CHAPTER 23
MARINGA-LOPORI-WAMBA LANDSCAPE

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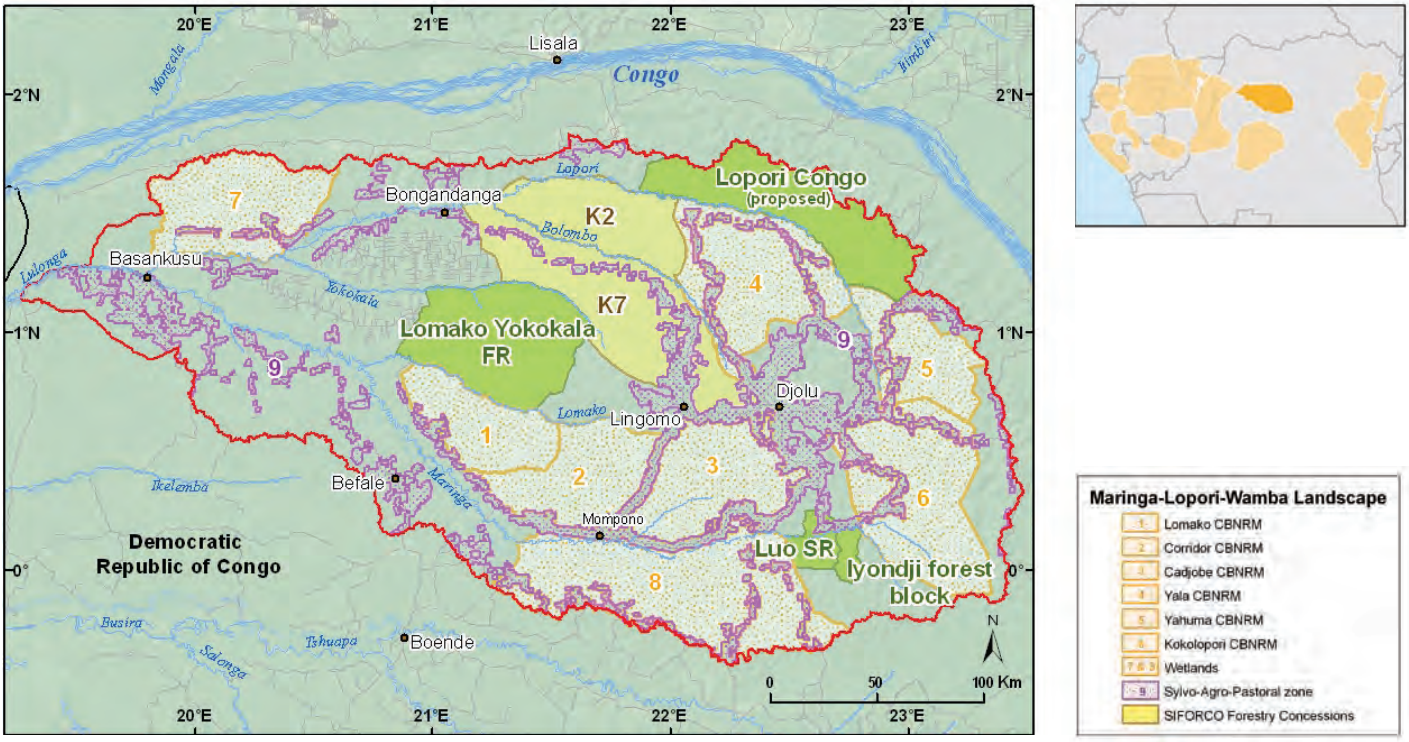
Land Use Planning



Sources: AWF, UMD-CARPE, OSFAC, FORAF, IUCN, Tom Patterson, US National Park Service.
Figure 23.1: Macro-zones for the Maringa-Lopori-Wamba Landscape

The 74,000 km² Maringa-Lopori-Wamba (MLW) forest Landscape is located in north-central Democratic Republic of the Congo (DRC). The Landscape is in one of the Congo Basin's least developed and remote regions. Its inhabitants are some of the poorest in Africa; most depend on natural resources to meet basic needs. Land use planning is needed to address a growing human population and the potential of a revived logging sector which could jeopardize both biodiversity and existing human livelihoods.

In recent years, a consortium of partners from several local and international institutions led by the African Wildlife Foundation, has been working together to begin building the foundation for a land use plan which will provide a scientific basis for prioritized interventions to make the MLW Landscape socio-economically, culturally and ecologically viable. The framework for achieving this objective is based upon spatially explicit landscape land use planning and zoning, combined with development and implementation of natural resource management plans for the specific zones.

During the past four years, members of the MLW consortium have been designing a land use planning model for MLW based on both AWF's Heartland Conservation Process (HCP) approach and the Central African Regional Program for the Environment (CARPE) Program Monitoring Plan. The model is being developed using biological and socio-economic surveys, interpretation of satellite imagery and consultations with local, national and international stakeholders. The results of the model contribute to preliminary land use planning and zoning within the Landscape. This zoning process is considered highly impor-

tant at the national level as the government of DRC has explicitly expressed the need for zoning plans within the country since the publication of DRC's Forestry Act in 2002.

Working with partners at the national and local level, significant progress has been made in developing a land use plan for MLW which includes a draft zoning map covering about 70 % of the MLW Landscape (Figure 23.1) and an agreed process for plan completion. As a result of the zoning process, the first macro-zone, the Lomako Yokokala Faunal Reserve (RFLY), was gazetted in 2006. A major objective of MLW's land use planning activities includes a dynamic zoning process of the proposed Sylvo-Agro-Pastoral zone (SAP). SAP refers to the rural complexes, or land that should respond to the spatial needs for agriculture and other human activities. One goal of the MLW project is to limit future land use and land cover changes to the delineated SAP zone. Remaining land outside the SAP zone will exist as undisturbed habitat, where a network of protected areas with maximum interconnectivity will be developed. Wildlife connectivity will be ensured by maintaining permanent forest managed in a sustainable manner by local communities.

The University of Maryland (UMD) and the *Université Catholique de Louvain* (UCL) are working in joint partnership to support land use planning in MLW. Together, UMD and UCL are providing the MLW team with spatially explicit maps and modeled data outputs of human population distribution, human accessibility, human threats to biodiversity, and predictive models of land use change for land use planning and zoning activities in MLW. These modeled outputs help to systematically predict future threats to forested areas in the Landscape and guide zoning, planning, and Landscape management.

The work of the AWF-led consortium in the MLW Landscape has been valuable to national and regional policy-making and is noted for being both participatory and dynamic. Because of this, the work has been acknowledged to serve as a potential model for implementing future land use planning and zoning in other CBFP Landscapes. Consequently, the MLW Consortium will seek ways to refine its work and share its learning experiences with members of other CBFP Landscapes.

Spatial modeling, complemented by field reconnaissance, is both increasing our understanding of the local socio-economic drivers within the MLW Landscape and informing us of opportunities to improve conditions for humans and biodiversity. Consortium efforts include assisting in the development of tools enabling sustainable development and land use planning. The MLW Consortium team will share findings from the work in order to contribute to international efforts reducing pressure on the environment and assist in proposing sustainable development alternatives for local people whose lives depend directly on the benefits extracted from their surrounding ecosystems.

Photo 23.1: Loading a barge in Basankusu.

Table 23.1: Vegetation cover, land use/land cover change (2000-2005) and estimation of human population densities for each of the preliminary identified macro-zones.

Macro-zone name	Area (km²)	% swamp	% forest	% rural complex and young secondary forest	Active fire points 2006-2007	% change 2000-2005	Human population density (inh./km²)
Wetlands	8,405	35.1	62.1	2.3	N/A	0.4	6.3
Kokolopori	4,002	9.9	89.4	0.7	N/A	0.2	4.8
SIFORCO K7	3,816	25.8	71.7	2.1	14.0	0.3	7.5
Yala CBNRM	3,411	16.6	80.6	2.1	N/A	0.6	8.5
Yahuma area	1,889	10.2	88.1	1.7	N/A	0.1	2.2
Lomako Yokokala Faunal Reserve	3,626	20.3	78.9	49.0	9.0	0.1	3.8
Corridor CBNRM	2,440	19.2	78.1	2.6	5.0	0.1	6.5
Lomako CBNRM	2,042	32.9	66.5	0.4	2.0	0.1	4.0
SIFORCO K2	2,485	16.4	81.4	1.1	13.0	0.3	4.0
Lopori Congo area	3,381	15.7	83.2	0.8	5.0	0.3	2.8
Cadjobe CBNRM	2,821	11.7	86.0	2.2	16.0	0.2	5.6
Iyondji forest block	719	18.9	79.7	0.8	0.0	0.2	9.3
SAP (Marxan)	10,372	12.0	53.2	34.6	1,017.0	3.4	31.8
Total	**49,409**					**1.0**	
Outside macro-zones	**23,557**					**0.4**	
Total MLW	**72,966**	**25.9**	**67.3**	**6.42**		**0.8**	**8.0**

Source: AWF/UCL/UMD.

Human Activities

Information on the distribution of human populations in the MLW Landscape has been updated and is shown in table 1. Contrary to the formerly estimated population density of 3-6 inhabitants/km² in MLW (Congo Basin Forest Partnership, 2006), recent spatial modeling on human distribution suggests that human density is 8 inhabitants/km² (Kibambe, 2007), with densities of 2-4 inhabitants/km² in the proposed or existing protected areas and 31.8 inhabitants/km² in the proposed Sylvo-Agro-Pastoral zone. The total human population of the MLW Landscape is estimated to be 586,732 inhabitants.

The primary livelihood activity of most of the inhabitants of MLW is slash-and-burn agriculture. The MLW program has been monitoring the environmental impact of these human activities through the observation of active fire points detected by the MODIS sensor on board the Aqua and Terra satellites and distributed online by the Fire Information for Resource Management System (FIRMS). Fires, which are strongly associated with slash-and-burn agricultural activities in MLW, are observed primarily on the periphery of roads, established settlements, and agricultural areas. Active fires have increased in quantity and intensity in recent years, indicating a steady recovery of agricultural activities in the Landscape. MLW's agricultural recovery is likely facilitated by recent renewed political stability in the region, coupled with a gradual reopening of access to the urban markets. The MLW project, through its land use planning and zoning activities, is actively working toward limiting agricultural activities to a Sylvo-Agro-Pastoral (SAP) zone designed to concentrate cultivation in areas with good access to markets.

In 2005, for the first time after over half a decade of war and instability in the region, 700 tons of agricultural goods was transported to Kinshasa along the Maringa River (Belani, 2006). Since 2007, the total number of barges and smaller boats assuring the transport of basic commodities and agricultural crops along the Maringa and Lopori rivers has increased.

Although agriculture is slowly recovering, local communities continue to depend on bushmeat as a source of protein in MLW. For most people in the MLW Landscape, it is more economical to hunt wildlife (including such species as porcupine, sitatunga, and forest hog) than purchase domestic meat at the market.

Surveys have determined that hunting pressures are most acute in former logging concessions

and in areas surrounding high slash-and-burn activity. The needs of growing local communities are driving expansion of slash-and-burn agriculture and charcoal production resulting in deforestation, fragmentation, and habitat loss threatening wildlife populations and providing new inroads for bushmeat hunting. The Landscape's biodiversity, therefore, is threatened by an array of interacting human activities. MLW's land use planning activities should mitigate and guide human livelihoods for the well-being of both people and biodiversity.

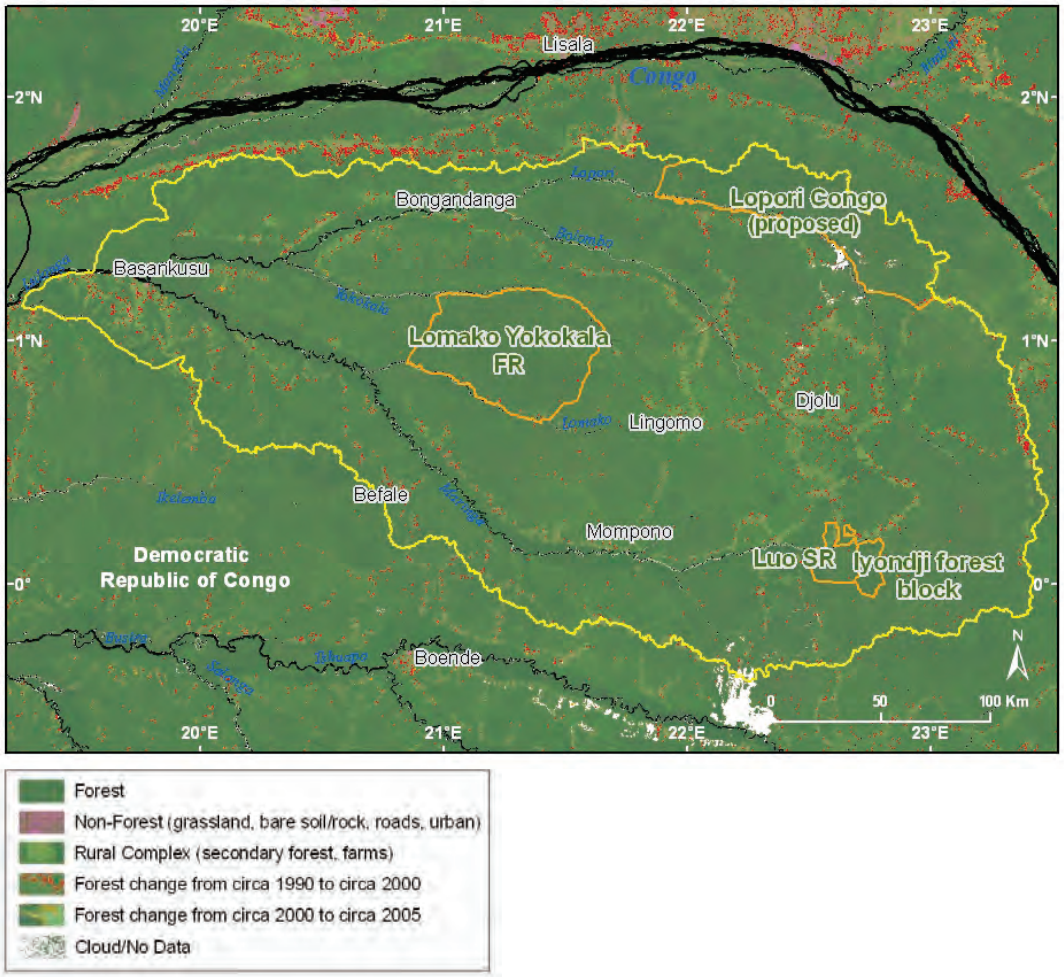
Table 23.2a: Agricultural trade in the Maringa-Lopori-Wamba Landscape

Agricultural product	Unit	Purchase price/unit ($)	Primary destinations	Date	Data collection	Sources
Maize	Sack (120 kg)	9	Djolu	Nov-07	Market surveys	Tabu, A., 2008.
Cassava	Sack (120 kg)	11	Bongandanga	Feb-08	Market surveys	Tabu, A., 2008.
Groundnut	Sack (50 kg)	89	Mbandaka: Lomata port	May-08	Market surveys	Senga, G. AWF., 2008. Pers. obs.

Table 23.2b: Bushmeat trade in the Maringa-Lopori-Wamba Landscape

Bushmeat species	Unit	Purchase price/unit ($)	Primary destinations	Date	Data collection	Sources
Peter's duiker (*Cephalophus callypigus)*	Whole/smoked	12.10 (n=3; 9.10-14.50)	Mbandaka	June 08	Market surveys	Dupain, J. AWF. 2008 Pers. obs.
Porcupine *(Atherurus africanus*)	Whole/smoked	10.00 (n=3; 9.10-10.90)	Mbandaka	June 08	Market surveys	Dupain, J. AWF. 2008. Pers. obs.
Black mangabey *(Lophocebus aterrimus)*	Whole/smoked	19.60 (n=4; 12.70-27.30)	Mbandaka	June 08	Market surveys	Dupain, J. AWF. 2008. Pers. obs.
Blue duiker *(Cephalophus monticola)*	Whole/smoked	11.50 (n=3; 10.00-12.70)	Mbandaka	June 08	Market surveys	Dupain, J. AWF. 2008. Pers. obs.
Sitatunga *(Tragelaphus spekei)*	Fore leg smoked	18.20 (n=1)	Mbandaka	June 08	Market surveys	Dupain, J. AWF. 2008. Pers. obs.
Sitatunga *(Tragelaphus spekei)*	Hind leg/smoked	31.90 (n=2; 27.30-36.40)	Mbandaka	June 08	Market surveys	Dupain, J. AWF. 2008. Pers. obs.
Sitatunga *(Tragelaphus spekei)*	Whole/smoked	77.30 (n=2; 72.70-81.80)	Mbandaka	June 08	Market surveys	Dupain, J. AWF. 2008. Pers. obs.
Red river hog *(Potamochoerus porcus)*	Three quarter/ smoked	72.70 (n=1)	Mbandaka	June 08	Market surveys	Dupain, J. AWF. 2008. Pers. obs.
Red river hog *(Potamochoerus porcus)*	Whole/smoked	100.60 (n=3; 90.90-109.10)	Mbandaka	June 08	Market surveys	Dupain, J. AWF. 2008. Pers. obs.

Forest Cover



Sources: SDSU, UMD-CARPE, NASA, SRTM, IUCN, FORAF.

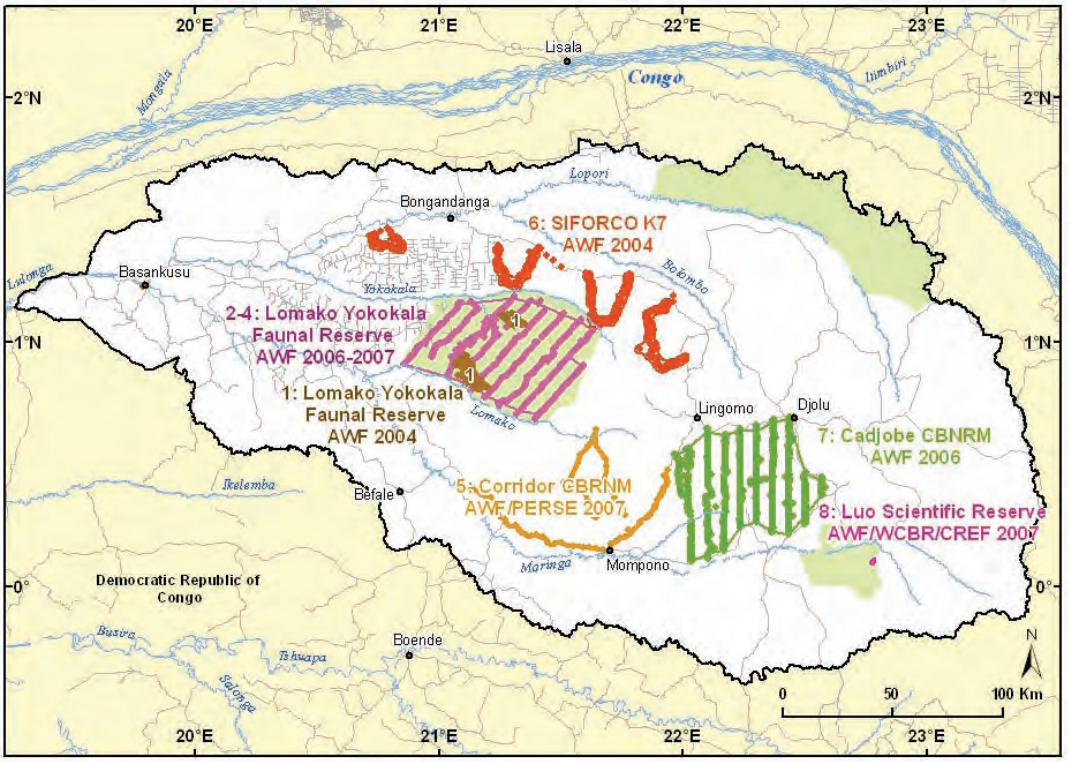
Figure 23.2: Composite Landsat satellite image of the Maringa-Lopori-Wamba Landscape overlain with 1990 to 2000 (in red) and 2000 to 2005 forest loss (in orange)

Table 23.3: Forest cover and forest loss in the Maringa-Lopori-Wamba Landscape from 1990 to 2005.

	Forest area			Forest loss			
Landscape area	1990 (km^2)	2000 (km^2)	2005 (km^2)	1990-2000 (km^2)	1990-2000 (%)	2000-2005 (km^2)	2000-2005 (%)
72,369	68,756	68,162	67,938	594	0.86	224	0.33

Forest cover and forest cover loss are derived from Landsat and MODIS satellite data.
Sources: SDSU, UMD-CARPE, NASA.

Forest change (tables 23.1 and 23.3, Figure 23.2) throughout the Landscape is still relatively low in comparison to other regions within the Congo Basin. Spatial analyses of deforestation patterns (based on 173,289 points of land cover change between 1990 and 2000) show that more than 98 % of deforestation occurring in MLW took place in areas having a human density of 3-15 inhabitants/km^2 (Kibambe, 2007). In 2006-2007, 89 % of the 1,355 detected MODIS active fire points from UMD's FIRMS project were located within 1 kilometer from existing roads, suggesting that rural complexes are expanding around existing roads and settlements. The proposed Sylvo-Agro-Pastoral zone experienced a 3.42 % decrease in forest from 2000 to 2005 (Hansen, *et al.*, 2008). However, a number of active fire points were detected at larger distances from roads and settlements. This indicates an ongoing trend of patchy habitat destruction, and thus also hunting, in remote forest blocks. Even the Lomako Yokokala Faunal Reserve, a protected area, experienced a 0.1 % forest loss between 2000 and 2005. The MLW team hopes that toward 2010, through improved management, forest loss will be limited to the suggested SAP macro-zones.



Sources: AWF, PERSE, WCBR, CREF, UMD-CARPE, OSFAC, FORAF.

Figure 23.3: Biological and human activity survey transects in the Maringa-Lopori-Wamba Landscape

Photo 23.2: Field mission to record the boundaries of the Lomako Reserve.

Since 2004, the MLW team has conducted 8 biological surveys covering over 2,000 km of transects in the Landscape (Figure 23.3). The surveys recorded observations of large mammals as well as selected human threats to biodiversity (table 23.4). The team has adapted its approach over time; recent surveys use standardized reconnaissance methodologies (Omasombo, in prep.). The objective of the surveys has been to assess conservation potential within the Landscape, including within potential macro-zones, focusing primarily on observations of bonobos and other large mammals as well as human activities which threaten the viability of the species' populations.

Throughout the Landscape, the presence of bonobos is confirmed, albeit in very different densities. It is possible that MLW might harbor a significant proportion of the global bonobo population, and ongoing biological surveys aim to help improve understanding of the spatial distribution and densities of their populations within the Landscape as related to human activities and ecological factors. Forest elephants have also been observed in MLW. Although the spatial

distribution of their populations is not yet well understood within the Landscape, they seem to be surviving mostly in patchy relict populations.

When a macro-zone is gazetted, a monitoring program is developed. In the Lomako Yokokala Faunal Reserve (RFLY zone), biological surveys are now conducted twice per year as part of the zone's monitoring program. The latest results of these surveys show for the first time a significant increase in observations of traces of bonobos and forest elephants (see Special Interest section).

Special Interest

Increase of Bonobo Presence in the Lomako Yokokala Faunal Reserve (RFLY)

The Lomako Yokokala Faunal Reserve (RFLY), created in 2006 with support from AWF, covers 3,026 km². From the 1970's to 1990's, this forest was famous for being a long-term bonobo research site. The Congolese Institute for Nature Conservation (ICCN) manages the RFLY with support from AWF. Funding is provided by USAID/CARPE, the Alexander Abraham Foundation, the Arcus Foundation and the French Agency for Development through FFEM.

Since the beginning of the MLW program in 2004 and the initiation of gazettment of the proposed Reserve, AWF has been leading efforts to monitor populations of large mammals and human activities, both of which have been major components of the Reserve's management plan under development. While monitoring surveys were conducted initially by AWF, the surveys are now conducted by agents of ICCN as well as representatives of local communities trained by AWF. Recording observations of forest elephants, bonobos, and human activities, the surveys, which are organized twice per year, consist of nine reconnaissance transects covering 450 kilometers. In September-October 2007, a third biological survey was conducted. The survey summary presented in table 5 shows a sharp increase in observations of both the number of bonobo nests and of traces of forest elephants through time, along with a sharp decrease in the number of active hunting camps: of an initially recorded 45 hunting camps, 30 are now abandoned.

Photo 23.3: Hunting camp in Lomako Reserve.

Table 23.5: Indices of kilometer abundance (IAK) for signs of forest elephants, bonobos and active hunting camps.

	IAK June-July 2006	IAK Sept-Dec 2006	IAK Sept-Dec 2007
Forest elephant (*Loxodonta africana cyclotis*) traces	0.11	0.09	0.22
Bonobo (*Pan paniscus)* nest observations	0.27	0.34	0.68
Active hunting camps	0.1	0.07	0.03

Forest elephants: number of traces. Bonobos: number of nest observations. Human activity: number of active hunting camps.
Source: Belembo, 2007.

Table 23.4: Biological survey results from the Maringa-Lopori-Wamba Landscape

Sur-vey	Site name	Survey date	Lead organization(s)	Total km of recces	Num-ber of transects	Total km of transects	Elephant presence	Elephant traces encounter rate	Ape presence	Ape nest group encounter rate	Human sign
1	Lomako-Yokokala Faunal Reserve	Aug-Oct 2004	AWF		21	105	No		Yes	0.8/km	0.7/km
2	Lomako-Yokokala Faunal Reserve	Apr-Jun 2006	AWF	450			Yes	0.11 traces/km	Yes	0.27 individual nests/km	1.1/km
3	Lomako-Yokokala Faunal Reserve	Sept-Dec 2006	AWF	380				0.09 traces/km	Yes	0.34 individual nests/km	0.73/km
4	Lomako-Yokokala Faunal Reserve	Sept-Dec 2007	AWF	450				0.22 traces/km	Yes	0.7/km	0.61/km
5a	Corridor (CBNRM)	Oct-Dec 2007	AWF, PERSE	120			No		Yes	0.00/km	3.23/km
5b	Corridor (CBNRM)	Aug 2008	AWF	63			Yes	0.46 traces	Yes	0.70/km	0.36/km
6	SIFORCO K7	Aug-Oct 2004	AWF	211			Yes	N/A	Yes	N/A	N/A
7	Cadjobe (CBNRM)	Apr-Jun 2006	AWF	401			No	0.00 traces/km	Yes	0.00/km	1.51/km
8	Luo Scientific Reserve (proposed extension)	Aug-Sept 2007	AWF, WCBR, CREF	32			No		Yes	0.31/km	N/A

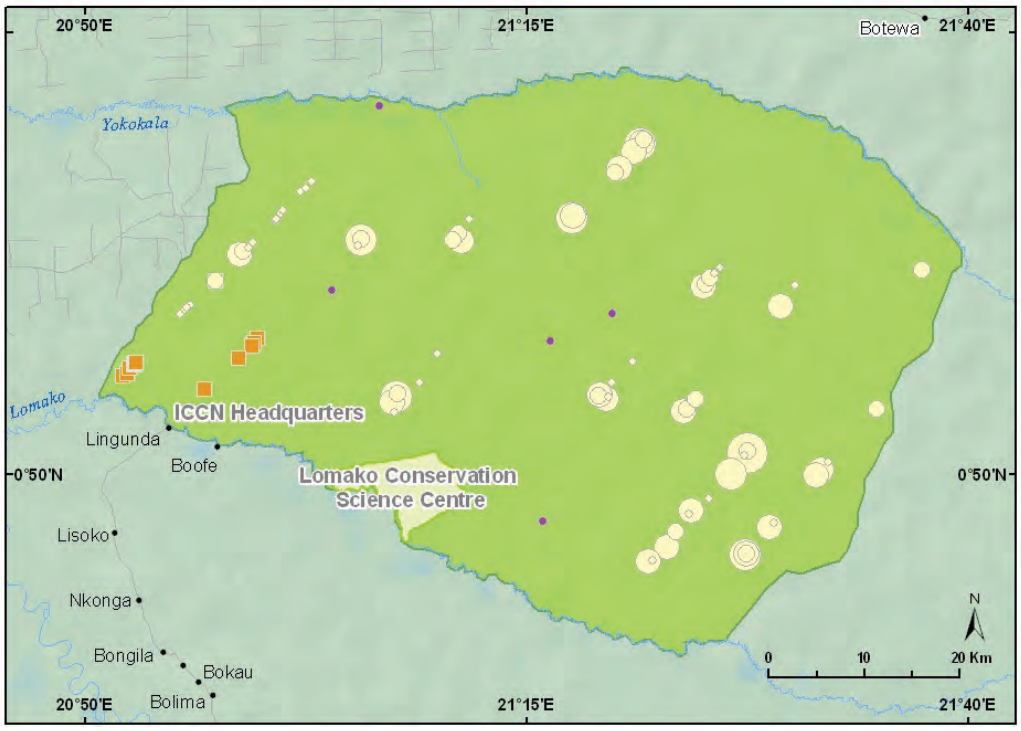
1) a). Omasombo, V. 2004; 1) b). Omasombo, et al.,. 2005; 2) Omasombo and Mpiana, 2006; 3).Mpiana and Belembo, 2007; 4).Belembo, 2007; 5) a) Likondo and Bekoma, 2008; 5) b)Belembo, in prep. 6) Likondo et al., 2004; 7) Likondo, 2007; 8) Likondo et al., 2007.

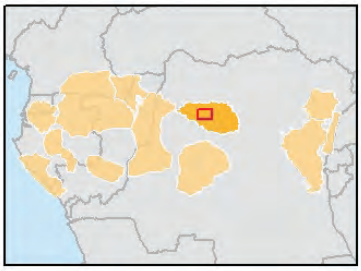
Increased evidence of bonobo and forest elephant presence in the Reserve coupled with evidence of hunting camp abandonment are encouraging signs for the general viability for these species within the Reserve. However, there is still much to learn about both species, including their exact numbers in the Reserve, their spatial distribution, and the importance of the Reserve for their habitat. For instance, it is not clear why, according to the surveys, bonobos are present in the Reserve only in patchy densities, or why forest elephant traces have been encountered only in close proximity to the ICCN-headquarters (Figure 23.4). It is hoped that ongoing surveys will help researchers learn more about these species in the RFLY Reserve.

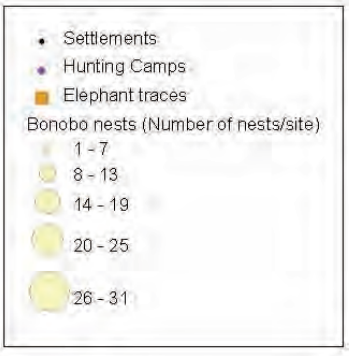
AWF is leading a bonobo habituation program which will prepare the RFLY Reserve for great ape tourism. An increase in bonobo observations has been corroborated by reports from community members living in and around the re-activated research site at Ndele, where bonobo habituation is taking place. AWF has been spreading the news of these developments within the primate research community. Tourism agencies interested in the development of bonobo-focused tourism will visit the RFLY Reserve in the coming months. Revenue from tourism in RFLY will be reinvested in the management of the Reserve and directed to the local communities. This should further strengthen the management of this unique protected area for the well-being of fauna and for the local communities living in the Reserve's periphery.

Photo 23.4: Trapping in the Lomako forest.

Photo 23.5: Harvesting of non-timber forest products is an important economic activity for many families.







Sources: AWF, UMD-CARPE, OSFAC, FORAF, IUCN, Tom Patterson, US National Park Service.

Figure 23.4: Abundance and distribution of bonobo nests and of traces of elephants recorded during the survey Sept-Dec 2007