Short Communication

Hunting of protected animals in the Parc National d'Ankarafantsika, north-western Madagascar

Gerardo García and Steven M. Goodman

Abstract Bones were obtained from the temporary camp of raffia palm fibre harvesters in the Parc National d'Ankarafantsika in north-western Madagascar. Based on the context of their deposition, knife-cut marks, and burn marks these animals were consumed for food. The minimum number of individuals (MNI) of wild animals represented in the sample was 49, and included turtles (MNI = 5), birds (MNI = 4), tenrecs (MNI = 4), Carnivora (MNI = 2), lemurs (MNI = 32), and bush pigs (MNI = 2). The majority of these animals are protected by Malagasy law and are endemic to the island.

Keywords Ankarafantsika, endemic vertebrates, hunting pressure, Madagascar, protected area.

Although hunting is one of the threats to wildlife on Madagascar (Mittermeier *et al*., in press) and excessive hunting has been invoked for the extinction of several species there (Dewar, 1997), little quantitative information is available. Bone remains recovered from archaeological sites indicate that wild animals have been a part of the Malagasy people's diet since the island was first colonized 2,000 years ago (Rasamuel, 1984; Rakotozafy & Goodman, in press). In more recent times a variety of animals have also been hunted for human consumption (Decary, 1939, 1950; Paulian, 1955; Kuchling, 1988; Randriamanalina *et al*., 2000). Apart from spiny tenrecs (Tenrecinae), fruit bats (Pteropodidae), and bush pigs *Potamochoerus larvatus* the sale of wild mammals in markets is rare.

During the latter part of April 2000 G.G. gathered bone remains from a campsite previously occupied by raffia *Raphia farinfera* (family Arecaceae) palm fibre collectors in the Parc National d'Ankarafantsika (Fig. 1). Whilst inhabiting the camp and working in nearby areas the collectors hunted wild animals to supplement their diet. To our knowledge this sample provides the first detailed information on human exploitation of wild vertebrates in recent times on Madagascar, and provides an insight into the level of human pressure on several protected species.

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The Parc National d'Ankarafantsika, originally named as a Réserve Naturelle Intégrale in 1927, is situated in the north-west of Madagascar in the Mahajanga Province and has an area of 135,800 ha. The management of the area and enforcement of laws associated with exploitation of forest products fall under the jurisdiction of the Association National pour la Gestion des Aires Protégées and the Direction des Eaux et Forêts. The Park is a mosaic of floristically heterogeneous dry deciduous forest, (Alonso *et al*., 2002), dissected by small valleys that have abundant *Raphia* palms. The site of the raffia collectors' camp was near Antsiloky Lake, the source of the Karambao River, in the central portion of the Park. The 2-ha Antsiloky Lake is near to a *doany* (sacred house), the site of an important ritual of the local Sakalava ethnic group.

Raffia exploitation for weaving fibres, building supplies, and food normally occurs during the dry season (May–October) and requires a permit. However, because of the limited means available to local authorities and the considerable size of the region, there is little control of exploitation and other activities of raffia collectors. Raffia gathering and trade is an important economic activity for local village communities, and numerous people are involved. During the harvesting season a base camp is normally established close to areas with concentrations of palms. The number of occupants of a camp varies, but usually consists of members of a single family, and normally the only food that they bring into the forest is rice. Women will often fish and collect local plants, including root tubers. Wild vertebrates, beetle larvae (family Cerambycidae), and honey are exploited for protein.

In April 2000 G.G. visited one of these collectors' camps in the company of six raffia harvesters that had

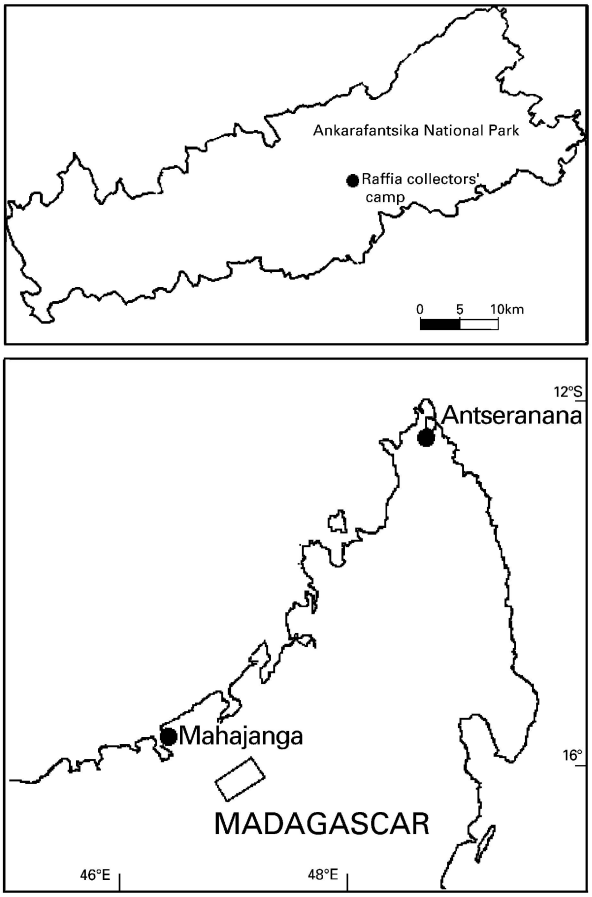

Fig. 1 Location of the Parc National d'Ankarafantsika in the north of Madagascar (lower figure), and the position of the rafia collectors' camp within the Park (upper figure).

used this specific site during the last harvesting season, and collected all bones found on the ground and in the leaf litter. According to the raffia collectors all of this material was from food remains discarded during their last residence, within the past year, at the site. Bone remains were identified using the comparative osteology collections in the Département de Paléontologie et d'Anthropologie Biologique, Université d'Antananarivo. Most recovered material could be identified to species. Paired bones of a taxon were separated and the largest number of elements from either the left or right side was considered the minimum number of individuals (MNI).

Reptile (turtle), bird, and mammal bones identified from the midden remains represented 14 animal taxa and at least 47 individual animals (Table 1). Cow (zebu) and goat remains were also found, brought from outside the forest and most likely used for ceremonies near Antsiloky Lake. Some fish bones were also found, and presumably represent animals collected either in the lake or nearby river. Given that fish represent the main protein component of the collectors' diet while camping (G. García, unpubl. data), it is clear that these remains are under-represented in the middens.

The most common animal remains found at the camp were of lemur (68% of the MNI). *Eulemur fulvus* and *Propithecus verreauxi* were the most abundant, each with a MNI of 12. On the basis of tooth eruption and wear, and bone ossification, all *P. verreauxi* and 11 of the 12 *E. fulvus* were adult. The next most common primate was *Lepilemur edwardsi* (MNI = 5). Forty of the 47 (85%) individuals identified within the remains were mammals. One species of freshwater turtle *Erymnochelys madagascariensis* was also identified, as well as four species of bird.

Domestic dogs often accompany the raffia collectors into the forest, and several bone remains found in the camp had tooth-gnawing marks that were almost certainly made by dogs, and finer incision marks presumably made by rodents. Some bones were probably carried away from the campsite by dogs and wild animals, and therefore the figures reported here are conservative estimates of the total number of animals left at the camp and do not represent the precise diet of the camp's occupants.

In the region of the Parc National d'Ankarafantsika local people hunt wild animals with a variety of techniques, including dogs for *Tenrec ecaudatus*, blow-pipes, snares, and *kotona*, a simple baited trap device made of trunks to capture alive *P. larvatus* or *Cryptoprocta* (family Viverridae). We found distinctive signs on the bone remains that indicated that the larger lemurs were killed with relatively fine metal shot, wounds that could only have been inflicted either by a commercial shotgun or a locally made 'bush model'. For many taxa, particularly mammals, there were clear signs of cut marks with a metal object and/or burn marks (Table 1). We consider these marks to be diagnostic signs that these taxa were consumed for food, and this was confirmed by interviews with villagers.

The most common species in the sample were the two largest species of lemurs in the region, *P. verreauxi* and *E. fulvus*, adults of which weigh *c.* 3.5 and 2.5 kg, respectively. These diurnal species would provide the highest protein return amongst the primates of the region. Another lemur, *Eulemur mongoz*, weighing 1.6 kg, is patchily distributed within the reserve (Schmid & Rasoloarison, 2002), but it was not identified within the remains. The smaller nocturnal species *Avahi occidentalis* and *Lepilemur edwardsi* often rest and sleep during the day in exposed places, and they can be taken by hand without the use of weapons. We found no signs of shotgun wounds in the bone remains of these lemurs, and given the cost of shotgun shells and the difficulty in finding materials for homemade shells, it is not

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Table 1 Species of wild animal found in a raffia-gatherers' camp in the Parc National d'Ankarafantsika, with the minimum number of individuals (see text for details), presence (+) and absence (−) of cut and burn marks found on bone remains, and 2002 Red List status (http://www.redlist.org).

Species	Minimum number of individuals	Cut marks on bones	Burn marks on bones	Red List status
Reptiles				
**Erymnochelys madagascariensis*	3	−	+	Endangered
Birds				
Egretta alba	1	−	+	−
**Accipiter francesii*	1	−	−	−
**Leptosomus discolor*	1	−	−	−
**Vanga curvirostris*	1	−	−	−
Mammals				
Family Tenrecidae				
**Tenrec ecaudatus*	4	+	+	−
Family Viverridae				
**Cryptoprocta ferox*	2	+	+	Endangered
Family Primata				
**Lepilemur edwardsi*	5	+	+	Lower Risk/near threatened
**Eulemur fulvus fulvus*	12	+	+	−
**Avahi occidentalis*	3	+	−	Vulnerable
**Propithecus verreauxi coquereli*	12	+	+	Vulnerable
Family Artiodactyla				
Potamochoerus larvatus	2	+	+	−

*Species endemic to Madagascar and neighbouring islands.

surprising that only the largest species are hunted with guns. The proportions of the four species of lemur amongst the bone remains is not the same as their occurrence in nature (Schmid & Rasoloarison, 2002), with larger species being disproportionately hunted.

One of the species found in the bone remains, *T. ecaudatus*, is an endemic species widely consumed across Madagascar. This species has a high reproductive potential, appears to be adapted to high levels of predation, and seems resilient to human habitat disturbance and to some degree of hunting pressure (Ganzhorn *et al*., 1990). Birds made up only 4 of the 49 individuals recovered from the bone remains, and of the four species identified, three are endemic to Madagascar and the Comoro Islands and include the endemic families Leptosomidae (*Leptosomus discolor*) and Vangidae (*Vanga curvirostris*). The recovered bone material suggests that there is less hunting pressure on birds than on mammals. However, in other areas of the island, birds are often plucked, roasted, and consumed at the site of capture, and therefore levels of hunting might be under represented in the midden remains. Also within the sample were two individuals of *P. larvatus*, a species that might have been introduced to Madagascar from Africa and that is consumed by many local Sakalava people. *E. madagascariensis* in the bone remains may have come from Antsiloky Lake, where there is a population that is intensively exploited during the raffia collection period, as well as during the months before the heavy rains (September–November) when females prospecting for nesting areas are more vulnerable (G. García, unpublished data).

Within the Parc National d'Ankarafantsika there is an official zone for *Raffia* exploitation of 950 ha where 20 or more camps are occupied each year, but the number of people legally or illegally exploiting raffia is not currently known. Although we do not know whether wild animals are exploited to a greater or lesser degree at sites other than the one described here, in other zones of the Park, such as Ankarokaroka, there is considerable hunting pressure on wild animals (Radespiel & Raveloson, 2001).

Of the 49 minimum number of individuals identified from the sample, 44 (90%) were of species endemic to Madagascar and neighbouring islands, of which 32 (65%) were lemurs. Many of these endemic taxa are considered threatened as a result of habitat disturbance and human hunting pressure. Although the Sakalava consider lemurs to be taboo (*fady*) or sacred (*masina*), these restrictions tend to apply only in certain areas of this cultural group's range (Ramanantsoa, 1976). Even in areas where these taboos are followed, immigrants from other cultural groups are not obliged to follow Sakalava customs. In recent years several taboos have become less important, and the effects of near famine and economic difficulties seem to have accelerated this process (Sautter, 1980).

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Given the low reproductive rates amongst the larger lemur species and the apparently high hunting pressure on these animals within the Park, current levels of exploitation by raffia collectors could have a major impact on local populations. For example, although *P. verreauxi* often reach sexual maturity at *c*. 5 years old, less than half have reproduced at the age of 6 years, and the oldest individuals live for nearly three decades (Richard *et al*., 2001). The maximum litter size is two, it is rare for females to give birth in consecutive years, and infant mortality is often high. One of the species in the middens, *E. madagascariensis*, was abundant until a few years ago (Kuchling, 1997), but is now absent from many rivers because of heavy human exploitation (G. García, pers. obs.).

The importance of the hunting of wild animals for food by local people in the Ankarafantsika region is poorly known as a subsistence strategy. Urgent studies are required to document the impact of these activities on the local biota.

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Biographical sketches

Gerardo García has worked on threatened species in a number of countries for over 10 years, including experience with captive breeding, zoos and wild populations. Recently his main research has been on the ecology of the endemic threatened freshwater turtle *Erymnochelys madagascariensis* at Ankarafantsika, Madagascar.

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