
Population and Distribution of Elephants (*Loxodonta africana africana*) in the Central Sector of the Virunga National Park, Eastern DRC

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ABSTRACT

Savanna-dwelling elephants (*Loxodonta africana africana*) were observed almost continuously over a three-month period in April-July 1998 in the central sector of the Virunga National Park (VNP). There were two aims: first and foremost, to provide preliminary information on the status and distribution of Virunga elephants in the aftermath of the civil strife following the outbreak of the Congolese Civil War in October 1996, and second, to furnish the basis for planning detailed sample surveys in the future. Direct observations indicated that the central sector of the VNP supported between 486 and 535 elephants, ranging over about 2,400 km².

Based on dung counts, a mean density of 0.3 elephants km² was obtained. The distribution patterns and relative abundance of elephants are briefly discussed and results are compared with previous censuses in the early 1980s, and between 1990 and 1996. Based on this study the outlook for the Virunga elephant population appeared extremely positive. However, with the continued global demand for ivory, potential new markets springing up and easy financial rewards obtainable all accentuating poaching levels, the population's status remains a matter of significant concern.

RESUME

Les éléphants de savane (*Loxodonta africana africana*) ont été observés de façon quasi continue pendant trois mois d'avril à juillet 1998 dans le secteur central du Parc National de Virunga (PNV). Un double but a caractérisé cette étude, en tout premier lieu, fournir des informations préliminaires sur le statut des éléphants au regard de l'éclatement de la guerre civile congolaise en octobre 1996, et ensuite, de mettre sur pied la base pour planifier des études détaillées dans l'avenir. Les résultats de cette étude ont indiqué que le secteur centre du PNV détient une population estimée entre 486 et 535 éléphants et la population se déploie sur une étendue de 2 400 km².

Basé sur le comptage des crottes, une densité de 0.3 éléphants au km² a été obtenue. Les types de distribution et d'abondance relative des éléphants sont brièvement discutés et les résultats sont comparés avec les recensements antérieurs des années 1980, et entre 1990 et 1996. Tablant sur cette étude les perspectives pour la population d'éléphants apparaissent extrêmement encourageantes. Cependant, avec la demande globale d'ivoire, de nouveaux marchés resurgissant éventuellement, et le gain facile qui en découle incitant au braconnage, le statut de cette population reste toujours l'objet d'une grande préoccupation.

INTRODUCTION

This study was initiated as a result of a widespread concern among wildlife managers, scientists and the public that Virunga elephant populations had suffered adverse effects from the recent strife in the eastern part of the Democratic Republic of Congo (DRC). All the ingredients were there: the period saw a phase of agricultural encroachment, reduction in forest cover, and a marked and steady deterioration in law and order in the midst of tremendous political instability and economic turmoil. This in turn has taken a heavy toll on wildlife populations and dramatically clouded the future of many large mammals, including elephants. Since 1991 most available information on elephant numbers in the Virunga National Park (VNP) has been based on guesswork and has not provided a suitable basis from which to determine population trends over time, or to discern the effects of policy or management (Said et al., 1995). The study was therefore clearly recognized as important.

Historical trends in elephant distribution in the central sector of the Virunga National Park

An elephant survey in 1959 estimated numbers at 3,293 in the central sector of the VNP (Mertens, 1983; Delvingt et al., 1990), and elephants were considered to be 'fairly common to common' over much of their range throughout the Park. The elephant population declined from 674 to 621 (Delvingt et al., 1990; Verschuren, 1993) following drastic poaching that took place in the lawless early 1970s and 1980s. From 1970 onwards, the country underwent a major economic decline as the value of its primary product, copper, fell on the world market. Budget deficits, inflation, and foreign debts led to a decline in the capacity of government institutions, including the Institut Congolais pour la Conservation de la Nature (ICCN, formerly IZCN). Large-scale international traders encouraged African poaching, which was facilitated by the ease of obtaining firearms and ammunition, by apparent complicity between some park

rangers and the poachers, and by the reported immunity of the big buyers from prosecution because they enjoyed political protection (MacGaffey, 1991). Studies carried out by Mertens (1983) indicated that only about 631 elephants remained. A further decline occurred between 1988 and 1990 with estimates of 500 and 469 individuals respectively remaining, mainly localised in bushland, and frequently splitting into two or three important herds (Aveling, 1990; Delvingt et al., 1990; Verschuren, 1993).

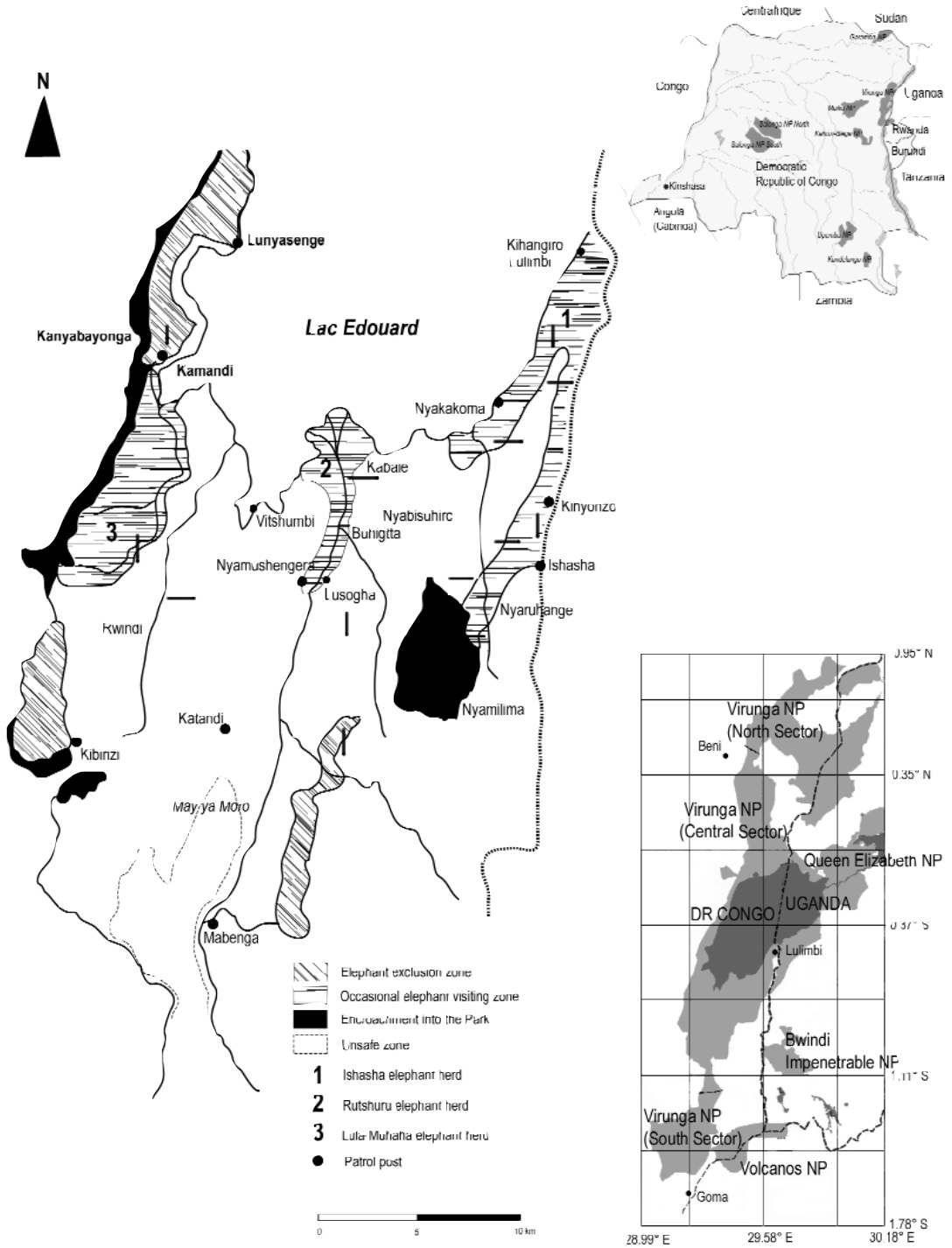
Throughout the 1990s, local and international conservationists struggled to stop the poaching of key species (elephant, mountain gorilla *Gorilla gorilla berengei*, hippopotamus *Hippopotamus amphibius*, buffalo *Syncerus caffer*). In some cases, despite facing heavily-armed refugees, anti-poaching patrols have partially controlled poaching and arrested both poachers and traders (Mubalama, 1999).

STUDY AREA

The survey was restricted to the central part of the VNP, which comprises the plains of Rwindi-Rutshuru-Ishasha and encompasses about 2,400 km², approximately 30% of the VNP's total area (Figure 1). It is an area of varied habitats including open grassland, grassland with thickets, thick bush, swamp, gallery forest and lakeshore, lying at an average altitude of around 1,000 meters. The region is well known for its spectacular scenery and its high levels of biodiversity. There are two headquarters in the central sector: Rwindi: 0°58'S, 29°19' E and Lulimbi: 0°31'S, 29°38'E. The Rutshuru River separates the Rwindi and Lulimbi sectors.

Along the Ishaha River the plains of Rwindi-Rutshuru-Ishasha are contiguous with the Queen Elizabeth National Park (QENP) in Uganda and together the two protected areas completely encircle Lake Edward (2,240 km²). They thus constitute 'transboundary' protected areas, physically and biologically linked, in which cross-border movements of elephant frequently occur.

Figure 1. Central sector of the Virunga National Park (DRC). Distribution patterns of elephant populations in the central sector of the Park and location of transects.



METHODOLOGY

Dropping count method

The spread of thickets and massive regeneration of *Acacia* species that followed the drastic reduction in elephant numbers to one sixth of its former size (Delvingt et al., 1990; Aveling, unpubl.) has led to poor visibility in the study site. A faecal census method was therefore used to determine abundance and relative densities of elephant populations.

I used a total of fifteen 2.5 km line transects to sample elephant dung. Because of the security situation in the region (several people were killed or wounded when travelling between Rwindi and Mabenga), the survey area was not stratified. Data were collected from two sample zones:

- 1) close to Rwindi and Lulimbi headquarters and existing and abandoned patrol posts (using different Virunga maps);
- 2) easily accessible areas close to gallery forest along the Rwindi, Rutshuru, Lula, Kasoso and Ishasha rivers. This sample zone was chosen because it was believed to be the eastern sub-population's dry season high-occupancy zone.

In general line transects were randomly placed within sampling zones (Norton-Griffiths, 1978). The distance along the transects and perpendicular distance were recorded for each elephant dung pile observed following the method outlined by Barnes & Jensen (1987) for censusing elephant populations. Foot surveys were carried out by a maximum of five observers using a 100 m string, a 50 m measuring tape and a compass. Unless an insurmountable obstruction was encountered, line transects were 2.5 km long and 10 m wide, and oriented at cardinal compass bearings from central points located across the surveyed area. Observer teams progressed along line transects at an average rate of 1.4 km/hr.

Along each transect, observers noted all elephant spoor, including dung piles, feeding and scratching sites, tracks etc. Only those dung piles that

could be seen from the line transect by the principal investigator or the field assistant were counted. In addition, distinctive indirect signs of elephants such as leaf stripping or de-barking of trees, breakage of main branches or trunks, and uprooting or pushing over of trees were recorded. Other data collected during the census included dominant vegetation species, evidence of human presence (including poaching) and spoor observations of all other large mammals, including hippopotamus, buffalo and antelope.

Elephant densities were calculated assuming a steady state system following the formula described by McClanahan (1986) and Barnes & Jensen (1987):

$$E = (Y * r) / D$$

where

E = Elephant density

Y = Dung pile density

r = Daily rate of dung pile decay

D = Defecation rate or number of dung piles produced per elephant per day

The daily rate of dung pile decay in VNP was measured during the study. Mean dung pile decay period was estimated as 61 days. Only four dung piles remained intact in the course of the survey ($r=0.025$, Mubalama & Sikubwabo, unpublished data). The data set that included one dry season sample and was based on 35 dung samples of known-age. Defecation rate was assumed to be 17 defecations per day (Wing and Buss, 1970).

Direct elephant counts by herd recognition and observation

In addition to the indirect method (dung count) used to determine elephant densities, a direct method was devised to estimate elephant numbers. For this purpose, field data collection forms were distributed at the VNP headquarters (Rwindi and Lulimbi) and patrol posts after intensive training sessions on data collection had been given to selected game scouts. One data

Photo credit: Sylvie Candotti



Photo 1. Virunga National Park, South Sector. View on Nyamulagira volcano.

form was completed by game scouts when actively patrolling while another was completed at the headquarters and/or patrol posts when game scouts saw elephants from their camps. At the end of each month, data were centralized at Rwindi and Lulimbi headquarters, and provided considerable insight into elephant movements in the study area.

The Lulimbi headquarters and Kinyonzo patrol post bordering Ishasha River, where herds of elephant frequently came to drink, were selected as research bases, and often served as good observation points. Apart from some interruptions when I had to be away from VNP, I patrolled the Park almost daily trying to locate elephants. With the exception of the Kasali mountain area dominated by *Olea europea ssp africana* woodland where security was a matter of concern, patrols were organised to ensure as complete a coverage as possible. Most parts of the Park were entered every month.

Herd composition counts were made by walking to different areas on consecutive days. Individuals were classified, where possible, following Hanks' (1979) criteria for ageing (Moss, 1988): old adult (30-60 years); younger adult (15-30 years); sub-adult (10-15 years); juvenile

(3-10 years); calf (1-3 years); under one year (< 1 year). On the strength of continual observations by the end of the study we were able to identify the three most important elephants herds and their preferred and occasional ranges (see Figure 1).

RESULTS

Elephant distribution and abundance

Estimated elephant densities were higher in the Lulimbi plains and plateau (0.38 per km²) than in the Rwindi area (0.20 per km²) (Table 1). Lulimbi accounts for about two-thirds of the total area occupied by elephants in the central sector of the VNP.

In April-July 1998 elephants occupied a fairly restricted range in the Rwindi-Rutshuru-Ishasha plains. Surveys revealed general population movements but may have missed important details, including long-distance movements of small numbers of elephants that have been recorded after particularly good rainy seasons. The presence of a few individually recognizable elephants enabled us to monitor individuals to a limited extent, but most were rarely seen more than three to five times. One group of two, a

Table 1. Calculated dung and elephant densities / km² in the central sector of the Virunga National Park.

Transect Location	Length of transect [km]	No. of 0.25 km segm. with dung	Segments with dung [km]	Segments with dung [%]	Dung density per km ²	Elephant density per km ²
Rwindi	10	10	2.5	7.5	138	0.20
Lulimbi	27.5	123	30.75	92.4	256	0.38
Total	37.5	133	33.25	99.9	-	-
Mean	-	-	16.6	-	197	0.29

r=0.025

female with an infant, and one group of five, two females with two infants, and one adult bull were however seen repeatedly over a period of 6 months from December 1997 to June 1998.

In addition, other family groups of 12 and 8 individuals as well as a lone elephant appeared to have been resident in the open short grass Lulimbi plains for short periods. However during most of the study they preferred thick bush, bushed grassland and gallery forest with easier access to water. Overall I recorded a total of 486 elephants, giving an estimated population size of between 486 and 535 for the central sector of the VNP (assuming a possible 10 % undercount).

The distribution of the main herds (see Figure 1) can be summarised as follows:

- 1) The "Ishasha herd" inhabiting the eastern part of VNP consisting of approximately 175 individuals, often split into two sub-groups. One "peripheral" group was frequently found to the north of Lulimbi headquarters near Lake Edward whilst the other moved in almost co-ordinated fashion towards the southern Ishasha area and was reportedly involved in shamba crop-raiding.
- 2) The "Rutshuru herd" comprising about 140 individuals, moving mostly between the Rutshuru delta and Nyabushi along the Rutshuru river where they were attracted to lush and abundant *Phragmites mauritanica* vegetation. Although both banks of the Rutshuru river were used by the same elephant community, individuals on the western bank seemed under considerably more stress, due presumably to the recent upsurge in poaching perpetrated by Mayi-Mayi fighters as well as military forces (Mubalama, 1999).
- 3) The "Lula-Muhaha herd" of about 65 elephants was frequently observed feeding on Pennisetum purpureum grass as well as *Coccinia grandis* and *Citrullus lanatus*, and was often found around the Tchanika swamp edges and lakeshore.

Table 2. Estimated elephant populations in Rwindi and Lulimbi areas (August 1998).

Area	Adults		Young		Total count		Observations
	Number	%	Number	%	Number	%	
Rwindi	144	73.8	51	26.2	195	100	Elephants wary
Lulimbi	188	64.6	103	35.4	291	100	Two herds freq. seen

Photo credit: Sylvie Candotti



Photo 2. Law enforcement office - Runangaba Field Station, Virunga National Park.

In general, social organisation was matriarchal with an old female leading the group, which consisted of her offspring and included males up to puberty and females of all ages. Other groups were interpreted as “extended family units” containing sub-groups led by mature females presumably after their mothers had died (Douglas-Hamilton, 1972; Laws et al., 1975). The group units varied in size from 10-20 individuals while mean ‘family unit’ size was 4.7. The mother-offspring unit was by far the most frequent family unit. One striking result was the tendency of elephant families to clump into herds of 100-200 individuals, a phenomenon also reported by Muhindo (unpubl.).

DISCUSSION

Although elephants were undisturbed during this study and were sometimes seen moving slowly, herds were usually bunched very tightly forming a huge grey wall of elephant hide. Two years or so before this study, gunshots were frequent in the VNP, and I suggest that the large herds observed had formed in response to poaching. Disturbance by illegal hunting results in elephants adopting a more compressed distribution in safe areas and therefore aggregating in larger groups (Eltringham, 1977). Poaching activity has been suggested as a key external factor

determining differential use of habitat elsewhere (Douglas-Hamilton, 1987).

Despite evidence indicating that in the very recent past elephants were far more widespread in the Rwindi-Rutshuru-Ishasha plains (Mertens, 1983; Mubalama, unpubl.), elephant movements were rather small, on the order of 10-20 miles, and communities localised. No convincing evidence of large-scale migration was observed, other than one isolated observation that was regarded as an extension of the usual erratic displacement movements rather than a true migration. Elephant movements tended to be directed towards Lulimbi where the greatest concentration of elephants occurred, feeding on *Cyperus articulatus*, *Sporobolus consimilis*, *Carissa edulis*, *Capparis tomentosa*, *Acacia sieberiana*, *Coccinia grandis*, *Citrullus lanatus* and *Maerua mildbreadii*. Movements towards the Rwindi area were shorter and elephants did not appear to get very far beyond the Rutshuru and Muhaha rivers where a high density of well-defined but abandoned elephant trails were noted. Elephants also spent substantial time feeding in fairly dense *Cyperus articulatus* swamps, *Croton macrostachyus*, *Kigelia pinnata* and *Pterygota mildbreadii* gallery forest (Rutshuru and Ishasha rivers) as well as ambatch tree *Aeschynomene elaphroxylon* woodland and *Phragmites mauri-*

Photo credit: Leonard Mubalama



Photo 3. A lone aggressive bull elephant crossing the Ishasha river and setting off for the neighbouring Queen Elizabeth National Park in Uganda.

tanica lakeshore swamp. They were difficult to observe in these habitats. Elephant movements in these habitats were routine and very predictable (Abe, 1992).

Elephants were not seen in some areas of VNP, including the southern sector of Kibirizi and the steep rocky slopes of the Mitumba mountains between Lunyasenge patrol post and Tumbwe River. This distribution pattern was almost identical to that observed by Verschuren (1993).

During the 1995 survey (Mushenzi, unpubl.), the army and Mayi-Mayi fighters were frequently seen to kill hippos, buffaloes and antelopes with automatic weapons and on several occasions, persistent shots were heard in the Park (Plumptre et al., 1997). Five tusks weighing on average 9 kg were recovered. Remains of 117 buffaloes and antelopes and a mound of hippo carcasses too numerous to count were recorded during this study. I did not find any flesh-covered carcasses of elephant calves. Two elephant tusks were collected by game scouts in the Lulimbi area but the cause of death was not clearly ascertained. All skeletons observed were at least two to three years old according to Jachmann's (1988) ageing estimation, indicating that very few elephants died as a direct result of the recent conflicts since belligerents involved, including Mayi-Mayi, obviously targeted other large to medium-sized terrestrial animals (Mubalama, 1999). This sur-

prising result strongly contrasted with previous rumours of heavy elephant poaching.

A direct counting method is not a foolproof one, especially in a study area of relatively broad-leaved woodland, and it is possible that total elephant numbers may be higher than counted. In addition, with shy and elusive animals often taking cover in secluded areas before they could be counted, the portion of the population hidden in gallery or clump forest at any one time may be large, thus influencing the accuracy of counts. Some of the problems experienced might have been overcome through the use of aerial surveys, although these may be limited by financial (e.g. prohibitive cost of an ultra-light aircraft) and political constraints.

Mean elephant density has decreased as compared to 1.04 elephant / km² found by André (unpubl.) just before the outbreak of the recent hostilities. However, baby elephants appeared to be common during the study period (Moss, 1988), but the big question remains why this current baby boom and what are the trends?

I estimated the carrying capacity of the central sector of the Park to be between 1,000 and 1,200 elephants with an average of 0.5 elephant per km², based on Pfeffer (1989). Given the present population, the central sector of VNP could probably support another 565 elephants and it is

conceivable that the population could reach these levels by about 2020, assuming that full protection over the whole area is provided, and that the recruitment and population growth rate of between 7-10 % per year in favourable conditions (Pfeffer, 1989) is maintained.

Future threats to VNP elephants

The reduced law-enforcement operations maintained by ICCN with the collaboration of Forces Armées Congolaises (FAC) were still having a slight positive effect: some poachers were arrested, and some ivory and some AK 47s were recovered by joint patrols. However, there was little evidence of substantial anti-poaching support from the FAC, the police or the administration. Although law-enforcement staff numbers have been increased, budgets for wildlife protection have plummeted and morale among park staff had become severely eroded to the point that, in some cases, game scouts and rangers depended on kickbacks from illegal activities in order to survive. While such behaviour may be understandable it remains totally unacceptable. There is thus a crucial need to improve the motivation of the poorly paid wildlife staff to boost their morale and put teeth into wildlife law-enforcement. The poverty of the rural population on the periphery of the Park, the present lack of

knowledge of elephant dynamics and behaviour, the ineffectiveness of the national wildlife service, and corruption with poorly paid game staff being susceptible to bribery (Barnes et al., 1995) could all potentially facilitate poaching.

Despite the fact that there were about 250 active game guards assigned in Rwindi and Lulimbi sectors of VNP, deployment of game staff has always presented logistical problems (Hart & Hall, 1996). Although average guard densities were around one guard per 10 km² (above the level recommended by IUCN) most of the game staff were inadequately armed with old service rifles (muzzle loading guns), usually with no more than two rounds of ammunition each, no match against groups of heavily armed poachers. Many non-functioning weapons continue to be carried by game guards in an attempt to sustain the desired image. However, most poachers were aware of the reality and not surprisingly showed scant respect for the rangers.

Four large fishing villages (Vitshumbi, Kyavinyonge, Nyakakoma and Kisaka) within the VNP with more than 40,000 inhabitants were expanding in contradiction of the laws governing Congolese protected areas. The Park provided them with spare arable land, clean water, construction materials and fuelwood (Mubalama,

Photo credit: Leonard Mubalama



Photo 4. A handsome close unit group forming a huge grey wall of elephant hide and pricking up its ears at the slightest sound of steps in the safety of the thick grove of *Capparis tomentosa*, VNP, DRC.

1995). People from these villages were chopping down trees, over-exploiting the fish stocks of Lake Edward and hunting animals. This has inevitably resulted in a critical 'hard-edge' effect on the Park's boundaries. With human population pressure increasing and elephant range shrinking across the VNP, creative solutions are required to this problem as the further spread of villages and agriculture on the periphery of the Park will undoubtedly increase competition between men and wildlife for land.

CONCLUSIONS AND RECOMMENDATIONS

Elephant numbers in the central sector of the VNP have declined drastically since 1959, but there is strong evidence that the population is now increasing despite persistent gloomy rumours about their fate following the recent mass die-off event of wildlife and the drastic reduction in wildlife range. If protection remains adequate or improves, the future of elephants in VNP seems assured for the next decade, especially in the framework of the recently initiated United Nations Fund for the World Heritage Sites in DRC.

It is however unclear how elephant status and distribution will change over the forthcoming decades given the obvious continuing tension in the Great Lakes region. Evidence from certain southern elephant range states suggests that there is still sufficient incentive to poach elephants (Dublin et al., 1995, Leader-Williams, 1996). Therefore, long-term efforts for the conservation of the central Virunga elephants and their habitat are more than ever required.

In conclusion, I stress that these results are preliminary and my hypotheses should be regarded as tentative. Continued data collection will help elucidate patterns and provide a better data set to compare with other elephant populations elsewhere in Africa. For a clear understanding of the social organisation of the Virunga elephants, long-term observations, combined with a thorough knowledge of most individuals in the population are absolutely necessary. How elephants use their range in the entire VNP and how they

interact with varied habitats remain open questions. Understanding the ecological scales of ecosystem dynamics in conservation areas is fundamental to the conception of appropriate policies (Waithaka, 1997).

It is imperative that in-depth research continues as an essential monitoring service. The impact of poaching on the stability of the family social structure of elephants should also be investigated, since it is vital to know the population's age structure in order to understand its dynamics. Such a study requires competent and consistent identification of all individuals and groups and should be a clear research priority. A radio-tracking programme with aerial monitoring support covering the whole of the VNP is required.

This study clearly emphasised the need for co-ordinated surveillance and research efforts in the VNP and the QENP and across international borders. In the same way, an elephant monitoring programme in the southern sector of the VNP could be performed and tied in with the International Gorilla Conservation Programme (IGCP) mountain gorilla census years.

Late and irregular payment of salaries should be solved under a new operational budget system proposed by the United Nations Fund. As additional conservation funding opportunities present themselves and tourism activities resume, wildlife staff should be provided with a performance-related salary. Meanwhile, the only current measure possible under today's harsh conditions is to exhort the game guards, in writing, to increase their efforts.

In the longer term, new equipment is required, including uniforms (different from the ones worn by military forces to avoid confusion), bullet-proof vests, boots, 4WD vehicles equipped with VHF mobile radio, speed boats, communication means (hand held VHF for foot patrols), camping gear, sleeping bags, rucksacks, rain-coats, etc. Run-down or abandoned former patrol posts which are not contributing to field operations need to be rehabilitated, including Ruti, Nyamitwitwi, Tchanzerwa/Busesa, Taliha, Lunyasenge, Mosenda, Muramba etc.

In order to improve anti-poaching performance, the Kabaraza elephant law-enforcement unit should be rehabilitated as a Strike Force whose efficacy will depend on good communication and mobility. This force should mount armed patrols throughout the Park on an unpredictable basis, and provide a rapid response unit to reports or calls for assistance forwarded by the various park headquarters. The unit should be properly armed and supplied with adequate ammunition to ensure that it is at least on an equal footing or better with poachers.

These recommendations could, at a relatively low cost, steer future work into effective channels to help in establishing a Virunga elephant management plan that integrates ecological management with the needs of the local people. I believe that the approach suggested above should reduce the great deal of strain in the relationship between park staff and local people. The VNP remains the showpiece of the ICCN and there is now an opportunity to manage Virunga elephants once more as a viable wildlife keystone species. The goal of conservation within Congolese policy should be to strive to maintain the VNP as a protected area where ecological processes can continue with minimum human influence: a goal worth striving for as we enter the twenty-first century.

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