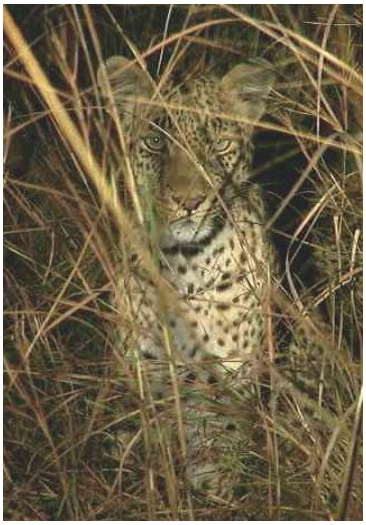
A survey of carnivores in the Niassa Reserve, northern Mozambique.

Report A



Niassa leopard

Large-spotted genet

Prepared for
Sociedade para a Gestão e Desenvolvimento
da Reserva do Niassa
Moçambique

By

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Survey of carnivores in the Niassa Reserve, northern Mozambique.

Objective

To complete a carnivore survey for SGDRN and to assess the potential for research on honey badgers and their interactions with other carnivores in the Niassa Reserve (NR), northern Mozambique.

Summary

Carnivores are considered ecological indicators of the viability of other members of their communities and the number and diversity of carnivores defines a healthy ecosystem. In addition, the large carnivores (lion, leopard and hyaena) are central to eco-tourism and provide crucial revenue through trophy hunting in four of the five buffer areas surrounding the core area of the reserve. A carnivore survey was conducted in Niassa Reserve (May – December 2003), using a variety of standard techniques including spotlight counts, track plates, live trapping and a call-up survey for lions and hyaenas. In total 26 carnivore species including domestic cat and dog were identified.

The level of illegal killing of carnivores needs to be assessed and monitored, particularly the trade in leopard, lion and jackal skins. Honey badgers and African clawless otter were also occasionally persecuted as problem animals. While leopards are common, spotted hyaena (0.001 adults /km^2) and lion densities appear lower than in other similar areas. This is likely to be primarily due to relatively low densities of medium sized prey, however other factors such as illegal persecution may also be important and this needs further investigation. The low density of lions is of particular concern given the lion's status as vulnerable on the International Red Data list and recent research, which suggests that lions are particularly vulnerable to trophy hunting due to their complex social organisation. The relatively large population of wild dogs in the reserve (estimated at 200-250 individuals) is of world- wide conservation importance. Of the smaller carnivores, genets (3 species) and African civet were the most common. Of particular interest were the two records of "black-tailed" white-tailed mongooses and two observations of the rarely seen Mellers' mongoose. Continued monitoring of large carnivore populations and assessment of the level of the illegal killing of carnivores is considered essential. Environmental education about carnivores for people living in the reserve is advised.

Acknowledgements

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1.0 Introduction

Carnivores are considered ecological indicators of the viability of other members of their communities since they are at the top of their respective food chains. The large carnivores, in particular are important for the regulation of both herbivores and smaller carnivores, and these in turn have effects on rodent and ultimately plant community dynamics. The presence of large carnivores therefore defines a healthy ecosystem (Frank, 1998). In addition to their ecological importance, carnivores are also potentially important for future eco-tourism initiatives, and lion, leopard and hyaena provide crucial revenues for both the reserve and the concessions through trophy hunting in five of the buffer areas surrounding the core area of the reserve.

Yet carnivore conservation is different from the conservation of the majority of other mammals, birds, amphibians, reptiles, insects and plants for several social and ecological reasons, the most general being that carnivores are perceived as a threat to humans. Ginsberg (2001) suggests that people perceive carnivores to be a threat because large carnivores have the potential to kill people, eat domestic livestock, spread disease and compete with people for food (meat, fish, honey). As a result people tend to persecute carnivores regardless of their density, numbers or actual threat to the person or livestock (Ginsberg, 2001).

It is therefore important that carnivores, particularly the large carnivores, are monitored in a conservation area. Simply monitoring occurrence provides the first step towards understanding the distribution, habitat needs and demography of a species. Surveys therefore provide a valuable opportunity to collect geographic and environmentally referenced information on the occurrence of uncommon carnivores. Yet carnivores pose particular problems for monitoring and estimations of actual population size are difficult as they are often cryptic, nocturnal, may have large home ranges and cannot be monitored by aerial census techniques. This has lead to a wide variety of methods being used to estimate carnivore abundance, with particular techniques suitable to some carnivores but not others.

2.0. Aims

In this survey we aimed to:

a) Provide a complete checklist of carnivore species found in NR with an indication of their relative densities and provide geographically referenced points on their distribution.
b) Provide an index of spotted hyaena and lion density using a repeatable call-up technique that will allow comparison of the densities of these two species in NR with other areas, and that can be repeated by SGDRN on a regular basis to track densities of these large carnivores over time.
c) Produce a template / field guide to the tracks of the common carnivores found in NR to aid game scouts in their identification while in the field.
d) Provide preliminary information on the local names of the carnivores in Niassa and their utilization by villagers in the Reserve, particularly their use as traditional medicine, food, and persecution as problem animals.
e) Do a preliminary investigation of the potential for further research on honey badgers and their relationship with local honey gatherers and traditional beekeepers.
f) Provide recommendations for management and research based on our findings.

Additional information on wildlife utilization (snare lines, traps, fish poisoning), honey gathering / beekeeping, mammal list, porcupine records, tsetse samples, reptile and amphibian samples, GPS points of roads and bridges have also been collected and are presented in Report B: Miscellaneous observations from the Niassa Game Reserve, northern Mozambique.

3.0 Methods & Study Area

3.1 Study Area

Niassa Game Reserve (NR), located in northern Mozambique encompasses an area of approximately 42 000 km^2 with a core area of 22 000 km^2 and a buffer area of 20 000 km^2 that is divided into five management concessions (Figure 1). The survey was initiated in May 2003 and continued until the rains made further work difficult in December 2003 (8 months).

NR is located within the Eastern Miombo Woodland eco-region (WWF 2001), which is characterised by geological stability over a long time period, a long dry season climate lasting more than 6 months, flat topography interrupted by monolithic granite inselbergs, sluggish drainage on the plateau, old nutrient poor soils, frequent fires, and low levels of large herbivores with episodic high levels of insect and small mammal herbivory. The long winter droughts and poor soils result in vegetation of low nutritional value. This reduces the eco-regions faunal carrying capacity and large herbivores generally occur in fairly low densities (WWF, 2001). In turn this is likely to be reflected in the carrying capacity of large carnivores (WWF 2001). The primary vegetation of NR is dry Miombo woodland variants (50 %), with some open savanna (40 %), wetlands (5 %), mountains and inselbergs (3 %) and riverine and mountain forest (2 %; SGDRN 2001).

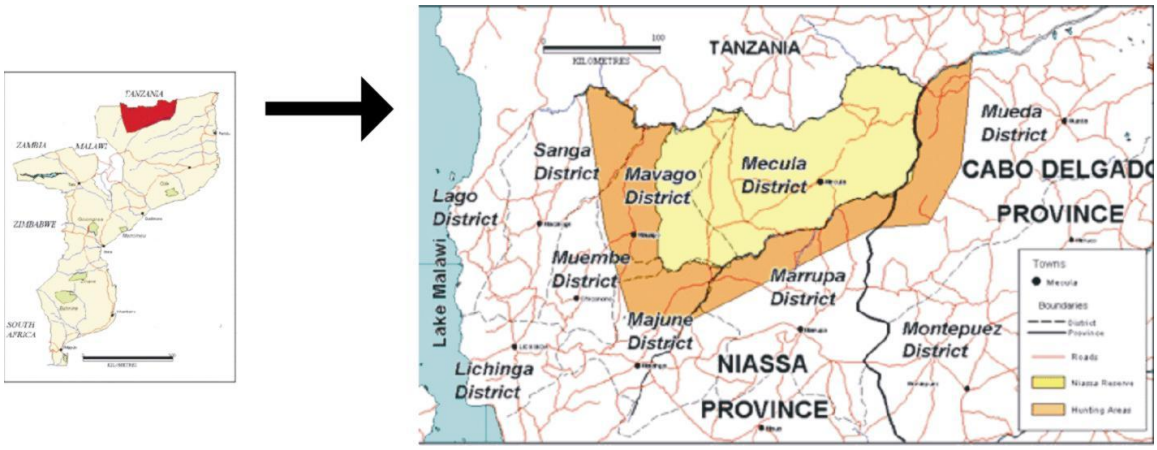

Figure 1: Niassa Game Reserve showing the core and buffer areas (www.niassa.com)

3.2 Methods

To achieve maximum coverage of NR, we worked from temporary vehicle based camps (15 camps in total) and radiated out from these camps.

A variety of techniques were used to locate and identify carnivores. These included spotlight counts, track transects, track plates, live traps, a lion-hyaena census using broadcasted calls, opportunistic (visual and track) sightings and conversations with local villagers, park staff, visitors, professional hunters, safari guides and researchers. These methods are presented in detail below to allow comparison with future work. It is not

possible to randomly sample NR due to the difficulties of sampling systematically off road. Data were therefore largely collected along existing roads, tracks and trails in NR and the maps of species distribution in NR reflect this. However, it is reasonable to assume that species that are widely distributed along areas close to roads and tracks are widely spread throughout the reserve and vice versa.

3 2.1 Opportunistic sightings

All visual observations, calls and tracks of carnivores identified opportunistically whilst walking or driving were noted. For each record the date, time, number of individuals, GPS coordinates, habitat and behaviour of the animal (where possible) were noted. A compact disc containing all records is lodged with SGDRN, Maputo.

3.2.2 Track plates / scent stations

Tracks detected at scented baits (track stations) have been widely used to determine presence / absence of carnivore species in an area. While the track plate data cannot be converted to estimates of abundance i.e. it is impossible to use this index to determine the exact number of civets in NR, the data can be used to examine broad differences in abundances between species and within species in different habitats (Zielinski & Kucera, 1995). In addition they are simple to use, inexpensive and since trends in track plate data do seem to parallel changes in carnivore abundance over time (Sargeant *et al*., 1996) they can be used to assess general long-term trends in carnivore populations.

At each track station, two sooted, aluminium plates (each 80 cm x 40 cm; total area: 80 x 80 cm) were placed in an open area, with a 60 cm high bait stick or scent post placed in the centre between the two plates (Plate 1). Track plates were sooted in the field using a paraffin torch (Uresk *et al.* 2003) and re-sooted whenever necessary. Animals that approached the bait stick, stepped onto the sooted plates and left "fingerprints" of their paws (Plate 1).

These prints were identified, measured with digital callipers and transferred to plain paper using clear packing tape to form a permanent reference collection of tracks. In addition fresh tracks on sandy or muddy substrates were traced

using a sheet of Perspex and a waterproof pen, The Perspex was placed directly above (1 cm) the ground so that the track could be traced. It was later transferred to plain paper by tracing.

Plate 1: A single track station showing two track plates and bait stick, and a typical track plate showing genet tracks.

Six transects, representing 43 track stations were placed in four habitats (Miombo woodland = 11 stations; vlei = 4 stations; mixed open woodland = 9 stations; floodplain = 19 stations) for 5-10 days representing 278 track plate nights. Each track station was set at least 0.5 km from the next to minimize a single animal visiting all track stations. Typically each track station was baited with a piece of sheepskin dipped in a “soup” mixture of blood, rotten fish, eggs, meat or fish. Baits were replenished where necessary. Each track station was checked at least once every two days, but usually every morning. Tracks were identified using templates of known tracks collected in NR and from available reference material (Stuart & Stuart, 2000; Liebenberg, 1992, 2000).

A visit to a track station was defined as the presence of tracks from a species. Data were analysed as number of visits per track plate night per species overall and in different habitats. In addition the total number of species recorded on track-plates in each habitat were counted to provide an indication of species richness in difference habitats.

3.2.3. Spotlight counts and track transects

The relative density of medium (2 – 20 kg) and large mammalian carnivores (>20 kg) within the study area were assessed through spotlight counts and track transects. Spotlight counts (801 km) were conducted from a vehicle driving at 8 –12 km/hr along available roads throughout the reserve core area and in Block C of the buffer zone. Transects were conducted from an hour after sunset until 04:00 and all carnivores were identified with the aid of a 400 000 candle-power spotlight and binoculars. An index score for each species was calculated as the number of individuals of each species observed per 100 km of road surveyed (Wilson & Delahay, 2001). Data are also represented as the percentage occurrence of each species calculated as the number of individuals of each species counted as a percentage of the total number of individuals observed.

In addition an index of the relative density of medium & large carnivores was obtained from independent 10 km track transects (n = 35; 350 km) located on suitably sandy roads or tracks. Each transect was walked in the early morning, and the presence or absence of fresh (within 12 hrs) tracks of medium to large carnivores (lion, leopard, spotted hyaena, serval, civet, honey badger, jackal) and for interest porcupines (whose spoor can be confused with that of honey badger) were noted. Data were analysed as the presence or absence of tracks from each species on each transect to prevent duplication (Wilson & Delahay, 2001).

3.2 4. Live traps

One small (0.3m x 0.25m x 0.25m) and three large (1m x 0.4m x 0.4m) drop door traps were regularly set in a variety of habitats (Plate 2). Each trap was checked every morning and evening to minimize the amount of time an animal would be confined. Each trap was baited with a variety of fish, honey, goat meat, eggs and chickens, depending on what was available. The primary aim was to catch and mark a honey badger, however other similarly sized species were also frequently caught and provided additional information for the carnivore survey. Where possible DNA samples (plucked hair in 90% alcohol) were taken from each individual that was captured before being released.

Plate 2: Typical set for the large trap used to catch honey badgers in NR

3.2.5. Hyaena and lion call up survey

A survey to determine an index of spotted hyaena and lion density was done in October 2003 using a tape play-back technique that has been widely used in other areas (Kruuk, 1972; Zank, 1995; Ogutu & Dublin, 1998; Mills *et al..,* 2001; Creel & Creel, 2002). Care was taken to match the techniques and tape used in other studies to ensure comparable results.

A 6-min long tape of sounds known to attract spotted hyaenas (Mills et al.. 2001) and lions (Oguto & Dublin, 1998) was obtained. The calls broadcasted were the bleating of a wildebeest calf, a squealing pig, an interclan fight between spotted hyaenas, the “whooping” call and hyaenas competing on a kill. The recordings were played back at full volume through a standard tape player attached to a 12-volt amplifier (TOA model CA130) with a rated output of 30 watts and connected to two 8 ohm horn speakers (TOA Model SC615) with a RMS rating of 15 watts (112 dB). The horn speakers were connected in parallel to produce a 4-ohm low impedance to improve sound quality. The horn speakers were attached to a pole 1 m above the vehicle roof (2.5 m from the ground) and pointing in opposite directions.

The survey was conducted over 10 nights in October 2003 along the existing road network in NR and the main road along the Lugenda River in Concession C (LUWIRE). At 10 km intervals (straight line, measured using GPS) the vehicle was stopped at a suitable point (as open as possible on high

ground) and the tape was played (53 call stations; Figure 2). Thirty minutes were spent at each station. After 3 minutes of playing the speakers were turned through 90^0. Five minutes after the end of the first playing the tape was replayed, again turning the speaker 90^0 after 3 minutes. If hyaenas were heard in the vicinity but did not appear the tape was played a third time. We scanned the vicinity with a spotlight at regular intervals. All carnivores that appeared or called in were noted.

Environmental conditions were kept as constant as possible and surveying was abandoned if the wind was above 2 on the Beaufort scale. Since consecutive call stations were at least 10 km apart and the drive between them took almost 40 minutes, the chances of double counting was considered remote.

It was not possible to test the distance from which spotted hyaenas or lions were attracted to the taped sounds or to assess the percentage of animals that responded to the calls (Mills *et al.*. 2001) due to the difficulties of finding groups, however the calls were easily audible by us from 2.5 km away. Given that hyaenas and lions have much sharper hearing than humans it is assumed that the minimum range of the call up equipment was 3.0 km. Experiments conducted in the Kruger National Park using similar equipment showed that the maximum distance that a hyaena was attracted from was 3.5 km. Hyaena densities were therefore calculated under the assumption that the minimum range was 3.0 km with a maximum range of 3.5 km and that the area covered per call site was therefore between 28.3 – 38.5 $km^{2.}$ The area surveyed from 53 call sites was therefore between 1499 – 2041 km^2.

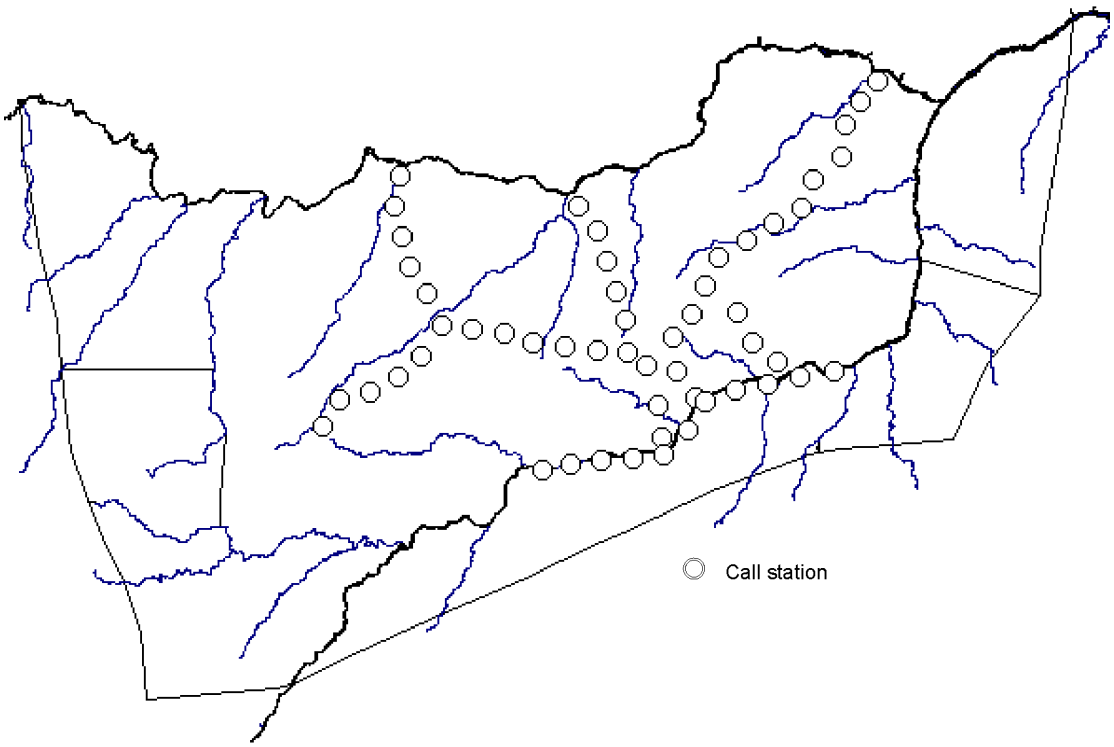

Figure 2: Position of call-stations used for lion and hyaena call-up survey in NGR. The call-stations are situated 10 km straight line from each other along available roads and tracks.

3.2.6 Utilization and persecution of carnivores

Conversations with local villagers living in the reserve and opportunistic sightings of wildlife utilization were recorded. This information is considered important for understanding the interactions between carnivores and people in NR and for identifying the needs for further work with these communities.

3.2.7 Immobilization and radio-marking of a honey badger

A honey badger caught in the drop-door trap was released into a large, robust hand-net, wound up inside the net to minimize movement and immediately hand injected in the rump with the immobilizing sedative drug Zoletil® (Tiletamine hydrochloride with the Benzodiazephine derivative Zolazepam in a 1:1 combination). While sedated the honey badger was fitted with a Telonics MOD 335 radio-collar. The procedure follows that used previously in the Kgalagadi Transfrontier Park (Begg *et al.*, 2003). The radio-marked honey badger was located from the ground using a two element hand-held antenna on an opportunistic basis.

3.0. Results & Discussion

4.1. Carnivore species checklist

A checklist of carnivores occurring in NR is provided in Table 1, with a subjective index of abundance. The scientific and common names are based on the recently published “Revised systematic checklist of the extant mammals of the southern African subregion” (Bronner *et al*., 2003). A field reference collection of the tracks of 16 common NR carnivores is provided with this report for potential use by field workers and game scouts working in NR (Appendix A). The tracks are from actual tracings taken in the field in NR.

Overall, 26 carnivore species from seven families (1 Hyaenidae, 5 Felidae, 4 Viverridae, 1 Nandiniidae, 8 Herpestidae, 3 Canidae and 4 Mustelidae) were confirmed to be present in NR. 24 species of carnivores were positively identified by visual observations and tracks including domestic cat and domestic dog (Table 2). The presence of a further 2 species, striped polecat / Zorilla (A. Macadona, pers. comm.*)* and palm civet (J. Wilson, pers. comm.) are indicated by verbal records. The presence of caracal and cheetah could not be confirmed and remain in doubt although D. Littleton from Luwire (Block C) may have heard a caracal call on one occasion, and a single record of a cheetah occurs in an original checklist of the NR (J. Alves, pers. comm.). While the distributions of Selous’ Mongoose may extend into NR, no sightings of this mongoose were made during the survey period and it is unlikely that this species occurs here (G. Veron, pers. comm.). Likewise, while striped hyaena occurs in Selous Game Reserve is has not yet been located in NR.

KEY FINDING(S): A checklist of 26 carnivores, including domestic cat and domestic dog, and a track reference for game scouts have been produced from this survey.

Table 1: Checklist of carnivores present in Niassa Game Reserve indicating the species confirmed through visual and track records, species recorded in NR from other sources (villagers, hunters, reserve staff, visitors) and species that might occur in the reserve but have not yet been located (Yes = confirmed present; (Yes) = present, Unk = unknown). In addition the average mass, predominant activity patterns (nocturnal/diurnal) and a subjective assessment of abundance based on the survey data are indicated (1= very rare; 2 = rare, 3 = fairly common, 4 = common, 5 = abundant, Unk = unknown)

Common Name	Scientific Name	Average Mass (kg)[1]	Present	Activity Pattern	Status
Family HYAENIDAE					
Spotted hyaena	*Crocuta crocuta*	40 – 90	Yes	N	3
Family FELIDAE					
Cheetah	*Acinonyx jubatus*	35 – 65	(Yes)	D	?
Leopard	*Panthera pardus*	28 – 90	Yes	N	4
Lion	*Panthera leo*	122 – 260	Yes	N	2
Caracal	*Caracal caracal*	12 – 19	Unk.	N / D	?
African wild cat	*Felis sylvestris*	3 – 6.5	Yes	N	3
Domestic cat	*Felis domesticus*	3 - 6	Yes	N	3
Serval	*Leptailurus serval*	5 – 18	Yes	N	2
Family VIVERRIDAE					
African civet	*Civettictis civetta*	7 – 20	Yes	N	5
Small-spotted genet	*Genetta genetta*	1.3 – 2.3	Yes	N	3
Large-spotted genets[1]	*Genetta maculata* *Genetta letabae*	1,2 – 3	Yes	N	4

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Common Name	Scientific Name	Average Mass (kg)[1]	Present	Activity Pattern	Status
Miombo genet	*Genetta angolensis*	1.3 – 2	Yes	N	5
Family NANDINIIDAE					
African palm civet	*Nandinia binotata*	2 – 3.2	(Yes)	N	1
Family HERPESTIDAE					
Bushy-tailed mongoose	*Bdeogale crassicauda*	1.3 – 2.1	Yes	N	3
Large grey mongoose	*Herpestes ichneumon*	2 – 4	Yes	D	2
Slender mongoose	*Galerella sanguinea*	0.4 – 0.8	Yes	D	5
Meller's mongoose	*Rhynchogale melleri*	1.7 – 3.1	Yes	N	2
White-tailed mongoose	*Ichneumia albicauda*	2.0 –5.2	Yes	N	3
Marsh mongoose	*Atilax paludinosus*	2.2 – 5	Yes	N	4
Banded mongoose	*Mungos mungo*	1.5 – 2.3	Yes	D	4
Dwarf mongoose	*Helogale parvula*	0.2 – 0.4	Yes	D	3
Family CANIDAE					
African wild dog	*Lycaon pictus*	18 – 36	Yes	D	3
Side-striped jackal	*Canis adustus*	7 - 12	Yes	N / D	4
Domestic dog	*Canis familiaris*	7 – 15	Yes	D	1

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Common Name	Scientific Name	Average Mass (kg)[1]	Present	Activity Pattern	Status
Family MUSTELIDAE					
African clawless otter	*Aonyx capensis*	12 –34	Yes	D	3
Honey badger / ratel	*Mellivora capensis*	5 –16	Yes	N / D	3
African striped weasel	*Poecilogale albinucha*	0.2 – 0.4	Yes	N	1
Striped polecat / zorilla	*Ictonyx striatus*	0.7 – 1.4	(Yes)	N	1

[1] = *Genetta maculata* (formerly *G. tigrina*) and *G. letabae* are both part of the large-spotted genet species complex and are not distinguishable by external characters, although both might occur in NR (Gaubert, pers. comm.)

[2] = Species mass taken from Kingdon (1997)

4.2 Relative densities

A variety of direct and indirect survey techniques were used to assess the relative density of carnivores in NR. Since survey techniques vary in their success at locating different carnivore species (Table 2), results must be interpreted with caution. If a survey technique is unsuccessful at locating a particular species this does not necessarily mean the species is not found in NR. However, if a species is not located by any of the techniques then it is a reasonably good indication that it is absent from NR or very rare (e.g. Selous mongoose). Likewise, when a species is commonly located by a variety of survey techniques, e.g. African civet and genet spp, this species is likely to be relatively common and widespread.

Some species give conflicting results, for example, side striped jackal were not located by trapping or track plates but were seen during spotlight counts and appear relatively commonly on track transects (Table 2). Honey badgers were not seen during spotlight counts or opportunistically and were rarely located on track plates or caught in live traps, but track transects and conversations with honey gatherers suggest they are relatively common but elusive. Due to its aquatic habits, the African clawless otter is unlikely to be located by any of the aforementioned survey techniques. Instead, we surveyed for this species by walking along suitable rivers looking for tracks and latrines.

Finally, since density is affected by body size, with larger species naturally occurring at lower densities than smaller species, there is limited value in directly comparing the density of the large predators with the small predators i.e. a lion versus a genet. The large carnivores (leopard, lion and spotted hyaena) are therefore discussed in detail in Section 4.4 and are only mentioned briefly here. More detailed information on each species is given in Sections 4.5 – 4.6.

4.2.1. <u>Comparison of species</u>

Overall slender mongoose, miombo genet, and African civet are considered abundant while Meller's mongoose, striped weasel and striped polecat are

considered rare (Table 2 & Table 3). Of the 24 wild carnivore species in NR, six species (slender mongoose, large grey mongoose, dwarf mongoose, banded mongoose, African wild dog and African clawless otter) are predominantly diurnal, 15 are predominantly nocturnal and two (honey badger and side striped jackal) are active during both the day and night.

During spotlight counts (801 km), 155 visual sightings of nocturnal carnivores representing 15 species were recorded (Table 2). Other than the African clawless otter, which is very habitat specific only two medium to large nocturnal carnivores were not recorded during spotlight counts, namely the honey badger and the lion. Information on the relative densities of animals seen at night may be important for assessing the potential for night drives as part of an ecotourist experience in NR. Genets were by far the most common carnivore species observed at night, representing 60 % of the sightings, with civet also relatively common (11 % of visual sightings). Additional non-carnivore species regularly seen during night drives were porcupines (see Report B), galagos (two species, Report B) and fruit bats (Report B). During the day slender mongoose was the most common carnivore seen, with banded mongoose common in floodplain habitats.

4.2 2. Comparison of habitats

The data from track plates provided information on the relative densities of small –medium sized carnivores in different habitats. Nine carnivore species visited track plate stations ranging in size from the striped weasel to the leopard. In Miombo woodland and vleis / dambos track plate visit frequency was 18.5 % and 5 % respectively, while track plates in open, mixed woodland and on the Lugenda floodplain both showed a 53 % visit frequency (Table 3). In addition, a higher number of species were recorded on track plates placed on the floodplain (9) compared to those in open, mixed woodland (4), pure miombo (4) or dambos (1). For the smaller carnivores this suggests that the Miombo woodland and vleis support a lower density and species richness than other habitats. Mixed woodland has low species richness but a high density of carnivores while floodplain habitat appears to support both a high species richness and a high densities.

Table 2: Relative abundance of carnivores in NR as determined using different survey techniques (opportunistic sightings, spotlight counts, track transects, track plates and live traps. Species are ranked in order of body mass and for track transects only medium to large carnivores were identified.

Common Name	Direct Observations							Track observations		Live Traps
	Opportunistic sightings		Spotlight counts (801 km)			Total Direct obs.		Track transects (n = 35; 350 km)	Track plates (n = 278 TP nights)	(n = 267 trap nights)
	No.	% occur.	No.	# / 100km	% occur.	No.	% occur.	% Transects	# visits (% frequency)[2]	# Indiv caught
Lion	2	1.3	0	0	0	2	0.7	28	0	0
Spotted hyaena	0	0	4	0.5	2.7	4	1.3	55	0	0
Leopard	0	0	3	0.4	2.0	3	1.0	59	3 (1 %)	4
Wild dog	13	8.2	5	0.6	3.4	18	5.9	4	0	0
African clawless otter	0	0	0	0	0	0	0	-	0	0
African civet	17	10.7	17	2.1	11.5	34	11.1	83	26 (9.%)	14
Serval	0	0	2	0.3	1.4	2	0.7	0	0	0
Domestic dog	6	3.8	0	0	0	6	2	-	0	0
Honey badger	0	0	0	0	0	0	0	10	2 (0.7 %)	1
Side-striped jackal	1	0.6	4	0.5	2.7	5	1.6	76	0	0

African wild cat	0	0	2	0.3	1.4	2	0.7	-	9 (3 %)	0
Domestic cat	0	0	2	0.3	1.4	2	0.7	-	0	0
White-tailed mong.	1	0.6	3	0.4	2.0	4	1.3	-	2 (0.7 %)	0
Marsh mong.	0	0	1	0.1	0.7	1	0.3	-	4 (1 %)	3
Large grey mong.	0	0	1	0.1	0.7	1	0.3	-	0	1
African palm civet	0	0	0	0	0	0	0	-	0	0
Meller's mong.	0	0	2	0.3	1.4	2	0.7	-	0	0
Genet spp. [1]	10	6.3	93	11.6	62.8	103	33.6	-	46 (17 %)	3[1]
Banded mong.	59	37.1	0	0	0	59	19.2	-	0	0
Bushy-tailed mong.	0	0	9	1.1	6.1	9	2.9	-	0	0
Zorilla	0	0	0	0	0	0	0	-	0	0
Slender mong.	43	27.0	0	0	0	43	14	-	2 (0.7 %)	0
Striped weasel	0	0	0	0	0	0	0	-	1 (0.4 %)	0
Dwarf mong.	7	4.4	0	0	0	7	2.3	-	0	0
Total records	**159**		**148**			**307**			**95 (34 %)**	**26**

[1] All genet species have been combined due to the difficulties in telling the species apart from far away and from tracks (see section 4.6.6).

[2] Visit frequency calculated as number of visits per track plate night per species, presented as a percentage.

Table 3: Results of track plate survey showing relative species richness and carnivore density in different habitats

Habitat type	Track plate nights	Visits [1]	% Frequency of visits (visits / track plate night)	No. of species recorded
Miombo woodland	92	17	18 %	4
Vlei / wetland	42	2	5 %	1
Open mixed woodland	66	35	53 %	4
Lugenda Floodplain	78	41	53 %	9
Total	**278**	**95**	**34 %**	**9**

[1] A visit is defined as the presence of tracks from a species on the trackplate

These differences are likely to reflect relative habitat diversity within each larger habitat category. Floodplains and to a lesser extent open woodland support a wider variety of microhabitats (thickets, riverine, palms, grassland, open areas, termitaria, fallen trees etc.) than uniform Miombo woodland or vleis. It has been suggested that due to annual droughts and frequent fires many species are at least seasonally dependent on non-miombo vegetation within the Miombo Eco-region to provide food, water and shelter (WWF, 2001).

KEY FINDINGS: Floodplain and mixed woodland habitat support a higher density of carnivores than mature Miombo woodland or vleis. In addition floodplain habitat supports higher species richness, than other habitats.

RECOMMENDATIONS: Eco-tourism activities should include a variety of habitats to maximise their chances of seeing a variety of carnivore species. In particular the eco-tones between habitat types are likely to support the highest density and numbers of species. Night drives through a variety of habitats are likely to be the most productive way for tourists to see carnivores.

4.3 Carnivores & people

Two carnivore species, which are present in NR, are of international conservation concern. Lion are listed as vulnerable and wild dog are listed as endangered on the International Red Data Species List (IUCN, 2003; Table 4). In addition African clawless otter, African wild cat, serval, lion and leopard are listed on CITES (i.e. international trade is restricted; Appendix 1 & 11; Table 4).

Trophy hunting operations take place in four of the five concession areas surrounding the core area of the reserve, with set quotas for lion and leopard. Trophy hunting of lions and leopards provides substantial revenues for both the concessions and NR. Currently, a typical 15 day lion hunt can bring in about US$24 000, with leopards slightly less at US$17 000.

The levels of illegal hunting of carnivores are unknown. As is commonly the case (Ginsberg, 2001), carnivores in NR are generally negatively perceived and persecuted because they can kill people, they are not sources of food themselves but they eat potential food (chickens, fish, honey, goats). Other than the large carnivores, many of the smaller, nocturnal carnivores are not known e.g. civet. Many people, even local hunters, show a lack of understanding about which carnivores are a threat to people and which carnivores are relatively harmless. Education about the value of carnivores, the differences between species and practical ways to minimize conflict eg. hive protection methods would be beneficial.

While people do not appear to eat carnivores in NR, three carnivore species (spotted hyaena, honey badger and side striped jackal) are widely used in traditional medicine (Table 4). We have found honey badger parts and skins from northern Mozambique for sale in markets in Malawi, Maputo and South Africa. Conversations with local hunters suggest that side-striped jackal skins from the reserve are sold in Malawi while leopard and lion skins are offered for sale in Cabo del Gado province. The level of persecution of problem

carnivores (honey badger, African clawless otter, genet *spp)* appears to be low although honey badgers and otters are killed opportunistically. See section 4.6.2 for further information on the interaction between honey badgers and beekeepers and honey gatherers.

KEY FINDING(S):

1. Within communities there is little understanding about the importance of carnivores and the differences between them.
2. Skins of leopard, lion and jackal are sold outside the reserve. The level of trade is unknown.
3. Problem otters and honey badgers are killed opportunistically but persecution of these two species appears to be low.

RECOMMENDATIONS: Further information is needed on the levels of all types of illegal killing of carnivores. Environmental education including carnivore identification, threats and value of carnivores and practical ways to reduce conflict is needed, particularly for children.

Plate 3: Male honey badger killed in chicken “mzinga” whilst raiding chickens in Chalange village, NR.

Plate 4: African clawless otter killed by fisherman and stuffed with sand.

Table 4: Interactions between local villagers and carnivores in NR, indicating the Yao names of carnivores, utilization (food, traditional medicine, trade) and problems caused. In many cases, similar species are not distinguished e.g. Genet refers to Miombo genet, large-spotted genet and common genet.

Common name	Yao name	Conservation Status[1]	Traditional medicine	Food	Problem Animal	Other uses
Side striped jackal	Licule	Not listed	Yes	No	No	Skins sold
Wild dog	Lisogo	Endangered	No	No	No	No
Weasel/polecat	Lipwisa	Not listed	No	No	N	No
Honey badger	Nkuli	Appendix 111	Yes	No	Yes (hives, chickens)	No
African clawless otter	Kawusi	Appendix II	No	No	Yes (fishermen)	No
Mongooses	Lizulu	Not listed	No	No	No	No
Spotted hyaena	Lituno	Not listed	Yes	No	Yes (humans)	No
Genet	Bendo	Not listed	No	No	Yes (chickens),	No
Civet	Jussi	Appendix III	No	No	No	No
African wild cat	Chiwuloo	Appendix II	No	No	No	No
Serval	Licule	Appendix II	No	No	Yes (chickens)	No
Caracal	Unknown	Appendix II	-	-	-	-
Cheetah	Unknown	Appendix I, Vulnerable	-	-	-	-
Leopard	Chizuvi	Appendix I	No	No	Yes (humans)	Skins sold
Lion	Lisimba	Appendix II, Vulnerable	No	No	Yes (humans)	Skins sold

[1] = Conservation Status refers to CITES Appendices and IUCN International Red Data List.

4.4. Lion, spotted hyaena and leopard

Leopards are the most common of the large predators, with spotted hyaenas intermediate and lions the least common. Territorial calling of large predators provides an index of relative abundance. While hyenas were heard calling on 36 nights and leopards on 22 nights, lions were only heard roaring on 9 nights over the eight months of fieldwork. On all occasions lions were heard on the floodplain of the Lugenda River, while spotted hyaena and leopard were heard throughout NR.

Lion spoor was located on 28 % of the track transects, while leopard and hyaena were found on 59 % and 55 % of transects respectively (Table 2). While leopard spoor was fairly regularly observed on the track plates (Table 2), neither spotted hyaena nor lion spoor were recorded using this technique. This is more likely to reflect their large size i.e. they can reach the bait stick without stepping onto the track plate than their density. Surprisingly, leopards were also caught in the live traps on 4 occasions despite the small size of the traps. While fresh tracks suggested that hyaenas investigated the traps on eight occasions, lion were not recorded at the trap sites.

During 8 months of fieldwork, we saw lions on one occasion (two lionesses; Figure 3), leopards were observed on 3 occasions (excluding individuals caught in traps; Figure 4) and spotted hyaenas were seen on 7 occasions (9 individuals; Figure 5) excluding the call-up survey (n = 22). No large clans of hyaenas were located and individuals were most commonly seen alone. Likewise the largest pride of lions recorded in NR is six with groups of 1-2 most common. A pride of 5 females was seen by F. Gear in Concession C. However no resident prides were regularly seen and could be identified by reserve staff or professional hunters. J. Wilson and D. Littleton (Luwire; Concession C) suggest a high level of movement in lions, individually recognisable lions are seen once and then not again suggesting large home ranges. Additional information on the seasonal movement of lions within the reserve and across the reserve and concession boundaries is needed to assess this further.

4.4.1 Call-up survey

A total of 22 hyaenas and 2 side-striped jackals were called in from 53 call sites. There was no response from hyaenas at 72 % (38) of the call sites, and no lions responded at all throughout the survey. The lack of lion response precluded calculation of a direct estimate of lion density. The average number of hyaenas seen at a call site was one, although it varied from 1 – 4 individuals. Overall the results give an estimated hyaena density of 0.01 - 0.015 hyaenas / km for NR. This can be extrapolated to suggest that the NR core area has between 220-320 hyaenas. The data reflect no differences in hyaena density from call sites within 3 km of the major rivers (Rovuma and Lugenda) and call sites further inland in mature Miombo woodland.

Compared to other areas surveyed using the same technique, hyaena densities were low (Table 5) and only comparable with the density of hyaenas in the Kgalagadi Transfrontier Park, which is a semi arid environment with relatively low prey densities. Selous Game Reserve, Tanzania, which is closest geographically to NR and has similar habitat (predominantly Miombo woodland), has a hyaena density at least six times higher than NR (Table 5). We suggest that these relatively low hyaena densities are most likely to reflect low densities of medium sized prey and this will also affect lions. This should resolve itself if prey densities continue to increase as has been the trend thus far (Craig & Gibson, 2002).

The total lack of response from lions was surprising since the same technique and tape have been used with success in numerous other studies (Zank, 1995; Ogutu & Dublin, 1988; Creel & Creel, 1997; Mills *et al*., 2001). J. Wilson suggests that the lion population and movement in Concession C peak around during June –July and that a call-up survey should preferably be conducted at this time, rather than in October. Creel & Creel (2002) have shown a strong positive correlation between lion and spotted hyaena densities in other areas. Therefore using the ratio between hyaenas and lions in Selous Game Reserve as an estimate (2.6:1; Creel & Creel, 2002), and our

population estimate for hyaenas in the core area of NR (220-320 adults), we can calculate a first estimate of lion population size in the core area of NR as 83 –120 adults. This can provide a starting point for further research.

Low lion densities are of particular concern given the lion's status as vulnerable on the International Red Data list and their importance as trophy animals. Recent research from Hwange National Park, Zimbabwe and Tanzania (A. Loveridge, 2004, pers. comm.) suggests that lions are particularly vulnerable to trophy hunting due to their intricate social organisation. It is well established that when new males enter a pride containing small cubs, they usually kill the youngsters (Packer & Pusey, 1983), and it has been suggested that if pride males are shot regularly the resulting turnover of males will lead to litters being constantly killed. In addition data suggest that a lion population's response to trophy hunting is complex as it can reduce the number of males associated with each pride, and may cause females to produce more male cubs than would normally be expected, with a decrease in the number of young females surviving to adult hood. This may yield numerous "shootable" males in the short term but may cause severe population reduction in the long term (Frank, 1998). Therefore removing even a single pride male from a population can perturb a large proportion of the population (Loveridge, 2004, pers. comm.).

Since male lions have very large home ranges encompassing multiple prides of females, male lions in the reserve are likely to be particularly vulnerable to hunting along the reserve border. Hunting concessions may therefore act as a significant sink for the protected population of lions inside the reserve. In the absence of elephant hunting, the quotas for lion are crucial for maintaining the financial viability of the hunting operations in the concession areas as lions remain the single most important and profitable species available for hunting.

KEY FINDING(S): Leopard are common, however both spotted hyaena and, in particular, lion occur at lower densities in NR than expected.

RECOMMENDATIONS: Continued and regular monitoring of all three of these top predators is essential given that they are:

a) Important ecological indicators of the health of the ecosystem and "umbrella" species i.e. if they are protected a large number of other species are protected under them.
b) Illegally killed, (spotted hyaena for traditional medicine, and lion and leopard for their skins).
c) Important for eco-tourism and legally harvested for trophy hunting, which provides revenues for both the NR and the concessions.

1. Regular call-up surveys using the same techniques would allow for monitoring of the hyaena and lion populations. Another call-up survey should be done in 2004 possibly in June /July rather than October to verify 2003 results. Subsequent to this, surveys could be done at least every 5 years initially to assess if numbers are increasing as prey densities increase.

2. While it is unlikely that the current conservative lion quotas are unsustainable, we advise that the reserve and hunting concessions proceed with caution. We recommend that more information on lion movements and densities be collected before quotas are increased. To this end we suggest that a sample population of lions both in a concession and in the core area of the reserve) be radio collared and monitored. J. Wilson & D. Littleton (LUWIRE) have expressed an interest in assisting with this. A proposal for such work will be submitted by us to SGDRN by the end of February 2004.

3. An effort should be made to collate all lion sightings made by researchers, hunters, and reserve staff to identify resident prides within NR.

4. In addition, as suggested by J. Wilson we recommend that the NR request all hunting operators to take photographs and GPS points of all lions killed to ascertain trophy size, lion age and quality (J. Wilson, pers. comm). Age can be estimated on the basis of body size until two years and then nose colour. The nose of young lions is entirely pink and becomes increasingly black until it

is entirely black at 8-10 years of age and beyond. Age and nose colour can be related as follows: black speckling = 2-4 years; 25 % black (mottled) = 4-5 years, 50 % black (splotched) = 5-8 years; 75 % black (livered) = 8-10 years (Craig Packer, 1991, in Creel & Creel, 2002). Evidence of a population decline will result in the hunting of young, subadult lions.

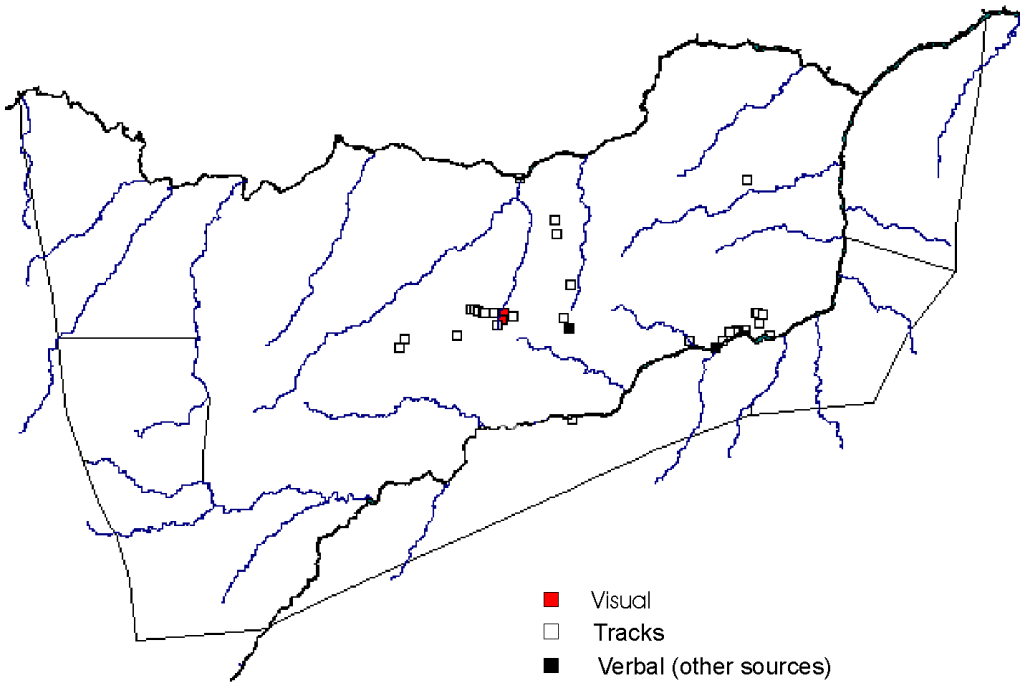

Figure 3: Lion records from Niassa Game Reserve: May-December 2003

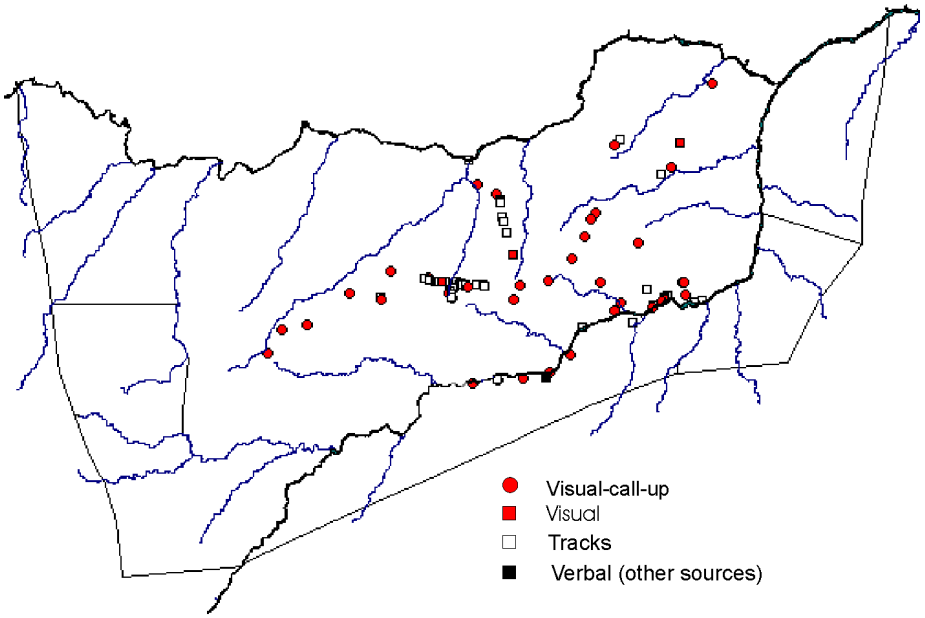

Figure 4: Spotted hyaena records from Niassa Game Reserve: May-December 2003

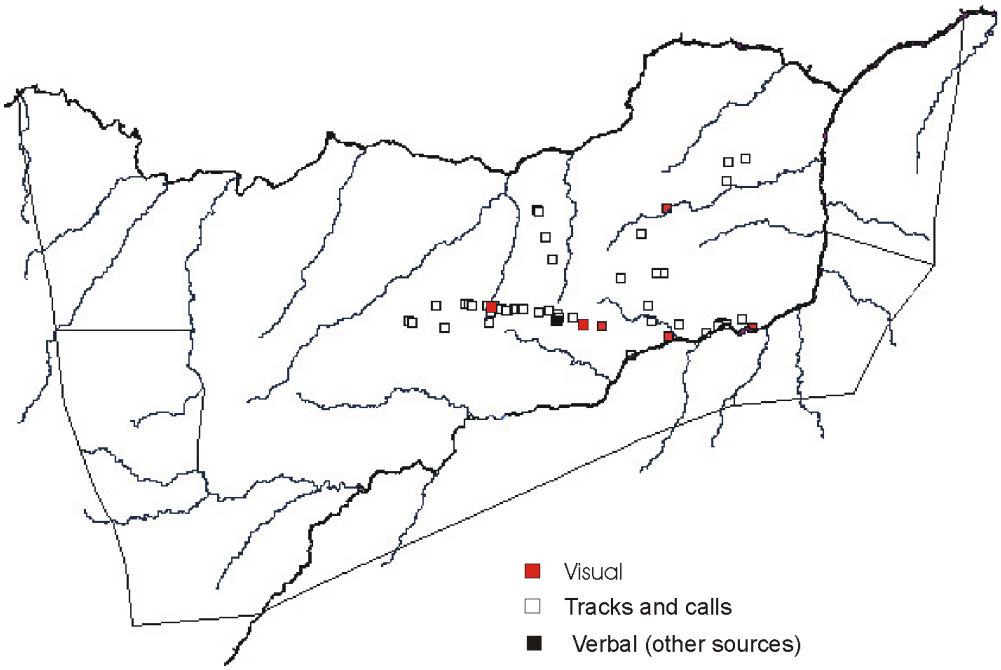

Figure 5: Leopard records from Niassa Game Reserve: May-December 2003

4.5. Canids

4.5.1 Wild dog

To date, 11 wild dog packs have been preliminarily identified (Table 6), Three packs (18 individuals; Table 4) were seen during the survey (Figure 6) and in all cases the wild dogs were hunting at night in the moonlight in Miombo woodland. A further 3-4 distinct packs have been identified on Luwire (Block C; ± 63 individuals) with 1 pack (± 12 individuals) identified on Kambacu (Block A; Table 6). On three occasions wild dogs were seen at Mbatamila, once a group of 5 and on two other occasions, two individuals (A. Macadona; pers. Comm.). Game scouts report to have seen wild dog packs at Nyati, Mbamba, and Catembe Posts however no specific details were taken and the number of individuals in each pack is unknown, although games scouts estimate between 10-20. A pack of wild dogs has also been seen at the Kiboko (Emmanuel, pers. comm.) where they killed an impala on the airstrip. This is likely to be one the Luwire packs. Craig & Gibson (2002) report two packs seen during the aerial census, but the number of individuals is unknown (Figure 6).

There may be some double counting due to the large home ranges of wild

dog packs (156 – 846 km^2 in Selous Game Reserve, Creel & Creel, 2002), however research also suggests that large areas might be used be two or more packs (Creel & Creel, 2002). A minimum of 110-130 dogs are therefore known to be within NR (including concession areas). Further unidentified packs are expected to be present particularly in the western side of the reserve including concession blocks D & E. Given an average pack size of 5-10 individuals (Creel & Creel, 2002) and the distribution of packs seen thus far in NR (i.e. all in the central and eastern sections; Figure 6) we would predict that a further 100-150 wild dogs (10-15 packs) are in the reserve bringing the total up to at least 200 - 250 individuals. This represents an estimated density of 0.5 - 0.6 adults / $100km^2$, which is low compared to the average density for woodland areas of 1.6 - 2.4 adults / 100 km^2 (Fanshawe *et al.,* 1997).

Previous studies of wild dogs have noted that both lion and spotted hyaenas may limit wild dog numbers by competitive exclusion from areas of high prey density and/or by direct predation (Mills & Briggs, 1993; Creel & Creel, 2002). In particular Creel & Creel (2002) have shown a strong negative correlation between wild dog and hyaena densities and wild dog and lion densities using data from eight ecosystems. Thus the relatively low hyaena and particularly low lion densities in NR may be of benefit to the wild dog.

Fanshawe *et al.* (1997) reviewed the status and distribution of remaining wild dog populations and found that the only known substantial wild dog population in East Africa occurred in southern Tanzania. Given that wild dogs are endangered (IUCN Red Data List) with a worldwide population of only 3000-5500 individuals (Fanshawe *et al.,* 1997), this population in Niassa Game Reserve of more than 100 individuals is of great conservation importance. Officially wild dogs receive total legal protection in Mozambique.

KEY FINDING(S): NR contains an important population of the endangered wild dog (a minimum of 100- 150 individuals). The area is particular suited to conservation of wild dogs because of its large size; relatively low lion and hyaena densities and low levels of conflict with humans due to the lack of

domestic livestock (Tsetse fly area).

RECOMMENDATIONS: Continued monitoring is essential. All staff, game scouts, hunters and researchers should be encouraged to keep accurate records and if possible photographs of wild dogs that are seen. Data should include information on pack size, time of sighting, GPS position and habitat. Ultimately this information needs to be forwarded to the IUCN/ SSC Canid Specialist Group so that this important population of wild dogs can be integrated into the worldwide plan for conservation of this endangered carnivore.

Table 6: Preliminary identification of wild dog packs in Niassa Game Reserve, May – December 2003.

Pack Name	Number of individuals	Observer
Chamba Pack	4	K & C Begg
Macalange pack	5	K & C Begg
Nkuti Pack	9	K & C Begg
Litule Pack-Luwire	22	J. Wilson
Ingapata Pack-Luwire	24	J. Wilson
Chitandi pack-Luwire	15	J. Wilson
Kambacu pack	12	Professional Hunter- Block B
Mbatamila pack	5	A. Macadona
Nyati Posto	± 5-10	Nyati Posto game scouts
Gomba Posto	± 5-10	Gomba Posto game scouts
Catembe Posto	± 5-10	Catembe Posto game scouts

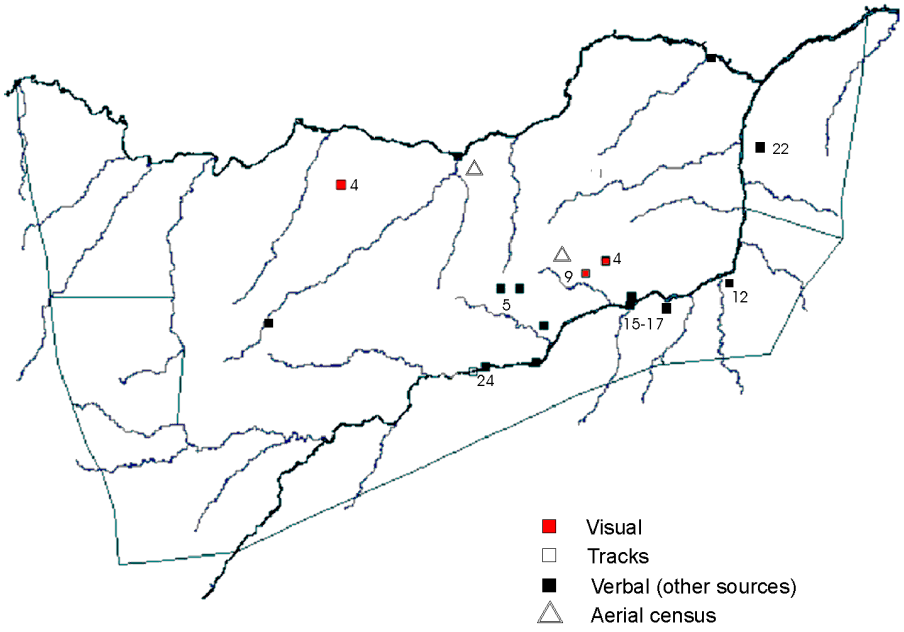

Figure 6: Wild dog records from Niassa Game Reserve: May-December 2003. The positions of wild dogs sighted from the air during the 2002 aerial census are also included (Craig & Gibson, 2002)

2. Side striped jackal

Track transects suggest that side striped jackal are common in NR (Figure 7) but they are seldom seen unless they have become habituated to a camp or village. For instance, 2-4 individuals are regularly seen around the rubbish pit in Maputo Camp at Mbatamila (J. Alves). Side striped jackals were only visually observed on 3 other occasions, once at night in the Matopi river bed (2 individuals) and twice in the day (2 + 1 individuals). No side striped jackals were caught in the traps or left their prints on the trackplates.

4.6. *Mustelids, Viverrids, Herpestids and small felids*

4.6.1. Striped weasel & striped polecat / zorilla

Both striped weasel and striped polecat were identified in NR from a single record, a trackplate record for the striped weasel and a sighting of a dead individual on the border of the reserve, outside Mussoma village for the striped polecat (A. Macadona, pers. comm., 2003; Figure 8).

4.6.2. Honey badger

Honey badgers appear to be widely distributed in NR (Figure 9) but proved difficult to trap and census. They were not detected using spotlight counts as has been found in other areas (Begg 2001) but tracks were identified on track plates on two occasions (Matope River area & Mbamba floodplain; Table 2). One young adult female (Mass= 5.2 kg, total length 845 cm; Figure 8) was captured and radio collared in early November. In December this individual was observed with another honey badger in the Nkuti region digging for rodents on a stream bank. Intensive observations will continue in 2004. A further 4 visual sightings of badgers were made by other observers. As found in other studies honey badgers do not appear to be exclusively nocturnal in NR but are frequently seen during the day. An additional 22 records of fresh spoor were collected with 4 records of honey badgers breaking into wild bee hives and one record of a honey badger digging up reptile eggs.

Five records of honey badgers killed in the reserve have been collected (2 were raiding chickens near Mecula, 1 was caught in a chicken “mzinga

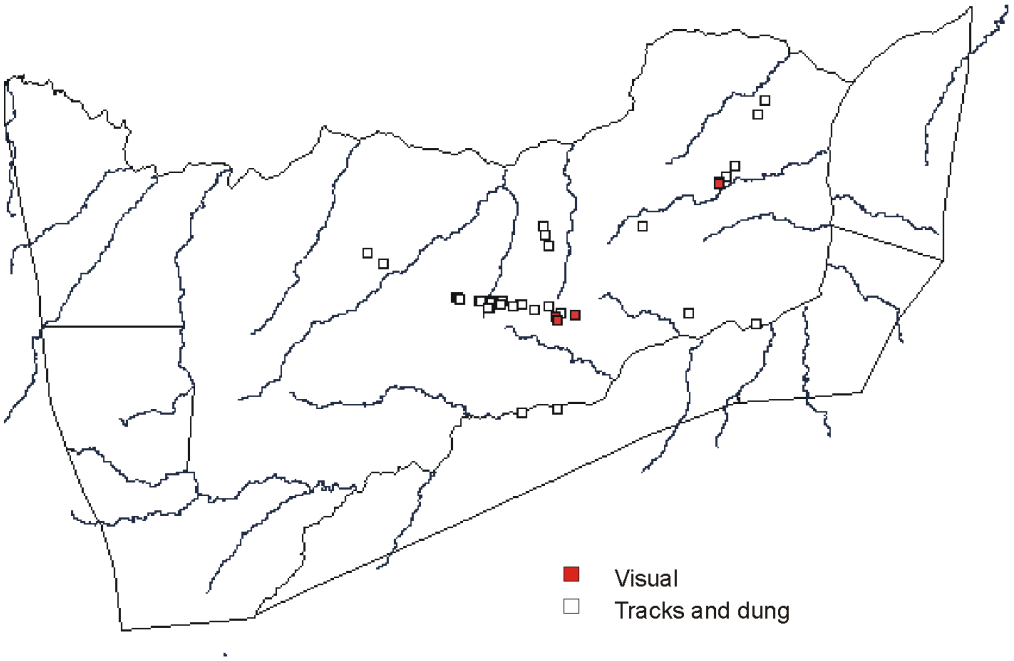

Figure 7: Records of side-striped jackal in Niassa Game Reserve:
May - December 2003

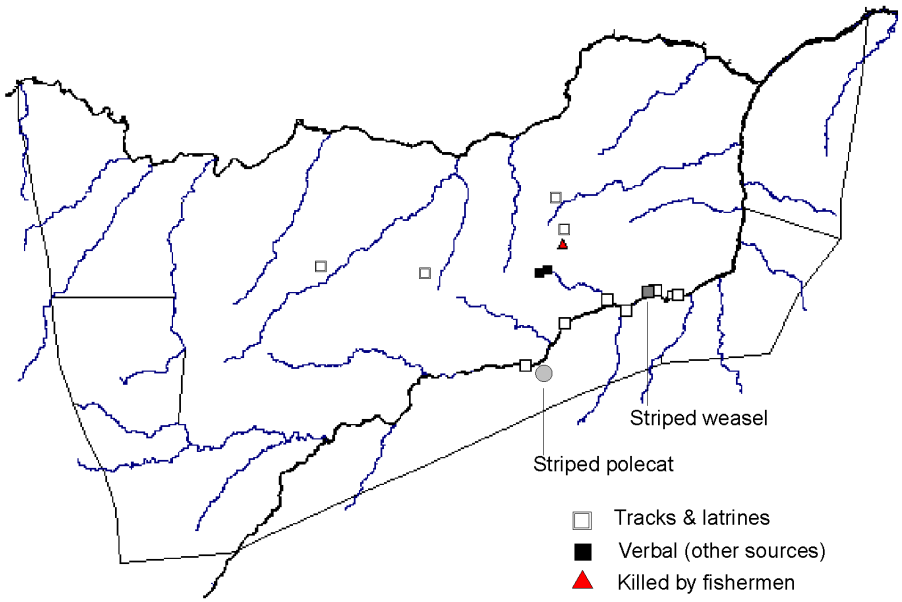

Figure 8: Records of the African clawless otter in Niassa Game Reserve.
The positions of the single records of striped weasel (tracks on track plate)
and striped polecat / zorilla (dead individual, A. Macadona, pers.com.) are also shown.

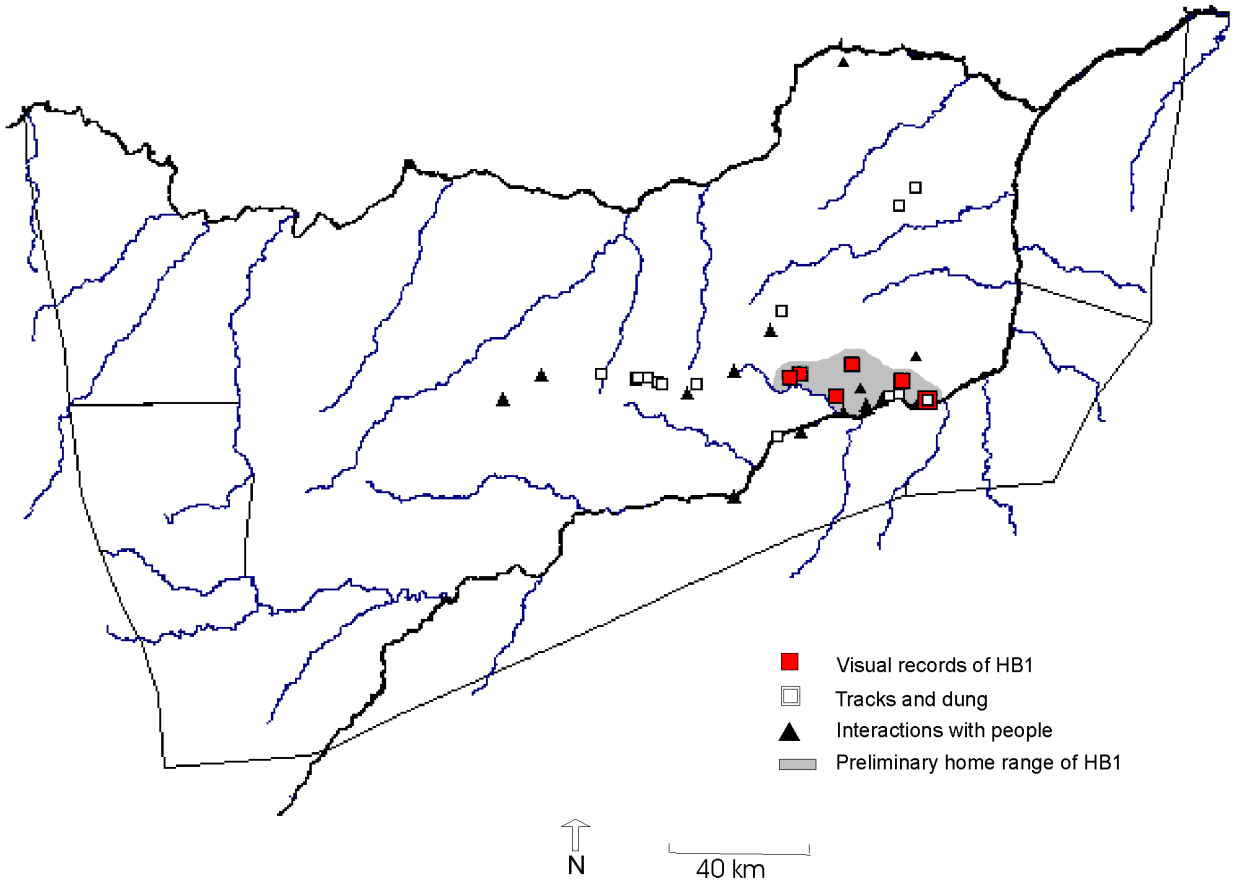

Figure 9: Records of honey badgers in Niassa Game Reserve: May-December 2003.
The positions and preliminary home range of the radiomarked female, Hb1 are also shown.

or chicken house whilst killing chickens and subsequently died (Plate 3) and 2 were killed by honey gatherers whilst raiding wild hives). The dead honey badger retrieved from the village (Plate 3) had a nylon snare embedded in his right paw (an old injury, still suppurating). It is likely that many small carnivores are caught in snares set for gamebirds. Five further reports of honey badgers killing chickens were received during the survey period with an additional 4 reports from beekeepers that honey badgers had raided and damaged their traditional bark hives or "mzingas" (10 hives). In NR traditional bark hives are simply placed in the fork of a tree, unlike many other traditional beekeeping communities (e.g.. Zambia, Tanzania and Kenya) where hives are typically hung from wooden hooks or bark rope to minimize honey badger damage. At this stage, conflict between traditional beekeepers and honey badgers is minimal primarily due to the low number of bark hives in NR. However, if traditional beekeeping is developed further as a sustainable source of income, then care must be taken to minimize the conflict by providing information on effective hive protection. See Report B for further observations on honey gathering and beekeeping in NR.

DNA samples (dried skin/ hair) from 4 honey badgers were collected (3 skin samples, one biopsy and plucked hair sample from the captured honey badger). These samples have been sent to Stellenbosch University for use in an ongoing study supervised by Dr. Conrad Matthee on the subspecies of honey badgers throughout their range.

KEY FINDING(S): Honey badgers are widespread in NR. One honey badger has been radio collared for intensive research in 2004 –2006. Honey badgers are considered problem animals and are opportunistically killed by local villagers, honey gatherers and beekeepers in NR, due to their liking for chickens and honey. They are also highly prized for traditional medicine.

RECOMMENDATIONS: Conflict with traditional beekeepers can be minimized by the hanging of traditional bark hives rather than by simply placing the hive in the fork of a tree. If traditional beekeeping is developed further in NR, a technique to "badger-proof" hives needs to included in training to prevent an escalation in conflict.

4.6.3 African clawless otter

African clawless otters appear to be relatively widespread along suitable rivers (i.e. where there is adequate cover for refuges, pools for fishing) in NR, particularly the braided river channels on the Lugenda River and its tributaries (Figure 8) but are seldom seen and were not visually located during this survey. General survey techniques (spotlight counts, track transects) are unlikely to locate otters due to their aquatic habitats and specific habitat requirements. Rather specific searches done along river courses are more successful as otter latrines (dung deposits) provide a long term, reliable indicator of their presence and otter tracks are easy to identify. Tracks and sign were located in eight areas.

All fishermen regularly suffer damage to their fishing traps from otters, but appear remarkably fatalistic about this and otters do not appear to be regularly killed. Instead, fishermen place a collection of ring segments from millipedes in fishing traps in areas where otters are known to be causing damage as this traditional medicine is thought to dissuade them. One otter killed by a fisherman (snare) was stuffed and displayed in Macalange village (Plate 4) and a DNA sample from this individual was collected and will be sent to P.Gaubert (see section 4.7). While Rowe-Rowe (1990) suggests that otters are killed for meat and skins in Mozambique we found no evidence of this in NR.

KEY FINDING(S): Otters are fairly common in river systems throughout NR. They cause significant damage to fishing traps and are considered a problem by fishermen. Fishermen kill particular problem individuals opportunistically but persecution levels appear low.

4.6.4. Domestic cat and dog

Domestic cats were seen on four occasions hunting at night in transformed habitat i.e. mashambas near villages and five domestic dogs were seen in Mecula (a group of four and one single dog). In conversation, Mecula residents stated that cats were common and were kept to kill rats. The presence of domestic cats is of some concern, although their numbers appear to be fairly low, since they easily become feral and interbreed with African wild cat. The low number of dogs in the reserve is beneficial as dogs frequently harass and kill small carnivores in other areas. Dogs are unlikely to survive for long due to the prevalence of Tsetse fly.

KEY FINDINGS: Domestic cats are fairly common, particularly in Mecula town but domestic dogs are rare.

RECOMMENDATIONS: The keeping of domestic cats should be strongly discouraged.

4.6.5 Mongooses

Eight species of mongooses are present in NR with slender mongoose and marsh mongoose the most common species and Meller's mongoose the most rare (2 observations; Figure 10; Figure 11). Bushy-tailed (Figure 12) and Meller's mongoose were only seen in mature Miombo woodland, with both observations of Meller's in woodland with numerous termitaria. Large grey mongooses were only found on the Lugenda floodplain (Figure 10). Slender, white-tailed, large grey, and bushy tailed mongooses were usually seen alone but on two occasions two bushy tailed mongooses were seen together. Banded mongoose and dwarf mongoose are the only two social mongoose species in NR. The average group size of Banded mongoose was 4.4 (range: 1-10) while the average group size of dwarf mongooses was 2 (1-3). These are small (banded mongoose average group size = 15 - 20; dwarf mongooses = 8; Kingdon 1997) compared to other areas. The reasons for these small group sizes are unclear but are likely to be a reflection of low prey density, and perhaps a low density of suitable refuges since both species rely on termitaries for refuge from predators and as dens. The impact of regular and

extensive fires on these species is unknown but may also have an effect.

Of particular interest in NR is the presence of a “black-tailed’ form of the white tailed mongoose, although the “normal“ white tailed variant is also present. Very dark morphs with black tails are also common in Uganda and West Africa (Kingdon, 1997; M. Hoffmann, 2004, pers. comm).

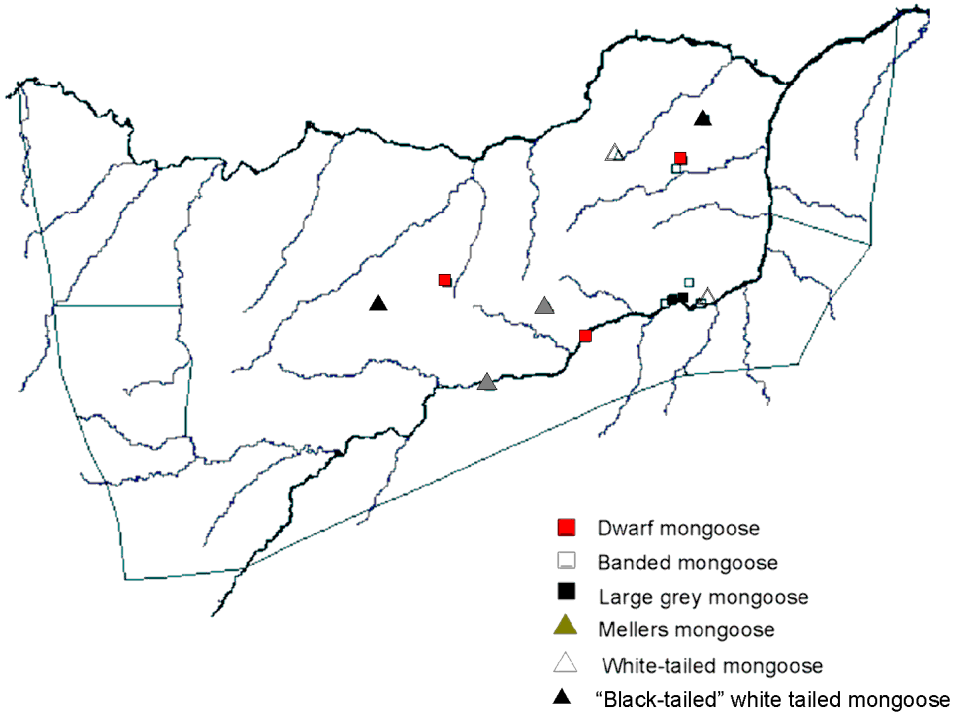

Figure 10: Records of dwarf, banded, large grey, Mellers and white-tailed mongooses in Niassa Game Reserve: May-December 2003.

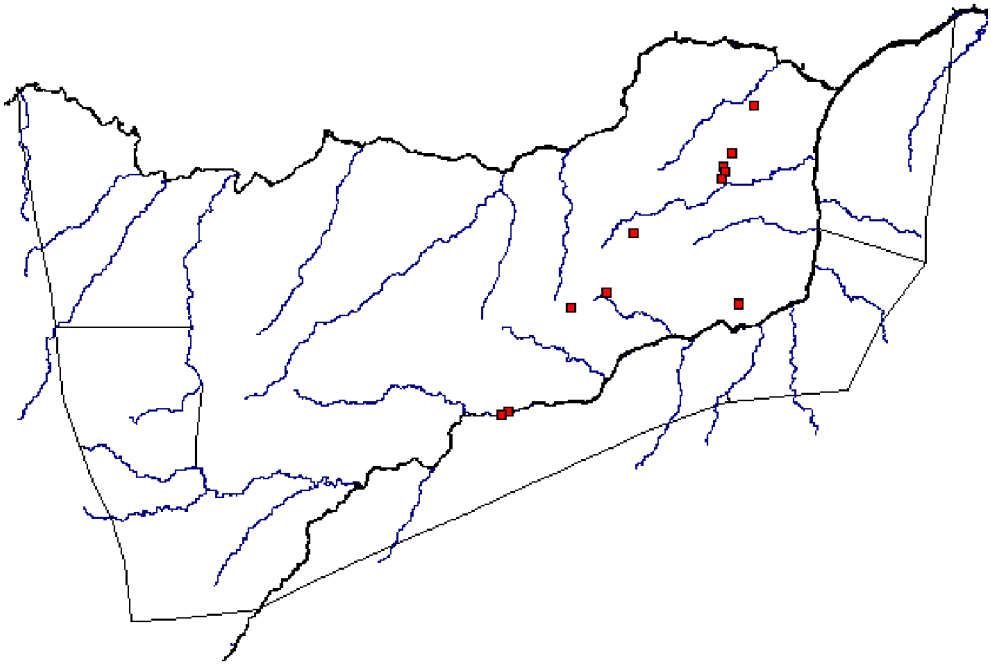

Figure 11: Visual records of bushy tailed mongoose in Niassa Game Reserve: May - December 2003.

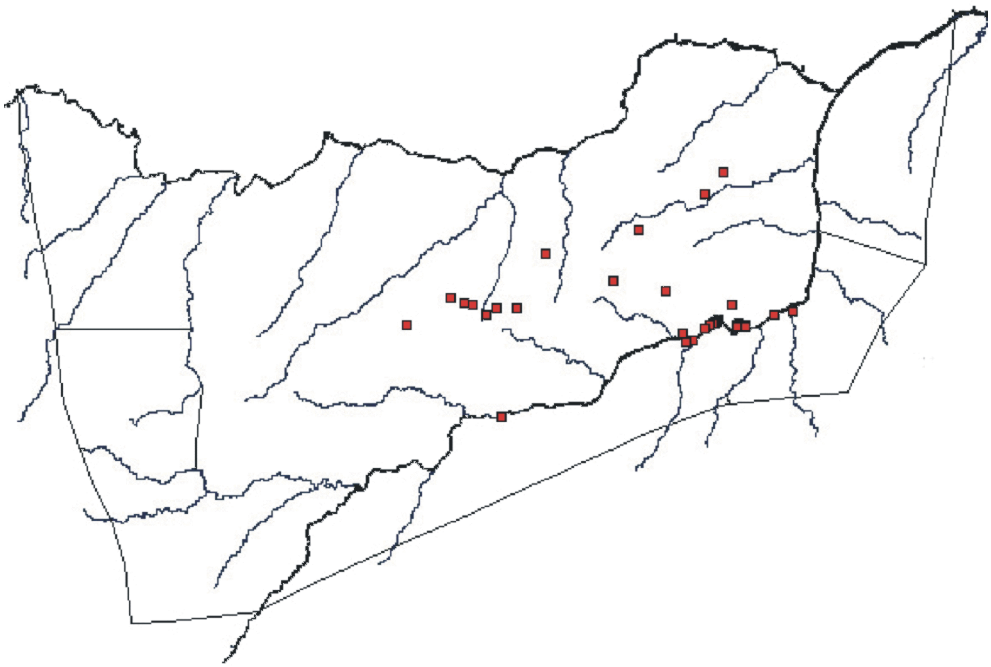

Figure 12: Visual records of slender mongoose in Niassa Game Reserve: May-December 2003.

KEY FINDINGS:

1. 8 species of mongooses are found in NR, including the rare Meller's mongoose.
2. An interesting black-tailed form of the white-tailed mongoose is present along with more common white-tailed form.
3. Banded mongoose and dwarf mongoose group sizes are smaller than average, but the reasons for this are unclear.

4.6.6. Genets and Civets

Genets and the African Civet are the most common nocturnal carnivores in NR and are found throughout the reserve (Table 2, Figure 13 & Figure 14). African Civets in particular are easily caught in cage traps on a wide variety of baits. Palm civets are rare with two visual sightings reported by J. Wilson on Luwire.

The taxonomy of the genet group has recently been reworked (Gaubert *et al.* 2003). Three or four species are likely to occur in NR, namely *Genetta genetta* (small spotted genet), *G. angolensis* (Miombo genet), *G. maculata* (formerly *G. Tigrina*) and *G. letabae* (not distinguishable from *G. maculata* from external characters; P. Gaubert, pers. comm., 2004). Given the difficulties in distinguishing the species from a distance all questionable species have been grouped together in Figure 12. However, the three trapped specimens were positively identified as *G. angolensis* (Miombo genet) which appears to be the most common genet species in NR. Large-spotted genets *(G. maculata* or *G. letabae*) were positively identified on five occasions and *G. genetta* on three occasions.

To help with field identification in the NR, P. Gaubert (pers comm. 2004; Museum of Natural History in Paris) has provided the following field criteria:
G. angolensis: tail with long hair, "bushy aspect" at its beginning, long black tip to tail, tip dark, dark hind legs, very few spots on scapular region, dorsal crest, border of inferior chops very dark.
G. genetta: tail with long hair (no bushy aspect at beginning), white rings to the tip of the tail, tip whitish, dark hind legs, dorsal spots on the rump partly

fused, dorsal crest, border of inferior chops very dark.
G. maculata (and *letabae*): tail without long hair, long black tip to the tail, tip dark, hind legs not very dark, forelegs completely clear, dorsal spots large and unfused, no dorsal crest, border of inferior chops clear.

4.6.7 Small felids: serval and African wild cat

Both serval and African wild cat were rarely seen, although African wild cat were recorded on track plates on nine occasions (Figure 15). While African wild cat were recorded in floodplain, woodland and transformed habitat (mashambas), serval were in open areas, with four of the six records in close proximity to a village. In other areas servals are vulnerable to dogs (Kingdon, 1997), particularly due to their habits of hunting in cultivation fallows, which brings them into close contact with people. The low number of domestic dogs in NR is therefore to their advantage.

4.7 *DNA samples*

DNA samples from 15 animals (excluding honey badgers) were collected: 8 civet, 3 miombo genet, 2 marsh mongoose, 1 large grey mongoose, and 1 African clawless otter (skin sample). All these samples will be sent to The Mammal & Birds Laboratory, Natural History Museum, Paris to contribute to a study on the phylogeny, evolution and conservation of small carnivores (P. Gaubert & G. Veron; gaubert@mnhn.fr). The researchers are particularly interested in samples from civets, palm civets, genets and mongooses and are also collaborating in a project on the phylogeny, phylogeography and conservation of otters with Klaus Koepfli (University of Califonia, La, USA). The samples will all be acknowledged as coming from Niassa Game Reserve.

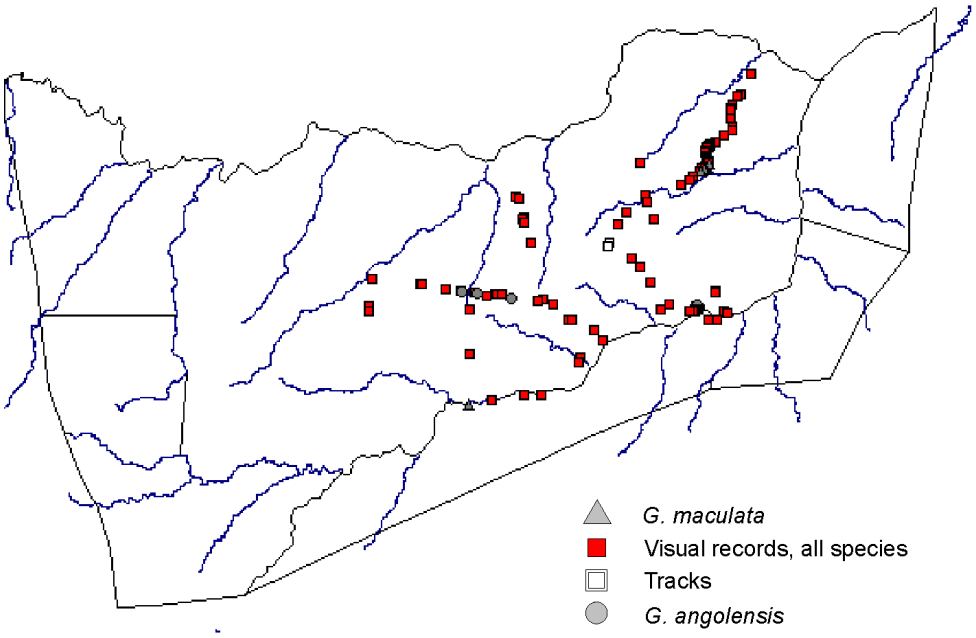

Figure 13: All visual records of Genets (*G.genetta, G. angolensis, G. maculata)* in Niassa Game Reserve showing confirmed records of large spotted genet (G.maculata) and miombo genet (*G. angolensis)*

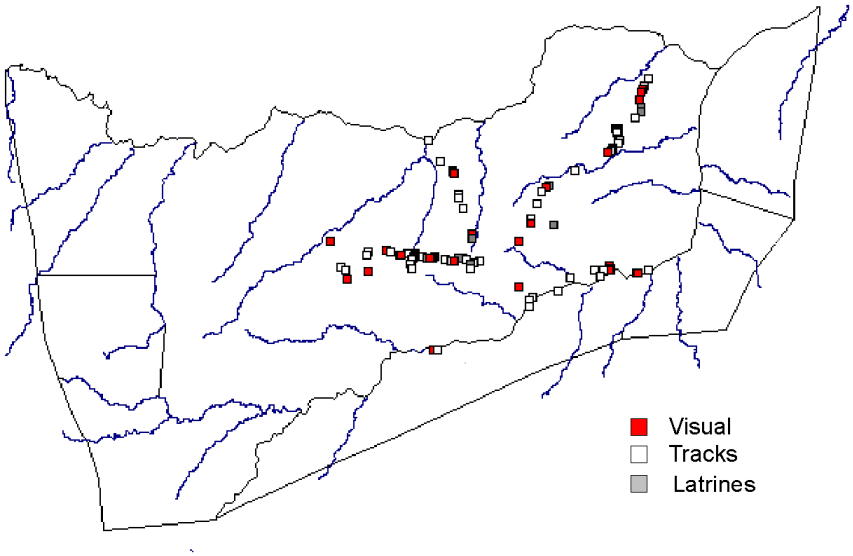

Figure 14: Records of African civet in Niassa Game Reserve: May - December 2003.

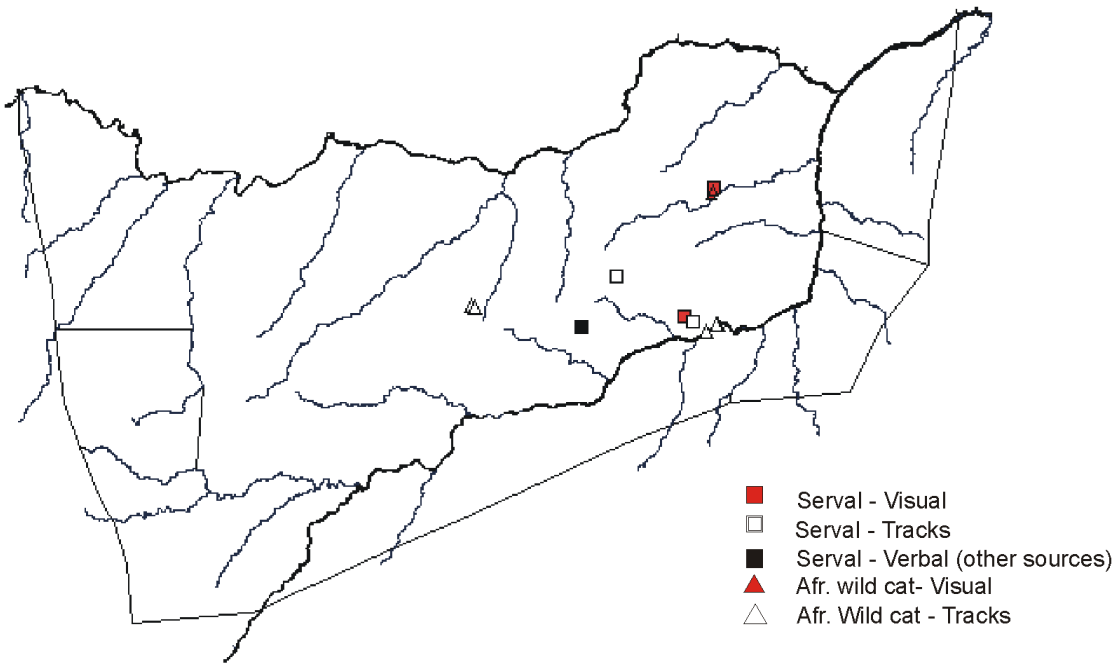

Figure 15: Records of Serval and African wild cat in Niassa Game Reserve: May - December 2003.

5.0. Conclusions and research priorities

Niassa Game Reserve supports a wide variety of carnivores ranging in size from the striped weasel to the lion, covering eight carnivore families and 24 wild species. They form a valuable component of the biodiversity in NR and due to their positions at the top of their respective food chains, they are vitally important for the functioning of the Niassa ecosystem. The larger carnivores, lion, leopard and spotted hyaena are particularly important as they are “umbrella” species i.e. their effective protection will ensure the protection of numerous other smaller species. Sightings of carnivores are important for future ecotourism in NR and lion and leopard provide substantial revenues for the NR through trophy hunting. It is therefore in the interest of NR to ensure that the carnivores are all adequately protected.

Based on the survey results and key findings, we suggest the following as priorities for future research and monitoring.

1. Regular monitoring of lion and spotted hyaena numbers to track future changes.
2. Accurate record keeping by professional hunters in concessions for carnivores killed (ie. GPS positions, trophy size and information on other individuals seen during the hunt.
3. Detailed record keeping of wild dog and lion sightings by game scouts, researchers and hunters to enable individual identification of prides and packs.
4. Further research into lion movements and home range sizes before lion quotas are increased to assess the potential impact of hunting on the boundary of the reserve.
5. Further investigation into the illegal killing of carnivores for the sale of skins (lion, leopard, jackal) and traditional medicine (spotted hyaena and honey badger)
6. If traditional beekeeping is encouraged as a sustainable form of income generation, beekeepers should be advised on how to hang hives to protect them from honey badgers in order to minimize an escalation in conflict.
7. An environmental education program for the villagers living in the reserve, particularly children. Carnivores are negatively perceived and persecuted because they can kill people, they are not sources of food themselves but eat potential food (chickens, fish, honey, goats). The level of illegal killing of carnivores in NR is unknown and difficult to assess, however their perceived threat is greater than their real threat. Education about the value of carnivores, the differences between species (which are dangerous which are not) and practical ways to minimize conflict i.e. hive protection methods would be beneficial. For children we suggest a “travelling” program that visits different schools throughout the reserve on a regular basis.

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Appendix A:

Tracks of 16 carnivores recorded in the Niassa Game Reserve

#	English name	Scientific name	Local name
1	Lion	*Panthera leo*	Lisimba
2	Leopard	*Panthera pardus*	Chizuvi
3	Spotted hyaena	*Crocuta crocuta*	Lituno
4	African wild dog	*Lycaon pictus*	Lisogo
5	African wild cat	*Felis sylvestris*	Chiwuloo
6	Serval	*Leptailurus serval*	Licule
7	Marsh mongoose	*Atilax paludinosus*	Lizulu
8	African civet	*Civettictis civetta*	Jussi
9	Side-striped jackal	*Canis adustus*	Licule
10	African clawless otter	*Aonyx capensis*	Kawusi
11	Genet	*Genetta spp.*	Bendo
12	Striped weasel	*Poecilogale albinucha*	Lipwisa
13	Slender mongoose	*Galerella sanguinea*	Lizulu
14	Banded mongoose	*Mungos mungo*	Lizulu
15	Large grey mongoose	*Herpestes ichneumon*	Lizulu
16	Honey badger	*Mellivora capensis*	Nkuli