Abundance and Distribution of Large Mammals in the Upper Ogun Game Reserve, Oyo State, Nigeria

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International Livestock Centre for Africa

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I feel that we have a moral responsibility toward animals, and that I have made a substantial commitment to this responsibility.

The principles of proper animal use in colleges of veterinary medicine cannot guarantee humane treatment in biomedical research. However, by setting a good example, our professionals can continue to contribute to improvement for the future, through education.

References
McCoulough, L.B. and Morris, J.P. III, ed. (1978) Implications of History and Ethics to Medicine, Centennial Academic Assembly, Texas A & M University, College Station, TX.

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T.A. Afolayan, K.R.N. Milligan, and S.O. Salami

In this study, three indirect methods (counts of animal droppings, footprints, and tracks) were used as indices to estimate the abundance and distribution of large mammals in the Upper Ogun Game Reserve, which is located in a typical Southern Guinea savanna zone of Nigeria. Thirteen animal species were recorded: kob, bushbuck, hartebeest, roan antelope and duiker were the most abundant. The distribution of large mammals appears to be controlled by several factors: accessibility to the River Ogun (the main source of water in the reserve), availability of food and cover, and the extent of illegal hunting.

An analysis of questionnaires distributed to various people living in villages around the reserve revealed that these people depend heavily on bushmeat for their animal protein requirements. They also use other wildlife products to meet their economic, social, and cultural needs. It is recommended that adequate protection should be accorded to the game reserve for at least 5 years. After that time, the area could be opened up to tourism, and controlled hunting could be permitted in the buffer zone around the reserve.

Zusammenfassung


Eine Analyse der Fragebögen, die an die Einwohner verschiedener Dörfer in der Umgebung des Reservats verteilt wurden, vermittelte die Information, dass diese Menschen hauptsächlich von Fleisch aus dem Busch für ihren Tierprotein-Bedarf abhängen. Sie verwenden auch andere Tierprodukte, um ihre wirtschaftlichen, sozialen Bedarfe zu decken.

Introduction

There is a paucity of information on the abundance and distribution of large mammals in Nigerian wildlife reserves (i.e., the National Park and other game reserves), and much of the data that are available were obtained mainly from mere guesses made by casual observers and visitors. Apart from Kainji Lake National Park, where some careful research work has been carried out, the available information for other reserves is inadequate, unreliable, and insufficiently scientific for efficient management of a game reserve. Even in Kainji Lake National Park, where some general population studies have been carried out (Child, 1974; Pelink, 1974; Milligan, 1979), no study has been conducted on the individual large-mammal species. Similarly, work in the Yankari Game Reserve in the northeastern area of Nigeria performed by Sykes (pers. comm.) and Geerling (1973) is not sufficiently comprehensive for developing a reliable management plan for that reserve.

Generally, very little is known about the wildlife populations of the 60 Nigerian wildlife reserves, which include the Upper Ogun Game Reserve, the most important game reserve in the Oyo state of Nigeria. We therefore decided to investigate the abundance and distribution of animal populations in this reserve. A second reason for our selection of the Upper Ogun was its importance to the people living in the villages that surround the reserve. Bushmeat (i.e., the flesh of wild animals) from this game reserve and from the surrounding forest reserves contributes immensely to the socioeconomic and cultural life of the people. There is a high demand for bushmeat in this area as a source of dietary protein, and it also plays a major role in traditional medicine.

The game reserve has suffered from indiscriminate hunting for a long time—most of the more valuable species are approaching extinction and are hard to find. In summary, then, the main objectives of this study were to provide reliable information on the abundance and distribution of large mammals in the reserve and to investigate the impact of illegal hunting by the local communities on the wildlife populations in the area. It is hoped that this information will be useful in the formulation of a long-term management plan for the game reserve.

Study Area

Upper Ogun Game Reserve (Fig. 1) with a total area of 1,100 sq km, is situated in the northwestern region of Oyo state, between latitudes 3½° and 4½° N and longitudes 8½° and 9° N. The mean annual rainfall in the reserve is about 1,250 mm with a 5-month dry season (November to March). The mean minimum and maximum daily temperatures are about 20 and 34°C, respectively. The terrain is gently sloping, with some rocky hills and inselbergs located on the southeastern section, along the boundary of the reserve. The main drainage system in the reserve is the River Ogun. It runs from north to south and flows through the whole length of the reserve. In addition, several other streams can be found east of the River Ogun. The soils are derived from undifferentiated basement complex materials. These soils are generally sandy and are classified as fergusino tropical soils on crystalline acid rocks.

FIGURE 1 Physical features of Upper Ogun Game Reserve

The reserve is situated at the northern boundary of the forest-savanna mosaic. It lies in typical Southern Guinea savanna woodland, with fairly dense woodland and forest outliers found in the northern region (Geerling, 1973). In his analysis of vegetation, Geerling was able to identify the following principal vegetation types:

1. Dense woodland and forest outliers
2. Mixed open savanna woodland; *Terminalia macroptera* savanna
3. Ironstone and outcrop vegetation
4. Riparian grassland and fringing woodland, occupying the flood plains and the areas along the River Ogun, respectively.
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Method

It was impossible to estimate the animal populations in the study area by direct methods because of poor visibility in the dense woodlands. We therefore resorted to indirect sampling techniques, which involved counting fecal droppings, animal tracks, and footprints. Similar indirect sampling methods have been used by Wing and Buss (1970) in Uganda and by Afolayan (1975) in the Kilimanjaro forest reserve in Tanzania to estimate elephant populations.

The most significant limitation in the use of these sorts of population indices is that they can only serve to indicate population trends over time and space and do not necessarily represent true head counts for the particular area under investigation. However, these methods were used in this study because they provided the only available means of obtaining information on animal activities and abundance in the study area. Only the animal species shown in Table 1 were included in this study.

The field study was carried out in the dry season of 1979. Ten transects were randomly selected, with a 100 X 20 m plot marked off along each transect. Indices of animal activities such as fecal droppings, trails, and tracks were observed on each of the plots. Information on types of vegetation and weather conditions at the time of observation were also recorded. After the droppings were counted for the first time, they were marked with wooden pegs and counted for the second time. The most significant limitation in the use of these sorts of population indices is that they can only serve to indicate population trends over time and space and do not necessarily represent true head counts for the particular area under investigation. However, these methods were used in this study because they provided the only available means of obtaining information on animal activities and abundance in the study area. Only the animal species shown in Table 1 were included in this study.

The population of each species $P_i$ may be estimated using the formula

$$P_i = \frac{D_i}{R_i \times T}$$

where $D_i$ is equal to its estimate $\hat{D}_i$ as above, $R_i$ is the defecation rate per day of species $i$, and $T$ is the number of days that elapsed between the first and second observations.

In the second part of the study, questionnaires were administered to determine the frequency of hunting activities, the value of the various wildlife species in terms of meat and medicinal uses, and the extent of protection afforded to the animals. A total of 150 of these questionnaires were distributed to hunters, market women, community leaders, and elders who resided in villages around the game reserve. The villages include Aha, Shepeteri, Amanrege, Ago-Amodu, and Ago-Omu.

Market prices for various kinds of bushmeat, trophies, and skins and bones were obtained from a sample of market women and hunters. Experienced hunters, patrocles, elders, and community leaders were interviewed on the medicinal uses of wildlife. Data on the number of offenses and arrests, and information on compounds and fines, was collected from the Game Management Headquarters of Oyo state.

Results

Table 1 lists the 13 species of large mammals studied in the reserve and the indices of their abundance, calculated from counts of droppings, tracks, and footprints. High counts for pellet groups, footprints, and trails were recorded for kob, cane rat, bush buck, duiker, and hare in the riparian savanna grassland, while low counts were recorded for hartebeest and roan antelope. (The nomenclature for the animals discussed follows that of Dorst and Dandelot, 1970.)

In the mixed-savanna woodland, the following species were identified: kob, aardvark, bush buck, hartebeest, and duiker. High pellet counts were recorded for these species, while low counts were noted for buffalo, elephant, and Red River hog. Seven animal species were identified in the open savanna woodland. Here, there was a decrease in pellet, footprint, and trail counts for kob, cane rat, and hare but a rise in the counts for bush buck.

In the dense woodland, a total of seven species was observed. Of these,

### Table 1. Density of Animals (Number/Square Kilometer) in the Upper Ogun Game Reserve

<table>
<thead>
<tr>
<th>Count</th>
<th>Pellet Group</th>
<th>Trail</th>
<th>Footprint</th>
<th>Average Density</th>
<th>Confidence Limits*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kob</td>
<td>25.08</td>
<td>11.87</td>
<td>18.04</td>
<td>18.33</td>
<td>±6.60</td>
</tr>
<tr>
<td>Cane rat</td>
<td>3.37</td>
<td>1.60</td>
<td>1.77</td>
<td>2.24</td>
<td>±0.97</td>
</tr>
<tr>
<td>Hare</td>
<td>1.31</td>
<td>0.64</td>
<td>0.80</td>
<td>0.91</td>
<td>±0.34</td>
</tr>
<tr>
<td>Duiker</td>
<td>1.93</td>
<td>2.03</td>
<td>3.11</td>
<td>2.35</td>
<td>±0.65</td>
</tr>
<tr>
<td>Aardvark</td>
<td>1.00</td>
<td>0.80</td>
<td>0.91</td>
<td>0.91</td>
<td>±0.10</td>
</tr>
<tr>
<td>Bushbuck</td>
<td>4.11</td>
<td>5.61</td>
<td>8.19</td>
<td>5.97</td>
<td>±2.06</td>
</tr>
<tr>
<td>Hartebeest</td>
<td>3.01</td>
<td>2.81</td>
<td>4.63</td>
<td>3.48</td>
<td>±0.99</td>
</tr>
<tr>
<td>Roan antelope</td>
<td>1.96</td>
<td>2.08</td>
<td>3.55</td>
<td>2.33</td>
<td>±0.88</td>
</tr>
<tr>
<td>Buffalo</td>
<td>0.19</td>
<td>0.44</td>
<td>0.80</td>
<td>0.47</td>
<td>±0.30</td>
</tr>
<tr>
<td>Crocodile</td>
<td>0.04</td>
<td>0.03</td>
<td>0.04</td>
<td>0.03</td>
<td>±0.005</td>
</tr>
<tr>
<td>Spotted hyena</td>
<td>0.07</td>
<td>0.07</td>
<td>0.11</td>
<td>0.08</td>
<td>±0.02</td>
</tr>
<tr>
<td>Elephant</td>
<td>0</td>
<td>0.03</td>
<td>0.06</td>
<td>0.026</td>
<td>±0.02</td>
</tr>
<tr>
<td>Red River hog</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>±0.00</td>
</tr>
<tr>
<td>Total</td>
<td>42.08</td>
<td>28.01</td>
<td>42.03</td>
<td>37.4</td>
<td>±8.10</td>
</tr>
</tbody>
</table>

*Confidence limits were calculated at the 5 percent probability level.
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Mathematical formulations were constructed for estimating populations from these data: Let \( d_i \) be the number of droppings accumulated in each plot for each species in the interval between the first and second observations (after decomposition). The mean for the whole sample is \( \bar{d} \), and the estimated total number of droppings accumulated for the species, for the whole study area, \( \bar{D} \), may be given by:

\[
\bar{D} = N \bar{d} \tag{1}
\]

where \( N = \text{Area of the study area } / \text{Area of plot} \).

The population of each species \( P_i \) may be estimated using the formula:

\[
P_i = \frac{D_i}{R \times T_i} \tag{2}
\]

where \( D_i \) is equal to its estimate \( \bar{d} \) as above, \( R_i \) is the defecation rate per day of species \( i \), and \( T_i \) is the number of days that elapsed between the first and second observations.

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there were high counts for hartebeest, roan antelope, duiker, buffalo, and bush­
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a spotted hyena was recorded in this
vegetation zone.

Considering the entire study area,
and the 13 animal species studied, kob
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\[
\begin{align*}
\text{Footprint} & : 8 \\
\text{Pellet} & : 50 \\
\text{Trail} & : 100
\end{align*}
\]

\[
\begin{align*}
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\]

Distribution of animals

Figure 2 shows the effect of the River
Ogun on the distribution of large mam­
als in the game reserve. The distance
from the river is presented on X axis,
while the Y axis shows the abundance
and distribution of pellets, trails, and
footprints. Counts for pellets, trails, and
footprints were higher along the river
course; counts decreased gradually as
the distance from the river increased.


\[
\begin{align*}
\text{Footprint} & : 8 \\
\text{Pellet} & : 50 \\
\text{Trail} & : 100
\end{align*}
\]

Utilization of Wildlife

The analyses of the questionnaires
showed that wildlife is a very important
part of the life of the local people, in
traditional medicine and witchcraft, and
as a source of protein. A wide variety of
wild animals are eaten by the local com­
unities, including all of the wild ungul­
ates, primates, hyrax, rodents, birds, and
reptiles. About 80 percent of the rural
population depends on bushmeat, and
approximately 40 percent take up hunt­
ing as a profession. About 65 percent of
the hunters interviewed stated that kob
is the most abundant animal species in
the game reserve and that bushbuck, harte­
beest, roan antelope, and duiker also occur in great numbers.

Among the Fulani, Hausa, and Bo­
ororo hunters, the weapons used for hunt­
ing range from bows and arrows to dane guns. Also, most of the local hunters use traps and ropes. About 90 percent of the
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were aware that hunting in the reserve is
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migrant hunters set up camps and are
able to remain in the reserve for as long
as 3 weeks at a time. Hunting is carried out principally during the dry season,
when the animals are easier to spot. The
dressed carcass is often chopped up into
small pieces, hard-roasted, and then
packed into sacks.

About 40 percent of the hunters inter­
viewed stated that they would prefer
to send their children to school instead of
training them to become future hunt­
ers. On the other hand, about 50 percent
held the view that hunting represents an
important tradition that ought to be
passed down to future generations. The
other 10 percent could not state catego­
rically whether it was preferable to train
children to hunt or to educate them for
other kinds of work.

Table 2 lists the 21 species of animals
that were for sale in various markets
around the reserve at the time of our
study, including Aha, Ago-Amadu, She­
peteri, Iseyin, Agunrege, Ago-Omu, and
Shaki. The average market price is given
for each species. Note that these prices
are not fixed: they fluctuate with time and
region.

In Table 3, the number of arrests of
the fines paid from 1967 to
1978 are presented. This information
was obtained from the Game Manage­
ment Headquarters in Oyo. A total of
115 arrests were made in 12 years; the
total amount of fines collected was
2,610.39 Naira. Most of the arrests
were made between December and May, but
at least 1 person was arrested in every
month.

Discussions

This study has revealed the impor­
tance of the River Ogun in determining
the abundance and distribution of some
ungulates and reptiles in the Upper Ogun
Game Reserve. The animals that are more
close to the river during the dry season are kob, bushbuck, cane
rat, duiker, and crocodile. Other spe­
cies such as hartebeest and roan ante­
lope were encountered at some distance
from the riverine areas. These latter species are often referred to as typical
upland savanna animals (Afolayan and
Ajayi, 1980; Milligan, 1979). Their choice
of habitat does not mean that these
animals do not require water—they do
visit watersides at least once daily, but
then return to the upland savanna areas.

Studies carried out on kobs in Nige­
ria (Child, 1974; Pelinck, 1974; Milligan,
1979) and elsewhere in East Africa have
shown that the animal is fairly sedenta­
ry. Normally, it does not travel farther
than 5 km from a source of water.

Figure 2 also shows the effect of the
River Ogun on the distribution of the ri­
parian species mentioned above (i.e.,
kob and allied species). High counts of
pellets, footprints, and trails of these
species are found along the River Ogun,
but the counts decrease rapidly as one
moves away from the river. A high rela­
tive population density was recorded
for kob and the allied species that are more
water-dependent, while lower densities
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vegetation zone.
Considering the entire study area, and the 13 animal species studied, kob had the highest pellet, footprint, and trail
counts, except in the dense savanna woodland. The density of kob populations was also highest (25.08/sq km, according to the pellet count index), followed by bush­
buck (5.97/sq km). The average density of all animals in the reserve, calculated from the indices used, is 37.4/sq km.

Distribution of animals
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and distribution of pellets, trails, and footprints. Counts for pellets, trails, and footprints were higher along the river course; counts decreased gradually as the distance from the river increased. Variations in the distribution of animal species also appear among the different vegetation zones. For example, buffalo, hartebeest, and roan antelope were more frequent in the dense savanna woodland than in other vegetation zones, while kobs were commonly seen in the riparian grassland and in the areas around the River Ogun.

Utilization of Wildlife
The analyses of the questionnaires showed that wildlife is a very important part of the life of the local people, in traditional medicine and witchcraft, and as a source of protein. A wide variety of wild animals are eaten by the local communities, including all of the wild ungul­
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<table>
<thead>
<tr>
<th>Species</th>
<th>Number of Arrests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kob</td>
<td>10</td>
</tr>
<tr>
<td>Bushbuck</td>
<td>5</td>
</tr>
<tr>
<td>Hartebeest</td>
<td>12</td>
</tr>
<tr>
<td>Roan Antelope</td>
<td>8</td>
</tr>
<tr>
<td>Duicker</td>
<td>6</td>
</tr>
<tr>
<td>Buffalo</td>
<td>3</td>
</tr>
<tr>
<td>Cane Rat</td>
<td>2</td>
</tr>
<tr>
<td>Crocodile</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2. The number of arrests of

Figure 2 also shows the effect of the River Ogun on the distribution of the riparian species mentioned above (i.e., kob and allied species). High counts of pellets, footprints, and trails of these species are found along the River Ogun, but the counts decrease rapidly as one moves away from the river. A high rela­
tive population density was recorded for kob and the allied species that are more water-dependent, while lower densities were noted for hartebeest and roan ante­
lope, which are less dependent on water. The importance of water, food, and cover in the distribution of ungulates has been shown by Afolayan (1976), who studied these species at the Mkomazi Game Reserve in Tanzania and by Field (1968), who also worked in East Africa. Field observed that ungulates require water for drinking, as well as for wallowing during hot weather. Geerling and

### TABLE 2. Approximate Market Prices of Bushmeat, Trophies, and Skins of Some Large African Mammals

<table>
<thead>
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Data from interviews with market women in Ago Omu, Shepeteri, Agungere, Ago Amodu and Aha villages.

### TABLE 3. Total Number of Hunters Arrested and Fined per Year in the Upper Ogun Game Reserve, 1967-1978

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Arrests</th>
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<th>Mar</th>
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<th>Jun</th>
<th>Jul</th>
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Data from the Regional Game Management Headquarters in Oyo town (Oyo state). No arrests were made in 1971 and 1972.
lope, which are less dependent on water.

The importance of water, food, and cover in the distribution of ungulates has been shown by Afolayan (1976), who studied these species at the Mkomazi Game Reserve in Tanzania and by Field (1968), who also worked in East Africa. Field observed that ungulates require water for drinking, as well as for wallowing during hot weather. Geerling and

### TABLE 2. Approximate Market Prices of Bushmeat, Trophies, and Skins of Some Large African Mammals

<table>
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<th>Animal species</th>
<th>Part of Animal Involved</th>
<th>Price (in Naira)</th>
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Data from the Regional Game Management Headquarters in Oyo town (Oyo state).

No arrests were made in 1971 and 1972.
Bokdam (1973) classified the large-mammal species they identified in Comoøe National Park, Ivory Coast, into three categories on the basis of the animals’ water requirements. Kob, waterbuck, and red-flanked duiker were classified as species that reside near water. This was also found to be true for the kob and the other allied species that we studied in the Upper Ogun Game Reserve. Elpheldt’s buffalo were classified as species that were partial to water and shade but that were also wide ranging. The third category included those species that do not have a daily need for water. Species in this category included hartebeest, roan antelope, warthog, oribi, and grey duiker.

The different vegetation zones also showed variations in the abundance and distribution of large mammals. This finding may be attributed in part to differences in plant species composition among the several zones. For example, kob, cane rat, and hare were more abundant in the riparian grassland than in the other vegetation zones. This fact demonstrates that water is not the only factor that determines the distribution of large mammals; the relative availability of perennial grasses for feeding is crucial as well. The availability of food (especially browse species) and cover in the dense savanna woodland is responsible for the relatively high density of roan antelope, bushbuck, and the somewhat lower numbers of duikers in this area. This finding supports the conclusion of Odum (1971) that distribution of large mammals is affected by availability of food and cover. Napierbax and Sheldrick (1963) have also demonstrated the importance of browse plants in the distribution and abundance of herbivores.

Utilization of Wildlife in the Upper Ogun Area

It became clear from our study that bushmeat comprises the bulk of the animal protein consumed by the people around the Upper Ogun Game Reserve. They also depend upon wildlife trophies for traditional medicine and for involving or appeasing the practices of witchcraft. Studies conducted by Ajayi (1971, 1978) and Asibey (1974) revealed that wildlife plays a significant role in the nutrition, dress, religion, and employment of the rural communities of the west African coast. In the study area, the bushmeat hunters and other traders in bushmeat realize a high level of revenue from their illegal sales. They therefore strive to maintain a flourishing trade in animals, irrespective of the law and the counter-efforts made by game managers. The number of arrests made, and the cash received in fines realized from these arrests, are negligible when compared with the number of animals that are being killed illegally every day, especially during the hunting season.

Therefore, it must be particularly emphasized that illegal hunting greatly affects the abundance and distribution of the animals in the study area, and constitutes an important factor in determining population levels, in addition to the other crucial factors, water, food, and cover.

Conclusions and Recommendations

In this study, we found that the Upper Ogun Game Reserve, which is located in a typical Southern Guinea savanna of West Africa, still contains high densities of kob, bushbuck, hartebeest, and roan antelope. The important factors that were identified as affecting the abundance and distribution of large mammals in the reserve are: source of perennial water, food (browse and grass species), cover, and illegal hunting.

Future prospects for tourism, and consequent benefits to management, seem favorable if the present methods of protection can be improved upon. One means of ameliorating present conditions might be to increase the number of patrolmen in the area. Those patrolmen who work only on a daily basis should be absorbed into the permanent service to ensure their effective cooperation and participation. Also, more patrol posts and stations should be built. Every effort should be made to encourage the participation of the local communities in every step taken by the state government to conserve wildlife in the area.

The revenue realized from the management of the reserve should be used to develop the local communities, in order to ensure their confidence and cooperation, as well as the success of the whole program. We also suggest that the reserve not be opened to tourism until 5 years after an adequate level of protection has been achieved and maintained. This study has shown that wildlife meat and trophies make a significant contribution to the socioeconomic and cultural life of the people in the area. We therefore recommend that hunting not be banned completely in the region. Instead, a buffer zone should be created around the reserve where controlled hunting can take place, while the reserve itself serves as a breeding and growing ground for the various wildlife species.

Acknowledgments

We wish to express our profound gratitude to the Chief Conservator of Forests for Oyo State and O.F. Falaye, Assistant Chief Conservator of Forests, Forestry Division, Secretariat, Ibadan, for giving us permission and the necessary assistance to carry out our field work in the Upper Ogun Game Reserve.

We are also highly indebted to Professor S.S. Ajayi, head of the Department of Wildlife and Fisheries Management, University of Ibadan, for providing us with the moral and financial support for producing this manuscript.

References


Napier-Bax, P. and Sheldrick, D.L.W. (1963) Some preliminary observations on the food of elephants in the Tsavo Royal
T.A. Afolayan—Large Mammals in Upper Ogun

Original Article

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The different vegetation zones also showed variations in the abundance and distribution of large mammals. This finding may be attributed in part to differences in plant species composition among the different vegetation zones. For example, kob, cane rat, and hare were more abundant in the riparian grassland than in the other vegetation zones. This fact demonstrates that water is not the only factor that determines the distribution of large mammals; the relative availability of perennial grasses for feeding is crucial as well. The availability of food (especially browse species) and cover in the dense savanna woodland is responsible for the relatively high density of roan antelope, warthog, oribi, and grey duiker.

Conclusions and Recommendations

In this study, we found that the Upper Ogun Game Reserve, which is located in a typical Southern Guinea savanna of West Africa, still contains high densities of kob, bushbuck, hartebeest, and roan antelope. The important factors that were identified as affecting the abundance and distribution of large mammals in the reserve are: source of perennial water, food (browse and grass species), cover, and illegal hunting.

Future prospects for tourism, and consequent benefits to management, seem favorable if the present methods of protection can be improved. One means of ameliorating present conditions might be to increase the number of patrolmen in the area. Those patrolmen who work on a daily basis should be absorbed into the permanent service to ensure their effective cooperation and participation. Also, more patrol posts and stations should be built. Every effort should be made to encourage the participation of the local communities in every step taken by the state government to conserve wildlife in the area.

The revenue realized from the management of the reserve should be used to develop the local communities, in order to ensure their confidence and cooperation, as well as the success of the whole program. We also suggest that the reserve not be opened to tourism until 5 years after an adequate level of protection has been achieved and maintained.

This study has shown that wildlife meat and trophies make a significant contribution to the socioeconomic and cultural life of the people in the area. We therefore recommend that hunting not be banned completely in the region. Instead, a buffer zone should be created around the reserve where controlled hunting can take place, while the reserve itself serves as a breeding and growing ground for the various wildlife species.

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Feral Dogs of the Galápagos Islands: Impact and Control

Bruce D. Barnett and Robert L. Rudd

Organisms introduced onto insular ecosystems, after they have become established, frequently increase to destructive numbers. Several species of mammals introduced onto the Galápagos Islands illustrate this ecological axiom. For example, domestic dogs intentionally introduced now exist as three major types: domestic, free-ranging or pariah, and feral. Problems derived from their presence are most apparent on the islands of Santa Cruz and Isabela. Feral and pariah dogs are both scavengers and predators. While other introduced mammals (chiefly feral cattle and pigs) have served as prey, in recent years severe depredations on the unique endemic Galapagian fauna have been caused by the dogs. The chief targets have included land and marine iguanas, tortoises, and colonially nesting marine birds. To counter this problem, a coordinated eradication and study program on all dog populations has been underway since 1979, and an eradication program on Isla Isabela, begun in 1981, continues with marked success. Control rests primarily on carefully placed flesh baits poisoned with Compound 1080 (sodium monofluoroacetate). Field studies on distribution, demography, behavior, and disease transmission also began on Isla Isabela in 1981. Particularly notable is the high incidence of filarial heartworm in several species of mammals, including the local human residents. Dogs are important reservoirs of this parasite. Descriptions of the problems created by the dogs and speculations on the nature of selective return to the wild state are presented.

Zusammenfassung


Introduction

The introduction of organisms from other areas can easily upset the delicate balance of natural island communities, especially when such organisms are not faced with the natural checks to their increase that are normally found in the home environment. Their rapid and successful establishment in such circumstances is likely, and is normally followed by an increase in their numbers at the expense of native flora and fauna. In contrast, island organisms, which have been isolated for a long period of time from more complex continental ecosystems, have become specialized to a simplified island environment and are often incapable of withstanding competition with, or predation by, introduced species. At the same time, other critical factors come into play. MacArthur and Wilson (1967) pointed out that because a given land area can support far fewer numbers of predators than prey, predators will be relatively rare, even on large islands; smaller islands may maintain a carrying capacity too low to support any permanent predator population. Also, the likelihood of dispersal of large, terrestrial predators to islands decreases as the distance from the mainland increases, and on islands that do not normally support large predators, natural selection has not favored the emergence of avoidance behavior in the endemic fauna.

A dangerous illustration of these concepts presently exists in the Galápa­gos Archipelago, where feral dogs seriously threaten populations of endemic fauna on the islands of Santa Cruz and Isabela (Fig. 1). Research on feral and domestic dog populations on Isabela, currently being conducted in conjunction with the Charles Darwin Research Station and the Galapagos National Park Service, should aid in understanding the establish­ment and impact of these kinds of introduced predators. Studies of the ecology and population biology of the dogs can provide a basis for the development of effective methods for their long-term control on these islands and in other areas where similar problems exist.

History

The introduction of domestic dogs to the Galapagos followed soon after the original colonization of the Archi­pelago. In 1832, José Villamil, a native of Louisiana, was granted permission by

B.D. Barnett & R.L. Rudd—Feral Dogs of Galapagos

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