Biodiversity Conservation at the Landscape Scale

A Program of the Wildlife Conservation Society
Supported by the USAID/Global Conservation Program

Ndoki-Likouala Landscape Conservation Area, Republic of Congo
Semi-Annual Report
April 2002 - September 2002

I. Summary of Activity Status and Progress

a. Introduction/Summary:

The Ndoki-Likouala Landscape Conservation Area, extending over approximately 30,000 km^2, comprises a vast stretch of lowland Guineo-Congolian forest, rich in African mahoganies and large mammals. Within the area, forest type varies from semi-deciduous forest in the northwest to swamp forest in the southeast. It is home to important populations of some of the continent's most endangered species: Forest elephants, western lowland gorillas, chimpanzees and bongo. The region has an extremely low human population density, and has until recently been isolated from modern human influence. Biodiversity of the region is partially protected in two reserves: the Nouabalé-Ndoki National Park (NNNP) and the Lac Télé-Likouala Aux Herbes Community Reserve (LTCR). Yet these reserves alone do not provide sufficient habitat for wide-ranging or low-density species, nor is the capacity of the Ministry of Forest Economy (MFE) strong enough to effectively manage these areas. Consequently, the unique and extraordinary biological values of the region are threatened by the rapid development of logging throughout northern Congo, the export of massive volumes of bushmeat that follows in its wake, and the creation of logging communities who increase pressure on forest resources.

The principle goal of the BCLS program in Ndoki-Likouala is to conserve biodiversity through the application of a landscape approach. To accomplish this goal, the program assesses the ecological status and requirements of landscape species (elephant, chimpanzee, bongo, buffalo and dwarf crocodile), develops management strategies across a mosaic of land-use zones that integrate their conservation, and helps to establish effective systems for this management. WCS works closely with staff from MFE charged with both wildlife protection and forest management, managers of logging companies that work around the reserves of northern Congo, and communities located in the region. In addition to upgrading the status and effectiveness of protected areas (NNNP and LTCR), the BCLS program is helping to design and establish systems of wildlife conservation and management on forestry concession lands under the auspices of the Projet de Gestion des Ecoystemes Peripheriques au Parcs (PROGEPP). This includes consultation to reduce the ecological impacts of logging operations (e.g., road placement, no-cut zones), prohibiting the hunting of endangered species and the export of any bushmeat from the concession, controlling logging-based demographic growth and impacts, establishing wildlife management systems for sustainable subsistence use by communities, and developing alternative sources of protein for community consumption.

During the reporting period, the Lac Télé Community Reserve team continued to make progress on their feasibility study of important biological and socio-economic aspects for the future management potential of the Reserve. Congolese nationals were recruited as assistants and trained for the biological and socio-economic surveys, and these surveys were begun. More regular contacts were maintained with villages around the LTCR as part of ongoing efforts to provide useful information regarding the environment and wise use of natural resources. Anti-poaching activities increased during the period as well, as collaboration improved with regional authorities. NNNP management support continues to be provided by several partners (CARPE, US Fish and Wildlife Service (USFWS), and WCS, among others). Funds from the BCLS/USAID program contributed to the operating costs for the National Park, with a focus on training Congolese nationals, carrying out law enforcement activities, and continuing research and monitoring of landscape (and other) species.

b. Highlights

- The success of elephant conservation in the area within Congo to the west of the National Park is shown by significant and successive increases over time in elephant abundance on trails, roads, a lake, and in the village lands of the Bomassa Triangle.
- A large mammal and human impact survey of over 5700 km^2 of the Ndoki-Likouala landscape was completed, comprising 75% of the Mokabi concession and 25% of the northern sector of NNNP. Elephant distribution and abundance outside the Park is severely limited by human settlements and activities, while elephants are more numerous and more uniformly distributed inside the protected area. Bongo and buffalo are rare or absent to the north of the Park as well as inside it. This survey provides an important baseline, assessing wildlife presence prior to logging impacts.
- Regular patrols inside the NNNP were undertaken by MFE and BCLS staff from both the Bomassa and Makao bases. During the reporting period, the Bomassa team completed twelve patrols in the west and south of the Park, finding little human sign and seizing only a single wire snare. During the same period, the Makao ecoguards completed six patrols, concentrating in the east and north of NNNP. As with the Bomassa patrols, there were few signs of human encroachment into the Park, and only one wire snare was found.
- PROGEPP field patrols resulted in seizure of 1299 wire snares, 30 shotguns (involved in wildlife law violations), 1 leopard skin, one gorilla skull, 7 crocodiles, and two sacks of elephant meat. A total of 71 legal charges were addressed against violators during this period.
- Six tri-national patrols took place on the Sangha River during the reporting period, along the limits of the NNNP, with partners from Cameroon and Central African Republic. For the reporting period, tri-national seizures included 165 cables, five 12-gauge shotguns and 11 associated cartridges and one locally manufactured gun.
- Bushmeat monitoring continues in the two National park bases of Bomassa and Makao. No changes in offtake or prices occurred in Bomassa, where the main salaried occupation is with the conservation project. However, prices and offtake rose significantly at Makao, with the arrival of a road and a logging company to the village.
- The LTCR team completed the second phase of its biological surveys in mid-June. Analysis of the distribution and density of large mammals in terra firma habitats has already been completed. The second phase of biological studies will determine the density and distribution of large mammals throughout the Reserve and in all habitats. In addition, these studies will determine if mammals are

pushed onto specific habitats during the wet season increasing their vulnerability to hunting.

- The LTCR team completed the first phase of socio-economic surveys that included a complete census of all of the villages within the Reserve, the creation of village maps and historical calendars, and the determination of primary household activities.
- The NNNP team completed initial models of the biological landscape for each landscape species as well as a model of the human landscape giving a spatial representation of the threats across the landscape.
- Research training for Congolese researchers at NNNP during this reporting period included botanical survey and herbarium techniques, use of a bibliographic database, and statistical analysis of large datasets using both spatial Geographic Information System (GIS) and nonparametric methods.
- Surveys of bushmeat entering the Kabo, Pokola, Ndoki 1 and Ndoki 2 sites showed a relatively stable trend in daily quantity of bushmeat registered from April-July 2002 with Ndoki 1 higher than Ndoki 2 or Kabo. During this period, the rate of snared bushmeat increased in Pokola from 5% taken by snares to 10-28%. Much of the snared meat registered in Pokola originated from the Danzer concession across the river.
- Household consumption of protein was monitored through examination of 1443 meals during this period in the concessions of the Congolaise Industrielle de Bois (CIB) logging company. Bushmeat made up 30-40% meals in Pokola and Kabo with fish in 50-60% of the meals. Domestic meat increased in diets in both Kabo and Pokola to 4-6% compared to 2% in earlier surveys. Bushmeat consumption was higher at Ndoki 1 and Ndoki 2 camps (>50%) and was complemented by fish consumption.
- An intensive ecoguard training program was designed and implemented in September 2002 to expand the PROGEPP ecoguard force from 20 to 40. Guards were trained in wildlife laws, CIB interior regulations for wildlife management, discipline, sports, arms training, logistics, patrol techniques, use of Geographic Positioning Systems (GPS) and forest navigation. This increase in staff will allow expansion of law enforcement activities to the Loundougou and southern Pokola areas, with staff salaries being paid by the CIB company.
- Two PROGEPP educators implemented the conservation awareness campaign working with 23 villages in the Kabo, Pokola, and Loundougou during this reporting period. A total of 847 CIB employees, non-CIB local community members, hunters, and Bendjele pygmies participated in various meetings on wildlife management and conservation.
- A total of 540 primary school students participated in conservation education lessons at Kabo (10 sessions) and Ndoki 2 (5 sessions). The protected species education manual and curriculum was finalized with the Regional Education Ministry authorities.
- Three national alternative activity technicians under the supervision of the CIB management plan coordinator and PROGEPP coordinator worked extensively at CIB sites and in the traditional villages within the concessions. This period was marked by a dramatic increase in CIB based efforts to import domestic protein to the Kabo and Pokola sites and the acquisition of 10 cold rooms for its storage.
- In July 2002 a 3-day workshop on "Wildlife Management and Conservation in Forestry Concessions in the Republic of Congo" was organized with funding from the US Department of State. WCS, the Ministry of Forestry Economy, the United States Forest Service (USFS), and USFW worked together at a technical workshop in Brazzaville bringing together 54 field practitioners, managers and

policy makers from Republic of Congo, Democratic Republic of Congo, Cameroon, and Central African Republic.

- The PROGEPP Director presented the ecological context and threats to the Congo Basin forests as part of Deputy Assistant Secretary of State's presentation on the United States Government's new engagement in the Congo Basin Partnership. In addition, the PROGEPP Director and Coordinator represented WCS at the ceremony for the announcement of the Congo Basin Partnership presided over by Secretary of State Colin Powell and His Excellency President of the Republic of Congo Mr. Denis Sassou-Nguesso.

c. Table of Activity Status

II. Detailed Description of Progress

a. Key program objectives for reporting period (April - September 2002)

The goals of the second half of FY 2002 included continued baseline data surveys, and monitoring the landscape species and human influences in the landscape. We aimed to continue work with neighboring logging companies in the Pokola, Kabo, Loundougou and Mokabi forestry concessions for sound management of wildlife resources. Our goal was to integrate local communities, government and logging companies where appropriate in the management of natural resources across the landscape, and influence national policy in the forestry and protected areas sectors. Finally, we intended to further the process of the elaboration of an integrated landscape conservation action plan through adoption of the Nouabalé-Ndoki National Park Management Plan (under separate funding this year), and drafting of chapters and interior regulations for CIB concession management plans for Kabo, Pokola and Loundougou concessions. In addition we pursued negotiation of an agreement between WCS, the Rougier logging company and the Government of Congo on management of the Mokabi concession: the final concession bordering Nouabale-Ndoki National Park.

b. Activity Description

OBJECTIVE 1: Establish baselines and monitor landscape species and the landscape context in which they are found.

Activity 1.1. Landscape Species Monitoring
On track

Reconnaissance surveys:
The large mammal and human impact survey covering over 5700 km^2 of the Ndoki-Likouala landscape was completed during this reporting period by Patrick Boudjan. The survey covered 75% of the Mokabi concession, 60% of the Lopola concession, and 11% of the Ipendja concession, and 25% of the northern part of the Nouabalé-Ndoki National Park (Fig. 1). The objective of the survey was to assess the conservation status of this area, and to compare the areas inside and outside the park before logging operations were underway to the north of the Park, thus providing a baseline on human and large mammal distribution and relative abundance. Further monitoring activities, including those based on the Monitoring of Illegal Killing of Elephants project under Convention on International Trade in Endangered Species of Flora and Fauna (MIKE-CITES) will be able to use these results as the pre-logging baseline for the area. The survey covered 1000 km^2 within NNNP; the previous survey had covered 4700 km^2, (including almost all the land in the three concessions within about 50 km of the NNNP boundary). Geo-referenced data were collected on all large mammal species and their indirect sign (such as dung and spoor), vegetation, topography, and human activities. The survey within the Park used eleven sample lines spaced about 6 km apart, totaling 231 km (Fig. 1).

About 5,700 large mammal signs were recorded within the Park, of which only 0.5% were made by humans. This is in contrast to the results from outside the Park, where 13% of over 13,000 recorded signs of large mammals were of human origin. In the area inside the Park, 62% of all signs were made by elephants; followed by red duikers (13%), gorillas (6%) and red river hog (6%). Outside the Park, only 42% of signs were made by elephants, 19% by red duikers and similarly to within the Park, 7% were made by gorillas and 5% by red river hog. Maps of the distribution of fresh elephant sign (dung and feeding sign) and elephant paths (ranging from abandoned to heavily used) are shown in Figs. 2 & 3.

The encounter rate of elephants and 95% confidence limits inside the Park was 16.14±3.14 signs/km. Outside the Park, elephant signs were less than half as abundant, at 6.79±1.34 signs/km. Conversely, inside the Park, encounter rate of human sign was 0.2±1.5 signs/km

while outside the Park human sign was nearly nine times more frequent, at 1.73±0.66 signs/km.

The encounter rate of humans was significantly greater in the logging concessions of Lopola, Ipendja and Mokabi, than inside the Park. The reverse was true for elephants. The signs of the following animals were all significantly more common per km inside than outside the Park: Red river hog (*Potamochoerus porcus*), Crowned guenon (*Cercopithecus pogonias*), Gray cheeked mangabey (*Lophocebus albigena*), Greater white nosed monkey (Cercopithecus nictitans), forest buffalo (*Syncerus caffer nanus*), red duikers (*Cephalophus natalensis*), apes, moustached monkey (*Cercopithecus cephus*) and aardvark (*Orycteropus afer*) (Fig. 4).

The encounter rate of elephants was significantly inversely correlated with that of humans. In addition, the encounter rate of the following species were all significantly negatively correlated with human sign: Red river hog, chimpanzee, forest buffalo, yellow backed duiker, gray cheeked mangabey, crowned guenon, putty-nosed guenon and gorilla. These data indicate the importance of the national park in maintaining wildlife, and demonstration that its status is recognized by neighboring people.

In addition to elephants, three terrestrial landscape species were recorded on these surveys. The percentage and type of observation recorded were as follows: 0.3% were chimpanzee sightings and vocalizations, 0.9% were chimpanzee nests, 0.2% were forest buffalo and finally, bongo constituted only 0.1% of all recorded observations. Large parts of this area were untouched by human disturbance during the survey, so the absence of bongo and buffalo are probably due to habitat type (closed-canopy terra firma forest) rather than due to hunting pressure. This confirms earlier observations by Blake (1997, 2000) that bongo and buffalo are rare in these northern management areas. Conservation of these species therefore must be focused outside the protected areas in the Kabo and Pokola concessions, where they occur in higher abundance, in order to conserve viable populations in the landscape (Elkan et al. 2002).

In the last report, we noted that the abundance of human and elephant signs was strongly inversely correlated. In addition, abundance of elephant sign and distance to the nearest human settlement was also inversely correlated, indicating no elephant presence within a distance of about 15-20 km from all villages in the area. In addition, we reported on the almost complete absence of elephant sign within 15 km of the Congo-Central African Republic international border, due to the presence of illegal C.A.R. immigrants who hunt both bushmeat and elephants (Fig. 5). When the elephant data for the interior of the NNNP were examined, it was clear that elephant sign increased in abundance from the outermost edge of the Park for the first 3 km, but then reached a plateau of about 10-15 signs/km (about twice that found just outside Park boundaries). This indicates that there is not the same type of elephant-concentration gradient from the edge to the center of the Park as is found outside, demonstrating that the animals feel unthreatened in the protected area. These data are being analyzed in greater detail using spatial modeling and results should be available in the next reporting period.

In summary, this survey shows that elephants are distributed throughout the whole of the northern part of the NNNP. However, outside of the protected area, their abundance is negatively related to the distance from the Park boundary as well as to proximity to human settlements. Their spatial distribution has been reduced in the recent past (perhaps within the last six or seven years). Elephants are essentially very uncommon in the area along the Mokabi River and its villages, as well as in the area along the international border of Congo and CAR that lies outside of the protected areas. NNNP remains their stronghold.

Mokabi Concession:
A final report on the joint PROGEPP/RDFE (Regional Department of Forest Economy) reconnaissance surveys on large mammals and human demographics and activities in the Mokabi concession was submitted to the Rougier company to help inform their efforts to develop wildlife management regulations (Activity 4.4). During this period the terms of reference for a training program in wildlife survey techniques along forestry transects was planned and dates for the first program were set for early 2003. Technicians from Rougier and three other forestry companies operating in the Likouala Region (Lopola, Ipendza, Mimbeli) will be trained in standard line-transect methods adapted to forest inventory programs as already applied in the CIB and IFO (Industrie Forestier de Ouesso - the logging concession west of Pokola, bordering the Odzala National Park) concessions (methods adapted from White and Edwards, 2000 and the MIKE program). Rougier will then undertake surveys of wildlife and human activity along forestry transects in the Mokabi concession to collect additional information, establishing a detailed baseline for development of wildlife conservation and management components of the Mokabi management plan.

Reconnaissance surveys in the Kabo and Pokola Concessions:
Wet season reconnaissance surveys were undertaken along 135 km of forest routes traversing the village hunting and protected zones of the Kabo and Pokola concessions. Chimpanzee and gorilla nests were observed in all zones surveyed, with buffalo and bongo sign rare in some areas but others with high relative abundance (Table 1). Elephant sign was surprisingly low in the Leme area. Sign levels in the Ikelemba zone of southern Pokola were high for all species compared to other zones. High abundance of elephants, chimpanzees, and gorillas was recorded in Ikelemba and Mboulé zones despite coinciding high levels of human activity. These areas fall under community hunting zones and are subject to regular small game hunting. These and earlier survey data suggest that when hunting regulations are respected and these species are not targeted, community hunting zones can serve as viable habitat areas for protected species despite relatively high small game hunting disturbances. Important forest clearings in these areas need to receive increased protection from small game hunting disturbance in order to further integrate conservation and wildlife management into these zones. These and other recce datasets are being spatially analyzed and integrated with CIB management plan data to provide a high-resolution assessment of large mammal distribution and abundance.

Table 1. Relative abundance of large mammal and human sign per km surveyed in four zones of the Kabo and Pokola concessions in the wet season 2002 (n= 135 km surveyed).

Route	Human sign	Elephant dung	Gorilla nests	Chimp	Buffalo sign	Bongo sign	Med. Duiker dung	Cerc. Monkey groups
Ikelemba (23km)	1.17	11.52	8.60	6.60	2.92	0.23	4.06	Na
Leme (18km)	0.88	0.94	1	1.55	0	0.16	5.38	0.77
Mboulé (27km)	2.28	7.95	1.94	4.48	1.08	0.75	1.53	0.40
Ndoki 1-2 (35km)	0.11	3.37	1.77	3.26	0.82	0.28	1.57	0.11

Data sets from recce surveys, markets and households monitoring, and law enforcement from the Kabo and Pokola concessions collected over 1999-2001 were analyzed and reported in a paper entitled "Assessment and Monitoring of Wildlife Management in Timber Concessions,

Northern Republic of Congo" (Elkan et al. 2003). This paper, to be submitted to a peer-reviewed journal, demonstrates the application of research and monitoring to adaptive wildlife management and protection in the CIB logging concessions.

Wali Bai monitoring:
Wali Bai is located approximately 4 km on foot from the NNNP Headquarters in Bomassa, in the Kabo Forestry Management Unit (FMU). This bai has been closely monitored since late 1999 and the information is vital to understanding whether or not landscape species (elephant, forest buffalo and bongo) visit the bai regularly. This information in turn is an indicator of whether or not the agreement between WCS and the community not to hunt in the bai is being respected. An analysis was made during the previous reporting period of the data covering two years of observations at Wali Bai, from January 2000 to December 31, 2001. The next reporting period will carry details of the full 2002 dataset in comparison with the 2001 dataset.

During this reporting period, seven species of large mammals were observed in the bai; as in the previous recording period, the two most commonly seen were forest buffalo and - almost always during the hours of darkness, around dawn or after 1630h - forest elephant. Four of the twelve known individual elephants identified from the Wali study were recorded at the site during this reporting period.

Animal sign around the bai was monitored weekly. Most sign was accounted for by three species: forest buffalo (31%), elephant (42%), and bongo (15%). This is very similar to the last reporting period. There were significantly more elephant sign during this reporting period than in the equivalent period the previous year (April-Sept 2001) but there were no significant differences for the other two landscape species (buffalo and bongo) (Fig. 6).

Buffalo, elephant, black and white colobus and bongo all visit Wali to ingest the *Spirogyra* algae that grows, year-round, in the water of the lake. Buffalo seem to prefer the lake during the dry season. Elephants use the lake intensively, and mostly at night, between dusk and about midnight. Comparisons of the whole dataset since 1999 show a continuous increase of elephant use of the area (Fig. 7). Bongo sign abundance in this dataset went up for the first time in 2002, but buffalo sign remained stable since 2001 (Fig. 7). The general relaxed behavior and the frequency of visits to the lake by these large and charismatic mammals confirms that the people of the villages of Bomassa and Bon Coin continue to respect the conservation agreement to leave the lake undisturbed. Of particular interest is that elephants are becoming more and more frequent at the site.

Two 3-km trails connecting Wali Bai with the village of Bon-Coin/Bomassa continued to be monitored each week for human and animal sign. As for the same reporting period the previous year, four species made up 84% of all sign: red duiker (4 species lumped together) (33%), elephant (31%) followed by gorilla and blue duiker (10% each).

Elephant visits to the village of Bomassa continue to be recorded on a daily basis. Elephants were commonly seen in Bomassa during this reporting period, (an average of 9 days/month). There have been no significant differences in the number of days that elephants are present in the village each month since 1999 (Fig. 8).

Elephant Monitoring in bais:
Using a similar setup to that of Dr. Andrea Turkalo in Dzanga Bai (C.A.R.), NNNP staff member, Clement Inkamba-Nkulu, continued his long-term elephant identifying and monitoring study during the reporting period. Using the same standardized methodology as Dr. Turkalo, he is in the process of building a database of identifiable elephants at the three

clearings within NNNP: Mabale, Mingingi and Bonye, providing insight on the movements and ecology of this species (Fig 11). These data will be compared to data from the early 1990s in order to assess the impact of protection efforts on large mammal populations. It will also contribute importantly to our understanding of the large-scale movements and spatial requirements of this landscape species. It is clear (from elephant radio collar data: see last report) that elephants are the most requiring of space among the species present in the region, and therefore their needs will be the greatest as a sufficient landscape area is determined.

During this reporting period Mr. Inkamba-Nkulu, Emma Stokes (who can identify 150 individual elephants that frequent Mbeli Bai) and Dr. Fiona Maisels (who can identify 12 individual elephants that frequent Wali Bai) made a visit to Dzanga Bai, where Dr. Turkalo is able to identify 2800 individual elephants. It is known, from the collared elephants, that they regularly travel up to 100 km in a few weeks. The objective was to compare identified individual elephants from each site to establish whether they use all bais to the same degree or not. This information is required to determine how vulnerable the elephant population of the landscape is if one particular bai is destroyed or subject to poaching.

A subset (N=168) of unmistakable individuals from Mabale, Mingingi and Bonye Wali and Mbeli Bai were compared to the 2800 elephants seen and identified at Dzanga Bai. Fifteen elephant from the Nouabalé-Ndoki area were identified as those known at Dzanga Bai (including two matriarchal groups and six males). One adult male had been identified by Mr. Inkamba-Nkulu at Mingingi, which lies 44 km away from Dzanga, and another had been identified in 2001 at Wali and in the Bon Coin manioc fields, 80 km away from Dzanga. Both matriarchal groups had been seen at both Mabale and at Mingingi, over 40 km from Dzanga.
Although we have only a small number of identified elephants that have been seen in several baïs, it has been informative to look at patterns of movement and at maximum distances moved. Data from the five elephants that had been collared by the NNNP elephant monitoring team and the data from the fifteen identified elephants that were documented in more than one place (from two or more of the following sites: Dzanga, Mabale, Mingingi, Bonye, Mbeli and Wali) were compared (Fig. 11). Mean maximum distance moved by collared elephants was 73±30 km. For the fifteen individually identified elephants, for whom we have much less data, the mean distance moved was 52.7±15.4 km. Overall the longest distances were just over 100 km. Two families were regularly seen in Dzanga, Mingingi and Mabale; these were two matriarchal groups.

The numbers of elephants at one or other baïs throughout the region have reached or are near asymptote: about 2800 at Dzanga Baï, over 600 at the baïs of Bonye, Mingingi and Mabale combined, and over 100 at Mbeli. The degree of 'fidelity' of particular elephants to particular baïs is still being examined. Other data indicate that elephants seem react to logging or hunting activities in the peripheral zones by changing their distribution patterns, including the use of particular baïs. Over time, bai monitoring is expected to substantiate this. For example, given that logging activities are scheduled within the next few years in the Bomassa Triangle (at a distance of less than 4 km from Mbeli baï), changes in the site fidelity elephants show will give us an idea of the distances elephants will put between themselves and active logging.

Aerial Videography:
Using aerial videography, twenty-four bais are being monitored to note changes in their physical structure as an indicator of large mammal use within the region including the protected areas of Nouabalé-Ndoki (Congo) and Dzanga-Sangha (Central African Republic) and in the peripheral zone around NNNP (Kabo and Pokola concessions). Two monitoring cycles of the bais were carried out during this reporting period, in May and September 2002. Mosaic images were produced for the second annual cycle, and digital versions distributed to

the three participating projects: NNNP, PROGEPP and the Dzanga-Sangha project (WWF-C.A.R.).

LTCR:
During the second half of FY 2002, two LTCR researchers and four LTCR research assistants continued surveys to obtain baseline estimates of large mammal abundance within the LTCR. Large mammals recorded during the surveys include four of the five chosen landscape species (all but dwarf crocodiles). The second phase of large mammal transects began in February 2002, and was completed in June 2002. Over 400 km of transects were sampled, stratified among all habitat types. These surveys demonstrate that the LTCR is a diverse site in terms of the habitats and animal species contained within its borders. Not only does it conserve a biome that is not well represented in the system of protected areas across central Africa, but it also harbors one of the highest densities of western lowland gorillas on the continent. In fact, LTCR contains the second highest density estimate of western lowland gorillas recorded, and matches the highest density recorded for a single habitat type (11.3 gorillas/ km^2 in terra firma forest). In addition, LTCR harbors all three African species of crocodiles, including the Dwarf crocodile, which is recognized as one of the most endangered crocodilians in the world. Finally, a variety of large mammals inhabit the reserve, including forest elephant, forest buffalo, sitatunga, bush pig, a number of forest antelope species, chimpanzee, hippopotamus, leopard and nine species of arboreal monkeys. Of the Ndoki-Likouala landscape species, only the bongo was not recorded in the LTCR.

Activity 1.2. Focal Ecological Studies on Landscape Species
On track

Elephants:
GPS Télémetry on elephants
The final results from the GPS-collared elephants were given in the previous reporting period. Since then one of the collared elephants has been reported over 100 km from his last known position in NNNP. He was reported from a village in the Lac Télé area by the villagers near the confluence of the Likouala and Bayi rivers. If this is verified, it shows that Lac Télé is a part of the landscape for individual elephants, as all the elephants were collared about 200 km north of the Reserve (this also demonstrates interest and collaboration in information collection on the part of villagers).

Elephant food study
The phenology study, aimed at understanding elephant movements in relation to seasonal food availability, continued during this reporting period. Two hundred trees from twenty different species known to be important to elephants are monitored on a monthly basis for the presence of fruits. An exploratory analysis of the fallen fruit data from the last four years (1999-2002) confirmed that 2002 was a poor fruiting year compared to previous years (Fig. 12). Fruit availability will influence elephant ranging patterns.

Elephant-human conflict
The NNNP management team continued to test and evaluate measures aimed at reducing human-elephant conflicts near Bomassa village. Beginning in 1998, elephants began to move into the area for the first time in memory, likely because of reduced poaching pressure attributable to the presence of the park. However, as a result, elephants also began to destroy fields to such an extent that most of the village has abandoned agricultural activities. The Project has tried a number of approaches, with mixed results, in an attempt to keep elephants away from fields.

This agricultural season, a single large field has been cleared, and divided amongst families in the village who volunteered to participate. Heavy gauge wire abandoned (and sold) by the logging company has been used to encircle the entire field, this time stretched between closely spaced trees. The cables have been smeared with a mixture of grease and hot chili peppers (*Capsicum* spp.) to repel the elephants. During the reporting period there have been only two elephant incursions reported in the field, both in instances where the pepper mix had been washed off in the rain and the "fence" had been weakened by constant pressure from the elephants. It is too early to be sure, but it appears that this approach may have a better chance at success, although it must be noted that it is relatively costly, and cannot be considered a model with widespread application.

Goualogo chimpanzees:
The first phase of the socio-ecological study of an undisturbed population of chimpanzees was completed in the area south of NNNP soon to be annexed to the Park itself, known as the Goualogo Triangle. This area encloses about 280 km^2 of intact forest, and includes several known communities of chimpanzees. The study has been looking at individually recognizable animals, with the objectives of understanding social and ecological aspects of this undisturbed, natural population, to serve as a baseline for comparison with logged regions. The cumulative curve of new individuals identified by days is reaching asymptote for adult males and females, suggesting that most of the chimpanzees in this community have been identified (over 170 individuals).

Publication of results to date:
Morgan, D. and C. Sanz. (in press). Naïve encounters with chimpanzees in the Goualogo Triangle. International Journal of Primatology.
Morgan, D. and C. Sanz. Fire of the Chimpanzee. Wildlife Conservation. Sept/Oct. 2002.

Dr. Samantha Strindberg and Dr. Fiona Maisels, in coordination with other members of the Congo team consolidated the information available for the five landscape species: elephant, chimpanzee, forest buffalo, bongo and dwarf crocodile, to produce biological landscape models for each species. These models took into account the vegetation preferences of each species, its use of different types of forest clearing and the impact of access to water on its behavior. The new and improved vegetation data that went into the biological landscapes are based on ground-truthed satellite images.

A human landscape model was developed in conjunction with the biological landscapes. That made spatially explicit the same threats that went into the landscape species selection process: cables, automatic weapons, commercial hunting and unsustainable safari hunting. The entire landscape was broken up into a large number of zones each with an associated management level and level of severity for each of the threats. The next step in this process is to overlay the biological and human landscapes to spatially assess priority areas of study and intervention for each of the landscape species. By combining the species-specific conservation landscape models a combination conservation landscape will emerge and highlight the areas where conservation activities are a priority.

Activity 1.3. Safari Target Landscape Species
On track

Bongo:
Eves Mahounou was recruited, trained, and fully integrated with the local team to conduct ecological research for the Mombongo research and conservation program. Activities during this period included a wet season camera trapping survey of bongo populations in Mombongo, camera trapping at Bagbali bai and the Safari zone, reconnaissance surveys and road surveys, tracking of bongo to collect information on food habits, patrolling of the area,

and improving camp infrastructure. Double camera units were implemented to increase capture rates and facilitate model testing procedures in mark-recapture analyses of open and closed population models (using software programs MARK and CAPTURE) - conducted to estimate population density. Plans to tag bongo with GPS/VHF units, a high priority for the BCLS landscape approach, are on track for the second half of 2003, in order to track their movements. A spatial model predicting the habitat requirements for bongo antelope is being developed from recce survey data and CIB wildlife surveys datasets.

Full data analyses were completed for bongo data collected over 1996-2001 and findings reported in three scientific publications. New information on bongo social organization and population ecology demonstrate that this species requires a landscape approach for its conservation, extending protection beyond protected area borders and over large expanses of forest. These papers present bongo social organization and aspects of its population ecology in detail. Further research, management regulation and monitoring, and development of landscape scale conservation strategies are presented and discussed. Given the on-going safari exploitation of bongo in Cameroon and CAR, research findings and methods to improve surveys and monitoring will be circulated and presented to the Tri-national managers of the region.

Buffalo:
Information on forest buffalo social organization and demographics continued to be collected through direct observations at Wali bai. Reconnaissance surveys, road surveys (Bomassa, Mombongo, Safari zone) and the CIB wildlife inventory transect collected data on buffalo relative abundance throughout the forest concessions. Building on Steve Blake's earlier findings in NNNP, Richard Malonga is developing the design (employing spatial data and vegetation maps) for an investigation to assess factors influencing the abundance and distribution of buffalo within the Ndoki landscape.

Activity 1.4. Hunting and Forestry Impacts
On track

NNNP:
The Bomassa - Bon Coin hunting monitoring continued and the results from 2001 and 2002 were compared. The Makao hunting monitoring also continued and volume and price of bushmeat were compared between the two Park bases of Bomassa and Makao over the last few years. In Bomassa, between 2001 and 2002, there were no significant changes in either the numbers of animals harvested or the price of bushmeat sold in the village (Figs. 14 & 15). This suggests that the hunting level may be sustainable, and that the socioeconomic situation is stable, thanks to the presence of the conservation project as an employment opportunity for local people. There was one exception: there was a significant reduction, by about a third, in 2002, of the numbers of primates hunted in the village. This could be the result of a public health meeting held by WCS veterinarian Annelisa Kilbourn in early 2002 that raised awareness about the risk of contracting disease (e.g., ebola) from consumption of certain primates. There were no changes in the prices of other goods (manufactured, agricultural, or non-timber, non-meat forest products) in Bomassa.

In Makao however, meat prices went up by a third after the arrival of the logging company and the access road to the village (Fig. 15). In addition, the prices of two other types of items rose significantly after the arrival of the logging company (manufactured goods, agricultural/forest products). The most striking change in hunting patterns was the sudden leap in numbers of blue duikers killed at Makao each month (about five times more than before the arrival of the loggers).

Peripheral Zone:
The PROGEPP team continued monitoring hunting practices and demographic trends in the logging concessions through bushmeat market, household, and demographic surveys at the major camps and towns. These data provide information on the effects of management interventions on hunting practices, information necessary to assess the impact of hunting on game populations, and gain insight into the nature and cause of demographic growth and expansion in the concession areas. Information from these surveys is immediately communicated to inform and adjust management interventions as well as to influence planners and decision makers regarding land-use and management planning needs.

Surveys of bushmeat entering the Kabo, Pokola, Ndoki 1 and Ndoki 2 sites were undertaken on 10 randomly selected days each month in conjunction with household consumption investigations to collect information on hunting practices and off-takes in relation to location, season, and management interventions. Market surveys showed a stable trend in the daily quantity of bushmeat entering the sites from April to July 2002 with Ndoki 1 higher than Ndoki 2 or Kabo. During this period the rate of snared bushmeat entering Pokola more than doubled from previous rates. Much of the snared meat registered in Pokola originated from the Danzer concession across the river. A new recruitment and training of ecoguards in October 2002 permitted expansion of ecoguard patrols to deal with increases in snaring around Ndoki 1.

Surveys of household consumption of protein collected information on 1443 meals during this reporting period. Bushmeat made up 30-40% of meals in Pokola and Kabo with fish represented in 50-60%. Domestic meat increased in diets in both Kabo and Pokola to 4-6% from 2% in earlier surveys. Bushmeat consumption was higher at Ndoki 1 and Ndoki 2 camps (>50%), followed by fish and with no consumption of domestic meat recorded. Increases in domestic meat at the large towns corresponded with efforts by the company to import large quantities of domestic meat to substitute for bushmeat.

A study was undertaken in Kabo and Pokola towns to assess the influence of how meat is sold (in large or small quantities) in relation to patterns in purchasing. This entailed detailed recording of weights and prices of different sales and techniques employed by bushmeat merchants. Experiments were conducted with the sale of beef in small and large quantities to compare with sales of bushmeat. Results indicated that the price of bushmeat sold in small quantities tripled in price compared to that sold in larger quantities. Beef sold in small quantities was more readily purchased than in large quantities. A pilot experiment showed that beef was purchased more rapidly when made available in small quantities. Preliminary observations indicate that substitution of domestic meat for bushmeat is essentially an economic problem that is greatly influenced by the manner in which it is made available.

In addition, a pilot study was undertaken to determine methods to assess and monitor freshwater fishing practices in the region and documented the important role of Pokola for fish commerce in the region (Report by Germaine Mavah et al. 2002). Household meal and bushmeat entry data from the Kabo and Pokola concessions collected from 1999-2002 were analyzed and presented in the assessment and monitoring paper mentioned above (Elkan et. al 2003).

Activity 1.5. Timber Exploitation and Impacts on Wildlife
On track

Direct and Indirect Impacts of Logging on Wildlife:
A research design and full proposal is being developed for a long-term comprehensive investigation of the direct and indirect impact of forestry exploitation on wildlife populations.

John Poulsen and Connie Clark will act as principal investigators on this program in partial fulfillment of their PhD. requirements. A full research proposal is being produced for circulation to potential donors (Fonds Francaise pour l'Environnement Mondial, USFS, and others). Data relevant to the investigation from reconnaissance surveys were analyzed. Data collected by the wildlife inventory teams of the CIB Kabo transects were organized and prepared for spatial analyses and density estimation using the program DISTANCE. Full analyses of these data as well as those from Loundougou and Pokola will be undertaken in the first half of 2003 for integration into the CIB management plan. CIB teams were monitored and evaluated every two months by PROGEPP researchers. The Bonyo camp located in the center of the safari zone of the Kabo concession was rebuilt and improved to act as a base for the research program.

Large mammal use of timber roads:
Monthly surveys of large mammal sign along two secondary roads in the Kabo concessions were continued during this period to improve understanding of the effects of timber road networks on large mammal populations. High levels of elephant and buffalo activity along with the presence of bongo, and other species were registered in the Mombongo area of the Kabo concession. The road surveys from the safari zone indicate a high level of leopard activity. Spotted hyena sign was low during this period. Leopard scat were collected and dried for diet analyses.

A male hyena was found dead in the Mombongo bai area in June 2002. The hyena was very thin and no evidence of predation by leopard was observed. The skull was collected and mandible sent to the SEGC (a scientific research lab) in Gabon for testing. The research design for an investigation of hyena abundance, distribution, and food habits was developed.

Large mammal use of timber roads near NNNP:
The 30 km road between Park Headquarters in Bomassa and the Ndoki Research Station on the edge of the Park continued to be monitored for large mammals. Animal and human sign, and their distance from the village are recorded. The road was monitored six times in 2002 (three during the reporting period). In 2002, a total of 2721 signs or actual sightings were recorded, roughly 15 per km. At least twenty-seven mammal species were recorded. Red duiker sign and elephant made up most of the total, with 22% and 19% of all sign respectively, followed by buffalo (15%), and red river hog and civet (7% each). Bongo and yellow backed duiker made up 5% and 6% of signs respectively.

When the entire 2001 dataset was analyzed and compared to 2002 data, no significant differences were found in animal presence along the road for any hunted species (Fig. 9). This was also the case for data between 2000 and 2001 (Fig. 9). This suggests that hunting pressure continues to remain stable, and with the possible exception of bush pigs, seems to be sustainably managed. Elephant sign was significantly more abundant along the road in 2002 than in 2001, with 2001 having shown a significant increase since 2000. (Fig. 9). Pig sign continues to be rare within the first 10 km of the village, as has been the case since 1996.

The evidence from above (See Activity 1.1) points to an increase in elephant frequency between the Sangha River and the Park, a sector that has been protected from poaching since 1993. In addition, the arrival and "residence" of elephants in the village of Bomassa-Bon Coin, previously a hotbed of ivory poachers, shows that the conservation project has been perceived as such by the elephants themselves, unlike in the area to the north of the Park. A report on elephant monitoring in Wali and the surrounding area was accepted by the British Ecological Society /Society for Conservation Biology annual conference in July 2002:
Maisels, F., Ekoutouba, D.-D., Abeguo, R., Mboulafini, M., Mahmadu, M., & Mobolombi, G. (2002) A forest lake in northern Republic of Congo: a window on forest elephant

conservation. In: British Ecological Society/ Society for Conservation Biology, Canterbury, U.K.

Goualogo chimpanzees:
The objective of this work was to assess how logging activities affect density, distribution, and behavior of chimpanzees both in the logged area, in the areas immediately adjacent to them, and also in areas up to 10 km away from logging. The study will also reveal whether major swampy rivers within the landscape (such as the Goualogo river itself) form a barrier to chimpanzee dispersal. This will provide a unique opportunity to evaluate the impacts of logging on chimpanzees, which have been documented to respond more negatively to logging than many other species. So far results from line transect surveys suggest that the density is just over 1.2 chimps per km^2. This is in the middle of the range for previous studies across Africa. This density will now be compared to that known from direct observations of individuals in their home ranges.

Activity 1.6. Physical Landscape and Habitat Types
On track

GIS data are continually collected (both aerial and ground-truthing) throughout the Ndoki-Likouala landscape in order to create more accurate maps of the area. These maps allow the projects to keep track of threats and react accordingly, as well as to develop a more complete picture of the various habitat types important to each of the landscape species.

Nadine Laporte and Tiffany Lin completed land cover mapping of the Kabo, Pokola, and Loundougou concessions and produced a draft vegetation map of the NNNP, Mokabi, and other areas to the north. These maps will be further refined in early 2003 through aerial and ground-truthing to monitor the impact of forestry exploitation (see also Activity 2.6).

A team of botanists visited the Park in July 2002 in order to conduct a floristic inventory of two mixed species sites in the southern boundary region of the park. Part of this information will be used as ground-truthing for land cover mapping.

Biochemistry and zoogeomorphology of forest clearings (bais and yangas):
The PROGEPP coordinator and other staff furthered the investigation of the biogeochemistry and zoogeomorphology of forest clearings. Soil and rock sample analyses were completed at the University of Minnesota Department of Water, Soils and Atmospheric Science. Preliminary results of these analyses will be reported on in the future. The PROGEPP coordinator examined forest clearing formation and distribution while participating in the WCS GIS training program in Kenya in June 2002. By employing remote sensing, aerial photographs and GIS tools in spatial investigation of clearings, this investigation aims to determine the origin of yanga and bai forest clearings, develop understanding of their importance within the landscape, and produce recommendations for monitoring and conservation of these (presumed) key habitat areas.

Activity 1.7. Additional Biodiversity Surveys
On track

NNNP:
In June 2002, the NNNP team hosted a team of French researchers who have been surveying the central African region for the presence of the two species of otters reported to be present. These surveys demonstrated that the Congo clawless otter (*Aonyx congicus*) is present. The Cape clawless otter (*Aonyx capensis*) was not observed.

LTCR:
LTCR is the only Ramsar site in the Republic of Congo, chosen for the high diversity and density of waterbirds along its river ways. The Reserve houses several nesting and breeding sites for the purple heron (*Ardea purpurea*), african darter (*Anhinga rufa*), night heron (*Nycticorax nysticorax*), long-tailed shag (*Phalacrocorax africanus*), and lily trotter (*Actophilornuis africana*) (Wetlands International Report). However, little else is known regarding the actual density and diversity of birds in LTCR. In January 2002, LTCR supported a study by Jerome Mokoko, a Congolese ornithologist, to determine the diversity and distribution of birds in the Reserve. A preliminary species list of over 300 species has been developed from this work.

In addition to the preliminary inventory of birds in LTCR conducted by Mr. Mokoko, two LTCR researchers and two research assistants initiated a survey of water birds to determine: (1) the density of water birds in the Reserve; and (2) seasonal fluctuations in water bird densities. A second survey was completed in March 2002. The surveys were hampered by methodological problems, but preliminary results indicate that there are significantly higher densities during the low water season (55.7 birds/ km^2) compared to the high water time of year (20.6 birds/ km^2). This suggests the importance of Lac Télé as a seasonal stopover point for migratory birds, but more surveys are needed to verify this.

Fish and reptiles:
The Lac Télé project has offered logistical support to biological experts to conduct inventories and surveys of fish and reptiles in the Reserve. The swamp forests of central Africa are poorly understood, yet are a vital habitat for the dwarf crocodile and other reptiles. The herpetofauna of these forests are little known, and are likely to comprise an important part of the overall Lac Télé faunal community. The majority of the inhabitants of the LTCR are fishermen, and therefore the economic importance of various species must be better understood if these resources are to be exploited in a sustainable manner. These studies are still in the planning stages.

Pilot Investigation of Bushmeat markets in Brazzaville:
Under separate funding, a one-month assessment was undertaken by a national research assistant to assist in planning the design for an investigation of the commercial bushmeat trade in Brazzaville. Preliminary information was collected on entry points (ports, airports, roads), markets, source areas, merchants and purchasers involved. Based on these observations a thorough investigation is being planned to generate information directly relevant to national level strategy development and implementation to control the commercial trade in wildlife.

Activity 1.8. Large Mammals and Human Use Patterns in the LTCR
On track

**Note: This activity was not described in the FY 2002 Implementation Plan, but is described separately here as it is deemed to be a significantly autonomous activity from the others in Objective 1.*

During the reporting period, the LTCR social science teams completed the second phase of their village surveys, and data were analyzed for both phases of this part of the feasibility study. These surveys show, among other important points, that there are over 13,000 inhabitants in 22 villages in and around the LTCR, although population density is relatively low (nearly 3 persons/ km^2). The overwhelming majority of people (91%) are members of the Bomitaba tribe, making them "indigenous" inhabitants of the region. In addition, a large

majority of the population (95%) reported earning their livelihoods from occupations or activities involving natural resource exploitation; nearly all adults are fishermen or farmers. Significantly, local communities perceived the need to alter their patterns of natural resource exploitation in order to avoid unsustainable use. In contrast to other parts of the landscape, bushmeat is not an important nutritional source for local communities. However, the export of bushmeat outside of the region is probably the primary threat to wildlife and the LTCR's biodiversity.

A detailed report "The Feasibility Study Report of the Lac Télé Community Reserve" (John Poulsen and Connie Clark) is available upon request from the WCS Living Landscapes Program.

OBJECTIVE 2: Strengthen local, on-site protection and management of biological resources across the landscape.

Activity 2.1. Law Enforcement
On track

NNNP:
Regular patrols within NNNP were conducted by MFE and BCLS staff from both the Bomassa and Makao bases. During the reporting period, the Bomassa team completed 12 patrols in the west and south of the Park, noting very little sign of human incursion, and resulting in the seizure of a single wire snare. During the same period, the Makao ecoguards completed 6 patrols, concentrating in the east and north of NNNP. Like their counterparts in Bomassa, these missions found very few human traces, and resulted in the seizure of one snare.

In addition, six monthly tri-national patrols took place on the Sangha River during the reporting period, along the limits of the NNNP, with partners from Cameroon and Central African Republic. For the reporting period, tri-national seizures included 165 cables, five 12-gauge shotguns and 11 associated cartridges and one locally manufactured gun.

LTCR:
Due to problems of lack of qualified personnel and inadequate funding, anti-poaching controls were suspended during this period. However, funding was secured from the USFWS to assure that patrols will resume during the next fiscal year.

Activity 2.2. Law Enforcement and Wildlife Management in Forestry Concessions
On track

During this reporting period, PROGEPP field patrol efforts by 4-6 MFE officers working with 20 ecoguards in the CIB concessions entailed: 591 patrol days at fixed posts controlling vehicles, 119 on mobile patrols in the forest, 5 controlling the Ouesso airport prohibiting export of bushmeat on flights to Brazzaville, in addition to the Tri-national patrols described above. These efforts (not including tri-national patrols) resulted in seizure of 1299 wire snares, 30 shotguns involved in wildlife law violations, 1 leopard skin, 1 gorilla skull, 7 crocodiles, and two sacks of elephant meat. A total of 71 legal charges were addressed against violators during this period including 30 against CIB employees and 41 against non-CIB employees. The majority of CIB violators were truck drivers. The drivers are given administrative sanctions which in many cases causes them to lose part or all of their annual bonus, and in cases of protected species they are fired. This data indicates an increased effectiveness of our ecoguards. The trucks have greatly reduced the amounts of meat they are

attempting to transport (i.e. small pieces). As the protection efforts increases the infractions remain high, because the teams are becoming stricter.

An intensive ecoguard training program was designed and implemented beginning in September 2002 with the goal of increasing the PROGEPP guard force from 20 to 40 (see Activity 2.8). Twenty new ecoguards were selected from a pool of 130 candidates interviewed. All those selected were born and raised in the Kabo, Pokola, or Loundougou concessions and exhibited a strong knowledge of the forest and high level of motivation. The additional staff, paid by CIB, will allow expansion of law enforcement activities to the Loundougou and southern Pokola areas, and is an example of CIB bearing increasing financial responsibility for law enforcement within the concessions.

Table 2. Law Enforcement Efforts and Return Rates in the Kabo and Pokola concessions 1998-2001.

Kabo	**1998**	**1999**	**2000**	**2001**
Patrol days	19	55	530	716
Snares	1560	1234	402	1016
.12 ga.	13	18	67	67
Elephant rifles	2	3	0	0
AK47	0	3	0	0
Ivory	3	0	1	2
Pokola	**1998**	**1999**	**2000**	**2001**
Patrol days	na	83	799	937
Snares	na	3811	7371	10438
.12 ga.	na	19	302	170
Elephant rifles	na	3	3	2
AK47	na	1	2	1
Ivory	na	4	45	4

Law enforcement data collection methods developed by the MIKE program were employed to monitor the success of wildlife law enforcement efforts. An analysis of law enforcement efforts undertaken for the period 1998-2001 demonstrated higher poaching pressures persistent in parts of the Pokola concession compared to Kabo (Table 2). While wildlife protection and management has been extended into much of the Kabo concession, the population center of Pokola continues to be a source of poaching, particularly for elephant in the southern reaches of the Pokola concession.

Activity 2.3. Bushmeat Control Along Key Transport Axes in the Region
On track

Agents of the Regional Direction of Forestry Economy (RDFE) in the Likouala implemented a series of wildlife conservation activities with technical assistance from PROGEPP and LTCR staff and funding from USFW Elephant Conservation Fund. Controls at the airport to reduce bushmeat export from Impfondo to Brazzaville continued with satisfactory performance during this period. Collaboration has been positive between PROGEPP and the Sangha Regional Director, M. Leonard Mouboundou. By the end of March, responsibility for execution of the airport bushmeat control operation had been successfully transferred to the RDFE.

Over March-June the agents of the RDFE Sangha and police at the airport appeared to have executed bushmeat controls in a satisfactory manner. However, a decline in rigor and several incidents involving Government authorities were registered in late June and July. Following a series of meetings, it was decided in mid-August that a trial period would be granted for the RDFE to clean up the operation: failure to restore order would result in suspension of support. Despite reassurances by the RDFE of its engagement in the operation, a WCS evaluation one month later found a continued lack of rigor. Therefore, in late September the Regional Direction and General Direction were informed of the temporary suspension of support to the operation due to the RDFE's lack of success in restoring the former efficiency of control activities. It is hoped that after training of the mobile ecoguard unit in the East concession that the capacity and motivation to successfully undertake these controls will be sufficiently developed to resume the airport control operation. It is recommended that support of the Likouala based efforts be continued with close performance monitoring. The General Direction will be asked to take a stronger role in engaging airlines, authorities, other factors to support the bushmeat control efforts.

Activity 2.4. Conservation Awareness and Education Initiative
On track

Peripheral Zone:
Two PROGEPP educators implemented the conservation awareness campaign working actively with 23 villages in the Kabo, Pokola, and Loundougou during this reporting period. Additional activities were also undertaken in Ouesso on protected species education. A total of 847 people participated in different meetings including CIB employees, non-CIB local community members, hunters, and Bendjele pygmies. Objectives of these sessions were to inform and discuss protected species, hunting techniques, hunting regulations, conservation and management principles, and relations between the project, company, Government, and local communities. In general attendance was favorable, however participation at CIB sites was noticeably lower than at non-CIB sites. This could be because CIB workers do not have as much time to participate in the meetings, as other villagers do. Many requested viewing of wildlife films.

A total of 540 students participated in conservation education lessons at Kabo (10 sessions) and Ndoki 2 (5 sessions) schools. Focused lessons were designed, developed, and taught on each of the following subject areas: water, vegetation, air, vegetables, elephants, soil, insects, primates, fish, trees, and reptiles. The protected species education manual and curriculum was finalized with the Regional Education Ministry authorities. The manual is being edited and graphics added for publication in 2003. Mark Gately (author of the WCS-Congo website (Activity 2.9)) assisted the PROGEPP education team in the finalization of the manual, information bulletins on specific subjects, and a teaching guide for publication.

A National Geographic Film team led by Cynthia Moses produced a film on the efforts of PROGEPP to reduce the bushmeat trade and promote wildlife conservation and management in the CIB concessions. Reporters from the New York Times visited the Kabo and Pokola concessions in August and wrote on the project in a special addition of the Science Times section on new approaches to dealing with a rapidly changing world environment (see Appendix 1).

LTCR:
LTCR continued a protected species education campaign in the 27 villages in and around the Reserve. The LTCR staff created a poster depicting the protected species found within the Reserve limits and distributed them for display in schools, hospitals, offices, village shops, and other high profile spots throughout each village. Posters were also given to all public

transport vehicles (both large boats and bush taxis) for display in their windows. In addition, three LTCR educators continued to hold awareness-raising meetings in villages to discuss protected species laws and how these laws affected the local population, as well as presenting the results of the socio-economic surveys in the villages as they relate to conservation issues.

Activity 2.5. Alternative Resource Production
On track

Peripheral Zone:
The alternative activity program aims to decrease pressures on wildlife populations by promotion of alternative income sources for local traditional people in place of commercial bushmeat hunting, and by promotion of local community managed activities that increase alternative animal protein availability (beef, chicken, fish, etc.) in the forestry concessions. Three national alternative activity technicians under the supervision of the CIB management plan and PROGEPP coordinators worked extensively at CIB sites and in the traditional villages within the concessions. This period was marked by a dramatic increase in CIB based efforts to import domestic protein to the Kabo and Pokola sites and the acquisition of 10 cold rooms for storage of imported domestic meat.

Progress during this period included:

- Technical and material assistance to traditional farmers with the vaccination of 2854 chickens in the Kabo and Pokola concessions and distribution of 180 m. of wire fencing. Six bundles of sawn wood and five kg of nails were distributed for construction of enclosures for goats and sheep.
- Technical assistance to farmers raising meat chickens in Pokola including facilitation of the supply of chicks and construction materials. CIB and PROGEPP facilitated development of a new chicken farm with importation of 1560 chicks and six tons of feed.
- CIB contributed bulldozer time to add four new tilapia ponds to a second site that supplement 14 basins at the first site. PROGEPP technicians provided permanent support and materials such as hoes and levels. The first basin produced 105 kg of fish that were sold on the Pokola market. The new basins have been stocked with 1000 fry per basin.
- Material assistance to local fishermen consisted of small loans to fishermen in the form of 1900m of fish net, 29 rolls of line, and 22 boxes of fishhooks. The PROGEPP research and monitoring program undertook a three-month pilot investigation to examine and test methods to monitor freshwater fisheries exploitation.
- 86 beef cattle were imported and consumed during this period as a result of efforts to promote domestic consumption in Kabo and Pokola.
- Technical assistance to pilot projects in guinea pig raising progresses with a current number of 40 in the experimental project and five pairs of guinea pigs and wooden cages distributed to interested local farmers during this period. Farmers have been successful in producing offspring over the past year, resulting in an average of 6 per pair.
- Pilot projects on snail raising as an alternative protein source have progressed with a high level of local interest in Kabo. This project is experimental and has been serving as a base of information on how to raise snails of this kind in a domestic setting. It is a very low cost means of producing protein, but it is slow at the start-up. The project has provided important information on how to best create a reproducing stock and raise the young. Initially, there were high losses due to a lack of information on how to raise snails. However, this experimentation has now led to a well-established pilot set up of 42 reproducing adults, 142 young,

and 50 eggs to date. This is encouraging, as snails are locally consumed by many ethnic groups in the region who harvest them wild from the forest.

- Assistance to vegetable farmers consisted of the sale, at cost price, of three kg of seeds to farmers in the region. Vegetables (cabbage, lettuce, tomatoes, leeks, eggplant, beans, cucumbers, carrots, etc) are produced and are available on the market on a regular basis in the larger town of Pokola, whereas smaller towns seem to concentrate their gardening efforts in the dry and transitional seasons.

Activity 2.6. Reduced-Impact Logging
On track

PROGEPP staff (with input from other WCS experts) are in the process of reviewing and commenting on the draft RIL program guidelines produced by Fred Glannaz, Benoit Demarquez and Dennis Dykstra for CIB. Official recommendation will be submitted to CIB in early 2003 for their consideration. CIB has continued pilot testing of improved road planning, felling, and logging skidding techniques.

Dr. Nadine Laporte, assisted by Tiffany Lin, produced a land cover map of the CIB concessions and proposed methods to monitor the impact of forestry exploitation using remote sensing tools. These maps will be adjusted iteratively as verification is improved.

Activity 2.7. Research Methods Training
On track

All research projects (See Activities 1.1 and 1.3) that occur within NNNP, LTCR and the Peripheral Zone include the participation of Congolese, either as lead researchers or as assistants.

NNNP:
Monthly research meetings are held in Bomassa, to which all researchers and research assistants are invited to attend (and to give presentations) from the Bomassa, PROGEPP, Mbeli, Goualogo, and Mondika groups. It is hoped that the LTCR research assistants will be able to come to at least one of the meetings in the next reporting period, despite transportation difficulties.

The objectives of the meetings are three-fold:
* to enable Congolese researchers to meet up on a regular basis in an academic atmosphere to discuss their research;
* to provide the opportunity to researchers to present their work to a scientific audience - and to learn how to deal with questions on their research;
* to keep colleagues up-to-date on each other's work.

The research meetings, which started in April 2000, are now in their third year and have proven very popular. In the reporting period, Congolese researchers have presented seminars on the following topics (1) Alain Ampolo, on the hyena signs and sightings in the Ndoki landscape; (2) Djoni Bourges, on anti-poaching in Nouabalé-Ndoki; (3) Patrice Mongo, on phenological studies in Mondika, a gorilla research camp; (4) Diane Doran, on the gorilla research at Mondika; (5) Fiona Maisels on the monitoring program at Nouabalé-Ndoki. Dr. Maisels also continues to mentor these researchers on a daily basis in all aspects of data collection, management, and interpretation in order for them to gain an understanding of the importance that sound research can play in the effective management of protected areas (see Activity 2.8).

LTCR:
In the LTCR, training continued for the Project field staff in the scientific method, sampling and specifically socio-economic survey techniques, such as how to design and conduct questionnaires, how to design village maps, how to create a village history, and how to complete a basic statistical analysis. The biological teams also received regular mentoring in methods for biological surveys.

Peripheral Zone:
Under PROGEPP, Antoine Moukassa and Richard Malonga continued mentoring of Germaine Mavah and Calixte Makoumbou in socio-economic and ecological research methods. Sarah Elkan and Antoine Moukassa provided regular instruction to Alain Ampolo, Malonga, Makoumbou, and Mavah on the use and applications of Arc View in their respective research subjects. Research assistant Eves Mahounou was trained in remote camera applications, video techniques, and data collection methods for the Mombongo based research program. Three new assistants will be recruited to reinforce the research team as Richard Malonga pursues his graduate research and Antoine Moukassa becomes more involved in project management in the Mokabi area.

Paul Elkan attended a workshop on mark-recapture techniques using the modeling program MARK at Colorado State University in June 2002. Information and skills developed through this workshop and in subsequent mark-recapture analyses will be of assistance to field research in northern Congo. Mark-recapture methods may be applicable to forest clearing resighting investigations of large mammals (i.e. elephant, gorilla, etc.), expanded camera trapping applications to the study of bongo, leopard and hyena, and used in conjunction with information generated using telemetry techniques.

Activity 2.8. Technical Training
On track

In addition to mentoring in scientific research as mentioned above in Activity 2.7, daily project operation at NNNP also includes long-term mentoring of Park administrative and management staff, with gradual devolution of responsibility to national staff for developing work plans and budgets[ngw34].

Patrick Boudjan and Clement Inkamba-Nkulu continue as research assistants dedicated to the elephant work in the area to the north of the Park and in the central baïs of the Park, respectively. Patrick Boudjan finished the survey of the area north of the Park in mid-June 2002. Mr. Inkamba-Nkulu will help with the elephant identification training session held by Andrea Turkalo in December 2002 at Dzanga, where his knowledge will be passed on to Cameroonian elephant researchers, and he will also learn more from Andrea Turkalo. Samantha Strindberg, the quantitative analyst of the core BCLS team, visited Bomassa and gave Patrick statistical and GIS feedback appropriate for the treatment of his dataset. Both Clement and Patrick have gained experience not only in ecological research, but also in planning and managing field expeditions, including purchasing, transporting, and accounting for food and equipment, and in managing work programs and salary calculations for small field teams of four to eight people.

This year two new research assistants began working with the NNNP team in Bomassa, Mustapha Mahmadu and Mireille Hockemba. During this reporting period, both received training in phenology data collection at Bomassa. Mireille was also trained in the use of EndNotes (a bibliographic database), including entering references, and the use of this program in written reports. In the middle of 2002, a botanical expedition led by Jefferson Hall and David Harris (Yale University and the Royal Botanical Gardens of Edinburgh,

respectively) provided introductory training to Patrick, Mireille and Mustapha on herbarium techniques and botanical inventory. Mireille is now research assistant to the Mbeli Baï study, under the guidance of the new Mbeli principal investigator, Thomas Breuer. Mustapha remains in Bomassa and continues the monitoring of Wali, large mammals around the village, and the phenology and roads monitoring.

Jean-Robert Onononga continues with the Goualogo chimpanzee project, under the direction of David Morgan and Crickette Sanz. Mr. Onononga finished the first phase of the before-and-after logging chimpanzee study currently underway in the Goualogo Triangle and the adjoining area to the south (see Activity 1.3). He then started a new study assisted in its design by Samantha Strindberg, which aims to identify the rate of chimpanzee and gorilla nest decay in the Ndoki landscape - a study essential to estimation of ape abundance and therefore to any assessment of logging impact. This is ongoing and Mr. Onononga will continue in the field until February 2003 on this study.

Peripheral Zone:
The PROGEPP Director, Coordinator, and Administrator mentored MFE officers, ecoguards, educators, administrators, and national researchers in project management, education, forest/wildlife management, research/monitoring and GIS data-basing. All staff team leaders and researchers are trained in use of computers (Excel, Word) and mentored in work plan development, budgeting and reporting on weekly, monthly, six month and annual cycles. GIS and English language skill development are encouraged particularly for researchers.

- Moise Zoniaba, chief of personnel and assistant administrator, took on increased project responsibilities in project management, interpretation of laws and representation of the project with local and regional authorities. Moise is interested in further developing knowledge and skills in project management, as well as use of Access in administrative database management.
- Marcel Ngangoue, MFE officer, chief of PROGEPP wildlife protection activities, has demonstrated strong leadership skills and discipline in overseeing expansion and management of the mobile brigade.
- Antoine Moukassa, socio-economic researcher, continued to oversee socio-economic research activities, received GIS training at the WCS training in Kenya and subsequently trained other researchers and research assistants. He represented WCS at several important meetings in Brazzaville and is regularly called upon in project management.
- Richard Malonga, ecological researcher, was awarded a fellowship to undertake graduate study in Conservation Biology. Richard is currently applying to University programs and will be improving his English language skills through intensive instruction in early 2003.
- Michel Sienzo, education team leader, has played an active role in developing the education program strategies and continues to expand in conservation education.
- Noel Langalanga, ecoguard assistant patrol leader, has taken on more responsibility with the increase in ecoguard personnel. Noel received leadership and personnel management training along with four other team leaders in a specialized accelerated component of the ecoguard training program.

An intensive ecoguard training program was designed and implemented in September 2002 to train 20 new ecoguards and refresher training for 20 existing guards. Legal and health screening of new recruits was undertaken in collaboration with the regional authorities and CIB hospital. The ecoguards received six weeks of training at the Kabo base followed by two weeks of field operations training in the forest concession. Trainers from WCS, MFE, RDFE, and the Likouala and Sangha Armed Forces instructed the ecoguards on wildlife laws, CIB

interior regulations for wildlife management, sports, arms training and discipline, logistic, patrol techniques, GPS and forest navigation, etc.

Activity 2.9. Development of Ecotourism Activities
On track

The government of Congo has expressed a keen interest in developing ecotourism within its protected areas. Despite the difficulties associated at present with travel in Congo, which limits the number of potential tourists, the NNNP team has begun to slowly develop a strategy for welcoming visitors to the Park. During the reporting period, improvements and additions were made to existing infrastructure (with funding from WCS and CARPE), which now allows a maximum of eight tourists to comfortably visit three sites in and around the Park. In addition, the WCS-Congo website (www.wcs-congo.org) was updated, and a 2003 calendar was developed for promotional distribution. All personnel (cooks, guides, boat drivers, etc) who will be affiliated with the tourism program undergo continuous training to prepare them for welcoming visitors. Finally, contact has been established with tour operators in Congo, Gabon, South Africa, Japan and the UK to explore interest in the NNNP program. During this reporting period, the Park was visited by 33 tourists (from the UK and the USA), including film teams from National Geographic and WCS.

Activities 2.10. Integration of Forest Peoples Communities into Management
On track

An expert consultancy on forest peoples in the peripheral zone is scheduled to be undertaken by Dr. Serge Bauchet in March-April 2003. BCLS socio-economic databases were expanded during this period with information on Bendjele communities and other peoples living in the Mokabi concession and updating of demographic databases for the Kabo, Pokola, and Loundougou concessions (Activities 1.4).

OBJECTIVE 3: Promote the development of national policies that support the landscape conservation approach.

Activity 3.1. Wildlife Law
Delayed

As with other Congolese government administrative processes, the wildlife law is still awaiting finalization and adoption. Constitutional and presidential elections in the last reporting period delayed progress, and legislative elections further delayed government work. As of the end of the reporting period, the new Congolese wildlife law has yet to be adopted.

Activity 3.2. Wildlife Management Workshops
On track

In late July 2002 the US Department of State sponsored a 3-day workshop on "Wildlife Management and Conservation in Forestry Concessions in the Republic of Congo." WCS, the MFE, the USFS, and USFW worked together to organize the technical workshop in Brazzaville bringing together 54 field practitioners, managers and policy makers from Republic of Congo, Democratic Republic of Congo, Cameroon, and Central African Republic. The objectives were to examine, refine and propose basic templates for wildlife management, law enforcement, and monitoring programs at the scale of forest concessions and identify the processes necessary for their integration in concession level, regional and national level planning in the Republic of Congo. The forum also contributed to related initiatives concerned with wildlife conservation in managed forests (i.e. CITES bushmeat

working group) through the exchange and communication of information on the concept of wildlife management and conservation in forestry concessions using practical "lessons learned" from northern Congo.

The results of the workshop will lead to formalized standards for the design, implementation, and monitoring of wildlife conservation and management programs in forest concessions proposed for adoption by the Ministry of Forestry Economy of the Republic of Congo. Directors of Wildlife of Central Africa and their representatives gained the opportunity to gather information about the lessons learned from the WCS-CIB-MEF efforts in northern Congo and apply the results of this experience to strategies in their respective countries as appropriate. The proceedings of the workshop will be published in the coming months for distribution to participants and other interested practitioners and policy makers.

Activity 3.3. Safari Regulations
On track

The PROGEPP director has continued to consult with the MFE on safari issues and monitor safari interest in Congo. No safari lobby activity was observed in Congo during this period. Discussions were held with tri-national partners from Cameroon and CAR (where safari exploitation of bongo is legal and expanding) regarding bongo management and monitoring programs. A working session for tri-national wildlife managers will be proposed for the second semester of 2003 to present and discuss recommendations for conservation, management, and monitoring generated from the findings of the Congo based bongo research program (Activity 1.3).

Activity 3.4. Wildlife within Forestry Concessions
On track

During this period PROGEPP staff worked to influence policy on wildlife management and conservation in timber concessions on national, and international levels through a variety of forums. A paper entitled "Wildlife conservation and management in forestry concessions in northern Republic of Congo." Elkan et al. was presented at the Society for Conservation Biology meeting in Canterbury UK in July 2002. The detailed full paper has been drafted for publication in a peer-reviewed journal in 2003. A summary overview of the approach was published for general audiences: Elkan, P. and S. Elkan 2002. "Engaging the Private Sector: a case study of the WCS-CIB-Government of Congo project to reduce commercial bushmeat hunting, trading, and consumption inside a logging concession.' AZA Communiqué December 2002.

Richard Malonga presented PROGEPP and its efforts to establish and improve wildlife management in forestry concessions in northern Congo at an international conference on Forest Law Enforcement sponsored by the US State Department in Brazzaville in June 2002. Antoine Moukassa gave a similar presentation on the PROGEPP approach at an international meeting sponsored by the International Tropical Timber Organization (ITTO) in Brazzaville in December 2002.

The PROGEPP Director and Coordinator attended the World Summit on Sustainable Development in August 2002 and gave a presentation on the northern Congo landscape initiative at an event organized by the International Tropical Timber Organization. The PROGEPP Director presented the ecological context and threats to the Congo Basin forests as part of Deputy Assistant Secretary of State, Mr. Jeffrey Burnham's public presentation on the US Government's new engagement in the Congo Basin initiative. The PROGEPP Director and Coordinator represented WCS at the ceremony for the announcement of the Congo Basin

Partnership presided over by Secretary of State Colin Powell and His Excellency President of Republic of Congo Mr. Denis Sassou-Nguesso.

The PROGEPP Director, Assistant Director of the NNNP and other WCS staff met with the President of Republic of Congo at an event organized by MFE in New York in September. US State Department, ECOFAC, and WCS representatives participating in the event urged the Minister to consider adoption of new measures to improve the environmental situation in Congo. The WCS LLP Director (Amy Vedder) and PROGEPP Director were able to discuss several key wildlife and forest management issues directly with President of Congo particularly regarding the importance of promoting wildlife conservation and management on a landscape scale, including timber concessions.

The World Bank CEO Forum-sponsored independent assessment of the CIB, WCS, and MFE initiative in the concessions, had to be rescheduled to the first semester 2003 due to schedules of the assessment team. Mathew Hatchwell, WCS European Coordinator, participated in the World Bank CEO Forum working group meeting in September on behalf of WCS.

Activity 3.5. Lac Télé Community Reserve Limits
On track

Following the completion of the feasibility study in June 2002, a specific proposal will now be developed which will evaluate the possibility of adjusting the boundaries of the LTCR to account for both socio-economic and biological elements vital to Reserve management.

OBJECTIVE 4: Elaborate a participative, integrated landscape conservation action plan.

Activity 4.1. Coordination Meetings
On track

During this reporting period, several meetings took place between the LTCR-NNNP teams, between the NNNP-PROGEPP teams, as well as between PROGEPP and LTCR partners. Regular contact is also facilitated by daily radio communications among the three sites.

Bi-annual meetings regarding the Kabo-Pokola-Loundougou forest management plan provide a formal context for interaction of the Ndoki-Likouala partners, MFE and RDFE representatives, private timber companies, donors and other stakeholders. Upon adoption of the NNNP management plan (Activity 4.4) a similar formal steering meeting system will be established, further promoting information exchange and collaboration on issues particularly related to the Park's management.

Activity 4.2. Kabo-Pokola-Loundougou Management Plan
On track

PROGEPP continued to contribute to the development of the CIB concession management plan during this period through oversight of the CIB wildlife inventories, support of Dr. Nadine Laporte's work on monitoring and land cover mapping, wildlife management programs, socio-economic and ecological studies, alternative activity program development, and conservation education in the concessions.

PROGEPP representatives participated in the CIB management plan steering committee meeting in November 2002. These meetings reviewed reports, work plans, and budgets and oriented strategies for the CIB management planning process. PROGEPP staff and the CIB

management plan team have established a schedule to work with consultants and other experts to draft wildlife management and conservation, socio-economic, and monitoring chapters for the management plan for the Kabo, Pokola, and Loundougou concessions. A first draft of the various chapters is due in June. The document will be reviewed, edited, and then distributed for examination in August. Given this schedule, the plan is likely to be adopted in early 2004.

Activity 4.3. Mokabi Concession Management
On track

The Rougier Company has adopted the wildlife regulation template from CIB interior regulations, and has begun to apply it in management of the Mokabi concession. PROGEPP staff drafted preliminary wildlife management guidelines for the Mokabi concession based on the findings of BCLS ecological and socio-economic research and the lessons learned from the CIB concessions. These guidelines will be proposed for adoption by Rougier and MFE. WCS-PROGEPP is providing training session for the Rougier wildlife survey team and other Likouala based companies in early 2003.

During this period the WCS legal department reviewed and amended a contractual agreement between Rougier, MFE, and WCS regarding management of the Mokabi concession. The document was sent to Rougier and the Government of Congo for review in December and a meeting is planned to discuss and finalize the agreement in mid-February, 2003.

Activity 4.4. Protected Area Management
Delayed

During the reporting period, the official public meeting required for the adoption of the NNNP management plan and the annexation of the Goualogo Triangle to the Park was cancelled twice due to scheduling conflicts. This meeting should occur early in the next fiscal year and the relevant documents will then be officially accepted.

c. Key management issues

- The development of roads associated with the opening of forestry concessions and public roads needs to be dealt with in a coherent planning process. At present there is little planning, no environmental assessment, and little political will to slow down road building. On the contrary, it is the driving impetus. The Loundougou road could have been moved away from the Park by 15 km with international development funding as part of a regional development plan.
- A remote option still exists to lobby the Government of Congo, EU, World Bank, and others to finance a road passing via the Terre de Kaboungas that would open road access to more than 7000 inhabitants of traditional villages and allow CIB to close or at least greatly restrict circulation on the current Loundougou road. Cost estimates to move the road require ground data for this scenario and quantified consultation with public work experts. A concerted multi-national focus needs to be brought to bear on northern Congo in order to develop a proper road and demographic center (towns, cities) development plan. The EU and other international donors have expressed interest in funding such a plan.
- Final adoption of the NNNP management plan and the official administrative procedure for annexation of the Goualogo Triangle remains in the hands of Ministry officials in Brazzaville. The Ministry has decided to include both in the same administrative process. The various election schedules throughout FY 2002 have impinged on the progress expected.

- The Lac Télé Likouala aux Herbes Community Reserve has potential to provide an informative model in Congo for collaborative management of natural resources with local communities. With only limited funding, however, feasibility work, surveys and staffing will be significantly constrained. Currently, the position of Director for the LTCR project is open for hire in order to reinstall an on-the-ground presence in the area.
- The increase in logging operations projected to occur in Congo over the next few years is staggering. Government has announced goals to more than double production of wood and expand industries. Asian companies, known to exploit more intensively and rapidly, have recently been attributed concessions in the south and are bidding on northern ones as well. Strong international pressure must be brought to bear in order to provide a stable and strong foundation at high Government levels for conservation efforts to progress in the coming years.
- The issue of the management status of the Djeke and Bomassa Triangles will be discussed in the coming months with the Government and CIB. CIB has been informed of the importance of the Djeke area for gorilla populations and received technical reports from the Djeke gorilla research program. CIB has formally stated that it does not plan to exploit the area before 2004 and that the issue will be treated under the concession management planning process during the course of 2003 in consultation with the Government, WCS and other parties.

III. Success Stories and Appendices

Success Stories

The success of elephant conservation in the area within Congo to the west of Nouabalé National Park is shown by significant and successive increases over time in elephant abundance on trails, roads, Wali bai, and in the village lands of the Bomassa Triangle.

The feasibility study of the Lac Télé Community Reserve resulted in vital information that will be useful for prioritizing future conservation activities in the Reserve. Biological and socio-economic surveys were conducted over a year and a half, resulting in short- and long-term recommendations to: continue enforcement to control illegal bushmeat hunting and trade around the region, develop a zoning plan for the Reserve, establish village conservation committees and develop alternative economic activities for residents. The process of conducting the study with many local staff helped to build a local constituency for resource management and conservation within the Reserve. In addition, the study was conducted concomitant with on-the-ground conservation activities, including education and conservation awareness raising, and technical training.

Appendix

1. New York Times, August 20, 2002. "Learning to Live with Logging and (Gasp!) Even Liking It.

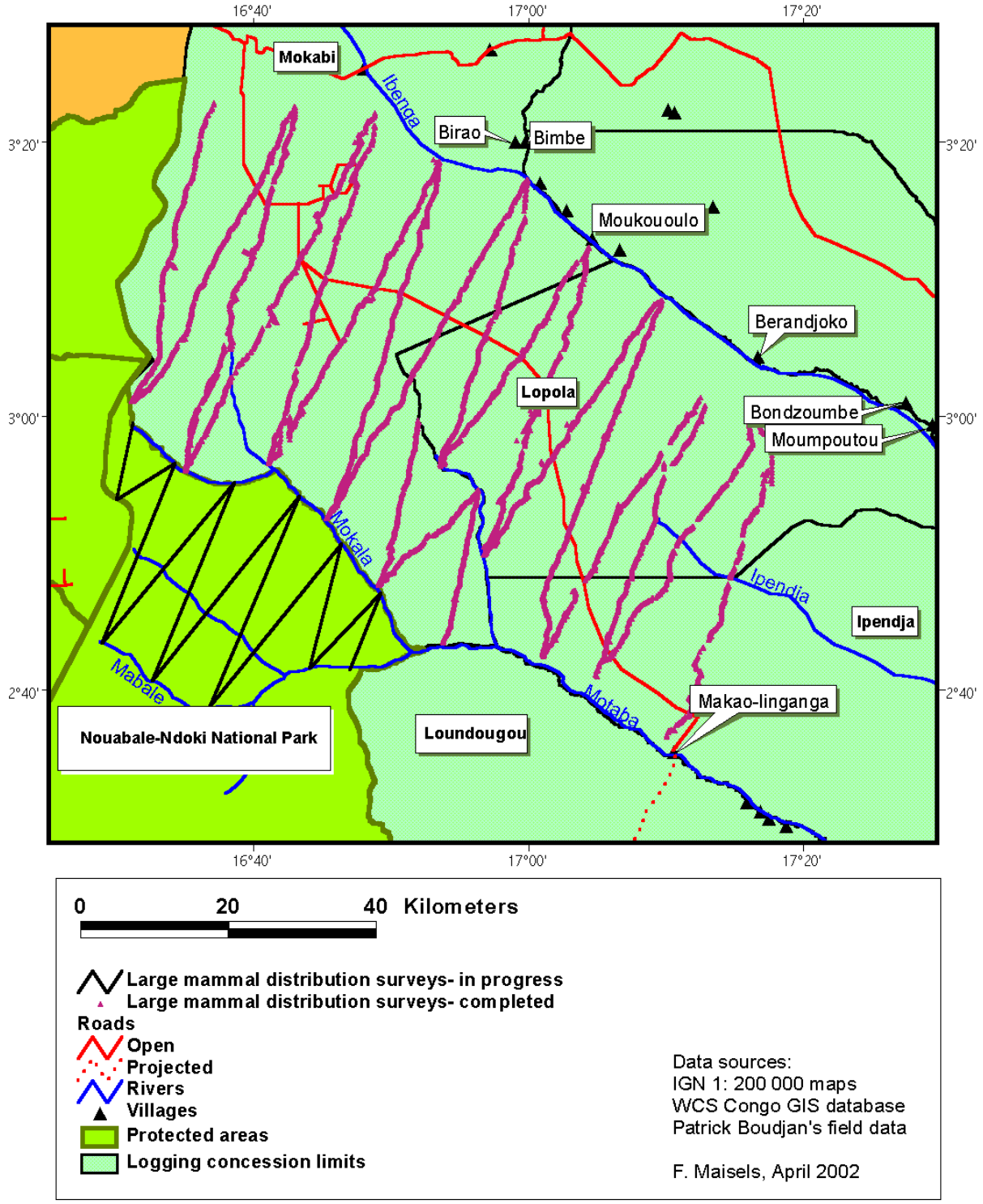


Fig. 1. Survey design of the large mammal and human impact study in the north of the Ndoki-Likouala landscape.

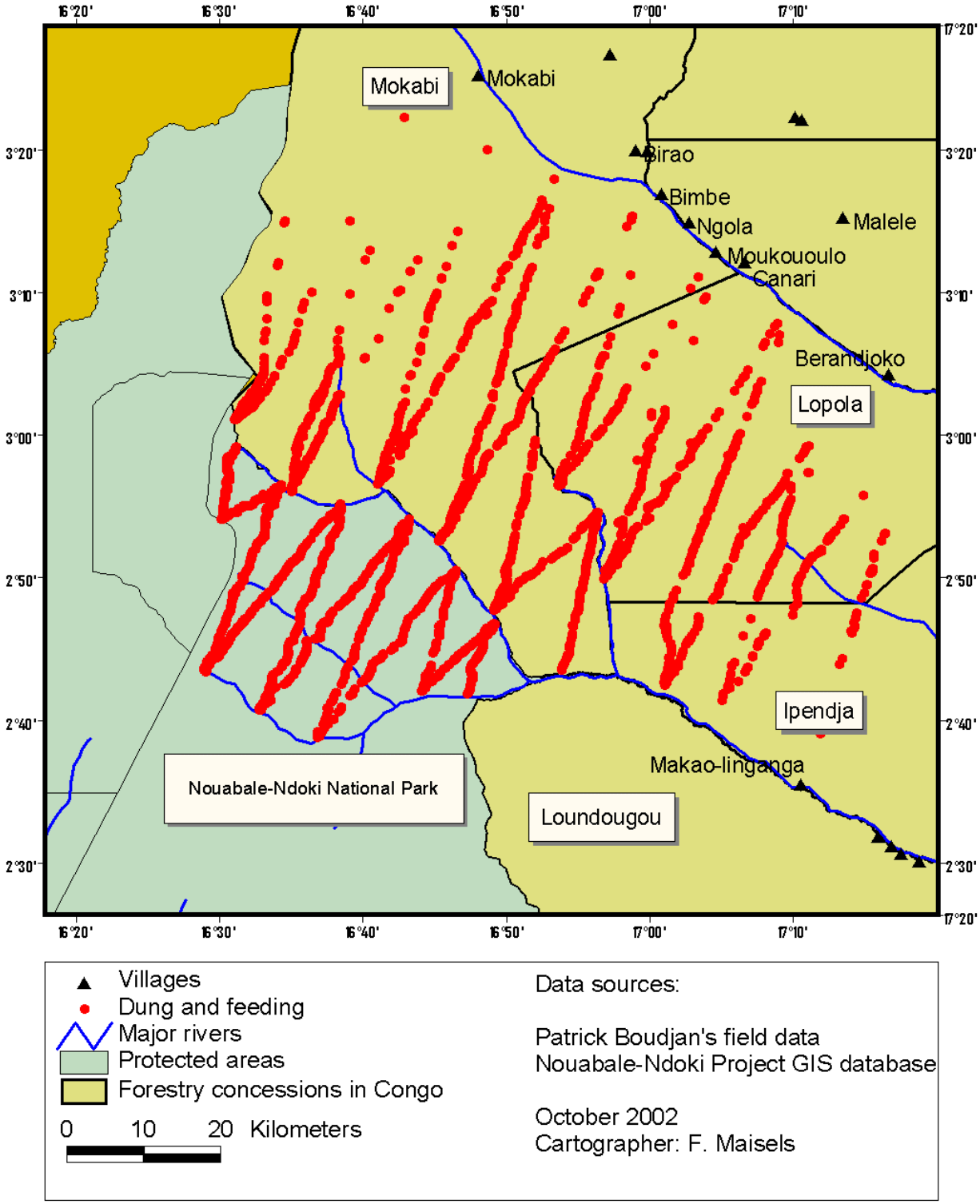


Fig. 2. Distribution of all elephant dung and feeding sign in the South Mokabi, Lopola, and Ipendja concessions, and the northern sector of Nouabalé-Ndoki National Park, 2002

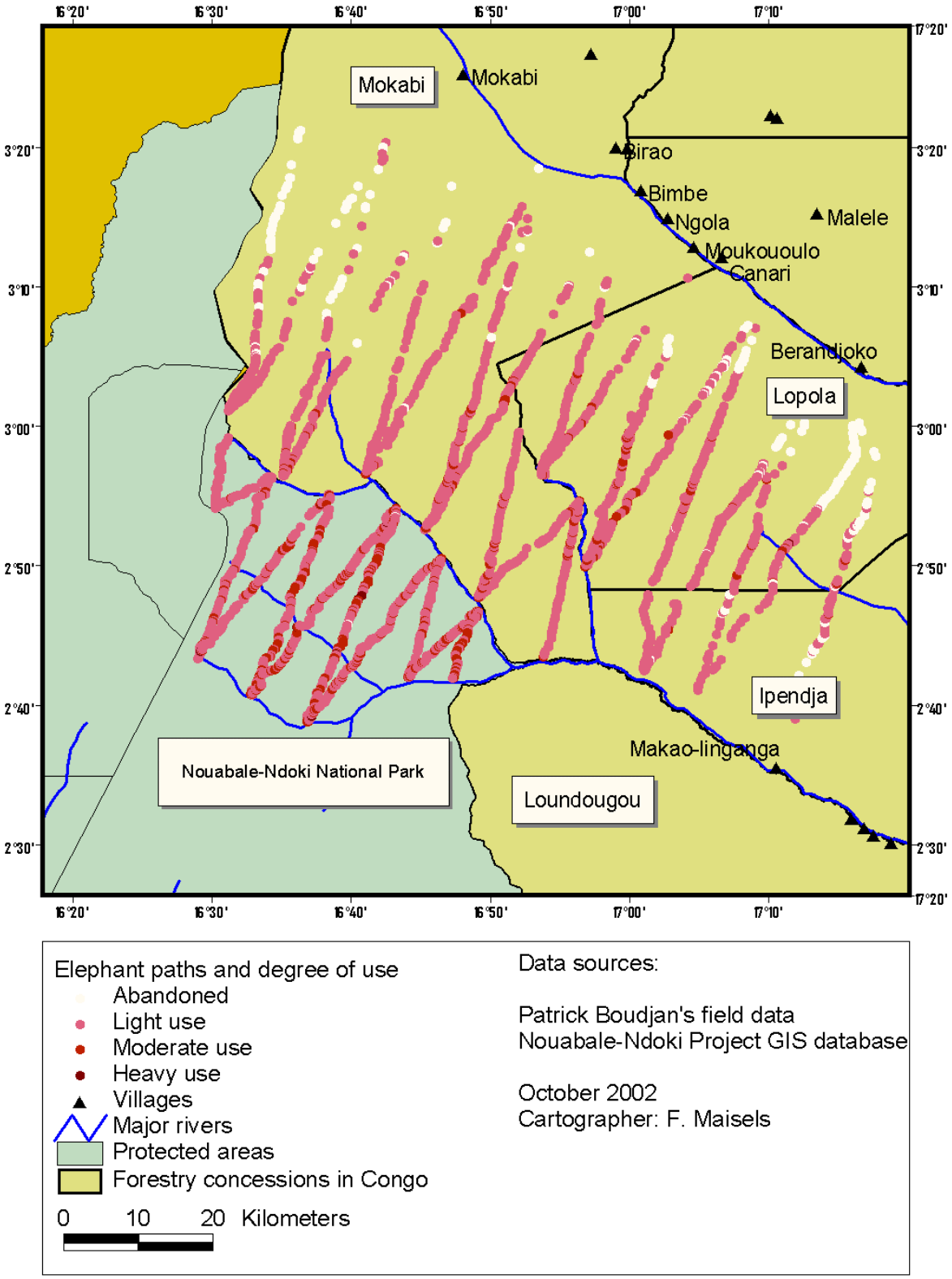


Fig. 3. Distribution of all elephant paths and their degree of use in the South Mokabi, Lopola, and Ipendja concessions, and the northern sector of Nouabalé-Ndoki National Park, 2002

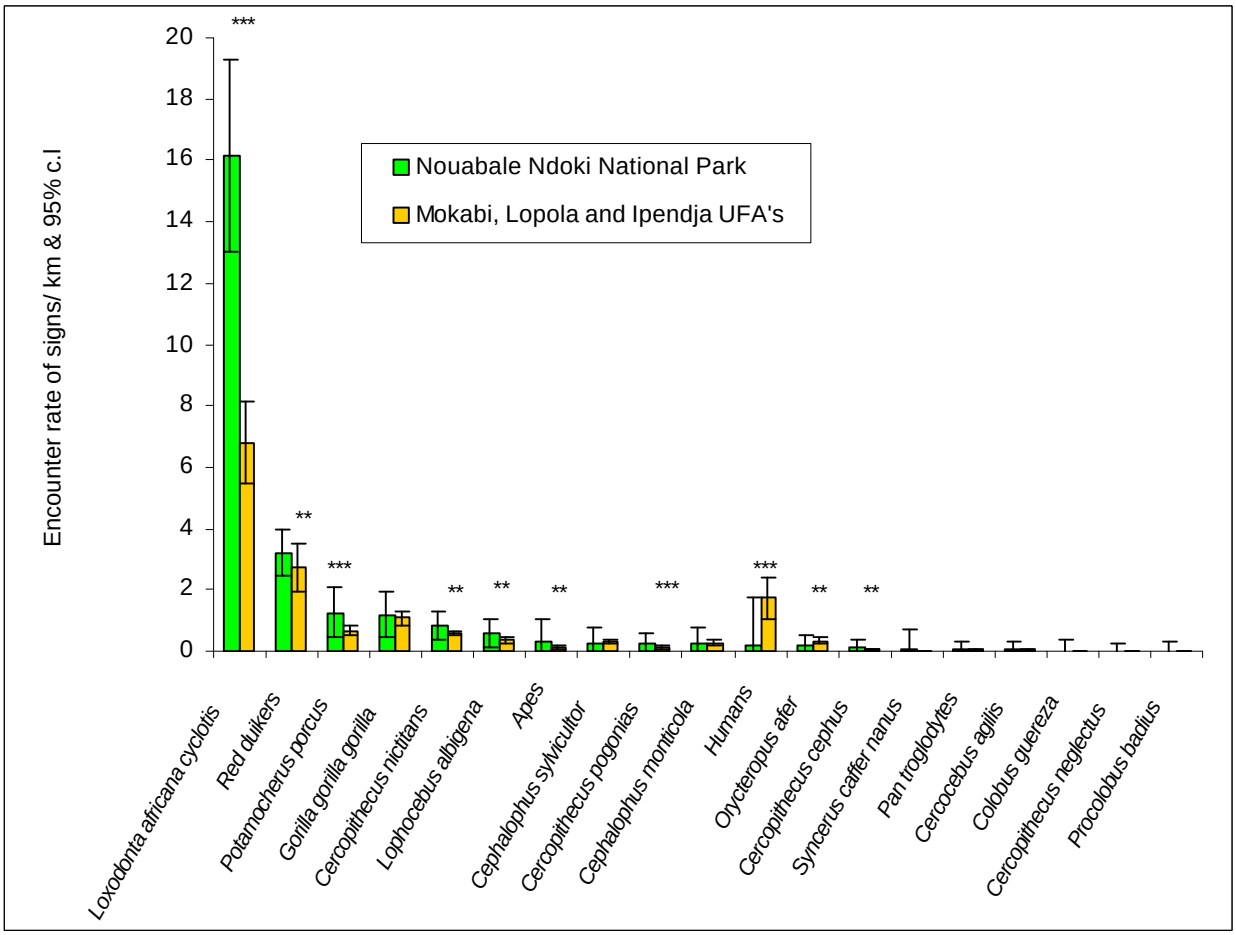


Fig. 4. Encounter rate per kilometre and 95% confidence limits of large mammals in Nouabalé Ndoki National park and in the UFAs Ipendja, Mokabi and Lopola. The levels of significant difference between the encounter rate inside and outside NNNP are shown as follows: ***=P<0.0001; *=P<0.01.

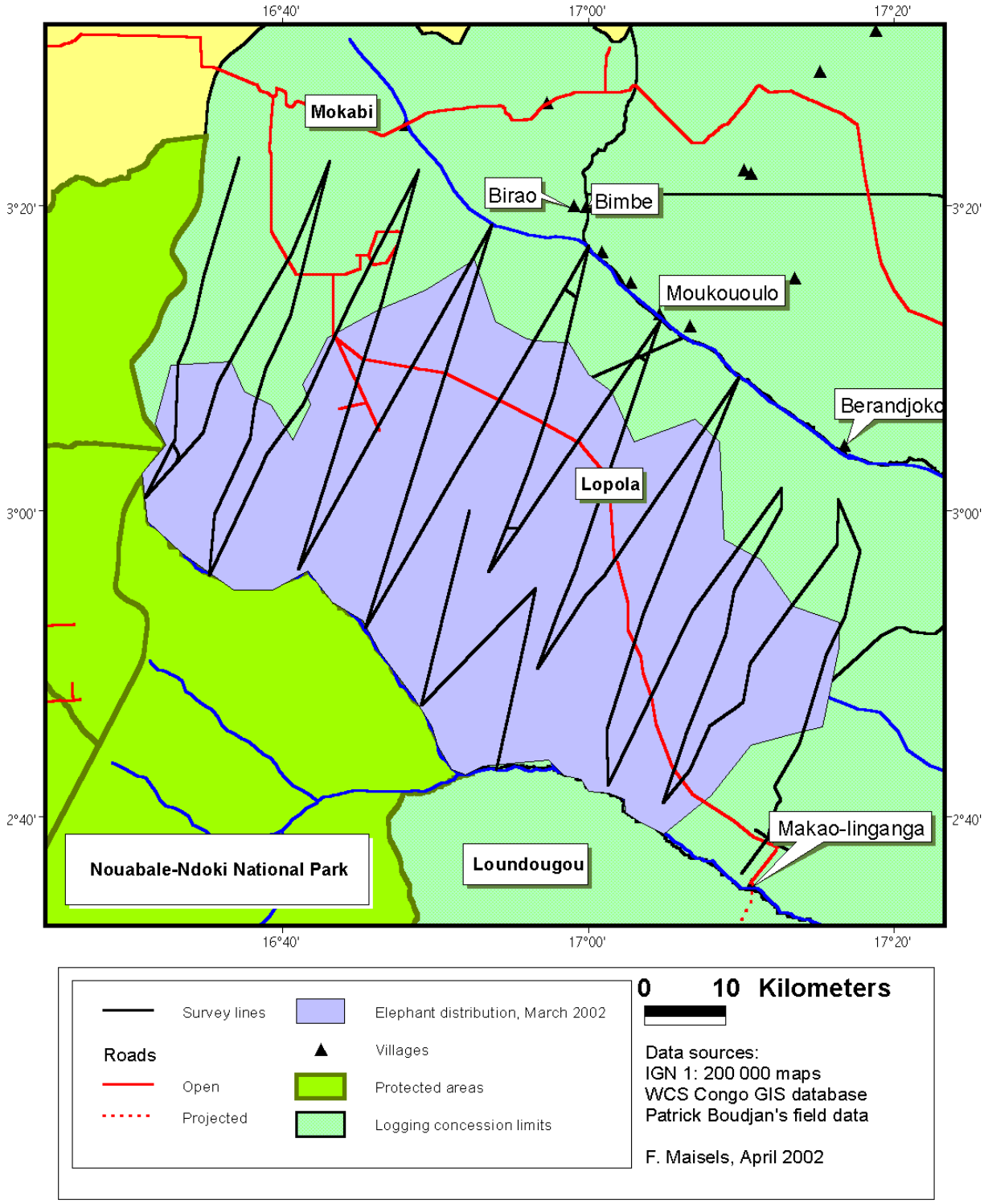


Fig. 5. Distribution of elephant sign –in gray- (both recent and evidenced from abandoned elephant paths), South Mokabi-Lopola-Ipendja concessions, north of Nouabalé-Ndoki national Park, March 2002.)

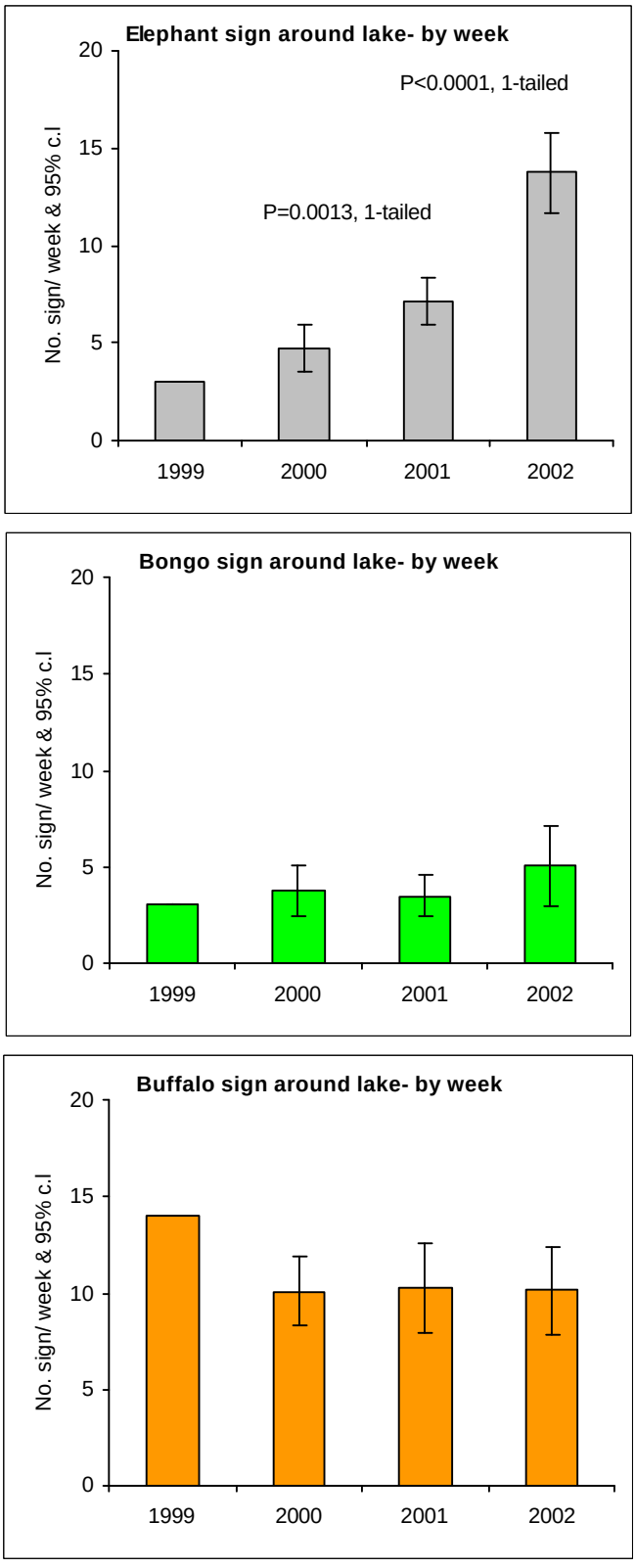


Fig. 6. Elephant, bongo, and buffalo sign around Wali Bai (numbers of sign/ week and 95% confidence limits, 1999-2002). Significant increases are shown between years (as the P-value).

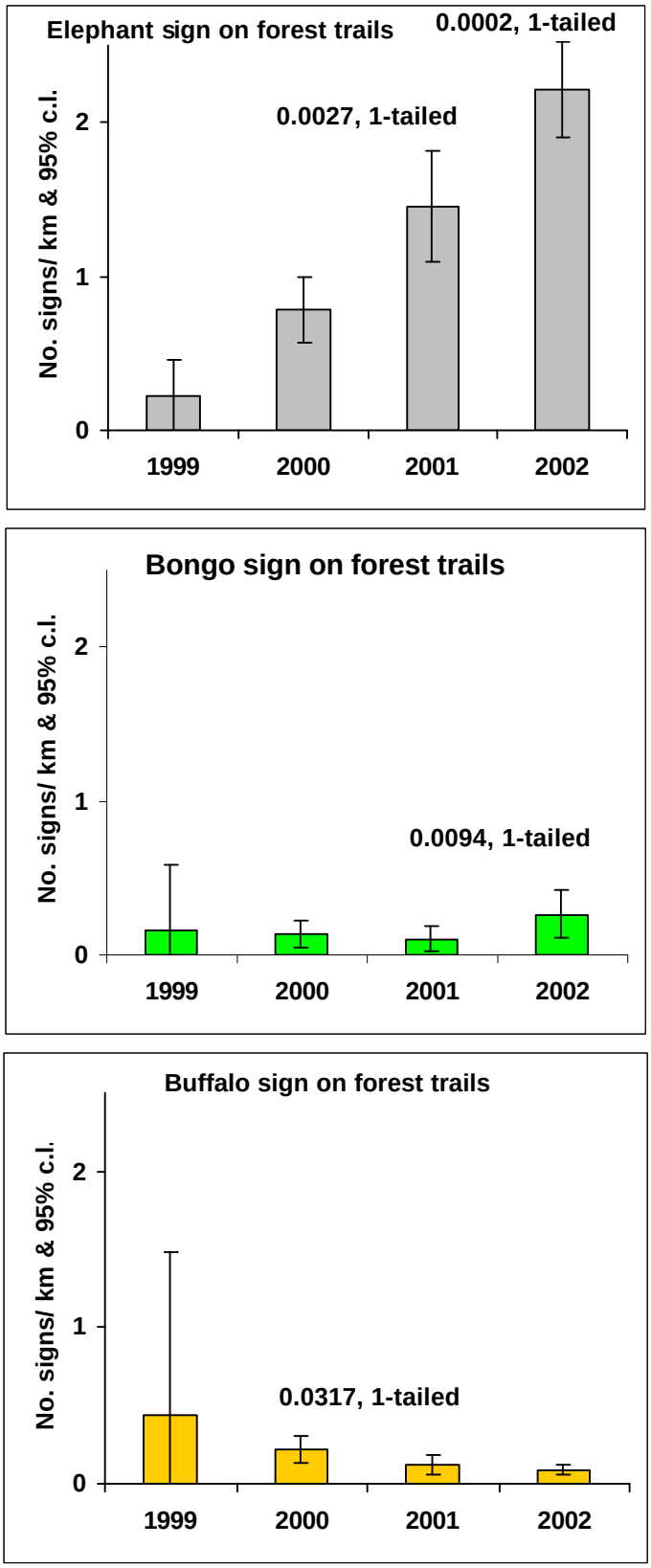


Fig. 7. Elephant, bongo, and buffalo sign on forest trails near Bomassa (numbers of sign/ km and 95% confidence limits, 1999-2002). Significant increases or decreases are shown between years (as the P-value).

Fig. 8. Mean numbers of days per month, per year, that elephants were in the area of Bomassa and Bon Coin fields and villages, 1999-2002, with 95% confidence limits. N months are shown for each year.

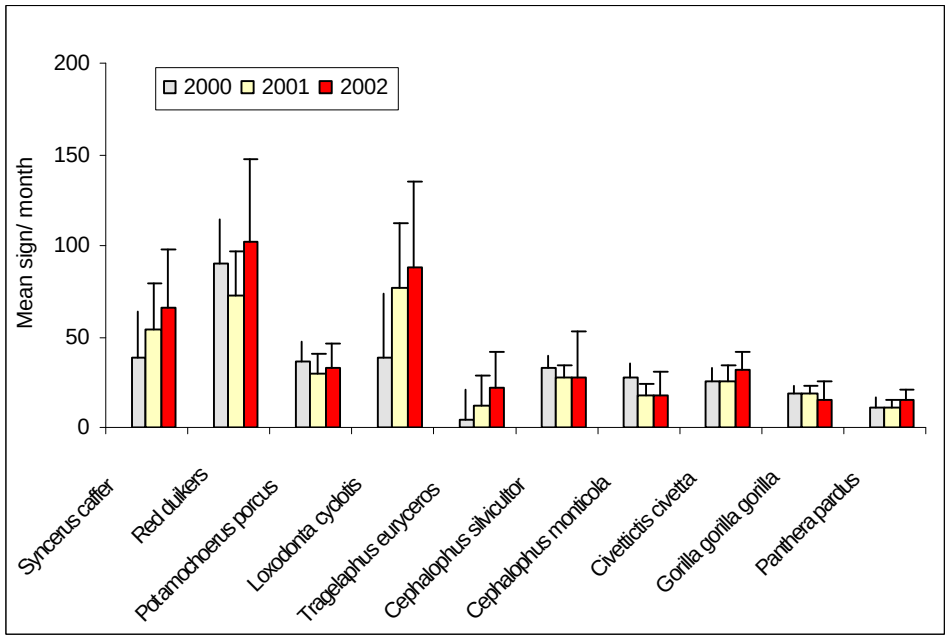


Fig. 9. Mean monthly (with 95% confidence limits) number of animal sign seen along the Bomassa road, 2000-2002.

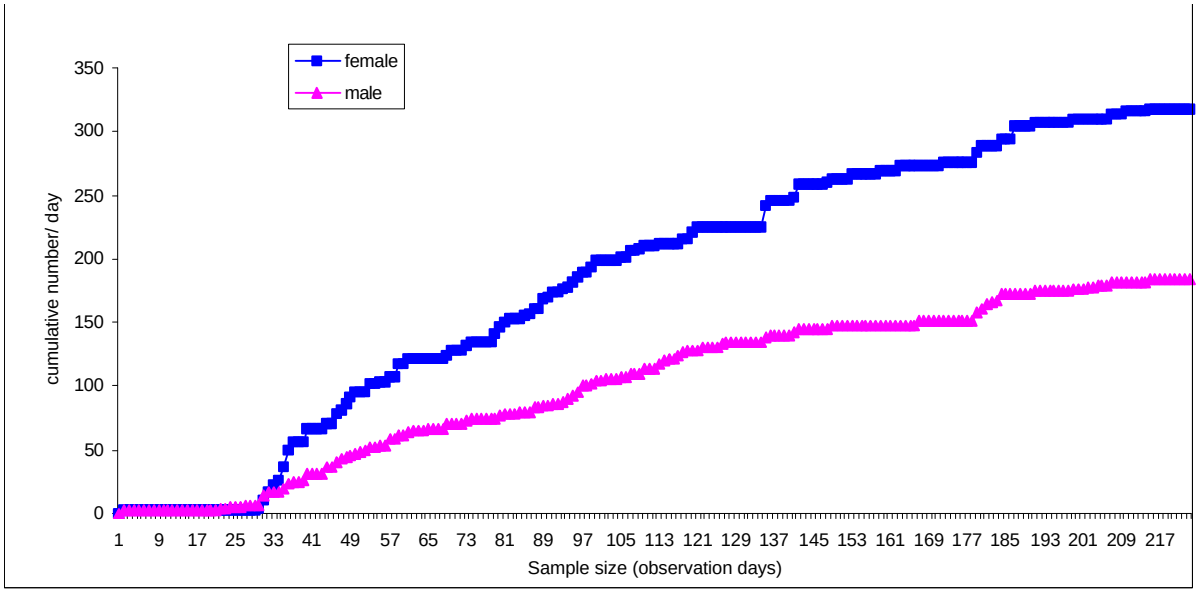


Fig. 10. Cumulative number of male and female elephants identified at Mingingi, Bonye and Mabale, March 2001- April 2002. 502 elephants. Note the flattening off of the curves around day 185.

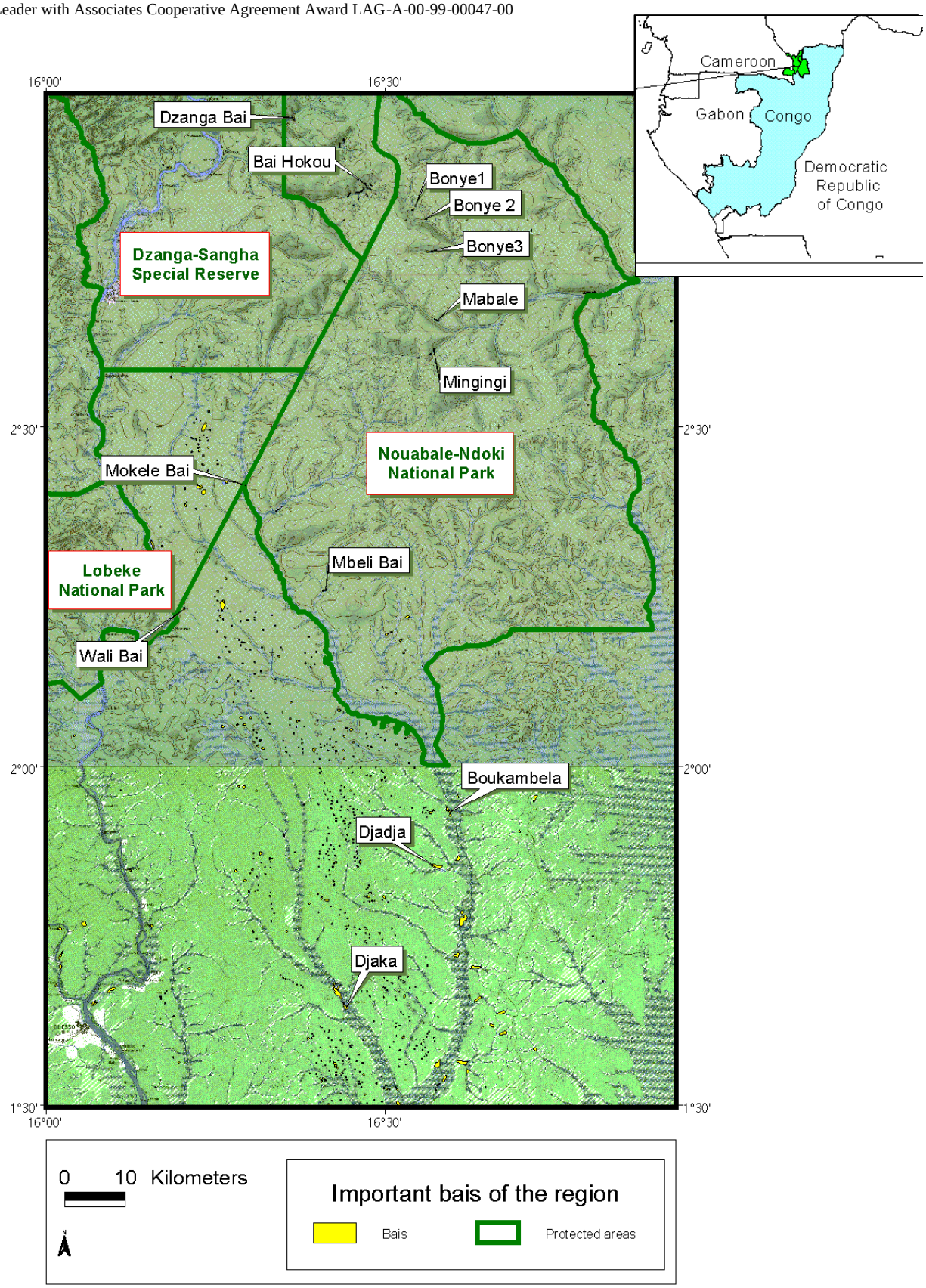


Fig. 11. Location of the principal baïs in the Landscape.

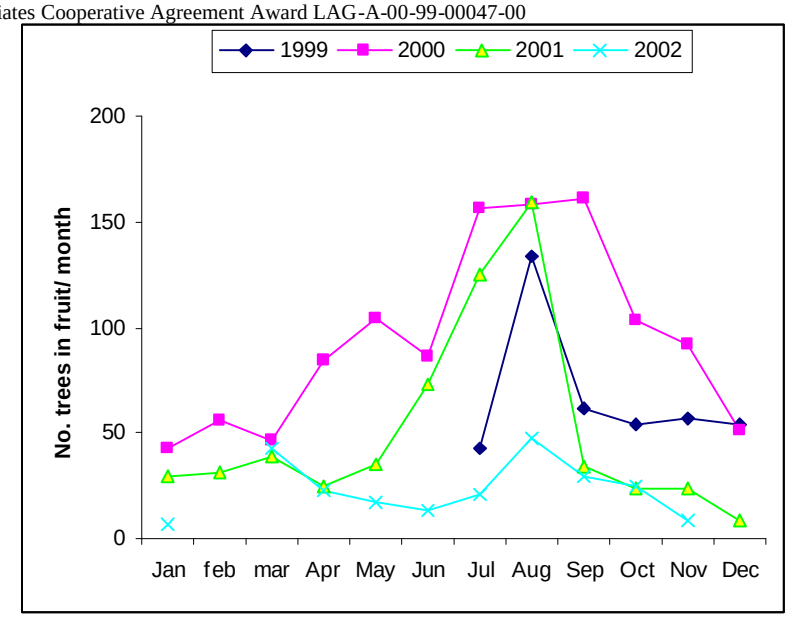


Fig. 12. Total numbers of trees per month, per year, 1999-2002, producing ripe fruit on the phenology circuits.

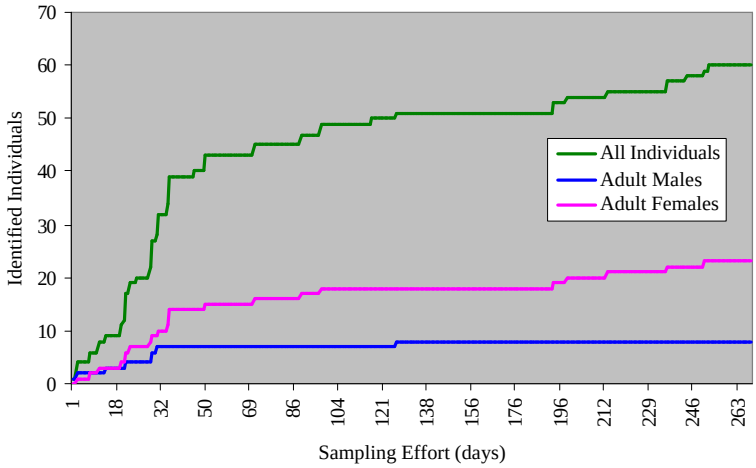


Figure 13. Moto chimpanzee community accrual curve for all known individuals, adult males, and adult females.

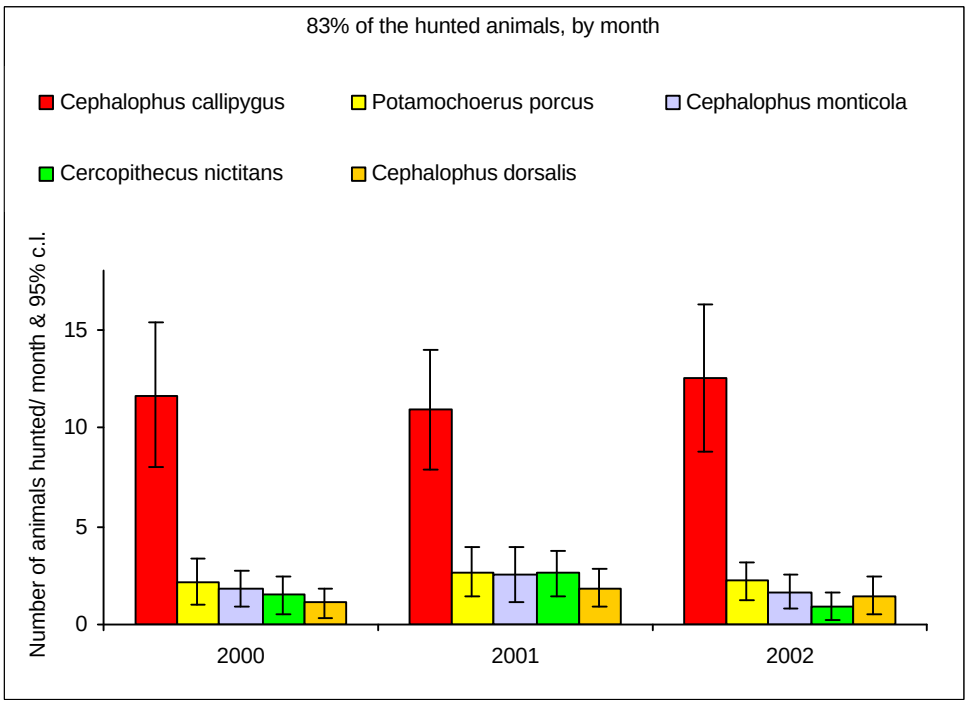


Fig. 14. Bomassa: Mean numbers of hunted animals, per year, per month, 2000-2002. Only the species comprising 83% of total individuals hunted are shown.

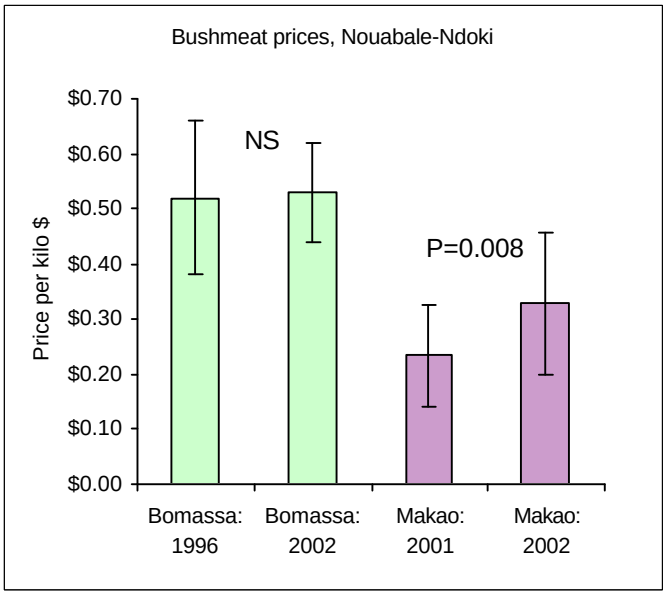


Fig. 15. Mean bushmeat price in $ per kilo, plus 95% confidence limits, (and P-value for the significant rise in price in Makao) in the two villages of Bomassa and Makao. No socio-economic change has taken place in Bomassa since 1996; a logging road and a logging camp was established in Makao in early 2002.

Learning to Live With Logging and (Gasp!) Even Liking It

By MARC LACEY

POKOLA, Congo Republic — "Bongo!" Paul Elkan exclaimed as he cruised down a logging road in this dense central African forest, keeping one eye out for animal tracks and the other on oncoming traffic.

A researcher with the Wildlife Conservation Society, Mr. Elkan can spot the tracks of the bongo, or striped antelope, while driving at top speed in his Land Cruiser. He knows many other soil signatures as well: the giant pads of the forest elephant, the cleft hooves of the duiker, the handprints of the chimpanzee, not to mention the tread marks left by logging trucks loaded down with hardwood rushing to the sawmill.

Irresponsible logging replaces rich ecosystems with barren fields. But scientists acknowledge that selective logging can actually help a forest grow and provide room for some animal species, like elephants and bongo, to forage, socialize and reproduce.

This new view that resources can often be managed both for economic and environmental value is uncomfortable for some conservationists. But it is spreading. In fact, some environmentalists say it is the best and perhaps the only approach to conserving nature in rapidly developing countries.

As a result, biologists working in threatened ecosystems around the world are increasingly trying counterintuitive strategies, promoting nonpolluting forms of shrimp farming instead of condemning it all as a disaster, finding ways to shape farms to preserve habitat and working with loggers instead of against them.

"It wouldn't be the best thing for Africa's forests to put a fence around them and keep everyone out," said Wale Adeleke, a forestry expert in Cameroon for the World Wildlife Fund. "Resources are supposed to be used. If you want to boost the growth of the forest you need to take out some older trees. But you have to log it in a way in which it is still around for future generations."

As for the bongo, Mr. Elkan finds plenty of tracks amid the turmoil of the logging operation here. "They like disturbances," Mr. Elkan said. "If you're going to study bongo you have to do it in perturbed forests."

There are certainly more and more of those. The last untouched forests of central Africa are being divided among logging companies. But instead of categorically condemning logging as destructive to the environment, conservation biologists are beginning to acknowledge that logging is a part of the future of the forest.

When Mr. Elkan is not tracking bongo, he is inside the offices of the Congolaise Industrielle des Bois, the main logging company here, gently nudging the executives to think about the wildlife in and around the trees the company fells.

Logging seems neat and clean on the maps and charts displayed in offices of C.I.B., as the German company is known. The 3.5 million acres of wilderness handed over to C.I.B. by the Congo Republic are divided into segments; roads are mere lines on the map; trees are specks.

But, up close, it is uglier. Bulldozers plow through the greenery to create corridors for extraction. Although only large, mature trees may be felled under the agreement the company has with the government in Brazzaville, collateral damage occurs.

Yet it is not the removal of the towering mahogany trees that causes the most distress to animals, scientists say. Logging brings with it unintended consequences that do not give many animals a chance.

The same roads that C.I.B. uses to pull its logs from the far reaches of the forest are used by hunters to go after the animals seeking refuge there. As the logging company grows — it is already the country's largest private employer with 1,500 workers — what used to be tiny villages in the remote forests are turning into boom towns.

Pokola had 7,200 residents three years ago, a huge population compared with other settlements. And more people keep coming. Pokola has some 11,400 residents today, a number that could pass 18,000 in 2005, according to projections. All those people need to eat, and bush meat is the prime source of protein in the region.

A stroll through the main market in this company town can be a stomach-churning experience. One stand sells whole smoked monkeys. There are antelope steaks, with the head and the hoofs displayed prominently for identification. Live crocodiles lie with their feet tied behind their backs. Cooked caterpillars go for a few cents each. All the bush meat is covered with flies.

Studies estimate that a million tons of wild meat is extracted from Congo Basin forests every year, and Mr. Elkan and his wife, Sarah, have been trying to find alternatives to this vast drain on wildlife.

Tilapia are now in the markets, raised in fish farms near the logging headquarters. So is beef, from cows that are carried on company barges from the Central African Republic. The panoply of programs to try to control the consumption of bush meat is referred to as alternative protein.

Not every experiment works. Raising porcupines, a delicacy here, proved a disaster. Many died and those that didn't escaped into the woods. Rabbits, too, have not thrived.

As it is now, less than 5 percent of the protein intake in the region comes from the alternative protein sources.

On another front, Mr. Elkan has worked with the government, the company and the residents to set up an intricate regulatory system for the hunting of bush meat, which is the meat from any animal found in the wild, whether it is protected or not.

Residents now have hunting permits and special zones. "Eco-guards," under Mr. Elkan's supervision, stop logging trucks at intersections to search for illegal carcasses and troll the forest for metal bands used to trap large numbers of wildlife at once.

Illegal bush meat is more difficult to find in the markets than it was a few years ago. There was a time when elephant steaks were readily available in Pokola, alongside chucks of chimpanzee and bongo, all protected species under Congo Republic law. Critics say the problem remains severe, although it is now well hidden in the forests.

The Wildlife Conservation Society began working closely with C.I.B. in 1999 after the company won rights to the area adjacent to Nouabalé-Ndoki National Park, which the conservation society runs for the government. The company was seeking to deflect criticism from environmentalists, mostly those in Europe.

Even with the cooperative agreement, differences remain. For instance, the company recently put a road about three miles from the park, prompting protests from Mr. Elkan. Still, the bulldozers went ahead.

"He gets excited when he sees nice animals, and I'm excited when I see a nice log," acknowledged Jean-Marie Mévellec, C.I.B.'s longtime director. "We have different jobs, although it's good that he's around to defend the animals."

Still, many environmentalists prefer a more confrontational approach. "We are calling on the government of Congo to commit to formal independent monitoring of logging company activities," said Filip Verbelen, a forest campaigner at Greenpeace.

Last summer, in a move that company officials had hoped would quell the critics, C.I.B. agreed not to log about 100 square miles of land in its concession, an area known as the Goualogo Triangle. Biologists had lobbied C.I.B. to save the forest because it has some of the highest densities of gorillas, chimpanzees and forest elephants.

Still, for every stretch of protected area there are many even larger swaths of forest set aside for logging. Preserving the Congo Republic's forests is but one of many challenges facing the government here, which is also grappling with political instability, corruption and poverty. Logging is the country's second-largest source of foreign currency, behind offshore oil drilling.

"We have to move away from protection, where we close off the forests," said Bai-Mass M. Taal, a forestry expert at the United Nations Environment Program in Nairobi. "We can use these forests in a way that strikes a balance."

Still, scientists say much remains unknown about the species that may be snuffed out when centuries-old trees crash on the forest floor. "Logging may favor some of the big cuddly species but that may be at the cost of some of the others," said Simon Counsell of the London-based Rainforest Foundation, who has criticized the partnership between C.I.B. and the Wildlife Conservation Society for focusing on a few large mammals.

As for Mr. Elkan, he said he had more appreciation for the profit-loss pressures of being a logger.

"We had a confrontational relationship in the beginning," he said. "There were C.I.B. managers who said, 'Wildlife is not our problem; we're here to cut trees.' Over the years, trust developed. They know I'm not trying to shut them down."

Photographs by Francesco Broli for The New York Times

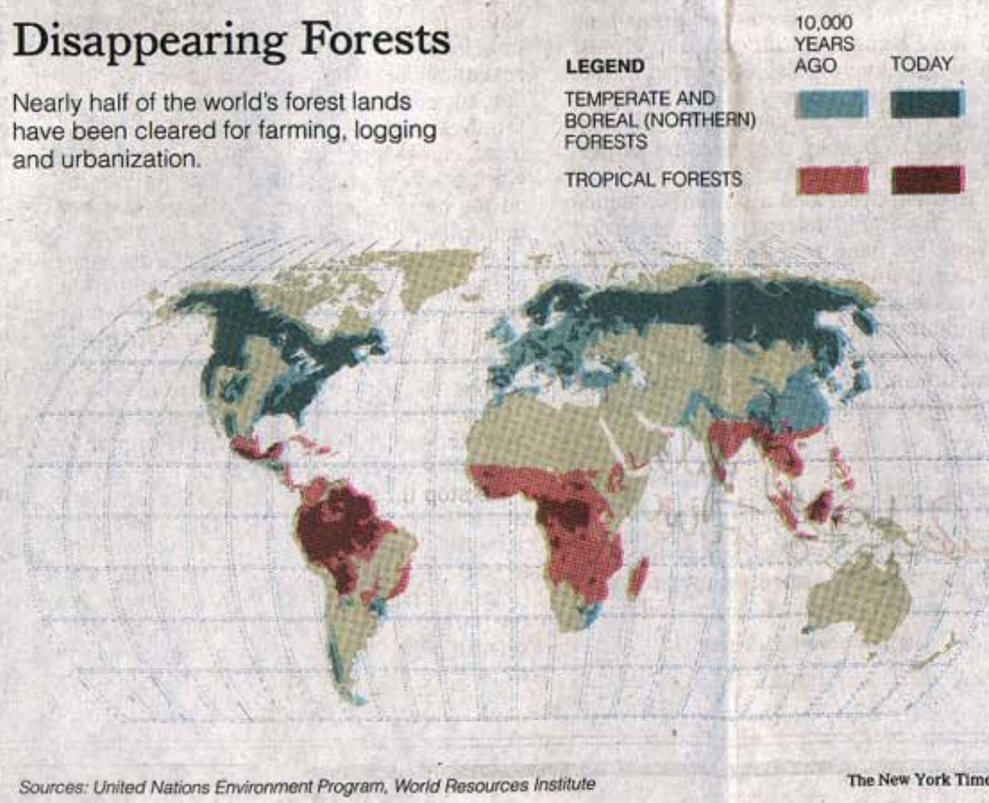
A road through the forest was built by the Congolaise Industrielle des Bois, the main logging company in Pokola, Congo Republic.

The logging company C.I.B. has agreed to harvest only large, mature trees.

As roads penetrate the forests, a vast drain on wildlife follows.

Disappearing Forests

Nearly half of the world's forest lands have been cleared for farming, logging and urbanization.



Sources: United Nations Environment Program, World Resources Institute

The New York Times