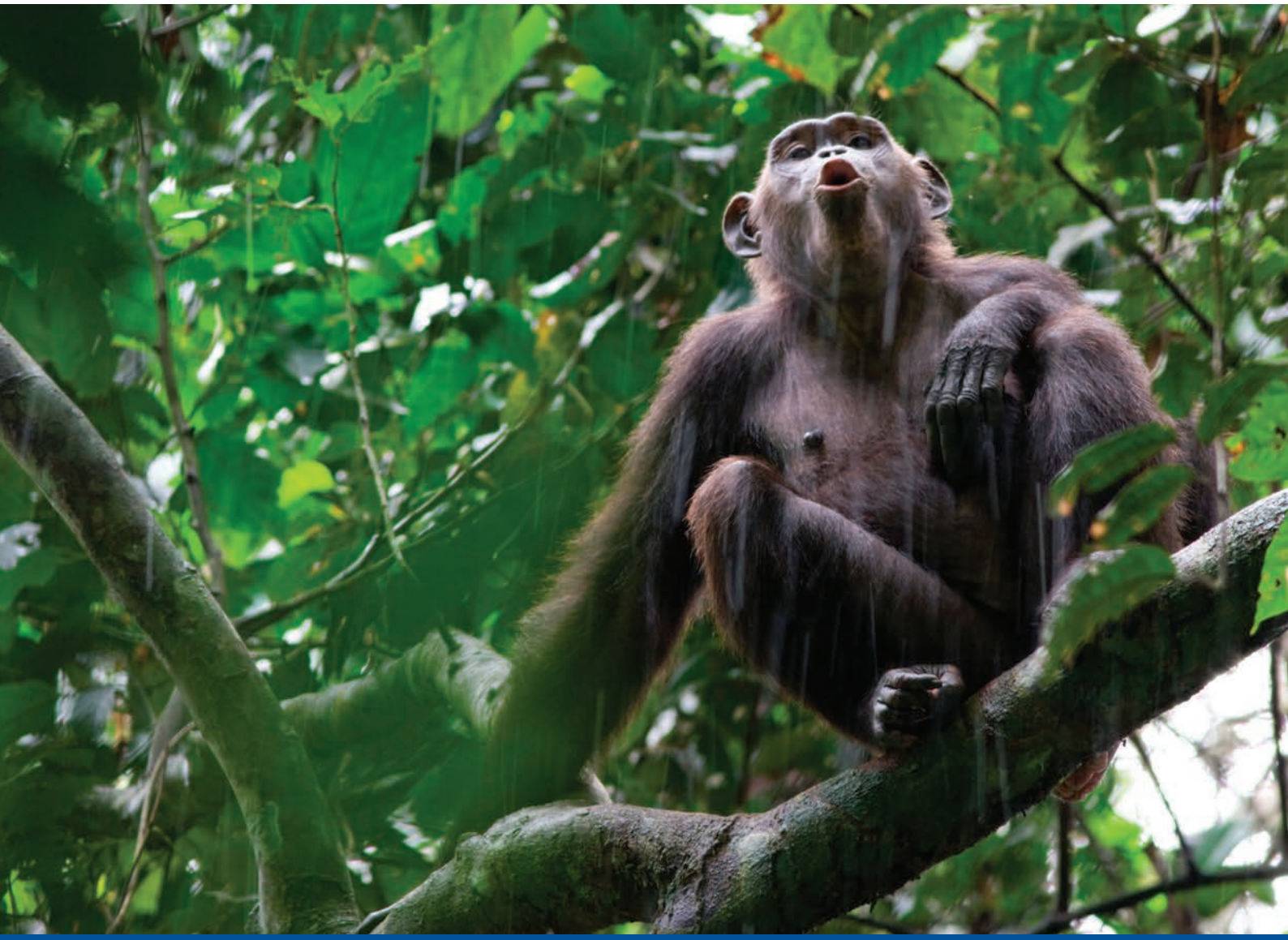
Great Apes and FSC: Implementing 'Ape Friendly' Practices in Central Africa's Logging Concessions

David Morgan, Crickette Sanz, David Greer, Tim Rayden, Fiona Maisels & Elizabeth A. Williamson



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SSC
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Cover photos: [front cover] Adult female chimpanzee in the Goualougo Triangle, Nouabalé-Ndoki National Park, Republic of Congo © Ian Nichols, National Geographic Society

[back cover] Aerial view of Congo Basin forest © Takeshi Furuichi

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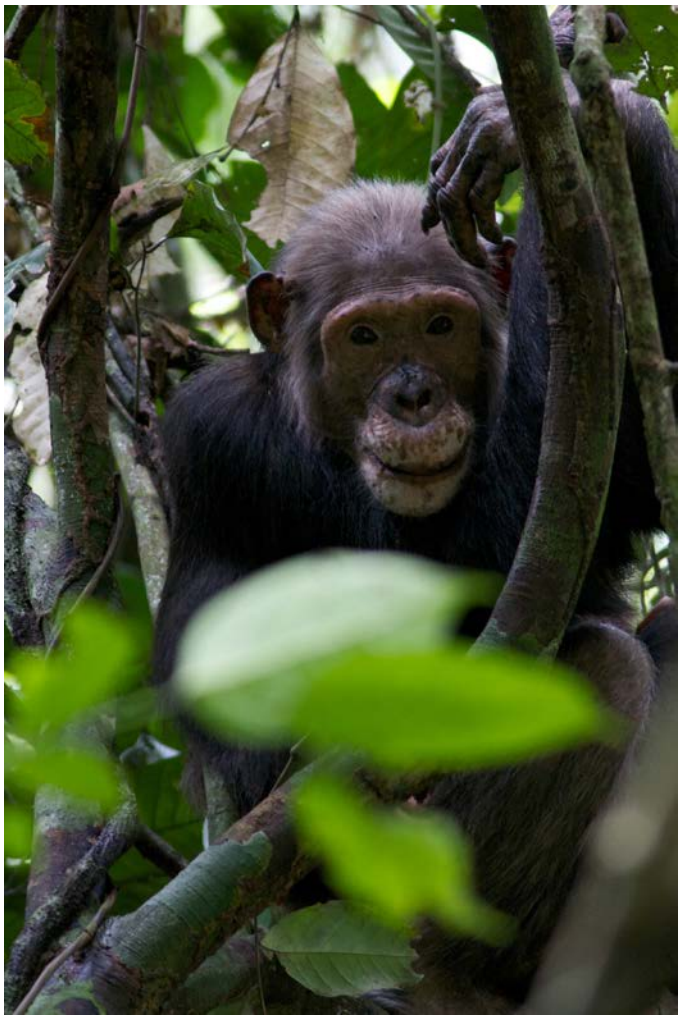
Section 1: Table of Contents

EXECUTIVE SUMMARY

The long-term survival of Africa's great apes has become increasingly uncertain. Dramatic declines in their population numbers have resulted from a combination of factors, including hunting, habitat loss and infectious disease. Although African apes are species of international concern, and despite concerted efforts since the 1980s to create protected area networks, develop conservation action plans and establish policy agreements, their populations continue to decrease. Future projections indicate that this trend will continue unless significant measures to reduce existing threats are taken immediately. The permanent disappearance of any ape species from the wild would be a huge loss to African biodiversity, to the important ecological function they play, and to our shared evolutionary heritage.

Roughly 23.5%[1] of Central Africa's forests are designated primarily for production (FAO 2011). In the Congo Basin (Cameroon, Central African Republic, Democratic Republic of Congo, Equatorial Guinea, Gabon and Republic of Congo), the majority of remaining forests outside of protected areas overlaps with habitat used by great apes (Tutin 2001). It has been suggested that to conserve endangered species (such as great apes), protection measures must be extended to other land-use types in the vast matrix in which protected areas are embedded. Putz and colleagues (2012) characterize secondarised forests as a 'middle way' towards maintaining biodiversity across these anthropogenic landscapes. As of 2010, 21 Forest Management Units in the Congo Basin had been awarded legal certificates, signifying their efforts to adhere to responsible forest management (Bayol *et al.* 2012). Certified concessions comprised 4,754 km^2 in 2010, of which 63.9% (3,040 km^2) was certified by the Forestry Stewardship Council (FSC), an independent, non-governmental, not-for-profit organization established to promote responsible management of the world's forests (Nasi *et al*. 2012). The increasing interest in FSC certification confirms that timber companies, in collaboration with their host governments, are willing to consider changes in forestry practices that promote the social and environmental stewardship required to maintain biodiversity. It is also of critical importance that policy makers understand that some alternative uses of production forestland, such as oil palm plantations, are simply not compatible with viable biodiversity conservation initiatives. Monocultures preclude the ecosystem services and non-timber forest products supplied by production forests, and do not supply the socioeconomic needs of local people, which are a requirement of FSC certification standards. Responsible production forestry practices are clearly better for biodiversity conservation than the conversion of land to monoculture plantations.



Female chimpanzee in the Goualougo Triangle, Nouabalé-Ndoki National Park, Republic of Congo © Ian Nichols, National Geographic Society

The objective of this document is to outline a framework within which logging companies adhering to FSC certification can be the catalyst needed to ensure the long-term preservation of African great apes. Building on Bennett's (2004) recommendations to the forestry sector for becoming more compatible with wildlife conservation, we provide specific guidelines and

1 Forest area in Central Africa is estimated to total 2,548,540 km^2 (FAO 2011; Table 1), and the area of forest designated primarily for production in 2010 was 598,440 km^2 (FAO 2011; Table 5). The countries listed as Central Africa are Burundi, Cameroon, Central African Republic, Chad, DRC, Equatorial Guinea, Gabon, Republic of Congo, Rwanda, Saint Helena, Ascension and Tristan da Cunha, São Tomé and Principe.

practical considerations as to how and why forestry and conservation practitioners should collaborate in maintaining wildlife. The most important immediate outcome of such partnerships will be a reduction in the illegal killing of apes. We also seek to promote collaboration between industry and conservation partners in identifying the High Conservation Value (Jennings *et al.* 2003) forest attributes that are necessary for great ape survival in production forests, at both the local and the landscape scale. For example, combining the timber operators' detailed and spatially-explicit tree data with the wildlife monitoring expertise of the conservation community would be a significant step towards maintaining vital forest functions and ecosystem services in production forests. Some logging companies could use forestry personnel to conduct wildlife monitoring, rather than execute surveys in collaboration with conservation experts. More important than who implements these activities is that monitoring is designed and implemented to yield accurate and precise information (for a summary of internationally recognized standards in great ape monitoring techniques, see Kühl *et al*. 2008). The incorporation of measures and safeguards for the protection of resources important for great apes in Forestry Management Plans, government Standard Operating Procedures, certification schemes and review processes would also greatly improve the conservation outlook of the gorillas, chimpanzees and bonobos in Central Africa.

Information on the great apes' preferred food species is useful for assessing and monitoring High Conservation Value Forest. Chimpanzees feeding on figs, Kibale National Park, Uganda © Alain Houle

Logging camp in northern Congo © Kent Redford

1. INTRODUCTION

Modern industrial timber extraction has transformed forests across central Africa over the past four decades. The floristic diversity and structure of most state-owned timber production zones called Forest Management Units (FMU) have been altered, and the wildlife, especially the large mammals, has been impacted to varying degrees. Little is known of the long-term direct and indirect effects of conventional exploitation on wildlife, especially how continued timber extraction will affect these populations over repeated harvests. Complex life history characteristics and diverse ecological needs underlie sensitivity to anthropogenic disturbance (Gaston & Blackburn 1997; Fisher & Owens 2004). Gorillas, chimpanzees and bonobos share many traits that increase their vulnerability to habitat change (see Box 1). Among the environmental threats, the intensity of logging disturbance likely plays an important role in whether or not ape populations persist in secondary forests. However, in the mid-1990s, a new consumer-led movement began to demand extraction practices with lower environmental impacts, and better ethical (usually social) standards for the forestry sector. Many timber producers complied in various ways, aiming to appease the environmentally

Box 1. African Great Apes at a Glance

There are two genera of African apes, gorillas (*Gorilla*) and chimpanzees (*Pan*). The genus *Gorilla* is divided into two species: the eastern gorilla (*Gorilla beringei*) and the western gorilla (*Gorilla gorilla*) (Sarmiento & Butynski 1996; Sarmiento & Oates 2000; Groves 2001). The eastern species consists of two recognized subspecies, the mountain (*Gorilla beringei beringei*) and Grauer's gorillas (*Gorilla beringei graueri*). The western species is also characterized by two subspecies, western lowland (*Gorilla gorilla gorilla*) and Cross River gorillas (*Gorilla gorilla diehli*). The western lowland gorilla is the most numerous and widespread, occurring across six central African nation states. The genus *Pan* is also composed of two species, the 'common' chimpanzee *Pan troglodytes* and the bonobo *Pan paniscus* (Jungers & Susman 1984; Coolidge & Shea 1992). Research over the last 50 years has shown that these African apes have complex life history traits that are closely tied to their ecology. Field studies carried out across equatorial Africa highlight the flexible behavioural patterns and ecological adaptability that have enabled these apes to evolve in a wide spectrum of dynamic and changing environments.

The group structures and mating strategies of *Gorilla* and *Pan* reflect differences in their use of resources despite their widespread coexistence. Gorillas live in small to medium-sized groups comprised of a dominant silverback male and his females. Among western populations, groups are typically led by a single male whereas some eastern gorilla groups feature several sexually-mature males (Weber & Vedder 1983; Robbins 1996; Harcourt & Stewart 2007). Solitary male gorillas who range alone are also characteristic of both species. Chimpanzees and bonobos live in communities with multiple males and females. Chimpanzee community sizes range from 20 to 150 individuals (Mitani 2006). This larger social unit regularly fissions into subgroups or parties which change in size and composition according to social conditions and food availability (Goodall 1986).

Both gorillas and chimpanzees range over considerable distances, but only chimpanzees show territorial behaviour—defending resources from other communities. One of the most notable variations within the *Gorilla* genus is the western gorilla's ability to incorporate a relatively high percentage of fruit into its diet. This contrasts with eastern populations that live at higher altitudes and rely chiefly on terrestrial herbs (Watts 1984; Ganas *et al.* 2004).

Great apes have long life spans compared to smaller species of primates and other mammals. Eastern gorilla females can survive into their mid-forties (Robbins *et al.* 2006); only a few males reach their mid-thirties. Chimpanzees and bonobos may live longer than gorillas; the oldest known chimpanzee was estimated to have survived to age 55 and others have been observed in their mid-forties (Hill *et al.* 2001). Great apes mature slowly and mothers spend most of their adult life rearing their offspring. Estimated intervals between successful births for females differ between populations. Studies of eastern gorillas indicate interbirth intervals of 3.9 to 4.6 years (Watts 1991). Data on western lowland gorillas indicate longer intervals (Robbins *et al.* 2004). Intervals between surviving bonobo and chimpanzee infants surpass those of gorillas, averaging 4.8 and 5.8 years respectively (Furuichi *et al*. 1998; Knott 2001). Due to their slow rates of maturation and reproductive stages, great ape populations are not able to recover quickly from hunting, habitat disturbance or disease epidemics. Detecting population declines is problematic because potential dips in abundance may lag behind the actual disturbances. Life history traits, phylogenetic age, as well as ecological specialization are important variables in determining a species' sensitivity to selective logging (Meijaard *et al*. 2008). Although gorillas and chimpanzees have repeatedly demonstrated their resilience to gradually shifting conditions and environments, the increasing pressures that humans are exerting on great apes and their environments simply have no historical analogue.

conscious North American, European and Japanese consumer markets. This movement is now gaining momentum in the African forestry sector. By 2011, 45,155 km^2 of Congo Basin forest had been certified[2], representing 10.2% of the area of logging concessions in the region[3] (Bayol *et al.* 2012). These are, however, modest gains, representing roughly 2.7% of the permanent forest estate (PFE)[4]. They include companies working in 22 concessions that have signed up to measures that reduce environmental impact with the intention of accessing 'green markets', which pay premium prices for environmentally friendly wood (an increasing number of governments have issued procurement policies banning the use of forest products harvested illegally and/or encouraging the use of forest products from sustainably-managed sources, FAO 2011). The new and intensifying relationship between Africa and emerging markets in China and India could, however, change how industrial timber companies adopt and adhere to certification schemes. Some industry analysts caution that the rise in Asian markets, which historically have been shown to be less concerned with biodiversity safeguards and environmental accountability, may directly undermine adoption of sustainable forestry management (SFM) practices and the role of certification schemes. If the demand for timber products in the Asian markets continues without requirements for environmentally-sound sourcing of timber, companies without strong ties to European and American markets will avoid certification, as it is not a legal requirement. Complying with certification standards can be more costly to a company than simply 'business as usual', although some evidence has pointed towards win-win situations in some reduced-impact logging (RIL) scenarios (Putz *et al.* 2008). A trend away from certification would be detrimental to environmental achievements made to date in African countries, and reduce the influence of agencies such as the African Timber Organization (ATO), Food and Agriculture Organization (FAO), International Tropical Timber Organization (ITTO), International Union for Conservation of Nature (IUCN) and World Resources Institute (WRI), which have long worked to strengthen institutional capacity in the African forestry sector, improve governance and promote transparency.

Growth in certification is viewed as a significant indicator of progress toward balancing industry needs with the preservation of biodiversity. Increasingly, conservation biologists and NGOs in Central Africa view certification as a sustainable model for production and one that could be adopted as standard practice for all forestry concessions (Section 3). However, critics and even some stakeholders are concerned that certification requirements do not set high enough standards to ensure the conservation of important biodiversity. Input from scientists and conservationists can fill important knowledge gaps and facilitate the broader communication of their findings (Putz & Viana 1996; Uhl *et al*. 1997). In the past, there was concern that researchers with on-the-ground knowledge of how to improve conditions for local wildlife were not able to effectively change standards (Bennett 2000), but this situation is improving and this document is an example of the progress made. Recent revisions to the Forestry Stewardship Council (FSC) *Principles and Criteria*[5] have increased reliance on process and reduced the number of absolute performance requirements. However, there is room for improvement in demonstrating to forestry companies how they can meet the FSC's environmental standards. FSC sets few concrete requirements for biodiversity protection, but instead leaves detailed specifics to national standard setting groups or certification bodies. For example, in the Congo Basin, FSC does not require that a fixed percentage of each concession be set aside for conservation purposes. Each company is required to identify the relevant environmental values and to take appropriate protection measures, but FSC does not prescribe what these should be. Evaluation of these elements is also left to the discretion of auditors and is judged on a case-by-case basis. Again, this is where input from scientists and conservationists can improve certification standards by providing evidence-based recommendations and specific indicators, which auditors can draw upon to evaluate whether environmental values are being preserved.

Given the importance of many central African forestry concessions for great apes, it is vital that appropriate indicators and means of verification be developed to guide both companies and

2 Total certified forest in the Congo Basin as of February 2011 (Bayol *et al*. 2012; Table 2.4)
3 Total area of forest concessions in the Congo Basin estimated at 441,514 km^2 (Bayol *et al*. 2012, Table 2.2)
4 Total lowland forest in the Congo Basin in 2010 estimated at 1,688,827 km^2 (Bayol *et al*. 2012, Table 2.2)
5 https://ic.fsc.org/principles-and-criteria.34.htm

auditors towards specific actions aimed at maintaining ape populations in managed forests. Building on existing recommendations to reduce the impact of logging disturbance on great apes (Morgan & Sanz 2007), the objective of this document is to provide clear guidance for range states, forestry managers and the FSC to help them to strengthen current requirements aimed at safeguarding important great ape populations in production forests, which comprise an estimated 598,440, km^2 of Central Africa (FAO 2011).

Complex environmental, social and economic issues must be addressed when attempting to reduce the threats confronting wildlife (Auzel & Wilkie 2000; Salafsky & Wollenberg 2000; Bennett *et al.* 2007; Poulsen *et al.* 2009; Guariguata *et al.* 2010; Lindenmayer & Laurance 2012). This document provides practical guidelines for (i) strengthening law enforcement within FMUs and (ii) implementing the High Conservation Value (HCV) approach, which aims to advance locally adaptable management strategies that maintain and enhance critical environmental and social values of forests (Jennings *et al.* 2003). Throughout this document we discuss measures that forestry policy makers and practitioners can implement to protect apes and their environments. The potential benefits of these initiatives will be far-reaching and enhance the survival prospects of many coexisting species. In this respect, apes can be used as a proxy for other terrestrial, avian and invertebrate species sharing similar ecological needs and habitats.

The geographic ranges of the majority of African great ape populations are believed to be outside protected areas. Thus, significant conservation benefits will result from the implementation of 'ape friendly' practices in production forests. Steps towards providing more participatory practices and concrete laws for forest and wildlife management in the Congo Basin were established in 2000 (Nasi *et al.* 2012). The signing of the Gorilla Agreement in 2007 by five range states indicates political will towards improving policy and environmental conditions for gorillas throughout their range, including the whole of the PFE (CMS 2007). Action points specified in the 'Gorilla Agreement' complement the African Forest Law Enforcement and Governance (AFLEG) action plan, which aims at curbing illegal exploitation of forest resources and promoting more effective management of wildlife (AFLEG 2003; see also www.illegal-logging.info). Presently, the terms for the management of the forest estate are formalized for each FMU in a Forest Management Plan (FMP), a document required of the logging company leasing the land for resource extraction. The FMP sets out the company's obligations for managing the timber, wildlife and local livelihood initiatives within the concession. At present, 135,504 km^2 of concessions in the Congo Basin are operating under management plans approved by governmental decrees, and a further 86,417 km^2 have FMPs in preparation (Nasi *et al.* 2012). This suggests that the fundamental parameters needed to build and strengthen conservation measures are available or developing. Logging firms working within FMPs

Gorillas spend a lot of time on the ground. Young adult female gorilla with her infant, Mondika, Republic of Congo © Ian Nichols, National Geographic Society

and national or international certification frameworks (such as FSC) have ecological databases that could be used to significantly improve the conservation status of great apes within their FMUs. We make recommendations for using this information to enhance protection efforts and develop site-specific strategies for ape conservation, based on synergistic collaboration and communication.

Forestry companies have the opportunity to be instrumental for the survival of African great apes outside protected areas. Well managed and monitored timber concessions that border strict nature reserves (IUCN category I) and national parks (IUCN category II) can act as buffers to illegal encroachment and settlement, habitat degradation and resource exploitation, such as hunting, which would otherwise severely decrease the identified inherent values (i.e., endangered species, forest attributes) of the landscape. Loss of species and or drastic changes in forest habitat can alter the ecological functioning of the very systems that range state governments are trying to conserve. To improve the conservation value of protected areas and their surroundings, neighbouring concessionaires should partner with governments and the conservation community to implement a framework of management prescriptions and evaluation procedures that identify and ensure the preservation of forest attributes necessary for wildlife well-being.

2. THE IMPORTANCE OF CONSERVING GORILLAS AND CHIMPANZEES

IUCN categorizes all species and subspecies of African great ape as Endangered or Critically Endangered on the Red List of Threatened Species (IUCN 2012). Ensuring the survival of their remaining populations is one of the greatest conservation priorities in equatorial Africa. The ecology and social systems of the great apes are complex, so it is not surprising that their responses to logging and associated habitat changes are also complex and still poorly understood. The negative impacts of the direct threats of hunting, land clearance and disease on great apes are exacerbated by the indirect and interlinked nature of underlying socio-political factors. For example, logging activities create access to hitherto remote forests, thus facilitating commercial hunting and the potential exchange of diseases between humans and wildlife. Considerable spatial overlap between apes and humans occurs in active logging concessions, which provides an increased means for cross-species transmission of diseases through contact with faeces, handling of shared food resources, or even direct contact. Thriving urban markets for bushmeat encourage the trafficking of large-mammal carcasses, including those of apes, from remote forest sources to city centres hundreds if not thousands of kilometres away. The interlinked nature of these factors complicates the interpretation of the analysis of the impact of forestry *per se* on great apes.

Large frugivores worldwide provide important ecosystem services (above all, seed dispersal for a significant proportion of tree species, and thus maintenance of floristic diversity and forest structure), and their removal from tropical ecosystems can have far-reaching consequences for tree community dynamics (Balcomb & Chapman 2003; McConkey *et al*. 2012; Effiom *et al.* 2013). This is particularly true for the great apes (Williamson *et al.* 1990; Wrangham *et al*. 1994). Gorillas and chimpanzees in Gabon disperse the seeds of 125 plant species (Tutin *et al.* 1996), and are the main or even sole disperser for some of them (Tutin *et al.* 1991; Voysey *et al.* 1999a). Great ape home range sizes and daily travel distances surpass those of most other forest primates, thus they can disperse seeds far from the parent plant, which is advantageous to seedling survival (Janzen 1970; Connell 1971). Chimpanzees discard seeds in ‘wadges’, which they spit out while foraging or travelling, as well as through their dung (Gross-Camp & Kaplin 2011). Gorillas often build their night nests in light gaps, which provide good growing conditions for seeds that germinate in their dung, aiding forest regeneration (Voysey *et al.* 1999b).

Gorillas and chimpanzees prefer slightly different forest types. Gorillas favour areas with a more open canopy and a thicker herb layer. They live, however, in the same forests and feed on many of the same tree species. As long as the forest types suitable for both are encompassed by the

conservation areas in production forests, this shared existence can be useful to informed and cost effective management approaches.

Maintaining particular forest attributes, such as food resources for apes, will also safeguard other vertebrate taxa. Several coexisting mammals such as elephants, forest hogs, duikers, numerous smaller primate species and hornbills consume many of the same foods as great apes. Efforts to protect ape food resources, therefore, will also benefit other species, as would efforts to control hunting and the illegal bushmeat trade. These actions will help to stem the downward trend in species diversity that typifies secondarised forests throughout the tropics.

Modern human demands for natural resources have led to the transformation of a large fraction of pristine great ape habitats into 'anthropogenic biomes' (Ellis & Ramankutty 2008). Habitat conversion can have both positive and negative impacts on local wildlife persistence and is at the centre of many of the challenges facing biodiversity conservation. Species-specific traits, such as abundance, mobility and dietary niche, are important in determining their responses to external disturbance. In Amazonia, arachnids and ants appear sensitive to even low intensity logging, with some communities rapidly responding with changes in population densities and species composition and richness (Azevedo-Ramos *et al.* 2006; Barlow *et al*. 2006). Other species such as some canopy-dwelling birds respond favourably (Mason 1996) or show no discernible response (Whitman *et al.* 1998). A substantial proportion of the literature detailing the impacts of logging has shown that generalist species with less restrictive social systems and diverse diets, such as folivores, are more adept at coping with environmental change. Evidence supporting this claim has been observed in ungulates such as sambar deer and banteng (Davies *et al*. 2001). In contrast, impacts of logging may be more detrimental for specialist species with constrained ranges or high site fidelity such as mousedeer (Davies *et al*. 2001) or insectivorous birds with specialized foraging modes (Thiollay 1992; Mason 1996).

Among mammals, primates are well known for socio-ecological flexibility. Studies across a variety of primates inhabiting human-disturbed habitats indicate that species-specific responses are not always predictable. This is exemplified in *Pan* and *Gorilla*, which demonstrate considerable variation in their responses to logging. Functionally, chimpanzees have been classified as forest specialists and gorillas as generalists (Bourlière 1985). Thus, the assumption that the former is more sensitive to habitat exploitation than the latter still dominates current thinking. In support of such claims, monitoring of chimpanzees during, or in proximity to, selective logging indicates

Chimpanzees on a road in Uganda © Debby Cox. Logging roads may bisect a chimpanzee community's home range. Chimpanzees adjust their behaviour to reduce risk to group members when crossing roads (Hockings *et al.* 2006).

that disturbance can have an immediate and potentially negative impact on their numbers (White & Tutin 2001). Several studies have also indicated that chimpanzees are more adapted to mature forest (Matthews & Matthews 2004; Clark *et al.* 2009; Stokes *et al*. 2010); however, nest counts at some other sites indicate that population numbers in secondary forest are similar to those in unlogged habitats (Plumptre & Reynolds 1994; Dupain *et al.* 2004; Arnhem *et al.* 2008; Morgan *et al*. submitted). Chimpanzees have certainly managed to survive in fragmented and modified forests in Nigeria, but sites surveyed recently are losing their remaining chimpanzees (Greengrass 2009) and this will continue unless drastic action is taken.

Gorillas on the other hand do not have the same foraging restrictions or social ranging limitations as chimpanzees or bonobos because they are not territorial. This may help them to resist the impacts of forestry activities. Post-logging nest surveys of gorillas have shown that they can persist at quite high densities as long as hunting is prevented (Matthews & Matthews 2004; Clark *et al.* 2009; Stokes *et al.* 2010). Nonetheless, gorilla densities decline in proximity to the roads and human settlements that are found throughout logging concessions (Poulsen *et al.* 2011), indicating variability in population responses in active or previously logged concessions. Evidence also suggests that gorillas may be at higher risk to some diseases than chimpanzees because they are more terrestrial and thus have increased contact with infectious pathogens associated with humans (Gillespie *et al*. in prep.).

Long-term monitoring of the rich primate community in Kibale National Park, Uganda, has shown that high-intensity logging is not compatible with primate conservation (Chapman *et al.* 2000). If forest exploitation is to occur, it should be both selective and low impact, although efforts to elucidate the short- and long-term impacts of timber exploitation on great apes are still in their infancy. Factors known to heavily influence primate densities, such as the spatial and temporal distribution of logging disturbance and the recovery time following tree extraction (Skorupa 1988; Weisenseel *et al.* 1993) can be re-evaluated with the large forestry and great ape datasets now available (for northern Congo, for example). Statistical analysis and simulation models can be used to assess and even predict the impacts of specific factors such as canopy loss, size of an active logging front and baseline ape abundance. A recent meta-analysis investigation clearly showed that African great apes are threatened by a variety of external factors, one of the most important being habitat loss (Junker *et al*. 2012).

3. CONSERVATION REQUIREMENTS OF THE FSC STANDARD RELEVANT TO GREAT APES

Certification systems such as FSC have an obvious appeal for tropical nations and foresters interested in the potential economic benefits of selling timber to environmentally conscious consumers. For governments, FSC provides the opportunity to increase production and technical expertise in their forestry sector in a timely and efficient manner, whilst also protecting biodiversity and ecosystem functioning during exploitation. At the same time, governments should assist forestry companies who seek to carry out viable timber exploitation over the long-term, for a variety of environmental, political and social reasons. The independent oversight provided by suitably qualified, expert audit teams, and the public reporting of audit findings, promotes transparency in the forest sector with indirect benefits for long-term improvements in governance.

There are numerous examples of the exhaustion of timber stocks in non-protected forests caused by repeated timber exploitation at unsustainable levels. Even when these secondary forests become devoid of valuable timber, the demand for roundwood remains, and the risk of illegal logging significantly increases in protected areas where remaining primary forests still exist. Illegal logging in parks threatens both flora and fauna, and the very integrity of the ecosystem that merited protected status in the first place. Continued degradation of logging concessions increases the likelihood that these secondarised forests will be cleared and converted to other land uses, notably agriculture and plantations. In most cases, the resulting habitat no longer provides local

people with vital environmental services (regulation of water regimes, contribution to mitigation of global warming) and non-timber forest products (edible fruits, leaves, medicinal plants, game). Range state governments have a vested interest in ensuring that human communities living in or near logging concessions have their interests and well-being considered in the management of these secondary forests. All too often, rural communities are disproportionately impacted in terms of economic and ecological costs by forest clearance and conversion. Human population size is rising in most of the countries of Central Africa[6], and effective management of secondary forests will be needed to avoid further marginalization of rural people.

The scope of the potentially beneficial aspects of FSC certification should not be underestimated in terms of integrating wildlife and human considerations. In the following sections, we summarize the conservation requirements of the FSC Principles relevant to great apes, and recommend additional actions for inclusion in certified forest management practices to enhance the conservation of great apes.

The FSC Certification System

The certification of forest management under the FSC system depends on auditing by a qualified independent auditing body. Auditing bodies are accredited for the FSC and verified annually to ensure that they respect the established procedures and standards.

Accredited auditors carry out annual audits of forest management companies, against an international standard of 10 principles. The standard includes elements concerning respect for national laws, respect for local and indigenous people's rights, safe working conditions and environmental attributes. For each principle, specific criteria are elaborated to enable the measurement of performance. These criteria can be interpreted and elaborated at national levels to provide more specific guidance to forestry companies and their auditors.

The principles of particular significance for great ape conservation are Principle 6, which concerns environmental values and impacts, Principle 7 on management planning, Principle 8 on monitoring and Principle 9 concerning the protection of HCVs. In the following section, we examine the existing requirements of these principles, and suggest ways in which the application of these principles could be improved in the great ape range states.

FSC Principle 6 – Environmental Values and Impacts

Principle 6 requires companies to assess the forest concession. The assessment process must:

- Identify existing environmental values (Criterion 6.1)
- Identify potential threats to these values from forest management activities (Criterion 6.2)
- Define and adopt appropriate measures to safeguard these values (Criterion 6.3)

The environmental values that must be evaluated are not defined in the standard, but will include the 'rarity, vulnerability and conservation status' of species and habitats present in a concession (FSC 2012). Clearly, the presence of endangered great apes and their habitat are of environmental value for concessions in Central Africa.

In addition to the assessment requirements, Principle 6 carries some vitally important requirements for concrete conservation measures:

- Direct protection of habitats (Criterion 6.4)
- Effective control of hunting (Criterion 6.6)

6 http://data.worldbank.org/indicator/SP.POP.TOTL

Direct protection of habitats is critical in some areas where disturbance would displace great apes into less favourable habitat. This is discussed in Section 6 (under Monitoring of Threatened Species in Logging Concessions).

Illegal hunting (which includes hunting of protected species such as great apes) should be formally and completely prohibited, and control measures should be in place to ensure that forest workers, local residents and immigrants do not engage in poaching or other illegal practices within forestry concessions. Nevertheless, strategies that promote a strong vested interest in the sustainable management of natural resources, such as wildlife, by local communities will likely have greater traction towards long-term success. Promoting selective hunting through effective law enforcement in designated 'controlled hunting zones' within logging concessions has the potential to limit overexploitation of wildlife. Organized hunts also increase the likelihood that offtake rates of game species are not exceeded and that illegal hunting is effectively controlled within concessions. Influxes of immigrants (migrants and foreigners) to logging towns can also result in significant increases in hunting of wildlife in forestry concessions (Poulsen *et al*. 2009). Local communities should be empowered to monitor and report illegal activities by these 'outsiders'.

Human disease transmission is a major threat to great ape survival that is not explicitly recognized in the FSC standards. However, given the obvious environmental value of great apes in the forests of Central Africa, we recommend a set of specific measures to combat disease transmission in certified forests. Some recommendations for improving the application of FSC principle 6 are proposed in the table below.

Identifying and Managing Risks and Threats to Environmental Values (based on FSC Principle 6)

Key Element of the Recommended 'Ape Friendly' Conservation Action
Potential impacts of human diseases on great apes
Rationale for Inclusion of Required Actions
As formulated, this criterion does not specifically address the impacts of poor management of human health on wildlife, especially great apes.
Recommended Indicators
• Forestry companies implement an education programme to explain the health measures and standards that employees must follow. • Employees are not allowed to enter the forest when they are ill. • Workers are treated for common parasites on a regular and prophylactic basis, and vaccinated for Polio, Diphtheria, Measles, Mumps, Rubella, Tetanus, Tuberculosis, Typhoid and Yellow Fever. • Forestry managers ensure that all latrines in a concession meet the depths required to reduce the likelihood of transmission of human parasites to wildlife. • Proper sanitation measures are established for employees working in concessions. For example, proper disposal of faeces away from a latrine requires that each hole must be dug to a depth of at least 30 cm. After use, the hole must be covered and compacted. • Forest managers control and monitor forest camps and exploitation sites to assess the health and behaviour of personnel and their adherence to specified sanitation measures.

Importance of enforcing health and safety measures for employees and their families

Implementation of health and safety measures is essential for both humans and wildlife in forestry concessions. This is particularly relevant to logging firms operating in Central Africa, where emerging and resurgent diseases are of great concern to both humans and wildlife. The health of great apes and forestry personnel are interconnected, as they are spatially very close within timber concessions. Concessions usually contain logging towns where hundreds or even thousands of people can be concentrated. In addition to the disease risks to wildlife, there is also the potential for forestry personnel to be exposed to deadly diseases such as the Ebola virus through the illegal handling and butchering of great ape carcasses. Transporting bushmeat through concessions on logging trucks appears to be common practice even in concessions where strict rules prohibiting

such activities are in place (Poulsen *et al.* 2009). As a consequence, large numbers of people could be exposed to highly infectious carcasses. Adoption of a more holistic approach to health and safety would reduce the risks of disease transmission for both humans and wildlife. Policy measures prohibiting the killing and transport of wildlife by company personnel and vehicles are necessary to curb potential health risks. Further, if basic sanitation measures are implemented, companies stand to improve the health, efficiency and overall productivity of their workforce while at the same time safeguarding wildlife.

Benefits of implementing recommendations that address FSC Principle 6:

- Improved employee health and long-term work performance.
- Reduced exposure of foreign pathogens to apes, other wildlife and the environment.
- Lower exposure and risk of infection to both apes and humans from diseases of human origin.
- Increased long-term survival of wildlife populations in forestry concessions.

FSC Principle 7 – Forest Management Plan

Principle 7 requires companies to produce a management plan that specifies policies and goals related to the environmental, societal and cultural characteristics of the leased concession. This assessment process must:

- Set policies and objectives that correspond to the scale and scope of the leased concession (Criterion 7.1)
- Describe natural resources that exist in concessions and develop plans to manage risks to those identified as HCV (Criterion 7.2)

These elements of the standard require that concession holders develop policies and objectives for Management Units appropriate to the specific environmental, social and cultural characteristics of the landscape. These are published in a Forestry Management Plan (FMP). Specifics of wildlife management are not provided by the standard, but guidance notes for monitoring programmes should be put in place to prevent negative impacts on HCVs (such as endangered species) within concessions.

During active exploitation of timber, sawn logs are often placed along logging roads ready for transport to saw mills
© David Morgan

Maintenance of Biological Diversity through Enhanced Management Planning (based on FSC, Principles 6 and 7)

Key Element of the Recommended 'Ape Friendly' Conservation Action
Subsidize mobile anti-poaching teams and enforce employee code of conduct
Rationale for Inclusion of Required Actions
Criterion 6.6 states that companies shall demonstrate that effective measures are in place to control hunting. In Central Africa, given the weaknesses in the law enforcement capacities of state governments, this is likely to require that companies actively finance the protection of wildlife from illegal hunting or trafficking. It will also require that companies put in place strict regulations dealing with illegal activities involving bushmeat and ensure that only authorized people can enter concessions.
Recommended Indicators
• An enterprise employs a 'wildlife manager' responsible for ensuring that employees are aware of, and follow, national and international wildlife laws, as well as internal company regulations concerning wildlife. • An enterprise provides adequate funds and logistics for patrolling concessions to monitor authorized hunting and to prevent illegal poaching and unauthorized trafficking and transport of wildlife products and hunting materials by company staff, contractors and non-employees. • The body directing eco-guard missions (usually a government body or a non-governmental organization or a combination of both) uses a monitoring system that allows the effectiveness of anti-poaching measures to be regularly evaluated and improved (i.e., MIST* or SMART**). • An enterprise provides employees residing in the FMU with non-wild protein (such as tinned, salted, or dried meat from domestic animals or fish) priced lower than bushmeat. In general, staff working in the field must have ready access to affordable protein to eliminate any need for hunting or fishing to obtain animal protein. No wild meat should be sold within concessions to or by employees or to or by any other person unless strictly controlled by law enforcement teams. Even in the latter case, only rodents and blue duikers should be sold and no other wild species. • Forestry teams are strictly limited to company employees, contractors and designated support staff; no family members accompany the forestry teams into concessions. • Forestry and contractor vehicles do not transport hunters, firearms, munitions, or wildlife (dead or alive) (unless for an authorized, law enforced hunt). • In partnership with government, non-governmental organizations, and local stakeholders, timber exploitation managers participate in the identification and implementation of 'controlled hunting zones' and law-enforced hunts of non-protected species. • Companies systematically monitor and document all incidences of illegal hunting. • Evidence of illegal hunting is immediately reported to the relevant authorities. • Compliance with laws protecting wildlife is evaluated annually by government forestry and wildlife agencies and independent auditing bodies such as the FSC. *http://www.ecostats.com/software/mist/mist.htm ** http://www.smartconservationsoftware.org/Home/HowcanSMARTworkforyou.aspx

Importance of subsidizing anti-poaching teams and enforcing employee code of conduct

One of the major challenges facing biodiversity conservation in timber concessions is the uncontrolled poaching of wildlife (Wilkie *et al*. 2001; Poulsen *et al.* 2009). The threat of hunting faced by gorillas, chimpanzees and bonobos is widespread (e.g., Williamson *et al.* 2013), though the extent and degree of harvesting is not well documented in most regions. Based on surveys of Gabonese city markets and rural households, great ape meat tends to constitute a small percentage of what is available and consumed (Foerster *et al.* 2012). However, even low offtake rates from hunting can have outsized impacts on vertebrate populations. Across the tropics, there are many examples of wildlife harvesting at unsustainable levels (Robinson & Bennett 2000). African great apes are no exception and their rarity and slow reproductive rates make them extremely vulnerable to any population perturbations (e.g., Williamson *et al.* 2013). The maximum percentage of sustainable offtake for a variety of smaller African and Latin America primate species ranges between 1% and 4%, which is very low when compared to other mammals such as rodents and ungulates (see

Robinson 2000). Based on these figures, even opportunistic poaching of gorillas, chimpanzees or bonobos is likely to be highly detrimental to their survivorship.

Studies of great ape abundance outside protected areas in Gabon indicated that in 1983, chimpanzee densities were reduced by 57% and gorilla densities by 72% in areas subject to heavy hunting (Tutin & Fernandez 1984). Further surveys also suggested that hunting may have led to the extirpation of great apes in some of these forests (Lahm 2001). Subsequently, Walsh *et al.* (2003) demonstrated that the great ape population of Gabon was halved between 1983 and 2000 by a combination of poaching (near towns and villages and along roads) and outbreaks of the Ebola virus in the remote northeast region. The time frame over which such detrimental and consequential population declines occur depends upon the initial abundance of species and the intensity of harvesting. It is likely that rapid decreases in great ape density begin close to human settlements and along transportation routes, followed by declines in more remote forests, including concession forests (Wilkie *et al*. 2001). Based on models of production sustainability, local depletion of a particular species could theoretically occur over a short timeframe. Observations of the temporal and spatial dynamics of hunting in logging concessions in northern Congo showed a rapid depletion of the prey base (Wilkie *et al*. 2001). Estimated rates of return in one concession declined by a stunning 25% during a three-week period, by which time hunters had opted to search for new hunting grounds with higher rates of return (Wilkie *et al*. 2001). Implementation of mobile anti-poaching teams could effectively halt poaching (Hillborn *et al.* 2006) and be highly effective in protecting wildlife in both protected areas and timber concessions (Stokes *et al.* 2010; Tranquilli *et al.* 2012). This has been demonstrated in the timber concessions of northern Congo, where comparison of great ape densities in 2006 with those in 2011 showed that their population densities had been maintained, which was attributed to effective anti-poaching measures (Maisels *et al*. 2012). It should be emphasized that support and commitment for such protection measures is an obligation of the concession holder and must be ensured for the long term. Both national governments and certification bodies are well-positioned to uphold and enforce hunting regulations. By either mobilizing protection efforts from within the company or subsidizing the costs of wildlife protection by an independent organization, specifically through support for eco-guards, timber companies stand to play a major role in great ape conservation.

Benefits of implementing recommendations that address FSC Principles 6 and 7:

- Immediate protection of wildlife from poaching.
- Increased long-term survivorship of vertebrate populations in forestry concessions.
- The logging enterprise is directly (and publicly) associated with improved stewardship of wildlife.
- Employment and effective management of ex-poachers as eco-guards further reduces hunting impact on wildlife.
- Reduced human encroachment and lower rates of introduction of foreign pathogens into an ecosystem.
- Removal of cable snares reduces the rate of injury and death of great apes and other wildlife.
- Reduced likelihood of illegal settlements being established in concessions.

FSC Principle 8 – Monitoring and Assessment

One key requirement in Principle 8 urges that the impacts of forestry activities on biodiversity be monitored. This is criterion 8.2.

This element of the standard requires that concession holders monitor and evaluate the environmental and social impacts of their activities, and monitor changes in forest conditions. Specifics on wildlife management are not given in the standard, although the guidance notes imply that monitoring activities will apply to wildlife populations, biodiversity and the status of HCVs within

concessions. We recommend that direct monitoring of the impacts of forestry activities on ape populations should be required in areas considered priorities for great ape survival (see Box 2).

Box 2. Priority Areas for Chimpanzee and Gorilla Conservation

Conservation Action Plans for African great apes identify priority areas and recommend actions for mitigating the threats to their survival. Those published to date are listed in Section 10. In 2005, a workshop was convened to identify priority sites for great apes in western equatorial Africa. Since large populations tend to have better long-term viability than small populations, the first criterion used to determine priority was great ape population size. The second was habitat block size (see ranking below). The third criterion was the importance of each site in biodiversity terms. Several areas classed as 'exceptional' and 'important' priorities were located in timber concessions. The action plan produced (Tutin *et al*. 2005) reviewed major threats to great apes and actions needed to reduce them.

Great ape population size, scored on a 5–point scale:	**Area of site, scored on 5–point scale:**
5 > 4,000 apes	**5** > 16,000 km^2
4 > 2,000 apes	**4** > 8,000 km^2
3 > 1,000 apes	**3** > 4,000 km^2
2 > 500 apes	**2** > 2,000 km^2
1 > 250 apes	**1** > 1,000 km^2

Monitoring and Assessment of Ape Populations (based on FSC Principle 8)

Key Element of the Recommended 'Ape Friendly' Conservation Action
Regular monitoring of threatened species in logging concessions
Rationale for Inclusion of Required Actions
This criterion does not clearly establish the need for long-term monitoring of threatened wildlife within forestry concessions.
Recommended Indicators
• Forest managers are well informed about the protected species occurring in a concession and that are subject to targeted monitoring activities. The monitoring of a particular species is justified on the basis of its rarity and vulnerability, and monitoring of great apes is conducted by a conservation organization or scientists with expertise in research and monitoring. If the concession holder chooses to use forestry personnel to carrying out monitoring, then appropriate training should ensure that standardized data are collected. • Forest managers confirm that a standardized wildlife monitoring programme is established, which enables assessment of abundance and distribution of wildlife populations over time, and that results and recommendations from such activities are discussed and considered during evaluations or independent audits. • Wildlife surveys are designed, conducted and analyzed following standardized methodologies (cf. Kühl *et al*. 2008). There are numerous resources available to operators who wish to implement research and monitoring programmes in their concessions (see Box 8). • Review and assessment of the monitoring programme is established in collaboration or in consultation with regional conservation biologists or local experts.

Importance of monitoring threatened species in logging concessions

Much of the geographic range of great apes and other large mammals in Central Africa falls outside protected areas. Most wildlife populations in this region have not been adequately surveyed, which means that the precision of estimates of great ape population sizes and distributions is low. The lack of precise data hinders assessment of the conservation value of these areas and the development of strategies to effectively safeguard wildlife residing outside protected areas. Forestry operators wishing to obtain or maintain certification are responsible for surveying environmental values in their concession. This information is essential to concession management, but may also contribute to larger-scale conservation efforts by addressing the void of information needed to

understand the impacts of their activities on great apes. Use of standardized methods to train staff, design surveys, collect and analyze data, and report on the distribution, population size and trends of threatened species would not only improve the quality of site-based surveys but also contribute to regional monitoring efforts by generating data that are comparable over time and between sites. Laufer *et al*. (2013) provide recommendations on how to avoid sampling and reporting biases that could undermine the comparability of logging investigations. Evidence-based results allow the effectiveness of conservation initiatives to be assessed at local scales, which is crucially important for ape conservation across the continent (Junker *et al*. 2012).

Benefits of implementing recommendations that address FSC Principle 8:

- Significant contributions to assessing the distribution and population sizes of globally threatened species.
- Information becomes available to establish effective strategies to mitigate the negative impacts of human activities on wildlife populations using evidence-based results.
- The presence of monitoring teams in the forest act as a deterrent to poachers and provides up-to-date information on hunting, poaching, illegal mining, settlements and agriculture and any other detrimental anthropogenic influences in concessions.
- Research teams can effectively expand forest surveillance coverage through systematic surveys that sample different habitat types and often remote areas that may not typically be frequented by protection staff. Longitudinal monitoring (through repeated reconnaissance, transect or point surveys) can also establish a valuable conservation presence in the concession, complementing protection efforts by providing additional real-time data on threats to wildlife.

FSC Principle 9 – Identification of HCV Areas

Principle 9 requires that an operator evaluates a concession to determine whether areas within a concession contain attributes that should be considered HCV. The concept includes biological values, environmental service values, and social and cultural values, but applies only to those elements that are considered particularly important (e.g., significant at a national level).

It is specified that the operator be required to assess a concession against six attributes or values. If part of the concession is considered HCV for one or more of these values, specific protection, management and monitoring measures must be elaborated. Given the importance of HCV attributes, these strategies must be developed in consultation with experts and stakeholders. Concessions containing significant concentrations of great apes are considered to be HCV areas (FSC Criterion 9.1) because all great ape species are listed as Endangered on the IUCN Red List of Threatened Species (IUCN 2012). The scaling of these values and definitions of minimum safe standards or threshold limits for species such as African great apes are a work in progress, but existing knowledge can contribute to more effective forestry planning and evaluation of the needs of great apes.

In concrete terms, great ape priority zones must be listed as HCV. This means that the threat of logging activities to great apes must be evaluated and specific measures to mitigate these threats must be put in place and monitored, consistent with a precautionary approach. According to the FSC Standard, even when knowledge of a potential threat to the local environment or society is imperfect, the forestry operator is required to take action(s) to decrease the risks or severity of damage (FSC-STD-01-001 V5-0 D5-0). Generic widespread threats, such as hunting and disease, should be addressed across the entire concession. Finer-scale measures focusing on identified key areas or attributes should be implemented in areas that support locally high concentrations of great apes prior to and after timber exploitation. In addition, assessments conducted during harvesting and extraction provide information on the immediate impacts of logging on wildlife and how other important environmental values respond to disturbance.

Maintaining Forest Attributes Important to Great Apes and Other Wildlife (based on FSC Principle 9)

Key Element of the Recommended 'Ape Friendly' Conservation Action
Forests identified as priority sites for great apes should be considered to be HCV areas. Priority sites throughout the geographic range of great apes have been determined using population size, habitat block size and overall biodiversity value (Box 2). Because great apes are endangered species, areas outside priority sites that contain significant concentrations of great apes are also considered HCV. Specific management measures for great ape protection and important areas of ape habitat should be included in Forestry Management Plans.
Rationale for Inclusion of Required Actions
Specific measures to protect great apes in areas recognized as high priority are not currently required.
Recommended Indicators
• Areas recognized as priority sites for great apes or with significant numbers of great apes are considered to be HCV. • The selection of zones for complete protection is made in consideration of the importance of an area for great apes and the presence of surrounding landscape features (e.g., protected areas, natural barriers). • Forest managers form partnerships with local or regional conservation biologists or scientists to assess the abundance and distribution of tree species deemed necessary for ape survival. • Forestry enterprises demonstrate that great ape food and/or nesting resource (tree) stocks are sustainably managed and protected by RIL procedures for the great apes' long-term survival needs. Forestry teams work in a systematically planned and mapped patchwork fashion, taking into consideration identified areas of high quality resources and progression of logging fronts. The size, time sequence and shape of logging compartment exploitation should be designed to provide refuge for great apes. • Parcels (usually 0.25 km^2) to be exploited simultaneously should not be placed within 4 km of each other or of road construction. • When logging within 1 km of potential barriers, it is advisable to work away from a river or edge to avoid pushing apes toward an impassable river or inhospitable habitat. • Logging fronts should move towards the centre of a chimpanzee community range, where known, rather than pushing group members towards the territory of a neighbouring community.

Importance of adaptive exploitation and defining forest attributes that are important to great apes

Gorillas and chimpanzees are highly dependent on the availability of a wide variety of plants for food and nesting, many of which are trees. Due to growing market demands, timber harvests will increasingly include trees other than *Aucoumea klaineana*, *Triplochiton scleroxylon* and *Entandrophragma* spp., which have dominated timber markets until now. As more tree species are extracted, it will be increasingly essential for forestry managers and wildlife experts to collaborate in ensuring that important food and nest trees are left at sufficient levels (abundance, biomass) for the great apes' survival.

A logging company's pre-harvest inventory and mapping of marketable and non-marketable tree species can provide a reliable and rich resource for assessing the abundance and spatial distribution of tree species (ter Steege 1998; Couteron *et al.* 2003; Réjou-Méchain *et al.* 2011). In combination with ape surveys and environmental data, forestry company inventory databases could be examined to determine which tree species act as drivers of ape distribution and abundance in forestry concessions. Fimbel and colleagues (2001) highlight such assessments as a basis for refining forestry practices. The merging of tree species and ape distribution datasets could be a powerful tool in concession management for enhancing great ape survival within the framework of RIL procedures.

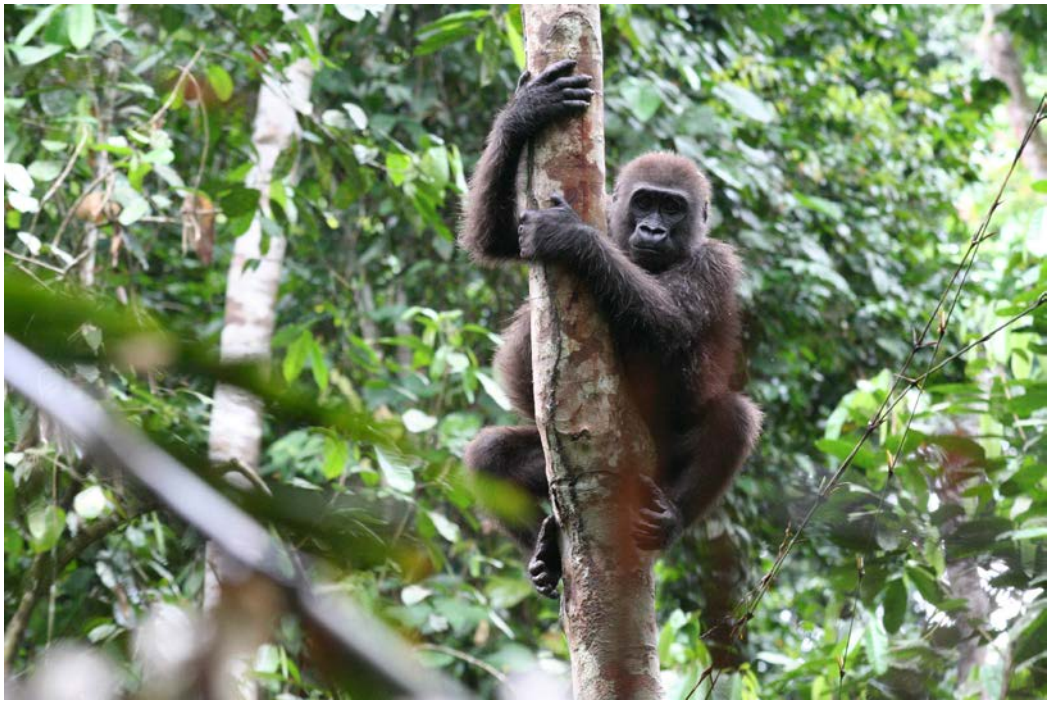
Food Resources. Although gorillas and chimpanzees eat a wide variety of foods, certain plant species are highly preferred while others serve as fallback foods (Doran-Sheehy *et al.* 2009). Information on great ape diets is available from many sites in equatorial Africa (Rogers *et al.* 2004; Head *et al.* 2011). By consulting food lists and/or collaborating with great ape experts, foresters

can identify trees within their FMU that are most important to great apes and other wildlife. Morgan & Sanz (2007) give a list of chimpanzee and gorilla tree foods recorded at different sites in the Congo Basin, noting which tree species are logged. From such initial assessments, mitigation strategies can be developed as part of the HCV precautionary approach. These assessments enable managers to be better informed regarding future timber offtake rates in relation to resources that are important for apes, also providing an opportunity to devise more specific offtake regimes, which take resource needs into account in subsequent logging cycles.

Nesting Resources. Certain timber trees may also be of conservation concern as important or preferred for nest building: all great apes construct night nests, which serve as sleeping sites and anti-predator defence (Fruth & Hohmann 1996). By assessing the abundance of tree species in an FMU in relation to gorilla and chimpanzee preferences for nesting in trees of particular species and size classes, predictions of future offtake rates with due consideration of great ape behavioural needs can also be made following the HCV precautionary approach. We recommend that quantitative assessments of HCV should be based on the resource needs of great apes, and use tree abundance/biomass estimates from the inventory databases of local logging companies. Analyses of these datasets could be carried out by logging company officials working with great ape experts to identify specific forest attributes important for the survival of gorillas and chimpanzees in their concessions.

Benefits of implementing recommendations that address FSC Principle 9:

- Promote long-term survivorship of great apes by mitigating the negative effects of exploitation or overharvesting of important (tree) resources.
- Attributes of High Conservation Value Forest (HCVF) for protected wildlife are identified and defined, and measures taken to decrease direct or indirect disturbance to those resources.
- More informed management decisions achieved through the availability of data that combine wildlife and forest attributes in a concession.



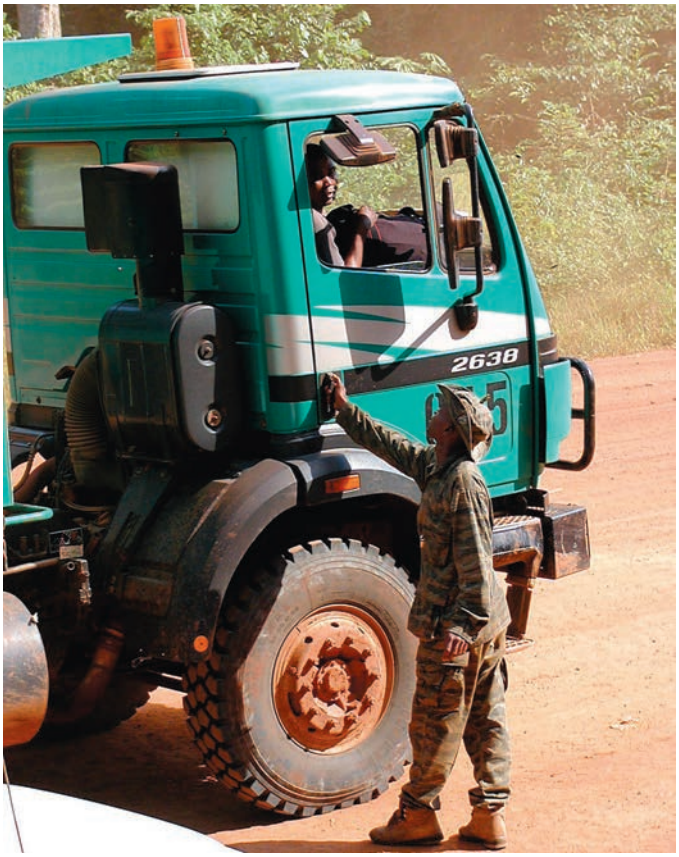
Both gorillas and chimpanzees forage high in the canopy of trees. Young western lowland gorilla at Bai Hokou, Central African Republic © Chloe Cipolletta

4. GREAT APES AND THE HCV CONCEPT

The HCV concept has become a central tool for the conservation of important landscape attributes both in and outside protected area networks. This approach advances locally-adaptable management strategies that maintain and enhance the critical environmental and social values of these forests. The concept was originally developed as a central tenet of the Forest Stewardship Council's 'Principles and Criteria for Responsible Forest Management'. Numerous tool-kits and practical guides are available to forestry practitioners interested in identifying, managing and monitoring HCVF attributes (Rayden 2009; see also www.hcvf.com). Despite growing awareness of the HCV concept and evidence that informed forestry and wildlife conservation are not incompatible, there remains a lack of detailed information on implementing this approach for endangered species.

Here we propose an approach at two scales, supported by evidence from monitoring. At the whole-concession scale, it is important that zones considered priority areas for great ape conservation are recognized as HCV by forestry operators[7]. Measures to address generic threats, such as hunting and disease, should be applied across and throughout these areas. Within a concession, at the scale of annual harvesting blocks, where finer-scale concentrations of great apes can be identified, measures should be taken to maintain the ecological conditions that gave rise to these concentrations.

Assessment of HCVF for great ape conservation. Forestry management units containing gorillas, chimpanzees and bonobos will vary in their conservation potential, due to factors such as great ape abundance, intensity of past and future extraction, and proximity to human settlements, so it is important to outline clearly how such areas can be identified by forestry managers and conservation practitioners. The most straightforward approach is to consult IUCN action plans for African great ape conservation (see Box 2 and Section 10). These action plans present priority sites, based on great ape population size, area of habitat, and overall conservation importance. Similar assessments can be undertaken for concessions, if information on great ape abundance and local threats is available. At a minimum, forestry operators should use wildlife inventories to determine whether their concession contains significant concentrations of great apes, which would make the area HCVF. Within the concession, gorilla and/or chimpanzee density is likely to be heterogeneous, some areas having higher densities than others. This is usually due to the distribution patterns of resources such as food trees, and may also be due to past and present hunting patterns. Areas of high ape density may also correspond with concentrations of preferred resources. To protect apes in these areas, adaptive management strategies emphasising maintenance of these particular resources may be found cost effective and logistically possible. More often, concessions are likely to provide a heterogeneous matrix of habitat types supporting lower numbers of apes across the landscape, but together they are complementary and necessary for ensuring gorilla and chimpanzee existence. In these cases, there may be a need to formulate conservation strategies that take into account seasonal patterns of range use. Further, information from the most recent surveys available should be sought, as the situation on the ground can change rapidly.



Ecoguards checking vehicles on a logging road in Congo © David Wilkie

7 Forestry operators should be aware that any forest concession containing significant concentrations of great apes similar to those found in recognized great ape priority zones may be considered HCV. Expert advice from great ape biologists should always be sought.

Management of HCVF for great ape conservation. To ensure the survival of great apes in HCVFs in or near FMUs, forestry managers should employ strategies that will maintain the attributes or environmental conditions necessary for ape survival. Progressive forest management should ensure that threats to wildlife survival, such as poaching, are reduced or eliminated. Technical support and training provided by a non-government organization can effectively keep companies current on standardized methods to monitor illegal or unsustainable activities in concessions and surveillance of wildlife towards informing the HCVF concept (see Box 3). Emphasis should also be placed on

Box 3. Case Studies of Logging Company-NGO Partnerships

The Wildlife Wood Project in Cameroon

The Wildlife Wood Project (WWP) was initiated in 2007 with the goal of ensuring that timber production forests contribute to biodiversity conservation in the Congo Basin. To this end, the Zoological Society of London (ZSL) partnered with two companies in Cameroon—Pallisco and SFID-Rougier—which together manage almost 9,000 km^2 of forest concessions between the Dja Conservation Complex and the Boumba-Bek/Nki Complex; two Exceptional Priority Areas for gorillas and chimpanzees (Tutin *et al*. 2005). These partnerships were established to pilot approaches of how company obligations under national forestry and wildlife regulations, FSC certification principals and criteria, and other sustainable forest management guidelines related to wildlife can be met; ensuring effective and sustainable wildlife management in working timber concessions.

The partnership is framed in the context of the companies' business model, and activities are clearly linked to FSC P&C (Principles and Criteria https://ic.fsc.org/the-revised-pc.191.htm). Much emphasis has been placed on implementing practical approaches to avoid or minimise impacts on great apes, following IUCN's *Best Practice Guidelines for Reducing the Impact of Commercial Logging on Great Apes in Western Equatorial Africa* (Morgan & Sanz 2007). The WWP is showing that the direct impacts of selective logging can be minimized, and is also supporting efforts to reduce the unsustainable poaching linked to logging activities.

Under the Wildlife Wood Project

Partner companies are encouraged to commit to a 'wildlife policy'—a publicly available declaration of intent to manage their operations in a sustainable and responsible manner, to which the company can be held accountable. Companies are assisted with the production of a Wildlife Management Plan, which provides the framework for delivering these commitments through the integration of wildlife management into their day-to-day operations. They establish wildlife and illegal activity monitoring teams, supervised by a 'wildlife manager' who has a management position within the company. Teams are trained and mentored by ZSL. Disease risks for both great apes and people are addressed through protocols for 'best forest practice' that provide information on disease transmission between wildlife and humans and the importance of sanitation and good hygiene for those who spend time in the forest or forest camps.

Field protocols and training materials developed for use by the companies include procedures for data analysis and management. Field data are collected using hand-held computers and then uploaded to a database, via *Cybertracker* software initially, but SMART software is now being introduced. SMART can upload, store and analyse data collected during surveys or patrols, and produce map-based reports for managers to easily assess monitoring and patrols. Toolkits have been developed to identify areas of HCV for great apes and other focal species. They include methods for identifying core areas of chimpanzee community ranges, which are then assigned HCV status and logging practices are adapted to minimise impact on the chimpanzees accordingly. Systems and protocols for identifying and responding to illegal activities are also being developed to assist with the detection, detention and prosecution of perpetrators.

Christopher Ransom & Paul De Ornellas

For further information see: http://www.zsl.org/wildlifewoodproject

Box 3 continued on next page

Box 3 continued from previous page

PROLAB—A Public-Private Partnership in the Loango-Moukalaba Corridor, Gabon

Oil and forestry companies operating in the Gamba complex play an important role in the economy of Gabon. However, the proximity of the industries to two national parks, Moukalaba-Doudou and Loango, could threaten the wildlife in the protected areas. While each company has a plan to prevent pollution, the principle threat to wildlife is the human population growth that comes with the opening of access to the area.

A three-part public-private collaboration was created in 2008 between the Ministry of Forests and Water, the forestry company *Compagnie des Bois du Gabon* (CBG) and the World Wide Fund for Nature (WWF) in a partnership called PROLAB (*Programme de Lutte Anti- braconnage et de Gestion de la Faune*). The objective of the partnership is to fight poaching and protect wildlife in the periphery of the two national parks, mainly consisting of several oil exploration permits and the CBG forestry concession, which was FSC certified in 2009. The partnership is active in the ecological corridor between the two national parks. An intervention team is composed of three agents from the ministry and an independent observer from WWF, who work closely with the local administration and with the National Parks Agency (ANPN).

Three main areas of intervention are: 1) education and awareness raising, 2) surveillance of hunting activity and 3) monitoring and evaluation.

Education and awareness raising

Education and information play an important role in making anti-poaching activities effective. PROLAB ensures that company employees, sub-contractors and local residents are all informed of the national laws concerning hunting, and the internal rules of the companies operating in the area, specifically the requirements of FSC certification, to which CBG adheres.

Surveillance

A national anti-poaching action plan specifies two types of surveillance. *Surveillance of hunting activities* is carried out by mobile patrols (with vehicles or on foot) that search for and record evidence of hunting, such as camps, trails, snare lines and shot gun cartridges. *Surveillance of the products of hunting* is effected by collecting data at fixed control points or mobile barriers that are erected at different access points throughout the area. These check points enforce control of the circulation of arms and hunting products, including bushmeat, in vehicles moving through the concession.

Monitoring & evaluation

Data from missions (both education and surveillance) are recorded and analysed using MIST software to ensure systematic follow-up. Wildlife inventories have been carried out using standardised scientific protocols and will be repeated at regular intervals to evaluate changes in the distribution and abundance of animals and the effectiveness of protection activities.

For a case study of PROGEPP in Congo, see Box 6 on page 24

See also: Arcus Foundation (in prep.). *State of the Apes: The Interface with Extractive Industries*. Cambridge University Press, Cambridge, UK.

assessing the relationships between wildlife and the suite of tree species identified in timber inventories. The ultimate goal is to reduce conflict between forestry and great apes by protecting them from hunters and minimizing the loss of essential natural resources. Activities designed to address these issues and the actions necessary to monitor them should be described in the FMPs for each concession, and within the national government's Standard Operating Procedures (SOPs). Knowledge of the regeneration processes of most timber species is lacking (Fargeot *et al.* 2004; Karsenty & Gourlet-Fleury 2006), but has been studied in species with slow growth (Vieira *et al.* 2005) or renewal rates insufficient to meet industry demands (Nwoboshi 1987; Okali & Ola-Adams

1987). Collaborative efforts between foresters and conservation biologists would enable timber production to be viable as well as promote long-term maintenance of tree species that are particularly important to great apes (see Box 4). Integrated approaches that set targets intended to maintain natural values and persistence of species that inhabit dynamic environments are increasingly influencing conservation practice (Pressey *et al.* 2007). Monitoring whether or not threat reduction has actually occurred is essential, as is monitoring of change (or stability) in ape abundance and distribution within concessions. Such activities should be explicitly outlined in the respective management plans. Several of the elements that are integral to implementation of the HCV management framework can be adapted for great ape conservation (Fig. 1).

Monitoring of HCVF for great ape conservation. Another major concern is the lack of support for long-term monitoring, which is already at risk of being overlooked as a critical conservation activity. Some studies have shown that chimpanzees and gorillas can persist in logged forests (Tutin & Fernandez 1984; Johns & Skorupa 1987; Plumptre & Reynolds 1994; Hashimoto 1995; White & Tutin 2001; Stokes *et al.* 2010; Potts 2011), but only as long as adequate resources are left to meet their ecological needs and areas are sufficiently well managed to eliminate or at least greatly reduce hunting. Where forest is deemed HCVF for gorillas, chimpanzees or bonobos, targeted monitoring is needed to evaluate the effectiveness of actions taken for their benefit. It may take many years for negative impacts to become apparent, which is why repeated, standardized surveying is essential to verifying that populations are stable. With real-time data showing that populations are declining, concession managers can respond immediately by intensifying anti-poaching patrols in particular localities and vehicle inspections along access routes. Where surveys may reveal no human pressures, intervals between surveys may be lengthened so that research and anti-poaching efforts can be allocated to areas with heightened threats. Management, research, and protection activities should be coordinated and synergistic to uphold certification standards in a cost effective manner. Scientists and conservationists working on great apes are valuable allies in the monitoring of population trends and assessments of resources needed for great ape survival in production forests (see Box 5). These partnerships can be mutually beneficial and some valuable accomplishments for conservation and insights into great ape behavioural ecology have been documented through studies in logged forests. Further, monitoring costs may be defrayed if the scientists or conservation organization procure outside funding.

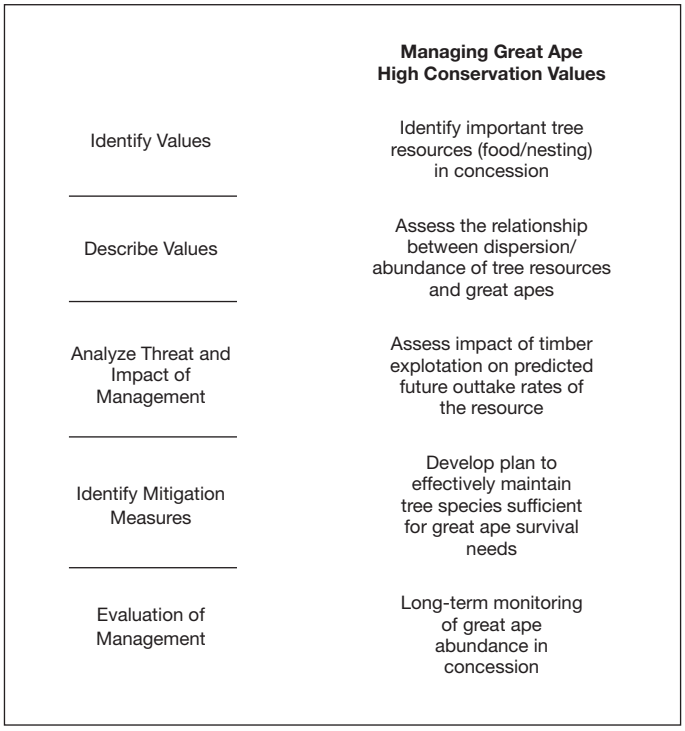


Figure 1. Concessions harbouring significant concentrations of great apes are considered HCV, and decisions about managing natural resources important to their survival may be approached in the following step-by-step manner.

Logging trucks may provide transport for poachers and bushmeat. Controls must be put in place to eliminate illegal trade © David Wilkie

Box 4. Using Timber Inventory Data to Conserve Great Apes

The continued availability of trees that are important resources for great apes will largely depend upon how timber producers diversify selection of tree species in response to available timber stocks and market demands. In the framework of approved management plans, a crucial aspect of forestry operations is the botanical surveys conducted prior to timber exploitation: the number, biomass and distribution of 30–60 tree species in particular size classes are recorded and geo-referenced (cf. Ezzine de Blas & Ruiz Pérez 2008). The specific number of species surveyed will vary with inventory intensity and interest of the company in tracking potentially marketable species. These data relate log harvests to tree growth and regeneration rates, aspects important to maintaining economically viable and environmentally sustainable operations. However, the potential of these datasets in terms of assessing forest attributes important to endangered species in concessions is underused. As a result, our understanding of forestry prescriptions and sustainability as it relates to FSC requirements may be underappreciated in the sense that existing survey data can be used to promote biodiversity conservation in ways that have not previously been recognized. Based on these observations, we suggest the following:

- That logging companies provide conservation managers with botanical survey statistics for concessions containing great apes (the details of and restrictions on the use of these data can be specified in a signed contract);
- that conservation managers relate tree species inventory data to resource use by great apes so that assessments on the distribution and abundance of important ape foods can be depicted spatially and future offtake rates modelled; and
- that forestry and conservation managers discuss survey results depicting the distribution and abundance of tree species in the concessions that are important to great apes, so that more informed timber prescriptions (road placement, tree offtakes) can be explored.

Such investigations are justified given the proven reliability of logging inventory data (Réjou-Méchain *et al.* 2011) and the ecological assessments that can be conducted to improve our understanding of the ecological characteristics of production forests, at a variety of spatial scales (ter Steege 1998; Réjou-Méchain *et al.* 2008). Extending analyses of timber inventory data sets to questions related to ape ecology will allow researchers to move beyond the simple comparisons of abundance estimates traditionally explored in studies of logging and towards a more integrated research trajectory that scientists across disciplines have been promoting for the last two decades.

The distribution of great apes is in part determined by resource availability, under both natural and anthropogenic dynamics. As trees are vital to gorilla and chimpanzee foraging and nesting requirements, large-scale spatially-explicit timber inventories offer an unparalleled opportunity to explore the fundamental survival needs of great apes in relation to particular forest attributes (i.e., trees). The location of forestry operations is also dictated by the presence or absence of particular tree species, and it is generally assumed that disturbance to the local environment and ape population will vary with the intensity of tree removal. One practical aim of juxtaposing ape and human interests in forest composition would be to determine the minimum cut diameter (MCD) limits of the tree species that have the least impact on ape abundance and distribution, yet still provide production levels viable to the industry. Based on such results, forestry managers could develop more informed strategies for maintaining HCV in future timber harvests, as well as demonstrating quantitatively their efforts to conserve biodiversity to 'green markets' and certification bodies.

Another proposal for maintaining HCV involves developing maps of tree species distribution that can be used to optimize extraction routes and team coordination under RIL procedures. When acted upon, such procedures reduce the negative environmental impacts of forestry (Bertault & Sist 1997). Careful planning of extraction routes not only reduces short- and long-term pressures on resident great apes and other wildlife, but also reduces harvesting costs to timber companies (Holmes *et al.* 2000, 2002; for discussion of the economics of RIL see Putz *et al*. 2008). Minimizing the overall amount of time spent in the forest, reducing machinery hours, and avoiding simultaneous exploitation of neighbouring forests will directly benefit conservation. Further, assessing the degree of logging impact on great ape distribution and behaviour in particular areas of an active forestry concession will also enable better understanding of how apes cope with the immediate disturbance of logging and of which environments they use as refuges. Such data are vital to identifying and maintaining priority conservation areas and attributes, and can contribute to more holistic management approaches that incorporate both timber production and the apes' resource needs (Fig. 2).

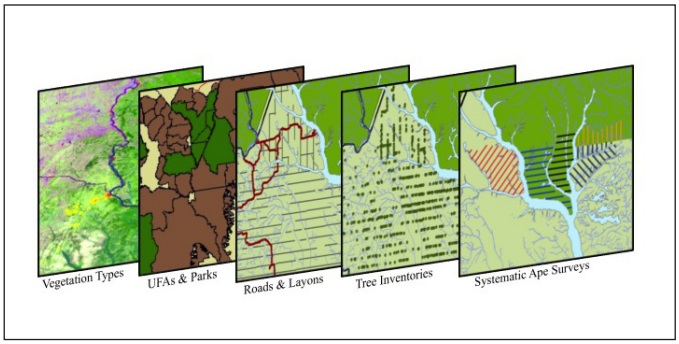


Figure 2. Combining tree inventory data with great ape survey data (and other datasets such as the spatial distribution of vegetation types, roads and skidder trails (layons), and nearby protected area boundaries) will provide a powerful tool for informing management of production forests.

Box 5. The Value of Long-term Studies of Great Apes in Production Forests

There are several long-term great ape study sites across Africa, some of which were established in timber concessions more than 40 years ago. In addition to studying the behaviour and ecology of great apes, these sites give immediate protection to the apes and other wildlife. Field scientists are potential partners to forestry managers and can provide expert assistance in understanding ape ecology, population dynamics and population monitoring. Research sites also provide long-term employment opportunities for local residents in relatively isolated areas and, likewise, opportunities for training interested national and international students in research and conservation. Benefits that can be accrued by local households and communities include revenue sharing and other economic activities. Further, many long-term research projects have initiated environmental education programmes, nature clubs or community outreach activities that foster awareness of the importance that forests play in providing environmental services and, at some sites, opportunities for ecotourism.

Kibale National Park, Uganda

In the 1970s, Thomas Struhsaker began the Kibale Forest Project to study primate ecology and behaviour in the multi-use forests in and around the Kibale Forest Reserve in Uganda. In 1993, the reserve was upgraded to a national park. Research continues to the present day and, since its inception, seven long-term research and conservation programmes have been established with many spin-off projects (Struhsaker 1997; Kasenene & Ross 2008). Two successful projects are the Kibale Chimpanzee Project and the Ngogo Chimpanzee Project, also in Kibale. Studies of the rich primate community have included assessments of how primates cope with mechanized logging and habitat fragmentation (e.g., Mitani *et al.* 2000; Chapman *et al.* 2000, 2005; Gillespie & Chapman 2008; Potts 2011). Using information on timber extraction rates and chimpanzee demographic profiles, researchers have even been able to relate female reproductive fitness to the degree of logging disturbance (Emery Thompson *et al*. 2007). Based on these studies, policies and recommendations for conserving the region's primates and the forests on which they depend have been developed. Many of the conservation measures proposed have been adopted by the Forest Department and Uganda Wildlife Authority, which are the agencies responsible for managing Kibale. Among the findings that highlight primate conservation in the context of mechanized logging were the following:

- If forest is designated for timber extraction, low-intensity selective logging is far more compatible with conserving primates than high-intensity logging;
- long-term monitoring of primates is a prerequisite to devising recommendations for forest management; and
- it is essential to consider the health risks associated with extraction and management activities in areas where humans and primates coexist.

Struhsaker (2008) offers several requirements for success of conservation programs in national parks:

- Effective law enforcement
- Long-term commitment (> 20 year time frame)
- Collaborative associations with international organizations
- Capacity building of nationals
- Scientific presence and monitoring
- Flexible management plans
- Educational support at local and national levels
- Sufficient level of secure funding (e.g., trust funds)

Box 6. Case Study of PROGEPP in Timber Concessions Adjacent to NNNP, RoC

Nouabalé-Ndoki National Park (NNNP) was gazetted in 1993 and forms part of the transboundary Sangha Tri-National Protected Area complex, which was inscribed as a World Heritage Site by the United Nations Education, Science, and Cultural Organization (UNESCO) in 2012. This area is rich in wildlife and extensive old-growth forests. However, NNNP is embedded in a landscape that has become dominated by commercial forestry concessions and an increasing human population since the 1990s.

To ensure more effective conservation around the park, the Projet de Gestion des Ecosystémes Péripheriques du Parc (PROGEPP), also known as the Buffer Zone Project (BZP), was set up in the concessions around the park. In 1999, a memorandum of understanding was signed between the Wildlife Conservation Society (WCS), the forestry company *Congolaise Industrielle du Bois* (CIB) and the Congolese government's *Ministère de l'Economie Forestière* (MEF). This agreement was intended to establish management systems that would ensure the long-term integrity of the forest ecosystem in the context of commercial exploitation of the Kabo, Pokola and Loundoungou-Toukoulaka logging concessions (Elkan *et al.* 2006; Clark *et al.* 2012).

This multi-stakeholder project was one of the first partnerships between industry, government and a non-government organization intended to conserve natural resources in production forests. The goal of this project is to implement informed management approaches to forestry activities and policies aimed at synchronizing more mainstream environmental and societal stewardship practices (de Walt 2012). Efforts to manage and conserve the resource base for timber production while adhering to RIL and biodiversity conservation were initiated in CIB's concessions in 2000. This area, now leased by Olam International Limited, is among the largest managed by any company in the region, totalling 11,973 km^2. In 2006, the Kabo concession was FSC certified. Certificates were awarded for the Pokola and Loundoungou-Toukoulaka concessions in 2008 and 2011 respectively.

Since this partnership began, several management activities have proven effective in conserving the biological values of the timber concessions. Among them are:

- Establishment of eco-guard units to enforce hunting laws through mobile forest patrols, roadside posts, and inspections of vehicles on logging roads and local markets/shops;
- establishment of hunting zones with regulated access aimed at sustainable harvesting of wildlife and non-forest products;
- effective monitoring and evaluation of law enforcement unit performance;
- maintenance of a communications network between local stakeholders, with clearly defined roles and responsibilities;
- progressive research and monitoring of important wildlife populations in relation to forestry and human encroachment, as well as human demographics and livelihoods; and
- forestry company adherence to the principles and criteria implicit in maintaining FSC certification.

Roads provide easy access to extensive stands of timber and other natural resources, including wildlife © David Morgan. Programmes to enforce laws protecting great apes and other wildlife must be established to prevent roads becoming conduits for bushmeat and illegal activities.

5. GORILLA AND CHIMPANZEE CONSERVATION IN CENTRAL AFRICA: OPPORTUNITIES AND OUTLOOK

There are several reasons for cautious optimism within the conservation context of African apes. First, the Congo Basin range states have allocated national park status to 12%, on average, of their forests (Nasi *et al.* 2012), which is similar to the percentage of protected areas recommended globally (Dudley & Phillips 2006). Second, there are still large numbers of gorillas and chimpanzees in Central African logging concessions. In addition, FMUs in this region are relatively large and, historically, exploitation regimes have focused on only a few tree species at relatively low levels of extraction (1–2 stems per ha; Pérez *et al.* 2005). For most concessions, there have been three to four timber exploitation rotations. While forest structure and floral diversity in these concessions have changed, some cautionary 'peak timber' levels have been approached (Shearman *et al.* 2012), and proposals and policies regarding sustainable forestry need to be addressed (Zimmerman & Kormos 2012); the disturbance of and alteration in key resources may be far less severe compared to more intensive exploitation regimes. Thus there are still opportunities to implement policies and practices pertinent to these valued resources. Further, many large production forests border national parks, and maintaining forest connectivity could effectively improve conservation scenarios at landscape scales. In fact, many of the priority areas identified for great ape conservation encompass both protected areas and logging concessions (see Kormos *et al.* 2003; Tutin *et al.* 2005). More than a decade of experience working with forest industry partners in the logging concessions bordering the Nouabalé-Ndoki National Park (NNNP) in RoC has shown that a continuous dialogue is absolutely necessary to ensure that conservation activities have a chance of success (Poulsen & Clark 2012).

Tutin (2001) called for more concerted and collaborative efforts between logging companies and conservation scientists to safeguard the long-term survival of African great apes. In addition to increasing the number of concessions certified, it is estimated that within the next five years nearly 63% of officially recognized logging concessions in the Congo Basin will operate under approved management plans that include SOPs for forest and wildlife management (Nasi *et al.* 2012). These are encouraging signs. Adoption of the 'ape friendly' practices proposed in this document (Section 3) for national and international certification standards, by governments as well by forestry managers, could benefit great apes throughout the region. In so doing, a means of encouraging non-certified concession holders to work towards FSC certification may also develop.

Finally, most of the recommendations in this document can be immediately enacted by any timber company that has inventoried the timber stocks in their respective FMUs. Inventory data help forestry managers and conservation practitioners to foretell and avoid exploitation thresholds that, if exceeded, could lead to progressive collapses in wildlife populations.

Western lowland gorilla in the Goualougo Triangle, Republic of Congo © Ian Nichols, National Geographic Society

6. SCIENTIFIC JUSTIFICATION FOR THE RECOMMENDATIONS PROPOSED

Enforcing Health and Safety of Employees and Their Families (FSC Principle 6)

The risks of infectious disease transmission between coexisting humans and great apes are well documented (e.g., Rouquet *et al.* 2005; Leendertz *et al.* 2006; Gillespie *et al.* 2008; Lonsdorf *et al*. 2011). Monitoring programmes record increasing numbers of cases of human viruses and bacteria being spread to apes, including influenza, adenovirus, rhinovirus, respiratory syncytial virus, pneumococcal pneumonia, herpes viruses, measles, mumps, cytomegalovirus, polioviruses, coxsackie viruses, *Salmonella*, *Shigella*, *Campylobacter* and gastrointestinal parasites. This highlights the enormous unintended threat humans pose to our closest living relatives (e.g., Homsy 1999; Woodford *et al.* 2002; Goldberg *et al.* 2007; Köndgen *et al.* 2008; Macfie & Williamson 2010). Great apes in isolated regions have been exposed to few if any human diseases; therefore, their immune systems are naïve to, and have no defence against, these novel pathogens. Exposure to even common human pathogens can prove fatal to chimpanzees and gorillas (Palacios *et al*. 2011; Ryan & Walsh 2011), so field projects working in great ape habitat protect the health of both apes and humans by implementing employee health programmes. Proactive measures will reduce the risks of both zoonotic and anthropozoonotic exchanges (Ali *et al*. 2004; Cranfield & Minnis 2007).

Subsidized Anti-poaching Teams and Employee Code of Conduct (FSC Principles 6 and 7)

Although protected areas are key to biodiversity conservation, their mere existence does not ensure the long-term survival of great apes (Kormos *et al.* 2003; Campbell *et al.* 2008) or other wildlife (Laurance *et al.* 2012). The most effective predictors of long-term survival of great apes have been shown to be conservation action, specifically guards and long-term presence of conservation NGOs (Tranquilli *et al.* 2012). Illegal bushmeat hunting (i.e., poaching) is eliminating wildlife across the forest biome, particularly in equatorial Africa (Bowen-Jones & Pendry 1999; Lahm 2001; Barnes 2002; Fa *et al.* 2002; Bennett *et al*. 2007; Nasi *et al.* 2008, 2011). Surveys in Central Africa indicate that offtake rates of most large mammals are unsustainable (Noss 1998; Wilkie & Carpenter 1999). Further, protected areas next to logging concessions will experience increasing human pressures when timber harvesting starts. Logging roads hugely increase access to previously remote, undisturbed, wildlife-rich areas of forest, and the arrival of hundreds or even thousands of people (logging company employees and their dependents) leads to significant increases in hunting in these areas (Poulsen *et al.* 2009). Arnhem *et al.* (2008) found that signs of hunting increased with time since logging began in a timber concession in Cameroon. In the buffer zone of NNNP, 0.01 hunt/gather signs per km recorded before logging increased to 0.24 hunt/gather signs per km during logging in the Kabo logging concession (Morgan *et al.* 2012). Logging employees have more disposable income than the average village dweller and are able to hunt or pay for bushmeat. The results are steep increases in hunting with the arrival of logging operations (e.g., Auzel & Wilkie 2000; Wilkie *et al.* 2001; Elkan *et al*. 2006; Bennett *et al.* 2007; Poulsen *et al.* 2009). Deployment of anti-poaching teams and enforcement of an employee code of conduct can be effective in countering such threats. These measures ensure that international and national laws are upheld in the concession and by company employees. Forestry personnel must be informed of the regulations, certification standards and the repercussions of violating these policies.

To combat the potentially negative impacts of forestry operations on biodiversity, an increasing number of logging companies have adopted management protocols promoted within national or international certification frameworks (such as the Programme for the Endorsement of Forest Certification Schemes, PEFC[8]). An evaluation of the performance of logging firms in Gabon has shown that those adhering to FSC certification standards were far more likely to apply forestry laws and best practices than non-certified companies. These results show clearly that the FSC

8 http://www.pefc.co.uk/

certification framework promotes improved environmental stewardship and legal compliance (Rayden & Essame Essono 2010).

Despite such gains, room for improvement is evident even for companies operating under management plans (Cerutti *et al*. 2008) and meeting certification standards. Further evaluation of logging companies in Gabon demonstrated a need for monitoring systems to track trends in wildlife management effectiveness within their FMUs. Indeed, data are lacking on whether and how certification activities are supporting great apes and other protected wildlife populations. Increasingly, multi-stakeholder efforts in the tropics are providing crucial feedback on lessons learned and how conservation initiatives in production forest can be improved.

National and international support is needed to strengthen the capacity of tropical timber-producing countries and improve efficiency in processing timber and managing concessions to benefit conservation. ITTO accomplishes such goals using internationally agreed upon policy documents, which can be adapted to local concession circumstances and implemented by field projects. One of the first such projects in Central Africa was initiated in the forests buffering NNNP (see Box 6).

Monitoring of Threatened Species in Logging Concessions (FSC Principle 8)

Due to the intensity of threats facing remaining wildlife populations, detecting relative change in great ape densities and distribution has become crucial. The ongoing monitoring of great apes and other protected wildlife in several parks and logging concessions in Central Africa demonstrates the feasibility of such programmes and how the information gained can be used for adaptive forest management (see Box 7). Further, long-term monitoring of gorillas and chimpanzees is providing valuable information about specific actions that can be taken to reduce the impacts of logging on great apes.

For example, strategic planning of the size, time-sequence and possibly shape of logging compartment exploitation could be designed to provide refuge for great apes and reduce disturbance to other wildlife during logging operations. Observations of chimpanzee communities at multiple sites provide evidence that staggering the timing of timber extraction across logging compartments may be key to avoiding chimpanzee population declines (Hashimoto 1995; Plumptre & Johns 2001). Similar observations were made of orangutans in logged forests (MacKinnon 1974). Maintaining patches of primary forest or areas that are not actively being logged while adjacent forests are exploited may provide refuge to great apes during and after logging (Matthews & Matthews 2004). In sum, research has shown that parcels (usually 0.25 km^2) to be exploited simultaneously should not lie within 4 km of each other or of road construction.

The shape of the 'annual allowable cut' (AAC) also merits consideration for ape conservation. Research has shown that large rivers, ridgelines and forest edges can serve as physical barriers or social boundaries to great apes. When logging within 1 km of potential barriers, it is advisable to work away from a river or edge to avoid pushing apes toward an impassable river or inhospitable habitat. Chimpanzees are territorial and excursions into another community's range are often

Box 7. Monitoring Great Ape Populations in Production Forests

Surveys conducted at the landscape scale in the RoC indicate that gorillas, chimpanzees and elephants can persist in logging concessions if anti-poaching efforts are maintained at high levels and are overseen by an independent body (Clark *et al.* 2009; Stokes *et al.* 2010; Poulsen *et al*. 2011). Clark *et al.* (2009) assessed transect data from four logging concessions while Stokes and colleagues (2010) surveyed five concessions. Morgan *et al.* (2006) conducted intensive surveys to monitor trends in ape and human encounter rates before, during and after logging in the Kabo FSC-certified concession (Fig. 5). This collaboration provided local experts and protected area managers with the ability to detect relative change in wildlife populations in the context of industrial timber exploitation. Despite past and present anthropogenic disturbance, the importance of these forests to great apes remained high and the concession serves as a case study for developing sustainable forestry techniques that take apes into consideration. Without FSC certification that regulates the selective harvesting of wildlife in authorized hunting zones and the elimination of commercial hunting, even neighbouring well-managed concessions rapidly lose their wildlife (Stokes *et al.* 2010). Without oversight by an independent body, populations of animals valued for items other than meat (elephants), and for their meat (duikers), can decline drastically within just a few years (Maisels *et al.* 2012).

Box 8. Towards Developing a More Collaborative Approach to Great Ape Conservation

Systematic, repeated surveys of great apes and other wildlife allow forestry managers to monitor their spatial distribution and abundance in relation to human activity. Importantly, survey design must be at the appropriate scale to ensure that detection of change is possible. In other words, a sufficient level of precision can be attained to distinguish change from stochastic fluctuations in ape abundance. Assessments of great ape population status enable concession managers to respond with appropriate actions. If monitoring efforts reveal that numbers have decreased in a particular area, then protection efforts (such as mobile anti-poaching patrols and inspection of vehicles for bushmeat) can be intensified and focused on that particular locality. Due to our close phylogenetic relationship with great apes, they are susceptible to infectious human diseases, and detection of a decline in ape numbers could signal punctuated mortality events stemming from zoonotic spillover rather then illegal harvesting of individuals for consumption. With this information, forestry operators could more appropriately respond to the anthropogenic threat by having their personnel screened for disease agents such as intestinal parasites. Although maintaining such efforts is relatively costly and labour intensive, systematic wildlife surveillance and preventative health measures combined with industry responsiveness are vital aspects of adaptive management (WHO 2013).

Until now, there has been little collaboration between scientists and industrial enterprises to gather such information and further our understanding of tropical ecosystems and their conservation. The online atlas of commercial tree species in equatorial Africa, PhytoAfri[1], and the CoforChange[2] project call for forest inventory data to be used for a better understanding of forest ecology. Similarly, governments, non-governmental organizations, institutions, and researchers, seem increasingly willing to collaborate when it comes to addressing important conservation issues. The Forest Transparency Initiative (FTI)[3] is a searchable repository containing the latest information on timber companies operating in central Africa. This database promises to assist efforts to guide more transparent forest governance and the adherence of timber companies to industry standards. The Ape Populations, Environments and Surveys (A.P.E.S.) initiative provides an opportunity and mechanism for the development of more collaborative approaches. The IUCN/SSC A.P.E.S. database[4] is a data repository that enables the global status of great apes, their habitat and conservation effort to be assessed (Kühl *et al.* 2007; Junker *et al.* 2012; Tranquilli *et al.* 2012). Adding survey data from logging concessions to this database will facilitate further meta-analyses of ape conservation status. Vast areas of forest leased by logging companies have yet to be surveyed for great apes (Fig. 6). As a benefit to data contributors, scientists managing the database are available to provide advice and assistance with survey data analyses. Contributors retain ownership and reserve the right to refuse third party access to their data. Logging company contributions to this data-sharing initiative would provide an excellent indication of their willingness to conserve great apes and commitment to environmental stewardship in their concessions.

1 http://phyto-afri.ird.fr/
2 http://www.coforchange.eu
3 http://beta.foresttransparency.org/
4 http://apes.eva.mpg.de

hostile and may be an attempt to expand the community's range (Mitani *et al*. 2010). If community boundaries are known, then extraction starting at the boundary and working inwards will be less disruptive than forcing chimpanzees into another community's territory. Encroachment of a neighbouring territory is likely to result in social upheaval and lethal conflict. Aggressive inter-community interactions in association with logging are thought to have reduced chimpanzee densities at Lopé in Gabon (White & Tutin 2001).

Adaptive Exploitation and Protection of Resources Important to Great Apes (FSC Principle 9)

It has often been claimed that selective logging primarily targets tree species that are not important resources for great apes and other large mammals. While this is true for some timber species, it is not for others (Morgan & Sanz 2007). Although each species of great ape has particular dietary preferences, gorillas and chimpanzees in western equatorial Africa show significant overlap in their foraging regimes. The Sapotaceae, Irvingiaceae and Moraceae include many species important to the great apes (Tutin & Fernandez 1993; Doran *et al.* 2002; Rogers *et al.* 2004; Morgan & Sanz 2006). In areas where gorillas and chimpanzees coexist, protecting particular tree species will be of benefit to both ape species and to other wildlife. It has been suggested that 'keystone resources' in logging concessions should be protected (Putz & Viana 1996). Remote video monitoring of fruit trees in the Goualougo Triangle of RoC has shown that several tree species are critical resources

for a suite of endangered mammal species. For example, *Chrysophyllum lacourtiana* is an important food for gorillas, chimpanzees, elephants and red river hogs, but is currently being exploited at a 'promotional level' to determine the harvest feasibility and if there is a viable market for this species (Fig. 3). Relating information on the spatial distribution and abundance of these trees to basic data on ape habitat use will contribute to identifying areas of particular importance to wildlife. Protection of resources that are essential for the survival of endangered species will strengthen the likelihood of HCVs being maintained both within and beyond national park boundaries, as recent research has shown that biodiversity is more effectively maintained in protected areas if the surrounding lands are well-managed (Laurance *et al.* 2012).

The convergence of commercial timber inventory data with satellite imagery of vegetation classes/habitats can elucidate environmental relationships such as tree species' distributions and above ground biomass estimates (Feldpausch *et al.* 2006). Analysis of such datasets should be incorporated into assessments of great ape survivorship in logging concessions and the evaluation of national certification standards. Habitat use by great apes (Devos *et al.* 2008) and habitat availability and connectivity can also be assessed using remotely sensed data (Bergl *et al.* 2012). Applying these approaches on a broader scale is increasingly possible and could facilitate better understanding of regional and continental-scale phenomena that impact great apes (see Box 8). Such assessments are also proving highly informative for other wildlife (Caillaud *et al.* 2010) and are a critical yet often under-emphasized component in three of the six HCV approaches established to identify and maintain such features. Further, more detailed assessments of 'forest attributes' important to apes can be accomplished using commercial timber inventories to link information on the spatial location of particular species with specific habitat types classified from satellite imagery. The preferences of great apes for particular species and habitats can then be extrapolated to landscape and regional scales to identify priority areas for ape conservation (Fig. 4). Furthermore, the effective management of HCV forests for these endangered apes will certainly benefit other wildlife.

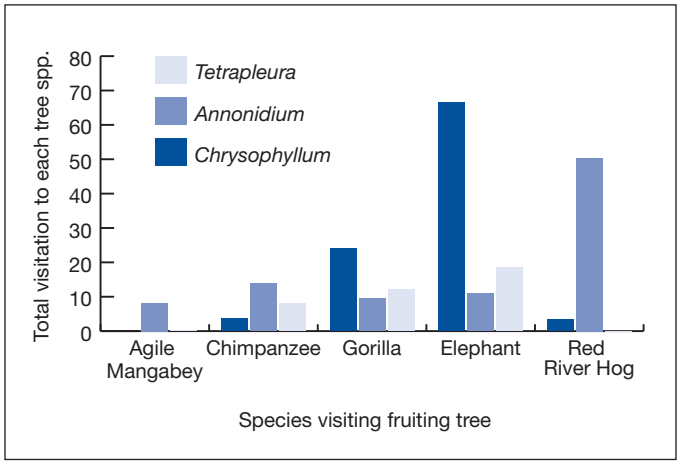


Figure 3. Large mammal visitation rates (measured as the proportion of all visits to each tree species) to three tree species. *Chrysophyllum lacourtiana* is currently logged in Central Africa at the promotional level. Protection of tree species identified as important resources to endangered wildlife (great apes, elephants) will increase the likelihood of maintaining HCVs in production forests.

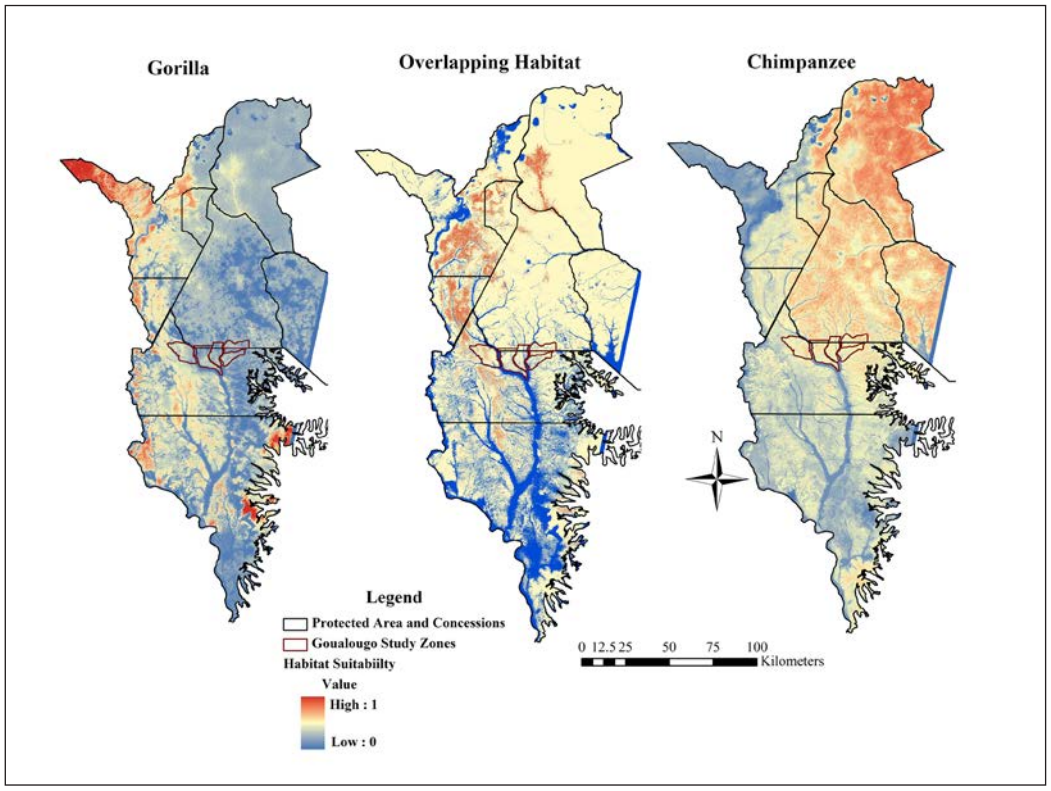


Figure 4. Spatial distribution of preferred foraging habitat or High Conservation Value Forest (HCVF) for gorillas (left) and chimpanzees (right) across NNNP and adjacent forestry concessions (analysis conducted in collaboration with E. Lonsdorf). The Goualougo Triangle study area is divided into five zones that are outlined in red. High quality habitat for gorillas and chimpanzees is indicated as increasing from white to red-brown. Less preferred habitat by species is indicated by cooler colours. Although habitat preferences overlap, there are distinct patterns in the spatial distribution of high quality habitat for gorillas and chimpanzees. Figure courtesy of Eric Lonsdorf.

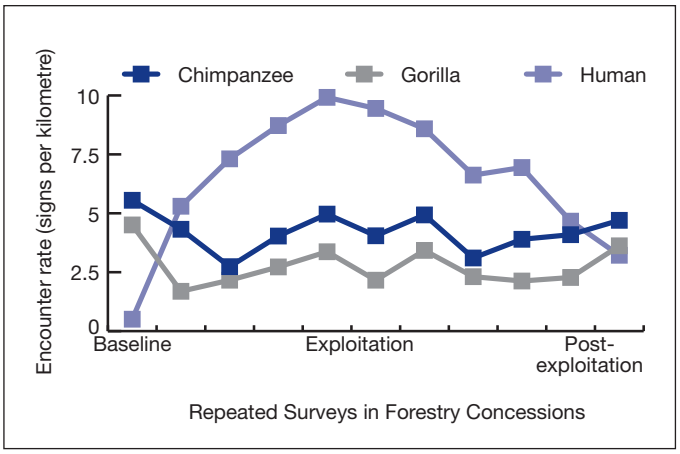
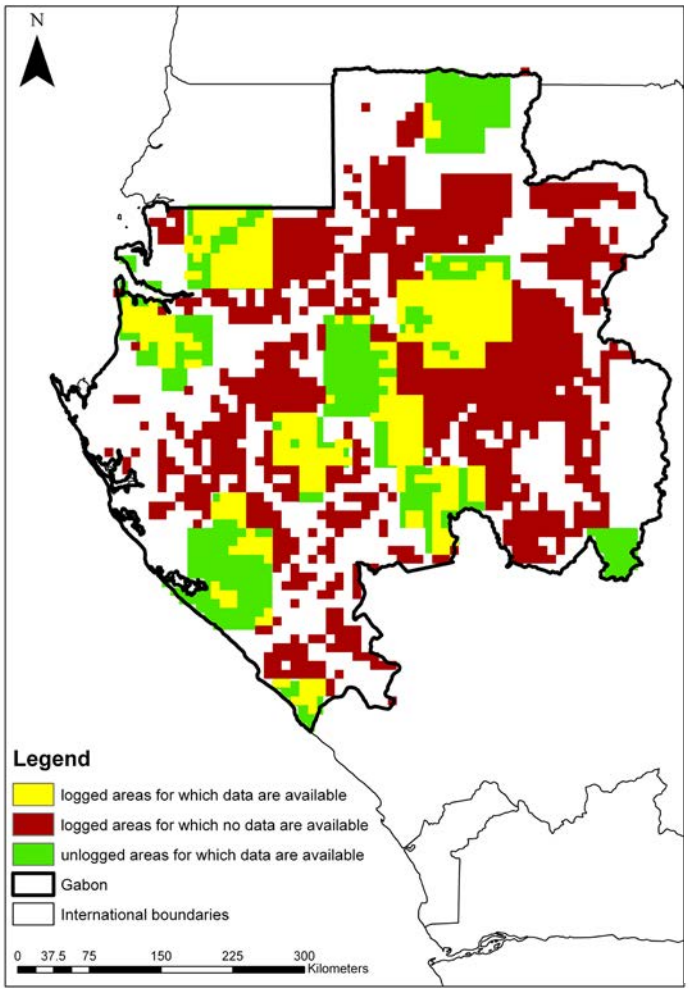


Figure 5. Encounter rates of human, chimpanzee, and gorilla signs in the Kabo forestry concession. The increase in human signs coincides with the arrival of forestry teams (Morgan *et al*. submitted). Encounter rates of chimpanzee and gorilla signs showed a slight decrease, but ape densities remained relatively stable during this period. The short-term impacts of logging were more apparent in the shifting spatial distribution of apes and their behavioural responses to increasing human activity.

We recommend that forest managers partner with great ape experts to assess data on growth, regeneration, tree stand abundance, size class distribution, and offtake rates within FMUs as they relate to ape survival needs. This will preserve resources necessary for the survival of great apes that may define or contribute to the HCV of a particular area. Standardized methods should be used to quantify the impacts of different exploitation regimes on forest diversity and structure in relation to the ecological needs of great apes and other endangered species.



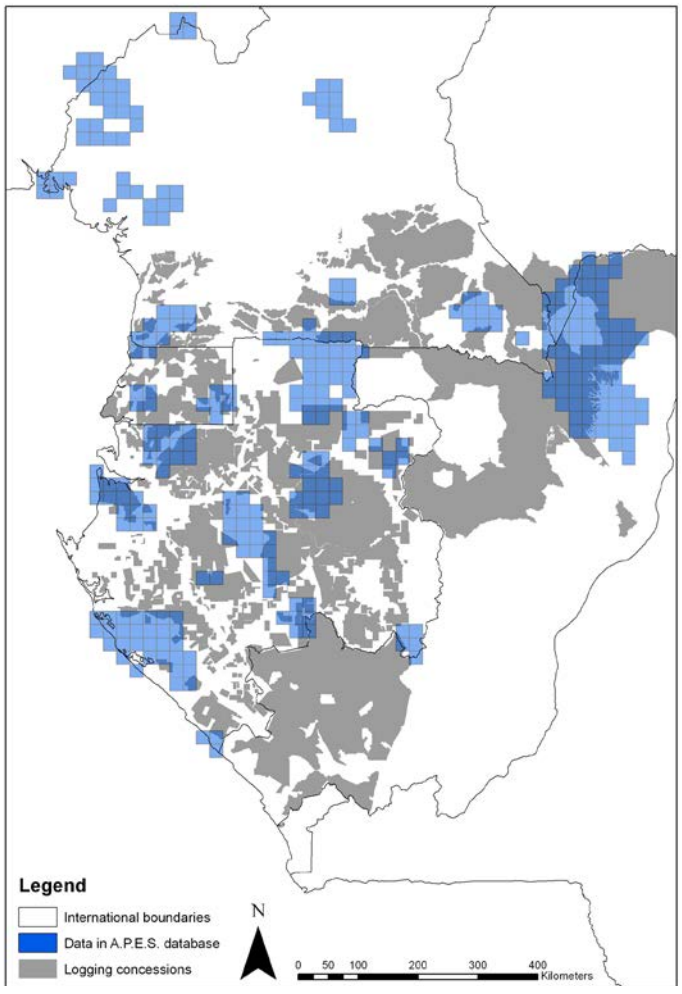


Figure 6a. Gap analysis of great ape survey data availability from protected areas and logged and unlogged concessions in Equatorial Guinea and Gabon, and parts of Cameroon, DRC and RoC (data and analysis provided by J. Junker and A.P.E.S. Portal*). Red indicates logged forests for which no ape survey data are available. Figure 6b. Map highlighting the lack of data from logged forests (grey). In contrast, a considerable amount of great ape survey data (light blue) have been collected in and around protected areas.

* http://apesportal.eva.mpg.de/

7. CONCLUSIONS

Emerging issues in Congo Basin land-use and natural resource exploitation centre on sustainable forest management and certification. New strategies and collaborations are increasingly being called upon to counteract the widespread forest degradation and overexploitation of resources that characterize many 'production forests' in the region (Nasi *et al.* 2011). FSC certification provides broad environmental, social and economic benefits. The management of forests under FSC urges forestry practitioners and conservation scientists to develop more synergistic collaborations to integrate specific wildlife needs into timber management. In this document, we have addressed principles of the FSC standard and recommended more inclusive measures to protect gorilla, chimpanzee and bonobo populations residing in multiple-use timber production forests.

Ecoguards with a dead duiker confiscated in the Kabo concession, Congo © David Wilkie

Recommendations:

1. **Decrease the risk of ape-human disease transmission** in concessions through educational campaigns and by implementing worker health programmes and field protocols.
2. **Strengthen law enforcement within concessions and address poaching** through the designation of controlled hunting zones. Fund well-trained and supervised teams of eco-guards and support strict compliance of judiciary laws for those convicted of poaching.
3. **Implement the High Conservation Value (HCV) approach and monitor ape populations in concessions.** Refine the High Conservation Value approach through studies of the abundance and distribution of tree species that are important to apes. Execute standardized surveys and establish long-term monitoring of great apes in concessions, preferably in collaboration with conservation biologists or ape experts.

Although there are many constraints facing such initiatives, the implementation of 'ape friendly' practices will build towards clearer design, monitoring and evaluation of great ape conservation in logging concessions. The actions recommended have the added value of producing the empirical data needed to quantify the environmental and species-specific benefits of FSC implementation. This should not be overlooked given the increasing pressure on government institutions to explore other land-use options, which often lack effective environmental stewardship measures. The stakes are nothing less than the future coexistence of our closest living relatives and the forests of the Congo Basin.

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9. ACRONYMS

AAC	Annual Allowable Cut
AFLEG	African Forest Law Enforcement and Governance
ATO	African Timber Organization
A.P.E.S.	Ape Populations, Environments and Surveys
BZP	Buffer Zone Project
CMS	Convention on Migratory Species
CIB	*Congolaise Industrielle du Bois*
DRC	Democratic Republic of Congo
FAO	Food Agriculture Organization
FMU	Forest Management Units
FMP	Forestry Management Plan
FSC	Forestry Stewardship Council
HCV	High Conservation Value
HCVF	High Conservation Value Forest
ITTO	International Tropical Timber Organization
IUCN	International Union of Conservation of Nature
MCD	Minimum Cut Diameter
MEF	Ministère de l'Economie Forestière
NGO	Non-government Organization
NNNP	Nouabalé-Ndoki National Park
RoC	Republic of Congo
P&C	Principles and Criteria
PEFC	Programme for the Endorsement of Forest Certification
PFE	Primary Forest Estate
PROGEPP	Projet de Gestion des Ecosystémes Péripheriques du Parc
RIL	Reduced-Impact Logging
SSC	Species Survival Commission
SOP	Standard Operating Procedure
SFM	Sustainable Forestry Management
UNESCO	United Nations Education, Science & Cultural Organization
WCS	Wildlife Conservation Society
WRI	World Resources Institute
ZSL	Zoological Society of London

10. CONSERVATION ACTION PLANS FOR AFRICAN GREAT APES

PDFs of these documents can be downloaded at: www.primate-sg.org/action_plans/

EAST AFRICA

Eastern chimpanzees (DRC, Rwanda, Tanzania, Uganda, Sudan and Burundi):

Plumptre, A.J. *et al*. 2010. *Eastern Chimpanzee* (Pan troglodytes schweinfurthii): *Status Survey and Conservation Action Plan 2010–2020.* IUCN/SSC Primate Specialist Group, Gland, Switzerland.

CENTRAL AFRICA

Bonobos (DRC):

IUCN and ICCN 2012. *Bonobo* (Pan paniscus): *Conservation Strategy 2012–2022*. IUCN/SSC Primate Specialist Group and Institut Congolais pour la Conservation de la Nature, Gland, Switzerland.

Grauer's gorillas and eastern chimpanzees (DRC):

Maldonado, O., Aveling, C., Cox, D., Nixon, S., Nishuli, R., Merlo, D., Pintea, L. and Williamson, E.A. 2012. *Grauer's Gorillas and Chimpanzees in Eastern Democratic Republic of Congo (Kahuzi-Biega, Maiko, Tayna and Itombwe Landscape): Conservation Action Plan 2012–2022.* IUCN/SSC Primate Specialist Group, Ministry of Environment, Nature Conservation and Tourism, Institut Congolais pour la Conservation de la Nature and Jane Goodall Institute, Gland, Switzerland.

Western lowland gorillas and central chimpanzees (Angola, Cameroon, Central African Republic, Equatorial Guinea, Gabon and Republic of Congo):

Tutin, C., Stokes, E., Boesch, C., Morgan, D., Sanz, C., Reed, T., Blom, A., Walsh, P., Blake, S. and Kormos, R. 2005. *Regional Action Plan for the Conservation of Chimpanzees and Gorillas in Western Equatorial Africa*. IUCN/SSC Primate Specialist Group and Conservation International, Washington, DC.

CAMEROON AND NIGERIA

Cross River gorillas:

Oates, J.F., Sunderland-Groves, J., Bergl, R., Dunn, A., Nicholas, A., Takang, E., Omeni, F., Imong, I., Fotso, R., Nkembi, L. and Williamson, E. 2007. *Action Plan for the Conservation of the Cross River Gorilla* (Gorilla gorilla diehli)*.* IUCN/SSC Primate Specialist Group and Conservation International, Arlington, VA.

Nigeria-Cameroon chimpanzees:

Morgan, B. *et al*. 2011. *Regional Action Plan for the Conservation of the Nigeria-Cameroon Chimpanzee (*Pan troglodytes ellioti*)*. IUCN/SSC Primate Specialist Group and Zoological Society of San Diego, San Diego, CA.

WEST AFRICA

Western chimpanzees (Benin, Burkina Faso, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Nigeria, Senegal, Sierra Leone and Togo):

Kormos, R., Boesch, C., Bakarr, M.I. and Butynski, T. (eds.). 2003. *West African Chimpanzees. Status Survey and Conservation Action Plan.* IUCN/SSC Primate Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK.

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12. CONTACTS AND RESOURCES FOR FURTHER INFORMATION

Ape Populations, Environments and Surveys (A.P.E.S.) Database and A.P.E.S. Portal

http://apesportal.eva.mpg.de/
email: apes@eva.mpg.de

Forest Stewardship Council (FSC)

http://www.fsc-uk.info
email: info@fsc-uk.org

High Conservation Value Network (HCVF)

http://hcvnetwork.org
email: info@hcvnetwork.org

International Tropical Timber Organization (ITTO)

http://itto.int
email: itto@itto.int

IUCN/SSC Primate Specialist Group

http://www.primate-sg.org/
email: sga_coordinator@conservation.org

Tropical Forest Trust (TFT)

http://tft-forests.org
email: info@tft-forests.org

A bonobo at LuiKotale, Salonga National Park, DRC © Caroline Deimel/MPI-EVAN

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1. *Species Conservation Priorities in the Tropical Forests of Southeast Asia: Proceedings of a Symposium held at the 58th Meeting of the IUCN Species Survival Commission, October 4, 1982, Kuala Lumpur, Malaysia.* Edited by R.A. Mittermeier and W.R. Konstant, 1985, 58pp. [Out of print]
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