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ABSTRACT. The objective of this study was to determine the density and habitat preference of the Black-and-rufous elephant-shrew (*Rhynchocyon petersi*) in Chome Forest Reserve, Tanzania. Chome Forest (143km^2) is located in the South Pare Mountains and provides critical habitat for endangered *R. petersi*. Twelve 300m transects were cut through the centre of the forest in an east-west direction and the number of elephant-shrew nests within 2.5 meters on each side of the transects was recorded. The mean number of nests per 100m transect (0.39 ± 0.47 [1SE]) translated to a density estimate of 19 elephant-shrews per km^2 (SE=23). Nest sites tended to be found in areas with greater than expected cover at the low (<5m) levels. These results indicate the population density of *R. petersi* is lower in the Chome Forest Reserve than in most populations in the Eastern Arc Mountains. The reasons for this difference and the conservation implications are discussed.

KEY WORDS : elephant-shrew, sengi, conservation, density.

INTRODUCTION

Africa's tropical forests are home to large diversity of species, many of which are endemic to the African continent. With increases in both human population and deforestation, more and more animals are becoming threatened (MYERS, 1988). The elephant-shrews or sengis (order Macroscelidea) are one such group. There are 15 species in this strictly African mammal group, three of which are referred to as "giant" elephant-shrews and are of the genus *Rhynchocyon* (Peters 1847). All three *Rhynchocyon* species are considered threatened due to habitat destruction and fragmentation, including the species that is the focus of this study, the Black-and-rufous elephant-shrew *(R. petersi*, Bocage 1880*)* (NICOLL & RATHBUN, 1990).

The giant elephant-shrews share similar life histories in that they are diurnal insectivores that live in lowland and montane forests and dense woodlands (RATHBUN, 1984). They can be found in altitudes ranging from sea level-2300m. While foraging they use their long proboscis to turn over leaf litter and dig up beetles, termites, other insects and centipedes. Once the arthropods are exposed, the sengi's long tongue extends and scoops them up (KINGDON, 1997).

For shelter, the giant elephant-shrews build nests. The dimensions of their shelters are typically one meter wide with a body-sized bowl of 20cm long, 15cm wide and 10cm deep (RATHBUN, 1979). Giant elephant-shrews live in monogamous pairs with defined territories and therefore each animal can make and maintain up to ten nests in one territory with several nests in use at one time (FITZGIBBON & RATHBUN, 1994). Their territories are typically about 1-1.7 hectare (RATHBUN, 1979). Because of their dependence on undisturbed forest and their large territories, their presence is an indication of a healthy forest ecosystem.

Of the giant elephant-shrews, the most is known about the Golden-rumped elephant-shrew (*R. chrysopygus*) and there are few records about *R. petersi*. The objective of this study was to estimate the density of elephant-shrews based on nest counts and analyze habitat preferences in an undisturbed forest reserve where *R. petersi* were known to occur (STANLEY et al., 1996).

MATERIALS & METHODS

Chome Forest Reserve is located within the Eastern Arc Mountains (37º 58' 0.12" E, 4º 17' 60" S), a range on the southeast coast of Kenya and the eastern coast of Tanzania. Chome Forest is made up of mostly wet montane forests (submontane, montane, and upper montane) with elfin forest on high ridges and heathlands on rocky, acidic soils. It covers approximately 142.8km^2 and is situated on the ridges and plateau of the South Pare Mountains in the district of Same in Kilimanjaro Region, Tanzania. The reserve was established in 1951 under the National Forest Policy and Draft Act to ensure ecosystem stability through conservation of forest biodiversity, water catchment and soil fertility. Because of the high annual rainfall and pristine forest cover, the forest has a high water catchment value and is an important resource for the 22 surrounding villages in the catchment area. The altitude in the reserve ranges from 1250-2400m. The estimated annual rainfall is 1400mm. During the dry season fire is a problem because it replaces dry and lower forests with heath land. Historically fire was not a threat but fires have increased with human activity near the forest. STANLEY et al. (1996) noted the presence of *R. petersi* in the Chome

Forest, but no study has documented the densities of these elephant-shrews in this forest.

This study was conducted in the rainy season between April 11th and 29th 2001. Chome Forest is accessible by road, but the forest itself is navigated only by footpaths. One such trail that is heavily trafficked bisects the middle of the forest from a west to east direction and is used by locals trekking from Mhero to Kanza or Mhero to Bombo. Because the path was established and because there had been sengi sightings in the area, this trail was chosen to be a reference path for transects. In order to estimate elephant-shrew density and habitat preference, transects were cut through the forest starting from the forest edge on the western side (near Mhero boundary). Twelve transects were cut perpendicular from the path, each 300m long and paced 500m apart. The first transect was 500m from the forest edge.

Nest frequencies within 2.5 meters on each side of the transect were tallied. Both newer (in use) and older nests were recorded. For more qualitative data, the number of scraping/digging sites was also tallied. Using a density conversion factor from FITZGIBBON & RATHBUN (1994) study on *R. chrysopygus*, the population density per km^2 was estimated.

To examine if giant elephant-shrews were selecting specific shade classes for their nests, percent canopy cover was estimated every 20m along each transect at each of three layers of canopy : $\leq$ 5m, 5-15m, and $\geq$ 15m. Percent canopy cover was divided into four shade classes, of 0-15%, 16-35%, 36-55% and >56%. Canopy cover was also recorded at each observed nest site and compared to available cover with χ^2 analysis.

RESULTS

The average number of nests found per 100m of transect was 0.39 (SE= 0.47). Using the density conversion factor from the FITZGIBBON & RATHBUN (1994) study, the estimated density was 19 per km^2 (SE=23). By extrapolation a liberal estimate for the whole reserve would be approximately 2700 *R. petersi*.

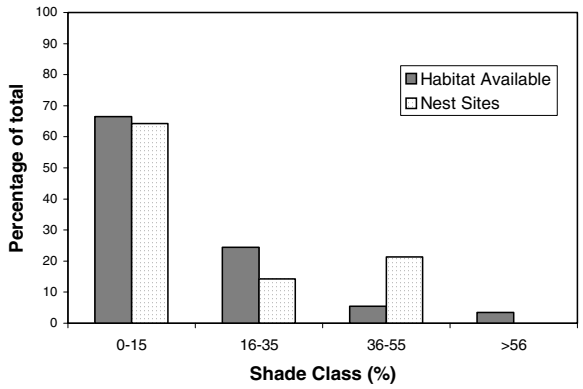

Fig. 1. – Shade classes for nest sites of *Rhynchocyon petersi* compared to the available habitat data collected every 20m.

There was no evidence that elephant-shrews were selecting specific shade classes in the middle or upper canopy layers (P > 0.10). However, in the lowest canopy layer (< 5m) elephant-shrews selected higher shade classes for nests than expected (χ^2 = 8.14, d.f.= 2, P < 0.05; Fig. 1). In particular the shade class of 36-55% was higher than expected (Fig. 1).

DISCUSSION

The estimated population of *R. petersi* in Chome Forest was 19 (SE=23) elephant-shrews per km^2. This estimate is most interesting when compared to density estimates of *R. petersi* from other forest reserves in the Eastern Arc Mountains. HANNA & ANDERSON (1994) estimated population density of *R. petersi* for seven study sites in the Eastern Arc Mountain range using similar techniques to this study (Table 1). The population density of Chome Forest Reserve is low when compared to these other sites where *R. petersi* was found. According to HANNA & ANDERSON (1994), the available habitat for *R. petersi* tends to be fragmented given its location at higher elevations, which is typically on isolated mountains. Current logging and hunting pressures on these forests have further exacerbated the lack of habitable areas for *R. petersi.* Though Chome Forest is closed to timber harvesting and hunting, pit saws and traps were sighted in the forest and therefore human activity in the forest could be limiting the numbers of *R. petersi*. Also because of the proximity of the village and the lack of a buffer zone, the forest is isolated which could prevent immigration into the existing population. FITZGIBBON (1994) suggested that for *R. chrysopygus* in Kenya, selective tree felling and pole cutting in protected areas have little effect on elephant-shrew densities but she warns that in unprotected areas, human pressure may be more of a threat.

TABLE 1

Estimated population densities of *Rhynchocyon petersi* in forest sites throughout Eastern Tanzania (from HANNAH & ANDERSON, 1994).

Forest site areas	Area (km^2)	Population density in pristine areas of forest reserve (No./ km^2)
Pugu	11	79.3
Kazimzumbwi	29	67.1
Ruvu	98	42.7
Kiono	20	42.7
Kisiju	2	0
Kwamkoro	Unknown	> 0 *
Kiwanda	Unknown	> 0 *
Chome – This study	143	19.0

* Not enough animals were captured for a density estimate, although a few animals were observed.

Rhynchocyon petersi chose nesting sites in areas of greater canopy cover than expected (Fig. 1), probably to avoid predators and to find sufficient leaf litter to construct nests. Nests were observed frequently at the base of trees, and typically wild coffee was the predominant shrub of the understory. Scraping and digging sites were often found near coarse woody debris perhaps due to the higher proportion of prey found living in this substrate. Finally, the forest edge seemed to have more nests (aver-

age of 2.7 nests/100m) than the other areas of the forest (0.3 nests/ 100m), indicating the Black-and-rufous elephant-shrew may perhaps forage in both the forest as well as in the surrounding heathland.

The population density conversion factor we used was determined from data collected on *R. chrysopygus* (FITZGIBBON & RATHBUN, 1994). HANNA & ANDERSON (1994) argued that *R. petersi* exist at lower densities than *R. chrysopygus*. If this is the case, then the conversion estimator results in a liberal density estimate for *R. petersi*. When extrapolating the population estimate for the entire forest, we assumed that the whole forest area provided adequate habitat for *R. petersi*, but there is evidence of disturbed areas of the forest which include burnings and heathland habitat which has not been known to support elephant-shrew nests. All of these surveys of *R. petersi* were conducted over short periods of time and ideally longer studies should be conducted. However, in general *Rhynchocyon* populations do not vary substantially over time (RATHBUN, 1979) so we are confident in our relative comparisons between forests.

The results of this study indicate that the population of *R. petersi* in Chome Forest Reserve is low and isolated when compared to other populations in the Eastern Arc Mountains and thus long term conservation plans must safeguard the future of the forest. This study also showed that forest cover is essential to the elephant-shrew, presumably to avoid predation, while leaf litter is crucial for nesting materials. With the proposed community conservation agreement and the re-opening of the forest to selective timber harvesting, the elephant-shrew population should be closely monitored.

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