CHAPTER 3

Biodiversity conservation and management

Corinne Maréchal[1], Valérie Cawoy[2], Christine Cocquyt[3], Gilles Dauby[2], Steven Dessein[3], Iain Douglas-Hamilton[4,5], Jef Dupain[6], Eberhard Fischer[7], Danielle Fouth Obang[8], Quentin Groom[3], Philipp Henschel[9], Kathryn J. Jeffery[10,11], Lisa Korte[12], Simon L. Lewis[13], Sébastien Luhunu[14], Fiona Maisels[11,15], Mario Melletti[16], Roger Ngoufo[17], Salvatore Ntore[2], Florence Palla[18], Paul Scholte[8], Bonaventure Sonké[15], Tariq Stevart[3], Piet Stoffelen[3], Dries Van den Broeck[3], Gretchen Walters[14], Elisabeth A. Williamson[11]

[1]ULg, [2]ULB, [3]NBGB, [4]Save the Elephants, [5]University of Oxford, [6]AWF, [7]University of Koblenz-Landau, [8]GIZ, [9]Panthera, [10]ANPN, [11]University of Stirling, [12]Smithsonian Institute, [13]University of Leeds, [14]IUCN, [15]WCS, [16]University of Rome, [17]University of Yaoundé I, [18]RAPAC

1. Introduction

Since the first edition of the State of the Forest (SOF), the state and conservation of biodiversity have been a continuing concern. Every subsequent edition has reviewed the threats to the fauna and flora of the subregion. In 2010, the subject was presented in a chapter entitled "Biodiversity in the forests of Central Africa: panorama of knowledge, principal challenges and conservation measures" (Billand, 2012). By devoting a new chapter to this subject, the SOF 2013 reaffirms the importance of biodiversity and the protection of species for the sustainable development of the forests of Central Africa.

The present chapter is not a monograph of the current situation; it makes no claim to be an exhaustive treatment of the biological diversity of Central Africa. Rather it follows the panorama drawn earlier while highlighting additional knowledge acquired and the tools available to follow the changes of the biodiversity and to facilitate its management. It also addresses some topical questions and recent experiences with the management/conservation of animal and plant biodiversity.

The first part of the chapter, which is particularly innovative, describes the available methods for estimating biodiversity in the forests of Central Africa. The first section concerns the large mammals, including most of the emblematic species; it then presents methodologies for evaluating plant diversity.

The second part presents the status of a number of emblematic species. It provides the most recent information on the critical status of elephant and great ape populations. After reviewing the state of knowledge of plant diversity, this sec-

Photo 3.1: INERA forest department herbarium – Yangambi, DRC

tion also describes the problems of invasive species through examples of the small fire-ant in Gabon and Cameroon, and the invasive plants in Sao Tomé. Surprisingly, this threat to the ecosystems of Central Africa has so far been given little attention by conservationists.

Several biodiversity tools and approaches are presented in the third and fourth parts. Attention is focused, *inter alia*, on the fundamental role of herbaria for the knowledge, conservation and management of plant biodiversity. A preliminary review of the trans-boundary protected area initiatives is presented, following the conservation measures described in SOF 2010. Lastly, Central Africa continues to be confronted with the extensive and indeed resurgent phenomenon of poaching and trafficking in animal species. Considerable attention is therefore given to the challenge to combat poaching. This question is addressed transversally in the last two chapters, which highlight concerted multiple action programs being developed in the region, including cross-border management

2. The methods of evaluating biodiversity in the forests of Central Africa

Box 3.1 : Assessment of the status of large mammals: some definitions

The terms "inventory" and "census" are often used equally in studies quantifying central Africa's large mammals. These exercises help document the abundance and distribution of living species in a given location at any given moment. Monitoring is a process which incorporates a time-related or temporal aspect ; the change in numbers over months and years, is examined. In general, the monitoring of fauna supports the management of the targeted species and of their habitat. The monitoring serves to evaluate management efficiency, identify zones confronted with conservation issues and to observe seasonal migrations or movements of species, etc.

2.1. Evaluation of large fauna

Monitoring wildlife is a fundamental requirement for guiding the management and conservation of species and their habitat. The presence of large-bodied mammal species with relatively slow reproduction rates combined with the intensity and distribution of human activities are two commonly used indicators for ecosystem health (Alstatt *et al.*, 2009 ; Atyi *et al.*, 2009). Generally, monitoring the status of large fauna first determines their population abundance and distribution, then identifies and prioritizes the factors which may impact their abundance and distribution in the future (generally threats). These factors are monitored for trends across space and time (IUCN/SSC, 2008).

2.1.1. The customary methods : distance sampling and reconnoitering

Distance sampling and reconnoitering on foot (recce) are the two most commonly used techniques to evaluate wildlife populations in the dense forests of Central Africa. Recces are based on the direct observation of the animals or, more generally, on monitoring the traces of their activity (footprints, droppings, nests, remains of meals, etc.). In distance sampling, only the droppings or nests (of great apes) are taken into account. We will give only a summary description of these two methods as they are described in detail in the reference work by White and Edwards (2000).

Customarily, distance sampling is applied along linear transects. One or more tracks are opened through the vegetation in a specific direction. Then, all observations of each dropping and each nest are counted along the track and the perpendicular distance of each observation in relation to the axis of progression is measured. The total number of animals present in the sample zone (known as absolute density) is then estimated on the basis of modeling the probability of detection of observations along the transects, the effective area covered (total length of transects x effective width of the transects), and the rate of production and degradation of the said observations (droppings or nests) according to site and season[7]. Distance sampling is considered by the scientific world as the reference method.

The theoretical basis for this method and some extremely useful field advice is described in detail in Buckland *et al.*, 2001 and 2004. The software program DISTANCE, which is available on the CREEM (Centre for Research into Ecological and Environmental Modelling) website (http://www.ruwpa.st-and.ac.uk/distance), is used both for the sampling design and for the analysis of the results (Thomas *et al.*, 2010).

Recce does not include the variability in detecting the animals. This method consists simply of noting the observations while travelling in an approximate direction on pre-existing tracks (footpaths, animal paths, etc.). The data collected are similar to those of data sampling but without measuring the perpendicular distance of the observation. These data are converted into an abundance index ("kilometric abundance index" or "encounter rate"), which may indicate temporal changes in a specific animal population.

2.1.2. Innovative methods: genetic estimation and camera trapping

New techniques for evaluating animal populations are in development; they include genetic estimation and camera trapping, which are adapted to rare, nocturnal or particularly discreet species. Genetic counting methods have been successfully used for small populations of forest elephants in Ghana (Eggert *et al.*, 2003), Asian elephants in Laos (Hedges *et al.*, 2013), great apes in Gabon (Arandjelovic *et al.*, 2010; Arandjelovic *et al.*, 2011) and gorillas in Uganda (Guschanski *et al.*, 2009) and in the Virunga mountains (Gray *et al.*, 2013). The method requires the prior establishment of the genetic profile of the animals on the basis of their DNA gathered on the ground (droppings or hairs). The results of the DNA analyses of the materials collected are then introduced into a mathematical capture-recapture (C-R) model which estimates absolute density. These results can also serve to construct accumulation curves for newly identified individuals.

Camera trapping consists of taking pictures of animals with cameras which are activated by infrared means (photo 3.2). A C-R model then makes it possible to calculate absolute densities for species which have characteristics enabling each individual to be identified, for example, the bongo in Congo (Elkan, 2003) and the Virungas National Park (Nixon and Lusenge, 2008), the leopard in Gabon (Henschel, 2008) or the elephants in the forests of Asia (Karanth and *et al.*, 2012). The development of spatially explicit capture-recapture techniques (SECR) now allows the robust estimation of animal density; this can also be used for unmarked animals (e.g. Chandler & Royle, 2011). For these unmarked animals, which are the majority of the species usually monitored in the Central Africa region (such as ungulates, apes and elephants), occupancy models (in which traps, transects, and surveys by independent observers can be treated as repeated observations for a local sample area) can also be used (O'Connell, 2011). Finally, a combination of remote video trapping, SECR and other methods has recently been successfully used for great ape and elephants in Gabon (Head *et al.*, 2013).

Photo 3.2: Installation of a photo trap for the study of African golden cat (Caracal aurata), south of the Ivindo National Park, Gabon

7. Given that it is impossible to count all the animals (or all traces of animals) of a given animal population or of an area, the census statistics (the number of animals or traces of animals actually recorded in a study) may be used to deduce an estimate of the population. The abundance of a particular species in a given area is then calculated by dividing the count statistic by the probability of detection of an animal or trace of an animal (for example, Nichols and Conroy, 1996) (MacKenzie *et al.*, 2006). The statistic count may also be determined from the number of animals captured, photographed or otherwise identified during capture-recapture studies (for example, Otis *et al.*, 1978), or the number of plots where an animal (or sign of an animal) has been detected through sampling of occupation of the plots (MacKenzie *et al.*, 2006).

2.1.3. Other available techniques

Other techniques exist within a context of more specific intervention. For example, counts by means of sweeps (complete coverage of a survey zone in order to detect all animals, or their signs, present there) (McNeilage *et al.*, 2006; Gray *et al.*, 2010) and the monitoring of animals accustomed to the presence of humans (Kalpers *et al.*, 2003; Gray and Kalpers, 2005) have been specially developed for great apes and a few other primates. The appeal technique (van Vliet *et al.*, 2009) or village surveys (van der Hoeven *et al.*, 2004; van Os, 2012) have tended to be used for the management of species of game in a hunting area. Interview surveys are also useful precursors for standardised field surveys (Meijaard *et al.*, 2011).

The range of counting methods is therefore broad (Maréchal, 2011). The choice of a suitable method depends on many factors: species targeted purposes of the study (management objectives, type of results anticipated, desired accuracy of estimates), field conditions (size of site, means available) (table 3.1). In a strict conservation context, this choice can be made using the decision tree proposed by proposed by Strindberg and O'Brien (2012).

Table 3.1: *Counting methods according to species of large-bodied mammals, level of expertise required and scale of application*

Method	Species target	Level of expertise required (knowledge, skills, necessary practices)	Area of application
Linear transect	***	+++ Navigation in forests, reconnoitering of signs and species, statistics for preparation of regulations for the study, analysis and interpretation of results, distance sampling	# to ###
Recce	***	++ Navigation in forests, reconnoitering of signs and species, statistics for preparation of standards for the study, analysis and interpretation of results	# to ###
Genetic counting	*	+++ Navigation in forests, statistics for preparation of standards for the study, analysis and interpretation of results, precautions for the storage of DNA, genetic analyses, C-R analysis	# to ###
Camera trapping	* or **	++ to +++ Handling photos, statistics for preparation of standards for the study, analysis and interpretation of results, C-R analysis and SECR	# to ###
Sweeps	* or **	++ Navigation in Forest	#
Monitoring accustomed animals	*	++ Individual reconnoitering of animals	##
Calling technique	** (duikers)	++ Competence of the caller, statistics for preparation of standards for the study, analysis and interpretation of results	#
Village survey	***	++ to +++ Interview techniques, cartography, statistics for preparation of standards for the study, analysis and interpretation of results	## to ###

Species targeted: *: only one species; **: a taxa or group of species; ***: all large-bodied mammals.
Level of expertise required: +: basic (basic knowledge of the forest); ++: medium (a particular skill); +++: confirmed expertise (several areas of knowledge/particular skills).
Scale of application: #: a few thousand hectares (a sector of a forest); ##: several tens of thousands of hectares (a forest concession, for example); ###: several hundreds of thousands of hectares (a massif).
Adapted from Maréchal, 2011

Box 3.2: Fauna censuses in forestry concessions

Corinne Maréchal
University of Liege

For 10 years or so now an increasing number of mammal censuses (large and medium-sized species) have been carried out in the logging forests of Central Africa. This is a result of the growing commitment of logging companies to the process of sustainable management, and also to the laws and regulations which now require them to take wild animals into account in the concessions allotted to them (Billand, 2010).

Under these laws, management standards and certification requirements, the animal population censuses in the concessions essentially serve (a) to provide the basis for the zoning plan delimiting sectors of protection and preservation, and (b) to evaluate, and thereby reduce the impact of logging (primarily from hunting) on animal species (Maréchal, 2012).

A 2011 study by the University of Liège, financed by CIFOR, reviewed the practices used to census wild animals in logging forests. To that end, 75 projects concerning some 60 forestry concessions were analyzed (Maréchal, 2011). The methods used to evaluate the fauna potential in logging forests are fairly similar to those used in forests intended for conservation. The most widely used methods are "distance sampling", "recces" on foot or a combination of the two (recce-transect). However, procedures appear to vary widely from one site to another, particularly regarding the collection of field data, the processing of results or the presentation of distribution maps.

This situation results from a lack of standardized operational procedures for evaluating the resource. In fact, even the most advanced management regulations say very little about the method of collecting and analyzing data on animal populations, while sustainable management procedures do not specify the variables to be measured on the ground for evaluating fauna.

It would therefore appear necessary to standardize the procedures for the evaluation and monitoring of large-mammal populations in forestry concessions management plans. Ideally, a new methodological framework should be developed, specially adapted to the particular context of industrial forestry, which should include the exploitation strategy, management objectives (including fauna), available skills, and the economic and logistical constraints particular to the concession. For this purpose, proposals have been made by Maréchal *et al.* (2011).

2.2. Evaluation of Flora

2.2.1. Contribution of forest inventories in concessions

One of the difficulties in studying the biodiversity of tropical forests, and hence defining priority areas for conservation, is obtaining good-quality field data at reasonable cost. In the context of the USAID/CARPE program (carpe.umd.edu), the Missouri Botanical Garden (MBG), the *Université Libre de Bruxelles* (ULB) and the Wildlife Conservation Society (WCS) have collaborated over four years to assist logging companies in identifying, within their concessions, suitable areas for conservation. The methodology which was evolved has subsequently been applied in several logging concessions in Gabon (Stévart and Dauby, 2011).

The forest inventory data are used to classify the principal habitats. However, these data are less precise than those collected by scientists, notably in terms of taxonomic identification, especially for rare species of trees and ground vegetation and,

Photo 3.3: Explosion of greenery in the understory of a Bas-Congo woodland – DRC

to a lesser extent, for non-commercial species. In order to minimize this bias, however, statistical methods that attach little weight to rare species (Rejou-Mechain *et al.*, 2010) make it possible to characterize the spatial variation of the various flora and to define a forest typology. This typology can be more precisely defined by targeted and more complete inventories, including additional data on flora, notably for endemic species.

Tested for the first time in Gabon on the Sylvafrica inventories in the concessions of the Rimbunan-Hijau – Bordamur group (Stévart and Dauby, 2009), this approach has enabled the identification of rare types of vegetation and other important requirements for large-bodied fauna. The recommendations subsequently issued were useful to Sylvafrica in formulating the development plan.

2.2.2. Example of permanent plots

A large complex of over 250 permanent plots with an area of between 0.2 and 50 ha and covering a total of approximately 500 ha has been established in tropical Africa in order to monitor and study vegetation (Picard and Gourlet-Fleury, 2008 ; African Tropical Rainforest Observation Network : afritron.org ; etc.). In these plots, all trees with a diameter of more than or equal to 10 cm (at 1.3 m above the ground or at 30 cm above the buttresses) were identified and georeferenced. In general, each tree is marked with paint or identified with a metal label to ensure their long-term monitoring.

These permanent plots are an essential tool in the study of the dynamics of forest stands. They also make it possible to study the processes at the origin of plant diversity and its probable past, present and future distribution, notably in the context of climate change. In addition, they help to answer questions about the impact of forest fragmentation on the distribution and abundance of plant species and the quantity of biomass stored in the various types of forest in forests with strong biodiversity or strong endemism. (see box 3.3 : Integrating ecological knowledge in management decisions : the contributions of the CoForChange project).

3. State of biodiversity in the forests of Central Africa

3.1. Current status of some emblematic mammals

Ideally, the protected areas should serve as cores of conservation and protection of large African fauna. They should be protected by effective teams and serve as a model for managing fauna over the long term. But numerous studies show the decline, even the collapse of large mammal populations (primates, elephants, antelopes, etc.), including within protected areas (Caro and Scholte, 2007 ; Craigie *et al.*, 2010 ; Bouché *et al.*, 2012).

The direct causes (proximate drivers) of this phenomenon are well known : poaching mainly and changes in land use (notably farming clearings). But among the deep-rooted causes (underlying drivers) will be found the ineffective management of the protected areas (Scholte, 2011).

3.1.1. Update on the illegal killing of elephants

Since 2002, the MIKE program (Monitoring the Illegal Killing of Elephants) of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) has been monitoring, in 15 protected sites in Central Africa[8], the illegal killing of elephants (a "vulnerable" species on IUCN's "red list", except for the forest elephant sub-population considered to be "in danger"). MIKE mainly collects data relating to elephant carcasses found in the field and calculates the PIKE index (Proportion of Illegally Killed Elephants), which is the number of illegally killed elephants as a proportion of the total number of carcasses counted (Burn *et al.*, 2011).

8 Boumba Bek and Waza in Cameroon, Bangassou, Dzanga Sangha and Sangba in CAR, Nouabalé Ndoki and Odzala-Kokoua in Congo, Lopé and Minkebé in Gabon, Garamba, Kahuzi Biega, Okapi Faunal Reserve, Salonga and Virunga in Democratic Republic of Congo and Zakouma in Chad.

Box 3.3 : Integrating ecological knowledge in management decisions : contributions from the CoForChange project

[1]Sylvie Gourlet-Fleury, [2]Adeline Fayolle
[1]CIRAD, [2]ULg

CoForChange is a project co-financed by the European Union, the National Research Agency (France) and the Natural Environment Research Council (UK).

A multidisciplinary team of researchers and forest engineers from eight public and private European institutions and four European countries in association with five African institutions, one international institution and 14 logging companies, (see list on http://www.coforchange.eu) collaborated from 2009-2012 on the GoForChange project. This multidisciplinary project set out to explain and predict possible future diversity of the humid tropical forests of the Congo Basin, and to propose tools to assist in decision-making for improved management of these forests which are subjected to increasing climatic and anthropogenic pressures. The project focused on a region of approximately 20 million hectares covering southwest RCA, south-east Cameroon and the northern Republic of Congo.

The project produced many results, some of which have major implications for forest planning and the conservation of forest ecosystems.

The integration of a large quantity of spatial information; geological maps, topographical SRTM data (Shuttle Radar Topography Mission), METEOSAT climate data, MODIS data (Moderate Resolution Imaging Spectroradiometer), vegetation activity, and zoning data supplied by partner forest companies has highlighted the influence of the geological substrate on the distribution of tree species and, more generally, on the floral and functional characteristics of forest populations (Fayolle *et al.,* 2012).

In particular, the sandstone substrates and to a lesser extent certain alluvial substrates upon which sandy soils have developed (RCA and north Congo) contain diversified forests composed of evergreen species that tolerate shade, grow slowly and are of dense wood. The pedologogical, anthracological (the study of conserved coal in sediments) and archeological findings demonstrated that these forests had not been disrupted by man and were probably ancient. Conversely, on the granite and schist substrates where richer soils have developed there are also diversified forests but composed of deciduous species whose canopies are prominently fast-growing heliophilic species, composed of average to low density wood. There are signs that these forests have been disturbed by man, especially where “ayous” (*Triplochiton scleroxylon*) species are observed. Most anthropogenic disturbance occurred in current *marantaceae* forests (Ouesso, north Congo region). The study of carbon isotopic profiles revealed that these forests, which are today very open, were not initially savannah but actually degraded forests that had been invaded by giant herbaceous plants, most likely because of a resurgence of human activity in the region beginning about 500 years ago.

A controlled environment study of the ecological requirements for principal tree species showed that these species were particularly resistant to drought at the “juvenile” stage, with the exception of certain pioneers such as the parasolier (*Musanga cecropioides*). This result is supported by studies carried out in the adult stages within the Mbaiki region in RCA.

The project proposed a new forest typology for the study region and completed an initial diagnosis of forest resilience to human and climatic (drought) impacts. These diagostic methods could be extended to other forests in the region, using the methodology suggested by CoForChange. This general assessment would be useful for planners who decide on priority zones for timber production and conservation. (it is better to produce where the soils are rich and the forests productive) and for logging managers (productive forest plantations can support a more dynamic silviculture than that currently practiced).

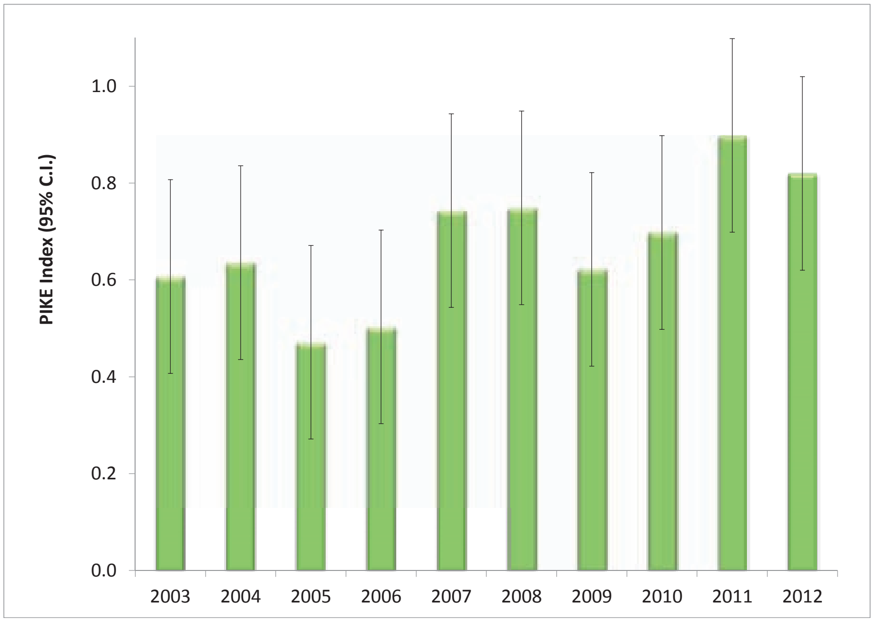

Figure 3.1 : Evolution of the PIKE index in Central Africa between 2003 and 2012 (confidence interval 95 %).

Source : CITES's MIKE program

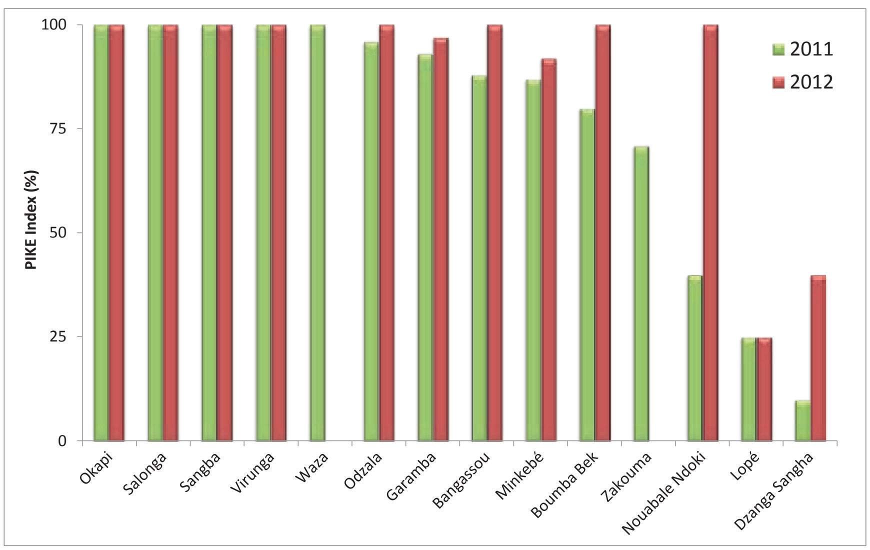

Figure 3.2 : PIKE values at the various MIKE sites in 2011 and 2012.

Source : MIKE's program Central Africa

Between January 2003 and June 2012, out of 2 175 carcasses counted, PIKE revealed two opposing trends : a decline in illegal killing between 2003 and 2006, and an increase up to 2011-2012 (figure 3.1).

Given that with a PIKE index of over 0.5 an elephant population is probably already in decline[9], it is apparent that the level of illegal killing was very high in the first half of 2012, with an average PIKE index of more than 0.7. In 2011, the situation was already serious as all the MIKE sites showed a PIKE index close to 100 %, except at Dzanga-Sangha, Lopé, Zakouma and Waza (figure 3.2).

Poaching is not confined to the MIKE sites, as was confirmed by the massacre in 2012 of 200 to 400 elephants, according to sources, in the Bouba Ndjda National Park in the north of Cameroon and of 30 more at Wonga Wongue in Gabon and in the region of Mayo-Lémié/Chari-Baguirmi in Chad.

These trends are confirmed by :

The ETIS program data (Elephant Trade Information System) run by CITES[10], which records ivory seizures in countries of destination ; these confirm the MIKE results over the period 2000 to 2012, with record ivory seizure levels between 2009 and 2011.

The GSEaf survey conducted by IUCN (Group of African elephant specialists in IUCN) in March 2012 among the network of researchers and elephant managers in 12 African countries showed a resurgence of poaching during the preceding 12 months in Cameroon, Gabon, Congo, Central African Republic and the Democratic Republic of Congo (DRC).

Details of the joint results of MIKE, ETIS and GSEaf are available at http ://www.cites.org/fra/com/SC/62/F62-46-01.pdf

The regular surveys conducted in West Africa show a decline in the elephant population of 76 % since 1980 (Bouché *et al.*, 2011). The same trend is apparent in the forests of Central Africa, with a decline of 62 % (Maisels *et al.*, 2013).

The resurgence of the illegal killing of African elephants can be linked to the economic boom in China and to the increase in the purchasing power of Chinese households (Martin and Vigne, 2011 ;

9 Monitoring the Illegal Killing of Elephants. CITES CoP 16 Doc. 53.1 available on http ://www.cites.org/fra/cop/16/doc/F-CoP16-53-01.pdf

10 http ://cites.org/eng/cop/16/doc/E-CoP16-53-02-02.pdf

Wittemyer *et al.*, 2011). Some experts consider that if poaching pressure remains at present levels, the species may disappear from Central Africa within 20 years (Maisels, personal comment). Strategic decisions were therefore taken at the CITES CoP16, in March 2013, to address this elephant poaching crisis (see 4.3. Recent CITES decisions on elephants).

3.1.2. Case of the great apes

There are four species of African great ape: bonobos, chimpanzees, eastern gorillas and western gorillas. The IUCN/SSC A.P.E.S. (Ape Populations, Environments and Surveys) Portal (http ://apesportal.eva.mpg.de/) and the Red List of Threatened Species (IUCN, 2012) provide up-to-date estimates of the geographic range, population size and the proportion of the populations located within protected areas for each of the nine great ape taxa (table 3.2). IUCN has published conservation action plans for eight of these taxa (IUCN and ICCN 2012; Kormos and Boesch, 2003; Maldonado *et al.*, 2012; Morgan *et al.*, 2011; Oates *et al.*, 2007; Plumptre *et al.*, 2010; Tutin *et al.*, 2005). These plans, together with survey results and vulnerability assessments, guide effort and resource allocation to priority conservation needs; nonetheless, the only great ape taxon that is not in decline is the mountain gorilla (Robbins *et al.*, 2011; Gray *et al.*, 2013).

Great apes have very slow rates of reproduction, making their populations extremely vulnerable to any level of offtake. The main threats to great ape survival are poaching for the bushmeat trade, habitat destruction and infectious diseases. Additionally, the live trade in young great apes is reportedly on the rise (Stiles *et al.*, 2013). Despite having full legal protection status in all range states, laws are often not enforced. The proportion of great apes in the total catch or gross weight of bushmeat is small, but nevertheless constitutes a large number of animals (Dupain *et al.*, 2012; Foerster *et al.*, 2012; Hart, 2009).

Habitat destruction is likely to become a more significant threat as forests are converted to agro-industrial plantations to meet increasing international demands (Carrere, 2010). Although deforestation rates in Central Africa are low (Mayaux *et al.*, 2013), they could change rapidly if poorly planned agro-industrial conversion goes ahead as it has elsewhere (Malhi *et al.*, 2013). A relatively small proportion of great ape range is protected (except for mountain gorillas as the entire population is in national parks). While 11 % of Congo Basin forests have been gazetted as protected areas, about 15 % is designated for timber exploitation (Nasi *et al.*, 2012). The latter proportion increases to nearly 50 % of western lowland gorilla and central chimpanzee habitat (Morgan and Sanz, 2007). Therefore logging concessions and the adoption of wildlife-compatible management practices are very important for great apes (Morgan *et al.*, 2013). An assessment of change in "suitable environmental conditions" for great apes over a period of 20 years (Junker *et al.*, 2012) showed that high hunting pressure or habitat degradation have rendered large tracts of forest unsuitable for great apes. The same assessment showed that since the year 2000 the proportion of ape range within protected areas has been reduced to 18 % to 60 % depending on the taxon (mountain gorillas excepted; Table 3.2).

Improved protected area management, especially law enforcement (Tranquilli *et al.*, 2012), and sound wildlife management in buffer zones are vital for ape conservation and for biodiversity in general (Laurance *et al.*, 2012). Furthermore, landscape-level conservation-focused land-use planning is essential to keep great apes from being reduced to isolated populations in forest fragments (Dupain *et al.*, 2010). Habitat fragmentation increases proximity between humans and apes and thus the likelihood of disease transmission from one to the other. The impacts of infectious diseases, such as the Ebola virus, Simian Immunodeficiency Virus and human respiratory viruses, are increasingly well documented, highlighting the need to consider interventions such as vaccination of apes (Ryan and Walsh, 2011). Recovery from disease outbreaks in slow reproducing species, such as apes, takes many years even under favourable conditions (Walsh *et al.*, 2003), and extinction risks are growing as ape populations become increasingly fragmented and isolated.

In the face of rapidly changing dynamics on the African continent (industrial agriculture, mining, infrastructure, human demographics, etc.), the survival of great apes will depend on evidence-based conservation strategies that have been tested empirically to demonstrate what works and what does not (e.g. Junker *et al.*, 2012; Tranquilli *et al.*, 2012).

3.1.3. Forest buffalo: a large grazer living in a forest landscape

The geographic range of the forest buffalo, *Syncerus caffer nanus*, is limited to the Congo Basin forest (Sinclair, 1977), but because of their elusive habits, few data exist for this subspecies of African buffalo (Blake, 2002; Melletti *et al.*, 2007a; Korte, 2008a). Although the forest buffalo inhabits forests and because it is the largest grazer in the rainforest ecosystem, it may play an important ecological role in maintaining clearings, using proportionally more open habitat than forest. The future of this subspecies depends on effectiveness of protected areas with special attention to forest clearings and mosaics of forest and savannas, where critical food resources are abundant. Habitat loss and poaching are major threats to forest buffalo populations (IUCN/SSC, 2008). Buffalo are hunted for their meat especially in rural areas, where human populations depend on bushmeat for protein increasing the hunting pressure on this subspecies.

Estimates of abundance are limited to a few sites where the open habitat allows for direct observation of buffalo. Forest buffalo population estimates range from 20 individuals at Campo-Ma'an National Park in Cameroon (Bekhuis *et al.*, 2008) to 500 at Odzala National Park in the Republic of Congo (Chamberlan *et al.*, 1998). Small numbers of buffalo are also reported in the Dzanga sector of the Dzanga-Ndoki National Park., Central African Republic, where the population is estimated at between 32 and 40 individuals (Melletti *et al.*, 2007b). At Lopé National Park in Gabon, the savanna and forest mosaic of the northeast portion of the park has an estimated population of 324 individuals (Korte, 2008b).

Given these low population estimates, their dependence on open habitat within the forest landscape and the stability of buffalo groups, open areas, which are large enough to support buffalo herds and have adequate protection from poaching, are crucial for maintaining forest buffalo populations in the Congo Forest Basin (Melletti *et al.*, 2007b; Korte, 2008b).

Table 3.2: *Summary of African great apes statistics*

Subspecies	Suitable environmental conditions – SEC (km²)	Total species range (km²)	Population estimate	IUCN category (population trend)	Percent of SEC in protected areas
Western lowland gorilla *Gorilla gorilla gorilla*	347 400	694 208	~150 000	CR (decreasing)	25.2
Cross River gorilla *Gorilla gorilla diehli*	2 975	3 648	200 – 300	CR (decreasing)	—
Grauer's gorilla *Gorilla beringei graueri*	10 900	21 600	2 000 – 10 000	EN (decreasing)	60.3
Mountain gorilla *Gorilla beringei beringei*	785	785	880	CR (increasing)	100
Bonobo *Pan paniscus*	97 975	418 803	15 000 – 20 000 (minimum)	EN (decreasing)	42.4
Central chimpanzee *Pan troglodytes troglodytes*	317 425	710 670	70 000–117 000	EN (decreasing)	25.5
Eastern chimpanzee *Pan troglodytes schweinfurthii*	816 450	961 232	200 000 – 250 000	EN (decreasing)	18.4
Western chimpanzee *Pan troglodytes verus*	555 450	660 337	23 000	EN (decreasing)	21.7
Nigeria-Cameroon chimpanzee *Pan troglodytes ellioti*	41 150	168 407	3 500 – 9 000	EN (decreasing)	—

CR: Critically Endangered, EN: Endangered

Sources: Campbell et al., 2012; Gray et al., 2013; IUCN Red List; IUCN/SSC A.P.E.S. Portal; IUCN and ICCN 2012; Maldonado et al., 2012 and Robbins et al., 2011

Photo 3.4: Forest buffalo in Bai Hokou – Dzanga-Ndoki National Park, CAR

The forest buffalo is declining across its geographic range (IUCN/SSC, 2008). Based on only a few population estimates, East (1999) estimated a total population of 60 000 forest buffalo with about 75 % of the population in protected areas. The future of this subspecies depends on well-managed protected areas as well as the strengthening of legislation governing hunting (IUCN/SSC, 2008 ; Cornélis *et al.*, in press). Thus, appropriate hunting regulations and enforcement of these regulations are also critical for maintaining forest buffalo populations.

3.1.4. The large carnivores

While the forests in the Congo Basin have long been an important stronghold for leopards, *Panthera pardus* (the apex predator in this habitat and an IUCN Red List near threatened species) (Nowell and Jackson, 1996), the forest-savanna mosaic habitat also once harbored important populations of lions, *Panthera leo* (Vulnerable), African wild dogs, *Lycaon pictus* (Endangered), and spotted hyenas, *Crocuta crocuta* (Malbrant and Maclatchy, 1949). Uncontrolled hunting by humans, however, has led to a dramatic decrease in wild ungulate populations (carnivore's prey), especially in the more accessible open habitats. Today, lions and African wild dogs are almost certainly extinct within the Congo Basin, while spotted hyenas have been reduced to one small and isolated population, surviving in the Odzala-Kokoua National Park in the Republic of Congo (Henschel, 2009). Vagrant hyenas have been detected in neighboring Gabon (Bout *et al.*, 2010), but no evidence exists for the occurrence of a second resident population within the Congo Basin.

In remote forest regions, wildlife populations (the prey of leopard), have been less severely affected by human activity, and consequently, leopards are still fairly widespread across intact core areas within the Congo Basin (Henschel, 2009). However, evidence is mounting that leopards have disappeared from a number of forest sites on the fringes of the Congo Basin (e.g. Andama, 2000 ; Angelici *et al.*, 1998 ; Maisels *et al.*, 2001 ; Willcox et Nambu, 2007), where human population density is higher. A recent study in central Gabon suggests that bushmeat hunting may precipitate the decline in leopard numbers through exploitative competition and that intensively hunted areas are unlikely to support resident leopard populations (Henschel *et al.*, 2011).

Photo 3.5: Male leopard prowling an abandoned logging trail in the NSG concession – East of the Lopé National Park, Gabon

Under these circumstances, land-uses that mitigate the effects of bushmeat hunting such as well-managed, large protected areas and similarly large and well-managed logging concessions, are essential for the effective conservation of leopards in the Congo Basin (Henschel *et al.*, 2011). Conservation efforts directed towards spotted hyenas should promote the rigorous protection of the remaining population in the Odzala-Kokoua National Park, and the establishment of a second population in the center of their former range, the Bateke Plateau (Henschel, 2009).

3.2. State of plant diversity

3.2.1. State of current knowledge on flora

Flowering plants (angiosperms)

Our knowledge of the vascular flora of Central Africa is incomplete. In the case of Rwanda, Burundi and DRC, the National Botanic Garden of Belgium is in the process of preparing a checklist of the vascular plants: the list can already be accessed online (http://dev.e-taxonomy.eu/dataportal/flore-afrique-centrale/). Table 3.3 shows recent estimates of the numbers of species in each country. In most cases, these are only rough estimates based upon the available data and in some cases the data are not available. The real botanical diversity is probably much higher than these estimates.

Lichens

The checklist of lichens and lichenicolous fungi (Feuerer, 2012) clearly demonstrates the fragmentary knowledge of this group of species in Central Africa (table 3.3). For more than half of the countries, no pertinent data are available. Countries for which more data are available still do not give a good picture of the total lichen diversity. The checklists are based on a small number of publications and the reported species belong to a rather small number of families. This indicates that research has so far mainly been driven by the interest of the individual investigators and their taxonomical knowledge at that moment. For instance, with the exception of São Tomé and Príncipe , not one species of one of the largest tropical families, the Graphidaceae, is mentioned. Lichens are generally very sensitive to changes in the habitat. So if the earth continues to warm all lichen species preferring cold conditions are threatened.

Algae

Algae are a group of aquatic photosynthetic organisms, which range in size from microscopically small to very large. Aquatic algae are responsible for more than half of the oxygen production on earth. The diatoms, one of the algae groups, are important bio-indicators of water quality, and they are used in paleolimnological studies to reconstruct past climate. Other algae include Cyanobacteria, which while more closely related to bacteria, are traditionally studied as part of the algae. Estimates of the species diversity of these two groups of algae in Central Africa can be found in Table 3.3.

Bryophytes and Pteridophytes

Bryophytes (hepatic, anthocerotes and mosses) and pteridophytes (lycopsides and ferns *sensu stricto*) have long been neglected in biodiversity inventories, particularly in tropical Africa. Even though some countries have been explored in depth, most of the data available for Central Africa are deficient, discoveries of new species are frequent and inventories are continuing (table 3.3).

Photo 3.6: Botanical garden – University of Kisangani, DRC

Table 3.3: *Botanical diversity in Central Africa*

<table>
<tr><th>Country</th><th>Angiosperms</th><th>Pteridophytes</th><th>Lichens</th><th>Algae</th><th>Bryophytes</th><th>Introduced</th></tr>
<tr><td>Burundi</td><td>3 413</td><td>174</td><td>21</td><td>690</td><td>152</td><td>288</td></tr>
<tr><td>Cameroon</td><td>8 500</td><td>279</td><td>101</td><td>n/a</td><td>585</td><td>410</td></tr>
<tr><td>DRC</td><td>8 203</td><td>378</td><td>183</td><td>487 (*)</td><td>893</td><td>364</td></tr>
<tr><td>Equ. Guinea (Annobon)</td><td rowspan="3">7 100</td><td>42</td><td>n/a</td><td rowspan="3">n/a</td><td>53</td><td rowspan="3">226</td></tr>
<tr><td>Equ. Guinea (Bioko)</td><td>204</td><td>1</td><td>352</td></tr>
<tr><td>Equ. Guinea (Rio Muni)</td><td>117</td><td>1</td><td>157</td></tr>
<tr><td>Gabon</td><td>4 710</td><td>179</td><td>2</td><td>n/a</td><td>316</td><td>n/a</td></tr>
<tr><td>Rep. of Congo</td><td>4 538</td><td>n/a</td><td>2</td><td>n/a</td><td>126</td><td>n/a</td></tr>
<tr><td>CAR</td><td>4 300</td><td>n/a</td><td>3</td><td>n/a</td><td>333</td><td>297</td></tr>
<tr><td>Rwanda</td><td>2 974</td><td>194</td><td>112</td><td>52</td><td>554</td><td>291</td></tr>
<tr><td>São Tomé</td><td rowspan="2">1 230</td><td>139</td><td rowspan="2">78</td><td>n/a</td><td>158</td><td rowspan="2">297</td></tr>
<tr><td>Príncipe</td><td>117</td><td>n/a</td><td>47</td></tr>
<tr><td>Chad</td><td>2 250</td><td>n/a</td><td>23</td><td>1 426</td><td>78</td><td>131</td></tr>
</table>

(n/a: no reliable data available or under review)
(*) For lake Tanganyika 956 species of algae have been recorded

Box 3.4: Mushroom diversity of Central Africa

Jérôme Degreef & André De Kesel
National Botanic Garden of Belgium

Only 2 500 mushroom species have been described in Africa, 70% of which are native or endemic (Mueller *et al.,* 2007). This inventory is far from complete however because it is estimated that in an ecosystem there are four to six times more mushroom species than superior plants. The first official list of Congo (DRC) mushrooms, produced by Beeli in 1923, recorded 593 species. In 1948, Hendrickx reported that the number had increased to 1 163, including Rwanda and Burundi. No report has been produced since then.

Due to their seasonal nature, producing a complete inventory of mushrooms requires much more field work than for other living species. Moreover, Central African mycologists are poorly represented within the whole African mycologist community. Indeed, in 2012, only 10 out of 200 members of the African Mycological Association (http://www.africanmycology.org/) were represented by Central Africa (Gryzehnhout *et al.,* 2012).

In view of this situation, priorities must be made for further research. Edible mushrooms constitute a particularly interesting group within the more general framework of the development of non-timber forest products (NTFP).

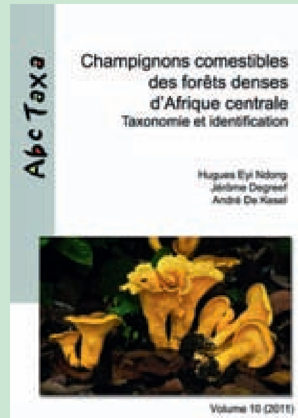

Figure 3.3: Edible mushrooms of central Africa's dense forests

300 edible mushroom species were recorded in tropical Africa (Rammeloo and Walleyn, 1993 ; Boa, 2006), more than half of which are related to living trees via a symbiosis called “ectomycorrhizae”.

These mushrooms play an important part in the ecosystem, but inevitably end up disappearing due to the disappearance of the associated trees. Abundance and diversity of these mushrooms may therefore be used as key indicators of the state of the forest.

In light of this, an illustrated training manual was recently published, enabling the identification of Central African dense forest’s most consumed species (Eyi Ndong *et al.,* 2011) (figure 3.3). It aims to improve local knowledge on African mushrooms and their diversity. The manual is available electronically (www.abctaxa.be) but also as a free hard copy thanks to support from the GTI (Global Taxonomy Initiative), a Belgian focal group, and from the BTC (Belgian Development Cooperation).

3.2.2. Threats to biodiversity: the case of invasive species

Invasive plants in São Tomé

In São Tomé and Príncipe various introduced plant species have spread from the crop-growing areas where they had been planted and have acquired an invasive character (Figueiredo *et al.*, 2011). In a context of high endemism and insularity, the phenomenon is particularly threatening to the country’s plant diversity.

Among these invasive plants are: *Cinchona* spp. (cinchona), *Rubus rosifolius* (Asian raspberry plant), *Tithonia diversifolia* (Mexican sunflower), *Bambusa* spp. (Stevart *et al.*, 2010). Cinchona is one of the 100 most invasive species in the world and its harmful impact on the biodiversity of invaded sites is recognized (http://www.issg.org/database/welcome/). Originating from Latin America, it was planted from the mid-nineteenth century in many islands to treat cases of malaria (Galapagos, Hawaii, São Tomé, etc.). Rapidly becoming naturalized, cinchona forms dense stands preventing the regeneration of natural forests. In São Tomé in particular, in the mountain ecosystems in which it proliferates and which it degrades, it reduces local biodiversity and disrupts ecotourism activities (Lejoly, 1995).

It is estimated that in São Tomé about one third of imported local flora has become naturalized. It may therefore be assumed that many of these plants are potentially invasive, albeit not yet detected as such to date.

Although these invasive plants have already probably caused irreparable damage (loss of biodiversity, including endemic species), the most remarkable ecosystems can still be preserved. For example, it would appear possible to control biodiversity loss in the Obo National Park and its surrounding area through evaluation of the situation, the prediction of future invasion, the eradication and control of the invasive species, and the awareness-raising and education of the local people.

The small fire-ant (*Wasmannia auropunctata*) in Gabon and Cameroon

Wasmannia auropunctata is a tiny, biting, red ant native to the neotropics, which has colonised and dominated many tropical and sub-tropical areas worldwide. In Africa, *W. auropunctata* was first recorded in Libreville, Gabon around 1913. It is presumed to have arrived on boats importing goods from the Americas (Santschi, 1914). Since then, it has spread across Gabon and north to neighboring Cameroon (figure 3.4). Recent genetic analyses suggest a single clonal origin for the entire regional population (Mikheyev *et al.*, 2009 ; Foucaud *et al.*, 2010).

Although some earlier infestations were a result of deliberate introductions of *W. auropunctata* as a method of limiting insect pests in Cocoa plantations (de Miré, 1969), currently its primary means of dispersal is inadvertent and mediated by human activities, notably logging and oil drilling (Walsh *et al.*, 2004 ; Mikheyev *et al.*, 2008), building and road construction, and the transportation of goods and vegetation (Wetterer and Porter, 2003).

The impacts of *W. Auropunctata* on biodiversity could be dramatic. For example, in Gabon, a greater than 95 % decrease in native ant species diversity has been attributed to *W. auropunctata.* (Walker, 2006). There is growing evidence that

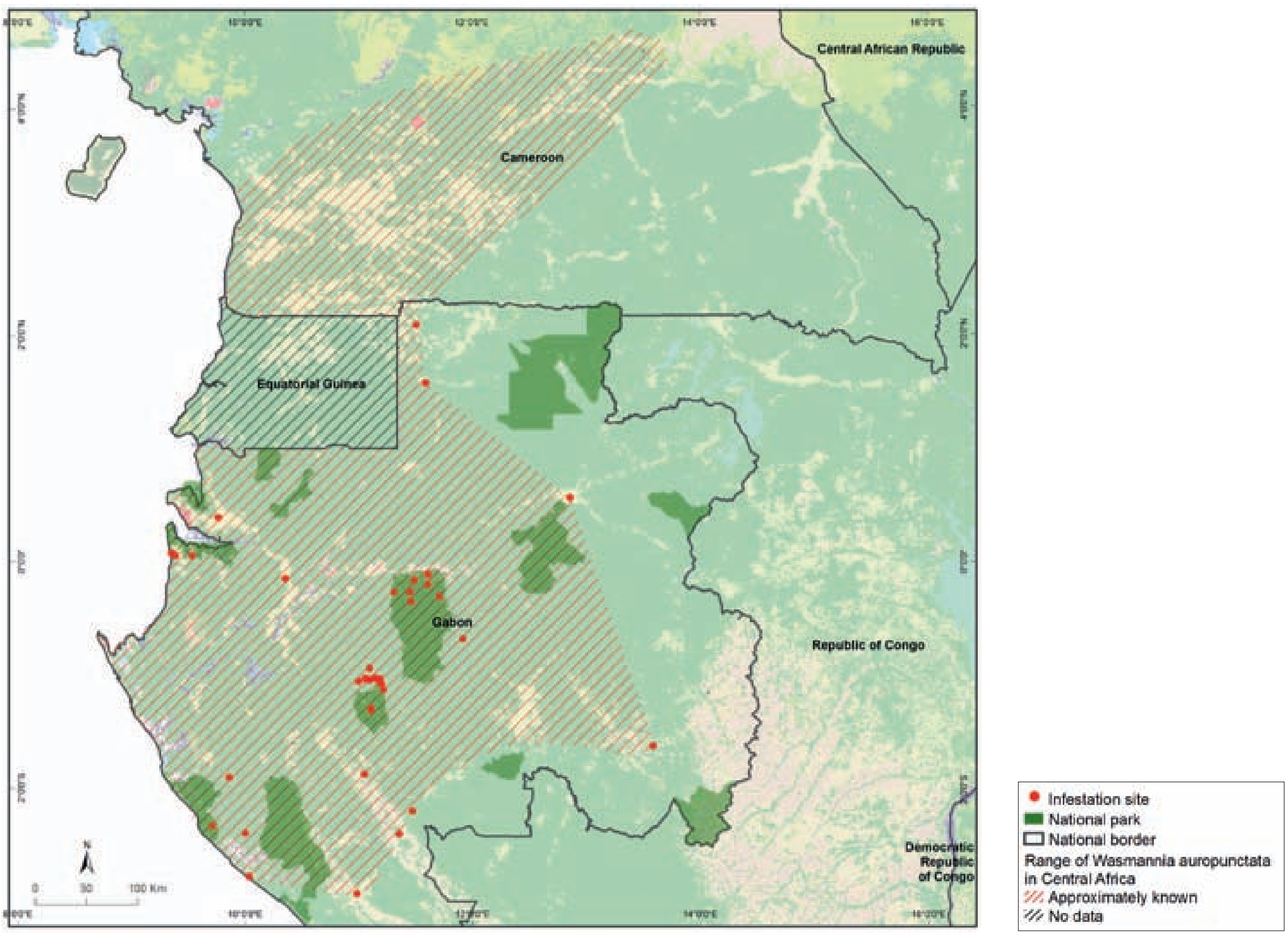

Figure 3.4 : Approximate known range of Wasmannia auropunctata in Central Africa (red hatching) ; red points indicate known infestation sites in Gabon. Black hatching : no data, although presence is likely.

Data sources : Wetterer et al., 1999 ; Walsh et al., 2004 ; Walker, 2006 ; Mikheyev, et al., 2008, 2009 ; Mikissa, 2010 ; Tindo et al., 2011 ; JP vande Weghe, O.Hymas, JB Mikissa, V. Mihindou and K. Jeffery, pers. obs.)

delicate ecosystem processes are being disturbed at different trophic scales, as populations of microbivore, detritivore, pollinating and mutualistic species are affected by the introduction of *W. auropunctata* (Dunham and Mikheyev, 2010; Mikissa, 2010). *W. auropunctata* has a mutualistic relationship with phloem-feeding insects, which cause damage to plants by sapping nutrients and increasing diseases (Smith, 1942; Delabie *et al.*, 1994; de Souza *et al.*, 1998; Fasi and Brodie, 2009). While long identified as a threat to crop species, its spread into protected areas and more undisturbed environments in Gabon is now causing concern for the conservation of native plant fauna.

Untreated *W. auropunctata* infestations can become unbearable to humans within a few years, due to the frequency of stings sustained in highly infested areas. Although not yet measured, the potential for damage to the economy of rural communities and to the development of tourism within Gabon is becoming increasingly apparent. Reports already exist of plantations, houses and villages being abandoned because of *W. auropunctata* infestations (J.B. Mikissa, pers. comm.). Appropriate fire-ant treatments and management programs have not yet been developed for Gabon, yet they are urgently required. While total eradication is now an unrealistic option, strategies should include public awareness, prevention of spread, monitoring, eradication of isolated infestations and treatment at advancing frontiers.

4. Tools for managing biodiversity in Central Africa

4.1. The legislation on traditional hunting and poaching

In Central Africa, all countries have included in their forestry codes provisions for local people to have access to faunal resources in their traditional lands. But this right of usage is limited and certain hunting practices are illegal. In the field, however, the dividing line is often difficult to establish between so-called traditional hunting and poaching (illegal hunting), between what is permitted and what is forbidden. These are defined in legislation but are difficult to reconcile with local practices. These distinctions are particularly relevant to hunting gear, the areas allocated to traditional hunting, the uses of bushmeat and the circulation of animal products. An examination of the legal provisions relating to the practice of hunting in Cameroon illustrates particularly well this situation on the ground and its contradictions (box 3.5).

Photo 3.7: Pygmy hunter and his game – UFA Bétou, Congo

Box 3.5: Hunting and poaching in Cameroon: What does the law say?

Roger Ngoufo
University of Yaoundé

Hunting in Cameroon requires, among other things, a hunting permit or license, which has been compulsory since 1981 (article 48 of the former Act No. 81-13 of 27 November 1981, and later article 87 of existing Act No. 94-01 of 20 January 1994 establishing regulations for forests, fauna and fisheries). The only derogation permitted concerns so-called "traditional" hunting defined as hunting carried out "with implements made from materials of plant origin" (Decree No. 95-466 of 20 July 1995 establishing the procedures for the application of the regulations relating to fauna). Under the Act of 1994, this traditional hunting "is authorized throughout the national territory except in state forests for the concession of fauna and on the property of third parties".

Again according to the relevant legislation, "products emanating from traditional hunting are exclusively intended as foodstuffs" (art. 24 of Decree No. 95-466 of 20 July 1995 establishing the procedures for the application of the regulations relating to fauna). This falls under the concept of the right of use defined as "the exploitation by local inhabitants of forest, fauna or fisheries products for personal use" (art. 4).

In Cameroon, poaching is defined as any act of hunting without a permit, in the closed season, in reserved places or with prohibited equipment or weapons" (art.3 of Decree No. 95-466 cited). Similarly, any traditional hunting procedure liable to jeopardize the conservation of certain animals may be restricted (art. 81 of Act No. 94-01 of 1994). By extension, "any person found, at any time or in any place, to be in possession of the whole or part of a protected class A or B animal, as defined in article 78 of the present Act, whether alive or dead, shall be deemed to have captured or killed it" (art. 101 of Act No. 94-01 of 1994).

Photo 3.8: Temporary poachers' camp

All these provisions *de facto* outlaw numerous widespread local practices, which thereby become acts of poaching. For example, the use of traditionally manufactured rifles, nets or steel cables is completely illegal, even though these practices are common at the local level. Certain ancestral practices using partially or fully protected species have thus become illegal, such as the killing of an elephant, which constitutes a rite of passage among the Bakas. Many people are also liable to fall under the ambit of the law through their involvement in any way in the traffic in animal products. In other words, it has to be acknowledged that the concept of "traditional hunting" provided by Cameroonian legislation does not tally with the facts on the ground.

4.2. The lists of threatened species

According to the IUCN Red List of Threatened Taxa (http://www.iucnredlist.org/), about 6 000 species have been evaluated in Central African countries. For these species, the levels of threat are detailed by group in Figure 3.5. While the majority of evaluated species are not threatened, 0 to 34 % of the species are classified as Vulnerable (VU), Critically Endangered (CR) or Endangered (EN) by group per threat category (e.g. 34 % of plants are classified as VU; 2 % of birds, EN). The high percentage of species for which there are no data available (DD – Data Deficient) is also worrisome.

The numerous species which remain unevaluated (and so unaccounted for in the statistics presented in Figure 3.5) are even more troubling. For example, of the approximately 8 000 plant species known from Central African forests (White, 1983), only 965 (12 %) have been assessed. For assessed mammals, most evaluations were conducted in 2008; of these, some 70 % are LC (Least Concern) while 12 % are VU, EN, or CR. Several of these threatened species are listed by CITES.

In general, evaluations of species are valid for approximately 10 years before they require updating (Schatz, 2009). Using this benchmark, as a whole, only 6 % of the Central African evaluations are out of date. However, in consulting the IUCN database, plants (particularly listed timber species) are clearly in the worst position, with 32 % of the evaluations requiring updating. Many groups were updated in 2012, with some 1 500 updates or additions, including all of the

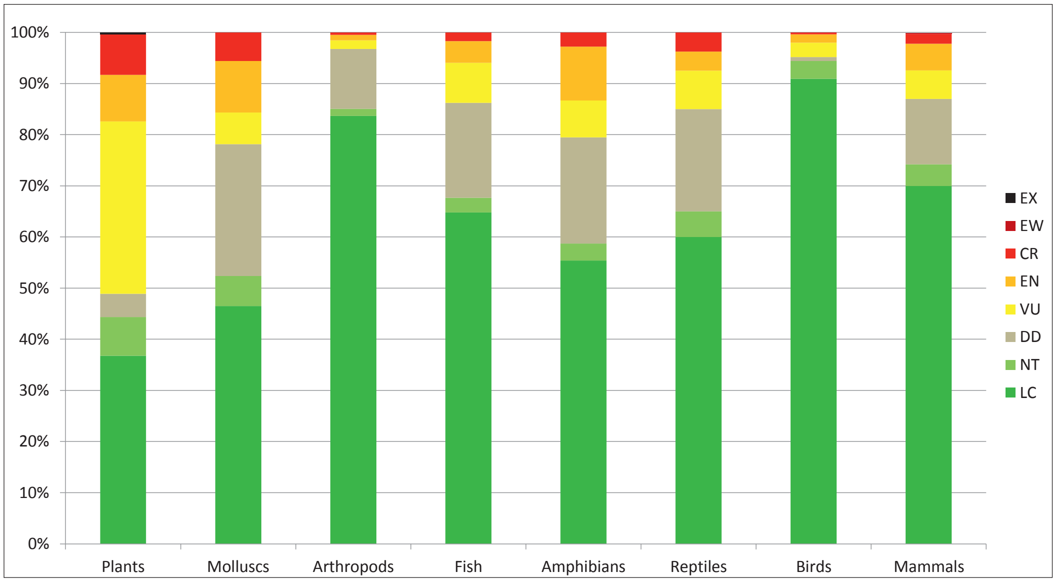

Figure 3.5: Percentage of Central African threatened species by category of threat and species group (EX: Extinct; EW: Extinct in the Wild; DD: Data Deficient; NT: Near Threatened; LC: Least Concern; CR: Critically Endangered; EN: Endangered; VU: Vulnerable)

listed birds and many mollusks, arthropods and fish.

Nonetheless, different cases show that a good understanding of the threat level is vital to help guide conservation action:

A number of Central African amphibians were assessed for the IUCN Red List in 2012. The IUCN Amphibian Specialist Group uses these assessments, in conjunction with priorities identified by the Alliance for Zero Extinction (AZE) and information provided by local partners, to identify the most critical habitats requiring conservation for the long term survival of some of the world's more threatened amphibians. Their priority sites include Cameroon's Mont Oku, Mont Manengouba, Mont Nganha, and the Bakossi Hills, each containing 35 to 85 species. These sites form part of the global set of priorities identified by the AZE, an effort to draw attention to habitat conservation of threatened species worldwide. In the Congo Basin, there are 15 AZE sites including those cited previously and the DRC's Itombwe Mountains, São Tomé's lowlands, Gabon's Mont Iboundji, and Rwanda's Nyungwe National Park (http://www.zeroextinction.org).

Another example of how the analysis of threat level informs conservation priorities is with the freshwater assessments of Central Africa conducted by IUCN, in which regionally threatened species of fishes, mollusks, odonates and crabs were mapped within river sub-watersheds (figure 3.6). The coastal equatorial regions (including Cameroon's crater lakes), the Lower Congo Rapids, and the Bangweulu-Mweru system in the Democratic Republic of Congo have the highest level of threatened freshwater species (Brooks *et al.*, 2011). Many of these areas qualify as Key Biodiversity Areas, areas which are globally important for biological conservation (Holland *et al.*, 2012). A related pan-African study on dragonflies found that the mountains of the Cameroon-Nigeria border had the most threatened species in the Congo Basin, while the highest number of DD species is found in north-eastern Gabon, a well-studied area in the 1960s and '70s which has not had subsequent field surveys (Clausnitzer *et al.*, 2012). Finally, a Red List of Cameroon's endemic plant species has given preliminary evaluations of more than 800 species (Onana & Cheek, 2011).

In Gabon, new surveys of poorly known, highly threatened and strictly endemic species in the Libreville area helped to inform the boundaries of the newly created Raponda-Walker Arboretum. The last remaining populations of *Psychotria wieringae* (EN), *Acricocarpus vestitus*, *Gaertnera spicata* amongst others are now guaranteed protection (Lachenaud *et al.*, 2013).

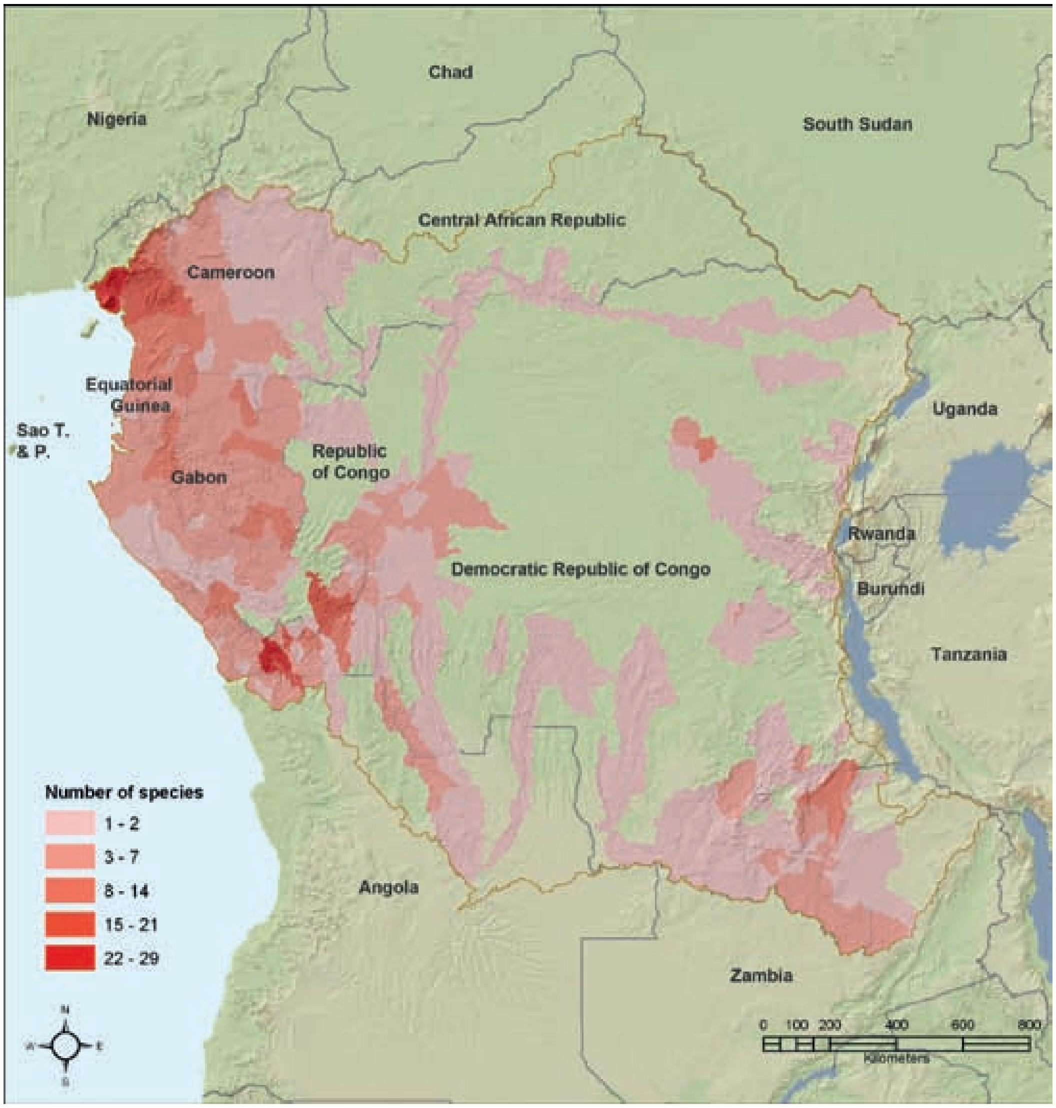

Figure 3.6: The distribution of regionally threatened species of fishes, molluscs, odonates and crabs within Central Africa, mapped to river sub-watersheds (Brooks et al., 2011)

Photo 3.9: Psychotria wieringae, one of several highly-threatened, rare and endemic species in the Libreville region of Gabon, which is now protected by the newly-created Raponda-Walker arboretum.

Finally, when species are threatened by commercial trade, they are often listed by the Convention on the International Trade of Endangered Species (CITES). Examples of large mammals on the list include the African elephant (VU) (for Central Africa this includes the forest elephant subpopulation (EN)), Western Lowland Gorilla (CR), Mountain Gorilla (EN), Chimpanzee (EN), Bonobo (EN), Mandrill (VU) and Drill (EN). Well known plants include *Prunus africana* (VU) and *Pericopsis elata* (EN), as well as many orchids (see box 3.6 for more information).

Box 3.6. IUCN's Red List and commercial trees: the case of Pericopsis elata (Harms) Meeuwen (assamela, afrormosia)

Jean-Louis Doucet and Nils Bourland
Gembloux Agro-Bio Tech / University of Liège

From the okoume (*Aucoumea klaineana*) to the sapelli (*Entandrophragma cylindricum*) many commercial tree species are included on IUCN's Red List (http://www.iucnredlist.org/). No less then half the species currently logged in Central Africa are considered threatened under the AIcd criterion. Among these species, those which have decreased in population by at least 50 percent over the last three generations are classified as vulnerable (VU), a reduction of at least 70 percent is classified as in danger of extinction (EN) or in critical danger of extinction (CR) if reduced by at least 90 percent.

However, the characteristics of these trees such as their longevity make the classification for the list unusually complicated. The duration of a generation defined by IUCN (2001), the average age of the parents of the cohort, is generally close to a century for most of the commercial species (Menga *et al.,* 2012). Furthermore, a poor understanding of the ecology of the commercial species underscoress the high priority for studying their autecology, particularly to evaluate threats so that forestry management can be improved in logging operations.

The assamela *(Pericopsis elata*), also known as the afrormosia or kokrodua, is classified as EN in IUCN's Red List and in annex II of CITES (species for which an export permit or re-export certificate is necessary). Its status was studied in Cameroon by Barland *et al.,* (2012a) in a forestry concession of about 120 000 ha. The population analyzed was suffering from a substantial regeneration deficit. The local abundance of this heliophilic species derives from old forest clearings, which enabled it to intitially regenerate (van Gemerden *et al.,* 2003; Brncic *et al.,* 2007). Because shifting agriculture was previously more common in these areas, conditions favoring its regeneration have diminished.

The assamela flowers regularly in the area studied starting at the age of about 120 years onwards while the average age of the reproducing adult trees is estimated to be about two centuries. In practice, it is impossible to determine the population reduction over three generations (i.e. 600 years) as called for by the IUCN. Moreover, the impact of commercial harvest on the assamela in Cameroon can be regarded as limited because the species may be felled only if its diameter is at least 90 cm, which would reduce the number of seed trees by only 12 percent in 30 years. If it is assumed that the population studied is representative of the Cameroonian population, the EN status would appear to be greatly exaggerated.

However, the situation may vary from one country to another. In the Republic of Congo and the Democratic Republic of Congo (DRC), the legal minimum diameter for harvest is only 60 cm, which threatens a greater proportion of seed trees and could adversely affect regeneration of the species.

Nevertheless, the assamela's distribution range in Central Africa coincides with some protected areas (Bowland *et al.,* 2012b). Thus, 7 percent of the assamela area in DRC appears to occur in protected areas, as opposed to 40 % in Congo and 46 percent in Cameroon.

Applying the IUCN criteria to timber species is therefore extremely delicate. It is even possible that today certain heliophilic species such as the assamela could be even more abundant than 600 years ago (see Brncic *et al.,* 2007).

Consequently, a more rigorous estimate of the status of species should take account of population dynamics considering future, and not past, anthropic impacts. Any simulation should necessarily consider the ecology of the species, the zoning plan of the countries included in its distribution area (including the proportion of distribution within protected areas), rates of deforestation, forestry legislation and the existence of reafforestation programs. Lastly, in light of national disparities, a regional approach appears essential.

In the case of heliophilic and anthropophilic species such assamela or okoume, conservation alone will not be sufficient to guarantee the maintenance of populations in the long term. Only rational management, integrating regeneration programs, will ensure their longlasting survival.

4.3. Recent CITES decisions on elephants

CITES is an international agreement between governments that aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival. Every two to three years, member states meet to review the implementation of the agreement. At the last conference of the parties to CITES, in March 2013 in Bangkok, strategic decisions were adopted for the first time about on-the-ground actions to collectively address the elephant poaching crisis and the escalating illegal trade in ivory (http://www.cites.org/common/cop/16/sum/E-CoP16-Com-II-Rec-13.pdf). The data illustrating the current elephant poaching crisis are outlined briefly in 3.1.1. "Update on the illegal killing of elephants" of this chapter.

Among other decisions, taking DNA samples on future ivory seizures greater than 500 kg is now mandated, and CITES parties are required to report annually on ivory stockpiles. Additionally, the discussion of the possibility of a CITES-sanctioned trade in ivory was postponed and the ban remains in place. Moreover, the CITES Secretary General will now cooperate with the UN Office of Drugs & Crime regarding illegal killing of elephants, illegal trade in ivory and the national security implications of ivory trafficking. Public awareness campaigns aimed at reducing the demand for ivory, which is the principal driver of the illegal killing of elephants, were endorsed by the CITES plenary. This endorsement further allows for the building of a coalition of individuals, scientists, NGOs, institutions and governments to take united international action to reduce demand for ivory. Finally, an agreement was adopted to strengthen the African Elephant Conservation Fund (http://www.fws.gov/international/wildlife-without-borders/african-elephant-conservation-fund.html) and the African Elephant Action Plan (http://www.bloodyivory.org/action-plan).

The Conference decided to establish Wildlife Incident Support Teams (WISTs), to be dispatched at the request of a country which has been affected by a significant poaching incident related to illegal trade or that has made a large-scale seizure of CITES listed specimens. The WISTs will assist and guide appropriate follow-up actions in the affected or intercepting country in the immediate aftermath of such an incident.

4.4. Herbaria, not only about naming plants

A herbarium is a collection of preserved plants for scientific research and education. Herbaria are a vital and irreplaceable taxonomic reference for plants, which identify thousands of plant names. Herbaria are complementary to the function of the Botanical Gardens as explained in the box 3.3 of State of the Forest 2010.: "Botanic gardens in Central Africa: roles and prospects".

Herbaria are essential to achieve the first objective of the Global Strategy for Plant Conservation (GSPC), which states that "Plant diversity is well understood, documented and recognized." (see: https://www.cbd.int/gspc). They are where new species are discovered, described and named. New species are often described many years after they were collected. Fontaine *et al.* (2012) estimated that the shelf life, between discovery and description, is on average 21 years for species of all kingdoms. Bebber *et al.* (2010) calculated that it takes between 23 to 25 years to describe half the new plant species collected in one year. This interval can be explained by the shortage of specialists, the tremendous amount of material available in herbaria (it estimated that the world's 2721 active herbaria together house 361 million specimens) and by the methodology of plant taxonomy itself.

Herbaria are also important for all types of research on plants such as genetics, palynology, wood anatomy, chemistry, pharmacognosy, inventories, etc. Vouchers specimens, which have all of the essential elements for identifying the specimen, including comprehensive labeling about the place, date, collector and habitat of collection, are crucial in many research domains.

Herbaria are not only a depository for dried herbarium specimens. They also hold associated materials such as liquid-preserved fruits and

Photo 3.10: Example of a restored herbarium in INERA – Yangambi, DRC

flowers, DNA samples, wood samples, drawings, watercolors, photographs, archives, literature, etc. The combined availability of these materials allows scientists to study the morphological and genetic variability of a species as well as its past and present distribution; calculate environmental parameters and potential distribution patterns; predict future distribution in the context of global change; document the distribution history of crops, pest and invasive species; evaluate the *in-situ* and *ex-situ* conservation of plants; and, provide a historical reference for carbon and nitrogen cycles.

The oldest herbaria in Central Africa date back to the early 20th century (e.g. the herbaria of Kisantu and Eala). From 1946 onwards, many local herbaria were founded. Many of these col-

Table 3.4: *Most important herbaria in the Congo Basin.*

Country	Name	Code	Institute	Number of specimens
Burundi	Herbarium of the Biology Department	BJA	University of Burundi	20 000
Cameroon	National Herbarium of Cameroon	YA	National Herbarium of Cameroon	96 000
	Herbarium Limbe Botanical & Zoological Gardens	SCA	Limbe Botanical & Zoological Gardens	30 000
	Herbarium of the school of Garoua wildlife	HEFG	Garoua wildlife school	11 000
Central African Republic	Herbarium faculty of sciences	BANG	Bangui university	10 000
	Herbarium Central Station of Boukoko	SCB	Central Station of Boukoko	3 600
Republic of Congo	Herbarium National of Congo	IEC	Study on plant resources center	40 300
Democratic Republic of Congo	Herbarium of the Centre for Training and Research Forest Conservation Epulu	EPU	Congolese Institute for the Conservation of Nature (ICCN)	8 000
	Herbarium of the university and INERA of Kinshasa	IUK	University of Kinshasa and INERA	29 000
	Herbarium of the Kisangani university	KIS	Kisangani university	10 000
	Herbarium of the Lubumbashi university	LSHI	Lubumbashi university	25 000
	Herbarium of the Kisantu botanical garden	KISA	Congolese institute for the conservation of nature (ICCN)	8 000
	Lwiro Herbarium	LWI	Research center in Natural Sciences Lwiro (CRSN)	15 000
	Kipopo Herbarium	KIP	National Institute for the Agronomic study and research (INERA)	25 000
	Luki Herbarium	LUKI	National Institute for the Agronomic study and research (INERA)	10 000
	Mulungu Herbarium	MLGU	National Institute for the Agronomic study and research (INERA)	10 000
	Yangambi Herbarium	YBI	National Institute for the Agronomic study and research (INERA)	150 000
Gabon	National herbarium of Gabon	LBV	CENAREST	40 000
Equatorial Guinea	National Herbarium and Documentation Centre	BATA	National Institute of Forest Desarollo	8 000
Rwanda	National Herbarium of Rwanda	NHR	Institute of Scientific and Technological Research (IRST)	16 700
São Tomé and Príncipe	Herbarium national of São Tomé and Príncipe	STPH	Directorate General of Environment, Ministry of Natural Resources and Environment	1 500
Chad	Herbarium of the Research Laboratory Veterinary and Zootechnical	-(*)	Livestock Ministry	8 000

(*) Not mentioned in Index Herbariorum

Source: Index Herbariorum: http://sciweb.nybg.org/science2/IndexHerbariorum.asp lections still exist and can be an important tool for the study of the biodiversity of the region. In addition to the collections in local herbaria, important collections from the regions can be found in European and North American herbaria (e.g. Kew, Meise, Missouri, Paris and Wageningen) (table 3.4).

In an effort to maintain historically important scientific collections, rehabilitation projects are underway in several herbaria with financial and technical support from international partners, including the Andrew W. Mellon Foundation (African Plants Initiative), the French Ministry of Foreign Affairs (Sud Expert Plantes), development cooperation agencies of several countries, the European Union, and several European botanical gardens and herbaria. These projects focus on the rehabilitation of institutions' infrastructure and collections, the training of technicians and researchers, as well as the digitization of collections. They provide support to local partners in the pest-control of herbaria, the mounting of herbarium samples, the classification and determination of herbarium specimens, and the digitization of collections, including the data-capture of botanical information. Scanned images of herbarium material from the Congo Basin, with their accompanying data, are made available via the internet (http ://plants.jstor.org/), and this is especially valuable to African researchers. These projects not only contribute to the development of local African institutions but also strengthen their scientific research both locally and internationally.

Photo 3.11 : Kaleidoscope of shape and color

5. Management of biodiversity in Central Africa

5.1. Lessons from Trans-boundary Protected Areas

In Central Africa, six trans-boundary protected areas (APTs) have been established since 2000 after cooperation agreements were completed ; (Kamdem Kamga, 2012), the Trinational Sangha Area (TNS : Cameroon, Congo and CAR), the Trinational Dja-Odzala-Minkebe Area (TRIDOM : Cameroon, Congo and Gabon), the Lake Télé-Lake Tumba Complex (Congo and CAR), the Binational Séna Oura-Bouba Ndjida Area (BSB Yamoussa : Cameroon and Chad), the Trans-boundary Mayumba-Conkouati Park (Gabon and Congo) and the Mayombe complex (Congo, DRC and Angola).

Two other trans-boundary complexes are in the process of being established : the Binational Campo Ma'an-Rio Campo Area (Cameroon and Equatorial Guinea) and the Monte-Alen-Monts de Cristal Area (Equatorial Guinea and Gabon). The expected accession of Gabon and the revision of the agreement on the Mayombe forest will make Mayombe the first quadpartite trans-boundary complex in Central Africa.

Photo 3.12 : River under a luxuriant forest, northern Gabon

In 2012 the Commission on Central African Forests (COMIFAC), with the financial support of the GIZ, commissioned a study to review the existing APTs and to propose a strategic orientation framework adapted to this type of conservation initiative (Ngoufo, 2013). The Great Virunga Trans-boundary Collaboration (GVTC), which comprises three countries, including one from outside the subregion (DRC, Rwanda and Uganda), was included in this study. The diagnosis has covered the processes of creating, managing, governing and financing these trans-boundary complexes.

The study concluded that the creation and management of trans-boundary complexes in Central Africa are technically feasible. However, their management and governance display shortcomings, even though their contribution to subregional integration and mutual cooperation in biodiversity conservation efforts is undeniable. Unfortunately, the financing of the protected areas very often falls short of actual needs and is too dependent on external financiers, which raises uncertainty about their sustainability.

A working group on the protected areas and wild fauna is being set up within the COMIFAC. It should serve as an interface between the subregional political bodies and actors on the ground and will promote greater capitalization on the lessons learned from the various APT initiatives. Other actions capable of significantly improving the functioning of the APTs may also be envisaged : overall planning on the basis of the management plans of the various protected areas concerned ; making the most of the tourism potential of the various sites (example of the Odzala-Kokoua National Park, see box 3.7) ; the mobilization of resources for the execution of the subregional Action Plan for the countries in the COMIFAC area for the strengthening of the enforcement of national legislation on wild fauna (PAPECALF – box 3.9), etc.

Box 3.7 : Ecotourism in the Odzala-Kokoua National Park

Robbert Bekker, Bourges Djoni Djimbi and Paul Noupa
TRIDOM

The Odzala-Kokoua National Park was created in 1935 and covers 1 354 600 hectares. It contains over 100 clearings where visitors can see a number of large mammals; plains gorillas, elephants, buffaloes, bongos and chimpanzees. These animals, as well as birds, reptiles and insects together with their exceptional habitats, give the park great ecotourism potential.

Photo 3.13 :Lango eco-lodge, Odzala-Kokoua national park, Congo

The sustainable financing and management of the park are guaranteed by the public-private partnership agreement of November 14, 2010 between the Government of Congo and the African Parks Network. The agreement is for a renewable period of 25 years. The park's development plan provides for complete protection of 60 % of its area with 40 % designated as transition and eco-development zones. In order to derive the greatest benefit from the park's natural and cultural riches and to contribute to local development, on April 29, 2011 the government signed a renewable 25-year partnership agreement with the Congo Conservation Company (CCC) for the rights to seven ecotourism and hunting concessions within and on the outskirts of the park. In return, it will make an annual payment of 5 % of its gross receipts to a village development fund.

The CCC has invested 5 million euros in the development of ecotourism. In 2012 it built three lodges (two top-of-the-range at Lango and Ndzéhi and one middle-range at Mboko) at a cost of 3.8 million euros, and it built two satellite camps in 2013. The three lodges employ about 100 people, 60 % from the area. All have been locally trained in hotel management.

The first 120 tourists arrived between August and September 2012. Starting in 2013, ecotourists are welcomed during the best visiting periods: January-February (lesser dry season) and June to mid-October (main dry season). The products offered include : discovery of the forest on foot, watching large wild animals from watchtowers, tracking groups of gorillas and sailing in dugout canoes.

In 2013, regulations to determine how village development funds are distributed were drawn up. Thus, of the 71 local villages direct and indirect beneficiaries are designated. Procedures for disbursement and management of the funds are also being established.

Box 3.8: Participative monitoring of the "Tri National de la Sangha"

[1]Dominique Endamana, [1]Kenneth Angu Angu, [2]Jeff Sayer, [3]Thomas Breuer, [4] Zacharie Nzooh, [1]Antoine Eyebe and [1]Léonard Usongo
[1]IUCN, [2] JCU, [3] WCS, [4] WWF

The "Sangha Group", starting in 2004 formed a group of the many actors involved in the management of the Tri National de la Sangha (TNS) forested landscape: managers of protected areas, research and conservation institutions, universities, loggers, local NGO's and civil servants.

This group has created a participative monitoring evaluation system (SEP) with the goal to analyze the impact of the actions taken to conserve biodiversity and to develop local communities at the landscape scale as well as to assess the results of these activities. This measure supplements the remote sensing monitoring of forest management initiated by the CARPE programme (Yanggen *et al.,* 2010).

These measures rely on the participative "bottom-up" approach which engages the local communities and indigenous populations according to the following steps : conceptualization of the tool, development and definition of the indicators and continuous monitoring of these indicators (Sayer *et al.,* 2007). The SEP has enabled a greater understanding of the dynamics within the TNS landscape as well as the identification of values ascribed to the landscape and has furthermore identified the avenues leading to environmental and socio-economic changes.

The indicators are grouped according to natural, physical, social and human benefits (table 3.5) (Department for International Development, 2001). The natural benefits have been divided into two categories; local resource importance (NTFP, subsistence game hunting, etc.) and global resource importance (large mammals: elephants, primates, etc.).

Table 3.5: *28 indicators used for TNS landscape monitoring (2006-2011)*

Local natural benefits	Global natural benefits	Human benefits	Social benefits	Physical benefits	Governance
Availability of four NTFP priorities	Illegally-killed elephants	Health care access	Running of the local committees on natural resources management	Manioc windmills	Application of the law
Availability of non-protected fauna	Bongo population	Standard of school attendance	Communal initiatives on natural resources management	Housing standard	Violation of rules on fauna
Commitment to sustainable management of forest process or certification		Ability of forest companies to employ local, qualified technicians	Perception of corruption (public and private sectors)	Number of drinkable water points	Sharing of eco-tourism and fauna benefits derived from forest management
			Level of associated activity	Access to nearest large urban center	Recurrence of local conflicts
			Progress in awarding of the Baka Community Forests	Level of tourism development	Re-establishment level of parliamentary committees
			Participation of the Baka in resolution of disputes in the court of the traditional chief	Wood transformation factory/workshop	Forest and fauna control
			Use of the forest license-fee	Market of the three products most in demand	

Monitoring of these 28 indicators started in 2006. Each indicator is assessed according to the Likert scale (ranging from 1 (worst-case situation of the indicator) to 5 (ideal indicator situation)). This process happens once a year during the annual Sangha group meeting, based on quantitative and qualitative data gathered by administrators of protected areas and by their partners, within their own proper

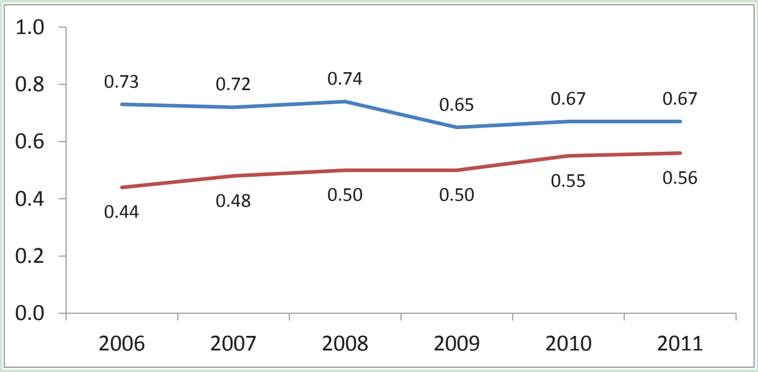

Figure 3.7 : Changes in conservation and development indices in the TNS 2006-2011

ecological and socio-economic monitoring evaluation system (figure 3.7).

The monitoring of these factors (Endamana *et al.*, 2010) has enabled the development of future conservation and development plans for the TNS (Sanker *et al.*, 2009) and has also increased the understanding of the landscape's resilience in facing external factors such as the 2008 international financial crisis (Sayer *et al.*, 2012). To achieve a consensus on the indicators, the landscape-level participative monitoring requires substantial time investment and patient involvement in monitoring from all the local actors, dialogue between all actors through an exchange platform, an adjustment of the indicators according to evolving stakeholder priorities and finally, the archiving of field data.

These benefits are applicable to other priority CBFP landscapes. The described approach will inspire the CGIAR institutions (CIFOR, ICRAF, Biodiversity International) long-term monitoring of "Referenced Landscapes" in their global research program on the changes of forest landscapes.

5.2. The management of wild fauna in Central Africa

5.2.1. The anti-poaching initiatives

In its previous edition, the State of the Forest outlined the multiple threats currently besetting the protected area systems in the subregion (Angu *et al.*, 2010). Among them poaching for ivory or bush-meat is considered likely to have the most serious impact on animal populations. This scourge has increased in recent years with the development of transnational criminal networks participating in the illegal traffic in fauna. The phenomenon is also having an impact in terms of public order and security as it has cost the lives of many trackers and ecoguards (Garamba in DRC, Zakouma in Chad, Bouba Ndjida in Cameroon).

Photo 3.14 : Squirrel caught in a trap – UFA Bétou, Congo

A range of anti-poaching measures

At the present time a whole series of tools and initiatives are being deployed to combat poaching. They may be summarized as follows :

- Supply of equipment : vehicles and weapons for anti-poaching teams, construction of security posts, particularly in sensitive areas and along access routes (roads, tracks, rivers, etc) ;
- Making sites secure : setting-up of security patrols, organization of lightning raids, creation of elite paramilitary units or support for national armed forces ;
- Strengthening capacity : increase in numbers and training of ecoguards ;
- Development of a MIST-type database (Management Information SysTem, available

on http://www.ecostats.com/software/mist/mist.htm) or SMART (Spatial Monitoring and Reporting Tool, available on http://www.smart-conservationsoftware.org/);

- Work with local populations: development of income-generating alternatives to poaching (e.g. agriculture, fisheries, market-gardening) and execution of education and awareness-raising programs;

- Increased law enforcement: strengthening and harmonization of legal and institutional frameworks regarding wildlife management, coordination of actions at the local, national and regional levels (see box 3.9 on PAPECALF).

Cross-border initiatives

The major anti-poaching innovation in Central Africa has been the move away from local or national initiatives to a cross-border approach. Coordination already exists in the TNS and TRIDOM (see section 5.1 and box 3.7). In late 2012, in order to respond to cross-border poaching, the tripartite plan involving Chad, Cameroon and CAR was approved by the COMIFAC Council of Ministers. In March 2013 an Extreme Emergency Anti-Poaching Plan (PEXULAB) was adopted as a supplement to PAPECALF in order to take urgent action against elephant poaching in Central Africa.

The cross-border anti-poaching actions are being set up in order to improve coordination of activities and involve the following principal participants: administrative authorities, protected-area conservationists, conservation project officials, etc. Cooperation takes the form of joint security operations in the border regions by multinational teams of ecoguards, sometimes supported by the armed forces. This strong cooperation between States needs to be further enhanced by the standardization of penalties and sanctions against poachers.

In October 2012, the Central Africa Protected Areas Network (RAPAC) initiated a study aimed at the harmonization of legislation relating to wildlife management. It will, *inter alia*, cover the various aspects of anti-poaching legislation in the subregion (procedures, penalties, etc.) and will propose common strategy actions.

Poaching unfortunately corresponds to the economic laws of supply and demand. Today it extends beyond non-compliance with the regulations relating to sustainable wildlife management in the various States. Poaching is becoming a question of national security and territorial integrity. More than in the past, the States responsible must take concerted action on poaching in order to guarantee the conservation of wildlife and its biodiversity.

Photo 3.15: Land turtle in Gabon forest

Photo 3.16: Gabon viper (Bitis gabonica) – Ndjolé region, Gabon

Box 3.9: Sub-regional action plan for the strengthening of the implementation of national laws on wildlife

Chouaïbou Nchoutpouen[1], Stephane Ringuet[2], Germain Ngandjui[2] and Marc Languy[3]
[1]COMIFAC, [2]TRAFFIC, [3]WWF

In February 2005, the Central African heads of state adopted a "Convergence Plan" outlining priorities for biodiversity management and for tackling poaching and the illegal exploitation of forest resources. Despite this political good will, the illegal poaching and trade, especially of ivory, have developed into extremely worrying proportions which pose a serious danger to vulnerable species such as elephants and great apes. Yet all these countries have signed and ratified several international conventions, including the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Convention on Biological Diversity (CBD). They have also all drawn up and adopted national laws in favor of sustainable wildlife management. Nonetheless, these laws are far from being implemented in the most efficient manner.

In June 2012, the COMIFAC Board of Ministers adopted a sub-regional Action Plan for the strengthening of the implementation of national laws on wildlife (PAPECALF). This groundbreaking plan, which will be implemented between 2012 and 2017, commits governments to reinforce the application of sub-regional national and international laws, conventions and agreements that regulate the management of wildlife in Central Africa. It aims to improve the implementation of the laws by introducing more efficient deterrent tactics against poaching and illegal trade. It also promises to aggressively increase the number of arrests and prosecutions of those implicated in poaching or illegal trade in the COMIFAC countries.

Specifically, the Action Plan's objectives are the following:

- strengthen cooperation and collaboration among the controlling and judicial authorities affected by the implementation of the laws on wildlife – both nationally and internationally - within the COMIFAC area;
- increase monitoring and checks, in particular in key transit areas or borders, internal markets and cross-border zones;
- introduce effective deterrents to tackle illegal wildlife poaching and trade; ensure prosecutions are carried out regularly and that they comply with respective national laws; ensure that the outcomes of investigations and prosecutions are closely monitored, published and widely broadcast;
- strengthen awareness of issues associated with illegal wildlife trade (Ringuet and Ngandjui, 2012; SC62 Doc. 30).

In order for PAPECALF to be effectively implemented, each country must allocate adequate financial and human resources to this end. The relevant government ministries must make everyone aware of this Action Plan though an effective communication process which results in implementation on a national level. Two bodies in charge of ensuring the Action Plan will be implemented have been created: a National Coordination Unit (CCN) which, in each country, will be embedded in the Ministry of Wildlife; and a Working Sub-Group on Wildlife and Protected Areas (SGTFAP), which will be embedded within the COMIFAC Working Group on Biodiversity.

The expected success of the implementation of the plan will rely on effective coordination and communication and sharing of information between the countries and the relevant organizations.

Box 3.10: Strengthening of cross-border surveillance in the TRIDOM area

Robbert Bekker, Bourges Djoni Djimbi and Paul Noupa
TRIDOM

TRIDOM is a cross-border tri-national complex of protected areas comprising the Dja wildlife reserve and the Odzala and Minkebe national parks. For two years now the TRIDOM partners have been taking a number of innovative actions to support the governments of the three concerned countries (Cameroon, Congo and Gabon) in their sovereign task of combating international poaching which is threatening elephants. These actions have taken the following forms:

Legal tools

As with the Sangha tri-national project, a cross-border protocol has been drawn up and will serve as a legal framework for joint surveillance operations along the common borders. In order to prosecute offenders of wildlife and environmental laws, three joint national committees have been established within the TRIDOM framework to monitor disputes and the application of laws (at Ouesso and Ewo in Congo, and at Makokou and Oyem in Gabon). Cross-border collaboration with Cameroon is being established. These committees operate under the aegis of the state prosecutors and comprise representatives of the ministries of forests and interior, the police, the *Gendarmerie* and armed forces, NGOs and economic partners.

The cross-border anti-poaching operation

The capacities of the surveillance teams on the ground have been strengthened. A common Management Information System (MIST) has been adopted in all the TRIDOM protected areas as a tool for monitoring anti-poaching activities. A total of 110 personnel have been trained to collect, analyze and interpret data (abundance of large mammals and human activities, size of fruit on the ground from the most important food plants). In addition, some 30 conservation workers (representatives of water and forests ministries, prefectures and sub-prefectures) have been trained in information techniques and the monitoring of wildlife. This training was given by national gendarmerie officers and by the state prosecutor attached to the Ewo Higher Court.

In Djoum (Cameroon), in Tala-Tala (Congo) and in Oyem (Gabon), the protected areas services, the brigades and the six frontier forestry posts were provided transportation equipment (vehicles, motorcycles, outboard motors), communications equipment (VHF radios, satellite telephones), and navigation and camping equipment.

These resources, valued at $ 530 000, have been financed by the Global Environment Fund. There are also plans to build a control post at the point where the frontiers of the three countries meet, close to the colonial marker near the village of Alati in Cameroon, and to base the future tri-national anti-poaching brigade there.

Lastly, TRIDOM conservation personnel have developed a joint cross-border anti-poaching action plan which was put into effect in 2013.

Example of a surveillance and anti-poaching unit in Congo

In order to contribute to the anti-poaching operation in the Forest Management Units (UFAs) at Tala-Tala (Sifeu) and Jua-Ikié (Sefyd) in the Department of Sangha in northern Congo, the TRIDOM project modeled its program on the WCS-supported experimental operation conducted in the Ngombé UFA (eastern part of the TRIDOM Congo segment). TRIDOM has supported a partnership between forest concession-holders, the government and WWF to create a surveillance and anti-poaching unit. In this context, the Forestry Department is making available the eco-guards responsible for conservation work, the forestry companies are financing operations on the ground in keeping with their concession commitments and WWF is providing its expertise in conservation and biodiversity. TRIDOM is supporting the initiative through the financing of equipment and training.

Community activities

Awareness-raising campaigns on community forests and conflicts between local people and elephants were conducted in order to remind these local people of the value of the natural resources within their environment. To date, 16 village communities on the edge of the Odzala-Kokua National Park have worked to reduce commercial hunting in exchange for the setting-up of income-generating activities (goat farming, aquaculture, beekeeping, development of a number of non-timber forest products, rehabilitation of coconut groves or intensive subsistence crops, etc.). Some communities want to participate in the surveillance of " strategic " clearings in order to reduce poaching and to facilitate the restoration of ecological corridors. Their objective, in the medium term, is to develop community-managed ecotourism.

Box 3.11 : An itinerant courthouse: the “mobile court” in the Salonga National Park (DRC)

Florence Palla
RAPAC

A mobile court now allows judges, prosecutors, defendants, witnesses and lawyers (around 20 people) to be transported right up into isolated areas. This had not been possible previously.

In November and December 2011, a *Chambre foraine* or mobile court was organized in Monkoto by the partners of the Salonga National Park (SNP), in support of the Congo Institute for the Conservation of Nature (ICCN). Ten poachers were tried for illegal possession of weapons and for poaching. By the end of the trial, seven life sentences had been handed out and the poachers were immediately transferred to Ndolo prison in Kinshasa. On this occasion, 12 weapons were seized and three (presumed) poachers were acquitted.

5.2.2. Action to combat trafficking of great apes

Several initiatives are specifically addressing the illegal trafficking of endangered great apes.

For example, the Last Great Ape Organization (LAGA, http://www.laga-enforcement.org/) is providing technical and legal assistance to Forestry and Wildlife Administrations in arresting and prosecuting illegal wildlife dealers in Cameroon, Gabon, Congo and CAR. Also LAGA has developed measurable standards of the effectiveness of enforcement of illegal trafficking (i.e. number of major traffickers arrested, convicted and imprisoned per week).

Also, new formal collaborative agreements by international agencies such as the International Consortium on Combating Wildlife Crime (ICCWC), which includes CITES, INTERPOL, the United Nations Office on Drugs and Crime (UNODC), the World Customs Organization (WCO), and the World Bank works to craft a comprehensive and collaborative approach to prevent illegal trade (http://www.cites.org/eng/prog/iccwc.php).

Other responses to great ape trafficking are described in “Stolen Apes”, available for download on the GRASP website (http://www.un-grasp.org/news/114-stolen-apes-counts-illegal-trade-toll). This report, published in 2013, is the first to analyse the scale and scope of the illegal great apes trade, and it highlights the growing links of sophisticated trans-boundary crime networks to wildlife trafficking.

At the sub-regional level, the COMIFAC Action Plan for the Strengthening of the Implementation of National Laws on Wildlife (PAPECALF 2012-2017) is another potentially effective instrument to shift the trend of great apes trafficking in Central Africa (Box 3.9).