

SURVEY OF GORILLAS *GORILLA GORILLA* AND CHIMPANZEES *PAN TROGLODYTES* IN THE RÉSERVE DE FAUNE DU DJA, CAMEROUN

Abstract: *The Réserve de Faune du Dja in Cameroun covers 5,260 km² of lowland tropical forest where few systematic surveys of large mammals have taken place. We adapted line-transect census methods to survey gorillas *Gorilla gorilla* and chimpanzees *Pan troglodytes* during 6 months of 1994 and 1995, and found that the Dja Reserve harbours important populations of both. The mean group size for chimpanzees was 2.2 ± 1.9 weaned individuals and their distribution seemed to be relatively even. Nest site density was 41.63/km², indicating a population of 0.79 weaned chimpanzees/km² (0.60–1.04/km²). Mean gorilla group size was 3.7 ± 3.1 weaned individuals. The overall density of nest sites was 36.37/km² which translates to 1.71 weaned gorillas/km² (1.02–2.86/km²). Preliminary results indicate populations of roughly 3,000 weaned chimpanzees and 2,500 weaned gorillas in the Dja Reserve. Gorilla distribution was uneven and concentrations of nests were found between 15 and 25 km from villages. Vegetation type and human presence seem to determine gorilla distribution in the Dja.*

Résumé: *La Réserve de Faune du Dja au Cameroun couvre 5,260 km² de forêt tropicale des plaines basse altitudes dans lesquelles peu d'inventaires systématiques des grands mammifères ont été effectués. Nous avons adapté les méthodes de recensement par transect linéaire pour échantillonner les gorilles *Gorilla gorilla* et les chimpanzés *Pan troglodytes* pendant six mois entre 1994 et 1995. Nous avons trouvé que la Réserve du Dja héberge d'importantes populations des deux espèces. La taille moyenne d'un groupe de chimpanzés a été évaluée à 2.2 ± 1.9 individus sevrés et leur distribution apparaît relativement continue. La densité des nids est de 41.63/km², indiquant une population de 0.79 chimpanzé sevré/km² (0.60-1.04/km²). La taille moyenne des groupes de gorilles était de 3.7 ± 3.1 individus sevrés et la densité globale des sites de nidification s'élève à 36.37/km², ce qui correspond à une densité de 1.71 gorilles sevrés/km² (1.02–2.86/km²). Une estimation préliminaire indique que des populations d'environ 3,000 chimpanzés sevrés et 2,500 gorilles sevrés sont présents dans la Réserve du Dja. La distribution des groupes de gorilles est discontinue et des concentrations de nids ont été trouvées entre 15 à 25 km des villages. Le type de végétation et la présence humaine apparaissent importants dans la détermination de la distribution des gorilles du Dja.*

Introduction

The fauna of the Réserve de Faune du Dja (5,260 km²) in south-east Cameroun is poorly known. Gartlan and Struhsaker (1972) presented preliminary information on primates of the Dja. At least 10 species of diurnal primates (*Miopithecus talapoin*, *Cercopithecus cephus*, *Cercopithecus nictitans*, *Cercopithecus pogonias*, *Cercopithecus neglectus*, *Cercocebus albigena*, *Cercocebus galeritus*, *Colobus guereza*, *Pan troglodytes troglodytes*, *Gorilla gorilla gorilla*) were already known to occur in the Dja. Gartlan (1989) noted, however, that no systematic inventories had been carried out in the Reserve.

Methods

The published literature on techniques for assessing the density of populations of animals using line-transects is abundant (e.g., Tutin & Fernandez, 1983), whilst the theory of line transecting is discussed, critically evaluated, and presented with models and survey designs by Buckland *et al.* (1993). We adapted line-transect census methods developed by Tutin and Fernandez (1983) to survey gorillas and chimpanzees during six months of 1994 and 1995. Seventeen transects, with a combined length of 95 km, were each surveyed twice for ape nests, at intervals of 5–7 months. A critical point to note with current census techniques is that strip-width is not predetermined: all animals or objects seen should be recorded, irrespective of their distance from the centre line of the transect. "Effective strip widths" are estimated *post hoc* by analysing perpendicular distance from the transect to the animal or object sighted, and "detection functions" determined (*i.e.*, the probability of detecting an object that is at distance y from the random line). This differs from surveys where a strip of a fixed width is searched. However, an important assumption of the DISTANCE model (see below) is that all objects of interest which lie on or above the centre line are detected with certainty (Buckland *et al.*, 1993). Violation of this assumption leads to underestimation of density, and renders the model inapplicable.

Because of the importance of detection of all objects on the line, and because of the reduced importance of "outliers" at relatively large distances from the transect line, most effort can be put into searching near the centre line of the transect. During this survey, particular effort was made to find all nests present at any individual nest site. Once a nest was detected, observers left the centre line to carry out a thorough search and record all nests whether or not they were visible from the transect centre line. Perpendicular distances to the centre of each nest site were calculated from the perpendicular distances measured to each nest. It should be noted that this differs from analyses of individual nest density, per Tutin and Fernandez (1983).

Due to the large size of the Dja Reserve and the short

duration of this study, extrapolation was to be made from a relatively small sample; thus, sampling of both the habitat and the animal populations had to be random (Buckland *et al.*, 1993). Transects were stratified according to distance from the nearest village, as recommended by Barnes and Jensen (1987), and orientated to lie across the drainage pattern with the intention of sampling a representative proportion of all vegetation types. GIS information was collected with an Ensign ExL GPS manufactured by Trimble Navigation. The field team consisted of one or two researchers accompanied by a local guide, plus two to four transect cutters and a compass bearer. Collecting data on animal signs is compatible with cutting of transects, and is in fact desirable, as animals may begin to use established transect lines as paths of travel. Such a change in animal movements would increase the density of signs located close to the centre line.

Data were analysed with the computer software package DISTANCE (Laake *et al.*, 1994), which produced estimates of the densities of ape nests from perpendicular distances recorded on transects. Densities of gorillas (G) and chimpanzees (C) were calculated from nest site densities (N) output by DISTANCE using the formula: $G \text{ or } C = (N \times \text{mean group size}) / \text{mean longevity of nest sites}$. The mean duration of chimpanzee nests in northeastern Gabon was found to be 113.5 days (Tutin & Fernandez, 1983) and this figure was applied to our data. Mean longevity of gorilla nest sites varies with the types of nests constructed, but we chose the 78 days mean estimated from long-term studies at Lopé (Tutin *et al.*, 1995). Mean group sizes were calculated from the number of nests at fresh nest sites only, including some sites found away from transects.

Results

Chimpanzees

Mean group or party size for chimpanzees was 2.16 ± 1.92 weaned individuals ($N = 62$, range = 1–9, median = 1), and the overall density of nest sites was estimated to be $41.63/\text{km}^2$. As chimpanzee (tree) nests have a greater longevity, this translates to a density of 0.79 weaned individuals/ km^2 (0.60 – $1.04/\text{km}^2$). To estimate the population for the Reserve as a whole, we took the lower limit of density estimates (0.60 weaned individuals/ km^2) suggesting a population of about 3,000 weaned chimpanzees for the Dja. Densities in different sectors were highly variable and seasonal differences were pronounced (Table 1). Despite this variation, the distribution of chimpanzees was considered to be relatively even when compared with that of other large mammal species.

We recorded vegetation type along transects and noted that the forest was often dense with secondary growth (22.8%), including an abundance of the

lianescent herb *Haumania danckelmaniana*, and thickets of rattan *Ancistrophyllum secundiflorum*. A monotonous topography seems to have contributed to the formation of swamp vegetation that is dominated by species of *Raphia* or by *Cyperus* and *Pandanus* (9.0%). Seasonally inundated forest, where *Uapaca* spp. trees are common, also covers a substantial area of the Dja (7.5%). Dry forest formed 55.0% of the transect sample. Chimpanzees showed a strong preference for nesting in mature dry forest (75.8% of nest sites) and a disproportionately low number of nests were located in secondary and seasonally inundated forest ($\chi^2 = 22.8$, $df = 2$, $p < 0.0001$).

Gorillas

We estimated an overall density of 36.4 gorilla nest sites/ km^2 . Using fresh nest sites only, including some sites found away from transects ($N=33$), mean gorilla group size was 3.7 weaned individuals (range = 1–12). Combined with site density, this translates to 1.7 weaned gorillas/ km^2 (range 1.02 – $2.86/\text{km}^2$). The majority of gorilla nests (61 of 94 sites; 64.9%) were found in two concentrations; one occurred between 15 and 25 km from villages, which coincided with a 700 m wide *Cyperus-Pandanus* marsh. The other was a river basin where *Raphia* swamps, forest, secondary gaps, old secondary forest with *H. danckelmaniana* and *A. secundiflorum*, and thickets predominated. In this sector the mean density of weaned gorillas was high at $5.01/\text{km}^2$.

In this same sector, a large difference in density was found between sampling periods (July: $7.88/\text{km}^2$; December: $2.69/\text{km}^2$). An overall density of 0.47 gorillas/ km^2 (0.23 – $0.99/\text{km}^2$) was calculated, excluding these two concentrations as they were considered to be unrepresentative of the reserve as a whole. If an extrapolation is made from this estimate to the entire reserve, the gorilla population is estimated at 2,472 weaned individuals.

The proportion of nests built in secondary forest and light gaps was only slightly higher than if gorillas' choice of nest site were random. Gorillas showed a strong tendency to nest in seasonally inundated and swamp forests which represented only 16.5% of the forest (42.4% nest sites; $\chi^2 = 20.39$, $df = 2$, $p < 0.0001$). Most nest sites were found at Ndengué (7.88 gorillas/ km^2 in July) and 49% of these were in *Raphia* swamp.

Discussion

Chimpanzees

The estimate of 0.79 weaned chimpanzees/ km^2 concurs with population estimates available for other regions of Central Africa. Tutin and Fernandez (1983) estimated the density of chimpanzees in Gabon to be $0.49/\text{km}^2$ (0 – $1.78/\text{km}^2$); White (1994) found 0.2 – $1.1/\text{km}^2$ for Lopé, and Stromayer and Ekobo (1991) reported 0.15 –

0.34/km² in south-eastern Cameroun.

Almost all tree nests found during the present study were attributed to chimpanzees, and we must consider the possibility that tree nests could have been misclassified following the recent finding of Tutin *et al.* (1995) that “due to the longer life span and greater visibility of tree nests, a proportion of gorilla nest sites ‘convert’ to chimpanzee nest sites when only tree nests remain visible”. Consequently, gorilla nest sites could be mistaken for chimpanzees’ nests during surveys, so that chimpanzee numbers would be over-estimated. It also remains to be established how often gorillas build tree nests. It is probable that some tree nests were misclassified during the present survey, especially given the very low number of tree nests attributed to gorillas. Only six tree nests found in the Dja were in association

gorillas have a greater association with inundated and riverine forests than with secondary vegetation. Gorillas in the Dja showed similar tendencies with respect to vegetation type.

There may be several reasons why vegetation type plays such a major role in determining ape distribution. We begin with the observation that there is a relative lack of nesting material in dry forest. *H. danckelmaniana* occurs at high density in dry forest and stems of this particular species are covered with spines. The spines may make them less suitable for nesting than other species of Marantaceae that are abundant in swamps and seasonally inundated forest, such as *Marantochloa* spp. and *Halopegia azurea*. *Cyperus-Pandanus* marsh areas provide both food and refuge, whilst the secondary forest, light gaps, and *Raphia* swamps provide abundant

Table 1. Chimpanzee densities in four sectors of the Reserve de Faune du Dja, Cameroun (1994–95).

Sector	Month sampled	Transect length (km)	No./km ²	Month sampled	Transect length (km)	No./km ²
Djolimpoum	May	25.0	0.69	December	23.1	0.95
Malele	June	25.0	0.35	December	23.0	0.55
Ndengué	July	24.7	1.33	December	24.7	0.56
Alat	August	20.0	2.04	January	20.0	0.67

with ground nests, and could thus be confirmed to have been built by gorillas.

Several tree nests were seen to persist for more than six months (at least 183 days; N = 10 sites). The decay rate used to estimate abundance has a strong influence on the density estimates obtained, so if nest duration in the Dja turns out to be greater than 113.5 days, we will have over-estimated the size of the chimpanzee population. To obtain a more accurate estimate of density, studies of nest decay are now needed from this site.

Gorillas

Comparative estimates of gorilla densities from other studies range from 0.44 gorillas/km² in Gabon (but up to 9.16/km²; Tutin & Fernandez, 1983), 0.89–1.45/km² in Central African Republic (reaching 5.6/km² in light gaps and up to 10.96/km² in secondary forest, Carroll, 1988); 1.6/km² also in CAR (Fay, 1989), 1.2/km² in northern Congo (2.4/km² in swamp forest, Fay & Agnagna, 1992) to 2.6/km² in the Likoula Swamps (Fay *et al.*, 1989). Vegetation type and distance from human population are the two major factors identified as influencing the distribution of elephants *Loxodonta africana* in tropical forest (Barnes & Jensen, 1987; Barnes *et al.*, 1991), and the same may be true for gorillas. High local densities in swamp forests were confirmed by Blake (1993) who found 5.88 gorillas/km² in *Raphia* dominated swamp, and 2.88/km² in *Raphia-Uapaca* forest. Lahm (1993) also showed that

herbaceous food. Fay *et al.* (1989) found that gorillas feed extensively on *Pandanus candelabrum* and other plants common in the Likouala Swamps of northern Congo. Similarly, herbaceous foods are common in the swamp forests of the Dja.

Blake (1993) explained gorillas’ use of the Likouala Swamps as a modification of the gorillas’ behaviour to avoid areas of human impact. Lahm (1993) also suggested that gorillas in northeastern Gabon survived by taking refuge from hunters in swamps, marshes and seasonally inundated forest. Species that are seldom hunted are nonetheless affected by the general disturbance of human activity. Both game and non-game species survive by adopting strategies to avoid human contact, such as changes in habitat use (Lahm, 1993). Whilst no attempt was made to evaluate hunting intensity during the present study, it is known that hunting occurs in the Reserve and that hunters regularly cross the Dja River to check their trap lines. We received reports that hunters were particularly active in the northeast and in parts of the south due to a high local demand for bush meat. We also found many snares in the south, although snares may not be a good indicator of the level of hunting of apes and elephants, which requires firearms. The lack of any significant relationship during this survey between large mammal densities and distance from the nearest village may be because hunters in the Dja are known to travel up to 40 km to check their snare lines (G. Ngandjui & P. Muchaal, pers. comm.), and hunters will certainly travel farther for the “grande chasse”. Most parts of the

Dja are less than 40 km from a village, whereas in northeastern Gabon hunting is usually concentrated within 10 or 15 km of villages (Lahm, 1993).

If gorilla distribution is patchy with localised high densities, how do we predict their distribution in other parts of the Reserve? In this study, nest sites were concentrated on transects between 15 and 25 km from villages. The estimate of 1.71 weaned gorillas/km² is surprisingly high, given the impression gained during fieldwork. Gorillas were encountered only twice during the surveys, although we often heard chest beats during the night while camping far from villages and in dense vegetation close to a river. The lower end of the estimate is considered the best general indicator of gorilla density (0.47/km²), but even this may not be appropriate for the entire Reserve.

Conclusions and Recommendations

It is clear that the Dja Reserve harbours important populations of gorillas and chimpanzees, and that the gorillas show a strong tendency to nest in seasonally inundated and swamp forest. These are habitats that provide abundant food, nesting material, and refuge from hunters. It would be unwise to extrapolate from these preliminary density estimates to the Reserve as a whole. Therefore, these results should be viewed with extreme caution. Further longer-term studies are needed to evaluate the patchiness of gorilla distribution and the importance of each vegetation type in sectors of the Dja that we were unable to visit.

A problem of particular concern is the killing of gorillas, chimpanzees, elephants and monkeys in southeastern Cameroun. All are hunted for their meat, and occasionally for trophies. We recommend that species priorities be established for all conservation actions, and that local people be taught to differentiate between threatened species and others which are more abundant. Under no circumstances should sport hunting be allowed in this region.

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succès, mais plutôt que les agences de développement qui appuient cette approche ont plus d'argent à offrir que les organisations qui favorisent une approche plus holistique de la conservation, c'est-à-dire une approche qui priorise la protection d'écosystèmes entiers sans possibilité d'exploitation. Si les réserves ont un rôle important à jouer dans la conservation, alors les taux de récolte sélective devraient être établis en fonction d'une conservation de tous les membres d'une communauté mature et non en fonction de la seule commodité de ce qui est récolté.

A BIOLOGIST'S PERSPECTIVE ON THE ROLE OF SUSTAINABLE HARVEST IN CONSERVATION

Abstract: *Sustainable harvest is a misunderstood and misused concept that has too often mistakenly been equated with effective conservation. This essay calls attention to recent publications that support a well-known, but generally ignored understanding of the severe limitations and general failure of attempts at sustainable harvest. Based on 35 years of experience with tropical conservation, I believe one of the main reasons the concept of sustainable harvest has gained preeminence in today's conservation arena is not because it has a well-established history of success, but because the development agencies that support this approach have far more money to offer than do organisations that advocate a more holistic approach to conservation with an emphasis on protection of entire ecosystems without exploitation. If extractive reserves are to play any significant role in conservation, then harvest levels must be established from the perspective of conserving all members of the old-growth community rather than just the commodity being harvested.*

Résumé: *La récolte durable des ressources est un concept mal compris et mal utilisé qui a, trop souvent, été mis sur le même pied que la conservation efficace. Le présent essai attire l'attention sur de récentes publications qui montrent les limites importantes du concept de récolte durable et l'échec habituel de cette méthode, une chose bien connue mais souvent ignorée. Sur la base de 35 ans d'expérience en conservation tropicale, je crois que la raison principale pour laquelle le concept de récolte sélective est omniprésent dans les sphères d'activités de conservation d'aujourd'hui, n'est pas parce qu'il s'agit d'une méthode à grand*

“Sustainable harvest” is one of the most commonly misunderstood and misused concepts in today's conservation arena. It is generally meant to refer to activities that involve the extraction of a natural resource in such a manner that the resource in question is not depleted and can renew itself so that similar levels of exploitation can occur indefinitely. This article addresses several of the more important misconceptions surrounding the idea that sustainable harvest is an important strategy for conservation and offers an explanation as to why the concept is currently so popular.

Unfortunately, the concept of sustainable harvest has too often been equated with effective conservation. To the contrary, sustainable harvest is invariably an activity whose objective is the material welfare of a select group of humans. Sustainable harvest does not necessarily have anything to do with conservation of other species except in a coincidental and passive way. Rarely is consideration given to the impact of so-called sustainable harvests on other, non-marketable species that are part of the ecosystem being exploited.

Four years ago Robinson (1993) provided an excellent critique of the concept of sustainable development and showed how it is generally incompatible with the goals of conservation. In spite of this and other forceful arguments and case studies showing how sustainable development projects can be counter-productive to conservation (*e.g.*, Wells & Brandon, 1992; Oates, 1995, 1997; Brandon, 1997; Kramer *et al.*, 1997; Noss, 1997), the “sustainable development” movement as a purported conservation strategy is gaining in popularity and is being funded at higher levels than ever before.

In the case of tropical forests, the sustainable harvest of timber has been given recent attention in semi-popular articles (McRae, 1997; Rice *et al.*, 1997), overviews by foresters and plant ecologists (Dickinson *et al.*, 1996), scientific tomes (Struhsaker, 1997), and policy perspectives by international development agencies (CIDA, 1997). One clear message from these publications is that the relevance of sustainable harvest to conservation remains very much open to question. My objective here is to highlight some of the key issues that must be considered if future attempts at sustainable