

TIMBER BEST PRACTICE GUIDELINES FOR
PROTECTED AREAS MANAGEMENT IN GABON

by

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Abstract

Located in Central Africa, Gabon contains large swaths of tropical forest that are a reserve for an incredible level of plant and animal biodiversity. In order to protect this biodiversity, in 2002 thirteen national parks were created along with buffer zones surrounding these parks. Since 2007 Gabon's national park agency, L'Agence Nationale des Parcs Nationaux (ANPN), has been the regulatory body governing both the parks and their associated buffer zones.

In recent years, Gabon's rapidly expanding timber industry has threatened the integrity of these parks. Within buffer zones, timber operators are required to submit environmental impact assessments to ANPN and the Ministry of Environment to demonstrate that timber operations will not negatively impact neighboring parks. However, as of 2012 ANPN lacked guidelines for how timber operations should be conducted in park buffer zones, and thus lacked a mechanism by which to enforce or monitor timber operators for environmental compliance.

To help resolve this challenge, I spent a total of thirteen weeks in Gabon as an intern with ANPN. I was assigned the task of developing best practice guideline recommendations for how timber operations should be conducted in national park buffer zones. I also incorporated a way to score companies for their compliance with these best practices. In order to create the timber best practice guidelines I assembled twelve international guidelines into one document, incorporated the priorities of ANPN, obtained feedback from forestry experts, and ensured the guidelines were realistic and context specific by working for five weeks with Olam Timber Gabon. I then created an associated compliance scoring template (CST) utilizing the theory of decision analysis and the method of swing weighting.

With the timber best practice guidelines and associated CST, ANPN is closer to being able to enforce good practices adjacent to national parks. They now have the ability to clearly state what they expect of timber operators in buffer zones, and they have a method to monitor operators for compliance. Given the negative impacts timber operations can have on ecosystems, the implementation of the guidelines will help ensure that Gabon's national parks remain intact for years to come.

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I. Introduction

Tropical Forests and Protected Areas

Tropical forests are important ecosystems for the world as we know it. Located in the band of latitude between the Tropic of Cancer and the Tropic of Capricorn, rainforests contain the highest levels of biodiversity of any ecosystem (Kricher, 2011). In the Neotropics alone there are an estimated 90,000 species of flowering plants, which represents five times the amount estimated to occur in North America (Kricher, 2011). Wildlife species diversity is also extremely high – for example, in only 1,500 hectares of forest in Costa Rica over 410 species of birds exist (Kricher, 2011). Additionally, tropical forests are one of world's largest sinks for carbon, storing approximately 40-50% of the globe's terrestrial carbon (Kricher, 2011). Tropical forests are thus of great importance for maintaining biodiversity and mitigating climate change.

Due to providing these essential ecosystem services, tropical forests are often the focus of protected areas. A protected area, as defined by IUCN in the IVth World Parks Congress in 1992, is “an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means” (Chape et al., 2008, pg. 7-9). The concept of protected areas is an old one, dating as far back as 300 BC when Indian elites set aside areas for wildlife and forests (Chape et al., 2008). Then in 1872 the first modern protected area was established as Yellowstone National Park (Chape et al., 2008). Since then the number of protected areas has grown substantially, with the World Database on Protected Areas recording 12.9% of the world in this status as of 2005 (Chape et al., 2008).

Buffer Zones

A more recent addition to the concept of protected areas is the practice of identifying what are broadly termed buffer zones, or managed areas adjacent to protected areas. The exact purpose of these zones is often debated, but they are generally designed to help manage incompatible land uses and diverse stakeholder goals. Their genesis can generally be traced to the United Nation's Man and Biosphere Programme that began in the 1970s. This program's goal is to create methods for balancing biological and cultural conservation with economic development in the various ecosystems of the world ("Biosphere Reserves", n.d.). Biosphere reserves generally include a core area, or protected area, surrounded by a strip of land that radiates outwards termed a buffer zone, followed by a transition area ("Zoning Schemes", n.d.). By this definition, buffer zones are largely aimed at protecting the core while the transition area allows for a balance of sustainable use of natural resources and ecosystem protection ("Zoning Schemes", n.d.).

As the Man and Biosphere Programme demonstrates, some environmentalists define buffer zones as predominantly serving the interests of conservation. However, others argue that buffer zones should balance economic development goals with protected area management goals (Naughton-Treves et al., 2005). The latter view came to prominence in the 1980s, following the 1982 World Parks Congress in which the need to involve local communities in protected areas conservation was emphasized (Naughton-Treves et al., 2005). Advocates argued that activities permitted by the Man and Biosphere Programme in transition areas should be extended to buffer zones, and coined these management areas integrated conservation development programs, or ICDPs (Naughton-Treves et al., 2005). These areas were viewed as prime locations for activities

such as agroforestry, tourism, and the sustainable use of forest resources (Naughton-Treves et al., 2005).

Differing from buffer zones in that they need not necessarily be located adjacent to protected areas are areas specifically designed to manage extraction of natural resources. One example comes from Brazil's extractive reserves, in which areas of land are set aside to allow local people to continue with their traditional rubber and other non-timber forest product extraction (Kinsbruner and Langer, 2008). The argument is that by allowing local people to continue with their traditional extractive activities, deforestation will be avoided from outside forces (Kinsbruner and Langer, 2008). Another example focuses on managing areas for large-scale extractive industries, with these areas being termed extractive resource zones ("U.S. Forest", n.d.). This concept was developed by USAID's Central Regional African Program in partnership with the U.S. Forest Service, and manuals have been produced recommending how to sustainably carry out large-scale resource extraction in Central Africa without compromising the integrity of the land these activities occur on ("U.S. Forest", n.d.). Goals of extractive resource zones include ensuring landholder income generation continues, local people's livelihoods are not negatively impacted, and ecosystem functions of the land in question remain intact ("U.S. Forest", n.d.). Thus, extractive resource zones are similar to ICDPs in their goals.

As this brief overview of buffer zones demonstrates, buffer zones are a management tool by which protected areas and ecosystem services can be better conserved. While some define buffer zones as areas for further conservation, others as areas to balance conservation with development, and yet others as areas to promote sustainable extractive activities, these three definitions need not be exclusive. The challenge is determining how to balance these interests to match the goals of the stakeholders involved, and to protect the conservation values of the area in

question. In the case of Gabon's protected areas, the focal country of this study, there is a clear need for buffer zones that promote both conservation and economic development. An explanation of this need follows.

II. Context: Gabon

Protected Areas and Timber Production

As the second largest expanse of moist tropical forest in the world, Africa's Congo Basin contains several protected areas (de Wasseige et al., 2010). Within Gabon, the focal country of this study, there are thirteen protected areas covering approximately 10% of the country ("L'Agence", 2012a). These protected areas were created in 2002 by President Omar Bongo after Mike Fay undertook his inspiring Megatransect through the Congo Basin, revealing its beauty and importance to biodiversity ("L'Agence", 2012a).

The vast majority of Gabon is covered by tropical forests, with dense lowland forests near the coast and more semi-deciduous forests moving inland (Laurance et al., 2006). Gabon contains other important habitats interspersed within this forested landscape, including swamps, savannahs, and mangroves (Laurance et al., 2006). The country boasts at least 4,710 plant species of which 508 are endemic to the country, and is home to an abundance of rare wildlife (de Wasseige et al., 2010). Gabon contains approximately 35,000 gorillas, 64,000 chimpanzees, and 60,000 elephants among other large mammals (Dr. C. Clark, Parks Gabon Cooperative Agreement and Mentor Forest Coordinator, Personal Communication, Feb. 20, 2012). Due to the rich diversity found in Gabon, the thirteen national parks within Gabon are of great conservation value.

With timber operations can come severe ecosystem degradation. Timber operations have both direct and indirect impacts on ecosystems. Direct impacts include the removal of large trees and other vegetation altering the structure of forests, soil damage, and disruption of hydrological processes through erosion and damming of waterways, amongst other impacts (“L’Agence”, 2012a). Timber operations also cause for the creation of new roads into previously untouched areas, allowing for the immigration of people and resulting indirect impacts such as the establishment of agriculture, illegal logging, and hunting (“L’Agence”, 2012a; Laurance et al., 2006).

Given the importance of the timber industry to Gabon’s GDP, it is an activity that is allowed adjacent to national parks (“L’Agence”, 2012a). However, Gabon has also recognized that timber operations pose a potential threat to the integrity of their national parks (“L’Agence”, 2012a). In order to remedy this situation, Gabon has taken the approach of utilizing buffer zones to balance the goals of park conservation with the need for timber operations (see Figure 2; “Presidence”, 2007).

Buffer Zone Management

In 2007 Gabon’s national park agency, L’Agence Nationale des Parcs Nationaux (ANPN), was created and charged with managing Gabon’s thirteen national parks (“L’Agence”, 2012a). In a prior 2001 Forest Code, 5km buffer zones had been established around all national parks and the Ministry of Waters and Forests had been given authority in these areas (“Assemble”, 2001). Then with the establishment of ANPN in 2007, the authority over buffer zones was transferred to them (“L’Agence”, 2012a). With the creation of ANPN and their regulation of buffer zones, it also became law that timber operators submit an environmental impact assessment to ANPN and the Ministry of Environment prior to conducting activities in these zones (“Presidence”, 2007).

In order to be approved, timber operators must demonstrate that their activities will not negatively impact the park they plan to conduct operations adjacent to (“Presidence”, 2007).

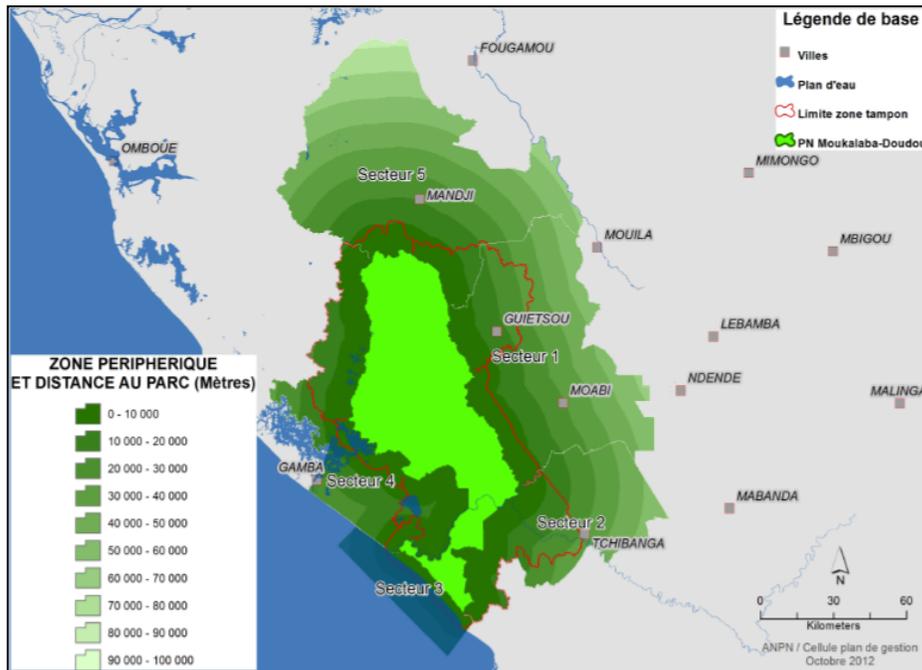


Figure 2. Example of a Buffer Zone in Gabon around Moukalaba-Doudou National Park
Source: (L’Agence, 2012b)

While Gabon has taken large strides towards protecting their national parks through the creation of buffer zones, since 2007 logging companies have continued to conduct unauthorized activities within buffer zones (“L’Agence”, 2012a). Often, these logging activities are quite damaging to the environment as their only guidance comes from Gabon’s Forest Code. While the Forest Code does contain items for how timber operators can reduce impacts to the environment, the standards are generally not stringent enough to protect sensitive areas like buffer zones. For example, the Forest Code only requires a rotation cycle of 20 years which according to several timber best practice guidelines and forestry experts is by far too short to preserve an ecosystem (Zimmermann, 1982; D. Fournier, Personal Communication, June 23, 2012). The Forest Code also directs timber operators to look to a National Technical Standard for specifics regarding practices for reducing impacts to the environment – to my knowledge, as of 2012 this technical

standard was not a validated document and thus was more of a suggestion than a law (O. Desmet, Olam Timber Gabon Personnel, Personal Communication, July 8, 2012).

Realizing that action needed to be taken, in 2010 ANPN announced that it would start enforcing its powers to regulate operations in buffer zones, and threatened to order a cessation of all timber operations until shown adequate environmental impact assessments (“L’Agence”, 2012a). Despite this pledge, ANPN lacked the resources to evaluate, monitor, and control timber operations in buffer zones (“L’Agence”, 2012a).

Cooperative Agreement between ANPN and USFWS

In order to remedy these challenges, in January of 2012 ANPN formed a Parks Gabon Cooperative Agreement with the United States’ Fish and Wildlife Service to (1) establish a division within ANPN responsible for buffer zone management, (2) define standards by which to evaluate environmental impact assessments, (3) define best practice guidelines for timber operations in buffer zones, and (4) deploy division agents to monitor timber operations for compliance with the defined best practice guidelines (“L’Agence”, 2012a).

My Task: Timber Best Practice Guidelines and Compliance Scoring Template

As an intern of ANPN, I was assigned the task of contributing to the mission of the Parks Gabon Cooperative Agreement by creating draft timber best practice guidelines, using international best practices as a desired template, for how timber operations should be conducted adjacent to national parks. In addition to assembling what these best practices should be, I was also asked to incorporate a way to score companies for their compliance with these best practices. Thus, I created timber best practice guidelines with an associated compliance scoring template¹. Note that these guidelines are designed to be utilized on concessions where selective logging is the method utilized, as this is the method carried out in Gabon.

¹ For a copy of the timber best practice guidelines and the associated compliance scoring template please contact the author directly.

III. Methods

To create the timber best practice guidelines I spent a total of thirteen weeks in Gabon as an ANPN intern during the months of May through August, 2012. I spent the first half of my internship based out of ANPN's Libreville headquarters, and the second half of my time working directly with Olam Timber Gabon in the town of Makokou (see Figure 3). My primary mentor from ANPN was Dr. Connie Clark, the Parks Gabon Cooperative Agreement and MENTOR Forest Coordinator, and Overseer of the Environmental Evaluation and Compliance Division. I also worked extensively with David Fournier, a U.S. Forest Service Technical Advisor to ANPN on Buffer Zone Management. During my time at Olam Timber Gabon, my primary mentors were Olivier Desmet, Director of Management and Certification Olam Timber Gabon, and Johnson Banguerem, Director of Management and Certification Makokou.



Figure 3. Location of the Development of the Timber Best Practice Guidelines
Source: Detailed Tourist Map of Gabon. (n.d.). Retrieved from:
<http://www.vidiani.com/?p=8487>

In order to create the timber best practice guidelines I had two major tasks – defining the timber best practices for buffer zones areas, and creating an associated compliance scoring template. The steps I took to complete both components follow.

Definition of Timber Best Practices

(i) Regulations and Compilation of 12 Best Practice Guidelines

Prior to beginning the process of compiling the timber best practice guidelines, I first located and became familiar with the relevant Gabonese laws dealing with timber operations. There are three entities within Gabon’s government that regulate activities dealing with timber operations – ANPN, the Ministry of Waters and Forests, and the Ministry of Environment. Each body has relevant regulations regarding timber operations: the National Parks Law of 2007; the Forest Code; and the Environmental Code respectively. As stated previously, the Forest Code in conjunction with the National Parks Law of 2007 gives ANPN the authority to control timber activities in buffer zones (“Presidence”, 2007; “Assemble”, 2001). Additionally, the Forest Code lays out very basic guidelines regarding timber operations – it states the annual allowable cut for all timber species, describes what the content of timber management plans should be, and outlines the inventory protocol for delineating where logging infrastructure will be placed and where sensitive ecological areas should be located (“Assemble”, 2001). Reviewing all of these relevant regulations allowed me to understand the context I was working in, and the need for more specific timber best practice guidelines.

I then conducted an extensive literature search to locate internationally recognized timber best practice guidelines with emphasis on selective logging operations in tropical forests. Through my own research, along with suggested documents by David Fournier and Dr. Connie Clark, I

extracted best practices from twelve documents to serve as the basis of the timber best practice guidelines (see Table 1).

Table 1. Documents Utilized as the Basis for the Timber Best Practice Guidelines

1	African Timber Organization and the International Tropical Timber Organization (2003). <i>ATO/ITTO Principles, Criteria, and Indicators for the Sustainable Management of African Natural Tropical Forests</i> . Author.
2	Beck, J., Bosch, M., and Connelly, B. (2009). <i>USFS Technical Assistance Mission to Develop the USAID/CARPE Extractive Resource Zone Planning Guide</i> . U.S. Forest Service. Retrieved from: http://www.rmportal.net/library/content/usda-forest-service/usda-forest-service-collections/usda-trip-reports .
3	Dykstra, D. and R. Heinrich. (1996). <i>FAO Model Code of Forest Harvesting Practice</i> . Rome, Italy: Publications Division of the Food and Agricultural Organization of the United Nations. Retrieved from: http://www.fao.org/docrep/V6530E/V6530E00.htm#Contents .
4	Forest Stewardship Council. (1996). <i>FSC International Standard: FSC Principles and Criteria for Forest Stewardship, Ver. 4-0</i> . Bonn, Germany: Forest Stewardship Council A.C. Retrieved from: https://ic.fsc.org/principles-and-criteria.34.htm .
5	Forest Stewardship Council. (2009). <i>FSC Forest Stewardship Standard for the Congo Basin Region</i> . Forest Stewardship Council A.C.
6	Food and Agricultural Organization of the United Nations. (2004). <i>Regional Code of Practice for RIL in Tropical Moist Forests of West and Central Africa</i> . Rome, Italy: FAO Publishing Management Service.
7	International Tropical Timber Organization. (1993). <i>ITTO Guidelines on the Conservation of Biological Diversity in Tropical Production Forests</i> . Yokohama, Japan: International Organizations Center. Retrieved from: http://www.itto.int/policypapers_guidelines/ .
8	Keller, G., and J. Berry. (2006). <i>Reduced Impact Logging (RIL) Road Issues in Tropical Forests</i> . Quincy, CA: USDA Forest Service.
9	Knowler, D. and J. Lovett. (1996). <i>Training Manual for Environmental Assessment in Forestry</i> . Prepared for FAO Regional Project 'Forestry Policy and Planning in Asia and the Pacific'. Retrieved from: http://www.fao.org/docrep/005/AC625E/AC625E00.htm .
10	Tropical Forest Foundation. (2007). <i>Tropical Forest Foundation Standard for Reduced Impact Logging</i> . Alexandria, VA: Author. Retrieved from: http://www.tropicalforestfoundation.org/get-verified/tff-ril-standard .
11	U.S. Forest Service. (n.d.). <i>Extractive Resource Zone Planning Guide: A U.S. Forest Service Guide (Version 1.0)</i> .
12	Zimmermann, R. (1982). <i>FAO Environmental Impact of Forestry</i> . Rome, Italy: Publications Division of the Food and Agricultural Organization of the United Nations. Retrieved from: http://www.fao.org/docrep/t0550e/t0550e00.htm#Contents .

I selected the software program Excel as the interface for the guidelines due to its international accessibility and ease of use. In Gabon, more advanced software programs are often unavailable and the skills needed in Excel to utilize the guidelines are very basic and easily taught. Initially, I organized the timber best practice guidelines into different Excel worksheets grouped by the environmental category being impacted - either flora, fauna, water, land, land/water, or landscape. Thus I originally had one worksheet devoted to each category, and then within each worksheet all of the best practices timber companies should employ to mitigate impacts to each respective category.

(ii) Incorporated the Priorities of ANPN and Re-Structured the Guidelines

Utilizing the best practices I had compiled as a foundation for discussion, I then worked extensively with ANPN stakeholders to ensure that agency priorities were adequately addressed. I worked with agency staff to understand what they viewed as the greatest threats from timber operations to national parks, and when necessary, integrated additional specific best practices into the timber best practice guidelines to address these threats.

I was able to accomplish this, in part, by attending a meeting between top ANPN decision makers and a representative from a Forest Stewardship Council (FSC) certified timber company. The representative had come to ANPN with a proposed environmental management plan for timber production in a national park buffer zone. During this meeting, ANPN offered their opinion to the company regarding management plan strengths and weaknesses. Specific attention was dedicated to management plan inadequacies (Dr. C. Clark, C. Mbina, and V. Medjibe, ANPN Personnel, Personal Communication, June 13, 2012). From this meeting, I was able to ascertain that ANPN was particularly concerned with the following issues:

- (1) The threat of hunting and elephant poaching by timber personnel.

- (2) The transport of bushmeat in timber company vehicles.
- (3) Road construction near national parks and associated threats (immigration of people leading to hunting, elephant poaching, habitat conversion to agriculture, etc.).
- (4) Village and population growth near national park boundaries.
- (5) Impairment of water quality, specifically erosion.

From attending the meeting between ANPN and the FSC certified timber company representative, I also discovered a more logical way to organize the timber best practice guidelines in Excel. The timber company representative, who had been contracted from the Gabon based consultancy firm TEREА, had also presented their clients' proposed management plan as an Excel template. However, the worksheets were organized by specific timber activity rather than environmental category being impacted. For instance, they had a worksheet for the activities of harvesting, skidding, landing yards, etc. (S. Dirou, TEREА Forest Director, Personal Communication, June 13, 2012). Then within each activity, they had listed the various best practices proposed by the forestry operator to protect the environmental categories of flora, fauna, water, and soil (S. Dirou, TEREА Forest Director, Personal Communication, June 13, 2012). They formatted it such that the source of impact, environmental category impacted, potential impact, broad mitigation measure, and specific best practice(s) were aligned in columns (S. Dirou, TEREА Forest Director, Personal Communication, June 13, 2012). A modified version of this structure struck me as a logical organization for the timber best practice guidelines I was compiling - it clearly outlined which timber production activities can negatively impact the environment, and what can be done to mitigate these impacts. The alternative structure also allows for one to print out a specific worksheet and provide it to the person in charge of implementing each activity in the field. This can allow for better execution of the best practice

guidelines on the ground, and thus I chose to adopt this structure for the timber best practice guidelines (see Table 2).

I specifically designed the guidelines to contain the following timber activities for each Excel worksheet: inventory process, temporary road construction and use, laterite quarries, harvesting, skidding, roadside landings, base camps, and hunting. The structure differs from that of TEREAs in that roads are specifically temporary, landings are specifically roadside landings, and there is an additional worksheet devoted to mitigating hunting (S. Dirou, TEREAs Forest Director, Personal Communication, June 13, 2012). That only temporary roads are allowed (unless given pre-approval by ANPN to build new roads) reflects the concerns of ANPN that new road networks generally bring with them the immigration of people (Dr. C. Clark, C. Mbina, and V. Medjibe, ANPN Personnel Personal Communication, June 13, 2012). That landings are only allowed to be roadside landings (placing logs adjacent to roads with no need to clear extra space for these logs) reflects the concerns of ANPN over the poor regeneration that can occur on landing yards (Dr. C. Clark, Parks Gabon Cooperative Agreement and Mentor Forest Coordinator, Personal Communication, June 13, 2012). Finally, the addition of a separate worksheet devoted to hunting reflects ANPN's strong concern for the indirect impacts of hunting that can occur in timber concessions (Dr. C. Clark, C. Mbina, and V. Medjibe, ANPN Personnel. Personal Communication, June 13, 2012).

Table 2. Example of Timber Best Practice Guidelines Structure

Buffer Zone Best Practice Guidelines				
Inventory Process				
Impact and Mitigation Measures				
Source of Impact	Item Impacted	Potential Impact	Broad Mitigation Measure	Specific Best Practice(s)
Cutting saplings to construct inventory camps.	Flora	Disturbance to regeneration of the forest.	Limit the size of wood utilized to construct inventory camps.	Limit the size of wood utilized to construct inventory camps to 5cm or less in diameter.
Inappropriate disposal of chemical and trash waste.	Land/Water	Pollution of soil and water from trash and chemicals.	Dispose chemicals, liquid, trash, and wastes including fuel and oil in an environmentally appropriate manner.	Do not place inventory camps within 100m of water bodies. Provide inventory teams with bags or containers to place their waste in. Ensure all non-biodegradable waste is evacuated from the forest. Schedule waste retrieval trips to transport non-biodegradable waste to proper waste facilities to be disposed of appropriately.

(iii) Incorporated Feedback from Forestry Experts

As an ANPN intern I also had the opportunity to work with, and learn from two forestry experts engaged by ANPN to reinforce the technical capacity of ANPN to manage resources in the buffer zones surrounding national parks. The first of these, David Fournier, had been assigned the task of advising a broader buffer zone management guideline for all extractive activities. The most influential interaction I had with him was touring an FSC certified timber company in the south of Gabon. Our purpose was to gain a better understanding of what existing “best” practices in Gabon looked like – essentially helping us define what we could realistically ask of timber operators within the Gabon context. David Fournier was quite impressed by what we saw, and he also made a few recommendations in regards to what the company could improve on (D. Fournier, U.S. Forest Service Technical Advisor to ANPN on Buffer Zone Management, Personal Communication, June 23, 2012). From this experience, I was able to integrate realistic compliance expectations into the timber best practice guidelines. I also incorporated David Fournier’s (2012) recommendations to ANPN outlined in *A Strategic Policy*

for Regulating Forest, Mineral, Gas and Oil Exploitation within Buffer Zones of the National Parks in Gabon into the timber best practice guidelines.

The second forestry expert with whom I had the privilege of working with was Dr. Francis Putz, a professor at the University of Florida and a reduced impact logging expert. Together, with a class of Gabonese Masters students, we toured an Olam Timber Gabon concession prior to my time working directly with Olam. From this experience, I obtained feedback from Dr. Putz as to what timber practices he felt could and should be implemented in Gabon to better protect the environment (F. Putz, University of Florida Professor, Personal Communication, July 20, 2012). I then integrated Dr. Putz's observations into the timber best practice guidelines.

(iv) Worked with Olam Timber Gabon

During the second half of my time in Gabon I worked directly with Olam Timber Gabon in Makokou. As a dual intern with both ANPN and Olam, my time working with Olam served two purposes: (1) highlight for Olam, practices they should start improving to prepare themselves for eventual ANPN enforcement of the timber best practice guidelines, (2) ensure for ANPN that no important mitigation measures were missing from the timber best practice guidelines that I would have failed to identify without spending significant time on an active timber concession.

To ensure inclusion of a range of context specific threats and mitigations into the timber best practice guidelines, I toured all of the various timber activities that occur on a timber concession over the course of five weeks. These included the inventory process, laterite quarries, road construction, harvesting, skidding, landing yards, and base camps. During this process I was able to identify areas in the timber best practice guideline that needed to be stated more clearly. I also added a few additional mitigation guidelines (best practices). For an example of clarifying a best practice, I added to the guidelines that inventory camps should not be constructed out of trees

larger than 5cm in diameter. Prior to this, the guidelines simply stated “create inventory camps to minimize damage to the forest”. In consultation with ANPN, I found this to be insufficiently specific to mitigate the threat of inventory camp construction (Dr. C. Clark, Parks Gabon Cooperative Agreement and Mentor Forest Coordinator, Personal Communication, Aug. 7, 2012). An example of a best practice guideline I added under the activity of the inventory process was that an outside third party should help patrol inventory camps to ensure hunting is not occurring. Prior to this, the guidelines only stated that timber companies needed to have their own management teams to patrol inventory camps, but I decided that more enforcement would be beneficial to truly avoid hunting.

(v) Considered National Park Context Specific Information

The final step in compiling the timber best practice guidelines was to consider how the guidelines would incorporate national park context specific information. As stated previously, there are thirteen national parks in Gabon (“L’Agence”, 2012a). These thirteen national parks are located all throughout Gabon (see Figure 1, 3), and were each chosen for a specific reason. Some were chosen to protect important wildlife populations, while others were chosen to protect important watersheds or unique ecosystems (Dr. C. Clark, Parks Gabon Cooperative Agreement and Mentor Forest Coordinator, Personal Communication, June 7, 2012). Thus, specific forestry practices may need to be carried out in the buffer zones of these parks according to their most important ecological characteristics.

As designed, the timber best practice guidelines are a tool that can be utilized in the buffer zone areas adjacent to any national park, and thus they are not park context-specific. However, national park staff are in the process of completing detailed management plans for each of the thirteen national parks. In these park management plans will be additional specific

practices that must be followed in buffer zone areas to protect the unique attributes of each park (Dr. C. Clark, Parks Gabon Cooperative Agreement and Mentor Forest Coordinator, Personal Communication, January 17, 2013). Thus, once the timber best practice guidelines have been validated by ANPN, they along with each park's management plan will need to be given to timber operators around each national park. In this way ANPN can be insured that timber operators in buffer zones are both carrying out best practices and taking into consideration park-specific information.

Creation of the Compliance Scoring Template

Once the timber best practice guidelines were complete, I then established an associated compliance scoring template (CST) to facilitate evaluation of how well timber companies comply with the timber best practice guidelines. In order to create the CST, I went through several steps. I first created a basic current practices scoring scheme to rate how well a company complies with each specific best practice. Then I developed a method to produce an overall score for how well a company mitigates each source of impact. I then weighted source of impact overall scores based on how damaging to the environment they are, with high weights denoting very damaging sources of impact, and low weights denoting moderately damaging sources of impact. In order to determine which sources of impact were most damaging to the environment, I elicited the opinions of ANPN. Finally, I created a method for producing a score for how well a company mitigates all sources of impact within a given timber activity (inventory process, harvesting, etc.), and for how well a company mitigates sources of impact across their entire concession (across all timber activities). I will walk through these steps in turn. It is helpful to first view Table 10 on page 41 which demonstrates the entire scoring process within a timber activity.

(i) Establishment of Current Practice(s) and Current Averaged Practice(s) Scores

To keep the scheme simple, if a company never carries out a specific best practice they receive a current practice score of 0, if they sometimes carry out a specific best practice they receive a current practice score of 0.5, and if they always carry out a specific best practice they receive a current practice score of 1. I chose to keep the scoring system basic because when ANPN verifiers go into the field to monitor timber operators, they will likely only tour a concession for a few days like any normal auditing body would do. When only able to see whether a company is implementing a specific best practice during such a short period of time, a more complicated scoring scheme is unnecessary and would suggest that verifiers had more in depth information. By keeping the scoring scheme this simple, it is a straight-forward process for ANPN verifiers to rate companies, and it properly reflects the amount of information they have.

Because there can be multiple specific best practices required to mitigate a single source of impact, the current practice(s) scores must be averaged over all of the associated specific best practices to obtain a measure of how well a company is mitigating a particular source of impact (see Table 3 “averaged current practice(s) score”).

Table 3. Example of the Scoring Scheme

Buffer Zone Best Practice Guidelines						
Inventory Process						
Impact and Mitigation Measures						
Source of Impact	Item Impacted	Potential Impact	Broad Mitigation Measure	Specific Best Practice(s)	Current Practice(s) Score	Averaged Current Practice(s) Score
Cutting saplings to construct inventory camps.	Flora	Disturbance to regeneration of the forest.	Limit the size of wood utilized to construct inventory camps.	Limit the size of wood utilized to construct inventory camps to 5cm or less in diameter.	1.00	1.00
Inappropriate disposal of chemical and trash waste.	Land/Water	Pollution of soil and water from trash and chemicals.	Dispose chemicals, liquid, trash, and wastes including fuel and oil in an environmentally appropriate manner.	Do not place inventory camps within 100m of water bodies.	1.00	0.63
				Provide inventory teams with bags or containers to place their waste in.	1.00	
				Ensure all non-biodegradable waste is evacuated from the forest.	0.50	
				Schedule waste retrieval trips to transport non-biodegradable waste to proper waste facilities to be disposed of appropriately.	0.00	

(ii) Establishment of Weights for Impact Sources and Activities

While the averaged current practice(s) score describes how well a company is mitigating a specific source of impact within a given timber activity (inventory, road construction, etc.), it does not take into account that some sources of impact are more damaging to the environment than others. Thus, if the final scoring scheme were limited to these averaged current practice(s) scores, it could allow for two companies to obtain the same overall company score (across all timber activities) when one company is mitigating all of the impact sources that are very damaging to the environment, and one company is mitigating all of the impact sources that inflict minimal damage to the environment. This inadequately meets the needs of ANPN and other auditing bodies. Thus, I introduced a weighted scoring scheme that differentiates between the most and least damaging sources of impact. In order to accomplish this, I employed a method known as swing weighting that is a process supported by the theory of decision analysis.

The theory of decision analysis acknowledges that whenever people make decisions regarding a set of alternatives, they infuse their own personal opinions and thus place a higher weight on some of the alternatives (Clemen, 1996). For example, during the temporary road construction process two potential threats to the environment are the transport of bushmeat (hunting), and accidentally hitting wildlife with timber company vehicles. As noted earlier, ANPN is very concerned with the transport of bushmeat in timber company vehicles (Dr. C. Clark, C. Mbina, and V. Medjibe, ANPN Personnel, Personal Communication, June 13, 2012). However, ANPN did not specifically state that it was concerned with wildlife accidentally being hit by timber company vehicles. In this scenario, ANPN made a judgment call that hunting is more important to mitigate than reckless drivers. In this instance, the score for the best practices that mitigate the transport of bushmeat would count more (have a higher weight) than the score

for the practices that mitigate reckless driving. One method of determining what these weights should be is swing weighting. I chose to utilize the process of swing weighting because it makes the priorities of the decision maker transparent, and ensures that their greatest concerns are addressed.

To demonstrate how I utilized the method of swing weighting, it is helpful to walk through the entire process for one of the timber activities. For example, in the inventory process there are five sources of impact with their associated specific best practices and current averaged practice(s) scores (as described above). Within the inventory process the decision maker, in this case ANPN, needs to decide how important it is to mitigate each impact source relative to the other four impact sources. To facilitate this decision making process, I presented ANPN with five hypothetical scenarios of how well each impact source would be mitigated. In each scenario, one of the impact sources would be fully mitigated (meaning the timber company would carry out all of the specific best practices to mitigate that impact source), while the other four impact sources would not be mitigated at all. I also presented ANPN with a reference case of having none of the five impact sources mitigated. Then, I asked ANPN to rank each of the five scenarios in order of importance to them, with a rank of 1 denoting that it was very important to them that that impact source be mitigated. Once the five scenarios were ranked, I then assigned 100 points to their top ranked scenario and 0 points to the reference case scenario. Next, I asked ANPN to assign points to the other scenarios between 0-100 points. This step in the process of swing weighting is important as it allows the decision maker to state that two impact sources are of almost equal importance to them – this would occur if say they assigned 100 points to their top ranked scenario and 98 points to their second ranked scenario. Then the final step is to determine the weight of each scenario - this denotes how important each scenario is to the decision maker

in relation to the other scenarios. This is accomplished by dividing the points assigned to each scenario by the total points of all of the scenarios (see Table 4 for an example of the entire process).

Table 4. Demonstration of the Swing Weighting Method for the Inventory Process

Scenario	Rank	Points	Weight
No mitigation measures for (1) construction of inventory camps, (2) inappropriate disposal of chemical and trash waste, (3) inappropriate disposal of human waste, (4) hunting by inventory teams, (5) use of inventory camps by poachers.	6	0	N/A
Only mitigation for construction of inventory camps.	4	40	$40/319 = 0.13$
Only mitigation for inappropriate disposal of chemical and trash waste.	3	50	$50/319 = 0.16$
Only mitigation for inappropriate disposal of human waste.	5	30	$30/319 = 0.09$
Only mitigation for hunting by inventory teams.	1	100	$100/319 = 0.31$
Only mitigation for use of inventory camps by poachers.	2	99	$99/319 = 0.31$

Total Points = 319

The above example demonstrates the process of swing weighting within the inventory process. The process was repeated within all of the other timber activities, and then across all of the activities (inventory process, harvesting, skidding, etc.). I utilized the identical process across all of the activities as I did for within each activity - if the word “impact source” is replaced with “activity” in the above explanation, that is the process I utilized. Thus, when utilizing the swing weighting method across the activities each activity is assigned its own weight. See Appendix I for the full process of determining weights for all sources of impact and for all timber activities.

(iii) *Combining the Current Averaged Practice(s) Scores with their Associated Weights to Obtain Activity Scores*

Once I had established a method for scoring each impact source, and a method for assigning a weight to each impact source, I then needed a way to combine these two items to produce an overall score for each impact source. To accomplish this, I multiplied the current averaged practice(s) score by its associated weight to produce an overall score for a given impact source. For example, in the inventory process if a company received a current averaged practice(s) score of 0.63 for mitigating the inappropriate disposal of chemical and trash waste, I then multiplied this by its weight of 0.16 (see Table 5).

Table 5. Demonstration of Obtaining the Overall Score for Each Impact Source

Buffer Zone Best Practice Guidelines								
Inventory Process								
Impact and Mitigation Measures					Decision Maker Rating Scheme			
Source of Impact	Item Impacted	Potential Impact	Broad Mitigation Measure	Specific Best Practice(s)	Current Practice(s) Score	Averaged Current Practice(s) Score	ANPN Priority Weight/Rank	Overall Score
Cutting saplings to construct inventory camps.	Flora	Disturbance to regeneration of the forest.	Limit the size of wood utilized to construct inventory camps.	Limit the size of wood utilized to construct inventory camps to 5cm or less in diameter.	1.00	1.00	0.13	0.13
Inappropriate disposal of chemical and trash waste.	Land/Water	Pollution of soil and water from trash and chemicals.	Dispose chemicals, liquid, trash, and wastes including fuel and oil in an environmentally appropriate manner.	Do not place inventory camps within 100m of water bodies.	1.00	0.63	0.16	0.10
				Provide inventory teams with bags or containers to place their waste in.	1.00			
				Ensure all non-biodegradable waste is evacuated from the forest.	0.50			
				Schedule waste retrieval trips to transport non-biodegradable waste to proper waste facilities to be disposed of appropriately.	0.00			

The overall score for a given impact source, by combining its current averaged practice(s) score and its weight, takes into account both how well a company is mitigating a particular impact source and how important it is that they do so (according to the weight placed on the impact source).

Finally, I needed a method to produce a score for each overarching activity (inventory process, harvesting, etc.). To accomplish this, I added all of the overall scores within a given activity together to produce a score for each activity. For example, for the inventory process there are five impact sources and thus five overall scores. For a given company, these overall

scores would be added to produce the score representing how well that company mitigated negative impacts to the environment during the inventory process. It is important to note that for a given activity a company can have a score ranging from 0 to 1. This is because the maximum current averaged practice(s) score each impact source can have is 1, and within an activity all of the impact source weights add up to 1 (see Table 6 on page 35).

(iv) Combining the Activity Scores with their Associated Weights to Obtain the Overall Company Score

Additionally, I needed a method to produce an overall company score for how well a company has mitigated environmental impacts throughout their concession (throughout their various timber activities of temporary road construction, harvesting, skidding, etc.). In order to produce an overall company score each activity score is multiplied by its corresponding weight, and then the products are added together. Each activity score must be multiplied by its respective weight because not all timber activities equally impact the environment – those activities with higher weights assigned to them impact the environment more (according to the opinion of ANPN). As with each activity score, a company’s overall score can range from 0 to 1.

(v) Creation of the Company Scores Worksheet

Once I had created the compliance scoring template for the timber best practice guidelines, I needed a way to display how well a timber company was complying with the guidelines such that ANPN employees could quickly determine whether a company was performing well or poorly. After consultation with ANPN, I chose to display the information both in table and chart format in a separate Excel worksheet of the timber best practice guidelines titled “company scores”.

Within the company scores worksheet ANPN requested that I display the information such that they could quickly determine whether the highest weighted impact sources within each timber activity were being mitigated. In order to accomplish this, I designated the impact sources that had the highest weight and weights within 90% of the highest weight as ‘majors’, while the rest of the impact sources I designated as ‘minors’. I created a table that shows how well each company is performing for each activity, and also broke apart scores for how well they are doing on mitigating their ‘majors’ and ‘minors’ within each activity.

ANPN also requested that I show how well a company was mitigating impacts to flora, fauna, land, land/water, landscape, and water across all of their timber activities. Thus, I created a table showing these scores. To explain how I created these scores, I will walk through an overview of how I calculated the score for mitigating water across all activities.

Within a given activity, there may be two sources of impact that harm water out of a total of five sources of impact. These two sources of impact have weights of say 0.23 and 0.40 – because these two values do not add up to 1, it is necessary to redistribute the weight between the two sources of impact according to their proportions so that they add up to one. In this case 0.23 would become 0.37 and 0.40 would become 0.63. If there is only one source of impact that mitigates harm to water within an activity, then that source of impact will have a weight of 1. Once I redistributed the weights across the sources of impact within each activity, I then multiplied each new impact source weight by its associated current averaged practice(s) score to obtain the overall score for the impact source. Finally, I added up all of the overall scores within an activity to obtain the activity score for how well a company was mitigating harm to water (the ‘water activity score’).

Once I had the water activity scores for all of the activities, I combined them to obtain the overall score for how well a company was mitigating harm to water. From previous calculations, I already had the weights associated with each activity. However, in the case of water, there were a few activities that did not contain impact sources that harmed water. It was thus necessary to redistribute the weights across the activities like I had done for the weights within each activity (if there had been an impact source within each activity that harmed water, there would have been no need to change the activity weights). Once I redistributed the weights, I then calculated the company's overall water score by multiplying each water activity score by each water activity weight, and then summed these values together. I then repeated this process for flora, fauna, land, land/water, and landscape.

Finally, ANPN requested a way to visualize how well a company was doing overall. Thus, I created a table showing the components going into the company's overall score for how they are mitigating impacts to the environment across their concession. For all of the above three mentioned tables I created a method to categorically describe the performance of a company based on their score, with a score between 0-0.33 being poor, between 0.33-0.66 being good, and between 0.66-1 being excellent. Additionally, I created bar graphs attached to the above three mentioned tables in order to allow ANPN to both read the scores in table format and visualize them in graph format.

Environmental Impact Scoring Scheme

The above compliance scoring template (CST) is the scheme that will be utilized in the timber best practice guidelines. As stated previously, the CST acknowledges that ANPN inherently infuses its opinions when it makes decisions. In the scheme, the priorities of ANPN

are captured by the weights associated with the various impact source scores and timber activity scores.

However, there are those who would oppose such a scheme because they feel that decisions should be made based on science and fact, not on a decision maker's opinions. In order to address this concern, I decided to also create what I will hereafter refer to as an environmental impact scheme in which the opinions and priorities of ANPN are not incorporated. Instead, this scheme incorporates objective scientific measures to rate how damaging to the environment a given impact source or timber activity is. I chose to create the environmental impact scheme in order to help ANPN decision makers reflect on their decisions, and perhaps change how they prioritize (place weight on) which impact sources are most threatening to the environment.

As the inspiration for my environmental impact scheme I looked to a timber management plan from Olam Timber Gabon produced by the Gabonese consulting company TEREА (TEREA, 2010). Within this management plan was a proposed scheme to rate how damaging certain timber activities are to the environment (TEREA, 2010). I also utilized the International Standardization Organization's (1998) document *Information to Assist Forestry Organizations in the Use of Environmental Management System Standards* as a guide. By utilizing these two documents as a starting point, I then created my own environmental impact scheme which takes into account the frequency, duration, area, intensity, and reversibility of any given impact to the environment (see Appendix II). To obtain the environmental impact score for a given impact, the following equation is utilized:

- Formula: $F * [(D + A + I + R) / 4]$

Each factor is defined as follows:

- Frequency (F): measures how many times per year a given impact occurs, or how many instances within a concession an impact occurs.
- Duration (D): describes how long the source of the impact lasts in terms of days and years.
- Area (A): the percentage of the concession an impact affects.
- Intensity (I): describes how reversible an impact is, ranging from an impact being 0-100% reversible.
- Reversibility (R): the amount of time it takes an impact to reverse in terms of days and years.

While this is not the scoring scheme utilized in the timber best practice guidelines, the scores for each impact source are listed in the guidelines adjacent to the weights given to each impact source from the compliance scoring template. Please see Table 7 on page 36 for an example, and Appendix III for the environmental impact scores for all impact sources.

As stated previously, the purpose of including the environmental impact scores in the timber best practice guidelines is to encourage ANPN decision makers to reflect on the way they prioritize impact sources. If within a timber activity the impact source with the highest weight also has the highest environmental impact score, then ANPN can be comfortable that they have prioritized appropriately. However, if the impact source with the highest weight has the lowest environmental impact score ANPN may want to re-consider how they are prioritizing (placing weight on) which impact sources are most threatening to the environment.

To determine how well ANPN weights mirror environmental impact scores, I conducted a brief comparison between the two for all timber activities. From my comparison, it appears that ANPN prioritizes well which impact sources are most threatening to the environment for

roadside landings, base camps, and hunting activities. Within the activities of the inventory process, temporary road construction and use, harvesting, and skidding, the impact sources with the highest weights do have high environmental impact scores, but they are somewhat out-of-order. For instance, within the activity of skidding, the impact source with the highest weight had a lower environmental impact score than the impact source with the second highest weight. Also, within the activity of laterite quarry construction and use, the impact source with the highest weight had one of the lowest environmental impact scores while the impact source with the lowest weight had the highest environmental impact score. Thus, for the activities of the inventory process, temporary road construction and use, harvesting, and skidding, ANPN should re-consider the subtleties of how they prioritize impact sources. As for laterite quarry construction and use, ANPN should seriously reflect on how they prioritize the threats posed by impact sources.

IV. Results

According to the task assigned to me by ANPN, I created timber best practice guidelines with an associated compliance scoring template (CST). The purpose of the guidelines and CST is to allow ANPN to clearly define what practices they expect timber operators to comply with in buffer zones, and it allows them to monitor timber operators for compliance. Additionally, the guidelines allow ANPN to help companies prioritize where they need to make improvements to their practices.

To demonstrate how the guidelines can be utilized, it is helpful to go through a scenario of comparing two companies. In this scenario, Company A only mitigates the impact sources that are ‘majors’ (have high weights associated with them), while Company B only mitigates the impact sources that are ‘minors’ (have low weights associated with them). Thus Company A is

mitigating all of the impact sources that can severely degrade the environment, while Company B is mitigating all of the impact sources that only moderately degrade the environment. To make the example as simple as possible, it will be assumed that Company A receives scores of 1 on all of the specific best practice(s) that mitigate ‘majors’, and Company B receives scores of 1 on all of the specific best practice(s) that mitigate ‘minors’. Both Company A and Company B receive scores of 0 on everything else.

Assuming this scenario, the difference in performance between the two companies can be visualized in Tables 8-9 and Figures 4-5 (pages 37-40). From Tables 8 and 9 it is clear that Company A rates “excellent” or “good” several times more than does Company B, and it can be seen that Company A has a much higher overall company score of 0.69 as opposed to Company B’s score of 0.32. It is also quickly apparent that Company A has mitigated all of the ‘majors’ within each activity (meaning it always carries out all of the specific best practices to mitigate ‘major’ impact sources). On the other hand, Company B has not managed to fully mitigate any of the ‘major’ impact sources.

The difference between Company A and Company B’s performances are also easily visualized in Figures 4 and 5 (on page 38 and 40). One can quickly look at Figures 4 and 5 and determine that Company A is complying with the best practice guidelines more successfully and is thus preventing more harm to the environment than Company B. Figures 4 and 5 also demonstrate how a company, in this case Company B, cannot only mitigate impact sources that only moderately degrade the environment (‘minor’ impact sources) and have a high score.

From seeing the results presented in this way, ANPN would quickly determine that Company B needs to make more improvements than Company A in complying with the guidelines. Firstly, they would see from Table 9 (page 39) that Company B needs to work on

mitigating ‘major’ impacts. As the ‘major’ impacts represent the greatest concerns of ANPN, ANPN would ask Company B to first fix their best practices in mitigating these impact sources before focusing on improving ‘minor’ impact sources. Thus, presenting a company’s score in this way can help companies prioritize which best practices to improve first.

ANPN can also specifically see where both companies need to make the most improvements by considering the bar graphs showing their total scores for each activity and for mitigating each impact category. In the case of Company B, it can be seen in Figure 5 (page 40) that they are especially poor at mitigating impacts to the environment during the temporary road construction process and in base camps. It can also be seen that they tend to poorly mitigate impacts to water throughout all of their timber activities. Thus, ANPN could highlight to the company where they are lacking in implementing best practices.

In order to help guide the company in the items it needs to fix, the last columns of the timber best practice guidelines are titled ‘recommendations’ under which ANPN personnel can write precisely what the company needs to improve on. ANPN personnel can state what tasks the company needs to undertake, whether there should be a change or addition in who is overseeing the task, the period the task should be fixed within, and the indicator of what will show the task has been completed. Please see Table 10 on page 41 for an example worksheet of Company B for how they are performing during the inventory process, and for how ANPN personnel are able to make recommendations for improvement. There are similar worksheets for each timber activity. From Table 10 it is also possible to obtain a sense of how detailed the best practices are that companies must comply with.

Table 7. Comparison of Weights and Environmental Impact Scores

Buffer Zone Best Practice Guidelines									
Inventory Process		Impact and Mitigation Measures			Decision Maker Rating Scheme			Environmental Rating Scheme	
Source of Impact	Item Impacted	Potential Impact	Broad Mitigation Measure	Specific Best Practice(s)	Current Practice(s) Score	Averaged Current Practice(s) Score	ANPN Priority Weight/Rank	Overall Score	Environmental Impact Score
Cutting saplings to camp; inappropriate disposal of chemical and trash	Flora	Disturbance to regeneration of the forest.	Limit the size of wood utilized to construct inventory camps.	Limit the size of wood utilized to construct inventory camps to 5cm or less in diameter.	0.50	0.50	0.13	0.07	2.50
	Land/Water	Pollution of soil and water from trash and chemicals.	Dispose chemicals, liquid, trash and wastes including fuel and oil in an environmentally appropriate manner.	Do not place inventory camps within 100m of water bodies. Provide inventory teams with bags or containers to place their waste in. Ensure all non-biodegradable waste is evacuated from the forest. Schedule waste retrieval trips to transport non-biodegradable waste to proper waste facilities to be disposed of appropriately.	1.00	0.63	0.16	0.10	3.50
Inappropriate disposal of human waste.	Fauna	Spread of diseases to primate species from human waste.	Ensure that human waste is disposed of appropriately.	Make inventory personnel aware of how diseases spread from human waste to primates. Instruct inventory personnel to bury their feces, vomit, and other human waste. Instruct inventory personnel to keep their distance from primates.	1.00	0.67	0.09	0.06	6.50
Illegal or inappropriate hunting or trapping of fauna by inventory teams.	Fauna	Disturbance of rare, endangered, threatened and wild populations by inventory teams.	Establish regulations regarding the hunting process and ensure they are publicized and enforced.	Ensure that international and national hunting regulations are followed and that inventory teams are made aware of them. Prohibit and penalize hunting during the inventory process. Install a mobile hunting control team to patrol inventory teams unannounced for signs of hunting and poaching (weapons, ammunition, large animal carcasses, snares, traps, etc.) and to remove any traps found. This team could be formed in partnership with local conservation organizations, the Ministry of Water and Forests, and/or ecoguards. Prohibit and penalize the transport and trade of bush meat, weapons, ammunition, large ammunition for elephants, snares, traps, and other materials for hunting in company vehicles. Check inventory team vehicles and baggage for bush meat, weapons, ammunition, large ammunition and satellite phones for elephant poaching, snares, traps, and other hunting materials prior to their departure and on their return from the forest.	0.50	0.72	0.31	0.22	18.00
Use of inventory camps by elephant poachers.	Fauna	Disturbance of elephant populations.	Take appropriate measures to ensure inventory camps are not accessible to poachers.	Limit the duration that inventory teams are in an area to decrease the incentive to hunt. Supply inventory teams with alternative protein sources that are cheaper than bush meat and a decent variety of other foods to decrease the incentive to hunt. Have a clear system in place for the penalties associated with disobeying hunting rules according to the severity of the infraction, and designate a person responsible for their enforcement. Have security checks at entrances to the forest concession to ensure that only approved vehicles enter the concession. Dismantle all inventory camps after use. Have a team in place to check dismantled camps after the inventory process and prior to the harvesting process (when an area is not being harvested) to ensure that inventory are not being utilized by poachers.	1.00	0.50	0.31	0.16	25.00

Table 8. Company Score Worksheet for a Company Mitigating all Majors

Activity Scores								
	<i>Inventory Process</i>	<i>Latente Quarries</i>	<i>Temporary Road Construction and Use</i>	<i>Harvesting</i>	<i>Skidding</i>	<i>Landing Sites</i>	<i>Base Camps</i>	<i>Hunting</i>
<i>Major's Score</i>								
Comply with Major's?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Overall Score	0.62	0.33	0.88	0.71	0.56	0.67	1.00	0.54
Total Possible Score	0.62	0.33	0.88	0.71	0.56	0.67	1.00	0.54
Normalized Score	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Category	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
<i>Minor's Score</i>								
Overall Score	0.00	0.00	0.00	0.00	0.00	0.00	N/A	0.00
Total Possible Score	0.38	0.67	0.12	0.29	0.44	0.33	N/A	0.46
Normalized Score	0.00	0.00	0.00	0.00	0.00	0.00	N/A	0.00
Category	Poor	Poor	Poor	Poor	Poor	Poor	N/A	Poor
Total Score								
Company Score	0.62	0.33	0.88	0.71	0.56	0.67	1.00	0.54
Total Possible Score	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Category	Good	Good	Excellent	Excellent	Good	Excellent	Excellent	Good
Total Company Score								
	<i>Inventory Process</i>	<i>Latente Quarries</i>	<i>Temporary Road Construction and Use</i>	<i>Harvesting</i>	<i>Skidding</i>	<i>Landing Sites</i>	<i>Base Camps</i>	<i>Hunting</i>
Activity Score	0.62	0.33	0.88	0.71	0.56	0.67	1.00	0.54
Activity Weight	0.13	0.09	0.14	0.13	0.10	0.11	0.15	0.15
Total Score	0.08	0.03	0.12	0.09	0.06	0.07	0.15	0.08
Total Company Score	0.69							
Total Possible Score	1.00							
Item Impacted Scores								
	<i>Fauna</i>	<i>Flora</i>	<i>Land</i>	<i>Water</i>	<i>Land/Water</i>	<i>Landscape</i>		
Company Score	0.51	0.67	0.42	0.78	0.00	1.00		
Total Possible Score	1.00	1.00	1.00	1.00	1.00	1.00		
Category	Good	Excellent	Good	Excellent	Poor	Excellent		
Legend: Performance Levels Based on Scores								
Category	Score							
Poor	$0 \leq X < 0.33$							
Good	$0.33 \leq X < 0.66$							
Excellent	$0.66 \leq X \leq 1$							

Figure 4. Company Score Graphs for a Company Mitigating all Majors

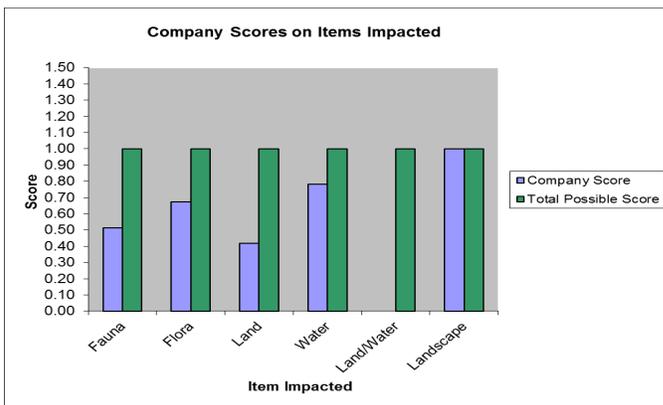
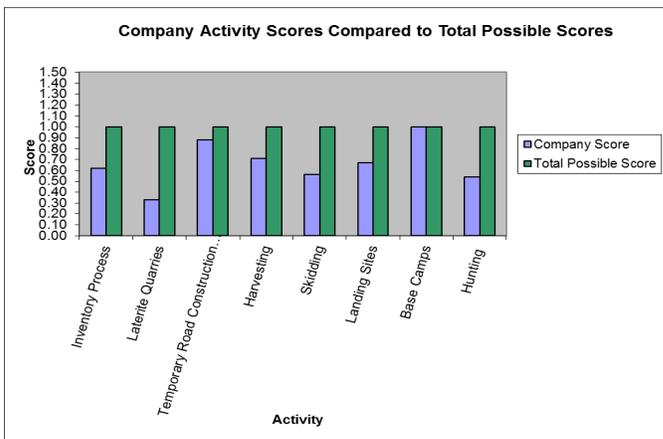
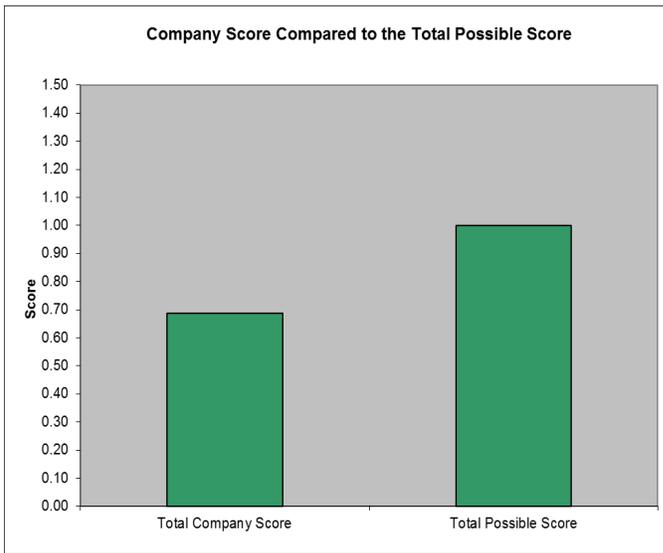


Table 9. Company Score Worksheet for a Company Mitigating all Minors

Activity Scores								
	<i>Inventory Process</i>	<i>Laterite Quarries</i>	<i>Temporary Road Construction and Use</i>	<i>Harvesting</i>	<i>Skidding</i>	<i>Landing Sites</i>	<i>Base Camps</i>	<i>Hunting</i>
Major's Score								
Comply with Major's?	No	No	No	No	No	No	No	No
Overall Score	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Possible Score	0.62	0.33	0.88	0.71	0.56	0.67	1.00	0.54
Normalized Score	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Category	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor
Minor's Score								
Overall Score	0.38	0.67	0.12	0.29	0.44	0.33	N/A	0.46
Total Possible Score	0.38	0.67	0.12	0.29	0.44	0.33	N/A	0.46
Normalized Score	1.00	1.00	1.00	1.00	1.00	1.00	N/A	1.00
Category	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	N/A	Excellent
Total Score								
Company Score	0.38	0.67	0.12	0.29	0.44	0.33	0.00	0.46
Total Possible Score	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Category	Good	Excellent	Poor	Poor	Good	Good	Poor	Good
Total Company Score								
	<i>Inventory Process</i>	<i>Laterite Quarries</i>	<i>Temporary Road Construction and Use</i>	<i>Harvesting</i>	<i>Skidding</i>	<i>Landing Sites</i>	<i>Base Camps</i>	<i>Hunting</i>
Activity Score	0.38	0.67	0.12	0.29	0.44	0.33	0.00	0.46
Activity Weight	0.13	0.09	0.14	0.13	0.10	0.11	0.15	0.15
Total Score	0.05	0.06	0.02	0.04	0.04	0.04	0.00	0.07
Total Company Score	0.32							
Total Possible Score	1.00							
Item Impacted Scores								
	<i>Fauna</i>	<i>Flora</i>	<i>Land</i>	<i>Water</i>	<i>Land/Water</i>	<i>Landscape</i>		
Company Score	0.50	0.33	0.58	0.22	1.00	0.00		
Total Possible Score	1.00	1.00	1.00	1.00	1.00	1.00		
Category	Good	Good	Good	Poor	Excellent	Poor		
Legend: Performance Levels Based on Scores								
Category	Score							
Poor	$0 \leq X < 0.33$							
Good	$0.33 \leq X < 0.66$							
Excellent	$0.66 \leq X \leq 1$							

Figure 5. Company Score Graphs for a Company Mitigating all Minors

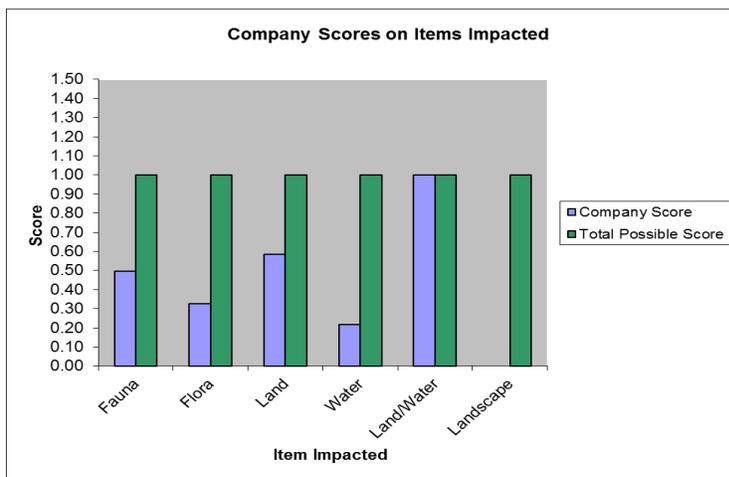
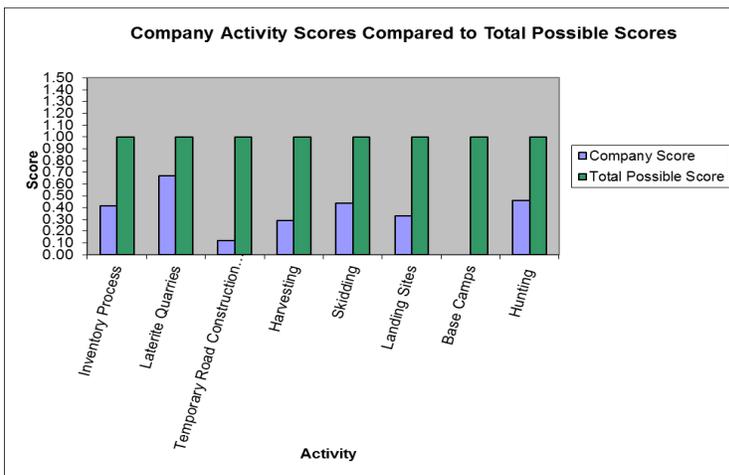
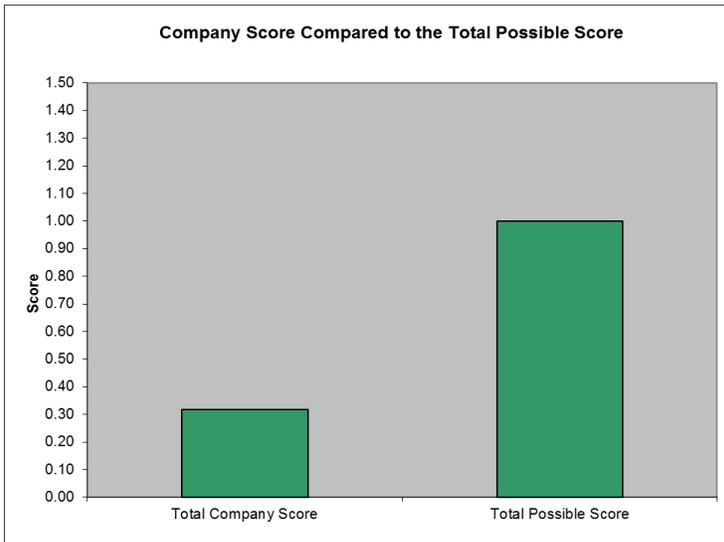


Table 10. Example Worksheet from the Timber Best Practice Guidelines for a Company Only
Mitigating Minor Impact Sources during the Inventory Process

Buffer Zone Best Practice Guidelines															
Inventory Process															
Source of Impact	Item Impacted	Potential Impact	Impact and Mitigation Measures	Broad Mitigation Measure	Specific Best Practice(s)	Current Practice(s) Score	Averaged Current Practice(s) Score	Decision Maker Practice(s) ANPN Priority Weight/Bank	Overall Score	Environmental Rating Scheme Environmental Impact Score	Task(s)	Current Overseer	New Overseer	Period	Indicator
Colony activities by construct inventory camps	Flora	Disturbance to regeneration of the forest.	Limit the size of forest cleared to construct inventory camps.	Limit the size of forest cleared to construct inventory camps.	Limit the size of forest cleared to construct inventory camps to 5cm or less in diameter.	1.00	1.00	0.13	0.13	2.50					
Inappropriate disposal of chemical and trash waste.	Land/Water	Pollution of soil and water from trash and chemicals.	Dispose chemicals, liquid, trash, and wastes including fuel and oil in an environmentally appropriate manner.	Dispose chemicals, liquid, trash, and wastes including fuel and oil in an environmentally appropriate manner.	Do not place inventory camps within 100m of water bodies, with bags or containers to place their waste in. Ensure all non-biodegradable waste is evacuated from the forest.	1.00	1.00	0.16	0.16	3.50					
Inappropriate disposal of human waste	Fauna	Spread of diseases to primate species from human waste	Ensure that human waste is disposed of appropriately.	Ensure that human waste is disposed of appropriately.	Schedule waste retrieval trips to transport non-biodegradable waste to appropriate facilities to be disposed of appropriately. Make inventory personnel aware of how diseases spread from human waste to their faces, vomit, and other human waste. Instruct inventory personnel to bury their faces, vomit, and other human waste.	1.00	1.00	0.09	0.09	6.50					
Illegal or inappropriate hunting or trapping of fauna by inventory teams.	Fauna	Disturbance of rare, endangered, or threatened wildlife populations by inventory teams.	Establish regulations regarding the protection of rare, threatened, or endangered species, and ensure they are publicized and enforced.	Ensure that international and national laws regarding the protection of rare, threatened, or endangered species is made aware of them. Prohibit and penalize hunting during the inventory process. Instruct inventory teams to report signs of hunting and poaching (weapons, ammunition, large signs of hunting and poaching for elephant poaching, snares, traps, etc.) and to remove any traps found. This team could be formed in partnership with the Forest Guards, the Ministry of Water and Forests, and/or ecoguards.	Prohibit and penalize the transport and use of weapons, traps and snares, elephant poaching, snares, traps and other materials for hunting in company vehicles. Check inventory team vehicles and baggage for such meat, weapons, ammunition, large ammunition and satellite phones for elephant poaching. Instruct inventory teams to dispose of materials prior to their departure and on their return from the forest.	0.00	0.11	0.31	0.03	18.00					
Use of inventory camps by elephant poachers.	Fauna	Disturbance of elephant populations.	Take appropriate measures to ensure inventory camps are not accessible to poachers.	Take appropriate measures to ensure inventory camps are not accessible to poachers.	Limit the size of forest cleared to decrease the incentive to hunt. Supply inventory teams with alternative food items such as instant noodle cups, both meat and a selection of other food to decrease the incentive to hunt. Have a clear system in place for the penalties associated with disobeying the rules of the inventory concession. Assign a person responsible for their enforcement. Check all entrances to the forest concession to ensure that only approved vehicles enter the concession. Demolish all inventory camps after use. Have a team in place to check dismantled camps after the inventory process prior to the logging process and ensure that logging frequently monitored) to ensure they are not being utilized by poachers.	0.00	0.00	0.31	0.00	25.00					

V. Discussion

If the integrity of Gabon's national parks is to remain intact, it is important that the threat of the rapidly expanding timber industry be addressed in the near future. Logging activities can severely damage sensitive ecosystems through both direct and indirect impacts, and if left unmanaged could irreversibly injure Gabon's national parks. As stated previously, as of 2012 ANPN lacked a definition of how they expected timber operations to be carried out in national park buffer zones, and lacked a way to monitor for compliance ("L'Agence", 2012a). Without having defined guidelines, timber operators could conduct their operations as they saw fit. The presented guidelines and associated compliance scoring template (CST) help ameliorate this issue. The timber best practice guidelines allow ANPN to clearly state how timber operations need to be conducted in buffer zones, and the associated CST allows ANPN to evaluate how well individual timber operators are complying with the guidelines. With the guidelines and CST, ANPN is now one step closer to being able to truly regulate and enforce good practices adjacent to national parks. Hopefully with the timber best practice guidelines, the associated CST, and Gabon's commitment to balancing conservation with economic development, Gabon's national parks will remain intact for years to come.

The timber best practice guidelines were assembled through a very extensive and in-depth process, taking into consideration context-specific information in Gabon. However, they are a very useful tool in that they can easily be utilized in neighboring Central African countries, and other regions of the world where selective logging is the norm. While additional best practices may need to be added to the guidelines according to the concerns of the new governing body and country-specific issues, the addition of new best practices is a very simple process. If taken to another country, the associated CST would also need to be altered because new weights

would need to be determined according to the new decision maker's opinions. However, the steps for this process are again very straight-forward. Thus, although the timber best practice guidelines and the associated CST are important tools for Gabon, they are very flexible and can easily be utilized elsewhere to help manage timber operations in buffer zone areas. Thus, if proven robust in managing timber activities in Gabon's park buffer zones, the timber best practice guidelines and CST have the potential to greatly aid conservation managers around the world.

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VIII. Appendix I – Elicitation Process for all Weights

Inventory Process

Scenario	Rank	Points	Weight
No mitigation measures for (1) construction of inventory camps, (2) inappropriate disposal of chemical and trash waste, (3) inappropriate disposal of human waste, (4) hunting by inventory teams, (5) use of inventory camps by poachers.	6	0	N/A
Only mitigation for construction of inventory camps.	4	40	0.13
Only mitigation for inappropriate disposal of chemical and trash waste.	3	50	0.16
Only mitigation for inappropriate disposal of human waste.	5	30	0.09
Only mitigation for hunting by inventory teams.	1	100	0.31
Only mitigation for use of inventory camps by poachers.	2	99	0.31

Total Points = 319

Laterite Quarries

Scenario	Rank	Points	Weight
No mitigation measures for (1) clearing of vegetation for laterite quarry construction (2) impairment of re-establishment of vegetation due to quarry construction (3) quarry construction near water (4) vehicle refueling, generation of waste from vehicles, and accidental oil spills.	5	0	N/A
Only mitigation for clearing of vegetation.	3	70	0.23
Only mitigation for impairment of re-establishment of vegetation.	4	50	0.17
Only mitigation for quarry construction near water	1	100	0.33
Only mitigation for vehicle refueling, generation of waste from vehicles, and accidental oil spills.	2	80	0.27

Total = 300

Temporary Road Construction and Use

Scenario	Rank	Points	Weight
No mitigation measures for any activity.	11	0	N/A
Only mitigation measures for clearing of vegetation along and adjacent to roads.	5	95	0.1709
Only mitigation measures for the construction and use of roads, causing erosion into waterways.	2	99	0.1781
Only mitigation measures for the construction and use of bridges on roads, causing erosion into waterways.	3	98	0.1763
Only mitigation measures for the removal of the canopy over roads, impacting the natural movements of arboreal species or increasing water temperatures disturbing aquatic life.	8	15	0.0270
Only mitigation measures for soil compaction (inhibiting regeneration) due to frequent vehicle passage on roads.	6	21	0.0378
Only mitigation measures for mistakenly building roads in areas meant to be set aside as protected areas.	4	97	0.1745

Only mitigation measures for accidental vehicle oil spills during vehicle refueling and usage.	9	10	0.0180
Only mitigation measures for gas exhaust and dust caused by vehicle movement on roads.	10	1	0.0018
Only mitigation measures for reckless driving, resulting in wildlife deaths.	7	20	0.0360
Only mitigation measures for migration of people into newly made road networks, causing deforestation, increased hunting pressure, etc.	1	100	0.1799

Total = 556

Harvesting

Scenario	Rank	Points	Weight
No mitigation measures for any activity.	6	0	N/A
Only mitigation measures for damage to the surrounding forest by impacting trees not destined for harvest.	4	80	0.19
Only mitigation measures for high logging intensity/impaired regeneration.	1	100	0.24
Only mitigation measures for logging near water - water pollution from erosion.	2	98	0.24
Only mitigation measures for trees that fall into waterways, damming waterways.	3	96	0.23
Only mitigation measures for re-filling chain-saw oil cans.	5	40	0.10

Total = 414

Skidding

Scenario	Rank	Points	Weight
No mitigation measures for any activity.	7	0	N/A
Only mitigation measures for unnecessary damage to the surrounding forest.	2	99	0.2788
Only mitigation measures for soil compaction (inhibiting regeneration) from skidding too intensely.	1	100	0.2817
Only mitigation measures for constructing and utilizing skid trails, causing erosion into waterways.	3	80	0.2254
Only mitigation measures for constructing and utilizing bridges on skid trails, causing soil erosion into waterways.	4	70	0.1972
Only mitigation measures for the removal of the canopy over skid trails, impacting the natural movements of arboreal species or increasing water temperatures disturbing aquatic life.	6	1	0.0028
Only mitigation measures for accidental vehicle oil spills during vehicle refueling and usage.	5	5	0.0141

Total = 355

Landing Sites

Scenario	Rank	Points	Weight
No mitigation measures for any activity.	3	0	N/A
Only mitigation measures for prohibited clearing areas adjacent to roads.	1	100	0.67
Only mitigation measures for controlling the use of pesticides and for cleaning up pesticide spills.	2	50	0.33

Total = 150

Base Camps

Scenario	Rank	Points	Weight
No mitigation measures for any activity.	4	0	N/A
Only mitigation measures for population growth in base camps, which can lead to increased hunting.	1	100	0.34
Only mitigation measures for hunting.	2	99	0.34
Only mitigation measures for deforestation.	3	95	0.32

Hunting

Scenario	Rank	Points	Weight
No mitigation measures for any activity.	3	0	N/A
Only mitigation measures for illegal hunting by timber company employees.	1	100	0.54
Only mitigation measures for hunting by villagers who lived in the area prior to the timber company's establishment.	2	85	0.46

Timber Activities

Scenario	Rank	Points	Weight
No mitigation measures for any activity.	9	0	N/A
Only mitigation measures for impacts that occur during the Inventory process.	4	90	0.13
Only mitigation measures for impacts that occur within Laterite Quarries.	8	60	0.09
Only mitigation measures for impacts that occur during the Temporary Road Construction and Use process.	3	98	0.14
Only mitigation measures for impacts that occur during the Harvesting process.	5	89	0.13
Only mitigation measures for impacts that occur during the Skidding process.	7	65	0.10
Only mitigation measures for impacts on Landing Sites.	6	75	0.11
Only mitigation measures for impacts that occur in Base Camps.	2	99	0.15
Only mitigation measures for Hunting (excluding hunting during the Inventory process and in Base Camps).	1	100	0.15

Total = 676

IX. Appendix II – Environmental Impact Rating Scheme

Formula: $F * [(D+A+I+R)/4]$

Frequency of the Source Causing the Impact/of the Impact (F)

- 1 0-1 occurrences per year/instances within a concession
- 2 2-24(once in a while - twice a month) occurrences per year/instances within a concession
- 3 25-52(2-4 times a month) occurrences per year/instances within a concession
- 4 53-182(4 times a month – half a year) occurrences per year/instances within a concession
- 5 Daily occurrence/more than 182 instances within a concession

Duration of the Source Causing the Impact (D)

- 1 Duration of < 1 day
- 2 Duration of $1 \text{ day} \leq X < 1 \text{ month}$
- 3 Duration of $1 \text{ month} \leq X < 1 \text{ year}$
- 4 Duration of $1 \text{ year} \leq X < 50 \text{ years}$
- 5 Duration of $> 50 \text{ years}$

Area Impacted (A)

- 1 0-20% of concession.
- 2 20.1-40% of concession.
- 3 40.1-60% of concession.
- 4 60.1-80% of concession.
- 5 80.1-100% of concession.

Intensity: How Reversible the Impact Is (I)

- 1 No noticeable changes to the forest flora, fauna, water, soil, air, or landscape.
- 2 Slight changes to the forest flora, fauna, water, soil, or landscape that will return to 100% of their original state through natural processes.
- 3 Changes caused by the impact large enough that mitigation measures in addition to natural processes are needed to correct the impact, and that will return the forest flora, fauna, water, soil, or landscape to 100% of their original state.
- 4 Changes caused by the impact so large that natural processes or mitigation measures can only return the forest flora, fauna, water, soil, or landscape to between $50\% \leq X < 100\%$ of their original state.
- 5 Changes caused by the impact very large, so that natural processes or mitigation measures can only return the forest flora, fauna, water, soil, or the landscape to between $0 \leq X < 50\%$ of their original state.

Reversibility Time of the Impact (R)

- 1 Impact reversible < 1 day.
- 2 Impact reversible $1 \text{ day} \leq X < 20 \text{ years}$
- 3 Impact reversible $20 \text{ years} \leq X < 50 \text{ years}$
- 4 Impact reversible $50 \text{ years} \leq X < 100 \text{ years}$
- 5 Impact reversible $\geq 100 \text{ years}$ or irreversible

X. Appendix III – Environmental Impact Scores for all Impact Sources

Inventory Process

Disturbance to regeneration by cutting tree saplings to construct inventory camps.	
I - 1	
A - 1	
D - 1	
R - 2	
F - 2	
	Score = 2.5
Pollution of soil and water from trash/chemical waste in inventory camps.	
I - 1	
A - 1	
D - 3	
R - 2	
F - 2	
	Score = 3.5
Spread of disease to primate species from humans and human waste.	
I - 4	
A - 1	
D - 3	
R - 5	
F - 2	
	Score = 6.5
Disturbance of rare, threatened, or endangered species populations from inventory personnel who hunt or trap wildlife.	
I - 5	
A - 5	
D - 3	
R - 5	
F - 4	
	Score = 18
Disturbance of rare, threatened, or endangered species populations from use of inventory camps by elephant poachers.	
I - 5	
A - 5	
D - 5	
R - 5	
F - 2	
	Score = 25

Laterite Quarries

Clearing of vegetation for laterite quarry construction.	
I - 3	
A - 1	
D - 1	
R - 5	
F - 2	
	Score = 5
Laterite quarry use leading to compaction and impaired regeneration.	
I - 5	
A - 1	
D - 2	
R - 5	
F - 5	
	Score = 17.5
Pollution of water from soil erosion from quarry construction/existence near water.	
I - 3	
A - 1	
D - 5	
R - 2	
F - 2	
	Score = 5.5
Pollution of water or soil from vehicle oil spills.	
I - 3	
A - 1	
D - 1	
R - 3	
F - 3	
	Score = 6.75

Temporary Road Construction and Use

Destruction of vegetation along and adjacent to roads.
I - 2
A - 1
D - 3
R - 5
F - 2
Score = 5.5
Pollution of water from soil erosion, resulting in disturbances in aquatic life.
I - 3
A - 3
D - 5
R - 2
F - 5
Score = 16.25
Inability of primate species to conduct arboreal movements across roads.
I - 3
A - 1
D - 5
R - 1
F - 2
Score = 5
Soil compaction by road usage.
I - 2
A - 1
D - 5
R - 2
F - 5
Score = 13
Road construction in areas set aside for protection for environmental reasons.
I - 5
A - 1
D - 3
R - 5
F - 2
Score = 7
Pollution of soil or water from vehicle oil spills.
I - 3
A - 1
D - 1
R - 3
F - 3
Score = 6.75
Air pollution from dust and gas exhaust from vehicles on roads.
I - 1

A - 1
D - 1
R - 1
F - 5
Score = 5
Death of rare, threatened, or endangered species from vehicle movement.
I - 5
A - 1
D - 1
R - 5
F - 2
Score = 6
Illegal felling, increased hunting pressure, and clearing of the forest for homes and agriculture from newly immigrated people.
I - 5
A - 5
D - 5
R - 5
F - 5
Score = 25

Harvesting

Damage to the surrounding forest by impacting trees not destined for harvest.
I – 2
A – 5
D – 1
R – 5
F – 5
Score = 16.25
Regeneration of the forest is impaired due to high logging intensities.
I – 5
A – 5
D – 1
R – 5
F – 5
Score = 20
Pollution of water from soil erosion, leading to disturbances in aquatic life.
I – 3
A – 5
D – 1
R – 2
F – 5
Score = 13.75
Damming of waterways from fallen trees, leading to disturbances in aquatic life.
I – 3
A – 1
D – 1
R – 1
F – 5
Score = 7.5
Pollution of soil or water from spilled chainsaw oil.
I – 1
A – 1
D – 1
R – 1
F – 4
Score = 4

Skidding

Unnecessary damage to the surrounding forest through skidding.
I - 2
A - 5
D - 1
R - 5
F - 5
Score = 16.25
Repeated vehicle movement on primary skid trails causing soil compaction/barriers to regeneration.
I - 2
A - 5
D - 2
R - 2
F - 5
Score = 13.75
Skid trail design, construction, use, and continued existence leading to erosion pollution into waterways.
I - 3
A - 5
D - 5
R - 2
F - 5
Score = 18.75
Removing canopy bridges over water crossings, increasing water temperatures and preventing arboreal species movements.
I - 3
A - 1
D - 5
R - 1
F - 2
Score = 5
Pollution of soil or water from vehicle oil spills.
I - 3
A - 1
D - 1
R - 3
F - 3
Score = 6.75

Landing Sites

Construction and use of landing sites, clearing vegetation, compacting soil, disturbing wildlife, potentially polluting waterways, and preventing regeneration.
I - 5
A - 1
D - 5
R - 5
F - 5
Score = 20
Usage and accidental spills of pesticides polluting soil and water.
I - 3
A - 1
D - 1
R - 2
F - 4
Score = 7

Base Camps

Population growth leading to increased hunting pressure on wildlife.
I - 5
A - 2
D - 5
R - 5
F - 5
Score = 21.25
Illegal or inappropriate hunting, trapping, of wildlife destroying rare, threatened, or endangered wildlife.
I - 5
A - 2
D - 5
R - 5
F - 5
Score = 21.25
Expansion of agriculture, building of homes, etc. leading to deforestation.
I - 5
A - 1
D - 5
R - 5
F - 5
Score = 20

Hunting

Illegal or inappropriate hunting/trapping by timber concession employees throughout the various timber activities in a concession.
I - 5
A - 5
D - 5
R - 5
F - 5
Score = 25
Hunting/trapping by pre-existing local villagers in a concession.
I - 5
A - 1
D - 5
R - 5
F - 5
Score = 20