Ndoki Likouala Surveys

Progress to August 2011

Fiona Maisels

In 1996, the International Union for the Conservation of Nature moved the western lowland gorilla *Gorilla gorilla gorilla* from Vulnerable to Endangered because of the continuing pressure from hunting. Just eleven years later, or just over half a gorilla generation, it was again moved, this time from Endangered to Critically Endangered (Walsh et al. 2007). This was because it was calculated that between 1980 and 2002 perhaps half of all the world's gorillas had died due to the combination of continued hunting and the epidemics of a viral disease, Ebola hemorrhagic fever (Leroy et al. 2004; Rouquet et al. 2005; Walsh et al. 2003). This disease hit large areas of eastern Gabon and western Congo in at between 1994 and 2005 killing hundreds of villagers and possibly thousands of apes and other animals in the surrounding forests (Bermejo et al. 2006; Walsh et al. 2003). It is suspected that the disease is spreading slowly to the east (Walsh et al. 2005), and is a very high potential risk to the large populations of apes still in the forests of Northern Congo, the south-western Central African Republic, and south-eastern Cameroon, all of which together form a large forest block interrupted only by rivers (Fig. 1).

Recent work by WCS in the Republic of Congo suggests that perhaps 120,000 gorillas occur in the north of the country (Stokes et al. 2008) which means that up to 75% of the world population of western lowland gorillas *Gorilla gorilla gorilla* could be within this single large area. In addition it is likely that perhaps 20% or more of all central chimpanzees *Pan troglodytes troglodytes* live in Congo (this time including Conkouati, in southern Congo) with most of the rest of both the world's gorillas and central chimpanzees living in neighboring Gabon.

How do we know this? Information on distribution of apes and other wildlife in the region is now available because since the 1990s, there has been greatly increased efforts for wildlife and human impact surveys and monitoring throughout Central Africa. Since 1990, twenty new national Parks have been created in the three countries of Gabon, Cameroon and Congo. There is a clear need and an opportunity for a comprehensive monitoring program applicable throughout the region. Surveys- and standardised training courses- started in Gabon, the Republic of Congo, and in DRC in the 1980s and early 1990s, and intensified in the 1990s and 2000s (Fig. 2). The methods are now institutionalised by the CITES-MIKE programme (Monitoring of Illegal Killing of Elephants) (MIKE 2005) and are also the standard IUCN methods (Kühl et al. 2008).

There is a five-step process from simply surveying an area through to assuring its conservation. The first is to train staff, the second is to design and implement surveys, the third is to analyze and report on the results, the fourth is to ensure results are fed back into effective conservation management and the fifth is to use the results to establish regular cycles of monitoring for adaptive management.

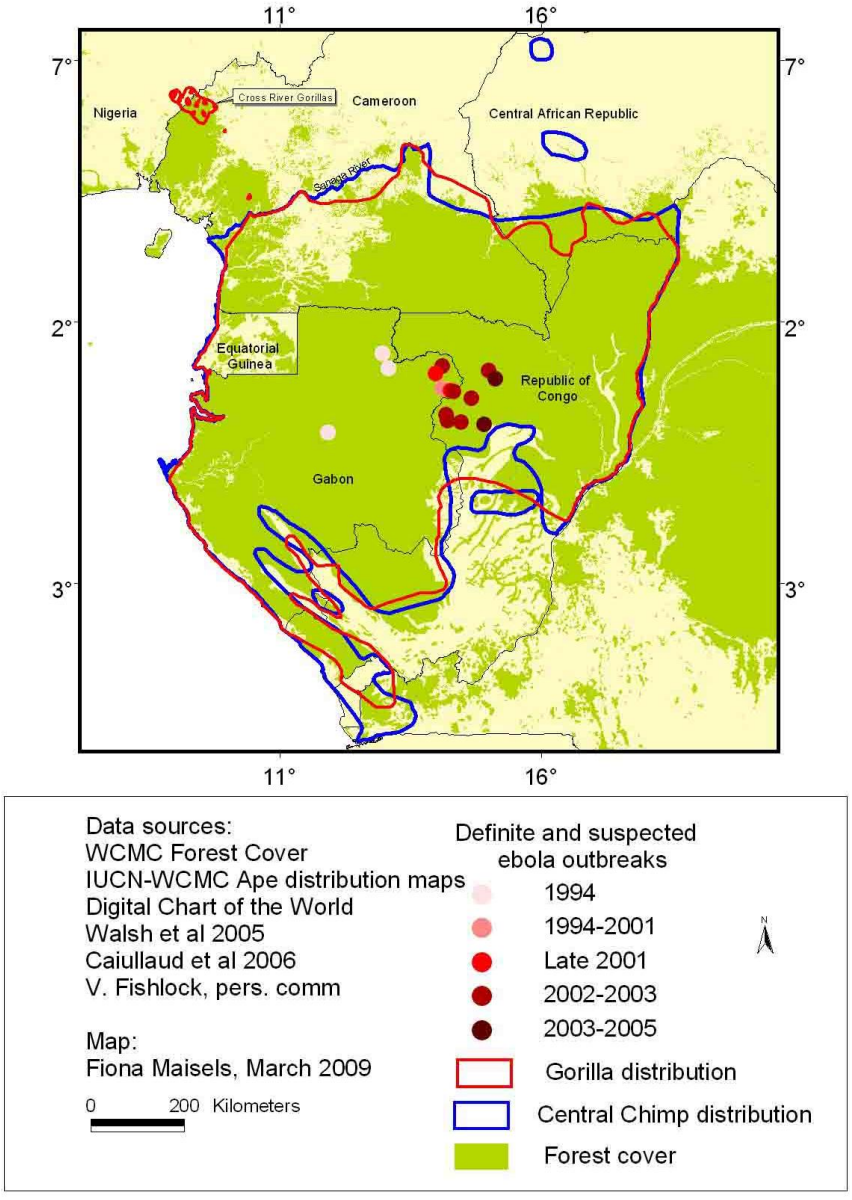

Fig. 1. Gorilla and central chimpanzee distribution, and sites of Ebola hemorrhagic fever outbreaks, 1994-2005

At least thirteen separate intensive, University-standard field training courses were organized from 1997 through to 2010 in Central Africa (in Congo, DRC, Gabon and Cameroon: Fig. 2), maintaining both continuity of trainers and of methods. The main subject of all of the courses was surveys and monitoring, including survey design, planning, implementation, analysis, and reporting. Lessons learned along the way were included in the training courses themselves and the way that survey planning and methodology was carried out. Two major freely available documents on training and implementation of surveys were produced as a result - the first was a manual of research methods for wildlife (White and Edwards 2000) and the second was the Best practice Guidelines of the IUCN for ape surveys and monitoring (Kühl et al. 2008) with detailed chapters also available on the internet. (Maisels 2008; Maisels et al. 2008a; Maisels et al. 2008b). In addition the MIKE methodology is also available on the internet (Hedges and Lawson 2006) which details methods specifically for elephant dung counts.

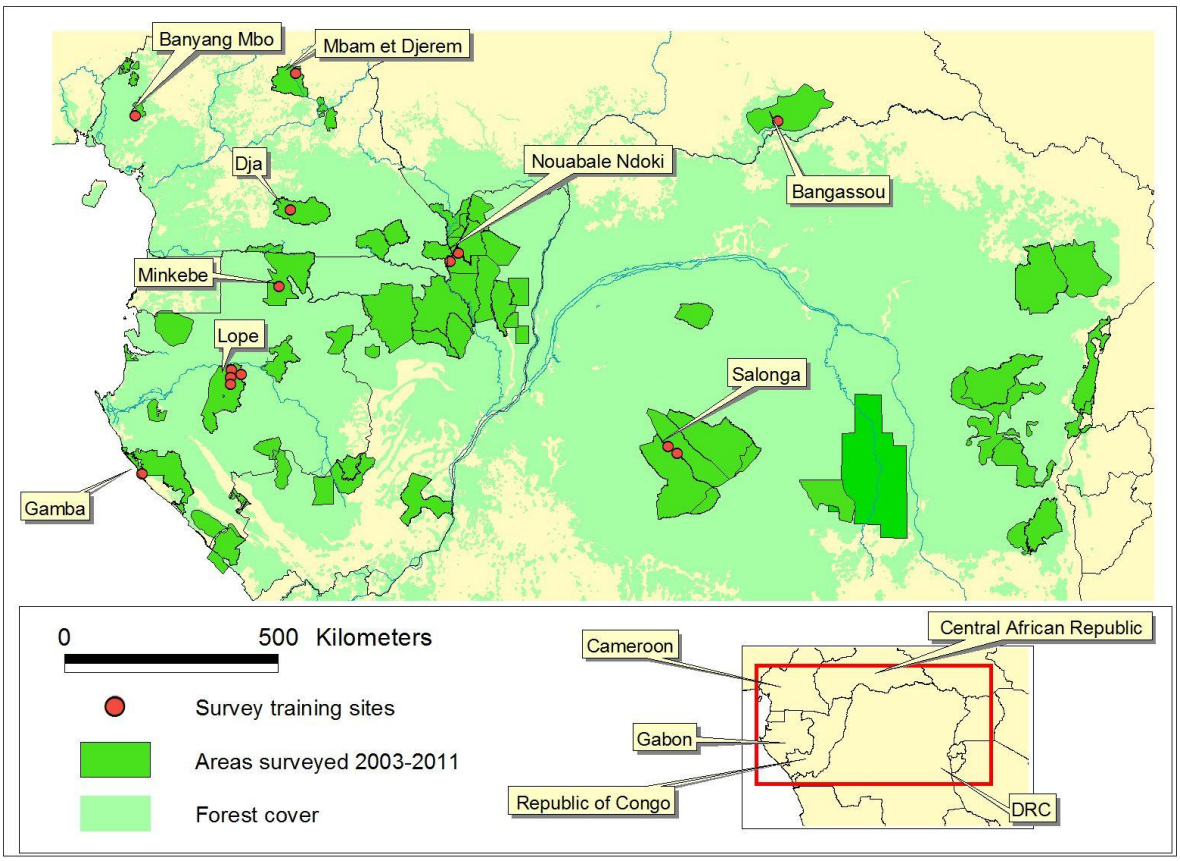

Fig. 2. Sites where surveys of wildlife and human impact in Central Africa were carried out, 2003-2011. Many have now been surveyed two or more times as part of standardized monitoring programs. Red dots are where training courses were held 1997-2010.

The trained staff then were able to comprehensively survey almost all of the forest Parks of Gabon, DRC, Republic of Congo and Cameroon, plus several large areas with unprotected status between 1999 and 2009 (Fig. 2). Many of the surveys allowed the estimation of density of elephants and apes, and all allowed distribution maps of relative

abundance to be created for these and most other wildlife species, and intensity of human impact at each site. One of these areas, comprising the whole of the Ndoki-Likouala landscape of Northern Congo (Figs. 2, 3) was surveyed - using transects in 2006 (Stokes et al. 2010). Results showed that the whole area was still of great importance for large mammal populations. Results also indicated that the integrated management system using a combination of the two protected areas (with real and effective protection from poachers and damage) and surrounding logging concessions *with strictly enforced rules on hunting and access* was a successful model for conservation.

This study was the baseline for the future monitoring of this landscape, which comprises the Nouabale-Ndoki National Park, the Lac Tele Community Reserve, and several large logging concessions, some of which have received FSC certification (Kabo and Pokola, of the company CIB *Congolaise Industrielle des Bois*).

This report details the successful team leader training course that has was carried out in Ndoki, northern Republic of Congo, between January- February 2010, the survey design that was established on the basis of the previous surveys in 2006 in the same region, and preliminary analysis of data for the terra firma areas. Methods are standard line-transects, as before.

Training course

A total of twenty people (all Congolese) attended the training course They included six completely inexperienced people who had recently graduated in biological or environmental sciences from the University of Brazzaville, one inexperienced person who was a fisherman from Lac Tele, ten existing WCS monitoring team leaders, one Lac Tele ecogarde team leader, and two ex-staff members from the WCS PROGEPP project (they had previously been in the Conservation Education and the Alternative Activities units, but their contracts had finished). Thus, there were ten people with wildlife monitoring experience and ten “new” people. This allowed for a good atmosphere of mentorship as the training progressed (Figs. 3, 4).. There were three main trainers- the WCS Regional Monitoring Officer (F. Maisels), the Nouabale-Ndoki research and monitoring coordinator (P. Boudjan) and the Goualougo Triangle Chimpanzee Project Biologist (J. Onononga). All three senior trainers had years of monitoring experience. Other teachers came in for one or two days and are mentioned below.

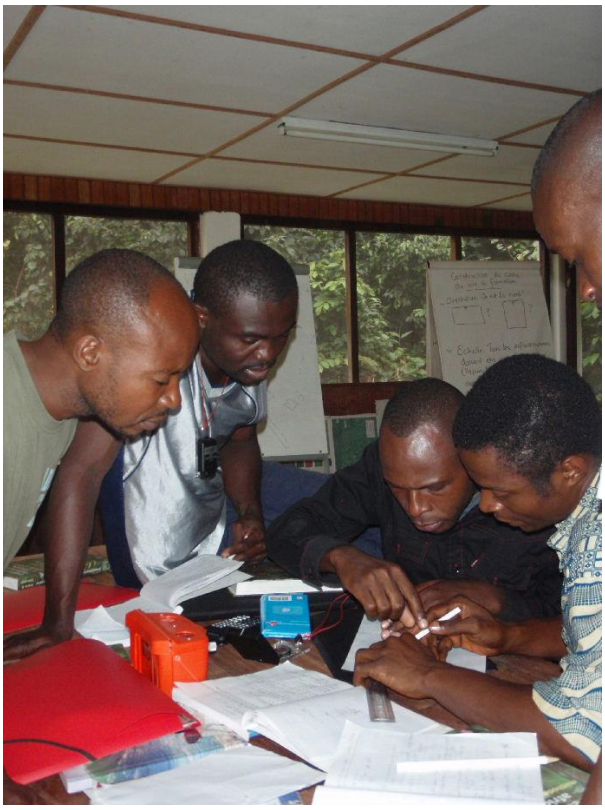

Fig. 3. Navigation theory…..

The training course was held between 12 January and 28 February in the Ndoki Training Camp on the western edge of the Nouabale-Ndoki National Park, northern Congo. The course modules were :

1. The scientific approach, including:
    a. The role of research and management of protected areas;
    b. Recording observations;
    c. Data analysis and interpretation;
    d. Reporting

2. Navigation- theory and practice in:

    a. Map and compass;
    b. GPS;

3. Computers and GPS interface:
    a. Basic operation;

b. Backup and data organization;
c. Word;
d. Excel;
e. Transfer of data between GPS and PC;
f. Introduction to GIS (ArcView)
g. Survey design using DISTANCE (for the existing team leaders)

4. Logistics of fieldwork :
    a. Planning a mission (route, equipment, supplies);
    b. Communication and safety; basic health;
    c. First Aid (Teacher: Medical doctor Matthjis Botman from local logging company CIB);
    d. Care of equipment on return to base.

5. Recces and transects :
    a. Cutting transects with minimal impact;
    b. Collecting data on recces and transects;
    c. Introduction to analysis of the data collected.

6. Sampling protocols of dung for ape health and genetic studies (Teacher: Alain Ondzie and Ken Cameron of WCS Global Health Program).

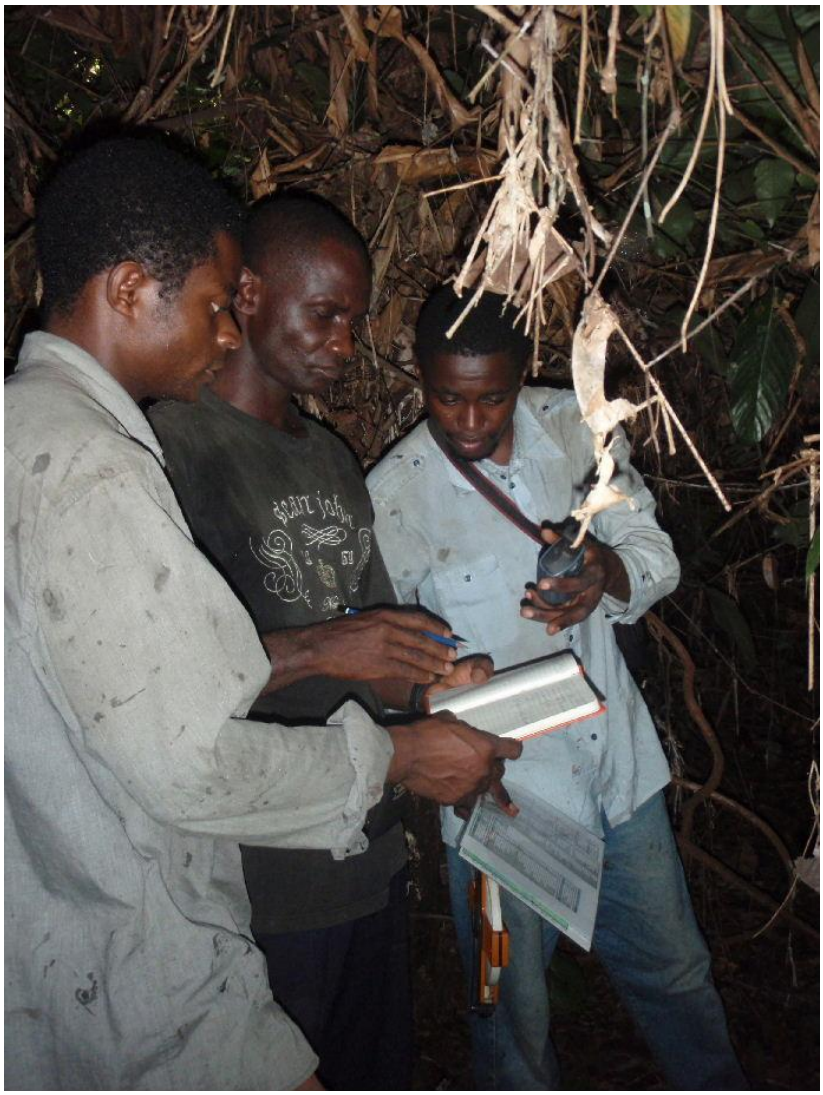

Fig. 4. Learning how to collect data and take GPS readings in the forest.

Survey design

During the training course the sampling design was completed (Fig. 5) using the results from the previous survey in 2006 to guide the strata and the intensity of sampling for this round of monitoring. The original strata were based on management units (concessions, protected areas) but the results showed that there was high heterogeneity within strata, including large differences in hunting pressure and large differences in vegetation type. This led to relatively wide confidence limits. In order to enable better assessment in this and especially subsequent monitoring cycles, the strata to be surveyed within the landscape were, in this, the 2010 design, based on the

results of the human and animal abundance maps of 2006 and on the encounter rates of the relevant sign from that survey. This design maximises both accuracy and precision for both elephant and ape population estimation. A total of 281 transects in nine strata were drawn up (Table 1).

Table 1. Transects in each stratum, 2010. See Fig. 6 for location of each.

Stratum	No. of transects	Length of each transect	Reason for stratum
Good elephant density	38	2.5	Terra firma; High elephant density in 2006
Bailly North	30	3	Swamps; High elephant density in 2006
Lac Tele Nord	32	2	Swamps; High gorilla density in 2006 (but low elephant density)
Lac Tele Sud and Bailly south (one unit)	29	2.5	Swamps; Low gorilla and elephant density in 2006
Loundougou Terre Firme	30	2	Medium elephant density in 2006. Terra firma.
Loundougou marecages (swamps)	33	2	Medium elephant density in 2006. Swamps.
Nouabalé-Ndoki National Park- north	32	2.5	High chimp density in 2006.
Nouabale-Ndoki National Park- south	32	2.5	Lower chimp density in 2006.
Sangha Low elephant density	25	3	Low elephant density in the regions of the logging towns of Kabo and Pokola

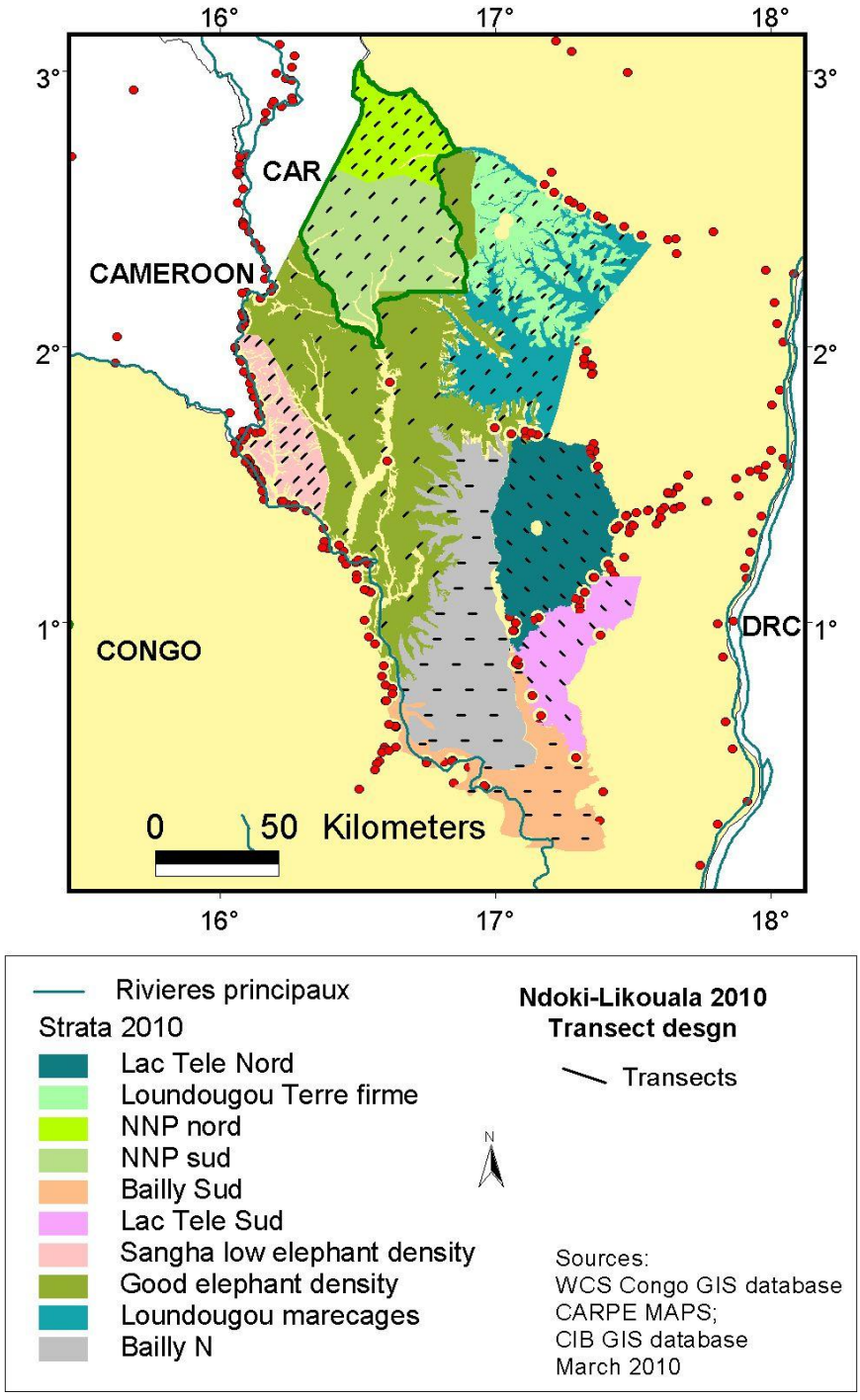

Fig. 5. Survey design for 2010, showing the different strata and the transect locations. Villages or logging camps are red spots.

Survey implementation

At the end of the training course, all participants had a week of rest and recuperation. This was followed by a week of logistics and planning for the surveys. The team leaders and assistant team leaders worked to produce their “circuit maps” within the whole of the landscape (e.g. Fig. 6) which were then plastified, as were their waypoint sheets. The teams then uploaded their waypoints into their GPS, ready for the field. They also organised their food lists and budgets, ensured that they had sufficient supplies, and established the communication protocol in case of emergency (using Thuraya sat phones). Two seasons of surveys were carried out (one in 2010 and one in 2011).The timetable for the surveys was based on (i) the surveys of 2006 were carried out between January and June and (ii) taking advantage of the low water levels in the first half of the year. Thus, during March through June 2010 all the strata East and North of the Lac Tele-Bailly swamps were completed by the field teams, and the swamp strata were completed between February-May 2011.

Each team comprised: a team leader (all are WCS existing team leaders); an assistant team leader (either existing WCS assistants, or newly trained people); a compass bearer and a transect cutter, and a small group of porters (locally recruited). The compass bearers had already had experience working with the monitoring teams before.

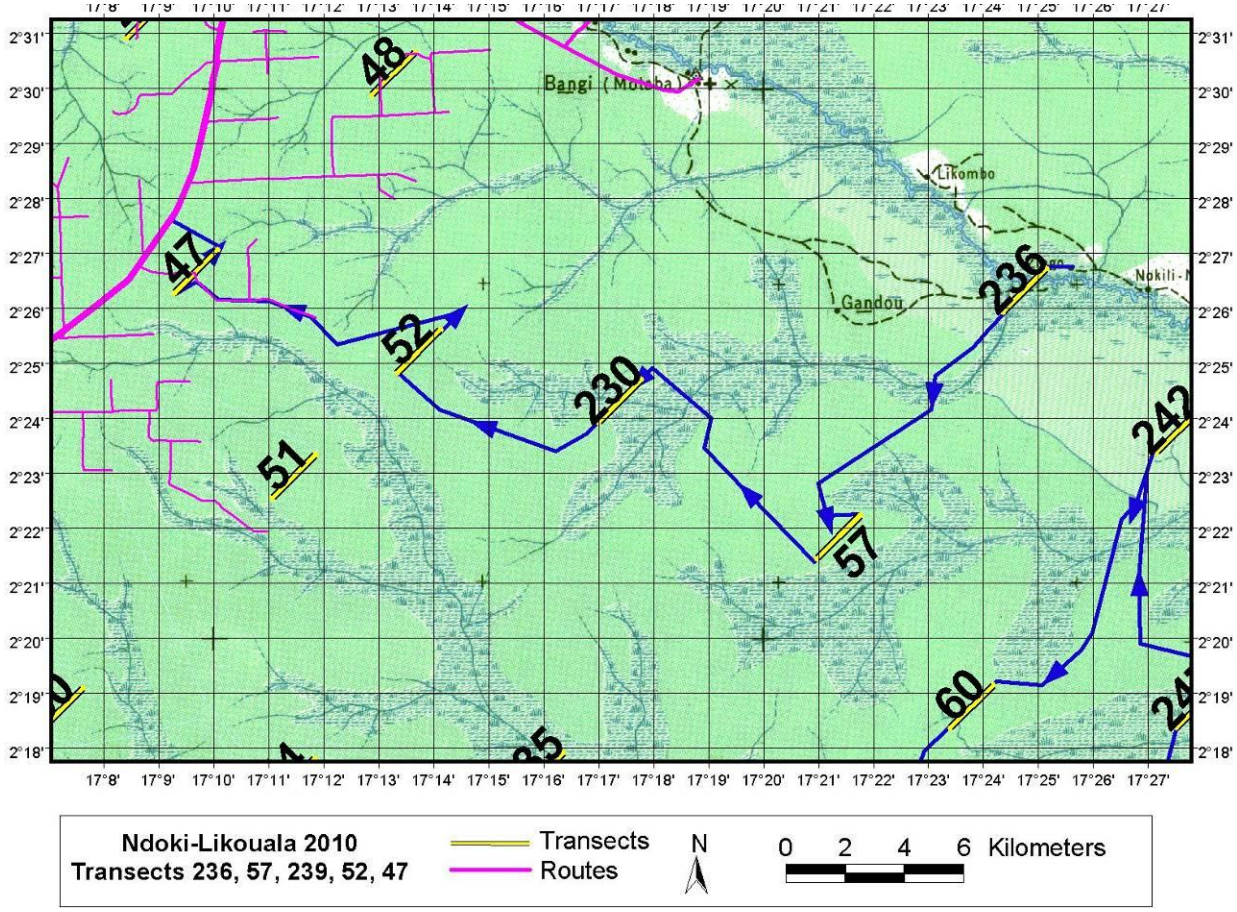

Fig. 6. Circuit for several transects in the Loundougou terra firma area, for one team (starting at Transect 236 and finishing at Transect 47)

Results

A total of 280 transects (676 kilometres) were completed by the teams. Only one transect was not done, due to very deep water. For now, analysis has been done on elephant dung density for the terra firma areas, and some distribution maps produced. A comparison with the strata of 2006 is given here, to investigate change over time. The final report, which will include all strata including the swamps, will be completed after an analysis workshop with all field staff to be held in late 2011.

Elephant dung density

There were very great differences per stratum (Table 2). As expected the National Park had the highest elephant dung density, together with the areas immediately south of the Park - the north of the Kabo concession, and the more remote areas of the Kabo and Pokola concessions (Fig. 7). Elephant dung density was low in the areas along the Sangha near the towns of Pokola and Kabo (and opposite Ouesso). Most of the Loundougou area (both terra firma and swamps) had low dung density as well.

Table 2. Elephant dung density in the areas surveyed in the landscape.

Stratum	Dung density	Coefficient of variation (%)	Confidence limits
Good elephant density	848	19	579-1245
Loundougou marecages (swamps)	223	27	128-387
Loundougou Terre Firme	184	25	112-303
Nouabalé-Ndoki National Park- north	1085	15	808-1458
Nouabale-Ndoki National Park- south	660	10	540-805
Sangha Low elephant density	91	64	27-308

When the transects of 2010 were superimposed on the strata of 2006, and the dung density compared (Fig. 8), there had been a significant reduction in elephant dung in the Pokola concession (Table 3)- densities were 39% down from 2006. There was also a trend towards a reduction in elephant dung in the Loundougou Concession (and a concomitant gain in the Nouabale Ndoki National Park) but, taken separately, these were not significant.

However, when all the data from all three CIB concessions were considered as a unit and the 2006-2010 elephant dung density compared, **there had been a highly statistically significant drop- the dung density- and thus elephant density- is now half of what it was in 2006 (Table 3).**

It should be recalled that in 2006, the dung density in the Mokabi concession, which has no wildlife management program, had dropped to only 22 dungpiles per km^{-2}. Ivory poaching in the region is becoming increasingly widespread and intense, due to increased demand from the Far East.

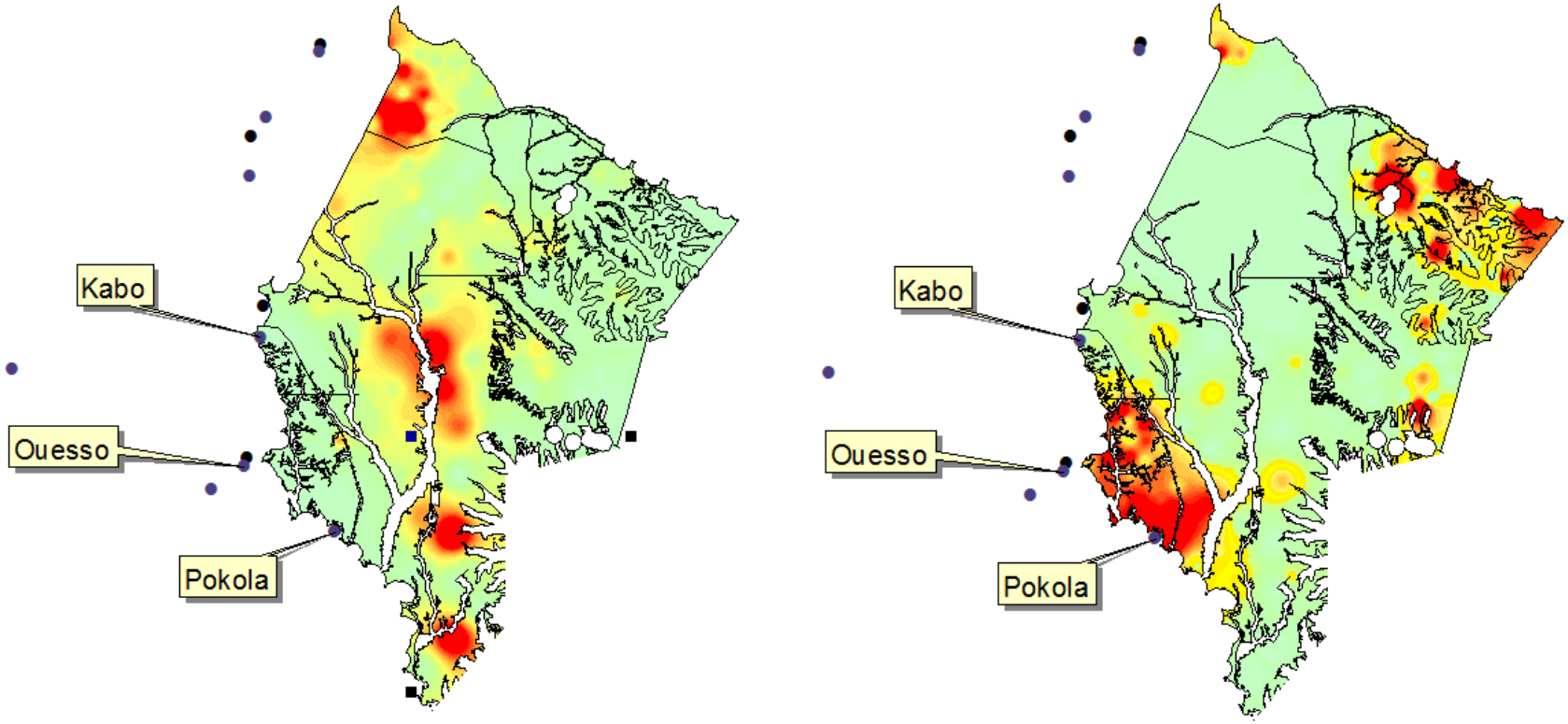

Fig. 7. Interpolation map of elephant dung (left) and human sign (right) in the landscape in 2010. Bright red= high abundance; green=low abundance

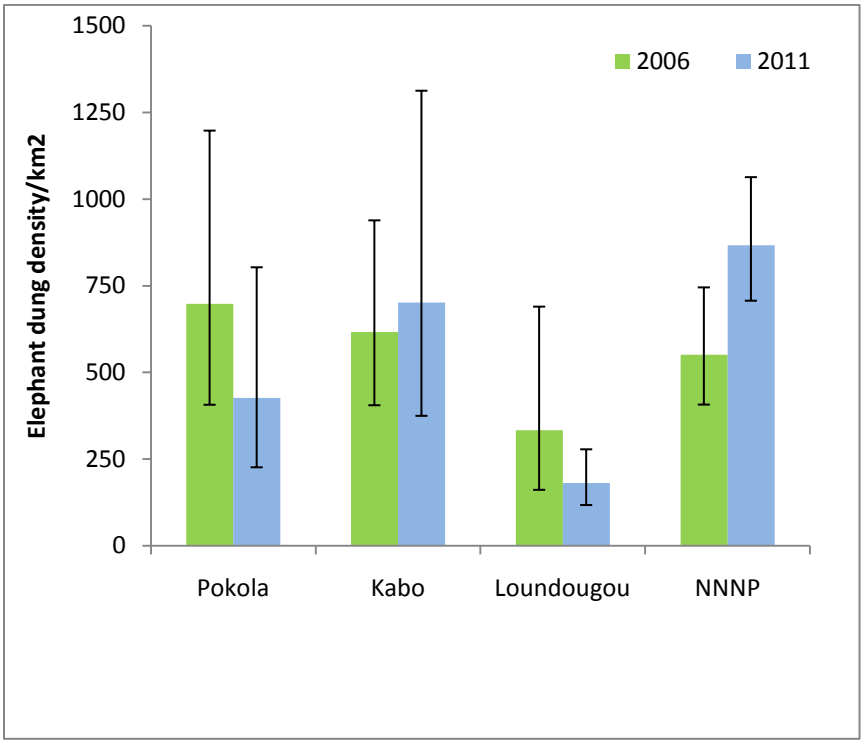

Fig. 8. Elephant dung density (and 95% confidence limits) in the Nouabale Ndoki National Park and the CIB logging concessions, 2006 and 2010.

Table 3. Using the 2006 strata, elephant dung in 2006 and 2010. Logging concessions separately, and together.

Stratum	Dung density 2006	Dung density 2011	P-value
Pokola	698	427	**0.0365**
Kabo	617	701	0.0959
Loundougou	334	181	0.188
NNNP	551	867	0.1528
All three CIB concessions together	781	397	**0.0012**

Great Apes.

There was much less difference between strata for great apes than for elephants (Table 4). This is also evident in the distribution map of great ape nests in 2010 (Fig. 9). As in 2006, it appears that it is habitat, rather than human pressure, which defines the ape populations in this landscape. In 2006, the surveys of the Mokabi concession, where hunting is not controlled, showed not only a very low elephant population, but a very low great ape population as well (Stokes et al. 2010). That great ape populations have been maintained in the logging concessions and that they are still comparable to that of the National Park shows that they are not being disproportionately affected by hunting in the CIB concessions.

Table 4. Ape nest density in the areas surveyed in the landscape in 2010.

Stratum	**Ape Nest density**	**Coefficient of variation (%)**	**Confidence limits**
Good elephant density	394	22	253-612
Loundougou marecages (swamps)	208	26	123-351
Loundougou Terre Firme	204	20	137-303
Nouabalé-Ndoki National Park- north	215	16	156-296
Nouabale-Ndoki National Park- south	157	20	106-233
Sangha Low elephant density	165	25	101-272

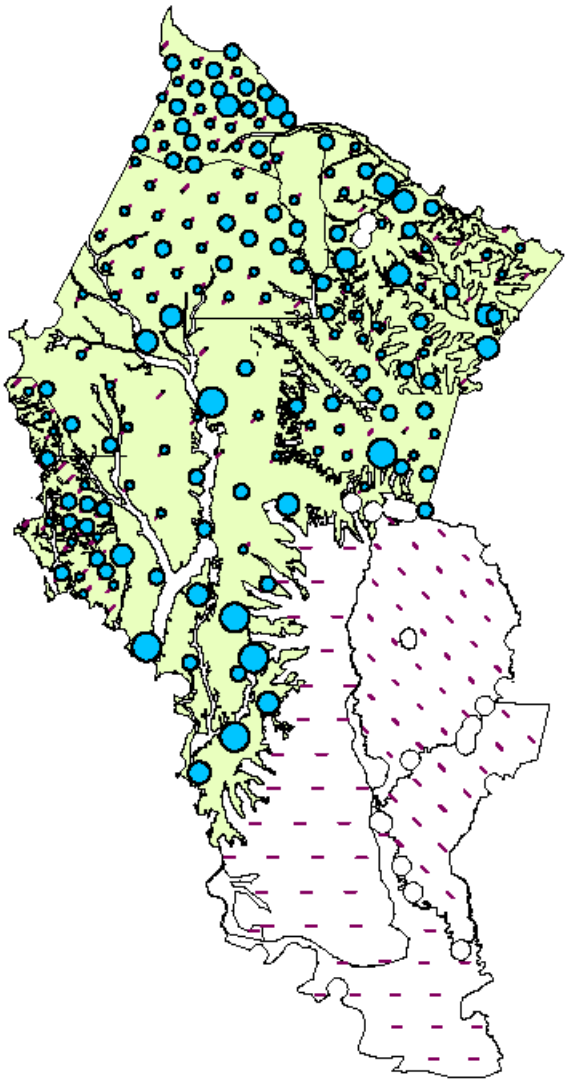

Fig. 9. Great ape nest encounter rate in the Nouabale Ndoki National park and the three logging concessions.

Hunter sign

All human sign was recorded along transects, and their encounter rate calculated and mapped (Figs. 7, 10). It is clear that elephant and human activity are mirror images of each other- elephants avoid humans and take refuge inside the most remote or well protected areas available. This has already been well documented both at this site and elsewhere (Blake et al. 2008; Stokes et al. 2010; Yackulic et al. 2011). There was no significant difference in the encounter rate of human sign within each management unit taken separately, nor when the concessions were grouped.

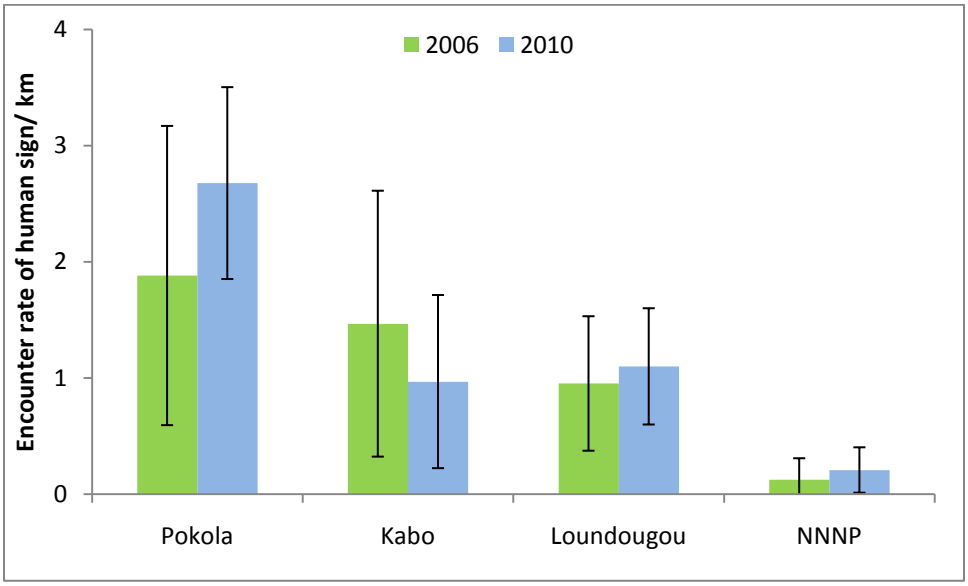

Fig. 10. Human sign encounter rate (and 95% confidence limits) in the Nouabale Ndoki National Park and the CIB logging concessions 2006 and 2010.

Conclusions

1. A training course was held in early 2010 where the existing and new WCS wildlife technicians received training (or recyclage) in standard methods of data collection and analysis. The training included the scientific approach, navigation, transects and recces, and basic first aid.

2. A survey design was drawn up that built on the results from the 2006 surveys in the same landscape, with the objective of improving precision of estimated density and/or encounter rate of wildlife and human sign.

3. The Ndoki-Likouala survey 2010-2011 was successfully completed with 280 transects (676 kilometres) walked throughout the landscape.

4. Analysis of the elephant dung density within the National Park and the CIB logging concessions showed that the elephant dung density in the concessions in 2010 had dropped (highly statistically significantly) to half of what it was in 2006. This is mainly due to loss within the Loundougou and Pokola concessions; Kabo has remained stable. There was some evidence of a slight (but not statistically significant) increase of elephant density within the Park, but not enough to compensate for the lost elephants outside.

5. By contrast, great ape nest density does not show great variation across the landscape. The distribution pattern is about the same as in 2006. It is likely that the wildlife management within the CIB concessions has been sufficiently strict to avoid the loss of the great ape population, but further analysis is required to confirm this. Great apes are taken opportunistically by bushmeat hunters, but are not targeted specifically due to their relative rarity, probably the fear of repercussions (they are completely protected) and the low profit margin compared to the risk of being caught with ape meat. Additional data on the ungulate data collected during these surveys (ungulates are the focus of most bushmeat hunting in this landscape) will be analysed to clarify the general bushmeat situation compared to 2006.

6. The encounter rate of human sign has not changed (statistically) significantly since 2006 within each management unit, nor within the CIB concessions as a whole.

7. The loss of elephants throughout the concessions points to significant ivory poaching which needs to be urgently addressed. Ivory poaching is reaching epic proportions throughout the whole of Africa, as the profit –to-risk ratio has greatly increased with the high price offered in the far East (especially China) in recent years.

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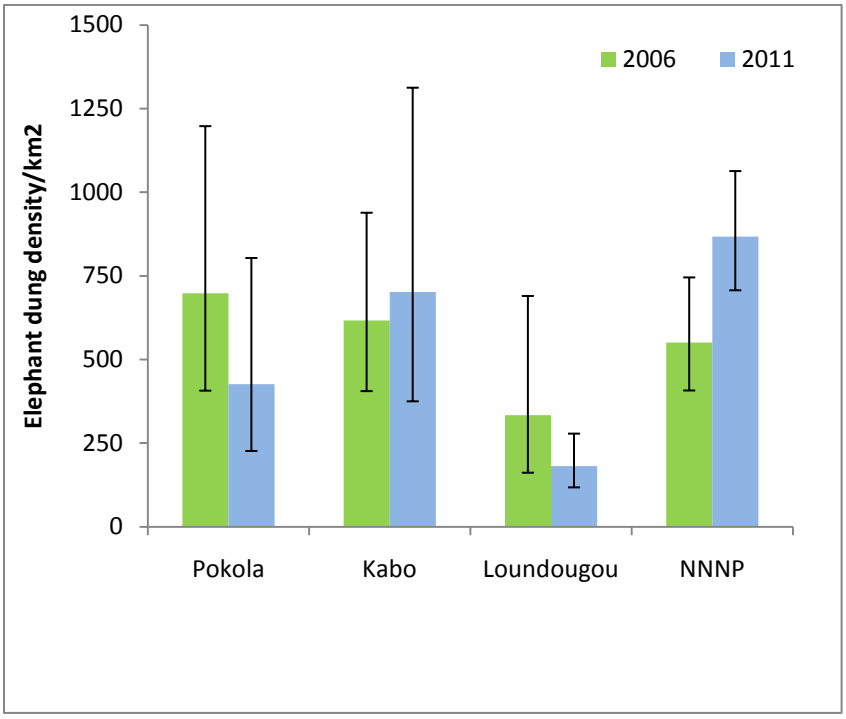
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1250
1000
750
500
250
0
Elephant dung density/km2
2006
2011
Pokola
Kabo
Loundougou
NNNP