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Abstract: In this article about mammals in Nigeria, the cheetah is classified among the vulnerable species and of which the populations decline.

Dans cette article sur les mammifères du Nigeria, le guépard est classé parmi les espèces vulnérables et dont les populations sont en déclin.

NIGERIAN MAMMALS

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Nigeria has a rich and diverse mammalian fauna of about 250 species belonging to 13 orders, 42 families and 133 genera (Happold 1987). There are several reasons why there are so many species. First, the large size of the country. Nigeria is one of the largest countries in Africa—923,768 km^2—and because there is a close relationship between area and number of species of mammals, a large number of species is expected. Secondly, Nigeria has many different sorts of vegetation which form bands or zones from east to west across the country. Each zone—rainforest, Guinea savanna, Sudan savanna and Sahel savanna—is characterised by its own special environment, and its own special fauna. Thirdly, the fauna of Nigeria has been influenced by past climates. During successive Ice Ages, the zones of vegetation retreated towards the Equator and much of the rainforest disappeared except for small patches in the Niger delta. Rainforest mammals survived only in this "refugium", and there was no longer any continuity of the rainforest along the coast of West Africa. Likewise, refugia were formed at other coastal locations in West Africa. During each Ice Age, the mammals in the Niger delta refugium were isolated from rainforest mammals in other parts of West Africa. During isolation, some species differentiated into new species and subspecies which, even now, are found only in Nigeria. When each Ice Age ended, the savanna zones moved northwards again, and the rainforests expanded so that in most places they became contiguous again. This process of contraction and expansion of the rainforests occurred several times, and has been responsible for the complex and varied patterns of distribution of West African mammals. The situation in Nigeria has been made more complex by the Niger River which has acted as a barrier to dispersal of some species, but not for others. The vegetation zones of Nigeria extend eastwards and westwards throughout West Africa, and hence the mammals of Nigeria, especially within the savanna zones, are similar to those of other West African countries from Senegal to Cameroun. Thus the present mammalian fauna of Nigeria is representative of the "West African" fauna, but it also contains species which are endemic to Nigeria. Because of the processes mentioned above, other West African countries have species which do not occur in Nigeria.

The mammalian fauna

The number of families, genera and species within each order of mammals is very varied (Table 1). The Chiroptera (bats) and Rodentia (rats and mice) are especially numerous (forming about 50% of the total). The Insectivora (shrews and hedgehogs), Carnivora (cats and dogs, civets and genets), Primates (apes, monkeys and galagos) and Artiodactyla (pigs, hippopotamus, buffalo, antelopes and gazelles) each comprise 8-13%.

Table 1. The numbers of families, genera and species of Nigerian mammals (modified from Happold 1987). Since this Table was prepared, a few additional species have been recorded for Nigeria.

Order	Common names	Families	Species	% of total fauna
Insectivora	Shrews, hedgehogs	3	26	10.5
Chiroptera	Fuit-bats, Insect-bats	8	71	28.7
Primates	Apes, monkeys, galagos	5	21	8.5
Pholidota	Pangolins	1	2	0.8
Lagomorpha	Hares	1	2	0.8
Rodentia	Squirrels, rats, mice, grasscutter, porcupines, etc	9	54	21.9
Carnivora	Cats, dogs, genets, civet, mongooses, otters	5	33	13.4
Sirenia	Manatee	1	1	0.4
Proboscidea	African Elephant	1	1	0.4
Hyracoidea	Hyraxes	1	2	0.8
Perissodactyla	Rhinoceros	1	1	0.4
Artiodactyla	Pigs, Hippopotamus, Giraffe, Buffalo, bushbuck, duikers, gazelles, etc.	5	32	13.0
Totals		42	247	100

These percentages are similar to those in other African countries, regardless of the actual number of species and the species involved. It always come as a surprise to most people to learn that the small mammals (bats, rats and shrews) form about 75% of mammalian species.

The number of species in each of the vegetation zones of Nigeria varies greatly (Table 2). The rainforest zone is the richest zone, primarily because of the large number of bats and rodents. Although there are 129 species recorded from the rainforest zone, only 96 of these occur in the rainforests on both sides of the Niger River (Happold 1987). The savanna zones are less rich, and the number of species declines gradually from south to north, so that the Sahel savanna has only about 40% of the number of species found in the rainforest.

Table 2. The numbers of species in each vegetation zone of Nigeria (after Happold 1987).

Order *	Vegetation zones			
	Rain forest	Guinea savanna	Sudan savanna	Sahel savanna
Insectivora	11	11	8	4
Chiroptera	41	35	25	10
Primates	14	9	4	2
Pholidota	2	1	0	0
Lagomorpha	1	1	2	1
Rodentia	32	23	17	8
Carnivora	11	20	22	16
Tubulidentata	1	1	1	1
Proboscidea	1	1	1	1
Hyracoidea	1	1	1	0
Perissodactyla	0	1	1	0
Artiodactyla	14	19	15	8
Totals	129	123	97	51
Number of species found only in this zone (percent)	97 (75%)	34 (28%)	8 (8%)	6 (12%)

* For common names for orders - see Table 1.

The number of species, and the species composition, may be analysed in detail by looking at trends within those orders that contain many species. Fig. 1 shows the number of species in selected orders and families in each vegetation zone, and the changes in composition between adjacent zones. Two general patterns are evident. The first, illustrated by the Chiroptera (bats) shows a declining number of species from the rainforest zone towards the Sahel savanna. A similar pattern is shown also by the Primates and Rodentia. The second, illustrated by the Carnivora, shows that for the order as a whole, and for some families, the number of species is highest in the Guinea and/or Sudan savannas, and is lower in the rainforest and Sahel savanna. A similar pattern is shown by the Artiodactyla. The analysis also shows that, for both Chiroptera

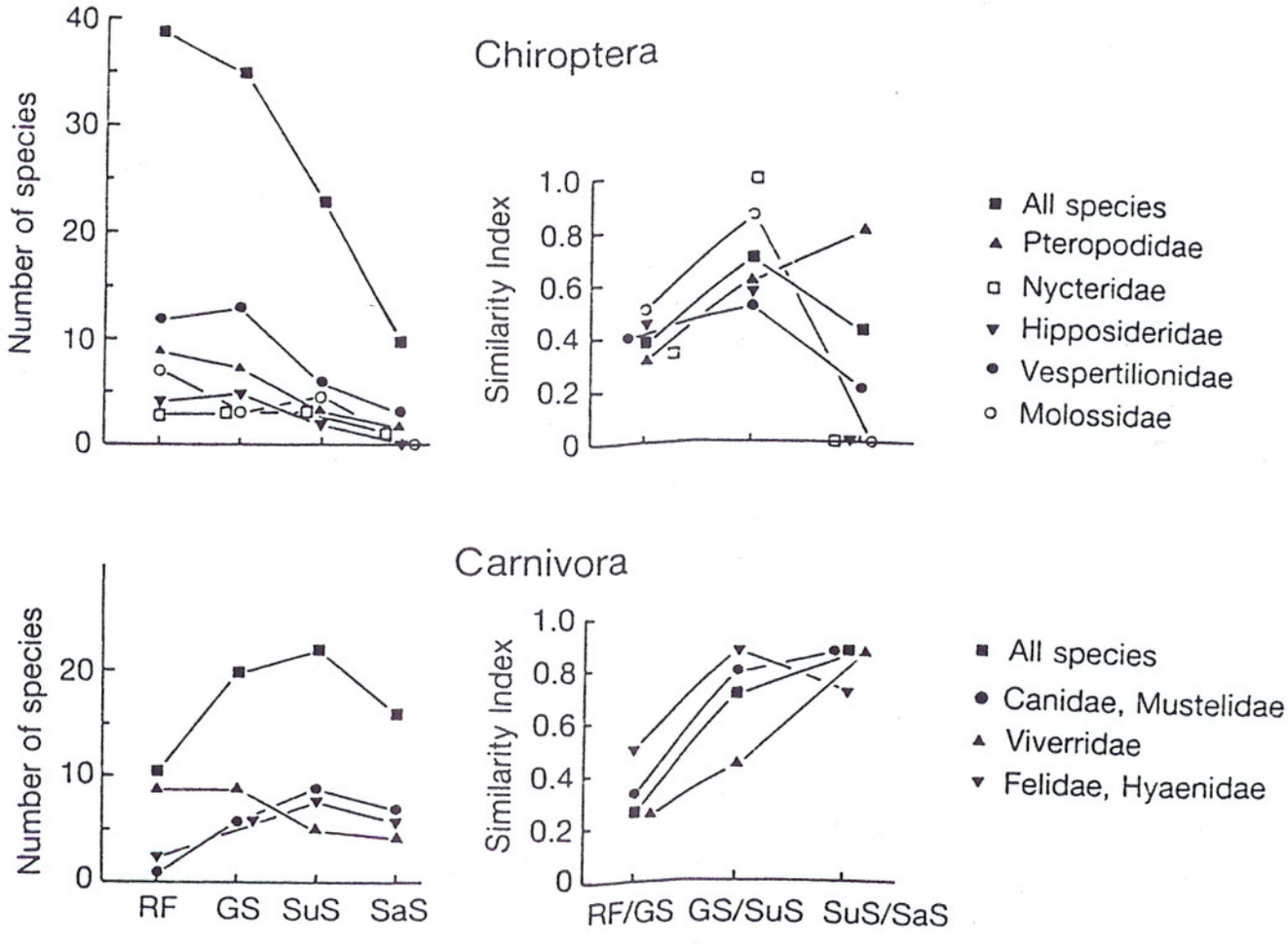

Figure 1: The number of species (left) and Similarity Index (right) of Chiroptera (top) and Carnivora (bottom) in Nigeria. Number of species: numerals indicate species numbers; RF = Rainforest , GS = Guinea savanna, SuS = Sudan savanna, SaS = Sahel savanna. Similarity Index: numerals indicate similarity between pairs of vegetation zones. 0 = no similarity, 1.0 = exact similarity. RF/GS = comparison between rainforest and Guinea savanna mammals, GS/SuS = comparison between Guinea savanna and Sudan savanna mammals, SuS/SaS = comparison between Sudan savanna and Sahel savanna mammals. (after Happold 1987).

and Carnivora (and all other orders), each vegetation zone supports a different set of species. For example, the species in the rainforest zone are mostly different from those in the adjacent Guinea savanna (similarity index 0.2 - 0.4). In contrast, the Guinea and Sudan savannas have considerable similarity in the composition of their faunas (similarity index 0.7 - 0.9). These analyses show that the mammals of the rainforest are very diverse and comprised of many species which occur only in the rainforest zone. In contrast, there is considerable similarity between the mammals of the Guinea and Sudan savannas, and lesser similarity between those of the Sudan and Sahel savannas.

History of mammalian studies

Recorded information on Nigerian mammals is very scarce prior to 1900. European travellers such as Henry Barth, Hugh Clapperton, John and Richard Lander, and Mungo Park occasionally recorded sightings of large mammals, but it was not until British administrators, foresters, teachers, missionaries and medical officers came to live in Nigeria at the beginning of the 20th century that collections of mammals were made for scientific study. Collectors in the early 1900s include W. J. Ansorge (Delta), G. L. Bates (Cameroun), G. Blaine (Donga River), A. Buchanan (Kano), Rev. G. Fox (Jos Plateau), Alexander Gosling (Lake Chad and Cameroun), I. R. P. Heslop (Owerri), R. Kemp (north-eastern Nigeria), W. P. Lowe (Lagos), P. F. Mason (Benin), A. S. Pearce (south-west Nigeria), D. R. Rosevear (north and south Nigeria), I. T. Sanderson (Cameroun) and P. A. Talbot (Bornu, Obudu, and Cameroun). Most of their specimens are housed in the Natural History Museum in London, and have been the subject of many scientific papers. Most of these papers were taxonomic, and frequently described species and subspecies new to science. The doyen of mammalian studies in Nigeria is undoubtedly D. R. Rosevear who for many years (1924-1954) served with the Forestry Department in Nigeria (Keay 1985). Rosevear published a series of 25 papers in the Nigerian Field between 1934 and 1950 on many species and families of Nigerian mammals, and published his "Checklist and Atlas of Nigerian Mammals" in 1953. After his retirement, he worked on the West African collections in the Natural History Museum in London, and produced his monumental works on bats, rodents and carnivores of West Africa (Rosevear 1965, 1969, 1974). Another prolific writer was Frank Collier, a contemporary of Rosevear, whose lovely paintings of Nigerian mammals were published in the Nigerian Field.

In recent years, since the early 1970s, many researchers resident in Nigeria (e.g. T. A. Afolayan, S. S. Ajayi, P. A. Anadu, J. S. O. Ayeni, G. S. Child, C. O. R. Everard, O. Funmilayo, P. Hall, D. C. D. Happold, J. Henshaw, P. J. Marshall, J. I. Menzies, J. F. Oates, E. E. Okon, and S. K. Sikes) have contributed to our understanding of Nigerian mammals (see References). The focus of their studies has been rather different from the earlier studies, placing more emphasis on the biology of species and communities, and the problems of management and conservation. During the last 70 years, the Nigerian Field Society has played an important part in promoting interest in mammals by publishing papers in the journal, hosting speakers at meetings, taking visitors to National Parks and Game Reserves, and encouraging schoolchildren to appreciate the natural history of the country (see Mohammed 1986 for a recent example).

Special species

Most of the species in Nigeria are also found in other countries of West Africa, and a few occur throughout much of sub-Saharan Africa. But there are some species which are very special, either because they are are endemic to Nigeria or because they are rare (and possibly endangered) throughout the continent of Africa. The World Conservation

Table 3. The 16 species of large threatened African mammals listed by the World Conservation Union which occur in Nigeria*. Species are classified as either Endangered, i.e. facing a high risk of extinction in the wild in the near future (EN) or Vulnerable, i.e. facing a high risk of extinction in the wild in the medium-term future (VU). A = Declining population numbers due to reduction in geographical distribution and/ or exploitation. B = Restricted geographical range and/or fragmented populations and/or decline in extent and quality of habitat. C = Small population size, decline in numbers. D = Very small population numbers, restricted geographical range. E = Possibility of extinction in wild likely to be 20% in 20 years (5 generations).

Common name	Scientific name	Localities in Nigeria	EN/VU	Reasons for listing
Red-bellied Monkey	*Cercopithecus erythrogaster*	A few rainforests in Niger Delta, west of the river	VU	A
Russet-eared Monkey	*Cercopithecis erythrotis*	A few rain forests in eastern Nigeria	VU	A
Preuss's Guenon	*Cercopithecus preussi*	A few rain forests in eastern Nigeria, east of Cross River	EN	A
Sclater's Guenon	*Cercopithecus sclateri*	Rainforests between Cross River and Niger River	EN	B
Black Colobus	*Colobus vellerosus*[1]	Rainforest patches on border with Benin Republic	VU	A
Drill	*Mandrillus leucophaeus*	Rainforests on Cameroun border	EN	A, C
Gorilla	*Gorilla gorilla*	Rainforests on Cameroun border	EN	A
Chimpanzee	*Pan troglodytes*	Rainforests on Cameroun border	EN	A
Hunting Dog	*Lycaon pictus*	A few habitats in Guinea and Sudan savanna	EN	C
Cheetah	*Acinonyx jubatus*	A few habitats in Guinea and Sudan savanna	VU	A, C
Lion	*Panthera leo*	A few habitats in Guinea and Sudan savanna	VU	A

[1]No data for Djibouti, Equatorial Guinea and Somalia

Crested Genet	*Genetta cristata* (2)	Rainforests on Cameroun border	EN	B
Manatee	*Trichechus senegalensis*	Niger and Benue rivers	VU	A
African Elephant	*Loxodonta africana*	A few habitats in savannas zones and (?) rainforest	EN	A
Pygmy Hippopotamus	*Hexaprotodon liberiensis* (3)	Delta of Niger and Cross rivers	VU	C, E
Red-fronted gazelle	*Gazella rufifrons*	A few habitats in Sudan and sahel savannas	VU	A

Notes:

* 10 species of small mammals are also listed as Threatened, but not included in the Table. These are the Giant Otter-shrew, two species of shrews, three species of bats, and four species of rodents.

(1) Considered a full species by Oates (1996); listed as *Colobus polykomus vellerosus* by Happold (1987).

(2) *Genetta poensis cristata* in Happold (1987).

(3) *Choeroposis liberiensis* in Happold (1987).

Union (formerly the International Union for the Conservation of Nature) lists 26 species which occur in Nigeria and which are also threatened in Africa as a whole (Table 3). Of these, two are endemic to Nigeria: the Long-footed Shrew *Crocidura longipes* known only from a few swamps in the Guinea Savanna, and Sclater's Guenon *Cercopithecus sclateri* which lives only in a few patches of rainforest between the Cross and Niger rivers (Oates et al. 1992, Oates 1996). The other 24 species occur either in Nigeria and one or two other adjacent countries, or are more widespread in Africa. The reasons for concern are varied and species-specific: either because the population is very small and declining, or the known populations are small and fragmented, or the habitat is limited and being destroyed. In addition, 13 species in Nigeria are listed as "Conservation Dependant" and 30 species as " Low Risk - near threatened" making a total of 68 species which are cause for concern. The Primates deserve special mention because in addition to the eight species listed in Table 3, Angwantibo, Olive Colobus, Red Colobus, Red-capped Mangabey and several galagos are listed on one of the IUCN categories given above. Nigeria has a special responsibility for the conservation of these species, especially for the larger species (Primates, carnivores, elephants, manatee) which are especially vulnerable to the effects of human activities. There are, of course, many other species—probably the majority of species—in Nigeria whose population numbers and geographical ranges have been reduced during the last 70 years but which are not yet

sufficiently endangered to warrant listing by IUCN.

Although mammals have been the subject of serious scientific investigation in Nigeria for almost 100 years, there are always surprises, e.g. when a new population is found in an unexpected place or another species is added to the country's checklist. Perhaps the greatest surprise in recent years concerns the Red Colobus in Nigeria. In 1987, Happold removed this species from the Nigerian fauna and wrote as follows:

> Recorded from Lake Barombi, near Kumba" (Rosevear 1953), "Nigeria (left bank of R. Cross)" (Rahm 1970) and "Region of Mt Cameroun" (Dandelot 1974), all in the former Cameroun Province of Nigeria. Struhsaker (1975) studied Red Colobus in the Korup Reserve in Cameroun, an area of 100,000 ha of rainforest adjacent to the Nigerian border to the east of Calabar, and it is likely that Red Colobus once occurred in the Oban Hills (J. F. Oates, in litt.). All known localities are now in Cameroun and there is no evidence that Red Colobus occur within the present Nigerian boundaries."

But in 1993/1994, a population of Red Colobus was discovered in the Niger delta between the Forcados and Nun rivers by C. B. Powell (Werre and Powell, 1997, Grubb and Powell 1999). This population represents a new subspecies *Colobus badius epieni*, similar to *C. b. pennantii* on the island of Bioko. It is likely that the Niger delta population survived in the delta refugium during the Pleistocene Ice Ages; it appears to have greater affinities with the Bioko population than with the subspecies to the east (*C. b. preussi* of Cameroun) and to the west (*C. b. waldroni* of Ghana).

Special studies

As might be expected, certain taxa have been relatively well-studied in Nigeria, while others have hardly been studied at all. However, studies on those Nigerian species which also occur in other African countries often provide useful information which is applicable to Nigeria. The rodents of Nigeria have been the subject of many papers, partly because of their economic importance. Nigeria has about 54 species of rodents, some very numerous and widespread, others rare and localised. Recent studies have investigated the ecology and demography of rodents in rainforests (Happold 1975, 1977), savannas (Anadu 1973) and plantations (Everard 1968), as well as reproduction and development (e.g. Anadu 1976,1979; Funmilayo and Akande 1979; Happold 1974, 1978; Rabiu and Fisher 1989). Other studies have considered rodents as an important source of food (Ajayi 1971, 1975) and in their role in the transmission of disease (e.g. Ikeh et al. 1995). Bats (both fruit-bats and insect-bats) are ecologically of great importance and there are even more species than there are of rodents. The 12 species of fruit bats of Nigeria have been well documented (Happold and Happold 1978), and one of these species, the Straw-coloured Fruit-bat *Eidolon helvum*, has been studied in great detail (e.g. Okon 1974, Fayenwo and Halstead 1974, Funmilayo 1979, 1985). Insect-bats, in contrast, have rarely been studied within Nigeria, and most of the available information is recorded by Happold (1987). Other taxa which have been the focus of noteworthy studies are shrews (Hutterer and Happold (1983), pangolins (Menzies 1971, Sodeinde and Adedipe 1994),

Primates (Anadu and Oates 1988; Harcourt et al. 1989; Oates 1982, 1985; Oates et al. 1992) and selected larger species of ungulates (Afolayan 1980, Child 1974, Henshaw 1975, 1979, Henshaw and Ayeni 1971, Marshall 1985). If these studies are placed in a pan-African context, it is evident that there have been relatively few in-depth ecological, behavioural or physiological studies of mammals in Nigeria, especially when compared with the wealth of studies in eastern and southern Africa. Nevertheless, Nigerian mammals are better known than are the mammals in a number of other African countries.

Mammals and Humans

In the past, mammals and other animals have played an important part in Nigerian society, especially in cultural and religious festivals, folklore, and traditional medicine (Adeola 1992). Products from wild mammals were used extensively for food, clothing and ornaments. Mammals still play an important role in Nigerian life, but probably to a lesser extent than in the past. The number of species utilised is not large. For example, a survey (based on interviews) in 1986 listed 16 species which were used in cultural ceremonies, the most preferred species being Bushbuck, Roan Antelope, Buffalo, Waterbuck, Grey Duiker, Cane Rat, Crested Porcupine, and Redless Tree Squirrel (Adeola 1992). Many of these species were also used for religious ceremonies, medicinal purposes and rituals. In addition, various parts (skulls, bones, etc.) of many other species are sold in local markets for various purposes: these include several species of monkeys, hyraxes, and hares (Shoga 1974 in Happold 1987). The almost mystical role of mammals is well illustrated by the folklore of hunters, expressed in "prose poetry" and song, which salutes the special characteristics of each particular mammal and helps the hunter to pursue his prey (Collier 1953, Ojoade 1986).

Some species of mammals cause damage to crops and houses. Many of the studies on rodents have investigated which species cause damage and how this may be minimised. Only certain species are considered as "pests" —the majority do not live in farms or plantations and do not impinge on human activities. The Multimammate Mouse, Pygmy Mouse, Rusty-bellied Mouse and Gambian Giant-rat are common species in farmlands in the south, often reaching high densities during the cropping season. In the north, several species of gerbils are the main pests in farmlands. The Multimammate Mouse, Nile Rat and (introduced) Black Rat may cause extensive damage to stored crops, and arboreal species (such as squirrels and Gambian Giant-rat) may cause damage in cocoa and oil palm plantations. In Nigeria, and in many other countries of the world, loss of growing and stored crops due to rodents is substantial. Hence, all these species need to be controlled (preferably by biological means rather than by poisons or trapping).

Wild mammals have always been a source of food for people in Nigeria (Ajayi 1971) as in all other countries of Africa. Wild mammals (together with birds, reptiles, fish and some invertebrates) were the only sources of animal protein before domesticated animals were readily available. In Nigeria, meat from wild mammals, birds and reptiles is referred to as "bushmeat" — a term which seems to be unique to Nigeria. Even now,

Table 4. The commonest species of mammals for sale at markets and roadsides as "bushmeat" in southern Nigeria. Data from Martin 1983 (Bendel State, November 1976 - October 1977) and Anadu et al. 1988 (Bendel State, June-August 1982). Values are expressed as percentages of total number of animals.

Common name	Scientific name	Martin (1983) n = 914	Anadu *et al.* (1988) n = 1099
Monkeys	*Cercopithecus mona*, *Cercopithecus torquatus*, "unidentified"	8	16 *
Giant-rat	*Cricetomys gambianus* **	8	22
Grasscutter	*Thryonomys swinderianus*	20	34
Duikers	*Cephalophus maxwelli*, *Cephalophus rufilatus* ***	26	11
Brush-tailed porcupine	*Atherurus africanus*	19	6
Bushpig	*Potamochoerus porcus*	3	3
Civet, Palm Civet	*Viverra viverra, Nandinia binotata*	4	<1
Tree Hyrax	*Dendrohyrax dorsalis*	3	<1
Bushbuck	*Tragelaphus scriptus*	3	4
Pangolin	*Manis tricuspis* and/or *Manis longicaudatus*	2	<1
Potto	*Perodicticus potto*	1	<1

* "unidentified" = 14%.

** Some giant rats may be the forest form *Cricetomys emini* (note by D.C.D.H).

*** Martin records "Small antelopes (mainly *Cephalophus* spp.)", Anadu et al. (1988) record "*Cephalophus maxwelli* 11%, *Cephalophus rufilatus* 0.2%". These two species are the commonest duikers in the rainforest zone. The Common Duiker, *Sylvicapra grimmia*, is sold as bushmeat in the savanna zones and near to the rainforest-savanna boundary.

bushmeat is a much favoured form of meat in both rural and urban areas because of its texture and palatability. Two recent surveys showed that Duikers, Grasscutters, Giant-rats, monkeys and porcupines formed 81-89% of all bushmeat on sale at roadsides at markets in southern Nigeria (Martin 1983; Anadu et al. 1988) (Table 4). In the surveys there were considerable differences in the percentage values due to differences in the

location, the time of year and length of each survey. Despite the high cost of bushmeat (N2.00 - N5.00/kg in 1977) compared with meat from domestic animals (N2.00/kg), many people prefer to buy bushmeat if they can afford it (Martin 1983). Estimates of the value of bushmeat vary, but it has undoubtedly increased over the years. In 1970, the value was put at N20 million (Charter 1970), but by 1988 it had increased to about N300 million (Anadu et al. 1988) due, in part, to inflation. All this, of course, puts increasing pressure on wild populations and has resulted in a decline in population numbers, perhaps below the level of sustainability. Anadu *et al.* (1988) record that retailers of bushmeat believe that some species have declined in availability but that others have increased. However, the results are ambiguous but most observers feel that, as for larger species, bushmeat is a declining resource. A decline in "bushmeat" has occurred in most parts of Africa, for the same reasons as in Nigeria: in the Central African Republic, for example, duikers have been hunted to such an extent that population numbers are no longer sustainable (Noss 1997). If bushmeat is to retain a place in Nigerian society, it is essential that hunting is regulated and that over-exploitation does not occur (Happold 1987, Anadu *et al.* 1988).

One alternative to wild-caught bushmeat is that that certain species, such as Gambian Giant-rats, Grasscutters and duikers could be "domesticated" or ranched (Ajayi 1983). However, feasibility trials have not been particularly successful and it is seems unlikely that "domesticated bushmeat" could provide an adequate supply of "bushmeat" at an economic price.

Mammalian Conservation

The 20th century has seen a gradual decline in the numbers of most species of mammals in Nigeria. For many species, especially those living in the rainforest zone, there has also been a reduction in the geographical range. Numerous reasons have been advanced for this decline—hunting during colonial days, over-exploitation by local hunters, clearing for agriculture, cutting of forests for timber, building of roads into previously remote areas, demand for bushmeat, lack of adequate wildlife laws and law enforcement, and increase in the human population—to name a few (Afoloyan 1980, Afolayan and Ajayi 1983, Anadu 1987, Ayeni 1985, Happold 1987). In fact, all of them have contributed to the present parlous state of affairs. Each of these will be examined briefly.

Hunting by sportsmen certainly reduced populations of the larger species in the early years of the 20th century. There were regulations which stated the numbers of each species which could be shot on licence, and which species (e.g. giraffe, rhinoceros) were totally protected. The overall effect of sport hunting is difficult to assess; most sport hunting concentrated on certain large savanna species (e.g. Elephant, Kob, Waterbuck, Roan Antelope, etc.) and had little or no effect on smaller and less obvious species. Nigeria (especially compared with many countries of eastern and southern Africa) was never considered as good hunting country because of the low density of animals, and the lack of open plains and woodlands. In retrospect, sport hunting had a relatively minor

effect when compared to some of the other reasons listed above. Hunting by local people using bows and arrows, pitfall traps, snares, nets and muzzle-loading shot guns ("dane guns") has always been a part of the life and culture of Nigerian society. When hunting is at a low intensity, and there is no over-exploitation, such hunting is not detrimental. However, as the demand for animal products has increased over the years (due primarily to the increase in human population), hunting pressure has increased and populations of many species of economic importance have been over-exploited. Matters are made worse because local hunting is virtually uncontrolled.

Clearance of land in savannas and rainforests destroys the natural environment. In savannas, clearance removes the diversity of natural trees, herbs and grasses which are required by wild mammals. In the past, "slash and burn" farming and "shifting cultivation" was not so detrimental because the roots of trees were not removed and, after a few years, the land was allowed to regenerate. However, "broad-acre farming" using mechanical equipment alters the environment to such an extent that only a few species of mammals can survive (some of which tend to be "pests" of crops). Burning of the savanna also alters the natural environment and reduces the number of species and individual mammals. Inter-annual burning of small areas of savanna may be advantageous (because it increases divrsity), but the current trend towards widespread burning every year is detrimental and results in declines in the diversity and numbers of mammals. In the rainforest zone, deforestation by logging and clearing has had an appalling effect on the forest ecosystem. Numerous studies within the rainforests of Africa (e.g. Barnes 1990) have shown that partially logged forests, and those that have been disturbed by forestry activities, have fewer species and lower populations of mammals than do undisturbed forests. Deforestation has reduced the area of rainforests to only a small percentage of what it was 70 years ago. Forest roads and tracks, built by logging companies for extracting timber, allow hunters to reach previously inaccessible parts of the forest so that few populations are safe from hunting. Rainforest mammals are especially vulnerable to human activities because they can live *only* in rainforest. Human activities in the rainforest zone have resulted in reduction of the geographical range and population numbers of all species of rainforest mammals. At worst, it has caused extinction, or near-extinction, of some populations.

Wildlife laws are one way of protecting wild species. Although Nigeria has had wildlife laws since the Wildlife Animals Preservation Ordinance of 1916 (Anadu 1987), none of them has really been effective in controlling the exploitation of wildlife outside conservation areas (i.e. outside National Parks and Game Reserves). As Anadu (1987) suggests, it will be impossible to implement wildlife laws until there are adequate funds and manpower, enforcement of laws, and while wildlife is considered to be "a God-given inexhaustible bounty".

Since the 1930s, there have been numerous reports and discussions about whether active conservation of Nigerian mammals was necessary and, if so, how conservation could be achieved (Happold 1971a). Many commentators in the 1930s noted the rapid

decline in wild animals, but there were conflicting ideas on how this decline could be halted (Happold 1971b). One viewpoint was that the hunting rights of local hunters must be respected and that conservation was only justified if it provided a supply of protein for local people. The opposite viewpoint was that the wishes of the local people were not the most important issue because if hunting continued as in the past, there would be few, if any, animals to hunt in the future. Other issues—stumbling blocks to progress—were the system of land tenure, the effects of cattle grazing, and whether any land could be made available for reserves. As a result, no effective action was taken and it was not until after Independence that most National Parks and Game Reserves were established.

Nevertheless, there have been a number of positive developments for the conservation of mammals. The first protected areas were declared in 1916, but they small in area and were never of great value. The first large Game Reserve was Yankari Game Reserve, an area of about 2,200 km ^{2}, proclaimed in 1955 (Jia 1971). Subsequently, many other reserved areas have been gazetted; some of them are very large in size (such as Kainji National Park - 5,341 km ^{2}) and able to give protection to all species of animals and plants in a meaningful way. Other important initiatives have been the formation of a Division of Wildlife and Conservation within the Federal Department of Forestry, the establishment of a Wildlife Management School, the formation of the (independent) Nigerian Conservation Foundation, and the increasing interest taken by some States. Most of the current 19 National Parks and Game Reserves and 19 proposed reserves (Anadu 1987) have been established since the early 1970s. Plans have been developed for conservation and wildlife management in several areas, e.g. Kainji National Park (Child, 1974, Ajayi and Hall 1979), Yankari National Park (Henshaw 1975), North-eastern Nigeria (Hall 1976), and Benue-Plateau State (Sikes, 1974).

However, in spite of all these positive initiatives, the outlook for mammals in Nigeria is not encouraging. For too many years, there has been overexploitation, degradation of habitats, deforestation, inadequate funds, and a general lack of interest in conservation. Nigeria has only about 2.5% of its land area in National Parks and Game Reserves, which places it in 30th position out of 39 countries of sub-Saharan Africa (range 0 - 30%) (IUCN 1987, see also Note 1). If only the large countries of Africa—those larger than 800,000 km ^{2}—are taken into account, Nigeria comes 9th out of 12 . Although these figures suggest that Nigeria has not done very well, the very high density of humans in Nigeria (89 persons/km^2 in 1987, and about 108 persons/km^2 in 1999) makes it very difficult to allocate large areas for conservation.

The root cause of inadequate conservation of mammals (and other species) is the very large number of humans in Nigeria. This is not a peculiarly Nigerian problem but one that affects most countries of the world. Nigeria has one of the fastest rates of population increase in the world (ca. 3%), as well as the largest population of all African countries. Since the first issue of *The Nigerian Field*, 70 years ago, the human

population of Nigeria has increased five-fold. The population was about 20 million in 1931, 31 million in 1952/53 (Nigeria 1953), 50 million in 1970 (United Nations 1981), and about 100 million in 1995. The estimated population now (1999) is 106-110 million. It is hardly surprising that such a huge and rapid increase has had drastic effects on Nigerian environments, and that the wildlife of the country has been severely disadvantaged. The problem now is what can be done to conserve the little that is left. All humans require food, shelter, services, employment and some measure of security; however, these requirements must be associated with the conservation of the many ecosystems - water, soil, vegetation, animals, and climate - on which all Nigerians depend for survival.

The future

It will never be possible for mammals to be as widespread and abundant as they were in the early years of the 20th century. The best that can be done now is ensure that representative habitats are conserved and that the populations of all species are sufficiently large to be self-sustaining. Every effort should be made to enlarge the number and area of National Parks and Game Reserves and to encourage an increase in the population numbers of all species within these protected areas. Conservation projects need to be based on ecological units which may cross State and national boundaries. The concept of Peace Parks, one of the most successful recent ventures in southern Africa, should be investigated for Nigeria and its neighbours. Private organisations, such as the Nigerian Conservation Foundation and the Nigerian Field Society, must continue to lobby and persuade governments to make positive contributions to the conservation of all natural resources. Many other improvements, such as better law enforcement, adequate funds for Parks and Reserves, better conditions for personnel employed in conservation work, and more emphasis on environmental education at all levels, are essential to ensure that Nigeria's wildlife survives for coming generations. Most difficult of all to accomplish—but the most essential—is the development of a completely new attitude to wildlife by all levels of Nigerian society. If Nigeria wants to maintain its biological diversity, it has to follow the example of other countries which have managed to integrate economic and technological advances with a large human population. Such countries have placed a high value on the integrity of ecological systems and on the animals and plants whose survival depends on these systems. If this can be done in Nigeria, one can hope that by the end of the 21st century, Nigeria's mammals (and other wildlife) will be more widespread, more numerous and better conserved than in 1999.

REFERENCES

Adeola, M. O. (1992). Importance of wild animals and their part in the culture, religious faith and traditional medicine of Nigeria. *Environmental Conservation* 19: 125-134.

Afolayan, T. A. (1980). A synopsis of wildlife conservation in Nigeria. *Environmental Conservation* 7: 207-212.

Afolayan, T. A. and Ajayi, S. S. (1983). Fifty years of Nigerian wildlife resources. *Nigerian Field* 47: 139-144.

Ajayi, S. S. (1971). Wildlife as a source of protein in Nigeria: some priorities for development. *Nigerian Field* 36: 115-127.

Ajayi, S. S. (1975). Observations on the biology, domestication, and reproductive performance of the African Giant Rat (*Cricetomys gambianus* Waterhouse) in Nigeria. *Mammalia* 39: 342-364.

Ajayi, S. S. (1983). Domestication of mammals in Africa. *Nigerian Field* 47: 145-156.

Ajayi, S. S. and Hall, J. B. (1979). An ecological management plan for the Kainji Lake National Park. In *Wildlife management in a savanna woodland*. (Ed. S. S. Ajayi and L. B. Halstead). Taylor and Francis, London. pp. 205-213.

Anadu, P. A. (1973). *The ecology and breeding biology of small rodents in the derived savanna zone of south-western Nigeria*. Ibadan, Nigeria: Ph.D. thesis, University of Ibadan. 215 pp.

Anadu, P. A. (1976). Observations of reproduction and development in *Mus musculoides* (Rodentia, Muridae). *Mammalia* 40: 175-186.

Anadu, P. A. (1979). Gestation period and early development in *Myomys daltoni* (Rodentia, Muridae). *Terre et Vie* 33: 59-69.

Anadu, P. A. (1987). Progress in the conservation of Nigeria's wildlife. *Biological Conservation* 41: 237-251.

Anadu, P. A., Elamah, P. O. and Oates, J. F. (1988). The bushmeat trade in southwestern Nigeria: a case study. *Human Ecology* 16: 199-208.

Anadu, P. A. and Oates, J. F. (1988). The Olive Colobus in Nigeria. *Nigerian Field* 53: 31-34.

Ayeni, J. S. O. (1985). Strategies for quick and effective conservation and recovery of the diminishing wildlife resources of Nigeria. *Nigerian Field* 50: 37-40.

Barnes, R. F. W. (1990). Deforestation trends in tropical Africa. *African Journal of Ecology* 28: 161-173.

Charter, J. R. (1970). Nigeria's wildlife: a forgotten National asset. In *WildlifeConservation in West Africa*. (Ed. D. C. D. Happold). I.U.C.N: Morges, Switzerland. p. 37.

Child, G. S. (1974). *An ecological survey of the Borgu Game Reserve*. F.A.O. FI/NIR24, Tech. Rep. 4. F.A.O., Rome. 130 pp.

Collier, F. S. (1953). Yoruba Hunters' Salutes. *Nigerian Field* 18: 52-67.

Everard, C. O. R. (1968). *A report on rodents and other vertebrate pests of cocoa in Western Nigeria*. Ministry of Agriculture and Natural Resources, Ibadan, Western Nigeria. Unpub. Rep.

Fa, J. E., Juste, J., Perez del Val, J. and Castroviejo, J. (1993). Impact of market hunting on mammal species in Equatorial Guinea. *Conservation Biology* 9: 1107-1115.

Fayenwo, J. O. and Halstead, L. B. (1974). Breeding cycle of the straw-coloured fruit bat, *Eidolon helvum* at Ile-Ife, Nigeria. *Journal of Mammalogy* 55: 453-454.

Funmilayo, O. (1979). The ecology of the straw-coloured fruit bat in Nigeria. *Revue de Zoologie Africaines* 93: 590-600.

Funmilayo, O. (1985). Sexual maturity in the African Fruit bat (*Eidolon helvum*). *Nigerian Field* 50: 13-20.

Funmilayo, O. and Akande, M. (1979). Body weight, diet and reproduction of rats and mice in the forest zone of south-western Nigeria. In *Wildlife management in savanna*

woodland. (Ed. S. S. Ajayi and L. B. Halstead). Taylor & Francis, London. pp. 136-141.

Grubb, P. and Powell, C. B. (1999). Discovery of red colobus monkeys (*Procolobus badius*) in the Niger Delta with the description of a new and geographically isolated subspecies. *Journal of Zoology, London* 248: 67-73.

Hall, P. (1976). Priorities for wildlife conservation in North-eastern Nigeria. *Nigerian Field* 41: 99-112.

Happold, D. C. D. (ed.) (1971a). *Wildlife Conservation in West Africa*. IUCN Publ. n.s. 22. International Union for Conservation of Nature, Morges, Switzerland. 60 pp.

Happold, D. C. D. (1971b). A history of wildlife conservation in Nigeria, and thoughts for the future. In *Wildlife Conservation in West Africa*. (Ed. D. C. D. Happold). I.U. C. N: Morges, Switzerland. pp. 9-14.

Happold, D. C. D. (1973). *Large Mammals of West Africa*. Longman, London. 105 pp.

Happold, D. C. D. (1974). The small rodents of the forest-savanna-farmland association near Ibadan, Nigeria, with observations on reproductive biology. *Revue de Zoologie Africaine* 88: 814-836.

Happold, D. C. D. (1975). The effects of climate and vegetation on the distribution of small rodents in western Nigeria. *Zeitschrift für Saugetierkunde* 40: 221-242.

Happold, D. C. D. (1977). A population study on small rodents in the tropical rain forest of Nigeria. *La Terre et la Vie* 31: 385-458.

Happold, D. C. D. (1978). Reproduction, growth and development of a West African forest mouse, *Praomys tullbergi*. *Mammalia* 42: 73-95.

Happold, D. C. D. (1987). *The Mammals of Nigeria*. Oxford: Clarendon Press. 402 pp.

Happold, D. C. D. and Happold, M. (1978). The fruit bats of western Nigeria. *Nigerian Field* 43: 30-37, 72-77, 121-127.

Harcourt, A. H., Stewart, K. J. and Inahoro, I. M. (1989). Gorilla quest in Nigeria. *Oryx* 23: 7-13.

Henshaw, J. (1975). *The ecology and mangement of Yankari Game Reserve*. FAO Technical Report : FO:DP/NIR/72/002. F.A.O., Rome. 106 pp.

Henshaw, J. (1979). Notes on habitat relationships of ungulates in Yankari Game Reserve, Nigeria. *Mammal Review* 9: 47-52.

Henshaw, J. and Ayeni, J. S. O. (1971). Some aspects of big-game utilisation of mineral licks in Yankari Game Reserve, Nigeria. *East African Wildlife Journal* 9: 72-83.

Hutterer, R. and Happold, D. C. D. (1983). The shrews of Nigeria. *Bonner Zoologische Monographien* 18: 1-79.

I.U.C.N. (1987). *IUCN Directory of Afrotropical Protected Areas*. I.U.C. N: Morges, Switzerland.

Ikeh, E. I., Ajayi, J. A. and Nwana, E. J. C. (1995). *Mastomys natalensis* and *Tatera gambiana* as probable reservoirs of human cutaneous leishmaniasis in Nigeria. *Transactions of the Royal Society of Tropical Medicine & Hygiene* 89: 25-26.

Jia, J. (1971). The Yankari Game Reserve: 1955-1970. In *Wildlife Conservation in West Africa*. (Ed. D. C. D. Happold). : I.U. C. N.: Morges, Switzerland. pp. 27-30.

Juste, J., Fa, J. E., Perez del Val, J. and Castroviejo, J. (1995). Market dynamics of bushmeat species in Equatorial Guinea. *Journal of Applied Ecology* 32: 454-467.

Keay, R. W. J. (1985). Donovan Rosevear, C. B. E. (1900 - 1986): Obituary. *Nigerian Field* 50: 51-52.

Marshall, P. J. (1985). An analysis of game viewing trips in Yankari Game Reserve. *Nigerian Field* 50: 53-58.

Martin, G. H. G. (1983). Bushmeat in Nigeria as a natural resource with environmental implications. *Environmental Conservation* 10: 125-132.

Menzies, J. I. (1971). The birth in captivity of a tree pangolin (*Manis tricuspis* Rafinesque) and observations on its development. *Nigerian Journal of Science* 5: 77-84.

Mohammed, G. A. (1986). Is wildlife disappearing in Nigeria? *Nigerian Field* 51: 31-34

Nigeria (1953). *The Nigeria Handbook*. Crown Agents, London. 339 pp.

Noss, A. J. (1997). The impacts of cable snare hunting on wildlife populations in the forests of the Central African Republic. *Conservation Biology* 12: 390-398.

Oates, J. F. (1982). In search of rare forest primates in Nigeria. *Oryx* 16: 431-436

Oates, J. F. (1985). *Action Plan for African Primate Conservation: 1986-90*. IUCN/SSC Primate Specialist Group, Stony Brook, New York. 41 pp.

Oates, J. F. (1985). The Nigerian Guenon, *Cercopithecus erythrogaster*: ecological, behavioural, systematic and historical observations. *Folia Primatologica* 45: 25-43.

Oates, J. F. (1996). *African Primates. Status Survey and Conservation Action Plan. Revised Edition*. IUCN/SSC Primate Specialist Group. IUCN, Gland, Switzerland. 80 pp.

Oates, J. F., Anadu, P. A., Gadsby, E. J. and Werre, J. L. (1992). Sclater's Guenon. *Geographical Research and Exploration* 8: 476-491.

Ojoade, J. O. (1986). Hunters and hunting in Yoruba folklore. *Nigerian Field* 51: 73-84.

Okon, E. E. (1974). Fruit bats at Ife: their roosting and food preferences. *Nigerian Field* 39: 33-40.

Powell, C. B. (1997). Discoveries and priorities for mammals in the freshwater forests of the Niger delta. *Oryx* 31: 83-85.

Rabiu, S. and Fisher, M. (1989). The breeding season and diet of *Arvicanthis* in northern Nigeria. *Journal of Tropical Ecology* 5: 375-386.

Rosevear, D. R. (1953). *Checklist and Atlas of Nigerian Mammals*. Government Printer. Lagos. 129 pp. + maps.

Rosevear, D. R. (1965). *The Bats of West Africa*. British Museum (Natural History), London. 418 pp.

Rosevear, D. R. (1969). *The Rodents of West Africa*. British Museum (Natural History), London. 604 pp.

Rosevear, D. R. (1974). *The Carnivores of West Africa*. British Museum (Natural History), London. 548 pp.

Sikes, S. (1974). Wildlife conservation with reference of Benue-Plateau State. *Nigerian Field* 39: 58-76.

Sodeinde, O. A. and Adedipe, S. R. (1994). Pangolins in south-west Nigeria - current status and prognosis. *Oryx* 28: 43-50.

United Nations, (1981). *Demographic Yearbook*. United Nations, New York.

Werre, J. L. R. and Powell, C. B. (1997). The Niger Delta colobus - discovered in 1993 and now in danger of extinction. *Oryx* 31: 7-9.