

Larger Mammal Diversity And Conservation Potential Of Four Mountains In Northern Cameroon

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Mammal diversity was examined on four previously unsurveyed mountains in northern Cameroon, including Mt. Ngang-Ha, Hoséré Vokré, Tchabal Gandaba, and Tchabal Mbabo. We provide a general description of the forest habitat found on each mountain, and evaluate conservation potential based on forest quality, mammalian species richness and abundance, and human impacts and attitudes toward conservation. The forest on Tchabal Mbabo is extensive and includes montane forest and montane scrub woodland of a rare dry type, while the forest on other mountains is less extensive, consisting primarily of small gallery forests. Among the four mountains, we recorded the greatest number of species on Tchabal Mbabo (18), and the lowest on Hoséré Vokré (9), but differences in species richness among the four mountains were not statistically significant. Tchabal Mbabo and Mt. Ngang-Ha had the highest overall abundance of mammals, due to large numbers of antelope and buffalo on Tchabal Mbabo, and large numbers of Red river hog *Potamochoerus porcus* on Mt. Ngang-Ha. The lowest mammal abundance was recorded on Hoséré Vokré.

Of the mountains surveyed, Tchabal Mbabo exhibits the greatest potential for conservation.

Diversité du Plus grande Mammifère Et Conservation Potentiel De Quatre Montagnes Dans Cameroun du Nord

Diversité du mammifère a été examinée sur quatre montagnes dans Cameroun du nord, y compris Mt. Ngang-Ha, Hoséré Vokré, Tchabal Gandaba, et Tchabal Mbabo. Nous fournissons une description générale de l'habitat de la forêt a trouvé sur chaque montagne, et évalue la conservation potentiel installé à sur qualité de la forêt, richesse de l'espèce mammifère et abondance, et impacts humains et attitudes vers conservation. La forêt sur Tchabal Mbabo est étendue et inclut la forêt du montagne et pays boisé du brossage du montagne d'un type rare sec, temps la forêt sur autre montagnes sont moins étendu, consiste essentiellement de petites forêts de la galerie. Parmi les quatre montagnes nous avons enregistré le plus grand nombre d'espèce sur Tchabal Mbabo (18), et le plus bas sur Hoséré Vokré (9), mais différences dans richesse de l'espèce parmi les quatre montagnes n'étaient pas statistiquement considérables. Tchabal Mbabo et Mt. Ngang-Ha avait la plus haute abondance totale de mammifères, dû à grands nombres d'antilope et buffle sur Tchabal Mbabo, et grands nombres de Potamochère *Potamochoerus porcus* sur Mt. Ngang-Ha. L'abondance du mammifère le plus basse a été enregistrée sur Hoséré Vokré. A inspecté des montagnes, Tchabal Mbabo expose le plus grand potentiel pour conservation.

Key words: mammalia, Cameroon, West Africa, montane forest, biodiversity, conservation

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INTRODUCTION

Montane forests are being degraded and lost at a more rapid rate than lowland rainforest (Doumenge et al. 1995), yet there are comparatively fewer programs designed to understand and conserve their biodiversity. Numerous factors threaten existing montane forest ecosystems in central Africa, including: over-grazing, subsistence agriculture, and hunting (Hamilton et al. 1995, Stuart 1986). In Cameroon, much of the forest of the Bamenda Highlands, including the lower reaches of Kilum has already been lost to cultivation, and many other montane regions are threatened (Stuart 1986). In addition, demand for bushmeat is high in the region (Njiforti 1996, Martin 1983, Asibey 1974) and hunting and poaching have lead to declines and local extinctions of many of the larger mammal species (Brugière 1995). Pastoralism is common in northern Cameroon, and populations of larger mammals may also suffer from related habitat degradation and competition with livestock (Happold 1996, Prins 1992). During the early 1980's and 1990's several of the major mountains in Cameroon were surveyed for vertebrates, but was principally focused on avifauna (Stuart 1986, Smith and McNiven 1991, Larison et al. in press). In contrast, few of the mountains have been systematically surveyed for larger mammals, especially in central and northern Cameroon. In this paper we report on the results of the first surveys of mammalian fauna for four mountains in northern Cameroon: Mt. Ngang-Ha, Hoséré Vokré, Tchabal Gandaba, and Tchabal Mbabo. We assess the conservation potential of each mountain based on species richness and relative abundance of larger mammals, quality and extent of forest, and human impacts and attitudes toward conservation.

SURVEY SITES

Surveys were conducted from 25 May to 20 July 1995. Specific dates and localities surveyed were: Mt. Ngang-Ha, 25 May-3 June 1995, 07°N 14°20'E, elev. 1,923 m; Tchabal Gandaba, 17-26 June 1995 07°30'N 13°20'E, elevation 1,960 m; Tchabal Mbabo, 11-20 July 1995, 07°16'N 12°09'E, elev. 2,456 and Hoséré Vokré, 8-14 June 1995, 08°30'N 13°50'E, elev. 2,049 m (Fig. 1).

Mt. Ngang-Ha

Mt. Ngang-Ha, spans an area of about 100 km² on the Adamawa Plateau, approximately 60 km west of Ngaoundéré. Most of the mountain is characterized by lightly wooded savannah, with forest limited to galleries that extend to a maximum elevation of 1550 m. The forest is not montane in character, although one montane tree species, Maesa lanceolata, is found at higher elevations, and high elevation species common to the Adamawa plateau, such as Dracaena arborea, and the palm Phoenix reclinata, are common. Galleries are characterized by many large tree species (>100 cm DBH) and abundant epiphytic growth. Transects totaling 2.9 km were cut and surveyed on the north slope between 1,230 m and 1,505 m elevation.

Hoséré Vokré

Hoséré Vokré consists of a 36 km "U"-shaped ridge spanning 360 square km, near the town of Poli. Most of this area consists of xeric wooded savanna with small and widely scattered gallery forests with little epiphytic flora. These galleries are not montane in character, their upper canopy of the galleries being dominated by *Syzygium guineensis*. Two montane

species, *Podocarpus milanjanus* and *Hymenodictyon floribundum*, are common in the lower canopy, however.

Transects totaling 1.5 km were surveyed on a south-east slope 5 km west of the small village of Ninga, between the elevations of 1,370 m and 1,595 m. Large boulders, made the gallery interiors impassable, so transects were conducted along the edge of the galleries.

Tchabal Gandaba

Tchabal Gandaba consists of a 66 km long ridge running in a northeast arc between the towns of Tignère and Mana. The habitat immediately to the west of Tchabal Gandaba is characterized by heavily wooded savanna and is largely uninhabited. We visited the central portion of the plateau, east of Gadjiwan, surveying forests on the west escarpment and top of the plateau. The heavily grazed savanna on the plateau is intersected by numerous small streams bordered by large gallery forests with a maximum elevation of 1,550 m. Forest patches are also found in the steep canyons on the western escarpment. Galleries are dominated by *Syzygium guineensis*, a large upper canopy tree. A number of are elevation species common to the Adamawa Plateau and common, including *Phoenix reclinata*, *Dracaena arborea*, and *Polyscias fulva*. *Raphia farinifera* is also common and there is abundant epiphytic growth. The two forests surveyed on the western escarpment differed from each other in species composition and general structure. The largest tract of forest surveyed was an open canopy forest with many large trees exceeding 100 cm DBH. This forest seems drier than the plateau galleries, as epiphytes are quite sparse, and *Raphia* is absent. At higher elevations the understory includes broad leafed ferns, and the montane shrub, *Brillantaisia nitens*. The second forest surveyed on

the west slope was less extensive than the first, more open, and the undergrowth comprised mainly of grasses.

Surveys were conducted between 1,550 and 1,250 m elevation. Transects totaling 2.7 km were surveyed; 1.2 km on the plateau and 1.5 km on the forested escarpment.

Tchabal Mbabo

Tchabal Mbabo is a 25-30 km bowl shaped east-west ridge. The thinly populated region to the north is characterized by thickly wooded savanna, which eventually joins the Faro Reserve. The north and west facing escarpments are extensively covered with montane forest and montane scrub woodland of a rare dry type (Thomas and Thomas 1996). Surveys were conducted on the plateau and north slope about 10 km northeast of Mayo Kélélé. Montane forest includes large gallery forests (50 x 1500 m) on the plateau at 2,010 m, while on the north slope, large patches of montane forests narrow into montane gallery forest, extending down slope to approximately 1,600 m grading into non-montane gallery forest, and thickly wooded savanna. The extent of montane and sub-montane forest has been estimated at 5000 Ha (Thomas and Thomas 1996), though we believe this estimate may be low. The upper canopy of the montane forest is dominated *Syzygium staudtii*, *Schefflera abyssinica* and *Carapa grandiflora*. The rich epiphyte flora includes numerous ferns, orchids and hanging lichens.

Transects totaling 4.3 km were completed, 2.1 km on the plateau and 2.2 km on the north escarpment between elevations of 1,750 and 2,010 m.

METHODS

Species Richness and Abundance

Mammals were surveyed by cutting transects while recording sign for non-primate species (Barnes and Jensen 1987; Nichols 1996; Koster and Hart 1988) and walking transects again 2-3 days later to record primates detected visually and aurally (NRC 1981; Fay 1988; White 1994). Local guides and hunters were hired to assist in cutting transects and the identification of animal sign. Total transect length varied for each site, depending on forest area and terrain. Due to steep, often impassable terrain and the relatively short transect distance (< 5 km) for each site, the number of sightings and sign observations for each species was insufficient for reliable density estimations (Fay 1988, Barnes and Jensen 1987, NRC 1981). We therefore report only relative abundance for each species. We do not include scat in our calculations because of the high rainfall encountered on Tchabal Mbabo, which caused scat to disappear within a day or two. Because the methods of data collection were different, primate abundances are analyzed separately from those of other mammals.

To obtain additional information on mammal species richness, we queried experienced hunters and other local inhabitants using a mammal guide (Dorst and Dandelot 1993). They were asked to identify from color plates those mammals which occurred and whether they were abundant or rare. Species that were identified consistently and were consistent with known habitat requirements and geographic range for each species, or could be corroborated by our own observations, were included in species lists. In an attempt to control for spurious claims and assertions we would also ask if species we knew could not occur in the region did occur. If individuals claimed such species also occurred their interviews were

discounted. Nomenclature of primates follows Napier and Napier (1994), and that of other mammals follows Kingdon (1997) .

Human Impacts and Attitudes

To assess human impacts and attitudes toward wildlife, interviews were conducted with local people. An attempt was made to interview a cross section of the society, by local tribe, sex, age group and vocation (typically herders, hunters and farmers). Interviews were structured so as to: 1) determine the extent of utilization of the forest by humans, including both the impacts on the forest and the degree of reliance by locals on forest products; 2) understand local attitudes about conservation; and 3) understand what local needs must be met for effective conservation to take place.

RESULTS

Mammals

We recorded eighteen species of mammals (direct or indirect observations made on transects or incidentally) on Tchabal Mbabo, as compared to 12, 11, and 9 species on Tchabal Gandaba, Mt. Ngang-Ha, and Hoséré Vokré, respectively (Table 1). These differences in species numbers were not statistically significant, however.

Three species of primates, including Olive baboon *Papio anubis* Guereza colobus *Colobus guereza* and Tantalus monkey *Cercopithecus aethiops tantalus* were recorded on all three mountains (Table 1). None were recorded on transects on Tchabal Mbabo, although all three species were recorded incidentally. Colobus groups of up to 14 individuals were observed on both Mt. Ngang-Ha and Tchabal Gandaba, but were only

observed in groups of 2-3 on Hoséré Vokré and groups of up to 4 on Tchabal Mbabo. Colobus are often found in riparian habitat or isolated forest patches (Oates 1977; Estes 1992) and on Ngang-Ha, they were observed on rocky outcrops above the forest, suggesting they easily move between forest patches separated by rocky ridges. Numbers of primate groups encountered were small and not statistically different among mountains ($X^2 = 2.8$, $df = 3$, $P < 0.75$)

A comparison of transects conducted in inhabited and heavily utilized areas (Hoséré Vokré and the plateaus of Tchabal Gandaba and Tchabal Mbabo), and uninhabited, little utilized areas (Mt. Ngang-Ha and the escarpments of Tchabal Gandaba and Tchabal Mbabo) indicate that fewer species are present in areas inhabited by humans, with a significant reduction in the number of ruminant species, and similar trends in carnivores and non-ruminants (Fig. 2). No Forest Buffalo *Syncerus caffer nanus* or Cape Buffalo *S. c. caffer* were recorded in inhabited areas, possibly due to competition from livestock.

The highest overall abundance of larger non-primate mammals was recorded on Tchabal Mbabo and Mt. Ngang-Ha ($X^2 = 8.8$, $df = 1$, $P < 0.03$). On Tchabal Mbabo, high mammal abundance was primarily due to large numbers of ruminants, while on Mt. Ngang-Ha it was due to primarily to large numbers of Red river hog *Potamochoerus porcus* (Fig. 3). The lowest overall large mammal abundance was recorded on Hoséré Vokré ($X^2 = 18.2$, $df = 1$, $P < 0.001$). No difference in the abundance of carnivores could be distinguished due to low numbers of encounters for these groups ($X^2 = 5.6$, $df = 3$, $P < 0.50$).

Several salient findings were made regarding mammal distributions on this survey. Bay duiker *Cephalophus dorsalis*, a species associated with

high forest, and occasionally, undisturbed galleries (Kingdon 1997), was recorded on Mt. Ngang-Ha and Tchabal Mbabo (Table 1, Fig. 3), attesting to the quality of forest on these mountains. The known distribution of Bay duiker does not extend north of the forest/savannah mosaic (Lamarque et al. 1990, Kingdon 1997). On Tchabal Mbabo, two threatened species, the endangered African wild dog *Lycaon pictus* (Vulnerable, Groombridge 1994) and Golden cat *Felis aurata* (listed as K, "likely threatened but data is insufficient to determine its status", Groombridge 1994) may occur on the mountain (Table 1, Fig. 3). Although wild dog was not recorded by us, consistent identification of wild dog from plates by local herders, along with their description of its characteristic diurnal behavior of hunting in packs strongly suggests it occurs. It is known to occur farther north in Cameroon but is extremely rare (Kingdon 1997, Brugière 1996). Most wild dog populations are in unprotected areas, and the species as a whole is in serious decline, particularly in west and central Africa (Fanshawe 1991). Other carnivores which appeared to be common on Tchabal Mbabo were Leopard *Panthera pardus*, which was heard emitting a territorial call on one transect, and Spotted hyena *Crocuta crocuta* which left tracks near our camp most nights.

Human Impacts

Although hunting was reported to occur on all mountains we surveyed, the greatest apparent impact we observed was alteration of habitat for agricultural purposes, including both grazing and farming.

The forests on these mountains have been heavily impacted by cattle grazing and seasonal burning by Fulani tribes people who are year round residents on all mountains but Ngang-Ha, where they are nomadic and use

the mountain seasonally. Burning for grazing appears to have resulted in substantial forest degradation and loss on these mountains. A sharp delineation between forest and savanna suggests that little seedling recruitment occurs outside of the main forests. In contrast, on the steep escarpments of Tchabal Gandaba and Tchabal Mbabo, which are not easily accessible, the effects of grazing and fire do not appear to extend far down slope, and here the montane forest grades into wooded savanna without sharp demarcation.

In addition to burning, other impacts of grazing are readily seen. With the exception of Ngang-Ha, grazing occurs year round on the mountains. We observed considerable erosion of grassland on the plateaus from overgrazing, particularly on Tchabal Gandaba. In the plateau forests on Tchabal Gandaba, the undergrowth was sparse, and large eroded areas were present where cattle access streams.

Subsistence agriculture is conducted around villages on the plateaus of Tchabal Gandaba and Tchabal Mbabo, as well as on Hoséré Vokré.

On Tchabal Mbabo, the practice of burning galleries on the plateaus to plant corn has become widespread in the last few years (personal observations, Smith and McNiven 1990). If continued, this practice is likely to severely impact existing galleries on the plateau over the next decade.

Attitudes Toward Conservation

With the exception of Hoséré Vokré, the populations on and around the mountains we surveyed appeared to have a positive attitude toward conservation, though some reservations were expressed by those whose livelihoods are most dependent on the areas we surveyed. Ngang-Ha, the

only uninhabited mountain, is considered sacred by the local Mboum tribe (Kini pers. comm.), and they do not depend on it for their livelihood. Thus, the likelihood of promoting conservation activities is high, especially if burning by nomadic Fulani can be halted. Based on interviews there is considerable disdain of the Fulani burning practices by the local Mboum people. Access to the mountain is controlled by the chief in the village of Ngang-Ha, who has wide jurisdiction in the area. However, the chief does not appear to exert control over use of the mountain by the Fulani.

Surrounding tribes make little use of the plateau on Tchabal Gandaba and Tchabal Mbabo, conducting their agricultural and hunting activities primarily in the lowlands near their villages, and therefore do not see conservation of the plateau as a threat to their livelihood. However, certain resident Fulani herdsman we interviewed on the plateaus, while not opposed to conservation, foresaw potential conflicts over grazing areas and increased loss of livestock to predators. Those on Tchabal Mbabo did express an interest in halting the practice of hunting by non-locals, which include hunters from nearby Nigeria, where, unlike Cameroon, many antelopes are now locally rare and endangered (Anadu and Green 1990). Working closely with the Fulani populations on Tchabal Gandaba and Tchabal Mbabo and assisting them with basic health care and education, could provide incentives to improve grazing practices and place a moratorium on hunting. Protestant missions based in Gadjiwan and Galim presently maintain dispensaries and subsidize schools in the region. Thus there is potential for collaborative efforts which could enhance existing programs and simultaneously win support for sustainable conservation efforts. An important factor favoring conservation on Tchabal Mbabo is the powerful regional control by local Yem-Yem chiefs in Sambolabo and

Galim, both of whom have expressed interest in conserving the mountain ecosystem.

In contrast, there appears to be little interest in conservation among indigenous people on Hoséré Vokré, as they consider all wildlife a threat to their crops. Indeed, we found little wildlife left on the mountain to conserve. Additionally, we noted profound cultural differences among the tribes occupying the mountain, including the Dupa, Doayo and Fulani. This, combined with the extreme suspicion of outsiders exhibited by the Doayo, the main tribe inhabiting the mountain, would make implementing conservation activities here a formidable task.

DISCUSSION

We believe that Tchabal Mbabo, Tchabal Gandaba, and Mt. Ngang-Ha all have high conservation potential. Conservation efforts on Hoséré Vokré should be a low priority at this time, as few large mammals are left where we surveyed, and current attitudes toward wildlife and conservation are inconsistent with the successful implementation of substantive conservation practices. However, additional survey efforts should be directed toward the southern portion of the mountain, as these areas are allegedly (based on interviews) richer in biodiversity. Additionally, efforts should be directed toward determining the population size and extent of the range of *Podocarpus*, the nearest known population of which is found on Mt. Kilum, approximately 300 km to the south.

Numerous large mammal species are found on Tchabal Mbabo, Tchabal Gandaba and Mt. Ngang-Ha, including both savanna species and species typically associated with forest. All three mountains have significant areas of forest which are uninhabited and little utilized by

humans, and the local inhabitants appear to have positive attitudes toward conservation. The trend toward fewer mammal species in areas inhabited by humans emphasizes the need for establishing protected areas which are not inhabited by humans, and for working with adjacent populations to reduce impacts on mammal populations. While care must be taken to involve local communities in conservation planning, ensure that their needs are taken into consideration and educate them regarding the value of conservation actions (Happold 1995; Alpert 1993, 1996), allowing continued local use within reserves can seriously conflict with the goal of conserving wildlife (Osemeobo 1988; Prins 1992; Alpert 1996). Issues surrounding grazing and agriculture, the main livelihoods in these areas, will need to be dealt with thoughtfully so as to achieve conservation goals without alienating local inhabitants.

Our results suggest that Tchabal Mbabo offers the greatest potential for conservation of any montane ecosystem we surveyed. Tchabal Mbabo offers the opportunity not only to protect habitat for a diverse array of mammals, but also to preserve a rare montane forest type (Thomas and Thomas 1996), and to protect habitat for a number of endemic bird species (Smith and McNiven 1993, Larison et al. in press). The Cameroon mountain system is known to have a large proportion of endemic plants and animals (Moreau 1966; Morton 1972; Stuart 1986). Additionally, the montane forest of Tchabal Mbabo has many characteristics of cloud forest (Hamilton et al. 1995), including persistent cloud cover at the vegetation level, gnarled trees of reduced stature, high diversity of non-woody epiphytes, and peaty soils (Thomas and Thomas 1996). Cloud forests typically serve important hydrological and watershed functions in the regions where they are found (Doumenge et al. 1995). Conservation

appears feasible here, as Tchabal Mbabo is sparsely populated, with human activities limited to cultivation and cattle grazing. Furthermore, the precipitous nature of the escarpment makes human intrusions into the forest there difficult and dangerous. This is in contrast with other montane areas to the south, including Mt. Cameroon, Mt. Kupe, and Kilum which are species rich and high in endemism, but where agricultural activity, overgrazing and hunting pressures are more intense (Collar and Stuart 1988). Considerable pristine habitat could be conserved if a portion of the gallery forests on the plateau, the north facing forest slope and the savanna woodlands below could be preserved. This would also protect a potentially critical altitudinal migration corridor for many species and maximize the chance of preserving an intact ecological community.

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Table 1. Mammals occurring or reported to occur on four mountains in northern Cameroon. A) species which were seen by authors, B) species detected by other means: aurally or by sign, C) species deemed likely to occur based on interviews with locals and known distribution.

Species Vernacular Name	Mt.	Hoséré	Tchabal	Tchabal
	Ngang-Ha	Vokré	Gandaba	Mbabo
<i>Papio anubis</i> Olive baboon	A	A	A	A
<i>Cercopithecus aethiops tantalus</i> Tantalus monkey	A	A	A	A
<i>Colobus guereza</i> Guereza colobus	A	A	A	A
<i>Lepus saxatilis</i> Scrub hare	—	C	C	C
<i>Heliosciurus rufobrachium</i> Red-legged sun squirrel	A	—	—	—
<i>Histrix cristata</i> Crested porcupine	B	C	B	B
<i>Atherurus africanus</i> Brush-tailed porcupine	—	—	—	B
<i>Thryonomys</i> sp. Cane rat	C	B	C	—
<i>Cricetomys</i> sp. Giant pouched rat	C	C	C	—
<i>Canis</i> sp. Common or Side-striped jackal	—	—	C	B
<i>Lycaon pictus</i> African wild dog	—	—	—	C
<i>Crocuta crocuta</i> Spotted hyena	—	—	B	B
<i>Genetta</i> sp. genet	—	—	C	—
<i>Civettictis civetta</i> civet	C	—	B	C
<i>Felis sylvestris</i> Wild cat	—	B	—	C
<i>Felis serval</i> Serval	—	—	—	C
<i>Felis caracal</i> Caracal	—	—	A	C
<i>Felis aurata</i> Golden cat	—	—	—	B
<i>Panthera pardus</i> Leopard	—	—	C	B
<i>Panthera leo</i> Lion	—	—	C	C
<i>Orycteropus afer</i> Aardvark	—	—	—	B
<i>Procavia</i> sp. Rock hyrax	A	B	C	C
<i>Potamochoerus porcus</i> Red river hog	A	C	B	B
<i>Hylochoerus meinertzhageni</i> Giant hog	—	—	B	B
<i>Phacochoerus africanus</i> Common warthog	C	B	B	—
<i>Syncerus c. caffer</i> Cape buffalo	C	—	C	B
<i>Syncerus caffer nanus</i> Dwarf forest buffalo	B	—	C	B
<i>Tragelaphus scriptus scriptus</i> Bushbuck	A	C	A	A
<i>Sylvicapra grimmia</i> Bush duiker	—	A	—	—
<i>Cephalophus rufilatus</i> Red-flanked duiker	A	C	A	C

<i>Cephalophus sylvicultor</i> Yellow-backed duiker	—	—	B	A
<i>Cephalophus dorsalis</i> Bay duiker	A	—	—	A
<i>Redunca sp.</i> reedbuck	C	A	C	C

FIGURE LEGENDS

Figure 1. Locations of four montane study sites in northern Cameroon.

Figure 2. Number of species detected on transects in inhabited and uninhabited areas on mountains in northern Cameroon. Total number of species was significantly lower for inhabited areas (Mann-Whitney $U = 1.96$, $df = 2$, $P < 0.05$), as was the number of species of ruminants (Mann-Whitney $U = 1.96$, $df = 2$, $P < 0.05$).

Figure 3. Relative abundance of mammal species on four montane sites in northern Cameroon; a) ruminants b) non-ruminants c) carnivores.

Asterisks denote mountains for which abundance is significantly different than all other mountains: * $P < 0.05$, ** $P < 0.001$. Scales differ for each graph.





