. Ia adalah haiwan karnivora Asia Tenggara yang paling sedikit dikenali taburannya dan hanya beberapa rekod yang pasti didapati pada dekad yang lepas. Spesies ini berjaya ditangkap dengan menggunakan perangkap dawai dan umpan pisang semasa kerjalapangan dijalankan di Gunung Alab, Daerah Tambunan, Taman Banjaran Crocker, Sabah, Malaysia pada Oktober 2010.

Kata-kata kunci: Karnivora, Mustelidae, perangkap hidup, Taman Banjaran Crocker

The Bornean Ferret Badger *Melogale everetti* (also known as Everett's Ferret Badger or Kinabalu Ferret Badger) was described in 1895 by Oldfield Thomas. Although it has been classified as a subspecies of the Javan Ferret Badger *M. orientalis* (e.g. Chasen 1940, Payne *et al.* 1985), today it is generally considered a separate species (Corbet & Hill 1992, Long 1992).

This species is endemic to the island of Borneo and is the only species of ferret badger on the island. It is known only from Gunung (Mount) Kinabalu (Payne *et al*. 1985) and adjacent areas in the districts of Penampang, Tuaran and Tambunan—the three districts where 57 museum specimens in the Sabah Museum were collected within a few years in the late 1960s–early 1970s; it is suspected to occur also on Gunung Tambayukon to the north of Kinabalu (Payne *et al*. 1985). In addition, there is a subfossil record from the Niah Caves in Sarawak (Harrison 1996). The observation by Boonratana (2010) from a tributary of the Kinabatangan River, Sabah, remains questionable, especially as the lower Kinabatangan is more than 200 km east of the other records and is in the extreme lowlands. All confirmed records are from uplands or highlands at 500 – over 3,000 m elevation (Borneo Carnivore Database; Wilting 2011). Specimens in the Sabah Museum and Sabah Parks collection show a broad colour variation from pale brown to dark brown with a paler underside (Fig. 1).

Very little is known about the diet of this ferret badger, but Payne *et al*. (1985) noted earthworms and small vertebrates. Dinets (2003) observed a Bornean Ferret Badger at a roadside garbage dump at Kinabalu Park. Javan Ferret Badger feeds at picnic sites along the tourist trails of Gunung Gede Pangrango National Park, Java (Duckworth *et al.* 2008), but it seems that the Bornean Ferret Badger has so far not been observed along the picnic sites at the hiking trails of Mount Kinabalu (FTYY and M. Lakim *in litt*. 2011). This species is believed to be nocturnal and ground-dwelling (Payne *et al.* 1985).

Fig. 1. Colour variation of the Bornean Ferret Badger *Melogale everetti* shown by specimens from the Sabah Museum, Malaysia. Specimens were selected to show the full range of dorsal colour variation and stripe length/breadth in the 57 specimens held there.

Gunung Alab, rising to 1,932 m asl, is one of several peaks in Crocker Range Park exceeding 1,500 m asl (Bernard 2004). Around the Gunung Alab substation (5°49'17.5"N, 116°20'29.5"E; Fig. 2), near a permanent plot in montane mossy forest, three transects of ten wire-mesh live-traps per transect were established for three nights to trap non-volant small mammals. Traps, all baited with banana, were placed at 10 m intervals along each transect. On 6 October 2010 *M. everetti* was captured in a trap (Fig. 3) at the locality of 5°49'30.8"N, 116°20'47.3"E at an altitude of about 1,945 m asl. The animal could not be tranquilised and measured (or aged or sexed) and was released on site after several pictures were taken. Its grey coloration (Fig. 3) contrasts with the basically brown museum specimens (Fig. 1).

Currently, the Bornean Ferret Badger is listed as Data

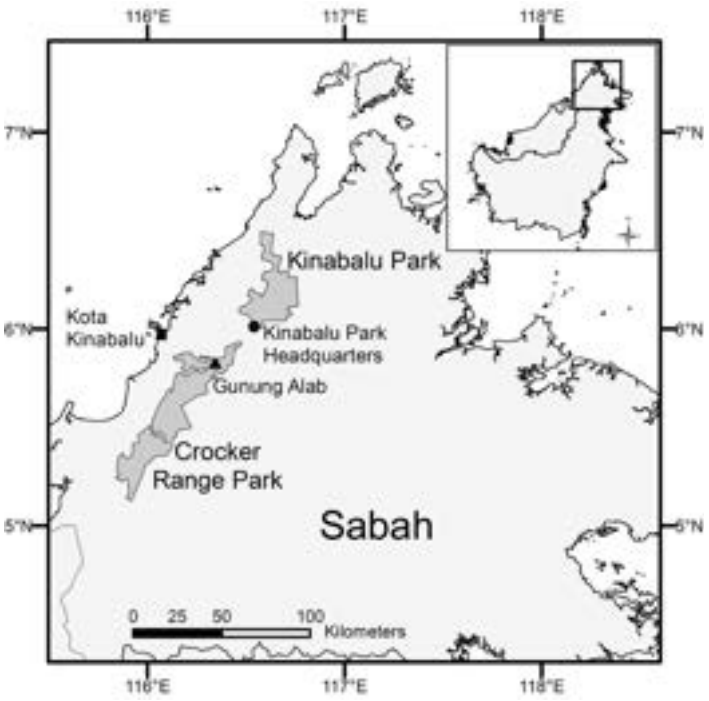

Fig. 2. Location of Crocker Range Park, Kinabalu Park and the study site of Gunung Alab Substation, Sabah, Malaysia.

Fig. 3. Bornean Ferret Badger *Melogale everetti*, in a wire-mesh live-trap, baited with banana. Gunung Alab, Crocker Range Park, Sabah, Malaysia, 6 October 2010.

Deficient on *The IUCN Red List of Threatened Species* (Duckworth & Azlan 2008) and almost nothing is known about its distribution, abundance, population trends and its susceptibility to habitat changes. The impact of other threats such as hunting is also unknown, but in any Sabah Parks' area, hunting is prohibited, and hunting levels within the parks are presumably too low to affect the species's status. However, the high number of specimens in the Sabah Museum indicates that this species might be comparatively easy to hunt. The extremely small distribution range of this species may make it highly vulnerable to climatic and other environmental changes. Thus there is a particular need for more survey work and research on the Bornean Ferret Badger. Such surveys could start with basic interview surveys in the villages around the Kinabalu and Crocker Range Parks. Surveys should also expand outside its currently known range, to the highlands of Sarawak, Brunei Darussalam and Kalimantan: it might have been overlooked in these, due to the low number of intensive surveys and the apparent general difficulties to record this species.

Furthermore, Griswold (in Allen & Coolidge 1940) described the Bornean Ferret Badger as a "not very common, purely primeval-forest dweller" and although it is unknown upon how many observations this description is based, such narrow habitat-use could threaten this species due to the habitat disruption in areas around the parks. Hence, in-depth ecological studies on the habitat requirements, to determine the ecological factors restricting this species to such a small distribution range, will be a prerequisite for efficient conservation actions. No less important will be the evaluation of the susceptibility of the Bornean Ferret Badger to direct threats, such as hunting and, maybe even more important for this species, to feral dogs *Canis familiaris*. These dogs could have a strong effect on the 'naïve' small ranging Bornean Ferret Badger through direct predation, competition and/or the transmission of infectious diseases. The dearth of recent records suggests that urgent conservation steps might be needed to protect the Bornean Ferret Badger from extinction. Alternatively, it may simply be grossly under-recorded by conventional survey methods: Robichaud (2010) found that across Laos, ferret badgers were indeed rarely recorded on most surveys, despite being locally common.

Acknowledgements

Many thanks to Institute for Development Studies (IDS) for appointing the first author as the consultant for faunal component of Crocker Range Park tourism development plan. We thank Sabah Parks for giving us permission to study small mammals in Mount Alab Substation and Albert Lo of the Sabah Museum for allowing access to their collection. We acknowledge the Director of the Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah, for allowing us to carry out this study in Crocker Range Park. We also thank the staff of Sabah Parks especially Tuan Yassin, Park Warden of Crocker Range Park, who provided much assistance and accommodation. We are indebted to J. W. Duckworth, Alexei Abramov and one anonymous referee for their comments on earlier drafts of this manuscript.

References

Allen, G. M. & Coolidge, H. J. 1940. Mammal and bird collections of the Asiatic Primate Expedition. *Bulletin of the Museum of Comparative Zoology* 87: 131–166.

Bernard, H., Kalsum, M. Y., Yasuma, S. & Lucy, K. 2004. A survey of a small mammals at several elevations in and around Crocker Range Park. Pp. 113–130 in Maryati, M., Zulhazman Hamzah, Takuji Tachi & Jamili Nais (eds) *Crocker Range scientific expedition 2002*. Universiti Malaysia Sabah, Kota Kinabalu, Malaysia.

Boonratana, R. 2010. Sighting of the Bornean Ferret Badger *Melogale everetti* in the Kinabatangan floodplains, and implications of its lowland distribution. *Small Carnivore Conservation* 42: 22–24.

Chasen, F. N. 1940. A handlist of Malaysian mammals: a systematic list of the mammals of the Malay Peninsula, Sumatra, Borneo and Java, including adjacent small islands. *Bulletin of the Raffles Museum* 15: i–xx, 1–209.

Corbet, G. B. & Hill, J. E. 1992. *The mammals of the Indo-Malayan region: a systematic review*. Oxford University Press, Oxford, U.K.

Dinets, V. 2003. Records of small carnivores from Mount Kinabalu, Sabah, Borneo. *Small Carnivore Conservation* 28: 9.

Duckworth, J. W. & Azlan, M. J. 2008. *Melogale everetti*. In: IUCN 2011. *IUCN Red List of Threatened Species*. Version 2011.1. www .iucnredlist.org. Downloaded on 2 May 2011.

Duckworth, J. W., Roberton, S. I. & Brickle, N. W. 2008. Further notes on Javan Ferret Badger *Melogale orientalis* at Gunung Gede Pangrango National Park, Java. *Small Carnivore Conservation* 39: 39–40.

Harrison, T. 1996. The palaeoecological context at Niah cave, Sarawak: evidence from the primate fauna. *Indo-Pacific Prehistory Association Bulletin* 14: 90–100.

Long, C. A. 1992. Is the Javan Ferret-Badger a subspecies or a species? *Small Carnivore Conservation* 6: 17.

Payne, J., Francis, C. M. & Phillipps, K. 1985. *A field guide to the mammals of Borneo*. The Sabah Society and World Wildlife Fund Malaysia, Kota Kinabalu, Malaysia.

Robichaud, W. G. 2010. A field record of Small-toothed Ferret Badger *Melogale moschata* in Central Laos, and other recent records of ferret badgers from the country. *Small Carnivore Conservation* 42: 32–34.

Wilting, A. 2011. The Bornean Ferret Badger *Melogale everetti*. Oral presentation at the *1st Borneo Carnivore Symposium*, 18–24 June 2011, Kota Kinabalu, Sabah, Malaysia.

[1]Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah, Jln UMS, 88400 Kota Kinabalu, Sabah, Malaysia.
Email: annawg888@gmail.com
[2]Conservation Biology Programme, School of Science and Technology, Universiti Malaysia Sabah, Jln UMS, 88400 Kota Kinabalu, Sabah, Malaysia.
[3]Zoology and Entomology Section, Sabah Parks, P.O. Box 10626, 88806 Kota Kinabalu, Sabah, Malaysia.
[4]Leibniz Institute for Zoo and Wildlife Research, Alfred-Kowalke-Str. 17, 10315 Berlin, Germany.

Obituary: Pralad Yonzon

It was with shock and regret that I heard of the untimely death of Dr Pralad Yonzon who was killed in Kathmandu on Monday 31 October 2011 when a truck ran into his bicycle as he was making his way home from work.

Although I only met Dr Yonzon on three or four occasions, I was always impressed by his knowledge of wildlife, in particular the Red Panda *Ailurus fulgens*, and his dedication to conservation in his homeland. The first time I met Pralad, he was still a student, writing up his PhD thesis on the Red Pandas of Langtang National Park under the supervision of Dr Malcolm Hunter of the University of Maine. He was attending a Red Panda Conference in Rotterdam where he presented one of the first papers on his Red Panda work. This was one of the first of the modern studies of Red Panda ecology in general and the very first on the *fulgens* subspecies: as such it was ground-breaking work.

Dr Yonzon continued his work on Red Pandas, including a preliminary study of Red Pandas in Bhutan. However, as time progressed, his interests expanded to encompass more general conservation. In 1986 he founded Resources Himalaya, a Nepalese knowledge-based organisation dedicated to conservation of natural resources, which gradually evolved into an NGO that also works towards promoting livelihoods of the mountain peoples.

In 2002, Dr Yonzon received the Order of the Golden Ark from Prince Bernhard of the Netherlands for his services to conservation in Nepal, Bhutan and Vietnam.

Until his death, Dr Yonzon continued his work promoting conservation and inspiring and mentoring young people to follow in his footsteps, while never forgetting his love of the Red Panda. He will be sorely missed by conservationists and lovers of the Himalayas everywhere. Our thoughts go out to his family at this tragic time.

Angela GLATSTON

Duckworth, J. W. & Azlan, M. J. 2008. *Melogale everetti*. In: IUCN 2011. *IUCN Red List of Threatened Species*. Version 2011.1. www.iucnredlist.org. Downloaded on 2 May 2011.

Duckworth, J. W., Roberton, S. I. & Brickle, N. W. 2008. Further notes on Javan Ferret Badger *Melogale orientalis* at Gunung Gede Pangrango National Park, Java. *Small Carnivore Conservation* 39: 39–40.

Harrison, T. 1996. The palaeoecological context at Niah cave, Sarawak: evidence from the primate fauna. *Indo-Pacific Prehistory Association Bulletin* 14: 90–100.

Long, C. A. 1992. Is the Javan Ferret-Badger a subspecies or a species? *Small Carnivore Conservation* 6: 17.

Payne, J., Francis, C. M. & Phillipps, K. 1985. *A field guide to the mammals of Borneo*. The Sabah Society and World Wildlife Fund Malaysia, Kota Kinabalu, Malaysia.

Robichaud, W. G. 2010. A field record of Small-toothed Ferret Badger *Melogale moschata* in Central Laos, and other recent records of ferret badgers from the country. *Small Carnivore Conservation* 42: 32–34.

Wilting, A. 2011. The Bornean Ferret Badger *Melogale everetti*. Oral presentation at the *1st Borneo Carnivore Symposium*, 18–24 June 2011, Kota Kinabalu, Sabah, Malaysia.

[1]Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah, Jln UMS, 88400 Kota Kinabalu, Sabah, Malaysia.
Email: annawg888@gmail.com
[2]Conservation Biology Programme, School of Science and Technology, Universiti Malaysia Sabah, Jln UMS, 88400 Kota Kinabalu, Sabah, Malaysia.
[3]Zoology and Entomology Section, Sabah Parks, P.O. Box 10626, 88806 Kota Kinabalu, Sabah, Malaysia.
[4]Leibniz Institute for Zoo and Wildlife Research, Alfred-Kowalke-Str. 17, 10315 Berlin, Germany.

Obituary: Pralad Yonzon

It was with shock and regret that I heard of the untimely death of Dr Pralad Yonzon who was killed in Kathmandu on Monday 31 October 2011 when a truck ran into his bicycle as he was making his way home from work.

Although I only met Dr Yonzon on three or four occasions, I was always impressed by his knowledge of wildlife, in particular the Red Panda *Ailurus fulgens*, and his dedication to conservation in his homeland. The first time I met Pralad, he was still a student, writing up his PhD thesis on the Red Pandas of Langtang National Park under the supervision of Dr Malcolm Hunter of the University of Maine. He was attending a Red Panda Conference in Rotterdam where he presented one of the first papers on his Red Panda work. This was one of the first of the modern studies of Red Panda ecology in general and the very first on the *fulgens* subspecies: as such it was ground-breaking work.

Dr Yonzon continued his work on Red Pandas, including a preliminary study of Red Pandas in Bhutan. However, as time progressed, his interests expanded to encompass more general conservation. In 1986 he founded Resources Himalaya, a Nepalese knowledge-based organisation dedicated to conservation of natural resources, which gradually evolved into an NGO that also works towards promoting livelihoods of the mountain peoples.

In 2002, Dr Yonzon received the Order of the Golden Ark from Prince Bernhard of the Netherlands for his services to conservation in Nepal, Bhutan and Vietnam.

Until his death, Dr Yonzon continued his work promoting conservation and inspiring and mentoring young people to follow in his footsteps, while never forgetting his love of the Red Panda. He will be sorely missed by conservationists and lovers of the Himalayas everywhere. Our thoughts go out to his family at this tragic time.

Angela GLATSTON

Recent confirmed records and distribution of the White-nosed Coati *Nasua narica* in Colombia

José F. GONZÁLEZ-MAYA[1], Abelardo RODRÍGUEZ-BOLAÑOS[2], Diana PINTO[2] and Alex Mauricio JIMENEZ-ORTEGA[3]

Abstract

White-nosed Coati *Nasua narica* (Procyonidae) occurs from USA to South America west of the Andes. It has been extensively studied in some of its distribution range, but lacks information on basic ecology and distribution for most of its range. For Colombia, information is particularly scarce. Three new records of the species for the Chocó region are presented, increasing the number of credible localities from six to eight. A number of other claims, including some museum specimens, that suggest a distribution in the country wider than the Pacific region, require verification.

Keywords: Chocó, geographic range, occurrence, Procyonidae, South America

Registros recientes confirmados y su distribución del Cusumbo *Nasua narica* en Colombia

Resumen

El Cusumbo *Nasua narica* es un miembro de la familia Procyonidae que se distribuye desde Estados Unidos hasta Suramérica al Oeste de los Andes. La especie ha sido extensivamente estudiada en ciertas áreas de su distribución pero la mayoría de ésta permanece sin estudiar, con ausencia de referencias sobre su ecología básica y distribución. Para Colombia la información es particularmente escaza. Se presentan tres nuevos registros confirmados para la región del Chocó, aumentando el número de localidades que respaldan su distribución de seis a ocho para Colombia. Otros registros sugieren una distribución más amplia en el país, más allá de la región Pacífico, pero requieren verificación.

Palabras clave: Ámbito geográfico, Chocó, presencia, Procyonidae, Suramérica.

Introduction

White-nosed Coati *Nasua narica* is a member of the Procyonidae, considered Least Concern by *The IUCN Red List of Threatened Species* (Samudio *et al*. 2008). It is distinguished from its only congener in South America, the South American Coati *N. nasua*, by the muzzle pelage and by the normal position of the hairs on the nape of the neck (externally) and by the midline-depressed palate, the parallel (not converging to the posterior) nasal bones and the absence of the postorbital process of the jugal bone (on skulls; Gommper 1996). The species is apparently rare in the United States of America, perhaps because its home-range size increases and population density decreases with latitude (Valenzuela & Ceballos 2000), but it varies from common to scarce in Central America (Samudio *et al.* 2008), and has been considered the most abundant small carnivore in some areas of Costa Rica (González-Maya *et al.* 2009) and Mexico (Ceballos & Miranda 1986). Its status is uncertain in the southern part of its distribution, south to Peru's Pacific lowland rainforests (Pacheco *et al.* 2009). The species seems much reduced across its range (Janson 1981, Samudio *et al.* 2008), through habitat conversion to farmland and general forest loss, hunting, population isolation, non-target effects of predator-control campaigns and canine distemper and rabies (Samudio *et al.* 2008). Nonetheless, it seems at least locally to be highly adaptable, including to habitat modification and fragmentation (Samudio *et al.* 2008). Indeed, where not heavily hunted, it probably benefits from habitat disturbance (although not outright conversion) and human presence (Elmhagen & Rushton 2007, González-Maya *et al*. 2009).

The species is extensively studied in the USA and Mexico (Valenzuela 1998, Hass 2002) and in some areas of Costa Rica and Panama (Sáenz 1994, Gommper 1996, González-Maya *et al.* 2009), but over much of its distribution even the most basic information, such as occurrence and qualitative abundance, remains unclear. The Pacific slopes of South America, within which lies its southern limit of distribution, are one of the least known areas for several taxa, including mammals such as brockets *Mazama* and tapirs *Tapirus*, and reptiles such as American Crocodile *Crocodylus acutus* and Spectacled Caiman *Caiman crocodilus*. Glatston (1994) reported White-nosed Coati to occur south, west of the Andes, to Peru. Emmons (1990) also reported it as present towards the west coasts of Colombia, Ecuador and northern Peru, and it is reported in recent mammal lists for Ecuador (Tirira 2011) and Peru (Pacheco *et al.* 2009), always on the westerns slopes of the Andes.

Previous records from Colombia

For Colombia, limited information exists regarding White-nosed Coati's range, based on few specimens, some of questionable credibility (Table 1). The specimen that Alberico *et al.* (2000) reported in the Instituto de Ciencias Naturales of the Universidad Nacional de Colombia (ICN) as from Magdalena department is given as from Cundinamarca department in the collection database (ICN 2011). Additionally, its validity is dubious: the specimen is apparently no longer held in the collection (pers. obs.), so requires tracking of its history and when (if) found, a review of its identification. At least five of the specimens

Table 1. Confirmed and claimed specimen records of White-nosed Coati *Nasua narica* in Colombia.

Collection	Catalogue No	Locality	County	Department	Collector name	Reference
IAvH	4755-1214	-	Ciudad Bolívar	Antioquia	Unknown	GBIF 2011
IAvH	4755-1213	-	Betania	Antioquia	Unknown	GBIF 2011
IAvH	4755-1211	-	Citará	Antioquia	Unknown	GBIF 2011
IAvH	87-24	-	-	-	Unknown	GBIF 2011
IAvH	4755-1215	-	Salgar	Antioquia	Unknown	GBIF 2011
IAvH	4755-1212	-	Andes	Antioquia	Unknown	GBIF 2011
IAvH	8-81*	Montebello	Norcasia	Caldas	C. Solano & M. Contreras	GBIF 2011
IAvH	8-80*	Montebello	Norcasia	Caldas	C. Solano & M. Contreras	GBIF 2011
IAvH	8-79*	Montebello	Norcasia	Caldas	C. Solano & M. Contreras	GBIF 2011
IAvH	7070*	PNN Tama. Cabaña del Parque. Rio Táchira	-	Norte de Santander	J. C. Contreras	GBIF 2011
IAvH	7080*	PNN Tama. Vda. El Diamante	Toledo	Norte de Santander	Y. Muñoz	GBIF 2011
ICN	ACG-2852*	-	Yacopí	Cundinamarca (see text)	A. Cadena	Alberico *et al.* 2000
UV	-	-	-	Chocó	-	Alberico *et al.* 2000
PSO-CZ	-	Imprecise; Pacific slopes in the biogeographic Chocó	-	Nariño	Unknown	Ramírez-Chaves & Noguera-Urbano 2010
MUA	-	Imprecise: Urabá	-	Antioquia	Unknown	Cuartas-Calle & Muñoz-Arango 2003
ICN & IAvH	‡	Imprecise: Chocó	-	Chocó (4 specimens)	-	Guzmán-Lenis 2004
USNM	309084	Imprecise; Pacific slopes in the biogeographic Chocó	Ricourte?	Nariño	M. Carriker, Jr.	Ramírez-Chaves & Noguera-Urbano 2010
FMNH	69599	Unguía, Gulf of Urabá	-	Antioquia	P. Hershkovitz	Decker 1991
FMNH	69600	Unguía, Gulf of Urabá	-	Antioquia	P. Hershkovitz	Decker 1991
FMNH	69601	Unguía, Gulf of Urabá	-	Antioquia	P. Hershkovitz	Decker 1991

FMNH: Field Museum, Chicago – United States;
IAvH: Instituto de Recursos Biológicos Alexander von Humboldt – Colombia;
ICN: Instituto de Ciencias Naturales, Universidad Nacional – Colombia;
PSO-CZ: Colección Zoológica Universidad de Nariño – Colombia;
USNM: United States National Museum, Washington D.C. – United States;
UV: Universidad del Valle – Colombia.
Specimen numbers asterisked (*) indicate records that need review (see text).
‡ Although Guzmán-Lenis (2004) gave no details of the specimens evidently examined, the four mapped localities show that they are different from those tabulated here.

held at the Instituto de Investigación de Recursos Biológicos Alexander von Humboldt of Colombia (IAvH) require confirmation of the species identification, because confirmed records of White-nosed Coati in Colombia, i.e. those in Decker (1991), Cuartas-Calle & Muñoz-Arango (2003), Guzmán-Lenis (2004) and Ramírez-Chaves & Noguera-Urbano (2010), come only from the Pacific (west) slope lowlands, neither from central Colombia in the uplands of the Eastern Andes (Cundinamarca), nor to the east of this mountain range (Norte de Santander and Caldas). By contrast, South American Coati is likely to occur in the latter two departments and probably also in Cundinamarca (USNM 544419 – GBIF 2011; ICN 2961, ICN 15496 – ICN 2011; Vélez 2004), which lie close to the species's generally accepted distribution (Emmons & Helgen 2008, Ferrer Pérez *et al.* 2009) and indeed to specific previous confirmed records (i.e. Caldas; Castaño *et al.* 2003, Sánchez *et al.* 2004). Furthermore, the Norte de Santander records are located near the Colombia–Venezuela border and the *Nasua* species occurring in Venezuela is *N. nasua* and not *N. narica* (Ferrer Pérez *et al.* 2009). Even given the clear morphological differences between the two *Nasua* species in Colombia, hasty assessments could lead to coati specimen misidentification.

The Antioquia records (all in the western lowlands, i.e. biogeographic Chocó) from IAvH are more plausible and the species was confirmed previously for the department (Decker 1991, Cuartas-Calle & Muñoz-Arango 2003).

Guzmán-Lenis (2004) also traced and validated some specimens of the species in Colombia for a preliminary review of the family in the country. No information for specimens reviewed (catalogue numbers) was given. Guzmán-Lenis's (2004) methodology refers to specimens deposited at ICN and IAvH, but the final map shows only four confirmed White-nosed Coatis, all of them in the Colombia–Panama border (i.e. not all specimens currently listed by these collections as White-nosed Coati).

According to all sources traced, there are only 19 White-nosed Coati specimens claimed from the country (Table 1), including those that we consider (above) to require review of their identification and provenance. Unfortunately, the influential map in Samudio *et al.* (2008) included Magdalena department in White-nosed Coati's range, apparently based on Alberico *et al.* (2000), which requires confirmation (see above). Various sources (e.g. García-Salinas *et al.* 2002, Montero 2004) state that White-nosed Coati occurs in parts of Colombia for which we have traced no specimen-based claims; these statements are not reviewed here, but further confuse the perceptions of this coati's status in Colombia.

New records in Colombia

Three new confirmed White-nosed Coati records in western Colombia, in the Chocó department, were obtained through local visits in the capital city of the department (Quibdó) and exploratory camera-trapping in the region.

Fig. 1. Captive White-nosed Coati *Nasua narica* in an Embera indigenous house found by the environmental authorities (CODECHOCO) in Quibdó city, department of Chocó, Colombia, during wildlife possession surveys in 2008.

Fig. 2. Camera-trapped White-nosed Coatis *Nasua narica*, department of Chocó, Colombia; (top) near Nimiquia (31 November 2010 at 16h40) and (bottom) Valle rivers (5 January 2010 at 17h22).

During control surveys by the environmental authority of the Chocó department (Corporación Autónoma Regional para el Desarrollo Sostenible de Chocó; CODECHOCO) for community possession of wildlife in Quibdó in 2008, a White-nosed Coati was found in a city house. The animal was held as a pet by indigenous people of the Embera culture (Fig. 1). Credible information regarding the origin, let alone exact capture site, was impossible to obtain.

During exploratory camera-trapping from October 2010 through January 2011 in two localities of the Valle settlement, Bahía Solano municipality, department of Chocó, 80 registrations, as pictures or videos, of White-nosed Coati were obtained. Using 10 camera-traps (Bushnell Trophy Cam) during 91 days, accounting for a sampling effort of 1,820 camera-trap-nights at both localities combined, a total of 365 events (pictures and videos) of 15 mammal species were obtained. These included 80 registrations of White-nosed Coati, 35 obtained near Nimiquía River (6°6'52"N, 77°25'16"W) and 45 near Valle River (6°6'30"N, 77°24'34"W) and all from below 10 m asl (Fig. 2). A preliminary examination of timing and fur patterns indicates that all the pictures probably involve only five individuals, three near Valle River and two near Nimiquía River.

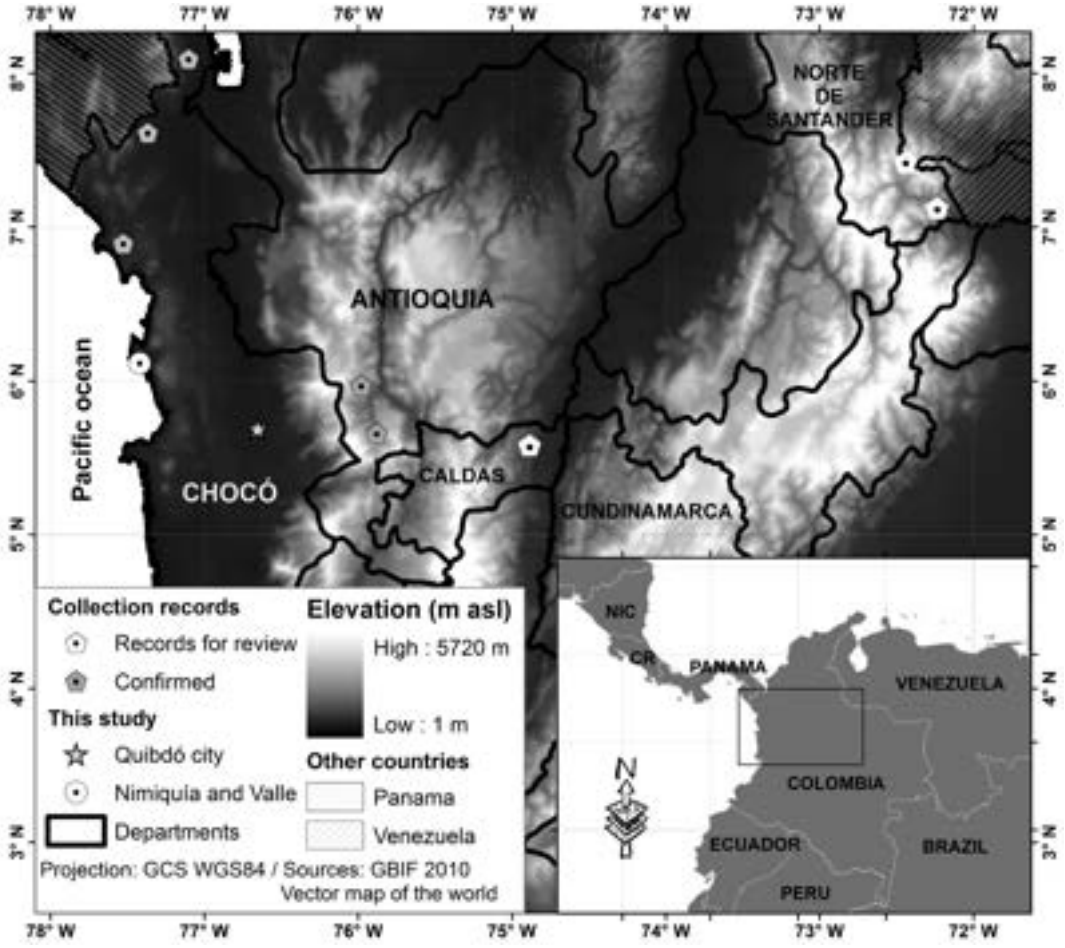

Fig. 3. Locality records of White-nosed Coati *Nasua narica* in Colombia. Collection records are shown only when specific coordinates were provided in the source (see **Table 1**).

Conclusions

González-Maya *et al.* (2011) indicated that a thorough review of the Colombian specimens catalogued as White-nosed Coati and a general clarification of the distribution of the species in the country, as one of the main research priorities for small carnivores in Colombia. This needs to recognise the potential for identification and labelling problems in various collections.

These two new locality records increase the confirmed localities in Colombia from six to eight, all in the Pacific region in the biogeographic Chocó, western Andes lowlands (Table 1; Fig. 3). The captive in Quibdó city with no locality was also in this general area. The records from Caldas and Norte de Santander, all east of the Andes and in highlands and the perhaps-lost specimen from Cundinamarca or Magdalena, remain to be reviewed.

Acknowledgments

Special thanks to CODECHOCO for providing the information collected during their work in the department. We thank Hugo Mantilla-Meluk and Sergio Solari for their assistance and advice and Hugo López-Arevalo from ICN for the information and access to ICN collection. Thanks to the reviewers and the editor for their insightful comments.

References

Alberico, M., Cadena, A., Hernández-Camacho, J. & Muñoz-Saba, Y. 2000. Mamíferos (Synapsida: Theria) de Colombia. *Biota Colombiana* 1: 43–75.

Castaño, J. H., Muñoz-Saba, Y., Botero, J. E. & Vélez, J. H. 2003. Mamíferos del departamento de Caldas – Colombia. *Biota Colombiana* 4(2): 247–259.

Ceballos, G. & Miranda, A. 1986. *Los mamíferos de Chamela, Jalisco*. Instituto de Biología, Universidad Nacional Autónoma de México, México D. F., Mexico.

Cuartas-Calle, C. A. & Muñoz-Arango, J. 2004. Lista de los mamíferos (Mammalia: Theria) del departamento de Antioquia, Colombia. *Biota Colombiana* 4 (1): 65–78.

Decker, D. M. 1991. Systematics of the coatis, genus *Nasua* (Mammalia: Procyonidae). *Proceedings of the Biological Society of Washington* 104: 370–386.

Elmhagen, B. & Rushton, S. 2007. Trophic control of mesopredators in terrestrial ecosystems: top-down or bottom-up? *Ecology Letters* 10: 197–206.

Emmons, L. H.1990. *Neotropical rainforest mammals: a field guide*. University of Chicago Press, Chicago, Illinois, U.S.A.

Emmons, L. & Helgen, K. 2008. *Nasua nasua*. In *2011 IUCN Red List of Threatened Species*. Version 2011.1. <www.iucnredlist.org>. Downloaded on 13 October 2011.

Ferrer Pérez, A., Beltrán, M., Díaz-Pulido, A. P., Trujillo, F., Mantilla-Meluk, H., Herrera, O., Alfonso, A. F. & Payán, E. 2009. Lista de los mamíferos de la cuenca del río Orinoco. *Biota Colombiana* 10 (1–2): 179–207.

García Salinas, G., Perico Manrique, D. & Rocha Caicedo, C. A. 2002. Uso de fauna silvestre en los alrededores de la serranía de Mamapacha (Boyacá, Colombia). Pp. 887–899 in Ange, C., Castaño-Uribe, C., Arjona, F., Rodríguez, J. V. & Duran, C. (eds) *Congreso mundial de Páramos, vol. 2*. Ministerio de Medio Ambiente, Cor-

poración Autónoma Regional de Cundinamarca, Instituto de Hidrología, Meteorología y Estudios Ambientales de Colombia, and Conservación Internacional Colombia, Bogotá, Colombia.

[GBIF] Global Biodiversity Information Facility 2011. *Nasua narica*. In *Global Biodiversity Information Facility Database*. <http://data.gbif.org>. Downloaded on 2 October 2011.

Glatston, A. R. 1994. *The Red Panda, olingos, coatis, raccoons and their relatives: status survey and conservation action plan for procyonids and ailurids*. IUCN, Gland, Switzerland.

Gommper, M. 1996. *Nasua narica*. *Mammalian Species* 487: 1–10.

González-Maya, J. F., Schipper, J. & Benítez, A. 2009. Activity patterns and community ecology of small carnivores in the Talamanca region, Costa Rica. *Small Carnivore Conservation* 41: 9–14.

González-Maya, J. F., Cepeda, A. A., Belant, J. L., Zárrate-Charry, D. A., Balaguera-Reina, S. A. & Rodríguez-Bolaños, A. 2011. Research priorities for the small carnivores of Colombia. *Small Carnivore Conservation* 44: 7–13.

Guzmán-Lenis, A. 2004. Revisión preliminar de la familia Procyonidae en Colombia. *Acta Biológica Colombiana* 9 (1): 69–76.

Hass, C. C. 2002. Home-range dynamics of White-nosed Coatis in southeastern Arizona. *Journal of Mammalogy* 83: 934–946.

[ICN] Instituto de Ciencias Naturales 2011. *Nasua*. In *Colleciones en linea – Instituto de Ciencias Naturales*. < http://www.biovirtual.unal.edu.co/ICN/>. Downloaded on 2 October 2011.

Janson, T. 1981. *Animales de Centro América en peligro*. Editorial Piedra Santa, Guatemala City, Guatemala.

Montero, C. R. 2004. Factores culturales y de uso que inciden en la cacería en el municipio de Mogotes, Santander, Colombia. Pp. 562–572 in Bodmer, R. (ed.) *Memoria VI Congreso sobre Manejo de Fauna Silvestre en la Amazonía y Latinoamérica.* Wildlife Conservation Society, Durrell Institute of Conservation and Ecology, and Universidad Nacional de la Amazonía Peruana, Iquitos, Perú.

Pacheco, V., Cadenillas, R., Salas, E., Tello, C. & Zeballos, H. 2009. Diversidad y endemismo de los mamíferos del Perú. *Revista Peruana de Biología* 16(1): 5–32.

Ramírez-Chaves, H. E. & Noguera-Urbano, E. A. 2010. Lista preliminar de los mamíferos (Mammalia: Theria) del departamento de Nariño, Colombia. *Biota Colombiana* 11 (1–2): 117–140.

Sáenz, J. 1994. *Ecología del Pizote (*Nasua narica*) y su papel como dispersador de semillas en el bosque seco tropical, Costa Rica*. MSc thesis. Regional Program in Wildlife Management, Universidad Nacional, Heredia, Costa Rica.

Samudio, R., Kays, R., Cuarón, A. D., Pino, J. L. & Helgen, K. 2008. *Nasua narica*. In *2011 IUCN Red List of Threatened Species*. Version 2011.1. <www.iucnredlist.org>. Downloaded on 2 October 2011.

Sánchez, F., Sánchez-Palomino, P. & Cadena, A. 2004. Inventario de mamíferos en un bosque de los Andes centrales de Colombia. *Caldasia* 26(1): 291–309.

Tirira, D. 2011. Updated species check list of mammals in Ecuador. In *Mamíferos del Ecuador*. <http://www.mamiferosdelecuador.com>. Downloaded on 13 October 2011.

Valenzuela, D. 1998. Natural history of the White-nosed Coati, *Nasua narica*, in a tropical dry forest of western Mexico. *Revista Mexicana de Mastozoología* 3: 26–44.

Valenzuela, D. & Ceballos, G. 2000. Habitat selection, home range, and activity of the White-nosed Coati (*Nasua narica*) in a Mexican tropical dry forest. *Journal of Mammalogy* 81: 810–819.

Vélez, D. M. 2004. Diagnóstico del uso de fauna silvestre en las veredas Mundo Nuevo, el Manzano y la Jangada en la Reserva Forestal Protectora de los ríos Blanco y Negro en el Municipio de la Calera (Cundinamarca-Colombia). Pp. 330–335 in Bodmer, R. (ed.) *Memoria VI Congreso sobre Manejo de Fauna Silvestre en la Amazonía y Latinoamérica.* Wildlife Conservation Society, Durrell Institute of Conservation and Ecology, and Universidad Nacional de la Amazonía Peruana, Iquitos, Perú.

[1]Proyecto de Conservación de Aguas y Tierras, ProCAT Internacional/Colombia. Bogotá, Colombia; &, Laboratorio de ecología y conservación de fauna silvestre, Instituto de Ecología, UNAM, México. Email: jfgonzalez@procat-conservation.org
[2]Grupo de Investigación en Biodiversidad de Alta Montaña, Universidad Distrital Francisco José de Caldas, Sede La Macarena, Bogotá, Colombia.
[3]Grupo de Investigación en Manejo de Fauna Silvestre, Programa de Biología, Universidad Tecnológica del Chocó "Diego Luís Córdoba", UTCH, Quibdó, Chocó, Colombia.

New records and conservation status review of the endemic Bengal Mongoose *Herpestes palustris* Ghose, 1965 in southern West Bengal, India

Jayanta Kumar MALLICK

Abstract

The taxonomic status of the poorly known Bengal Mongoose *Herpestes palustris* Ghose, 1965 remains controversial. Although it is widely considered a synonym of Small Indian Mongoose *H. (javanicus) auropunctatus*, there has been no credible refutation of its status as a species. Clarifying its taxonomic status is an urgent conservation priority because (i) it is endemic to a tiny range in southern West Bengal, India (in Howrah, North 24-Parganas, and South 24-Parganas districts), where it is (ii) tied to non-saline wetlands, which (iii) have been much converted (for agriculture, industries and satellite townships), degraded and fragmented, and so (iv) its available habitat seems to have greatly shrunk during the last four decades. In addition, it is possibly subject to threatening levels of poaching. During a survey from January 2010 to April 2011 and collation of 2007–2011 records, Bengal Mongoose was sighted in three sites with previous records or claims: Acharya Jagadish Chandra Bose Indian Botanic Garden, Shibpur in Howrah; Bheri N° 4 at Nalban fisheries of East Kolkata Wetlands (Ramsar Site n° 1208) in North 24-Parganas; and Joka (south-west Kolkata) in South 24-Parganas. It was also found in five new localities, all peri-urban habitats within Greater Kolkata, three in South 24-Parganas (Survey Park, Ajaynagar [Santoshpur], close to the Eastern Metropolitan Bypass; Kadamtala [Behala]; and Subhasgram, next to Sonarpur), one in North 24-Parganas (Rajarhat), and one in Howrah (Santragachhi). If Bengal Mongoose be a valid taxon, a thorough habitat survey across southern Bengal to lay the foundations for the development and implementation of a species conservation action plan is required. Pending taxonomic evaluation, the species's omission from *The IUCN Red List of Threatened Species* (where it is treated as a synonym of the widespread, non-threatened, Small Asian Mongoose *H. javanicus*) should be reconsidered.

Keywords: survey, wetlands, reclamation, habitat loss, population decline

ভারতের দক্ষিণ পশ্চিম বঙ্গে দেশীয় বাংলার নেউল হারপেসটেস প্যালুসট্রিস ঘোষ, ১৯৬৫ সংক্রান্ত নতুন নথি ও তার সংরক্ষণ অবস্থান পর্য্যালোচনা

সারসংক্ষেপ

স্বল্প পরিচিত বাংলার নেউল হারপেসটেস প্যালুসট্রিস ঘোষ, ১৯৬৫-এর জাতিগত অবস্থান একটি বিতর্কিত বিষয়। যদিও এটি ব্যাপকভাবে ছোট ভারতীয় নেউল হা. (জাভানিকাস) অরোপাঙ্কটাটাসের একটি সমার্থক হিসাবে গ্রাহ্য করা হয়, এর প্রজাতিগত অবস্থান সম্পর্কে কোন বিশ্বাসযোগ্য অস্বীকৃতি নেই। তবে এর জাতিগত অবস্থান ব্যাখ্যা করা খুবই জরুরী তার কারণ (১) এই দেশীয় প্রাণীটি ভারতের দক্ষিণ বঙ্গে একটি ক্ষুদ্র অঞ্চলে (হাওড়া এবং উত্তর ও দক্ষিণ ২৪-পরগণা জেলাগুলিতে) সীমাবদ্ধ, যেখানে এটি (২) শুধু অলবণাক্ত জলাভূমিতে পাওয়া যায়, আর সেগুলি (৩) ব্যবহারিক (কৃষি, শিল্প ও উপনগরী স্থাপন) কারণে অনেকটাই পরিবর্তিত, নষ্ট ও বিচ্ছিন্ন হয়ে গেছে, এবং সেই জন্য (৪) এর আবাস বিগত চার দশকে ভীষণভাবে সংকুচিত হয়ে পড়েছে। এছাড়াও এটি সম্ভবতঃ চোরাশিকারের ফলেও বিপন্ন হয়ে পড়েছে। জানুয়ারী ২০১০ থেকে এপ্রিল ২০১১ সালের মধ্যে অনুষ্ঠিত এক সমীক্ষায় বাংলার নেউল তিনটি পুরনো স্বীকৃত জায়গায় দেখা গেছে: হাওড়ার জগদীশ চন্দ্র বোস ভারতীয় বোটানিক গার্ডেন, শিবপুর; উত্তর ২৪-পরগণায় নলবনের ৪ নং ভেরি, পূর্ব কলকাতা জলাভূমি (রামসের স্থান নং ১২০৮); এবং দক্ষিণ ২৪-পরগণার জোকা (দক্ষিণ-পশ্চিম কলকাতা)। এটি আরো পাঁচটি নতুন স্থানে দেখা গেছে, সবকটিই বৃহত্তর কলকাতা উপনগরীর মধ্যবর্তী আবাস, তিনটি দক্ষিণ ২৪-পরগণায় (ইষ্টার্ন মেট্রোপলিটান বাইপাসের ধারে সার্ভে পার্ক, অজয়নগর [সন্তোষপুর]; কদমতলা [বেহালা]; ও সোনারপুরের পরে সুভাষগ্রাম), উত্তর ২৪-পরগণায় একটি (রাজারহাট), এবং হাওড়ায় একটি (সাঁতরাগাছি)। যদি বাংলার নেউল বৈধ জাতি হয়, তাহলে প্রজাতিটির সংরক্ষণ পরিকল্পনা তৈরী ও তা কার্য্যকরী করার ভিত্তি স্থাপনার্থে সমগ্র দক্ষিণ বঙ্গে একটি নিবিড় আবাস সমীক্ষা করা দরকার। এর জাতিগত অবস্থান নির্ণয়ের পূর্বে আই.ইউ.সি.এনের বিপন্ন প্রজাতির লাল তালিকায় এই প্রজাতিটির বাদ যাওয়ার বিষয়টি (যেখানে এটি ব্যাপক, অবিপন্ন ছোট এসিয়ার নেউল হা. জাভানিকাসের একটি সমার্থক হিসাবে গ্রাহ্য করা হয়) পুনঃর্বিবেচিত হওয়া উচিত।

মুখ্য শব্দাবলী: সমীক্ষা, মিষ্টিজলের জলাভূমি, দর্শন, বনহাঁসুলি, আবাস ও সংখ্যা হ্রাস

Introduction

Taxonomic background

In 1965 a new species of mongoose was named from West Bengal, east India: *Herpestes palustris* Ghose, 1965. Here called the 'Bengal Mongoose', *H. palustris* is also known as 'Marsh Mongoose' in some sources, but this name is already in wide use for *Atilax paludinosus* of Africa, which is not a close relative of *Herpestes* (Veron *et al*. 2004). Hussain (1999) named *H. palustris* 'Indian Marsh Mongoose', but this can suggest it is an Indian relative of *A. paludinosus*. It has also been called 'Salt Lake Mongoose', but this name is misleading; although the type locality is Nalban (as 'Nalbani'), Salt Lake (Ghose 1965), the record was not from brackish habitat; the name of the area is a reflection of its erstwhile saltiness, and the mongoose has been recorded only at and around non-saline wetlands (see below, in 'Distribution and Habitat Use'). The animal is very similar in external and skull morphology to Small Indian Mongoose *H. (javanicus) auropunctatus*, hence its late discovery, even though it occurs in one of the most densely populated areas of the world. Even today, some birdwatchers photographing *H. palustris* in the semi-urban non-saline wetlands of Kolkata Metropolitan Area consider them to be *H. (j.) auropunctatus*.

Because of this close similarity, Ghose's proposal remains controversial. Many subsequent sources in India, including the Zoological Survey of India (ZSI), the Wildlife Institute of India and the Indian Wildlife Protection Act (1972), as amended 2002, have treated Bengal Mongoose as a valid species (Soota & Chaturvedi 1970, Ghose & Chaturvedi 1972, Agrawal *et al*. 1992, De *et al*. 1998, Molur *et al*. 1998, Hussain 1999, Sanyal 1999, Walker 1999, Walker & Molur 1999, Alfred & Nandi 2000, Chattopadhyay 2001, Alfred & Chakraborty 2002, Alfred *et al*. 2002, Chaudhuri & Sarkar 2003, Anonymous 2004, Raghu Ram 2005, Nandy 2006, Dey 2007, Sanyal *et al*. 2007, Deuti 2008, Kundu *et al*. 2008, Basak 2009, Ghosh 2009, Mallick 2009, Sahajpal *et al*. 2009, Bahuguna & Mallick 2010, Chakraborty & De 2010, Sharma 2011). By contrast, most international sources either did not mention it (Nellis 1989, Taylor & Matheson 1999, Veron *et al*. 2006) or considered it conspecific with *H. (javanicus) auropunctatus* (Honacki *et al*. 1982, Corbet & Hill 1992, Wozencraft 2005, Wozencraft *et al*. 2008, Gilchrist *et al*. 2009). Similar treatment has been afforded by some influential Indian sources, e.g. Prater (1971), who made no mention of it, and Menon (2003), who stated (p. 108) under *H. javanicus* that "the Marsh Mongoose of West Bengal is possibly a sub-species".

Some international sources do not reject the taxon's validity, or at least not absolutely. Wenzel & Haltenorth (1972: 121) listed *H. palustris* as a separate species, but with the comment (in translation): "(taxonomic) status uncertain, may be only a subspecies of *javanicus*". Ewer (1973: 405) thought it was "possibly . . . only subspecifically distinct from *H. urva*…pending further clarification of [its] status I have not listed [it] as a distinct species". Ewer (1973) based her view on descriptions of habits (from Ghose 1965); her provisional linkage with *H. urva* shows that she presumably had not seen any specimens. Schreiber *et al*. (1989) placed *H. palustris* in an appendix of named taxa for which there was too little information to evaluate their validity. Wozencraft (1993) listed *H. palustris* as a valid species, based on Wenzel & Haltenorth (1972) and Ewer (1973). Van Rompaey & Colyn (1996) considered *H. palustris* a distinct species; although no discussion of it was given in the source itself, H. Van Rompaey (*in litt*. 1997) told J. W. Duckworth (*in litt*. 2011) that he felt it more useful to conservation to segregate named forms in cases of doubt, rather than to risk burying them in potentially inappropriate synonymy. Binninda-Emonds *et al*. (1999) and Feldhamer *et al*. (2007) treated Bengal Mongoose as a species, but did not discuss its taxonomy; the former, at least, did this because they took Wozencraft (1993) as their taxonomic baseline. Veron *et al*. (2008) accepted *H. palustris* as valid, but without any discussion on why they did so, at variance with their stated taxonomic reference (Wozencraft 2005); and in contrast to their earlier and later treatments (Veron *et al*. 2006, Gilchrist *et al*. 2009).

The characters used to define Bengal Mongoose are discussed below (under 'Morphological distinction…'). In sum, several lines of plausible evidence support its specific status, although none is conclusive on the data published. For most characters, contextual information is limited or non-existent concerning the sample sizes and locations of origin of specimens of Bengal and Small Indian Mongooses examined; and, for all, discussion of intra-taxon variation, particularly from across the wide range of Small Indian Mongoose, is inadequate. The latter information is necessary context to assess the taxonomic significance of the characters attributed to Bengal Mongoose. In particular, the dark area on the muzzle often now seen as diagnostic of *H. palustris* does occur in other populations of the *H. javanicus*–*H. auropunctatus* group of mongooses: in *siamensis* from Thailand and *rubrifrons* from southern China (Ghose 1965).

This uncertainty produces a conservation dilemma: if Bengal Mongoose is a valid taxon, then it is probably highly threatened (see below, under 'Population Trend'), but if it is not valid, then these southern West Bengal mongooses are irrelevant to conservation at all but the most local scale. No source considering Bengal Mongoose conspecific with Small Indian Mongoose (either as a subspecies or, apparently in some cases, not a valid taxon) detailed its reasons for so doing. The only independent evaluation of the characters used by Ghose (1965) to diagnose the species seems to be that of Agrawal *et al*. (1992: 107), who concluded that "as the distinguishing characters mentioned by Ghose (1965) hold good in the present series, it is maintained here as a distinct species". In the light of this, and since there seems to be no credible, let alone compelling, published case that it is not a valid taxon, a precautionary stance is taken here, and Bengal Mongoose is treated as a taxonomic reality at, for convenience, the level of species. Conclusive clarification of its taxonomic status is an urgent research and conservation need.

An associated problem is the identification of mongooses within its tiny range (which is detailed in 'Results: distribution'). Dey (2007: 33) wrote that "each and every trapped mongoose was *H. palustris*. So the inference was drawn that the entire mongoose population in the East Kolkata (= Calcutta) Wetlands is constituted of [Bengal] Mongoose", but apparently (Table 3) this was based on only six animals (three adult males, two adult females and one juvenile female) caught at one site (Nalban), weakening the validity of their conclusion for the entire range of Bengal Mongoose. Nonetheless, these findings are consistent with those of Ghose (1965: 173), "though sympatric with *H. auropunctatus*, [*H. palustris*] is confined to marshy areas, a habitat very different from that of the former".

So far as I have traced, there is no credible record of Small Indian Mongoose or of Grey Mongoose *H. edwardsii* from any non-saline wetland within the known geographic range of Bengal Mongoose. The only other mongoose in West Bengal, Crab-eating Mongoose *H. urva*, is restricted to its north, and highly distinctive in morphology; it is not discussed further. A compilation of the credible records of Small Indian Mongoose and Grey Mongoose from southern West Bengal would be most valuable, but was beyond the scope of the current work.

Agrawal *et al*. (1992: 106) recorded occurrence of Small Indian Mongoose in all districts of West Bengal, "near the human habitations, particularly adjacent to paddy or sugar cane fields and burial grounds"; marshes or swamps were not mentioned. Despite extensive occurrence of Small Indian Mongoose in West Bengal, only four specimens from the state are held at ZSI. Three are from the state's northern part. The only one from the south in Agrawal *et al*. (1992) is from Kolkata district without exact locality (and so its location relative to Bengal Mongoose range is not known). In Hooghly (21°56'N, 88°04'E), on the right bank of the River Hooghly, north of Howrah, the native place of the author, which supports large marshes, he found no *H. palustris*: all animals (about 100) sighted (opportunistically; there were no systematic observations) during last 40 years, including in marshes, were Small Indian Mongooses.

Small Indian Mongoose is listed as widespread in the East Kolkata Wetlands by Anonymous (2004) and Kundu *et al*. (2008); the latter is derived directly from the former, given the close similarity in text in the two documents. Kundu *et al*. (2008) tabulated the occurrence of both Bengal Mongoose and Small Indian Mongoose at all five localities in the East Kolkata Wetlands that they studied (based on the abbreviations as explained in Anonymous [2004]): Chowbhaga (CB), Bantala (BT), Jhagrasisa (JS), Sahebmara (SM) and Mahishbathan (MB), but the earlier source (Anonymous 2004) had recorded Bengal Mongoose only at Sahebmara (with Small Indian Mongoose recorded at all five sites). Whether the difference between sources reflects genuine change in opinion or editorial slackness is not clear. These two sources gave no evidence of critical identification of mammals, and even stated that the mammal listings were derived from "field observation and secondary data … collected from the local residents and fishermen community" (Anonymous 2004: 10). Therefore, this apparent claim of widespread overlap between the two species is here considered at sufficient risk of error to need corroboration. Similarly vague reference was made to overlap in habitat use between Bengal Mongoose and "both the species of mongoose" (apparently Grey Mongoose and Small Indian Mongoose) by Sanyal (1999), a statement ignored here because the evidence on which it was based was not presented.

Grey Mongoose occurs in both north and south West Bengal, but seems not to have been collected from the specific sites of Bengal Mongoose; specimens are held at ZSI from Basirhat in North 24-Parganas, and it occurs in Alipore in South 24-Parganas (Agrawal *et al*. 1992); Bengal Mongoose has not been recorded from these sites. During the present study, Grey Mongoose was photographed (Fig. 1) at Barasat in North 24-Parganas and Chintamoni Kar Bird Sanctuary (Narendrapur) in South 24-Parganas, where no Bengal Mongoose was sighted.

Thus, it seems that within the geographic range of animals showing the gross morphological characters of Bengal

Fig. 1. Grey Mongoose *Herpestes edwardsii*, Chintamoni Kar Wildlife Sanctuary, Narendrapur, South 24-Parganas District, West Bengal, India, on 13 February 2011 (Photo: Shantanu Bhattacharya).

Mongoose, all individuals from wetlands critically examined have fitted Bengal Mongoose, not other mongoose species, and so, for the present review, all recent records of Small Indian/Bengal Mongooses in the East Kolkata Wetlands are taken to be Bengal Mongoose. Further information may require this stance to be re-evaluated, and it is of the utmost importance that future authors reporting the species specify the detail of numbers, precise locations, and the basis of identification (as either species) for every single record, wherever possible with photographic evidence. Dey (2007: 31) wrote that "because these two species (Bengal and Small Indian Mongooses) are sibling species, so trapping was a must for identification" and although the present review has brought together all records including of untrapped individuals, Dey's (2007) view should guide all future work. Camera-trapping and active photography may also generate records open to certain and independent identification.

Morphological distinction between Bengal and Small Indian Mongooses

The original description of *H. palustris* distinguished it from Small Indian Mongoose by a number of mostly somewhat subtle features (Ghose 1965; see Table 1). Ghose (1965) considered that the morphological characters, ecological conditions, duration of foraging, food habits, hunting techniques, and the apparent absence of hybridisation (although he did not specify how, on the information available, this could safely be concluded) tend to indicate that Bengal and Small Indian Mongooses are sibling species. Subsequent microscopic examination of the structure of dorsal guard hairs of different mongoose species (including samples from seven Small Indian Mongooses from six widely spaced localities and nine Bengal Mongooses from three localities) supports the specific status of *H. palustris* (De *et al*. 1998): one absolute difference was found, in the scaling pattern, as were various others that are either very subtle or apparently reflect difference in the range of variation (see below, Table 2).

Bengal Mongoose closely resembles Small Indian Mongoose. The blackish patch on the muzzle above the nose (Fig. 2) is its most prominent external distinguishing mark (Ghose 1965; see photographs in Dey 2007), although it is shared by

Table 1. Morphological[1] and behavioural differences among Bengal Mongoose *H. palustris*, Small Indian Mongoose *H. (j.) auropunctatus* and Grey Mongoose *H. edwardsii*.

Criterion	Bengal Mongoose	Small Indian Mongoose	Grey Mongoose	Source
Head and body length	28–36 cm	25 cm	33.5–35.8 cm	Agrawal *et al.* 1992
Tail length	22–26 cm	26 cm	33.2–34.2 cm	
Weight	450–900 g	305–662 g	1,400–1,700 g	NEWS *in litt.* 2006, Dey 2007, Bahuguna & Mallick 2010
Length of hind foot	5.1–6.4 cm	4.8 cm	6.6–6.9 cm	Agrawal *et al.* 1992
Length of ear	1.8–2.7 cm	0.9 cm	1.5–2.8 cm	
Cranial length	61.8–72.3 mm	58.4 mm	72.7–73.4 mm	
Condylobasal length	60.9–71.5 mm	57.2 mm	71.4–72.5 mm	
Maxillary width	10.1–12.9 mm	10.7 mm	12.5–13.7 mm	
Least interorbital width	9.8–12.1 mm	11.6 mm	12.5–13.8 mm	
Postorbital width	8.6–13.8 mm	17.0 mm	11.2–12.8 mm	
Length of fourth upper premolar	5.6–6.3 mm	5.5 mm	6.4–7.2 mm	
Length of first lower molar	4.8–5.8 mm	3.2 mm	6.2–6.3 mm	
Zygomatic width	29.5–34.6 mm	29.0 mm	34.8–38.0 mm	
Coat	Rough	Smooth and silky	Usually coarse	Ghose 1965, Bahuguna & Mallick 2010
Dimorphism in colour	Dimorphic (both dark and light forms), not correlated with season, age or sex	Much individual variation in colouration, but no dichromatism reported	Colour varies due to age, season and locality factors	
Grizzling of pelage	Coarse	Fine	Coarse	
Muzzle	Black patch	Dark brown, no patch	Rusty brown, no patch	
Tail	Darker tip in 8 out of 19 specimens originally examined (more clearly seen in the light form)	No darker tip	Whitish or yellowish-red tip, but never black	
Cranium	Narrows abruptly behind the orbit so that postorbital region appears as a constriction between frontals and cranium	Gradually narrows from the orbit	-	
Crest	Well-developed	Not so well-developed	-	Ghose 1965
Skull	Stronger, slightly longer, and with bulging forehead; in general more similar to H. edwardsii than to H. *(j.) auropunctatus*	Weaker, shorter, and without bulging forehead	-	
Basioccipital	Broader	Narrower	-	
Inner margins of the bullae	Subparallel	Not subparallel	-	
Teeth	Robust and strong; cusps of molars and premolars less pointed	Weak, cusps of molars and premolars more pointed	-	
Posterior chamber of the bullae	Reduced and more inflated	Less reduced and less inflated	-	
Odour	"Obnoxious"	No such odour	-	
Food preference	Small fish and aquatic invertebrates, among snails preferring the water snail *Pila globosa*	Mainly carnivorous, among snails preferring the land snail *Achatina fulica*	Carnivorous	Ghose 1965, Deuti 2008, Bahuguna & Mallick 2010

(continued)

Table 1. (continued)

Criterion	Bengal Mongoose	Small Indian Mongoose	Grey Mongoose	Source
Hunting	Semi-aquatic hunter, more active during the early morning and late afternoon	Terrestrial hunter, hunts throughout the day	Terrestrial hunter	Dey 2007, Deuti 2008, Bahuguna & Mallick 2010
Ecological niche	Only non-saline wetlands, mud-banks near the water's edge	Various; but not in non-saline wetlands, in southern West Bengal	Near human habitations	Ghose 1965, Agrawal *et al.* 1992, Dey 2007, Deuti 2008

[1]Characteristics of guard hairs are presented in Table 2.

Fig. 2. Bengal Mongoose *Herpestes palustris*, grey phase, showing the dark suffusion on the muzzle, Survey Park, Ajaynagar, West Bengal, India, on 9 November 2010 (Photo: S. Bhattacharya).

Fig. 3. Bengal Mongooses *Herpestes palustris*, Nalban, West Bengal, India, on 17 February 2011; (top) grey phase, urinating; (bottom) rufous phase (Photo: S. Jha).

taxa in the *H. javanicus–H. auropunctatus* complex in some other parts of its large range (Ghose 1965).

Bengal Mongoose females are smaller (body length 30–32 cm, tail length 25–27 cm, weight 500–625 g) than males (body length 32–36 cm, tail length 26–28 cm, weight 625–900 g) (Agrawal *et al*. 1992, Dey 2007). It is dimorphic in colour, with dark and light forms (Fig. 3): the former has individual contour hairs alternately banded black and buff-yellow, the latter has them banded blackish brown and straw yellow (Ghose 1965, Alfred & Chakraborty 2002).

The diameter, scale type, scale count, scale margin and medullary configuration of dorsal guard hairs of the two species were distinguishable in the samples analysed by De *et al*. (1998; see Table 2), and while they found that in some cases Bengal Mongoose was more similar to other mongooses than to Small Asian Mongoose, their results require corroboration. Specifically, they did not examine enough specimens to notice the colour dimorphism in Bengal Mongoose mentioned by Ghose (1965) and others, and the sampling of *H. javanicus–H. auropunctatus* was too spatially limited to account for intraspecific variation across its large distribution range; moreover, only one specimen came from a state next to West Ben-

Table 2. Microscopic and macroscopic profile of dorsal guard hairs of Bengal Mongoose *H. palustris*, Small Indian Mongoose *H. (j.) auropunctatus* and Grey Mongoose *H. edwardsii*.

Character[1]	*H. palustris*	*H. (j.) auropunctatus*	*H. edwardsii*
Physical characters			
Colour	Alternately banded with ochraceous buff and Prout's Brown with Prout's Brown tip.	In general alternately banded with clove brown and buff with clove brown tip.	Tip clove brown then alternately banded with cream buff and clove brown. In some of the hairs overall ferrugineous tinge evident.
Total length	14–25 mm (18.5 ± 3.45)	13–18 mm (14.83 ± 1.76)	20–31 mm (25.61 ± 3.34)
Apical diameter (μ)	25–50 (40.83 ± 6.31)	25–50 (41.66 ± 5.23)	50–90 (70 ± 12.4)
Middle diameter (μ)	50–100 (80 ± 7.64)	50–100 (79.16 ± 9.19)	70–100 (90 ± 8.17)
Basal diameter (μ)	50–70 (58.33 ± 4.78)	50–75 (62.5 ± 4.5)	50–90 (60 ± 5.4)
Number of bands	Variable, 96–90% hairs five banded and rest seven banded.	Variable, 78–81% hairs five banded and rest seven banded.	Variable, 80–85 % hairs seven banded and rest five banded.
Width of bands	Variable, Prout's brown bands usually wider than ochraceous buff; width of Prout's brown bands 2–6 mm (3.77 ± 0.51) and that of ochraceous buff 1–4 mm (2.75 ± 0.07)	Variable, clove brown bands usually wider than buff except at base; width of clove brown bands 2–6 mm (3.97 ± 1.05) and that of buff 2–4 mm (2.66 ± 0.16)	Variable, but clove brown bands usually wider than Cream buff except at base; width of clove brown bands 3.30–5.0 mm (4.02 ± 0.6) and that of cream buff 2–4 mm (2.88 ± 0.54)
Surface structure			
Scale pattern	Irregular wave	Flattened irregular mosaic	Irregular wave
Scale count	148–200 (160)	95–120 (104)	180–225 (220)
Scale margin	Smooth with few notches	Smooth	Crenate
Side-to-side scale length	10–20 mm (16 ± 2.02)	10–20 mm (16 ± 3.06)	20–40 (30 ± 4.58)
Proximo–distal length	4–10 mm (7.01 ± 1.16)	7–10 mm (8.31 ± 0.08)	2–7 (5 ± 0.91)
Medulla			
Medullary configuration	Narrow aeriform lattice	Unbroken with cortical intrusion	Unbroken with cortical intrusion
Medullary Index	0.75–0.76 mm (0.755 ± 0.004)	0.88–0.90 mm (0.885 ± 0.0067)	0.81–0.83 (0.82 ± 0.003)

[1]After De *et al.* (1998). Neither the location-specific source of samples nor the sample sizes are given in the original. Numerical values are given as range (mean ± one standard deviation).

gal, and none from the state itself. Thus, the possibility of an overlap in characters, perhaps even clinally, between Bengal Mongoose and geographically overlapping/nearby Small Indian Mongoose could not be investigated. Sahajpal *et al*. (2009) wrote of the distinctiveness of Bengal Mongoose hair under the microscope but unfortunately compared it only with Grey Mongoose, Ruddy Mongoose *H. smithii* and Crab-eating Mongoose, and it is therefore not clear how, if at all, Bengal Mongoose differs in the characters investigated from Small Indian Mongoose.

Although previous documents have stressed Bengal Mongoose's similarity to Small Indian Mongoose, confusion with Grey Mongoose can also be problematic. In the field, Bengal Mongoose seems closer in size to Grey Mongoose than to Small Indian Mongoose, an impression reflecting the measurements in Agrawal *et al*. (1992; although measurements of only one Small Indian Mongoose are given). Grey Mongoose can be distinguished by its grey coat, heavier build, thicker and bushier tail, higher stance (due to longer legs, particularly the hind ones), and the absence of any black patch on the muzzle.

Landscape ecology

Southern Bengal has numerous inland non-saline wetlands, situated in the alluvial flood plains of the River Hooghly, a distributary of the River Ganga. (A distributary is a stream that branches off and flows away from the main river.) Two types of wetlands are found in the Hooghly sub-delta. Large swamps, e.g. the Sundarbans, have a greater proportion of open saline water surface (salinity varies from low to high, depending on the upstream freshwater discharge) and are generally deeper than the marshes, have trees, and are usually found along river flood-plains and poorly drained basins. The present review traced no claim of Bengal Mongoose in such habitat. It is the marginal marshes, e.g. the East Kolkata Wetlands, that are continually inundated with waste-water of the metropolitan city, and are mostly treeless but otherwise with lush plant growth, that support this species.

Apart from being a rich repository of aquatic and semi-aquatic flora and fauna of the Lower Gangetic Plains Bio-geographic Zone (7B; Rodgers & Panwar 1988), these multiple-use wetlands contribute much to the socio-economic well-being of the local communities (Kundu *et al*. 2008).

The East Kolkata Wetlands, those on the eastern bank of the River Hooghly, were an extension of the Sundarbans until the eighteenth century. The tidal effect ceased in 1930 with rapid silting up of the River Bidyadhari since 1913 (Furedy 1987). These wetlands were converted into sewage-fed fisheries (bheries) by receiving (and decomposing) waste-waters through a series of channels and locks. The present conservation areas of the East Kolkata Wetlands are located at Bidhannagar South (21 ha, North 24-Parganas district), Tiljala (14 ha, Kolkata district), Sonarpur (44 ha) and Bhangar (45.49 ha; South 24-Parganas district) (Chattopadhyay 2001). In 1995, the area of Bidhannagar was 12.5 km^2 and East Kolkata Wetlands within this municipality extended over 33.5 km^2. Thereafter 21 km^2 was added to Bidhannagar, of which Sector V comprises 2.3 km^2.

These marshes differ from other Indian wetlands by their negligible surface catchment; instead, a perched aquifer lies more than 400 feet below them. The marshy edges, infested with the aquatic plants like cattails *Typha*, reeds *Phragmites*, sedges (Cyperaceae), grasses (Gramineae) and Water-hyacinth *Eichhornia crassipes* form the typical habitat of Bengal Mongoose (NEWS *in litt*. 2006, corroborated by records assembled here).

Previous field studies and records of Bengal Mongoose

Since the proposal of *H. palustris* as a valid species, for which materials were examined from Duttabad (= Dattavad; north of East Kolkata Wetlands), Hederhat (= Hedearhat; between Kalikapur and Mukundapur, south of East Kolkata Wetlands) and Nalban (= Nalbani), all east of the Eastern Metropolitan Bypass, in North 24-Parganas district, there have been several extensions of known range. Agrawal *et al*. (1992) accepted specimens from the Botanical Gardens at Shibpur and from Nazimganj (both Howrah [= Haora] district) and from Bantala (= Bantal; south-east of the East Kolkata Wetlands) and Sukhchar (both in North 24-Parganas district). In addition, three reports of its occurrence in South 24-Parganas district were available, but only that of Ghose & Chaturvedi (1972) was supported by a specimen, or by any detail of the record(s). Molur *et al*. (1998) and Raghu Ram (2005) simply stated that the species occurred so are here considered as only unconfirmed reports (see below, Table 3). Two reports have been published on its prime habitat in the East Kolkata Wetlands. The first study was undertaken by ZSI in 2005 (Deuti 2008), the second by a Kolkata-based non-governmental organisation (NGO), the Nature Environment & Wildlife Society (NEWS), in 2005–2006 (Dey 2007). Although many other sources have mentioned the species, these are the only five presenting original records of distribution or natural history. In addition, Mallick (2009) compiled the records available since Bengal Mongoose's original description, including more detail on NEWS's 2006–2007 survey results than is available in Dey (2007). No further field study has been undertaken since 2006 to investigate the current global status of Bengal Mongoose and assess its conservation needs.

Of late, seven local bird-watchers and photographers (S. Mallick, S. Jha, S. Bhattacharya, A. Chatterjee, H. G. Mukhopadhyay, P. K. Biswas and L. Barman) have reported a number of sightings of Bengal Mongoose in the surroundings of a few fragmented wetlands of Howrah, North and South 24-Parganas districts, all within Greater Metropolitan Kolkata, to the author. The present study collates these records and reports on investigations of the occurrence of Bengal Mongoose in many wetlands, including some that were not surveyed earlier.

Study sites

The non-saline wetlands in the south and south-east of Kolkata city comprises many water bodies in North and South 24-Parganas districts. Only those sites where Bengal Mongoose was sighted during 2007–2011 are described. All are within Greater Kolkata. The survey area is shown in Fig. 4.

In North 24-Parganas District, the East Kolkata Wetlands (22°25'–40'N, 88°22'–35'E) were declared a Ramsar site (n° 1208) in 2002. This funnel-shaped area extends over 125 km^2 with 268 water bodies on both sides of a dry-weather flow channel discharging into the Kulti Gong (the waste-water outfall). This marsh is an inter-distributary (encased by the distributary and tidal channel) wetland in the mature delta of the River Hooghly. Originally, it was a vast region of tributaries and distributaries extending between the River Hooghly on the west and the River Bidyadhari (now dead) on the east (Kundu 2010). These wetlands sustain the world's largest and oldest integrated resource recovery practice that combines agriculture and aquaculture to use the refuse and waste-waters of Kolkata metropolis (Kumar 2010). Floristic diversity of these wetlands is mediocre, even in the core area. Macrophytes include *Sagittaria montevidensis*, *Cryptocoryne ciliata*, *Cyperus*, *Acrostichum aureum* and *Ipomoea aquatica*. Embankment- and bund vegetation is mostly dominated by *Fimbristylis ferruginea*, *Suaeda maritima*, *Acanthus ilicifolius*, *Excoecaria agallocha* and *Avicennia officinalis*. Salt Lake proper (which, despite its name, has been non-saline since 1930; Furedy 1987) is dominated by numerous algae, clumps of reeds like *Aegiceras majus* and cattails like *Typha elephantina*. The marshy, shallow and large water bodies or wetland bogs including swampy edges are fully or partially filled with emergent hydrophytes, such as *Phragmites karka* and *Typha angustifolia* (Anonymous 2004). These wetlands are lined by narrow mud-banks, on which grasses and a few stunted trees grow (Deuti 2008). These wetlands are rich in mongoose food items, e.g. fish, freshwater crustaceans including shrimps, molluscs (Gastropoda, Bivalvia), bugs (Hemiptera), beetles (Coleoptera), amphibians (Amphibia) and turtles (Testudines) (Anonymous 2004).

Nalban, North 24-Parganas District

Nalban (Fig. 5) is the largest wetland of East Kolkata Wetlands (Deuti 2008), covering 167.14 ha (413 acres) and composed of a few bheries located near Chingrighata. It is bounded by Eastern Metropolitan Bypass on the west, Basanti Road on the south and Salt Lake City (Bidhannagar) on the north and east. It is owned by the Fisheries Department of the Government of West Bengal, and used for pisciculture. Compared with the vastness of open water, few patches of aquatic plants have been left. The periphery of the bheries is covered with aquatic vegetation like Water-hyacinth. Most of the recent studies of Bengal Mongoose were conducted in N° 4 bheri (Dey 2007, Deuti 2008, Mallick 2009).

Sahebmara, North 24-Parganas District

The privately-owned Sahebmara is the second largest bheri of East Kolkata Wetlands, spread over 147.18 ha. Its ecology closely resembles that of Nalban.

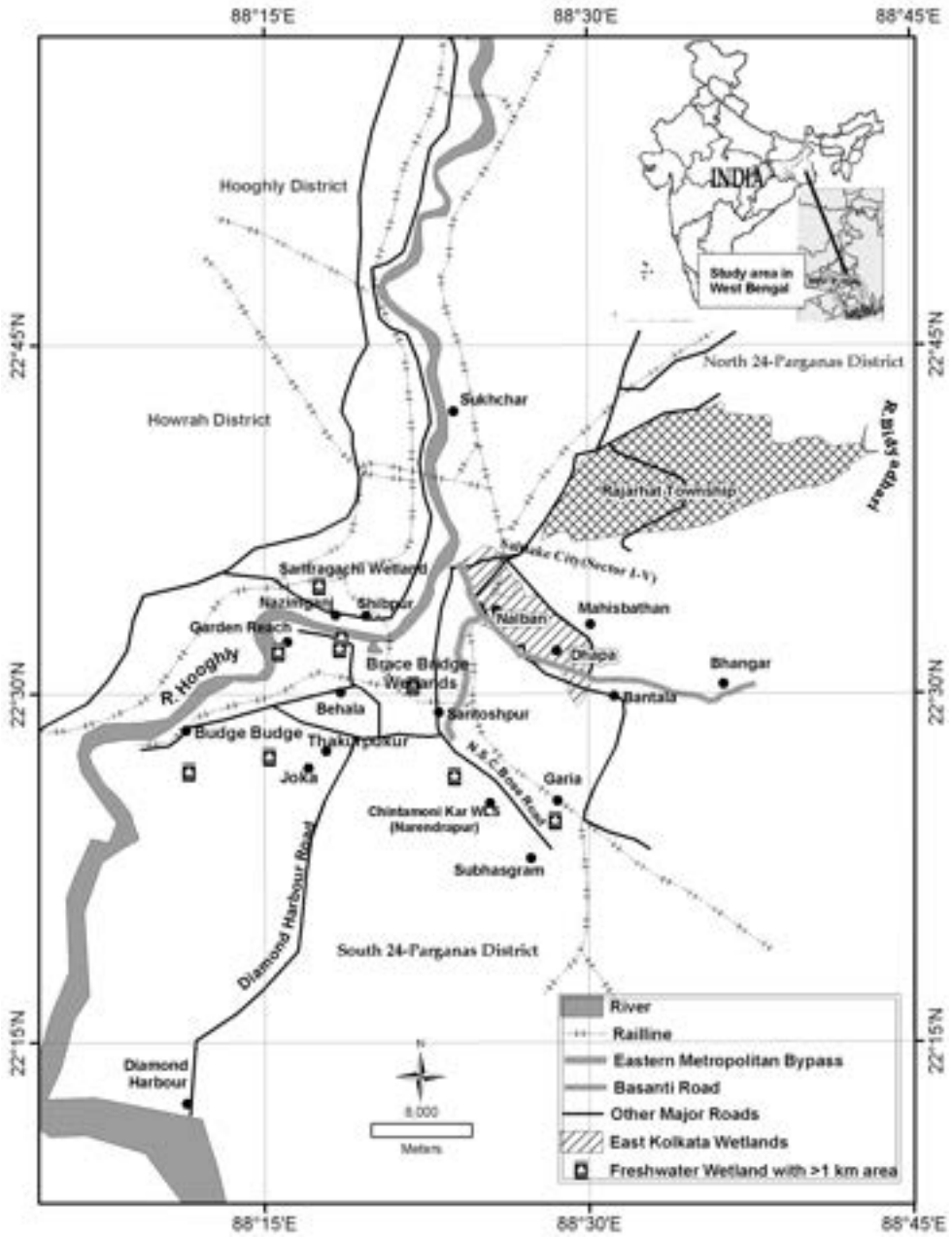

Fig. 4. East Kolkata Wetlands and surroundings, West Bengal, India. The entire world range of Bengal Mongoose *Herpestes palustris* lies within the area mapped, except for the extension for 47 km south of Diamond Harbour to Bhasna.

Fig. 5. Bengal Mongoose *Herpestes palustris* habitat at Nalban, West Bengal, India, on 26 March 2011 (photograph by S. Mallick).

Rajarhat, North 24-Parganas District

This part of East Kolkata Wetlands is nearer to the erstwhile spill-over basin of the River Bidyadhari on the east. Keshtopur, Bagjola and three other canals pass through this area. Due to the development of New Town at Rajarhat during the recent years, mongoose habitat has further reduced. Only a few small wetlands with aquatic vegetation remain, including Khari Bari bheri, Munshir bheri, Diller bheri, Narkeldangar bheri and Mollar bheri.

Acharya Jagadish Chandra Bose Indian Botanic Garden, Howrah District

This Government-owned National Garden, covering an area of 1.09 km^2, is located at Shibpur on the west (right) bank of the River Hooghly. The garden has many exotic tropical plants and many indigenous species. It has 27 large and medium ponds, a few connecting with the River Hooghly. These ponds contain more than two dozen fish species. The garden is

rich in molluscs, aquatic bugs and beetles, dragonfly (Odonata) nymphs, grasshoppers and crickets (Orthoptera), millipedes/centipedes (Myriopoda) and crabs (Decapoda) (A. Chatterjee *in litt*. 2010).

Santragachhi, Howrah District
Out of 24 ha of Santragachhi (= Santragachi), the 'Makal jheel' (lake) is spread over 12.8 ha, roughly rectangular (length about 915 m, width 305 m, perimeter 2,418 m and depth 4–7 ft), at an altitude of 8 m. It lies south of Santragachhi railway yard, about 20 km east of the East Kolkata Wetlands, and is surrounded by dense human habitations, khatals (cow sheds) and small-scale industry. The jheel has several small islands, prolific Water-hyacinth, and large trees along its banks. *Typha latifolia* is moderately common, but *Phragmites communis* rare. The land is owned by the South-Eastern Railways and has been managed by the State Forest Department since 1992. The jheel receives various domestic and industrial sewage, and refuse-dumping is engulfing part of the wetland. It supports thousands of resident and migratory birds, and a wide variety of zooplankton, molluscs and fish.

Joka, South 24-Parganas District
Joka is a semi-urban area at the edge of south-west Kolkata, where the Indian Institute of Management, Calcutta (IIMC) is located to the east of the arterial Diamond Harbour Road (NH 117). Just behind IIMC lies a government-owned tract of fallow mixed wetland-grassland (54.63 ha), rich in wild plants and animals (Raghu Ram 2005). The area was entirely a marsh until much was converted for agriculture and towns, mainly during the early 1970s. The east–west Charial khal (canal) forms the northern boundary of the wetland. The grassland starts a short way down the Yani Sarani (dirt road) and is dominated by *Phragmites*, *Saccharum*, *Erianthus*, *Imperata*, *Desmostachya* and *Achyranthes*. The non-saline wetland is seasonally covered by *Typha*, *Sagittaria*, *Cyperus*, *Cryptocoryne*, *Acrostichum*, *Ipomoea*, *Eleocharis* and others. There is another wetland (area <1 ha), Green View, near Joka Goddess *Kali* temple (about 3 km from IIMC) with some reed bed, grasses and aquatic plants.

Kadamtala, South 24-Parganas District
Kadamtala is part of the satellite township of Behala. A few privately-owned lakes, including Katapukur, Harirpukur, Majhi's pond (totalling in area <1 ha), surrounded by aquatic vegetation, survive.

Survey Park, South 24-Parganas District
Survey Park, Ajaynagar, lies at the eastern end of Santoshpur, bounded by Eastern Metropolitan Bypass on the west, about 5 km south of Salt Lake City. Of late, a satellite township has been developed here. The area has many big ponds and lakes (privately-owned) including Kalibaripukur, Nilpukur, Haludpukur, Kaanchpukur, surrounded by aquatic vegetation. There are many big bheries a few kilometers away at Kalikapur and Mukundapur on the eastern side of the bypass (22°29'32"N, 88°23'48"E). Formerly, this area was a part of Brace Bridge Wetlands, which were distributed over 12.35 km^2 (a 14 km stretch from Santoshpur on the south to Majherhat railway station on the north). Regular inflow of water from the River Hooghly at high tide with very low salinity and outflow during low tide transformed 70% of the original swamp into low-vegetation marshland. This vast swamp witnessed the impact of human activities in the post-independence period (1947 onwards). Systematic removal of *Typha* and *Phragmites* and cutting of native flora like *Aeschynomene*, and insanitary land-

Fig. 6. Bengal Mongoose *Herpestes palustris* burrow, Nalban, West Bengal, India, on 20 February 2011; (left) close-up, (top) showing multiple openings in proximity (Photos: S. Mallick).

filling with refuse and solid waste reduced the quality of water drastically and gradually changed the area to a human-made ecosystem over the years (Ghosh & Nandi 2009).

Subhasgram, South 24-Parganas District
Subhasgram (Changripota) is located 2.8 km south-east of Sonarpur on the left side of Netaji Subhas Chandra (N. S. C.) Bose Road. A few privately-owned jheels (small, well-covered with aquatic vegetation) and gardens survive nearby, particularly west of the railway lines, where human habitations are scattered. But, the newly developed satellite township has almost destroyed the wetland habitat on the eastern side.

Methods

To explore the present distribution of Bengal Mongoose in all three districts known to support it (Howrah, North and South 24-Parganas; Fig. 4), post-2006 records were collated and a field survey was conducted (by the author, S. Mallick, S. Bhattacharya, S. Jha and some other photographers, local forest staff and NGOs), during January 2010–April 2011 (152 person-days, on average 12 hours/day). The survey and/or the collated osbervations investigated known or reported Bengal Mongoose sites at Sukhchar and East Kolkata Wetlands, North 24-Parganas (north-eastern part of Bengal Mongoose range), Shibpur in Howrah (western part), Diamond Harbour, Budge Budge (Bajbaj), Patiatala and Joka, South 24-Parganas (southern part), as well as similar marshes within the known general range of Bengal Mongoose beyond East Kolkata Wetlands, which had not been surveyed for the species earlier. These new sites are located around:

(1) Rajarhat wetlands, east of East Kolkata Wetlands next to Salt Lake City;
(2) Eastern Metropolitan Bypass up to Garia;
(3) the State Highway (N. S. C. Bose Road) to Baruipur via Kamal Gazi, Narendrapur and Sonarpur;
(4) Diamond Harbour Road (National Highway 117) via Behala up to Joka; and
(5) Santragachhi wetlands, 20 km west of East Kolkata Wetlands, by the side of Kona Expressway.

Existing information was collected from the Wildlife Wing (headquarters) in the Forest Department of the Government of West Bengal, and from NGOs working in these wetland areas. Literature was consulted to prepare a database of Bengal Mongoose records. Specimens preserved by ZSI, Kolkata, were studied before the survey to assist in identification of Bengal Mongoose in the field.

A preliminary investigation selected potential localities of Bengal Mongoose in consultation with the concerned authorities, NGOs and local inhabitants. Bengal Mongoose is diurnal (Dey 2007, Deuti 2008), so the present survey was scheduled from 06h00 to 18h00. The species was surveyed by direct sighting. Narrow mud-banks on the shallow wetlands are the known haunts of Bengal Mongoose (Deuti 2008), and burrows located along the banks of bheries were watched at length to note the morning exit of mongooses from them and their evening return.

Five mongooses were captured during January–April 2011 by NEWS at Nalban, following the protocol of Dey (2007), who in 2006 had caught six of them. Japanese wire traps baited with live country chicken were placed near burrows under camouflage of leaves of Water-hyacinth. Trapped mongooses were identified, measured, weighed, sexed, marked black on the tail-tip (with hair-dye), and then released on the spot. The whole operation from setting the trap until release usually took about three hours.

To estimate the population status of Bengal Mongoose in the sample sites at N° 4 bheri, Nalban, the burrow count method was followed. Based on observed morning exit and evening return of mongooses, the study team selected burrows (Fig. 6) on the slopes of canal banks and bheries, and closed the mouths of the burrows with clay in the late evening when all mongooses were assumed to have entered the burrows. Next day, in the early morning, the team counted the number of burrows that were opened.

Results

Distribution
During the 45 years since its discovery, *H. palustris* has been reported from over a dozen sites in southern West Bengal (i.e. its entire world range). Records up to 2006 are summarised in Table 3. In addition the Bombay Natural History Society confirmed that it holds no specimens of *H. palustris* or of *H. (j) auropunctatus* from within the range of *H. palustris* (S. Bajaru *in litt.* 2011). The total area of non-saline wetlands surveyed during 2010–2011 was under 200 km^2. Bengal Mongoose was sighted in three previously reported sites and three previously undocumented peri-urban ones (Table 4). The former comprised Acharya Jagadish Chandra Bose Indian Botanic Garden, Shibpur (1.09 km^2); Bheri N°4 in Nalban fisheries (1.67 km^2); and Joka (about 0.55 km^2). The new sites comprised Survey Park, Ajaynagar (Santoshpur) close to Eastern Metropolitan Bypass (southern limits of Brace Bridge Wetlands during mid-twentieth century, now a satellite township) (<1 ha); Kadamtala (Behala) (<1 ha); and Subhasgram (<1 ha) next to Sonarpur. In addition, Indranil Mitra (of the Wildlife Wing, Forest Department; *in litt*. 2011) sighted the species at Rajarhat wetlands (<1 ha) near Bagjola canal and Debarati Bose (of Rabindra Bharati University, Kolkata) confirmed (*in litt.* 2011) sighting of Bengal Mongoose at Santragachhi Jheel (12.8 ha).

During 2007–2011, there were 18 direct sightings involving 33 mongooses (22 unsexed, six males, two females and three cubs). All trapped animals (four males and one female) at Nalban during January–April 2011 were identified as *H. palustris* (as in this area earlier; Dey 2007). Whereas ZSI collected comparatively many Bengal Mongooses (32) during the 1960s, before promulgation of the Indian Wildlife (Protection) Act in 1972, NEWS caught only a few individuals, all from Nalban: six in 2006 (Table 3) and five in January–April 2011 (Table 4), reflecting legal restrictions, not an inability to find more mongooses to trap.

Bengal Mongoose was not found in 27 other fisheries (covering about 11 km^2 in total) surveyed in the East Kolkata Wetlands close to Nalban. These were visited on 64 days (roughly totalling 400 hours of searching), during January–August 2010 (Table 5). It should not be concluded that Bengal Mongoose is absent from these areas, but it is at best very rare in them: surveys were sufficiently intensive to be confident that none held a large population. In addition, neither Bengal

Table 3. Past records (1964–2006) of Bengal Mongoose *Herpestes palustris* from its entire world range[1].

Location	Sex[2]	Date	Source
District: Howrah			
Shibpur (22°33'N, 88°18'E)	1♂	25 Nov 1964	Collection: B. Biswas, ZSI; Agrawal *et al*. 1992
Nazimganj (south of Shibpur)	1♂+1♀	26 Jan 1965	Collection: R. K. Ghose, ZSI; Agrawal *et al*. 1992
District: North 24-Parganas			
Salt Lake (22°35'N, 88°25'E), Bantala (22°31'N, 88°26'E), Duttabad (22°36'N, 88°26'E), Hederhat (22°29'N, 88°23'E), Nalban (22°34'N, 88°25'E) (East Kolkata Wetlands)	19♂+8♀	21 Jan, 27 Apr, 7, 21 Jun, 11, 26 Jul, 21, 27 Dec 1964; 21 Feb, 21 Mar, 28, 31 (*sic*) June, 28 Nov, 5 Dec 1965	Collection: B. Biswas, ZSI; Ghose 1965, Agrawal *et al*. 1992
Sahebmara bheri (22°33'N, 88°25'E) (East Kolkata Wetlands)	not known	2004	Records open to severe doubt (see text), no details given; Anonymous 2004
Sukantanagar (22°33'N, 88°24'E) and N° 4 bheri, Nalban (22°33'N, 88°25'E) (East Kolkata Wetlands)	20 unsexed	Jan–Dec 2005	Sighting: K. Deuti, ZSI; Deuti 2008
N° 4 bheri, Nalban (East Kolkata Wetlands)	3♂+3♀	11 March 2006	Trapped and released: NEWS *in litt*. 2006
Sukhchar (22°43'N, 88°22'E)	1♂	2 August 1964	Collection: B. Biswas, ZSI; Agrawal *et al*. 1992
District: South 24-Parganas			
Bhasna (= Bhajna in Soota & Chaturvedi 1970) (exact location not known)	1♀; "very common"	28 Sept 1967	Collection; sightings (presumed): Y. Chaturvedi, ZSI; Ghose & Chaurvedi 1972
Budge Budge (22°28'N, 88°10'E) and Patiatala (exact location not known)	Not known	1990s	Records require corroboration, no details were specified; S. Chattopadhyay *et al*. in Molur *et al*. 1998 and in Walker 1999
IIM wetland, Joka (22°26'N, 88°17'E)	Not known	2005	Record open to severe doubt[3]; Raghu Ram 2005

[1]All locations lie in southern West Bengal.

In addition, Kundu *et al*. (2008) indicated occurrence in Chowbhaga (opposite Bantala), Jhagrasisa and Mahishbathan, but these records are ignored here (see text).

Specimens (skin, skull and incomplete postcranial skeleton) of a male and two unsexed Bengal Mongooses are held by the Museum Victoria, Australia (registration nos 4388/4389; 4838/4839/4840; 4920/4921). They came through the Royal Melbourne Zoo (N. W. Longmore *in litt*. 2011), and their origin is apparently not recorded.

[2]Sex could be determined only for animals handled by ZSI and NEWS.

[3]No details are given, and the photograph purportedly of the species lacks any black patch on the muzzle

Mongoose nor its signs were found at Dhapa (East Kolkata Wetlands), which extends over 34.2 ha, the dumping ground of solid wastes of Kolkata and its neighbourhood. No other mongoose species was seen at any survey wetland.

Photographic documentation

Photographs of sighted or trapped Bengal Mongooses were taken at four sites: N° 4 bheri of Nalban, Ajaynagar (Survey Park), Joka and Subhasgram. Trapping and release operations were also documented. In February 2011, three photographs were taken by S. Jha at Nalban, one each of a Bengal Mongoose foraging, urinating at a bush of *Parthenium hysterophorus* (an exotic poisonous herb), and running fast across an unmetalled road. Both phases were photographed, a light-phase animal at N° 4 bheri, Nalban, and a dark-phase animal beside the wetland at Joka. Some photographs failed because at any sound or disturbance the mongoose usually fled fast (as found by Deuti 2008).

Habitat use

Burrows assumed to be those of Bengal Mongoose were found mainly in the secluded and undisturbed portions of the mudbanks at Nalban. In a stretch of ½ km in the core area of N° 4 bheri, 11 to 13 Bengal Mongooses were estimated. In the newly discovered sites, the animal was found in backyard gardens of recently developed urban settlements, south of the East Kolkata Wetlands. These sites were marshland before conversion to dry land. Thorough searching found no mongoose burrows near these gardens, suggesting that the animals observed were merely visitors from nearby unconverted marshland.

Natural history (group size, diurnality, behaviour)

Of the 33 individuals sighted during 2007–2011 (Table 4), 18 sightings were of singles, four of duos, one of a trio and one of a group of four. A pair moving close to each other was located in a backyard garden in south Kolkata. Three pups accompanied by an adult-sized animal, presumably the mother, seen at Nalban, hurriedly entered a burrow. A loner in a backyard at Survey Park, Ajaynagar (Santoshpur) stood on its hind legs to monitor the surroundings, a stance also observed at Nalban.

Bengal Mongoose was found to be very shy, generally hiding in the reeds or long grasses and aquatic vegetation, as noted earlier by Deuti (2008). At monitored burrows on the

Table 4. Recent records (2007–April 2011) of Bengal Mongoose *Herpestes palustris* from its entire world range.

Location	Sex	Date	Source
District: Howrah			
Santragachhi Jheel (lake) (22°34'N, 88°16'E)	1 unsexed	14 April 2011	Sighting: Debarati Bose *in litt.* 2011
Shibpur	4 unsexed (n+q)*	13 Sept 2010	Sighting: A. Chatterjee verbally 2010
District: North 24-Parganas			
N° 4 bheri, Nalban, East Kolkata Wetlands	3 unsexed (n)	21 Nov 2010	Sighting: A. Chatterjee *in litt*. 2010
	1♀+3 cubs (r)	29 Jan 2011	Trapped and released / sighting: NEWS *in litt*. 2011
	1 unsexed	17 Feb 2011	Sighting: S. Jha *in litt*. 2011
	1♂ (n)	19 Feb 2011	Trapped and released: S. Mallick *in litt*. 2011
	1♂+2 unsexed (n+p)	20 Feb 2011	Trapped and released / sighting: S. Mallick *in litt*. 2011
	2♂ (n)	26 Feb 2011	Trapped and released: S. Mallick *in litt*. 2011
	2 unsexed (n)	26 Mar 2011	Sighting: S. Mallick *in litt*. 2011
	4 unsexed (n+p)	30 April 2011	Sighting: NEWS *in litt*. 2011
Keshtopur, Rajarhat wetland (near Bagjola canal) (22°37'N, 88°25'E)	1 unsexed	22 April 2011	Sighting: I. Mitra *in litt*. 2011
District: South 24-Parganas			
Green View wetland, Joka (22°26'N, 88°18'E)	1 unsexed	29 Nov 2010	Sighting: A. Chatterjee verbally 2011
Indian Institute of Management wetland, Joka	1 unsexed	29 Dec 2010	Sighting: H. G. Mukhopadhyay *in litt*. 2011
Kadamtala, Behala (22°29'N, 88°18'E)	1 unsexed	2009	Sighting: P. K. Biswas *in litt*. 2010
Survey Park, Ajaynagar, Santoshpur (22°29'N, 88°23'E)	1 unsexed	9 Nov 2010	Sighting: S. Bhattacharya *in litt*. 2010
Subhasgram (22°24'N, 88°26'E)	1 unsexed	1 Jan 2007	Sighting: S. Bhattacharya *in litt*. 2010
	1 unsexed	10 Sept 2010	Sighting: S. Bhattacharya *in litt*. 2010
South Kolkata (exact locality not known)	2 (p)	5 Feb 2011	Sighting: L. Barman *in litt*. 2011

*n= single, p= duo, q= trio, and r= group of four.

mud-banks in N° 4 bheri at Nalban, the animals emerged cautiously just after sunrise and, if the environment was found undisturbed, they went foraging; otherwise, they took refuge in their burrows. The foragers returned to their burrows before sunset and stayed there overnight. Out of 20 burrow mouths sealed with mud in the late evening, five were found opened early the next morning, suggesting that at least a quarter of burrows contained animals. It may be more, because a disturbed animal may not come out of the burrow until, presumably, it feels safe. For example, a mongoose stood erect after coming out of the burrow in the morning, monitoring the surroundings, but when a bicycle passed at a distance of about 10 m it returned to its burrow and did not emerge during the following hour's observation.

Since the burrows of Bengal Mongoose are multi-channelled with openings located side-by-side (Fig. 6b), presumably for easy escape, the number of burrow-openings does not indicate the population. Although mongooses spend the night in burrows on mud-banks, they seem to shelter in grasses and shrubs during the day, because they were neither seen in the open in scorching sunlight nor to return to their burrows during hot mid-day.

Hunting animals were seen during the present study, frequently, to jump on a dense bed of Water-hyacinth and search for aquatic food, with only the feet becoming wet in the process. They were also watched wading along the pond banks, poking paws into crevices and sifting through mud to take frogs and crustaceans. These mongooses were not seen, however, to swim, or even to immerse themselves. Another hunting situation involving a mongoose here identified as a Bengal Mongoose was reported and photographed at Santragachhi Jheel on 26 January 2010 at 09h49 (Sen 2010). A snipe *Gallinago* was spotted on a Water-hyacinth mat by the mongoose, which then sat down, prospecting; the snipe flew, apparently sensing the presence of the mongoose.

Bengal Mongoose was generally silent but sometimes mewed, or gave low yelps or growls in rage with bristling of the hair (thereby growing in apparent size), particularly of the tail.

A Bengal Mongoose finding a trap with live bait typically encircled the trap a number of times, then approached close to threaten the bait with a hissing sound, hitting at it with its paw. It also often clambered about, with skill, on the cage gratings. Failing to capture the bait from outside, it entered the cage through the opening. Immediately after the cage shut, the trapped animal showed aggression, made an open-mouthed fierce protest or display and moved up and down. However,

Table 5. Sites surveyed in the East Kolkata Wetlands, southern West Bengal, India, where no Bengal Mongooses *Herpestes palustris* or their signs were found.

Name of the bheri	Area (ha)	Remarks
Chinta Singh Bheri	75.10	Dumping of refuse by Bidhannagar Municipality, filled up over the years and being converted to paddy fields.
Sardar Bheri	66.79	Drying up due to reduced flow of waste water.
Nater Bheri	71.18	Drying up due to reduced flow of waste water
Munshir Bheri	69.25	Located in Mahishbathan area; degraded and encroached by Nabadiganta (New Town) Industrial township
Mollar Bheri	54.99	Degraded and encroached
Narkeltala Bheri	75.88	Degraded and encroached
Patrabad Bheri Nos. I-IV	132.94	Destroyed by Rajarhat New Town Project
Baro Paresh Bheri	98.89	Degraded and encroached
Choto Paresh Bheri	37.35	Degraded and encroached
Goltolla Bheri	42.72	Reduced in size
Barochaulari Bheri	27.38	Degraded and encroached
Chotochaulari Bheri	23.15	Degraded and encroached
Jhagra Sish Bheri	62.32	Degraded and encroached
Gonpotta Bheri	50.73	Degraded and encroached
Uttar Gorumera Bheri	57.52	Degraded and encroached
Durga Bhasan Bheri	56.98	Under cultivation
Heder Bheri	NA*	Both under cultivation and fishery.
Chaker Bheri	27.29	Degraded and encroached
Gopeshwar Bheri	34.18	Degraded and encroached
Chachari Bheri	NA	Degraded and encroached
Hena Khali Bheri	NA	Under cultivation and fishery
Har. Kara Bheri Nos. I-V	22.22	Degraded and encroached
Eani Jheel Bheri	NA	Degraded and encroached
Diller Bheri	17.17	Degraded and encroached
Danir Bheri	14.79	Degraded and encroached
Ban Bheri	17.67	Degraded and encroached
Garumara Bheri (South)	39.40	Degraded and encroached

*NA= Not available

after struggling for some time, it calmed down. When the gate was opened for its release, it usually moved backwards to come out of the trap. Creeping (reflecting the literal meaning of its genus) was particularly observed at the time of entering or leaving the trap. Some mongooses were seen to avoid the trap in the presence of people or other sources of disturbance.

It used the tail probably to balance either when standing upright (laid straight on the ground), or moving fast (kept almost straight in the air). A mongoose, before entering the trap, was found to curve (angular and U-shaped) the tapering lower part of the tail outward, possibly as a gesture of threat. When it entered the trap, the tail-tip was seen to form an inward loop in defence. In another case, a mongoose fearlessly entered the trap straight away, keeping its tail in its normal position with the tip close to the ground. No upward loop of the tail was ever observed.

Bengal Mongooses were sometimes encountered apparently shifting from one patch to another. While running fast, they sometimes even turned without slowing down. However, sometimes they paused for a moment to look around and then quickly dashed into cover next to the path.

Discussion

Distribution and habitat use

From 1964 to 2005, Bengal Mongoose records (Table 3) ranged from Sukhchar in the north to Bantala (on the left side of Basanti Road) in the east, Shibpur in the west (with provisional reports from Budge Budge and Joka) and Bhasna in the south. Bhasna, 47 km south-east of Diamond Harbour, is 110 km from Salt Lake, whereas Sukhchar is about 12 km from Salt Lake. This gives a north–south range of 122 km. During the present survey and record collation, the northern known limit is Nalban, the eastern limit is extended to the Rajarhat Wetlands, the western limit is extended to Santragachhi, about 5 km north-west of Shibpur (Howrah), and the southern limit is Subhasgram. Subhasgram is well north of the previous southern limit: it is 31 km north of Diamond Harbour, compared with 47 km to the south-east. Therefore, Bengal Mongoose range may recently have contracted both in the northern and southern parts, although neither Sukhchar or Diamond Harbour were thoroughly surveyed recently, so the species may still occur in them.

During 2007–2011, Bengal Mongoose was found in five new peri-urban habitats within its previously documented geographic range. No published documents indicate any previous survey in these areas by the forest department, ZSI or any NGO, and there is no reason to invoke a range expansion. Similarly, it is possible that the species might be found in further yet-to-be-surveyed non-saline wetlands in the region.

During 2007–2011, Bengal Mongoose was sighted only in inland non-saline wetlands. No records of Bengal Mongoose from salty or even brackish habitats, such as the present Sundarban mangroves, were traced, but very little suitable survey has been conducted in them, so the possibility remains that the species uses such habitat. In addition, although Bengal Mongoose visits dryland areas adjacent to some occupied wetlands, it has not yet been found in such habitats contiguous with its known range but away from wetlands, such as at Chintamoni Kar Bird Sanctuary (6.956 ha; 22°42'N, 88°40'E) to the right of N. S. C. Bose Road, near Adi (= old) Ganga, 12 km south of the East Kolkata Wetlands. This was formerly an orchard and holds Grey Mongoose (direct sighting by the author), but not, apparently (based on considerable observation), Bengal Mongoose or Small Indian Mongoose.

Bengal Mongoose is a den-digging animal living around large but shallow non-saline water bodies, fully or partly covered with a thick growth of aquatic plants, i.e. bogs, marshes and swamp-edges infested with reeds (Alfred & Chakraborty 2002, Dey 2007, Deuti 2008). It makes inter-connected burrows of about 45–55 cm long and 33 cm deep with 3–4 entries mainly along the slopes of the water bodies (NEWS *in litt*. 2006). Permanent underground burrows are short-mouthed, whereas the tunnel is wider with downward slope from the mouth (NEWS *in litt*. 2006). Deuti (2008) reported that the mother enlarges her own burrow by re-excavation before giving birth. The area surrounding the occupied burrow is devoid of clay particles, with fresh scratch marks often apparent near its mouth (NEWS *in litt*. 2006). Burrows were not found in drier areas. It seems that the territory of each Bengal Mongoose is not extensive, but is small, fixed, exclusive and usually spaced along the water's edge (NEWS *in litt*. 2006). Deuti (2008) found Bengal Mongoose burrows on mud-banks less frequented by people, and observed mongooses running away when approached. Though Bengal Mongoose was not found amid human habitations adjacent to Nalban during the present study, it was occasionally sighted near them peripheral to fragmented small wetlands south of the East Kolkata Wetlands.

Behaviour

Most Bengal Mongooses were seen alone (18; Table 4) during 2007–2011 and, since Small Indian Mongoose is usually solitary (Veron *et al*. 2004), it seems likely that Bengal Mongoose also is. Bengal Mongooses were sighted mostly in the early morning and late afternoon during the present survey. They enter the burrow just before sunset (based on about 12 observations). Deuti (2008) also recorded that they are more active between 06h00 and 08h00 during summer and between 07h00 and 10h00 during winter. After a gap of six to seven hours (probably resting period), they resume foraging between 16h00 and 17h00 during summer and between 15h00 and 17h00 during winter (Deuti 2008). The time of starting activity varies, in part depending on the sunrise (difference of about an hour between summer and winter) and the intensity of day-temperature. During cloudy days, they were seen moving around outside the above times.

Bengal Mongoose lives on aquatic animals like small fish, crustaceans, molluscs, crabs, amphibians, small reptiles, their eggs, insects and larvae (Ghose & Chaturvedi 1972, Dey 2007, Deuti 2008), but may also take birds (see above, 'Results: natural history'). Molluscs consumed include the common aquatic snail *Pila globosa*, bivalves like *Lamellidens marginalis* and gastropods like *Bellamya bengalensis* and *Lymnaea*. These molluscs abound at the water's edge. Their broken shells were seen scattered at mongoose burrow-mouths by Deuti (2008).

Various aquatic bugs (Hemiptera: *Gerris spinolae*, *Sphaerodema annulatum*, *Ranatra elongata*, *R. varips*, *Laccotrephes griseus*, *Diplonychus annulatus* and *D.* [= *Sphaerodema*] *molestum*) and beetles (Coleoptera: *Canthydrus laetabilis*, *Cybister tripunctatus*, *Hydrocoptus subvittatus*, *Hypoporus bengalensis*, *Eretes sticticus*, *Hydrophilus olivaceus* and *Berosus indicus*), dragonfly nymphs, terrestrial grasshoppers, crickets and centipedes, crabs etc. are also taken by Bengal Mongooses (Deuti 2008). They were seen taking giant water bugs and diving beetles, which possess hard elytra and wing membranes (Deuti 2008). Juveniles eat various land insects and the small mollusc *Lymnaea* (Deuti 2008). After eating, mongooses sometimes use a long fore-claw to clean the teeth, like a toothpick (Deuti 2008).

Little is known about Bengal Mongoose reproduction. A lactating female was collected in June (Ghose 1965). Dey (2007) recorded courtship and mating started in March and young (2–3) were born in June, but Deuti (2008) stated that breeding takes place during January–March, when the male was often seen to chase the female along the mud-banks and most births were observed between April and June. He stated that the cubs grow rapidly within 2–3 months and by August–September come out of the burrow to hunt with the mother. He also observed the cubs playing near the mouth of the burrow in the evening of September–October. A mother and three cubs were, however, seen at Nalban in January during the present survey. This indicates that probably the breeding time is not fixed, and thus resembles that of Small Indian Mongoose (Bahuguna & Mallick 2010).

Deuti (2008) also reported that the male takes no part in care of the young and the mother guards and protects her cubs ferociously, even by attacking Yellow Monitor lizards *Varanus flavescens*, which try to prey on mongoose cubs.

Population trend

Alfred & Chakraborty (2002) assumed that Bengal Mongoose has declined drastically due to large-scale conversion of wetlands to human habitation. In the 1960s, Bengal Mongoose was fairly common throughout East Kolkata Wetlands, extending over 125 km^2, at Salt Lake, Bantala, Duttabad, Hederhat and Nalban, wherefrom 27 mongooses were collected. All five areas were surveyed during 2007–2011, but Bengal Mongoose was found only at Nalban. Survey effort was sufficient to conclude that it is now very rare in, or may be absent from, the other four areas.

The maximum number of mongooses captured in a day at one location (Nalban) was six (in 2006; NEWS) and the cor-

Table 6. Former bheries destroyed in Bidhannagar township, 24-Parganas district, India.

Name of bheri	Present use
Bidyadhari Spill Cooperative Fisheres	Vidyasagar and Laboni Housing, B.D. Market
Knakrimari bheri	Bhaba Atomic Research Center
Boro bheri	Baisakhi and Digantika Housing
Daser bheri	Mayukh Bhawan and other government office premises
Nortala khas bheri	Salt Lake Stadium
Kansar bheri	Baisakhi Housing
Bager bheri	Nicco Park (formerly Jhilmil)
Kajar bheri	Industrial estate, IT (Sector IV)
Hansar bheri	Industrial estate, IT (Sector V)

responding figure in January–April 2011 is five. In the five new sites, only singles or duos were seen, and only once or twice at each site.

Therefore, the information on which to assess population trend is fragmentary. In 2005, about 20 Bengal Mongooses were reported to live closely in burrows in a 50 m secluded portion of the mud-bank between Sukantanagar and N° 4 bheri (Deuti 2008), whereas, following the burrow count method (see above), 11 to 13 Bengal Mongooses, including breeding pairs and cubs, were estimated in the same site over a stretch of ½ km in the core area of N° 4 bheri during the present survey. However, this does not necessarily mean a major decline in this bheri's population. A single location-specific change in habitat quality (say, re-profiling the earthworks) might have caused an equally location-specific change in mongoose population, or distribution of burrows. However, all lines of evidence (common-sense assumptions of effects of habitat conversion; resurvey of 1960s sites; and decreased number found at N° 4 bheri) are consistent with a severe decline having occurred. The area occupied by Bengal Mongoose during the late twentieth century was reported to be <500 km^2 (Molur *et al*. 1998), but the present survey assessed the probable extent of such area to be <200 km^2, representing a major decline since the 1960s.

Threats and conservation status

Several potential anthropogenic threats to Bengal Mongoose have been proposed (Chattopadhyay 2001, Alfred & Chakraborty 2002, Dey 2007, Mallick 2009, Bahuguna & Mallick 2010), and a participatory assessment of threats to Indian carnivores (Molur *et al*. 1998) gave it the national IUCN Red List status of Endangered. However, globally, *The IUCN Red List of Threatened Species* considers Bengal Mongoose a synonym of *H. javanicus* and does not list it. Given the possibility that Bengal Mongoose is a valid and highly threatened species, the global *Red List* should review this stance and consider listing it, perhaps as Data Deficient reflecting the taxonomic uncertainty. The species was upgraded by the Indian Wildlife Protection Act (1972), as amended 2002, from Schedule IV to Part II of Schedule II, providing absolute protection, and offences under which are prescribed the highest penalties (Bahuguna & Mallick 2010). In such cases, the minimum imprisonment prescribed is three years, which may extend to seven years with a minimum fine of INR 25,000 (see Section 51 of the said Act).

Threats to the species comprise habitat loss due to large-scale conversion for agriculture, satellite townships, industries and roads; conversion of large portion of natural wetlands to fisheries; clearing of aquatic vegetation; canal concretisation; dumping of municipal solid wastes; and poaching and illegal trade in mongoose hair for paint-brush industry.

Much habitat has been lost by large-scale conversion for agriculture, satellite townships, industries and roads. Many bheries were filled up and converted to human habitations in the north-eastern East Kolkata Wetlands (Table 6). Due to large-scale conversion since the 1950s there were only about 200 bheries in East Kolkata Wetlands in the 1990s. In 1945, of the total wetlands of about 8,000 ha, nearly 4,628 ha of area were occupied by fisheries. Since 1953, after the formation of Salt Lakes Reclamation Scheme, the area under fisheries declined steadily. By 1970, the expanding city had engulfed Salt Lakes by about 2,000 ha. In the northern Salt Lake area, 26 fisheries were taken over by Salt Lake City housing complex alone. During 1969, there was a large-scale conversion of fisheries when some bheries turned vested. The major parts of wetlands are held either by Government or influential people and the people living on the wetland mostly do not have property rights on the wetland. The land, considered as owned land, is actually the vested land distributed amongst the marginal farmers and fishers through the process of land reforms under West Bengal Land Reforms Act of 1955, but these latter people do not have selling rights of these vested lands. Saha Ghatak (2010) found that local people do not really care for either conservation of environment or about the ecological importance of the East Kolkata Wetlands, and most of them prefer non-wetland-based livelihood to wetland-based livelihood. Under political patronage, these vested lands were distributed among landless people. Some co-operatives were formed. But, a large part was converted into paddy fields: the total conversion around this time was about 6,000 ha. Cultivation also started on the dried-up bed of the River Bidyadhari. Although local fishery owners and legal actions halted further encroachment of the wetlands, the process was not stopped. Throughout the 1970s, creeping conversion continued. New townships like Kasba, Vaishnabghata, Patuli and others came up spread over about 800 ha. Starting from the northern hub of Ultadanga flyover to Garia in the south, the Eastern Metropolitan Bypass, operating since the late 1970s, runs over a stretch of 21 km, cutting through the East Kolkata Wetlands and then extending southwards, where many satellite townships have developed during the last four decades.

Of those (semi-)natural wetlands that have not been drained, many have been converted to fisheries, with fragmentation and degradation of those parts not yet converted. Pisciculture involves clearing of the aquatic vegetation used by foraging Bengal Mongooses (see discussion on foraging technique, above). So, compared with the vastness of the open water (Fig. 5), only a few patches of aquatic plants remain. Thus, comparatively little Bengal Mongoose foraging habitat remains in most bheries. Concretisation of both sides of the main canals in East Kolkata Wetlands, where the burrows of Bengal Mongoose are located, has occurred. This reduces bur-

rowing opportunities, and, presumably, foraging habitat and invertebrate populations.

Municipal solid wastes (domestic and commercial organic-rich sources) of Kolkata are dumped (2,500 tonnes/day) for production of vegetables in the landfill sites, and untreated industrial effluents at Dhapa (East Kolkata Wetlands) have been released over an area of 21.4 ha. As this dumping site was being filled up, an alternative site was selected in 2010 by the side of the main dumping ground. Much methane is discharged from this site, needing immediate remediation because runoff into nearby water bodies creates environmental hazards for wetland-dependent species (i.e., including people) (Purkait & Chakraborty 2011).

Mongoose poaching to meet the demands of the paintbrush industry is on the rise in south Bengal (K. Ghosh, Statesman News Service, Kolkata, *in litt*. December 2002). Trapped mongooses are beaten to death, and the hair (about 10 g/animal, fetching Rs.25.00) is plucked by hand (K. Ghosh *in litt*. 2002). K. Ghosh (*in litt*. 2002) identified a few villagers in North and South 24-Parganas districts engaged in this occupation. The Forest Department of West Bengal seized mongoose-hair brushes (508 in 2002–2003, 56 in 2004–2005, and 887 in 2007–2008) and mongoose hair (2 kg in 2004–2005) in Kolkata and suburbs (Annual Report 2009–2010). For a species with such a small, fragmented, range, even modest levels of offtake could heighten the risk of extinction. Although Nandy (2006) considered that Bengal Mongoose might be threatened by capture for the pet trade, this seems unlikely to be so.

Conclusions

In sum, it seems that Bengal Mongoose has become rare in its entire range except at Nalban (Dey 2007, Deuti 2008, this survey), its largest remaining habitat-block. Though Nalban has a number of bheries, only the little-disturbed core area of N° 4 bheri is considered viable habitat (NEWS *in litt*. 2006). Bengal Mongoose is rare in Sahebmara bheri on the west, its second largest habitat-block. It was not sighted at four locations, Bantala (south-east), Choubhanga (south) [opposite Bantala], Jhagrasisa (east) and Mahishbathan (north) areas within the East Kolkata Wetlands, despite survey during October 2010 at levels adequate to find the species if present and anything other than extremely rare. Moreover, the East Kolkata Wetlands have reportedly been omitted from the latest Indian National Wetland Atlas prepared by Ahmedabad-based Space Application Centre (SAC), a part of the Indian Space Research Organisation (ISRO) (*Times of India*, 18 July 2011). So, there is a risk of derecognition of this Ramsar site.

Survival of the restricted-range Bengal Mongoose depends on existence of non-saline wetlands. Therefore, Nalban (a government-owned fishery used by the communities) is recommended for declaration as a Conservation Reserve as per provisions under the Wildlife (Protection) Amendment Act of 2002. Active conservation of the habitats and inhabitants should be implemented earnestly by the nodal agency (East Kolkata Wetlands Management Authority) involving the local people and NGOs. Captive breeding of Bengal Mongoose has already been recommended (Walker 1999), but no follow-up action has yet been undertaken. Clarification of the current distribution and status of Bengal Mongoose requires in-depth survey of all non-saline wetlands remaining in southern West Bengal, and adjacent areas of potentially suitable habitat. This would allow a cohesive species action plan to be developed and implemented. But most importantly, the taxonomic validity of Bengal Mongoose urgently requires assessment, through a critical re-evaluation of all purported morphological, behavioural and odour characters, and DNA-based investigation. This should use many individuals of *H. javanicus–H. auropunctatus*, from within West Bengal and across the rest of their range. Depending on the result, Bengal Mongoose may be anything from one of the most threatened and high-conservation-priority small carnivores in the world, to merely an indicator of pervasive habitat problems of only local significance.

The records on which these conclusions are based have not been subject to opinions on their identification from people other than the original observers and/or authors. And the number of animals examined in-hand from southern West Bengal remains small. Thus, as stated in the introduction, this study has assumed that the small mongooses of wetlands in this part of West Bengal are all Bengal Mongooses. Other than by a major trapping programme, the validity of this assumption could be tested by the collation of many photographs of Small Indian Mongoose, Grey Mongoose and Bengal Mongoose from localities across their range in India and neighbouring countries, and taken from a range of lighting conditions and angles showing animals in varied postures and behaviours, and of varying ages and sexes, and the group discussion of what these images show and how useful are the purported identification characters. Many cases with birds have shown that this approach (pioneered by Porter *et al.* [1974]), and now widespread particularly since the advent of the internet) gives immensely valuable perspective, addition to what can be gained from direct study of skins, on how to use distinguishing characters in the field. The continuing lack of clear guidelines on field identification (the species is not in the two most commonly-used identification guides to Indian mammals, Prater [1971] and Menon [2003]) mean that people who have not the opportunity to study skins lack clear guidance on how to identify Bengal Mongoose. Thus, much potential insight on the animal remains untapped.

Acknowledgements

I am specifically grateful to all those persons and institutions, who helped in conducting this study at various locations or provided field information to build up the database on Bengal Mongoose – ZSI; NEWS; IIM, Kolkata; staff of Forest Department; respondent villagers as well as the birdwatchers and photographers like Sumanta Mallick, Soma Jha, Shantanu Bhattacharya, Indranil Mitra, Debarati Bose, A. Chatterjee, H. G. Mukhopadhyay, P. K. Biswas and L. Barman for their records that stimulated the search in the new areas. I am also indebted to Indranil Mitra for providing the map of the study area, and to Jerry Belant, Richard Kraft, Divya Mudappa, Géraldine Veron (Harry Van Rompaey library) and Roland Wirth for providing references. Besides, I express my gratitude to Vivek Sahajpal, Sameer Bajaru and Wayne Longmore, who provided information, and to two referees for their comments on an earlier draft.

References

Agrawal, V. C., Das, P. K., Chakraborty, S., Ghose, R. K., Mandal, A. K., Chakraborty, T. K., Poddar, A. K., Lal, J. P., Bhattacharyya, T. P. & Ghosh, M. K. 1992. Mammalia. Pp.105–107 in Director, Zoological Survey

of India (ed.) *Fauna of West Bengal, part I, overview, Mammalia, Aves and wildlife*. Zoological Survey of India, Kolkata, India.

Alfred, J. R. B. & Chakraborty, S. 2002. Endemic mammals of India. *Records of Zoological Survey of India, Occasional Paper* 201: 1–37.

Alfred, J. R. B. & Nandi, N. C. 2000. Faunal diversity in Indian wetlands. *ENVIS Newsletter* 6(2): 1–3.

Alfred, J. R. B., Sinha, N. K. & Chakraborty, S. 2002. Checklist of mammals of India. *Records of Zoological Survey of India, Occasional Paper* 199: 1–289.

Anonymous 2004. *Final report on preliminary study on biodiversity of sewage [fed] fisheries of East Kolkata Wetland ecosystem*. Institute of Wetland Management & Ecological Design, Salt Lake, Kolkata, India.

Bahuguna, N. C. & Mallick, J. K. 2010. *Handbook of the mammals of South Asia*. Natraj publishers, Dehra Dun, India.

Basak, A. 2009. *Environmental studies*. Dorling Kindersley (India) Pvt. Ltd, Delhi, India.

Bininda-Emonds, O. R., Gittleman, J. L. & Purvis, A. 1999. Building large trees by combining phylogenetic information: a complete phylogeny of the extant Carnivora (Mammalia). *Biological Reviews of the Cambridge Philosophical Society* 74: 143–175.

Chakraborty, R. & De, J. K. 2010. *Atlas on hairs of Indian mammals, Part I, Carnivora*. Zoological Survey of India, Kolkata, India.

Chattopadhyay, K. 2001. *Environmental conservation and valuation of East Calcutta Wetlands*. Indira Gandhi Institute of Developmental Research, Goregaon, Mumbai, India.

Chaudhuri, A. B. & Sarkar, D. D. 2003. *Megadiversity conservation: flora, fauna and medicinal plants of India's hotspots*. Daya Publishing House, Delhi, India.

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

De, J. K., Chakraborty, S. & Chakraborty, R. 1998. Identification of dorsal guard hairs of five Indian species of mongoose, *Herpestes* Illiger (Mammalia: Carnivora). *Mammalia* 62: 285–296.

Deuti, K. 2008. Habits, food preference and family life of the Marsh Mongoose (*Herpestes palustris* Ghose, 1965) in the Salt Lake Swamps near Calcutta, West Bengal. *Records of Zoological Survey of India* 108(2): 47–50.

Dey, P. 2007. Study on Marsh Mongoose (*Herpestes palustris*, Ghose) in the East Kolkata Wetland. *Environ* 10: 31–33.

Ewer, R. F. 1973. *The carnivores*. Cornell University Press, Ithaca, NY, U.S.A.

Feldhamer, G. A., Drickamer, L. C., Vessey, S. H., Merritt, F. & Krajewski, C. 2007. *Mammalogy: adaptation, diversity, ecology*, 3rd edn. Johns Hopkins University Press, Baltimore, Maryland, U.S.A.

Furedy, C. 1987. From waste land to waste-not land: the role of the Salt Lakes, East Calcutta, in waste treatment and recycling, 1845–1930. Pp. 145–153 in Sinha, P. (ed.) *Calcutta: the urban experience. Essays in honour of Prof. Nisith R. Ray*. Riddhi-India, Calcutta, India.

Ghose, R. K. 1965. A new species of mongoose (Mammalia: Carnivora: Viverridae) from West Bengal, India. *Proceedings of the Zoological Society of Calcutta* 18(2): 173–178.

Ghose, R. K. & Chaturvedi, Y. 1972. Extension of range of the mongoose, *Herpestes palustris* (Mammalia, Carnivora, Viverridae), with a note on its endoparasitic nematode. *Journal of the Bombay Natural History Society* 69: 412–413.

Ghosh, A. 2009. *Biodiversity conservation*. A.P.H. Publishing Corporation, New Delhi, India.

Ghosh, A. K. & Nandi, N. C. 2009. Community-based wetland management: a case study of Brace Bridge Nature Park (BBNP), Kolkata, India. Pp. 125–152 in Smardon, R. C. (ed.) *Sustaining the world's wetlands: setting policy and resolving conflicts*. Springer Science, New York, U.S.A.

Gilchrist, J. S., Jennings, A. P., Veron, G., & Cavallini, P. 2009. Family Herpestidae (mongooses). Pp. 262–328 in Wilson, D. E. & Mittermeier, R. A. (eds) *Handbook of the mammals of the world, vol. 1. Carnivores*. Lynx Edicions, Barcelona, Spain.

Honacki, J. H., Kinman, K. E. & Koeppl, J. W. (eds) 1982. *Mammal species of the world: a taxonomic and geographic reference*. Allen Press Inc. & the Association of Systematics Collections, Kansas, U.S.A.

Hussain, S. A. 1999. Mustelids, viverrids and herpestids of India: species profile and conservation status. Pp. 27–28 in Hussain, S. A. (ed.) *Mustelids, viverrids and herpestids of India*. Wildlife Institute of India, Dehra Dun, India.

Kumar, R. 2010. Integrated management planning for East Kolkata Wetlands. *East Kolkata Wetlands* 1: 7–15.

Kundu, N. 2010. East Kolkata Wetlands: an introduction. *East Kolkata Wetlands* 1: 1–6.

Kundu, N., Pal, M. & Saha, S. 2008. East Kolkata Wetlands: a resource recovery system through productive activities. Pp. 868–881 in Sengupta, M. & Dalwani, R. (eds) *Proceedings of Taal 2007: the 12th World Lake Conference*. International Lake Environment Committee, Jaipur, India.

Mallick, J. K. 2009. Endemic Marsh Mongoose *Herpestes palustris* (Carnivora: Herpestidae) of East Kolkata Wetlands, India: a status report. *Journal of Threatened Taxa* 1: 215–220.

Menon, V. 2003. *A field guide to Indian mammals*. Dorling Kindersley (India) Pvt. Ltd, Delhi, India.

Molur, S., Nameer, P. O. & Walker, S. (eds) 1998. *Report of the workshop "Conservation Assessment and Management Plan for Mammals of India" (BCCP – Endangered Species Project)*. Zoo Outreach Organisation and Conservation Breeding Specialist Group – India, Coimbatore, India.

Nandy, H. 2006. Threatened mammals of West Bengal. *West Bengal* 48(10): 25–30.

Nellis, D. W. 1989. *Herpestes auropunctatus*. *Mammalian Species* 342: 1–6.

Porter, R. F., Willis, I., Christensen, S. & Nielsen, B. P. 1974. *Flight identification of European raptors*. T. & A. D. Poyser, Calton, U.K.

Prater, S. H. 1971. *The book of Indian animals*. Bombay Natural History Society and Oxford University Press, Mumbai, India (eleventh impression, 1998).

Purkait, N. N. & Chakraborty, D. K. 2011. Pattern of methane emission from a garbage dump. *Current Science* 101: 528–531.

Raghu Ram, T. L. 2005. *Biodiversity register Indian Institute of Management Calcutta: birds–snakes–lizards–mammals*. CMDS Project, Centre for Development & Environment Policy, IIM, Kolkata, India.

Rodgers, W. A. & Panwar, H. S. 1988. *Planning wildlife protected area network in India: the report.* Wildlife Institute of India, Dehradun, India.

Saha Ghatak, D. 2010. *Trade-off between conservation of environment and economic development? A case study of East Kolkata Wetland*. M.A. thesis, Graduate School of Development Studies, International Institute of Social Studies, The Hague, Netherlands.

Sahajpal, V., Goyal, S. P., Raza, R. & Jayapal, R. 2009. Identification of mongoose (genus: *Herpestes*) species from hair through band

pattern studies using discriminate functional analysis (DFA) and microscopic examination. *Journal of the Forensic Science Society* 49: 205–209.

Sanyal, A. K., Ramakrishna & Alfred, J. R. B. 2007. Faunal resources in West Bengal. *West Bengal* 49(10&11): 38–48.

Sanyal, P. 1999. Common mustelids, viverrids and herpestids of West Bengal. Pp. 59–61 in Hussain, S. A. (ed.) *Mustelids, viverrids and herpestids of India*. Wildlife Institute of India, Dehra Dun, India.

Schreiber, A., Wirth, R., Riffel, M. & Van Rompaey, H. 1989. *Weasels, civets, mongooses, and their relatives: an action plan for the conservation of mustelids and viverrids*. IUCN, Gland, Switzerland.

Sen, S. K. 2010. The hunter and the hunted and the effectiveness of camouflage. Delhibirdpix. [https://groups.google.com/group/delhibirdpix]. Downloaded on 20 April 2011.

Sharma, U. 2011. Effect of global warming on biodiversity in India. Pp. 76–84 in Uttar Pradesh State Biodiversity Board (ed.) *National Conference on Forest Biodiversity: Earth's living treasure, 22nd May 2011*. Uttar Pradesh State Biodiversity Board, Lucknow, India.

Soota, T. D. & Chaturvedi, Y. 1970. On five new species of nematodes from vertebrates. *Proceedings of the Indian Academy of Sciences, Section B* 71: 100–108.

Taylor, M. E. & Matheson, J. 1999. A craniometric comparison of the African and Asian mongooses in the genus *Herpestes* (Carnivora: Herpestidae). *Mammalia* 63: 449–464.

Van Rompaey, H. & Colyn, M. 1996. An annotated bibliography of the Herpestidae and Viverridae (Carnivora, Mammalia). *Musée Royal de l'Afrique Centrale, Annales Sciences Zoologiques* 279: 1–411.

Veron, G., Colyn, M. & Dunham, A. E. 2004. Molecular systematics and origin of sociality in mongooses (Herpestidae, Carnivora). *Molecular Phylogenetics and Evolution* 30: 582–598.

Veron, G., Patou, M. L., Pothet, G., Simberloff, D. & Jennings, A. P. 2006 (for 2007). Systematic status and biogeography of the Javan and Small Indian Mongooses (Herpestidae, Carnivora). *Zoologica Scripta* 36: 1–10.

Veron, G., Patterson, B. D. & Reeves, R. 2008. Global diversity of mammals (Mammalia) in freshwater. *Hydrobiologica* 595: 607–617.

Walker, S. 1999. Endemic and non-endemic mammals in Indian zoos – from Central Zoo Authority Data Base 1998 and BCPP CAMP Workshop Output. Part III – civets and mongooses of India. *Zoos' Print* 14(8): 7–18.

Walker, S. & Molur, S. 1999. Conservation breeding and Indian species of mustelids, viverrids and herpestids: a perspective. P. 108 in Hussain, S. A. (ed.) *Mustelids, viverrids and herpestids of India*. Wildlife Institute of India, Dehra Dun, India.

Wenzel, E. & Haltenorth, T. 1972. System der Schleichkatzen (Viverridae). *Säugetierkundliche Mitteilungen* 20: 110–127.

Wozencraft, W. C. 1993. Order Carnivora. Pp. 279–348 in Wilson, D. E. & Reeder, D. M. (eds) *Mammalian species of the world. A taxonomic and geographic reference*, 2nd edition. Smithsonian Institution Press, Washington D.C., U.S.A.

Wozencraft, W. C. 2005. Order Carnivora. Pp. 532–628 in Wilson, D. E. & Reeder, D. M. (eds) *Mammalian species of the world. A taxonomic and geographic reference*, 3rd edition. The John Hopkins University Press, Baltimore, U.S.A.

Wozencraft, W. C., Duckworth, J. W., Choudury, A., Muddapa, D., Yonzon, P., Kanchanasaka, B., Jennings A. & Veron, G. 2008. *Herpestes javanicus*. In: IUCN 2010. *IUCN Red List of Threatened Species*, version 2010.4. <www.iucnredlist.org>. Downloaded on 29 May 2011.

Wildlife Wing, Directorate of Forests, Government of West Bengal, Bikash Bhawan, North Block, Salt Lake City, Kolkata 700 091, West Bengal, India.
Email: jayantamallick2007@rediffmail.com





Small carnivores of Peninsular Malaysia (see page 8): Banded Civet *Hemigalus derbyanus* (top left, Photo: Marcus Chua), Small-toothed Palm Civet *Arctogalidia trivirgata* (top right, Photo: Chan Kwok Wai), Common Palm Civet *Paradoxurus hermaphroditus* (middle left, Photo: Celine Low), Malay Civet *Viverra tangalunga* (middle right, Photo: Alan Yeo), and Yellow-throated Marten (bottom, Photo: Nick Baker).

The production and distribution of this issue is met from subscriptions.

ISSN 1019-5041