Case study 4 - Monitoring of Wildlife Populations : Lessons Learned from Central Africa

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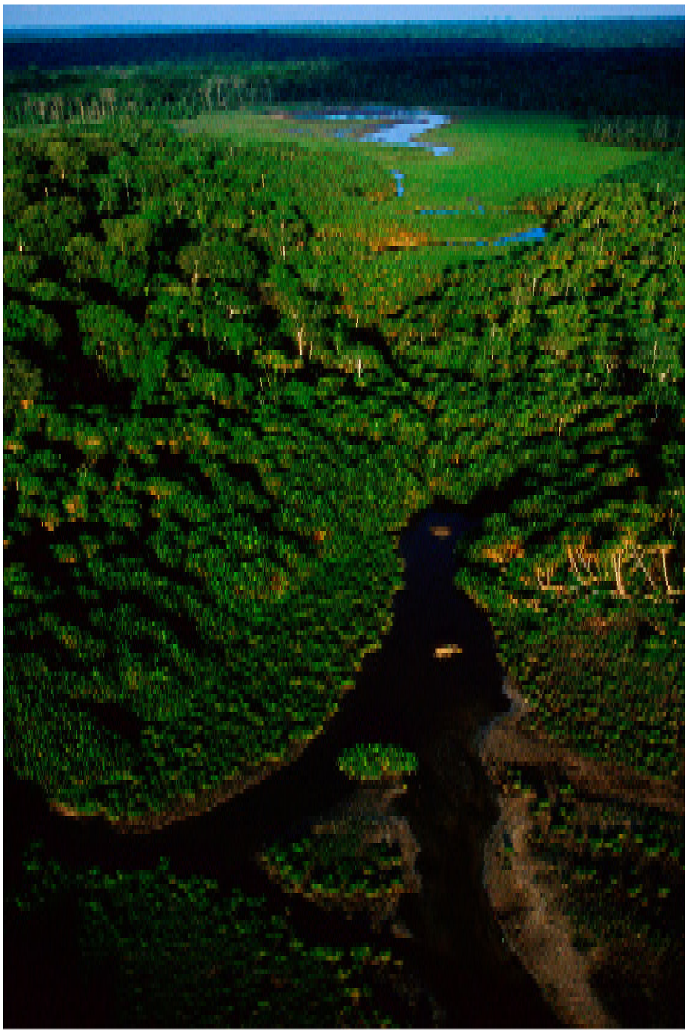
Introduction : The need for standardized wildlife monitoring

The biodiversity within the humid tropical forests of the world is typically about 50 percent of the global total, although they cover only 15 percent of the earth's surface. The Central African block is the second largest of these forests after Amazonia, and much of it is still unlogged, closed canopy tracts with continuous cover. These forests contain important populations of large, endangered mammal species such as forest elephant, gorilla, bonobo and chimpanzees, plus medium-sized mammal species including monkeys, forest antelopes, pigs and buffalo. In addition, the individual trees within these forests are often many hundreds of years old, and maintain a myriad of smaller species of fauna and flora, often endemic to small areas within the main forest block (although the degree of endemicity varies tremendously over the area). There have been long cycles of forest retreat and regrowth, caused by climatic cycles; at present the cycle is approaching its maximum for forest cover and would eventually take over the savannah islands within the block if not held back, up to a point, by burning.

Archaeological record

People have lived in these forests for many thousands of years. The archaeological evidence suggests that the vegetation was not always simply affected by the climatic cycles, but was also greatly changed by people's activities. There seems to have been extensive habitation, clearing and cultivation in the Congo Basin between about 1000 BC to about 400 AD, followed by a human population crash. In the Gabon area (the Ogooué basin), a similar human population crash seems to have occurred in about 500 AD, after an intensive period of 800 years of iron working, which would have required a great deal of forest

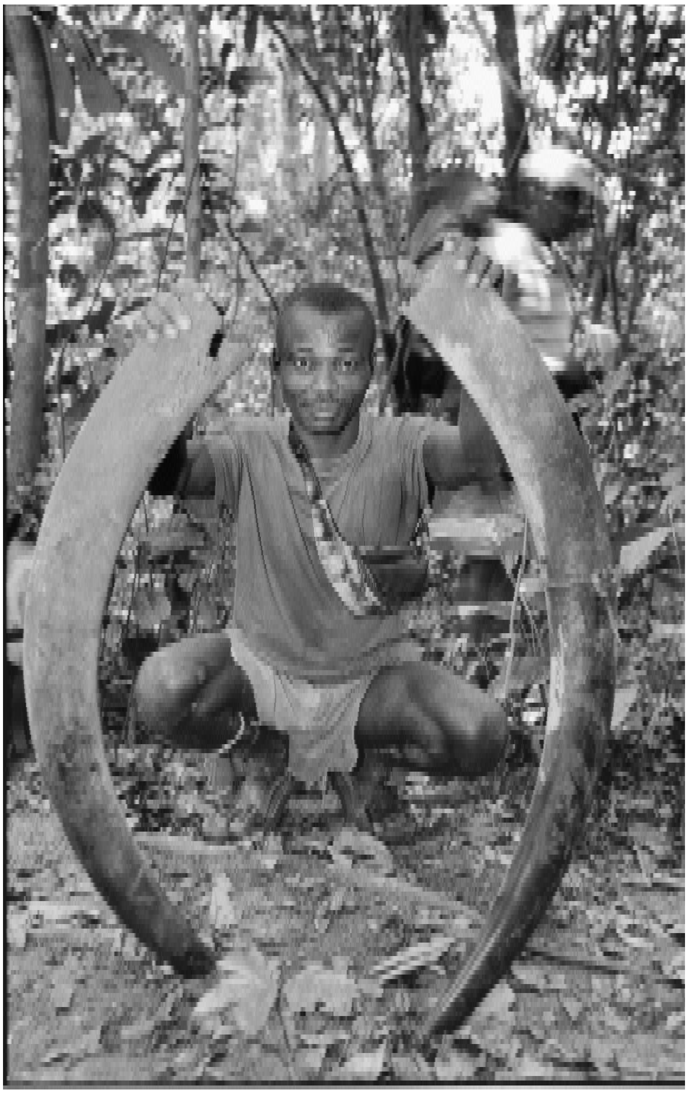


cover removal (Mbida et al., 2000; Oslisly, 2001; Willis et al., 2004; White, 2001). The forests then recovered, at least for a while. In the last few hundred years, and especially over the last hundred years, the rate of harvest of many species of wild plants and animals has far outstripped the rate at which they are replaced leading to a net decline in populations. This accelerated harvesting of wild species has been caused by three main factors: (i) great improvements in the technology of extraction (firearms, metal cables, chainsaws); (ii) rapidly growing human populations in the region (about 3 percent per year: UNDP (2006)), resulting in a doubling of the population every 20 years); and (iii) growing international markets for exotic goods such as ivory, tropical hardwoods, and even bushmeat. China is now the world's most important importer of ivory, tropical logs and sawn wood (ITTO, 2006; Milliken et al., 2007) and most of their ivory and much of their timber comes from the Central African forests.

Vulnerability

The vulnerability of any given species is a function of both its intrinsic rate of reproduction, and of its value to humans as a resource. General rules of thumb are that, for any given taxonomic group, the larger the individual, the slower it reproduces. For example, hardwood timber trees can take many decades to reach maturity and to set seed, and even then some species only fruit once every few years. Small herbs, by contrast, are often annuals. The same is true for animals – the slowest to reproduce are the apes and elephants, which can take up to 15–20 years to reach maturity, and even then only give birth to one young every four years. Contrast this with rodents, many of which reach maturity in a matter of months and can produce litters of several animals more than once a year. Likewise, the commonest small antelope in these forests, Blue duikers, can reproduce after one year and give birth to one offspring annually.

The value of certain products also leads to overharvesting. Overexploitation of most of the valuable hardwood species currently on the international tropical timber market has led to most of them being placed on the IUCN Red List – for example most of the central African mahogany species (all the Entandrophragmas, Afrormosia, Wenge, African mahogany, Bossé), plus Okoumé, Moabi, Azobe, Bahia and a great many others are all now either considered Endangered or Vulnerable (IUCN Red List, 2006). The value of ivory has led to a sharp decline in elephant numbers across the world, and most recently in Central Africa (Blake et al., 2007). Wild meat is considered a traditional luxury in modern Central African cities and it is often served on important occasions (marriages, funerals, etc.). Although it is more expensive than domestic meat in cities, people are prepared to pay the higher prices if they can afford to (Wilkie et al., 2005).



Relevance to management

What does this mean for the more vulnerable plants and animals of the Congo Basin? Outside protected areas (i.e., national parks and reserves), it is likely that most of the large mammals will be hunted out of the forests within the next few decades, unless rapid and effective wildlife management strategies are undertaken immediately. Indeed, in many areas, especially those in countries with high human population density, this has already happened, especially around towns and larger villages. Even some protected areas in the region have effectively no real protection and exist only on paper. For the vulnerable plant species (mostly the hardwood trees), only truly sustainable logging will result in the long-term survival of their populations. By "sustainable" we mean harvesting at or below the rate of recruitment of young trees into the reproductive population, implying protection of seed trees, maintaining long felling rotations, and maintaining the seed disperser agents, most of which (80 percent) are mammals and large birds in this region.

Monitoring and evaluation

In order to verify whether the chosen management strategies are actually having the desired effect on maintaining the vulnerable, slow-reproducing, large species (elephants, apes, large trees) plus the smaller but targeted species such as forest antelopes, pigs and monkeys, monitoring programmes are essential. Over the last two decades, many different bodies including governments, professional researchers and conservation organizations have realized that a continuous, permanent monitoring programme across the whole Congo Basin is necessary to follow changes in the extent and quality of the forest itself, the species living within it, the distribution and abundance of its fauna, and the distribution, abundance and activities of its human populations. Forest-cover monitoring is generally most cost-effective using remote sensing, and this has been and continues to be successfully carried out in the Congo Basin (see Chapter 9, CBFP: State of the Forest 2006 and Chapter XX in this series of Lessons Learned). By contrast, there remains an important need for monitoring of wildlife and human population distribution and abundance within the forest itself. In order to be able to detect change over such a wide area and over long periods of time, the methods of data collection and reporting have become standardized, and the indicators for animal and human populations are basically the same throughout not only the Congo Basin, but in all tropical humid forests worldwide.

Methodology of wildlife monitoring

Monitoring of elephants and large ungulates in the grasslands of Africa has been carried out for decades using direct counts of individuals or herds during foot surveys, counts from off-road vehicles or from small aircraft. All these methods assume that most of the animals can actually be seen! In the savannahs this is mostly true and methods have improved over the last 20 years to calculate the numbers of animals likely to have been missed during the surveys. However, animals living in a closed canopy forest are not so easily counted. Firstly, they cannot be counted from an aircraft, because of the tree cover. Secondly, counts cannot be made from vehicles, as the distance one can see into a forest is a few metres, and animals move away from the sound of an approaching car and are hidden by vegetation. Finally, even people walking through the forest can see only a short distance, and animals usually detect their presence and move away before they can be recorded. This has led to the development of methods that do not require that the animals themselves are detected, but rather that the signs they leave behind are the units of census.

Since biologists began working in the region, we have been producing maps of where the different species occur. Population size estimates for some species such as elephants and apes followed. These estimates ranged from "best guesses" based on interviews with local hunters or foresters at remote sites, through sample-based methods aimed at estimating a mean density across a large area, to, in the case of some populations, fairly accurate head counts which assumed that most of the animals in an area of interest were known individually. This latter approach was really only possible with small ape or elephant populations which were the subject of intensive study and where individuals are distinctive. However, it is neither feasible nor cost-effective to monitor multiple groups over a large landscape. Sampling methods had to be developed which work under the forest canopy. Over the last 20 years, the methods for monitoring large mammal abundance and distribution in lowland tropical forests have become standardized. The methods are based on calculating the density and/or abundance of the animals themselves, or certain signs (such as nests or dung) which are produced at a fairly uniform rate by each individual animal, and which are visible no matter what the substrate (unlike footprints). Surveys carried out using these methods between about 1983 and now have allowed alarm bells to be rung for the great apes in Central Africa (Walsh et al., 2003) where it was realized that half of all apes had died over a twenty-year period due to a combination of Ebola and hunting. Similarly, the international elephant monitoring programme of IUCN/CITES (MIKE, or Monitoring the Illegal Killing of Elephants) showed that even in what had been believed to be the stronghold of forest elephants in central Congo, there were a mere handful remaining (MIKE, 2005; Blake et al., 2007). These types of surveys were also used to inform the Regional Action Plan for the Conservation of Chimpanzees and Gorillas in Western Equatorial Africa (Tutin et al., 2005) and the revision of the status of the western lowland gorilla from Endangered to Critically Endangered (Walsh et al., 2007).

Lessons learned

Avoid bias

Much of this work has been spearheaded by groups of wildlife mathematicians, who have examined the sources of bias caused by pitfalls into which one can easily fall (Buckland et al., 2001, 2004; Hedley and Buckland, 2004; Sanz et al., 2007; Sutherland, 1996; Walsh and White, 1999; Walsh et al., 2000, 2001; and many others). One of these pitfalls was that people would often walk along existing roads to collect animal or human data. It was much easier, much faster, and avoided wetlands and other habitats difficult to traverse. Of course this resulted in an overestimation of human signs and an underestimation of animal signs, as hunting and trapping was usually more intensive near roads. Another bias was to carry out an intensive survey of one small area and then extrapolate to a much larger area without good knowledge of different habitats or hunting pressures that might be present in the areas not surveyed. . For these reasons, modern surveys now try to cover the entire area of interest, using an evenly spaced sampling plan, so that the sampling is representative of the whole site (whether it is a protected area, a logging concession, a community forest, or a combination of these and other land-use types).

Don't jump in and do an intensive survey right away

In general, any wildlife monitoring programme goes through a series of steps. A short site visit is made to assess logistics, contact local communities, and hear peoples' perceptions of wildlife in their forests. This is often followed by a pilot study consisting of walking for a week or so in the forest, and if wildlife seems to be relatively abundant, by a few pilot transects distributed evenly throughout the area of interest (straight lines along which wildlife signs and human activities are recorded and georeferenced). The results of the pilot transect are used to decide whether to do a survey where the objective is to estimate animal density or whether simply to map relative abundance of the target species (and of human activity). For estimating density, a comprehensive survey design is set up over the whole area, which will have enough samples and enough overall effort to estimate animal density with an acceptable degree of precision (a measure of the intrinsic variability of the data across the area). The results provide an estimation of animal (or sign) density, plus the data is set to create distribution maps.

In the cases where wildlife has been intensively hunted over a number of years, we simply cannot do enough transects to assess animal abundance without spending huge amounts of time (and thus money) which could otherwise be spent on activities which would reduce the hunting pressure. In these cases a survey design is drawn up which consists of lines across the area of interest, which are walked by field teams, but along which they collect a smaller set of data than on transects, and along which they move about four times as fast as on transects (so the cost of these surveys is about a quarter of that of those designed to assess density). The results of this type of survey, known as reconnaissance surveys, are expressed as the number of animals or animal signs (or human signs) per kilometre walked, and serve as the basis for maps of animal and human distribution and relative abundance over a landscape.

Training people takes time and has to be done well

Over time, we have realized a great deal of training is necessary for the survey teams to bring back meaningful data. In the early stages of work in the region (in the early 1990s), training courses of a week or two were given, after which teams carried out work for months without supervision. However subsequent examination of the results showed that they often made mistakes, got lost, or lost data. Since then training courses have been longer, with a great deal of practical work involved, and repetition of field tasks so that people get used to the different aspects of the field work.

Back up data and reports in several places!

The Central African region is a volatile one, to say the least. Most of the countries in the forest block have undergone either one or more full-blown civil wars or some kind of regionally restricted civil unrest in the last two decades. Apart from the loss of life, the long-term results are a general lowering of the standard of living for urban dwellers (food restrictions, loss of access to medical supplies and services, cuts in electricity and water supplies (very isolated rural populations are sometimes not so much affected)), and the deterioration of national infrastructure (railway lines, roads, public buildings such as schools, etc.). Importantly, the national documentary storage and/or scientific services are often pillaged during civil war. National herbaria, museums, ministries, and all offices that might contain computers have been broken into and all useful objects removed, including the paper on which herbarium specimens were mounted. This has important implications for long-term monitoring. All data and reports should be recorded electronically, copied, backed up, and kept in several places: at the site of origin, plus in the appropriate national ministry, plus (if they were produced by another body) at the local and offshore offices of the scientific or conservation institution which produced them. At present (2008), a monitoring database for Central Africa is being constructed (the FORAF project) which will be web-based and thus not subject to local unrest which has destroyed so much of the documentary evidence of past surveys.

Finally, as part of these "Lessons Learned", we present a Decision Tree which was originally designed as part of the IUCN Best Practice Guidelines for Surveys and Monitoring of Great Ape Populations (Kuehl et al., 2008). The book will be mainly online and contains chapters on survey design, field practicalities, and training. It was written using a great deal of the experience gained in carrying out surveys and monitoring programmes in the Central African forests from 1990–2007. The Decision Tree is laid out like a botanical key, where successive questions lead the reader to a series of decisions as to how to

carry out the survey.

What to do when: A decision tree for wildlife surveys in forested environments

I. First let us assume you need to know how many animals are present in the population

Question 1. Are all animals in the population known individually and can they be found within a few weeks AND/OR are they relatively few in number, and found within a small area?
This is the case with very few animals. The Rwanda tourist gorillas come close!

a. Yes: carry out full count of known individuals, OR use a sweep sample to cover the whole of the area of interest.
b. No: go to Question 2.

Question 2. Is the rough encounter rate of nest groups or other signs that will be used to estimate density already known?

c. No: conduct pilot study consisting of a few transects throughout the area of interest in order to obtain a rough idea of encounter rate (this should only take a couple of weeks). Then go to Question 3.
d. Yes: go to Question 3.

Question 3. Decide on the target coefficient of variation you require for the survey. If the survey or series of surveys is to be used for monitoring purposes, then a power analysis should be conducted to estimate the probability of being able to detect a trend given the potential variability in the data and the given monitoring design (same can be said for methods based on mark-recapture, etc.). Using the encounter rate derived from the pilot study, calculate how many kilometres of transect you would need to estimate density of nest groups (use the formula found in Chapter 7, section 7.2.2.1. of Buckland et al., 2001). Is the number of kilometres feasible considering the time and resources that you have available?

e. Yes: design a transect-based survey using a combination of ArcView or ArcGIS and the DISTANCE program, and implement it using trained teams in the field; use the results to estimate the population of apes in the area surveyed.
f. No: go to Question 4.

Question 4. You cannot calculate density without enormous cost. Therefore you cannot estimate numbers of animals using transect methods. Given the practical constraints, are encounter rates too low to enable density calculations from transect methods?

g. Yes: if you have access to trained staff and a partner laboratory to process the information, consider designing a survey using genetic markers and implement it. (NB: A pilot study is advised – this may or may not be more costly than transect methods).

h. No: consider index methods (go to Question 5).

***II. Either you cannot estimate how many animals are present in the population and/or you do not need to know at this point. However you can calculate area of occupancy (distribution maps) and relative abundance*.**

Question 5. Are there sufficient resources to cover the whole area using recce walks?

i. Yes: create a recce sampling design using a combination of ArcView or ArcGIS and the DISTANCE program and implement it using trained teams in the field. Results will provide a distribution map and relative abundance over the area.
j. No: consider interview-only surveys.

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