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A SMALL-MAMMAL SURVEY AT TASEK BERA, PAHANG, MALAYSIA'S FIRST RAMSAR SITE

BY

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A Small-mammal Survey at Tasek Bera, Pahang, Malaysia's First Ramsar Site

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Abstract: A comprehensive baseline survey of the non-volant small mammal community at Tasek Bera was conducted over a period of 48 days. Several different methods, namely trapping, transect walks and spotlighting were used, as each method is biased to a different species assemblage. A total of 33 species of small mammals from nine orders were recorded. Of these, 15 species are protected under Malaysian laws and five are included in the IUCN Red List. Compared to other sites studied, Tasek Bera showed a relatively high density and biomass of small mammals. Potential threats at the site include persecution by locals, hunting and habitat destruction.

INTRODUCTION

Tasek Bera, an alluvial peat swamp ecosystem (Lim *et al.* 1982), is located in the lowlands of south-western Pahang state, Peninsular Malaysia (3° 2.5'N, 102° 39.25'E). Tasek Bera consists of a mosaic of habitats, described by Giesen (1998). The dominant habitats are rivers and streams, open water bodies, *Pandanus-Lepironia* swamps, peat swamp forest, freshwater swamp forest and secondary swamp forest. Lowland forest surrounds the wetland, some of which is heavily disturbed. The habitats in which the surveys were conducted are described below.

The wetland system and the surrounding forest support a very rich biological community and also play an important role in flood control, water flow regulation and water purification, and provide natural resources for the local community (see Benstead *et al.*, 1993; Mohd Shahwahid, 1997). Given its importance, the wetland is now protected under an international treaty, the Convention on Wetlands of International Importance (1971), or Ramsar Convention, and is Malaysia's first Ramsar site. While the wetland habitats cover an area of c. 7,000ha, the Ramsar site encompasses an area of over 26,000ha and a buffer zone of 27,500ha. As a contracting party to this convention, Malaysia has undertaken responsibility to maintain the ecological character of Tasek Bera and make wise use of its wetland resources.

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Tasek Bera, as is the case with similar sites worldwide, has the potential to become a popular ecotourism destination. This raises the issue of which sections of Tasek Bera could be opened for ecotourism, without undermining the original objectives of sustainable use and conservation. However, to date, little detailed information is available on the area's biodiversity and this also holds true for other sites worldwide (McDade *et al.*, 1994). Most studies conducted so far have been short, providing a quick assessment of the fauna present at the site. More comprehensive information is required for site management purposes.

Studies on small mammals in swamp forest ecosystems are very scarce. Previous studies on the fauna of Tasek Bera mainly focussed on zooplankton, benthos and fish (Furtado and Mori, 1982; Benstead *et al.*, 1993). General wildlife surveys were of short duration (less than one week) and *ad-hoc* in nature (Khan *et al.*, 1991; Benstead *et al.*, 1993; DWNP, 1997). As an initial step to rectify this gap in knowledge, the focus of this research project was to conduct a comprehensive baseline survey of the non-volant small mammal community at selected areas within Tasek Bera.

HABITATS SURVEYED

The following descriptions are based on Giesen (1998), who conducted an evaluation of the habitats and flora at Tasek Bera.

Peat Swamp Forest

The swamp forests at Tasek Bera are similar to swamp forests elsewhere in Malaysia, but have little in common with the coastal peat swamps, both floristically and structurally, owing to the topogenic origins of the peat at Tasek Bera. The peat swamp forest trees are generally not taller than 15–20m (occasionally 25m) and the canopy is quite open – hinting at local human disturbance. A lot of the trees are bent and gnarled. Most numerous are many species of *Eugenia*, including *E. spicata*. The undergrowth is dominated by an often very dense mat of 1.5–2m coarse sedge *Thoracostachyum sumatranum*, which may be accompanied by ferns, the aroid *Lasia spinosa*, and the shrubby *Melastoma malabathricum*. The area surveyed was also characterised by narrow channels of flowing water, with many logs and roots along the banks. *Pandanus helicopus* is common along streamsides.

Lowland Forest

Lowland rainforest at Tasek Bera is well developed and generally dominated by members of the dipterocarp family, such as *Anisoptera scaphula*, *Dipterocarpus baudii*, *D. cornutus*, *D. costulatus*, *D. crinitus*, *D. kerrii*, *D. rigidus*, *Parashorea stellata*, *Shorea acuminata*, *S. laevis*, *S. leprosula*, *S. ovalis*, *S. parvifolia* and *Vatica lobata*. The canopy is closed and trees often attain a height of 30–40m, with emergents up to more than 50m – especially *Koompassia excelsa* and *K. malaccensis*. However, many tree and shrub species occur, and palms are common in the understorey. There are also many rattans and other woody climbers. The undergrowth is generally not very dense.

Disturbed Lowland Forest

Most of the lowland forest in the Tasek Bera area has been selectively logged over the past two/three decades and, in addition, shifting cultivation by the Semelai has also contributed to the degradation of lowland forest. The net result is a patchwork of primary forest, secondary forest, secondary scrub and forest in various stages of regeneration. In totally degraded areas, this dryland forest may be dominated by *Macaranga*, *Mallotus* or *Commersonia bartramia*, but on the whole these degraded forests are relatively rich in species and many are regenerating vigorously and well on the way to recovery. Common are impenetrable bamboo thickets and dense patches of rattans. Trees and shrubs that are common in these degraded forests are generally fast-growing, small species, but also include saplings of primary forest species.

MATERIALS AND METHODS

Three plots were established within the area. The first plot was at Tanjung Kuin, in lowland forest, which was selectively logged in the '70s and is now in an advanced state of regeneration (3° 7.93'N; 102° 36.58'E). The second plot was near Pos Iskandar, in peat swamp forest that is seasonally flooded (3° 1.61'N; 102° 39.43'E), and the third plot was near Kampung Jelawat (3° 0.02'N; 102° 39.72'E), in lowland forest which was recently logged and further disturbed by shifting cultivation. The area of natural habitats at Tasek Bera in which all three sites are situated, is surrounded by extensive oil palm and to a lesser extent rubber plantations.

This study was conducted between March and June 1998, with 48 days in the field. Each site was sampled twice: 12–19 March and 7–14 May at Tanjung Kuin, 9–16 April and 20–27 May at Pos Iskandar, and 23–30 April and 2–9 June at Kampung Jelawat.

Several different methods were used in this study, each being biased to a different species assemblage (Catling *et al.*, 1997). Trapping is suitable for diurnal and nocturnal small mammals; transect surveys, for primates, squirrels and vocal diurnal small mammals; tracks and signs, for ungulates, otters and mammals favouring open areas; and spotlighting for nocturnal small mammals. For the purpose of this study, a small mammal is defined as any individual weighing up to 5kg.

Small mammals were trapped using collapsible Tomahawk® traps (42cm x 13cm x 13cm). At each site, four 200m transects were laid at random, with two tomahawk traps placed every 20m – one trap on the ground and one in the sub-canopy. Traps were checked once a day between 0900 and 1100h and bait replaced as necessary.

To assist the capture of the widest possible range of small mammals a variety of baits, such as ripe banana, oil-palm fruit, dried coconut kernel, jackfruit and fish, were used at random during each sampling period (Zubaid and Khairul, 1997). Each individual captured was anaesthetized with diethyl ether and the following parameters recorded: species, sex, reproductive condition, head and body length, hind foot length, ear length and height of capture. A uniquely numbered ear tag was attached to each individual prior to release.

At Tanjung Kuin and Kampung Jelawat, transect surveys were conducted by following the logging road. Each transect was surveyed once after checking the traps and once at night. At Pos Iskandar, transect surveys were done by boat, travelling along a channel in the peat swamp forest both during the day and night. During the surveys, footprints, marks and vocalizations were recorded.

Spotlighting was conducted at each site between 2000 and 0200h, from a vehicle moving along the transects at Tanjung Kuin and Kampung Jelawat and from a boat at Post Iskandar, with the aid of a Coleman® million-candlepower spotlight.

RESULTS

A total of 33 species of small mammals from 9 orders were recorded during the survey (Table 1). Twenty species of small mammals were recorded at Tanjung Kuin, 15 at Kampung Jelawat and 12 at Pos Iskandar. Only three species, *Callosciurus notatus*, *Maxomys whiteheadi* and *Prionailurus bengalensis*, were recorded from all three study areas. *Cynocephalus variegatus*, *Pteropus vampyrus*, *Manis javanica*, *Ratufa bicolor*, *Ratufa affinis*, *Rhinosciurus laticaudatus* and *Hystrix brachyura* were only recorded from Tanjung Kuin; *Echinosorex gymnurus*, *Ptilocercus lowii*, *Callosciurus nigrovittatus*, *Lariscus insignis*, *Pithecheir parvus*, *Lenothrix canus*, *Leopoldamys sabanus* and *Viverra zangalla* from Kampung Jelawat; and *Tupaia minor*, *Sundasciurus tenuis*, *Petinomys vordermanni*, *Amblonyx cinerea* and *Lutra perspicillata* from Pos Iskandar.

Trapping provided the most comprehensive data on distribution and abundance (Table 2). The other methods gave less comprehensive data as the records were made opportunistically, but were useful for indicating species presence in an area. Based on the trapping data (Table 3), the density and biomass of small mammals were 34.5 individuals/ha and 7245.9g/ha at Tanjung Kuin, 27.5 individuals/ha and 6222.0g/ha at Kampung Jelawat, and 24.7 individuals/ha and 4565.1g/ha at Pos Iskandar.

DISCUSSION

No endemic small mammal species were found at Tasek Bera during the survey, but some protected species were recorded. These included *Cynocephalus variegatus*, *Nycticebus coucang*, *Prionailurus planiceps*, *Prionailurus bengalensis*, *Arctogalidia trivirgata*, *Viverra zangalla*, *Petaurista petaurista*, *Petinomys vordermanni*, *Ratufa affinis*, *Ratufa bicolor*, *Hystrix brachyura*, *Amblonyx cinerea*, *Lutra perspicillata*, *Manis javanica* and *Tragulus javanicus*. Of these, the IUCN (1996) considers *Prionailurus planiceps*, *Hystrix brachyura* and *Lutra perspicillata* as vulnerable, and *Amblonyx cinerea* and *Manis javanica* as near-threatened.

Potential threats to the small mammals at the sites include persecution by local people (e.g. otter species, see below), hunting (e.g. mouse deer) and habitat destruction – mainly as a result of shifting cultivation but also due to uncontrolled fires.

Table 1. Small mammals recorded from the three study plots at Tasek Bera.

Common name/Species	Tanjung Kuin	Pos Iskandar	Kampung Jelawat
moonrat/ <i>Echinosorex gymnurus</i>			*
Malayan flying lemur/ <i>Cynocephalus variegatus</i>	*		
Malayan flying fox/ <i>Pteropus vampyrus</i>	*		
Common treeshrew/ <i>Tupaia glis</i>	*		*
Lesser treeshrew/ <i>Tupaia minor</i>		*	
Pentail treeshrew/ <i>Ptilocercus lowii</i>			*
Slow loris/ <i>Nycticebus caucang</i>	*		
Malayan pangolin/ <i>Manis javanica</i>	*		
Black giant squirrel/ <i>Ratufa bicolor</i>	*		
Common giant squirrel/ <i>Ratufa affinis</i>	*		
Plaintain squirrel/ <i>Callosciurus notatus</i>	*	*	*
Black-banded squirrel/ <i>Callosciurus nigrovittatus</i>			*
Slender squirrel/ <i>Sundasciurus tenuis</i>		*	
Low's squirrel/ <i>Sundasciurus lowii</i>	*	*	
Three-striped ground squirrel/ <i>Lariscus insignis</i>			*
Shrew-faced ground squirrel/ <i>Rhinosciurus laticaudatus</i>	*		*
Vordermann's flying squirrel/ <i>Petinomys vordermanni</i>		*	
Red giant flying squirrel/ <i>Petaurista petaurista</i>	*		*
Monkey-footed rat/ <i>Pithecheir parvus</i>			*
Dark-tailed tree rat/ <i>Niviventer cremoriventer</i>	*		
Brown spiny rat/ <i>Maxomys rajah</i>	*		*
Whitehead's rat/ <i>Maxomys whiteheadi</i>	*	*	*
Mueller's rat/ <i>Sundamys muelleri</i>	*	*	
Grey tree rat/ <i>Lenothrix canus</i>			*
Long-tailed giant rat/ <i>Leopoldamys sabanus</i>			*
Malayan porcupine/ <i>Hystrix brachyura</i>	*		
Small-clawed otter/ <i>Amblonyx cinerea</i>		*	
Smooth otter/ <i>Lutra perspicillata</i>		*	
Malay civet/ <i>Viverra zangalunga</i>			*
Small-toothed palm civet/ <i>Arctogalidia trivirgata</i>	*	*	
Leopard cat/ <i>Prionailurus bengalensis</i>	*	*	*
Flat-headed cat/ <i>Prionailurus planiceps</i>	*	*	
Lesser mouse deer/ <i>Tragulus javanicus</i>	*		*
Number of species	20	12	15

Table 2. Species and individuals recorded by each sampling method.

Species	Trapping	Transect survey	Spotlighting
<i>Echinosorex gymnurus</i>	1		
<i>Tupaia glis</i>	37		
<i>Tupaia minor</i>	3		
<i>Ptilocercus lowii</i>	1		
<i>Callosciurus notatus</i>	42		
<i>Callosciurus nigrovittatus</i>	5		
<i>Sundasciurus tenuis</i>		1	
<i>Sundasciurus lowii</i>	4	1	
<i>Lariscus insignis</i>	5		
<i>Rhinosciurus laticaudatus</i>		1	
<i>Petinomys vordermanni</i>	1		
<i>Petaurista petaurista</i>			2
<i>Ratufa bicolor</i>		1	
<i>Ratufa affinis</i>		1	
<i>Maxomys whiteheadi</i>	37		
<i>Maxomys rajah</i>	43		
<i>Sundamys muelleri</i>	26		
<i>Leopoldamys sabanus</i>	8		
<i>Lenothrix canus</i>	4		
<i>Pithecheir parvus</i>	1		
<i>Niviventer cremoriventer</i>	1		
<i>Arctogalidia trivirgata</i>	2	1	2
<i>Viverra zangara</i>			1
<i>Nycticebus coucang</i>			1
<i>Tragulus javanicus</i>		23	3
<i>Prionailurus bengalensis</i>			9
<i>Prionailurus planiceps</i>		1	7
<i>Amblonyx cinerea</i>		3	
<i>Lutra perspicillata</i>		4	
<i>Cynocephalus variegatus</i>		1	
<i>Pteropus vampyrus</i>		1	
<i>Manis javanica</i>			1
<i>Hystrix brachyura</i>		1	

Table 3. Trapping results from the three study plots at Tasek Bera.

Species	Tanjung Kuin	Kampung Jelawat	Pos Iskandar
<i>Echinosorex gymnurus</i>		1	
<i>Tupaia glis</i>	28	9	
<i>Tupaia minor</i>			3
<i>Ptilocercus lowii</i>		1	
<i>Callosciurus notatus</i>	16	10	16
<i>Callosciurus nigrovittatus</i>		5	
<i>Sundasciurus lowii</i>	3		1
<i>Lariscus insignis</i>		5	
<i>Petinomys vordermanni</i>			1
<i>Maxomys whiteheadi</i>	20	1	16
<i>Maxomys rajah</i>	18	25	
<i>Sundamys muelleri</i>	1		25
<i>Leopoldamys sabanus</i>		8	
<i>Lenothrix canus</i>		4	
<i>Pithecheir parvus</i>		1	
<i>Niviventer cremoriventer</i>	1		
<i>Arctogalidia trivirgata</i>	1		1
Number of species	8	11	7
Total number of individuals	88	70	63
Density (individuals/ha)	34.5	27.5	24.7
Biomass (g/ha)	7245.9	6222	4565.1

Tanjung Kuin had the highest number of species, density and biomass in comparison with Kampung Jelawat and Pos Iskandar (Tables 1 and 3). This is probably due to the fact that Tanjung Kuin is a lowland forest which was selectively logged in the early 1970s and is at an advanced stage of regeneration. Selective logging is not expected drastically to reduce food availability or nesting sites. The flush of new growth in the gaps created may in fact increase the availability of food. Only species with specialized food or habitat requirements would be seriously affected (e.g. flying squirrels, which require tall trees) (Johns, 1992).

In contrast, the forest at Kampung Jelawat was more recently logged and also influenced by shifting cultivation. The low diversity in the seasonally flooded peat swamp forest is not surprising given its lower plant species diversity, low canopy height, and flooding regime. The greater volume, more complex structure and greater plant diversity of the lowland forest would be expected to lead to a higher faunal diversity in comparison with the peat swamp forest.

Compared to other sites studied (Table 4), Tanjung Kuin, Kampung Jelawat and Pos Iskandar show a relatively high density and biomass of small mammals.

Table 4. Comparison of density and biomass estimates of small mammals with previous studies (trapping data only). (UD = undisturbed forest, DF = disturbed forest).

	Density (individuals/ha)		Biomass (g/ha)	
	UD	DF	UF	DF
Harrison (1969)	4.1–4.9	7.1	730–840	810
Langham (1983)	5.75–7		900–1140	
Stuebing and Gasis (1989)		16.5		1920
Zubaid and Khairul (1997)	27.8	23.6	4536	5859
Tanjung Kuin (this study)		34.5		7245.9
Kampung Jelawat (this study)		27.5		6222
Pos Iskandar (this study)		24.7		4565.1

The existing forest should be preserved in its present state in order to maintain this high density and biomass. The greater diversity and biomass at Tanjung Kuin compared to Kampung Jelawat suggests that the small mammal population at the latter site will become richer as the disturbed forest is allowed to regenerate, and that natural regeneration is an appropriate management strategy for such areas, as recommended by Giesen (1998). This argument is reinforced by the presence of non-targeted mammal species detected during the transect surveys (such as the tiger *Panthera tigris*, sun bear *Helarctos malayanus*, barking deer *Muntiacus muntiacus*, Malayan tapir *Tapirus indicus* and gibbons *Hylobates lar*) at Tanjung Kuin and Kampung Jelawat.

Most mammals found in Peninsular Malaysia are dependent on lowland rainforest (Muul and Lim, 1978; Medway, 1988). Although some species are able to make use of new habitats, most remain dependent on neighbouring patches of forest and cannot survive without them. This can be seen in the case of the squirrels at Tasek Bera. The giant squirrels, *Ratufa* spp., were noted only at Tanjung Kuin and these are species typical of forests with a high and closed canopy. Flying squirrels such as *Petaurista petaurista* and *Petinomys vordermanni* can thrive in greatly modified habitats, provided the tall trees in which they nest are not cut down (Muul and Lim, 1978). Logging normally involves the removal of tall trees, thus threatening the survival of these species.

Of all the protected small mammal species present in the area, the most vulnerable are the otters. The two species of otters found at Tasek Bera, *Lutra perspicillata* and *Amblonyx cinerea*, are considered rare in the area. Based on information provided by the local people, the population of otters is decreasing as they are being eliminated by fishermen. This is because the otters raid the fishing nets and/or fish traps and in the process destroy the apparatus. The otters were found to be using the extensive and compact pandanus stands (*Pandanus helicopus*)

and sedge beds (*Lepironia articulata*) along the narrow channels. Clearing of this vegetation to improve water flow and navigation may affect the resting and breeding grounds of otters.

Small mammals are considered an important component of the forest ecosystem. They contribute to the energy flow and nutrient recycling in forests, being seed predators and/or seed dispersers (Forget and Milleron, 1991; Paschoal and Galetti, 1995). In addition, small mammals form the prey base for carnivores and raptors (Brisbal 1986; Emmons 1987; Rajaratnam, 1996). Habitat loss and the degradation of the lake system and surrounding forests is likely to result in the local loss and extinction of flora and fauna. Loss of both unique habitats and attendant flora and fauna would drastically alter the tourism and research potential of the site, as well as its conservation value (Benstead *et al.*, 1993).

One important factor that is often neglected when creating protected areas is the need for a biologically-realistic buffer zone. Although many semi-aquatic animals depend on both aquatic and terrestrial habitats to complete their lifecycle and maintain viable populations, the delineation of buffer zones is normally not taken into consideration or is arbitrarily defined (Semlitsch, 1998). Not much is known of the degree of cross-utilization of the lowland forest, swamp forest and other wetland habitats by small mammals. In the absence of this information, the precautionary principle should be applied in ensuring the conservation of lowland forest surrounding wetland habitats in order to maintain biological diversity. The fact that five species recorded in the peat swamp forest were not recorded at the two lowland forest sites, and 21 species recorded in lowland forest were not recorded in peat swamp forest, supports the view that conservation of both these habitats is necessary.

Applied research is necessary to provide a scientific basis for site management and ecological studies should be conducted on the habitat requirements, diet, population density, breeding behaviour, movements and survival of small mammals, globally threatened species being of highest priority. Long-term survival of species will be ensured only when the requirements of each species are met within the dispersal range of that species (Kikkawa and Dwyer, 1992).

Checklist information on wildlife, although often perceived as of little quantitative value and largely anecdotal, should be collected systematically. Checklists fill a niche between rigorous (and costly) programmatic monitoring and the purely anecdotal perceptions of amateur and professional naturalists, and provide useful information at local, regional and continental scales (Droege *et al.*, 1998, Wright *et al.*, 1998). Checklists can form the basis of a daily logbook for recording wildlife observations at a reserve, of interest for informal monitoring and also for visitor information.

A database containing information on fauna and flora has been incorporated into the Tasek Bera Ramsar Site management plan. These data are required to monitor the status of species in relation to site management objectives. Particular attention is being applied to species of conservation importance (i.e. globally vulnerable species such as the flat-headed cat, and smooth-coated otter), through the development of species conservation or recovery plans for the site.

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