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Brief Report

Introducing an Innovative Semi-Captive Environment for the Philippine Tarsier (*Tarsius syrichta*)

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In response to demands for research, captive breeding, and tourism, a semi-captive environment was created for the Philippine tarsiers (*Tarsius syrichta*) in Corella, Bohol, Philippines. The 7600-m^2 enclosure was continuous with the surrounding habitat, and utilized a unique predator control fence design and a lighting system to attract nocturnal insects. During 2 years of observation, the locations of over 500 tarsier sleeping sites were recorded. Tarsiers were found to prefer dense, low-level vegetation in secondary forests, with perching sites averaging 2 m above the ground. Up to 10 tarsiers were observed within the enclosure at one time, which is a high density compared to densities based on home-range estimates for wild tarsiers in the vicinity of the study site. In addition, the tarsiers were observed to be more social than previously reported. Zoo Biol 24:101–109, 2005. © 2005 Wiley-Liss, Inc.

Key words: *Tarsius syrichta*; captive breeding; Philippines; semi-captive

INTRODUCTION

While there have been significant gains in scientific knowledge about wild *Tarsius syrichta* in recent years [Neri-Arboleda, 2002; Dagosto et al., 2001], there has been little success in the development of captive breeding programs [Haring and Wright, 1989; Lewis, 1939; Cook, 1939]. In Corella, on the island of Bohol (Fig. 1), we constructed a 7,600-m^2 semi-captive enclosure at the Philippine Tarsier and

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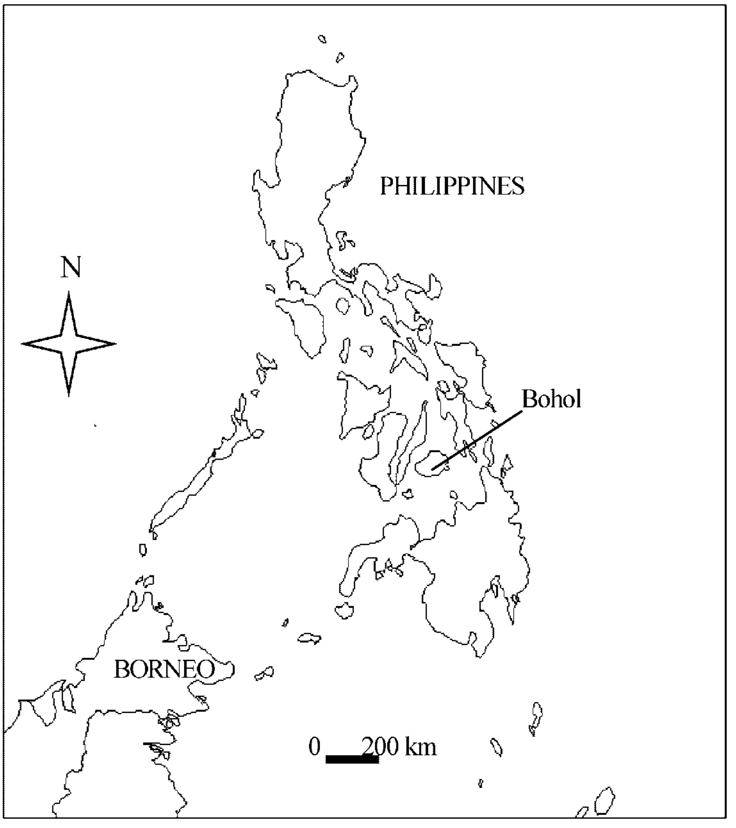

Fig. 1. Map of the Philippines identifying the geographical location of the study site.

Wildlife Sanctuary to facilitate tarsier research and captive breeding, and provide an opportunity for visitors to see tarsiers in their natural environment.

The goal of our preliminary study was to analyze habitat conditions and quantify habitat use by tarsiers in the semi-captive enclosure. We collected this information to 1) introduce a semi-captive approach to housing tarsiers, 2) provide details about a successful captive environment for others attempting to keep tarsiers in captivity, and 3) encourage further investigation of the factors involved in effective tarsier husbandry.

MATERIALS AND METHODS

Study Site

The habitat in the enclosure was continuous with the surrounding habitat, which supported a population of wild *T. syrichta* [Neri-Arboleda, 2002]. The enclosure was located in a valley surrounded by hills up to about 150 m above sea level, with varying successional stages of secondary-growth, evergreen tropical forest. The mean daytime temperature during the study period was 27.5°C, and the average annual precipitation at the study site was 1,963 mm.

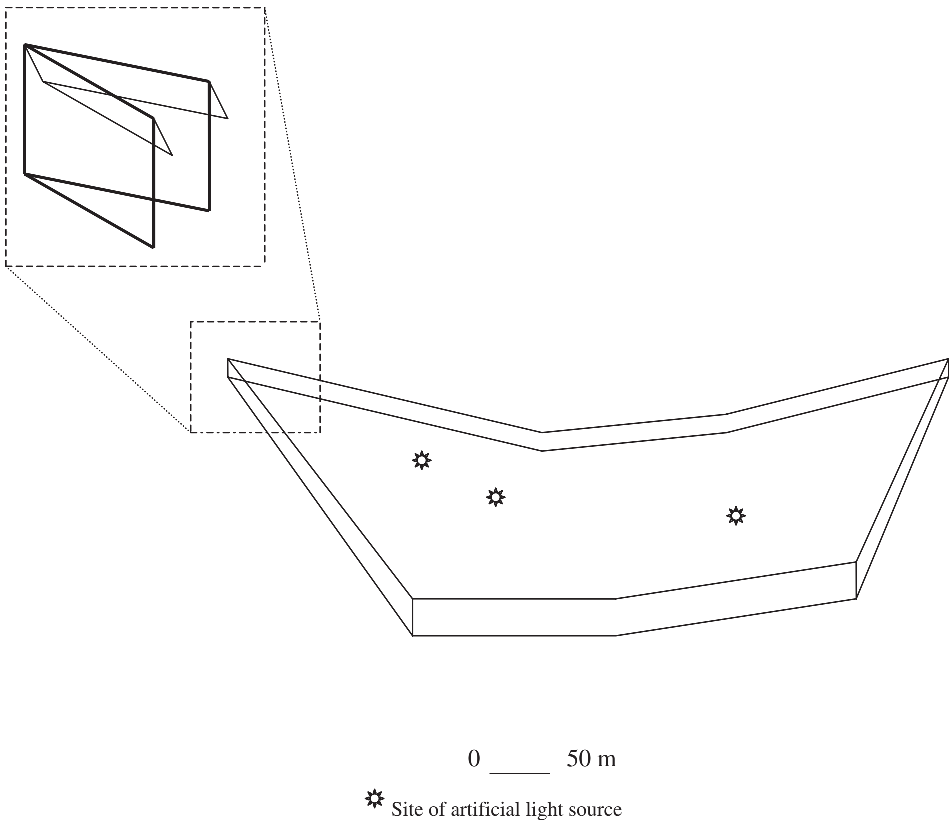

Fig. 2. Drawing of the enclosure, with the left corner enlarged to show the fence design and size perspective.

The enclosure provided a semi-captive environment in that adult tarsiers could enter and leave the enclosure by leaping over the perimeter fence, but juveniles were unable to do so because of an inward-sloping upper section of fine-mesh wire (Fig. 2). The main predators of tarsiers, including feral cats (*Felis catus*) and several species of arboreal snakes, were excluded by this perimeter fence, with the exception of two small snakes that we removed during the study period. Halogen and fluorescent lights installed at three locations in the enclosure increased food availability for the primarily insectivorous tarsiers by attracting nocturnal flying insects. By trimming existing vegetation, installing small cement water-collection pools, and placing limbs and transplanting trees to attract specific insect prey species, we provided an optimal tarsier habitat and encouraged the tarsiers to remain in the enclosure.

Monitoring

Observations were made from May 2000 to May 2002, with an intense 5-month monitoring period from September 2000 to January 2001. During this period, two technicians performed independent daily scan sampling of the enclosure to locate tarsier sleeping sites. They recorded the sex and approximate age of the tarsiers, as well as the location and elevation of sleeping sites. Site elevations were measured in meters from the ground, and locations were plotted on a map of the area that included established trails and landmarks.

Vegetation Sampling

Tarsier sleeping site data (n = 534) enabled us to quantify habitat use. They showed specific trends toward areas of intensive habitat use, which we classified into "clusters" (Fig. 3). We defined clusters of habitat use as areas where we recorded 10 or more observations that were not separated by > 5 m from the nearest adjacent observation. This method allowed us to classify clusters into four different habitat-use intensity levels based on the numbers of observation they contained. Clusters that contained 100 or more observations were classified as "high use," those with 50–99 observations were classified as "medium use," those with 25–49 observations were classified as "low use," and those with 10–24 observations were classified as "rare use."

Intensive vegetation sampling provided data on habitat structure within each habitat-use intensity level. Twenty sampling sites (1 m^2 each) were chosen randomly within each of the four levels. At each sampling site we measured canopy height and stem density at ground level and at heights of 1 m and 2 m above ground. These

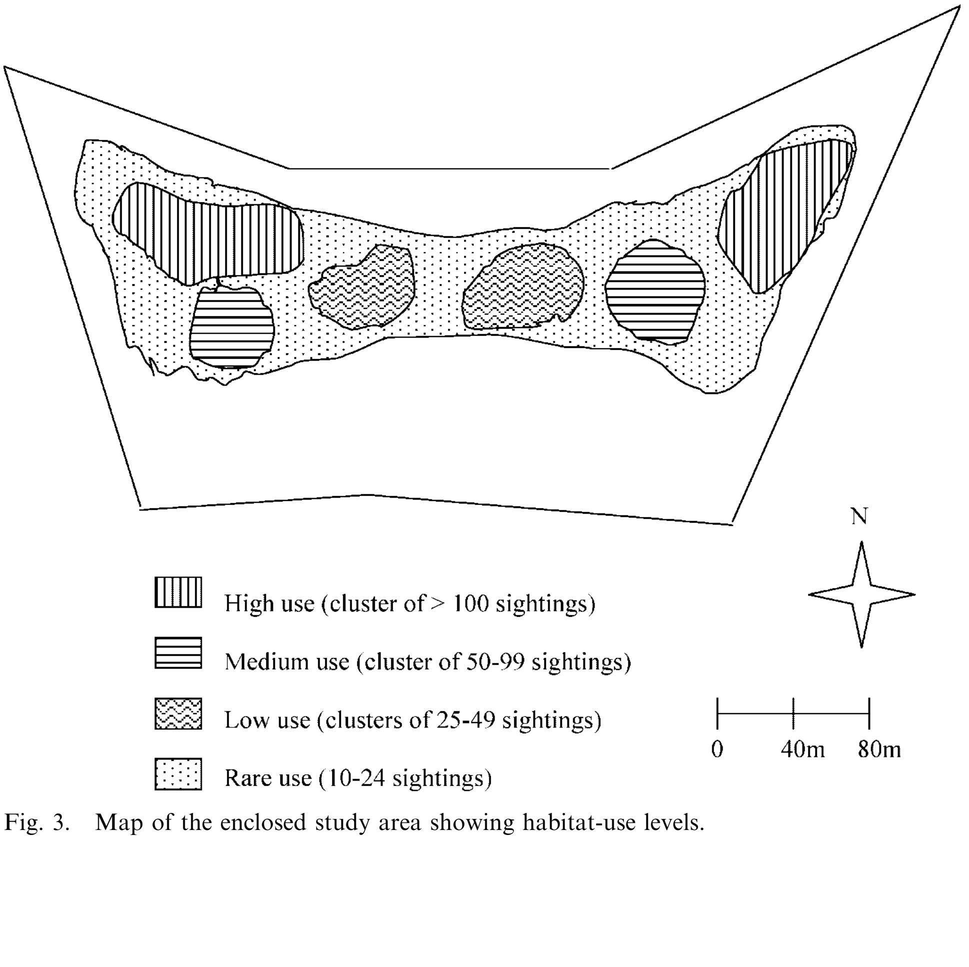

Fig. 3. Map of the enclosed study area showing habitat-use levels.

heights were chosen on the basis of sampling feasibility and previously published data on height use by other tarsier species [MacKinnon and MacKinnon, 1980; Trembel et al., 1993; Roberts and Cunningham, 1986; Niemitz, 1979]. Ground-level vegetation and canopy height were also recorded because the tarsiers were observed to use ground cover and high canopy perches as escape cover.

RESULTS AND DISCUSSION

As with other tarsier species, tree height, stem diameter, and other components of vegetation structure are important factors in *T. syrichta* husbandry. MacKinnon and MacKinnon [1980] reported that *T. spectrum* was observed a majority of the time at heights of <3 m, with resting sites usually higher than that. Other studies found that *T. dianae* used sleeping sites at a mean height between 1.6–3.0 m [Trembel et al., 1993], and *T. bancanus* used sleeping sites at a mean height of ~ 2 m [Roberts and Cunningham, 1986; Niemitz, 1979]. Dagosto et al. [2001] observed that wild *T. syrichta* chose sleeping sites at or near ground level. We found that in the semi-captive enclosure, *T. syrichta* used sleeping sites at a mean height of ~ 2 m (1.99 m for males, 2.23 m for females, 1.85 m for juveniles, and 2.03 m for females with juveniles) (Fig. 4).

Vegetation in the study area was composed primarily of secondary forest and shrub growth (Fig. 5). We found that the tarsiers used sleeping sites in secondary forest even when other habitat types were available (Fig. 6). This is likely due to the greater availability of perch sites and dense understory cover in secondary forest. The perch sites preferred by *T. dianae* and *T. bancanus* were about 2 cm in diameter [Trembel et al., 1993; Crompton and Andau, 1987], while the larger *T. spectrum* preferred trees of 3–4 cm diameter [Niemitz, 1984]. For *T. syrichta*, high-use areas

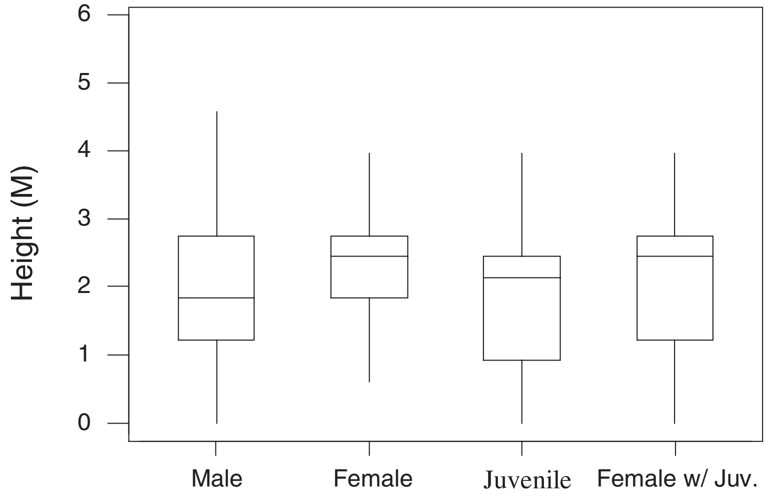

Fig. 4. Box plots of height use by tarsiers showing the mean, the first and third quartiles, and the range of observations of males (n = 172), females (n = 199), juveniles (n = 70), and females with juveniles (n = 93).

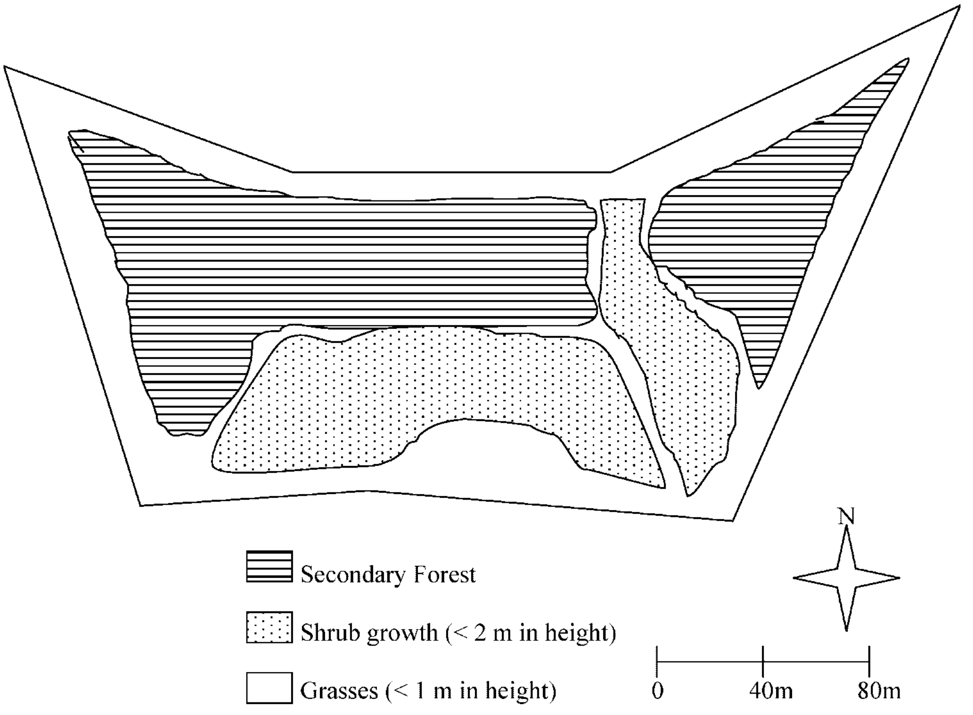

Fig. 5. Map of enclosed study area showing vegetation types.

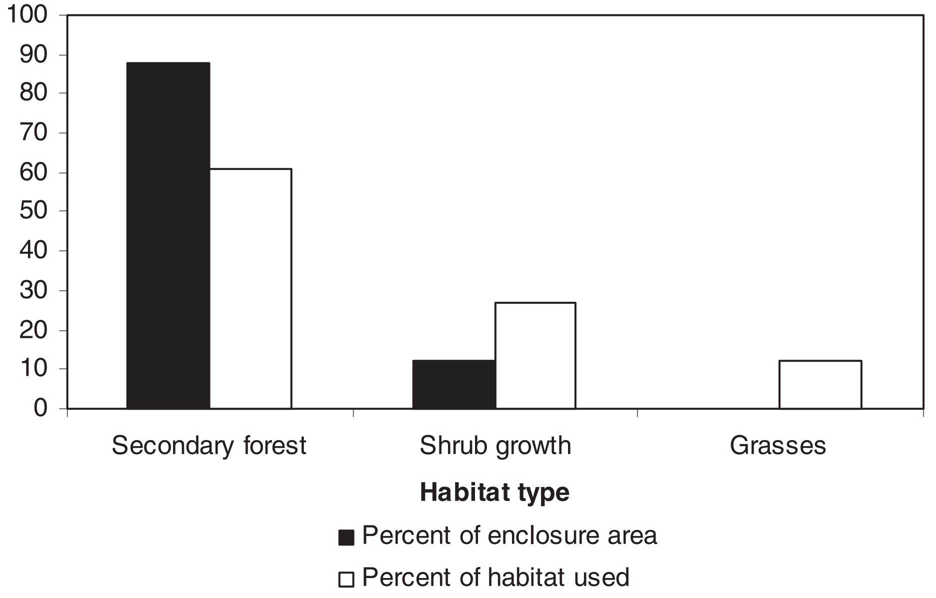

Fig. 6. Comparison of availability of habitats to the use of habitats within the enclosure.

Table 1. Mean number of stems at each habitat use level at three sampling heights separated into stem diameter classes

		Stem diameter class (cm)				
Use level	Height	0.2–0.49	0.50–0.99	1.00–2.99	3.00–5.99	>6.00
High	Ground	24.3	4.7	4.7	1.1	0.2
	1 m	5.9	3.1	4.3	2.2	0.2
	2 m	4.5	3.2	3.1	1.5	0
Medium	Ground	26.0	6.4	2.6	0.6	0.8
	1 m	4.4	4.8	1.6	0.8	0.2
	2 m	1.0	2.0	1.0	1.0	0
Low	Ground	18.8	3.0	2.0	1.4	0.6
	1 m	5.8	3.2	1.2	2.0	0
	2 m	3.2	2.4	1.6	0.6	0

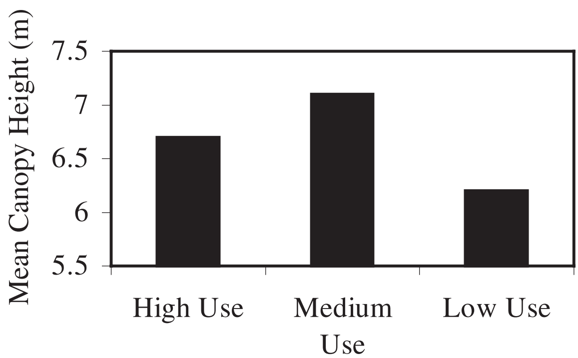

Fig. 7. Comparison of mean canopy height between high, medium, and low use level areas.

(2 m) had more stems at diameters of 1–3 cm than did medium- or low-use areas (Table 1).

Other factors that affected site selection were the amount of shade from the sun, and the distance from trails or edge habitat. Dagosto et al. [2003] cited the importance of large-diameter trees (>40 cm dbh) as an "anchor" for sleeping and feeding areas for *T. syrichta*. We were not able to verify this in the enclosure, due to the lack of trees >30 cm in diameter. However, as noted in other species [MacKinnon and MacKinnon, 1980], we observed *T. syrichta* to use higher perch sites for calling and scent-marking than for sleeping. Canopy heights differed little between medium- and high-use areas, while low-use areas frequently were grassy with low tree canopies (Fig. 7).

Semi-Captive Densities and Behavior

The average number of tarsiers recorded in the enclosure was 6.73 ± 1.76 per daily session. Daily variation in tarsier density was mainly associated with wind, rain, or human visitation. The maximum observed densities are of interest because they indicate that the 7,600-m^2 semi-captive enclosure provided habitat for at least 10 tarsiers. This average density of 760 m^2 per tarsier contrasts with previous estimates of wild *T. syrichta* home range size just outside of the enclosure of 6 ha (60,000 m^2) per male and 2.5 ha (25,000 m^2) per female [Neri-Arboleda, 2002].

Studies of wild *T. syrichta* have shown that males are typically solitary, with home ranges overlapping those of multiple females but rarely overlapping those of other males. It has been reported that female home range overlap is rare to absent [Neri-Arboleda, 2002; Dagosto and Gebo, 1997]. On several occasions we observed a female with a juvenile sharing sleeping sites with another tarsier at heights of 3 m or more, with only centimeters of separation between each other on the same tree. One such group stayed together for a period of over 2 months (through November into January). Other sleeping-site groupings were also observed within the enclosure for shorter periods of time ranging from a few days to a month. Haring et al. [1985] reported similar observations of captive *T. syrichta* forming small groups; however, other studies of *T. syrichta* in the wild showed that tarsiers were strictly solitary, such that two tarsiers were never closer together than 1 m at a sleeping site [Dagosto and Gebo, 1997]. While it would be inappropriate to make sweeping generalizations on mating systems and social organization on the basis of data collected in this study, we found a marked difference in behavior between captive and wild *T. syrichta*. In captivity, *T. syrichta* exhibited some level of limited allocare, similar to that shown by *T. spectrum* [Gursky, 2000]. In contrast, previous studies of wild groups showed that this species either exhibits monogamy or some level of a noyau mating system [Neri-Arboleda, 2001].

CONCLUSIONS

This preliminary study of a successful semi-captive environment quantified characteristics of habitat use by tarsiers. We offer this information for use by other facilities in maintaining populations of *T. syrichta*. In addition to the topics addressed here, we emphasize the need for further research on other factors that might contribute to the success of this enclosure design. Future investigations are needed to understand 1) the effect of manipulating vegetation to attract prey species, 2) the role of artificial lighting in increasing prey densities, and 3) the impact of predator control on successful tarsier husbandry.

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