Human Hunting and its Impact on Bonobos in the Salonga National Park, Democratic Republic of Congo

John A. Hart[1], Falk Grossmann[2], Ashley Vosper[1], and Jose Ilanga[3]

Introduction

Hunting is one of the most important threats to many great ape populations, including bonobos, in central Africa (Kano and Asato 1994, Bowen-Jones and Pendry 1999, Rose 1998, Susman et al. 1981) and it could be one of the determinants of apparent gaps in their historical range (Kingdon 1997, Kortlandt 1995 Kano1984). Butynski (2001) and Dupain et al. (2001) have attributed recent reductions in the bonobo's range over the last two or three decades to increased hunting pressure. Killing even small numbers of bonobos can have significant and long-term negative impacts on local populations, because of their long maturation, slow reproduction and cohesive social communities.

Subsistence hunting is not a new phenomenon in the bonobo's range. Traditionally, local communities near Wamba refrained from hunting bonobos for religious reasons (Kano et al. 1996, Tashiro 1995). Traditional taboos against killing bonobos prevail among the Iyaelima people who live within the Salonga National Park (Thompson et al. 2008). Other observers report that bonobos may occasionally be taken by hunters, but are not a targeted bushmeat species (Thompson-Handler et al. 1995). Dupain et al. (2000), Thompson-Handler et al. (1995), Draulans and Van Krunklesven (2002), and Idani et al. (2008) report that commercial hunting is increasing in the bonobo's range, implying that they are at risk. Local and ethnic differences in hunting traditions are likely to have a variable impact on bonobos. Changes in hunting patterns could possibly bring new risks.

[1] *Lukuru Project, Tshuapa-Lomami-Lualaba Landscape, c/o 1235 Ave. Poids Lourds, Kinshasa, D.R. Congo*

[2] *Wildlife Conservation Society, Africa Program, Tanzania*

[3] *Ministry of Environment, Nature Conservation, Water and Forests, D.R. Congo*

T. Furuichi and J. Thompson (eds.), *The Bonobos: Behavior, Ecology, and Conservation*

Relationships between bonobos and human populations in the areas they both occupy remain ambiguous in the Salonga landscape and elsewhere (Reinartz et al., 2006). Grossmann et al. (2008) show that there is no consistent relationship between occurrence of bonobos and proximity to human settlement, or human access routes in the park and its vicinity. Some of the largest concentrations of bonobos are in the immediate vicinity of settlements. Bonobos and humans also co-exist closely at other sites in their range, e.g., Wamba, Yasa and Lilungu, (Thompson et al. 2008, Kano et al. 1996). Knowledge of the ecological, economic and cultural basis of these associations and their stability are important as human occupation, hunting, and other extractive activities increase within the bonobo's range, altering longstanding relations between bonobos and people.

Unregulated hunting remains widespread in the bonobo's range. Hunting is unlikely to be replaced by alternative subsistence and employment opportunities in the near future as long as wildlife populations remain available and alternative means to generate income remain beyond the reach of most rural Congolese. Hunting traditions are changing rapidly in many areas with the arrival of new hunting methods, the growth of commercial bushmeat trade, and the depletion of targeted wildlife populations and vulnerable species. An understanding of how hunting affects bonobos is needed to guide efforts to control and manage hunting in areas where this is possible.

Salonga National Park, covering ca. 33,346 km^2, is one of the least disturbed areas within the bonobo's range and contains an important population of bonobos estimated at ca. 15,000 individuals (range 7,100 – 20,400) (Grossmann et al. 2008). The park covers ca. 10% of the bonobo's range and is centrally located within that area. It should be one of the most important areas for conservation of bonobos. However, despite its remoteness from major settlements, large size, and status as a UNESCO World Heritage Site, the Salonga National Park is under growing threat from uncontrolled illegal hunting (Draulans and Van Krunkelsven 2002). Hunting has already largely reduced the park's once important elephant population (Blake 2005). An important question is just how safe are the park's bonobos and what can be done to ensure their protection?

Protection of the Salonga's huge area remains a major challenge for the national park service, the Institut Congolais pour la Conservation de la Nature (ICCN). Approximately 158 guards are based in the park at 21 stations and patrol posts, an average of one guard per 211 km^2 (Omari 2006). A decade of political instability has weakened ICCN's ability to control the park. Guards cannot effectively patrol all areas. Some engagement by ICCN with local people in favor of the park will be essential if the park and its vulnerable fauna are to be protected. Information on how local people use the park and affect its wildlife is required to guide efforts to involve them in supporting its conservation. An analysis of the impact of subsistence and other extractive activities, especially hunting, is needed. What strategies and activities will best ensure the protection of the park's important population of bonobos? What lessons can be applied to the protection of bonobos in other areas of their range?

Objectives

We provide information to inform the public of the issues outlined above and develop guidelines for the control and management of the impact of hunting on bonobos. This information is based on a 3-year program of faunal and human activity inventories in the park and associated interviews and hunter surveys in selected villages in the park's immediate periphery. Our goal was to determine where and to what extent hunting has been and is likely to be a dominant factor in the distribution and abundance of bonobos, and to identify specific hunting practices and economic and ecological contexts that are likely to pose a significant threat. Specific objectives for this chapter include:

- describing patterns of human hunting in the Salonga National Park and selected areas of its immediate buffer zone;
- comparing landscape scale trends in the occurrence of monkeys, ungulates and elephants, the primary hunted species in the landscape, with bonobos;
- providing an assessment of the spatial distribution and intensity of hunting, and its economic and social correlates in representative blocks within the Salonga landscape;
- evaluating the current and future risk of hunting to bonobos in the park and surrounding areas; and
- developing recommendations for the conservation of bonobos and improving control of hunting in the Salonga National Park.

Methods

We collected data from 2003 – 2006 from 3 primary sources: 1) field surveys to determine the distribution and abundance of selected fauna including bonobos, and the relative frequency of hunting, fishing and other extractive activities within the park and portions of its buffer zone; 2) analysis of satellite imagery and interviews with local people to map past settlements within the park and establish how former settlers and their descendents continue to use the park and affect bonobos; and 3) surveys of hunters to determine hunting practices, trends in commercial bushmeat trade, and their affect on bonobos in selected settlements in the vicinity of the park.

Surveys of Fauna and Human Activities in the Park

We conducted surveys of large mammals, including bonobos, elephants, ungulates and monkeys (guenons, colobus and mangebeys), and human activities, including hunting, fishing and passage (paths and machete cuts), at 2 spatial scales via a multiphase, nested survey design (Grossmann et al. 2008). In Phase I surveys we sampled most

of the northern and southern sectors of the park, and a block of over 2000 km^2 of the corridor separating the two. We collected data on GPS-referenced and compass oriented reconnaissance walks (termed recces) that were systematically allocated on a spatial grid of ca. 10 × 10 km.

In Phase II we surveyed 3 inventory blocks – Lokofa, Iyaelima and Lomela – each with an area of 2000 – 2750 km^2. We identified the blocks during Phase I surveys as being representative of the range of bonobo occurrence, human settlement and hunting patterns within the park. We made Phase II observations from both recces and line transects which were allocated systematically at a spatial grain of ca. 5 × 5 km. Line transects were 1.4 km in length and measured on the ground with GPS and topofil. We measured perpendicular distances from line of travel to the observations on line transects and documented their location with GPS. We used DISTANCE software (Thomas et al. 2001) to analyze results.

We collected field data on indicators of large mammal occurrence, including direct encounters with animals (seen, heard or both), observations of dung and feeding signs, and for bonobos, nests. We identified dung and feeding signs to species or to a broader taxonomic group when specific identification was not possible. We recorded age class (fresh, recent, old, and disappearing) for dung and nests. Further information on nest count methods and field team deployment is found in Grossmann et al. (2008).

Field indicators of human hunting included direct encounters with hunters, observations of snares (classed as active, or inactive, and by the size of the sapling anchor), spent cartridges, gunshots and hunting camps. We recorded hunting camp activity (occupied, recently abandoned, and long-abandoned), the number of shelters and beds, and the presence and size of meat drying racks. Field teams also recorded fishing camps, other fishing signs (dammed streams, fish traps), trail crossings, machete cuts, and evidence of all other extractive activities. We photographed most of the illegal hunting and fishing camps we encountered in the park.

We integrated the field indicators recorded on the Phase I surveys for each of the faunal groups– ungulates, monkeys, elephants and bonobos– and the indicators of hunting into composite indices of relative occurrence for each of the 233, 10 × 10 km analytical quadrats that had at least 5 km of recce coverage. We calculated indices for each quadrat by summing the indicator encounter rates in the cell (observations/km) weighted by an integrated score based on each indicator's probability of detection, the certainty of its identity, possible time lapse between the detection of the indicator and the actual occurrence of the animal or hunting activity, and the production and decay rates of the indicator. The criteria for the scoring are presented in detail in this volume (Grossmann et al. 2008). The integrated weighting scores for the field indicators are in Table 12.1.

The composite indices have a log normal distribution. We transformed raw index values to base 10 logarithms and classed these on an ordinal scale as low, average, and high. The mean +/– one standard deviation of the log-transformed value is average. We classed the grid cells with the highest 12 index values as very high.

Table 12.1 Weighting scores for observed field indictors used to develop composite indices of faunal occurrence and hunting intensity. See Table 12.2 in Grossmann et al. (2008) for criteria definitions.

A) Faunal indicators:

	Criteria					
Indicator	Certainty of identity	Probability of detection	Time lapse	Production rate	Decay rate	Total score
Feeding sign / km	0	1	1	0	0	2
nests / km	1	2	0	1	1	5
Dung / km	1	1	1	1	1	5
Fauna seen or heard	2	0	2	0	0	4

B) Hunting indicators:

	Criteria					
Indicator	Certainty of identity	Probability of detection	Time lapse	Production rate	Decay rate	Total score
Camps / km	1	2	0	1	2	6
Snares / km	2	2	1	2	1	8
Hunters encountered	2	0	2	0	0	4

Imagery and Field-based Mapping of Former Settlements in the Park

We used satellite imagery to locate and map existing and former village settlements within the park, which have a distinct visual signature of regenerating vegetation. We investigated the history of most of the former settlement sites in the Phase II Lokofa Block via field visits and interviews with local guides. We gathered information on the identity of former occupants, approximate date and cause of abandonment, location of the displaced population, and current use of the former settlement and its surrounding forest.

Village-based Data Collection

We complimented field data on hunting indicators recorded on recces and transects with information on hunters and hunting practices gathered from interviews and direct observations by trained observers in villages located outside the park in the vicinity of the Phase II Lokofa Block and an immediately adjoining area covering about 2000 km^2, the Lokolo Block. The data includes village censuses, inventories of hunting equipment (snares and shot guns) and counts of hunting dogs. We

assessed the level of involvement in the bushmeat trade of a sample of local hunters from different ethnic groups who hunted in the park. We made additional observations on the export of bushmeat at key transit points on the Luilaka and Lokolo Rivers used by hunters to gain access to the western half of the southern sector of the park. We interviewed hunters that we encountered in the park during the Phase I and Phase II field surveys to obtain information on their community of origin, current village base, and where they hunted in the park.

Human Occupation and Hunting in the Salonga National Park

The Salonga National Park is one of the largest and most intact forest ecosystems in Central Africa (Siegert 2003). Humans occupied areas that are now included in the park at probably < 1 inhabitant/km^2 overall in the past. Forty percent of the park, ca. 13,300 km^2, is located > 15 km from the nearest human settlement. Yet despite this low level of human occupation, the park remains relatively accessible along a network of rivers, navigable by dugout canoe, that traverse both sectors of the park in an east-west direction and by several abandoned roads around parts of the park periphery that are still traversable by foot and bicycle (Grossmann et al. 2008).

Communities living in the vicinity of the park belong to several ethnic groups classed as pygmies (Iyeke) or villagers (Nkundo). Most speak related languages within the Mongo language group, widespread in Congo's central cuvette region. The people share the same basic subsistence economy based on shifting cultivation, forest gathering, fishing and hunting of small to medium sized animals (monkeys, ungulates, large rodents), with the emphasis on fishing and riverine settlement versus hunting and upland settlement varying by ethnic background.

About 215 villages are located around the periphery of the park. Most are small. Nine villages are located inside the park border. Kitawala in the northern sector (population ca. 5,000–7,000) is the largest, established in the early 1960s by members of a syncretic religious sect. Eight villages of the Iyaelima, totaling ca. 2,500 inhabitants are located in the southern sector. Residents of most of the communities living in and around the park regularly hunt and fish within the park limits. Although settlement and extractive activities within its limits are illegal, fishing and hunting in the park have persisted since the park's creation in 1970, and traditional land claims have not been fully resolved. See also Thompson et al. (2008) in this volume for a detailed case study of the Iyaelima.

Habitat modification, mainly by shifting agriculture, and hunting are the human influences of greatest concern for the conservation of bonobos. Shifting agriculture may create both favorable and unfavorable sites, depending on the extent of clearing, age of regeneration and occurrence of favored food trees. Conversely, hunting is at best a neutral factor, but more likely to have a negative impact on bonobos. The impact of hunting is likely to vary depending upon hunting methods, frequency of use of an area by hunters, and whether bonobos are targeted species.

Hunters operating in the Salonga National Park use active pursuit with bow-and-arrow or 12-guage shotguns, and snares and traps. The primary targeted species are medium-sized ungulates (duikers and pigs) and monkeys. Hunters also target larger rodents, birds, reptiles and small carnivores using pitfalls, snare lines along barriers and other specialized methods; however, these smaller species comprise only a minor portion of the bushmeat consumed and sold. Differences in hunting methods between communities are mainly in the relative importance of pursuit versus snares, in the prevalence of the use of firearms, and the degree to which dogs are used.

We classified hunters as either locally based or mobile professionals. Locally based hunters are more likely to own and use dogs and bows and arrows. Mobile professionals often reside outside the Salonga National Park area and visit temporarily to hunt meat to sell. Many mobile professionals specialize in the use of large numbers of snares. Locally based hunters hunt for subsistence but also sell varying amounts of surplus meat to itinerant meat buyers who gain access to the area along the network of rivers. Bushmeat is exported from the Salonga National Park and its vicinity to Mbandaka and Kinshasa to the west and to the mining centers of the Kasai to the east and south.

A special category of professional hunter is dedicated to elephant hunting. They are armed with military-grade weapons, are highly mobile, and use expeditionary operations including porters and local guides. Despite seriously depleted elephant populations in the park (Blake 1995) ≥ 4 elephant hunters were recorded in the park over the course of the surveys.

Table 12.2 is a summary of hunting methods recorded in the Salonga National Park, and an assessment of the risk they pose to bonobos. Appendix 1 is a list of the large mammals of the Salonga National Park, and their frequency as hunter kills based on observations and interviews.

Results

Faunal Occurrence and Hunting Indices

In Phase I (2003 – 2004), we surveyed a total of 325, 10 × 10 km (100 km^2) quadrats via 2,900 km of systematic reconnaissance walks covering ca. 82% of the park area and 2,100 km^2 within the corridor separating the northern and southern sectors. In Phase II surveys (2005– 2006), we conducted inventories on 186 transects (260 km in total) and 1,509 km of systematic reconnaissance walks in three blocks: Lokofa, Iyaelima and Lomela. Grossmann et al. (2008) provide further details on the survey deployment and maps of survey coverage.

Figure 12.1 is a map of occurrence of bonobos, ungulates, monkeys and elephants in 10 × 10 km quadrats with ≥ 5 km Phase I reconnaissance coverage. Contiguous grid cells have been grouped into larger blocks covering 900 – 4,750 km^2 each used to estimate bonobo populations (Grossmann et al. 2008) and evaluate the impact of hunting.

Table 12.2 Hunting and trapping methods observed in the Salonga National Park and the threat they likely pose to bonobos.

Hunting type	Class	Subclass	Note	Threat to Bonobos
Active Pursuit	Firearms	12 gauge shotgun	Includes both imported and locally manufactured weapons; locally reload cartridges primary ammunition.	Major: probably highest cause of opportunistic kills.
		Military weapons (FAL, Kalashnikov)	Weapons and ammunition obtained through military or police channels.	Potentially major: limited numbers of weapons in use.
	Bow and arrow	Steel tipped arrow	Used for pigs; hunters often use dogs.	Moderate: may be used for terrestrial bonobos.
		Poison arrows	Specialized use for primates and smaller game	Low: not likely to deliver lethal dose to large animal.
Trapping	Snares	Large cane cable noose	Designed to hold pigs and large antelope.	Major: death or serious injury likely.
		mid-sized cane, cable or nylon noose	Designed to hold small to mid-sized ungulates	Major to moderate: Death possible serious injury probable
		Small cane, nylon noose	Designed to hold rodents, birds	Low: death unlikely, injury to hands or feet possible
		Barrier	Designed for small animals	Low: Visible and avoided
		Arboreal	Designed for squirrels, pangolins, birds	Negligible
	Pitfall	Large mammal	Designed for larger ungulates.	Low: bonobos can climb out

Large mammals occur widely in the park and buffer zone. Patterns of relative abundance vary significantly between the four taxa (pair-wise X^2 tests, $P \leq 0.05$). Important concentrations of bonobos occur in the southern sector of the park in the Iyaelima (B) and Southwest (F) blocks, the northern sector in the Lomela (C) and West Lomela (L) blocks, and the Corridor (H). In contrast, bonobos are absent or occur in low, widely dispersed numbers in the Lokolo (D), Lokofa (A) and South Central blocks (E) in the southern sector, and in the Northwest (I) and North Central (J) blocks in the northern sector. Grossmann et al. (2008) in this volume provide further analysis of distribution and population estimates of bonobos for the park and eastern corridor.

Small and mid-sized ungulates, including primarily duikers (*Cephalophus spp*), chevrotain (*Hyemoschus aquaticus*) and red-river hogs (*Potamochoerus porcus*) are

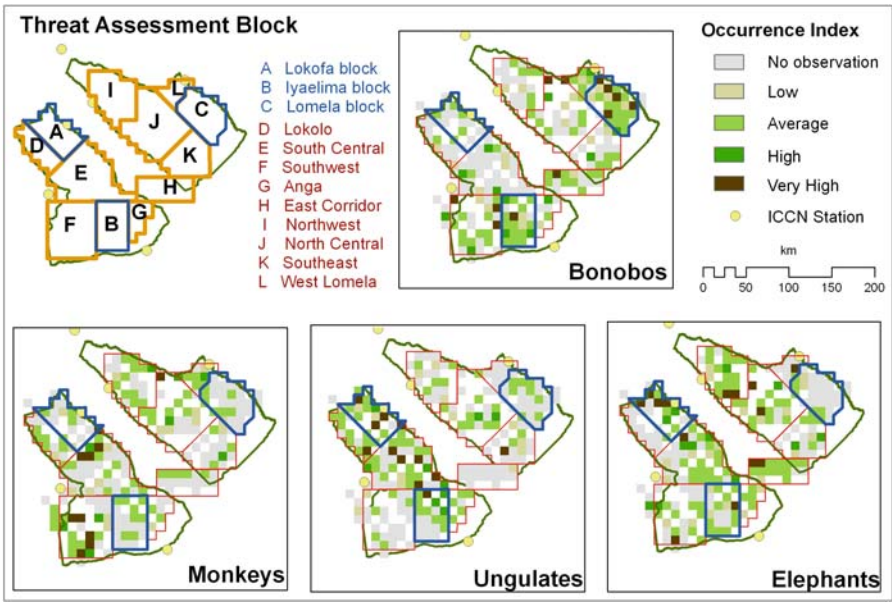

Fig. 12.1 Occurrence of bonobos, ungulates, monkeys and elephants in the Salonga National Park, and surveyed corridor integrating weighted Phase I encounter rates of field indicators for 10 × 10 km quadrats having ≥ 5 km recce survey coverage. Contiguous quadrats are grouped into Threat Assessment Blocks to evaluate impact of hunting on bonobos and other fauna. Lokofa, Iyaelima, and Lomela Threat Assessment Blocks cover Phase II Population Inventory Blocks described in Grossmann et al (2008) (*See Color Plates*).

most abundant in the southern sector of the park in the Lokofa (A), Lokolo (D) and South Central (E) blocks and in the northern half of the Iyaelima block (B). They are less abundant in the northern sector of the park in the Northwest (I), Lomela (C) and West Lomela (L) blocks and in the southern sector in the Southwest (F) block and Corridor (H). Monkeys in contrast are abundant in the Southwest (F) block, and locally in the South Central (E) block (southern sector), but were found only in low numbers in the Lomela (C) and Southeast (K) blocks (northern sector) and in the Corridor (H).

Indicators of elephants were concentrated locally around large swampy clearings (termed *Botoka ndjoku*, or elephant baths) in the Lokofa (A), Northwest (I), South Central (E), North Central (J) and Iyaelima (B) blocks, and in the Corridor (H). In contrast, they were markedly absent in the Lomela (C) and Lokolo (D) blocks. *Botoka ndjoku* in blocks with low elephant abundance had low levels of visitation.

We recorded indicators of hunting, including 26 direct encounters with hunters, in 165 (51%) of 325, 10 × 10 km Phase I quadrats (Fig. 12.2). Snares and hunting camps were the most frequently observed indicators. We noted spent shot gun cartridges and specialized traps, such as pits falls, on just a few occasions, and rarely heard gunshots. The infrequency of spent ammunition can be accounted for by the fact that most hunters retrieve and reload spent cartridges. We recorded fishing

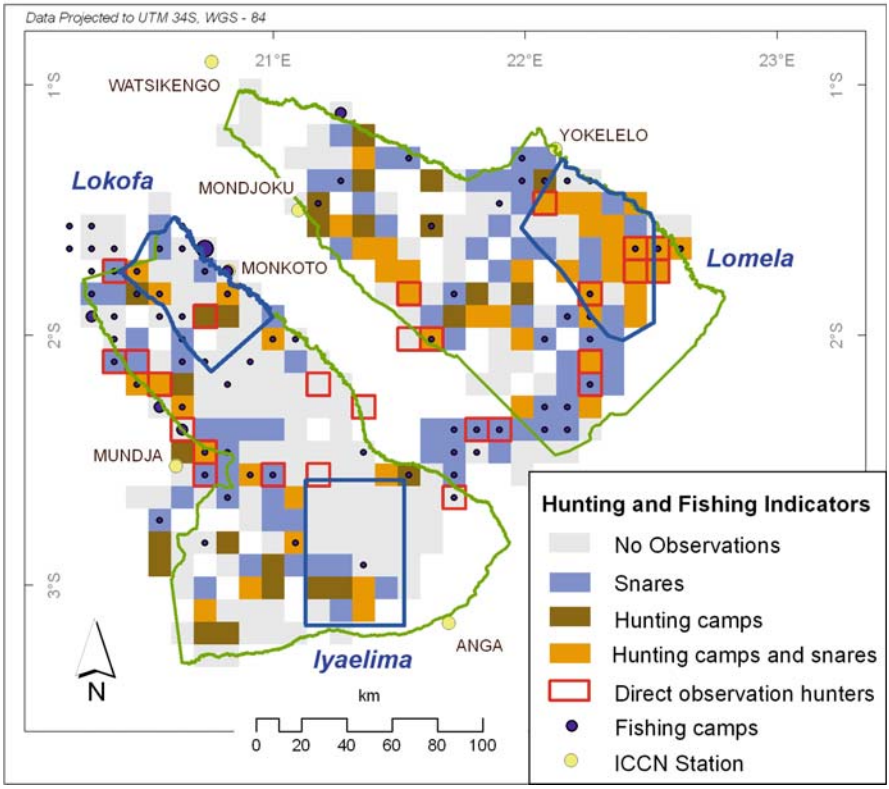

Fig. 12.2 Hunting and fishing indicators recorded on Phase I surveys in the Salonga National Park and surveyed corridor. Phase II inventory blocks are shown in outline (*See Color Plates*).

camps in 61 survey quadrats in the park. Most were concentrated along larger water courses. Hunting camps were in 75 quadrats with a wide distribution throughout the park. Some camps served as bases for both fishing and hunting.

Figure 12.3 is the distribution of composite hunting index for the 233, 10 × 10 km quadrats with ≥ 5 km of recce coverage. While hunting was widespread throughout the park, intensive hunting was concentrated in the eastern quarter of the northern sector and along the Lomela River. Large areas of the southern sector, in contrast, had low hunting indices. Hunting indices in the corridor between the two park sectors were comparable to indices in many areas within the park itself, and were notably lower than indices for large areas of the northern sector of the park.

Former Settlements in the Park

Figure 12.4 gives the location of former settlements and associated clearings in the Salonga National Park as determined by analysis of satellite imagery, site visits and interviews. Most former settlements, locally termed *mpumba* or *eladji*, were abandoned

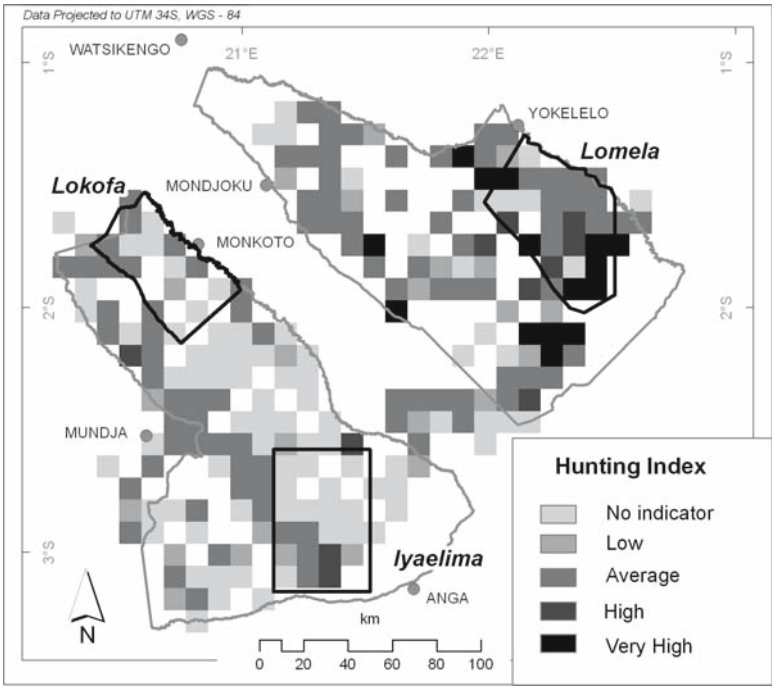

Fig. 12.3 Composite hunting index integrating weighted Phase I encounter rates of field indicators for 10 × 10 km quadrats having ≥ 5 km recce survey coverage in the Salonga National Park and surveyed corridor. Phase II inventory blocks are shown in outline.

before the park's creation in 1970 as a result of colonial and post-colonial policies to regroup human people along roads. Although these settlements are no longer permanently occupied, the former clearings and surrounding forests are still claimed and used by descendants of the original occupants mostly for hunting and fishing. The Lokofa Block contains a relatively high proportion of the park's former settlements.

Bonobo abundance is negatively correlated with proximity to areas of former settlement (Fig. 12.5). The relative depletion of bonobos extends out from the area of regenerating secondary vegetation in the abandoned clearings and gardens, several kilometers into the surrounding undisturbed forest. Thus, the reduced rates of occupation by bonobos can not be attributed to the direct effects of habitat modification.

Descendants of former occupants return to *mpumba* in the park to hunt and fish years after the villages have been abandoned. Those interviewed stated that most of the displaced communities had no problem gaining access to land for gardens in their new settlement areas, but that access to new hunting and fishing territories remained difficult and a source of conflict between communities even presently. Thus, the *mpumba* and *eladji* within the park remain the primary access to bushmeat and fish for many displaced communities.

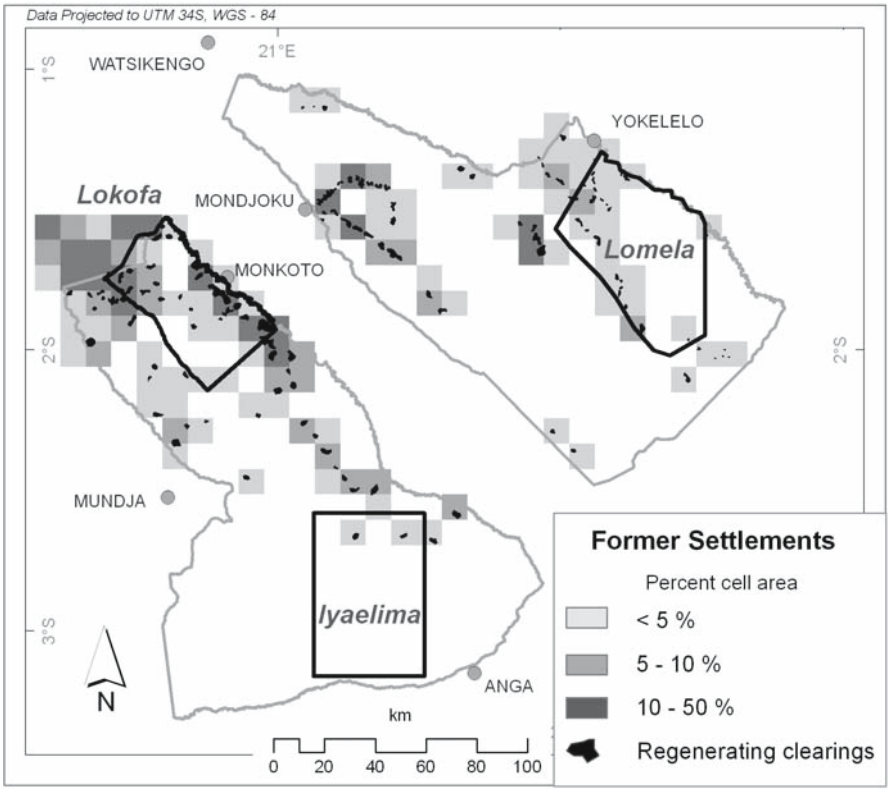

Fig. 12.4 Former settlements (*mpumba*) within the Salonga National Park abandoned before creation of the park in 1970. The proportion of the quadrat area covered by regenerating vegetation is given for 10 × 10 km quadrats with *mpumba*. Phase II inventory blocks are shown in outline.

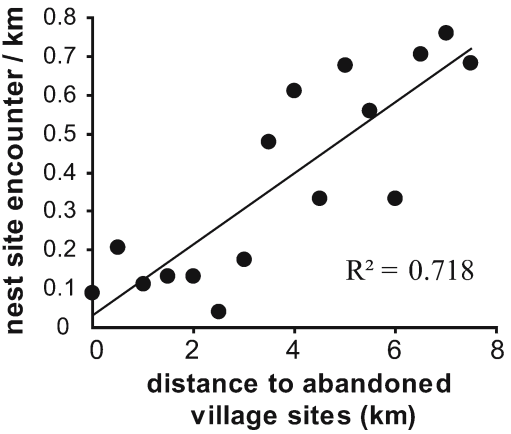

Fig. 12.5 Bonobo abundance (nest group encounter rate) and distance to former settlements (*mpumba*) for all surveyed *mpumba* in the Salonga National Park.

This apparent limitation of fish and wildlife resources, even where human densities are low, is characteristic of areas with low nutrient soils such as the leached sands and weathered substrates found over much of the western Salonga National Park (Barnes and Lahm 1997). Similar substrate-linked constraints may determine settlement and hunting patterns in other areas and could also play a role in determining occupation by bonobos.

Village and Hunter Surveys

Systematic surveys were conducted in 37 villages along the Wafania-Boleko road bordering the western border of the southern sector of the park. Hunters based in these villages hunt within the Salonga National Park, including 13 villages totaling 5,800 inhabitants bordering the Lokofa Block and 24 villages totaling 6,335 inhabitants bordering the adjacent Lokolo Block (Fig. 12.1). We conducted interviews in 147 households and with an additional 62 hunters, including both pygmy (Iyeke) and villager (Nkundo) ethnic groups identified in the villages or encountered within the park in the Lokofa Block during Phase II surveys.

Table 12.3 is a summary profile of the surveyed villages. Although the Lokofa and Lokolo communities have approximately the same number of inhabitants, the villages bordering the Lokolo Block have more hunters than the villages bordering the Lokofa Block. Both Lokofa and Lokolo villages had comparable equipment indices (snares per hunter and shotguns per hunter) with dogs used frequently in both areas. Lokolo villages had higher involvement in the commercial meat trade than Lokofa Block villages (7 vs. 4) and a greater presence of mobile professional hunters (12 vs. 3). All of the 20 hunters encountered by survey teams within the park in the Lokofa Block during Phase II inventories were based in just two villages, and almost all were Iyeke pygmies.

In the Lokofa villages, only one of the three professional hunters we interviewed had his own camp in the forest at the time of the survey. Two had rented their cable snares and shot guns to local hunters in exchange for a share of the meat. All of the 12 mobile professionals we interviewed in the Lokolo villages had their own hunting camps in the park or joined forces with local hunters. One elephant hunter, with links to the Congolese military, operated in the Lokolo Block during the survey period. In Mangilombe village (total population 807, including both Iyeke and Nkundo), the most active hunting village among the communities bordering the Lokolo Block, 3 of the 4 professional hunters present came from Mbandaka and were related by marriage to the traditional chief who provided them with illegal authorizations to hunt inside the park.

Ungulates and monkeys comprised the near totality of the meat recorded in transport from the park or along the road to the dugout canoe ports of Wafania (export point for the Lokfa Block) or Boleko (export point for the Lokolo Block). Other observed bushmeat species included pangolins, porcupines and possibly elephant. Survey teams recorded no bonobos in the bushmeat samples examined, and no hunters admitted to killing or selling bonobos, although several said that dead bonobos were occasionally brought into their village by hunters.

Table 12.3 Profiles of communities with significant hunting in the Lokofa and Lokolo Blocks (southern sector, Salonga National Park) [1]

Block		Total inhabitants	Villages with major commercial hunting	Hunter census		Equipment and hunting dog inventory			
				Locally based	Mobile professional	Snares	Shotguns	Bows	Dogs
Lokofa 13 villages	Total census	5,800	4	290	3	33,242	89	603	342
	average per village	446	–	22	–	2,557	7	46	26
	range	83 – 1663	–	No data	–	0 – 12,800	0 – 15	0 – 119	0 – 78
Lokolo 24 villages	Total census	6,330	7	830	12	93,650	277	No data	No data
	average per village	264	–	35	–	3,902	12	No data	No data
	range	41 – 807	–	4 – 200	–	400 – 20,000	4 – 36	No data	No data

[1]Survey period March – August, 2005. See Fig. 12.1 for Block location.

Although many locally based hunters participate in the commercial trade, most do so in a limited way to provide cash to buy basic supplies (machetes, salt, soap, petrol, cooking pots), luxury or investment items (radios, shotguns, bicycles, sewing machines), to pay school fees, or less frequently, to produce capital for family events such as marriages. In a list of 21 exchange equivalents for bushmeat developed from interviews in the villages bordering the Lokofa Block, 9 items were clothing, 4 were luxury or capital investments and 9 were subsistence supplies.

Mobile professional hunters reported that they exported their meat to urban markets in Mbandaka and rarely traded it locally. Exchange rates (Congolese franc equivalents) for bushmeat traded at the village or hunting camp at the beginning of the bushmeat chain are one fourth to one tenth the prices paid for the same item once it reaches the urban market in Mbandaka.

Discussion

Impact of Hunting on Bonobos and Other Fauna

Bonobos, ungulates, monkeys and elephants differ in their distribution and abundance in the park. No single species or taxonomic group can be used to provide a comprehensive index of the impact of hunting in the park. Each species responds differently to ecological factors and to the effects of hunting. Ungulate abundance decreased consistently from low hunting to high hunting quadrats in Phase I surveys. This expected relationship between relative faunal abundance and hunting pressure was not recorded for any other species, although for all taxa, including bonobos, the proportion of quadrats with high faunal abundance was lowest for the grids with high hunting indices (Fig. 12.6).

Table 12.4 is a summary of bonobo densities, human settlement and hunting practices in the three Phase II inventory blocks. In the Lokofa Block, bonobo nests were significantly less abundant in quadrats with the highest hunting indices (T tests, $P < 0.5$). Locations with high snare encounters had fewer nests. Most nests were

Table 12.4 Profiles of Phase II inventory blocks

Block	Bonobo densities[1] (per km^2)	Human settlement	Hunting methods	Bonobo kills recorded	Commercial meat trade	Hunter attitude toward bonobos
Lokofa	0.278 (0.102 – 0.395)	peripheral	Snare, shotgun, archery	None	present	Neutral / unknown
Iyaelima	0.670 (0.328 – 0.803)	interior	Snare, archery, shotgun	None	absent or low	Avoid
Lomela	0.865 (0.441 – 1.00)	Interior and peripheral	Snare, shotgun	Yes	high	Possibly targeted

[1] Mean and 95% confidence limits for estimate.

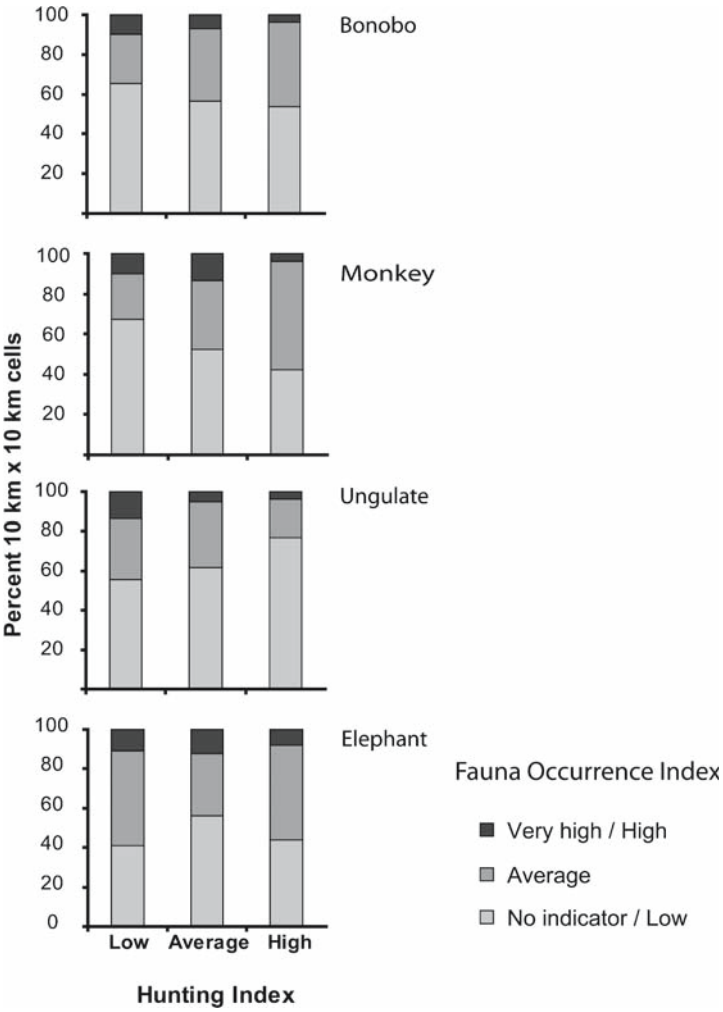

Fig. 12.6 Faunal occurrence in relation to hunting indices for 10 × 10 km Phase I quadrats with ≥ 5 km recce coverage in the Salonga National Park and surveyed corridor.

found in quadrats with low hunting indices or where no hunting indicators were found (Fig. 12.7). In the Iyaelima Block, in contrast, bonobos were widespread and abundant in areas used by local hunters, and we detected no relationship between bonobo abundance and hunting indices. A similar situation was initially detected in the Lomela Block during the Phase I survey (2005), but by the time of the Phase II survey (ca. 1.5 years later), a number of quadrats in the area of the Kitawala village where we had recorded average to high bonobo indices during Phase I, contained few or no bonobo nests during the Phase II inventory. The Lomela Block was the only area in the Salonga National Park where survey teams recorded bonobos killed

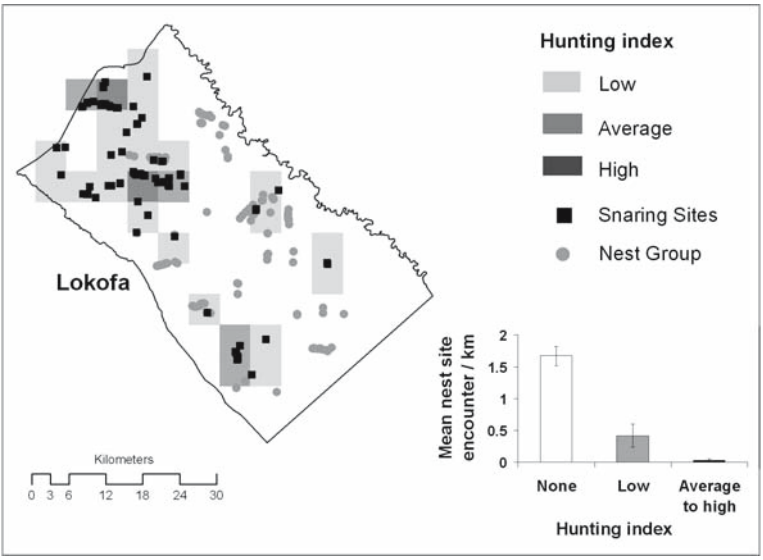

Fig. 12.7 Hunting indices, snare localtions, and bonobo nest groups recorded on Phase II inventories in the Lokofa Block. Histogram shows mean +/− SE nest group encounters for 5 × 5 km quadrats.

by hunters. We estimated that over 20 mobile professional hunters operated in the Lomela Block during the period of the surveys. We recorded no mobile professional hunters in the Iyaelima Block, where the local Iyaelima actively discourage outsiders from hunting in their forest (Thompson et al. 2008). We recorded 3 mobile professional hunters in the villages bordering the Lokofa Block.

Human Settlement and Bonobos

Bonobos live in close proximity to some villages in the Salonga National Park and the surrounding area. However, we found a negative relationship between bonobo abundance and proximity to former settlements in the park, most of which are used by descendants of the former inhabitants for hunting and fishing. The reduction of bonobo populations around former settlements is most likely the result of sustained hunting at the site over many years. Hunters that we interviewed stated that some *mpumba* in the Lokofa Block have been hunted consistently for over six decades. Reductions of some of the bonobo populations around *mpumba* are probably not recent and continued hunting may prevent re-colonization of depleted sites. These observations support Butynski (2001), Dupain et al. (2001) Kingdon (1997), Kortlandt (1995) and Kano (1984), who argued that past hunting pressure may have produced gaps in the bonobo's historic range, and that current hunting promotes ongoing range reduction.

Displaced communities will continue to seek access to their former *mpumba* hunting grounds as long as areas outside the park are over-exploited or until alternative sources of income – and protein – become available and accepted. The relationship between human occupation of the forest and occurrence of bonobos may be highly dynamic as suggested by the apparent decrease in bonobos in the Lomela Block from 2005 – 2006, during a major increase in hunting.

The key point in the relationship between people and bonobos is not where human settlements occur, but rather where and how people hunt. Bonobos and humans are likely to coexist, even in close spatial proximity, where hunters do not target bonobos because of cultural taboos or where hunters use methods that do not put bonobos at risk. Bonobos are vulnerable where hunters unselectively target large bodied species, or broaden their range of targets to include bonobos as preferred game species are depleted.

Threats to Bonobos in the Salonga National Park

We identified three primary threats to bonobos occupying the Salonga National Park. These included:

1) ***High hunting indices:*** Intensive hunting is a threat to bonobos even when they are not targeted, since the non-selective hunting methods widely used in the park (cable snares) are likely to catch, maim or kill bonobos, as has been documented with chimpanzees (Hashimoto 1999, Reynolds et al. 1996). Bonobos are also likely to be killed opportunistically by hunters with firearms when they are encountered. Areas with high hunting levels are likely to include a higher proportion of mobile professional hunters who may be more inclined to seek and kill bonobos.
2) ***Commercial bushmeat:*** Market hunting leads to an intensification and spatial expansion of hunting. By controlling the prices they pay for meat, commercial buyers can manipulate locally based hunters to produce unsustainable off takes. Large bodied, social bonobos are especially at risk where commercial hunting prevails, as each individual animal provides large quantities of meat and multiple kills are possible for each encounter. The perception (true or not) is that higher populations of wildlife in the park attract commercial hunters. They claim to have ready access to areas of the park that are not patrolled by ICCN. Hunters in the park may also avoid the need to pay fees or provide tribute to traditional authorities in exchange for hunting rights. These are significant gains to hunters pursuing marginally higher profits.
3) ***Absence of active protection:*** The control of the Salonga National Park by the ICCN is incomplete and ineffective. Some areas of the park have never been patrolled.

Three additional factors represent indirect threats and reduced or uncertain levels of direct risk. They can potentially affect the impact of hunting on bonobos.

4) ***Faunal depletions:*** Reductions in populations of ungulates and monkeys that are selected by most hunters could put bonobos at risk if hunters turn to bonobos as alternative targets.
5) ***Former settlements:*** Bonobo populations are likely to be threatened in areas that have an extended history of hunting, in particular in former settlement areas within the park that are used as traditional hunting grounds by local communities. Given their long life spans and wide daily ranging, bonobos will be exposed to accumulating risk, even under lower hunting levels, if the areas they occupy are hunted consistently over time.
6) ***Hostility of local populations:*** We found that some local communities that are hostile to the park and the presence of ICCN staff threaten guards and prevent their deployment in areas of the park where they are hunting illegally. This may also facilitate expansion of direct threats such as commercial hunting.

These six threats vary spatially in their influence and they do not affect the park's bonobos equally. Table 12.5 is an evaluation of the relative importance of each of these threats in the 12 threat assessment blocks (eleven within the park and one in the eastern corridor between the two park sectors) that were delimited to develop estimates of bonobo populations given in this volume in Grossmann et al. (2008) and mapped in Fig. 12.1. For each threat, the level of risk is graded from low to high, on a three point scale (1–3). Composite threat scores are calculated for each block by multiplying the sum of the scores of the three direct threats by 2 and then calculating the average of the direct and indirect threat scores combined.

While the scoring of threats is approximate and the calculation of risk is just one of several possible computations, several trends are nevertheless evident:

1) Over 14% of the park area and over 22% of its bonobos are highly threatened. Another 25% of the bonobos are only slightly less threatened. Just 3% of the park area and < 3% of its bonobos could be classified as low risk.
2) Threats to bonobos are not distributed equally. The Lomela and West Lomela blocks, both of which have high bonobo occurrence, also have among the highest threat scores.
3) High hunting levels and commercial bushmeat trade were recorded in five of the 12 blocks, covering over half of the park's area.

Conservation Potential

The ICCN is the sole authority legally mandated to patrol the Salonga National Park and ensure protection of its fauna. An index of the potential protection of the park area by ICCN staff can be defined as a function of the distance from park stations or patrol posts, weighted by the number of guards present at each location. The potential protection index can be compared with an index of hunting levels to provide an overall assessment of the vulnerability of the park's bonobos (Fig. 12.8).

Table12.5 Threat to bonobos posed by hunting and related risks in the Salonga National Park and eastern corridor [a]

Sector	Threat Assessment Block [b]	area (km^2)	Bonobo population (mean estimate) [c]	Hunting pressure	Commercial bushmeat trade	Absence active protection	Faunal depletion	Hunting history	Local Hostility	Composite score	Level of threat to bonobos [d]
South	A. Lokofa	2300	611	2	2	1	1	3	1	2.5	intermediate
	B. Iyaelima	2400	1526	2	1	2	2	1	2	2.5	intermediate
	D. Lokolo	1550	415	2	3	3	2	3	3	4.0	high
	E. South Central	4750	1213	1	2	2	1	2	2	2.5	intermediate
	F. Southwest	4200	2212	1	2	3	2	1	1	2.7	intermediate
	G. Anga	1100	412	1	1	1	2	2	1	1.8	low
	Unsampled zone	1800	667	2	2	2	2	2	2	3.0	intermediate
North	C. Lomela	2700	2242	3	3	3	3	2	3	4.0	high
	I. Northwest	3100	1064	2	2	1	3	3	1	2.8	intermediate
	L. West Lomela	4700	1391	3	3	2	2	2	2	3.7	intermediate
	J. North Central	2500	1106	3	2	3	3	1	2	3.7	intermediate
	K. Southeast	900	643	3	3	2	3	3	3	3.8	high
	Unsampled zone	3700	1380	3	3	2	2	2	2	3.7	intermediate
Total Park	**Totals / Mean**	**35700**	**14883**	**2.2**	**2.2**	**1.9**	**2.2**	**2.1**	**1.9**	**3.1**	**intermediate**
Buffer Zone	East Corridor	2100	809	2	3	3	3	1	2	3.7	intermediate

[a] See text for definitions and scoring of threat criteria.

[b] See Fig. 12-1 for block locations.

[c] Bonobo population estimates developed in Grossmann et al. (2008).

[d] Level of threat to bonobos given by composite score: < 2.5, low; 2.5 – 3.7, intermediate; > 3.7, high.

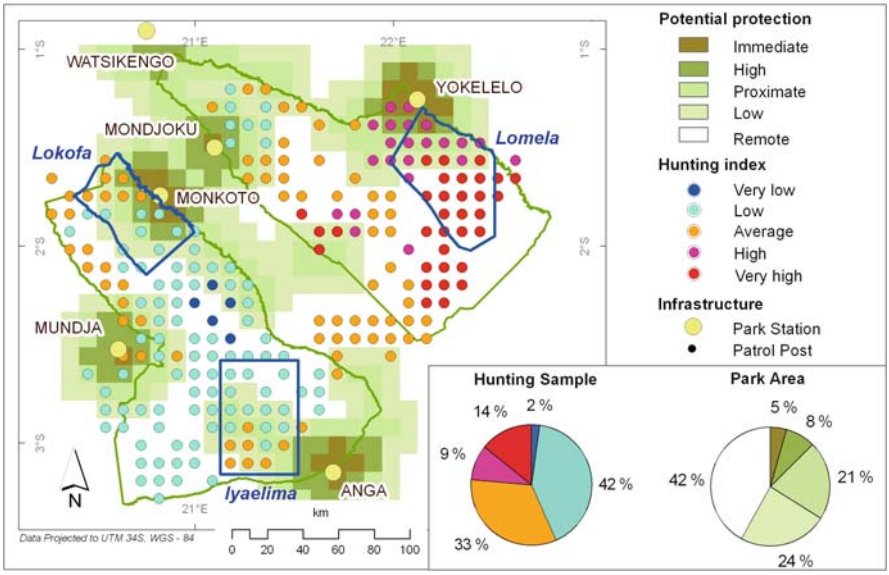

Fig. 12.8 Getis-Ord G, hunting hot spots, and potential protection indices computed as a function of distance from established ICCN infrastructure (patrol posts and park stations) weighted by number of park guards based at the site (*See Color Plates*).

Based on this index, only about one third of the park area is classified as having proximate or higher potential protection. Over 40% of the park is remote (> 20 km and > 30 km respectively) from manned patrol posts or park stations. Elevated hunting indices, as grouped by the Getis Ord G, hot spot analysis (Mitchell 2005), are concentrated in the Lomela Block and in the eastern third of the northern sector where ICCN bases are remote and potential protection very low.

The analysis also shows that proximity to ICCN patrol bases is unlikely to explain the low levels of illegal hunting we recorded in portions of the southern sector of the park. Many of these areas are remote from ICCN bases and infrequently patrolled. They have no *mpumba*, and may not have been claimed as traditional hunting territories before the creation of the park. Professional mobile hunters simply may not yet have reached these areas, or alternatively, they may have hunted these areas and left before the surveys. In the northern sector, high levels of hunting were found even in areas of proximate potential protection. Under its current deployment, ICCN's infrastructure and staff are poorly placed to deal with some of the most significant threats to the park.

Hostility between ICCN staff and local communities hinders deployment of park guards and reduces their efficiency. The inability of ICCN and local communities to resolve seemingly simple problems ingrains antagonism against the park. Unresolved land claims and disputes over park limits are a constant distraction to the ICCN. Congo's decade of conflict and political instability left the ICCN weakened

and opened some of the country's parks to land grabs and destruction that are not easily reversed (Hart 2005). The Salonga National Park, due to its large area, remoteness and lack of known mineral reserves, still remains intact compared to some other protected areas in Congo. However, more than 20% of the 215 villages surrounding the Salonga National Park, and all of the nine villages located within the park have long standing disputes with the ICCN that impede collaboration (Thompson et al. 2008).

Recommendations to Improve Protection of Bonobos

Protected areas are one of the basic mechanisms to ensure conservation of vulnerable species. Yet legal gazettement, and even the deployment of park guards, are not sufficient to ensure the integrity of the protected area or the conservation of its fauna. Salonga National Park contains a significant population of bonobos and covers ca. 10% of their range. Despite the park's World Heritage status, illegal hunting occurs over wide areas. Almost a quarter of the park's bonobos are at high risk from illegal hunting. It is unlikely that the ICCN will be able to deal with the threats fully. Solutions are urgently required or the park risks having one of its most valuable assets seriously reduced. Failure to protect the Salonga National Park and its bonobos could compromise efforts to establish other protected areas within the bonobo's range.

We offer the following recommendations as guidelines for immediate actions:

Recommendation 1: Control the most dangerous hunting. High levels of hunting in areas that contain concentrations of bonobos present the most important threat. It may not be possible to eliminate high levels of hunting everywhere, but a focused approach to reduce hunting in areas that are most important for bonobos is needed.

Recommendation 2: Target specific hunters. Our interviews and observations in the field revealed that the bulk of the intensive hunting in any given area of the park is likely led by a small, readily identified group of hunters, most of whom are involved in the commercial bushmeat trade. These hunters and their associated buyers should be the first focus of control by ICCN. In some cases, controls on specific hunting practices might mitigate the impact of hunting on bonobos. The advantage of the focused approach is that it reduces the likelihood of misdirected punishment of hunters who, though operating illegally within the park, are less threatening to bonobos.

We recommend a combination of individualized and collective approaches for hunter education. Individualized education programs can be tailored to specific hunting territories, ethnic concerns, hunting methods and specific hunters. Individualized approaches also develop a basis for personal responsibility – and its benefits – a key element in legal recourse and for certain opportunities such as alternative sources of income or employment, including the possibility of hiring former poachers as park guards.

Recommendation 3: Reduce local hostility. We recommend that selected demands by local communities for access to key sites and resources within the park

be evaluated, and agreements be developed where access and utilization can be controlled and will not damage park values. Arrangements with local communities could include agreements that commit them to support protection of the park in exchange for access rights. Locals could be hired to participate in the monitoring of park use, an approach already initiated by some international NGOs supporting the park. Novel approaches, like "cultural tourism," that permit controlled access and managed use of the park for cultural events, such as some types of seasonal fishing, might be possible. Not all proposed uses will be compatible with the protection of the park, and negotiations should ensure that the overall outcome is improved conservation of the site. This approach will require that the ICCN acquire capacities such as community outreach and conflict resolution. A pilot project in the Lokofa Block to delimit contested park limits with participation of local communities improved relations with the ICCN, but it is not certain if this approach can be used to resolve more difficult issues such as illegal hunting and fishing.

Conclusions

Salonga National Park's globally significant population of bonobos are at best only partially protected and secured. Illegal hunting is widespread in the park. High levels of hunting in areas where bonobos are most abundant is the most important threats. Salonga National Park has a long history of human use focused mainly on fishing and hunting. Demands by local communities for access to the park's resources will continue to be made, and new approaches are needed to respond to these while at the same time ensuring the integrity of the park and protection of its key fauna, including bonobos. The multiphase program of field inventories in conjunction with village and hunter surveys is an efficient way to identify areas with high concentrations of bonobos, and to evaluate dangers to them. Despite the serious threats, Salonga National Park represents one of the best opportunities for long term conservation of bonobos. Support of both local communities and ICCN are required to secure the park and protect its bonobos.

Acknowledgements We acknowledge the support of the Institut Congolais pour la Conservation de la Nature (ICCN) for the Salonga survey project We thank the CITES-MIKE program, Wildlife Conservation Society (WCS), USAID's Central African Regional Program for the Environment (CARPE), the Alexander Abraham Foundation and World Wide Fund for Nature (WWF) for financial support.

We are grateful to the more than one hundred individuals who participated in surveys and assisted in providing the major logistical effort to support the survey teams in remote locations. Field team leaders who deserve special mention include: Maurice Emetshu, Aime Bonyenge, Bernard Ikembelo, Simeon Dino, Pupa Mbenzo, Samy Matungila, Menard Mbende and Pele Misenga. Community surveys were led by Georges Lombombe and Jeef Ikwange. Inogwabini Bila Isia and Omari Ilambu assisted in the training of the field teams.

We thank WCS and WWF for their support in developing a series of workshops in the field in the Lokofa Block, and supporting workshops in Kinshasa on conflict resolution and management plan development that provided input for the development of some of the conclusion presented here.

We extend a special expression of appreciation to Jo Thompson for sharing her experiences with the Iyaelima with us and for providing essential support and encouragement in the preparation of this chapter.

References

Barnes RFW, Lahm SA (1997) An ecological perspective on human densities in the central African forest. Journal of Applied Ecology 43: 245–260

Blake S (2005) Forêts d'Afrique centrale: rapport final sur les relevés démographiques d'éléphants (2003–2004). CITES –MIKE, Nairobi, pp 135

Bowen-Jones E, Pendry S (1999) The threat to primates and other mammals from the bushmeat trade in Africa, and how this threat could be diminished. Oryx 33: 233–246

Butynski TM (2001) Africa's great apes In: Beck B, Stoinski TS, Hutchins M, Maple TL, Norton B, Rowan A, Stevens EF, Arluke A (eds) Great apes and humans: the ethics of coexistence. Smithsonian Institution Press, Washington DC, pp 3–56

Draulans D, Van Krunkelsven E (2002) The impact of war on forest areas in the Democratic Republic of Congo. Oryx, 36: 35–40

Dupain JL, Van Krunkelsven E, Van Elsacker L, Verheyen RF (2000) Current status of the bonobo (*Pan pansicus*) in the proposed Lomako Reserve (Democratic Republic of Congo). Biological Conservation 94: 265–272

Dupain JL, Van Elsacker L, Verheyen RF (2001) The status of the bonobo in the new Democratic Republic of Congo. In: Galdikas B, Briggs N, Sheeran L, Shapiro G (eds) All apes great and small, Vol. I: Chimpanzees, Gorillas and Bonobos. Kluwer, New York, pp 57–74

Grossmann F, Hart JA, Vosper A, Ilambu O (2008) Range occupation and population estimates of bonobos in the Salonga National Park: application to large scale surveys of bonobos in the Democratic Republic of Congo. In: Furuichi T, Thompson J (eds) The bonobos: behavior, ecology, and conservation. Springer, New York, pp 189–216

Hart JA (2005) Wildlife Wars – The Democratic Republic of Congo's national parks and their guardians under siege. International Herald Tribune Op-Ed June 7 Paris

Hashimoto C (1999) Snare injuries of chimpanzees in the Kalinzu Forest, Uganda. Pan Africa News 6: 5

Idani G, Mwanza N, Ihobe H, Hashimoto C,Tashiro Y, Furuichi T (2008) Changes in the status of bonobos, their habitat, and the situation of humans at Wamba, in the Luo Scientific Reserve, Democratic Republic of the Congo. In: Furuichi T, Thompson J (eds) The bonobos: behavior, ecology, and conservation. Springer, New York, pp 291–302

Kano T (1984) Distribution of pygmy chimpanzees (*Pan paniscus*) in the Central Zaire Basin. Folia Primatologica 43: 36–52

Kano T, Asato R (1994) Hunting pressure on chimpanzees and gorillas in the Motaba River area, northeastern Congo. African Study Monographs15: 143–162

Kano T, Lingomo B, Idani G, Hashimoto C (1996) The challenge of Wamba. In: Cavalier P (ed) Great ape project: Ecta & Animali 96/8. Milano, pp 68–74

Kingdon J (1997) The Kingdon field guide to African mammals. Princeton University Press

Kortlandt A (1995) A survey of the geographical range, habitats and conservation of the pygmy chimpanzee (*Pan paniscus*): An ecological perspective. Primate Conservation 16: 21–36

Mitchell A (2005) The ESRI guide to GIS analysis, vol 2: Spatial measurements and statistics. ESRI Redlands, California

Omari I (2006) Review of the ICCN infrastructure of PN Salonga. WWF, Kinshasa

Reinartz GE, Inogwabini BI, Ngamankosi M, Wema LW (2006) Effects of forest type and human presence on bonobo (*Pan paniscus*) density in the Salonga National Park. International Journal of Primatology 27: 603–634

Reynolds V, Burch D, Knight J, Smith R, Walter J (1996) The nature, causes and consequences of injuries sustained by wild chimpanzees in the Budongo Forest, Uganda. Abstract, XVIth Congress of the International Primatological Society

Rose AL (1998) Growing commerce in bushmeat destroys great apes and threatens humanity. African Primates 3: 6–10

Siegert F (2003) Assessment of land cover and land use in the Salonga NP based on satellite imagery. Remote Sensing Solutions (RSS-GmbH) and GTZ, Kinshasa. 16 pages Unpublished report

Susman R, Badrian N, Badrian A, Thompson-Handler N (1981) Pygmy chimpanzees in peril. Oryx 16: 179–183

Tashiro Y (1995) Economic difficulties in Zaire and the disappearing taboo against hunting bonobos in the Wamba area. Pan Africa News 2

Thomas L, Laake JL, Strindberg S, Marques F, Borchers DL, Buckland ST, Anderson DR, Burnham KP, Hedley SL, Pollard JH (2001) Distance 4.0. Beta 1. Research Unit for Wildlife Population Assessment, University of St. Andrews, UK, *http://www.ruwpa.st-and.ac.uk /distance/*

Thompson J Myers, Lubuta MN, Kabanda RB (2008) Traditional land-use practices for bonobo conservation. In: Furuichi T, Thompson J (eds) The bonobos: behavior, ecology, and conservation. Springer, New York, pp 227–244

Thompson-Handler N, Malenky RK and Reinartz GE (1995) Action plan for *Pan paniscus*: report on free-ranging populations and proposals for their preservation. Zoological Society of Milwaukee, Wisconsin, United States

Annex 12.1 Large Mammals of the Salonga National Park (nomenclature following Kingdon 1997)

Taxon	French	English	Vernacular	Occurrence in hunter kills (2003 – 2006)
ELEPHANT				
Loxodonta africana cyclotis	Eléphant de fôret	Forest elephant	Ndjoku	Uncommon
GREAT APES				
Pan paniscus	Bonobo	Bonobo	Edja, Esumbu, Mokomboso	Rare
ANTHROPOID PRIMATES				
Piliocolobus tholloni	Colobe bai	Tshuapa red colobus	Djofe, Kolongo	Common
Colobus angolensis	Colobe d'Angola	Angola pied colobus	Libuka	Uncommon
Cercopithecus ascanius	Cercopithèque ascagne	Red-tailed guenon	Nsoli	Common
Cercopithecus (mona) wolfi	Cercopithèque de wolf	Wolf's guenon	Mbeka	Common
Cercopithecus neglectus	Cercopithèque de Brazza	De brazza's guenon	Bosila	Not recorded
Allenopithecus nigroviridis	Singe de marais	Allen's swamp monkey	Ekele	Rare
Lophocebus aterrimus	Cercocebe noir	Black mangabey	Ngila	Common
Cercocebus chrysogaster	Cercocebe à ventre doré	Golden-bellied mangabey	Inku	Uncommon. No observations from park
UNGULATES				
Potamochoerus porcus	Potamochère	Red river hog	Nsombo	Common
Hyemoschus aquaticus	Chevrotain aquatique	Water chevrotain	Etambe	Uncommon
Tragelaphus spekei	Sitatunga	Sitatunga	Mbuli	Common
Tragelaphus euryceros	Bongo	Bongo	Mpanga	Not recorded
Cephalophus monticola	Cephalophe bleu	Blue duiker	Mboloko	Common
Cephalophus nigrifrons	Cephalophe à front noir	Black-fronted duiker	Bombende, Nkulufa, Nginda	Common
Cephalophus dorsalis	Cephalophe bai	Bay duiker	Bofala	Common
Cephalophus silvicultor	Cephalophe à dos jaune	Yellow-backed duiker	Mbende, Lisoko	Uncommon
Cephalophus callipygus	Cephalophe de peter	Peter's duiker	Mpambi, Mbengele	Common

(continued)

Annex 12.1 (continued)

Taxon	French	English	Vernacular	Occurrence in hunter kills (2003 – 2006)
Syncerus caffer	Buffle de fôret	Forest Buffalo	Mpakasa, Ngombo	Not Recorded
CARNIVORES				
Panthera pardus	Léopard (Panthère)	Leopard	Nkoy	Uncommon
Civettictis civetta	Civette d' Afrique	Afrique Civet	Bowane, Ibobi	Rare
Genetta servalina	Genette servaline	Servaline genet	Iyeni	Common
Genetta tigrina	Genette tigrine	Blotched genet	Nsima	Common
Nandinia binotata	Nandinie	African palm civet	Mbio	Common
Aonyx congica	Loutre du Congo	Swamp otter	Iyoko	Not recorded
Mellivora capensis	Ratel	Honey badger	Esisi, Lokusa, Mpolo	Not recorded
Atilax paludinosus	Mangouste des marais	Marsh mongoose	Bolia ya mai	Not recorded
OTHER				
Galagoides demidoff	Galago de Demidoff	Demidoff's galago	Isile	Not recorded
Perodicticus potto	Potto de Bosman	Potto	Nkatshu	Not recorded
Smutsia gigantea	Pangolin géant	Giant pangolin	Ikaka	Rare
Phataginus tricuspis	Pangolin commun	Tree pangolin	Nkalamonyo	Common
Uromanis tetradactyla	Pangolin à longue queue	Long-tailed pangolin		Not recorded
Potamogale velox	Potamogale	Giant otter shrew	Yoongo	Rare
Dendrohyrax arboreus	Daman d'arbre	Tree hyrax		Rare
Atherurus africanus	Athérure africain	Brush tailed porcupine	Iko	Uncommon
Anomalurus derbianus	Anomalure de Derby	Lord Derby's anomalure	Lokiyo	Uncommon
Protoxerus stangeri	Ecureuil géant	Giant squirrel		Not recorded