Abundance and habitat selection of the Malabar spiny dormouse in the rainforests of the southern Western Ghats, India

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The Malabar spiny dormouse *Platacanthomys lasiurus* is a rare endemic mammal of the Western Ghats. We studied the factors influencing its distribution and abundance in two tropical rainforest areas, the Kalakad–Mundanthurai Tiger Reserve and the Anamalai hills. Abundance was highest in the lower altitudinal zone (700–900 m) and during the south-west monsoon. Habitat structural parameters typical of mature undisturbed rainforests, particularly climber density, influenced the occurrence of dormice. Their absence in plantations and smaller rainforest fragments suggests that such habitat alterations may cause local extinction of the species.

THE Western Ghats is an important region of plant and animal endemism. Over 1500 plant and 285 vertebrate species are endemic to the Western Ghats[1,2]. The Malabar spiny dormouse (*Platacanthomys lasiurus* Blyth 1859) is one of the 12 endemic mammals. It is found in the region from Shimoga (Karnataka) to the southern tip of the Western Ghats[3]. The species is the country's sole representative of the family Muscardinidae, which is a group of rodents showing Palaearctic affinities[3]. Unlike the dormouse *Muscardinus avellanarius*, which has been extensively studied in Europe[4], there have been no studies on the ecology and distribution of the Malabar spiny dormouse. The European studies have shown that dormice have *K*-selected life-history traits and are more susceptible to habitat loss and fragmentation[5]. Anecdotal natural history information on the Malabar spiny dormouse suggests that it is a predominantly arboreal species inhabiting dense moist forests[6,7]. Being a species of structurally complex forests, its distribution and ability to persist in disturbed areas may be determined by the availability of suitable structural attributes in the habitat.

In this paper, we describe: (i) patterns of abundance and distribution of the Malabar spiny dormouse in relation to altitude and season in undisturbed rainforests, and (ii) habitat structural factors influencing its occurrence. Based on our findings and prior studies[8,9], we attempt to predict the vulnerability of the species to habitat alteration and fragmentation.

Study areas

We surveyed small mammals in a large tract of undisturbed rainforest in the Agasthyamalai–Ashambu hill range and the matrix of tea, coffee and cardamom plantations surrounding rainforest fragments in the Anamalais. The undisturbed rainforest sites were within the Kalakad–Mundanthurai Tiger Reserve (KMTR, c. 900 km^2, 8°25′ to 8°53′N and 77°10′ to 77°35′E). Plantations were located between 1100 and 1450 m above sea level in the Anamalai hills (c. 1000 km^2, 10°13′ to 10°33′N and 76°49′ to 77°21′E), where rainforest fragments were surveyed by Prabhakar[8]. In both areas, the mid-elevation zone (700–1400 m) contains tropical wet evergreen forest of the *Cullenia–Mesua–Palaquium* series[10]. The sites sampled in KMTR were Kannikatti (690–970 m), Sengaltheri (900–1300 m) and Kakachi (1210–1310 m). Mean annual rainfall in the study sites was more than 2000 mm. We identified three distinct seasons: south-west monsoon (June–September), north-east monsoon (October–January) and dry season (February–May). The

The Malabar spiny dormouse is one of the endemic mammals of the Western Ghats found in KMTR. (Photo: S. U. Saravanakumar)

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study was carried out between October 1996 and August 1997.

Methods

Live-trapping was carried out for small mammals using standard Sherman traps (9 × 9 × 21 cm, Panwar Hichrome Plating and Engg. Works, Jodhpur). Traps were placed at 10 m intervals on the forest floor in grids of 7 × 7 (area of grid = 0.49 ha[9]). Two grids placed at least 200 m apart were monitored simultaneously for five consecutive days. All grids were located randomly and were not resampled. Six grids were sampled in each season at each site, with the following exceptions. In Sengaltheri, small mammals were not sampled during the north-east monsoon and only three grids were laid during the dry season. In Kannikatti, only five grids were monitored during the dry season. A mixture of banana, grated coconut and crushed groundnuts was used as bait. Traps were checked every morning and re-baited whenever necessary. Fresh traps were put in place of traps with captures. Trapped animals were measured and ear-clipped for identification.

Thirteen site and habitat variables were measured within 5 m radius circular plots centred on traps with captures of Malabar spiny dormouse[11]. The following variables were measured: altitude (altimeter), canopy height (clinometer or visual estimation), canopy cover (spherical densiometer), height of shrubs (stems < 10 cm girth at breast height) and ground vegetation (herbaceous plants < 50 cm in height, measured with tape), litter depth (average of four measurements taken around the trap using calibrated probe), and basal area of trees > 30 cm girth. Densities of shrubs (within 2 m radius), trees, climbers, buttresses and canes, and distance to the nearest large tree (measured with a tape to a tree > 60 cm girth) were also recorded. Similar plots were laid around five randomly chosen traps within each grid in order to assess availability of habitat attributes.

Abundance measures calculated were capture rate (number of individuals per 100 trap-nights), and density (minimum number alive, MNA/ha). Traps that were sprung without captures, stolen or knocked over by wild animals were excluded from the total trap-night effort. Chi-square contingency test was used to examine differences in capture rates among sites and seasons in KMTR. For site differences we excluded north-east, since Sengaltheri was not sampled during that season. While testing for seasonal difference, data from Kakachi were excluded as there were no captures in this site (inclusion of the data did not change the results). Non-parametric Mann–Whitney U Test was used to examine differences in habitat variables between capture and random plots in Kannikatti and Sengaltheri[12].

Table 1. Morphometrics of the Malabar spiny dormouse captured in KMTR

	Male (N = 8)		Female (N = 12)	
Variable	Mean (SE)	Range	Mean (SE)	Range
Body weight (g)	55.8 (4.4)	34–72	68.6 (2.8)	51–81
Head and body length (mm)	94.6 (3.7)	82.5–113.5	89.3 (2.5)	74–100
Tail length (mm)	92.6 (3.2)	74.7–104	92.4 (2.2)	81–106

Results

In total, there were 21 captures of 20 individuals (1 recapture) of the Malabar spiny dormouse during 9347 trap-nights of sampling in KMTR. The dormouse was the second most abundant of the six species of small mammals (*Rattus rattus*, *Suncus murinus*, *S. montanus*, *Funambulus tristriatus*, *Mus famulus*) captured during the study. Basic morphometric measurements of the eight males and 12 females are given in Table 1.

Analysis of capture rates showed significant differences among the three sites in KMTR ($\chi^2 = 11.07$, $df = 2$, $P < 0.001$). Abundance appeared to be negatively related to altitude, with Kannikatti having the highest capture rate and density (12 individuals, 1 recapture), followed by Sengaltheri (8 individuals, Figure 1). The difference in capture rate between Kannikatti and Sengaltheri was, however, not statistically significant ($\chi^2 = 1.18$, $df = 1$, $P > 0.05$). Though no dormouse was captured in Kakachi, it was sighted during casual observations and may occur in relatively low numbers. There was a significant seasonality in capture rates ($\chi^2 = 18.86$, $df = 2$, $P < 0.001$). About 90% of the captures were during the south-west

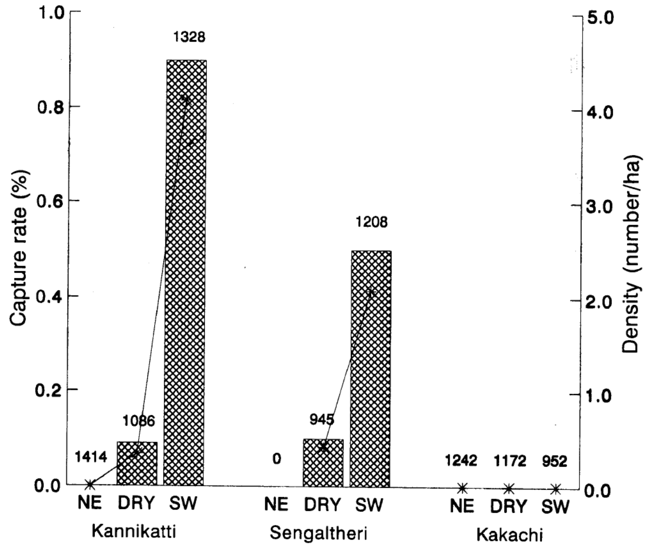

Figure 1. Capture rate (hatched bars) and density (line) of Malabar spiny dormouse in relation to sites and seasons. NE, North-east monsoon; DRY, Dry season; SW, South-west monsoon. Numbers above each bar represent sampling efforts in trap-nights.

monsoon and only two individuals were captured during the dry season (Figure 1).

Habitat variables such as canopy cover, basal area, climber (mostly liana) and cane densities were significantly higher in capture plots than in random plots (Table 2). The distance to the nearest large tree was lower in capture plots (Table 2). Among these variables, climber density appeared to be particularly significant because it was almost five times greater in the capture plots than in the random plots.

In the Anamalais tea, coffee and cardamom plantations, which form the matrix around the forest fragments, were sampled for 2104 trap-nights. Cardamom estates (4 grids overall, 908 trap-nights) and tea plantations (3 grids, 558 trap-nights) were sampled in three seasons, while the coffee estate was sampled during the south-west monsoon and dry seasons (3 grids, 638 trap-nights). The Malabar spiny dormouse was not captured in any of the three plantations, although five other species of small mammals were captured (*R. rattus*, *S. murinus*, *F. tristriatus*, *Mus dunni*, *Golunda ellioti*).

Discussion

The results indicate that the abundance of Malabar spiny dormouse is influenced by altitude, season and habitat structural characteristics, especially climber (liana) densities. Lower capture rate of the dormouse at higher altitudes is in concordance with earlier reports which indicate that the species occurs mostly below 900 m and is rare above 1200 m[3,8,9]. Capture rate was 0.2226% in a rainforest fragment above 1400 m in Anamalais (6 captures in 2695 trap-nights)[8] and 0.1005% (12 in 11,938 trap-nights) in shola forests above 1800 m[9]. The altitudinal pattern in KMTR may be related to structural and floristic variations along the altitudinal gradient; for instance, climber density, which was identified as an important habitat variable for the occurrence of dormouse, was least in Kakachi, the higher elevation site.

Many studies of small mammals in tropical forests have shown an increase in their abundance during the wet season, which is often attributed to breeding activities and juvenile dispersal[9,13,14]. Higher capture rate of the Malabar spiny dormouse in KMTR during the south-west monsoon may reflect a similar pattern and behaviour. Ten of the 18 individuals captured during the south-west monsoon were juveniles. The larger body weight of the females may reflect their breeding status (Table 1).

The habitat parameters that stand out to be of consequence for the dormouse are also characteristic of mature tropical rainforests. It is likely that variables such as canopy cover, basal area and climber density are important for arboreal mammals. On release after capture, the dormice usually used lianas to climb up into the canopy. The use of lianas to move about in the canopy explains the significance of climber density as a structural parameter to predict its occurrence.

The establishment of plantations involves radical alterations of the rainforest habitat. Habitat alterations include clear felling (for tea estates) and the removal of many large trees, climbers and understorey vegetation (in coffee and cardamom plantations). Such habitat changes can account for the absence of the Malabar spiny dormouse from the plantations. However, the species has earned the name 'pepper rat' due to its occurrence as a pest in pepper plantations[6]. It is possible that the dormouse will occur in some plantations that provide food resources or are in proximity to large tracts of rainforest. In addition, habitat changes in plantations modify resource availability making it conducive to colonization by commensal rodents. Species such as the Western Ghats palm

Table 2. Comparison of site and habitat parameters at Malabar spiny dormouse capture and random plots in KMTR.

Variable	Capture plot $N = 21$ Mean (SE)	Random plot $N = 109$* Mean (SE)	Mann-Whitney U Test	
			Z	P
Altitude (m)	993.8 (39.9)	947.6 (14.2)	– 0.35	0.73
Canopy height (m)	27.0 (1.2)	25.8 (0.5)	– 1.59	0.11
Canopy cover (%)	98.1 (0.4)	96.0 (0.6)	– 2.44	0.015
Shrub height (m)	2.4 (0.2)	2.4 (0.1)	– 0.18	0.86
Shrub density (#/plot)	14.0 (1.6)	13.7 (0.7)	– 0.21	0.84
Ground vegetation height (m)	0.42 (0.05)	0.44 (0.03)	– 0.03	0.97
Litter depth (cm)	2.4 (0.2)	2.1 (0.1)	– 1.29	0.20
Basal area (m5/ha)	126.5 (19.0)	91.9 (7.0)	– 1.90	0.058
Tree density (#/ha)	933.7 (113.3)	929.8 (41.0)	– 0.29	0.77
Climber density (#/plot)	7.3 (3.0)	1.5 (0.2)	– 4.42	< 0.001
Cane density (#/plot)	3.5 (0.9)	2.1 (0.3)	– 2.14	0.032
Buttress density (#/plot)	1.33 (0.26)	1.3 (0.1)	– 0.25	0.81
Distance to large tree (m)	1.8 (0.4)	2.8 (0.2)	– 2.61	0.009

*The 109 random plots were distributed over 26 grids in Sengaltheri and Kannikatti. In a few grids less than five random plots were sampled.

squirrel (*F. tristriatus*), a generalist arboreal species, that occur at higher abundance in plantations (D. Mudappa, unpublished data) may pose as competitors to the Malabar spiny dormouse.

Prabhakar[8] found that the dormouse occurred only in the largest rainforest fragment (Akkamalai, 20 km^2) in the Anamalais. It was not recorded in five small fragments less than 50 ha in area and one medium-sized fragment of 185 ha[8], all of which are man-made fragments highly disturbed by human activities. However, in less-disturbed natural fragments of the high-altitude shola forests, the species is reported from 60 to 600 ha[9]. Laurance[15] found that small mammal species that could survive in man-modified habitats persisted or increased in fragments, while those that avoided these habitats declined or disappeared. The Malabar spiny dormouse may be an example of the latter type.

The results suggest that the Malabar spiny dormouse, a rare endemic, is sensitive to habitat alteration. Apart from this, trapping by local people for its purported medicinal value poses a possible threat to this species (K. K. Ramachandran, pers. commun.). The maintenance of large tracts of rainforest without tampering the structural complexity, especially in lower altitudes such as Kannikatti and control of trapping by local people are required to ensure the conservation of the Malabar spiny dormouse.

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ACKNOWLEDGEMENTS. We thank the United States Fish and Wildlife Service for financial support. Dr M. S. Pradhan, Zoological Survey of India, Pune, helped in species identification. The Tamil Nadu Forest Department provided research permit and logistic support. Poovan, Doraipandi and Iyappan assisted in data collection. We thank Mahesh Sankaran and T. R. Shankar Raman for their comments on the manuscript. Advice from Madhusudan Katti and three anonymous referees helped strengthen the manuscript.