ANNEX 1 : Overview of the TL2 Conservation Landscape and Survey Methods

The TL2 Conservation landscape, spans almost 30,000 km^2 of the middle Lomami Basin, in a region bordered by the Congo (Lualaba) River on the east and the Tshuapa River on the west. The landscape comprises lowland, closed canopy forest transitioning to the savanna ecotone in the south. This region was the largest remaining unexplored intact forest block in Central Africa at the time the surveys were initiated (Figure 1.1).

Within the area explored, we identified a region, the TL2 Conservation Landscape, that included natural habitats with a scattering of local communities living in the landscape that are good candidates for a community based approach to landscape management. The limits of the TL2 Conservation Landscape are defined on the basis of the current and recent distribution of two flagship species, the bonobo and the elephant, and secondarily by the occurrence of other large mammals (including endemic species), habitat diversity, human settlement and traditional forest use areas, and an assessment of the potential for faunal recovery in areas currently depleted by hunting (Table 1.1).

Multi-stage surveys

The landscape was delimited and its fauna and human use were documented through a multi-staged program of surveys that spanned a 26-month period from March 2007 through May 2009. The surveys used a nested design with the coverage at each stage based on the results of earlier stages, and with sampling locations at each stage selected from within the areas surveyed previously. This approach allowed us to focus greatest effort in the areas of highest proven conservation value, identify a landscape of conservation importance and develop proposals for conservation zoning.

Table 1.2 summarizes how overall project objectives were defined in each stage as a function of the varying spatial extent and resolution of the survey. Table 1.3 provides information on survey coverage and design at each stage.

In the first stage, the region to be explored was divided into 49 survey blocks, of 30 x 30 km (900 km^2), and then each block into a10 x 10 km grid to orient the reconnaissance. Survey teams visited each block, and attempted to visit at least 4 to 5, 10x10 km sampling grids on a track circuit through the block. Observations of faunal sign and indicators of human activity were made from compass directed forest reconnaissance walks (termed recces). The exploratory surveys allowed us to discover and delimit a conservation landscape within the region.

Based on the results of the exploratory surveys we could exclude areas with depleted faunas where human occupation and use of the forest rendered the possibility of faunal recovery difficult or unlikely. Some of these areas might be appropriate for subsequent wildlife restoration and natural resource management projects, however, immediate attention had to be focused in the wildlife-rich zones where there were serious and urgent threats.

The exploratory surveys were followed by a second stage of line transect inventories and additional recces in selected 30 km blocks within the conservation landscape. Blocks were selected and transects placed to provide representative data to estimate populations of key fauna, specifically bonobos and elephants, and to quantify the human impact of hunting. Block selection was stratified. One stratum, "*southern bonobo zone*" consisted of 12 contiguous 30 km blocks (10,800 km^2) in the southern forest and savanna ecotone. A second stratum consisted of five blocks distributed in the remainder of the landscape.

Table 1.1. Biological, historical and socio-economic features used to identify the TL2 Conservation Landscape and develop proposals for its zoning.

Landscape attributes	Why important	How evaluated
Distribution of flagship species [a]	• Species unique to Congo. • Regional, national and international conservation icons	• Counts of dung, feeding sign, nests, feathers • Direct encounters on recces, transects
Occurrence of large mammals	• Primary hunted species • Species and subspecies endemic to landscape	• Counts of dung, feeding sign, feathers • Direct encounters on recces, transects
Habitat diversity	• Ensure conservation of a diversity of flora and fauna • Include micro sites with high faunal use, such as "bais" and "parcs" within landscape • Accommodate full range of seasonally-linked habitat changes and faunal migrations	• Satellite image classification, • Habitat classification on recce-transects. • "Parcs" bais' and other micro habitats and important sites for fauna were discovered on ground surveys and in collaboration with local hunters.
Human settlement and use	• Historical and ethnic associations with the landscape identify local stakeholders and their roles. • Historical and geographic trends in resource use determine urgency and severity of threats.	• Interviews with local staff during field surveys • Village meetings and interviews
Potential for faunal recovery [b]	• Intact habitats with low human settlement but depleted faunas can support key fauna if protected.	• Interviews with local staff during field surveys • Village meetings and interviews

Notes

[a] Bonobo and elephant primarily, but also okapi and Congo peacock.

[b] Criteria used to assess potential faunal recovery include:
- Length of time since depletion,
- Identity and origin of hunters before depletion.
- Relative abundance before depletion,
- History of human wildlife conflict,
- Occurrence of favored micro sites or other attracting features.
- Receptivity of local villagers to protect area in order to allow faunal recovery.

Table 1.2. Three overall objectives are developed as a function of spatial extent and spatial resolution in a multi-stage survey.

Survey Stage	Survey Objectives		
	A) Determine faunal distribution and abundance	B) Assess habitats	C) Evaluate human occupation and impacts
1 Exploration	Range occupancy	Major formations and geographic clines	Settlement and use of forest
2 Inventory	Density and abundance	Faunal - habitat associations	Impact of local hunting and exploitation forest
3 Faunal Focal Area	Develop disappearance and production rates for bonobo nests to inform conversion of nest counts to estimates of bonobo numbers	Characterization of zones of high repeated faunal occurrence ("bais", "parcs" and bonobo nesting areas) Seasonal and spatial variability in site use by key fauna	Individual hunters identified and their use of key sites evaluated

Annex 1-table 3. Summary of 3-stage survey design in the TL2 landscape June 2007 – June 2009,

Survey Stage	Survey design unit	Sampling grid	Total Survey coverage		Survey Methods and Data	Design	Landscape and Zones delimited
			Area (km^2)	Track log (km)			
1) Exploratory (2007)	30 x 30 km Landscape Survey Blocks (N = 49)	10 x 10 km	44,000	Recce: 2550 km	• Forest Recces • Indicator encounter rates (no/km): Faunal occurrence and human activity • Habitat classification along track	Recce orientation points cover at least one third of 10 km sampling grid in 30 km landscape blocks	*Conservation landscape* • Distribution and relative abundance of large mammal fauna and human use • Regional political and economic linkages
2) Faunal inventories, human impact (2008)	2 Strata: Northern N = 5 blocks Southern Bonobo N = 12 blocks	5 x 5 km	15,300	Transect 306 km Recce: 2132 km	• Line transect density estimates (no/km^2) of indicators • Indicators: Nests, dung, snares. • Forest recces indicator encounter rates (as above) • Habitat classification along track	30 km landscape blocks stratified by faunal occurrence. Systematic placement of 1 km transects on 5x5 km sampling grid in selected blocks, 18-36 transects per block. Recces between transect start points	*Management Zones*: • Integral Protection / National Park • Community conservation multiple use zones
3) Focal fauna sectors (2008-09)	2 Sectors : Luidjo and Tutu	5 x 5 km	3,000	Transect 30 km Recce: Not measured	• Repeated line transect inventories of faunal indicators and direct observations (primates) along path grids. • Bonobo nests followed from construction to decay • Hunter follows to determine snare placement and removal	Repeated surveys along 6 km transect lines. Hunter follows included intensive searches to locate hunting camps and identify owners followed by snare removal with cooperating hunters	*Focal faunal concentration and intervention zones*: • Tutu Basin • Lomami-Luidjo

In the third stage we focused on repeated transect inventories within selected sectors where we had found some of the highest concentrations of bonobos and elephants. The repeated inventories provided a basis for evaluating use of space by these two species, and estimates of bonobo nest production and nest decay rates, both key parameters for converting estimates of nest density to estimates of bonobo population size.

The inventories were supported by ground patrols and snare sweeps consisting of directed searches for camps and snares with collaborating hunters from local communities associated with the area.

Figure 1.2 shows the distribution of the 30 x 30 exploratory stage survey blocks with the limits of the conservation landscape and a proposed national park and the two Stage 3 focal fauna sectors. Figure 1.3 presents tracklogs of the recce coverage in Stages 1 and 2. Figure 1-4 locates the line transects and identifies the two strata for Stage 2 inventories

Data Collection and Field Protocols

Data collection was accomplished by five field teams led by trained team leaders with at least 5 years experience in large mammal surveys in DRCongo forests. The "*equipe technique*" for each team consisted of 5 individuals, advancing in linear file, all of whom made observations along the line of travel. The line was led by a *pisteur* who opened passage with a machete. He was guided by a *bousolier* (compass man) followed by two observers, one to look up in the trees for primates and nests, one to concentrate on indicators in the forest understory and forest floor. The observers also were responsible for measurements, GPS records and photos, The field leader managed the data entry and ensured quality control of the observations. Porters and camp assistants followed the data team. Most data collection circuits lasted from 15 to 25 days.

Two methods were used to collect data during the surveys: Compass line recces and line transects. Compass line recces followed established compass directions towards pre-established route points (often sampling grid centroids). Line transects were directed in a similar manner with the exception that in line transects there were predetermined start points and directions. For both recces and transects, all observations were geo-referenced with GPS and important observations were recorded by digital photo as well.

With the exception of primates, which were observed directly, most observations were made of animal or human sign. The indirect evidence of animal occurrence and human activity is termed an "indicator". The occurrence of any given species or activity, such as hunting, could usually be assessed by more than one indicator. Annex 1-1 lists the indicators for animals, and Annex 1-2 lists indicators for different human activities surveyed on the landscape A sample field sheet for recce data collection is provided in Annex 1-3.

Line transect data collection was similar to that for recces, with the exception that line transects had specified start and end points, and perpendicular distances were measured from the transect line to the center of selected indicators observed from the line (dung, snare, bonobo nest and primates). Line transect data provides encounter rates, as in recces, and in addition provides a basis for estimating densities using the DISTANCE software.

Data collection methods used in the TL2 surveys are similar to those used in surveys of other sites in DR Congo and across Central Africa, including the MIKE surveys. The use of the same basic methodology permits comparisons of results across sites, and at different time periods.

Survey Analysis

Preliminary analyses were conducted at each stage to permit design of subsequent steps. Further analysis continues, with specific scientific and conservation products planned. Table 1.4 summarizes the analytical program.

Table 1.4. Analytical framework for TL2 surveys.

Stage	Data handling	Analysis	Conservation products
1) Exploration	Geo-referenced field observations entered on spread sheets and referenced to photos. Track logs down loaded and verified. entered into GIS	• Total track logs mapped to 10 km sample grids. Grids classed by coverage (km recces) • Weighted indicator encounter rates for fauna and human activities are integrated into indices of relative occurrence and mapped across the landscape for sample grids with > 5km coverage	• Occurrence maps for fauna and human activities (hunting) • Key faunal zones identified and evaluated in relationship to occurrence and proximity of hunting
2) Inventories	Geo-referenced field observations entered on spread sheets and referenced to photos. Track logs down loaded and verified. entered into GIS	• DISTANCE analysis for line transect data to determine densities of bonobo nests, ungulate and elephant dung, and snares • Conversion of indicator densities to faunal densities using estimates nest disappearance and production rates for nests (see Stage 3) and dung. • Regression analysis of nest densities against recce encounter rates to estimate densities in blocks with recce encounter rates but not line transect estimates • Multivariate modeling to determine relationship between faunal densities and hunting history, settlement and habitat	• Bonobo and elephant population estimates for the Conservation Landscape • Effects of habitat quality and human occupation on fauna estimated and mapped. • Conservation risk indices developed for landscape
3) Focal faunal area surveys	Bonobo nest visits entered in Excel with photos Snare locations mapped and catches recorded.	• Bonobo nest classification, decay, site reuse and nest accumulation quantified • Snare circuits mapped and snares cleaned out • Local nest occupation zones identified and mapped	• Nest production and decay dynamics contribute to population estimates. • Bonobo nesting hot spots identified and mapped. • Snares cleared hunter collaboration developed

Figure 1.1. The red oval marks the location of the Tshuapa-Lomami-Lualaba region in central DR Congo where surveys were conducted.
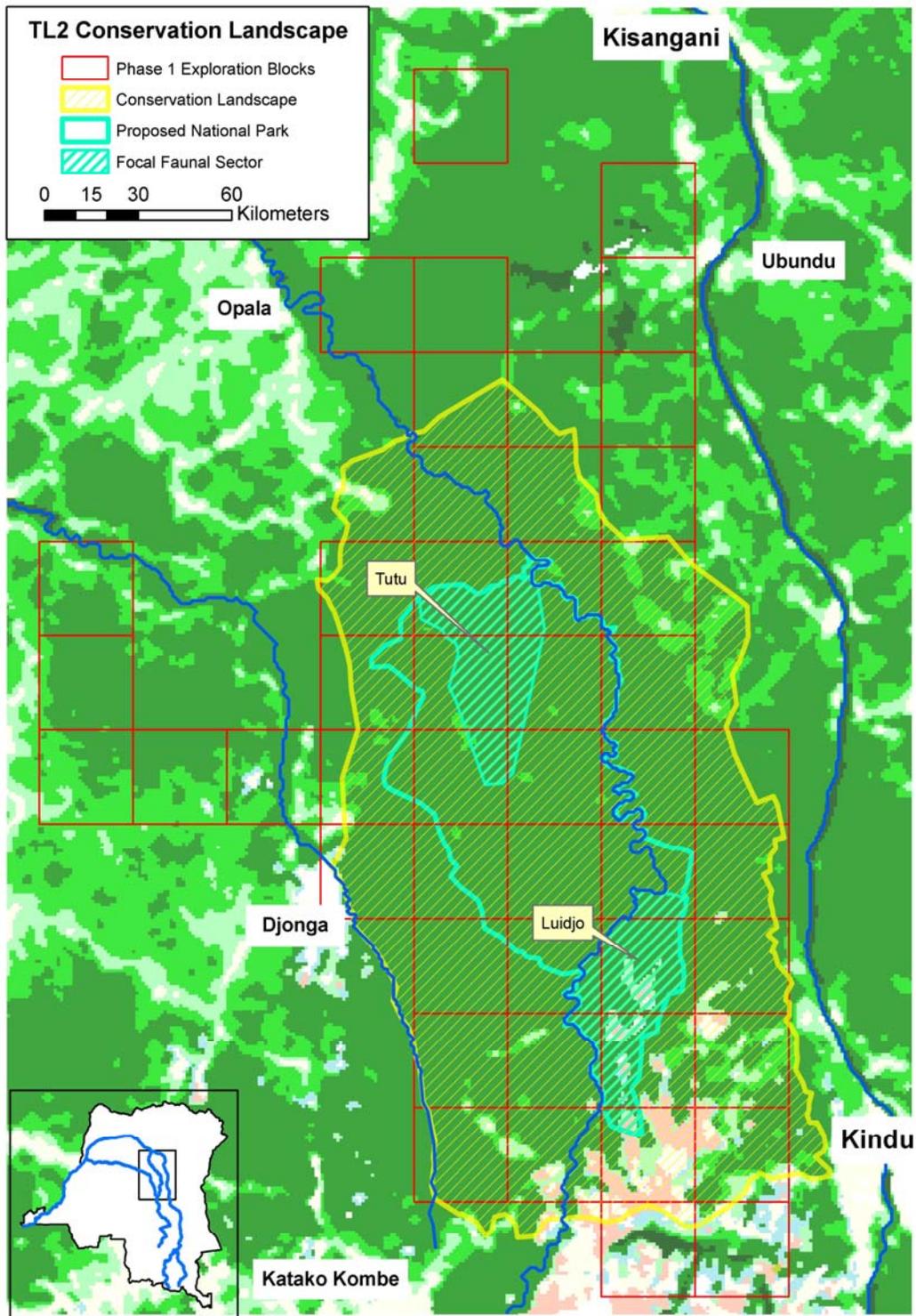
Figure 1.2. 30 x 30 km (900 km^2) blocks surveyed during Stage 1 exploration of the TL2 landscape. TL2 Conservation Landscape and first proposal for a National Park in the landscape are shown. Focal faunal sectors are covered in Stage 3 surveys..
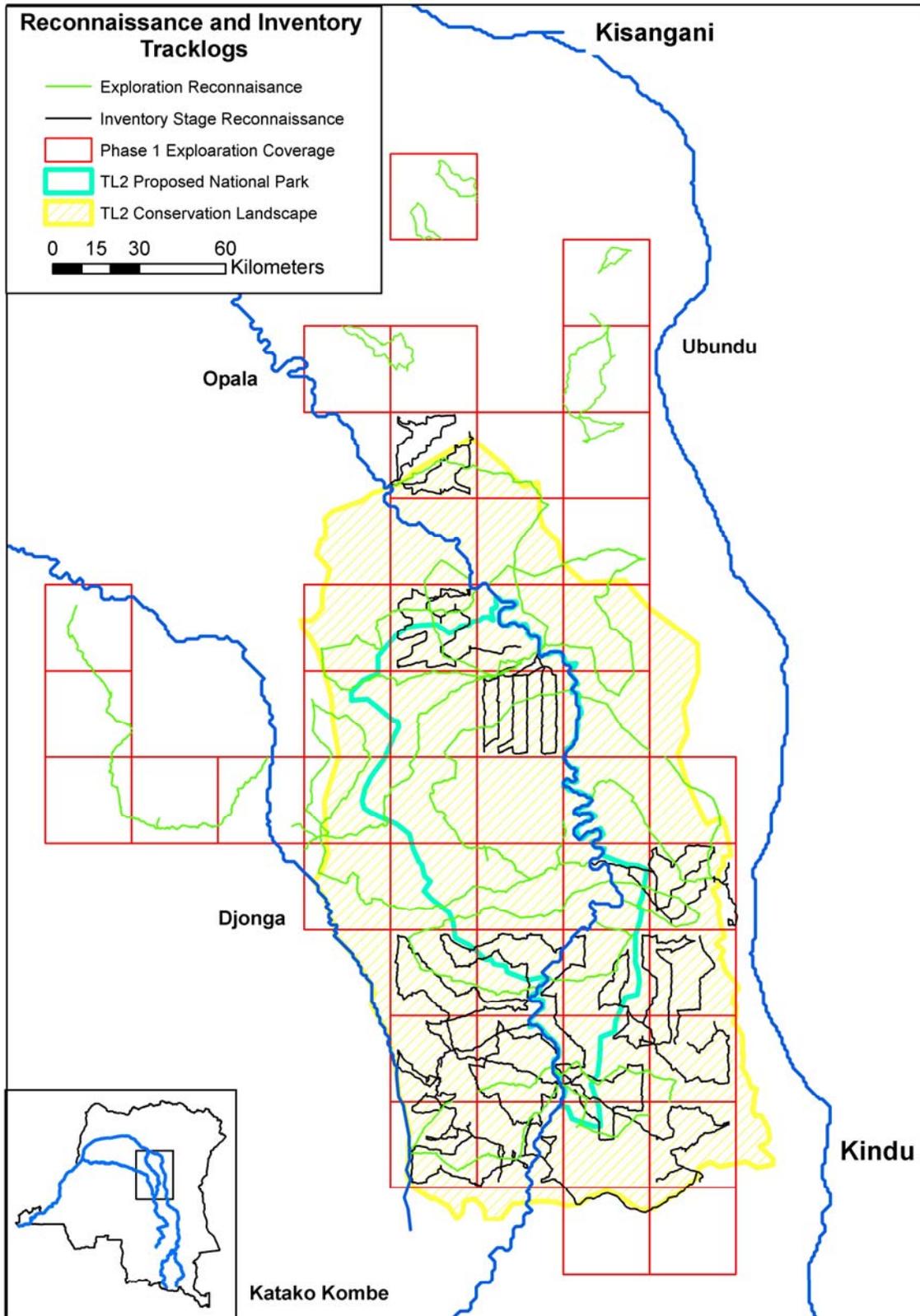
Figure 1.3. Track log coverage of recces and transects in survey blocks in the TL2 Survey Zone.
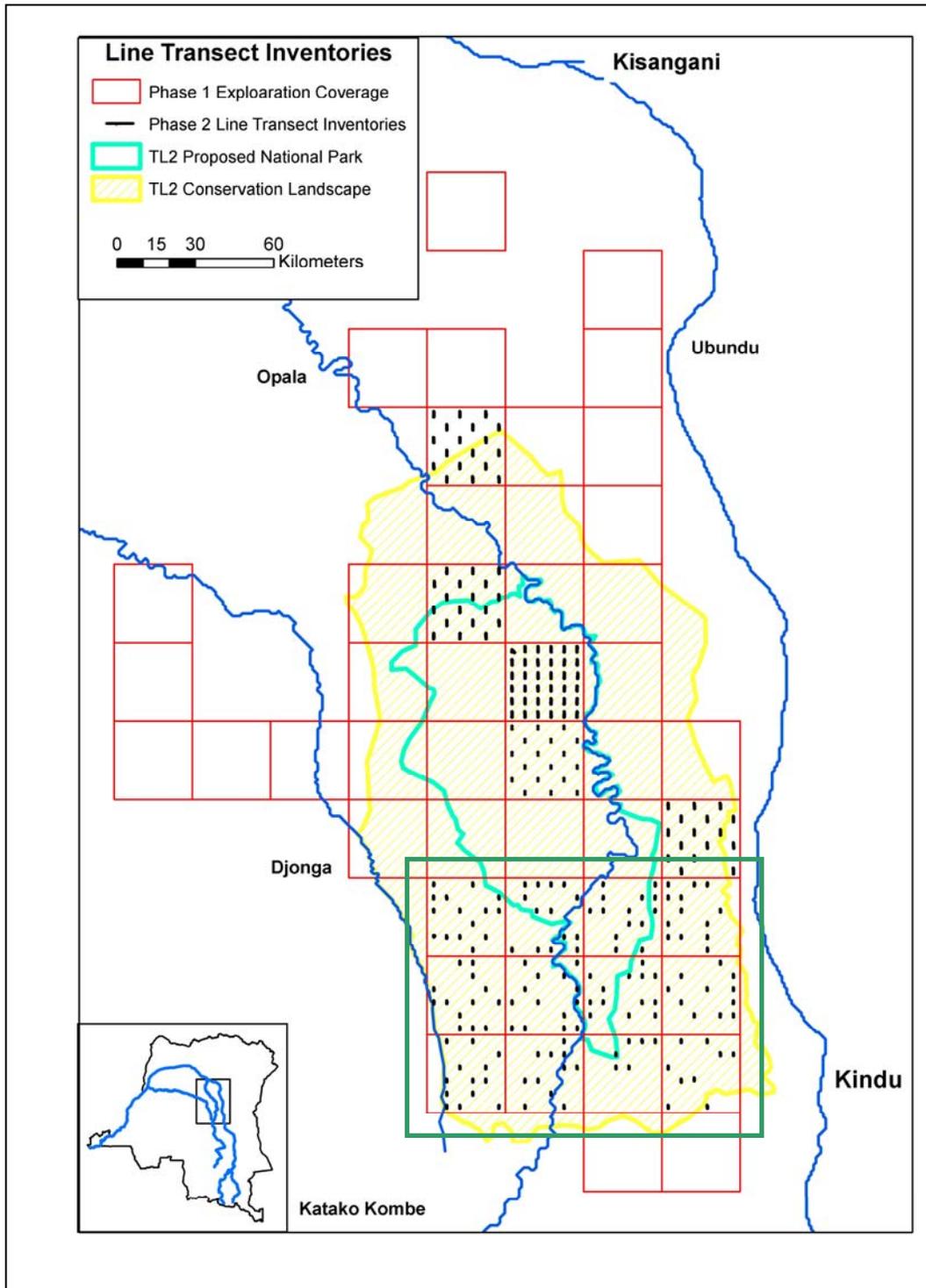
Figure 1.4. Locations of Stage 2 line transect inventories in the TL2 Conservation Landscape. The green rectangle identifies the Southern Bonobo Zone stratum. The remaining blocks comprise a second stratum.

ANNEX 1-1. Large mammal fauna and indicators recorded on TL2 surveys.

Taxon	Espèces	Importance pour la conservation et gestion	Indicateurs observés sur terrain
Eléphant	*Loxodonta africana cyclotis*	Espèce phare: Protection intégrale au niveau national.	Crotte, boulevarde, active, bain actif observation directe
Okapi	*Okapia johnstoni*	Espèce phare: Protection intégrale	Crotte, observation directe
Bonobo	*Pan paniscus*	Espèce phare: Dans le TL2, une des plus grande populations en RDC.	Nids, crottes, observation directe,
Petits ongulés [a]	*Cephalophus monticola* *Hyemoschus aquaticus*	Principale faune de chasse et de commerce de bushmeat.	Crotte, observation directe
Céphalophes rouges [a]	*Cephalophus nigrifrons* *C. callipygus* *C. dorsalis*	Principale faune de chasse et de commerce de bushmeat.	Crotte, observation directe
Céphalophe à dos jaune	*Cephalophus sylvicultor*	Principale faune de chasse et de commerce de bushmeat.	Crotte, observation directe
Suidés	*Potamochoerus porcus,*	Principale faune de chasse et de commerce de bushmeat. .	Crotte, observation directe
Grands ongulés	*Tragelaphus speki* *Tragelaphus euryceros* *Tragelpahus scriptus* *Redunca arundinum* *Syncerus cafer*	Indicateurs de l'impact de chasse au fusil et impact présence humaine	Crotte, observation directe, broutage
Singes	Cercopithèques (6 espèces) Colobes (2 espèces) Cercocèbe (1 espèce)	Indicateurs de biodiversité et de la productivité de la forêt. Cible importante de la chasse et de commerce de bushmeat	Observation directe
Léopard	*Panthera pardus*	Prédateur principal	Trace, crotte, grattage, carcasse de proie
Autres	*Orycteropus afer* *Manis gigantea*	Protection intégrale au niveau national.	Terriers

NOTE : This table is in French as it was used in a presentation in DR Congo.
[a] Identification of individual species is not certain within these taxa, and confusion between dung of red duikers and small ungulates is possible. Analyses generally lump all duikers.

Annex 1-2. Indicators of human activity recorded on surveys

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Activity class	Indicator	Classification	Classification criteria
Hunting	Snare	• Large fauna (pigs, large ungulates), Medium (duikers) • Small (porcupines) • Other: Arboreal, barrier sets and other • Active or inactive	Cane size, snare material,
	Gun shot	• 12 gauge • other	Sound
	Camp	• Active, recently abandoned, long abandoned	Number shelters/beds Size/number meat drying racks
	Spent ammunition	• 12 gauge • other	Ammunition type
Settlement	Village	• Size • Ethnic group • Associated economic activity	
	Garden	• Size • Activity	Crops
Mining	Test pit	Ye Age	
	Extraction site	Active, recently abandoned, long abandoned	
	Camp	Active, recently abandoned, long abandoned	Number shelters/beds
Fishing	Camp	Active, recently abandoned, long abandoned	Number shelters/beds
Other	describe	describe	describe

Annex 1-3 Compass line RECCE:

RECCE ID :	MIKE SITE:	NOTES: Page ___ de _____ Numéro des cartes accompagnantes:
GPS DEPART: Lat.: Long.: LIEU DEPART	GPS FIN: Lat.: Long.: LIEU FIN:	

No	Time	Quadrant	GPS	Specific Habitat Type / Landscape element	Topo-	Animal Species	Type of Sign	Age of Sign	Number of animals or sign	Human Sign				Notes (notes on observations, human activity)
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