Photo: Reduced impact logging establishes limited extraction rates and minimum stem diameter whilst minimizing the collateral damage associated with the removal of larger, more valuable trees. © ZSL

CHAPTER 4

Avoiding the chainsaws: industrial timber extraction and apes

Introduction

Industrial timber extraction is dominated by the removal of timber for round wood. It is considered a serious threat to biodiversity with significant repercussions, particularly for forest-dependent species such as the great apes and gibbons, who rely on the forest and its resources for survival. Most of the tropical forest zone is covered with logging concessions and will likely be logged unless there is a change in land-use allocation. As different types of logging have emerged, so too have their impacts on the environment. In particular, selective logging, although extensive in nature, has relatively less impact. However, if the long-term impacts on the fate of the great apes and gibbons of old-growth habitat transformation to secondary forests

and further degradation by repeated logging are to be significantly reduced, harvesting intensity must remain low and over longer time frames.

Current knowledge on the effects of logging on gibbons is outlined in Chapter 3; however, because of the lack of information on conservation efforts with gibbon species in logging concessions, this chapter focuses on the interface of logging with great apes only.

The initial section of this chapter presents detail on the various forms of industrial logging with particular emphasis on sustainable management and its uptake and impact on the environment. Section two focuses more specifically on the interface of great apes and industrial logging. Two case studies from Central Africa, Cameroon and the Republic of Congo, highlight initiatives where conservationists are engaging with logging companies to secure positive outcomes for ape conservation. Key findings of the chapter include:

"Although SFM is incorporated into policy and legislation of many producer countries, implementation is often weak, rendering the regulatory frameworks redundant."

- The prohibitive cost of implementing sustainable forest management (SFM) is cited as a key reason for lack of uptake within the tropical forest context;
- Although SFM is incorporated into policy and legislation of many producer countries, implementation is often weak, rendering the regulatory frameworks redundant;
- Evidence that current SFM practice is not sustainable owing to short cutting cycles is currently not incorporated into species-specific conservation strategies;
- Much conservation action is based on the premise that logging is an unavoidable reality for tropical forestry and conservation groups and organizations are engaging with industry to mitigate its impacts;
- There is a lack of clarity on the compatibility of ape conservation with industrial logging as a result of unresolved research findings on the impacts of sustainable forest management on ape behavior.

Industrial logging in tropical forests

This section initially presents an overview of the different types of logging followed by a more detailed treatment of sustainable logging practices and the viability of this approach for the conservation of biodiversity. The purpose of timber production is to harvest trees from forest landscapes to produce wood and wood products. Three types of logging practice dominate the industry:

- **Clear felling**, which is often associated with the conversion of forests to plantation or some other land use or associated with the harvesting of fiber for pulp and paper mills. This form of clear–fell–replant is not compatible with managing forest biodiversity.
- **Selective logging**, which removes specific valuable species from a forest but with no regard for the environmental effects of extraction.
- **Reduced impact logging** (RIL) is also considered a form of selective logging but limited extraction rates and stem diameters are maintained. This is done in conjunction with minimizing the collateral damage associated with the removal of larger, more valuable trees. The intention is to enable the forest to naturally rejuvenate from young trees that were growing prior to logging or from the seeds of the remaining trees (van Kreveld and Roerhorst, 2009). While reduced impact logging has been found to maintain some ecosystem services such as carbon (Putz *et al.*, 2008), it does not address some key issues related to biodiversity conservation largely linked to the indirect impacts of tropical forestry.

Sustainable forestry management (SFM)

The potential impacts that forestry operations can have on forests, biodiversity, and the associated ecosystem functions they provide have been recognized for some time. Actions to try to mitigate these impacts while also utilizing the forest as an economic resource have also been implemented and are commonly defined under the term SFM; however, there is no clear consensus on the definition of the term. The International Tropical Timber Organization (ITTO) encourages its members, who represent over 90% of the tropical timber trade, to manage their operations in such a way as to provide, "a continuous flow of desired forest products and services without undue reduction of its inherent values and future productivity and without undue undesirable effects on the physical and social environment" (ITTO, 2013).

Whereas a more holistic definition of SFM is provided by the UN: "Sustainable forest management as a dynamic and evolving concept aims to maintain and enhance the economic, social and environmental value of all types of forests, for the benefit of present and future generations" (UN (2008), Resolution 62/98, p. 2).

Despite a broadly agreed international consensus that SFM should be the vision that guides forest managers, SFM has gained limited traction in tropical forests to date. Only 7% of permanent forest estates within the ITTO's member countries are considered to be responsibly managed (Blaser and Sabogal, 2011), although there is no clarity as to whether this means that sustainability has been achieved. Conventional/intensive logging is still therefore the predominant choice in a majority of forestry operations which gives little priority to long-term sustainability (Putz, Dykstra, and Heinrich, 2000; Shearman, Bryan, and Laurance, 2012). One of the main reasons cited by timber companies as preventing them from adopting an SFM approach is the prohibitive cost of implementation and a corresponding lack of realistic incentives to do so (Putz *et al.*, 2000). There is an acknowledgment that this issue must be addressed if SFM, especially in the tropical forest context, is to become the norm; companies are businesses that must remain economically viable if they are to succeed.

A number of options exist that seek to increase and guide the implementation of SFM within tropical forests. These range from the development of voluntary guidelines through to market-linked certification systems to the establishment of policy or legislative instruments.

Voluntary guidelines

A number of trade organizations exist to promote the development of the tropical timber sector and over the last 10–15 years they have moved towards incorporating sustainability as a goal. These organizations help develop technical guidelines, training and financial support for countries and industry to support the implementation of more sustainable practices in the sector.

> "Only 7% of permanent forest estates within the ITTO's member countries are considered to be responsibly managed."

The ITTO was established in 1986 to promote the protection and sustainable management of tropical forests and looks to balance the need for economic development with environmental and social safeguards. The ITTO is a voluntary organization that develops and promotes better trade practices in the use and management of tropical forest. In 1993, following the development of the Convention on Biological Diversity (CBD), ITTO produced *Guidelines on the Conservation of Biological Diversity in Tropical Production Forests*. Since then the ITTO has collaborated with the IUCN (International Union for Conservation of Nature), revising the ITTO guidelines and providing additional protocols to forestry companies

for conservation management (ITTO and IUCN, 2009).

The Association Technique Internationale des Bois Tropicaux (ATIBT) (www.abtibt.org) supports the development of and capacity building in the tropical timber industry in Central Africa. Formed in 1951, it has increasingly adopted an approach that is grounded in SFM.

A fundamental problem across tropical forest countries is the permissive and corrupt jurisdictional environments that result in weak law enforcement of illegal logging and practice. This means that implementing responsible logging practice imposes a high opportunity cost, which is likely to be a key factor in the poor uptake of SFM in the tropical forest context. The implication is that the level of support provided by these industry organizations is not sufficient incentive to drive widespread change in the sector.

Certification

Forest certification is a market-based mechanism that incentivizes timber producers to implement more sustainable practices. However, certification does not indicate that sustained yields have been achieved – it certifies compliance with a number of best practices, and thereby commands either a market premium, or in other cases market access. There are at least seven voluntary, independent certification bodies worldwide with the Forest Stewardship Council (FSC) as the key international certification scheme in the tropics. It provides standard setting, trademark assurance, and accreditation to companies, organizations, and communities interested in responsible forestry. The FSC is an independent non-profit NGO and the only truly global certifier of tropical forests that carries the support of a broad

Photo: For many tropical timber producing countries sustainability underpins legislation behind the management of their national forest estate . . . however, implementation is often weak.
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TABLE 4.1

Summary of extent of FSC-certified forest in Congo basin and Southeast Asia

Region	Area of FSC-certified forest	
	10 km²	Proportion total forest
Congo basin[1]	44 610	0.02
Southeast Asia[2]	22 880	0.01

1. Cameroon, Republic of Congo, and Gabon
2. Cambodia, Indonesia, Laos, Malaysia, and Vietnam

Data from FSC (2013) and FAO (2010b, 2011b).

base of environmental NGOs (Gullison, 2003; Nussbaum and Simula, 2005). Since its foundation in 1993, the FSC has certified over 1.8 million km² of forest, in 80 countries (FSC, 2013). While this represents the equivalent of 4.5% of the world's forests, uptake in tropical forests has been significantly less extensive (Table 4.1).

Although certification uptake in tropical regions has been increasing over the last few years, it still represents a tiny fraction of overall production forest area. Perceptions related to the lack of sufficient demand for certified products, combined with front-end costs associated with achieving certification, are possible reasons for this. Despite this, FSC certification has been more successful to date in improving management practices than any other improved forestry model, particularly in regards to biodiversity, and has encouraged many stakeholders to modify their approach to logging (Sheil, Putz, and Zagt, 2010). In fact, Principle 6 relates directly to conservation of biodiversity and states "Forest management shall conserve biological diversity and its associated values, water resources, soils, and unique and fragile ecosystems and landscapes, and, by so doing, maintain the ecological functions and integrity of the forest" (FSC, 2012). While there is a trend of increasing demand for FSC products on the international market (FSC, 2013), the impact on tropical forests has been minimal.

Consumer country measures

Controls at the purchasing end of the timber supply chain have recently been developed. The EU Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan, which was designed to stop illegal timber entering the region's markets, is an example of this and is enforced through bilateral agreements between the EU and producer countries (see Chapter 1).

Although not a consumer nation policy per se, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is increasingly utilized by countries to ensure that trade in listed timber species is legal, sustainable, and traceable. Around 350 tree species are listed under CITES Appendices (CITES, 2013a), and trade in their products is therefore subject to regulation to avoid utilization that is incompatible with their survival (see Box I.2 in the Introduction).

CITES works with the ITTO to promote sustainable forest management and to build the capacity of developing states to effectively implement the Convention as it relates to listed tree species. However, it is not considered to be an effective strategy for curbing the trade in illegal logging as the number of important timber species listed is considered to be insignificant to the volume of timber traded (S. Lawson, email communication, July 27, 2013).

Producer country measures

For many tropical timber producing countries sustainability underpins legislation behind the management of their national forest estate. In Cameroon the adoption of the 1994 forestry laws meant that forestry concessions have to be managed on the basis of approved "Forest Management Plans" (FMPs) that should ensure sustainable use of the resource and avoid social and environmental damage. The laws detail a forest zoning system within which a forest management unit (FMU) represents the "concession" allocation within the permanent forest estate. Large-scale timber production typically operates within the FMU. FMUs are leased at public auction and although limited harvesting can begin immediately, an FMP must be submitted to the Ministry of Forestry and Wildlife (Ministere des Forets et de la Faune – MINFOF) within 3 years. The FMP is envisaged as a document outlining how the FMU will be sustainably managed and should include an assessment of the potential social and environmental impacts of harvesting and how these will be minimized and mitigated to ensure the forest resource is maintained (République du Cameroun, 1994).

Similar measures exist in other countries and although over 140 000 km² (14 million hectares) of forests in Central Africa have management plans (Bayol *et al.*, 2012), implementation is weak. In the Cameroon context for example, these policies do not ensure the application of SFM and improved outcomes on the ground (Cerutti and Tacconi, 2008).

Can sustainable forest management contribute to tropical forest biodiversity conservation?

The increasing encroachment of industrial timber extraction in ape habitats and the documented increasing impact on their socio-ecology raises a number of crucial questions about the compatibility of this form of resource extraction on ape and broader biodiversity conservation. Does the application of SFM practices in relation to industrial logging reconcile profitable utilization of the resource with "maintaining and enhancing the economic, social and environmental value of the forest" (UN (2008), Resolution 62/98, p. 2)? Is there evidence that responsible logging maintains or enhances biological diversity in tropical forests and thereby can contribute to ape conservation and be truly sustainable?

Timber production in tropical forests has a range of effects on their biodiversity. The complexity of understanding these impacts is reflected in the lack of consensus from research at this interface over the last 10–20 years. For example, studies that have focused on responses in species' population parameters depend very much on the traits of the studied species. Studies looking at the impact of logging on terrestrial and bark-gleaning insectivorous birds or bats showed a significant adverse impact (Putz *et al.*, 2000; Peters, Malcolm, and Zimmerman, 2006) whereas those looking at impacts on species with more generalist needs observed less of a negative effect (Johns, 1997).

Similarly a temporal effect can be seen whereby patterns in responses observed immediately after logging can change as time passes. After an initial decline related to the disturbance of the logging process in Indonesia, primates seem to cope relatively well, particularly if they have a generalist diet. The critical factors determining a species' ability to recover are often tied to duration of logging disturbance, as well as time passed since logging took place. Sun bears, however, suffered if fruiting tree diversity was not maintained and most of their recorded range is therefore within primary non-logged forest. Ungulates, on the other hand, as generalist herbivores, seem to be able to adapt

to the change and partially benefit from the increase of grazing areas as the canopy opens up (Meijaard *et al.*, 2005). Studies that look at changes in measures of diversity or species richness overall also present conflicting trends with no change, for example, observed in the diversity and structure of butterfly assemblages in logged areas in Belize (Lewis, 2001) while marked differences have been documented between logged and undisturbed forests amongst moths in North American forests (Summerville and Crist, 2001). To some extent the patterns associated with observed impacts on species depend on where, how, and when you look.

Findings in relation to the impact of different management systems on biodiversity support the concept that populations of many species are significantly lower in conventionally logged concessions than those that are selectively logged, of which the best model is certified forest. The findings of a long-term study in Northern Congo sought to tease out the different effects of the direct and indirect impacts of logging on the abundance of a number of species. Significant populations of wildlife were observed in the logged forests, although these were still less than in unlogged areas (Clark *et al.*, 2009). A similar pattern was observed in Borneo, where many species increased in abundance after the initial disturbance of logging had passed, linked perhaps to the opening up of the canopy and new growth, with numbers returning to previous levels over time (Meijaard *et al.*, 2005).

Several additional factors influence species abundance, namely proximity to protected areas and distance from roads and settlements, reflecting the impact of hunting pressure (Fa, Ryan, and Bell, 2005). Illegal and unsustainable hunting indirectly linked to logging operations represents a far greater threat to species conservation than the direct impact of tree removal (Milner-Gulland and Bennett, 2003; Meijaard and Sheil, 2007, 2008). The opening up of forests for logging with associated roads and expansion of local human populations is linked to increased pressure on wildlife from hunting (Wilkie *et al.*, 2001; Fa *et al.*, 2005; Laporte *et al.*, 2007). Indirect impacts of logging and other extractive industries are explored in more depth in Chapter 7.

Photo: The opening up of forests for logging with associated roads and expansion of local human populations is linked to increased pressure on wildlife from hunting.
© GTAP/D. Morgan

Wildlife population density is reported to be higher in certified forests than in any other logging system and, in some rare instances, wildlife density is higher in certified forest than some protected areas (Clark *et al.*, 2009; van Kreveld and Roerhorst, 2010). The Deramakot FS concession in Sabah, Malaysia, is an example of this where the density of large mammals is higher within the concession than in the surrounding protected areas. A contributing factor is likely to be improved law enforcement on the concession (e.g. effective patrols and guarded roads). This, however, highlights both the need for better management of protected areas and the positive contribution that responsible management of timber forests can effect on conservation (van Kreveld and Roerhorst, 2010). The control of hunting is therefore considered to be a critical aspect of certification and the FSC, in response to criticisms from civil society, updated their standards to make this explicit (FSC Watch, 2008).

> "Wildlife population density is reported to be higher in certified forests than in any other logging system."

Overall, evidence suggests that implementing the principles of sustainably managed forestry can make a contribution to conservation relative to the impact of conventional logging. The application of SFM principles in tropical forests is not however considered to be a viable alternative to unlogged primary forests and an effective protected area network where no extraction maintains the full ecological function of these areas (Clark *et al.*, 2009; Gibson *et al.*, 2011; Woodcock *et al.*, 2011).

Viability of current industrial logging and relevance for ape conservation

To maintain or enhance timber yields, a minimum cutting cycle of 50–100 years would be required (Brienen and Zuidema, 2007). In some of the larger sized concessions, felling cycles range from 10–20-year intervals with a period of about 30–40 years to allow the timber to regenerate before felling is resumed. These re-entry schedules are considered to be far too premature because they do not allow adequate forest recovery with evidence that depletion, and in some cases extirpation of most timber species, occurs within three cutting cycles (Hall *et al.*, 2003; Shearman *et al.*, 2012; Zimmerman and Kormos, 2012).

Tropical timber producing countries in Asia-Pacific are therefore believed to be reaching "peak timber" exploitation levels (Shearman *et al.*, 2012) due to continued depletion of native top-quality timber species at "unsustainable" cut levels, implying a "timber famine" is imminent. While the necessary data are lacking to provide a comprehensive assessment detailing the number of times concessions throughout tropical Africa and Asia have been repeatedly exploited, it is reasonable to assume that many concessions are likely to be second and third growth forests since the 1950s (ITTO, 2006). Concessions closer to human population centers are generally small artisanal managed forests with a longer history of more intensive exploitation than larger scale industrial concessions, due to factors such as market demands and access (Pérez *et al.*, 2005). As it is likely that those smaller artisanal managed concessions were initially intensively exploited, they have already incurred steep and detrimental changes in forest structure as the volume and dimensions of trees dramatically diminish with subsequent exploitation (Hall *et al.*, 2003). Further, evidence has led to contrasting views on the possibility and feasibility of natural regeneration techniques and the merits of SFM in general (Shearman *et al.*, 2012; Zimmerman and Kormos, 2012). These concerns about the overall sustainability of large-scale logging are further compounded by the failure of World Bank funded development in this

sector to achieve reductions in poverty and environmental destruction (IEG, 2012).

These arguments are countered by claims that there are trade-offs to be made and that subsidizing industry action towards managing timber concessions in a more ecologically friendly manner will be of benefit to conservation initiatives. Secondary forests have been characterized as a "middle way" towards ensuring conservation of biodiversity across mosaic landscapes that consist of highly degraded human-modified habitats to those important enough to be left intact and strictly off-limits to extraction (Putz *et al.*, 2012). The current conservation paradigm has in large part broadened from the protection focused approach of the 1980s to also emphasize securing species survival prospects beyond the boundaries of reserves and within the heterogeneous matrix of single and multi-use forests.

To attain success beyond the confines of areas established for strict protection, initiatives require safeguards to protect biodiversity and improve the economic lives of human populations living in proximity to the permanent forest estates (PFE). PFE incorporate land for production and protection (Blaser *et al.*, 2011). Although participation in such initiatives has been slow to gain traction across great ape ranges, there are multiple indications that trends are on the rise:

- A growing number of concessionaires across the African sub-regions have started adopting SFM practices and certification schemes (Table 4.2). Just over 140 000 km² (14 million hectares) or 8.2% of forested area are under formal management (Bayol *et al.*, 2012). Production PFE categorized under SFM across Africa totaled roughly 66 000 km² in 2010, which is an increase of 23 000 km² since 2005. Similarly certified forest in African ITTO producing countries more than tripled from 14 800 km² to 46 300 km² between 2005 and 2010 (Blaser *et al.*, 2011). Certified forests however accounted for just 2.8% of the production PFE in African ITTO member states. Most progress towards implementing certification standards on the African continent has occurred in the Congo Basin (van Kreveld and Roerhorst, 2009), where the Republic of Congo leads in total area of concessions certified by FSC, notably between two companies, followed by Gabon (Nasi, Billand, and van Vliet, 2012).
- Timber companies that take their environmental responsibilities seriously are increasing across the orangutan range, as indicated by increased certification through Indonesian timber certification (*Lembaga Ekolabel Indonesia,* LEI) (Muhtaman and Prasetyo, 2004) and the FSC. However, it remains to be seen whether those commitments translate into reduced forest loss in timber concessions that contain wild orangutans.
- The Sabah Government at the Rio Earth Summit in 1992 indicated its long-term commitment to maintain 50% of its state as natural forest (Embas, 2012, p. 3), and aims to ensure FSC certification of all its remaining natural forest concessions by 2014 (REDD Desk, 2011). There is acknowledgement by the government that it will take several decades of minimal revenues from timber extraction until forests have recovered to a productivity level that again allows for timber extraction.
- The Indonesian government has made similar commitments, for Kalimantan at least, by promising to retain a minimum of 45% of the land area as forest (President of the Republic of Indonesia, 2012) – note that the definition of forest in this context remains to be clarified and it is unclear whether "forest" would also include timber plantations. The mechanisms to do so, however, remain unclear,

"To attain success beyond the confines of protected areas, initiatives require safeguards to protect biodiversity and improve the economic lives of human populations."

TABLE 4.2

Attributes of permanent forest estate within the range countries of African apes

Country	Permanent forest estate attributes Natural forest (10 km²)										
	Total available for harvesting		Management plan		Certified		Sustainably managed		Total area production forest		Total area protection forest
	2005	2010	2005	2010	2005	2010	2005	2010	2005	2010	2010
Cameroon	4,950	6,100	1,760	5,000	0	705	500	1,255	8,840	7,600	5,200
Central African Rep.	2,920	3,100	650	2,320	0	0	186	0	3,500	5,200	560
Rep. Congo	8,440	11,980	1,300	8,270	0	1,908	1,300	2,494	18,400	15,200	3,650
Dem. Rep. Congo	15,500	9,100	1,080	6,590	0	0	284	0	20,500	22,500	25,800
Gabon	6,923	10,300	2,310	3,450	1,480	1,870	1,480	2,420	10,600	10,600	2,900
Ghana	1,035	1,124	1,150	774	0	150	270	155	1,150	774	396
Liberia	1,310	1,000	0	265	0	0	0	0	1,310	1,700	194
Côte d'Ivoire	1,870	1,950	1,110	1,360	0	0	277	200	3,400	1,950	2,090
Nigeria	1,060	1,060	650	na	0	0	na	33	2,720	2,720	2,540

Note: modified from ITTO (2011). Courtesy of David Morgan and Crickette Sanz.

and insufficient engagement between different government departments is not conducive for developing optimal trade-offs between economic, social, and environmental goals.

However, any potential benefits derived from SFM and its trade activities risk being undermined by unchecked or illegal logging practices, which are a pressing threat, as well as illegal allocation of logging permits that not only undermine the ecology of the forest but also the associated social benefits (Smith, 2004; Blaser *et al.*, 2011; Global Witness, 2012a; see Box 4.1). Economic development patterns in Africa have also become increasingly diverse and the trade in African timber faces increasing competition from a range of non-timber commodities (aluminum, steel, plastic) and non-native crops that threaten to replace the very existence of naturally regenerating forests. It appears that the only way towards securing a viable future for natural forest-based tropical wood products is emphasizing SFM and adoption of certification standards to ensure growth and persistence in the forestry sector. However, there is poor understanding of the low uptake of certification schemes in tropical forests despite financial investments in this direction. Furthermore, if prospects for wildlife conservation are to be truly considered more needs to be done in the overall process to resolve impacts such as bushmeat hunting. In order to achieve this, greater efforts would be required by conservation scientists to aid forestry managers in identifying site-specific needs that they can act upon (Bennett, 2004).

Considering that large areas of ape habitat are logging concessions (see subsequent sections), the likelihood of their conversion to formal protection has been greatly diminished. Voluntary independent certification has the best potential to improve practice in the short term as the standard, expert independent auditors and transparency coupled with the involvement of stakeholders such

as conservation organizations and local communities have proved an effective way to influence logging practice. The case studies towards the end of this chapter outline how this has been achieved in two sites in Central Africa. Perhaps most significant to the survival prospects of great apes is that certified forestry practices also strive to ensure that exploited tree species are managed as renewable resources. This principle is largely overlooked by ape conservationists who usually view these criteria solely as forestry standard and less as a tool for assessing and managing ape survival prospects. However, African tropical hardwood trees are currently central to forestry discussions of renewable resources and debates on sustainability. Based on available growth ecologies of timber species, most ecologists advocate a "precautionary approach" so that unrealistically optimistic felling cycles are avoided.

Logging and great apes

This section presents detail on the overlap of great apes with logging concessions. It further presents two case studies from Central Africa where conservationists are engaging with the timber industry to mitigate impacts on great apes through the use of sound science, dialog, and partnership.

Logging and orangutan distribution

A recent study (Wich *et al.*, 2012b) showed that an estimated 29% of the current orangutan distribution in Borneo is found in natural forests exploited for timber, where logging is allowed but forest conversion is prohibited. A smaller proportion (21%) of orangutan distribution lies within protected areas where logging and conversion are prohibited. In these forests, despite logging

BOX 4.1

Illegal logging

Illegal logging encompasses a number of activities that include the removal of timber from protected areas, harvesting in excess of concession permit limits or outside concessions, and violating export bans, international trading rules, or CITES. Although no clear definition exists, it significantly undermines responsible logging operations and threatens the integrity of forest ecosystems. It also represents lost revenue for countries where it is on-going and is considered to contribute to a 7–16% reduction in world timber prices, as trading prices are compromised due to the availability of illegal wood (Seneca Creek Associates and Wood Resources International, 2004).

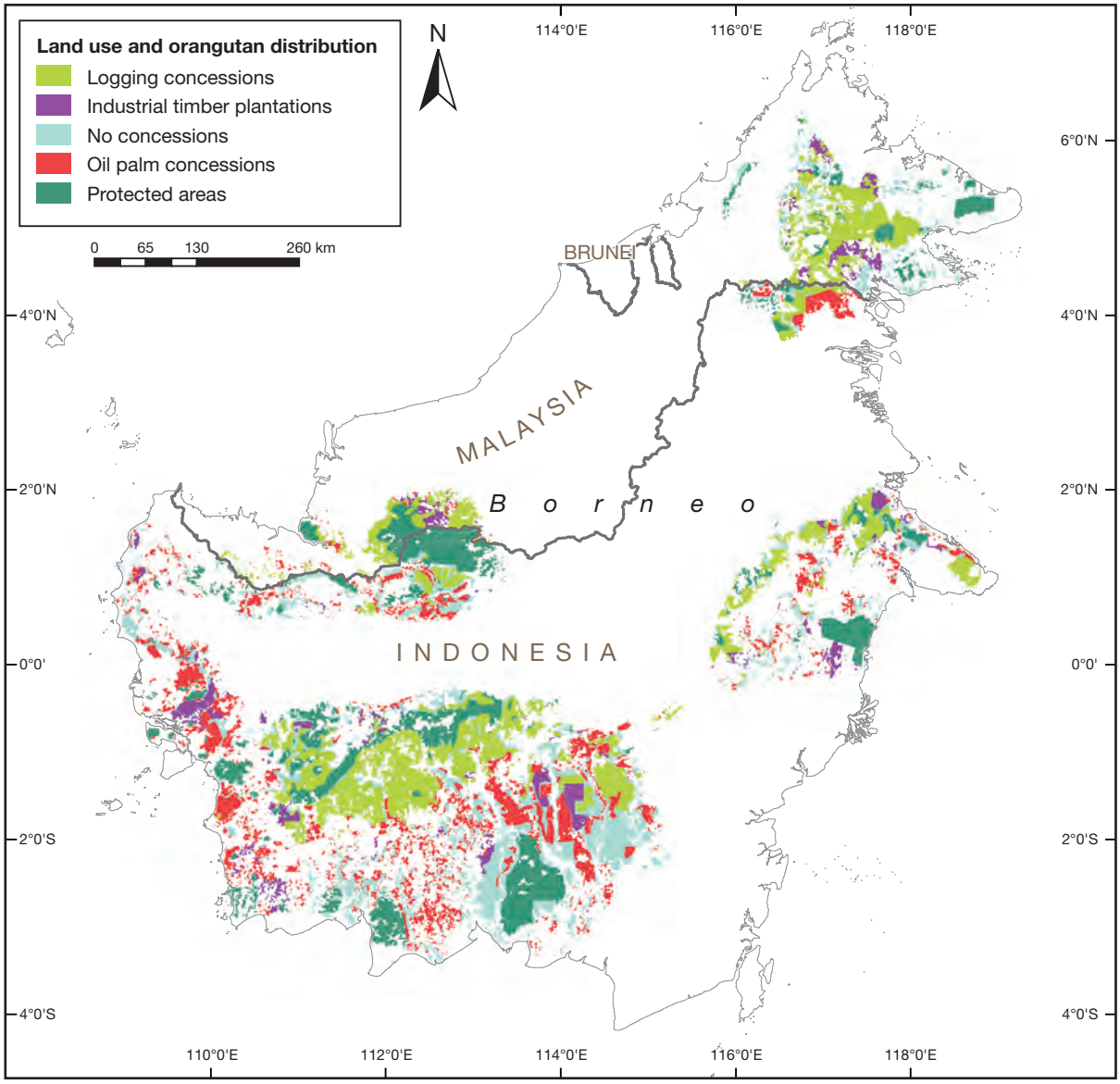
It is estimated that in 2007, approximately a quarter of Cameroon's timber production was illegal, and the figure for Indonesia stood at 40% in 2005. Furthermore, the figures for Indonesia do not include questionable allocation of licenses for clearance to make way for agricultural plantations, at the expense of the natural forest (Lawson and MacFaul, 2010). The equivalent of 50 000 km^2 of forest was destroyed as a result of over 100 million cubic tons of illegal timber being felled globally in 2009. Declines in these trajectories prior to 2009 have been attributed to the global financial crisis and actions by some producer countries, such as Indonesia where, in 2005, a Presidential Instruction on Illegal Logging was issued (Lawson and MacFaul, 2010). More recently, trade agreements under frameworks such as FLEGT and the Lacey Act hold some promise for further changes in illegal logging rates as long as they are effectively enforced.

Photo: "Considering that large areas of ape habitat are logging concessions, the likelihood of their conversion to formal protection has been greatly diminished." © Alison White

prohibition, illegal activities can still occur due to ineffective protection on the ground. An almost equal percentage (19%) overlaps with undeveloped industrial oil palm concessions, and 6% overlaps with undeveloped industrial timber plantations. Although these concessions are still forested they are expected to be converted to plantations in the near future. Finally, an estimated 25% of the orangutan distribution range occurs outside of protected areas and outside of concessions, with 13% and 12% on conversion forests and in production forests, respectively. Conversion forests include forested regions allocated explicitly for non-forest purposes such as oil palm plantations (see Figure 4.1).

FIGURE 4.1

Orangutan habitat in Borneo and the land use to which it has been allocated



ITP= industrial tree concessions and IOPP = industrial oil palm concessions (Wich *et al.*, 2012b)

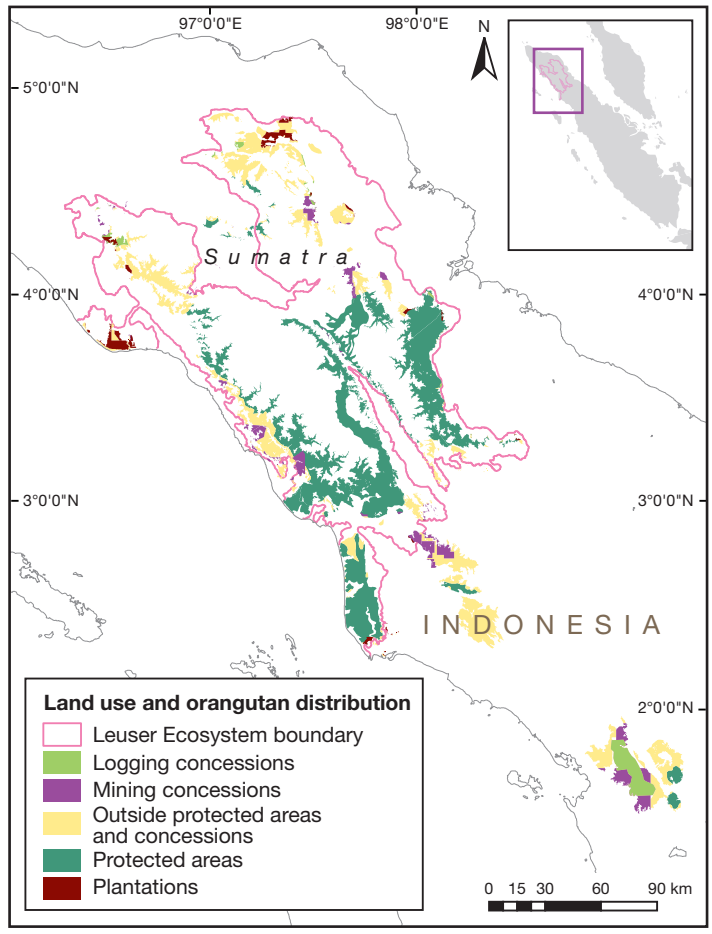
On Sumatra almost equal percentages of orangutan distribution are found within protected areas (43%) and outside protected areas and concessions (41%) (Wich *et al.*, 2011b; Figure 4.2). Protected areas were defined as those areas that fall under management by the Ministry of Forestry and are strictly protected. They therefore do not include the Leuser Ecosystem area outside of the Gunung Leuser National Park in Aceh, which has been designated as a National Strategic Area. Including this area in the protected area category would increase the percentage of orangutans in protected areas, but would also create considerable overlap between the concessions and protected area category.

The overlap of orangutan distribution with logging concessions is much less than on Borneo at only 4%. The overlap with plantation concessions (almost exclusively oil palm) is 3%, and 9% of orangutan distribution is under mining concessions (Figure 4.2).

A specific problem associated with unsustainable timber extraction is that it leaves natural forest concessions with limited economic potential to generate revenues. The next step often chosen is to convert these natural forest stands into more intensively managed plantations of one or a few tree species. This pattern of conversion from natural forest to logging concession to managed plantations highlights the risks of engagement in any form of industrial logging. As the timber value of the forest decreases, alternatives to selective logging become attractive and increase the likelihood of conversion away from natural forests. Even though such plantations provide some habitat for orangutans, carrying capacity appears to be far lower than in natural forests, while human–orangutan conflicts due to crop damage further limit their chances of survival (Campbell-Smith, Sembirang, and Linkie, 2012). The implementation of sustainable forest management (SFM) in natural forest concessions is thus considered to be a key strategy in orangutan conservation.

FIGURE 4.2

Orangutan habitat in Sumatra and land-use allocation



Note: Multiple boundaries of Gunung Leuser National Park exist and the SK 276 are used in this analysis.
Courtesy of S. Wich.

Logging and African apes

Using data on land use provided by the World Resources Institute (WRI, 2012) and the latest data on the distribution of great apes in Africa provided by the A.P.E.S. (Ape Populations, Environments and Surveys) database, distribution range map polygons for each species/subspecies were overlaid on data for both the protected area network and forest concessions to produce maps

TABLE 4.3

The estimated range within protected areas and timber concessions of great ape taxa found in Central Africa

Great ape species/subspecies	Total range, km² (Congo Basin only)	Range within protected areas, km² (proportion)	Range within timber concessions, km² (proportion)
*Gorilla beringei beringei** (mountain gorilla)	259	259 (1.00)	0 (0.00)
Gorilla beringei graueri (Grauer's gorilla)	64 860	23 719 (0.37)	0 (0.00)
*Gorilla gorilla diehli** (Cross River gorilla)	2414	998 (0.41)	76 (0.03)
Gorilla gorilla gorilla (western lowland gorilla)	691 277	99 722 (0.14)	338 114 (0.49)
Pan paniscus (bonobo)	420 018	63 163 (0.15)	56 698 (0.13)
Pan troglodytes ellioti (Nigeria-Cameroon chimpanzee)	123 672	17 949 (0.15)	11 144 (0.09)
*Pan troglodytes schweinfurthii** (eastern chimpanzee)	886 103	131 553 (0.15)	45 311 (0.05)
Pan troglodytes troglodytes (central chimpanzee)	712 951	101 727 (0.14)	336 555 (0.48)

* Estimates do not include range outside of Central Africa, defined here as Cameroon, CAR, Gabon, Equatorial Guinea, Republic of Congo, and DRC.

TABLE 4.4

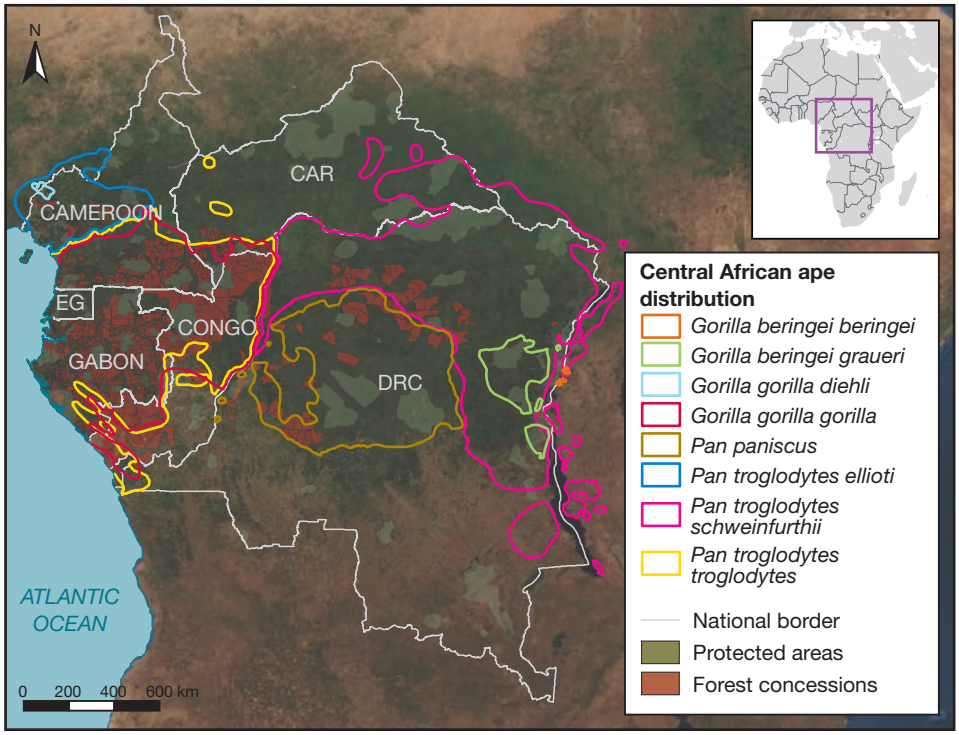
Estimated area of priority sites for conservation of western lowland gorilla and central chimpanzee within protected areas and timber concessions in the Congo Basin

Site name	Priority level	Total area, km²	Area in timber concessions, km² (proportion)	Area in protected areas, km² (proportion)
Odzala complex	Exceptional	39 694	24 116 (0.61)	15 257 (0.38)
Lac Télé complex	Exceptional	26 550	1715 (0.06)	4494 (0.17)
Sangha Trinational	Exceptional	27 811	16 964 (0.61)	7388 (0.27)
Loango-Gamba complex*	Exceptional	13 062	2593 (0.20)	12 208 (0.93)
Dja	Exceptional	6238	140 (0.02)	5864 (0.94)
Boumba Bek/Nki	Exceptional	6110	343 (0.06)	5599 (0.91)
Lopé/Waka	Exceptional	7434	1656 (0.22)	5703 (0.77)
Ivindo	Important	2989	112 (0.04)	2842 (0.95)
Rio Campo complex	Important	5843	1511 (0.26)	2486 (0.43)
Belinga-Djoua	Important	3453	2443 (0.71)	0 (0.00)
Mengamé	Important	1220	27 (0.02)	1027 (0.84)
Conkouati/Mayumba*	Important	7066	5517 (0.78)	3508 (0.50)
Ebo-Ndokbou	Survey	1426	0 (0.00)	0 (0.00)
Maiombe	Survey	7999	3286 (0.41)	0 (0.00)

* Both Loango-Gamba complex and Conkouati/Mayumba contain sites classed as both forest concessions and protected areas, meaning total proportion > 1.00

FIGURE 4.3

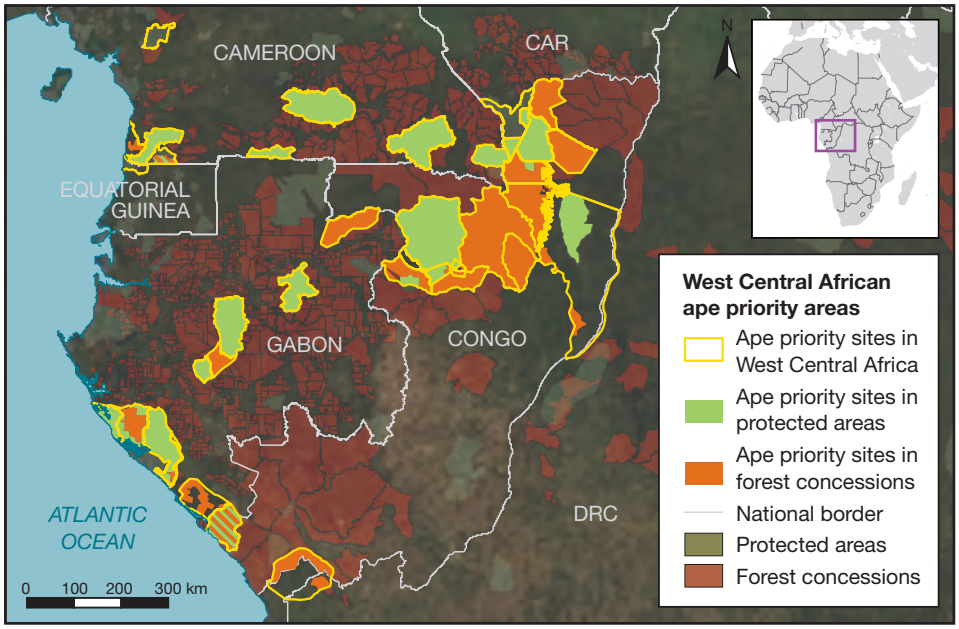
Great ape distribution and overlap with protected areas and timber concessions



Map layers derived from World Resources Institute (www.wri.org), A.P.E.S. database, and Environmental Systems Research Institute (www.esri.com). Courtesy of ZSL

FIGURE 4.4

Priority conservation areas for great apes in West Central Africa* related to protected areas and timber concessions



Map layers derived from WRI, A.P.E.S. database, and ESRI. Courtesy of ZSL.

* Tutin *et al.*, 2005

representing the portion of each species' range located within these two land classes (Figure 4.3). Proportions of ape ranges in protected areas and timber concessions were then assessed and tabulated (Table 4.3). Data on forest concessions in Tanzania, Uganda, Rwanda, and Nigeria were not available so the analysis focused purely on the eight ape species/subspecies found within the Central African region (encompassing Cameroon, Central African Republic (CAR), Gabon, Equatorial Guinea, Republic of Congo, and Democratic Republic of Congo (DRC)). This also represents the area in which tropical forestry operations are most extensive. The results demonstrate that for three of the African great ape subspecies over 10% of their remaining range is within timber concessions and for two of those, the sympatric central chimpanzee (*Pan troglodytes troglodytes*) and western lowland gorilla (*Gorilla gorilla gorilla*), this rises to almost 50% of their total range. This represents a major proportion of both subspecies' ranges and conserving them within timber concessions is therefore considered to be crucial to securing their future.

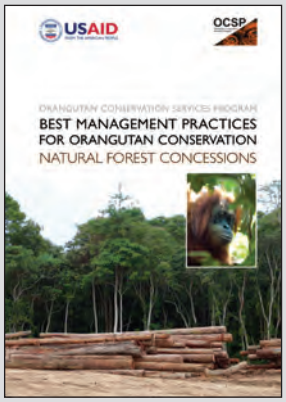
A second analysis focused on existing conservation planning efforts for these two widely distributed great apes. Following an expert-led assessment process, 12 priority areas were identified as key to securing the future for the great apes of the western Congo region (Tutin *et al.*, 2005). Some of these areas are wholly contained within protected areas but to explore the role that timber concession management might play in securing these sites a similar analysis to that conducted for distribution was carried out (Figure 4.4 and Table 4.4). For certain priority sites such as the Dja and Boumba Bek/Nki the vast majority of the zone is within the protected area network and only a tiny fragment is contained within timber production forest; however, Dja is surrounded by timber concessions. For a number of other key sites, such as the vast Sangha and Odzala complexes, timber concessions encompass over 60% of the total area as well as significant portions in other priority sites. Management of the timber concessions is therefore considered to have a significant bearing on the conservation status of the site itself and conservationists working in this region are increasingly engaging with the timber production industry as part of a strategy to conserve the great apes of the Congo basin.

BOX 4.2

Best practice guidelines for logging and apes

Best Management Practices for Orangutan Conservation: Natural Forest Concessions (Pedler, 2010) presents best practice guidelines for orangutans developed under the auspices of the USAID-funded Orangutan Conservation Services Program (OCSP). It outlines four key commitments for companies to embrace to meet their corporate social responsibilities. They encompass: articulating a corporate commitment to protect orangutans; adhering to laws and regulations; implementing management planning and monitoring of orangutans; and engaging in landscape-level collaborative management.

Great Apes and FSC: Implementing "Ape Friendly" Practices in Central Africa's Logging Concessions (Morgan *et al.*, 2013) was prepared by the IUCN Species Survival Commission (SSC). It outlines a framework within which logging companies adhering to FSC certification can incorporate the long-term preservation of great apes into their activities; providing practical considerations for collaboration between forestry and conservation practitioners in maintaining wildlife.



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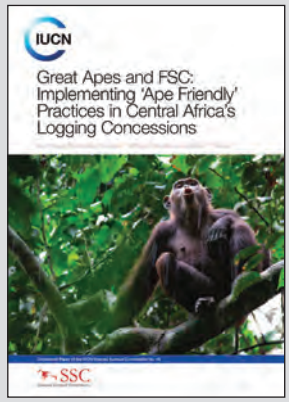

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CASE STUDY 1

Evaluating the effects of logging on great apes: Goualougo Triangle case study

The Nouabalé-Ndoki National Park (NNNP) in northern Republic of Congo (2°05'–3°03' N; 16°51'–16°56' E) is part of the larger transboundary Sangha Trinational (TNS) forest conservation area, extending over approximately 35 000 km^2 and comprising of a vast stretch of lowland Guineo-Congolian forest in Republic of Congo, CAR, and Cameroon. The NNNP was founded in 1993 and, while rich in wildlife and world-renowned for conservation efforts, this protected region lies at the center of a landscape that since the 1990s has become dominated by commercial forestry concessions.

In an effort to initiate more effective conservation activities around the core conservation area encompassing the NNNP, the Project for Ecosystem Management in the periphery of NNNP (PROGEPP – *Projet de Gestion des Ecosystémes Péripheriques du Parc*) was signed in 1999 between the Wildlife Conservation Society (WCS), *Congolaise Industrielle du Bois* (CIB), and the Congolese government's *Ministere de l'Economie Forestiere* (MEF). This agreement aimed to establish management systems that would maintain the long-term integrity of the forest ecosystem in the context of commercial forest exploitation for the Kabo–Pokola–Loundougo logging concessions (Elkan *et al.*, 2006). To date, the CIB is one of only ten companies in the Congo Basin to adopt and adhere to formal measures of sustainable development (Bayol *et al.*, 2012). In 2006, the Kabo forestry concession was the second FSC-certified concession in all of Central Africa. Initial surveys in the Kabo concession indicate that gorilla densities are comparable to those in NNNP (Stokes *et al.*, 2010), implying that FSC certification processes have produced positive results and benefited conservation in the context of timber exploitation However, it had not been determined if and how low impact logging practices affect gorillas and chimpanzees.

A study was therefore initiated by the Goualougo Triangle Ape Project (GTAP) of Lincoln Park Zoo to evaluate the effects of selective timber harvesting on wild gorilla and chimpanzee populations, with an additional aim of then developing initiatives to mitigate any negative impacts so as to contribute to the conservation of these endangered species. The study employed a multi-faceted approach incorporating detailed knowledge about species-specific habitat preferences, ecological needs, and ape behavior. Utilizing data collected along standardized line transects before, during, and after timber operations, ape distribution in relation to increasing human influence was mapped and a model for monitoring at-risk ape populations in production forests was developed.

The study was conducted in the Goualougo Triangle, located between the Ndoki and Goualougo Rivers, an area that was recently annexed to the NNNP (Figure 4.5).

The study area was divided into zones to systematically evaluate changes in ape abundance and distribution as related to protection status, forestry activities, and other factors.

- Zone A is a pristine forest in the National Park that serves as a control condition for analytical studies of anthropogenic disturbance.
- Zone B is also a pristine forest in the National Park. It has been further subdivided into Zones B1 and B2 because the apes in these areas are expected to be affected differently by future logging activities in Zone C. Zone B1 is where the Goualougo Triangle Ape Project focuses efforts to study habituated chimpanzees and gorillas.
- Zone C is comprised of the pristine forest along the southeastern boundary of the NNNP. It is part of an FSC-certified logging zone (Kabo Forestry Management Unit) attributed to CIB. The first harvest of this forest is scheduled to begin by early 2015.
- Zone D is adjacent to the southwestern border of the NNNP. It is part of the Kabo Forestry Management Unit. The area was previously exploited for timber between 1971 and 1972 by the Société Nouvelle des Bois de la Sangha (SNBS), and subjected to a second harvest cycle from 2005 to 2009.

During the second cycle of logging activities in Zone D, abundance and spatial distribution of apes were monitored via repeated surveys of ape nests along line transects. Between October 2004 and December 2010, 11 passages of line transect surveys were repeated in the Kabo forestry concession. The first survey passage was conducted after logging activities had been dormant for more than 30 years. All subsequent surveys were conducted during active timber prospection, exploitation, and post exploitation.

In the active logging zone of the Goualougo Triangle, an inverse relationship between ape presence and human hunting and gathering activities was observed, suggesting that chimpanzees and gorillas became more cryptic in response to human contact (Morgan *et al.*, 2013). This occurred despite

FIGURE 4.5

Goualougo Triangle study area

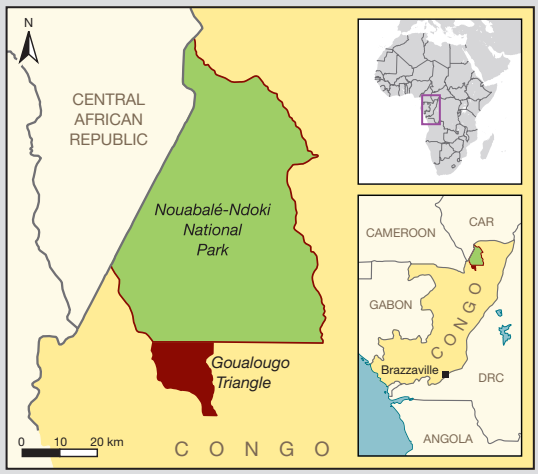
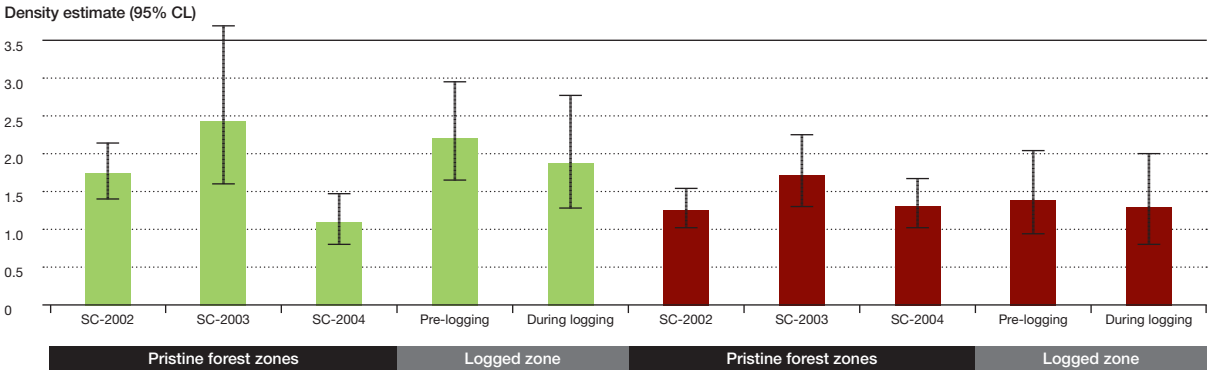


FIGURE 4.6

Chimpanzee and gorilla density estimates in pristine and logged forests, Goualougo Triangle study zones



GORILLA CHIMPANZEE

the fact that forestry activities and staff were often focused on particular areas for only days or weeks before moving to another section of the zone.

Within the active logging zone (Zone D) of the Goualougo Triangle, the study documented the arrival of forestry teams into a landscape. Gorilla and chimpanzee signs were significantly more frequent than human signs during the baseline surveys in 2004 and were similar to neighboring pristine forests located in the NNNP (Morgan *et al.*, 2006). During the course of timber exploitation, no dramatic fluctuations in ape abundances were observed. Density estimates in Zone D remained similar over the 8-year study period. In fact, densities of both ape species remained relatively stable during and after logging had been active in the area (Figure 4.6). However, long-term monitoring is still required to establish the impacts of logging into the future.

Spatial shifts in habitat use

Although the abundances of apes remained stable, there were indications that both species were impacted by the disturbance associated with the arrival and activities of forestry teams. While global density estimates for each zone were stable, there were changes in the way the apes occupied their ranges. Prior to the arrival of forestry teams, chimpanzees and gorillas were concentrated in habitats predicted to have the highest foraging value for each of these respective species. Over the course of this study, both species shifted away from areas of highest human disturbance and into neighboring forests with lower forage quality but less human disturbance. It seems that both gorillas and chimpanzees were driven away from active logging, with pre-exploitation levels of ape abundance not reaching normally expected levels until 2 km distant from the areas of greatest disturbance. These results support previous assertions that gorillas and chimpanzees seek neighboring "refuge" areas during periods of active disturbance (Hashimoto, 1995; Matthews and Matthews, 2004; Arnhem *et al.*, 2008). Importantly, the apes were displaced within the normal ranging distances for both species.

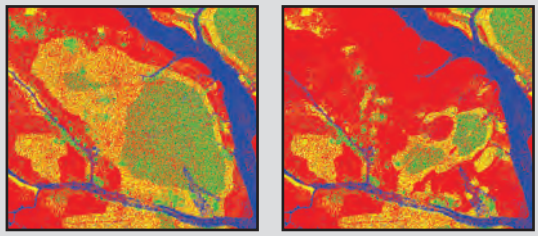
The responses of both species supported species-specific predictions, with gorillas dispersing considerably further in reaction to disturbance and chimpanzees contracting rather than expanding their ranging, presumably to avoid potential conflicts with neighboring groups.

Disturbance associated with forestry activities may have resulted in decreased access for chimpanzees to preferred and assumed high quality habitat over the course of the study. Availability of the most suitable forest patches for chimpanzees was significantly reduced in 2009 when compared to pre-exploitation or baseline levels (Figure 4.7). It is considered that shifts in great ape distribution therefore seem to represent a trade-off of optimal resource use and decreased contact with human disturbance. Assessing ape spatial distribution in different logging conditions and environments to more precisely define their ecological needs and interspecies interactions is required so that it can be communicated to forestry managers to ensure the preservation of key resources for ape survival within concessions.

Present-day changes in ape behavior were examined and interpreted in reference to past logging. The research demonstrated a legacy effect from previous logging on the nesting behavior of both gorillas and chimpanzees. The change in nesting behavior is believed to be due to past and recent timber exploitation rather than underlying ecological factors that predate timber extraction. The results indicate that gorillas and chimpanzees adjust their nesting patterns to cope with potential changes in forest structure, abundance, and diversity associated with timber exploitation. The consistency in behavioral responses between past and present logging regimes implies enduring impacts that may be due in part to similar silviculture techniques, tree species removals, and overall disturbance regimes employed in the 1970s and during the more recent logging cycle. RIL practices and adherence to FSC certification standards are likely to have decreased the direct impacts on ape numbers, but environmental changes in the forest ecology nonetheless elicited significant behavioral responses. Given the recurrent nature of timber exploitation, such behavioral alterations are likely to increase.

FIGURE 4.7

GTAP study Zone D in the Kabo logging concession, a mosaic of suitable and non-suitable habitats for chimpanzees



Before After

Green filled areas represent the location of most preferred habitat for chimpanzees, with yellow areas decreasing in chimpanzee preference. Red filled areas represent the least suitable habitat for chimpanzee nesting and foraging. Blue areas represent rivers and streams. Our results indicate that accessibility to particular areas changes due to logging disturbance. The panel on the left depicts habitat available to chimpanzees in 2004, representing the pre-logging phase in this study. The panel on the right represents a time when logging had been underway for 3 years. As logging advanced, the availability of chimpanzee preferred habitats decreased owing to human occupation and disturbance.

Implications for ape conservation locally and regionally

The origin of NNNP and recently granted protected status of the Goualougo Triangle were the result of a forward-looking approach, which took into consideration scientific studies of great apes as well as local societies' needs (Ruggiero, 1998; der Walt, 2012; Elkan and Elkan, 2012). The Goualougo Triangle was known to be of exceptional conservation value during the initial planning of the NNNP, and WCS actively lobbied the Congolese Government for inclusion of the area within the protected area boundary in 1992. However, the National Park was created without inclusion of the Goualougo Triangle and the long-term protection of the apes in this region remained uncertain for two decades. Subsequent discussions between the Congolese Government, WCS, and the local logging company CIB were focused on sparing the intact forests of the Goualougo Triangle from timber exploitation. After several years of debate, a flexible land-use planning approach resulted in an agreement that recognized the biological value of the Goualougo Triangle and recommended that it should be maintained in its pristine state via formal protection. However, obtaining official protected status was a long-term process. In 2003, a positive step towards protection occurred when the Congolese Government announced that the Goualougo Triangle, comprising 250 km^2 of pristine forest, would be officially annexed to the National Park. While this proclamation received a great deal of public attention the area remained unprotected for another 9 years. The official decree from the President of the Republic of Congo modifying the boundaries of the NNNP to include the Goualougo Triangle finally occurred on January 20, 2012.

Discussions with the logging company about the Goualougo Triangle led to identification of other important conservation areas within the active logging concessions surrounding NNNP. As part of its FSC certification process, CIB announced two additional important conservation set-aside areas in the Kabo Forestry Management Unit. The two areas, the Djéké Triangle and the Bomassa/Mombongo zone, comprise over 150 km^2 and are located in the Bomassa Triangle. The Bomassa Triangle provides an important conservation conduit in the Sangha Trinational protected area network by connecting national parks in the Central African Republic (CAR) and the Republic of Congo. The Djéké Triangle is a pristine forest block located within the Republic of Congo between NNNP and Dzanga-Ndoki National Park. Both areas contain important complexes of bais and yangas (natural clearings frequented by large mammals) and are the subject of long-term ecological research programs. The set-aside agreement recognized the conservation and scientific value of the region and its potential for ecotourism development and was reached after stakeholder discussions between CIB, WCS, and the Government of Congo.

A further significant step was recently taken in 2012 when the Sangha Trinational conservation complex was named a World Heritage Site by the United Nations Educational, Scientific and Cultural Organization (UNESCO). The site consists of a 25 000 km^2 contiguous area across the Republic of Congo, Cameroon, and the CAR and marks the first World Heritage site that spans three nations. The core of the Sangha Trinational conservation complex is formed by three contiguous national parks connected by the Sangha River.

The preservation of the Goualougo and Djéké Triangle forests was a landmark conservation initiative that continues to have far reaching impacts. Thriving research (GTAP and the Mondika Research Center) and ecotourism projects (Mondika, and Djéké Triangle Ecotourism Project), which are compatible with regional conservation planning strategies, have been established in these areas.

At the same time, these sites continue to facilitate advocacy for ape conservation through education programs and support of Congolese nationals in continuing research and graduate education. The success of these projects relies upon the involvement and support of stakeholders from the local villages. The economic dimensions of sustainable forestry have led to opportunities for employment and access to health programs for local Ba'Aka staff in the periphery of the NNNP. These efforts are considered both to promote alternative activities to unsustainable hunting and to address current gender and ethnic imbalances in development opportunities.

The research conducted by GTAP not only furthered understanding of the interaction of African great apes and SFM but also enabled further identification of important conservation areas to be set aside and not utilized for industrial exploitation. This arguably enhanced the conservation status of these species in this landscape; however, significant alterations in the nesting behavior of the ape species as a result of long-term logging raise a number of unresolved questions regarding the compatibility of industrial logging and ape conservation.

CASE STUDY 2

Wildlife Wood Project – Cameroon

The Wildlife Wood Project (WWP) was initiated by the Zoological Society of London (ZSL) as a way to assist the tropical timber industry to achieve more sustainable practices that contribute to conserving the biodiversity of the Congo basin. Initially they sought to develop pilot models to show how FSC certification principles and criteria and SFM could be implemented and used to ensure sustainable wildlife management in working timber concessions.

ZSL's goal was sustainable wildlife management within timber production landscapes using the WWP as a mechanism to provide timber companies with the capacity to achieve this goal as part of their standard operating practices. For this to succeed their industry partners had to commit to four key elements:

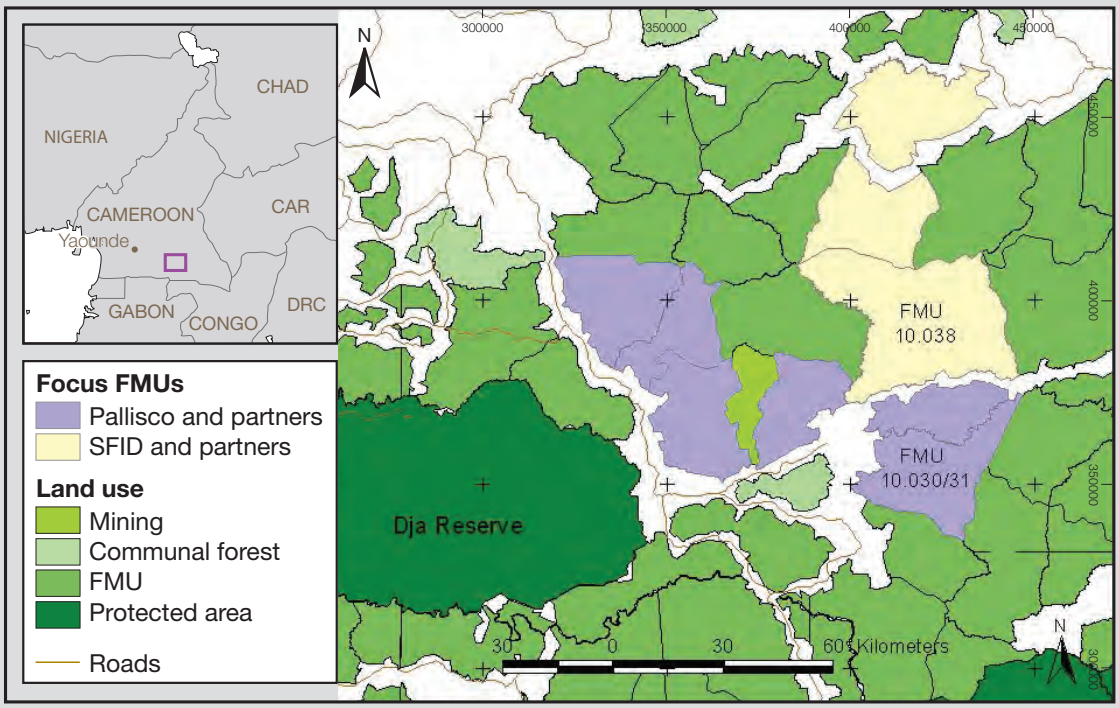
- To work with ZSL to develop and implement the necessary monitoring and management systems to ensure that wildlife populations are not significantly impacted by their activities.
- To take suitable steps to ensure that illegal activity, and in particular illegal and unsustainable hunting, are not taking place within their area of operation.
- Engage with other stakeholders, in particular local forest communities, to meet project objectives, and, crucially, to ensure that they are not adversely affected by the timber enterprise.
- And finally, and in the longer term perhaps most significantly, to commit to develop the necessary capacity in terms of human resources and logistics to sustain on-going delivery of project objectives.

Many of these objectives are part of a company's obligations under Cameroonian forestry law and FSC certification standards; however, the tools and approaches to realize these obligations are often lacking or not implemented.

Identifying willing, suitable partners to develop long-term working relationships within a supportive national context was the first step. Following consultations with a number of companies, two were identified as suitable and willing to partner on WWP: Pallisco and SFID-Rougier.

FIGURE 4.8

Wildlife Wood Project area of intervention, bridging the landscape between the Dja Biosphere Reserve and Boumba Bek National Park



The forestry concessions highlighted are managed by company partners and encompass almost 7000 km^2.

Courtesy of ZSL

The initial focus for WWP activities extended over Pallisco's and SFID's allocated FMUs in the eastern region of Cameroon, in the landscape between Dja and Boumba bek/Nki (Figure 4.8). This production forest block of almost 6500 km^2 is an area larger than the nearby Dja Faunal Reserve World Heritage Site. These FMUs are located in the transition zone between the mixed moist semi-evergreen Guineo-Congolian rainforests and the evergreen forests of the Congo Basin. They are a mosaic of mixed mature forests without predominant species and secondary forests at different succession stages. Three main timber species account for the majority of timber harvested in these concessions:

- the sapele or sapelli (*Entandrophragma cylindricum* – sometimes called "poor man's mahogany");
- the ayous or abachi or obeche (*Triplochiton scleroxylon* – African whitewood); and
- the tali or missanda (*Erythrophleum ivorense* – sasswood tree).

From a biodiversity perspective, these concessions are located at the northeastern border of the Tri-national Dja-Odzala-Minkébé (TRIDOM) landscape, a high priority conservation zone spanning the borders of Cameroon, the Republic of Congo, and Gabon. They are home to remarkable forest wildlife, such as the western gorilla, common chimpanzee, and forest elephant, including populations within or bordering areas of highest priority for the conservation of these species.

The Cameroonian legal context and certification

The management of all forests in Cameroon comes under the legislative framework outlined by the 1994 forestry laws, which enshrine the principles of SFM.

For FSC-certified companies and those seeking certification, the principles and criteria (Box 4.3) are amongst the strongest incentives in timber production forests for sustainable forest management and, in particular, actions that favor wildlife conservation. Several of the principles and criteria agreed for the Congo Basin region are explicit regarding the impacts of logging operations on wildlife populations and the responsibilities of companies to mitigate them.

The effects of logging on mammals

Wildlife monitoring programs were designed and implemented in two concessions managed by Pallisco and SFID, FMU 10.030 (1180 km^2) and FMU 10.038 (1520 km^2), to assess the response of wildlife populations to logging activities.

In each concession four permanent biomonitoring stations were established, including one "impact station," where logging operations were in effect during the time of the study, and three "control stations," where no logging took place in their immediate surroundings (> 2 km), with data collected by the timber companies' wildlife monitoring teams. The results of this study provide a baseline for future monitoring and allowed for exploration of the immediate effects of logging on the study species that included forest elephant, yellow backed duiker, western lowland gorilla, and common chimpanzee. Trends in abundance of these species showed a different

BOX 4.3

FSC principles relating to wildlife

"Principle 1: Forest management shall respect all applicable laws of the country in which they occur, and international treaties and agreements to which the country is a signatory, and comply with all FSC Principles and Criteria." (FSC, 2002, p. 4)

It should be noted that under this principle the forest manager is obliged to be aware of and contribute towards national biodiversity strategies. The manager is also obliged to ensure that no illegal or unauthorized activities take place within the concession and to liaise with the national authorities to achieve this.

"Principle 2: Long-term tenure and use rights to the land and forest resources shall be clearly defined, documented and legally established." (FSC, 2002, p. 4)

"Principle 3: The legal and customary rights of indigenous peoples to own, use and manage their lands, territories, and resources shall be recognized and respected." (FSC, 2002, p. 5)

A key element of this principle, in relation to forest conservation, is the obligation to engage with local forest dependent communities and ensure that they maintain their customary rights and resource access and that those resources are maintained.

"Principle 6: Forest management shall conserve biological diversity and its associated values, water resources, soils, and unique and fragile ecosystems and landscapes, and, by so doing, maintain the ecological functions and the integrity of the forest."(FSC, 2002, p. 6)

Under this principle are criteria that oblige the organization to identify potential impacts and take steps to preserve ecosystems and threatened species. This includes controlling hunting and ensuring company staff are not involved in production, consumption or trade of wild meat.

"Principle 7: A management plan – appropriate to the scale and intensity of the operations, shall be written, implemented, and kept up to date. The long-term objectives of management, and the means of achieving them, shall be clearly stated." (FSC, 2002, p. 7)

The management plan referred to under this principle should detail objectives relating to, amongst others, identifying and protecting rare, threatened, or endangered species, and including explicit reference to the High Conservation Value Forest (HCVF) framework (see Box 4.4 for detail on Principle 9 relating to HCVF). The HCVF concept is of particular importance to wildlife conservation as it obliges the concession manager, in consultation with relevant stakeholders, to identify, monitor, and manage areas of high conservation value to maintain and/or enhance them.

BOX 4.4

The High Conservation Value Forest concept (HCVF)

"Principle 9: Management activities in high conservation value forests shall maintain or enhance the attributes which define such forests. Decisions regarding high conservation value forests shall always be considered in the context of a precautionary approach."
(FSC, 2002, p. 9)

Six classes of social and environmental HCVF values (FSC, 2008, p. 1) have been established that forest managers are obliged to take account of:

"1. Forest areas containing globally, regionally, or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species, refugia).
2. Forest areas containing globally, regionally, or nationally significant large landscape-level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance.
3. Forest areas that are in or contain rare, threatened, or endangered ecosystems.
4. Forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion control).
5. Forest areas fundamental to meeting basic needs of local communities (e.g. subsistence, health).
6. Forest areas critical to local communities' traditional cultural identity (areas of cultural, ecological, economic, or religious significance identified in cooperation with such local communities)."

Before logging can begin, forest managers are obliged to engage with other stakeholders in a participatory process to assess, identify, and map areas of HCVF within their concession. These assessments must then be made publically available. Once identified, the concessionaire must work with these stakeholder groups to agree a monitoring and management system to maintain and/or enhance these values. It is noteworthy that, under this principle, criterion 9.4 requires a specific data collection protocol to be developed and annual monitoring to verify the status of the HCVF that feeds into adaptation of the FMP.

pattern in each of the two logging concessions. In FMU 10.030, logging activities were observed to have no impact on chimpanzees as no significant changes in abundance were detected before and after logging. There was also no difference in abundance between the impact station and control stations. This seems to indicate that chimpanzees in this FMU did not move away from the impact station during logging operations and one might conclude on this basis that the species is tolerant of the logging practices at the site. In FMU 10.038 however, a significant drop in relative abundance was detected at the impact station after logging, evidenced by a lower encounter rate with chimpanzee signs than for those found in the two control stations. On the basis of the data from this concession one might draw the opposite conclusion: that chimpanzees are adversely affected by logging activities and move away from the associated disturbance.

The study did not identify any significant changes in population size of chimpanzee or of the sympatric western lowland gorilla as a consequence of logging operations across all sites. It is possible that in subsequent years different trends might become apparent, although the literature tends to suggest that the immediate post-disturbance phase is when wildlife are most impacted (White and Tutin, 2001; Arnhem *et al.*, 2008). Thus the target species assessed in this study seem to have mostly been able to cope with the direct impacts of selective logging activities as they occur in Pallisco and SFID's FMUs. This is likely partly due to the low extraction rates of one stump per hectare (0.01 km^2/10 000 m^2) and subsequent low levels of disturbance in these concessions and suggests that RIL associated with SFM is consistent with maintaining populations of large mammals.

Adapting logging to mitigate impacts on great apes

The identification and management of HCVF is a key concept in the FSC certification standard (Box 4.4). This is a potentially invaluable tool for wildlife conservation in the timber production landscape and has also been adopted as an industry standard in other sectors such as the Roundtable for Sustainable Palm Oil (RSPO).

HCVFs are perhaps more easily understood when they represent spatially discrete areas such as cultural sites for local people or riverine forest that maintain ecosystem functions. Identifying areas vital for threatened species, particularly for mobile larger mammals, can prove more challenging.

ZSL promotes the concept that the core territories of chimpanzee communities represent refuges for the species and should be viewed as HCVF. These should be identified, mapped, and logging practices adapted in these areas to minimize their impacts. To identify the core areas, timber company wildlife teams use an adaptive sampling method, developed by ZSL, to more efficiently survey large blocks of production forests by concentrating survey effort in areas where apes are more abundant. Adaptive Recce Transect Sampling (ARTS) involves walking "recce" transects, taking the easiest path along a pre-planned route and whenever a chimpanzee nest is encountered, cutting a cross of more rigorous straight line

transects to identify additional nests and inform the core territory mapping process. In the example below, in SFID's FMU 10.056 (76 660 ha/767 km^2), two areas with a high concentration of nest sites were identified using the ARTS method suggesting the presence of at least two chimpanzee communities in the logging block (Figures 4.9a and b).

On this basis a number of recommendations were made for the management of the forest block:

- To organize tree cuts to enable chimps to retreat to these core areas, i.e. to cut towards the core area, to alternate the cutting blocks in such a way as to avoid splitting the community, and to avoid erecting barriers that the chimps will not cross as harvesting approaches the core area.
- To establish annual monitoring of the HCVF areas and carry out surveys to identify core chimpanzee areas during the annual tree inventory prior to each annual allowable cut (AAC).
- To complement this with strategies to reduce poaching in the concession and in particular in the vulnerable areas when harvesting approaches the chimpanzee HCVF.
- To incorporate these recommendations into the overall forest management plans.

These recommendations have already begun to be implemented although proof of the efficacy of the management of these chimpanzee HCVFs will only be seen in the monitoring program over the coming years.

While not elaborated on here, other aspects of the WWP that are part of the holistic approach to improving the management of logging concessions for the benefit of conservation include:

- mitigating disease transmission through the development of health protocols for company staff (see Chapter 7 for more information on the dangers of disease transmission),
- developing management strategies to mitigate unsustainable and illegal hunting that not only involve the private sector but also local communities (see Chapter 7). In fact, engagement with local communities is an explicit action that considers them an essential component of the forest ecosystem. Engaging communities is considered essential to empower them to play a role in managing their resources.

FIGURE 4.9

(a) Density of chimpanzee signs observed within one active five-year logging block, collected using ARTS methodology

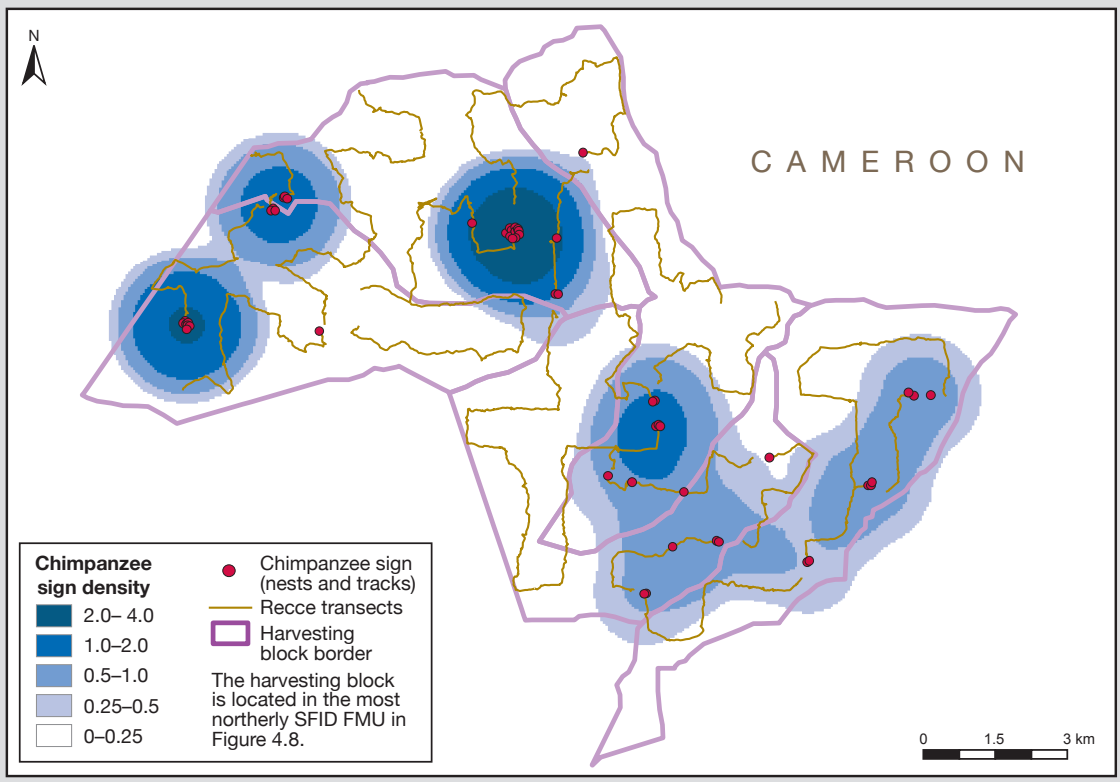
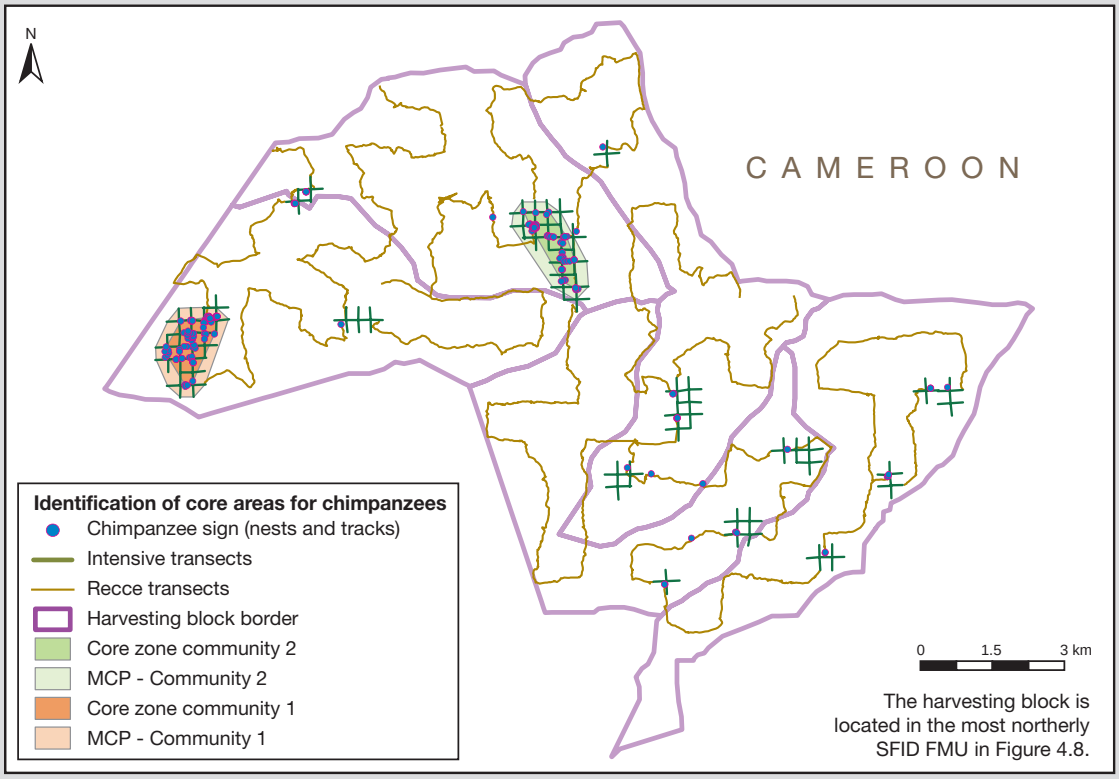


FIGURE 4.9

(b) Data from (a) enable core areas of use for chimpanzees to be identified and mapped and for logging regimes to be adapted to mitigate their impacts



MCP (minimum convex polygon) indicates the boundaries of the community's home range.

When viewed together, the FSC principles and criteria, forestry laws, and other guidelines appear to comprehensively address the issues relating to sustainable forest management and ensuring good outcomes for wildlife. They explicitly state the criteria that a forestry operation must meet and in the case of the FSC they include both indicators and means of verification for demonstrating that they have been achieved.

These case studies demonstrate that initial research at the interface of responsible logging and great apes indicates that they can co-exist, however only a very small number of companies are applying the techniques outlined in these contexts. Further to this, the costs of engaging logging companies to implement more ecologically friendly practices have been borne by conservation organizations, raising questions about the viability of this approach at a wider scale.

Conclusion

Insights from the Goualougo Triangle and the WWP have illustrated the importance of collaboration between the logging industry, conservationists, and local governments to address the environmental dimensions of sustainable forestry that can mitigate the impacts on apes. Engagement beyond areas of strict protection becomes a necessity when attempts at conservation have failed and logging is moving forward. Developing more efficient and informative ways of assessing ape habitat and designing actions that protect ape resource needs in the context of timber exploitation then becomes

an important way to mitigate the impacts of logging.

However, research that focuses on the broader impacts of current SFM practice on forest ecology points to wider repercussions to biodiversity beyond single species such as apes, highlighting the need for additional research on the interaction between the broader impacts of logging on forest ecosystems and local communities. Without a better understanding at this interface, current SFM practice is likely to be inadequate to meaningfully reconcile conservation and industrial logging. Furthermore initial exploitation of primary forest by selective logging is linked to an increased probability of these areas being converted to plantations or agroforestry areas. This further diminishes biodiversity stock and eliminates options for meaningful SFM. Additional analysis of the policy and legislative environments can provide some insights into the causes of this trajectory and represents an added gap in current understanding.

Although there is an acknowledgment that strict protection is always the preferred course of conservation action, pressures on tropical forest ecosystems are unlikely to diminish in the foreseeable future. Local and global demand for the resources that forests provide, alongside competition for the forested land itself from agriculture, agroforestry, urbanization, and mining are on-going and are crucial factors for increasing engagement by a range of stakeholders. Unless other models are developed that move beyond private logging concessions, such as timber plantations in degraded lands, encroachment of logging into primary forest and ape habitats will continue. Ultimately, it appears that SFM benefits great ape conservation within the current context of poor environmental management in many ape range states, but this does not necessarily assure longer-term benefit. In addition, there need to be greater incentives, through funding and other mechanisms, to encourage change in practice and behavior by logging companies. At present, best practice is not generally the standard that is adhered to.

Acknowledgments

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