L'Okoumé, fils du manioc : Post-logging in remote rural forest areas of Gabon and its long-term impacts on development and the environment.

Olivier Hymas

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"We do need time to think. We do need time to digest. We do need time to misunderstand each other, especially when fostering lost dialogue between humanities and natural sciences. We cannot continuously tell you what our science means; what it will be good for; because we simply don't know yet. Science needs time. —*Bear with us, while we think*"

(The Slow Science Academy, 2010)

"Theory helps us to bear our ignorance of facts"

(Santayana, 1896, p.125)

"On the Shoulders of Giants"

(Merton, 1993)

"I, [Olivier Hymas,] confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis" (UCL, 2015).

Signed:____

Abstract

Development and conservation theory use a chain of logic to suggest that timber industries bring long-term development to rural areas at the expense of the environment. This logic chain assumes that the arrival of industry and their transport infrastructure in an un-exploited area creates employment opportunities that result in economic development which attracts migrants and the commodification of agricultural and forest products.

However, this chain does not factor in historic natural resource exploitation before the arrival of timber companies, nor what occurs after their departure. This thesis proposes an alternative chain of logic which incorporates these two. By using historic literature, social and ecological methods, this alternative is explored in Gabon, where 60% of roads are logging roads and 44% of its forests are timber concessions.

The long history of exploitation of natural resources has resulted in the local extinction of species which have then recovered, while any resulting development has been one of booms and busts. Two sets of sites, where transport infrastructure had been created by timber companies, demonstrate the repercussions of the departure of companies. Only in the less remote sites was it found that commercial bushmeat hunting occurred. In the remote sites transport infrastructure had collapsed, livelihoods had reverted to subsistence activities, migrants had left, while education levels were worse. In one remote village animal signs were higher than in a remote village that had never been logged. These findings correspond with Von Thünen's classic theory on land use and access.

By overlooking the drawbacks of the accepted chain of logic, misleading blanket assumptions have been created. This can contribute to project failure. Assumption drag has been created not only due to a lack of a multidisciplinary approach but also because research is usually only carried out while timber operations are occurring.

Acknowledgement

For all the “monomaniacs” (Wadham, 2013, p.132).

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Now pass me the palm wine and palm grubs.

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Preamble

As the father of economics, Adam Smith has had a large influence on our current understanding of the world. This study is both social and ecological, and tries not only to use but to integrate those two approaches. The backbone of the work has its origins in economics.

As neither I, nor the intended audience, are likely to be versed in the writings of Adam Smith, I use brief extracts from his influential 1776 book "An Inquiry into the Nature and Causes of the Wealth of Nations" as a preamble to this study.

For Adam Smith, and the economists that followed him, the livelihoods chosen by rational people who rely on the environment are based on strategies that would best contribute to their survival as well as that of those who are close to them:

> [a]mong the savage nations of hunters and fishers, every individual who is able to work, is more or less employed in useful labour, and endeavours to provide, as well as he can, the necessaries and conveniences of life, for himself, or such of his family or tribe as are either too old, or too young, or too infirm to go a hunting and fishing (Smith, 1981, p.10)

They do so by using the environment in different ways to fulfil their current needs, for:

> [i]n that rude state of society [...] in which every man provides everything for himself [...] Every man endeavours to supply by his own industry his own occasional wants as they occur. When he is hungry, he goes to the forest to hunt; when his coat is worn out, he clothes himself with the skin of the first large animal he kills: and when his hut begins to go to ruin, he repairs it, as well as he can, with the trees and the turf that are nearest it (Smith, 1981, p.276).

In such precarious situations wealth can only be generated when an individual:

> possesses stock sufficient to maintain him for months or years, he naturally endeavours to derive a revenue from the greater part of it; reserving only so much for his immediate consumption as may maintain him till this revenue begins to come in (Smith, 1981, p.279).

Such a state of affairs can only occur if people have a market in which to sell the stocks that they have, for:

> [w]hen the market is very small, no person can have any encouragement to dedicate himself entirely to one employment, for want of the power to exchange all that surplus part of the produce of his own labour, which is over and above his own consumption, for such parts of the produce of other men's labour as he has occasion for (Smith, 1981, p.31)

It is through supplying of access to markets that the transport infrastructure, created by industries, can contribute to development and so help reduce “that rude state of society” that is poverty.

1 Introduction: isolated states, timber companies and remote rural communities in Gabon

Timber companies in remote rural forest areas are said to contribute to a chain of events leading to development at the expense of the environment (Figure 1-1). At the same time conservation and development practitioners have commonly associated the creation of timber-related transport infrastructure[1] in remote rural forested areas with the opening up of areas to hunting and trade of threatened species (Oates, 1999, p.7) as well as other Non-Timber Forest Products. People who participate in this trade include outsiders. This chain of events (Figure 1-1) has been used by conservation and development practitioners in the creation of initiatives to reduce commercial hunting and environmental degradation while promoting development in areas where timber companies operate.

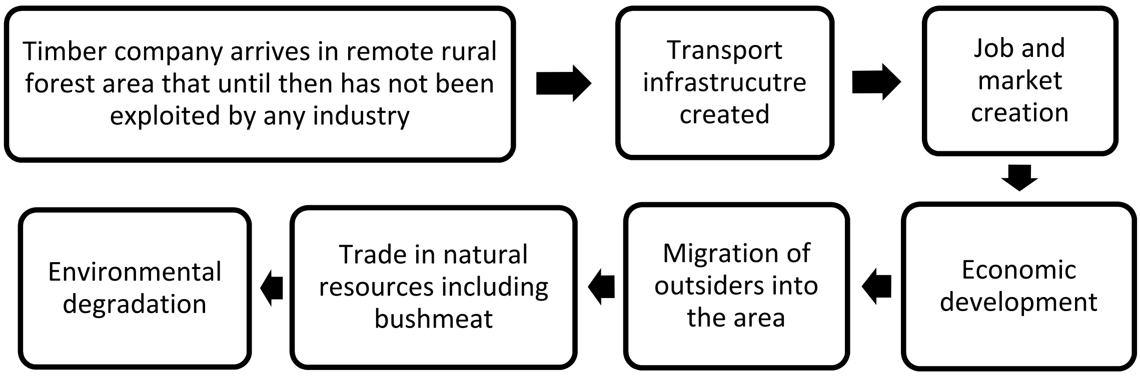

Figure 1-1: The typical chain of logic that conservation practitioners use to plan projects. A conservation project can act at any one of the steps to reduce environmental degradation.

These conservation and development initiatives have focused their interventions on actors from various parts of this chain, with the overall objective of reducing environmental degradation. Conservation projects have been created that focus on timber companies such as projects that help in the planning of transport infrastructure in reduced impact logging projects or in the education of timber companies' employees on hunting laws. Other conservation projects have intervened at the community level with projects designed to help in the creation of economies that are sustainable such as Integrated Conservation and Development Projects and alternative livelihoods.

[1] The term "transport infrastructure" will usually be used throughout this thesis instead of roads, for it includes infrastructure such as bridges, culverts and ferries, which are just as important as the roads between them.

However, this chain of logic assumes that without intervention the arrival of timber companies in remote rural forest areas always results in the continued exploitation of natural resources and development with resulting environmental degradation. When faced with such situations conservation and development practitioners rarely explore alternative theories (Weiss, 1995, p.67) or other possible outcomes to the arrival of a timber company in a remote rural forested area. At a time when the success of alternative livelihood projects and their ilk is being questioned (Roe *et al.*, 2014) it is useful to re-examine this chain of logic.

I propose that the chain of events suggested by conservation development practitioners (Figure 1-1) is only part of the story, and that it is compromised by two omissions. Though the catalyst of this chain of events may sometimes be the arrival of timber companies, this cannot always be assumed to be the case, for the arrival of timber companies may in itself be the result of previous land use which has led to the growth of tree species that are of interest to timber companies. The inclusion of previous land use (Figure 1-2) forms the basis of my first amendment to the original chain of logic (Figure 1-1). The second amendment to the original chain of logic is to include the eventual departure of timber companies (Figure 1-2), for though there has been ecological research on ecosystems after timber companies depart, similar research has not been undertaken on either development of communities or the trade in wildlife after the departure of timber companies, with current knowledge mostly based on research carried out while timber operations were taking place (see Chapter 1.2.7 and Appendix 11.1).

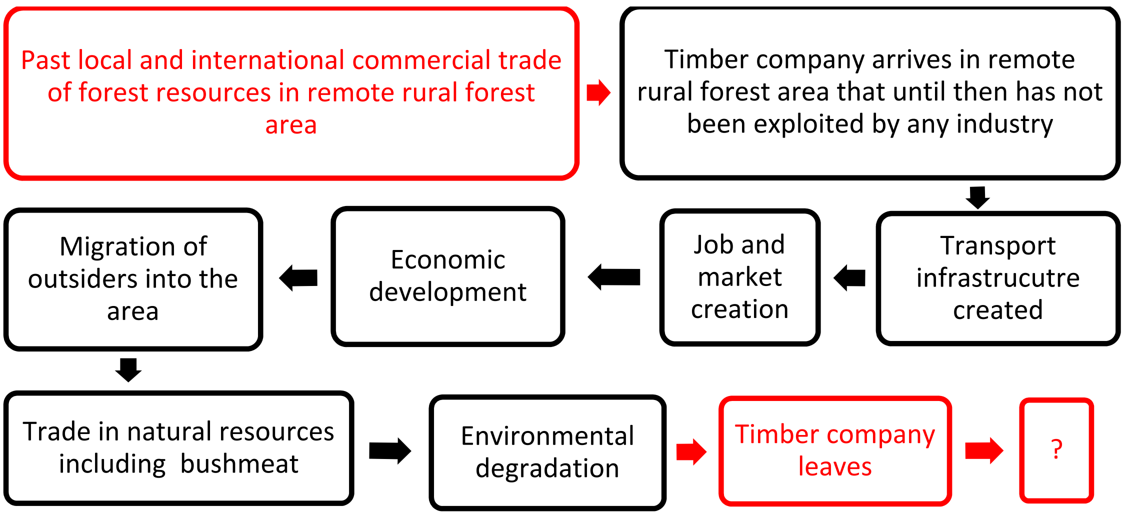

Figure 1-2: The omissions (in red) in the chain of logic used by conservation practitioners to the arrival of timber companies in remote rural forested areas.

The first amendment has mostly been dealt by the likes of Leach and Mearns (1996b) and Fairhead and Leach (1998) who have shown that most forested areas in Africa have been used at one time or another by local people. Though this is sometimes acknowledged by conservation practitioners this thesis shows that African landscapes have also been impacted by centuries of international commercial exploitation of natural resources, which started to influence the African landscapes from at least the 1400s. The past human use, either by local people or by industries, can lead, through succession, to a forest environment that is of commercial interest to the timber industry as well as biodiversity interest to conservationists.

The second amendment, the departure of timber companies, is less understood by conservation and development practitioners. Though there has been research on both the short-term and long-term impacts of timber companies on tree and animal species, the research on the impact of timber companies on livelihoods and the trade of natural resources, especially of the bushmeat trade, is mostly based on studies carried out while timber operations are occurring (Chapter 1.2.7 and Appendix 11.1). This makes it difficult to predict the long-term post-departure impacts of timber companies on either the economies of rural communities or on the trade in natural resources by these communities.

In this thesis it is proposed that the increase in development and market economy at the expense of the environment that arises with the arrival of timber companies and their transport infrastructure in remote rural communities is unlikely to continue when timber companies depart remote rural forested areas. For, as observed by economists, geographers and developers, transport infrastructure alone does not equate to long-term development. The assumption by conservation practitioners that it does has created “assumption drag”, whereby scientific research is persistently compromised by outdated core assumptions. In this case, the assumption that transport infrastructure equates to development invalidates the chain of logic that they use (Figure 1-1) and in turn undermines any conservation project based on it. This is especially the case for remote rural forested areas of a rentier state (Yates, 1996) such as Gabon displaying the following characteristics: no land shortage, the main economic activity is not logging or agriculture, and clear felling is not carried out.

This thesis proposes an alternative chain of logic (Figure 1-3) to the one used by conservation practitioners (Figure 1-1). This alternative takes on board and extends the findings of economists, geographers and developers on transport infrastructure as well as historical use of landscapes.

This proposed chain of logic (Figure 1-3) is principally investigated through the implications of departure of timber companies on various communities in remote rural forested areas of central Gabon and how this impacts transport infrastructure, education, employment and livelihood activities (particularly the commercial trade of wildlife in the form of bushmeat, rather than the “wild meat” that is consumed locally (Mack and West, 2005, p.5)), as well as ecological impacts.

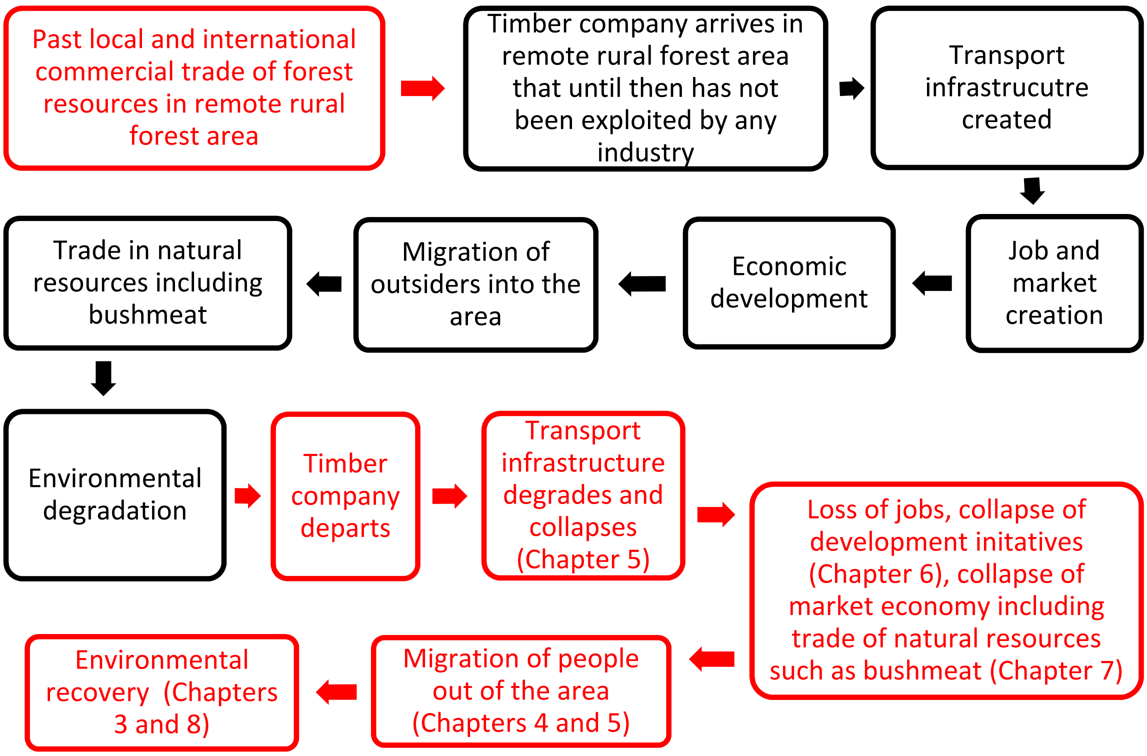

Figure 1-3: Proposed chain of logic (in red) added to the typical chain of logic (in black) to the arrival of timber companies in remote rural forested areas, numbers correspond to events described below. Note The migration of people out of the area can occur at any time after the timber company departs.

Based on the findings of economists, geographers and developers on transport infrastructure it is proposed that distance from markets is more important in the long-term development and environment of communities in remote rural forested areas than the presence of a timber company. Any economic and market development that occurs while a timber company is present in such areas is negated once they depart. This is because the transport infrastructure that was created starts to collapse with the departure of timber companies unless it is take over by the state. This in turn causes a change in the spatial relationship between transport infrastructure and market access which can result in the collapse of development and the trade in natural resources if the nearest market town is so remote that communities effectively become "Isolated" from the market economy. If this is the case then conservation projects that try to alleviate poverty and environmental degradation through the sustainable commodification of natural resources are unlikely to succeed in the long-term. Furthermore, with the departure of timber companies environmental degradation is reduced which can lead to environmental recovery (Figure 1-3). So though there may be short-term environmental degradation while a timber company is present, the long-term impact on the Gabonese landscape creates a patch dynamic successional landscape, whereby the constituent parts of the landscape have undergone different disturbance regimes at various times with the potential for regeneration and recolonization that such patchiness holds.

In this thesis the proposed chain of events that occurs after the departure of timber companies from a remote rural forest area (Figure 1-3) is investigated on the basis that their departure results in the degradation of transport infrastructure which in turn leads to:

1. the reversal of the migration of people, with departure of in-migrants who were attracted to the area by the timber company, while some of the original population stays (investigated in Chapters 4 and 5),
2. increased transport costs (investigated in Chapter 5),
3. reduced access to education facilities and employment (investigated in Chapter 6), while the commodification of activities comes to a halt and becomes re-focused on subsistence activities (investigated in Chapter 7),
4. forest recovery, as logging and other economic activities have come to a stop, and the forest landscape is released from disturbance, succession starts and species populations recover even though subsistence hunting may continue (investigated in Chapter 8).

1.1 Overview of chapter

The remainder of this chapter is a literature review that forms the framework for the proposed chain of events after a timber company leaves a remote rural forest area (Figure 1-3). The chapter starts off with a summary of assumption drag (Chapter 1.2.1) and then gives the theoretical background to transport and markets (Chapter 1.2.2) which shows how the literature on transport and markets has changed over time (Chapter 1.2.3). It continues with an outline of how this theory and literature can be applied to the impacts that the arrival and subsequent departure of timber companies can have on development and local economies (Chapter 1.2.4). The framework continues with literature on the effects of the arrival of timber companies on the environment (Chapter 1.2.5) and also of environmental changes that occur after timber companies depart, through the theory of patch dynamics (Chapter 1.2.6). This literature review finishes with the aims and structure of this thesis.

1.2 Literature review

1.2.1 Assumption drag

> "The specialist knows more and more about less and less and finally knows everything about nothing" attributed to Lorenz,
>
> "avoid the corollary of Lorenz's dictum: that generalists … know nothing about everything" (Fisher, 2004, p.363).

Assumptions based on generalisations from the rest of Africa, and elsewhere, may have led to the chain of logic used by conservation practitioners (Figure 1-1) when addressing the impacts of the timber industry in Gabon, especially in the long-term. This has led to environmental policies that could be detrimental to the current and future management of the Gabonese environment and its species (Engone Obiang *et al.*, 2014; Leach and Mearns, 1996b).

"Assumption drag" (Ascher, 1979; Brysse *et al.*, 2013; Keilman, 1998; Oppenheimer *et al.*, 2008, p.162) deals with how scientific research can be compromised by bad information, with assumption drag occurring when outdated or inappropriately extrapolated core assumptions are persistently used in theories, such as the use of assumed but incorrect historic baselines for forest cover (Fairhead and Leach, 1998) and old, inaccurate population statistics (Ascher, 1979; Ascher, 1978)[2]. The unreliability of assumptions is aggravated by time and space, for though some assumptions may be correct at a certain time and place it cannot be assumed to be so at another.

The way in which human activity in tropical forests is observed by outsiders is biased by assumption drag. This should be no surprise given the amount of knowledge, spanning many disciplines, an observer would need to understand fully any landscape being looked at. For though an observer may be well versed in forest ecology they may not be as well versed in other disciplines or other sources of knowledge, such as history, and so are dependent on information from others, with limitations that the observer may not be aware of. These accumulated assumptions can have consequences in the design of projects when integrating ideas from other

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[2] This thesis of course is not immune to such issues.

disciplines, especially as advice from other disciplines is often sought late in the design process, if at all (Campbell, 2005).

An outcome of this specialisation of different "bodies of information" has resulted in heterotopian (Foucault, 1986; Foucault, 1984) (Appendices 11.2 and 11.3) landscapes, whereby experts from different disciplines are able to talk about similar processes that have gone into forming a particular landscape, without understanding each other (Grabbatin and Rossi, 2012)[3].

In the social sciences assumption drag has been written about since the 1970s (Ascher, 1999a; Ascher, 1979; Ascher, 1978), however it has recently found a new audience in the biological sciences due to the debate over climate change where it has been used by the Intergovernmental Panel on Climate Change (IPCC)[4] in an effort to understand some of the misunderstandings in the debate (Oppenheimer *et al.*, 2008; Brysse *et al.*, 2013). Similar assumption drag has also occurred in Gabon, where certain theories based on a postulated chain of events have been questioned (Table 1-1), though this does not mean that these theories are not applicable elsewhere.

Though some assumption drag can be rectified by getting the most up to date information, it is not possible to remove all assumptions, either because no data exist for a specific geographical area or time, or because of limited knowledge of ground-breaking research in other disciplines. This is especially difficult due to the ever-increasing number of publications and reports in one's own discipline for

> the balance of expertise continues to tilt in the direction of the experts – the increasing specialization of the modernizing intellectual reduces the non-specialist's capacity to judge the validity and implications of experts' methods (Ascher and Steelman, 2006, p.87).

[3] As an example of the heterotopian view that a landscape can have is the way the same landscape can be seen differently by a biogeographer, cultural geographer or political ecologist see Appendix 11.2.

[4] Throughout this thesis I have resisted the attempt to use acronyms, the exception to this is for names of companies and equipment, such as GPSs, that are more well known by their acronyms. In 200 Galen wrote "the chief merit of language is clearness, and we know that nothing detracts so much from this as do unfamiliar terms; accordingly we employ those terms which the bulk of people are accustomed to use …" (Galen and Brock, 1916, p.4). Though acronyms can make certain documents easier to read (Fred and Cheng, 2003) they can also "burden the reader" (Grange and Bloom, 2000, p.4), especially as their use is growing exponentially (Fred and Cheng, 2003). For people of other disciplines this makes documents harder to read. Furthermore, an acronym from one discipline may have a different meaning in another. In a text that is to be read by people from multiple disciplines it is important to reduce distractions and confusion that can be caused by acronyms. For example according to the acronym finder the abbreviation PA can have 258 meanings, none of which includes Protected Areas (Acronym Finder, 2015).

Furthermore, to check all the assumptions behind an initiative would require significant resources, both monetary and time, which are not available in crisis-driven conservation or development.

Author	Assumed chain of logic as seen in the paper			But research in Gabon shows	Some confounding factors to assumption
Schmidt-Soltau (2009)	Creation of National Park	Access to natural resources by local people is reduced	Poverty increases	Foerster, *et al*. (2012) found no wealth differences between remote villages next to a park and similar ones that are not.	Poverty can be due to a variety of reasons. Understanding these reasons is hindered by the movement of people.
Brown and Williams (2003)	Regulated bushmeat trade	Sustainable hunting and trade of bushmeat	Increased wealth of households with hunters	Coad, *et al*. (2010) found that half of the income that men gained was spent on alcohol and cigarettes, while women purchased food.	People in a community are impacted by and react differently to regulations and wealth.
Nasi, *et al*. (2008)	Reduced barriers to legal gun hunting	Increased bushmeat trade	Increased revenue for the state through taxes	Wilkie, *et al*. (2006) found that the costs of enforcing hunting regulations outweigh any income that the state could earn through the bushmeat trade.	Collection of taxes is dependent on ease of access to the tax payer.
(CARPE, 2006, p.173)	Frequent anthropo-genic Savannah fire	Loss of trees	Loss of biodiversity	Walters (2012; 2010) found that in plateaux Batéké frequent burning of the savannah results in more trees and biodiversity.	Some biodiversity is dependent on anthropogenic disturbances.
(CARPE, 2006, p.145)	Frequent savannah fire	Degraded plant cover	Increased threat to forest	Jeffery, *et al*. (2014) found that there is forest expansion occurring in Lopé National Park, even though fire is used as a management tool to supress it.	Ecosystems react differently to anthropogenic disturbance.

Table 1-1: Examples of assumed chain of logic for some theoretical papers which have been put into question by research in Gabon.

This situation is further aggravated when assumptions are borrowed from a single parallel discipline in isolation from others (Ascher, 1979, p.149; Balmford and Cowling, 2006). Though using assumptions from one discipline may be quicker when designing conservation initiatives it runs contrary to the multidisciplinary nature of conservation and conservation biology which stipulates that interdisciplinary collaboration is needed (Clark *et al.*, 2011a; Clark *et al.*, 2011b; Drury *et al.*, 2011; Ehrenfeld, 1987; Fox *et al.*, 2006; Lowe *et al.*, 2013; Lowe *et al.*, 2009; Mermet *et al.*, 2013; Newing, 2010; Phillipson *et al.*, 2009; Pooley, 2013; Pooley *et al.*, 2014; Schultz, 2011; Soulé, 1985; Szabó and Hédl, 2011; Szabó, 2010). However, even in an interdisciplinary approach, reality has to be restricted, for it is not possible to cover everything (Gluckman, 2007). Sooner or later it has to be accepted that we have to be naïve in certain aspects of an interdisciplinary approach, which reduces how far generalisations can go (Devons and Gluckman, 2007).

1.2.2 Von Thünen's spatial analysis of tradable resources

Assumption drag is present in the way conservation and development practitioners think about the impacts of timber companies on communities in remote rural forest areas, whereby "the development of roads and road networks is strongly correlated with economic growth and national wealth" (Wilkie *et al.*, 2000, p.1615), even though economists and geographers have been questioning this correlation since at least the 1970s (Barwell *et al.*, 1985; Barwell, 1996; Bryceson *et al.*, 2008; Bryceson and Howe, 1993; Creightney, 1993; Edmonds, 1982).

From the debate among conservationists and developers on logging roads it is apparent that some researchers in both fields find that spatial analysis, with its origins in the work of von Thünen, is important. The following section gives a brief overview of the origins of spatial analysis to highlight how the original model by von Thünen is still relevant to the communities in remote rural forested areas of Africa and particularly when looking at the impacts of transport infrastructure created by timber companies. However, it also needs to be recognised that the spatial analysis of the impacts of logging roads on economies is not "static" (Lambin, 1994, p.76), and thus von Thünen's model may not always be relevant, especially in areas where transport costs are minimal and do not have an impact on local economies (Lambin, 1994, pp.77–78).

Research on transport infrastructure, economies and land use by trade economists and geographers was transformed in 1826 with von Thünen's "seminal" (Angelsen, 2007, p.4; Mäki, 2004, p.1719) theory on market access and agricultural land use which laid out "the foundation of land use theory" (Fujita and Krugman, 1995, p.506). Though von Thünen's theory has been much expanded upon, his basic approach can still be valid today, especially in some African countries, as the underlying assumptions about the economics of trade are still relevant. These assumptions, summarised by von Thünen, are that:

> near the Town will be grown those products which are heavy or bulky in relation to their value and hence so expensive to transport that the remoter districts are unable to supply them. Here too we shall find the highly perishable products, which must be used very quickly. With increasing distance from the Town, the land will progressively be given up to products cheap to transport in relation to their value (von Thünen, 1966, p.8) (bottom right of Figure 1-4)[5].

Von Thünen applied Adam Smith's ideas to agriculture. His approach was based on the "analyses [of] economic rent and agriculture as a function of the distance to the market" (Lambin, 1994, p.75). By having markets as one of the key components to land rent, he realised that certain farm products would no longer be economical to trade at a certain distance from a market. At such distances the rational farmer should not spend time and effort trying to trade such products. It follows that this should also be true for commercialised products that are collected from forest environments such as Non Timber Forest Products.

This land rent approach originated at a time when the majority of tradable items were transported over land by horse power (Clark, 1967), or waterways. The transport of products to a town could therefore take several days. This state of affairs stands in sharp contrast to today, where, in the "western world", people are used to the possibility of next day delivery to "locations worldwide" (DHL, 2013). However in countries such as Gabon, these promised delivery services frequently break down. In such countries transport infrastructure is in such a poor state that it can sometimes take a day in a car to travel a few hundred kilometres, even when roads are available (Foster and Briceño-Garmendia, 2010; Megevand and World Bank, 2013, pp.90–92; Pourtier, 1984). It is in these circumstances that von Thünen's land rent approach becomes once more relevant.

The theory that von Thünen put forward demonstrated how land around a town would be used rationally, so as to maximise its value. He concluded that:

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[5] This model continues to be used in standard textbooks and has produced a large literature, as well as variations that are still used by economic geographers and geographical economists (Mäki, 2011). It has also been used by ecologists to predict deforestation (Ahrends *et al.*, 2010; Angelsen, 2007; Chomitz, 2007).

> fairly sharply differentiated concentric rings or belts will form around the Town, each with its own particular staple product. From ring to ring the staple product, and with it the entire farming system, will change; and in the various rings we shall find completely different farming systems (von Thünen, 1966, p.4) (bottom right of Figure 1-4).

Today variations of this simplified model (Figure 1-4) have been shown to be applicable in numerous examples of how transport infrastructure is associated with market access and trade in agricultural crops (Angelsen, 1997; Barwell, 1996; Howe and Richards, 1984; von Thünen, 1966). Recently this has been expanded to also cover the trade in bushmeat and other Non-Timber Forest Products (Auzel and Wilkie, 2000; Cowlishaw *et al.*, 2005b; Solly, 2007; Wilkie and Carpenter, 1999; Wilkie *et al.*, 2001; Wilkie *et al.*, 2000; Wilkie *et al.*, 1992).

The traders of Non-Timber Forest Products, such as smoked bushmeat (Auzel and Wilkie, 2000), or sacred and medicinal plants, travel further than agricultural products. This is because Non-Timber Forest Products usually constitute an "easily traded resource as it is transportable, has a high value/weight ratio and is easily preserved at low cost" (Nasi *et al.*, 2008, p.13), as predicted by von Thünen's analysis for one of the outer rings (bottom right in Figure 1-4). An exception to this is for bushmeat in Gabon[6] where fresh meat is both preferred and also harder to transport, requiring traders to find bushmeat nearer to market towns so that it can arrive in the market fresh. Spatial dynamic theory predicts that the bushmeat for trade in Gabon would therefore be supplied from one of von Thünen's inner rings where "highly perishable products, which must be used very quickly" (von Thünen, 1966, p.8) can be found, with the radius of this ring being influenced by transport conditions. If distance to market is of importance to a hunter's decision to participate in the trade of bushmeat, then changes to von Thünen's rings should influence this decision.

[6] Why this preference should be the case in Gabon has yet to be explored. The common assumption, from bushmeat trade studies in dry environments (for example Brown and Marks, 2007), is that smoked meat lasts longer than fresh meat (Brown, 2007; Nasi et al., 2008). This may not apply to humid tropical areas where smoked meat needs to be kept above a kitchen fire, otherwise it quickly deteriorates.

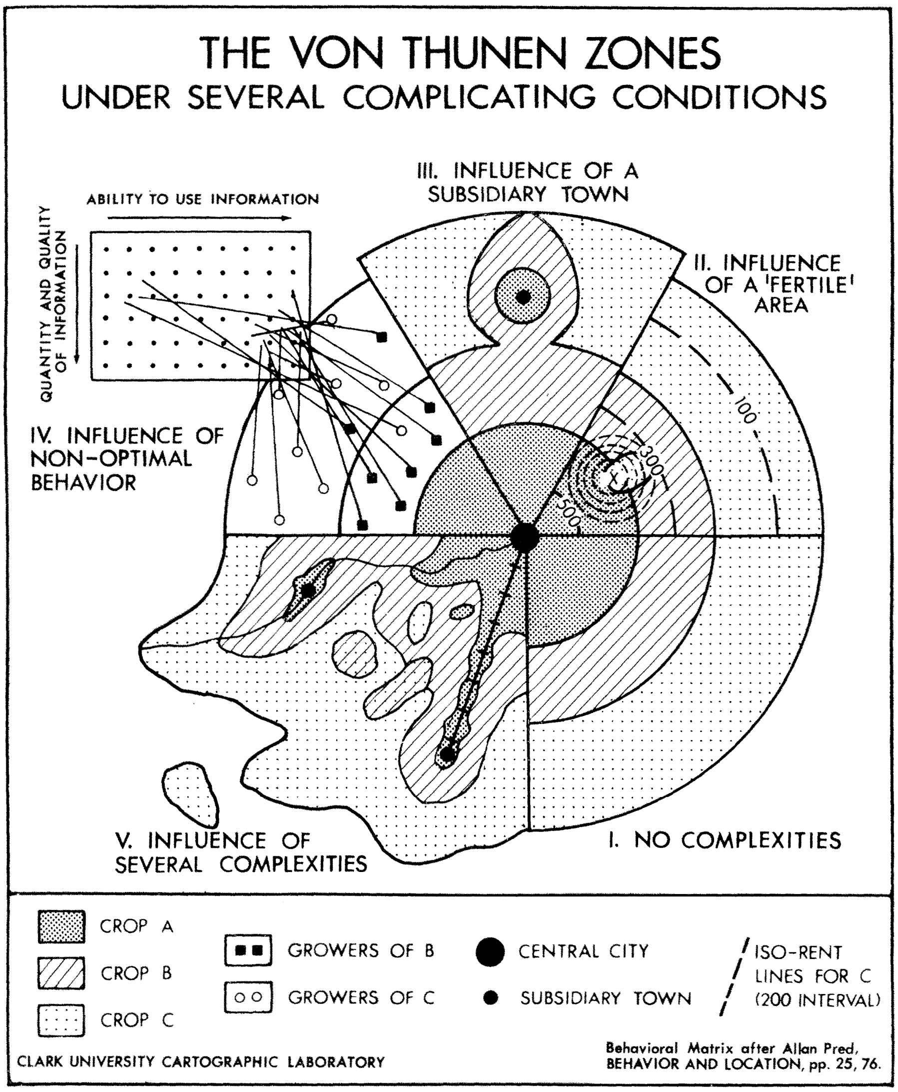

Figure 1-4: Von Thünen's rings under different conditions (from Peet, 1969, p.287; and Mäki, 2011, p.54)

However, the studies that have looked at the impact of transport infrastructure on the commercialisation of forest products have usually been carried out when market access is perceived to be relatively stable, either due to the short lengths of observer time in the field or because the transport infrastructure is still being used and maintained by outside interests such as timber companies, and so any resulting spatial analysis could be perceived to be static. Few studies have looked at how changes in market access due to degradation of transport infrastructure impacts the direct or indirect income from commercialisation of forest products or the commodification of livelihood activities of people in remote rural forest communities. An exception is the model proposed by Ling and Milner-Gulland (2006)[7] and work by Abbot on the sale of natural resources around Lake Malawi National Park (Abbot, 1996, p.158).

[7] They used a bioeconomic approach to look at the sustainability of bushmeat hunting, which incorporated variables such as demand and costs into their models.

It should also be recognised that spatial patterns created by trade and transport routes may not be static but be continually changing due to factors such as changes in technology. This was recognised by von Thünen in his spatial analysis models when he relaxed the parameters[8]. Since then others have also continued to add temporal dimensions to it (Lambin, 1994, p.76). That economic and environmental spatial patterns resulting from the transport infrastructure created by timber companies are not at equilibrium needs to be understood for the long-term success of projects that involve trade and transport, such as alternative livelihood projects, Integrated Conservation and Development Projects, or in understanding the impacts of timber companies on the trade of bushmeat.

The disequilibrium of the spatial patterns associated with transport infrastructure and market access is exemplified by the arrival in a remote rural forested area of timber companies who have an important impact on transport costs and so access to markets. Their arrival can result in a temporary re-configuration of von Thünen's rings to incorporate village communities which were previously unable to trade due to transport costs from the central market "Town" (von Thünen, 1966, p.7). When the timber company departs, and if there are no other reasons for the transport infrastructure to be maintained, the rings collapse back towards the original market "Town". Village communities that were once connected to the market town during the presence of the timber company become once more "Isolated" from markets as transport costs increase (Figure 1-5).

This disequilibrium is of concern since it is the stability of access to markets that is supposed to perpetuate the development and commodification of natural resources that is assumed to be initiated by the construction of transport infrastructure in remote rural forested environments (AFD, 2014), including the extraction of bushmeat for trade and other items of conservation concern that are the basis for alternative livelihood projects and Integrated Conservation and Development Projects. If the spatial pattern of transport infrastructure and access to markets undergoes such a major change then projects that are based on helping people living in remote tropical forested environments to increase their income through the commercialisation of forest products are unlikely to work. Adam Smith's and von Thünen's economic rationality (top left of Figure 1-4) suggests that when transport infrastructure becomes degraded, local people's use

[8] The change in spatial structure to market access does not only have to be due to the degradation of transport infrastructure but can also be due to other factors such as increase in number of traffic jams. Such as "go slows" in Lagos, Nigeria.

of the forest shifts from one that was mostly based on commercial use to one that is mostly based on subsistence use.

If this is the case then the pressure on the environment will also change. Furthermore, in Gabon, the fact that urban market preference is for fresh bushmeat rather than smoked means that rapid and reliable access to markets is needed if a villager wants to trade bushmeat in a market. In effect the degradation of transport infrastructure should start off a chain of events that impacts both the environment (such as the regrowth of trees) and the economic trade of Non-Timber Forest Products (like bushmeat). That chain starts with the contraction of von Thünen's rings.

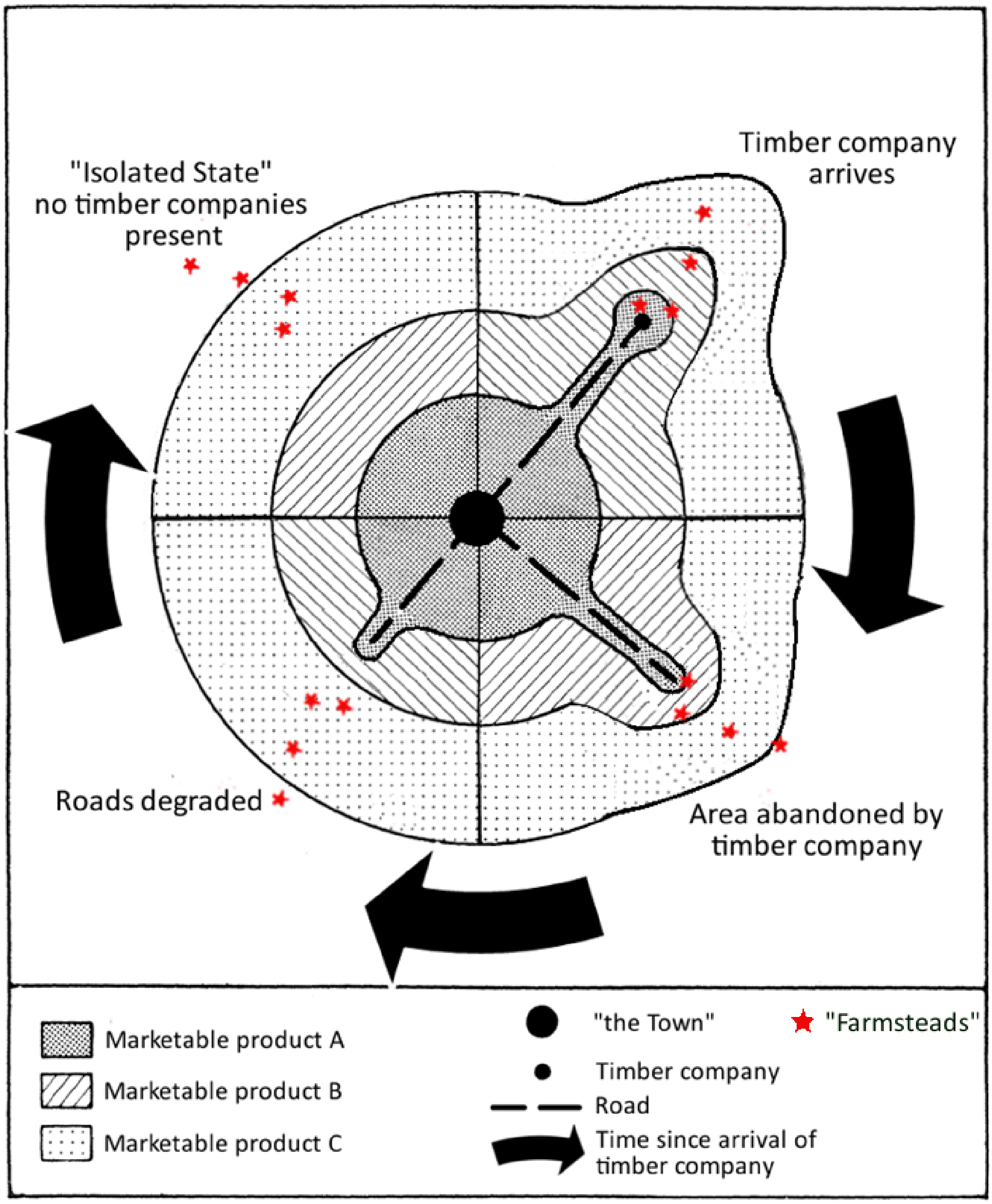

Figure 1-5: Idealised chain of events around a market "Town" when a timber company arrives in an "Isolated State" showing how the land where marketable products are found changes, based on von Thünen's rings, resulting in the marketable products for villages, "farmsteads", changing as roads degrade.

1.2.3 Transport infrastructure and development

Since von Thünen's 1826 seminal work on transport and markets, the impacts of transport infrastructure on the development of economies and land use have had two centuries of academic interest. This research has been conducted by various disciplines, including engineers, geographers, sociologists, economists and ecologists, each with their own voluminous literatures. Roads have been "evaluated from physical, biological, and socioeconomic points of view, often under only one perspective in isolation from the others" (Gucinski *et al.*, 2001, p.1) with different fields, mutual awareness of each other's contributions remaining relatively restricted (Bryceson *et al.*, 2008, p.460). The general thrust of the literature on transport infrastructure by economists and geographers has ranged from authors celebrating the unquestionable benefit of transport infrastructure on economies through market demand models, to those taking a more cautious approach in the 1970s (see Bryceson and Howe, 1993). For the latter, benefits arise only under certain conditions (Barwell, 1996; Bryceson and Howe, 1993; Edmonds, 1998; Van de Walle, 2002) with transport infrastructure having a complex relationship with the economy (Creightney, 1993).

The importance of transport infrastructure to development in colonial Africa was recognised by the colonial powers when Lugard in 1922 remarked that "the material development of Africa may be summed up in the one word 'transport'" (Lugard, 1922, p.5). This theme continued for half a century. Lewis, in 1955, wrote that "a cheap and extensive network of transport and communications … is the greatest blessing that any country can have from the economic point of view" (in Mwase, 1989, p.237). Taaffe *et al*., in 1963, observed that "in the economic growth of underdeveloped countries a critical factor has been the improvement of internal accessibility through the expansion of a transportation network." (Taaffe *et al.*, 1963, p.503). These views resulted in, among others, the World Bank, colonial and post-colonial governments and other donors investing heavily in the construction of major roads in Africa during the 1950s and 1960s and then rural roads in the 1970s (Bryceson *et al.*, 2008; Edmonds, 1982).

By the end of the 1970s, there was mounting evidence that investment in transport infrastructure was not having the economic and developmental returns that had been predicted, suggesting that improvement in transport alone is "unlikely to result in significant benefits" (Mwase, 1989, p.243; Bryceson *et al.*, 2008). Moreover researchers were finding that there was a "correlation between quality of route and the existence and reliability of public transport services" (Barwell *et al.*, 1985, p.128) with vehicle operating costs (Mwase, 1989) being negatively correlated to quality of roads, so much so that taxi drivers and vehicle owners would refuse to ply certain routes due to the cost of repairs to the vehicle (Porter, 1995; Porter, 2002).

This refusal could be seasonal, i.e. during the rains, or all year round (personal observation). When roads have to be taken, then poorly maintained ones could still make "almost any journey … an 'expedition' where you arrived on time if you were lucky" (Nyerere (1973) in Mwase, 1989, p.236), or you might not arrive at all.

One of the reasons for the failure of transport infrastructure to always contribute to development is due to the prohibitive cost of its construction[9] and maintenance, making it impossible to create tarmac roads to service all the rural population (Barwell *et al.*, 1985, p.135; Edmonds, 1982). This includes rural populations that live in extremely remote areas of the developed world. Though unimproved roads, even laterite roads, are relatively inexpensive to create, without proper yearly maintenance their "surface may have totally disappeared" within four years (Porter, 2002, p.287). This was already being observed in an 1886 interview when de Brazza[10] commented:

> 'What about the fertility of the country?' 'It is marvellously fertile; in fact, it is over fertile. Things grow too quickly. We could not get our roads kept open. When we cut a road, thirty kilometres wide [sic], through the trees, it was soon made impassable' (Anonymous, 1886, p.6).

In the 1990s development economists and the World Bank (Riverson *et al.*, 1991) took "on board spatial interests previously restricted to geographers, and rediscovering the links between economics and population density pioneered … decades earlier" (Bryceson *et al.*, 2008, p.461). Though they noted how important transport infrastructure is to rural communities, as it may broaden the economic opportunities available to rural people (Barwell, 1996, p.46) and can be a prerequisite for modern agriculture allowing communities to be transformed from subsistence to market economies (Riverson *et al.*, 1991, p.17), there was also a growing consensus that the effect of transport infrastructure is location specific. Following von Thünen, Chomitz and Gray (1996) concluded that "[r]oads play an important role in determining rent-and thus land use"

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[9] In South America road construction costs in 2002 were "US$750 [£378.38] per kilometre for unimproved roads, and US$2,000 [£1,009.02] per kilometre for all-season roads" (Perz *et al.*, 2007, p.548). While in 2003 the principal logging roads in Gabon cost between 9,400,000 cfa (£9,744.39) to 12,500,000 cfa (£12,958.00) per kilometre while secondary logging roads cost between 5,700,000 cfa (£5,908.83) to 7,200,000 cfa (£7,463.79) per kilometre (Jaffré, 2003a, p.260).

[10] Nor is it limited to tropical forests, even routes going through the manicured forest of the English countryside have to be maintained, for "[i]n the nineteenth-century Suffolk small sickles called 'hooks' were hung on stiles and posts at the start of certain well-used paths: those running between villages, for instance, or byways to parish churches. A walker would pick up a hook and use it to lop off branches that were starting to impede passage. The hook would then be left at the other end of the path, for a walker coming in the opposite direction" (Macfarlane, 2012, p.17).

(Chomitz & Gray, 1996, pp.487-488), but they found that the impact of roads depends on many factors including culture, history and ecology as well as improvement in agriculture technology (Barrett *et al.*, 2001, pp.325–326), so that if transport to and from a local market is blocked by “physical barriers” (Riverson *et al.*, 1991, p.vi), high transport costs, culture or a combination of the three, then there is less incentive for farmers to become market orientated (Pourtier, 1984). For these reasons donors in the 1990s became wary of supporting the construction of rural roads and some introduced a policy to “not build what cannot be maintained' holding that 'rehabilitation is nothing more than a reward for lack of maintenance'” (Edmonds, 1998, p.29).

Von Thünen’s 1820s theory on land-rents and distance from markets (von Thünen, 1966) and the continuing research in the field, all point to the importance of well maintained transport infrastructure on economic activities. It is not the presence of transport infrastructure alone that is important in developing economic activity but rather the state of the transport infrastructure (Barwell *et al.*, 1985; Bryceson *et al.*, 2008; Mwase, 1989; Porter, 2002; Porter, 1995) as well as its location (Barrett *et al.*, 2001) and cost of transport.

When transport infrastructure is created or improved the economic outcomes are not evenly distributed within a community, with the poor benefiting the least (Bryceson *et al.*, 2008, p.476). The existing unequal redistribution of income is both reinforced and intensified while certain types of productive activity become redundant (Edmonds, 1982, p.29). Furthermore these economic benefits may also change with time, through yearly seasonal changes or social unrest (Giles-Vernick, 1996, p.250). Neither does transport infrastructure reduce time spent walking to collect essential products, especially in “a walking world” (Porter, 2002, p.206) where women carry water and fuelwood[11] (Bryceson *et al.*, 2004, p.54; Bryceson *et al.*, 2008; Edmonds, 1998). Men may gain most from improved access to markets “with, perhaps, a slow trickle-down of indirect benefits to women” (Bryceson and Howe, 1993, p.1722) if at all, though this is also dependent on culture (Edmonds, 1998).

The economic return to local people from the creation of transport infrastructure may be further reduced by the arrival of in-migrants who are often better equipped in materials, skills, and finance than local people, allowing them to capture more of the benefits, and by doing so displace local people from the new economic opportunities that are created (Chomitz, 2007;

[11] In certain cultures the “walking world” is actively sought for by women, as it is the only time that they can be free to talk between themselves. Projects that have tried to reduce this walking world by placing water pumps in villages have in some cases faced resentment by women because this freedom to talk is removed (personal communication Mohamed-Katerere 2015)

Hodgkinson, 2009; Mertens and Lambin, 1997; Poore and Sayer, 1991; Rich, 1985; Riddell, 2011; Sinha *et al.*, 1989).

As there is an inverse relationship between the distance a community is from a major market and the number of bush taxis serving them, as well as a positive relationship between the distance of a community and the cost of transport, then "only a minority" (Barwell, 1996, p.46) of communities will be situated in the right place where long-term benefits from the construction of roads, including the ones built by the timber industry, can arise.

These more cautious approaches to the benefits of transport infrastructure can also be found in the transport literature of developers from the 1990s and ecologists at the turn of the millennium. However, the ecological and development literature on transport infrastructure created by timber companies has yet to integrate these findings, resulting in assumption drag. It is probable that assumption drag has been aggravated due the evaluation of transport infrastructure by conservation practitioners in isolation from other disciplines (Ascher, 1979, p.149; Balmford and Cowling, 2006).

1.2.4 Timber companies, transport infrastructure and development

There have been long running debates concerning livelihoods and economic welfare of people living in remote rural tropical forest village environments of developing countries. One of these debates has explored the association between the location of conservation initiatives, their remoteness and the ways they are associated with the poverty typically found in these areas (Curran *et al.*, 2009; Sunderlin *et al.*, 2008; Redford *et al.*, 2008; Riddell, 2011; Wilkie *et al.*, 2006). The result of these associations has been an increased interest in sustainable development initiatives, especially in the way that forests and their natural resources can be used to alleviate poverty. These initiatives can be through forestry, as defined in the Seventh World Forestry Congress (Vernell, 1971)[12], with the help of timber companies supporting development, through the commodification of natural products including projects that promote the trade in Non-Timber Forest Products, other alternative livelihoods or Integrated Conservation and Development Projects, including the captive rearing of non-domesticated animals for trade,

[12] During the Seventh and Eighth World Forestry Congress, foresters declared that "[f]*oresters recognise that forestry is concerned not with trees, but with how trees can serve people*" (Westoby, 1987, p.xii; from the Seventh World Forestry Declaration, paragraph 13 Vernell, 1971), or more explicitly "[f]*orestry and a forest policy ... 'should concern itself with all places where, and every conceivable way in which, forests, woodlands and trees can contribute to human welfare'*" (Westoby, 1987, p.xii; from the Seventh World Forestry Declaration, paragraph 13 Vernell, 1971).

livestock, agriculture and the honey trade (Arnold, 2001; Arnold and Townson, 1998; Angelsen and Wunder, 2003; Chomitz, 2007; Hodgkinson, 2009; Huffmann, 1931; Sunderlin *et al.*, 2003; Vedeld *et al.*, 2004) and through various Reducing Emissions from Deforestation and Degradation (REDD+) and Payments for Ecosystem Services (PES) initiatives (Agrawal *et al.*, 2011).

A continuation of this debate is the impact that these same people have on the environment, especially in the case of protected areas. This debate has left conservationists and social scientists deadlocked, as highlighted in a recent special issue of *Conservation and Society* (Agrawal and Redford, 2009a; Agrawal and Redford, 2009b; Bray and Velazquez, 2009; Chicchon, 2009; Curran *et al.*, 2009; Krueger, 2009; Schmidt-Soltau, 2009; Springer, 2009). In some cases this debate has resulted in proposals for the re-introduction of fortress conservation methods (Oates, 1999) with some being concerned that Reducing Emissions from Deforestation and Degradation initiatives may go down a similar path (Agrawal *et al.*, 2011; and debate between Beymer-Farris and Bassett, 2013; Beymer-Farris and Bassett, 2012; Burgess *et al.*, 2013). Others advocate ways in which local people can continue to use the natural resources in a sustainable manner such as in the form of alternative livelihoods (García-Amado *et al.*, 2013; Roe, 2013; Wicander and Coad, 2015) or legalised bushmeat trade (Brown and Williams, 2003; Nasi *et al.*, 2008).

In both debates the impact of access to local markets, via transport infrastructure in the form of roads, has emerged as an important issue. The building and subsequent utilisation of transport infrastructure has both short-term and long-term impacts that can either be direct or indirect, with consequences that may either be positive or negative (Gucinski *et al.*, 2001; Sinha *et al.*, 1989) depending on the viewpoint of the observer (Appendix 11.3). For conservationists, roads are seen as a threat to the environment as they promote the commercialisation of natural resources that are found in remote rural forested areas. For developers, the same roads allow not only commerce and so poverty alleviation but also the delivery of services such as health and education. This debate is not limited to forest environments; a similar debate has also centred on roads in and around the Serengeti (Dobson *et al.*, 2010; Fyumagwa *et al.*, 2013; Homewood *et al.*, 2010). It is, however, the lack of transport infrastructure that is one of the defining attributes of remote rural forest areas.

Though there are numerous forest resources that can be exploited, in most forests timber has one of the highest values (Sunderlin *et al.*, 2003, p.63) resulting in timber companies usually being the only commercial industry in these remote rural forest areas (Sunderlin *et al.*, 2005;

Sunderlin *et al.*, 2003). In Central Africa timber companies are the principal constructors of transport infrastructure, especially in remote rural forested areas. Due to the impacts that this transport infrastructure can have on both the environment and development, conservationists and developers, through different types of initiatives, are now collaborating with timber companies.

Even before the United Nations Millennium Development Goals were established (FAO and DFID, 2001), collaboration in the forestry sector had received international interest by donor agencies, governments (national and international), the World Bank (Geschiere, 2009, pp.70–72), developers and conservationists as a way to "alleviate poverty" (Angelsen and Wunder, 2003, p.1). The timber industry became the "focal point for development interventions" in remote rural forested areas (Angelsen and Wunder, 2003, p.1; Geschiere, 2009, p.72) with development agencies "seeking to 'bypass the state'" (Geschiere, 2009, p.71) so as to improve economies, access to health care and access to education, at both local and national levels while also limiting deforestation and allowing local populations to gain access to a cash economy in ways that agriculture cannot provide (Bouet, 1974). Because of this interest there has been a policy of promoting sustainable logging and its certification (Fisher, 2004; Whiteman, 2000) as a way to achieve three objectives: 1) the sustainable harvesting of timber, 2) in a manner that is ecologically sustainable, 3) but which still allows development.

The Congo Basin Forest Partnership (CBFP), a partnership of more than 70 conservation organisations, government agencies and donors in Central Africa, has had a policy of promoting collaboration with timber companies. In a 2005 report they stated:

> *[l]es filières bois emploient une main d'œuvre et créent de nombreux emplois qui font vivre des familles entières, des villages, des petites villes. Souvent installées dans des régions éloignées des infrastructures et des zones peuplées, les exploitations et les unités industrielles créent des pôles d'activités et assurent des missions de service public (désenclavement, routes, dispensaires, écoles)* (CBFP, 2005, p.33)[13].

[13] The timber industry employs a labour force and creates a number of jobs, underpinning the livelihoods of whole families, villages and small towns. Often established in areas that are far from infrastructure and populated zones, the timber industry and their industrial units, create centres of activity and ensure delivery of public services (roads, dispensaries, schools).

While in a 2006 report, the USAID Central Africa Regional Program for the Environment (CARPE) stated that:

> until recently, industrial logging had a very negative image: it was the source of the destruction of forests and the disappearance of fauna. It has certainly always had a number of negative impacts on the environment, but more and more of its potentially positive aspects are also being acknowledged. Not only can it make a lasting contribution towards socioeconomic development, but it can also become a powerful ally of conservation (CARPE, 2006, p.30).

As elsewhere in Central Africa (Zhang *et al.*, 2006) the timber industry in Gabon has had an important role to play in the construction of transport infrastructure (Map 1-1) since they are the principal builders of transport infrastructure in the region (Wilkie *et al.*, 2000). While logging roads account for 13% of the length of all roads in the Democratic Republic of Congo, in Gabon they account for more than 60% (Laporte *et al.*, 2007, p.1451; see also Blake *et al.*, 2008; and Wilkie *et al.*, 2000). This transport infrastructure allows the transport of timber from the point where a tree is logged to the point where it will be sold. For this to occur logging roads are constructed in different manners, some of which have a long life, while others do not. These roads range from small "temporary" tracks going from the felled tree to a road, to large evacuation roads to take the logs to the nearest saw mill, railway or port. In all cases the quality of these logging roads, and so how long they last, depends on the timber company creating them. This transport infrastructure is also used by others including local people and outsiders for commercial activity (Wilkie *et al.*, 1992), by Non-Government Organisations personnel as a way to access project sites (personal observation) or by civil servant / government administrations to get to remote communities, especially at election time (personal observation).

This opening up of remote rural areas by timber companies can have similar "multiplier effects" to those of opening up of other types of transport infrastructure that contributes to the development of an area (Sunderlin *et al.*, 2003). Like other types of transport infrastructure, the timber industry brings opportunities either directly or indirectly (Auzel and Wilkie, 2000). However, in Gabon there is no *de facto* system of royalties from logging to local communities (Ondo Ntsame, 2007, pp.61–66) [14]. For local people it can bring employment opportunities,

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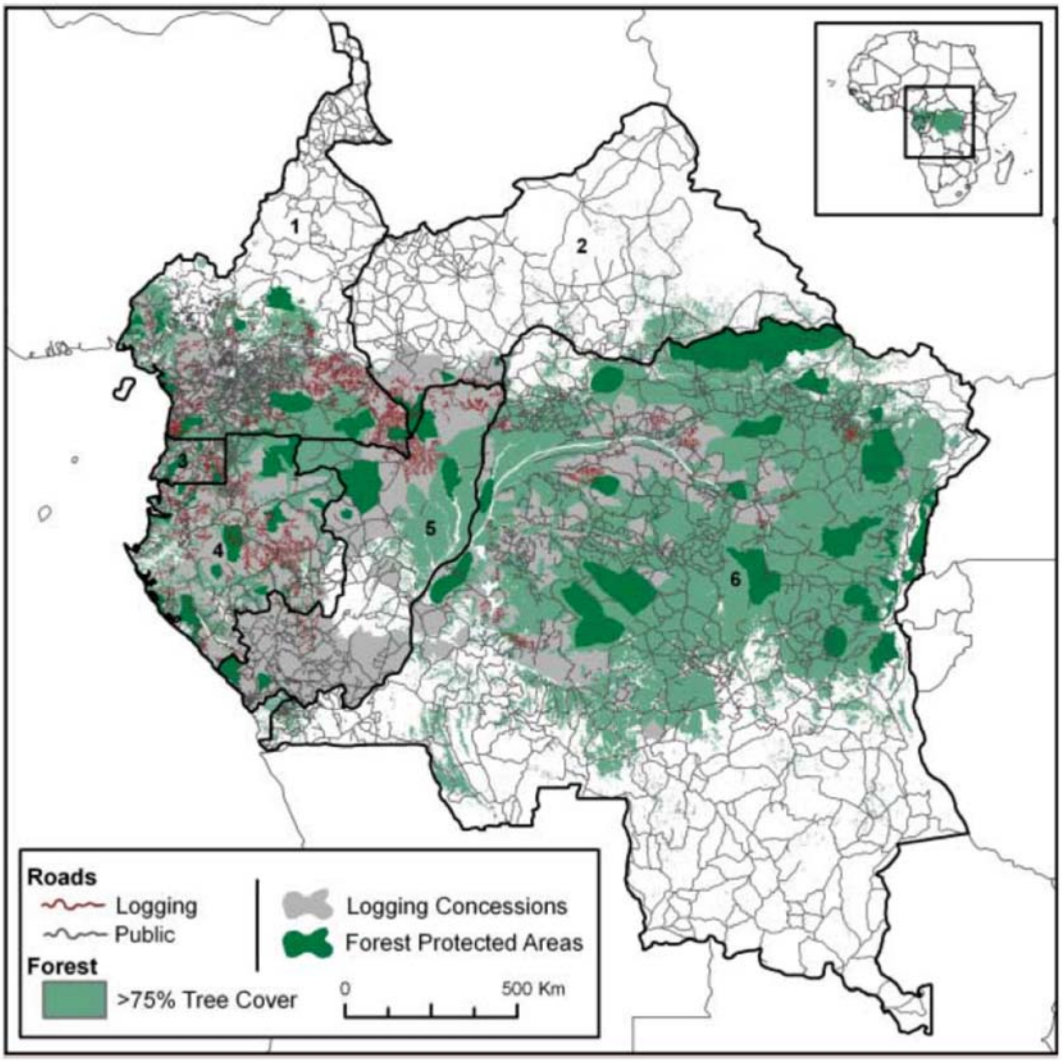
[14] The Gabonese Forestry Code in article 251 says "*Pour promouvoir l'aspect social de la politique de gestion durable, il est mis en place une contribution notamment financière, alimentée par les titulaires de ces concessions pour soutenir les actions de développement d'intérêt collectif initiées par lesdites*

either directly with the timber company itself or indirectly through services that the timber company requires, and through access to other markets created by their arrival (Bouet, 1977; Meye, 1969). One such market is the commercial trade of bushmeat which is sometimes considered to be so important to local people "that without the revenue obtained from hunting, they would be unable to obtain basic cooking utensils, clothing, medicine, and educational materials for school-age children" (Wilkie *et al.*, 1992, p.59; see also Hodgkinson, 2009; Riddell, 2011).



Map 1-1: Logging concessions and roads in Central Africa (from Laporte *et al.*, 2007, p.1451)

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communautés. La nature et le niveau de cette contribution sont définis par le cahier de charges contractuelles lié à chaque concession. La gestion de cette contribution est laissée l'appréciation des assemblées représentatives des communautés concernées" (République Gabonaise, 2001) – "To promote the social aspect of sustainable management policy, it is established a contribution, in particular financial, funded by the holders of such concessions to support the collective interest of development initiated by those communities. The type and level of this contribution are defined in the contractual document associated with each concession. The management of this contribution is left to the discretion of the representatives of the communities concerned".

Direct employment opportunities with timber companies are varied and can include jobs where local knowledge is important, such as forest guides working with timber prospecting teams (Whiteman, 2000) or manual, unskilled labour employed in building roads and assisting with the cutting and transporting of the timber (Angelsen and Wunder, 2003; Arnold, 2001; Poschen, 1997; Scherr *et al.*, 2003; Whiteman, 2000). Employment that involves manual labour, especially unskilled labour, constitutes by far the majority of the opportunities created by the arrival of timber companies (Balimunsi *et al.*, 2011), yet these jobs are often of short duration with relatively low pay, do not include social benefits or health care (Arnold, 2001; Colchester, 1999; Moseley and Reyes, 2008; O'Connor, 2004; Poschen, 1997; Whiteman, 2000), and can be very hazardous (Moseley and Reyes, 2008; Poschen, 1997) with poor working conditions (Balimunsi *et al.*, 2011). Such casual employment conditions can be illegal in countries such as Gabon, but in practice they are all that is on offer to local people and are usually sought after, with timber companies in remote rural forested areas serving as a "last-resort employer" (Sunderlin *et al.*, 2003, p.62). Through recommendations local elites can have significant say on who gets employed by the companies (Colchester, 1999; Lambin, 1994, p.4; Ribot, 2009; Rich, 2005; Sunderlin *et al.*, 2003, p.64).

More technical and better paid jobs, such as those operating machines, often go to outsiders, some of whom are brought by the timber company from urban areas (Whiteman, 2000). These people, who have the necessary training and skills to operate machinery (Poulsen *et al.*, 2009), receive not only better pay but also social benefits and health care[15] (Angelsen and Wunder, 2003; Arnold, 2001; Poschen, 1997; Scherr *et al.*, 2003; Whiteman, 2000).

This in-migration of workers brings about major changes in the population size of local communities. In northern Congo the population of one area increased by 70% over a six year period (Poulsen *et al.*, 2007, p.142). These increases are not only due to timber companies who bring in their own employees but also because of in-migrants attracted by both the access created by timber companies and the markets created by their employees (Bryant *et al.*, 1997; Eves and Ruggiero, 2000; Geist and Lambin, 2001; Hodgkinson, 2009; Meijaard and Center for International Forestry Research., 2005; Nasi *et al.*, 2008; O'Connor, 2004; Riddell, 2011; Robinson *et al.*, 1999). The result of the change in population is an increased pressure on the

[15] In Gabon labour (skilled and un-skilled) from outside the country has long been (Lasserre, 1955), and continues to be (Christy *et al.*, 2003), sought as they are not only cheaper to hire than local labour, but also readily available compared to the small Gabonese labour force. This was also a major issue in the past when many of the timber operations required a large manual workforce (Bouet, 1974).

forest environment both to satisfy subsistence needs and also the commodification of natural resources through the commercial extraction and sale of forest products. This increase is not only for forest based natural resources such as Non-Timber Forest Products including bushmeat, but also for agricultural land which is created at the expense of the forest (Bryant *et al.*, 1997; Chomitz, 2007; Wunder, 2001).

Though a lot has been written on how timber companies are a major source of employment in remote rural forest areas (Pinedo-Vasquez *et al.*, 2001), there is little data on the actual number of people being employed by timber companies (Angelsen and Wunder, 2003; Poschen, 1997; Whiteman, 2000). In Gabon available data indicate that 12,000 (FAO, 2009) to 14,121 (Bayol *et al.*, 2012) people are employed in the forestry sector, about 1.9% of the labour force (FAO, 2009) though this only includes full time employment and does not indicate whether they are local people, migrants or expatriates (Bayol *et al.*, 2012; Poschen, 1997). Data on indirect job creation rarely exist, such as hunters employed by the workers of timber companies (Auzel and Wilkie, 2000), cooking, supplying drinks and lodging, jobs that local rural people are more likely to obtain (Poschen, 1997; Whiteman, 2000).

So far, this review has shown how the transport infrastructure created by timber companies acts in a similar way to any other transport infrastructure, however there are major differences. The transport infrastructure created either through government or donor funds is usually maintained, even if not on a regular basis. For example, in Gabon the only non-timber transport infrastructure that is funded and built or maintained is that which forms part of the Trans-African Highway system, connecting Gabon to its neighbouring countries. These roads are usually funded by international donors. Apart from these highways, some of the transport infrastructure in and around major towns is usually funded and maintained by the Gabonese government.

Though there may be political reasons, such as during elections, for the Gabonese government to invest in the construction of transport infrastructure in remote forested areas, its low rural population means there is no sound economic reason to do so (Aicardi de Saint-Paul, 1987; Pourtier, 1989), since “logging roads are converted to public roads where population density is high” (Laporte *et al.*, 2007, p.1451). It is more likely that an existing road will be repaved than a new road built, or even a feeder or secondary road upgraded (Zhang *et al.*, 2006). This is one of the reasons that the Gabonese administration does not maintain the 60% of logging roads that have been constructed by tropical timber companies in remote rural forest areas.

Furthermore, unlike the transport infrastructure created by governments and donors to connect countries and towns, the transport infrastructure created by timber companies is less durable as there are few long-term incentives for the companies to either create lasting roads or maintain the ones that they have created. Of the 60% of logging roads in Gabon it is not possible, through current remote sensing, to say whether they are passable either by vehicle or by foot. Logging roads have a "short life span" (Riverson *et al.*, 1991, p.vi; Zhang *et al.*, 2006). Without constant maintenance these roads usually become covered in a high density of saplings that span the former road (Lasserre, 1955; Pinard *et al.*, 2000) which discourages passage even for hunters (personal observation).

It would seem that the Gabonese State has, intentionally or not, taken into account von Thünen's question, when he asks "[i]n which districts and to what point of the Isolated State will highways and railroads be constructed to advantage?" (von Thünen, 1966, p.240). This is a question that the promoters of development and conservation initiatives, such as ones by the Congo Basin Forest Partnership that rely on timber companies and the transport infrastructure that they create, have failed to ask. This is especially relevant as timber companies usually have several logging concessions, which are sometimes a great distance apart (Poschen, 1997) and so are continuously moving. This movement can be in the form of rotations from one concession to another, which occurs every three to eight years or so (Bouet, 1977, p.90), or the selling off of exploited concessions. When a timber company does move they generally take along the migrant workers they employed in the previous concession (Poschen, 1997), although there are some who stay behind (personal observation). By contrast, rarely do the timber companies continue to hire the local employees (Pinedo-Vasquez *et al.*, 2001). So whatever the multiplier-effects that open up with the arrival of a timber company, they are, by the nature of the timber industry, unstable (Bouet, 1974).

It is therefore reasonable to question whether logging, sustainable or not, can improve local economies in the long-term, even if there is the collaboration with conservation initiatives, especially when taking into account the findings of economists and geographers, for whom the developmental effects of roads are location specific.

1.2.5 Transport infrastructure and the environment

Transport infrastructure has also been recognised as one of the factors that has an impact on the environment (Ingles, 1965 in Gucinski *et al.*, 2001). In the 1970s, researchers dealt with "road ecology" (Coffin, 2007; Forman, 1998) and its effects on pollution, noise, erosion, road kill and how roads formed barriers (for a number of references see Coffin, 2007; Gucinski *et al.*, 2001; Mertens and Lambin, 2000; Rich, 1985; Sinha *et al.*, 1989; Spellerberg, 1998; Wisdom *et al.*, 2000).

Lugo and Gucinski (2000) used the following metaphor to describe the area affected by roads: a road is "a 'cylinder' with changing dimensions that meanders across the landscape" (Lugo and Gucinski, 2000, p.252). In the Amazon forest, 90% of the deforestation occurs within a "cylinder" of about 100 km wide (de Barros Ferraz *et al.*, 2009)[16]. Lugo and Gucinski (2000) concluded that roads should be considered as a man-made ecosystem which interfaces with other ecosystems that it crosses. These other ecosystems can either be more vulnerable or more resilient to the changes that this new cylindrical road ecosystem brings. Road ecosystems are not static but, due to patch dynamics, change over time reaching a "new ecological … state" (Lugo and Gucinski, 2000, p.253). The same would apply to the economic opportunities that the roads create: as the road ecosystem changes, so will the economic opportunities that the road creates. If the transport infrastructure is left with no maintenance, both the road ecosystem and the economic opportunities could revert to conditions that may be similar, though not necessarily, to the ones that existed before the transport infrastructure was built.

Transport infrastructure can therefore be thought of not only as a man-made ecosystem (Lugo and Gucinski, 2000) with ecological dynamics and succession, but also as being the "physical manifestations of the social connections and the economic and political decisions that lead to land use change" (Coffin, 2007, p.396). As the state of the transport infrastructure changes so the economic dynamics, political decisions, social connections and the environment change (Mongo, 2010).

For the last couple of decades researchers have been studying the effect of the timber industry on forests and their recovery, including the effects of logging roads and skid trails. When transport infrastructure, e.g. logging roads, go through forested areas (Lugo and Gucinski, 2000), it causes deforestation (Chomitz and Gray, 1996; Coffin, 2007; Gucinski *et al.*, 2001; Mertens and Lambin, 2000) or other types of degradation such as defaunation (Wilkie *et al.*, 1992; Zhang *et al.*, 2006). This research has shown how important it is "to remember von Thünen's lesson: that road improvements near markets or ports are transmitted through the entire network, affecting deforestation hundreds of miles away" (Chomitz, 2007, p.189; Ahrends *et al.*, 2010).

Much has been written about deforestation (Lambin, 1994), as well as defaunation (Brashares *et al.*, 2011; Brashares *et al.*, 2004; Brown, 2007; Brown, 2003; Wilkie *et al.*, 2001). In both cases the processes involved are complex, making them difficult to model, though there have been

[16] This is probably not the case in Central Africa, as only 10% of the canopy is impacted by logging roads (Bryant *et al.*, 1997; Zhang *et al.*, 2006).

attempts to do so for deforestation (Ahrends *et al.*, 2010; Lambin, 1994). There are far fewer models of defaunation. Though there are similarities between deforestation and defaunation, there are also differences. A forested area may have a low deforestation rate but a high defaunation rate (Auzel and Wilkie, 2000); for this reason defaunation may sometimes have to be analysed separately from deforestation. The ultimate direct agents of both deforestation and defaunation are well known (Agarwal *et al.*, 2002; Chomitz, 2007; Lambin *et al.*, 2003; Lambin *et al.*, 2001; Lambin, 1994; Wunder, 2001). For deforestation they include logging, slash-and-burn cultivation, in-migration and settlement, fuelwood gathering, cattle ranching, logging and forest fires (Lambin, 1994; Megevand and World Bank, 2013), while for defaunation the ultimate agents are subsistence or commercial hunting, including trophy hunting.

The proximate indirect forces of deforestation and defaunation seem to be similar but, due to the complex interaction of indirect forces, are less well understood. These forces include, but are not limited to, economic, cultural, political (including corruption at both national and international scale[17]), demographic, environmental, geographical, agricultural and technological factors (Geist and Lambin, 2001; Lambin, 1994; Davies, 2002b). For deforestation these proximate forces interact with each other in different ways; some are present in certain situations while absent in others. Rarely is only one of the forces solely responsible (Geist & Lambin, 2001; Lambin, 1994). From the available observations of the bushmeat trade similar (Bennett, 2002; Cowlishaw *et al.*, 2005a; Poulsen *et al.*, 2009; Rich, 2007a; Rowcliffe *et al.*, 2005; Rowcliffe *et al.*, 2004; Wilkie *et al.*, 1992) proximate forces seem to be at play.

Within the last couple of decades studies on the impact of transport infrastructure on hunting have been carried out (Bennett, 2002; Bryant *et al.*, 1997; Cowlishaw *et al.*, 2007; Cowlishaw *et al.*, 2005b; Cowlishaw *et al.*, 2004; Laurance *et al.*, 2008; Laurance, Croes, *et al.*, 2006; Mendelson *et al.*, 2003; Nasi *et al.*, 2008; Wilkie *et al.*, 2000; Wilkie *et al.*, 1992; Wilkie *et al.*, 2001), while the interaction between logging roads and hunting has also been studied (Auzel and Wilkie, 2000; Bennett, 2002; Elkan *et al.*, 2006; Laurance *et al.*, 2008; Laurance, Croes, *et al.*, 2006; Nasi *et al.*, 2008; Wilkie *et al.*, 2001; Wilkie *et al.*, 2000; Wilkie *et al.*, 1992) with local hunters commenting "'It will be good when the Société opens up a new logging unit, because then there will be more game; the forest around Pounga [village] is empty'" (Wilkie *et al.*, 1992, p.59). These studies all conclude that the indirect effects of logging roads, through market

[17] "'It's not the... the oil and the filth and the poisonous chemicals that are the real cause of pollution, Brigadier. It's simply greed'" (Hulke, 1974).

economies, include the opening up of "forests to hunting, fuelwood gathering, and clearing for agriculture" (Bryant *et al.*, 1997, p.16), for

> [l]ogging infrastructure and industrial roads usher in a domino effect of factors known to intensify hunting pressure, such as population growth from an immigrant workforce, increased income and demand for wild meat, increased forest access and increased extraction to international markets for specialist products like ivory ... evidence across the [Central African] region indicates that secondary impacts of logging activity are currently of far greater ecological importance (Abernethy *et al.*, 2013, p.6).

Research on the trade of bushmeat and the creation of transport infrastructure that opens up previously inaccessible rural areas has shown that it can "intensify bushmeat hunting by providing hunters greater access to relatively unexploited populations of forest wildlife and by lowering hunters' costs to transport bushmeat to market" (Wilkie *et al.*, 2000, p.1614). This argument is similar to early theories of transport infrastructure and development whereby transport infrastructure was seen as an economic blessing. The bushmeat markets can be either local (for consumption at the logging site) or distant (to be sold in urban markets). In the case where transport infrastructure is created by timber companies their employees have the means to hire local or outside hunters to supply them with animals products that can then be either directly consumed as "wild meat", exported or sold as "bushmeat" (Auzel and Wilkie, 2000; Bouet, 1974; Lasserre, 1955; Mack and West, 2005; Poulsen *et al.*, 2009). In the past timber companies directly contracted local hunters to supply bushmeat (Lasserre, 1955; Bouet, 1974).

The resulting conclusion has been that the threat by the timber industries, in the Congo Basin, is not one of deforestation, but defaunation due to the bushmeat trade that develops around logging areas (Bennett and Gumal, 2001; Eves and Ruggiero, 2000; Fimbel *et al.*, 2001; Nasi *et al.*, 2008; Rieu and Binot, 2006; Robinson *et al.*, 1999; Wilkie and Carpenter, 1999; Wilkie *et al.*, 1992). However, the drivers of the consumption of wild meat and trade of bushmeat are complex (Brashares *et al.*, 2011) and include economic, social and geographic factors, among others.

One driver of the bushmeat trade, as well as trade in other agricultural products and Non-Timber Forest Products, is urban population centres (Chomitz, 2007; Chomitz and Gray, 1996; Wilkie *et al.*, 2000; Wilkie *et al.*, 1992; Zhang *et al.*, 2006). Starkey (2004; Wilkie *et al.*, 2005) showed that though the proportion of wild meat consumed in Gabon is roughly equally distributed between rural and urban areas, its consumption was for different reasons. While wild meat was consumed in urban areas as a luxury good, in rural areas it was consumed as it was the cheapest source of meat available. Similar results were found in a continent-wide multi-site survey (Brashares *et al.*, 2011), with the consumption of wild meat and trade of bushmeat in rural areas being dependent on, among other factors, the proximity to wildlife and ease with which bushmeat could be marketed, with the least accessible villages being more likely to consume wild meat locally than trade it.

This demand has an impact on how far traders are willing to travel along the roads radiating out of these urban centres. How far they go "is likely to be proportional to the population" (Zhang *et al.*, 2006, p.110). Though the link between hunting and biodiversity loss has been widely written about (Brashares *et al.*, 2011; Brashares *et al.*, 2004; Laurance *et al.*, 2008; Laurance, Croes, *et al.*, 2006; Nasi *et al.*, 2008; van Vliet *et al.*, 2012; Watson and Brashares, 2004; Wilkie and Carpenter, 1999; Wilkie *et al.*, 2001) few studies have looked into the factors that influence decisions to participate in the bushmeat trade (for exceptions see Brashares *et al.*, 2011; Coad, 2007; Coad *et al.*, 2010; Kümpel *et al.*, 2009). It is likely that a hunter's decision to trade rather than consume wild meat is dependent on access to markets (Brashares *et al.*, 2011), since markets, rather than the hunters themselves as is proposed by Kümpel *et al*. (2009, p.1), are the critical link between supply and demand, with hunting being a "dynamic system in which individual hunters respond to changes in system variables such as costs of hunting and prices obtained for their catch" (Ling and Milner-Gulland, 2006, p.1).

The role of the timber industry in the creation of bushmeat markets has resulted in conservation organisations pushing timber companies and law makers to ban the hunting of bushmeat in timber concessions and its transport in company vehicles, though in many cases commercial hunting in timber concessions is already regulated either through national laws[18] or through guidelines demanded by the certification and timber organisations (for example International Tropical Timber Organization, 2003) of which a timber company may be a member. There has also been collaboration of development and conservation agencies with timber companies to reduce hunting in timber concessions through the projects that include alternative livelihood

[18] For instance the Gabonese Article 44 in the Decree number 689/PR/MEFEPEPN of the 24 August 2004, states that for the protection of soil and water and the conservation of flora and fauna a management plan must propose how access will be controlled – "*Le plan d'aménagement doit préciser également les mesures générales visant la protection des sols et des eaux ainsi que la conservation de la flore et de la faune. Pour cela, les dispositions pour empêcher l'accès aux parcelles après la fermeture des assiettes* [an area logged] *annuelles de coupe et pour contrôler les pratiques de la chasse doivent être explicitées.*" (République Gabonaise, 2004).

projects and Integrated Conservation and Development Projects with the aim to reduce wildlife offtake.

The “received wisdom” (Leach and Mearns, 1996a) or blanket assumption made by some ecologists studying the impact of timber companies on local economies and trade of natural resources such as bushmeat is that the transport infrastructure created by timber companies is thought to be the primary factor behind environmental degradation and commercial hunting in Africa. This blanket assumption is similar to those held by the early transport researchers who thought that transport infrastructure and economies were closely correlated. While research from other disciplines on transport infrastructure has been evolving away from blanket assumptions, this has not yet happened in the ecological domain.

To have an impact on the environment, transport infrastructure in remote rural forested areas (e.g. logging roads) would have to meet a minimum set of criteria. In the case of hunting, such criteria would include, among others, cultural preference for wild meat, access to markets where there is a human population density high enough for demand to outstrip supply, lack of other areas from where bushmeat can be supplied at a lower cost, low transport cost to markets, ways to preserve the meat which are culturally acceptable (Wilkie *et al*. 2005) and can preserve the meat during its transport in a given climate (Brown and Marks, 2007, p.96). These criteria do not cover other local cultural and social aspects, which could range from interdictions on hunting specific species to the barring of certain people from trading due to their ethnicity, or historical events between families (personal observation). When criteria such as transport costs are factored in, then spatial models of land use that include land rent, such as von Thünen’s, need to be taken into account.

Though there is little doubt that the creation of transport infrastructure by timber companies operating in remote rural areas helps to supply bushmeat markets with wildlife, the question remains as to its long-term continuation after timber companies depart. The increased trade in bushmeat and local animal population depletion may be true while a timber company is operating in an area. However, there has been little research (Chapter 1.2.7 and Appendix 11.1) to see if these trends continue once a timber company has left an area, especially when it comes to remote rural forest areas of rentier economies.

1.2.6 Patch dynamics and logging

"L'Okoumé, fils du manioc"[19]
(Aubréville, 1948)

Ecological succession from a disturbance has been discussed by biologists for over a century (McCook, 1994) and has formed a body of work called "patch dynamics" that has been used, among other things, to show the succession of events that occur after a natural tree fall (Arriaga, 1988; Bugmann, 2001; Levey, 1988) as well as to show how areas that had previously been under a "slash and burn-agricultural" management are today mature forests (Adams and McShane, 1996; Boulvert, 1990; Fairhead and Leach, 1998; Fairhead and Leach, 1996; Leach and Mearns, 1996b; Maley, 1990; Oslisly, 2001; Richards, 1999).

Any disturbance to tropical rainforests, or any ecosystem, "disrupts the physical or biological structure of an ecosystem" (Pickett *et al.*, 1999, p.707) resulting in a chain of successional events that can take the ecosystem, and the people who live in it, down different paths (van der Maarel, 1993). The result of this is that different ecosystems, and their parts, are impacted in different ways (del Moral and Grishin, 1999). A landscape is therefore heterogeneous, consisting of a dynamic patchwork of areas that have experienced different disturbances at different times, scale and magnitude (van der Maarel, 1993) and which are either recovering from the disturbance or moving the landscape to another state (Pickett and Rogers, 1997).

The chain of successional events that follows any disturbance will depend on the type and intensity of the original disturbance (Everham III and Brokaw, 1996) as well as the ecological and anthropogenic conditions of the area at the time of the disturbance (Pickett *et al.*, 1999). While a large continuous disturbance may completely damage an ecosystem, disturbances that are of "low intensity" may only lead to temporary shifts in the patchwork (Łaska, 2001).

Logging is a form of environmental disturbance that originates from outside an area and like other types of disturbances creates a patch dynamic succession of regrowth. Like any other disturbance, logging may not be uniform (Everham III and Brokaw, 1996) with different spatial extents, length of time and magnitudes (van der Maarel, 1993) occurring at different, but specific, spatial and temporal points (Łaska, 2001). While selective logging operations may only directly impact a small part of the surrounding vegetation and less selective logging operation may directly cause damage on a larger scale, both may have a larger indirect impact on the environment such as the displacement of animals (Durrieu de Madron *et al.*, 2000; Hall *et al.*,

[19] *Okoumé*, the son of manioc.

2003; Hawthorne *et al.*, 2011; Hawthorne, 1993; Levey, 1988; Makana and Thomas, 2006; Medjibe *et al.*, 2011; Picard *et al.*, 2012).

Findings on deforestation and afforestation, depending on various physical environmental factors and logging intensity, show how resilient tropical forests can be to disturbance and how quickly they can recover, though maybe not to the previous level of biodiversity (Chazdon, 2003; Guariguata and Dupuy, 1997; Laporte *et al.*, 2007; Nabe-Nielsen *et al.*, 2007; Pinard *et al.*, 2000). These dynamic patchworks of disturbance and succession can interact with each other (Hobbs and Huenneke, 1992) and spread, through interacting species, at varying speeds throughout the ecosystem and into adjacent ecosystems and landscapes forming a continuum of dynamic patches which, especially in forest, are in three dimensions (Bugmann, 2001; Pickett and Rogers, 1997). Furthermore these successional paths can be impacted by other disturbances or influences from outside an area, which can be natural or anthropogenic of origin and include development and conservation initiatives (Hobbs and Huenneke, 1992; Pickett *et al.*, 1999; Pickett and Rogers, 1997).

In Gabon, gaps created during the selective felling of trees are usually too small to stimulate growth of “light-demanding species” that are also of economic value such as the timber tree *Okoumé (Aucoumea klaineana*, Pierre) (Engone Obiang *et al.*, 2014). By contrast, timber parks where the wood is stocked before being transported, are “likely to be important for the regeneration of many species due to the large-scale, long-lasting alterations of soils and light environment” (Nabe-Nielsen *et al.*, 2007, p.32), in some cases this creates micro-habitats that reduce competition for other tree species allowing less resilient tree species to dominate (Nabe-Nielsen *et al.*, 2007; Pinard *et al.*, 2000). This can be seen in the forests of Gabon where past features of logging concessions stand out from the rest of the forest. Features such as logging roads that become “long and narrow corridors” (Guariguata and Dupuy, 1997, p.21) or the Decauville rail[20] routes of the 1920s that were observed as wide lighter green strips in aerial surveys of Gabon carried out in 1950s, indicating *Okoumé* trees (Biraud, 1959). In this way the long-lasting impacts in structure and floristic characteristics may give selectively logged forest (as is common in Gabon) a particular ecological role.

Though the chain of successional events that originate from a disturbance can easily be observed in the short-term, especially when the community being observed is “close to human time and

[20] A system of track that allowed timber companies to go deep in the forest. The waggons were first pushed by people and later by small trains.

spatial scales” (Pickett *et al.*, 1999, p.708) of metres and years, the long-term effects are more difficult to observe, especially if the observer’s experiences are based only on “particular levels of [ecological] organization” (Pickett *et al.*, 1989, p.129). This is because the chain of successional events can span large spatial and temporal scales (McCook, 1994), with species that occurred before a disturbance only returning after hundreds of years later (Pickett and Rogers, 1997). In this way an ecosystem that at first sight looks stable and at equilibrium can in fact be a mosaic of dynamic patches at various successional points all resulting from a disturbance that occurred many centuries ago, all of which are interacting with each other. Some patches act as biodiversity sources from which others patches are recolonizing (Arriaga, 1988; Łaska, 2001).

For these reasons some management plans for protected areas are having to simulate disturbance so as to maintain the landscape (Baker, 1992; Hobbs and Huenneke, 1992). Lopé National Park in Gabon, is a case in point where, based on historic and archaeological research, a fire management plan has been created to maintain the savannas (Jeffery *et al.*, 2014) that first appeared 2,500 BP and are now being encroached by forest (Maley, 2001a; Maley, 2001b; Maley, 2001c; Oslisly, 2001; Oslisly and Dechamps, 1994).

If this disturbance regime is itself disturbed then these species could disappear. For example *Okoumé*, a near-endemic timber tree found in Gabon is dependent on heavy disturbance and is the reason that this tree is sometimes referred to as the “*fils du manioc*”[21] (Aubréville, 1948; Engone Obiang *et al.*, 2014), as it is one of the first timber species to reclaim old manioc fields. It is due to the heterogeneous nature of disturbance and the chain of successional events, including logging and post-logging, that it is difficult to predict the long-term outcome of a timber operation on either the landscape or the people in that landscape.

It is now widely acknowledged that the perception that environments have been, until only recently, scarcely touched by humanity is a myth. Natural landscapes have long been modified by humans (Adams and McShane, 1996; Adams, 2004; Adams, 1996; Fairhead and Leach, 1996; Leach and Mearns, 1996b; Pretty, 2011), either directly for example through setting fires (Kull, 2004), or indirectly such as via hunting (Terborgh and Estes, 2010). These landscapes have also shaped human culture (Pretty, 2011). This is true for Gabon as well as the wider Central Africa region (de Blas and Ruiz Pérez, 2008; Oslisly, 2001; White, 2001; Zhang *et al.*, 2006).

[21] “the son of manioc”.

However, assumption drag is so pervasive in Central African conservation that the positive role of anthropogenic influences has not always been systematically factored into either ecological research or conservation projects. Gabon is a case in point. There is still a common misconception that it is one of Africa's last Edens (BBC Travel, 2013; National Geographic, 2007; Odendaal and Day, 1999), with the result that research is often based on "received wisdom" that has become "common knowledge" in the environmental literature of Africa (Leach and Mearns, 1996b). This has led to Gabon's forest being described as being "primary", "virgin" or "untouched" forests (Adams and McShane, 1996; Engone Obiang *et al.*, 2014; Fairhead and Leach, 1998; Fairhead and Leach, 1996; Leach and Mearns, 1996b).

The contradiction between the acknowledgement that environments have been touched by humans and then describing forests as un-touched by humans can partly be attributed to the lack of true multidisciplinary collaboration, even though this is often said to be important in conservation biology (Clark *et al.*, 2011a; Clark *et al.*, 2011b; Drury *et al.*, 2011; Ehrenfeld, 1987; Fox *et al.*, 2006; Lowe *et al.*, 2013; Lowe *et al.*, 2009; Mermet *et al.*, 2013; Newing, 2010; Phillipson *et al.*, 2009; Pooley, 2013; Pooley *et al.*, 2014; Schultz, 2011; Soulé, 1985; Szabó and Hédl, 2011; Szabó, 2010). Landscapes are always complex in nature from no matter what disciplinary viewpoint (Appendix 11.2).

Though there is concern that timber companies will have dramatic consequences on the forest landscapes of the Central Africa (which some see as 'pristine': Clark *et al.*, 2009; Laurance *et al.*, 2008; Poulsen *et al.*, 2009; Wilkie *et al.*, 2001), as they have elsewhere (Laurance, 2001), there are few long-term datasets from this region to draw upon to predict the future of these landscapes (Ernst *et al.*, 2012; Hansen *et al.*, 2008; Laporte *et al.*, 2007; Mayaux *et al.*, 1999). One analysis warns that current data:

> does not prove that tropical forest decline is not happening; it merely shows that it is difficult to demonstrate it convincingly using available tropical forest area data, despite the dedication of all who collected them (Grainger, 2008, p.822).

The assumption by conservationists and developers that forests are untouched and that there has been no commercial trade in natural resources prior to the arrival of timber companies in remote rural forest areas (Figure 1-2) is partly due to patch dynamics which, in tropical rainforests, quickly erases any signs of past human disturbance. Understanding patch dynamics in Gabon may give us an understanding of what may occur when timber companies depart from a remote rural forest areas and so allow us to investigate the second amendment (Figure 1-3) to the chain of logic that starts with the arrival of timber companies. Though logging is a relatively new activity, the trade of natural resource extraction is not.

1.2.7 Current research on the impacts of timber companies and their transport infrastructure on development and the environment

This literature review on the impacts of timber companies on development and the environment of remote rural forested areas has shown that when transport infrastructure is created by timber companies, development of remote rural forested areas occurs at the expense of the environment. In particular the growing literature on the bushmeat trade has often pointed a finger at the timber companies as enabling the trade of endangered species (Fimbel *et al.*, 2001; Karesh and Noble, 2009; Laurance and Peres, 2006; Laurance and Useche, 2009; Malhi *et al.*, 2013; Robinson and Bennett, 2000; Wilkie *et al.*, 2001). It is based on this that development organisations, conservation agencies and donors have focused their attention on timber companies with whom they collaborate on projects. This section looks at what evidence there is to support these claims.

In May 2014 a literature search using Google Scholar (UK)[22] and Metalib[23] was carried out. Three sets of words were searched in the complete texts (i.e. not tagged keywords) a) Logging Africa, b) Bushmeat Logging Africa and c) Logging Development Africa. From each of these searches the summaries and abstracts of the first 500 results from Google Scholar and 200 results from Metalib (a total of 21,000 results) were considered. These abstracts and summaries were examined and filtered for papers based on data from the field, of which 68 accessible papers were found (see Appendix 11.1 for full details of the search and its results). Of these papers only three studies have looked at the impact of timber companies on hunting and bushmeat after timber companies have left a forested area in Africa. This is compared to fifteen studies that looked at these impacts while logging operations were ongoing (Table 1-2). Furthermore, these three studies were undertaken a couple of years after the timber company had departed and the impacts of the departure of the timber company was not the principal focus. Similar results are achieved when using these search parameters for articles on the developmental impacts of timber companies which returned five articles related to post-logging studies (Table 1-2).

[22] Google scholar ranks documents by how relevant the full text is to the search words, who published and wrote the article and how often and recently has it been cited.
[23] Metalib is a service provided by UCL Library's as a search engine that includes GeoBase, Jstor, PubMed, Scopus, UCL library and Zetoc. Respectively the results of the search were as follows a) Google Scholar 112,000 and Metalib 13,469, b) Google Scholar 5,390 and Metalib 515 and c) Google Scholar 81,200 and Metalib 9,829.

Though it has been thought that the poor states of roads may limit the trade of bushmeat (van Vliet and Nasi, 2008a), which has also come out in models of the sustainability of commercial bushmeat hunting where it was found that "assessing hunting sustainability is situation dependent" (Ling and Milner-Gulland, 2006, p.1), this literature search provides little field data to confirm these suppositions.

By comparison, studies on the impacts of timber companies on vegetation and fauna are more numerous and have been carried out before, during and after timber operations (Table 1-2). These studies indicate that in general both the vegetation and fauna can recover, in some cases to levels higher than pre-logging, but this recovery is spatially variable even for the same species.

	Number of references that looked at impacts from logging			
	Pre-logging exploitation	Logging exploitation	Post-logging exploitation	Total
Vegetation / carbon	7	10	19	36
Mammals	2	6	24	32
Other animals	0	2	8	10
Bushmeat / trade / hunting	0	15	3	18
Social / development / health / migration / livelihoods	1	14	5	20

Table 1-2: Number of relevant articles found from a literature search using Metalib and Google Scholar, with the key phrases "Logging Africa, "Bushmeat Logging Africa" and "Logging Development Africa" and organised into five categories. For each of the key phrases the first 500 results from Google Scholar and 200 results from Metalib (total number of results = 21,000) were looked at.

It would therefore seem that the current literature on the impacts of timber companies on either hunting or development in Africa is based on a limited number of field studies which have mostly focused on, and given a snapshot view of, the situation while timber companies are operating.

Such studies that have been done have been carried out while the spatial pattern between transport infrastructure and market access is in a near stable state, due to maintenance of the transport infrastructure by timber companies, and has overlooked the possibility of major change when logging comes to an end. Furthermore the bushmeat trade studies found in this literature search (Table 1-2) are principally from authors that have a biological background, while the social papers are more multidisciplinary (Appendix 11.1, Table 11-1). The lack of cross-disciplinary perspective of these bushmeat trade studies has resulted in "negative learning" where "scientific beliefs […] diverge over time from the a *posteriori* right answer" (Oppenheimer *et al.*, 2008, p.155; Brysse *et al.*, 2013).

A further problem with many studies of bushmeat markets (Coad, 2007; Cowlishaw *et al.*, 2007; Kümpel, 2006; Starkey, 2004) and their impact on livelihoods (Brown and Williams, 2003; Brown, 2003; Davies and Brown, 2007; van Vliet *et al.*, 2012; van Vliet and Nasi, 2008a) is that, by their nature, they focus on urban areas and active logging concessions (Auzel and Wilkie, 2000; Wilkie *et al.*, 1992), with few looking outside this bushmeat market zone of influence (but see Wilkie *et al.*, 2000). This is understandable, for if there is to be a study on commercial bushmeat hunting there must be both a market and a transport system to get the bushmeat to the market. But it also means that there is road side bias (Chambers, 1983) with little information on the sites where the bushmeat trade has broken down, for instance due to a collapse in transport infrastructure.

1.3 Aim of thesis

With the intent to explore the amendment to the chain of logic used by conservation practitioners (Figure 1-1), I intend to explore whether the transport infrastructure created by timber companies in remote rural forest areas of rentier states is dependent on their presence and disintegrates with their departure. In the long-term this deterioration results in a change of the spatial relationship between transport infrastructure and market access which in turn results in development and trade of Non-Timber Forest Products such as bushmeat coming to an end (Figure 1-6).

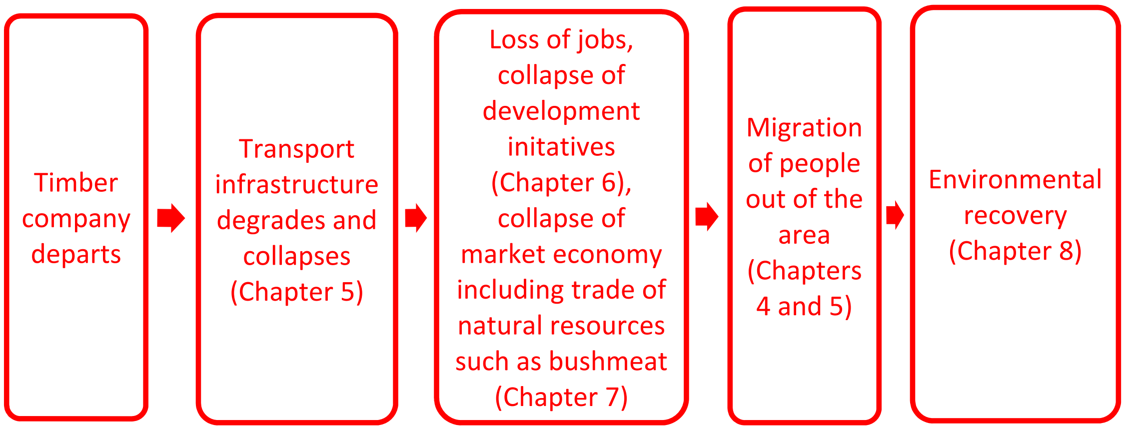


Figure 1-6: Proposed amendment to the chain of logic used by conservation practitioners.

This spatio-temporal (Maddison, 2009) change in the impact of timber companies fits well with the theories developed by economic geographers and geographical economists since the 1800s when the first spatial economic models were being developed by the economist von Thünen. The above process is investigated in the chapters that follow through these questions and hypotheses, using methods as outlined in Chapter 2.2:

1. How has access to the study sites, in the form of cost and travel time, changed first with the arrival of timber companies and secondly with their departure? It is hypothesised that the average speed at which public transport travels decreases

with increased distance from a market, whether or not there has been logging or timber companies based in the village (Chapter 5).

2. What impacts have timber companies had on the migration of people, especially after their departure? It is hypothesised that people are attracted to timber companies, but once these depart people also leave (Chapters 4 and 5)
3. How has development in the form of education and employment been impacted by the departure of timber companies? It is hypothesised that the distance a village is from a market is more important than the past presence of a timber company in shaping education and employment (Chapter 6).
4. How has the trade of Non-Timber Forest Products in the form of bushmeat been impacted by the departure of timber companies? It is hypothesised that the bushmeat trade no longer occurs in the villages furthest from the market, with people's livelihoods largely being based on subsistence (Chapter 7).
5. How has the trade of Non-Timber Forest Products impacted the environment, especially with the departure of timber companies? It is hypothesised that in the more remote areas there are more animal signs, signs of forest succession and fewer signs of human disturbance in the forests around these villages (Chapter 8).
6. To put some of the findings in historic context, this thesis also looks at the ecological impacts of various phases of natural resource exploitation in Gabon starting from the Atlantic trade of natural resources to Europe in the 1400s (Chapter 3) and then the nineteenth century trade in one of the study sites (Chapter 4). In doing so I attempt to show how forest use, be it for logging or conservation, may be dependent on past uses of the forest.

It is important to emphasise the context of this study (as outlined in Chapter 2.1) and to continually bear it in mind throughout this dissertation. The study was undertaken in one of the most remote areas of an African country, Gabon, whose main source of revenue is offshore oil. It is a country in which there is a low population density, no land shortage, where there is little incentive to transform landscapes from forest into agriculture[24] and where timber operations are selective due to the distribution of commercially exploitable tree species in the forests. Under these conditions, and when there are no other factors that maintain access to remote rural forested areas, then the outcome of the abandonment of a remote rural forested area by

[24] Although in the last couple of years there has been a push to transform fallow "degraded" forest into oil palm plantations.

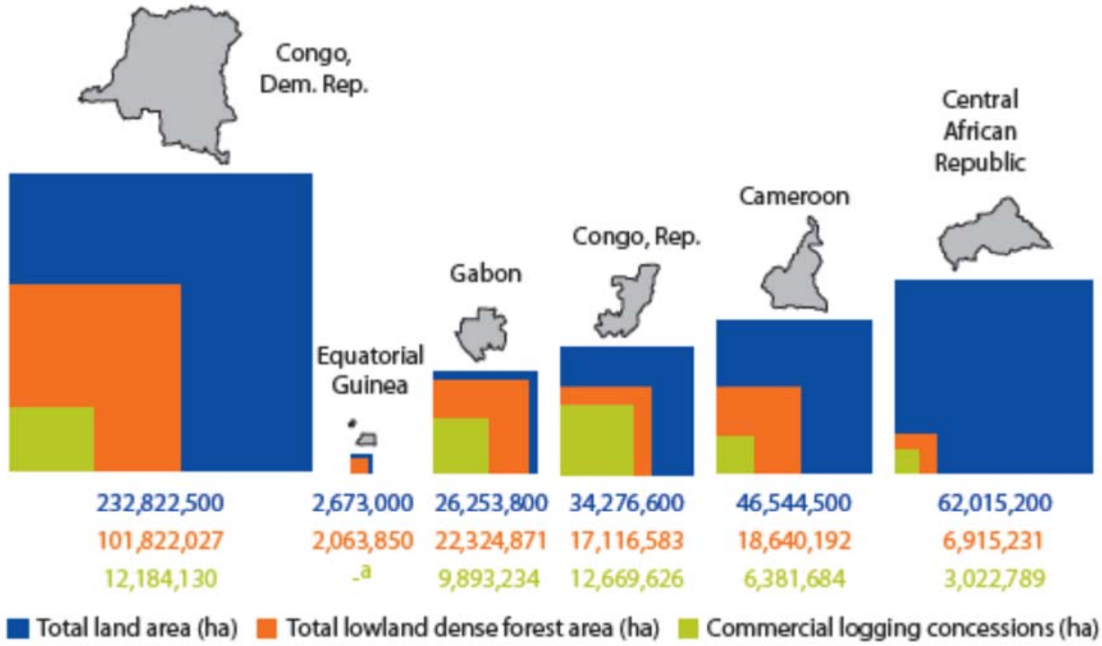
timber companies may have results that are quite different from the increased environmental degradation found in post-logging situations in South American and other African countries (Hodgkinson, 2009).

2 Background to the study sites and methods

2.1 An overview of Gabon

Map 2-1: Map of Gabon, including area of study sites. Based on (Nations Online Project, 2012). Area of study site in red oval.

This study was carried out in Gabon (Map 2-1), an African country that is not only “little known” to Anglophones (Aicardi de Saint-Paul, 1989, p.vii; Darlington and Darlington, 1968, p.ix) but is also an exception to many generalisations commonly applied to sub-Saharan Africa. The following section will give an overview of Gabon, highlighting some of the particularities that puts it apart from much of the rest of sub-Saharan Africa (Figure 2-1).



Source: Data prepared from de Wasselge et al. 2012.
Note: ha = hectare.
a. In Equatorial Guinea, all logging concessions were cancelled in 2008.

Figure 2-1: An example of one of the many particularities of Gabon, the amount of land area that is forested (from Megevand and World Bank, 2013, p.2)

2.1.1 Geography and Climate

Gabon sits astride the equator in Western / Central Equatorial Africa (Gardinier and Yates, 2006), with an Atlantic coast line of 800 km and a land mass of 267,667 square km (Aicardi de Saint-Paul, 1987). The terrain consists of lowland plains that stretch 30 to 200 km inland and then rise to a maximum of 300 metres in altitude. These plains continue along the principal rivers of Gabon: the Ogooué, Nyanga and Ngounié. Outside these coastal and riverine plains the rest of the country consists of plateaus from which two principal mountain chains rise: the Monts de Cristal in the north and the Du Chaillu Massif in the centre and the south.

The climate is equatorial with a uniform temperature of around 26^{o}C and high relative humidity (Gardinier and Yates, 2006). Yearly the mean daily temperatures varies from a low of 21^{o}C to a high of 28^{o}C (Wilks, 2003). There are two rainy seasons that generally run from mid-February to mid-May and then from mid-September to mid-December (Gardinier and Yates, 2006). The small dry season that runs between mid-December to mid-February is more pronounced in the north than the south; in some years the small dry season in the south may just consist of a reduction in rains rather than a complete halt to them (Wilks, 2003). The mean annual rainfall fluctuates between 150 to 300 centimetres per year with the north-west being the wettest while the extreme north-east and south-west are the driest (Wilks, 2003).

2.1.2 The Peoples of Gabon

There is evidence of hunter-gather *Homo erectus* inhabiting Gabon from 100,000 BP (Clist, 1999; Clist, 1995; Vansina, 1990) with traces of *Homo sapiens* appearing 40,000 BP (Clist, 1999). Bantu-speaking peoples started to arrive along the coast of Gabon around 3,400 BP (Clist, 2005, p.788; Ehret, 2002, p.113; Vansina, 1990, p.51). Later, around 2,500 BP, they migrated overland, using the routes offered by rivers and ridges (Clist, 2005; Oslisly, 2001). This migration occurred at a time when the climate became increasingly dry resulting in savannah corridors opening up in the forest (Clist, 2005; Clist, 1995; Ehret, 2002, p.82; Maley, 2001a; Maley, 2001b; Oslisly, 2001; Wilks, 2003, p.21). In the wake of Vansina's (1990) work, researchers using similar methods have identified three cultural systems that were simultaneously present in Gabon from around 2,500 BP, (1) nomadic Pygmies[25], groups living on the edge of areas occupied by Bantu-speaking people, (2) Neolithic Bantu-speaking peoples, and (3) Iron-working Bantu-speaking peoples (Clist, 1995; Klieman, 2003, p.219; Klieman, 1997, p.146). It is on these cultures that today's ethnicities are based (Clist, 1995; Klieman, 1997).

Today linguists generally separate the peoples of Gabon into one of eight Bantu linguistic sub groups (Myènè, Kèlè, Kota, Tsogo, Eshira, Mbédé, Nzabi and Fang) and one non-Bantu-speaking group the Pygmies, (which include the Baka, Babongo and Bakoya (Gardinier and Yates, 2006, p.529; Knight, 2003)). Some groups, such as the Fang (who represent one quarter of the Gabonese population), are recent migrants, having, "within the memory of man" (Burton, 1863, p.46), originally moved into the northern reaches of Gabon from Cameroon in the 1600s and resulted in the displacement of other peoples from northern and central Gabon (Chamberlin, 1977; Cinnamon, 1998; Gardinier and Yates, 2006). In the 1840s the Fang started a major migration south, in order to have direct access to trade with the Europeans who were appearing on the coast at the time (Briault, 1943; Bruel, 1930; Chamberlin, 1977; Cinnamon, 1998; de Brazza, 1887; de Compeigne, 1875; Deschamps, 1965; Deschamps, 1962; du Chaillu, 1861; Gardinier and Yates, 2006, p.123; Gray, 2002; Klieman, 2003; Metegue N'Nah, 2006; Ngolet, 2003; Raponda-Walker, 2002; Touchard, 1861; Trilles, 1912).

Though this early Fang migration and associated displacements may have been due, among other things, to trade, conflict, and access to resources, more recent migrations, from the late 1800s and early 1900s, have also been due to the management practices of the colonial administrators (Bruel, 1930, pp.161–162), which included the recruitment of soldiers, forced

[25] See Appendix 11.4 on why the word Pygmy is used throughout this thesis, rather than one of the many alternatives.

labour and tax collection, (Coquery-Vidrovitch, 2001; Gray, 2002; Metegue N'Nah, 2006; Metegue N'Nah, 1981; Rich, 2007a). These practices were amplified by a timber industry that was attracting labour from all over Gabon as well as further afield (Gray, 2002; Rich, 2007a; Rich, 2005). In the early 1900s the displacement of large numbers of people resulted in outbreaks of disease (Headrick, 1994) and famine (Chamberlin, 1977; Cinnamon, 1998; Coquery-Vidrovitch, 2010; Rich, 2007a; Rich, 2005) that resulted in the creation of "dead zones" (Gray, 2002, p.160), including in one of the study sites.

2.1.3 Population

With an official 2011 population of 1,534,000, a mean density of five people per square kilometre (United Nations Statistics Division, 2009), a population that is only increasing slowly (Figure 2-2) and a rural population that makes up 13.8% of the entire population (United Nations, Department of Economic and Social Affairs, Population Division, 2012), Gabon has a rural population that is low compared to many other African countries and this rural population is decreasing by 1.7% per annum (United Nations, 2012).

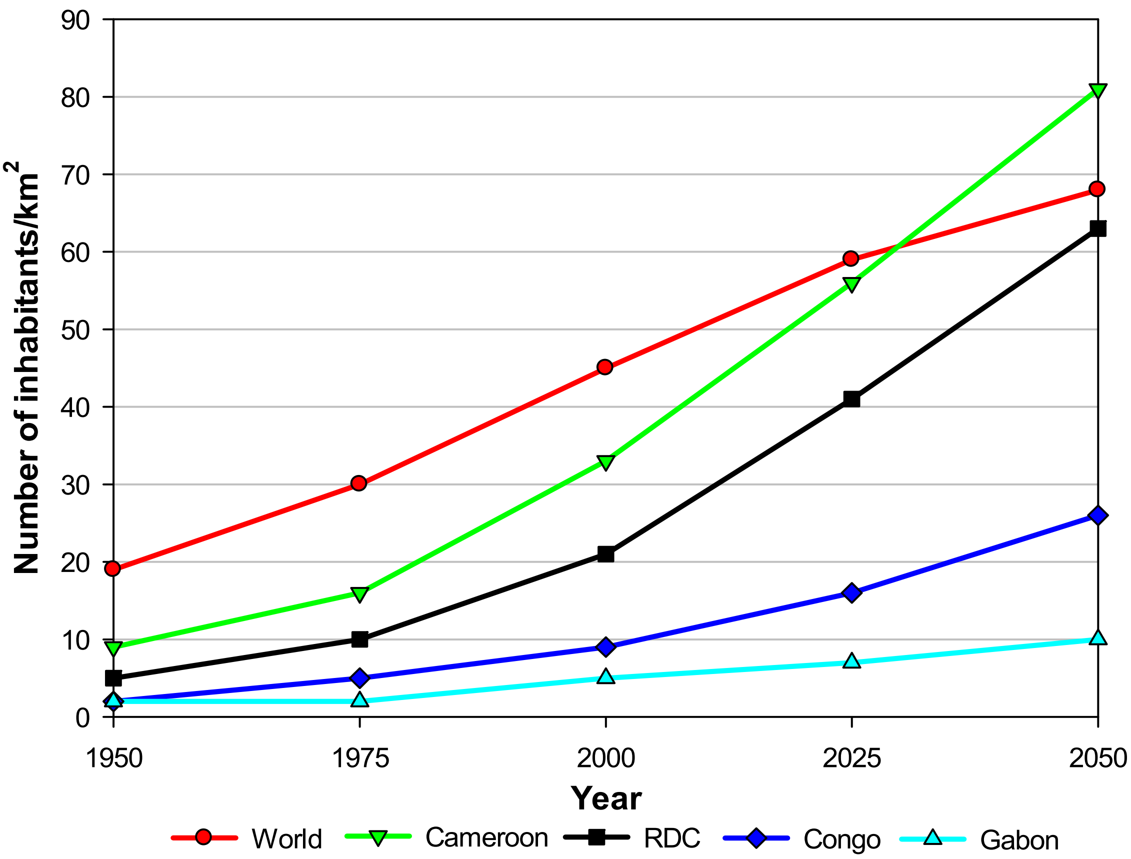


Figure 2-2: Demographic evolution and projections in the Congo basin (adapted from Ongolo *et al.*, 2013, p.177).

However, the censuses that have been carried out in Gabon have been poorly organised with data being regularly manipulated upwards (Bruel, 1930, p.158) and being "*systématiquement cachées ou déformées par un gouvernement frappé du complexe d'infériorité de la taille … les* *résultats du recensement ont été, pour les besoins de la cause, passablement modifiés*"[26] (X..., 1977, p.155). Demographers believe that there are probably around 1,474,586 people in Gabon (Gardinier and Yates, 2006, p.359; World Bank, 2012) others think there are fewer than 1,000,000. Projections from the French *Ministère de la Coopération* estimated that the population of Gabon in 2000 would be 747,697 (Gaulme, 1988, p.35). Ever since the first population censuses carried out by the colonial administration in Gabon, there has yet to be an un-biased population census. This is due both to methodological deficiencies and to problems in logistics, where far flung villages make it impossible for censuses to be carried out (personal observation, Gaulme, 1988). After *regroupement*[27], which occurred at various times both before and after Gabon's independence, the population of Gabon has become concentrated around the 565 km of "asphalt roads" and in urban centres (Sautter, 1966; Walker, 2010, p.72; World Bank, 2012) and the railway (Map 3-2).

It is among the urban population, which represents 86% of the Gabonese people, where many of the in-migrants from Central and Western Africa can be found. The urban in-migrant population is found mostly in Libreville and Port-Gentil, where there are around 244,550 in-migrants from Africa, France and China (World Bank, 2012); the Chinese have recently overtaken the French as the biggest resident in-migrant population in Gabon.

2.1.4 Colonisation

Before and during the early part of European colonisation the name "Gabon" referred to the area directly around Libreville and the Gabon Estuary. Different authors reveal that the French colonisation of Gabon occurred at various times from 1839[28] the year when the French signed the first treaty to be given *"deux lieues de terre*"[29] (Gaulme, 1988, p.80; Merlet, 1990, p.61; Pourtier, 1989, p.2; Spero, 1973, p.141). From 1910 to 1958 Gabon was part of the *Afrique Equatoriale Française*[30] and then in 1960 it gained independence.

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[26] "systematically hidden or distorted by a government feeling threatened by [its population's] small size … the results of censuses were, for strategic purposes, significantly modified".
[27] French term used to define villagisation process.
[28] Other dates that have been used are 1843 (Cuvillier-Fleury, 1904, p.78; Gardinier and Yates, 2006, p.xlviii), 1878 (Denys, 1920, p.58) or 1886 (Merlet, 1990, p.20). These dates depend on different treaties signed with various chiefs along the coast, from Loango in the south to Rio Muni in the north (Gardinier and Yates, 2006, p.xlviii).
[29] "two leagues of land"
[30] French Equatorial Africa

2.1.5 Economy

From the 1900s to the 1960s logging was the most important generator of revenue. Oil was discovered by the French in 1929 and its exploitation started in 1957 (Gardinier and Yates, 2006, p.260). It very quickly came to dominate Gabonese exports (Dowie, 2009; Laurance, Alonso, *et al.*, 2006; Wunder, 2003). Thirty years of oil exports made Gabon wealthy (United Nations Statistics Division, 2009). With a GDP per capita of $8,729 in 2010 (World Bank, 2012), it was one of the wealthiest countries of the region, being only recently overtaken by similarly oil-rich Equatorial Guinea.

Even though many rural Gabonese have ties, through the extended family, to elites in the Gabonese administration, this recent wealth is not evenly distributed. Poverty is still prevalent, especially in ethnic groups that have no political representation. As of 2005, the lowest 20% of the population was estimated to share only 6.1% of the income (The World Bank Group, 2007), with a Gini coefficient[31] of 41.5 in 2005 (The World Bank Group, 2014).

Economists have raised concerns that Gabon is too dependent on oil, making it vulnerable to worldwide fluctuations in oil price, events which have been behind several minor economic crises in Gabon (Wunder, 2003; Yates, 1996). The production of oil and the rate of new discoveries have been declining since the late 1990s (Gardinier and Yates, 2006; Leigh and Olters, 2006; Pourtier, 2010, p.1; Wilks, 2003, p.74; Wunder, 2003). For this reason the World Bank has encouraged Gabon to diversify its economy by promoting logging, mining and tourism (Wunder, 2003).

2.1.6 Gabon and land use

Due to Gabon's history (Rich, 2007) and the comparative wealth of the urban population, there are few Gabonese who carry out commercial agriculture, be it large scale mechanised agricultural industries or small scale individual farmers growing agricultural products to be sold (Pourtier, 1984).

With just 1% of its land cultivated (U. S. Department of State, 2009) and an agricultural and food production index that is so small as to be insignificant (United Nations Statistics Division, 2009), Gabon imports a lot of the food from neighbouring countries and Europe, with France supplying 27.7% of its overall imports (U. S. Department of State, 2009). Rural villages and urban towns of Gabon are not therefore surrounded by a sea of agriculture as predicted by von Thünen as would

[31] An measure of inequality where 0% equates with perfect equality and 100% represent maximum inequality.

be found in some other African countries (Nigeria - Watts, 1987; Cameroon - Guyer, 1987; e.g. Tanzania - Bryceson, 1987).

Commercial agricultural products such as tomatoes, onions, bananas and plantains mostly come from Cameroon (Guyer, 1987, pp.136, 141), though some West Africans have set up their own small plots around Libreville from where they grow crops to be sold, such as cassava and sweet potatoes. When Gabonese do grow crops it is usually for subsistence. Commercial cultivation, in Gabon, is seen as a job for in-migrants, while many urban and some rural Gabonese aspire to a job in an office as a civil servant (Rich, 2005; Rich, 2007a).

Even with logging occurring, this unique combination of factors has resulted in Gabon having a low deforestation rate, less than 1%. The 84.5% of Gabon's land that is covered in forest[32] (Figure 2-1) (United Nations Statistics Division, 2009) is being reduced by only 10,000 ha/year (FAO, 2009; FAO, 2006).

As commercial agriculture is unimportant and the rural population is low, there is no population of landless migrant agricultural labourers. So unlike the situation in other places (Hodgkinson, 2009; Poulsen *et al.*, 2009; Riddell, 2013; Riddell, 2011), newly built logging roads do not yet attract a mass in-migration of people looking for potential agricultural land.

In 2002 Gabon set aside 11% of its territory as protected areas in the form of thirteen national parks and in the process cancelled 800,000 ha of timber concessions (WCS, 2007a). As well as protecting the environment there was also the objective of creating high end tourism as a way to diversify the economy (WCS, 2007a).

2.1.7 The study sites

The first set of study sites for the present thesis are in the middle reaches of the Ikoy River, in Gabon's Du Chaillu Massif (Map 2-2 and Table 2-1). This area was chosen as it is one of the most remote areas in Gabon, where market access is difficult and, at certain periods of the year, impossible. To the west of the site is the *sous-prefecture* of Ikobey, which in 2003 had an "unofficial" population of 221[33]. Beyond the rugged hills of Ikobey is the Ngounié River with, on its banks, the towns of Sindara and Fougamou. To the north of the study site is the Lopé National Park and then, on the other side of the Park on the banks of the Ogooué River, the towns of Lopé and Ndjole. To the south of the study site is the Waka National Park followed by one of the

[32] The rest being savannas.

[33] This "unofficial" population is from the raw data of the 2003 census, before it was manipulated for official purposes as a state-approved document.

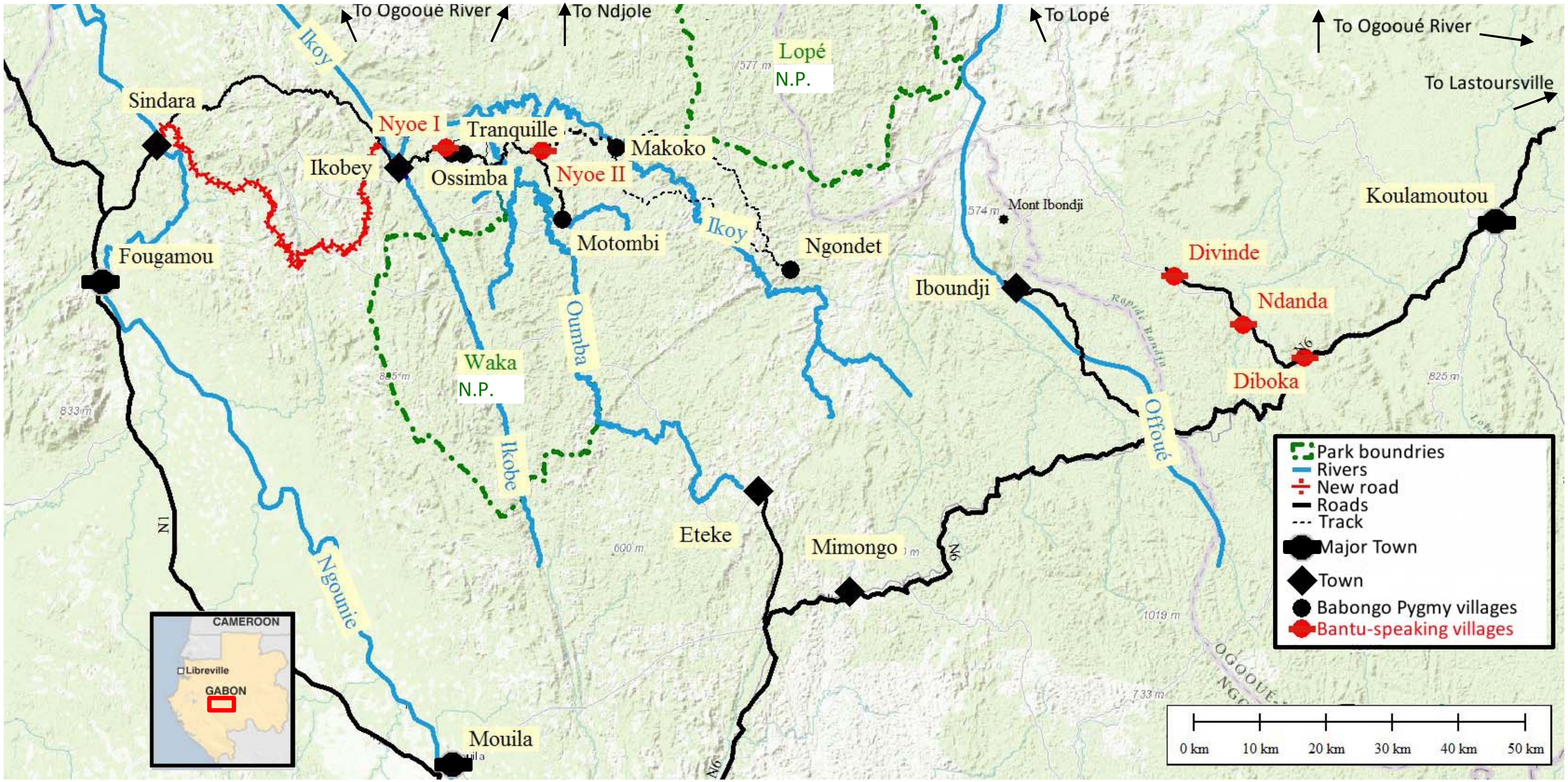
earliest roads in Gabon running from Koulamoutou to Sindara via Mimongo Town and Mouila. Finally to the east the rugged hills continue across the Offoué River to Mount Iboundji and then descend to the logging town of Lastoursville as well as the town of Koulamoutou, both along the banks of the Ogooué River, the latter being the area where the second set of study sites are located (Map 2-2).

Village Name	Nearest market	Distance from market (km)	Pop. size	Principally populated by	Past presence timber company	Last logged (years)	Road access
Diboka	Koulamoutou	41	114	Bantu	No	Never	Yes
Ndanda	Koulamoutou	56	111	Bantu	No	8	Yes
Divinde	Koulamoutou	73	86	Bantu	Yes	8	Yes
Nyoe I	Ikobey	107	68	Bantu	No	4	Yes
Tranquille	Ikobey	110	59	Pygmies	No	4	Yes
Ossimba	Ikobey	113	18	Pygmies	No	4	Yes
Nyoe II	Ikobey	134	59	Bantus	Yes	4	Yes
Motombi	Ikobey	150	36	Pygmies	No	4	Yes
Makoko	Ikobey	152	92	Pygmies	Yes	10	No*
Ngondet	Ikobey	196	74	Pygmies	No	Never	No

Table 2-1: Summary of characteristics of each study site village. NOTE: the village of Makoko did have road access ten years ago.

Many of the villages at the start of the road, near the main highway, have been there since the early colonial days, at a time when Sindara was an active missionary town. However the principal focus of the study is the last section of the road beyond the town of Ikobey. At the furthest end of the logging road the villages are recent; two of the study site villages Nyoe I and Nyoe II were originally formed at the time of the original timber companies, *La Société l'Okoumé de la N'gounié*[34] (La SONG) (Simon, 1953, p.26; Lepemangoye-Mouléka, 2009, see maps in Sautter, 1966, p.762; and Suret-Canale, 1987, p.235). In the 1960s Nyoe II was created as a smaller village next to La SONG's base, which the villagers took over when the timber company left. Others like Tranquille, Ossimba and Motombi were created later. Makoko was created in 2000 (Map 2-2) near what was originally La NEF's (off-shoot of La SONG) timber company headquarters. The Babongo Pygmies settled next to this base a few years after it was abandoned, however the building material for the base had already been taken by the Bantu-speaking Mitsogho of the area to construct houses in villages such as Nyoe II. Since the closing down of La NEF's site the logging road going to the village of Makoko has become overgrown, and is barely a path through thick undergrowth.

[34] The Society of Okoumé of the Ngounié (a river).



Map 2-2: Location of the study site, with Babongo Pygmies and Bantu-speaking study site villages. Based on the following sources: Basemap - (ESRI, 2012), Park boundaries - (Institut Geographique National, 2008).

East of Makoko lies one other village, Ngondet. This is another Babongo Pygmy village that is off the road, and a hard day's walk for the Babongo Pygmies, from Makoko. There are several routes through the forest that go to this village, one of which is to walk along an old logging road and then, when this logging road comes to an end at a steep hill about half way to the village, following a small path that continues through the forest (Map 2-2). Around this village, during colonial times, there had been many other villages containing several ethnicities (Ossimba, Akele, Mitsogho, Apingi, and Babongo Pygmies). On some maps the old village of Mimongo, labelled *Ancien Mimongo* (TerraMetrics, 2011), can still be seen, while on the ground there is still evidence of these old village sites, including clearings, fruit trees and old pots (personal observation).

To the west of the Ikobey study site lies the first road that was created in Gabon. Started in 1910 and finished in 1927, this road was first a path created to divert riverine traffic around the Samba falls between the town of Fougamou and Sindara. The Samba falls was at the time a bottle neck to the riverine transport on the Ngounié River (Gray, 2002, pp.151–153; Gouvernement Général de L'Afrique Equatoriale Française, 1928, p.VI). Eventually this path became part of the first road network that joined the middle and lower parts of the Ngounié (Lasserre, 1955) and later joined Libreville to Franceville, before the *Route Economique* was built.

The second set of study sites is near the market town of Koulamoutou. This site was chosen as a comparison to the Ikobey site due to their relatively easy market access, with the market being closer to these village sites than the ones in the Ikobey site (Map 2-2). Koulamoutou is the *chef-lieu* of l'Ogooué-Lolo province. In 2003 this town had an "unofficial" population of 17,393; it is about half an hour from the *Route Economique* that crosses Gabon. As the *chef-lieu*, the local administration is based there and there are numerous shops and daily markets, including a bushmeat market (Starkey, 2004). There is also a national airport. To the west of Koulamoutou lies the second set of sites. These villages are in the foothills of the Du Chaillu Massif, with one village, Divinde, being not far from Mont Iboundji and so the most easterly study site village in the Ikobey area, though access is only through the forest. To the south of Koulamoutou is Franceville, while in the east is Lastoursville, a major logging town with a railway station.

2.2 Overview of methods

There are many theoretical and methodological tools at the disposition of conservation biologists that allow them to study different parts of an ecosystem, including historical, social and ecological dimensions. All these tools have their strengths but also their weaknesses, for every method has its weaknesses (Bernard, 2011; Maier and Imazeki, 2013). Both the past and current bias towards a subset of tools that mostly originate from the natural sciences has biased the outcomes of conservation efforts towards the limitations inherent in these tools[35]. By using both the biological and social tools triangulation between datasets can be carried out (Drury *et al.*, 2011) to reduce biases, assumption drag and negative learning.

The push for a multidisciplinary approach to conservation has been practiced since at least the 1950s (Balmford and Cowling, 2006; Drury *et al.*, 2011; Ehrenfeld, 1987; Mermet *et al.*, 2013; Newing, 2010, p.411; Pooley *et al.*, 2014) with the rise of sub-disciplines (see table in Cooke *et al.*, 2013; as well as table in Pretty, 2011; Balmford and Cowling, 2006; Clayton and Brook, 2005; Grabbatin and Rossi, 2012; Mascia *et al.*, 2003; Schultz, 2011) that have brought "significant new bodies of information" (Healy and Ascher, 1995, p.1) including methodological techniques and theoretical frameworks, though as yet these disciplines and even sub-disciplines have not managed to fully integrate with each other (Ascher, 1999b; Newing, 2010; Pretty, 2011).

However, such multidisciplinary collaboration is difficult, not only due to academic differences such as language used, ethics, methodology, respect as well as lack of funding and time constraints that advantage "quick and dirty" methods over more time consuming and in-depth methods (Balmford and Cowling, 2006; Drury *et al.*, 2011; Fox *et al.*, 2006; Harris and Lyon, 2013; Martín-López *et al.*, 2009; Martín-López *et al.*, 2008; Phillipson *et al.*, 2009; Sandbrook *et al.*, 2013; Sievanen *et al.*, 2012). Collaboration is further hindered as career advancement is increasingly being linked to impact factor of papers which are usually lower in inter-disciplinary journals, even though multidisciplinary work increases the likelihood of scientific articles being published in high impact journals (Uzzi *et al.*, 2013), while social science papers submitted to conservation biology journals are reviewed by biologists (Adams, 2007; Campbell, 2005; however see Hicks *et al.*, 2010). Due to these difficulties multidisciplinary teams may not be the best way forward, rather multidisciplinary people are needed (Adams, 2007, p.276; for an example of the mishmash of disciplines, including: history, sociology, geography and linguistics

[35] The use of only social science tools also creates biases.

see Alexander, 2000). However, at a time where knowledge is expanding at a pace where academics cannot keep up with the literature in their own field, it is even harder for a multidisciplinary person to stay ahead of the literature from several different fields and so they need to demarcate their research[36]. A multi-disciplinary person cannot be expected to be an expert is all the disciplines that they will need to help them elucidate problems, however they should have the skills to understand colleagues from different disciplines who may use ideas, language and ethics that are different to theirs. Furthermore they should be able to translate these in such a fashion where it is not only understandable to themselves but also to their colleagues in their own discipline and should be able to bring ideas from different disciplines together.

The following outline of methods is my effort to try and incorporate a multidisciplinary approach to this study, by using both biological and social science methodologies (Ascher, 2007, p.144) to collect qualitative and quantitative data that is needed. Full methods are given in the relevant chapters. I have used an adaptive methodology / research approach to the research questions that I have posed. This allows the findings from the study sites to demarcate the investigation, allowing one to refine the background research and methods needed. In this way it reduces the risk of too narrowly circumscribing the interconnected data to one discipline, and so the risk of ignoring relevant information from other disciplines that may be important to this investigation.

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[36] Devons and Gluckman (2007, pp.162–169) proposed a five step procedure for demarcating an anthropological investigation, which can also be useful for a multidisciplinary person or team to follow. The first step that they proposed was to carefully *circumscribe* (Devons and Gluckman, 2007, pp.185–212) the research to isolate a manageable "amount of interconnected data" (Devons and Gluckman, 2007, p.162) in both time and space. Once this is done then facts and events that can be taken for granted from other disciplines need to be *incorporated* (Devons and Gluckman, 2007, pp.169–173). Flowing from this is also the need to base an analysis on theories and hypotheses from other disciplines which, also often have to be taken for granted this step Devons and Gluckman called *abridgement* (Devons and Gluckman, 2007, pp.173–185). In the process of *abridgement* there will be times when the researcher has to make *naïve* (Devons and Gluckman, 2007, pp.212–253) assumptions about complex events that are studied by other disciplines, by doing so they have to carefully disregard the research of others and just taken their findings at face value. The limits of naïvety have to be respected by both the researcher and fellow colleagues from other disciplines (Devons and Gluckman, 2007, pp.166–169). The researcher should be wary of drawing conclusions from their studies that go beyond their expertise, while fellow colleagues should be wary of criticising this naïvety, especially if it is not central to the research being carried out. The final step is *simplification* (Devons and Gluckman, 2007, p.169), whereby facts and variables from the researchers own field have to be simplified, for example by using well known models and using a sampling structure that limits the data that needs to be collected to the bare essentials.

The study was principally undertaken in two different environments, the first being the village where social methods were used and the second the area around each village where ecological methods were used.

The study was carried out in two periods. Pilot work from October 2008 to February 2009 was used to get to know the area of each site, select appropriate villages and test methods. The principal fieldwork was carried out during the second period running from February 2010 to August 2010, with follow up questions carried out from September 2010 to January 2011. During this time a total of approximately one month was spent in each village, spread out over the year. The principal fieldwork was carried out in the dry season starting at the end of the short rainy season and finished at the beginning of the long rainy season.

Research was conducted in two different sites that were formerly logged. The first set of sites around Ikobey, chosen due to the difficulty of access to the communities there, had been abandoned by timber companies four years before the start of the study (Table 2-3). However just at the end of the study in 2011 a Chinese timber company started operations in the area. It is in this site that a more detailed study was undertaken. The site consisted of six villages, four of which are next to a road and two far from a road (Table 2-3). Some of these sites were populated by Babongo Pygmies, others by Bantu-speaking peoples (Table 2-4). To get to these sites public transport was used at first and then, later on in the study, personal transport was used.

The second set of sites, around Koulamoutou, had been abandoned by timber companies eight years previously. However access to the communities in this site is still relatively easy, with the roads last being maintained within the last three years (Table 2-4). This site consists of three Bantu-speaking villages, but only one has been directly influenced by timber companies, Divinde; the other two villages, Diboka and Ndanda, are at various distances from the major market town of Koulamoutou.

2.2.1 Historical approach

This thesis is primarily socio-ecological, though it does bring in some historical elements, mainly from authoritative secondary sources (such as Chamberlin, 1977; Coquery-Vidrovitch, 2001; Gray, 2002; Gray, 1998; Headrick, 1994; Klieman, 2003; Martin, 1972; Merlet, 1990; Patterson, 1975a; Rich, 2007a; Sautter, 1966; Vansina, 1990). Online archives were also used, particularly those offered by the Internet Archive (www.archive.org), the British Library (www.bl.uk), the

British Newspaper Archive (www.britishnewspaperarchive.co.uk), *Bibliothèque nationale de France* (gallica.bnf.fr), *Persee* (www.persee.fr) and *Horizon Pleins Textes* of the *Institut de Recherche pour le Développement* (horizon.documentation.ird.fr). The results from this research feed into the chapter on the background to Gabon, its environment and the timber industry in Gabon (Chapter 3), the chapter on the background of the study site (Chapter 4), in the chapter on the timber industry and access (Chapter 5) and finally the chapter on the timber industry and development (Chapter 6).

To allow the findings of this research to be put into the local context, village histories were recorded in the Ikobey site (Table 2-2, for detailed methods of village histories see Chapter 4.3). This information was triangulated with interviews from other villages, old foresters' accounts, and historical accounts found in the literature and in electronic archives, as well as with maps from the 1960s onwards.

<table>
<tr><th rowspan="2">Village</th><th rowspan="2">Distance to market (km)</th><th rowspan="2">Number of households in village</th><th rowspan="2">Total population of village</th><th colspan="2">Oral histories</th></tr>
<tr><th>Number of interviews</th><th>Total number of people involved</th></tr>
<tr><td>Diboka</td><td>41</td><td>38</td><td>114</td><td colspan="2" rowspan="3">Oral histories were not carried out in these villages.</td></tr>
<tr><td>Ndanda</td><td>56</td><td>20</td><td>111</td></tr>
<tr><td>Divinde</td><td>73</td><td>21</td><td>86</td></tr>
<tr><td>Nyoe I</td><td>107</td><td>16</td><td>68</td><td>4</td><td>9</td></tr>
<tr><td>Tranquille</td><td>110</td><td>15</td><td>59</td><td>4</td><td>8</td></tr>
<tr><td>Ossimba</td><td>113</td><td>5</td><td>19</td><td>5</td><td>9</td></tr>
<tr><td>Nyoe II</td><td>134</td><td>15</td><td>59</td><td>6</td><td>12</td></tr>
<tr><td>Motombi</td><td>150</td><td>6</td><td>36</td><td>5</td><td>10</td></tr>
<tr><td>Makoko</td><td>152</td><td>22</td><td>92</td><td>5</td><td>12</td></tr>
<tr><td>Ngondet</td><td>196</td><td>14</td><td>74</td><td>5</td><td>10</td></tr>
</table>

Table 2-2: Summary of the number of open interviews and total number of people involved in the collection of oral migration histories as used in Chapter 4.

2.2.2 Geographic information system methods

A Global Positioning System (GPS) was used to pinpoint the location of each study site and each building in the village, in this case a Garmin GPSMAP 76CSx which allows reception of satellites under a forest canopy. A track log, in both distance and time, was recorded for the route used to get to and from these sites to the nearest market. The time taken to get from each village to the nearest market was averaged (full details in Chapter 5.4). These data (Table 2-3) are used in the chapter on the timber industry and access (Chapter 5), the chapter on the timber industry and development (Chapter 6) and the chapter on livelihood activities (Chapter 7).

A GPS was also used during the forest and animal surveys to create waypoints for the start and end of the transects as well as for individual waypoints observations. This dataset was used in the chapter concerning the human impact on wildlife and on the forest (Chapter 8).

GPS data were analysed using several different Geographic Information System software packages including ExpertGPS (Foster, 2013), to quickly work out distances between waypoint along the transects, and Global Mapper (Blue Marble Geographics, 2013) to map track logs and place them on digitised maps (both old and recent).

Village	Nearest market	Distance to market (km)	Road last maintained prior to 2010	Last maintained by	Number of cars observed in 12 day period	Cost of taxi to market	Average number of hours to market (N)
Diboka	Koulamoutou	41	1 month	State / Timber company	85	500	1.40 (5)
Ndanda	Koulamoutou	56	3 years	State / Timber company	4	1000	2.15 (3)
Divinde	Koulamoutou	73	4 years	State / Timber company	4	1500	3.25 (2)
Nyoe I	Fougamou	107	4 years / 1 month	Timber company	2	6000	5.30 (8)
Tranquille	Fougamou	110	4 years / 1 month	Timber company	2	6000	5.45 (8)
Ossimba	Fougamou	113	4 years	Timber company	2	6000	6.00 (8)
Nyoe II	Fougamou	134	4 years	Timber company	2	6500	7.20 (8)
Motombi	Fougamou	150	4 years	Timber company	1	7000	9.03 (4)
Makoko	Fougamou	152	10 years	Timber company	road not passable	6500	14.20 (10)
Ngondet	Fougamou	196	no road	NA	no road to village	6500	40.30 (4)

Table 2-3: Summary of access data to each village site from the nearest market.

Village	Principal ethnicity	Demographic data used in Chapter 4				No. of employed people who were recorded for data in Chapter 6	Items collected data used in Chapter 7	
		Total no. of Households	No. of households who participated (% of households who participated)	Total Pop. size (2010)	No. of people who participated		No. of households who were recorded (% of households who participated)	No. of people who were recoded
Diboka	Pove	38	35 (92%)	114	73	36	36 (95%)	75
Ndanda	Pove	20	18 (90%)	111	42	18	18 (90%)	41
Divinde	Pove	21	19 (90%)	86	42	14	19 (90%)	40
Nyoe I	Mitsogho	16	11 (69%)	68	40	17	15 (94%)	49
Tranquille	Babongo	15	11 (73%)	59	41	9	15 (100%)	41
Ossimba	Babongo	5	5 (100%)	18	17	6	5 (100%)	15
Nyoe II	Mitsogho	15	15 (100%)	59	49	18	15 (100%)	38
Motombi	Babongo	6	6 (100%)	36	21	6	6 (100%)	22
Makoko	Babongo	22	15 (68%)	92	51	17	20 (91%)	54
Ngondet	Babongo	14	13 (93%)	74	39	3	14 (100%)	47

Table 2-4: Summary of semi-structure interviews used as data for the various chapters. For Chapter 6 all employed people were recorded. For Chapter 7 all people who returned to the village with an item were recorded. Percentage of people who participated are not show here as the total 2010 population size includes children and infants.

2.2.3 Social methods

Questionnaires (Appendices 11.5 and 11.6) and village histories were carried out in each of the study villages, usually by myself carried out in French with a Mitsogho translator at hand in case further explanation is needed. In rare cases, usually with elders, interviews were carried out in Mitsogho with a translator. In all cases the interviews were recorded electronically and, in the case of the interviews carried out in Mitsogho, they were then translated into French by the translator who was present at the interview.

In each of the questionnaires the principal representative of each household was asked to participate in demographic questionnaires concerning themselves and their fellow members of the household (full details in Chapter 4.3), including ones who were born in the household but had migrated away. Where possible education levels and past employment of people in the household were collected from each individual or, when unavailable, from the head of the household (full details in Chapter 6.4). In the context of this research a household is considered to be a group of people living in one house; this could include several buildings, such as kitchen, main house and secondary house. To help in the identification of households, a map of the village was created with the help of members of the village. For each house a number with a GPS point and a head of household was attributed. Due to the small size of Gabonese villages[37] no sampling strategy was used, with all the households asked to partake in the study (Table 2-4 and Table 2-4). For various reasons, some households preferred not to participate, however the large majority did with the lowest percent of participating households being 68% in the village of Makoko (Table 2-4).

To encourage participation in the questionnaires and to compensate participants for their time, in a locally meaningful but not excessive way, food items were given to participating households (e.g. rice, salt, sardines, tomatoes, oil, coffee, sugar and powdered milk). To further help the local economy these items were bought from the nearest shop (this also reduced carbon emissions that would have resulted from these items being transported by ourselves from urban

[37] In some cases villages have less than 10 people.

areas). To encourage participation in open-ended group interviews on village histories, soft drinks were distributed during the interviews[38].

The questionnaires (Appendices 11.5 and 11.6) were based on, but not limited to, those that have been used by several other projects in Gabon, including *Projet Gibier*[39] that ran in Gabon between 2000 to 2007, and the Gabon Parks and People project that was carried out in 2005 (Wilkie *et al.*, 2006). The first set of questionnaires (Appendix 11.5, Table 2-4) covered simple demographic data used in Chapter 5, and on transport infrastructure created by timber companies. This questionnaire also covered education levels and past employment histories and was used in Chapter 6 on analysing post-logging development impacts.

Data on age or date of birth were collected. However, in some cases, especially for the elderly and the Babongo Pygmy populations, no birth date or age could be ascertained. When this occurred the age of a person was estimated either by asking other villagers or in the worst cases visually. For this reason, data concerning the age of a person was split into one of the following five subjective age categories:

- infants – 0 to 12 months,
- child – 2 year to 12 years,
- teenager – 13 to 18 years,
- adult – 19 to 59 years,
- elderly – 60 + years.

A second set of questionnaires (Appendix 11.6, Table 2-5) covered the activities that were carried out by each participating household. This was repeated over a period of twelve days, including the items that were brought into the household (full details in Chapter 7.4). These data were used in Chapter 7 concerning post-logging livelihood activities.

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[38] The drinks distributed during these interviews were non-alcoholic. If alcoholic drinks were distributed, this was at the end of the interviews and consisted of local drinks such as palm wine, rather than spirits such as kai-kai (distilled palm wine) and gin.
[39] Managed partially by myself.

Village	Distance to market (km)	Dates of survey	Number of households in village	Total population of village	Number of households who were recorded	Number of people who were recorded	Number of times people were recorded in collection survey	Number of items collected that were recorded
Diboka	41	02/06/2010 to 14/06/2010	38	114	36	75	344	977
Ndanda	56	16/06/2010 to 28/06/2010	20	111	18	41	163	406
Divinde	73	04/07/2010 to 26/07/2010	21	86	19	40	187	380
Nyoe I	107	22/05/2010 to 02/06/2010	16	68	15	49	189	318
Tranquille	110	08/05/2010 to 20/05/2010	15	59	15	41	173	339
Ossimba	113	26/04/2010 to 07/05/2010	5	19	5	15	98	160
Nyoe II	134	18/04/2010 to 30/04/2010	15	59	15	38	144	294
Motombi	150	03/04/2010 to 16/04/2010	6	36	6	22	92	163
Makoko	152	18/03/2010 to 30/03/2010	22	92	20	54	169	246
Ngondet	196	03/03/2010 to 15/03/2010	14	74	14	47	177	261

Table 2-5: Summary of the number of people participating during the twelve day collection survey.

2.2.4 Ecological methods

Ecological data were collected along eight strip transects radiating out from each village site like the spokes on a wheel (full details in Chapter 8.4). Over a distance of two kilometres animal tracks seen one metre on either side of the transect line were noted. As best as possible these tracks were identified to the species level, which in the case of elephants is a simple task, otherwise to the order, as in the case of antelopes (Davies, 2002a; Sutherland, 2006; White and Edwards, 2000a).

In addition to noting animal signs, human disturbance on the forest was also noted. This included signs of hunting, agriculture and logging. The stage of forest succession was also noted as one of three categories, plantation (old or new), secondary forest and mature forest. Both of these datasets were used in the chapter concerning the human impact on animals and the forest around the sites (Chapter 8).

2.2.5 Data analysis

Various statistical[40] analyses were used with different statistical packages. In the case of univariate analysis QED was used (Seaby and Henderson, 2007), for various analyses R (R Core Team, 2014; RStudio Inc., 2014) was used with the following packages: RExcel (Baier and Neuwirth, 2009), Rcmdr (Fox, 2005), MASS (Venables and Ripley, 2002) for carrying out AIC calculations, Linear Mixed Models and Generalised Linear Models, pscl for Zero-Inflated Poisson and Zero-Inflated Negative binomial testing, (Jackman *et al.*, 2014), lmtest for testing various linear regression models (Hothorn *et al.*, 2014).

Before any modelling was conducted data were tested for normality, outliers and collinerarity as set out by Zuur *et al*. (2010) using R package lattice (Deepayan, 2008). The resulting final models were tested for validity by looking at the normality of residuals, homogeneity and independence (Zuur *et al.*, 2009, pp.19–22). Overdispersion was assessed using Pearson residuals (Zuur *et al.*, 2015, p.146).

Models for Chapters 5 to 8 were chosen using an information-theoretic approach following Anderson and Burnham (2002). This uses Akaike's Information Criteria (AIC) or Akaike's Information Criteria corrected for small sample bias (AICc), depending on sample size (Anderson

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[40] From the German *Statistik* "to describe efforts in the comprehensive description of political states" (Hilts, 1978, p.24).

and Burnham, 2002; Zuur *et al.*, 2009). All possible model combinations were tested using the automated methods in the MuMln R package (Bartoń, 2004).

Generalised Linear Models (GLMs) were used in Chapters 6 and 7. Due to the excessive number of zeros in the education response variable, representing people with no education, the Generalised Linear Model of the education dataset, in Chapter 6, was investigated with Zero-Inflated Poisson (ZIP) and Zero-Inflated Negative Binomial (ZINB) fitted to the data (Zuur *et al.*, 2009, pp.261–293). The employment data in Chapter 6 were investigated with a logistic mode and resulting models were tested with an AIC approach.

As the animal sign observations in Chapter 8 consist of nested count data that is overdispersed, a Generalised Linear Mixed Model (GLMM) fitted with a negative binomial distribution was used. This was done using the glmmADMB package in the R environment (Bolker *et al.*, 2012; Fournier *et al.*, 2012, p.245; Zuur *et al.*, 2015, p.146).

In all cases the data analysis is only exploratory in nature and conclusions can only be indicative[41], with the results from these methods only indicating the best model from different alternatives. They cannot distinguish if the proposed models, the computer[42] used to created them or the data that is put into them[43], suffer from GIGO (Garbage In Garbage Out) (Askira Gelman, 2011; Babbage, 1864; Hinde, 2004; Searle, 1993)[44]:

> Every model is an abstraction from reality. It seeks to throw out the bath water of irrelevancies while firmly holding on to the baby of significant relationships. The problem is that when reality involves people it is not easy to discern which relationships are significant. All too often the model-builder, having constructed his model, has the sensation that he has understood reality, and is therefore but

[41] Only after repeats of this study (Ascher, 1979; Frieler *et al.*, 2013; Goldfarb and King, 2013; Maier and Imazeki, 2013; The Economist, 2013a; The Economist, 2013b; The Economist, 2013c) with an eye on "negative learning" (Brysse *et al.*, 2013; Oppenheimer *et al.*, 2008) can the results drawn from this study be thought of as more definitive, assuming unbiased calculations without errors (Herndon *et al.*, 2013; Jager and Leek, 2013; Keilman, 1998; Tyszkiewicz, 2013).

[42] Such as computers with an Intel P5 Pentium processor, which suffered from incorrect decimal results, also called the Pentium FDIV bug (Nicely, 2011; Halfhill, 1995).

[43] Into which errors can accumulate from several sources including methodological issues including faulty equipment (e.g. findings on faster than light neutrinos Reich, 2011; Reich, 2012), using baseline data that has been found to be incorrect errors (Keilman, 1998; Maier and Imazeki, 2013), or a simple typographical error in an excel sheet such as a bad cell or column reference (Tyszkiewicz, 2013).

[44] GIGO has been "transmuted to Garbage In, Gospel Out" (Hinde, 2004, p.12).

> one step from mastering it. Doubtless the same sensation of mingled enlightenment and power filled our remote ancestors when they drew stags and mammoths on the walls of their caves. Alas, one has only to contemplate the god-awful mess our economies are in today to realise how far from reality are the models erected by the various schools of economists. Similarly, and precisely because people enter into the equation, the models of managerial science often fail to reflect reality (Westoby, 1984, p.148).

Models and statistics should be used with great care (Appendix 11.7) for just as political science holds up "a chalkboard universe inhabited by *'homo economicus,:'* which, in the name of utility maximization, tries to erase all trace of culture, history, personality or any quirky quality that might smudge the one size fits all model" (Jacobsen, 2001; Rees, 2002) so ecological models reduce complex interactions that in reality are so complex that a large computer may be needed (Adams, 2009). Equally, while the researcher during the reduction process will be unlikely to capture all the relevant variables and data, some of which may play a role in certain situations and not others, especially if a variable varies considerably over years or decades such as rainfall in Africa (Behnke *et al.*, 1993).

2.2.6 Critique of data collection

The use of statistics is not the only area in which care needs to be taken in the interpretation of the data in this thesis. There are also several issues with this study and methods, not least the number of villages used. It would have been preferable to have had sets of several villages at various distances from the same market where only the time since a timber company was present varied for village sets, with the starting point of this chronosequence being just before the departure of a timber company. In this case the dataset would have had several villages ten kilometres from a market which differed by the number of years since a timber company departed, followed by set of villages at other distances from a market. However, reality is much more complex, with, as in this case, villages having different ethnicities, topography, histories, political alliances, all of which complicates any analysis.

Furthermore, the number of villages that would have been required would have led to a long study length and logistical issues. Logistical issues would have been especially hard in the case of villages far from market towns due to the breakdown in transport infrastructure making it increasingly difficult to get to these villages, as was discovered by a livelihood and protected area project in Gabon who were unable to continue their research in one of their sites (Foerster *et al.*, 2011). Such logistical issues can be resolved but only at great expense, for example through the use of 4 by 4s, which in turn biases any social research that is carried out, as this results in raised expectations as well as perceptual biases from the communities involved (Maranz, 2001; Woodhouse *et al.*, 2015, p.9) (Picture 2-1 and Appendix 11.3).

Picture 2-1: Expectations from transport (illustration from Maranz, 2001, p.x)

Expectations are not the only issues with social methods; there are pitfalls and traps of which the researcher needs to be aware (Bernard, 1994; Cooke and Kothari, 2001; Cornwall, 2011; Kumar, 2002; Wolcott, 2005). Some of these are discussed below in relation to this study.

The use of oral histories has created much discussion, especially around history and memory and how these histories can be used and abused (Thomson, 2007; Thomson, 1998). They can also mark specific events that have marked the people recounting the oral history (Thomson, 2007; Thomson, 1998). Within this study it was found to be easier and quicker to understand the broad brushstrokes of the migration of the people to the Ikobey site through one meeting that involved as many members of the community as possible. Although this approach produced the most confusion as different members of the community tried to integrate their histories into a general one of the village, especially if the village consisted of several ethnicities. However, it also allowed the memory of individual community members to be jogged. This helped when it came to recording the finer details of the oral histories in follow up oral histories carried out with small groups within the community. These oral histories also highlighted two important events that had a major impact on the people who migrated into the Ikobey area, *régroupement* and the arrival of the early timber companies (Chapter 4).

The use of semi-structured interviews in each of the village sites to get information on demography, employment and education, rather than purely structured interviews, not only allowed the basic collection of data but also to give further details about schools and employment, especially in relation to migrations and timber companies. This did result in the interviews being longer and increased the risk of prompting the respondent towards a certain response at the risk of others (Bernard, 1994). However, this was un-avoidable since the objective of the research was known by all the community in each village. A village meeting involving all the community was carried out before the start of the research to introduce myself, the project, the assistants and the method of compensation that was being given to people who participated in the study.

Though general data on education and employment was collected from the household head for the people who were absent, in-depth data is limited to the people who were currently in the village at the time. This had the result that the observation discussed in Chapter 6 on the disintegration of development after a timber company has left an area, may be biased towards the less educated as well as the unemployed, as it could be that the educated and employed are no longer in the village.

As data on transport to each village was only collected during the dry season (Chapter 5), this data only represents the best case scenario not only for speed and time to each village but also for taxi fares. During the wet season speed to each village would decrease while time and taxi fare to each village would increase. This would have repercussions on any trade carried out by the villagers, as in the wet season the transport infrastructure breaks down, resulting in the road being closed for days and weeks at a time, so further increasing the difficulty in trading natural resource products in towns.

Due to the break down in transport during the wet season, the data collected on the use of natural resource items that people return with to the village (Chapter 7) also represents a best case scenario, as these data were also collected during the dry season when transport to market is easier. Other sources of bias in this data set, especially when the trade in bushmeat is involved, is the unwillingness of people to display such products. However, through active participation within the community, being clear with the community regarding the objectives of the study and because of the small size of the villages involved whereby it was hard to come in and out of the village without others knowing, this bias was reduced.

3 Background resource use history. Exploitation of natural resource since the Atlantic Trade and its short and long-term impacts on the environment and economic development of Gabon

> “wherever humans have trodden, the natural environment is somehow different, sometimes in barely perceptible ways, sometimes in dramatic ways” (Balée and Erickson, 2006, p.ix).

3.1 Summary

This chapter explores the first part of the proposed amendment to the chain of logic, that timber companies open up areas that have not previously been commercially exploited (Figure 1-1 and Figure 1-3). In the process it discusses the short-term impacts of the trade in natural resources on the environment and then suggests the probable long-term impacts that they have had on the environment both in ecological terms of patch dynamics, and also in terms of the economic development of Gabon. This chapter focuses on what Gabonese history can tell us as to the likelihood of long-term success of conservation and development initiatives in remote rural forest areas that rely on transport infrastructure built by timber companies.

This chapter shows that the trade of natural resources from Gabon did not start within the last hundred years with the penetration of timber companies into remote rural areas, as claimed by some (e.g. Fay, 2004b), but can be tracked back to at least 6,000 years ago with the exploitation of basalt rock (Clist, 1995) (Appendix 11.8). Human impact on Gabon’s forest builds and wanes with changes in politics, trade, discoveries, technological advances, transport and disease. It cannot be said that there is “primary” or “virgin” forest in Gabon, or that environmental degradation of these forests is a recent phenomenon.

The spread of trade and then colonisation has resulted in increasingly industrialised natural resource extraction, which accelerates with technological and political changes. However, the same processes resulted in several disease epidemics and famine that had a role in reducing the population of Gabon and in shaping its environment. This has resulted in a landscape that contains areas which are highly valued by timber companies, due to the number of *okoumé* trees, and by conservationists, due to their biodiversity.

This chapter does not offer a historical analysis, but rather uses mostly secondary sources relatively easily available to ecologists interested in Gabon[45] to review the past and current trade of natural resources from Gabon. This overview commences with the important, if indirect, role that trade has had on the Gabonese landscape, that of facilitating the spread of disease (Chapter 3.2.1). The chapter then summarises the trade of natural resources before and during the Atlantic Trade period and some of the environmental impacts that this may have had (Chapter 3.2.2). However, this chapter's principal focuses is on the trade of natural resources during the colonial and post-colonial period, especially that of the trade in timber (Chapter 3.2.3). It shows that the trade of timber in Gabon has not led to the development of local economies but rather has been behind economic booms and busts that date back to at least 1815 (Chapter 3.2.3.3). Furthermore, though the exploitation of timber has become more mechanised, it has not led to an increase in environmental degradation but rather the opposite due to reductions in the size of the workforce.

3.2 Introduction

Though conservationists usually acknowledge that there is a long history of local people using the African landscapes, it is less recognised that the commercial exploitation of natural resources from this landscape also has a long history. In Gabon the commercial exploitation of resources predates the start of the Atlantic Trade. Later historical descriptions of this commerce shows how they impacted both the environment and the economic development of Gabon.

The biophysical landscape can be read "like a text, but not one that is readily accessible to historians' and epigraphers' methods because it is not written in a decipherable script, but rather is inscribed in a subtle, physical sense by learned, patterned behaviour and action" (Balée and Erickson, 2006, p.2). This "text" can be useful to conservationists when thinking about the impacts that timber companies may have on remote rural forested areas and its succession once they depart, as it allows a comparisons with other similar landscapes that have undergone disturbance in the past (Reich *et al.*, 2001). These landscapes, since their disturbance which can be either natural or human, are at various stages of succession through patch dynamics.

Historical, archaeological, and linguistic references on the trade of natural resources from Gabon abound. This history of natural resource trade in Gabon can be split into four periods, 1) pre-

[45] Surprisingly mostly in English.

Atlantic trade (pre mid-fifteenth century) (Appendix 11.8), 2) the Atlantic trade (mid-fifteenth century to mid-nineteenth century) (Appendix 11.9), 3) the colonial trade based on logging (end of the nineteenth century to 1960) (Appendices11.10, 11.11 and 11.12) and 4) the post-colonial trade (1960 onwards) which is dominated by oil and minerals. The process of transition from one period to another does not occur abruptly but rather with a progressive change as economic niches open and close over time. These economic niches are exploited by various players who at different times adapted themselves to exploit the different economies and ecologies that appear (Klieman, 2003; Klieman, 1999; Klieman, 1997; Vansina, 1990).

Understanding of the first period is limited by the archaeological data available and is widely acknowledged by conservationists (Delègue *et al.*, 2001; Maley, 2001a; Maley, 2001b; Maley, 2001c; Ngomanda *et al.*, 2007; Oslisly *et al.*, 2013; Oslisly, 2001; Palla *et al.*, 2011; Schwartz, 1992; Schwartzman *et al.*, 2000; White, 2001; White, 1992; Wilks, 2003). From the second period, at the start of the Atlantic trade, available data increase with the trading accounts dating from this time[46]. For instance, due to its value, the trade in ivory has been well documented before, during and after the Atlantic trade (Barnes, 1996; Douglas-Hamilton, 1979). The third period is dominated by the exploitation of timber and has impacted the study sites. In the fourth period revenue from logging has been overshadowed by off-shore oil, though timber is still Gabon's biggest exploited natural resource by surface area. This chapter focuses on the colonial and post-colonial periods and is mostly viewed in relation to logging.

In describing some of the historical trade in natural resources that has shaped the Gabonese landscape, not only do I try to address the first part of the proposed amendment to the logic chain (Figure 1-1 and Figure 1-3), but I also put into historical context the study sites that are used to investigate what may occur after a timber company leaves a remote rural forested area.

Migration and the spread of disease, due to increased trade and the breaking down of trade barriers, that started during the Atlantic trade period and continues today, have had a profound impact on the Gabonese landscape, partly explaining the presence in Gabon of areas that have high *Okoumé* densities. As trade, migration and disease partially underpin the Gabonese

[46] These being full of references on where and what to trade, where natural resources have been exhausted, prices and other information to help the then merchant trader.

landscapes I first describe a framework to help understand the possible environmental consequences that these continue to have.

3.2.1 Trade and the spread of disease in Gabon (mid-fifteenth century to present)

In Africa, the "cradle-land" (Reader, 1998, p.234), humans and some of their parasites and diseases have had millennia to co-evolve (Hartwig and Patterson, 1978). Over this time they have achieved "biological harmony"[47] (Spinage, 2012, p.1194). However, people outside of Africa have long viewed Africa as an "unhealthy tropical cesspool" (Zeleza, 1993, pp.40–41). Though this view may be biased, stemming from a Europe that is no longer at the mercy of diseases such as cholera and malaria (Zeleza, 1993, p.41), the recent West African Ebola epidemic, where 11,299 people died (WHO, 2015), is a reminder of the devastation disease outbreaks can cause[48].

Diseases, both zoonotic and human, have played a significant role in determining the demography (Cordell, 1983, p.49) and the ecology of Africa. Spinage (2012, pp.821–1364) dedicated a third of his book on African Ecology to the description of the different impacts that various diseases have had on Africa, adding that the "tsetse flies and trypanosomiases, [are] two of the most important influences in African ecology" (Spinage, 2012, p.v). Disease, famine and migration, have resulted in the depopulation of rural areas that has shaped, and continues to shape, the environment of Africa[49] including Gabon (Coquery-Vidrovitch, 2010) and, in the early twentieth century, one of the research sites. This depopulation has led to Gabon being named one of the last "African Edens" (BBC Travel, 2013; National Geographic, 2007; Odendaal and Day, 1999).

Diseases have hindered the exploration, trade and colonisation of Africa by European powers (Birmingham and Martin, 1983; Curtin, 1968; Curtin, 1989; Curtin, 1998; Debusman, 1993; Patterson and Hartwig, 1978; Webb, 2013). Before sanitation and quinine, the death rate for Europeans arriving in Africa was 50 percent; it fell to 25 percent in the following years (Curtin, 1998, p.1). These deaths were not limited to Europeans. African soldiers were conscripted to

[47] It can take as little as 150 years for zoonotic diseases to become established in humans (Spinage, 2012, p.1194).

[48] "Emerging diseases" such as Ebola and HIV are likely to be ancient diseases (Spinage, 2012, p.1204). The oral histories that were recorded in this study from the Waka area, hint that the diseases that the elders say wiped out some of their villages when they were young seem to have had symptoms similar to Ebola.

[49] As is being witnessed in the current Ebola outbreak in West Africa.

European armies[50], as they were thought to be more resistant to the African climate, but they also succumbed to the diseases in the environments in which they operated[51].

From the start of the Atlantic trade, the spread of disease in Gabon originated either from outside Africa or from zoonotic diseases from within. Their spread was facilitated by trade routes (Bruel, 1930, pp.170–171; Coquery-Vidrovitch, 1985, p.49) with traders being at greater risk from diseases (Patterson and Hartwig, 1978, p.12). However, as traders rarely diverted from these routes diseases did not spread far (Patterson and Hartwig, 1978, p.6). This association between trade, other colonial conditions that favoured movement of people and disease is not unique to Gabon and is found in other African countries (Spinage, 2012, p.1034) as well as around the world[52].

For the British African colonies this effect has been termed *Pax Britannica* (Ford, 1971, p.390) and resulted in an unintentional "outbreak of biological warfare on a vast scale" (Ford, 1971, p.489) that assisted the "scramble for Africa" (Pakenham, 2010). For Richards and Spinage the *Pax Britannica* theory is "a simple evolutionary stage model of ecological change" (Richards, 1983, pp.20–21; Spinage, 2012, pp.1034–1038; Zeleza, 1993, p.41) whereby the cultural and biological adaptions to the local disease and epidemic environment has been disrupted (Patterson and Hartwig, 1978, p.3). This disruption can be due to the introduction of new diseases, changes in populations from war and famines, changes in population movements (Patterson and Hartwig, 1978, p.3), the arrival of foreigners from outside of Africa (Patterson and Hartwig, 1978, pp.7–8), and the adoption of new activities and technologies such as those related to agriculture[53] (Patterson and Hartwig, 1978, p.6; Vansina, 1983, p.109) or

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[50] The annual military disease mortality of European soldiers in African garrisons varied widely, from 200 deaths per thousand to 600 deaths per thousand (Curtin, 1998, p.4).

[51] Though the death rate was lower. For example, between 1816-1873 African soldiers serving in the British army in West Africa had a mortality rate of 29 per thousand, they were susceptible to epidemics, such as smallpox that could result in the forced withdrawal from operations, such as during the 1824 siege of the Cape Coast in the Asante empire (Curtin, 1998, p.52).

[52] Darwin observed that this has occurred around the world. He wrote "there appears to be some more mysterious agency generally at work. Wherever the European has trod, death seems to pursue the aboriginal. We may look to the wide extent of the Americas, Polynesia, the Cape of Good Hope, and Australia, and we find the same result" (Darwin, 1882, p.435).

[53] "Once upon a time (but not too long ago) there lived a tribe deep within the Dark Continent. These people tilled the soil to raise crops of roots and grains, for they had little meat to lend them strength. Illness often befell them, but even so, in this dry land they were not overly troubled with the fever sickness brought by the mosquito, Now in the Northern World there was a powerful republic that had compassion on these people and sent their Wise Men to relieve the mean burden of their lives. The Wise Men said, "Let them farm fish," and taught the people to make ponds and to husband a fish called tilapia.

transportation (Debusman, 1993, p.42; Patterson and Hartwig, 1978). All these disruptions can occur at different frequencies while interaction with neighbouring communities varies, epidemiological conditions will differ both in space and time (Patterson and Hartwig, 1978, pp.5–6).

These disruptions can also occur for diseases to which Africans have acquired some resistance, such as malaria and yellow fever, which can then become epidemic (Curtin, 1998, pp.5–11). In the case of malaria this occurs when new strains are introduced, either through the movement of people (Patterson and Hartwig, 1978, p.12; Zeleza, 1993, p.43) or when people lose their resistance after having gone long periods without being infected, that can be related to the use of insecticides to kill mosquitoes or the extensive use of anti-malarial drugs (Webb, 2013, p.9).

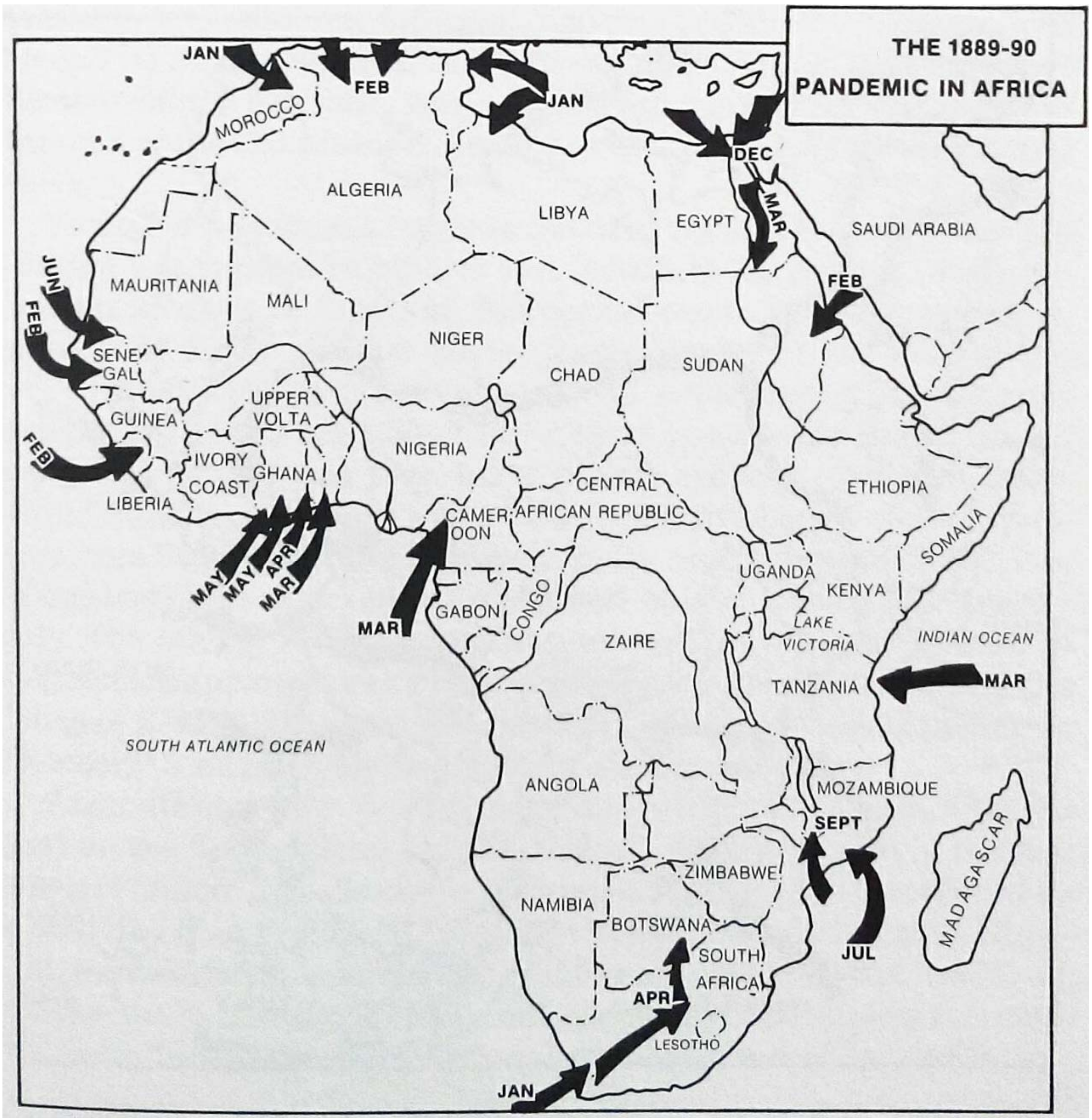
The equilibrium between Africans and their disease environment has been disrupted several times. The worst disruptions occurred between 1890 and 1930 (Coquery-Vidrovitch, 1985, p.46; Patterson and Hartwig, 1978, p.4) where various epidemics reduced the population of Africa, making this period Africa's equivalent to the European black death of the fourteenth century (Zeleza, 1993, p.41). Though historical documents on demography and the number of deaths that occurred since the start of the Atlantic trade are imprecise (Patterson, 1975b), especially at the beginning of the period, there are innumerable reports from explorers, administrators, doctors and missionaries of villages being empty of people due to epidemics (for example Bruel, 1935; de Brazza in Sautter, 1966, p.968; du Chaillu, 1867b; Kingsley, 1879; Marche, 1882; Nassu, 1914; Touchard, 1861).

Later demographic data were collected in a more systematic fashion. For instance it is probable that between 1.5 to 2 million Africans died during the influenza pandemic of 1918-1919[54] (Patterson, 1981, p.413; see also Coquery-Vidrovitch, 1985, pp.60–61; Patterson and Hartwig, 1978, p.19; Patterson, 1986; Sautter, 1966, pp.859–860; and Spinage, 2012, pp.1201–1202)

The people learned well, and within a short time they had dug 10,000 pits and ponds. The fish flourished, but soon the people could not provide the constant labors required to feed the fish and keep the ponds free of weeds. The fish became smaller and fewer, and into these ponds and pits came the fever mosquitoes, which bred and multiplied prodigiously. The people then sickened and the children died from the fever that the medicine men from the cities called malaria, The Wise Men from the North departed, thinking how unfortunate it was that these people could not profit from their teachings. The people of the village thought it strange that Wise Men should be sent them to instruct in the ways of growing mosquitoes." (Desowitz, 1978, p.36).

[54] These dates seem to correspond to the time when the Waka study site became depopulated (see chapter 4).

(Map 3-1), representing 1.5% of the entire population of Africa (Patterson, 1981, p.404)[55]. The rapid development of transportation networks at this time aided this pandemic (Patterson and Hartwig, 1978, p.12; Patterson, 1981, p.405; Sautter, 1966, p.625), while in Gabon the spread was further facilitated by administrative failures, drought and famine and the return of soldiers from the First World War (Bruel, 1930, p.171; Rich, 2007a; Rich, 2007b).



Map 3-1: The ports from which Influenza spread throughout Africa during the 1889-90 influenza pandemic (from Patterson, 1986, p.63; for more details see Patterson, 1981, pp.401–431 and detailed map on p. 431).

[55] For Patterson "[n]othing else, not slaving, colonial conquest, smallpox, cerebrospinal meningitis, the rinderpest panzootics of the 1880's and 1890's, nor the great trypanosomiasis outbreaks in East and Equatorial Africa after 1900 killed so many Africans in so short a time" (Patterson, 1981, p.404), and yet it has been little documented (Patterson, 1981, pp.404–431).

Disease-related depopulation has a long history in Gabon. The disappearance of iron workers between 1,400 and 800 BP from Lopé suggests that the area became devoid of humans for a 600 year period (Oslisly, 2001, pp.112–113; Spinage, 2012, p.1194). Oslisly (2001, pp.112–113) hypothesises that this could have been due to a severe epidemic which struck rapidly as he found “sites that seemed almost intact, with artefacts lying on the surface of the ground as if suddenly abandoned” (Oslisly, 2001, p.113). Spinage hypothesises that this depopulation could have occurred due to “malaria, trypanosomiasis, influenza, and a deadly arbovirus” (Spinage, 2012, p.1194), though he favours trypanosomiasis as it is known to have depopulated areas.

For Gabon, Headrick (1994) analysed the spread of disease from the start of the Atlantic trade period (see also Debusman, 1993; and Coquery-Vidrovitch, 1985 for the rest of equatorial Africa). Over the same period Chamberlin (1977) described the way that Europeans took over the trade of natural resources describing it as a series of phases that started on the coast. By bringing together these two separate works I summarise how the three-phased inland penetration of European traders into Gabon has impacted the Gabonese landscape (Figure 3-1).

Chamberlin’s original analysis splits traders into three tiers depending on their interaction with the Atlantic shipping trade and the flow of goods to and from the interior (Figure 3-1). Chamberlin’s first tier consisted of traders who dealt directly with merchant ships, second tier traders dealt with the first tier middlemen, and finally third tier traders operated the stages between the producers and second tier middlemen (Chamberlin, 1977, pp.6–7). Middlemen in the second and third trade tiers vied with each other to gain control of the prestigious first tier[56] (Chamberlin, 1977; Gray, 2002, p.26; Patterson, 1975a; Vansina, 1990).

[56] In Gabon the outcome of this rivalry was depicted by Du Chaillu who wrote that: “[n]one of these Shekiani fellows dare trade directly with the white men. They must all submit to the extortions of their neighbours who are so fortunate as to possess the seashore; and if Ogoula were to attempt direct trade-though he has the finest chances-his town would be burned down in a week” (du Chaillu, 1861, p.132).

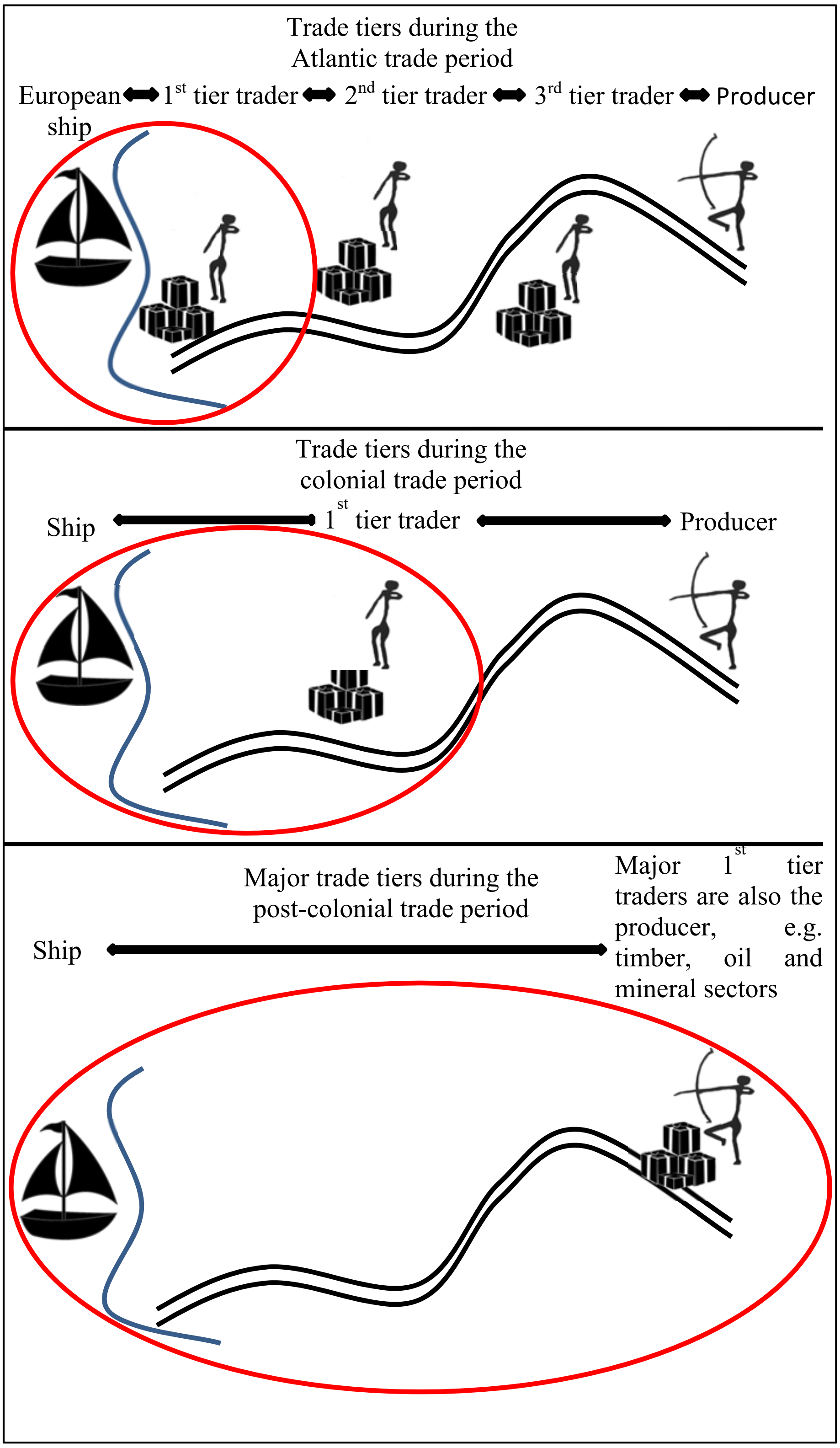


Figure 3-1: Historic change of trader tiers and the area susceptible to the spread of disease due to trade (red circle), created by combining the works of Chamberlin and Headrick. Trading tiers are based on Chamberlin's (1977) trade analysis while the spread of disease is based on Headrick's (1994) analysis.

Over time Europeans slowly took over each of the tiers and enhanced the extraction of natural products along the trade routes. This was done by getting to understand local cultures and landscapes and then integrating themselves into it them (Marche, 1882; Marche, 1878)[57], but also through the introduction of European technologies, logistics and policies that broke down trade barriers. As they took over the different tiers, African participation in the trade of natural resources reduced as did the revenue that they received, while the area under the influence of diseases brought in or spread by Europeans grew.

Though the spread of disease has only been systematically recorded and described since the mid-twentieth century, there are plenty of accounts starting from the Atlantic trade that describe the impacts of diseases in Gabon (Coquery-Vidrovitch, 1985; Debusman, 1993; Marche, 1879; Newman, 1987; Patterson, 1975b; Rich, 2007b; Sautter, 1966). Accounts both by Europeans and Gabonese indicate how the encounter between Europeans and Africans resulted in epidemics. The coastal trade brought diseases such as smallpox, syphilis, cholera, measles and chickenpox to Gabon (Patterson, 1975b, p.227; Patterson, 1974)[58].

The first phase of the spread of diseases was unlikely to result in epidemics or spread far from the coast as the relay system of the trade network, where goods are moved from trader to trader to their final destination, would also have limited the transmission of disease (Headrick, 1994, p.8). Competition by coastal African first tier traders restricted trading access between Europeans seagoing traders and inland African second tier traders (Chamberlin, 1977; Gray, 2002; Headrick, 1994). This competition resulted in various Gabonese ethnicities migrating to the coast to participate in this trade (Newman, 1987, p.p88; Touchard, 1861, p.9).

By migrating to the coast, different ethnicities came into contact with disease and strains of diseases that were previously unknown to them (Sautter, 1966, p.798). This gave the Gabonese coast a reputation as a place where both Europeans (de Compeigne, 1875, p.97) and Africans came to die, it was described at the time as a “great gulf in which wave after wave of more dense population of the vast interior has been swallowed up and lost” (Rollin Porter (1851) cited in Patterson, 1975b, pp.218–220). The ethnic groups coming to the coast would “suffer the same extinction that the previous migrants to the coast suffered” (Kingsley, 1879, p.409). After each

[57] This is similar to the way that Bantu-speaking people are thought to have migrated across Gabon (Klieman, 2003; Klieman, 1999; Klieman, 1997).

[58] Smallpox and syphilis are two diseases that both Europeans and Africans recognised (Headrick, 1994).

epidemic the surviving local population would have some immunity to the diseases being brought in regularly by ships (Debusman, 1993, p.40; Patterson and Hartwig, 1978, pp.8–9; Richards, 1983, pp.14–15; Spinage, 2012, p.1202) but as the reservoir of unexposed and more susceptible people grew with each new generation, so epidemics could once more occur, impacting the young more than the old (Curtin, 1998, p.51; Patterson, 1975b, pp.227–228).

The Mpongwe (Patterson, 1975b) of the Gabonese estuary are given as an example by various historians, explorers and administrators of Gabon as a population who suffered from various diseases. One of the first smallpox epidemics that was documented by the Europeans and Americans occurred between 1864 to 1865 (Newman, 1987, p.88; Spinage, 2012, p.1248; Zeleza, 1993, p.66) where a French trading boat brought smallpox to Gabon from Senegal, it reduced the Mpongwe population by two-thirds (Patterson, 1975b, p.226), more would have probably died if American missionaries had not been able to obtain some smallpox vaccine[59] with which they vaccinate the people on the northern bank of the estuary (Patterson, 1975b, pp.227–228). This was not the first such epidemic. Mpongwe oral histories recorded at the time mention a smallpox epidemic in 1847 that killed half of the population

The 1864 to 1865 smallpox epidemic impacted all of Gabon decimating local populations[60] (Gray, 2002, p.95; Headrick, 1994, p.33; Walker, 1870, p.79)[61]. As riverine traders came increasingly in contact with Europeans, so diseases spread along the major riverine trade routes and impacted riverine peoples such as the “Galoa, Enenga and Okande” (Patterson, 1975b, pp.234–235). However, the interior was largely spared as communities were relatively isolated from their neighbours (Curtin, 1968, pp.199–200). These epidemics not only killed people directly but also brought down retribution against people accused of witchcraft, for in Gabon there is the “widespread idea … that one never dies of natural causes; one is always poisoned” (Rich, 2001, p.627; see also Le Testu, 1918, pp.130–132).

[59] The first ever smallpox vaccine, rather than variolation, was created in 1796 by Edward Jenner who used a cowpox lesion (in Latin *vaccinia*) to vaccinate a boy (Riedel, 2005, p.24).
[60] Gabon was spared the smallpox epidemic that swept through Africa during the 1920s and 1930s (Schneider, 2009, p.207).
[61] Until then the Gabonese had not heard of smallpox (Spinage, 2012, p.1284), and did not have a tradition of inoculation, unlike other parts of Africa (Vossen *et al.*, 2014; Zeleza, 1993, pp.48–49). The people in the interior of Gabon claimed that smallpox was brought in packing-cases from the coast (Spinage, 2012, p.1284).

The introduction of quinine increased the sphere of European influence and allowed them to settle along the coast. It also allowed early explorers and traders, such as Du Chaillu[62] and de Brazza (Marche, 1879, pp.327–328), to penetrate the interior of Gabon through waterways and existing trade routes (Headrick, 1994, p.8).This led to the second phase in the spread of diseases (Gray, 2002, p.95), which started around 1880 and lasted till the start of the First World War (Debusman, 1993, p.40). During this period new parasites such as sand fleas causing jiggers[63], brought in from South America, spread throughout Africa by the 1890s (Nassu, 1914, pp.36–37; Patterson and Hartwig, 1978, p.10; Spinage, 2012, p.1304; Zeleza, 1993, p.44).

The explorers, and especially their porters, brought with them venereal diseases and sleeping sickness, both of which were well known in coastal parts of Gabon, into areas where it had not previously occurred [64] (Spinage, 1973, p.966). These diseases and epidemics resulted in population decline, either directly through mortality or indirectly through reduced fertility and increased morbidity (Spinage, 1973, p.1191). Once again these epidemics were often limited to the trade routes themselves (both land and riverine routes), with nearby villages not being affected (Coquery-Vidrovitch, 1985, pp.49–50; Patterson and Hartwig, 1978, pp.7–8; Sautter, 1966, pp.624–625; Spinage, 2012, p.982).

The final phase of the spread of disease occurred after the First World War with Europeans consolidating their trade by taking over the second and third trading tiers and in some cases the production of natural resources. They further penetrated inland away from water ways and set up commercial concessions, which later became timber concessions. Europeans had up to the end of the nineteenth century been living mainly along the coast and in a couple of riverine

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[62] Du Chaillu described how he saw the start of a smallpox epidemic inland where: "Elanga, one of Olenda's nephews, was taken ill with a disease which the natives had never before seen. It was described to me, and I thought I recognised in the description the symptoms of small-pox. The next day the news came from a neighbouring village that Elanga had died. There was a great deal of mourning and wailing among the people; and all the inhabitants of Olenda, with the exception of the old king, went to join in the wild manifestations of grief. Now, Elanga was one of the Ashira men who had been to Obindji to fetch my baggage, and a suspicion of foul play or witchcraft, as usual, arose in the minds of the Ashira people, which, in addition to the other causes of unfriendliness, threatened to embarrass my movements" (du Chaillu, 1867a, pp.121–122). This epidemic started a year later in Ngosi district between the coast and the Du Chaillu Massif.

[63] These sand fleas were brought from Rio de Janeiro to Angola in ship ballast in 1872.

[64] Thirty years after Du Chaillu, the population of Loango had been decimated as were the people along the caravan routes that led to it (Headrick, 1994, p.33).

trading posts such as Lambaréné where they had set up trade factories[65] (Walker, 1870). Trading was still limited to the riverine routes and principal trade routes, with the inland access controlled by second tier African middlemen who now only managed access between the first tier European coastal factories and the areas where resources were being harvested (Chamberlin, 1977). The creation of commercial concessions by the French broke down the last trade barriers and put an end to second tier African middlemen. This resulted in Europeans, mainly the French, setting up factories deep in the forest where they traded directly with the producers (Chamberlin, 1977; Coquery-Vidrovitch, 2001; Gray, 2002).

Europeans such as Quéru, who traded in the area of the Ikobey study site in the early 1900s (Coquery-Vidrovitch, 2001), were penetrating the most remote parts of Gabon away from the principal trade routes in search of resources. This included ivory, which was becoming rare on the coast (Headrick, 1994, p.42) and wild rubber which people went deeper into the forest to collect (Spinage, 2012, p.1033). In this way traders were expanding the zone directly influenced by the Atlantic trade. Once again this speeded up the transmission of disease as it brought people in remote areas into contact with coastal diseases (Headrick, 1994, p.42; Patterson and Hartwig, 1978, pp.9–10).

This spread of disease was likely further facilitated by timber concessions and the development of transport infrastructure. Both created a large demand for labour in a country that had already been depopulated by disease. This created two major outbreaks of diseases and famine, firstly between 1914 to 1916 and then between the 1920s and 1930s. A forester wrote for a 1918 conference:

> [*d*]*ans toute la partie exploitable de la forêt du Gabon il devient de plus en plus rare de rencontrer des villages en plein forêt. La maladie du sommeil, l'alcoolisme, les maladies vénériennes ont fait disparaitre une grande partie de la population et le reste, décimé, s'est rapproché petit à petit des points d'où il était facile d'aller aux factoreries européennes*[66] (Quilliard, 1920, p.645).

[65] Factories is the original English term for a colonial trading post set up by Europeans in foreign territories. It is here where natural resources and other products were stocked before being either sent to the coast or to Europe (Diffie, 1977).
[66] "in all the exploitable areas of the Gabonese forest, it is becoming more and more rare to find villages in the middle of the forest. Sleeping sickness, alcoholism, venereal diseases have resulted in the

During the war years, 1914 to 1918, 60,000 people were recruited from southern Gabon as porters to help the war effort in Cameroon (Gray, 2002, p.154). These displacements, and other effects of colonisation, resulted in the disappearance of villages through labour migration, while famine and disease, as witnessed by colonial administrators (Gray, 2002, p.158), resulted in bodies and skeletons along trade routes (Coquery-Vidrovitch, 1985, pp.54–56; Sautter, 1966, p.860). Ultimately the forest reclaimed villages and trade routes and population density maps began to show empty areas (Sautter, 1966, p.969). These processes of depopulation shaped Africa's disease environment today (Patterson and Hartwig, 1978, pp.11–12).

In the *Afrique Equatoriale Française*, of which Gabon was part during the colonial period, a third of the population was lost between 1914 and 1921, with Gabon being the worst affected (Coquery-Vidrovitch, 1985, p.56; Debusman, 1993, p.42; Sautter, 1966, p.861)[67]. Vansina (in Coquery-Vidrovitch, 1985, p.56), estimated that in this period Gabon lost half its population.

These losses in Gabon after the First World War were due to droughts and then absence of a dry season, which meant that fields could not be cur and burnt, resulting in food shortages (Rachel Jean-Baptiste, 2010, p.71; Sautter, 1966, p.859) that occurred at the same time as colonial troops where regaining their barracks in Libreville after the defeat of the Germans in Cameroon. At the same time head taxes were introduced channelling labour away from subsistence agriculture towards mining, forest concessions (Patterson and Hartwig, 1978, p.13) and commercial agriculture (Sautter, 1966, p.862). Furthermore, in 1918, the global influenza pandemic swept through Gabon (Rich, 2007b, pp.241–242), an impact made possible by the development of transport infrastructure to help trade and administrative control (Patterson and Hartwig, 1978, pp.11–12).

During the inter-war period, 1920s to 1930s, access to labour became increasingly important to colonial administrators as labour shortages began to appear. Labour was needed by both the

disappearance of a large part of the population and the rest, decimated, have slowly come closer to places where they can get easy access to European factories"

[67] The early twentieth century particularly impacted the Fang, just like the mid-nineteenth century had impacted the Mpongwe. The Fang had continued to migrate to the coast or new trading centres to participate in trade and with this the mortality rate of the Fang increased (Patterson, 1975b, p.235; Sautter, 1966, pp.860–872). Missionaries estimated that in the influenza pandemic of 1918 10% of the population of Kango (east of Libreville) died (Rich, 2007b, p.249), while by 1930 the Fang population had reduced by a half (Coquery-Vidrovitch, 1985, pp.54–56). In Sindara, near the Waka study site. There was a 16.6% mortality rate in 1917 (Bruel, 1935, p.338).

colonial administration and commercial entrepreneurs. This labour was obtained from areas inland because the coastal plains had a low population (Pourtier, 2010, p.3) who preferred commercial work over manual labour (Headrick, 1994, p.127), though people from all over Gabon and outside it were hired as labourers (Sautter, 1966, p.770). The introduction of a head tax further helped in increasing the work force (Appendix 11.11). The colonial administration was using manual labour to build Gabon's first transport infrastructure, especially roads (Gray & Ngolet, 1999), while the booming timber industry was soaking up all other available labour (Coquery-Vidrovitch, 2001, p.455), bringing the colonial administration and the timber industry into conflict (Rich, 2005). The timber companies hired one-fifth of the Gabonese population[68] (Coquery-Vidrovitch, 2001, p.457; Coquery-Vidrovitch, 2010), and were referred to by the colonial administration as being "*de grands dévoreurs d'hommes"*[69] (Pourtier, 1989, p.173).

The resulting mixing of people from all over the country in places such as timber camps created a national identity but also fostered the spread of diseases, such as malarial and venereal diseases (Coquery-Vidrovitch, 2001, p.456; Headrick, 1994, pp.125, 128), while the poor quality food rations resulted in beriberi (Pourtier, 2010, p.4). This occurred not just in the timber camps but also near administration posts. The imposition of head taxes also encouraged women to take part in prostitution, with marriage being undermined as *concubinage*, and prostitution became commercialised[70], bringing in revenue both to the women involved and their families (Headrick, 1994).

The reduction of a rural labour force, through migration, disease and low fertility, created famines in Gabon (Gray and Ngolet, 1999; Meye, 1969, p.59; Rich, 2007a) and depopulation throughout the 1910s and 1920s (Pourtier, 1989, p.173). From 1920 to 1931 the Gabonese population rose slowly, though doctors reporting at the time "were ubiquitous [sic]" that there was a decrease in population (Headrick, 1994, pp.109, 426). From 1931 to 1960 the population

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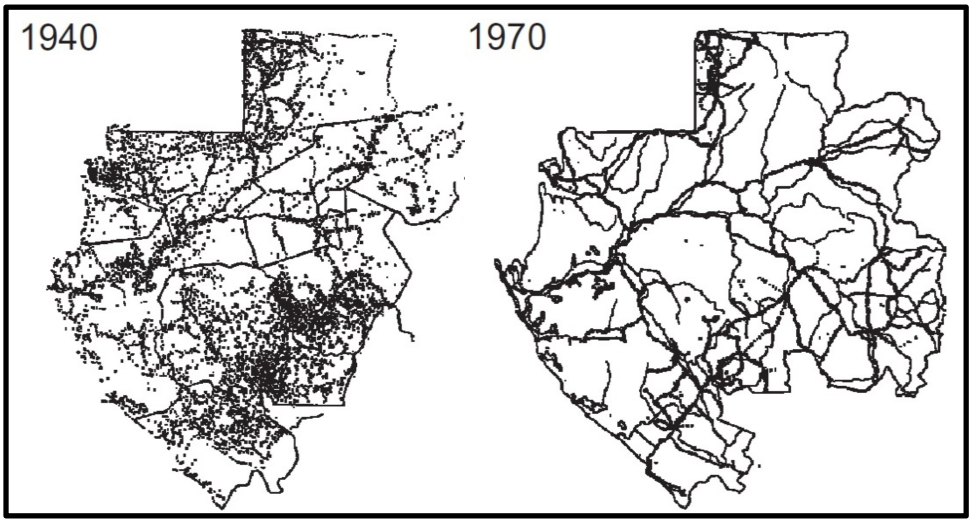
[68] This was occurring at a time where the concessions near waterways were being exhausted of *Okoumé* (Quilliard, 1920, p.650) resulting in an increase in man power needed to move, the now, distant *Okoumé* trees to waterways (Pourtier, 1989, pp.152–153). For example in 1929 logs had to be rolled for fifteen kilometres before reaching a waterway (Coquery-Vidrovitch, 2001, p.455).

[69] "big devourers of people"

[70] "The workers, bachelors with or without their wives, were infected by prostitutes around the camps, and returned home with venereal disease and the money for a first or second wife. Many wives left behind considered themselves free because their bride price was not fully paid. During the two-year separation they earned cloth or jewellery for themselves by granting favours to the men who stayed in the village" (Headrick, 1994, p.127).

was stable. But during this period it was becoming less rural with people migrating to roads and urban areas, partly due to "*regroupement*, the concentration and resettlement of subject peoples in stable villages" (Burnham, 1975, p.594) (Map 3-2).



Map 3-2: Population distribution of Gabon. The province of Haute-Ogooué (Southeast) was added to Gabon in 1964 (adapted from Pourtier, 1989; and Sautter, 1966).

The depopulation of Gabon and later the migration of people from rural to urban areas, resulted in some Gabonese landscapes being released from anthropogenic disturbances. As signs of past villages rapidly degrade in Gabon, the origins of these anthropogenic disturbances are usually lost[71]. However, they live on as a patchwork of landscapes that are at different stages of succession, some of which date back centuries. In some cases areas of "virgin" forest that are about to be exploited by timber companies have been exploited in the past, with the only evidence of this exploitation being in old maps or old trade accounts (Chapter 4).

3.2.2 Brief overview of the history of trade in natural resources in pre-colonial Gabon and its short and long term impacts on the environment (pre late nineteenth century)

During the pre-Atlantic period (Appendix 11.8) trade mostly formed around iron and copper mineral resources (Clist, 2005; Dupré and Pinçon, 1997; Klieman, 2003; Klieman, 1997; Ngomanda *et al.*, 2007; Oslisly, 2001; Wilks, 2003). The consequences of the extraction and

[71] The exception to this are charcoal deposits, indicating either old smelting areas or places where slash and burn cultivation had once taken place.

transformation of these mineral resources in this period was the emergence of specialists such as blacksmiths, a centralisation of the economy, increase in fuelwood collection, increased plantation establishment and hunting to feed and trade with the specialists who did not carry out agricultural activities (Clist, 1995; Ehret, 2002; Klieman, 1997). Its impact on the Gabonese landscape can still be seen in savanna sites such as Lopé and coastal savannas (Biraud, 1959; Gaulme, 1988; Maley, 2001c; Ngomanda *et al.*, 2007; Oslisly, 2001; Oslisly and Dechamps, 1994; Palla *et al.*, 2011; Schwartz, 1992; White, 2001) that first appeared 2,500 BP (Maley, 2001a; Maley, 2001b; Maley, 2001c; Oslisly, 2001; Oslisly and Dechamps, 1994) and slowly became forest. To stop this succession conservation practitioners have put in management plans based on fire (Jeffery *et al.*, 2014).

The development of an international trade of African natural resources occurred during the Atlantic period (Table 3-1) (Appendix 11.9). Though it started slowly in the sixteenth century (Merlet, 1990, p.20; Patterson, 1975a, p.8) it boomed in the eighteenth and early nineteenth century with natural resources being traded in bulk quantities (Gardinier and Yates, 2006; Sautter, 1966, p.729). This boom was partly the result of the European industrial revolution where mass production led to cheap products (Ehret, 2002) for which there was a great demand in Africa (Vansina, 1990).

Period (century)	African products traded	European products traded
Seventeenth	Ivory, wax, honey, palm oil, dyewood / red wood / camwood (padouk), black wood (ebony), slaves (small scale).	Old iron and nails.
Eighteenth	Ivory, elephant tails, hippopotamus teeth, parrot feather, wax, honey, palm oil, dyewood / red wood (padouk), black wood (ebony), slaves.	Various metals, guns, beads, textiles, alcohol.
Nineteenth	Ivory, elephants tail, hippopotamus teeth, parrot feather, wax, honey, palm oil, dyewood / red wood (padouk), black wood (ebony), wild rubber.	Various metals, guns, beads, textiles, alcohol.

Table 3-1: Products traded during the Atlantic period.

One of the principal natural resources that was traded was ivory. Due to this it has been well documented and can be useful in analysing the outcomes of the current trade in Gabonese ivory. Today there is a conservation interest in the decline of forest elephant populations which have given rise to the fear that the "[l]oss of keystone species like elephants impacts the integrity of ecosystems and their services … [including the] long-term viability of the second most important carbon capture forests in the world" (Wasser *et al.*, 2010, p.1331), this being due to a "potential for a major wave of tree recruitment failure" (Blake *et al.*, 2009, p.466). Predictions of forest elephant population extinctions are not new, dating back to at least 1850 (Appendix 11.9). This revival of conservation interests in elephants has, in Gabon, resulted in military intervention to protect elephants for:

> [i]f we lose our elephants we will enter the same spiral that has seen wildlife and natural resources plundered elsewhere in Africa, with the inevitable consequence of political instability and conflict in dysfunctional ecosystems where man can no longer live sustainably in harmony with nature. Today I have undertaken to create an elite military unit that will be signed into law this month, which will support our National Parks Agency in their critical work to manage Gabon's natural treasures (Presidential press release: Parcs Gabon, 2011).

The Atlantic trade in ivory resulted in the local extinction of elephants from different areas in Gabon. By the mid-1600s the supply of ivory from around the coastal areas of Mayumba, Sette-Cama and Mayombe was poor with ivory traders having to go to Bukkameale, "also known as, the Mountains of Ivory," (Martin, 1982, p.208), probably in the southern part of the Du Chaillu Massif (Martin, 1982, p.204; Martin, 1972, pp.17, 41), a walk of a month and a half, where ivory was exchanged for salt from the coast (Martin, 1982).

By the early 1800s elephants also become locally rare in the Gabon Estuary[72]. Walker, in 1866, observed that *"les trappes à l'éléphant devinrent très-nombreuse sans que nous vissions* [sic] *cependant un seul animaux* [sic]*"*[73] (Walker, 1870, p.64), and this was after a week of walking away from Libreville up one of the rivers entering the Gabon Estuary. At the same time the Fang had to go far to find ivory to supply the Mpongwe traders (Chamberlin, 1977, p.104; Gaulme, 1991, p.84; Patterson, 1975a, p.59).

The disappearance of elephants from these areas would have changed the tree composition of the forest due to the role that forest elephants play in the distribution of seeds (Blake *et al.*, 2009). It would also have changed the forest structure, with elephant trails becoming overgrown and disappearing (Fairhead and Leach, 1994, p.501; Fay, 2004a).

[72] With "[e]lephant herds visited the Estuary less and less" (Chamberlin, 1977, p.101).
[73] "the elephant traps became numerous, even though we did not see one single animal"

Elephants can today be found in areas where they were once locally extinct. In the 1950's elephants were "*abondant"* (Lasserre, 1955, p.121) in the coastal savannas of the Gabon Estuary and the Mayumba coast. Even today elephants can be seen "strolling the beach" (Fay, 2004a), with a population of "a few thousand elephants in and around Loango today" (Fay, 2004a). This historic literature of Gabon indicates that though elephant populations in the past have collapsed, they have also recovered as long as there is a viable source population (Okello *et al.*, 2008).

3.2.3 Colonial trade – late nineteenth century to independence (1960)

The export of natural resources that started with the Atlantic trade has slowly evolved into a trade that still underpins the Gabonese economy today. In the colonial era logging (Appendices 11.10, 11.11 and 11.12) became the focus of this trade and of colonial policies, and by surface area is still the most important natural resource that is being exploited (Figure 2-1). Until the late 1890s first tier traders from Britain[74], Germany and the United States of America were free to set up factories and exploit the natural resources of Gabon with little hindrance by the colonial administration, who even provided them with protection (Gardinier and Yates, 2006, p.xlix)[75]. The ivory trade was dominated by British[76] and German[77] companies until its restriction in 1904 (Chamberlin, 1977, p.123; de Compeigne, 1876, p.226; Neuville and Ch. Breard, 1884, p.131). The Germans also dominated the timber industry until the First World War.

The dominance of trade by other Europeans infuriated the French (Coquery-Vidrovitch, 2001; Cuvillier-Fleury, 1904, p.80; Gaulme, 1991, p.85) who, upon the recommendations of de Brazza (Gardinier & Yates, 2006, p. 313), set about creating a concession system[78] and trading routes that favoured French companies. From these concessions the French exploited natural resources such as ivory, rubber, raphia, oil palm and wood. This monopoly was already declining

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[74] Until the 1890s the trade in the Gabon Estuary was dominated by the British, with the presence of the Liverpool based companies of Hatton and Cookson, who had 39 trading counters, and John Holt who had 59 trade counters (Coquery-Vidrovitch, 2001, p.234).

[75] At this time the French were not interested in trade, but rather colonial expansion and administration, only becoming interested in trade when they saw other countries benefiting from their colony (Rich, 2007a).

[76] British company Hatton and Cookson, a Liverpool based company who had a monopoly over ivory exported from the Gabon Estuary.

[77] Francis Würmer and Company.

[78] These commercial concession companies were able to limit those who could use their concessions, including through passage and sale of products to the Gabonese within them (Coquery-Vidrovitch, 2001, pp.238–243).

by the 1930s, when companies that held commercial concessions relinquished them in return for forestry concessions [79] (Coquery-Vidrovitch, 2001; Gardinier and Yates, 2006, p.314; Headrick, 1994) that officially ended at independence[80] (Spero, 1973).

In the first decades of the 1900s the French colonial administrators were exploring ways to develop their colonies. They saw forestry[81] as a way to bolster the colonial budget (Lasserre, 1955)[82] and so helped the transformation of the timber trade (Coquery-Vidrovitch, 2001, p.450). This forestry policy was one of the catalysts for the modern timber industry. Enterprising Europeans, some of whom had previously been only involved in the second and third trading tiers, rushed to set up timber companies (Coquery-Vidrovitch, 2001, p.452; Pourtier, 1989; Rich, 2005) that undertook the whole process from the production of logs by cutting trees to its export (Bouet, 1974), circumventing the different Gabonese trading tiers and independent producers. Timber exports soared from around 3,375 cubic metres in 1896, to an average of 654,098 cubic metres per year by 1930[83] (Figure 3-2) (Appendix 11.12) (Gaulme, 1988, p.119; Rich, 2005, p.154).

3.2.3.1 Pre-Industrial Okoumé logging

The trade in wood for export began in Gabon at the same time as the Atlantic trade (Wilks, 2003, p.72), though not on an industrial scale. This trade included dyewoods, ebony, and fuelwood for ships that were returning to Europe or Brazil (Merlet, 1990; Patterson, 1975a; Quilliard, 1920; Sautter, 1966, p.759). However, "*le contact avec les Européens puis la colonisation française ont conféré à la forêt d'autres valeurs, économiques, en la faisant entrer dans la mondialisation des échanges"*[84] (Pourtier, 2010, p.1). In Gabon, the timber industry became focused on *Okoumé*[85]*,*

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[79] For example in return for its commercial concession the SHO (*Société Commerciale Industrielle et Agricole du Haut-Ogooué*) received 35,000 ha forestry concession.

[80] Unofficially the monopoly has continued until relatively recently through development aid linked to French industries operating in Gabon (Darlington and Darlington, 1968; Labrousse and Verschave, 2002; Yates, 1996).

[81] During the 1918 French Colonial Agriculture Congress it was concluded that animal husbandry and agriculture were only suitable for the drier parts of the West African colonies, while forestry was only suitable for the humid Central African region, including Gabon (Denys, 1920).

[82] As well as supply France with the timber it needed due to the heavy toll the war had taken on French forests, providing wood for the Allies and French troops (Chevalier, 1928; Puyo, 2001, pp.486–487).

[83] Though there are large variations between authors on estimated rates of exploitation (Jaffré, 2003a, p.266; Pourtier, 2010, p.4).

[84] "contact with the Europeans and then the French Colonisation conferred onto the forest other values, economic ones, by bringing it into the globalisation of exchange"

[85] The wood itself, being easy to transform into plywood, has many uses including the making of furniture, veneer, boats, aeroplanes (such as The RAF's Mosquito used in World War II), in the Eurostar trains, and

a sub-endemic tree whose distribution is centred on Gabon[86]. *Okoumé* an emergent can live for 150 to 300 years and become over 50 metres tall with a diameter of two metres (Mapaga *et al.*, 2002).

The first log of *Okoumé* arrived on the coast of the Gabon Estuary in July 1889, brought in by Fang boatmen who were then the first tier traders. This log did not interest the French but it did interest the German consul in Libreville who, after an analysis of the wood in Hamburg, discovered how easy it was to manipulate and unroll the wood to make plywood (Coquery-Vidrovitch, 2001, p.442; Jaffré, 2003b; Pourtier, 2010, p.2; Quilliard, 1920). Within three months the Germans began exporting *Okoumé* logs back to Germany[87] (Gaulme, 1988, p.117; Hilling, 1963; Jaffré, 2003a, p.263; Pourtier, 2010, p.2). Soon afterwards they were followed by the British and ten years later the French became interested[88] (Coquery-Vidrovitch, 2001, pp.441–442; Cuvillier-Fleury, 1904; Jaffré, 2003a, p.263; Lasserre, 1955).

Okoumé was most accessible in coastal and riverine areas, where logs could be floated out (Lasserre, 1955). Places such as the Gabon Estuary (Jaffré, 2003a, p.263; Rich, 2005) and the lakes along the Ogooué River (Meye, 1969; Pourtier, 2010, p.2; Sautter, 1966, p.757) became important producers of *Okoumé* due to their small creeks and waterways as well as these areas being designated as free trade zones outside the concession monopolies. It is likely that these areas would also have had abundant *Okoumé* as its growth would have been aided by previous anthropogenic use, such as occurred during the production of salt (Appendix 11.9).

These early timber operations were small scale manual affairs (Biraud, 1959, p.10; Jaffré, 2003b, p.314; Quilliard, 1920) (Picture 3-1), being carried out in a similar fashion to the extraction of any other natural resources shipped to Europe at that time. The timber would have been transported by second tier traders to the European first tier traders before being loaded onto

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construction (which was especially important in the reconstruction of France post World War II) (Gaulme, 1988; Hillier, 1913, p.83; Labrousse and Verschave, 2002; Les Actualités Françaises, 1947; Puyo, 2001; Wilks, 2003; World Resource Institute, 2000).

[86] Though it can also be found just over the borders in neighbouring Cameroon, Congo and Equatorial Guinea (Lasserre, 1955). Due to this distribution, Gabon has become the biggest producer of *Okoumé* in the world.

[87] From the German Woermann Company based in Libreville.

[88] When the first batch of logs finally arrived in France, merchant rivalry resulted in delays that further hindered the French trade of *Okoumé* for 25 years (Coquery-Vidrovitch, 2001, pp.441–442).

ships (Coquery-Vidrovitch, 2001, pp.441–442; Pourtier, 2010, p.3; Quilliard, 1920, p.647; Rich, 2005, p.153; Lasserre, 1955).

Picture 3-1: Men Rolling an *Okoumé* log. Photo from Cermak and Lloyd (1962)

As long as there were timber trees readily available that could be cut and easily transported without using capital intensive equipment, there was little need to change a trading system that had been working for over 400 years. As *Okoumé* trees became rare the loggers moved inland (Quilliard, 1920). Once in the interior they had to overcome the problem of transport[89] which, until the First World War, used rudimentary low-cost, labour-intensive techniques (Picture 3-1). Changes in technology and government policies brought about the advent of industrial logging (Coquery-Vidrovitch, 2001, p.446), which changed the economic structure of the timber industry (Lasserre, 1955) and impacted labour and the environment.

3.2.3.2 Modern industrial logging

With the introduction of pulleys, cables, Decauville rail[90] (Picture 3-2), tug boats (in the 1920s) and tractors (in the 1930s) (Lasserre, 1955), access to waterways ceased to be necessary for logging operations. All these developments allowed timber companies to pass obstacles such as *"de*[s] *marécages infranchissables"*[91] (Quilliard, 1920, p.650), which in turn helped drive an increase in production (Coquery-Vidrovitch, 2001, p.450; Jaffré, 2003a, p.264; Jaffré, 2003b; Rich, 2005). The introduction of these new technologies further increased the start-up costs, contributing to the end of the independent Gabonese timber companies (Pourtier, 1989, p.154;

[89] Draught animals could not be used to haul timber due to the climate and livestock diseases.

[90] In Gabon, the narrow gauge Decauville rail, first introduced in 1913 (Coquery-Vidrovitch, 2001, p.448; Pourtier, 2010, p.2; Pourtier, 1989, p.153), had by 1935 proliferated to 675 kilometres of tracks (Pourtier, 2010, pp.2–3), further allowing timber companies to penetrate the forest (Jaffré, 2003a, pp.263–266; Pourtier, 1989). At first the wagons carrying the logs were pushed by hand (Picture 3-2) but, as the distances to the waterways increased, locomotives were introduced (Pourtier, 1989, p.153).

[91] "impassable swamps"

Rich, 2005) and of small independent European timber companies (Coquery-Vidrovitch, 2001, p.450)[92].

Picture 3-2: Pushing *Okoumé* logs on early railways. Picture from Cermak and Lloyd (1962)

Already, at this early stage of the timber industry, its elitist nature was apparent, needing both monetary and political capital. The high initial capital outlay needed for industrial logging (Lasserre, 1955), combined with profits that are only realised in the long term, resulted in an industry which needed guarantees from political administrations and markets (Angelsen and Wunder, 2003; Coquery-Vidrovitch, 2001; Quilliard, 1920). Without these guarantees the timber industry was, and still is, at the mercy of markets and policies[93]. With the addition of a biased permit system and allocation of labour, African loggers were slowly pushed out of the industry (Appendix 11.11).

After the Second World War, with the creation of the *Office des Bois de l'Afrique Equatoriale*[94] and improved technology such as Caterpillars and logging trucks, industrial logging took off (Jaffré, 2003a, pp.263–266; Lasserre, 1955; Pourtier, 2010, pp.3, 6). Between 1950 and 1970 production rose from 376,464 cubic metres to 1,500,000 cubic metres (Figure 3-2) (Coquery-Vidrovitch, 2001; Gaulme, 1988, p.119; Jaffré, 2003b) helped by the introduction of chainsaws (Pourtier, 1989, p.154). At this time, only 10% of the Gabonese forest was being exploited (Forests Monitor Ltd, 2001).

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[92] In 1933 there were still some Gabonese and some European timber camps that were operating entirely by hand (Gaulme, 1988, p.31; Meye, 1969; Puyo, 2001, pp.488–489; Rich, 2005, p.158). However, they were a dying breed.

[93] This created difficulties for the French during the early phase of European timber companies in Gabon (Coquery-Vidrovitch, 2001; Quilliard, 1920) as well as in 1938 when exporting *Okoumé* was stopped due to late payments to the exporters by their clients (Sautter, 1966, p.768).

[94] "Office of Equatorial Africa woods"

The introduction of the first Caterpillars, bulldozers and logging trucks increased penetration into the forest resulting in an increase in production, and allowed the opening of the second forestry zone (Pourtier, 2010, p.3) (Map 3-3). The introduction of the chainsaw allowed a tree to be cut in *"quelques minutes, contre un jour ou deux à la hache"*[95] (Pourtier, 2010, p.6), while airplanes were used to identify forested areas where there were high densities of *Okoumé* trees[96]. All these new technologies meant that the timber industry needed less manual labour. By 1959 the industry needed only half the labour force than it required at the start of the century (Biraud, 1959, p.10). However, it required more financial capital to carry out its work (Lasserre, 1955).

In 1987 completion of the railway running from Libreville to Franceville (Map 3-3) further opened up the forest. The railway was constructed to transport manganese from the mines in Moanda and to allow the exploitation of wood around the *zone d'attraction du chemin de fer*[97]. As with the introduction of lorries and the Decauville rails, the new railway allowed for the rapid expansion of logging away from waterways (Jaffré, 2003a, p.265; Pourtier, 2010, p.6; Wunder, 2003).

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[95] "a couple of minutes, instead of a day or two by axe"
[96] The aerial identification of *okoumé* is easiest during the small dry season (January to February), when the new leaves are still red (Clément and Guellec, 1974). The introduction of planes for the identification of areas with high densities of *Okoumé* resulted in Gabon having one of the highest number of airstrips per unit area in the world (Bouet, 1974).
[97] "Zone of attraction due to the railway"

Map 3-3: Map of the current logging zones in Gabon (from Pourtier, 1989)

Although land based natural resources had been the principal focus of industries during the colonial period, offshore oil became the focus of industries soon after Gabonese independence. The period between 1960 to 1986 saw the decline of the importance of timber to the Gabonese economy. In 1963 timber represented 75% of Gabonese exports but by 1970 timber only represented 7% of exports (Jaffré, 2003b) and 10% in 1980 (Pourtier, 1989, p.191). Today oil represents 80% of Gabonese exports (Pourtier, 2010, p.7)[98].

Even though oil became the biggest earner for Gabon (Pourtier, 1989), today's timber industry is still important, with members of the Gabonese administration gaining from both forestry (Pourtier, 2010) and oil rents (Yates, 1996). Today two-thirds of Gabon's forest have either been logged at least once or allocated as a concession (World Resource Institute, 2000; Wunder, 2003).

However, though forestry became an important player in Gabon, the revenue raised by the Gabonese colonial timber industry was not re-invested in Gabon or its infrastructure, rather the revenue went to the federal budget that was used to develop other parts of the colonial *Afrique Equatoriale Française*, including the railway in the Republic of Congo which was largely financed from the sales of *Okoumé* in Gabon (Pourtier, 2010, p.4).

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[98] Starting in 1966, it was rapidly swamped by the opening up of the oil industry (Gaulme, 1991, pp.85–86; Hilling, 1963; Marcus, 1960, p.67; Pourtier, 2010, pp.1, 6).

3.2.3.3 Colonial logging and economic development: a boom and bust industry

The Gabonese and Gabon itself did not capture the full benefits from logging. The Gabonese, through changes in colonial government policy, logging permits, labour distribution and lack of capital (Appendix 11.11) were slowly pushed out of the lucrative first tier trade position and then the secondary and tertiary trade tiers and even as independent producers, all to the benefit of Europeans and their companies. By Independence the Gabonese were mostly relegated to being employed by European companies, and today by timber companies from around the world. Furthermore the number of employed Gabonese decreased as technological advances reduced the need for manual labour. During the colonial era the revenue produced by logging in Gabon went to other regions of the *Afrique Equatoriale Française*, while in the post-independence period the revenue went to urban areas at the expense or rural transport infrastructure[99] (Gaulme, 1991; Gaulme, 1988).

Development from the logging industry in Gabon has been hindered by a history of boom and bust (Figure 3-2). One of the first of these cycles occurred after the Napoleonic wars, in 1812, when the British army stopped buying large quantities of Gabonese redwood to dye soldier's uniforms (Patterson, 1975a, p.38) leading to a slump in dyewood prices (Patterson, 1975a, p.64).

In the twentieth century there have been several episodes of boom and bust, culminating in the decline of the timber industry with the rise in oil exploitation. The first bust was during the First World War where shipping between Gabon and Europe was disrupted due to the dominance of German and Dutch shipping companies (Quilliard, 1920, p.649)[100]. It occurred again in 1929, during the Great Depression, when the stock market crash led to a collapse in demand for *Okoumé*[101] with the result that many small timber companies mostly Gabonese closed down (Gaulme, 1988, p.119; Rich, 2005, p.165), though also some European (Pourtier, 2010, p.3; Puyo, 2001, p.491; Sautter, 1966, p.767; Meye, 1969). Companies that did not go bankrupt had to lay off employees with people migrating to Libreville or returning to agriculture. This had wider

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[99] "'Starve the city dwellers and they riot; starve the peasants and they die. If you were a politician, which would you choose?' Relief worker in the Sahel" (Timberlake, 1988, p.1).

[100] The withdrawal of these companies and the 25% price increase by the remaining shipping companies (Coquery-Vidrovitch, 2001, p.443) made it difficult to transport and market *Okoumé* logs to Europe (Quilliard, 1920, p.648).

[101] During this time prices for *Okoumé* went from 30 to 60 francs a tonne in 1916, to 800 francs before the Great Depression and then collapsing to 250 francs in 1931 (Sautter, 1966, p.767; Lasserre, 1955).

impacts on the local Gabonese economy as there was no longer a market selling food to timber camps (Rich, 2007a, p.108).

These boom and bust fluctuations, like the *"dents de scie"*[102] (Lasserre, 1955, p.163), were due to factors outside the control of the timber industry but also due to factors that they could control. For instance the 1938 crash occurred due to late payments for timber (Sautter, 1966, p.768); the 1952 crash was due to the over production of *Okoumé* and reduced demand (Lasserre, 1955). Between 1974 and 1975 exports of timber fell by 40% (Jaffré, 2003a, p.264) due to a combination of the economic crisis, lack of competitiveness, bureaucratic burdens to commerce, exhaustion of the coastal forests and insignificant investment in the infrastructure of the interior (Gaulme, 1988, p.119; Pourtier, 2010, p.4; Wunder, 2005).

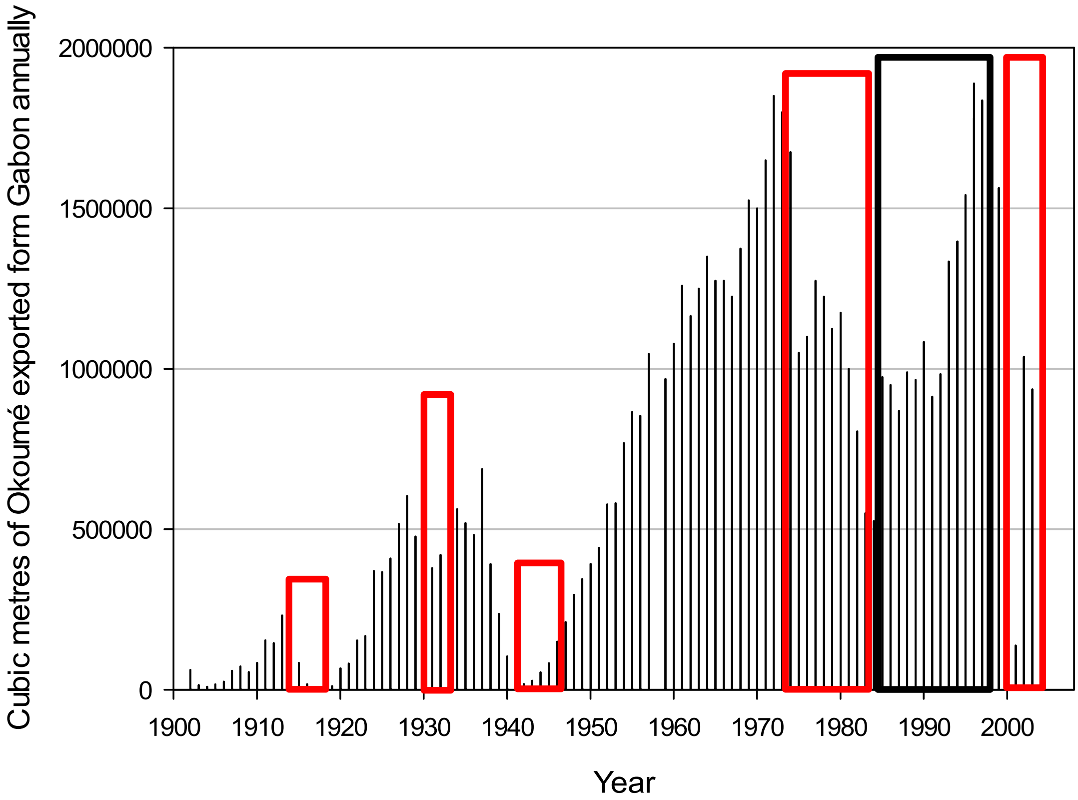


Figure 3-2: Exports of *Okoumé* from Gabon. The 1896 to 1962 data was converted from metric tons to cubic metres calculated using the Brunck et al. (1990, p.92) conversion factor. For the raw data see Table 11-4 in Appendix 11.12. The red boxes indicate busts and the black boxes the booms that are mentioned in the text.

[102] "teeth of a saw"

With the arrival of Asian timber companies[103] in the 1990s, the timber industry started to recover from the decline induced by oil. This recovery was short lived, as the Asiatic financial crises of the late 1990s resulted in a fall in demand for Gabonese timber and once again resulted in bankruptcy and layoffs[104] (World Resource Institute, 2000).

The most recent timber industry bust occurred during the 2008 global economic crisis. Even before the crash there had been a reduction in the exploitation of *Okoumé* because overharvesting had resulted in large stock piles and a fall in price as companies tried to sell off their stocks. At first the 2008 crash seemed to have mostly affected the French timber companies, further strengthening the Asian companies who now dominated the Gabonese timber industry (Karsenty *et al.*, 2010, p.176; Pourtier, 2010, p.9). Eventually even the Asian timber companies succumbed to the slowdown by reducing their production while also having some layoffs (Sayer *et al.*, 2012).

Redundancies due to the 2008 recession occurred in both the local and migrant worker forces, including those who had found indirect work servicing the timber industry (Bayol *et al.*, 2012; Karsenty and Bayol, 2012; Sayer *et al.*, 2012). Within Central Africa the timber industry had already resumed operations by 2010 (Sayer *et al.*, 2012), the exception being in Gabon where a moratorium on the selling of unprocessed timber was put in place (Bayol *et al.*, 2012; Karsenty and Bayol, 2012). The decision in 2010 by the then newly elected Gabonese president to ban the export of logs (Pourtier, 2010, pp.7–8) “triggered an unprecedented rush to export the logs stored, whatever the price”[105] (Karsenty *et al.*, 2010). It is still too early to say what the long term impacts of the 2008 financial crisis will have on logging management practices in Gabon or the environment (Karsenty and Bayol, 2012), but large Forest Stewardship Council certified concessions were being sold and “replaced by large but less environmentally responsible companies” (Karsenty *et al.*, 2010, p.172).

[103] Asian timber companies started to arrive in Gabon because of the logging bans they faced in Asia.
[104] This crisis also brought about a temporary reversal of competition, allowing French firms to once more dominate the Gabonese timber industry.
[105] It also resulted in Asian companies shipping saw mills to Gabon, while French timber companies lobbied the French administration to help overturn the ban, so far without success.

3.2.4 Short-term environmental impacts of logging

The short-term direct impact of the early logging industry on the environment was the exhaustion of *Okoumé*, with European timber companies being able to leave one area of exhausted forest to exploit another area of forest (Lasserre, 1955; Meye, 1969, p.58; Rich, 2005, p.155). Today only 3% of the first zone (Map 3-3) is *"forêt primaire"*[106] (Jaffré, 2003a, pp.204, 233). However, due to the timber industry's preference for *Okoumé* and because of the cost of living and transport, logging has become more and more selective (White, 1994b).

The short-term indirect impacts of the early logging industry would have probably been greater than of logging itself. Because of the larger labour forces involved and the unpredictability of transport, timber companies relied on local food supplies (Biraud, 1959, p.10; Meye, 1969). Large areas had to be converted from forest to agricultural land to feed this labour force[107]. To do this timber companies employed people[108], such as the wives of loggers (Bouet, 1974), to create plantations; one company, in 1965, set up a 200 ha plantation for its 15,000 employees (Coquery-Vidrovitch, 2001, p.457). Other companies, such as the one operating at the Ikobey study site, encouraged the creation of local markets where local producers could sell food either directly to the timber companies or to the workers (Biraud, 1959, p.10; Bouet, 1974). These plantations would have become more important after the numerous labour-related famines that occurred in Gabon in the first half of the twentieth century (Rich, 2007a). The creation of plantations resulted in a ring of cultivation around the timber base (Bouet, 1974), similar to von Thünen's rings around Towns.

To supply protein the timber companies employed people to hunt and fish (Lasserre, 1955). Hunters and fishermen were usually not salaried but rather independent operators, including Europeans, who negotiated a fixed per kilogram price for the meat and fish that they caught. The animals sold to the timber companies were "*essentiellement d'éléphant, de phacochère, de buffle, de porc-épic ou de singe"*[109] (Bouet, 1974, p.6), elephants were especially targeted due to

[106] "primary forest"

[107] Early European timber operations in the 1900s did import some of their foodstuffs from Europe, urban centres and other parts of Africa (Coquery-Vidrovitch, 2001, p.457) and even Asia (Lasserre, 1955).

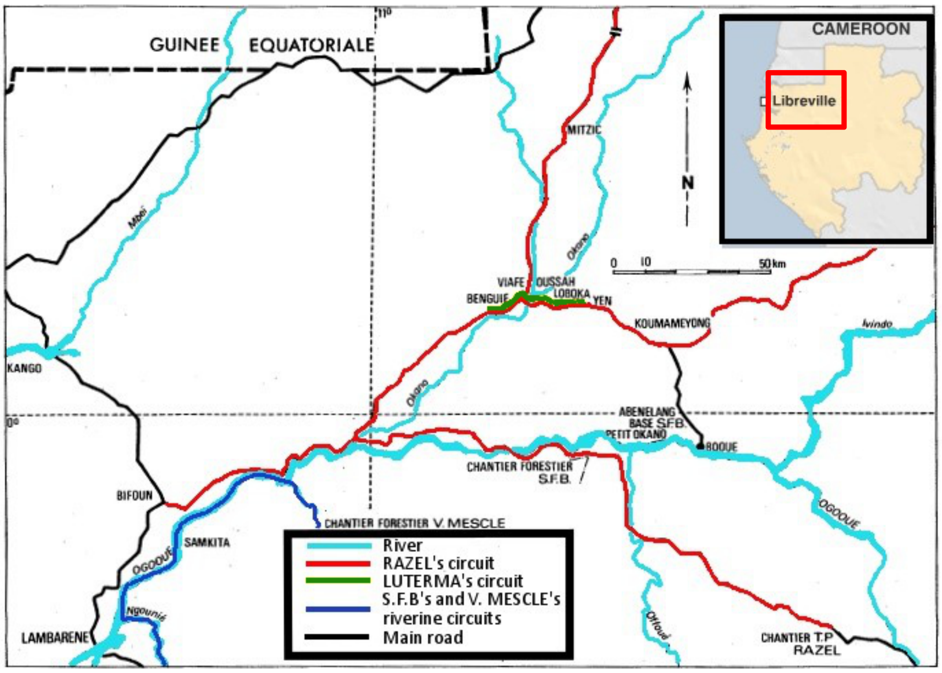
[108] People were employed to cultivate due to the unpredictable nature of the timber industry where an employee could not be sure that they would be in the same place for the whole cultivation cycle, and so were wary of creating plantations which they might not be able to harvest (Bouet, 1974).

[109]"essentially elephants, warthogs, buffalo, porcupines or monkeys"

the amount of people the meat could feed relative to the cost of hunting them (Bouet, 1974). So these early timber companies also had an impact on the wildlife.

With the mechanical advances in the timber industry the need for a large work force decreased (Lasserre, 1955) as did the need to feed a large labour force. Though this may have reduced the indirect local impact of logging, due to no longer needing plantations, the introduction of trucks allowed the timber industry to buy food supplies from farmers outside the local area. These trucks covered large distances, in some cases nearly crossing the whole of Gabon (Map 3-4), competing with each other to find the cheapest plantain, manioc or yams while driving an increase in the price of food (Bouet, 1974). Along these routes subsistence agriculture was transformed to commercial agriculture and so spread the indirect environmental impacts of logging to the national scale.

The use of waterways to transport the logs would probably not have had much new impact on the wildlife, as these waterways had long been used as a method to transport goods since before the Atlantic trade. However, wildlife would probably have been impacted by the inland penetration of the Decauville rails that allowed hunters to penetrate further into the forest. At the start of the use of the Decauville rails, impacts may have been greater since the ivory trade and extraction of other wildlife had yet to be regulated (de Hillerin, 2005). As a result animal populations may have reduced.



Map 3-4: Different circuits used by forestry companies in the 1960s and 1970s, used to get supplies for their concessions. Adapted from maps in Bouet (1974; 1977, p.99).

3.2.5 Long-term environmental impacts of colonial logging

Okoumé is of particular relevance for the timber industry as it was, and still is, the main exported tree species in Gabon. There is a growing body of evidence that indicates that its distribution is determined by past anthropogenic activity (Biraud, 1959; Delègue *et al.*, 2001; Engone Obiang *et al.*, 2014; Gaulme, 1988). As a light loving tree species that grows quickly [110] in clearings larger than a quarter of a hectare[111] (Biraud, 1959, p.8), *Okoumé* seedlings do not survive well in the shady environment of a mature forest (Biraud, 1959, p.4; Delègue *et al.*, 2001).

Clumps of *Okoumé* trees in mature forest therefore indicate places where there has been forest succession from past clearings due to various human activities or due to natural disturbances, triggering a succession that is still occurring. However, though a cohort effect of disturbance on *Okoumé* age structure can be seen (Engone Obiang *et al.*, 2014) with "*peuplements"* of *okoumé* (Biraud, 1959, pp.10–12; Lasserre, 1955, p.151) having been found in various places at different times, care must be taken when trying to hypothesise what the original human disturbance was, as there can be overlapping factors.

It is because of the light loving nature of *Okoumé* that the long-term impact of depopulation on Gabon's landscape (Map 3-2) could already be seen by the end of the 1950s. With a reduced presence of villages in the forest due to epidemics in the 1920s and 1930s, old plantations resulting in a forest succession where among others[112] *Okoumé* trees came to dominate the forest and which, 40 to 70 years later (Medzegue *et al.*, 2007; Sautter, 1966, p.751) around the late 1950s, would be ready for the timber industry to harvest. Biraud (1959) gives examples where old village sites[113] have been discovered in Gabon because of the presence of various

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[110] *Okoumé* can grow at a rate of one metre in height per year and one and a half centimetre in diameter per year (Fuhr *et al.*, 1998, p.22), depending on light and humidity (Wilks, 2003, pp.86–90)

[111] The legal exploitation diameter at breast height is of 0.7 metres (Biraud, 1959, p.11; Medzegue *et al.*, 2007), allowing an *Okoumé* tree to be legally exploited in around 41 years, when grown in plantations, or 70 years in natural forest conditions. However, even though *Okoumé* quickly re-establishes itself (Biraud, 1959, p.8; Pourtier, 2010, p.5,8; Wilks, 2003, p.85), the current rotation of exploitation in timber concessions, where some concessions have been exploited for the third or fourth time, has resulted in the removal of the "tallest and straightest" (Wunder, 2003, p.22) leaving behind trees that are not as suitable for commercial exploitation (Wunder, 2003).

[112] Resulting in forest *"riches en grandes arbres, comme 'okoumé, l'ilomba et le movingui qui ont nécessité de la lumière pendant les premières années de leur croissance"* (Wilks, 2003, p.2003) ("rich in tall trees, like *Okoumé, l'imoba* and *movingui*, which need light during the first years of their growth").

[113] One of the villages that Biraud mentions was in what was then the N'Golo forest reserve in the southeast of Gabon. Other villages found were in areas completely uninhabited by people, like the Lolo forest reserve (Biraud, 1959, p.6).

trees including *Okoumé* and the fruit trees. An old civil servant is reported to have said that people had fled this village due to an outbreak of disease that occurred after the First World War (Biraud, 1959, p.6). The same patch successional processes once again started in the 1940s and 1970s due to the rural to urban migration occurring in Gabon at the time (Sautter, 1966, p.751) (Map 3-2). The rural to urban migration in Gabon has resulted in a reduction in this sort of anthropogenic disturbance to the forest and combined with the current selective logging techniques that are being used, large forest gaps are no longer being created resulting in a reduction of *Okoumé* regeneration (Engone Obiang *et al.*, 2014; Wunder, 2003).

Colonial exploitation of the forest of Gabon has also had little long-term impact on the forest landscape. Though in 1930s it was no longer possible to log *Okoumé* in the Gabon Estuary (Chamberlin, 1977; Cinnamon, 1998; Gaulme, 1991; Patterson, 1975a; Rich, 2005), today *Okoumé* trees can be found throughout the *Forêt Classée de la Mondah* and the rest of the Gabon Estuary, including areas outside the *Okoumé* plantation created in the 1950's (Lasserre, 1955). The high densities of *Okoumé* in this area have even been called "*peuplements d'Okoumés"*[114] (Biraud, 1959, p.12) and can be found along the coast and in the Ogooué basin, with both the Gabon Estuary and coastal forests having the oldest of these *Okoumé* areas (Biraud, 1959, p.12).

The early routes used to transport *Okoumé* logs have not had a permanent long-term impact on the forest landscape. The abandonment of timber holding areas, villages built by the timber companies and the first transport routes, including the ones where logs were rolled, and the Decauville rail, all encouraged the growth of *Okoumé*, maybe to the detriment of other types of trees that require no disturbance. Aerial surveys, carried out in the 1950s by foresters to find *"les jeunes peuplements d'okoumé"*[115] (Lasserre, 1955, p.151), showed wide green strips of forest where *Okoumé* trees had overgrown old Decauville routes (Biraud, 1959, p.10). These strips also show the impact of changes in technology with the oldest strips being larger due to the early use of steam engines for the Decauville rails, with wood from the surrounding forest collected for the furnaces to generate steam, while younger strips were narrower, reflecting the

[114] "population of *Okoumé*"
[115] "young stands of *Okoumé*"

1939 introduction of diesel locomotives which resulted in less destruction along the rail tracks (Biraud, 1959, p.11)[116].

Though other species are logged, today's timber industry still seek *Okoumé* which is found at an average density of one to three exploitable trees per hectare, and current logging in Gabon is very selective (Lasserre, 1955; White, 1994b). Owing to a low population that is not land hungry, and with logging only representing a small fraction of the national budget, the current deforestation rate of Gabon is less than 1% of the total forested area per annum (Coquery-Vidrovitch, 2001, p.446; Pourtier, 2010, p.5; Wilks, 2003, pp.28, 36; Wunder, 2003). So today's exploitation of Gabonese forest by timber companies has little direct impact on the forests themselves, compared to previous logging operations where wide alleys had to be made to extract the timber. However, it has had an impact on the structure and species composition, with mature forest being rare along the coast.

3.3 Conclusion

The environment in Gabon has long been affected by people from both within and outside Gabon, including Europe and the Americas. People have been living off, exploiting and trading the natural resources of Gabon for at least 6,000 years. From the late 1800s until the 1950s colonial practices resulted in a decrease in the human population with people also becoming concentrated in certain areas. These factors have modified the pressures on the environment and resulted in a patchy landscape that is a mosaic of various stages of succession, which has fluctuated with historical events. The impression of recent observers, from outside Gabon and Africa, that Gabon is a wild place or "Eden" is due to the history of settlements and resource use in Gabon as well as more recent rural demographic decline because of the outbreaks of famine and diseases and then the rural to urban migration that allowed the release of different parts of the landscapes from anthropogenic disturbances.

The climate in Gabon favours not only rapid decomposition but also rapid recovery after disturbance, leaving little physical evidence of past human presence (Clist, 2005). To the untrained eye an agricultural plantation that has been abandoned for less than a decade looks like an untouched forest (Guillard, 2010). Through patch dynamics it becomes a mature secondary forest within 50 years (Wilks, 2003, p.24) and, in due course old growth or "mature

[116] Current logging roads usually have a 50 metre strip where trees are cut to allow the sun to dry the roads (White, 1992), along which *Okoumé* trees later grow.

forest" (Dauby, 2012), that only trained foresters and botanists can differentiate. There is a traditional saying that indicates how resilient (Mumby *et al.*, 2014) the Gabonese environment is, "*l'Okoumé, fils du manioc*"[117] (Aubréville, 1948) to indicate that *Okoumé* forest quickly takes over manioc plantations. Just as forest elephants are said to be the "tree planters" of forest (Blake *et al.*, 2009) so are people (Pretty, 2011).

In Gabon the historic exploitation of natural resources has resulted in short-term localised species extinction, such as in the case of elephants. However, in the long-term, these species have recovered. In this way the fortunes of elephants "have risen and fallen with human activity" (Fay, 2004a). This seems also to be the case for logging, where the first logging sites have become repopulated by *Okoumé* and other species. Though it can be argued that these tree species are early successional species, it can also be argued that the Gabonese forests have always been influenced by past disturbance, be it natural or anthropogenic, and are therefore a patch work of forest succession that is of different ages. Recent research (Engone Obiang *et al.*, 2014) has indicated that today's selective nature of logging in Gabon does not introduce enough disturbance in the forest to maintain these early successional species. A similar result has been found in the management of savannas, where the fire regime has had to be put in place to keep the Lopé savannas open, though this has not been enough to keep the forest back (Jeffery *et al.*, 2014; Walters, 2012).

How the early exploitation of natural resources contributed to the development of Gabon is difficult to quantify; though it contributed to the development of some kingdoms it also resulted in the destruction of others (Martin, 1982; Martin, 1972). With the arrival of Europeans during the Atlantic Trade period the potential for economic development from the trade in natural resources reduced as they slowly took over the different trading tiers and the control of revenue from trade.

With technological advances, the production of natural resources, like timber, increased[118]. However, this occurred at the expense of manual labour with fewer people being employed. The long-term development potential of the exploitation of remote rural forest areas by the timber

[117] "*Okoumé*, the son of manioc".
[118] The introduction of guns, which were not controlled in Gabon (Martin, 1982, 1972), would have had a similar impact on the production of ivory.

industry is further diminished by its dependence on outside factors that has resulted in a boom and bust industry.

Though advances in technology have resulted in both higher production of timber and the possibility to penetrate deeper in to the forest, they have also allowed the timber industry to be more selective and less destructive, no longer having to cut alleys ten metres wide so that each log can be rolled.

Historical trends in Gabon can therefore give an indication of what could occur under the right environmental conditions and if the right land management practices are put in place. For instance the current ivory demand from China adds further weight to the recent creation of the National Park network in Gabon and the need for this to be managed correctly, with modern law enforcement tools used to pinpoint poaching areas (e.g. Uno *et al.*, 2013; WCS, 2013; Wasser *et al.*, 2010). If this is carried out elephant populations could once more expand in Gabon. Understanding these past recoveries of elephant populations is both essential for the conservation of elephants and other animals as well as the conservation of forest landscapes due to the role that forest elephants play in the distribution of seeds (Blake *et al.*, 2009) as well as being the conservation “focal species for other large mammals” (Epps *et al.*, 2011, p.603).

These historic examples of the trade in natural resources also indicate the problems of setting up conservation or development projects that rely on the transport infrastructure of industries such as timber companies. The boom and bust nature of the trade of natural resources, be it due to local exhaustion of the resource being exploited or to outside factors, has resulted in the coming and going of industries based on the exploitation of natural resource found in remote rural forest areas. This does not bode well for the long-term success of such conservation or development projects that rely on the presence of the timber companies for the maintenance of transport infrastructure.

This chapter has shown that the assumption by conservation practitioners that remote rural forest areas have neither been disturbed by people or been industrially exploited in the past is misguided. The base line upon which a conservation project bases its success is impaired because the historical past in the chain of logic (Figure 1-1) is misrepresenting, it being impossible to tell if a conservation success is due to the project itself or just natural recover from past disturbance. By taking into account the past the amended chain of logic (Figure 1-3) allows conservation practitioners to better define the outcomes of their project and also decide whether conservation intervention is indeed needed or if it is better to let nature take its course.

4 Migration, population and patch dynamics in the Ikoy Valley

4.1 Summary

As with the previous chapter, this chapter looks at the first part of the amended chain of logic used by conservation practitioners (Figure 1-1 and Figure 1-3). This chapter dissects the historical processes that have occurred more widely across Gabon and shows in detail how they have also occurred to one of the study sites above Ikobey which is found in the upper reaches of the Ikoy valley which covers approximately 4,000 square km. It does this with the aid of oral histories of migration and the available literature. It shows that the recent environmental degradation attributed to the recent arrival of timber companies into the Ikobey area is not new and that the exploitation of natural resources from this area started over a century ago; since then these natural resources have recovered. It also shows how the arrival and departure of successive companies has impacted the local economy and local as well as national migration into and out of the area.

Rivalry between different groups of people seeking access to the different trade tiers culminated with the French setting up factories and taking over all trade in the Ikobey area. As with the rest of Gabon the rivalry and then the opening up of trade routes by the French in the area resulted in the spread of disease and the creation of a “dead zone” (Gray, 2002, p.160) empty of people. There the forest was released from anthropogenic disturbances and through succession resulted in the growth of large *Okoumé* stands in areas that were once plantations and the recovery of animal populations, which would later attract timber companies and conservationists.

After a thirty year period people fleeing *regroupement* penetrated into the edge of this dead zone, creating a complicated dynamic where parts of the forest were recovering from past anthropogenic disturbances while other parts were once again being impacted by anthropogenic disturbances.

This chapter also starts to investigate the second amendment to the chain of logic where it is proposed that in-migration comes to a stop and reverses when timber companies depart remote rural forest areas of rentier states. The arrival of the first timber companies into the Ikobey area resulted in the disappearance of the dead zone as local people migrated towards the timber company in search of employment. The migration into the dead zone was heightened with timber companies bringing in their own employees. However, with the departure of timber companies the in-migrants that arrived with them left, while local people continued their

migration down the roads created by the timber companies. This once again created a dead zone in the upper reaches of the Ikoy valley where anthropogenic disturbances have ceased. This migration brings up the possibility that projects involving natural resource utilisation in formerly logged areas may find that these sites become empty of people as they continue their rural to urban migration towards markets.

4.2 Introduction

As with the impacts of the arrival of timber companies in a remote rural forest areas, this thesis, with its results, conclusions and discussions that derive from it, can only be understood within the context of the site in which the study was undertaken. Even within a limited area there can be significant differences between case studies[119] (Brashares *et al.*, 2011, p.13932). For this reason the context of a location needs to be understood (Ascher, 2007, p.142). In this chapter only the background history of the Ikobey study site is explored. The background of the Koulamoutou site has been recently outlined by Starkey (2004), Coad (2010; 2007) and Kialo (2007).

Conservation and development practitioners often assume that timber companies are the first industries to exploit the natural resources of a remote rural forest area. While this may be true for some areas, the claim that timber companies are the first to commercially exploit the natural resources of the Ikobey area (Brainforest, 2010; Kramkimel *et al.*, 2005; Rambaldi *et al.*, 2010; WCS, 2007a) is not. In one case this assumption drag has led consultants to claim that the "access road [into the Ikobey area] has been carved through the forest canopy by an Asian logging company" (Rambaldi *et al.*, 2010), even though logging operations, and their transport infrastructure, were started in this area in the 1960s by French timber companies.

There is a consensus in the conservation literature that the arrival of timber companies leads indirectly to environmental degradation due to increased population which, in some cases, can be permanent (Abernethy *et al.*, 2013; Auzel and Wilkie, 2000; Bryant *et al.*, 1997; Hodgkinson, 2009; Poulsen *et al.*, 2007; Riddell, 2011; Robinson *et al.*, 1999). The impression that the arrival

[119] For example the Gabonese study sites chosen by Starkey (2004), Coad (2007), Walters (2010) and the present thesis are each separated by only one hundred kilometres, but each has a different history, environments and access among other factors (Table 11-5, Appendix 11.13).

of timber companies results in in-migration ignores the possibility that in and out migration, due to multifaceted trade in natural resources, may pre-date the arrival of timber companies.

In some areas in-migrants to remote rural forest areas may stay once timber companies depart (Bryant *et al.*, 1997; Chomitz, 2007; Chomitz and Gray, 1996; Geist and Lambin, 2001; Hodgkinson, 2009; Nasi *et al.*, 2008; Wunder, 2001), especially where there is little available land elsewhere or where poverty is high (Hodgkinson, 2009), the result of which is that environmental degradation continues in the long-term. However, this may not be the case when timber companies depart from remote rural forested areas in rentier states like Gabon, where land availability is not an issue.

Though the distances undertaken in the movement of Bantu-speaking and Pygmy populations discussed below are small, most being less than 100 km, I have here described them as migrations since these movements have been occurring because of outside push and pull factors (Jónsson, 2010; Molho, 1986; Rhoda, 1983) rather than local day to day needs, such as following prey, in the way usually associated with the movement of Pygmy populations. Furthermore, these small distances are similar to the movements undertaken by the various Bantu migrations during their slow but cumulatively long-distance migration from the Cameroonian/Nigerian grasslands (Klieman, 2003; Klieman, 1999; Klieman, 1997; Vansina, 1995; Vansina, 1990; Vansina, 1984).

This chapter uses some of the "landscape history" (Marcucci, 2000, p.70) framework, framing the understanding of changes in a landscape by placing it in its spatial context with all its constituent parts and identifying "keystone process" (Marcucci, 2000, p.72). This landscape history starts off with a brief summary of the known recent history of the Ikobey site and former migrations that once occurred in the area. This is then expanded with the use of oral migration histories from local people, introducing their perspective. Oral migration histories for each of the three ethnicities currently in the Ikobey area are then summarised (primary data and a full discussion can be found in Appendices 11.14, 11.15 and 11.16).

4.2.1 Sedentary Pygmies in Gabon

Although Bantu-speaking farming populations are usually more sedentary than Pygmy populations, who are often assumed to be mobile hunter gathers, in Gabon many of the Pygmy populations are also relatively sedentary compared to Pygmy groups elsewhere. The Pygmies of Gabon do not conform to the "primitive" and "romantic" views of anthropologists (Frankland,

2001) (Appendix 11.17), being too much like their Bantu-speaking neighbours. Frankland observes that researchers interested in Pygmies have gone out to find groups in the "most pristine environment" (Dupré, 1999, p.135), furthest from the roads, in the deepest, darkest forest as far from outside influences as possible within a "forest cocoon" (Bahuchet and Guillaume, 1982; Riddell, 2011; Rupp, 2011), and accessible Pygmies groups have "at best, been ignored or, at worst, been categorized as culturally degraded" (Frankland, 2001, p.241)[120].

As access to Pygmy groups of Gabon is relatively easy they have been largely overlooked by explorers, anthropologists, ecologists and missionaries (Bahuchet, 1993b) since at least the 1940s. Until recently the only thing known about the Pygmies of Gabon was that they are more or less found throughout the country (Bahuchet, 2007) and very little is known about them (Bahuchet, 1993a; Mayer, 2007; Knight, 2003; Mayer, 1987). Before the 1980s "anthropological and ethnographical research was, with a couple of exceptions, not encouraged in Gabon" (Knight, 2003, p.82). Since 2000 this is being rectified by young anthropologists (Bonhomme *et al.*, 2012; Knight, 2006; Knight, 2003; Matsuura, 2009; Matsuura, 2006; Soengas, 2010; Soengas, 2009; Paulin, 2010; Ruyter, 2010; Ruyter, 2003; Weig, 2013).

These young anthropologists have found that in contrast to the Pygmy groups in the northern Congo basin, the Babongo Pygmies of Gabon are much more sedentary (Matsuura, 2006; Matsuura, 2009; Soengas, 2010), confirming the 1930's accounts of Andersson on how the Pygmies of southern Gabon lived in villages similar to their Bantu-speaking neighbours (Andersson, 1983; Le Roy, 1928; Trilles, 1933). It has been suggested that the past Pygmy mobility in Gabon may have been an outcome of economic marginalisation during the Atlantic trade (Klieman, 1999; Klieman, 1997; Klieman, 2003; Rupp, 2011). Genetics studies have also highlighted this sedentarisation and the fact that Southern Gabonese Pygmies share more genetic material with their Bantu-speaking neighbours than do other Pygmy groups (Quintana-Murci *et al.*, 2008). However, this is not to say there are no semi-mobile Pygmy groups in Gabon. The Baka Pygmies in northern Gabon, recently arrived within the last hundred years, are still very mobile (Paulin, 2010; Weig, 2013). It is likely that mobility in different Pygmy groups depends on how they have adapted to different environmental and social circumstances.

[120] A view that continues in Gabon where a forester told me in 2007 "*il n y a pas des Pygmées au Gabon*" ("there are no Pygmies in Gabon").

4.3 Methods

The methods used here are as for the previous chapter, but complemented by old maps of the areas and first-hand data in the form of oral migration histories. The background material for this chapter also includes the literature on Central Gabon and the Du Chaillu Massif, in which the Ikobey site is located. In contrast to the writing on the coastal region, the literature on inland Gabon before the mid-1800s is patchy. Historians have tentatively identified Dapper's 1600s Bukkameale, from which ivory came, as being the southern edge of the Du Chaillu Massif (Martin, 1972, p.17). More detail on central Gabon and the Du Chaillu Massif began to appear in the 1800s. This came from explorers such as Du Chaillu, missionaries such as Le Roy and Raponda Walker, commercial agents such as Walker (father of Raponda Walker) and Quéru and administrators like Le Testu. The first description of the Ikoy River comes from Quéru and dates between 1907 and 1909. As an employee of the *Société Commerciale Industrielle et Agricole du Haut-Ogooué* (SHO) based along the Ikoy River, he wrote about the commercial concession and its trade factories as well as the natural resources that were harvested in the Ikobey area and kept in the factories before being transported to the coast (Coquery-Vidrovitch, 2001, p.382).

Village	Date of principal interview	Number of participants
Nyoe I	09/05/2010	6
Tranquille	27/04/2010	3
Ossimba	28/04/2010	3
Nyoe II	22/04/2010 to 23/04/2010	10
Motombi	12/04/2010 to 15/04/2010	7
Makoko	24/03/2010	12
Ngondet	05/03/2010	9

Table 4-1: Number of participants and dates when principal oral migration interviews were carried out.

The oral migration histories were recorded first with a group of adults and elders from each of the Ikobey study villages (Table 4-1) so as to get an overview of the migration and then in separate smaller groups, some of which were based on ethnicity. In each of the first group interviews a map was drawn on the ground consisting of the villages that people had created during their migration, starting with the current village. Once a map had been drawn, open-ended questions were asked on each of the villages mentioned, including why they had left the previous village, why they have moved to the village in question and the path they used to get to the village in question. This information was supplemented with the current known locations of named places, a local event calendar constructed from dates of major local historically salient events and the smaller group interviews (Table 4-2). Data from each of the villages were triangulated with each other and used in follow up questions.

Approximate date	Event
1950	*Regroupement* carried out by Ekoga
1960	Arrival of Madre / La Song timber company
1990	Departure of Madre / La Song, arrival of La NEF timber company
2000	Arrival of Malaysian logging company

Table 4-2: Local event calendar.

Current demographic data (Table 2-4) was collected in each of the study site villages by interviewing the head of each household in the village (Chapter 2.2.3 and Appendix 11.5) and then from the individuals of the household. As Gabonese villages are small it was possible to interview all the heads of households who were willing to participate and so obtain an accurate population size of each village (Table 4-3).

Village	Principal ethnicity	Demographic data used in Chapter 4			
		Total no. of Households	No. of households who participated	Total Pop. size (2010)	No. of people who participated
Diboka	Pove	38	35	114	73
Ndanda	Pove	20	18	111	42
Divinde	Pove	21	19	86	42
Nyoe I	Mitsogho	16	11	68	40
Tranquille	Babongo	15	11	59	41
Ossimba	Babongo	5	5	18	17
Nyoe II	Mitsogho	15	15	59	49
Motombi	Babongo	6	6	36	21
Makoko	Babongo	22	15	92	51
Ngondet	Babongo	14	13	74	39

Table 4-3: Summary of the number of households who participated in the demographic data collection.

The demographic data of the household included the members currently living in the household, their age, their education level, whether they had been employed and the number of children that they have had. For each child that was recorded additional demographic data was collected on whether they still lived in the village or had migrated away, and if they had where they currently lived.

Past demographic data was retrieved for most of the villages from an “unofficial” database of the 2003 census; however this database did not include the two forest villages of Makoko and Ngondet.

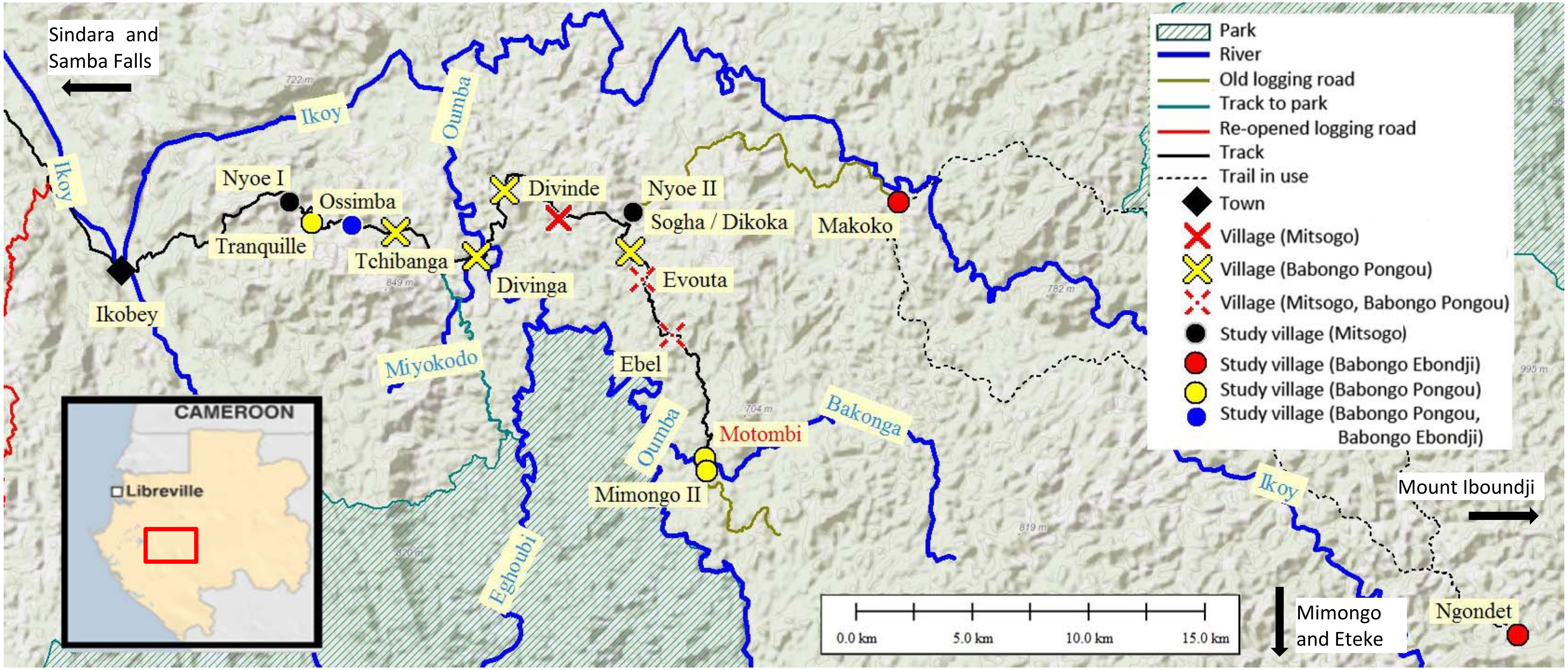
4.4 Results

4.4.1 The People in the area of the Ikobey study site

Fifteen villages are found along the final section of road beyond Ikobey (Map 4-1). These villages are principally inhabited by two populations, the Mitsogho, a Bantu-speaking people and the Babongo Pygmies. In addition to these populations there are the remains of a third population, the Akele, also a Bantu-speaking people, but of this group only three elders remain.

It is generally accepted by historians (Barnes, 1992, p.8; Gray, 2002; Vansina, 1984), consultants (Kramkimel *et al.*, 2005; Brainforest, 2010; Rambaldi *et al.*, 2010), linguists (Klieman, 2003; Klieman, 1997) and even the Gabonese that these two principal population groups of the Ikobey study site, especially the Babongo Pygmies, have been living in the Du Chaillu Massif for a considerable time. According to Klieman, a historical comparative linguist, the languages spoken by today's Mitsogho and Babongo Pygmies have a common root in proto-Itsogho-Himba that has been spoken in the Du Chaillu Massif since 4,000 BP (Klieman, 1997).

Conservation and development Non-Government Organisations (NGOs) have taken this generalisation and applied it to the populations of Babongo Pygmies and Mitsogho who currently live along the Ikoy River above Ikobey (Eisen, 2010; Maisels *et al.*, 2008; Ndong *et al.*, 2008; Rambaldi *et al.*, 2010; Rayden and Essame Essono, 2011; WCS, 2007b), portraying the people along the middle reaches of the Ikoy River as having been there for a long time and using this generalisation as a justification for work with these "indigenous" Babongo Pygmies (Mebia, 2009).



Map 4-1: Current villages above Ikobey. Basemap - (ESRI, 2012), Park boundaries - (Institut Geographique National, 2008).

Village name	Year of census	Population size	Principal population	Migration route into the area	Approximate overland distance (km)
Nyoe I	2003	63	Mitsogho	Oumba	70
Tranquille	2003	33	Babongo Pygmy	Oumba	130
Ossimba	2003	22	Babongo Pygmy	Oumba + Ikoy	130
Tchibanga	2003	39	Babongo Pygmy	Oumba	
Dikouka	2003	33	Babongo Pygmy	Oumba	
Gheghouba	2003	19	Babongo Pygmy	Oumba	
Divinde	2003	153	Mitsogho	Ikoy	
Nyoe II	2003	58	Mitsogho	Oumba	90
Evouta I	2003	85	Mitsogho	Oumba	
Ebel	2003	55	Babongo Pygmy	Oumba	
Motombi	2003	34	Babongo Pygmy	Ikoy	100
Mimongo II	2003	33	Babongo Pygmy	Ikoy	
Makoko	2010	92	Babongo Pygmy	Ikoy	100
Ngondet	2010	74	Babongo Pygmy	Ikoy	70

Table 4-4: Population size of the villages above Ikobey, excluding the forestry camp, with the total approximate distance that the people in the study villages migrated. The village of Dikouka, no longer exists, with the population being integrated into other villages.

However, the oral histories I collected from the present day population of Mitsogho, Babongo Pygmies and the remaining Akele currently living along the Ikoy River all tell of how they are all recent arrivals, with the Bantu-speaking Mitsogho arriving first. They all refer to their recent migration from the surrounding areas into the Ikoy River area as occurring between the mid-1960s to 2000, with overall migration distances ranging from 70 to 130 km (Table 4-4). According to these people, when they first came into the area along the Ikoy River it was uninhabited. However, history shows that the area has not always been empty, rather there is evidence for “dead zones” appearing and disappearing in this area (Avelot, 1905) (Map 4-2 and Map 4-3) as summarised in Figure 4-1, and though the names of the rivers and hills of the area are Akele, the Mitsogho and Babongo Pygmies are thought to have once occupied this area before the arrival of the Akele.

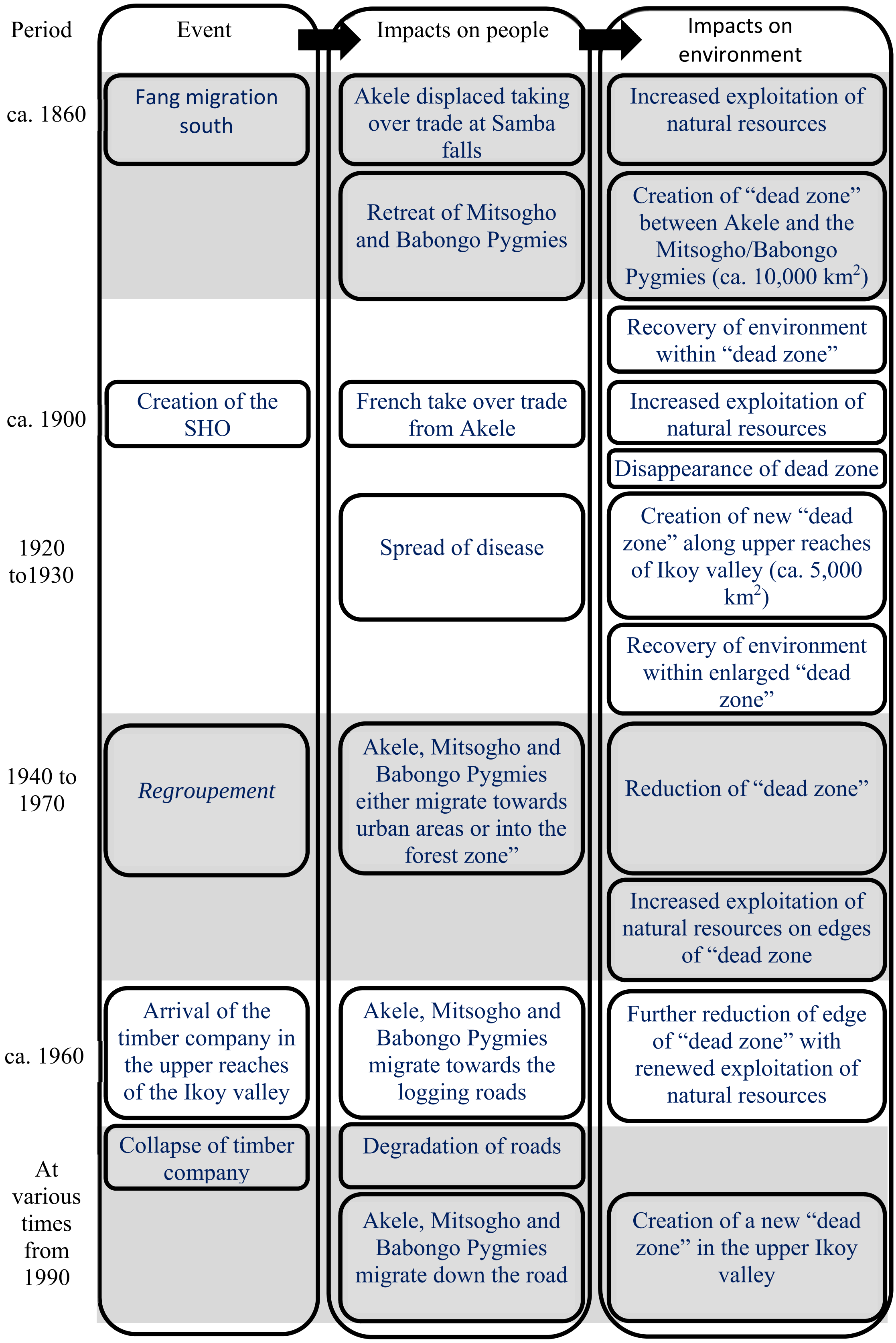
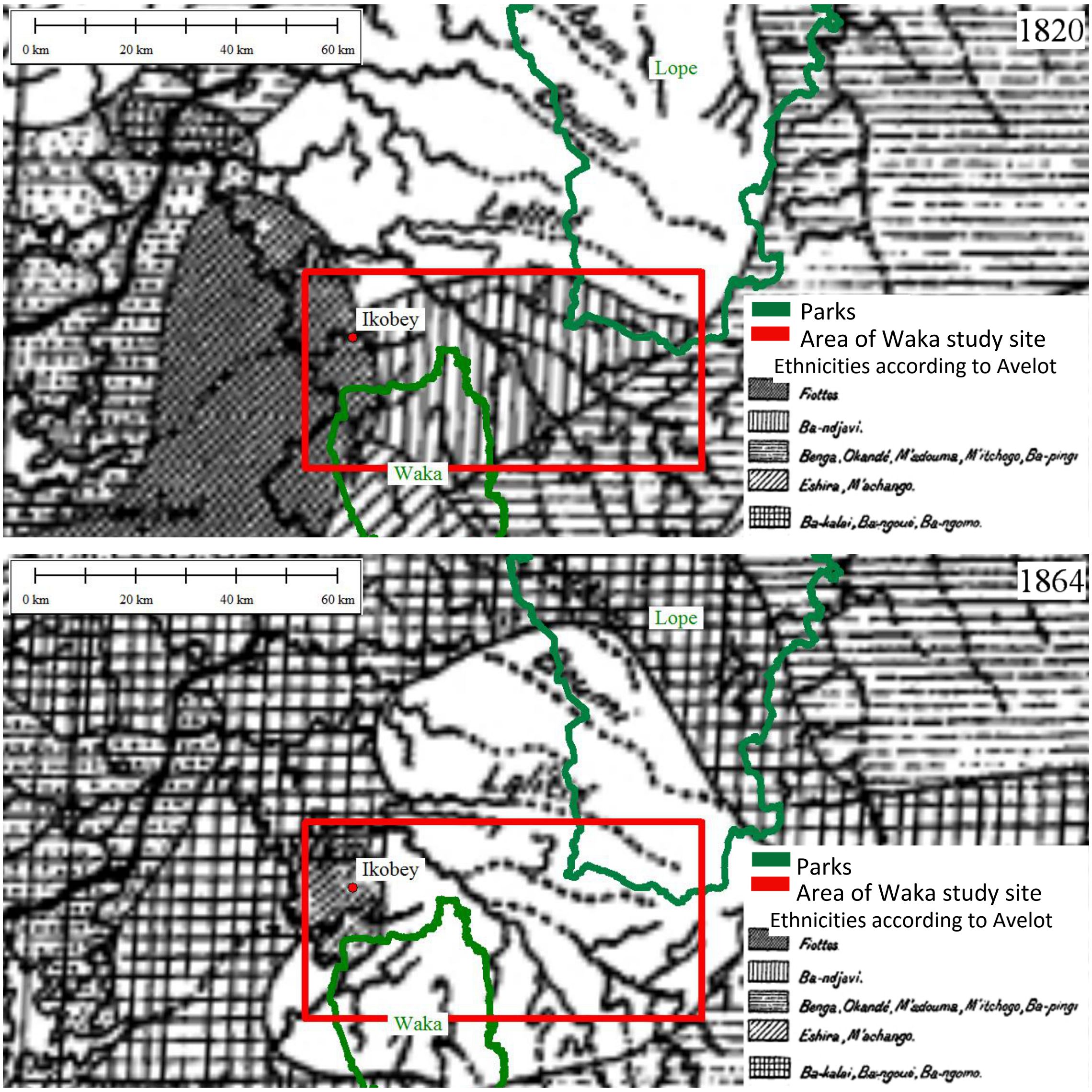
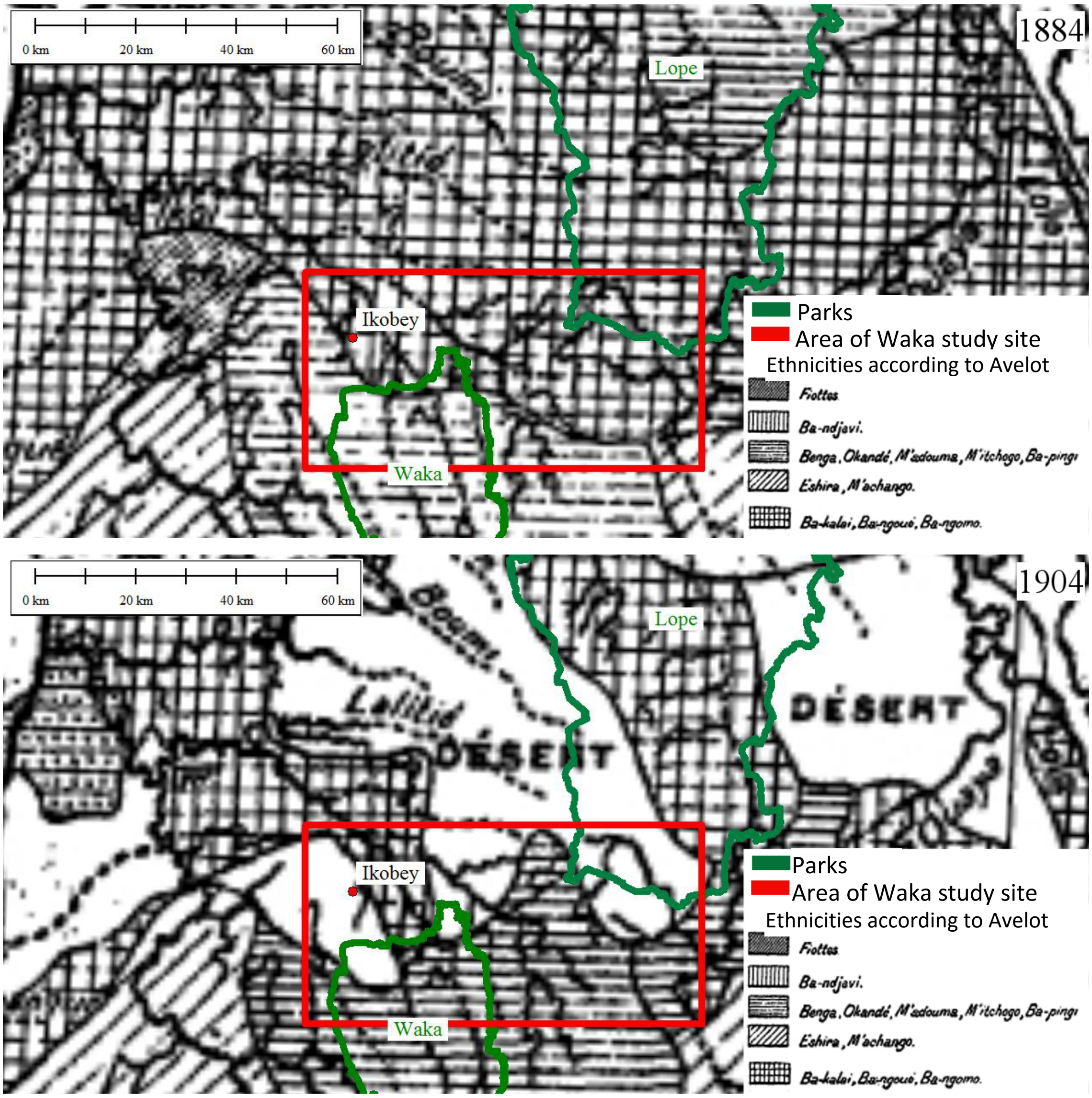


Figure 4-1: Summary of events and the impact that they had on both the people and the environment of the villages of the Ikobey study site.



Map 4-2: Maps showing the formation of dead zones (white area) between 1820 and 1864 (based on maps in Avelot, 1905, pp.62, 63)



Map 4-3: Maps showing the formation of dead zones (white area) between 1884 and 1904 (based on maps in Avelot, 1905, pp.64, 65)

4.4.2 Migrations

The first three sections of this migration history, pre-1930, are based on secondary sources while post-1930 the migration history is based on secondary sources and oral histories as detailed in Appendices 11.14, 11.15 and 11.16.

4.4.2.1 The Akele migration (pre 1890)

The Akele migration into the Ikobey area started in the 1840s due to competition with the Fang[121] who were trying to increase their position in the trading tiers (du Chaillu, 1861, p.121; Chamberlin, 1977; Cinnamon, 1998; Gray, 2002; Sautter, 1966, p.745; Walker, 1870, p.142). The result of this was the migration of the Fang southwards from southern Cameroon. In doing so they triggered a series of events that led to the displacement of people throughout northern and central Gabon (Avelot, 1905; Gray, 2002), including the Akele who also went southwards (Sautter, 1966, p.743; Van der Veen, 1991).

By the 1870s, at Samba Falls (Map 4-1, Map 4-4), the Akele took over an important part of the riverine trade from the Bantu-speaking Villi and Eshira (Gray and Ngolet, 1999). At this point on the Ngounié River, near Sindara, riverine trade is forced onto paths (Chamberlin, 1977; Gray, 2002), making it an important place to control the flow of forest resources to the European factories that were further downstream. By controlling this key location, the Akele became the second tier traders of the area (Chamberlin, 1977) and monopolised the trade in forest resources coming down the Ikoy River, including ivory, beeswax and later, wild rubber and slaves (Chamberlin, 1977; Gray, 2002), which put them in direct competition for access to trade with the Mitsogho.

This event also meant that the inhabitants of the Ikoy valley, similar to the people described by early explorers like du Chaillu (du Chaillu, 1867a; du Chaillu, 1867b) and shown on early maps by Avelot (1905), Nassu (1914) and Neuville (1884), were now exposed to the Akele advance. Presumably the Babongo Pygmies were also exposed, but there are no references to their presence in the area at this time; Pygmies were only “re-described” and “re-discovered” by Europeans in the 1860s (du Chaillu, 1872; Malte-Brun, 1867; Schweinfurth, 1969, first published in 1874).

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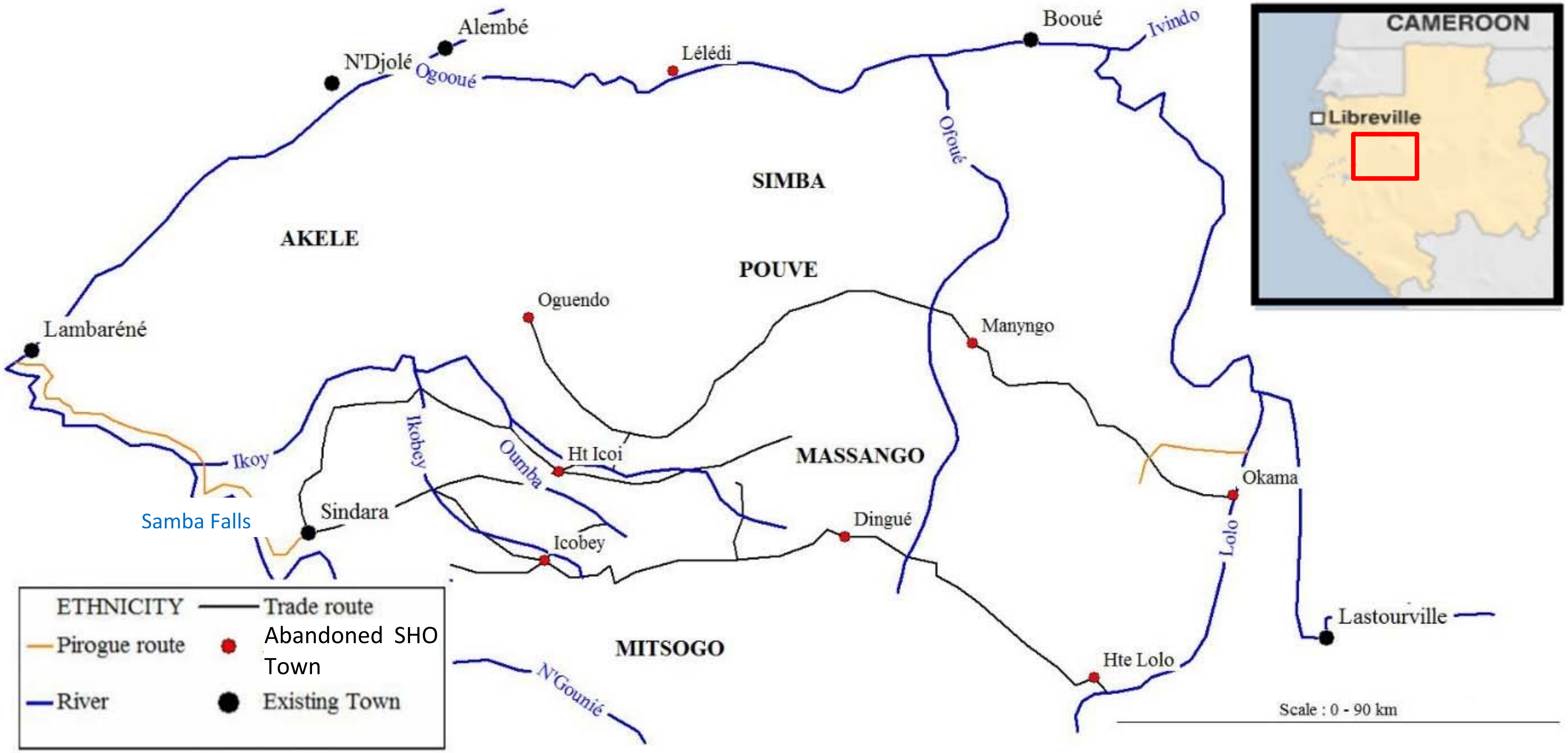
[121] Like the Fang, the Akele were traders, hunters, enslavers, warriors (Sautter, 1966, p.743) and semi-nomadic (Bowdich, 1819; Sautter, 1966, p.744).

By the 1890s the Akele had forced out the Mitsogho and other inhabitants of the Ikoy area (Gray, 2005, p.235; Gray, 2002, pp.57–58) and presumably also the Babongo Pygmies, since current accounts of the Akele, by both themselves as well as the Mitsogho and the Babongo Pygmies, all tell of how other peoples stayed away from the Akele. As an Akele explains:

> *nous sauvages avant, c'est-à-dire nous les Akele, c'est que on était trop méchant, quand les autres* [Mitsogho and Babongo Pygmies] *voit dans la route, qu'on a passé la route, ou on mangeait la casse à dent ' oh les Akele ont passés' pour les histoires de bagarre étaient parce que nous était trop mauvais ... ils évitent cette zone*[122].

The fleeing Mitsogho and Babongo Pygmies went east and southeast towards Mount Iboundji, the town of Mimongo and the village of Eteke (Map 4-1). Only a concentrated effort by the Mitsogho in the late 1890s stopped this Akele advance (Gray, 2005, p.235; Gray, 2002, pp.57–58). This resulted in the creation of a dead zone between the Akele and the other populations in the upper reaches of the Ikoy valley (Avelot, 1905; Gray, 2002), where the forest environment likely started to recover.

[122] "before we were savage, that is us the Akele, we were too horrible, when the others [Mitsogho and Babongo] see in the road that we had passed, as we left behind traces of *casse à dents* [a type of food made from manioc tuber], 'Oh the Akele have passed through here', and, due to past fighting as we were so bad, … they avoided these zones". Nyoe II, Akele 22/05/10 [recording DS400078; 31:42].



Map 4-4: Old trade routes used by E. Quéru, and SHO agent, between 1907-1909. Adapted from (Coquery-Vidrovitch, 2001, p.382).

4.4.2.2 The arrival of the French (1890 – 1930)

Trade became the downfall of the Akele, for it led to direct competition with the French, who in the 1900s were reinforcing their commercial effort in Gabon by expelling the major foreign traders of the time, namely the British and Germans (Barnes, 1992; Chamberlin, 1977; Coquery-Vidrovitch, 2001; Patterson, 1975b; Pourtier, 1989).

In 1893 the Minister of the Colonies un-officially awarded Daumas, the then most important French trader in the Gabon Estuary, the first commercial concession in Gabon part of which included the Ikoy valley and Ikobey[123]. This consisted of eleven million hectares of forest and 700 km of river that Daumas could have for a thirty year period (Coquery-Vidrovitch, 2001, pp.14, 44; Cuvillier-Fleury, 1904, pp.92–93; Rouget, 1906, pp.610–611). On the death of Daumas, in 1897, his concession became the *Société Commerciale Industrielle et Agricole du Haut-Ogooué*, the SHO (Coquery-Vidrovitch, 2001, p.44).

The SHO concession included the areas of Sindara as well as the Ikobey and Ikoy River valleys (Coquery-Vidrovitch, 2001, p.380). In 1907 one of the first commercial agents for the SHO, Quéru, was sent to set up factories in the middle reaches of the Ikoy River (Map 4-4) (Coquery-Vidrovitch, 2001, p.381; Gray, 2005). In the following years he made an inventory of the natural resources that could be commercialised and found Akele villages throughout. This agent organised the buying and transport of rubber, ivory, raphia (Barnes, 1992, p.25; Coquery-Vidrovitch, 2001, pp.381–383) and later palm nuts via a network of caravan routes resulting in the disappearance of the dead zone. By 1928 the whole of the Ikobey area was criss-crossed with caravan routes, SHO trading posts and villages (Map 4-5), some of which can still be seen on current maps.

Though today's population of Babongo Pygmies, Mitsogho and Akele, or their grandparents, were not in the Ikobey areas during the 1900s, some elders do remember their grandparents talking about the old trade routes running from the town of Mimongo to Sindara (Map 4-6). Along these trade routes their grandparents collected palm nuts, raffia and rubber that they went to sell in Sindara:

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[123] Other commercial concessions were created in 1899 in the rest of the *Afrique Equatoriale Française* (Cuvillier-Fleury, 1904, p.94).

ah oui, imo. Il y avait ça, l'corde la, le caoutchouc là c'était le travail pour les vieux. Avec le café la avec le palmier là. Il porte ça juste au Sindara là. Ça c'est le travail pour les vieux d'avant, on avait compris ça, c'était le travail pour les vieux, le raphia aussi[124]

4.4.2.3 Famine and disease (1930)

The disappearance of the former dead zone was short lived, as elsewhere in Gabon the free trade networks that the French brought in also enhanced the spread of disease. Between the late 1920s and early 1930s disease[125] and famines were also occurring in the Ikobey area and resulted in the early SHO trade routes being abandoned. By the 1930s the upper reaches of the Ikoy had once more become a dead zone (Gray, 2002, p.160) with the population of this area being decimated before the First World War by a succession of famines (Choubert, 1954, p.37) and the remaining Akele fleeing. For around thirty years the area lay empty as people feared that it was cursed (Choubert, 1954, p.37; Gray, 2002).

During this thirty year period the forest of this area was released from anthropogenic disturbance allowing the growth of *Okoumé* trees and recovery of animal populations that had previously been hunted either for food or to be traded. The trees would later attract foresters, while the wildlife would later attract conservationists.

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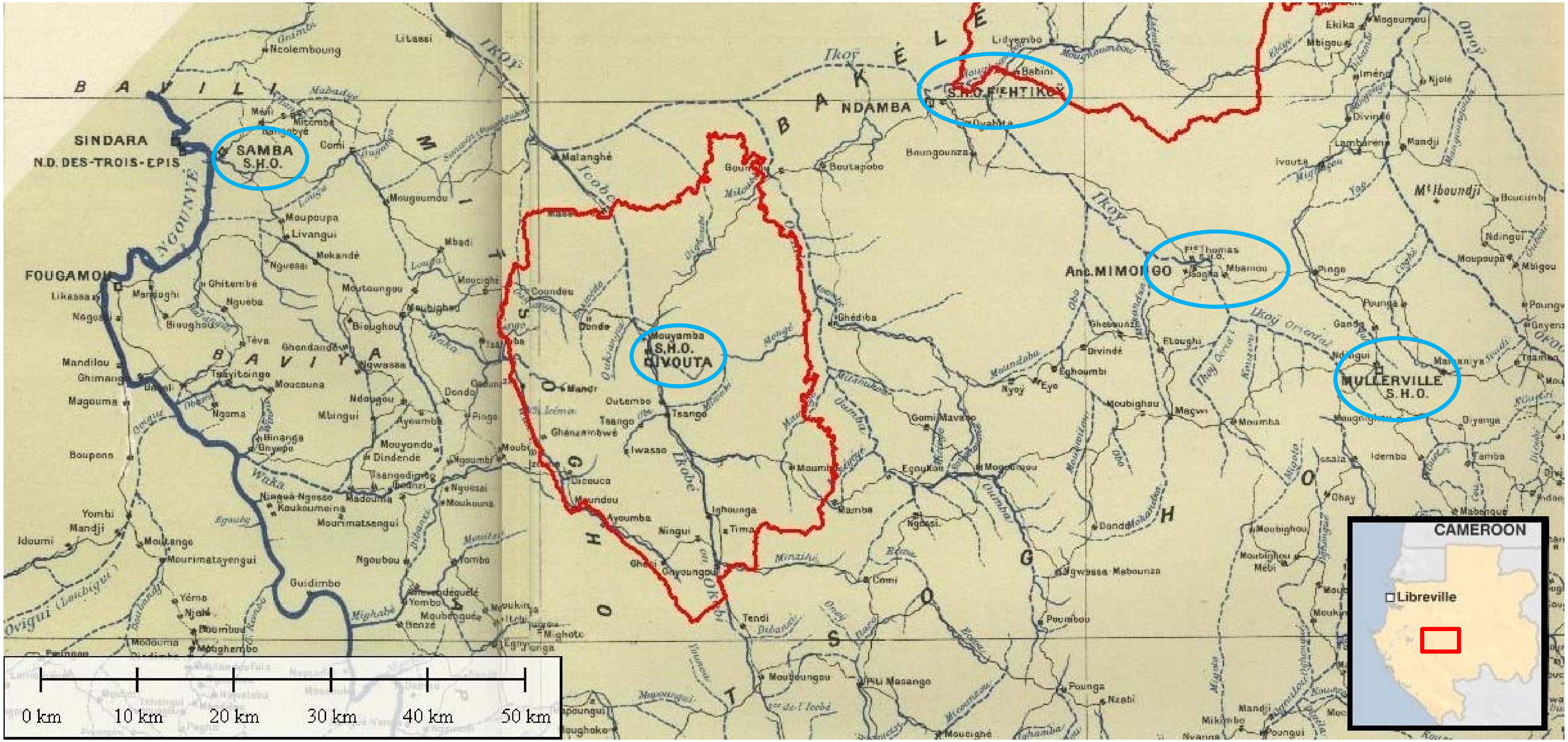
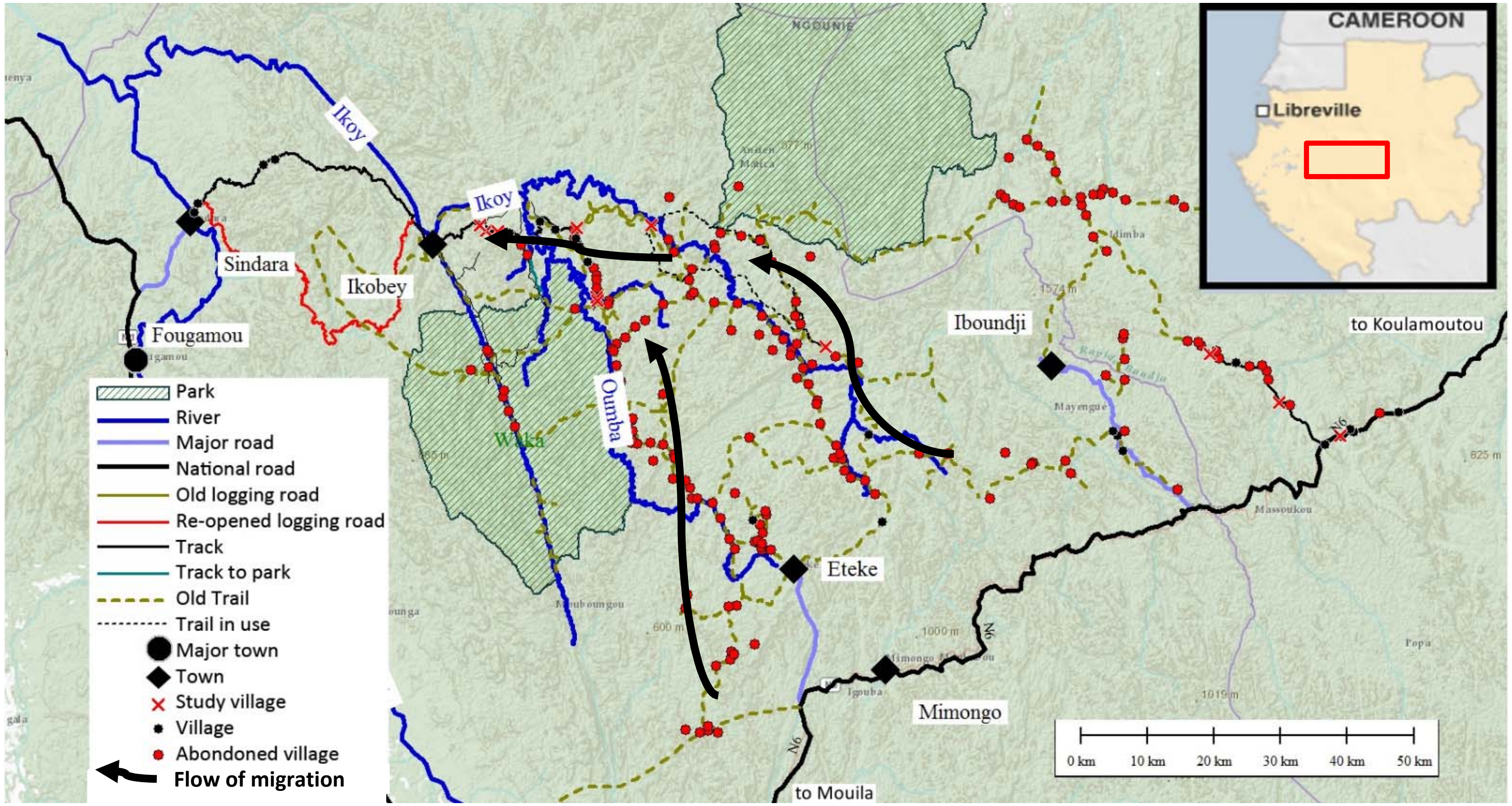
[124] "oh yes, *imo*. That did exist, cord, rubber, that was the work for our parents. With coffee and oil palm. They carried that all the way to Sindara. It was the work of our parents, we heard about that, it was the work of our parents, raphia as well". Makoko, Babongo Ghebondgi 24/02/10 [recording DS400079;08:07].
[125] Even today unrecorded disease epidemics, of unknown origins, are a serious issue for the villages of the middle reaches of the Ikoy River. The elders of the village of Ngondet talk about how the nearby village of Komi was abandoned when most of the people died, with the two remaining elderly Akele of Nyoe II blaming the Mitsogho for using sorcery to kill off the Akele in the area.



Map 4-5: Old trade routes, villages and SHO bases in 1928, with the addition of the current park boundaries (in red), old SHO factories in blue. Adapted from (Mariol, 1928).



Map 4-6: Old village sites and trade routes found along the Ikoy, Oumba and Ikobey River from the 1960s. Based on the following sources: Basemap - (ESRI, 2012), Park boundaries - (Institut Geographique National, 2008), old village sites, paths and roads from - (Army Map Service, 1966a; Army Map Service, 1966b; Army Map Service, 1966c; Institut Geographique National, 2008; Institut Geographique National, 1994; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1986; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1980; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1969; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1967a; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1967b; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1962).

4.4.2.4 Regroupement and migration back to the Ikoy River (1930 – 1960)

This thirty year period came to an end with Gabon's Independence from France in 1960. Along the road that was constructed between 1930 and 1960 linking the towns of Mimongo, Mouila and Sindara to Koulamoutou, the Gabonese administration continued the policy of *regroupement*. But, as during previous efforts, not everyone consented to move (Abitsi and Lepemangoye-Mouleka, 2009).

Today's Mitsogho, Babongo Pygmies and Akele elders found in the middle reaches of the Ikoy River, tell of how they fled *regroupement* by leaving the roads to the south of the headwaters of the Oumba and Ikoy Rivers and entering the forest. For the most part these people used the then rarely-trodden Akele and SHO trade routes. In doing so they entered the headwaters of the Ikoy and Oumba Rivers where they established a number of villages.

The local administration started to create paths in the headwaters of the Ikoy, Oumba and Ikobey Rivers along which they continued to encouraged people to regroup (Map 4-6). These paths were maintained by the villagers along them *"on faisait avec la pelle"*[126]. The routes were *"bien débroussé, parce que quelqu'un qui était distant, tu le voyait venir"*[127]. Traders who used these routes were not just the Mitsogho, or even the Gabonese, but *"il y avait des Maliens qui arrivent jusque dans ces villages, qu'ils avaient appelés Ajoka, commerçants"*[128]. Administrators from Mimongo town also used the routes *"pour que ils ne sont pas énervés par la forêt, pour voir la population"*[129].

In this way the edge of the dead zone, created thirty years earlier, began to be once more filled, reversing any forest succession that was going on at the time. Each time the administration asked people to regroup near a town some refused and migrated deeper into the forest. As a Mitsogho explained, "'*Comme on nous a tapé donc obligatoire on doit descendre on ne part plus*

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[126] "we made it with a spade". Nyoe II, Mitsogho 09/05/10 [recording DS400079; 23:38].
[127] "the routes were cleared well, as when someone was far away you could see them coming". Nyoe II, Mitsogho 23/04/10 [recording DS400080; 31:00].
[128] "there was the Malians who came all the way into those villages, they were called the *Ajoka*, traders". Nyoe II, Mitsogho 23/04/10 [recording DS400080; 31:10].
[129] "so that they were not too annoyed by the forest when they went to see the population". Nyoe II, Mitsogho 09/05/10 [recording DS400079; 23:38].

à Mimongo, il n'a pas fallu que il nous tape'. Voilà comment ils sont descendus"[130]. As they migrated into the forest each ethnicity created their own villages.

4.4.2.5 Recent migration and timber companies

By the 1960s, the French commercial concessions had been or were being disbanded. The SHO had already left the Ikobey area in the 1930s with the company being split up (Coquery-Vidrovitch, 2001, p.388; Gaulme, 1988, p.116; Suret-Canale, 1987, p.130). Part of the former SHO commercial concession was bought by M. Madre and then became, after his death, La SONG, *"Madre c'est La SONG, c'est Madre qui a commencé"*[131]. While operational the five companies that formed the *"groupe Madre"* exported 50,000 tonnes of wood per year (Charbonnier, 1957).

La SONG exploited the forest around Sindara and Ikobey as well as other places in Gabon. In the area around Ikobey they had a 100,000 ha concession used to supply logs to the Tarragona saw mills in Spain (Gomez-Jordana, 1971; Suret-Canale, 1987, p.235). The coming of Madre at Sindara encouraged people to cross the mountains to look for work. To do this they used "*la route caravane a sorti vers Ikobey pour aller à Trois Epis* [the mission at Sindara]"[132], this included the Babongo Pygmies who left the village "*Ebondji Mitone ils ont quitté là-bas jusqu' à Sindara pour trouver le travail … à Sindara, avec La SONG. Avec les loco* [train]"[133]

At the end of the 1960s La SONG timber company was entering the dead zone that had developed in the Ikobey area thirty years earlier. In entering this area they would have found many stands of light-demanding *Okoumé* that had grown on the plantations that villagers had previously cultivated before the dead zone was created thirty years earlier. Only when Madre reached this point did people start to settle once more in the upper reaches of the Ikoy, above Ikobey.

[130] "'as we were beaten, we are obliged to go down, we will no longer go to Mimongo, he should not have beaten us'. And that is why they went down.". Nyoe I, Mitsogho 09/05/10 [recording DS400093; 1:19:03].
[131] "Madre is La SONG, it was Madre who started". Nyoe 1, Mitsogho 14/07/10 [recording DS400098; time 01:58].
[132] "the caravan route emerged near Ikobey to then go to *Trois Epis* [the mission at Sindara]". Nyoe I, Mitsogho 09/05/10 [recording DS400093; 2:01:06].
[133] "Ebondji Mitone, they left there to go all the way to Sindara to find work … at Sindara with La SONG. With the trains". Makoko, Babongo Ghebondgi 12/07/10 [recording DS400095; 11:50].

4.4.2.6 *Old trade routes and recent migrations (1960 – 2000)*

The arrival of Madre and La SONG in Ikobey had an impact on migration into the Ikobey area with people starting to migrate towards the timber companies (Abitsi and Lepemangoye-Mouleka, 2009) and by doing so filling in the previous dead zone. As they migrated all the people found was forest. Before the timber companies came, in the 1960s, the area above Ikobey was empty of villages *"ici c'est la forêt tout ça c'était la forêt, Nyoe I et Nyoe II c'est la SONG qui a ouvert ça"*[134], *"il n'y avait pas des vieux villages"*[135]. The number of people involved in these migrations is unknown, however, today the current population of Mitsogho, Akele and Babongo Pygmies is approximately 800, all of whom live in the villages that have resulted from these migrations (Table 4-4).

While the timber companies were coming up from Sindara, the Mitsogho, Akele and Babongo Pygmies, who today live along the middle reaches of the Ikoy River, were migrating towards Ikobey from the southeast, along two routes. A first group of Mitsogho followed the Oumba River downstream (Map 4-7). Latter, a second Mitsogho group (Map 4-7) followed by the Akele (Map 4-8) and Babongo Pygmies (Map 4-9 and Map 4-10) followed the Ikoy River downstream. The migration of people into the middle reaches of the Ikoy River culminated in 2000 when a group of Babongo Pygmies, originating from around Mount Iboundji, also followed the Ikoy River downstream. It was in this area that the different ethnicities started to live together in the same village.

In all the cases the objective pulling them towards Ikobey was *"d'aller vers les Blancs, on voyait les layons* [Madre] *ils en profitaient déjà pour dire que quand les Blancs vont venir on va nous retrouver là"*[136], because in the forest there was:

> *la souffrance, chercher le savon le pétrole les autres ont voulé approcher d'un village plus proche... on ne voulait plus rester où il y avait les éléphants et les*

[134] "here everything was forest, all that was forest, Nyoe I and Nyoe II, it was La SONG that opened it up". Makoko, Babongo Ghebondgi 24/02/10 [recording DS400043; 17:15].
[135] "there were no old villages". Nyoe II, Akele 22/05/10 [recording DS400078; 16:25].
[136] "to go towards the Whites, we could see their transects [Madre's], they took advantage of the situation and said that when the Whites come they will find us here". Nyoe II, Mitsogho 23/04/10 [recording DS400093; 27:26].

gorilles ... [papa] il était fatigué de la forêt [maman] par rapport à l'approche pour certain nourriture, pour le savon et le sel[137].

The use of the old trade routes as migration routes came to an end when they encountered the timber company coming up from Ikobey, after which they used the logging roads to migrate towards Sindara as well as back up the Ikoy River, moving in step with the timber companies and in some cases taking over the old logging camps.

Madre and La SONG established the modern-day town of Ikobey, where they set up their base, and created all the present-day roads that stopped short of a steep escarpment in the east. They were in this area for over thirty years, from 1956 to the 1990s (Lepemangoye-Mouléka, 2009), but only exploited the forest along some of the roads that Madre had originally laid out, including all the way up to Makoko where they went bankrupt. Though there have been other timber companies none have lasted as long in this area, the maximum other timber companies have spent in the area is six years "*la NEF a fait même pas 2 ans*"[138] and they have all been content to re-open the old and now overgrown logging roads that Madre created, but none have got to the end of the original roads that Madre had created.

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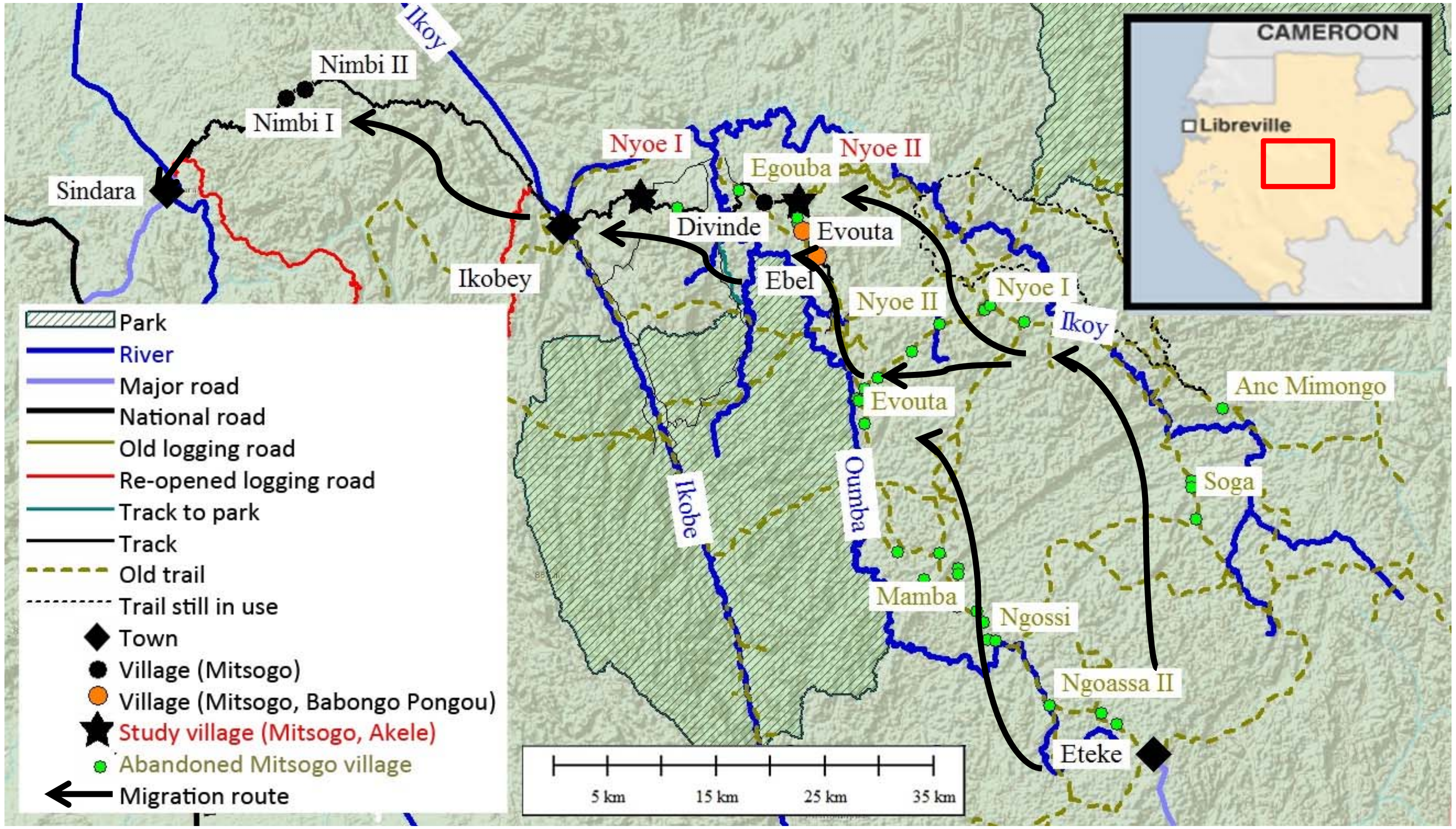
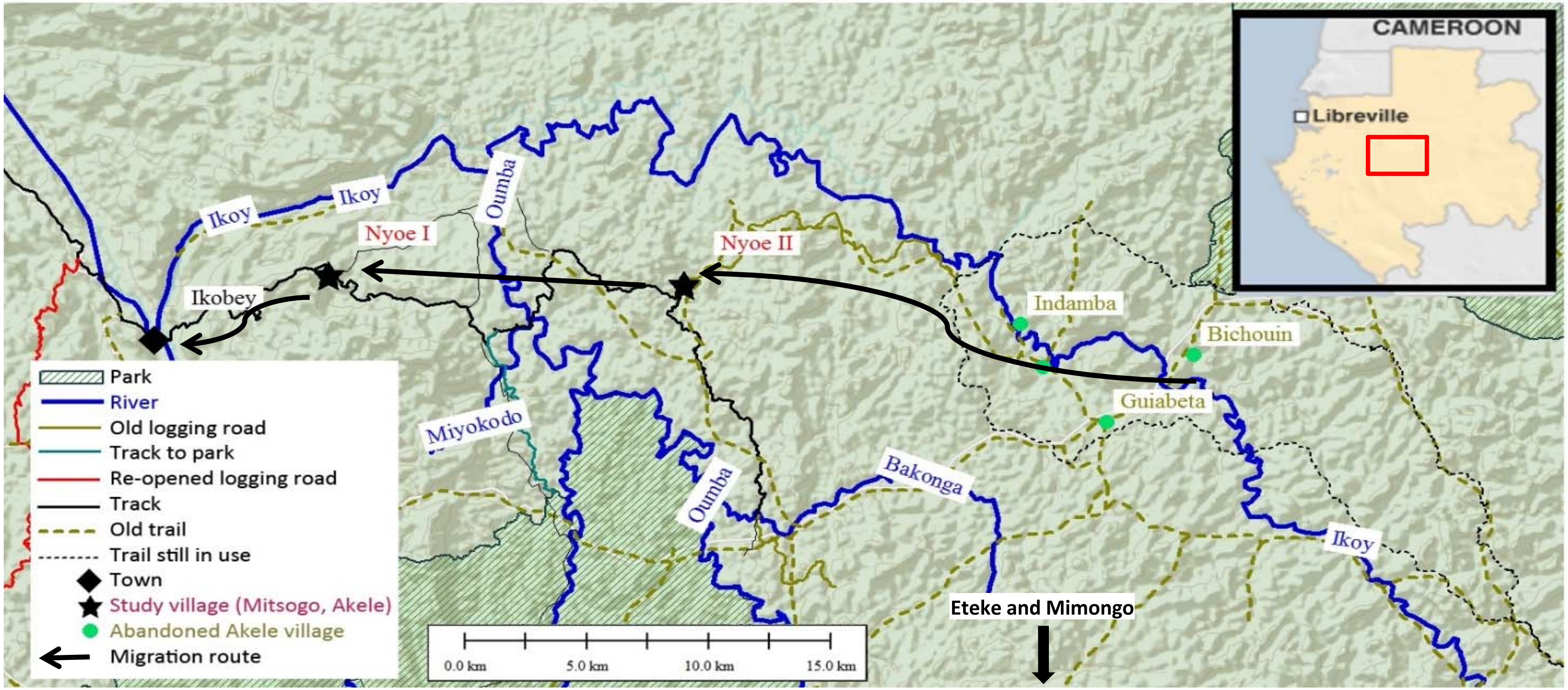
[137] "suffering, to go get soap, kerosene, the others wanted to go closer to a village … we did not want to stay where there were elephants and gorillas … [father] was tired of the forest [mother too] … due to the distance of certain foods, for soap and salt" Motombi, Babongo Ghebondgi 24/02/10 [recording DS400010; 02:41, 06:10].

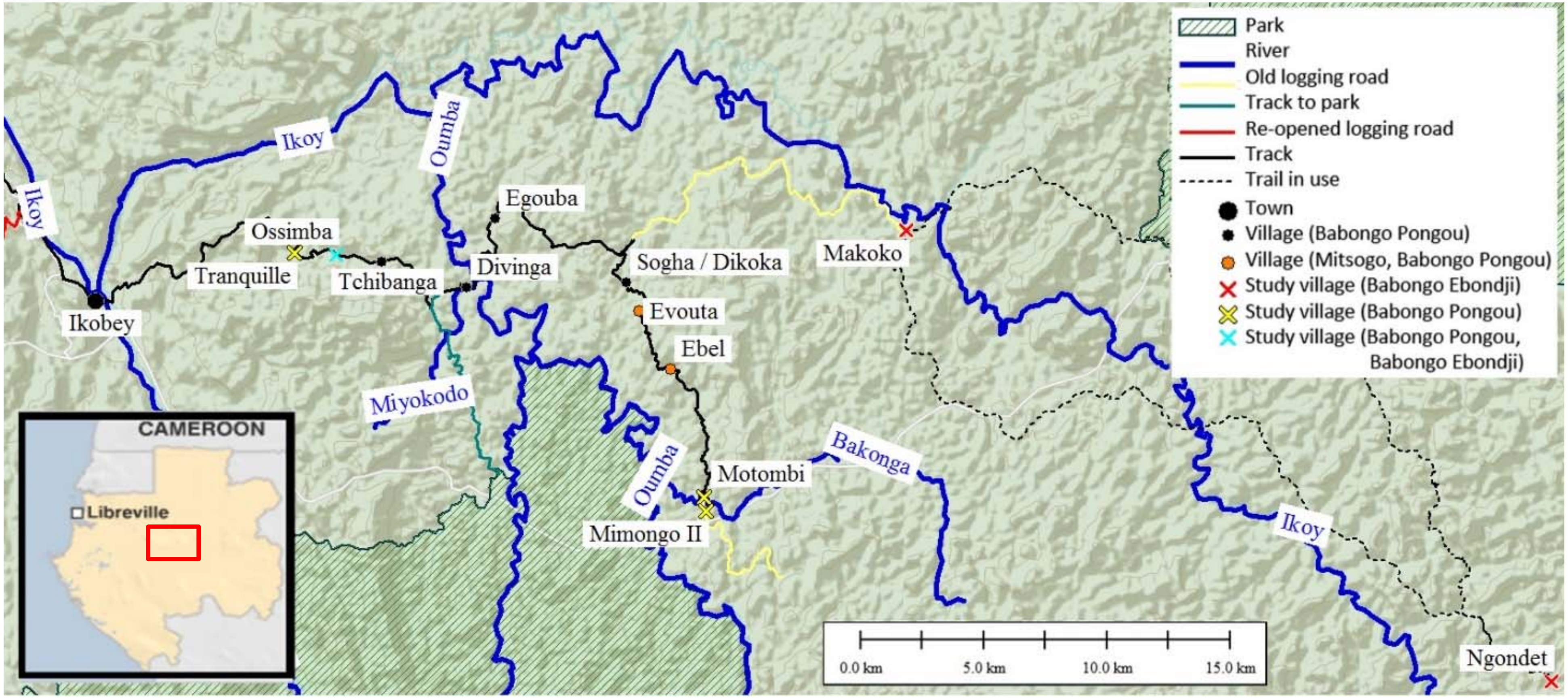
[138] "NEF did not even do two years". Nyoe 1, Mitsogho 12/07/10 [recording DS400098; time 01:46].



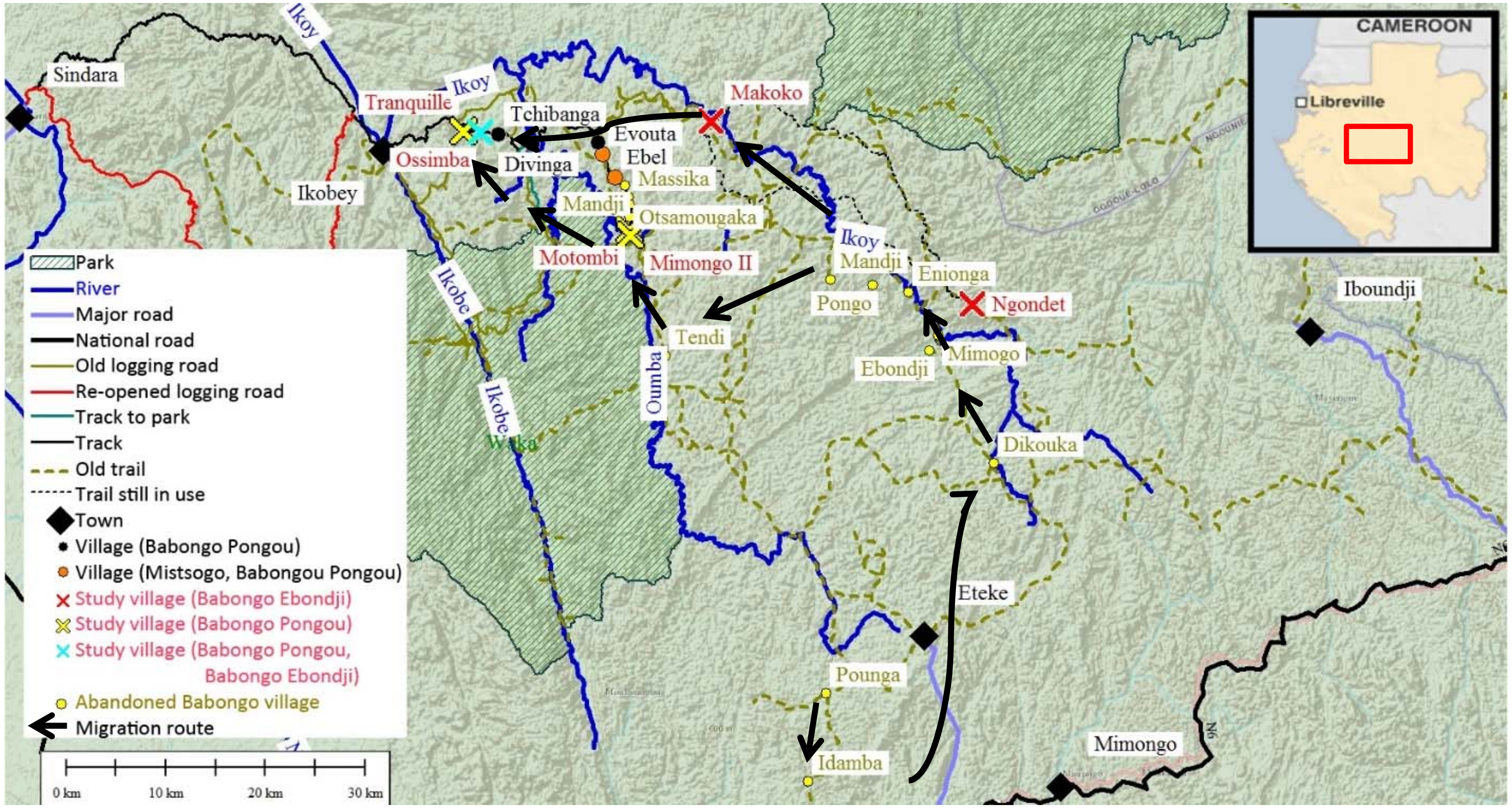
Map 4-7: Current and past Mitsogho villages around Ikobey, with their migration route. Based on oral histories, the maps are from the following sources: Basemap - (ESRI, 2012), Park boundaries - (Institut Geographique National, 2008), old village sites, paths and roads from - (Army Map Service, 1966a; Army Map Service, 1966b; Army Map Service, 1966c; Institut Geographique National, 2008; Institut Geographique National, 1994; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1986; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1980; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1969; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1967a; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1967b; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1962).



Map 4-8: Current and past Akele villages above Ikobey, with their migration route (the last Akele at Nyoe I passed away at the start of the field work). Based on oral histories, the maps are from the following sources: Basemap - (ESRI, 2012), Park boundaries - (Institut Geographique National, 2008), old village sites, paths and roads from - (Army Map Service, 1966a; Army Map Service, 1966b; Army Map Service, 1966c; Institut Geographique National, 2008; Institut Geographique National, 1994; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1986; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1980; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1969; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1967a; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1967b; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1962).



Map 4-9: Current Babongo Pygmies villages above the town of Ikobey. Based on the following sources: Basemap - (ESRI, 2012), Park boundaries - (Institut Geographique National, 2008), trails, tracks, roads – track logs collected between 2008 to 2011.



Map 4-10: Migration of the Babongo from their old abandoned villages to the Babongo villages above Ikobey. Based on oral histories, the maps are from the following sources: Basemap - (ESRI, 2012), Park boundaries - (Institut Geographique National, 2008), old village sites, paths and roads from - (Army Map Service, 1966a; Army Map Service, 1966b; Army Map Service, 1966c; Institut Geographique National, 2008; Institut Geographique National, 1994; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1986; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1980; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1969; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1967a; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1967b; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1962).

4.4.2.7 Recent timber companies, current population and migration (2000 to present)

The last timber company to operate in the areas was Bordamure[139], a Malaysian timber company that worked in the area for six years and left in 2006. This timber company only operated as far as Motombi and, like their most recent predecessors, brought in much of their own labour.

Between the census of 2003, when there were still ongoing timber operations, and the 2010 census (Table 4-5) when timber companies had departed, the majority of villages[140] in the Ikobey site have shown a small increase in population size (Figure 4-2, Table 4-6), but this increase is not significant (One Way ANOVA, $F = 1.438$, $DF = 2$, $P = 0.297$). What increase there has been was mostly due to births of children fathered by the departed employees of the timber companies, as opposed to in-migration, with one person observing "*il reste plus rien des forestiers, sauf les enfants*"[141].

This apparently stable population is not formed from in-migrants who arrived from outside the area due to the past presence of timber companies, since the ethnic composition of the village sites in 2010 indicates that the majority of each village's population is made up of people who arrived from the surrounding area when Madre re-opened the area in the 1960s (Figure 4-3, Table 4-6). Therefore, unlike elsewhere, the employees brought in by the timber companies have not stayed in the area; rather they have left when the timber companies departed, "*quand les forestiers partent, leurs travailleurs parte aussi*"[142].

[139] At the end of the study period, at the end of 2010, a Chinese timber company started operations; these operations only lasted just over a year.
[140] The exception being the village of Tranquille that was created by the slow splitting up of a neighbouring village.
[141] "there is nothing left from the foresters, except for children". Nyoe I, Mitsogho 12/07/10 [recording DS400098; 22:15].
[142] "when the foresters leave their workers leave as well." Nyoe II, Mitsogho 23/04/10 [recording DS400093; 28:30].

Village	Principal ethnicity	No. of House-holds	Pop. size 2010	No. people inter-viewed	No. of Infants	No. of children	No. of teen-agers	No. of adults	No. of elderly
Diboka	Pove	38	114	73	7	18	10	55	24
Ndanda	Pove	20	111	42	11	41	16	39	4
Divinde	Pove	21	86	42	11	28	8	34	5
Nyoe I	Mitsogho	16	68	40	3	16	4	42	3
Tranquille	Babongo	15	59	41	5	16	3	33	2
Ossimba	Babongo	5	18	17	1	5	0	10	2
Nyoe II	Mitsogho	15	59	49	2	16	7	29	5
Motombi	Babongo	6	36	21	2	11	0	20	3
Makoko	Babongo	22	92	51	6	20	11	48	7
Ngondet	Babongo	14	74	39	5	32	3	33	1

Table 4-5: Summary of 2010 census data.

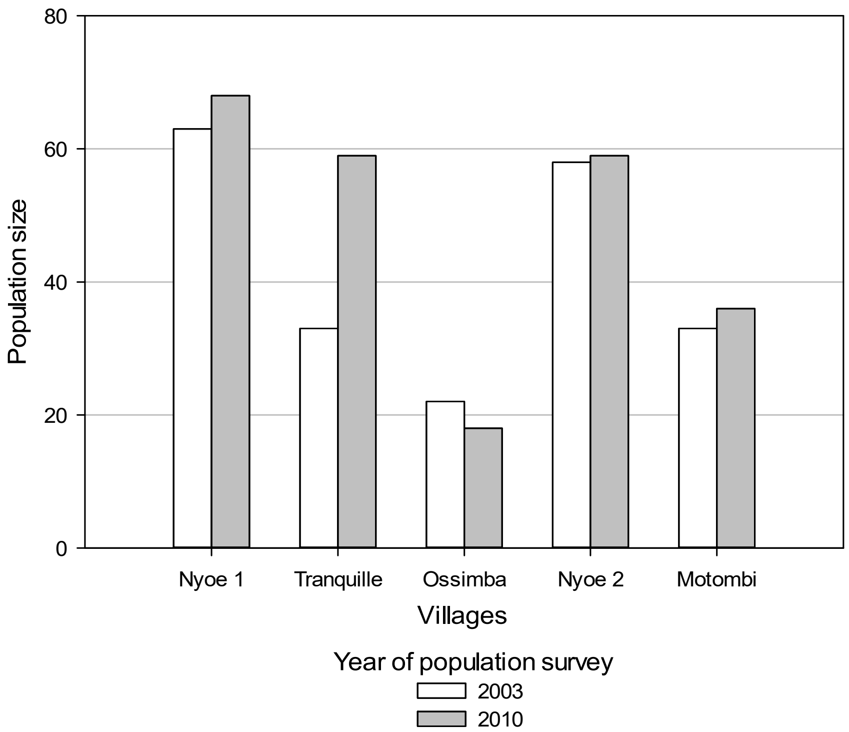


Figure 4-2: Changes in population of study villages between 2003 and 2010.

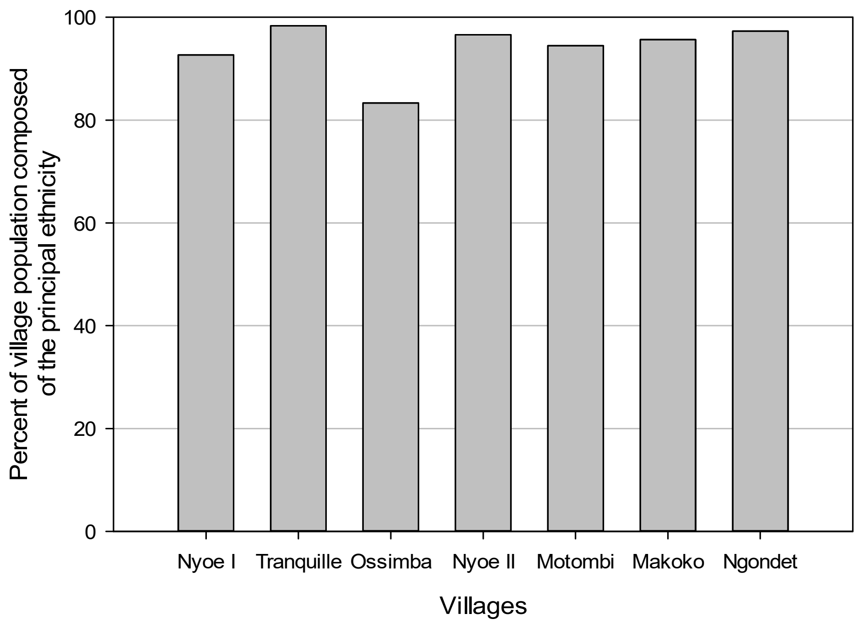


Figure 4-3: Proportion of each village that is made up of one of the principal ethnicities of the area

This lack of long-term in-migration of people from outside the area can also be seen in the 2003 and 2010 population data where the 2003 census shows an extra village called Bordamure, situated between Ossimba and Nyoe II, with a population of 128. This village housed all the timber companies workers who "*quand Bordamure est parti, tous leurs personnel sont parti aussi*"[143]. In 2010, after it became the Waka National Park's headquarters, it was only inhabited by two people, both park guards, and in 2013 this logging village had been completely abandoned[144]. Abandoned logging villages similar to this can be found throughout the Ikobey area.

Village names	Year of census		Primary principal ethnicity in 2010			Secondary ethnicity in 2010			Total %
	2003	2010	Ethnicity	No.	% of pop.	Ethnicity	No.	% of pop.	
Nyoe I	63	68	Mitsogho	63	92.65	Babongo	4	5.88	99
Tranquille	33	59	Babongo	58	98.31	Mitsogho	1	1.69	100
Ossimba	22	18	Babongo	15	83.33	Babongo	3	16.66	100
Nyoe II	58	59	Mitsogho	57	96.61	Akele	2	3.38	100
Motombi	33	36	Babongo	34	94.44	Babongo	2	5.55	100
Makoko	na	92	Babongo	88	95.65	Simbaka	4	4.34	100
Ngondet	na	74	Babongo	72	97.30	Simbaka	1	1.35	99

Table 4-6: Principal population ethnicity in villages. Highlighted villages are villages where the timber industry had a base during this period.

With the timber companies' abandonment of the upper reaches of the Ikoy valley, people have continued to migrate down the logging roads towards Ikobey, migrating as the transport infrastructure collapses. For example each time that:

> *ponts qui étaient coupés on a préféré de venir ce côté-ici. A l'époque La SONG était retourné, et on ne pouvait pas travailler ce pont, et les voitures pouvaient refuser de nous retrouver dans les villages*[145].

These migrations continue as they see that development in the area is coming to an end:

[143] "when Bordamure left, all their personnel also left". Nyoe I, Mitsogho 17/07/10 [recording DS400098; 32:51].

[144] The park headquarters being moved to Ikobey.

[145] "bridges were broken, we preferred to come this side. At the time La SONG had gone and we could not repair the bridge, and cars would refuse to come to fetch us in our villages" Nyoe II, Akele 24/05/10 [recording DS400082; 1:17:02].

en fait à ce moment on ne voit plus rien de beau donc ce qui est sûr ont va continuer juste à Ikobey ... puisque la route est en train de se fermer on attend encore un peu si il n'y a plus de sociétés qui arrivent on continue[146].

As of 2014 the Babongo Pygmy village of Makoko had been moved further down the road towards Nyoe II so as to get better access to transport (personal communication Kevin Ndong, 2014). In this way the dead zone in the upper reaches of the Ikoy valley is once more expanding with the forest being once again released from human disturbance allowing recovery to take its course.

4.5 Discussion and Conclusion

The trade of natural resources, *regroupement* and epidemics are the major keystone processes that have not only influenced the people who live in the upper reaches of the Ikoy valley above Ikobey, but have also resulted in a patchwork of forest succession including a forest rich in *Okoumé* trees and wildlife.

4.5.1 The impact of trade on logging and conservation

The commercial exploitation of natural resources of the Ikobey area dates back to before the last decades of the 1800s. Since this time people have competed for access to the natural resources of the area. Today conservation organisations and timber companies are the current players in a long history of local resource use, the impacts of which are still playing out on the environment and the people of the area.

There is no reason to believe that the exploitation of natural resources by the SHO during the first decades of the 20th century did not lead to temporary local exhaustion of resources, especially of ivory and rubber, as it did elsewhere in Gabon, such as described in Chapter 3 for the Gabon Estuary, the Ogooué River, the Ngounié River and Mayumba. An 1895 account from near the area mentions that "*même l'ivoire, très commun chez les Aouendjis et chez les N'Javis, se fait rare à partir du pays des Massangos, pour disparaître complètement chez les Mitsos* [Mitsogho]"[147] (Berton, 1895, p.214).

[146] "in effect at this moment, we no longer see anything good, if this continues we will go to Ikobey … as the road is starting to close, we will wait a bit more, if there are no longer any companies that come them we will move". Nyoe II, Mitsogho 23/04/10 [recording DS400093; 29:04].
[147] "even ivory, that is very common at the *Aouendjis* and at the *N'Javis*, becomes rare starting from the county of the *Massangos*, to disappear completely at the *Mitsos*"

Following an epidemic, the Ikobey area was left empty of people for some thirty years, releasing the environment from anthropogenic disturbance. This resulted in a succession from old plantations to a forest with a high density of *Okoumé* trees, sometimes misread as "pristine" forest. The high productivity of the forest and the presence of old fruit trees also probably contributed to an increase in endangered species of animals such as gorillas and chimpanzees and the recovery of elephants that had once gone locally extinct.

It is due to the history of the area with past exploitation and the subsequent dead zones that the area became very attractive, firstly to timber companies that were drawn to the *Okoumé* stands and later, in 2002, to conservationists due to the large populations of endangered species found in the area today, leading to the creation of the Waka National Park. Today, with the departure of timber companies from Ikobey, conservation practitioners are becoming a new "keystone process" (Marcucci, 2000, p.72) in the history of this landscape.

4.5.2 The impact of trade on migration

The people living in the upper reaches of the Ikoy valley, including the Babongo Pygmies, have been interacting with trade in various natural resources for hundreds of years. It has impacted their migration in and out of the area. These findings contrast with research on Pygmy "hunter-gatherer" groups of the northern Congo Basin, from which a Pygmy stereotype, that is used for all Pygmy groups, has been created (Rupp, 2011). The findings here indicate that the Babongo Pygmies of Ikobey may be more interested in trading Non-Timber Forest Products and buying goods than in living only from the forest. The pull of trade has impacted the migration of both the Bantu-speaking populations and the Babongo Pygmies, which corroborates Klieman's thesis that the Babongo Pygmies participated in the Atlantic trade route autonomously as "specialist procurers of forest products" (Klieman, 1999, p.95). They did, and do, this by choosing the people with whom they traded, and by seeking trade routes, rather than by being dependent clients of a specific Bantu-speaking people as is described by Riddell (2011). This resulted in some Pygmy groups having a more sedentary lifestyle than others (Klieman, 2003; Klieman, 1999, pp.95–96; Klieman, 1997; Matsuura, 2009; Matsuura, 2006). Their independence is further backed up by the following description by Battell in 1613 of what is now believed to be a Pygmy group that was found eight days walk east from Mayumba (Battell, 1901, p.52; Klieman, 1999, p.96; Martin, 1972, pp.16–17), near what is now Mouila:

> Pygmy Elephant-Hunters to the north-east of Mani Kesock are a kind of little people called Matimbas, which are no bigger than boys of twelve years old, but

> are very thick, and live only upon flesh, which they kill in the woods with their bows and darts. They pay tribute to Mani Kesock, and bring all their elephants' teeth and tails to him. They will not enter into any of the Marombos houses [Mayumbas houses] , nor will suffer any to come where they dwell; and if by chance any Maramba, or people of Longo [Loango], pass where they dwell, they will forsake that place and go to another (Battell, 1901, p.59).

One important finding from these oral migration histories is the dispelling of the myth created by assumption drag that the people around Waka National Park have continuously been there for millennia (Brainforest, 2010; Eisen, 2010; Rambaldi *et al.*, 2010; WCS, 2007b). Though the Mitsogho and Babongo Pygmies are known to have been in the wider area for a considerable amount of time (Klieman, 2003; Klieman, 1997) and in the past they may have periodically resided there, there have been several stretches of time when this area was empty of people.

The complicated in and out migration raises the question of land-rights in the Ikobey area. Conservation and development organisations have been using the label of "indigenous peoples" and "autochthones" (Geschiere, 2009) as the basis for their work with the Babongo Pygmies living in the area of the study site, using traditional land-rights as a justification of their work (Eisen, 2010; Brainforest, 2010; Rambaldi *et al.*, 2010). Some have even suggested that these populations represent the first people to live in the area and that they, and the bio-diverse environment that surrounds them, need protecting (WCS, 2007b, p.246), especially from timber and other industries. This approach has increased tension between the ethnicities in Ikobey, with the Mitsogho, who are recognised by all the ethnicities in the area as the first to migrate back into this "dead zone", being side-lined by researchers, developers and conservationists from outside who claim that the Babongo Pygmies were there first[148]. Similar tension between Bantu-speaking peoples and Pygmies caused by outside intervention has been found by other researchers (Geschiere, 2009, p.128; Rupp, 2011, pp.244–245).

The concern by conservationists that the timber companies operating in remote rural forest areas result in the permanent migrations of people into such sites, as shown in the chain of logic used by conservation practitioners (Figure 1-1), is not an issue in forest areas of Gabon such as in this Ikobey site. The migrants who did come to work for timber companies usually lived within

[148] Even though there have been several outsiders who have conduct their own migration histories from talking to the people in the area.

the area of the timber company's base and left when the timber company did, resulting in abandoned logging villages throughout the area; this corresponds to the alternative chain of logic that has been proposed in Figure 1-3. These findings contrast sharply with others, including for neighbouring African countries, where industries (Auzel and Wilkie, 2000; Riddell, 2011; Wilkie *et al.*, 1992), including conservation projects (Hodgkinson, 2009), attract permanent in-migrants in search of employment. In such areas these in-migrants stay when the industries depart in the "belief that logging will resume soon" (Hodgkinson, 2009, p.283). In Gabon it would seem that only local people such as the Mitsogho and Babongo Pygmies of Ikobey hold such beliefs, while migrants from outside the area do not. Furthermore, the arrival of the timber companies may have had a positive impact on the surrounding forest as it encouraged the grouping of once dispersed village sites onto the logging road near the timber companies' base as occurred in Gabon with the road construction of the 1940s (Sautter, 1966).

Given the abandonment of these sites by in-migrants attracted to remote rural forested areas by timber companies, any environmental impact should only last as long as the timber company is present, though this impact may be severe. If this is the case, then the recommendation by Wilkie *et al* (2000) that conservation practitioners should "focus their environmental mitigation efforts, at least in the short-term, on logging companies" (Wilkie *et al.*, 2000, p.1620) is applicable. However, to focus long-term development and conservation efforts on collaboration with timber companies is unlikely to succeed, especially in the case of the upper reaches of the Ikoy valley where people are moving towards the towns of Ikobey and Sindara. In such areas conservation and development initiatives based on working with timber companies, such as a resource management plan created for the area (Brainforest, 2010; Rambaldi *et al.*, 2010), may have limited long-term success.

5 The timber industry and access

5.1 Summary

The principal supposition of this thesis is that von Thünen's model of the link between land use and market access is still applicable in certain situations such as remote rural forest areas of rentier states, and as such needs to be taken into account by conservation and development projects that collaborate with timber companies. By looking at the evolution of transport infrastructure and its users after timber companies have left the study areas, this chapter explores the degradation of transport infrastructure and the resulting implications for the proposed chain of logic (Figure 1-3 and Figure 1-6). It shows that transport infrastructure degrades once timber companies depart, which has a knock-on effect on the frequency of vehicles that use the roads and the price of transport. This result confirms that some of the variables underpinning von Thünen's land-use theories are relevant to the study site. For geographers and transport economists the results are perhaps unsurprising. However, for development professionals and conservation practitioners these results do point to one of the fundamental reasons, the degradation of transport infrastructure, as to why current initiatives to help the sustainable development of remote rural forest areas commonly fail (Wicander and Coad, 2015), even when such initiatives are carried out in collaboration with timber companies.

By relying on received wisdom (Leach and Mearns, 1996a) from their own disciplines and not taking into account findings by geographers and transport economists, assumption drag is occurring. As a result any sustainable development initiatives by development or by conservation practitioners are likely to fall prey to the fluctuations in transport infrastructure, whether seasonal, annual, or both, that can undermine the economic basis of projects. This could only be remedied by incorporating and funding the maintenance of transport infrastructure into sustainable development initiatives.

5.2 Theory

Geographers and transport economists have long concluded that transport infrastructure has an influence on development, but the relationship between the two is complex, there being only certain situations in which transport infrastructure leads to a positive development outcome. Remote rural areas of Africa with high levels of poverty and transport issues seem not to fulfil the necessary conditions for long-term development (Sunderlin *et al.*, 2005). Conservation and development initiatives are commonly based on assumptions dating from early 1900's when transport infrastructure was thought to always result in development and rarely take into account current understanding of transport infrastructure, local transport systems, or how local people use them (Leach and Mearns, 1996a).

Von Thünen's spatial analysis was postulated nearly two centuries ago at a time where products were transported by horse or waterways with the result that transport cost and time to markets were a limiting factors to how land could be used. Though the world has drastically changed and the current relevance of von Thünen's spatial analysis has been questioned (Lambin, 1994; Mäki, 2004) and doubted (Jackson, 1972), there are still numerous versions of von Thünen's model (Fujita and Krugman, 1995). Transport infrastructure has improved since von Thünen postulated his analysis, but where spatial distance may no longer be the main issue, transport cost and time to markets are still limiting factors to how land can be used. This is especially the case in remote rural forested areas of rentier states, where there is no economic incentive to maintain transport infrastructure in areas far from the resource upon which the state is reliant.

Spatial analysis, such as von Thünen's, would predict that long-term development in remote rural forest areas is dependent on the maintenance of transport infrastructure and its quality. If this is the case then timber companies' contribution to the development of remote rural forest areas through the transport infrastructure that they create may not be economically sustainable in the long-term, unless such projects put in place some sort of maintenance of transport infrastructure. However, the perception that timber companies are creating lasting infrastructural development contributes to encourage policies by development professionals, conservation practitioners and donors to collaborate with timber companies in the hope of a win-win situation (Wells *et al.*, 2004) of promoting sustainable development with minimal environmental degradations in these areas.

This chapter tests the application of von Thünen's spatial analysis to the study sites by investigating the evolution of transport infrastructure after timber companies depart remote rural forest areas, thus evaluating the long-term viability of these sustainable development initiatives.

5.3 Research questions

To explore the change in spatial dynamics in access to remote rural forest areas, and so the potential for long-term development, the evolution in transport infrastructure after timber companies departed is investigated. This chapter asks the following questions:-

1) How was the transport infrastructure into the sites created?
2) How was and is this transport infrastructure maintained?
3) How has access to transport changed with the departure of timber companies?
4) Is access more impacted by distance that a village is to a market town, or by the past presence of a timber company?

5.4 Methods

The Ikobey site is used to explore the transport infrastructure of remote rural forested areas, where study site villages are 100 to 200 km from the nearest market. The Koulamoutou site is used to explore the transport infrastructure of less remote sites, where study site villages are 40 to 80 km from the nearest market.

To investigate what factors impact current public transport to the sites, the village sites that are on roads used by taxis are used (n=8) (Table 5-1). To investigate the impacts of the departure of logging companies on the state of transport infrastructure, the village of Makoko, which has an old overgrown logging road, is included (n=9) (Table 5-1).

Village	Nearest market	Distance to market (km)	State of Road	Taxis directly available in village	No. of journeys to the study sites where transport times and costs were recorded
Diboka	Koulamoutou	41	Usable	Yes	5
Ndanda	Koulamoutou	56	Usable	Yes	3
Divinde	Koulamoutou	73	Usable	Yes	2
Nyoe I	Fougamou	107	Usable	Yes	8
Tranquille	Fougamou	110	Usable	Yes	8
Ossimba	Fougamou	113	Usable	Yes	8
Nyoe II	Fougamou	134	Usable	Yes	8
Motombi	Fougamou	150	Usable	Yes	4
Makoko	Fougamou	152	Unusable	No	10
Ngondet	Fougamou	196	None	No	8

Table 5-1: Summary of data collection on the state of transport infrastructure and availability of public transport.

The creation of transport infrastructure in each of the sites is explored using the available literature (such as Coad, 2007; Gray, 2002; Lepemangoye-Mouléka, 2009; Pourtier, 1989; Rich, 2007a; Rossatanga-Rignault *et al.*, 2005; Starkey, 2004). Interviews were conducted with the head of each study village about the road (creation and maintenance) and logging history. Maintenance of the transport infrastructure is also explored with a year-long participatory observation.

Analysis of past access to each of the sites is investigated with the use of open ended interviews with villagers as well as with people who previously worked in the areas. Analysis of current access is investigated by looking at the distance to each study village and the amount of time it took to travel from the village to the nearest market town. This was measured by taking GPS track logs (2008 to 2011) to record the distance and time taken for public transport during the dry season (representing the best case scenario) (Table 5-1). The track log started from each study village to the principal market, marking points every thirty seconds. This log included the social stops that were taken along the route. These data were transferred to a computer, where software (Mapsource, ArcView, Global Mapper, TopoGrafix, ExpertGPS) was used to calculate the distance and time to each village site. These times were then used to calculate the averaged speed (km/h) to each site.

It should be noted that the track log represents a best case scenario as it does not reflect the true nature of access to the public transport systems. This can only be understood by adding the additional time spent to walk to the nearest place where public transport is available and the amount of time needed to wait for public transport to arrive and then to gather its passengers, collect its load, ready its systems and leave the place[149]. Waiting time for public transport depends on the frequency of bush taxis which was based on a twelve day survey in each village site, carried out during the dry season, which noted the times a car arrived (and its type – taxi or private) or passed each study site. This yielded the number of taxis per week and was used as the frequency of transport variable.

The cost of transport from each study village to the nearest market was obtained from fares that taxi drivers demanded while I was using public transport to get from each of the study site villages to the nearest market place. These fares were noted and compared with those of fellow

[149] Though these types of data were collected it was deemed as too variable to be used, as there are many influencing factors, even including elephants blocking the path leading to a taxi point.

passengers as well as fellow Gabonese assistants. These taxi fares did not change during the study period; once again the fares represent the best case scenario as they were collected during the dry season when prices are usually the lowest.

The data on average speed, cost of transport per kilometre travelled and frequency of taxis were examined using various linear models to look at whether distance or past presence of a timber company are more important on access time to each of the villages. These variables were first tested for normality, outliers, and collinerarity with data exploration following Zuur *et al*. (2010). An information-theoretic approach was taken to model selection following Anderson and Burnham (2002). This uses Akaike's Information Criteria (AIC) or Akaike's Information Criteria corrected for small sample bias (AICc), depending on sample size (Anderson and Burnham, 2002; Zuur *et al.*, 2009). Following data exploration a maximal model was chosen a priori as well as all possible model combinations using the automated methods in the MuMln package (Bartoń, 2004) in the R statistical environment (R Core Team, 2014). The following maximal Gaussian multiple regression model was used:

MinKMH ~ PresenceCompany * Distance + PostLog * Distance + MaxKMH * PresenceCompany + MaxKMH * PostLog + Distance : MaxKMH + eps

Where:

MinKMH = Minimum speed to travel in km/h, taking into account time to get to a taxi spot and waiting for a taxi (which can take several days),

PresenceCompany = Was there past presence of timber company around a village,

Distance = Distance to the nearest market from a village,

PostLog = Time since timber company left the area around the village,

MaxKMH = Maximum speed to travel in km/h, where there is no time needed to get to or wait for a taxi,

eps = residual error or unexplained information

For exploratory purpose the "dredge" function in the MuMIn package of R was used to fit different combinations of the model above, resulting in 72 different model combinations available, from which an average model was defined where the AICc differences from the top models were less than three. The relative importance of parameters in these average models was used to define the final model for fitting, whereby PostLog and PresenceCompany were consistently the most important explanatory variables in the average models while MaxKMH had a small relative importance and so was removed for model parsimony (Table 5-2). The final model from the important variables identified was:

MinKMH ~ PresenceCompany + Distance + PostLog

The resulting final model was then tested for validity by looking at the normality of residuals, homogeneity and independence (Zuur *et al.*, 2009, pp.19–22).

Models	df	logLik	AICc	Delta	Weight
134	5	125.32	-239.32	0	0.52
1346	6	125.48	-237.06	2.26	0.17
1345	6	125.45	-236.99	2.33	0.16
1234	6	125.4	-236.89	2.43	0.15

Variable codes of models	1	2	3	4	5	6
Term	Distance	MaxKMH	PostLog	Presence	Distance: PostLog	Distance: Presence

Model-averaged coefficients

	Estimate	Std. Error	Adjusted SE	z value	Pr(>|z|)	Sig. at
(Intercept)	1.3599436	0.0260751	0.0267161	50.903	<2e-16	0
Distance	-0.0055185	0.0001984	0.0002032	27.152	<2e-16	0
PostLog	-0.3007013	0.0180194	0.0184444	16.303	<2e-16	0
Presence	0.2964016	0.0184757	0.0189024	15.681	<2e-16	0
Distance: Presence	-0.0001607	0.0002995	0.0003076	0.522	0.601	
Distance: PostLog	0.0001368	0.0002895	0.0002973	0.46	0.645	
MaxKMH	-0.0003429	0.0009293	0.0009544	0.359	0.719	

Full model-averaged coefficients (with shrinkage)

Term	(Intercept)	Distance	PostLog	Presence	Distance: Presence	Distance: PostLog	MaxKMH
Average coefficients	1.36E+00	-5.52E-03	-3.01E-01	2.96E-01	-2.69E-05	2.21E-05	-5.28E-05
Relative variable importance		1	1	1	0.17	0.16	0.15

Table 5-2: Average top models from combining all the different variables of the full linear regression, which resulted in 72 different possible models.

5.5 Results

This following description of transport infrastructure in the different sites shows how much timber companies have impacted transport infrastructure and its maintenance in the Ikobey sites, while in the Koulamoutou sites transport infrastructure is more dependent on the state.

5.5.1 Creation of transport infrastructure to the sites

Access to the Ikobey area is via a road that starts at a ferry crossing on the eastern bank of the Ngounié River (Map 5-1), where there was originally a Decauville rail system. The ferry links the villages and timber companies on the eastern side of the Ngounié to the rest of Gabon. It is a key component to transport into the area and its management is dependent on timber companies.

The eastern side of the Ngounié River was opened in the 1950s up by Madre and then *La Société l'Okoumé de la N'Ggounié* (La SONG), with the construction of a Decauville rail system, after which they carried on building the roads to Ikobey and onwards:

> *Il n'avait pas la route* [Ikobey]… *C'est M. Madre qui a fait tout, tout, jusqu'à là-bas. Mais les espagnols* [La SONG], *quand ils sont venus ils ont trouvé la route bien tracé au fin fond. C'est M Madre, Madre… Jusqu'à Mimongo, c'est M Madre qui a fait la route*[150]*.*

This road penetrated 60 km into the Du Chaillu Mountains, as the crow flies, coming to a halt at a steep escarpment in the east. It was built in various stages between 1960s and the 1990s by Madre and La SONG (Lepemangoye-Mouléka, 2009, p.8), and once more opened up the area 40 years after the SHO had left in 1910 (Chapter 4). It was along these roads that the migrations, described in Chapter 4, took place.

In contrast to the Ikobey site, transport infrastructure to the Koulamoutou sites was originally created by either the state for the part nearest to Koulamoutou, or by timber companies for the part furthest from Koulamoutou. The national road that was started in 1910 at Sindara and continued its way to Koulamoutou, was completed by the 1950s. It runs through Diboka, one of

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[150] "There was not a road [Ikobey] … It was Mister Madre who did everything, everything, right up to over there. But it was the Spanish [La SONG] when they came they found good roads going far. It was Mister Madre, Madre … All the way to Mimongo; it was Mister Madre who made the roads" Ikobey, Mitsogho 14/07/10 [recording DS4000102; time 19:36].

the study villages (Coad, 2007; Pourtier, 1989; Starkey, 2004). As with Sindara (Gray, 2002; Rich, 2007a) the people of Diboka were required by the colonial government to participate in its construction (Coad, 2007; Starkey, 2004). Some spent their whole lives constructing the section of road that ran between Koulamoutou and Mouilla, as one person from Diboka recounts "I started building this road when I was young and finished when I was old, where I retired"[151].

Access to the village sites of Ndanda and Diboka is on a road that branches off the *Route Nationale* at Mouila-Pouve. Originally a loop created by the colonial and post-colonial state to get to the town of Iboundji, it was later extended by timber companies and eventually went all the way to Lopé.

5.5.2 Past and current maintenance of transport infrastructure in the sites

In the Ikobey site the timber companies that followed La SONG included French timber companies, small Gabonese companies and Malaysian companies. These have yet to exploit the forest along all the logging roads that their predecessors created, neither have they been able to maintain the transport infrastructure created by them. With few exceptions[152], the latter timber companies have mostly been content to re-open a subset of the existing roads.

The transport infrastructure maintenance undertaken by many of these latter companies has usually been done in haste, with bridges being quickly made from logs cut in the surrounding area, typically soft woods. This maintenance has not stood the test of time, neither have the short cuts that were later created. During the rains the roads become quickly blocked by mud slides or deeply eroded ruts. The general consensus by local people was that Madre had made good roads and bridges that other timber companies have not been able to replicate. One of the villagers remarked on the construction of a new bridge in Ikobey by SUNNLY, a Chinese timber company, "*le pont là, au départ c'est fini, ça pas duré. Mais le pont de Madre, bien travaillé ça a bien duré*"[153].

[151] Interview with elderly man from Diboka on 19/11/2010, not recorded.
[152] Where Bordamure, a Malaysian timber company, created some roads and short-cuts, an informant noted "It was the Malaysians who worked over there, always over there, is where the Malaysians worked, not La NEF, not La SONG, it was the Malaysians who worked deep in the forest, right up to the limits of Eteke … it's far". Motombi, Babongo Pongue Pygmies 17/04/10 [recording DS400077; 58:55].
[153] "that bridge [new bridge at Ikobey] when they leave [of the Chinese loggers], it is finished, it will not last. But the bridge of Madre, was well built, it has lasted a long time". Nyoe I, Mitsogho 12/07/10 [recording DS400098; 13:33]

When the last of the timber companies left the Ikobey area in 2006 maintenance of the transport infrastructure came to a halt (Table 5-3). By the start of the field work, in 2008, the road to Ikobey itself was practicably impassable with many of the bridges having to be temporarily mended each time a vehicle wanted to pass. It was only at the end of 2010, when SUNNLY, brought in heavy machinery, that maintenance of the roads restarted and access to Ikobey was no longer an "adventure". However, SUNNLY decided to only re-open an old La SONG road to Ikobey, by-passing the road that had until then been used, and in doing so upsetting the villagers who were along this road. The newly re-opened road was twice as long as the original route. A few weeks before the end of the study SUNNLY had repaired the road leading into the first study villages of Nyoe I and Tranquille.

Although the ferry to cross the Ngounié River used to be run by the state, it has not worked for many years, with parts now being scavenged from the ferry to repair similar ferries in less rural parts of Gabon. It is thanks to a tug boat, brought in and run by a timber company, that the ferry can still be used to transport vehicles across the river. However, the timber company that owned the tug departed before negotiations on its use had been finalised with the timber company that bought its timber concession (SUNNLY). Without maintenance from the previous owner the tug boat broke down resulting in transport across the river being cut off for the last six months of 2010, until the new timber company repaired the tug in 2011. While the tug boat was no longer operating SUNNLY had a small passenger boat which, to the dismay of local people, only allowed its personnel and supplies across the river.

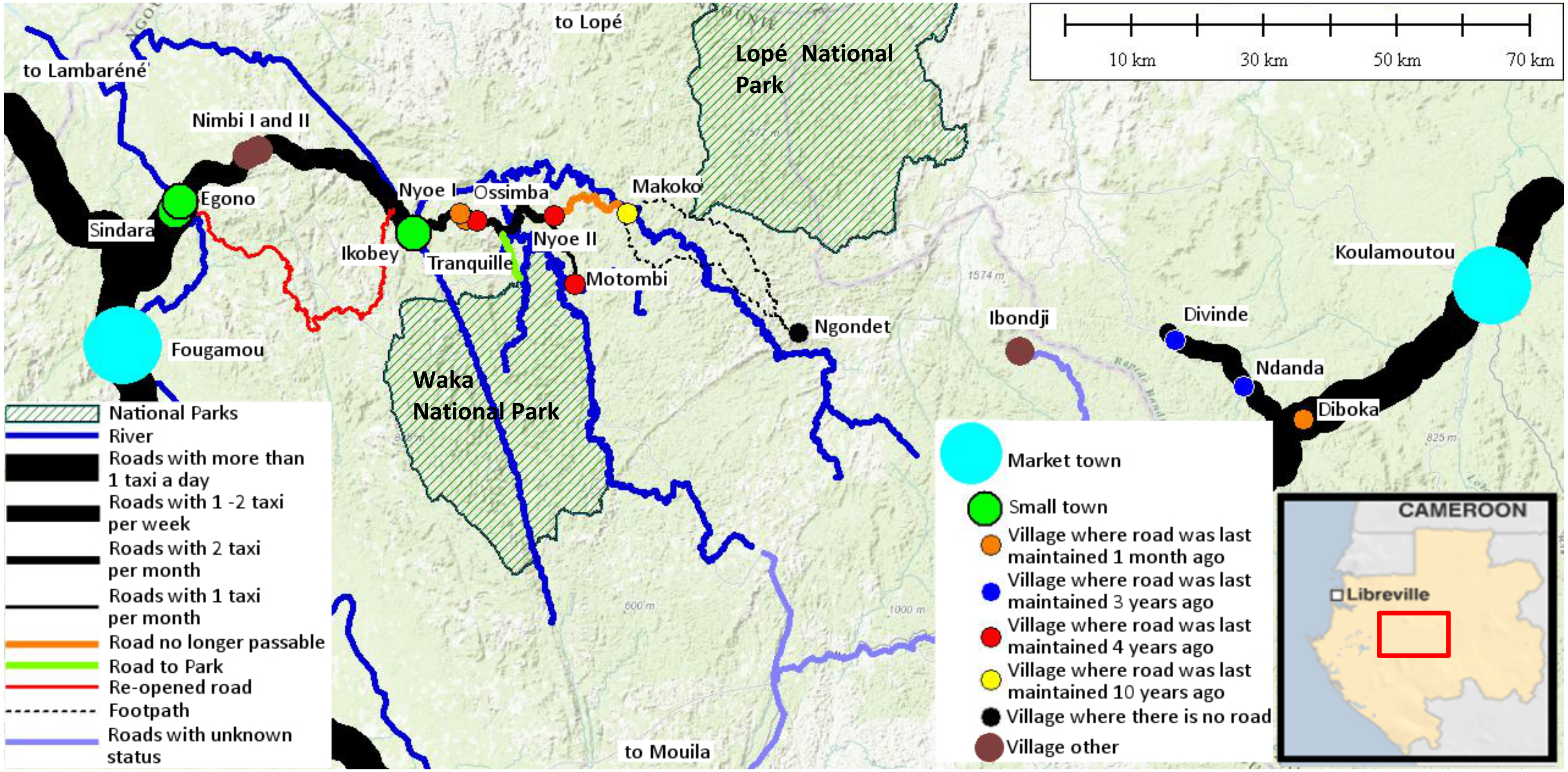
In the Koulamoutou site the situation is slightly different. The completion of the *Route Economique* in 1967 resulted in the national road between Koulamoutou and Mouila becoming redundant (Rossatanga-Rignault *et al.*, 2005, p.110); rarely do people now use it to go to Mouilla or Libreville (Coad 2007). However, the Route Nationale is still open to Iboundji town with the timber company (*Société du Bois Lastoursville*[154]) having maintained it, at the request of the local administration, just before the study was undertaken in Diboka (Table 5-3).

[154] Timber Society of Lastoursville.

Village names	Distance to market - km	Years since last logged	Time since transport infrastructure maintained	Transport infrastructure last maintained by
Koulamoutou sites				
Diboka	41	Never	1 month	State/Timber company
Ndanda	56	8	3 years	State/Timber company
Divinde	73	8	3 years	State/Timber company
Ikobey sites				
Nyoe I	107	4‡	4 years / 1 month	Timber company
Tranquille	110	4‡	4 years / 1 month	Timber company
Ossimba	113	4	4 years	Timber company
Nyoe II	134	4	4 years	Timber company
Motombi	150	4	4 years	Timber company
Makoko †	152	10	10 years	Timber company
Ngondet †	196	Never	No road	Never

Table 5-3: Distance to the principal markets with time since loggers had last been in each village and time since the maintenance of the roads to each village. Notes: ‡ in both these villages loggers returned at the end of the study and repaired the road. †Neither Makoko nor Ngondet have a viable road.

The road going from Ndanda and Divinde was abandoned by timber companies in 2000 after which their roads quickly degraded (Starkey, 2004, p.94). Since 2007 the road now ends at Divinde (Map 5-1), with the roads that once led to Lopé and Iboundji both being overgrown and impassable (Coad, 2007, p.47). Maintenance of these remaining roads was carried out three years ago by timber companies, once again at the request of the local administration. At the end of the study period in 2010, only one of the bridges on the road between Divinde and Ndanda was in a bad state.



Map 5-1: Map of the logging road re-opened by the Chinese logging company SUNNLY. Based on the following sources: Basemap - (ESRI, 2012), Park boundaries - (Institut Geographique National, 2008), trails, tracks, roads – track logs collected between 2008 to 2011.

5.5.3 Changes in access to public transport in the sites

Though longitudinal data on changes in public transport do not exist for the study sites, oral histories and participatory observation indicate that there has been a change in public transport of the Ikobey site, with a slow decline in the public transport which started when the last of the timber companies left the area in 2006. This is compared to a slight increase in the Koulamoutou site where the regular bush taxi service to Diboka now consists of approximately seven cars a day rather than the "3–5 cars passing through the village each day" observed by Coad (2007, p.43) (Table 5-4), even though timber companies were no longer using this road as they had been during Coad's study (Coad, 2007, p.92).

When timber companies were present in the Ikobey site, private vehicles passed frequently, including timber company vehicles but also other vehicles and a twice weekly bread truck and beer trucks. These other vehicles also transported local people and were so frequent that there was no need for a bush taxi service (personal communication Starkey, 2013). In 2006 the last timber company departed from the Ikobey area, transport started to break down, private vehicles no longer came and the *sous-préfet* started to offer transport for people. This service only lasted until the vehicle broke down, six months later. In 2008, the route to Ikobey was plied by one of three taxis, depending on which was functioning at the time. This was further reduced to two taxis after the owner of one gave up repairing his vehicle, and then in 2010 by one temperamental bush taxi that had been stranded on the eastern bank of the Ngounié when the tug broke down. These latter bush taxis were usually organised by people who were coming into the area to buy "*bois amer*"[155] or looking for traditional medical treatments, visits which principally occurred in the dry season. Local people would then use these taxis to obtain transport out of the area.

The link between degraded transport infrastructure and cost of vehicle maintenance was reflected with a villager remarking the "*Jean Aime et Jérôme* [taxi drivers] *venaient ici tous le temps, mais aujourd'hui ils ne viennent plus car la route est trop mauvaise. Ça casse la voiture trop vite*[156] ".

---

[155] "bitter wood" used in the fermentation of alcohol.

[156] "Jean Aime and Jérome [two taxi drivers], used to come here all the time, but, today, they no longer come as the road is too degraded. This breaks cars too quickly" Nyoe I, Mitsogho 17/07/10 [recording DS400098; 19:07].

The public transport route to the study site itself, after Ikobey, was in a worse state. At the start of the study only one taxi irregularly plied the route. Between 2009 and 2010 bush taxis had completely abandoned the route, and only irregular vehicles belonging to the Gabonese administration or environmental organisations reached beyond Ikobey. At the end of 2010 SUNNLY's vehicles started to appear regularly, but these drivers were not allowed to take local people, though they were often seen transporting their local girlfriends and associated family members.

While people from Ngondet, Makoko (villages without road access) and even Motombi were already walking to other villages to gain access to taxis, from 2009 everyone from the villages after Ikobey had to walk to Ikobey and wait there to get a taxi. This wait could last a week or longer.

Village	Distance to market town - km	Number of taxis to markets over 12 day period	N of time taken to get to village	Average time to market –minutes, including waiting and walking (equivalent number of days)*	Distance travelled per average time including waiting and walking-km/hour*	Average time to get to market, excluding waiting and walking – hours≠	Distance travelled per average time, excluding waiting and walking–km/hour≠	Cost of taxi to market – cfa	Cost taxi per distance to market - cfa / km
Koulamoutou sites									
Diboka	41	85	5	303 (0.21 days)	8.10	1.67	24.50	500	12.20
Ndanda	56	4	3	4,517 (3.14 days)	0.74	2.24	24.95	1,000	17.86
Divinde †.	73	4	2	4,588 (3.19 days)	0.96	3.42	21.42	1,500	20.55
Ikobey sites									
Nyoe I ǂ	107	2	8	8,730 (6.06 days)	0.74	5.50	19.45	6,000	56.07
Tranquille ǂ	110	2	8	8,745 (6.07. days)	0.75	5.75	19.13	6,000	54.55
Ossimba	113	2	8	8,760 (6.08. days)	0.77	6.00	18.83	6,000	53.10
Nyoe II †	134	2	8	8,840 (6.14 days)	0.91	7.33	18.27	6,500	48.51
Motombi †	150	1	4	17,343 (12.04 days)	0.52	9.05	16.57	7,000	46.67
Makoko ≡	152	0*	10	17,660 (12.26 days)	0.52	14.33	10.60	6,500	48.51
Ngondet ≠	196	0*	4	19,820 (13.76 days)	0.59	50.33	3.89	6,500	48.51

Table 5-4: Distance and travel time to the principal markets, with frequency and cost of taxis. Notes: * Maximum time to market if based on getting a taxi after waiting for a taxi. ≠ Distance travelled per average time is calculated by dividing the distance to market with the minimum average time it takes to get there. † End of usable road. ǂ in both these villages the road was maintained at the end of the study by a timber company, after the data was collected. ≡ Road no longer usable. ≠ No road present.

5.5.4 Factors that may impact access to transport in remote rural forest areas

There seems to be a strong correlation between the speed of taxis, the time it takes to reach a village and their frequency, while frequency of taxis has a strong correlation with time it takes to reach a village and the cost of the taxi ride (Figure 5-1). Within the whole study site the average speed of taxi travel to the different villages with usable roads is 19.30 km/h, this being the best case scenario as it does not included traveling to a taxi point and waiting. The average speed when traveling to a taxi point and when waiting times are included drops to 1.56 km/h (Table 5-4). The result of these correlations are that taxis arrive more frequently in villages that are near the market than the ones further away (Figure 5-2) while that the cost of taxi per distance travelled reduces with increased taxi speed, the average cost of public transport being 38.68 cfa/km (Figure 5-3).

The maintenance of transport infrastructure around a village is collinear with the years since the area was last logged, the distance the village is from the market, the village population size and the taxi cost (Figure 5-4 and Figure 5-5).

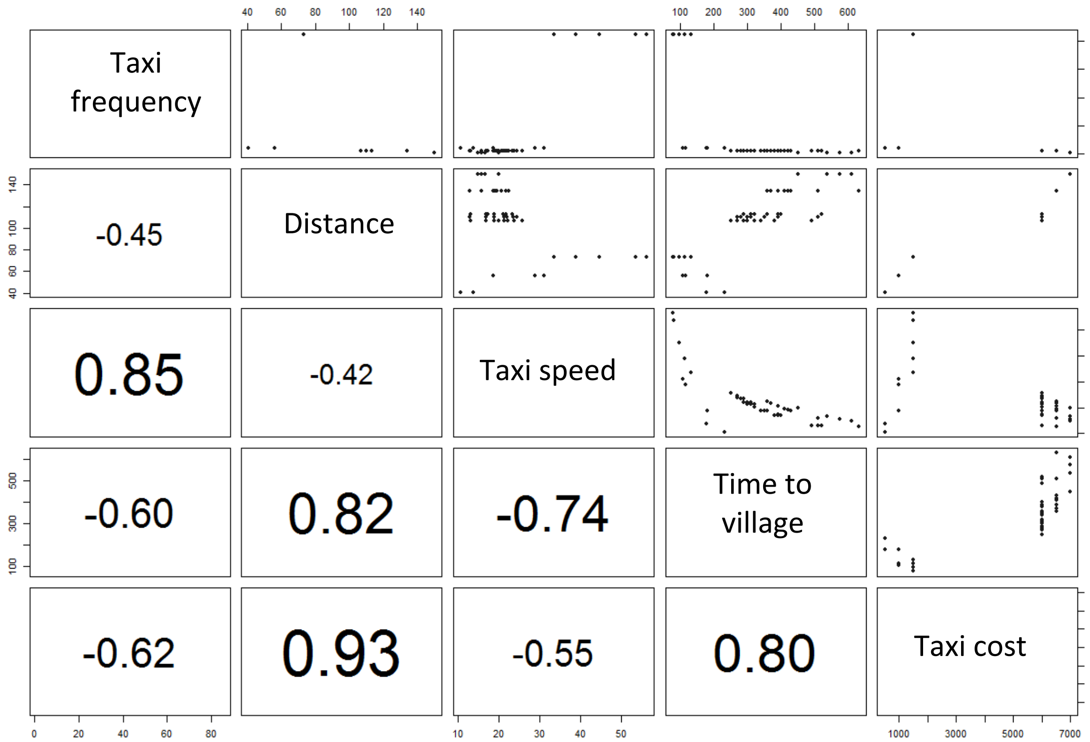


Figure 5-1: Pairplot of selected explanatory transport variables (diagonal). Each cell below the variables represents an estimated pairwise Pearson correlations between the corresponding variable at the top of the column with the variable to the right of the row. The font size of these values is proportional to the absolute value of the estimated coefficient, so the bigger the font the more correlated the pair of variables (see Ieno and Zuur, 2015, p.81 for Pairplots).

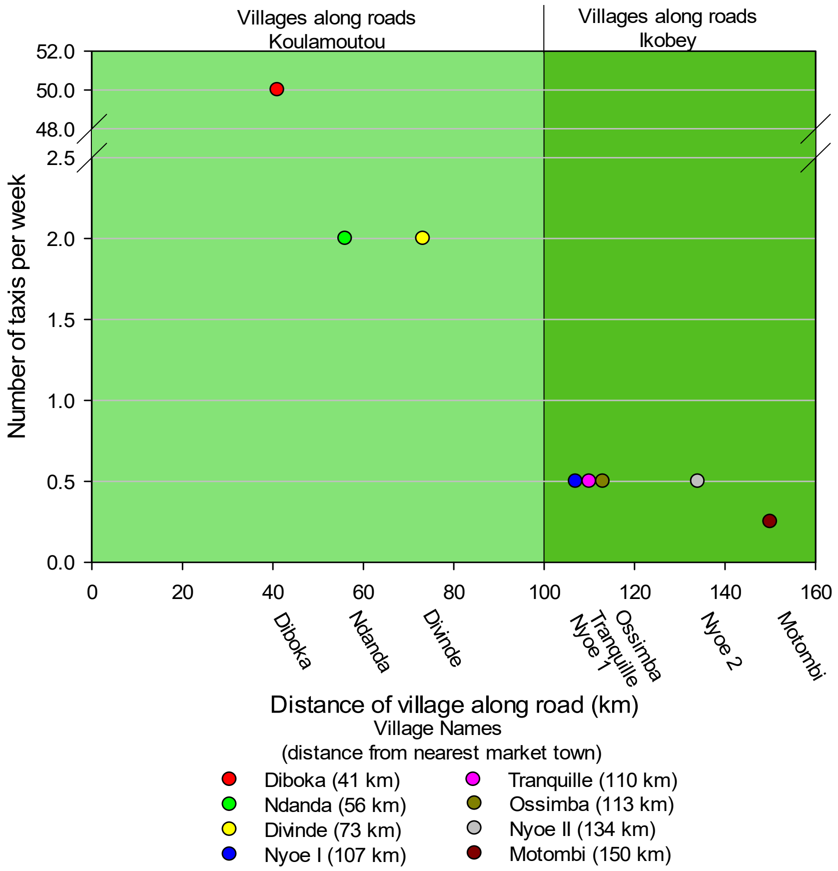


Figure 5-2: Number of taxis from the various villages to the nearest market from the Koulamoutou and Ikobey study sites. NOTE: The villages of Makoko and Ngondet can only be reached via footpaths and so have been removed.

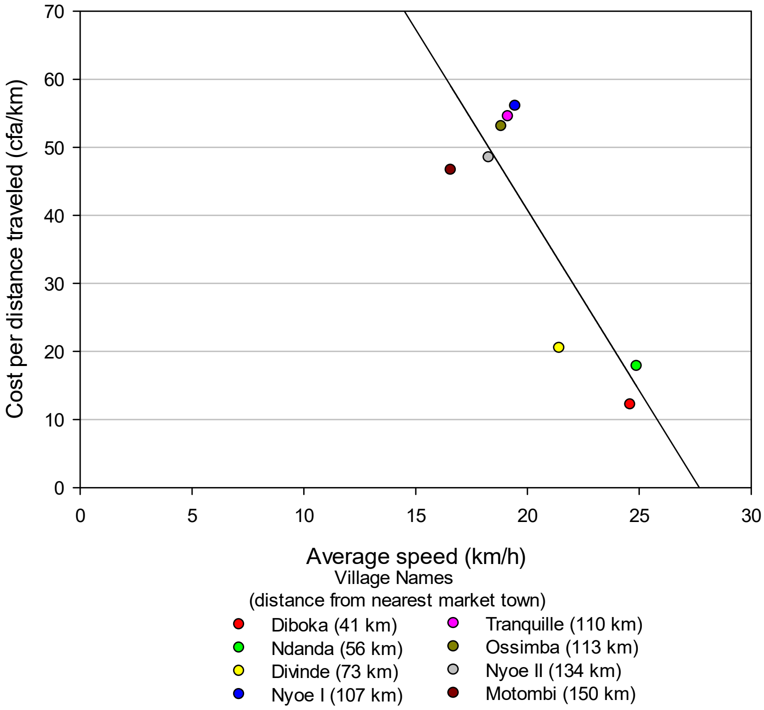


Figure 5-3: Relationship between the cost per distance of taxis and the average speed to each village site from the various villages to the nearest market. NOTE: The villages of Makoko and Ngondet can only be reached via footpaths and so have been removed. The linear regression of the cost per distance travelled (r^2=0.699) is significant (ANOVA, F=17.235, DF=7, p=0.006).

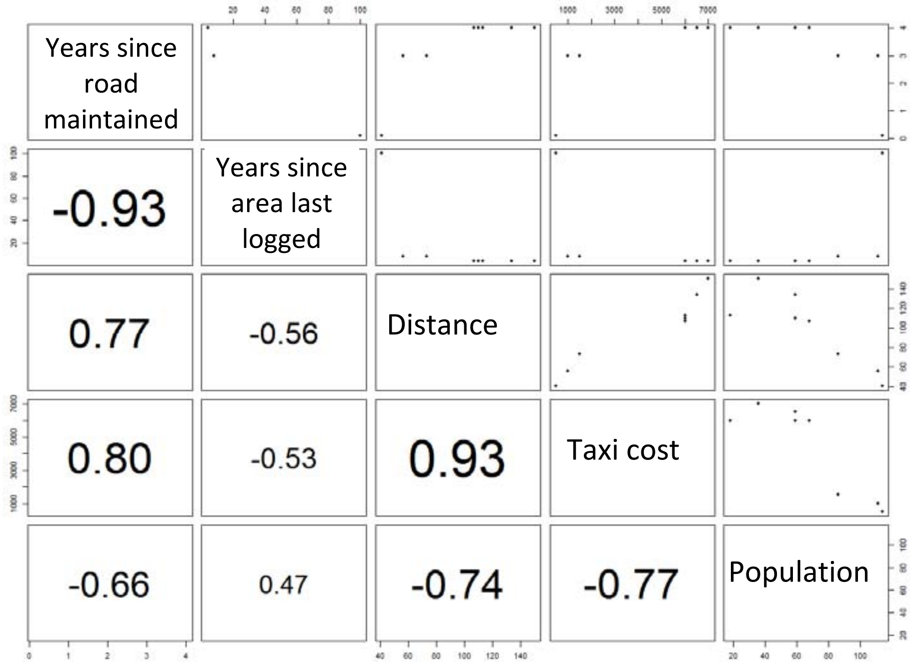


Figure 5-4: Pairplot of selected explanatory variables influencing years since road was last maintained (diagonal). The lower panel contains estimated pairwise Pearson correlations and the font size is proportional to the absolute value of the estimated coefficient (see Ieno and Zuur, 2015, p.81 for Pairplots).

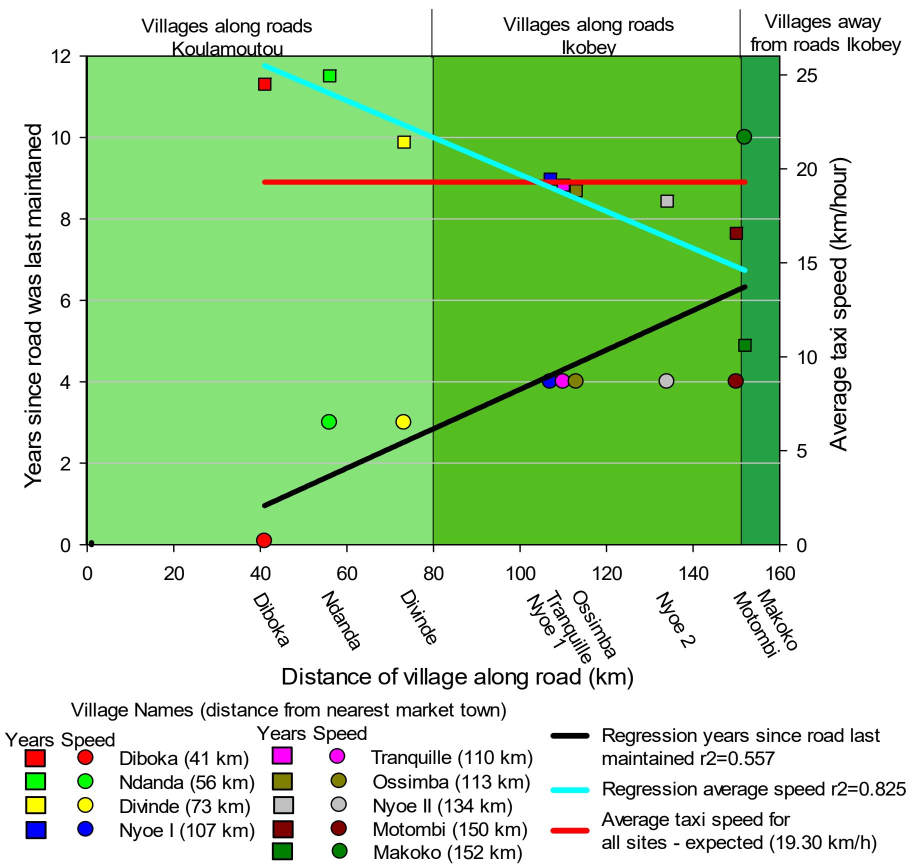


Figure 5-5: The impact of distance between villages and market on the number of years since the road was last repaired and how this affects speed of taxis. The red line shows the average speed for all the sites. NOTE: Ngondet is not present as the village has no road. The linear regression for years since road was last maintained against distance (r^2=0.557) is significant (ANOVA, F=8.806, DF =8, p=0.021) while the average speed linear regression (r^2=0.825) is also significant (ANOVA, F=112.260, DF =7, p=0.000), with a very high coefficient of determination.

A full model of the key explanatory variables that explains most of the variability of the speed of travel, including walking and waiting times, to the market towns from the villages where logging has occurred, indicates that distance, past presence of timber company in a village and time since the area around a village was last logged are the most important explanatory variables (Table 5-5). Other variables or interactions between the variables were not significant.

Distance to market has a small negative impact on speed of travel while past presence of a timber company had a positive impact on this speed and time since the area was last logged had negative impacts on this speed (Table 5-6 and Figure 5-6), indicating that although the past presence of a timber company improves access to an area, time since logging came to an end, and hence since the departure of timber companies, has the opposite effect.

Best fit model					
	Estimate	Std. Error	t value	Pr(>|t|)	Significance at
(Intercept)	1.3572376	0.0163219	83.15	0.000	0
Presence	0.2929996	0.0089716	32.66	0.000	0
Distance	-0.0055048	0.0001417	-38.83	0.000	0
PostLog	-0.2980411	0.0083012	-35.90	0.000	0

Residual standard error	0.022		Multiple R-squared	0.978
Degrees of freedom	47		adjusted R-squared	0.977
F-statistic	710.4		p-values	0.000
Degrees of freedom	3 and 47			

Table 5-5: Best fitting model of the variables that go into explain the speed of travel to the nearest market from each village. Based on the important explanatory variables that was highlighted in the four average models with a Delta of less than three (Table 5-2).

Situation		Estimate				Formulas for speed to market town
Timber company present	Years since last logged	Intercept	Distance	Presence	Post Logging	
No	Less than five	1.357	-0.0055	NA	NA	1.357 – 0.0055 * Distance
Yes	Less than five	1.357	-0.0055	0.293	NA	1.357 + 0.293 – 0.0055 * Distance
No	More than five	1.357	-0.0055	NA	0.298	1.357 - 0.298 – 0.0055 * Distance
Yes	More than five	1.357	-0.0055	0.293	0.298	1.357 + 0.293 – 0.298 - 0.0055 * Distance

Table 5-6 : Average speed predictions for these study sites chosen on AICc values (Table 5-5 and Figure 5-6).

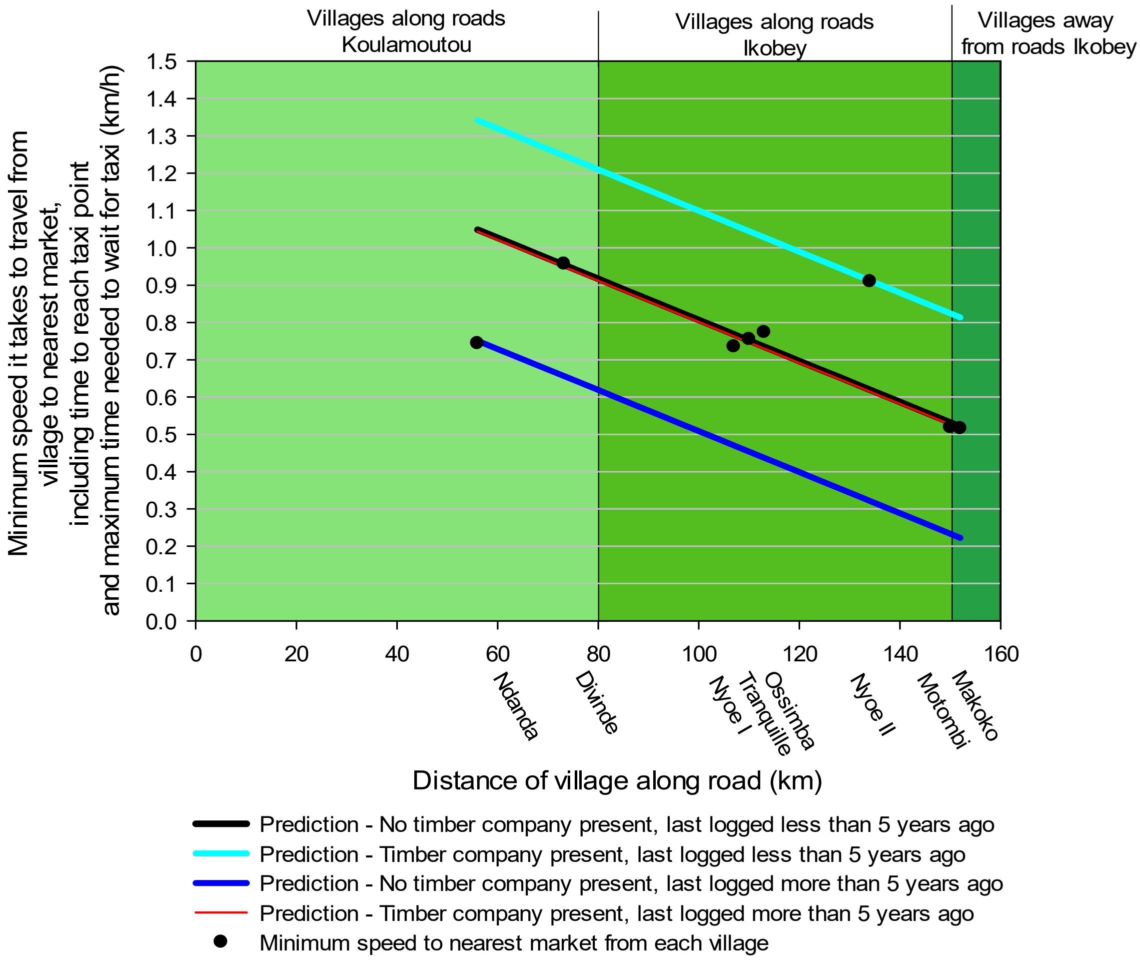


Figure 5-6: Best fitting model of the impact of different logging scenarios on minimum speed to market against distance, with data points from study sites.

5.6 Discussion and Conclusion

A long-term longitudinal dataset would have been preferable when looking at the impacts that the departure of a timber company has on public transport and transport infrastructure. With the data that is available for these study sites, it is evident that while timber companies were present in the Ikobey site they contributed to the number of vehicles that came into the area. Not only were vehicles belonging to the timber companies using this transport infrastructure, but also other vehicles used it, such as the ones that brought in supplies for shops in the area, where the employees of the timber company and their families could get a wide range of goods. It was in such vehicles that local people sought transport to get in and out of the area, making taxi services redundant. When the timber company left the area the number of other vehicles also reduced and finally came to a stop. This had an impact on the possible commercial activities available to local villagers in these areas, which will be further explored in Chapter 7.

The dataset indicates that the departure of timber companies from remote rural forested area results in a degradation of both public transport usage frequency and transport infrastructure. As recounted by a villager "*on ne pouvait pas travailler ce pont, et les voitures pouvaient refuser de nous retrouver dans les villages* [on the other side of the broken bridge] "[157].

In this study there is an inverse relationship between the distance a village is from the market town and the taxi frequency as well as a positive relationship between the distance of a community and transport cost (Barwell, 1996, p.46). Based on this analysis it would therefore seem that von Thünen's spatial rings hold true for the maintenance of transport infrastructure, with transport infrastructure further from market town being less likely to be maintained than ones near, as well as for frequency of taxis and cost.

The cost per distance travelled to the different study villages levels out at the furthest reaches of the study site. This is probably due to local people at the furthest end of the road only being able to afford transport up to a certain price. Due to this levelling out of prices and the increase in maintenance costs of vehicle, taxi drivers become even more reluctant to ply certain routes. The ones that do may do so because they have family relations in the area or because a client in town has paid a premium fare, in which case it makes economic sense for the driver to go back to an urban area with their car full[158], even if this means that they have to go to the end of the road, or along roads that are more degraded to find clients. However a taxi driver will usually find all the clients that he needs before the end of the road and the vehicle will usually be full before it reaches the end point (Barwell, 1996, p.3).

It therefore seems that von Thünen's predictions also hold for transport cost and time to these study sites. For some academic disciplines these finding are self-evident. Development economists and geographers would expect taxi drivers to be economically rational[159], in that they prefer to ply routes where some profit can be made rather than the routes that are no longer profitable. If this is true then it is unlikely that long-term economic development and environmental degradation can continue when timber companies leave a remote rural forest

[157]"we could not mend the bridge, and cars refused to pick us up in the villages [on the other side of the broken bridge]" Nyoe II, Akele 24/05/10 [recording DS400082; 1:17:02].
[158] Especially if the car does not belong to them.
[159] This assumption can break down when a taxi driver has family, friends or girlfriends along a route.

area. These findings refute the chain of logic set out by development professionals and conservation practitioners (Figure 1-1).

The degradation of transport infrastructure in the Ikobey site has also impacted conservation. With the creation of Waka National Park, negotiations were held with a timber company to transform their timber base in the north of the park to become the headquarters of the park. From 2006 this base was developed. However by 2009 the road to this base was barely passable (Picture 5-1) and in 2013 the park base was moved to Ikobey.

For the local people the transport situation in the Ikobey area has been accepted. Without these timber companies:

> *les migrations ne sont pas encore finis, en fait à ce moment on ne voit plus rien de beau donc ce qui est sûr on va continuer jusqu'à Ikobey ... puisque la route est en train de se fermer on attend encore un peu s'il n'y a plus de sociétés qui arrivent on continue*[160].

However, assumption drag based on the idea of the link between transport infrastructure and development of the early 1900s has resulted in the recent knowledge on this infrastructure and development not being taken into account by conservation agents when designing sustainable development projects in remote rural forest areas where timber companies are operating. It is unlikely that such projects can continue when timber companies depart, especially when increased taxi cost and transport time to markets are taken into account unless transport maintenance is integrated into these projects.

[160] "the migrations are not yet finished, in fact at this moment we no longer see good things, so we will go to Ikobey … as the road is starting to close, we will wait a bit more, if no other company comes, we will move on" Nyoe II, Mitsogho 23/04/10 [recording DS400093; 29:04].

Picture 5-1: Collapsed bridge on the road to the headquarters of Waka National Park in 2009 (Picture: Kevin Ndong, 2009).

6 Post-logging and disintegration of direct development by timber companies

6.1 Summary

Industries that operate in remote rural forested areas are often said to improve the economies of such areas. This economic development is due to “multiplier effects” (Sunderlin *et al.*, 2003) that such industries bring, including improved access to education and employment opportunities. This chapter looks at the proposed chain of events as set out in Chapter 1, specifically direct development of education and employment, when a timber company leaves a remote rural forest area (Figure 1-3 and Figure 1-6). Indirect impacts are looked at in Chapter 7.

Within the study sites education is impacted more by distance from markets than the past-presence of the timber industry. Though the education of children in villages far from markets benefit from the presence of a timber company, it is found that that of teenagers does not. It seems that teenagers may prefer to find work for timber companies that are in their village rather than carry on secondary education in establishments that are further away.

There has also been a cohort effect in that teenagers also seem to have lost out on training. While adults and the elderly recount how the early timber companies in Ikobey had a policy of providing training such as driving and using chainsaws, this no longer applies to the more recent timber companies. The number of people employed also seems to be impacted more by the distance a village is from a market than whether or not a timber company was present in the past. However, what employment opportunities are to be found in remote rural forest areas are likely to be based on logging. Once again there seems to be a change in policy by timber companies; while the early timber companies had a policy of recruiting local people, more recent timber companies bring in workers from outside the area, especially in jobs that require more skill.

This change in timber company policies is occurring at a time when policies such as Reducing Emissions from Deforestation and forest Degradation (REDD+) and Forest Stewardship Council (FSC) are encouraging timber companies to help development in remote rural forest areas. Today in forested areas of West-Central Africa development in education and employment seems to be linked to transport infrastructure, which, as predicted by von Thünen models, is severely restricted and costly in remote rural forest sites such as Ikobey (Chapter 5).

6.2 Theory

The appearance of a timber company in remote rural forest areas can have a developmental impact on local people through "multiplier effects" (Sunderlin *et al.*, 2003). These multiplier effects are attributed to the presence of the timber company either directly or indirectly. The direct multiplier effects can include education and employment. There are, however, few data to show how big an impact these multiplier effects have on local people (Angelsen and Wunder, 2003; Arnold, 2001; Poschen, 1997; Scherr *et al.*, 2003; Sunderlin *et al.*, 2003), especially in the long-term and after a timber company leaves an area.

Von Thünen's model can be used to explore the impacts that the timber industry would have had on education (von Thünen, 1966, pp.291–295). By comparing the "ring […] nearest to the Town" (von Thünen, 1966, p.291) with the ring "at the edge of the cultivated plain" (von Thünen, 1966, p.291) von Thünen predicted that the addition of transport cost would increase the price of schooling the further a school was from "the Town" (von Thünen, 1966, p.293), assuming "schooling is equally good" (von Thünen, 1966, p.293). In addition to the transport costs, he added that due to "the bad road and weather conditions of winter [, or the rainy season,] the children will have to walk across the fields to go to school, which is liable to affect their health, and certain to reduce attendance" (von Thünen, 1966, p.293). All of these issues would also make the supervision of distant schools a "far more difficult task" (von Thünen, 1966, p.293) and more expensive.

In some of the forests of South America these predictions have been confirmed by Godoy (Godoy and Contreras, 2001). The further one goes into remote rural forested areas the lower the likelihood of finding schools. When there are schools, the higher the likelihood of teacher absenteeism, due to the difficulty for teachers to collect wages and also the difficulty of supervising them (Godoy and Contreras, 2001). In such situations timber companies have sometimes taken on the government's role in providing schooling (CARPE, 2006; O'Connor, 2004).

Conversely the impacts of education on deforestation rates are inevitably complex. They include the impact that education has on the ability of a person to negotiate the conditions under which outsiders, such as government officials and the timber companies, have access to local land, and also the ability to have access to, and experiment with, new ideas and technologies. Education also allows people to pursue alternative opportunities, such as employment or further education (Godoy *et al.*, 1998), some of which may result in the person migrating out of the area. All these may result in reduced deforestation (Godoy *et al.*, 1998) but may also increase it (Ribot, 2009).

The impact of the presence of timber companies on employment has received more attention (Angelsen and Wunder, 2003; Arnold, 2001; Balimunsi *et al.*, 2011; Colchester, 1999; Lambin, 1994; Poschen, 1997; Ribot, 2009; Rich, 2005; Scherr *et al.*, 2003; Sunderlin *et al.*, 2003; Whiteman, 2000), regarding the upsurge they bring in local employment opportunities. However, it is unlikely that this upsurge is sustainable, with local people losing the employment once timber companies depart.

6.3 Research question

In the amended chain of logic, it is proposed that any education and employment benefits that occur with the presence of a timber company in a remote rural forest area, come to an end with a collapse in both jobs and education when the company leaves.

If the presence of a timber company is comparable to a *de-facto* "Town", with similar spatial associations, then does the long-term departure of timber companies have an impact on the direct development of a remote rural forest area? This is explored through the following questions:-

1) Is education, as measured by UN education index (see below), more closely related to the distance a village is from a market town or to the past presence of a timber company?
2) Is employment more closely dependent on the distance from a market town or the past presence of a timber company?

6.4 Methods

This chapter makes use of data from questionnaires on education and employment (Appendix 11.5), oral interviews (Chapter 2.2) and digitised 1:100,000 ING/INC maps of Gabon (Institut Geographique National, 2008).

The education dataset (Appendix 11.5) was collected by asking the individuals in a household (as established in the demographic dataset, Chapter 4) the level at which they had ended their education (Table 6-1); in the case where individuals were not available then the head of household was asked.

Gabonese education levels	Approximate equivalent UK education levels	Approximate number of years of schooling
CE1, CE2, CEP, CM1, CM2, CP1, CP2.	Primary school	1 to 6
Troisièmes, quatrièmes, cinquièmes, sixièmes, BEPC.	Secondary school / GCSE	7 to 10
Première, secondaire, terminale, BAC, BTS, BIT.	College / A levels	11 to 12
BAC +.	University	13 +

Table 6-1: Levels of schooling used in the education survey.

From this education dataset an Education Index (Barro and Lee, 2010; Klugman *et al.*, 2011; United Nations Development Programme, 2013a) and School Life Expectancy (Barakat, 2012; Ram, 1999; UNESCO, 2009) were calculated. The Education Index (He) was used to look at the education of adults and the elderly using Klugman *et al*'s formulae (2011, p.263):

$$H_e = [((mys - mys_{min}) / (mys_{max} - mys_{min})) * ((eys - eys_{min}) / (eys_{max} - eys_{min}))]^{1/2}$$

Whereby:

H_e = Education Index

mys = mean years of schooling

eys = expected years of schooling

while:

mys = average education of adults and elderly from the dataset of each village site

mys_{min} and eys_{min} = 0 (United Nations Development Programme, 2013a, p.2)

mys_{max} = 13.3 – for the United States of America (United Nations Development Programme, 2013a, p.2)

eys = 13 – for Gabon (United Nations Development Programme, 2013b, p.145)[161]

eys_{max} = 18 (United Nations Development Programme, 2013a, p.2)

The School Life Expectancy Index was used to look at the education of children (aged from two to twelve) and teenagers (aged from thirteen to eighteen), and was calculated using part of the School Life Expectancy equation dealing with the known numbers of enrolled students (UNESCO, 2009, p.7):

$$SLE_a^t = \sum_{i=a}^{n} \frac{E_i^t}{P_i^t}$$

Whereby:

SLE_a^t = School life expectancy at an age a in year t.

E_i^t = Enrolment of the population of age i (for i = a, a+1,…, n) in school year t; n denotes the theoretical upper age-limit of schooling.

P_i^t = Population of age i in school year t. Age of level i denotes the total school age population of that level.

As this dataset does not have specific ages, the population (P) used is the population of children with the population of teenagers. The enrolled population (E) is the number of enrolled children added to the number of enrolled teenagers. Because of this, the School Life Expectancy should not be compared with other School Life Expectancy results of other studies.

Employment in each village was measured by asking the head of the household and members of the household, the number of people living in the house who have been or who still are employed. The members of the household that had been employed were then interviewed

[161] Gabon has a high literacy rate, though this may only be reflecting the urban nature of Gabon's population, and may not be applicable in remote rural forest areas.

about their employment history (Appendix 11.5). For each of the jobs that they mentioned information was collected on: who they had been employed with, job description and period of employment. Each of the companies mentioned was classified into business type (e.g. logging, mining, government, railway etc.) and each of the jobs carried out was also categorised (e.g. driver, lumberjack, prospector, shop keeper etc.). The average salary level for these jobs was taken from the databases created by *Projet Gibier* and Gabon Parks and People Project, the latter having been partly collected in the Ikobey area (Chapter 2.2). If a person had been employed in the local area then a discussion was also carried out with them on the perceived benefits that the company had brought to the area.

The place names that people gave in reply to their place of education or place of employment were located on a map of Gabon and the road distance between these and the study site village in question was calculated using GIS software (such as ESRI's ArcView and Blue Marble's Global Mapper).

The education dataset was first tested for normality, outliers, and collinearity. Due to collinearity between the different variables it was only possible to explore how the number of years that a person has been educated is related to distance from a market and past presence of a timber company. To see if there has been a generational change in the number of years of education, the education dataset was also explored with children and teenagers grouped together and adults and elderly grouped together.

Generalised Linear Models (GLMs) were fitted to test for the effect of the presence or absence of timber companies on the number of people that had been educated. Models assuming Poisson then negative binomial distributions exhibited overdispersion (greater variation in the data than assumed for the distributions used). Possible sources of overdispersion were considered (Dobson 2002, Zuur *et al* 2013) and it was concluded that zero inflation was the main cause. Due to the number of people who had not been educated, zero inflation was causing overdispersion in Poisson and Negative Binomial models (Zuur *et al.*, 2009, pp.261–293). For this reason Zero-Inflated Poisson (ZIP) and Zero-Inflated Negative Binomial (ZINB) were fitted to the data and then a likelihood ratio was compared to test these (Zuur *et al.*, 2009, pp.261–293). From this the ZINB model was chosen. The resulting final model was then tested for validity by looking at normality of residuals, homogeneity and independence (Zuur *et al.*, 2009, pp.19–22). The final models being:

YrsEd ~ Distance * Presence Company

Where:

YrsEd = Number of years of education of each person in the village,

Distance = Distance to nearest market from a village,

Presence Company = Past presence of a timber company around a village.

And:

YrsEd ~ Distance + Age Group

where:

YrsEd = Number of years of education of each person in the village,

Distance = Distance to nearest market from a village,

Age Group = Age categories.

The employment dataset was used to explore the impacts of distance and past presence of a timber company on whether a person has been employed or not was analysed using a binomial logistic model to give the probability of employment based on distance from the nearest market. Once again this dataset was tested beforehand for normality, outliers, and collinearity. The resulting final models were:

Employed ~ Distance * Presence Company

and

Employed ~ Distance

Where:

Employed = Whether the person has been, or still is, employed,

Distance = Distance to nearest market from a village,

Presence Company = Past presence of a timber company around a village.

6.5 Results

6.5.1 Education

One of the multiplier effects attributed to timber companies in remote rural forested areas is education. Within the Ikobey area the first timber company Madre/La SONG had originally set up a school and dispensary at Ikobey and a school in Nyoe II, both of these were accessible to everyone (personal communication, villagers from Tranquille, Ossimba and Motombi, 2010). All these schools were taken over by the state when La SONG left in the 1990s. The timber companies that have since followed, be they French, Gabonese, Malaysian or Chinese, have given only token gestures of assistance to these schools.

The school at Nyoe I was created through lobbying by the communities. Though the schools at Nyoe I and Nyoe II are now both state schools, the teachers officially appointed to them are not present and so either the local population or the official teacher have appointed someone else to take over. This is not the case for the schools in the Koulamoutou study sites where all the official teachers are present. As all the schools in the sites are in Bantu-speaking villages (Table 6-2) these results mostly concentrate on the education of the Bantu-speaking people rather than the Babongo Pygmies.

Study area	Village name	Principal population	Distance from market	Distance from village to school (km)		
				Primary	Secondary	College
Koulamoutou	Diboka	Bantu-speaking	41	0	0	41
Koulamoutou	Ndanda	Bantu-speaking	56	0	15	56
Koulamoutou	Divinde	Bantu-speaking	73	0	32	73
Ikobey	Nyoe I	Bantu-speaking	107	0	9	107
Ikobey	Tranquille	Babongo Pygmies	110	3	12	110
Ikobey	Ossimba	Babongo Pygmies	113	6	15	113
Ikobey	Nyoe II	Bantu-speaking	134	0	36	134
Ikobey	Motombi	Babongo Pygmies	150	16	52	150
Ikobey	Makoko	Babongo Pygmies	152	18	54	152
Ikobey	Ngondet	Babongo Pygmies	196	62	98	196

Table 6-2: Distance to different types of educational establishments from each study village.

As for the South American finding of Godoy and Contreras (2001), the Bantu-speaking villages near market towns (Diboka, Ndanda and Divinde), and so with better transport infrastructure and facilities, are not only nearer to higher education facilities but are also more likely to have a functional primary school than the villages further from market towns (Table 6-2). However, even though a village near the market town may have a primary school, not all the pupils are enrolled in these, some preferring to go to a primary school that is not in their village, usually in the market town itself. This is not the case for the Bantu-speaking pupils far from the market town (Nyoe I and Nyoe II) where the roads are in worse condition (Chapter 5).

In all the Bantu-speaking villages except for Diboka, teenagers who want to attend secondary schools have to go to a secondary school outside the village, and while Diboka does have a secondary school the majority of secondary students prefer to go to the secondary school in the nearest market town. This is reflected in both the number of children and teenagers (Table 6-3) as well as the number of adults and elderly (Table 6-4) who have been to secondary school.

With distance from a market town there is a change in School Life Expectancy of the Bantu-speaking children and teenagers, which shows a high negative correlation with the distance from a market town (Figure 6-1).

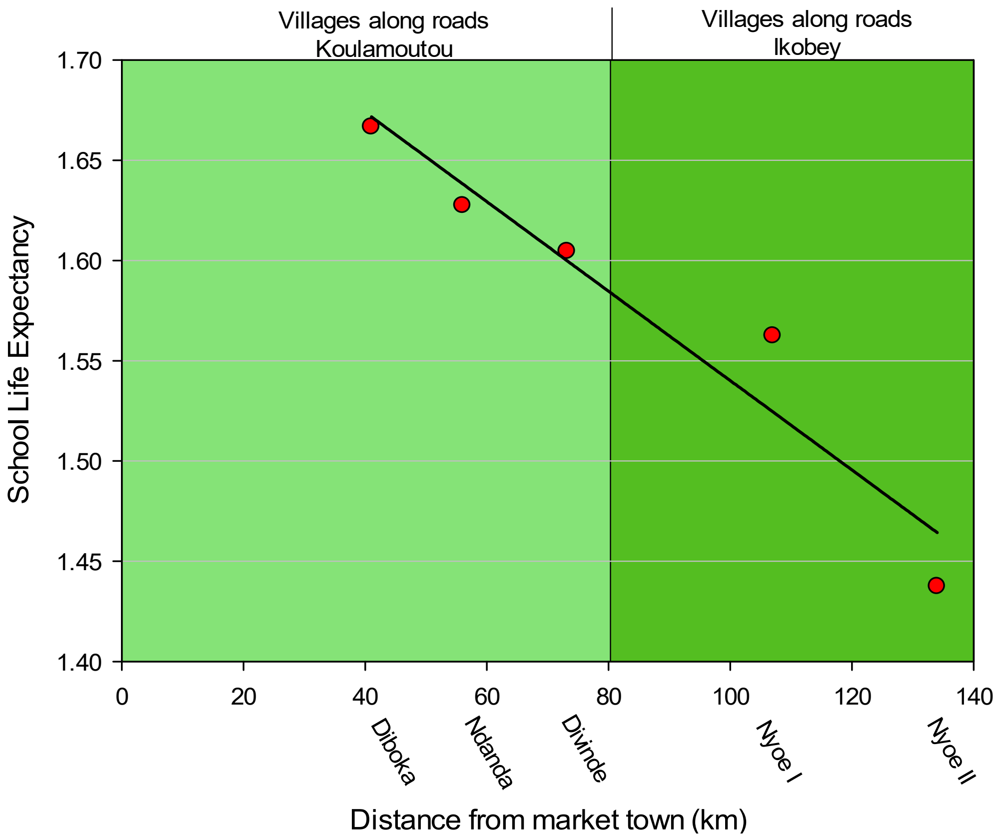


Figure 6-1: School Life Expectancy of children and teenagers of the Bantu-speaking villages. The linear regression of School Life Expectancy (r^2=0.925) is significant (ANOVA, F=36.963, DF=4, p=0.009).

Due to the collinearity between the continuous explanatory variables of distance, speed to a village, frequency of taxis and cost of taxis (see Chapter 5.5.4), education is only looked at through the distance to nearest market continuous explanatory variables. It is found that the number of years that Bantu-speaking villagers are educated is significantly impacted by distance (Table 6-5), with no evidence that children, teenagers and adults are affected differently. The resulting model indicated that the number of years of education of the Bantu-speaking population reduces with distance from a market town to such an extent that on average two years are lost in the furthest villages when compared to the nearest (Figure 6-2).

Village	Distance to market (km)	Number of households in village	Total population of village (2010)	Total children and teenage population (2010)	Frequencies (%) of children and teenagers experiencing given years of education				
					Total	0	1 to 6	7 to 10	11 to 12
Diboka	41	38	114	28	28 (100%)	10 (36%)	16 (57%)	2 (7%)	0 (0%)
Ndanda	56	20	111	57	57 (100%)	12 (21%)	18 (32%)	17 (30%)	10 (18%)
Divinde	73	21	86	36	36 (100%)	14 (39%)	11 (31%)	2 (6%)	9 (25%)
Nyoe I	107	16	68	20	20 (100%)	7 (35%)	11 (55%)	2 (10%)	0 (0%)
Tranquille	110	15	59	19	19 (100%)	7 (37%)	12 (63%)	0 (0%)	0 (0%)
Ossimba	113	5	19	5	5 (100%)	4 (80%)	1 (20%)	0 (0%)	0 (0%)
Nyoe II	134	15	59	23	23 (100%)	9 (39%)	14 (61%)	0 (0%)	0 (0%)
Motombi	150	6	36	11	11 (100%)	11 (100%)	0 (0%)	0 (0%)	0 (0%)
Makoko	152	22	92	31	31 (100%)	16 (52%)	15 (48%)	0 (0%)	0 (0%)
Ngondet	196	14	74	35	35 (100%)	32 (91%)	3 (9%)	0 (0%)	0 (0%)

Table 6-3: Number of children and teenagers who have been educated, separated in to number of years of education.

Village	Distance to market (km)	Number of households in village	Total population of village (2010)	Total adults and elderly population (2010)	Frequencies (%) of adults and elderly experiencing given years of education				
					Total	0	1 to 6	7 to 10	11 to 12
Diboka	41	38	114	79	79 (69%)	22 (28%)	45 (57%)	10 (13%)	2 (3%)
Ndanda	56	20	111	43	43 (39%)	9 (21%)	28 (65%)	4 (9%)	2 (5%)
Divinde	73	21	86	39	38 (44%)	10 (26%)	23 (59%)	5 (13%)	0 (0%)
Nyoe I	107	16	68	45	45 (66%)	13 (29%)	30 (67%)	2 (4%)	0 (0%)
Tranquille	110	15	59	35	34 (58%)	16 (46%)	17 (49%)	1 (3%)	0 (0%)
Ossimba	113	5	19	12	12 (63%)	9 (75%)	3 (25%)	0 (0%)	0 (0%)
Nyoe II	134	15	59	34	34 (58%)	4 (12%)	21 (62%)	5 (15%)	4 (12%)
Motombi	150	6	36	23	23 (64%)	12 (52%	11 (48%)	0 (0%)	0 (0%)
Makoko	152	22	92	55	55(60%)	37 (67%)	18 (33%)	0 (0%)	0 (0%)
Ngondet	196	14	74	34	34 (46%)	27 (79%)	7 (21%)	0 (0%)	0 (0%)

Table 6-4: Number of adults and elderly who have been educated, separated in to number of years of education.

Count model coefficients (negative binomial with log link)					
	Estimate	Std. Error	Z value	Pr(>|z|)	Significance
(Intercept)	2.065	0.065	31.905	<2e-16	***
Distance	-0.004	0.001	-5.012	5.4e-7	***
Age Group	0.019	0.055	0.341	0.733	
Log (theta)	1.635	0.142	11.505	<2e-16	***

Table 6-5: Results from a Negative Binomial model exploring the effect of distance and age on the number of years that Bantu-speaking villagers have been educated.

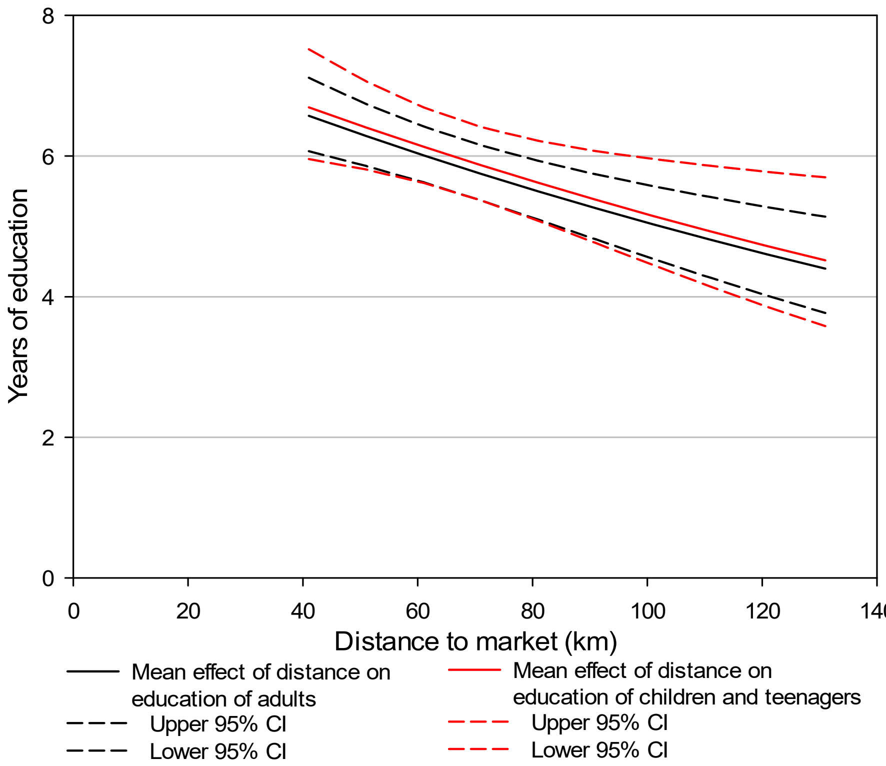


Figure 6-2: Model of impact of distance that a village is from a market on the number of years of education of the Bantu-speaking population.

When adding the factor variable of the past presence of timber companies, it would seem that there is no added benefit of the past presence of a timber company in village on the number of years that a Bantu-speaking villager is educated; rather in villages furthest from the market people have fewer years of education (Table 6-6 and Figure 6-3). Furthermore, the past presence of a timber company in villages far from market towns may hinder the education of Bantu-speaking teenagers as they may leave school to work in the timber company or to help service the timber companies' employees; however, children may benefit (Figure 6-4). That the past presence of timber companies hinders education in villages far from market towns could be due to teenagers preferring to find employment which is available in their village rather than continuing their education in a secondary school that is not in their village. This employment may be with the timber company or for the workers of the timber company, such as cooking, cleaning and hunting.

Count model coefficients (negative binomial with log link)					
	Estimate	Std. Error	Z value	Pr(>|z|)	Significance
(Intercept)	2.305694	0.087236	26.43	<2e-16	***
Distance	-0.00946	0.001585	-5.969	2.39E-09	***
Presence Company Y	-0.34915	0.195904	-1.782	0.07471	.
Distance : Presence Company Y	0.007066	0.002351	3.006	0.00265	**
Log (theta)	1.696853	0.145254	11.682	<2e-16	***

Table 6-6: Results from a Negative Binomial model of number of years that Bantu-speaking villagers have been re is the presence of a timber company in the past.

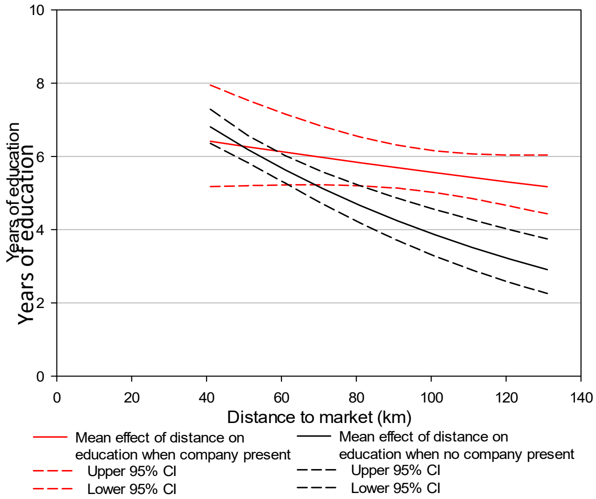


Figure 6-3: Model of impact of distance that a village is from a market and past presence of a timber company on the number of years of education of the Bantu-speaking population.

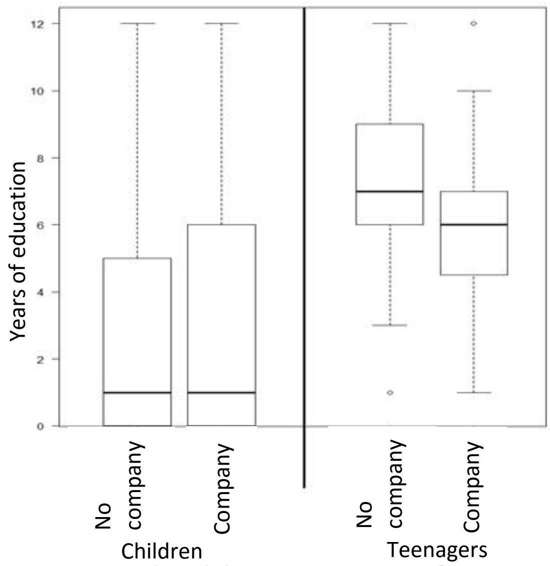


Figure 6-4: Plot of the number of years that Bantu-speaking children and teenagers are educated comparing villages where there has been a timber company present with ones where there has not.

The School Life Expectancy of children and teenagers is impacted by distance from a market town, with the role that timber companies play reducing the negative impact of distance by a maximum of two years in the villages furthest from the market towns. As secondary education facilities are not found in the villages far from markets, secondary schooling in distant rural forest areas seems to be succumbing to von Thünen's "bad road" and do not seem to have the benefit of the education infrastructure supplied by von Thünen's "Town". Secondary schooling is further hindered due to the presence of employment in the village.

There is also the possibility that there has been a policy change within the different timber companies that have operated in Ikobey that has further impacted the training of teenagers. In open interviews Bantu-speaking adults and elders of Ikobey repeatedly commented that the early timber companies, who helped set up the first schools in the area, had an active policy of training the young in various skills such as driving heavy vehicles and using a chainsaw, "*Madre,* *nous a montré comment conduire et couper le bois*"[162] and "*Sans La SONG, je n'aurais pas ce travail avec SUNNLY, c'est eux qui m'ont appris tout. Aujourd'hui les jeunes n'ont pas la chance, plus personne les apprends comment travailler le bois* "[163].

The more recent timber companies no longer carry out such training, preferring to employ people from outside the area who already have the required skill sets.

6.5.2 Employment

The other direct multiplier effect attributed to timber companies is job creation. Within both study sites the majority of Bantu-speaking adult men and some Bantu-speaking adult women have had paid employment. These adults form the biggest employed population in the villages, with few teenagers having gained paid employment (Table 6-7 and Figure 6-5). This finding seems to indicate that the teenagers who drop out of school do not do so to find work, but rather to service the timber companies' employees such as hunting and selling bushmeat for them or preparing alcoholic drinks. The number of Babongo Pygmies who have had paid employment is yet lower. Overall the largest employer is the timber sector, including saw mills (Figure 6-6). The importance of this sector changes with distance from a market town (Figure 6-5), with logging becoming more important the further a village is from a market, while jobs in other sectors generally decrease (Figure 6-5).

Village	Distance to market (km)	Number of households in village	Total pop. of village (2010)	Number of people employed (% of total population)			
				Total	Teen.	Adult	Elderly
Diboka	41	38	114	36 (32%)	1 (0.9%)	24 (21%)	11 (10%)
Ndanda	56	20	111	18 (16%)	0 (0%)	16 (14%	2 (2%)
Divinde	73	21	86	14 (16%)	0 (0%)	13 (15%)	1 (1%)
Nyoe I	107	16	68	17 (25%)	0 (0%)	16 (24%)	1 (1%)
Tranquille	110	15	59	9 (15%)	0 (0%)	8 (14%)	1 (2%)
Ossimba	113	5	19	6 (32%)	0 (0%)	5 (26%)	1 (5%)
Nyoe II	134	15	59	18 (31%)	0 (0%)	15 (25%)	3 (5%)
Motombi	150	6	36	6 (17%)	0 (0%)	4 (11%)	2 (6%)
Makoko	152	22	92	17 (18%)	1 (1%)	11 (12%)	5 (5%)
Ngondet	196	14	74	3 (4%)	0 (0%)	3 (4%)	0 (0%)

Table 6-7: Summary of number of people who have had paid employment in each village.

[162] "Madre, showed us how to drive and cut wood". Nyoe I, Mitsogho 10/05/10 [recording DS400098; 00:42].

[163] "Without La SONG, I would not have this work with SUNNLY, it is them who taught me everything. Today the young are not lucky, no one teaches them how to work the wood" Nyoe II, Mitsogho 22/04/10 [recording DS400079; 1:35:42].

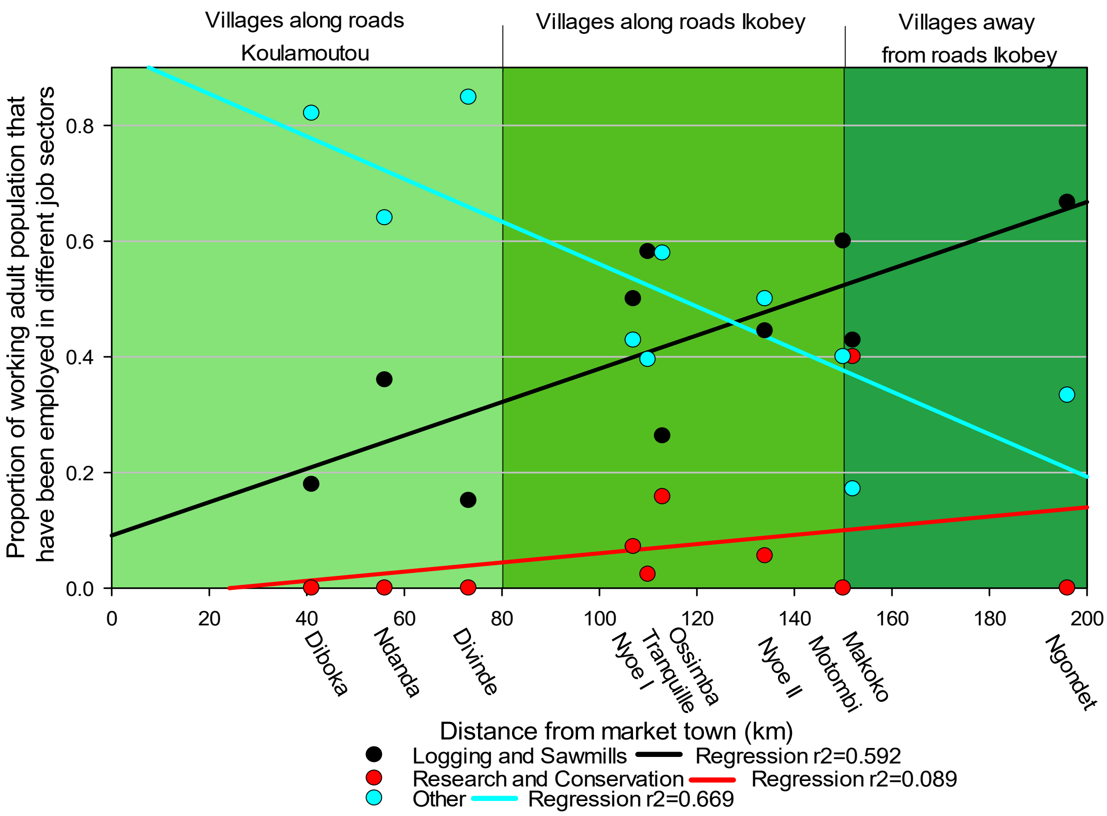


Figure 6-5: Percent of people employed in each of the study village, excluding children and infants.

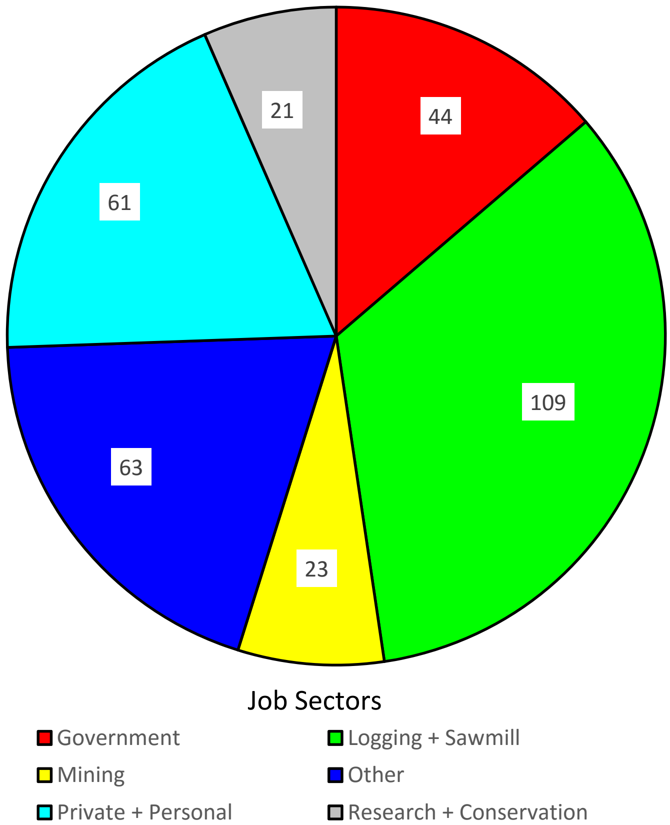


Figure 6-6: Key employment sectors in all study villages, with total number of people employed in all sectors N=321.

However, with distance from the market there is a general decrease in the overall percentage of people who have been employed in the villages at the farthest ends of the road, especially in the Babongo Pygmy villages (Figure 6-7 and Table 6-8). A binomial model exploring the impacts of distance and past presence of timber companies (Table 6-8) on the proportion of people employed in the sites indicates that the past presence of timber companies has no significant impact and yields a higher AIC (569.59, df 4). By contrast the distance binomial model by itself (Table 6-9) has a high significant impact with a somewhat lower AIC (568.89, df 2) and is a simpler model that indicated that there is a significant effect (Figure 6-7).

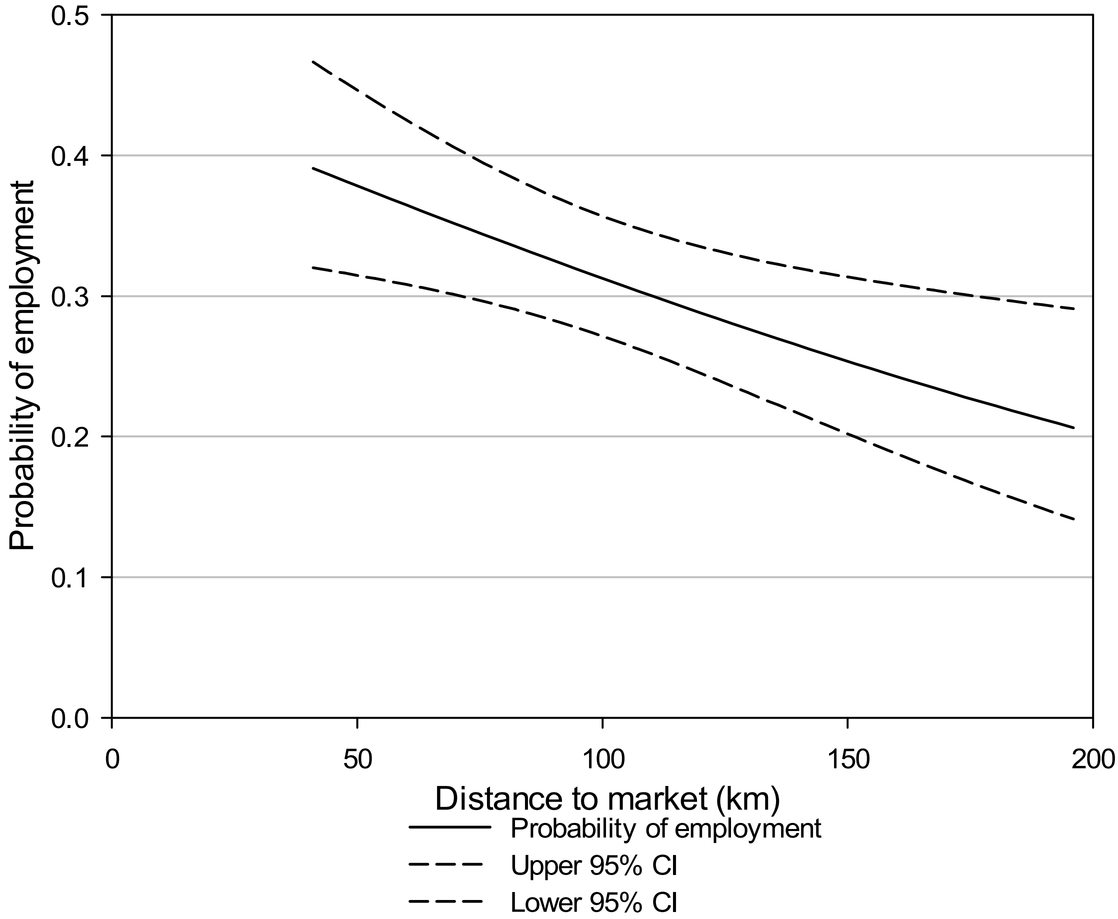


Figure 6-7: Effect of distance from the nearest market on the probability of employment.

Model 1: Glm(formula = Employment ~ Distance * Past Presence of company, family = binomial, data = Employment)					
Deviance Residuals:					
Min	1Q	Median	3Q	Max	
-1.0113	-0.882	-0.804	1.353	1.939	
Coefficients:					
	Estimate	Std. Error	z value	Pr(>|z|)	Significance
(Intercept)	-0.057	0.257	-0.223	0.824	
Distance	-0.008	0.003	-3.155	0.002	0.001
Past presence of company	-0.660	0.699	-0.944	0.345	
Distance : Past presence of company	0.008	0.006	1.406	0.160	
(Dispersion parameter for binomial family taken to be 1)					
Null deviance: 572.54 on 460 degrees of freedom					
Residual deviance: 561.59 on 457 degrees of freedom					
AIC: 569.59					
Number of Fisher Scoring iterations: 4					

Table 6-8: Results of a binomial model impacts of distance from the nearest market and past presence of a timber company on whether people have been employed.

Model 2 : Glm(formula = Employment ~ Distance, family = binomial, data = Employment)					
Deviance Residuals:					
Min	1Q	Median	3Q	Max	
-0.996	-0.924	-0.765	1.371	1.777	
Coefficients:					
	Estimate	Std. Error	z value	Pr(>|z|)	Significance
(Intercept)	-0.205	0.232	-0.883	0.377	
Distance	-0.006	0.002	-2.728	0.006	0.001
(Dispersion parameter for binomial family taken to be 1)					
Null deviance: 572.54 on 460 degrees of freedom					
Residual deviance: 564.89 on 459 degrees of freedom					
AIC: 568.89					
Number of Fisher Scoring iterations: 4					

Table 6-9: Results of a binomial model impacts of distance from the nearest market on whether people have been employed.

When local people are employed by timber companies it is only for the duration that the timber companies stay in the area, with the departing timber companies taking along the personnel that they came with (personal communication villagers from Tranquille, Ossimba, Motombi, Nyoe I and Nyoe II, 2010).

Of the employment opportunities that the people in the study sites have had, most have been in unskilled jobs where little training is needed (Figure 6-8), with skilled jobs mostly going to outsiders. One villager commented that:

> *Aujourd'hui, c'est les étrangers qui coupent le bois, même les malaysiens et chinois, nous ont fait seulement le guide. Au temps de La SONG, je conduisais les camions*[164].

What jobs are available to local people mostly involve manual labour, ranging from being forest guides and security guards to grass cutting. In the villages near the market towns, where transport infrastructure is good (Chapter 5), there is an increase in the number of people who have had skilled jobs (jobs where formal education or job training is needed), ranging from accounting and secretarial work to mechanics and chainsaw operators (Figure 6-8).

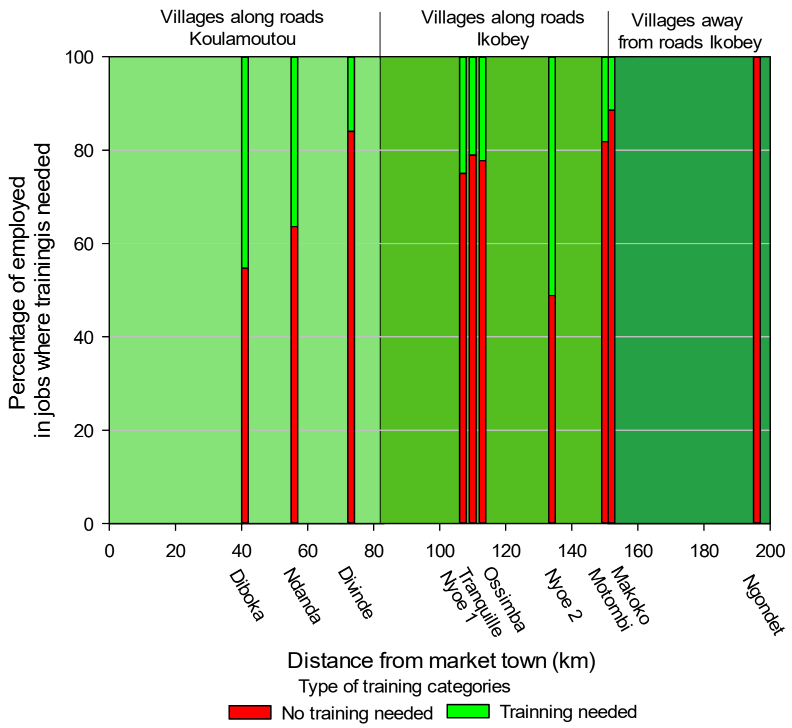


Figure 6-8: Percentage of jobs where some sort of training is needed.

[164] "Today, it is the foreigners who cut wood, including Malaysians and the Chinese, we are only guides. When La SONG was here, I drove the lorries" Nyoe II, Mitsogho 10/05/10 [recording DS400098; 05:22].

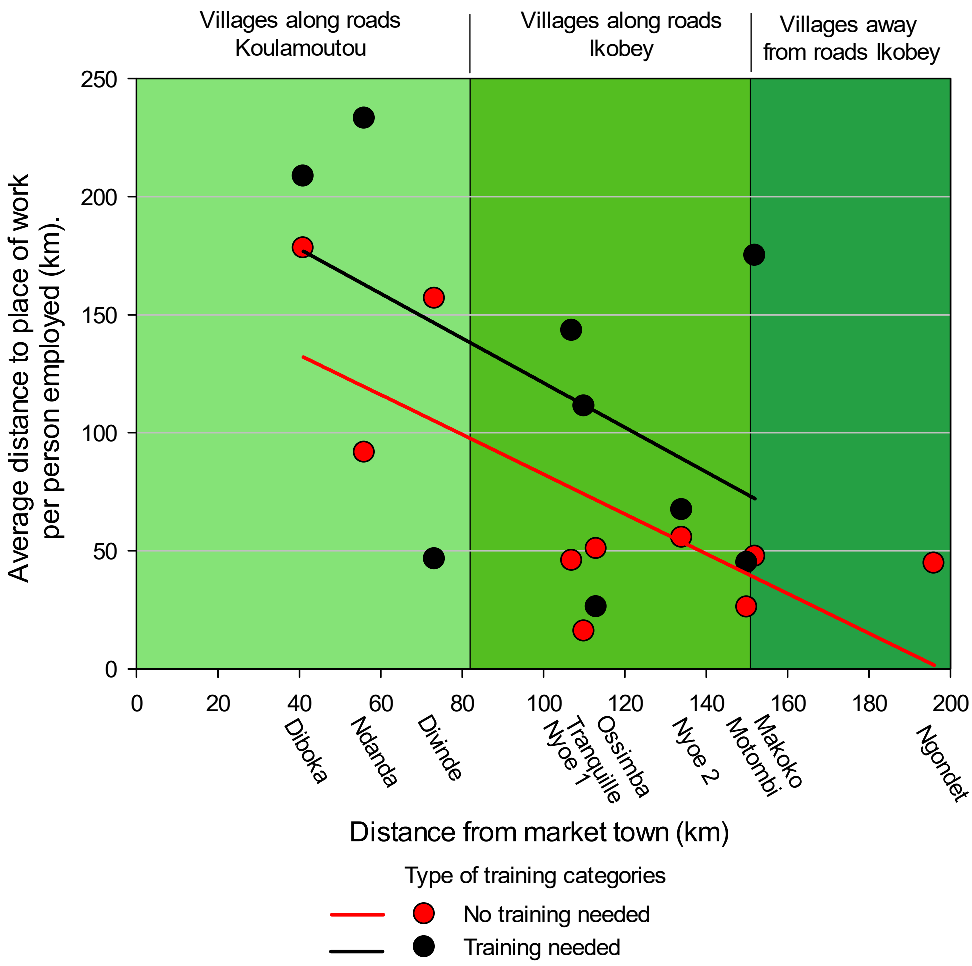


Figure 6-9: Distance people from each village have to migrate to find employment. The linear regression of the distance people with no training have to migrate to find work (red line) (r^2=0.536) is significant (ANOVA, F=9.225, DF=9, p=0.016). The linear regression of the distance people with training who had once migrated to find work in the past (r^2=0.241) is not significant (ANOVA, F=2.227, DF=8, p=0.179).

A Mann-Whitney U-test was used on the dataset of the employed Bantu-speaking villagers (Nyoe I, Nyoe II compared with Ndanda and Divinde) and suggests that there is a difference in the distance people are prepared to migrate to be employed (Mann-Whitney U-test, U=1059, n1=58, n2=56, p=0.001). The people who have been employed in the villages near market towns are prepared to migrate further from their village to look for a job opportunity, especially when they have been looking for jobs that require skilled work, and then return to their home village once the work is finished (Figure 6-9). One of the reasons for this is that transport is easier in villages near the markets allowing the people of these villages to return to them without great difficulty. However people living in villages further away may find it too difficult to return to their village and prefer to stay in the market town, and so may not be available at the time this dataset was collected. However, this does not seem to be the case, as few people from the villages further from the market have permanently migrated away (see below).

The state of the roads and so public transport may be contributing to this willingness to travel further, as it facilitates the communication with the family members who remain in the village. The people who have been employed in the villages further from the market towns have found employment near their village, usually with timber companies. They do not seem to seek employment opportunities further afield, probably hindered by the transport infrastructure (Chapter 5), and so are reliant on the employment opportunities created by the presence of timber companies near their villages.

6.5.3 The impacts of migration on education and employment

The results above concern the impact of distance from markets and timber companies on education and employment of the people who currently still live in the villages concerned. It does not give much insight into how distance and timber companies have impacted people who have already migrated out of the village.

People who have skill sets that employers require or who have better education may migrate away from their villages to seek better employment opportunities (Stark, 1982). Sending students or workers out of the village may be a household strategy to diversify their income opportunities through remittances (Akokpari, 2006; Ellis, 1998), and may result in people permanently migrating out of the village (Deshingkar, 2012), though this may not always be the case, especially in times of recession (Oyono, 2004; Oyono, 1998; Oyono *et al.*, 2005; Oyono *et al.*, 2003).

It is therefore of interest to see how many people have migrated out of the village. Though the demographic dataset used in Chapter 4 does not give the reason for migrations, it does include the people who were born in the household and who have left (Table 6-10 and Figure 6-10). It indicates that people nearer to market towns are more likely to migrate away from the village than the ones further from the market town. It is likely that the reason for the migration of children, that only occurs in the villages near the Koulamoutou market, is for education.

That few adults have migrated out of the villages furthest from the markets, as compared to the villages nearest the market, also suggests that it is people with better access to transport that migrate further away to find jobs.

Village	Distance to market (km)	No. of house-holds in village	Total Pop. of village including migrants	Number of people who have migrated away from village (% of total population including migrants)				
				Total	Infants	Children	Teenagers	Adults
Diboka	41	38	267	153 (57%)	0 (0%)	12 (4%)	28 (10%)	113 (42%)
Ndanda	56	20	164	53 (32%)	2 (1%)	10 (6%)	9 (5%)	32 (20%)
Divinde	73	21	133	47 (35%)	1 (1%)	15 (11%)	13 (10%)	18 (14%)
Nyoe I	107	16	71	3 (4%)	0 (0%)	0 (0%)	1 (1%)	2 (3%)
Tranquille	110	15	62	3 (5%)	0 (0%)	0 (0%)	0 (0%)	3 (5%)
Ossimba	113	5	22	4 (18%)	0 (0%)	0 (0%)	1 (5%)	3 (14%)
Nyoe II	134	15	77	18 (23%)	1 (1%)	0 (0%)	5 (6%)	12 (16%)
Motombi	150	6	36	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Makoko	152	22	99	7 (7%)	0 (0%)	0 (0%)	4 (4%)	3 (3%)
Ngondet	196	14	79	5 (6%)	0 (0%)	0 (0%)	0 (0%)	5 (6%)

Table 6-10: The number of people who have migrated away from the village.

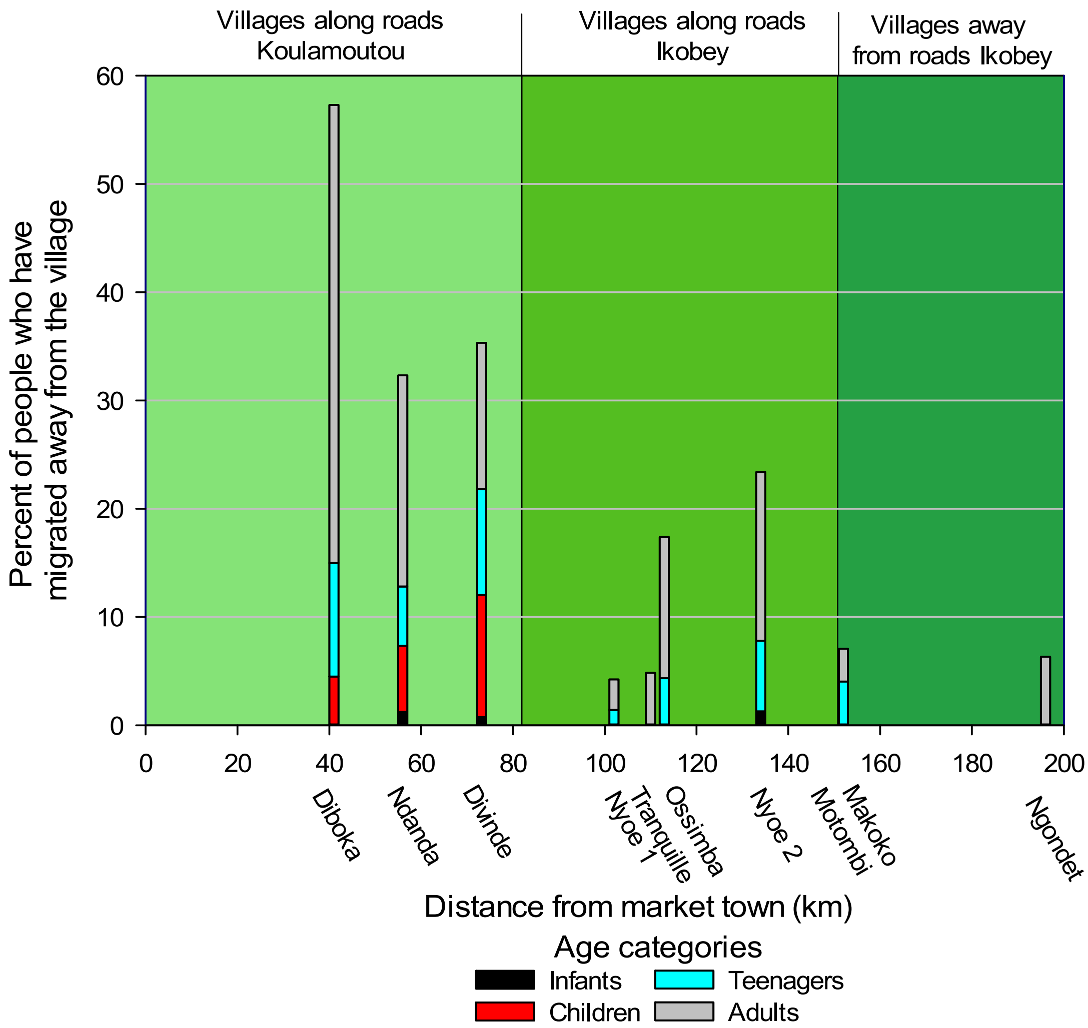


Figure 6-10: Percentage of people who have migrated away from the village.

6.6 Discussion and Conclusion

M. Madre and La SONG both seemed to have had a policy that significantly advanced development of the area, including the building of durable roads and bridges that lasted longer than the period that they exploited the area (Chapter 5). They also helped build schools, dispensaries, hired local people and taught them new skills. From discussion with several old foresters this policy does not seem to have been restricted to M. Madre and La SONG.

These policies further encouraged the migration of the Mitsogho, Babongo Pygmies and Akele into the study area (Knight, 2006). When La SONG left, the development of the area came to an end resulting in the collapsing of infrastructure. This degradation of infrastructure has resulted in the migrations of some of the Mitsogho and the Babongo Pygmies toward Ikobey, propelled to move when bridges along the old logging roads collapse, so as to maintain access to trade networks.

The impact that the past presence of the timber industry in a remote rural area has in the development of that area depends on their policies. If a timber company has appropriate policies then the impacts of poor transport infrastructure can be overcome. Though the early timber companies in the Ikobey site had such policies, these policies have changed with time and with the turnover of different timber companies. The first timber companies had a policy of not only recruiting people from the area but also helping in the education of their children and training of teenagers. Recent timber company policies, such as SUNNLY, have shifted to recruiting personnel from outside the area, especially for jobs that require skills, and are no longer investing in the education of children. The result of this change in policy has been to reduce the length of time that any direct development impact lasts after a timber company departs. After they have departed, the state of transport infrastructure and other factors dictate how long the post-development impacts of timber companies will last in remote rural forested areas.

Once again the chain of logic that dominates conservation thinking (Figure 1-1) is shown to be simplistic when it comes to predicting the long-term outcomes of the presence of timber companies on education and the creation of employment. Without the inclusion of the departure of timber companies, as has been done in the proposed alternative (Figure 1-3), the long-term success of conservation projects that also try to have an impact on development is not guaranteed. The lack of long-term development in these study sites also corresponds to the lack of long-term development resulting from historic exploitation of natural resources in Gabon (Chapter 3). The proposed alternative chain of logic (Figure 1-3) is only one possible long-term outcome, with other possibilities depending on various factors that may be unique not just to the local area but also to a country.

6.6.1 Education

Von Thünen's prediction that schooling facilities far from market towns will not be the same as facilities near market towns is borne out in this study, with distance to market being important to the number of people getting education, especially secondary education. The presence of a timber company may even reduce the number of years that teenagers stay in secondary education as they may prefer to leave education to help service the employees of the timber company, such as hunting for them. Either directly or indirectly, the timber company may hinder a person from going to another village to continue their secondary education. Without the support from the timber industry, both directly to the school and to transport infrastructure, the primary and any secondary schooling systems in these remote rural forested areas collapse, especially when the timber company departs.

When timber companies invest directly in local education in remote rural forest areas, these facilities, and the roads that provide access to them, break down after the timber company has left, unless these roles are taken over by the state. Even when education facilities are taken over by the state it is unlikely that the ones in remote rural areas will be run as they previously were, as teachers abscond from their remote post or, as in the case here, designate someone who is not qualified to take their place. From the interviews it is apparent that the early timber companies may have had a larger role to play in the education and training of Bantu-speaking local people than is currently the case and that this effect lasted after they departed.

The fact that timber companies no longer support education or training may also be having a longer-term generational effect, with a long term decrease in out-migration as cohorts of local youth coming through do not have the skill set needed to compete for jobs outside the area.

6.6.2 Employment

One of the positive developmental impacts of the presence of a timber company in a remote rural forested area is said to be the employment opportunities that open up for local people. From this study it seems that distance from a town has a more important role in employment than the presence of a timber company, with the role being to reduce the number of people who are employed. Though timber companies are responsible for most of the employment in remote rural forest areas while they are present, the long-term employment opportunities created by timber companies are not apparent in the study sites, with paid employment coming to an end when timber companies depart.

Due to the lack of diversity in employment opportunities in these remote rural forested area and with technical employment going to outsiders, people have the choice of either migrating away from the area and their families or relying on livelihoods based on agriculture, gathering, hunting and fishing (see Chapter 7).

For the people who migrate away from the village to find paid employment after a timber company has departed, it would seem that this also depends on distance from the nearest market. People living in villages near the market, where the transport infrastructure is in good state, are more willing to travel further to gain paid employment and then come back to their village when they are no longer employed. The people far from a market town do not seem to have migrated out of the area, or, if they did, have not returned to their villages once their employment is over.

This difference may be due to transport infrastructure and the frequency of taxis, as villages near market towns have better transport systems allowing the people who live in these areas to access a wider range of other paid employment opportunities. Not only does easy transport allow a market town to have a larger employment catchment area but there is also a higher diversity of employment opportunities (Smith, 1981; von Thünen, 1966). Transport also helps in the creation and the maintenance of networks between family and friends. It not only facilitates finding a job and moving to the area where a job is located, it also allows workers to return to their home village either after the job is over or for weekends. Furthermore, the lower education of the people furthest from the market town may have resulted in these people staying in their villages to find employment as they do not have the required education or skill set to be competitive in the wider job market.

The employment opportunities that are created by timber companies have probably changed over time. As logging technology becomes more sophisticated, the need for manual labour has decreased and more technical labour is required. Manual labour would have once been needed not only in the logging process, from the cutting of trees to its transport, but also in feeding the workers in the timber camps. Today, in remote rural forested areas, food is transported from towns and is no longer supplied by agricultural workers, while chainsaws and Caterpillars have replaced the axe for cutting trees and the metal bar for moving the logs. Elders from the Ikobey study sites still recall the time when logging was a manual process, having participated in the use of pitsaws, axes and metal bars. This technological change has resulted in the employment opportunities that open up with timber companies requiring more skills and education, which makes them less accessible to the local populations who have to make do with poorly paid unskilled employment.

In the past the timber industry may have helped the education of people as well as given them employment, but today this is no longer true. As the duration of stay of timber companies within the Ikobey and Koulamoutou study sites has decreased, from those staying decades such as La SONG in an area like Ikobey, to those now only lasting a couple of years as in the case of Bordamure and SUNNLY (Chapters 4 and 5), there is less of an incentive to invest in local infrastructure or education. The need for timber companies to train local people has been further eroded by their ability to easily bring in, and feed, workers from outside the area, including from outside Gabon. This is due to technological advances in transport that has made vehicles more reliable and cheaper, bringing down transport costs. This has further reduced the long-term development potential of timber companies since they no longer need to employ local people. The overall result is that where previously timber companies may have acted like a "Town" in von Thünen's "Isolated Stated", they no longer do so, or only in the most ephemeral way, with the result that access to market towns becomes critical in the education and employment of population in remote rural forest areas, even when a timber company is present.

7 Post-logging and livelihood activities

7.1 Summary

In the previous chapters the proposed chain of logic (Figure 1-3 and Figure 1-6) was investigated from the perspective of transport access (Chapter 5) and development (Chapter 6). In this chapter the issue of change in the market economy and the trade of natural resources is investigated.

This chapter demonstrates that when a timber company is present in an area a market economy is created, with similar properties to von Thünen's "Town". However, when the timber company departs, this *defacto* "Town" economy breaks down and with it the market-based livelihoods built around the commercial exploitation of the environment surrounding villages. The end result is that local people resume the subsistence way of life that they had prior to the company's arrival.

Only in villages where transport infrastructure allows easy and economical access to markets do local people's livelihood strategies continue, post-logging, to include the commercial exploitation of the environment around them.

7.2 Theory

Due to the transport infrastructure that is created by timber industries operating in remote rural forested areas, it has been assumed that this industry also has a long-term indirect impact on the forest environments that surround their concessions (Chapter 1.2.4). Among other reasons, this assumption is based on the idea that access opens up the natural resources of remote rural forests to the market economy through multiplier effects that are well documented, which includes the arrival of employees of timber companies who have the means to either hunt commercially themselves or hire others to do so (Colchester, 1999; Dove, 1993; Eves and Ruggiero, 2000; Wilkie *et al.*, 1992). The resources that can be exploited are either directly sourced from the forest, such as through hunting and gathering, or indirectly sourced through the conversion of forest into commercial agricultural land.

Timber industries also create a local market for natural resources (Angelsen and Wunder, 2003; Auzel and Wilkie, 2000; Sunderlin *et al.*, 2003) to supply food and alcoholic beverages to people attracted to the area for employment. People come to work either directly with the timber company (Nasi *et al.*, 2008) or in services associated with the timber company such as in transportation, cleaning and maintenance (e.g. tailoring and mechanics) (CARPE, 2006), construction, accommodation and prostitution (Angelsen and Wunder, 2003; Colchester, 1999; Dupré, 1981; Gray, 2002). The timber industry also helps the commodification and trade of agricultural and Non-Timber Forest Products, such as bushmeat, to markets further afield, as described by recent studies on the bushmeat trade and the timber industry (Auzel and Wilkie, 2000; Bird and Dickson, 2007; Eves and Ruggiero, 2000; Fimbel *et al.*, 2001; Laurance, Alonso, *et al.*, 2006; Meijaard and Center for International Forestry Research., 2005; Poulsen *et al.*, 2009; Poulsen *et al.*, 2007; Robinson *et al.*, 1999; Wilkie and Carpenter, 1999; Wilkie *et al.*, 1992). In this way a timber company becomes a *defacto* "Town" with spatial impacts similar to von Thünen's "Town".

These local markets can be supplied and operated either by the local community (O'Connor, 2004) or through stores that are run or are supported by the timber industry; in Gabon these timber company stores are often called *économats*[165] (Bouet, 1977). In the past locally produced goods would have formed a larger part of this market economy in remote rural forest areas of Gabon as the food supplies for timber companies were largely locally procured. In this way even villagers who were not directly employed by timber companies would have benefited from the presence of the companies, such as through the selling of agricultural products. However, local food supply is seasonal and unreliable. With improvements to transport infrastructure and modern vehicles, food can now be reliably imported in bulk quantities from towns and cities and include foreign imports (Bouet, 1977). Today any local food production is more orientated towards agriculture or the gathering and hunting of Non-Timber Forest Products. Hunted products can be consumed locally as "wild meat" or traded with either workers or in markets further away as "bushmeat" (Mack and West, 2005, p.5).

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[165] These *économats* are generally stocked with items brought from outside the areas and have a credit system, "*bons pour*" (credit) (Bouet, 1974, p.6). In these stores employees can obtain food, beer, batteries, clothing and so on. In the past it would have been in these stores that the majority of an employee's salary would be spent (Lasserre, 1955) resulting in the employee being indebted to the timber companies' store (Bouet, 1974).

7.3 Research questions

If the commodification of Non-Timber Forest Products, such as bushmeat, that developers and conservationists associate with timber companies, is to continue in the long-term, then it would be expected that the trade in these products should not be hindered by the collapse in transport infrastructure after timber companies leave remote rural forest areas.

7.4 Methods

As well as participant observation of items that were being brought to the villages and how they were used, a survey of items brought back to the village (Appendix 11.6) was carried out over a single twelve day period in each village during the dry season. This survey was carried out from six in the morning to seven in the evening, by which time the majority of people, including hunters, had returned to the village. During this period all items brought into the village were recorded as they entered the village. This included the name of the person with the item, the household for which the items were destined, the type and number of items, the type of environment the items were obtained (plantation, forest, river) and how the items were to be used (consumed or sold).

Often collection trips consisted of exploiting multiple environments. Due to this, each individual trip was divided by the number of different environments that were visited. So in the case of a person visiting, in a single trip, both plantations and forest, this would count for half a trip in the forest and half a trip in the plantation. In all cases people were always asked for permission to record the items brought to the village. In no case did people openly refuse to participate and, as most of the villages are small, people taking unusual routes back to their home would have been noticed (this was not observed to have occurred).

As villages in Gabon are small, it was possible to observe the majority of the coming and goings of the population and so to record most items that came into the village. People returning at night were the exception. Not all households are represented in the data collected (Table 7-1 and Table 2-5). This was due to some households being in forest at the time (such as in the case of Makoko) or having gone to town (such as in the case of Diboka). Not all the population of each village collects items from the forest, especially non-able bodied people such as the elderly and children, so the percent of the total population of each village that collects items is reduced (Table 7-1).

Village	Number of households recorded during collection survey (as % of all households in the village)	Number of people recorded during collection survey (as % of the total population of the village)	Number of trips recorded during collection survey
Diboka	36 (95%)	75 (66%)	344
Ndanda	18 (90%)	41 (37%)	163
Divinde	19 (90%)	40 (47%)	187
Nyoe I	15 (94%)	49 (72%)	189
Tranquille	15 (100%)	41 (69%)	173
Ossimba	5 (100%)	15 (79%)	98
Nyoe II	15 (100%)	38 (64%)	144
Motombi	6 (100%)	22 (61%)	92
Makoko	20 (91%)	54 (59%)	169
Ngondet	14 (100%)	47 (64%)	177

Table 7-1: Summary of results from twelve day period during which people returning with items to the village were recorded.

In most cases the items were carried in baskets of similar sizes so there was no need to empty out the whole basket each time. Instead an estimate of the number of items being carried was made based on previous trials of filling up baskets with common items e.g. yams, manioc tubers, sweet potatoes etc. As this survey was carried out during the same season, the type of products and size should not vary.

Monetary equivalents of items brought to villages were derived from existing market datasets collected by previous projects that had been carried out in Gabon. These datasets include data from *Projet Gibier* (2000 to 2007)[166], the Gabon Parks and People project (Wilkie *et al.*, 2005), and the Ph.D. theses of Malcolm Starkey (2004) and Lauren Coad (2007), all of which were also carried out in Gabon; the latter three datasets included data from the study sites. These datasets include the same items but were put together using different units. For example, in the case of manioc tubers these datasets include the price of one kilogram of manioc tubers, one individual manioc tuber, one basket of manioc tubers and one bag of manioc tubers. Using these different datasets it was possible to calculate the estimated total market value of items that were brought into the village, for both the items that were destined to be consumed and the items destined to be sold (though not the items that were destined to be both consumed and sold). This estimated total market value was used to compare the economic activity of the different village sites.

[166] Partially carried out by myself.

The data on the value of items brought into the village were examined using various Generalised Linear Models (GLMs). Variables were first tested for normality, outliers, and collinearity with data exploration following Zuur *et al*. (2010). An information-theoretic approach was taken to model selection following Anderson and Burnham (2002). This uses Akaike's Information Criteria (AIC) or Akaike's Information Criteria corrected for small sample bias (AICc), depending on sample size (Anderson and Burnham, 2002; Zuur *et al.*, 2009). Following data exploration a model was chosen a priori as well as all possible model combinations using the automated methods in the MuMln package (Bartoń, 2004) in the R statistical environment (R Core Team, 2014). The following normal distribution multiple regression model was used as the full model:

Value ~ Presence * Distance + Presence * Pop + eps

Where:

Value = Value of items brought,

Presence = Presence of timber company around a village,

Distance = Distance to the nearest market from a village,

Pop = Population size of village,

eps = residual error or unexplained information.

Modelling of the dataset is limited to all items brought to the village and non-bushmeat items brought that were destined to be used. This constraint was due to limitations in the dataset where the selling of items, including bushmeat, were rarely observed (Figure 7-1). The lack of data in these categories was not because people were hiding these items as during the whole research period people openly hunted protected species.

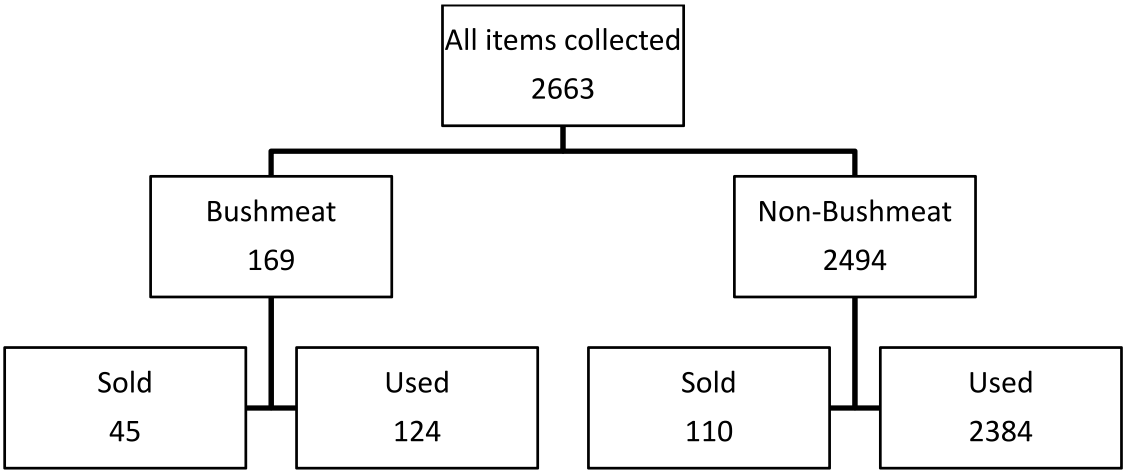


Figure 7-1: Breakdown of the total number of items collected around the villages.

From the 13 different model combinations available, an average model was defined where the AICc differences from the best model were less than three. The resulting final model was then tested for validity by looking at the normality of residuals, homogeneity and independence of the variables (Zuur *et al.*, 2009, pp.19–22).

7.5 Results

7.5.1 Overview of market sites

In the past, timber companies in the Ikobey area, such as La SONG (Chapter 4) and La SEB (*Société Équatoriale des Bois*), regularly held weekly markets in different villages. In this way they could buy food items from the villages to feed their employees (personal communication, Ekia, J.-P., 2010, Ossimba). This practice continues in the village of Diboka, in the Koulamoutou study site, where food items are sometimes, though not regularly, procured for the timber companies based in Lastoursville (personal observation).

Recent timber companies who had worked in the Ikobey area and in the village of Divinde transported their food supplies from either Libreville, Lambaréné, Fougamou, Koulamoutou or Lastoursville (Map 2-1) (personal communication villagers from Tranquille, Ossimba, Motombi, Nyoe I and Divinde 2010). La SONG and Bordamure, two timber companies that were based in the Ikobey area, also ran *économat* stores where their employees could buy items; these shops were stocked from outside the area (personal communication villagers from Tranquille, Ossimba, Motombi, Nyoe I and Nyoe II, 2010).

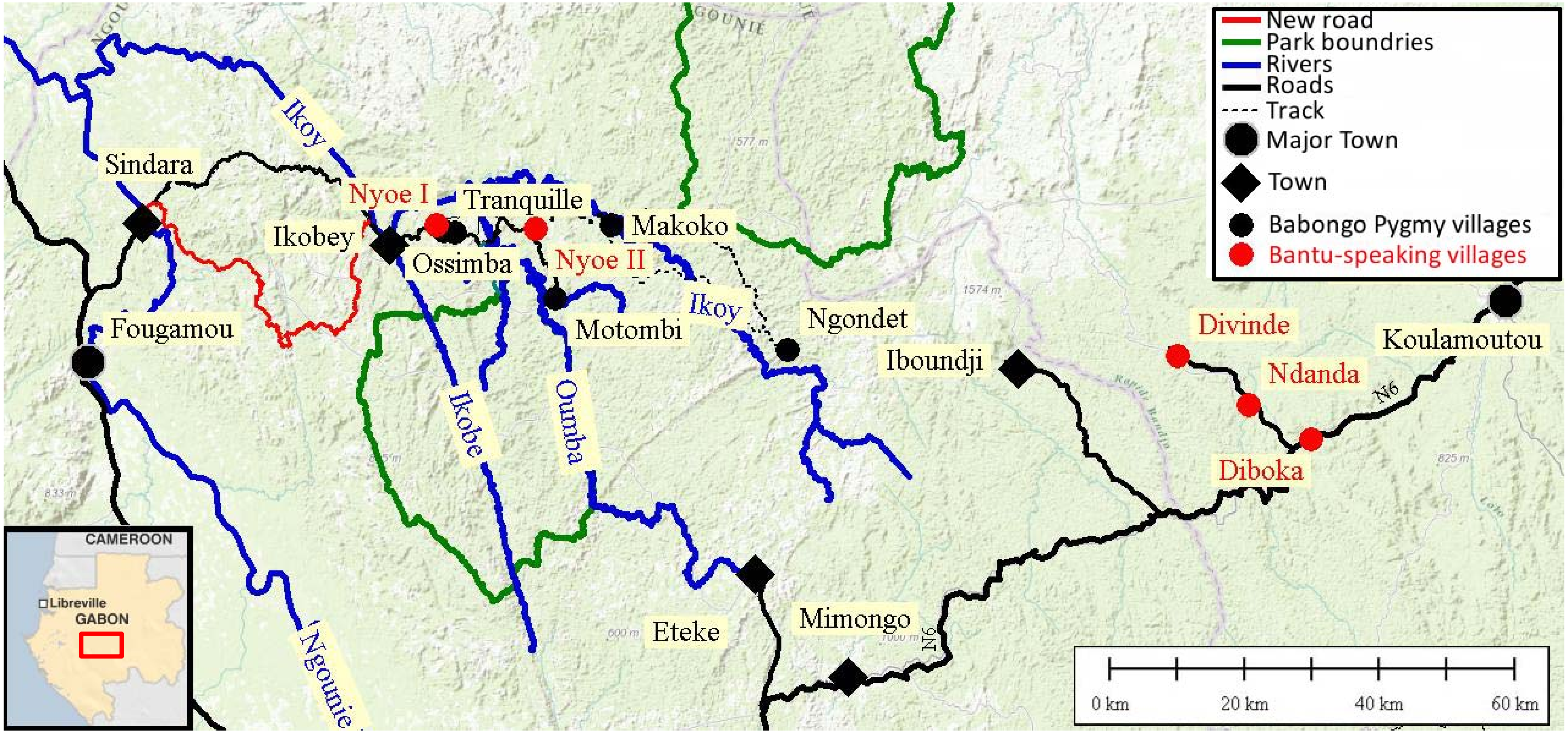
While timber companies were present bushmeat was being transported out of Ikobey to the towns (personal communication, Starkey and various villagers). During the study period in the

Ikobey site no natural resource product, including bushmeat, was gathered with the objective of being sold. However, with the arrival of SUNNLY, the Chinese timber company that started work in the Ikobey area at the end of the study period, a market for palm, honey and sugar cane wine started (personal communication villagers from Tranquille, Ossimba and Motombi, 2010 and personal observation) while bushmeat was not openly sold (personal observation)[167].

Currently there are no regular markets in the Ikobey area where food items can be traded. The nearest such market is in Fougamou (Map 7-1), which is 107 km away from the closest study village (Chapter 5). Since the timber companies left the area, and before the return of SUNNLY, no traders or other middlemen came from nearby towns, the nearest being Fougamou and Lambaréné, to buy food items. Only rarely were people going from the Ikobey area to these towns to trade food items.

In the Koulamoutou study sites there are two regular trading activities. The village of Diboka, the village with the easiest access to the nearby Koulamoutou markets which is 41 km away from the nearest study village (Chapter 5 and Map 7-1), was visited on a weekly basis by a middlewoman from Libreville who buys plantains from this village, as well as the immediately surrounding villages. The other trading activity is the selling of bushmeat, which is either sold on the edge of the road, as is usually the case in Diboka, or by transporting it to Koulamoutou. The villages of Ndanda and Divinde (Map 7-1), the villages with the hardest access to the Koulamoutou markets, 52 and 73 km away respectively (Chapter 5), have a bush taxi that comes once a week to buy bushmeat from the hunters. This bush taxi, cum middleman, supplied the hunters with the equipment needed to hunt while also taking orders for the villagers.

[167] It is likely that any sales during the study period would have been observed, since people openly hunted protected species during this time.



Map 7-1: Location of the study sites. Based on the following sources: Basemap - (ESRI, 2012), Park boundaries - (Institut Geographique National, 2008).

7.5.2 Overview of livelihood activities based on the environment

> *Singe aux arachides ou Foutou. — Ce singulier mets forme le plat national dans le Baoula (Afrique équatoriale française)*[168] (De Noter, 1931, p.43; Fuligni and Aquindo, 2015, p.119).

In all the sites, items are gathered and harvested by the local population (Figure 7-2). These items are principally derived from the plantations and the forest. Even though few items are traded, and none was traded within the community, all of the food items brought back to the village sites have a market value (Figure 7-2 and Figure 7-3). Of all the items collected in the forest environments, the highest values accrue to animal products in the form of bushmeat and wild meat (Figure 7-2 and Figure 7-3). Yet little of this bushmeat was sold by the villagers in the Ikobey site, most of it being consumed in the villages (Figure 7-3). Furthermore, due to the quantity of non-bushmeat items that were collected and then consumed (Figure 7-4) in the Ikobey site, the value of these non-bushmeat items (Figure 7-2) is higher than of the bushmeat that was sold (Figure 7-3). This was not the case in the Koulamoutou study sites where food items including bushmeat are traded. The people of Diboka traded more non-bushmeat items than the other villages due to the presence of a regular plantain trader while the other Koulamoutou sites trade food products in the form of bushmeat (Figure 7-3). Hunting is therefore an important economic activity in the Koulamoutou villages, not only due to the presence of a transport infrastructure, but also because of the regular presence of traders.

This analysis is consistent with the principle that in the communities where access is easier (in this case the Koulamoutou communities), the forest is used less for subsistence activities and more for commercial activities, with more bushmeat being sold. However, in communities where access is harder (in this case the Ikobey communities), this principle no longer holds. Though there is little trade by the villagers in the two villages that are off the main road (Makoko and Ngondet), there is trade in valuable, non-perishable, forest products such as *bois amer* (*Garcinia* spp.)[169] which is used throughout Gabon to ferment various types of wine including palm and honey wine; the over use of this tree has resulted in its rapid disappearance from the forests of Gabon (Walters, 2010).

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[168] Monkey in Peanut sauce or Foutou. - This singular dish forms the national dish in the Baoula (French Equatorial Africa).

[169] These villagers also trade ivory which was done to order, with the gun and ammunition supplied by outsiders who come into the area specifically for this commodity. It should be noted that neither of these villages have guns, with all hunting done either with cable traps or by poisons arrows. This only occurred twice throughout the three years spent in the study sites.

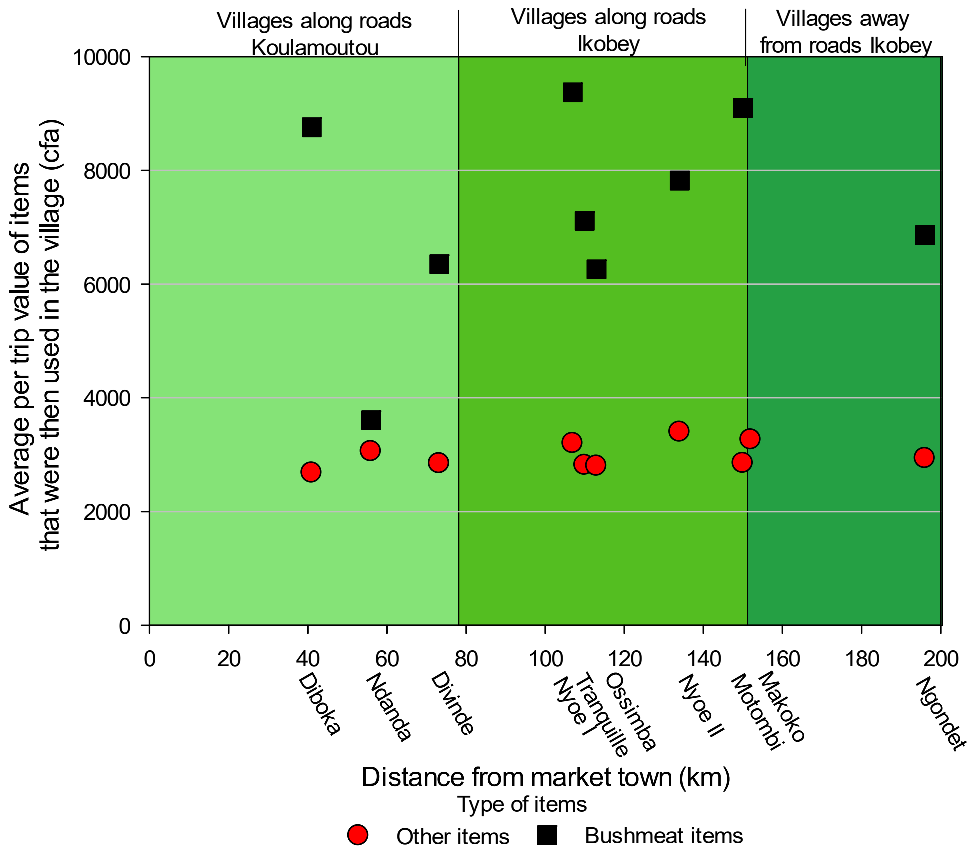


Figure 7-2: Value of items brought back to the village that are then to be used. Excluding any item where a part of it was used and another part sold.

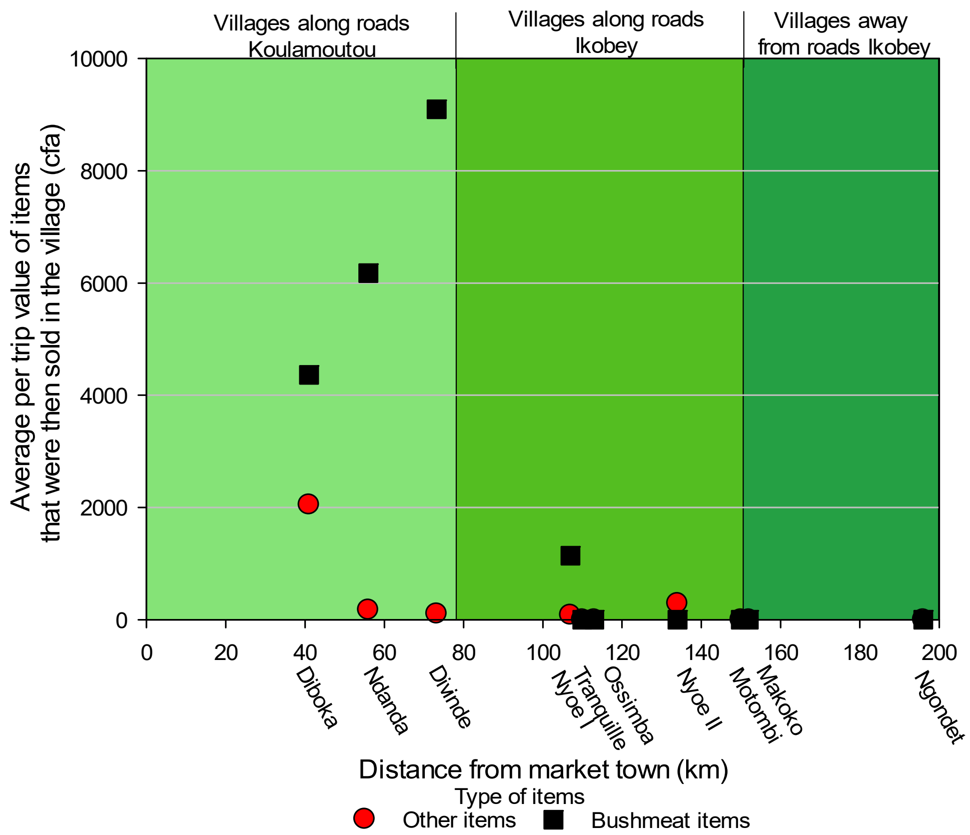


Figure 7-3: Value of the items brought back to the village that are then to be sold. Excluding ivory and any item where a part of it was used and another part sold. The sale of items, especially of bushmeat, in the Ikobey village is very small.

Though bushmeat and wild meat (Mack and West, 2005, p.5) have the highest per item value, the amount of non-bushmeat items collected is higher (Figure 7-4). The number of trips into the forest to collect non-bushmeat items increases with distance from market (Figure 7-5). Within the Ikobey sites the majority of the gathering activities occur in either the forest or plantations, while in the Koulamoutou site the majority of gathering activities occur only in the plantations (Figure 7-5). However this could be a reflection of the fact that the forests around the Koulamoutou villages are more distant, especially around Divinde and Diboka (Chapter 8), than the forest around the Ikobey villages.

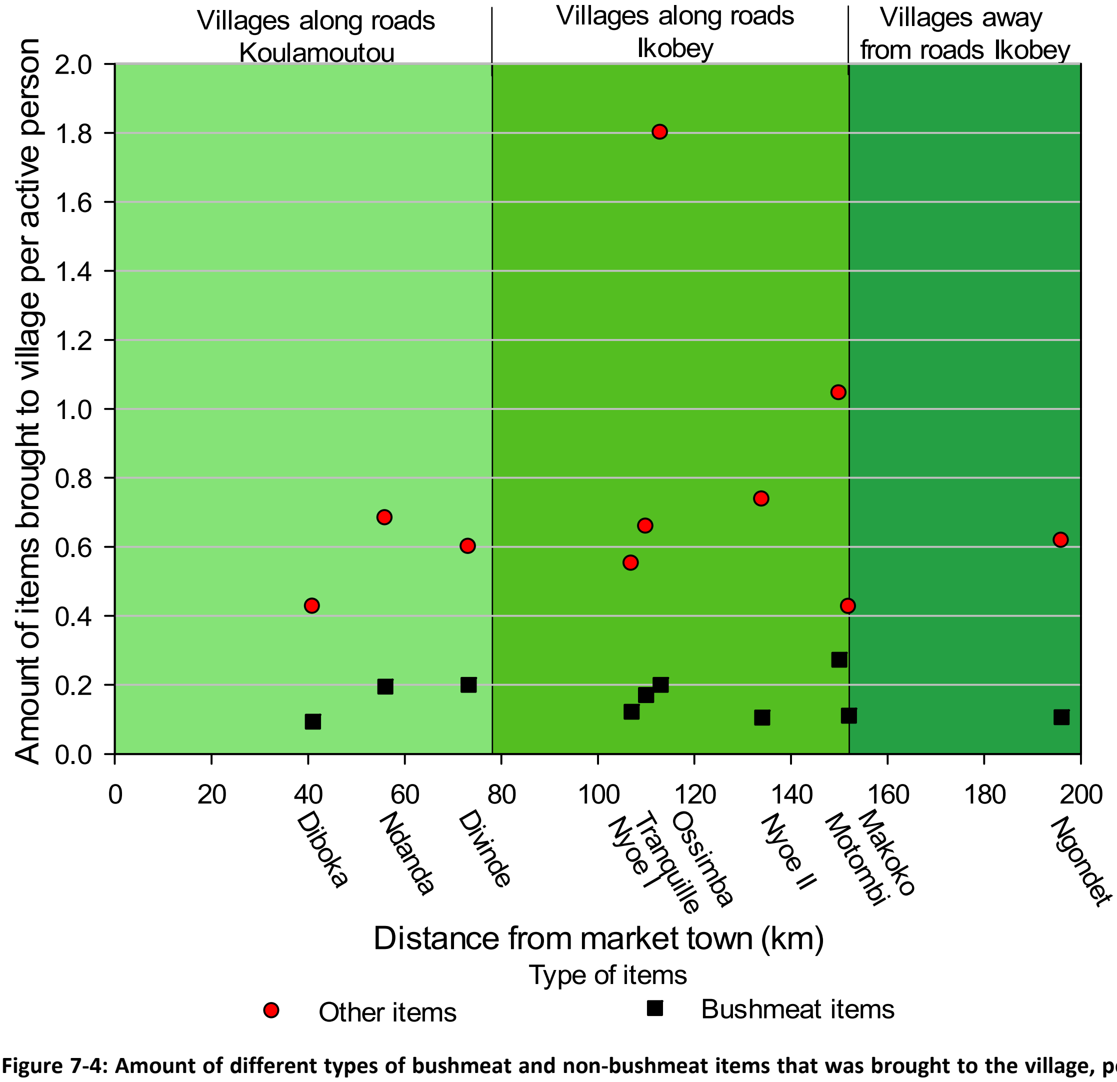


Figure 7-4: Amount of different types of bushmeat and non-bushmeat items that was brought to the village, per person who participated in survey.

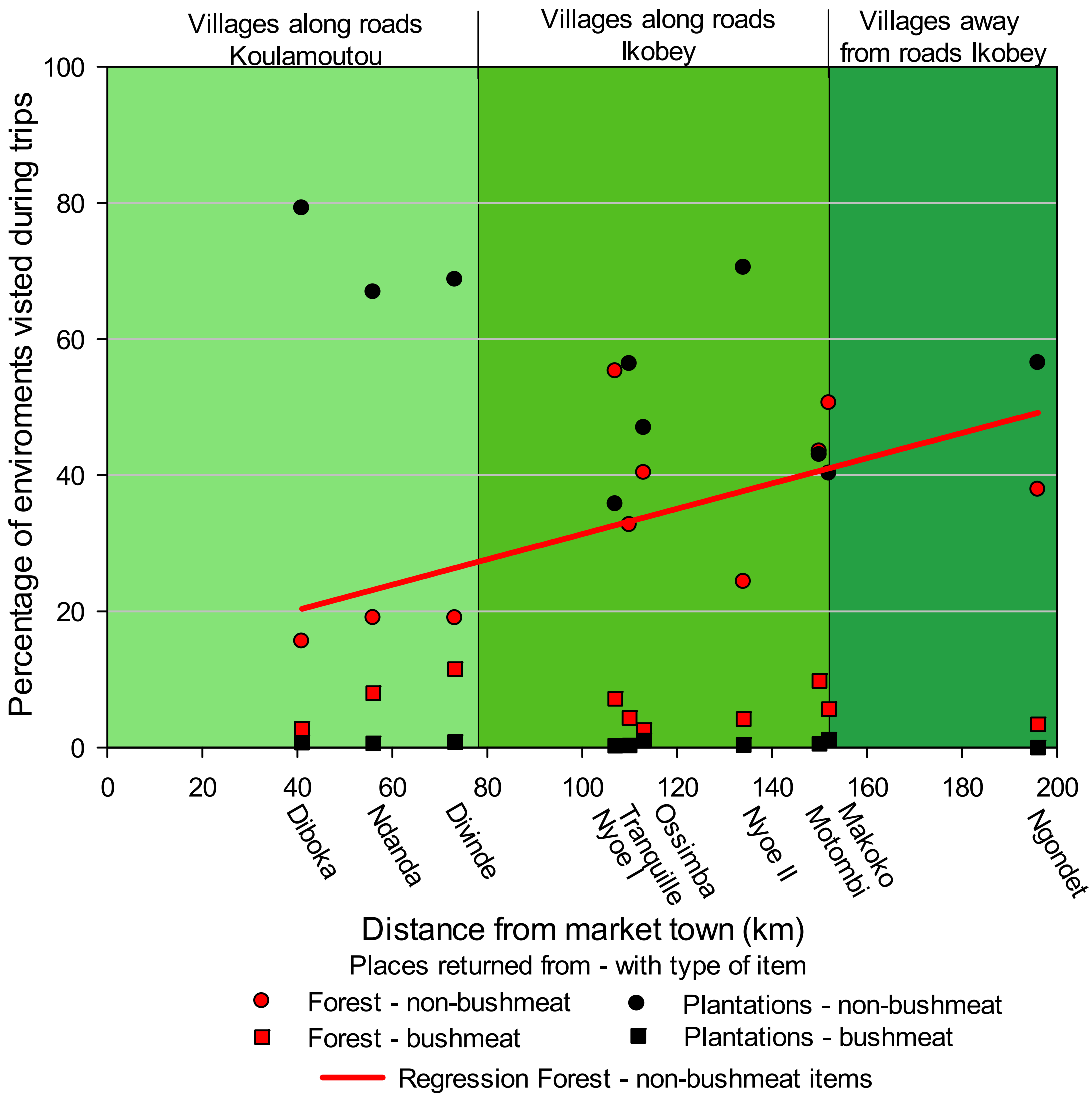


Figure 7-5: Distribution of each of the environments from which items were transported back to the village by the active population, each trip. The linear regression of the forest environments visited by people (r^2=0.399) is significant (ANOVA, F=5.302, DF=9, p=0.050). The linear regression of the plantation environments visited by people (r^2=0.299) is not significant (ANOVA, F=3.412, DF=9, p=0.102).

In the Ikobey area people of all age groups participate in the collection of items from the surrounding environment. This differs from the Koulamoutou site where children partake less in these activities (Figure 7-6), presumably as most are at school (Chapter 6).

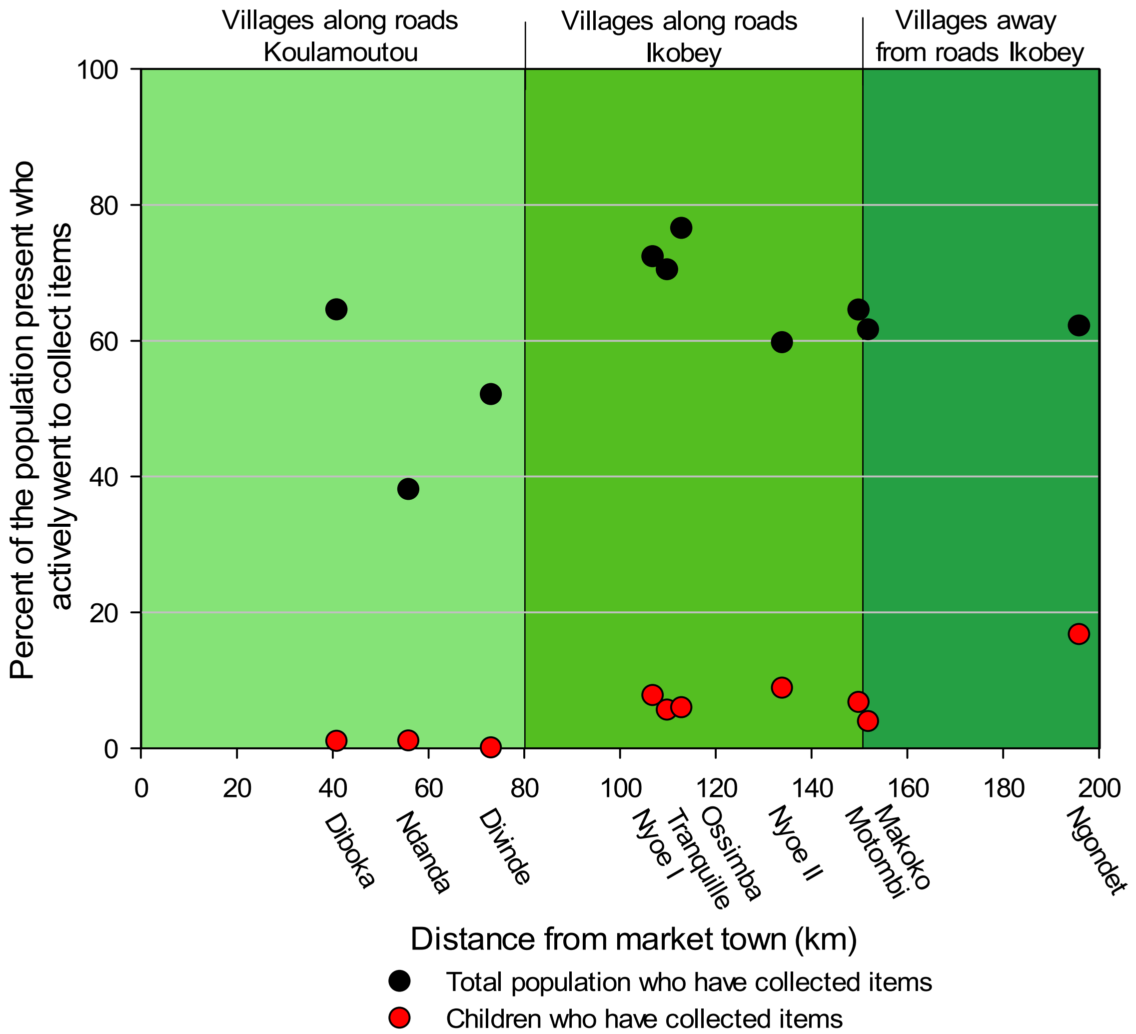


Figure 7-6: Percent of population who have collected items from the forest, plantation or rivers during the study period.

Due to dataset limitations in the number of items that people brought back to the village, where bushmeat and wild meat formed only a small fraction of the items collected while most items collected were consumed rather than sold (Figure 7-1), it is difficult to model in any direct way the impact that the past presence of timber companies has had on the commercial collection of bushmeat. However, it is possible to investigate the effects of distance from market and past presence of a timber company on the pooled total of all the items collected and then, separately, on the non-bushmeat items collected and used.

The first model concerns the value of all items that people have brought back from the village (Table 7-2 and Figure 7-7). The first relatively important variable associated with the value of items brought back to the village (bottom of Table 7-2) is distance which is significantly related, followed by the past presence of a timber company base, which is not significantly related. The model suggests that with distance from markets the value of items brought back to villages increases but the past presence of a logging company has no effect (Figure 7-7).

model.avg.default(object = get.models(ms2, subset = delta < 3))
where ms2 = glm(Value~ Presence*Distance+Presence*Pop, family = poisson,data = Live4)

Component models:

	df	logLik	AICc	Delta	Weight
1235	6.00	-23298.23	46608.48	0.00	0.38
12345	7.00	-23297.31	46608.67	0.18	0.35
13	4.00	-23301.04	46610.10	1.62	0.17
1	3.00	-23302.55	46611.11	2.63	0.10

Term codes:

Distance	Population	Past Presence	Distance: Past Present	Population: Past Presence
1	2	3	4	5

Model-averaged coefficients:

	Estimate	Std. Error	Adjusted SE	z values	Pr(>|z|)	Significance
(Intercept)	7.5608	0.1558	0.1559	48.5060	< 2e-16	***
Distance	0.0026	0.0008	0.0008	3.3510	0.0008	***
Population	-0.0005	0.0013	0.0013	0.3520	0.7250	
Past Presence Yes	-0.5716	0.4710	0.4711	1.2130	0.2250	
Population: Past Presence Yes	0.0088	0.0037	0.0037	2.4100	0.0159	*
Distance: Past Presence Yes	0.0021	0.0016	0.0016	1.3510	0.1768	

Full model-averaged coefficients (with shrinkage):

	Estimate	Std. Error	Adjusted SE	z values	Pr(>|z|)	Significance
(Intercept)	7.5608	0.1558	0.1559	48.5060	< 2e-16	***
Distance	0.0026	0.0008	0.0008	3.3510	0.0008	***
Population	-0.0003	0.0012	0.0012	0.2950	0.7678	
Past Presence Yes	-0.5131	0.4787	0.4788	1.0720	0.2838	
Population: Past Presence Yes	0.0064	0.0050	0.0050	1.2810	0.2003	
Distance : Past Presence Yes	0.0007	0.0014	0.0014	0.5380	0.5907	

Significance. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Relative variable importance:

	Distance	Past Presence	Population	Population: Past Presence	Distance: Past Presence
Importance :	1	0.9	0.73	0.73	0.35
N containing models:	4	3	2	2	1

Table 7-2: Average model of the variables that contribute to the value of all items with which people have returned to the village, based on AICc.

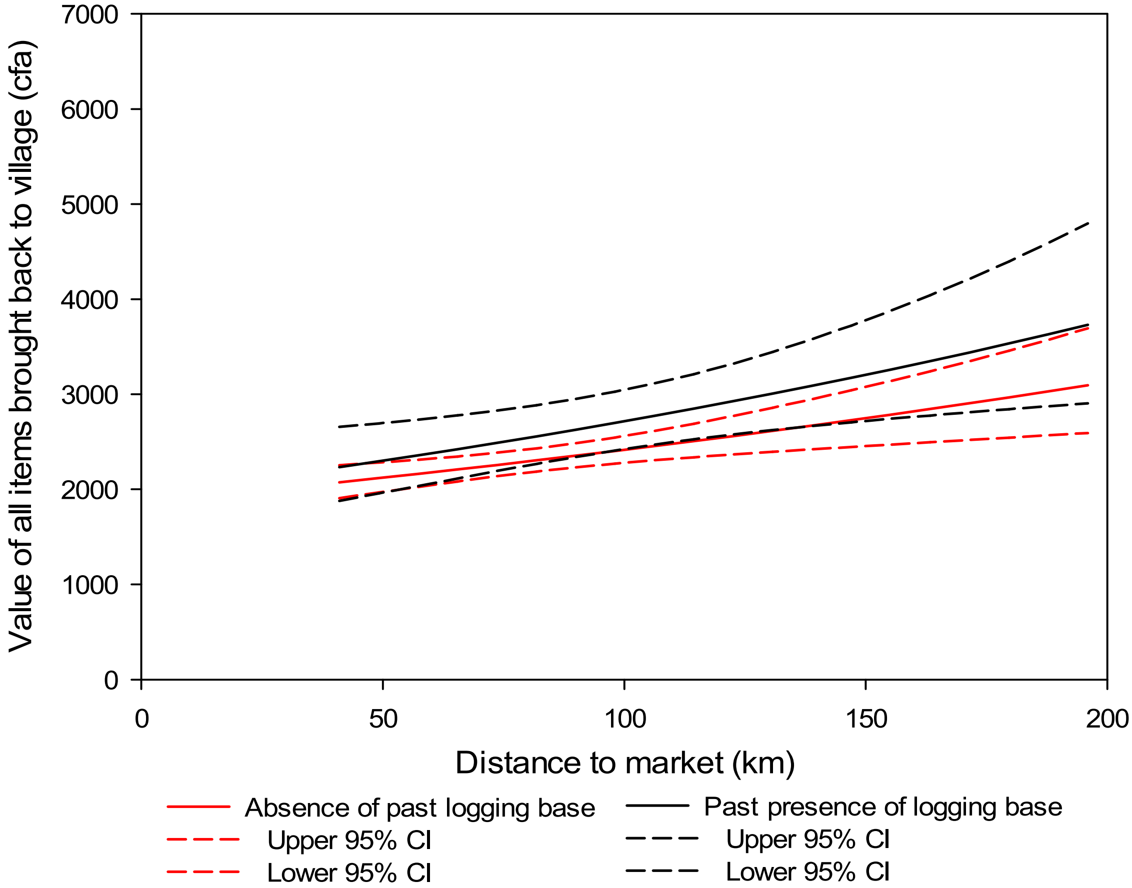


Figure 7-7: Model of the variables that contribute to the value of all items with which people have returned to the village, based on model from average AICs.

The second model considers just the value of the non-bushmeat items that were then used (Table 7-3 and Figure 7-8). Distance is again the highly significant variable. Neither the past presence of a timber company nor population have any significant role to play (Table 7-3 and Figure 7-8).

model.avg.default(object = get.models(msNBU2, subset = delta < 3))
where msNBU2 = glm(Value~ Presence*Distance+Presence*Pop, family = poisson,data = Live6)

Component models:

	df	logLik	AICc	Delta	Weight
12345	7.00	-20160.1	40334.15	0.00	0.50
1	3.00	-20165.04	40336.10	1.95	0.19
1234	6.00	-20162.13	40336.30	2.16	0.17
134	5.00	-20163.34	40336.71	2.56	0.14

Term codes:

Distance	Population	Past Presence	Distance: Past Presence	Population: Past Presence
1	2	3	4	5

Model-averaged coefficients:

	Estimate	Std. Error	Adjusted SE	z values	Pr(>|z|)	Sig.
(Intercept)	7.1491	0.2166	0.2166	32.9990	< 2e-16	***
Distance	0.0050	0.0010	0.0010	5.0390	0.0000	***
Population	-0.0025	0.0013	0.0013	1.8970	0.0578	.
Past Presence Yes	-0.7575	0.4704	0.4705	1.6100	0.1074	
Distance: Past Presence Yes	0.0037	0.0016	0.0016	2.2940	0.0218	*
Population: Past Presence Yes	0.0073	0.0036	0.0036	2.0460	0.0408	*

Full model-averaged coefficients (with shrinkage):

	Estimate	Std. Error	Adjusted SE	z values	Pr(>|z|)	Sig.
(Intercept)	7.1491	0.2166	0.2166	32.9990	<2e-16	***
Distance	0.0050	0.0010	0.0010	5.0390	0.0000	***
Population	-0.0017	0.0016	0.0016	1.0530	0.2920	
Past Presence Yes	-0.6143	0.5172	0.5172	1.1880	0.2350	
Distance: Past Presence Yes	0.0030	0.0021	0.0021	1.4620	0.1440	
Population: Past Presence Yes	0.0037	0.0044	0.0044	0.8240	0.4100	

Significance codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Relative variable importance:

	Distance	Past Presence	Distance: Past Presence	Population	Population: Past Presence
Importance:	1	0.81	0.81	0.67	0.5
N containing models:	4	3	3	2	1

Table 7-3: Average model of the variables that contribute to the value of non-bushmeat items with which people have returned to the village that are just used, based on AICc.

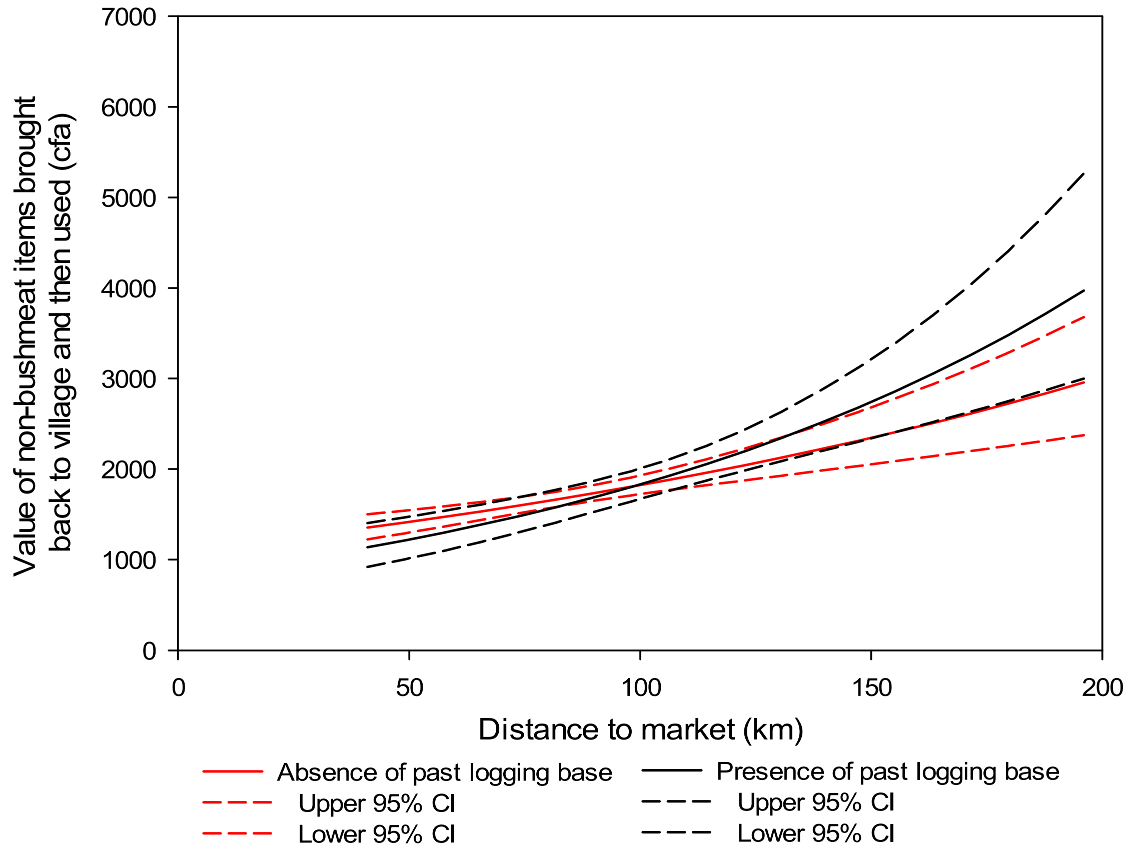


Figure 7-8: Model of the variables that contribute to the value of non-bushmeat items with which people have returned to the village and which are then used, based on model from average AICs.

7.6 Discussion and Conclusion

With the policy of holding weekly markets, the early timber companies in the Ikobey area were able to include local women, who looked after plantations, in the development of this remote rural forest area. In this and other ways timber companies once filled the role of the "Towns" in von Thünen's "Isolated State". Though this is still sometimes the case, the fact that timber companies now bring most of their food and workers from the outside means that the market relationship between villagers and timber companies has decreased and so today's presence of timber companies in a remote rural forest area is less likely to be economically beneficial to villagers.

People in the remote rural forested villages of the Ikobey study site currently have subsistence livelihoods, with few products being traded, even in villages where there have been timber operations in the past. Local sale of items within the community is not a common occurrence. When items were to be sold people either had to go to the nearest market (this was especially the case in the Ikobey sites), or wait for a trader to come to the village (this only occurred in the Koulamoutou sites). Only in the villages near the market town of Koulamoutou do livelihoods start to become orientated towards commercial activities. In both sites the principal livelihood activity of the community revolves around the collection of non-bushmeat products that are consumed. Even though bushmeat and wild meat have a higher monetary value per item, it only becomes an important part of the communities' livelihood in villages near markets where it can be commercialised, such as the Koulamoutou communities, and not in communities further from the markets such as the Ikobey communities.

The value of natural resources collected in this study is best explained by distance to the nearest market, while the past presence of a timber company only has a marginal impact in areas further from the market. While a timber company is operating in an area, livelihoods may become orientated towards commercial activities, including the commercial trade of bushmeat, but these multiplier effects do not seem to be sustained in the long-term in remote rural forested areas. Without some other organisation taking over the maintenance of transport infrastructure, these commercial activities break down when the timber company departs. Furthermore, in the remote rural forested areas non-bushmeat items are being collected and consumed more than wild meat items, while the value of the non-bushmeat items that is consumed is higher than that of the bushmeat items that are sold. If this is the case then the legalisation of the commodification of bushmeat as a way to alleviate poverty (Brown, 2003; Brown and Williams, 2003; Nasi *et al.*, 2008; van Vliet and Nasi, 2008a) may in some cases have the opposite effect if it results in the diversion of labour away from the collection of non-bushmeat items that are destined to be consumed.

The finding that the maintenance of transport infrastructure is important in the commercial trade of bushmeat is in agreement with theories of transport and development, where certain criteria have to be met before transport infrastructure can have an impact on economies. It also corroborates von Thünen's model for it is only in the areas where it is easy to transport bulky perishable goods, such as plantains and bushmeat (usually sold fresh in Gabon), from the villages to the markets that people will be involved in their trade. In remote rural forested areas such as Ikobey, only non-perishable high value Non-Timber Forest Products, such as ivory and *bois amer*, can be commercialised. It is likely that non-perishable crops, such as manioc and yam tubers, cannot be commercialised in these areas due to the high cost of transporting these items to the market town, in relation to their low market value.

Therefore there are exceptions to development professionals' and conservation practitioners' chain of logic (Figure 1-1) that assume transport infrastructure has a long-term impact on rural economies, leading to commercialisation and increasing extraction of natural resources (Hodgkinson, 2009).

This would suggest that conservation practitioners and development professionals also need to take into account such models as von Thünen's, or other distance based models (Lambin, 1994), when it comes to working with timber companies in remote rural forest areas or in the commodification of natural resources. In doing so the different outcomes of the long-term presence of a timber company in a remote rural forest area can be predicted and planned for, such as the ones in the proposed chain of logic (Figure 1-3), which may mean that in Gabon conservation measures may only need to be prioritised while a timber company is operating in a remote rural forest area. By contrast development projects may need to take into account the change in the commercial environment once timber companies depart. David Ricardo's 1820s "Law of Rent". From which von Thünen drew insight, needs to be considered when considering the possible commercial livelihoods of remote communities for the:

> most fertile, and most favorably situated, land will be first cultivated, and the exchangeable value of its produce will be adjusted in the same manner as the exchangeable value of all other commodities, by the total quantity of labour necessary in various forms, from first to last, to produce it, and bring it to market. When land of an inferior quality is taken into cultivation, the exchangeable value of raw produce will rise, because more labour is required to produce it (Ricardo, 1821, p.60).

It would however not be appropriate simply to generalise from this study and conclude that commercial activities always break down with the departure of a timber company from a remote rural forest area. This certainly does not seem to be the case in South America or in some other parts of Africa, where other factors result in transport infrastructure being maintained and the price of public transport being kept down after timber companies departs or when there are resources that have a market price that more than compensates the break down in transport (Chomitz, 2007; Chomitz and Gray, 1996; Hodgkinson, 2009; Riddell, 2013; Riddell, 2011; Robinson and Bennett, 2000). No matter how "inferior" land quality and access to it is, as long as the "exchangeable value of raw produce" is greater than the labour "required to produce it" then it is likely that commercial activities will continue after the departure of timber companies.

8 Logging and the long term impact on the environment

> "Increased hunting activities following logging operations will definitely have a negative long-term impact on primate populations in the Campo-Ma'an area if no further, more effective conservation measures will regulate wildlife use in the future" (Matthews and Matthews, 2002, p.155).

8.1 Summary

Industries that open up remote rural forested areas in rentier states are thought to have impacts on both the forest and its wildlife. Conservationist practitioners, as indicated by their chain of logic (Figure 1-1), are concerned that the opening up of remote rural forest areas by timber companies results in the increased offtake of rare species that were previously out of reach of commercial hunters. However, in the chain of logic as proposed here (Figure 1-3 and Figure 1-6), the increased offtake is unlikely to continue in the long-term after timber companies have left remote rural forest areas. This is because of the break-down in transport infrastructure (Chapter 5) which may result in the collapse of the trade in Non-Timber Forest Products (Chapter 7) due to an increase in transport prices that result in unfavourable terms of trade.

If this is the case, then the threat to the long-term survival of rare species in remote rural forest areas where timber companies operate, through their trade, could be overestimated in conservationists' concerns. This chapter explores the various environmental impacts that timber companies have had around the study sites. The environmental impacts analysed included vegetation succession, signs of human impacts and signs of animal occurrences around the study site villages

The findings indicate that around villages that are near markets, whether or not there was a timber company nearby, there is less mature forest, more plantations and fewer animal signs. However, in villages further from markets where timber companies were once based but have left, and where the market economy has subsequently broken down, signs of wildlife are highest in the site where the timber industry had departed over ten years ago as opposed to sites where there has been no logging or sites where timber companies have recently left.

Signs of rare threatened animals that are on IUCN's Red List of Threatened Species are found around the study sites where timber companies have been operating. These include signs of elephants, chimpanzees and gorillas in areas where nearly half a century of logging came to an end four years ago. In the Ikobey area, where elephants had become locally extinct over a

century back, as recounted by Berton in 1895 (Chapter 4.5.1), there are now ample signs of their renewed presence.

8.2 Theory

Even though it has been noted that forest animal species may recover after logging (Brugière and Gautier, 1999; Clark *et al.*, 2009; Plumptre and Reynolds, 1994; Struhsaker *et al.*, 1996; White, 1992), but not always (Chapman *et al.*, 2010; Chapman *et al.*, 2000; Matthews and Matthews, 2002), conservationists are concerned that the opening up of previously inaccessible forest areas by timber companies' transport infrastructure facilitates the hunting of endangered wildlife for the bushmeat trade. It is feared that the offtake for trade is high enough to threaten the long-term survival of wildlife (Auzel and Wilkie, 2000; Fimbel *et al.*, 2001; Laurance, Alonso, *et al.*, 2006; Milius, 2005; Poulsen *et al.*, 2009; Robinson and Bennett, 2000; Robinson *et al.*, 1999; Wilkie *et al.*, 2000).

Timber companies account for 60% of the transport infrastructure in Gabon, a higher proportion than for other countries in Central Africa (Blake *et al.*, 2008; Laporte *et al.*, 2007; Wilkie *et al.*, 2000). Work by Laurance *et al* (2006, 2008) in Gabon found that the impact of roads on animal populations depended on the time of day, with little hunting impact on nocturnal arboreal mammal species (Laurance *et al.*, 2008). The impact that they did find on these species was limited to road edges. In contrast, the impact on diurnal mammals extended hundreds of metres into the forest (Laurance *et al.*, 2008, p.728; Laurance, Croes, *et al.*, 2006). However this divergence between diurnal and nocturnal hunting in Gabon could be due to there still being a large enough diurnal animal population to meet Gabonese hunter's needs that they do not have to undertake nocturnal hunting. There are some exceptions to this such as in northern Gabon where hunting often only occurs at night (personal observation) as diurnal animals are rare[170].

If transport infrastructure created by timber companies is linked to the decline of endangered species due to commercialised hunting, and if this transport infrastructure persists when the companies depart, then it would be expected that endangered species would be rare even after timber companies depart. However, this thesis has shown that in remote rural forest areas of Gabon, timber infrastructure degrades after timber companies depart (Chapter 5) resulting in the collapse of the commerce of Non-Timber Forest Products (Chapter 7).

[170] Nocturnal hunting also occurs in other African countries such as in Cross River State in Nigeria (personal observation).

8.3 Research question

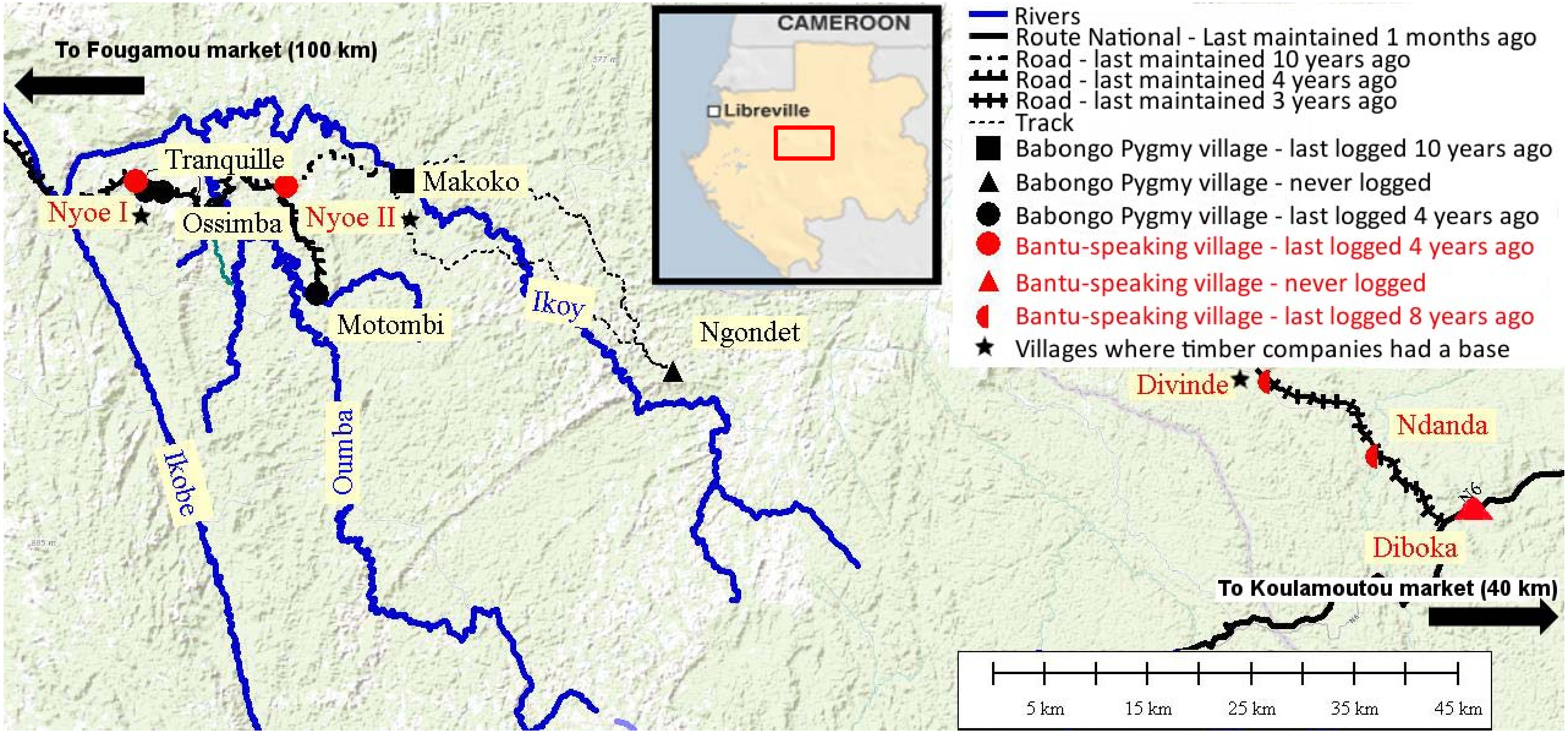
This chapter explores the impact that the departure of timber companies in remote rural forest areas has on animal populations, as evidenced by their signs, in particular areas where timber companies had been operating for decades.

While timber companies are operating in remote rural forest areas, transport to market towns is relatively easy, but with their departure the market economies of villages in remote rural forest areas which are based on the extraction of natural resources break down. In this case there should be fewer signs of hunting in these remote rural forests, an increase in animal populations, and signs of forest succession.

8.4 Methods

This chapter makes use of data from strip transects (Burnham and Anderson, 1984; Greenwood, 2006, pp.57, 105–106) in which all observable animals and human signs were counted one metre on either side of the centreline; these were carried out around each village site (Map 8-1). Four strip transects were repeated twice (eight in total) for each village site. The repeated strip transects were set approximately ten meters to the side of the previous one. This was done to reduce the risk of counting the same animal or human signs twice and were all conducted during the same season, the dry season, to reduce seasonal effects on signs (White and Edwards, 2000b, p.231). Due to the impacts of topography on animals (Vanleeuwe, 2008) and variations between habitat type, season and observer's ability to detect animals (Breuer and Breuer-Ndoundou Hockemba, 2012), care needs to be taken when using the data from these types of method to compare vastly different sites.

Except where constrained by geological barriers such as rivers, strip transects were carried out using cardinal directions (North, South, West and East) starting at eight in the morning from the centre of the village, taken from the location of the chief's flag. From this central point, and using one of the four cardinal bearings on a compass, a GPS was switched on and a track log started. For each bearing, a team of four people walked to the edge of the village, usually behind the last house, from where a GPS waypoint was taken. The team carried on walking for a further fifty metres and took another waypoint and started the strip transect. These strip transects were carried out for two kilometres, using the fifty metre starting waypoint as a reference point to calculate the distance. Each two kilometre strip transect would take four to six hours to complete, depending on the terrain. Due to limitations of time, transects were not cut beforehand, which added to disturbance (White and Edwards, 2000b, pp.230–231).



Map 8-1: Summary of study villages showing distance to nearest market, when road was last maintained, the last time the area around the village was logged and the villages where timber companies had a base.

To minimise disturbance a small team of four went along the strip transect. This team consisted of a note-taker, a tracker, a person checking the bearing and a path-cutter to make a minimalist passage for the others to pass. In each village of the study, the same tracker and note-taker were used. The tracker, just behind the path-cutter (White and Edwards, 2000b, pp.230–231), showed the note-taker any animal sign and sign of human impacts (roads, paths, traps, logging, etc.) that were one metre to either side of the centreline, and, where possible, identified the animals to which it belonged. For each sign the note-taker created a waypoint, and recorded this point and the associated signs observed at that point. The tracker used was a local Babongo hunter who had knowledge of the area (Laurance, Croes, *et al.*, 2006; Parnell, 2000, p.157).

It is recognised that there are many issues with strip transects, not least the assumption that everything within the strip will be observed which is unlikely, especially at distances furthest from the centreline; there are also boundary effects (Burnham and Anderson, 1984; Seber, 1986). It is due to this reason that a narrow strip (Buckland, 2001, p.3) that is one metre on either side of the centre line is used, with observed signs being verified to fall within this strip by the use of a metre long stick where the centreline is taken to be between the tracker's feet.

Observations may also be missed due to thick vegetation cover, difficult terrain where concentration is focused on moving along the transect, and fatigue. Fatigue is a rarely mentioned issue of transect methods, but is especially relevant on long transects. It is highly likely that observations along long transects will be negatively impacted by fatigue, resulting in more observations at the start than the end of the transect. Though there have been studies to look at different factors that may affect transects, such as the impacts of different observers and the density of foliage which methods manuals seek to minimise (Davies, 2002a; White and Edwards, 2000a), the impact of observer fatigue has yet to be explored[171]. As the same tracker and note-taker were used throughout the study, the fatigue factor should be roughly similar, so any dip in the number of observations at the end of the two kilometre transects should be similar. For these reasons animal abundance and animal density have not been calculated. Rather the data has just been used to compare the number of animal signs observed around each village site.

In addition to the noted animal and human impact signs, the note-taker also recorded the stage of forest succession of the waypoint, classifying it into one of three categories: plantation,

[171] Though a similar method to measure the impact of foliage density on observations could be used, whereby objects are randomly placed along the transects that are to be measured before the observation team starts its work.

secondary forest and mature forest. Plantations included newly cut plantations that had yet to be burnt, burnt plantations that had yet to be planted, newly planted plantations, plantations less than two years old (still being used) and abandoned plantations (usually more than two years old). Secondary forest was noted when umbrella trees (*Musanga cecropioides*) were visible; Umbrella trees are a fast-growing light dependent species that colonises old plantations. Mature forest was taken to be forest where no umbrella trees were visible. It should be noted that the term "primary" forest has not been used here as in Africa it is highly likely that the majority of the forests have been used by people at one time or another. Hence, in this study "mature" forest is used.

Though using umbrella trees is a crude categorisation of the transition from plantation to mature forest, it is used as it an easily identifiable, common tree in areas of Gabon (De Saint Aubin, 1963, p.166) that have been disturbed. Its canopy forms an important stage in the development of mature forest trees which can, after fourteen years, be seen as a understory of four and a half metres in height under the umbrella tree canopy of twenty-three metres (Coombe and Hadfield, 1962, p.222). However, with a lifespan of approximately twenty years (Todou and Meikeu Kamdem, 2011), the presence of umbrella trees can only indicate disturbance that occurred within this period and not before.

The data from the GPS were downloaded into a computer and placed into a database, with the observations recorded, the altitude, the distance from the start of the strip transect and the waypoint number. The animal signs that were observed were then given a threat status by using the categorises of the IUCN's Red list of Threatened Species (Figure 8-1) and grouped into Threatened (Critically Endangered, Endangered, and Vulnerable), Lower Risk (Near Threatened and Least Concern) and Other categories. This last category includes species for which there are no data, which have not been evaluated or where the animal signs could not be identified to the species level.

Each of the human impacts that were observed were placed into a database with the GPS location, distance from start of transect and waypoint number noted. These impacts were also placed into one of three categories: gathering (traps, shotgun shells, wine, gathering), logging (felled trees, stumps and old logging camps) and transport (paths, tracks and roads).

From the recording of vegetation succession created at each animal and human sign waypoint, the principal level of vegetation succession was calculated for each 100 m interval along the transect and entered into a database. In cases where the types of vegetation succession were found to be equal in a 100 m interval then the principal vegetation succession category for both the interval and previous 100 m interval was taken.

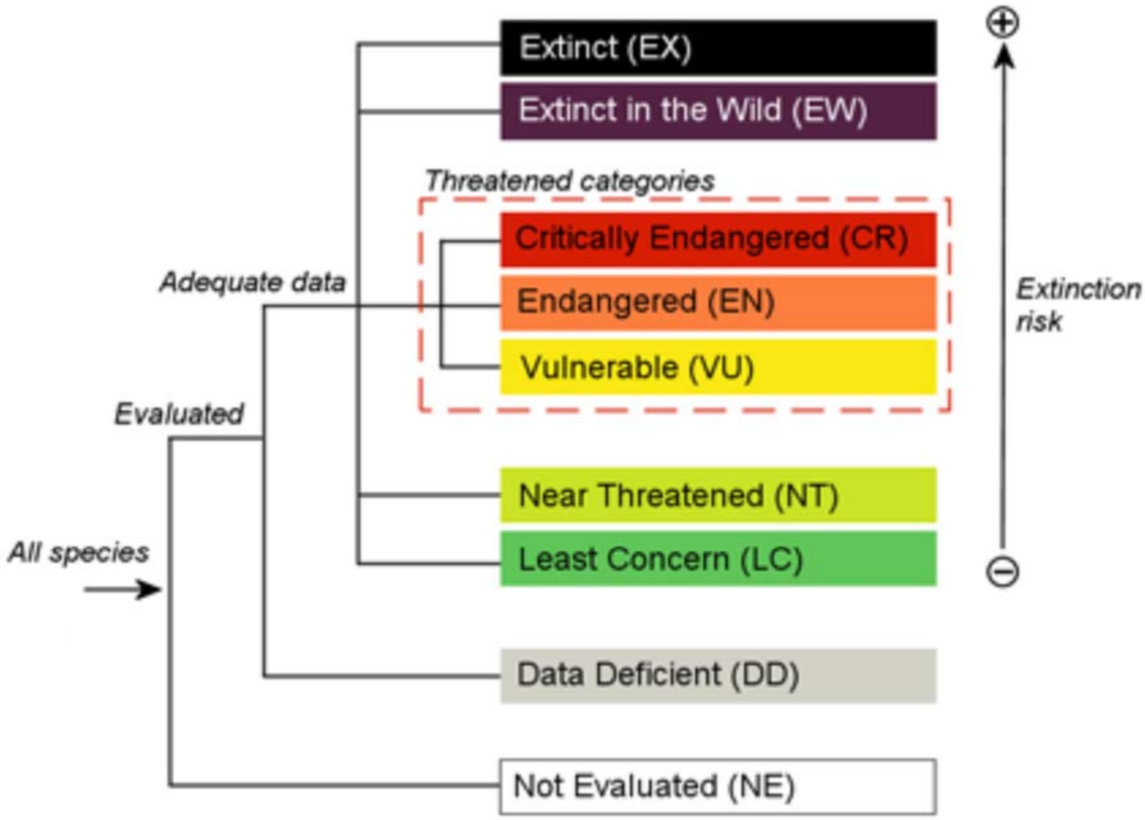


Figure 8-1: Structure of IUCN Red List categories (from IUCN, 2012, p.5).

Due to zero-inflation, where there are many sections of the strip transect with no observations, modelling was not carried out with the IUCN threat categories or the number of hunting signs observed. Instead modelling was just carried out on the number of animal signs. As the animal sign dataset consists of nested count data that is overdispersed, Generalised Linear Mixed Models (GLMM) fitted with a negative binomial distribution were used (Bolker *et al.*, 2012; Fournier *et al.*, 2012, p.245; Zuur *et al.*, 2015, p.146).

The set of predictor variables used to investigate the frequency of animal signs consists of the characteristics of the villages. These were first tested for normality, outliers and collinearity following Zuur *et al*. (2010). At the end of this process the village characteristics kept were as follows: distance of the village from the market, principal ethnicity of the village, past presence of a timber camp and time since timber companies left the area around the village (grouped into never logged, logged more than six years ago and logged less than five years ago).

With the predictor variables various models were created and one was selected using an information-theoretic approach (Table 8-1) following Anderson and Burnham (2002); in this case Akaike's Information Criteria (AIC) was used (Anderson and Burnham, 2002; Zuur *et al.*, 2009).

From these models the following Generalised Linear Mixed Model with a negative binomial distribution was selected (Table 8-1):

Total_animals ~ Distance + Last_Logged + (1|Village/Tran)

Where :

Total_animals = total number of animal signs per 100 m interval,

Distance = Distance to the nearest market from a village,

Last_Logged = Time since timber company left the area around the village (grouped into never logged, logged more than six years ago and logged less than five years ago),

(1|Village/Transect) = Observations are nested in transect which in turn are nested in village.

The chosen models were tested for validity by looking at the normality of residuals, homogeneity and independence (Zuur *et al.*, 2009, pp.19–22). Overdispersion was assessed using Pearson residuals (Zuur *et al.*, 2015, p.146).

8.5 Results

8.5.1 Vegetation

The vegetation transects show that there are a greater number of hundred metre transect sections that are mature forest in the Ikobey sites than the Koulamoutou sites, with, in general, an increase in the number of mature forest sections with distance from the nearest market (Figure 8-2). Although plantations and secondary forest cover decrease with distance from markets, none of these produce significant linear regressions (Figure 8-2)[172].

Around all villages there are hundred metre transect sections that consist of plantations. However, it is around the Koulamoutou village of Diboka, nearest to the Koulamoutou market town (Map 8-1), where there are the greatest number of sections that consist of plantations, reflecting the importance there of commercial cultivation, especially of plantain (Chapter 7).

[172] The rugged nature of the terrain around the Koulamoutou village of Ndanda may be the reason for the amount of mature forest around this village.

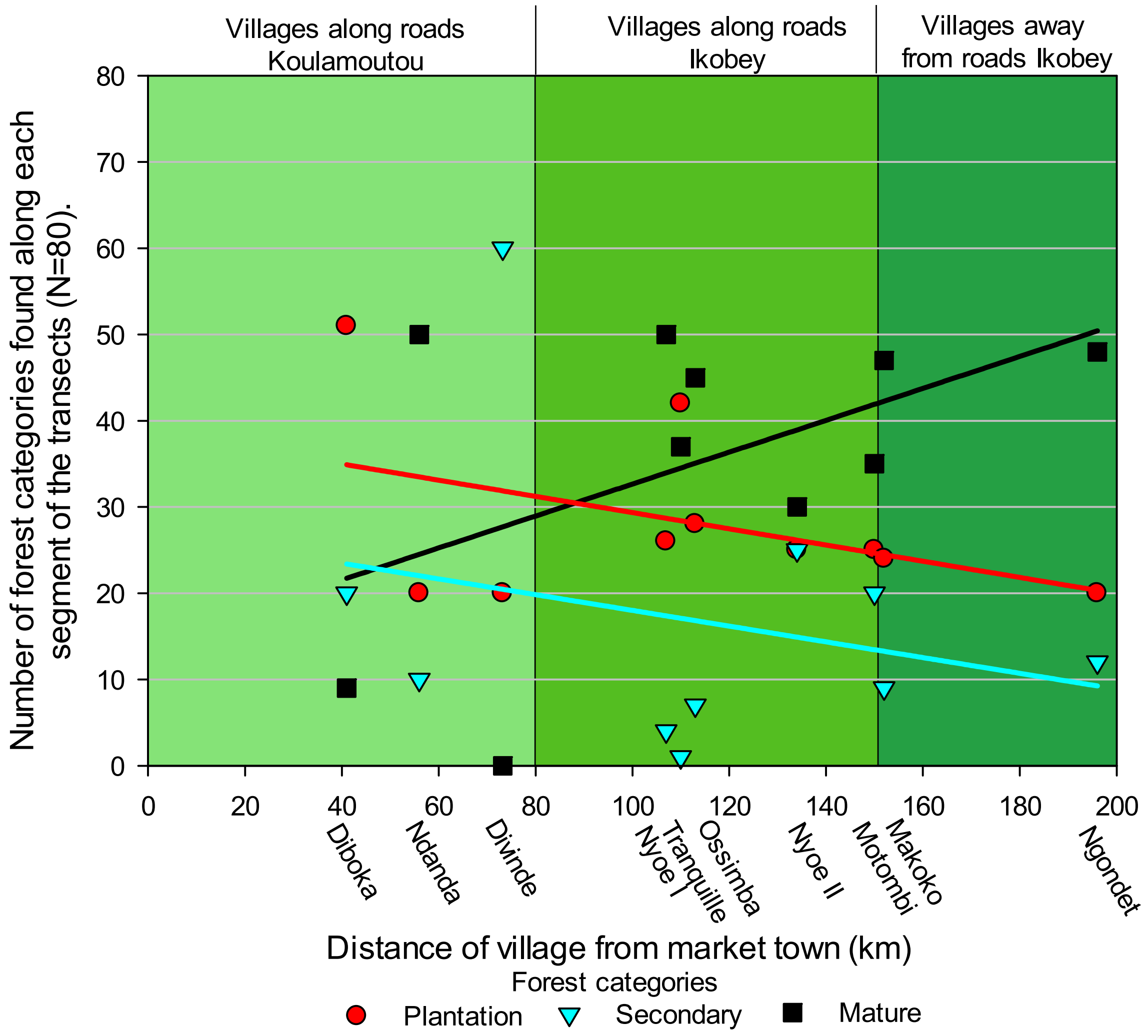


Figure 8-2: Principal forest type of each 100 m sections of the transect in each of the study site villages. The proportion of Plantations and Secondary forest decrease with distance from market town, while mature forests increase. In no case is the linear regression significant (ANOVA Plantation F=1.847, DF=8, p=0.211; Secondary F=2.653, DF=8, p=1.420; Mature F=0.557, DF=8, p=0.477).

8.5.2 Impacts

The environment around the Ikobey sites had more signs of long-term human disturbance in the forest than the environment around the Koulamoutou sites (Figure 8-3, Map 8-1). This consists mostly of logging activity including logging roads, reflecting the length of time that timber companies have been operating in the Ikobey area (Chapter 4). These types of impacts reach a peak just before the end of the regularly used road at Nyoe II, and are concentrated around the villages where timber industries previously had a base. In some cases there was evidence of the boom and bust nature of the timber industries (Chapter 3.2.3.3), with the presence of abandoned logs especially in the Ikobey sites. Though the most remote village of Ngondet had evidence of logging, this was in the form of artisanal logging and was minimal.

Roads and paths were found throughout the village sites. The roads in the Koulamoutou sites nearest to the market were mostly constructed by the state, colonial or post-colonial governments, while the roads in the Ikobey site and the furthest village in the Koulamoutou site (Divinde) were mostly constructed by timber companies. No roads were found around the village of Ngondet, but this site has the highest number of observed path signs, reflecting not only that there are no roads that people can use, but also the historic human occupation in the area with a number of abandoned villages (Chapter 4).

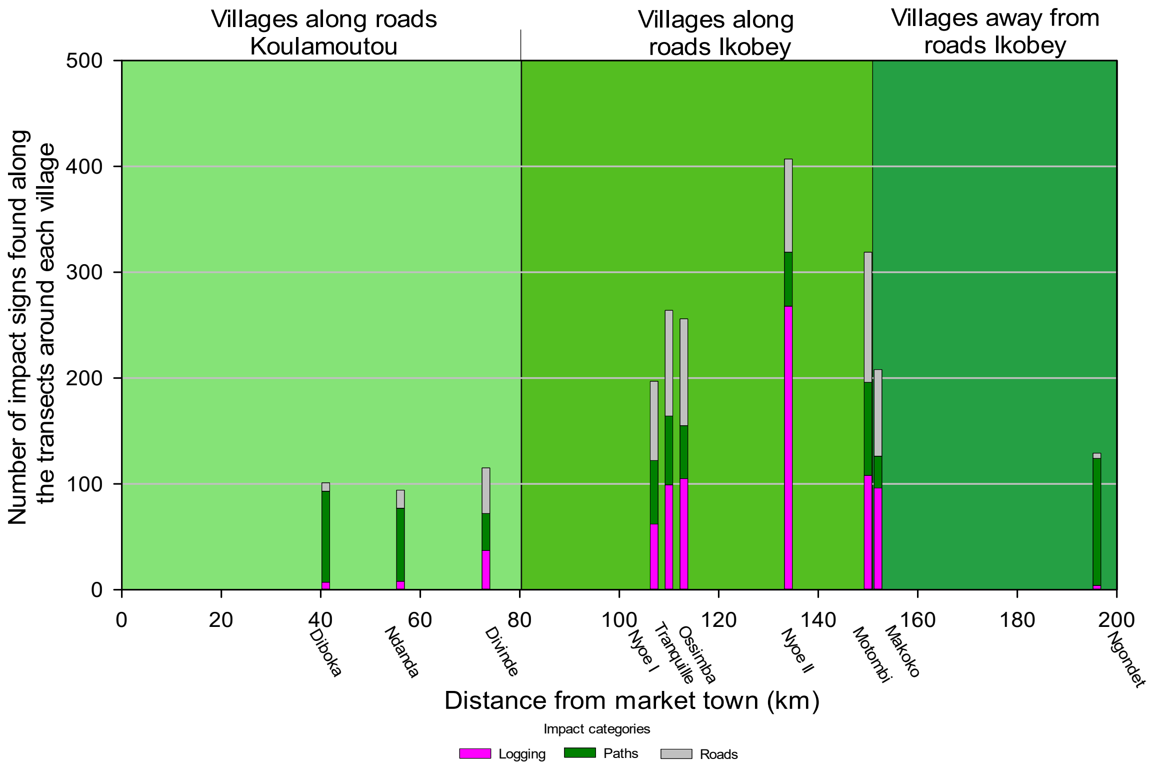


Figure 8-3: Overall long-term human impacts on the forest found along the transect in each of the study site villages.

When grouping together all the short-term, individual, human impact signs there does not seem to be a trend with distance from market (ANOVA, F=0.056, DF=8, p=0.819, Figure 8-4). However, hunting signs were found on all the transects undertaken, but were mostly concentrated around the two Koulamoutou villages nearest the market, Diboka and Ndanda (Figure 8-4). The reason that there were fewer signs of hunting around the Koulamoutou village of Divinde is likely to be due to the lack of mature forest (Figure 8-2), as hunting does occur in this village (Chapter 7) and maybe overhunting. In either case the hunters must go further afield to hunt and so outside the area covered by the transects.

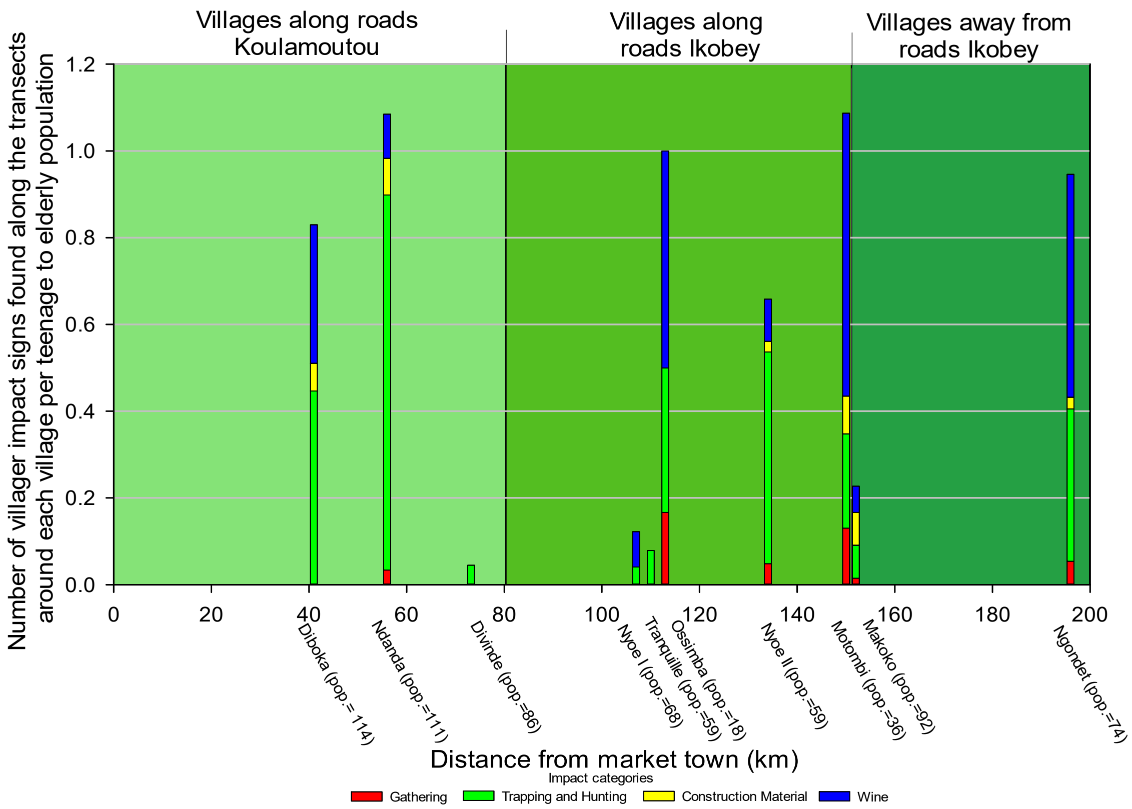


Figure 8-4: Overall short-term, "individual", human impacts on the forest found along the transect in each of the study site villages.

Evidence of the making of wine was also seen around all the study sites (Figure 8-4). Wine making around the Bantu-speaking villages is based on palm wine and limited to the area directly around the village. Wine making around the Babongo Pygmy villages is centred on honey wine, especially in the forest villages, which consists of cutting any tree where bees can be found and so can occur anywhere in the forest and not only near villages.

8.5.3 Animals

In all sites animal signs were found along the transects. There seems to be a significant trend in the number of animal signs found around the villages and distance from market town, with the number of animal signs increasing with distance from the nearest market town (ANOVA, F=5.419, DF=8, p=0.048, Figure 8-5).

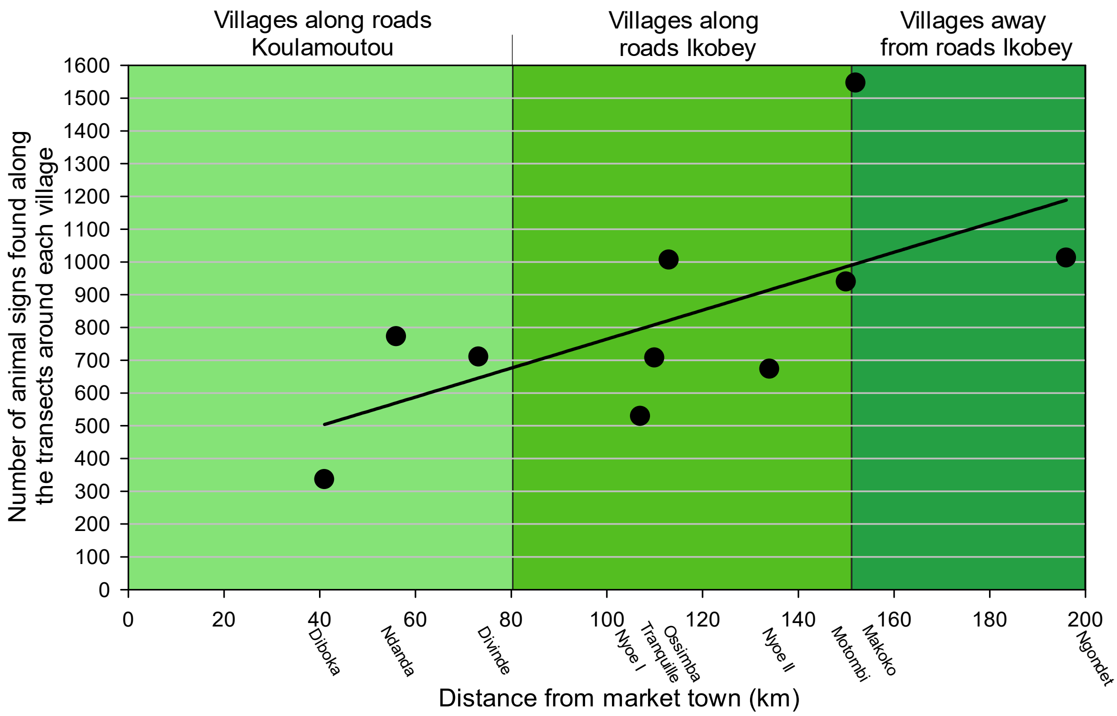


Figure 8-5: Number of all animal signs observed along the transect in each of the study site villages. There seems to be an increase in the total number of animal signs with distance from market with the linear regression (r^2=0.404) being significant (ANOVA, F=5.419, DF=8, p=0.048).

The different types of animals, represented by their signs, also increased with distance from the nearest market town. Antelope and porcupine signs were dominant throughout the sites (Figure 8-6), while rarer and more threatened species, such as great apes and elephants, were more important in the sites that are furthest from the nearest market town (Figure 8-6). That antelopes and porcupine signs are dominant would be expected not only due to detectability of the signs that they leave behind but also due to their life histories with rapid reproduction rates (Kingdon, 2003) allowing them to recover quicker from being exploited. That great apes and elephants are more important at sites further from market towns could again reflect their life histories, with slower reproduction rates (Kingdon, 2003) resulting in increased time before these populations can recover after being exploited.

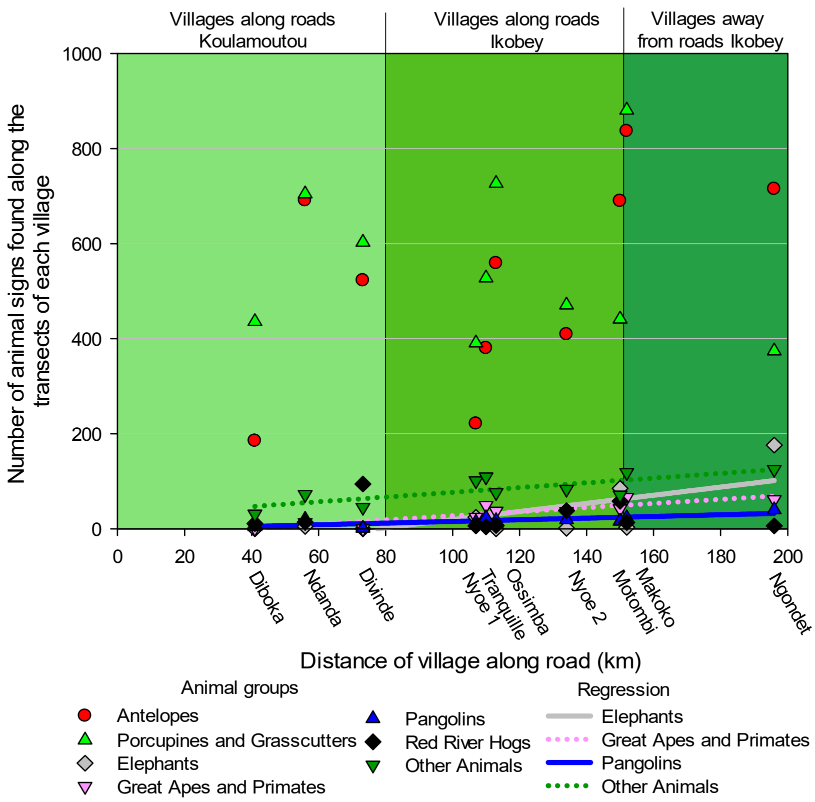


Figure 8-6: Number of all animal signs observed along the transect in each of the study site villages. The linear regressions that are significant are shown: Elephants (r2=0.502, ANOVA, F=8.051, DF=8, p=0.022), Great Apes and Primates (r2=0.785, ANOVA, F=29.285, DF=8, p=0.001), Pangolins (r2=0.595, ANOVA, F=11.731, DF=8, p=0.009) and Other Animals (r2=0.596, ANOVA, F=11.785, DF=8, p=0.009).

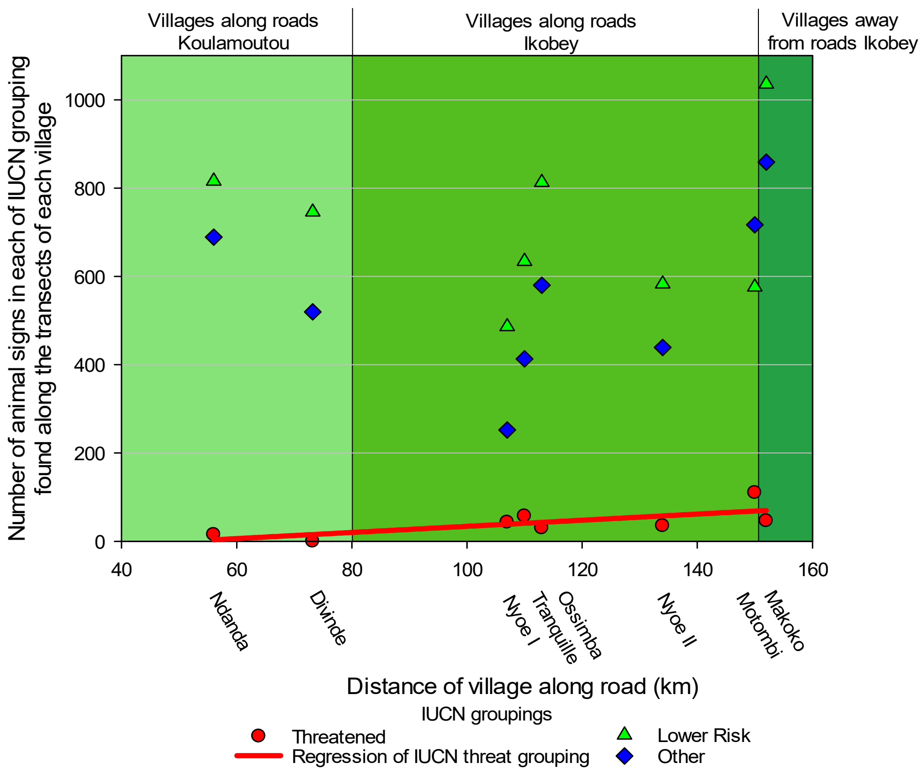


Figure 8-7: Animal signs grouped by principal IUCN Red list of Threatened Species categories found along the transects of villages where logging has occurred. The linear regression that is significant is the threatened grouping consisting of IUCN categories Critically Endangered, Endangered, and Vulnerable (r2=0.522, ANOVA, F=6.549, DF=8, p=0.043).

In the sites where logging has occurred in the past the abundance of species categorised as threatened in IUCN's Red list of Threatened Species (Critically Endangered, Endangered, and Vulnerable) also increases significantly with distance of the site from a market town. There does not seem to be a trend in sign frequency for animal signs categorised under Lower Risk (Near Threatened and Least Concern) or Other (Figure 8-7). If commercial hunting due to the timber industry were affecting threatened species in a similar way, then this trend in the number of animal signs categorised as threatened should not be seen.

Overall there does not seem to be a trend in the total number of animal signs with the population size of a village (ANOVA, F=0.004, DF=8, p=0.955, Figure 8-8), even though village population size generally decreases with distance from market town (Figure 4-2).

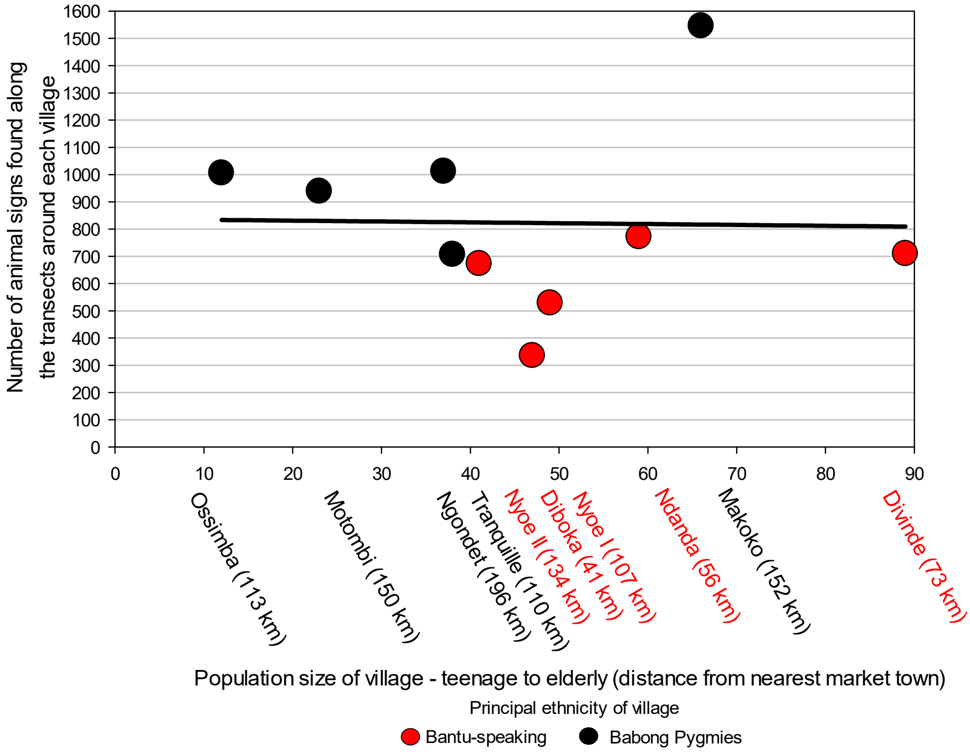


Figure 8-8: Number of all animal signs observed along the transect in each of the study site villages by population size (teenage to elderly). Though there is no general trend, it does show that the Babongo Pygmy villages (in black) have more animal signs that the Bantu-speaking villages (in red). The linear regression (r^2=0.0004) is not significant (ANOVA, F=0.004, DF=8, p=0.955).

Of the various models tested using generalized linear mixed models (GLMM) with a negative binomial distribution approach (Table 8-1), the variables that have a significant impact on the frequency of animals signs are distance from a market, areas around villages that have been logged less than five years ago and those that have never been logged (Table 8-2).

The overall village's distance from market has a positive impact on the number of animal signs. Time since logging also has an effect with sign frequency highest in areas that were last logged more than six years ago, but lower and similar across areas that have either never been logged or logged less than five years ago (Figure 8-9).

Model variables	Df	AIC	AIC differences	Akaike weight
Total_animals ~ Distance + Last_Logged + (1|Village/Tran)	7	9219.4	0	0.621
Total_animals ~ Distance * Last_Logged + (1|Village/Tran)	9	9221.26	1.86	0.245
Total_animals ~ Last_Logged + (1|Village/Tran)	6	9225.32	5.92	0.032
Total_animals ~ 1 + (1|Village/Tran)	4	9225.62	6.22	0.028
Total_animals ~ Distance + (1|Village/Tran)	5	9225.76	6.36	0.026
Total_animals ~ Camp + (1|Village/Tran)	5	9226.98	7.58	0.014
Total_animals ~ Last_Logged + Camp + (1|Village/Tran)	7	9227.2	7.8	0.013
Total_animals ~ Distance + Camp + (1|Village/Tran	6	9227.22	7.82	0.012
Total_animals ~ Distance * Camp + (1|Village/Tran)	7	9229.1	9.7	0.005
Total_animals ~ Distance + Camp* Distance : Camp + (1|Village/Tran)	7	9229.1	9.7	0.005

Table 8-1: AICs results from various Generalised Linear Mixed Model with a negative binomial distribution investigating how the frequency of animals signs (Total_animals) is impacted by variables that characterise each village site, namely distance from market (Distance), past presence of a timber base (Camp) and time since the area around the village was last logged (Last_Logged – grouped into never, less than 5 years and greater than 6 years). Highlighted are the chosen model and the null model.

glmmadmb(formula = Total_animals ~ Distance + Last_Logged + (1 | Village/Tran), data = Animals, family = "nbinom")					
AIC: 9219.4					
Coefficients:					
	Estimate	Std. Error	z value	Pr(>|z|)	Sig.
(Intercept)	1.819	0.139	13.11	< 2e-16	***
Distance	0.004	0.001	3.36	0.00078	***
Last_Logged -Less_5	-0.431	0.118	-3.66	0.00025	***
Last_Logged -Never	-0.511	0.145	-3.54	0.00041	***
Significance. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1					
Number of observations: total=1600, Village=10, Village:Transect=80					
Random effect variance(s):					
Group=Village	Variance	StdDev			
(Intercept)	1.075e-08	0.0001037			
Group=Village:Transect	Variance	StdDev			
(Intercept)	0.1721	0.4148			
Negative binomial dispersion parameter: 4.14 (std. err.: 0.27104)					
Log-likelihood: -4602.7					

Table 8-2: Results from Generalised Linear Mixed Model with a negative binomial distribution of Total_animals. In this model villages characteristics that concern distance and time since the area around the village was last logged are the predictor variables.

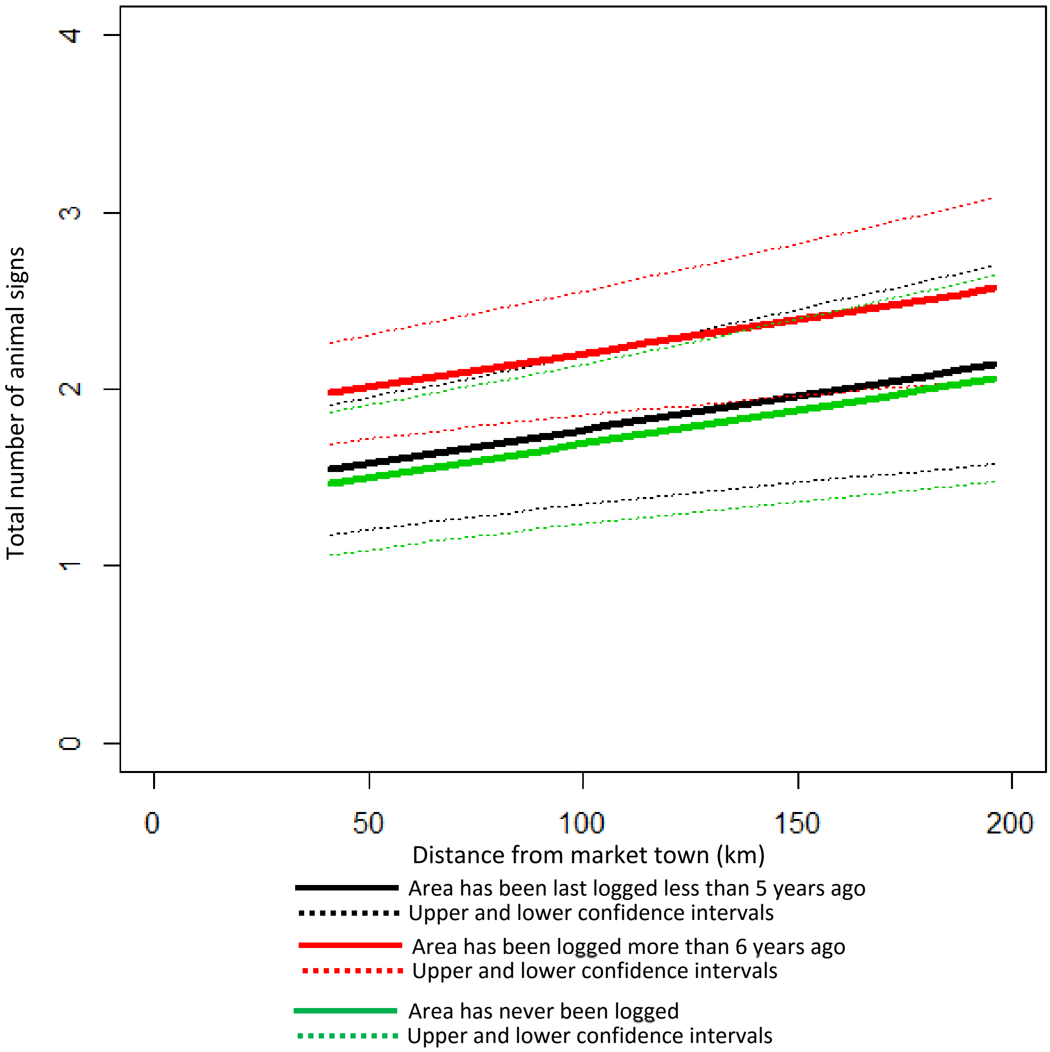


Figure 8-9: Model predictions from Generalised Linear Mixed Model where an area has either never been logged or has been logged at different times in the past. Only areas that have never been logged or logged within the last 5 years are significant in the model. Though the model can also be fitted with data from areas where logging occurred more than 6 years ago, as done here, it does not come out in the model as a significant predictor variable due to the number of sites within this category.

8.6 Discussion and Conclusion

Taken separately, the impacts of timber companies, local communities and distance from economic markets in whichever way they are measured on forest environments are complex. This complexity increases when all these factors are combined. It is therefore foolhardy to try to generalise directly from this study site to other places. However, as for any case study, the results from this study can inform understanding of possible outcomes on landscapes of the arrival of a timber company in a remote rural forested area.

Mature forest is found in nearly all the sites, especially in the Ikobey sites that are further from major transport infrastructure. The exception is one village, Divinde near Koulamoutou, where no mature forest can be found. It seems that this area has been heavily logged in the past. This is because, compared to the other villages, Divinde is not only situated near the railway, as are the neighbouring villages of Ndanda and Diboka (respectively seventeen and thirty-two kilometres away) allowing easy timber transport, but also it is situated in a relatively flat area, where trees are accessible without difficulty. In comparison, the neighbouring village of Ndanda has much more mature forest than the more remote villages in Ikobey because the terrain around this village is rugged and so timber companies find it harder to harvest the trees.

The type of terrain that timber companies find in their concession has a large impact on the amount of timber that they extract. While timber companies have been exploiting the area in Ikobey since the 1960s, and even though the area had been heavily exploited for other resources at the beginning of the 1900s (Chapter 4), mature forest is still widely found throughout the area. In comparison, timber companies in the Divinde site have only operated for around twenty years.

The lack of mature forest in the village that has been heavily logged, Divinde, has meant that hunters from this village have to go further afield, further than the two kilometre transects that were carried out. The commercialisation of bushmeat in the Koulamoutou sites, as seen in Chapter 7, is visible in the number of trapping signs found around these villages.

The fact that there are fewer threatened species found around the villages near markets than the villages further afield may be due to this commercialisation, but it may also be due to the lack of mature forest around these villages. With distance from market there is an increase in the number of threatened species that were found around villages where logging activity had occurred in the past. Distance to market seems to be the likely cause of the amount of plantations in the village nearest to the market (Diboka), where there is evidence of the commerce of locally grown crops.

In the areas furthest from market sites there is some evidence that previous sites that have been logged may have a positive long-term impact on certain wildlife species but only under certain conditions. Here it has been observed, through the use of animal signs, that animal populations seemed to be the largest and with a higher diversity in the Makoko village site, where the time since the area had last been logged was the longest, this finding adds evidence to what was supposed by Adams and McShane (1996, p.217). The Makoko site had the following conditions: a decade had passed since the last time the area had been logged, the road had not been used for a similar period and the majority of the human population had migrated away from this area with only the Babongo Pygmies remaining. This finding is not at odds with the ecological knowledge of certain species, such as elephants, which are known to be attracted to areas that were once occupied by people. As such sites, the secondary forests have more fruiting trees, which have been left behind by people, and more foliage than mature forests (Barnes et al., 1991; Walker, 2010).

By allowing light into the forest, timber companies also encourage the growth of light demanding tree species. Some species such as the umbrella trees *Musanga cecropioides*, are common. But others such as the sub-endemic timber tree, *Okoumé*, are potentially threatened (Wunder, 2003, p.35) as sapling recruitment is being affected by the reduction in deforestation, through the disappearance of villages, and their associated cultivation (Engone Obiang *et al.*, 2014) in rural Gabon (Map 3-2). As Gabon becomes more urbanised (Chapter 1) and shifting-cultivation becomes less common, the opening up of the canopy by timber companies may be the only way to protect threatened light demanding tree species.

This is not to say that all areas in which timber companies once operated will be as resilient and see a recovery of animal populations (see Hodgkinson, 2009; and Riddell, 2011 as examples of a different outcome due to the timber industry). In Gabon it is likely that timber concessions near market towns will be less resilient, this being due to higher human population and so more land competition between people and wildlife, both for food and subsistence (Ahrends *et al.*, 2010; DeFries *et al.*, 2010; DeFries *et al.*, 2006; Gordon *et al.*, 2012; Smith *et al.*, 2010; Smith *et al.*, 2001).

Though it is assumed by some that animal populations cannot recover around market towns, the history of elephants in Gabon shows that it can happen (Chapter 3 and Appendix 11.9). In the Loango area elephants had gone locally extinct in the 1600s (Martin, 1982); however today there is a population of “a few thousand elephants”(Fay, 2004a). Around the capital, Libreville, elephants went locally extinct in the 1800s (Walker, 1870) but today can be seen in the nearby Pongara National Park (Blanc et al., 2007).

The results presented in this chapter show that the distance from a market and time since logging has occurred have an impact on the frequency of animal signs. However, ethnicity may also have a role to play on the frequency of animal signs (Appendix 11.19). The models containing ethnicity were rejected due to their complexity, having higher degrees of freedom and because the size of the dataset is problematic.

Further research which included many more ethnicities would be needed to see if the relationship between ethnicity and number of animals is not just an artefact of the sites selected in this study. However, the possibility that there is a link could further complicate the design of conservation projects that wish to reduce hunting through projects tied to timber companies.

As a "'one-size-fits-all' strategy" (Giles-Vernick, 2002, p.201), certain conservation projects may not be appropriate when numerous ethnicities are in and around a timber concession. For Giles-Vernick when conservation projects involve different ethnicities then:

> it would be useful to conduct historical, economic, social and cultural studies […] to develop different conservation (and, when appropriate, development) strategies […] such strategies would have to continue to be tailored to changing populations, economic conditions, and environmental perceptions and practices (Giles-Vernick, 2002, pp.201–202).

Ethnicities may have an impact on the frequency of animal signs for any number of reasons (Cohen, 1978; Kialo, 2007). This includes difference in gun ownership between Bantu-speaking villagers and the Babongo Pygmies (Riddell, 2011) or difference in hunting skills between Pygmy populations and Bantu-speaking population, whereby the former are known to be better hunters (Mavah, 2011; Riddell, 2011, p.156). Other reasons that ethnicities impact wildlife, and so the number of animal signs, include the way that different ethnicities react to markets, roads and trade (Noss and Cuéllar, 2001), while different ethnicities migrate in different ways (as shown in Chapter 4 and by Klieman (2003)) with new in-migrant ethnicities unusually having different attitudes to wildlife (Dzingirai, 1996). The religious orientations of different ethnicities (Amador *et al.*, 2015), due to taboos on types of animals that can be captured as well as traditional beliefs against excessive hunting, can also have an impact on wildlife. Finally different ethnicities perceive risks that originate from wildlife in different manners and react accordingly (Dickman, 2010).

9 Conclusions and Discussion

"Conservation Biology: a Dialog of the Deaf" (Agrawal and Ostrom, 2006, p.681; Sandbrook *et al.*, 2013, p.1487)

9.1 Overview

For many conservation practitioners and development professionals, timber companies are thought to bring development to remote rural forest areas at the expense of the environment through "multiplier effects" (Sunderlin *et al.*, 2003) both directly because of the presence of timber companies and indirectly due to the creation of transport infrastructure into a once inaccessible area. These multiplier effects are said to include employment and the trade of natural resources that result in the immigration of people into the area. While the use of natural resources by local communities may have been sustainable before the arrival of timber companies, the arrival of in-migrants generates additional pressure on the environment that may no longer be sustainable. This chain of logic (Figure 1-1) has resulted in the unlikely collaboration among conservation organisations, development organisations and timber companies. However, it is filled with assumptions that may, or may not, be true in any one location or at any one time (Ascher, 1999a, p.109; Marcucci, 2000; Rackham, 2003; Szabó and Hédl, 2011).

While conservation and development projects that either collaborate with timber companies or use their infrastructure may be successful in the short-term, they may not be successful in the long-term, this being due to the accumulation effect of "assumption drag", (Ascher, 1979; Brysse *et al.*, 2013; Keilman, 1998; Oppenheimer *et al.*, 2008, p.162). Outdated core assumptions are persistently used, having been created by, among other things, inappropriate generalisations. One of these generalisations is that the transport infrastructure created by timber companies leads to local development (Sunderlin *et al.*, 2003) through commercial activity (Wilkie *et al.*, 1992; Auzel and Wilkie, 2000) at the expense of the environment through both deforestation (Coffin, 2007; Lugo and Gucinski, 2000) and defaunation (Brashares *et al.*, 2011; Wilkie *et al.*, 1992; Zhang *et al.*, 2006), especially in remote areas that have never been commercially exploited before (Abernethy *et al.*, 2013; Bryant *et al.*, 1997). Though not explicit, it is implied that these impacts continue in the long-term.

This thesis questions two of the assumptions in this chain of logic (Figure 1-1). The first is that remote rural forest areas have never been exploited commercially before the arrival of a timber company and the second is that the impacts of timber companies, on both development and the environment, are long-term. By integrating these queries, an alternative chain of logic

(Figure 9-1) was proposed in Chapter 1. At the centre of this alternative chain of logic is the proposal that the transport infrastructure created by timber companies may also be dependent on their continual presence without whom the transport infrastructure collapses, which in turn contributes to changes in the spatial configuration of market spheres of influence.

Different parts of this alternative chain of logic (Figure 9-1) were explored in this thesis by looking at the impacts of the arrival and departure of timber companies on a remote rural forest area and a less remote area of Gabon, remoteness being measured as distance from a market town. It is recognised that the dataset used in this study has several weaknesses not the least of which is its small size.

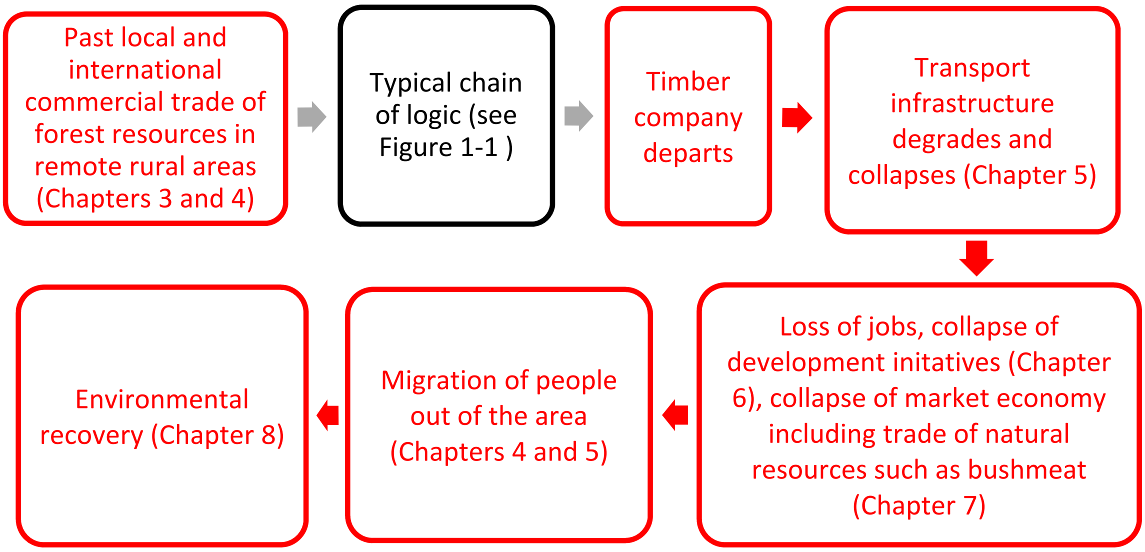


Figure 9-1: Proposed amendment (in red) to the chain of logic used by conservation practitioners.

The past commercial use of natural resources in Gabon was explored in Chapter 3 and then for one of the study sites in Chapter 4; these chapters also looked at the development and environmental outcomes of the historic natural resource use. The impacts that the timber industry had on transport infrastructure were explored in Chapter 5, and how this influenced migration was explored in Chapters 4 and 5. The development impacts of timber companies were separated into two parts, the first part, in Chapter 6, looked at education and employment, the second part looked at livelihoods and was explored in Chapter 7. Finally, the long-term environmental consequences of timber companies, after they had departed, was explored in Chapter 8. The results from these explorations are summarised below and in Table 9-1.

	Chain of logic					
	Timber company arrives in remote rural forest area that until then has not been exploited by any industry (Chapter 9.2)	Transport infrastructure created (Chapter 9.2.2)	Job and market creation (Chapter 9.2.3)	Migration of outsiders into the area (Chapter 9.2.4)	Trade in natural resources including bushmeat (Chapter 9.2.5)	Environmental degradation (Chapter 9.2.6)
Assumptions	The area has never been exploited by industries.	Current timber industries are creating new transport infrastructure that have long-term impacts.	Jobs and markets are created with the arrival of a timber company.	Migration of people from outside the area occurred when timber companies came.	Commercial trade in bushmeat is being carried out.	The environment is being degraded due to timber companies logging practices and commercialisation of .natural resources such as bushmeat.
Is there any data that shows that this assumption is true within the proposed project area?	No	Conflicting data, some reports mention that the Malaysian timber companies are behind the creation of roads, while others report that roads have been around since the 1960s.	No	No	Conflicting data, past reports indicate that there was bushmeat trade occurring, but currently there are no data.	Conflicting data, past reports show that there are fewer animals in the area where timber companies were operating, but currently there are no data.
If not, or uncertain, how can it be show that this assumption is true within the proposed project area?	- Ask local people. - Ask local administration. - Look in archives and historical documents.	- Ask local people. - Ask local administration. - Ask past and present timber companies for the maps of the area, with the roads that they have built of propose to build.	- Long term economic data of the area. - Ask people about current and past employment.	- Long-term demography of the area. - Local census. - Ask local people and administrator.	- Market study on trade of natural resources out of the area. - Study of use of natural resources.	- Previous reports. - Animal survey. - Vegetation survey.
Result	- Local people mention that elders used old paths to transport natural resources to Sindara, though no one was in the	- Local people mention how they migrated using the road built by the timber companies in the 1960s. - Local administrators and	- People had been employed by timber companies but currently most	- Local census shows that there has been no long-term migration into	- No natural resources were seen to be traded. - The majority of natural resources that	- Surveys shown that the impact on the environment is dependent on many factors, including how long the area has

	Ikobey area at the time. - Local administrators do not recall other industries having exploited the area before the first timber company in the 1960s. - Old maps and historical documents from beginning of the 1900s, show that the area dotted with SHO factories where rubber, ivory and raphia were stored before being exported.	people explain how the early timber companies had created all the current roads in the area. - Timber companies, local people and local administrators all mention how the most recent timber companies mostly re-opened old roads that had been made by previous timber companies.	do not have jobs. - The first timber companies bought food from local people, but latter on they stopped and transported the food supplies from the city.	the area, with outsiders having left when timber companies left.	were collected from the environment were used in subsistence.	been abandoned by the timber industry. It does not seem that animals have been put at long-term risk due to the commercialisation of bushmeat.
Conclusion	Assumption is false	Timber companies in the past created roads, but the more recent companies limited themselves mostly to re-opening up the old roads.	Long-term job creation does not happen. No long-term local markets created.	No long-term in-migration of people into the area.	Though trade in natural resources may have occurred in the past while the timber company was present, it no longer occurs.	Environment degradation is not only due to timber companies. It would seem that when timber companies depart the environment can recover.

Table 9-1: Analysis of assumption drag based on the chain of logic events of the arrival of a timber company in a remote rural forest area to environmental degradation.

9.2 Summary of results

9.2.1 Past natural resource exploitation in Gabon

One of the objectives of this study was to put into perspective the current ways in which Gabon's natural resources are being used today compared with how they were used in the past. In Chapter 3, I addressed the assumption that the large scale commercial exploitation of natural resources is relatively new (Figure 1-1) and showed that by taking into account the proposed chain of logic (Figure 9-1), today's remote landscapes should be seen in the context of previous commercial exploitation of natural resources. In some cases this past exploitation may be directly linked to creating a landscape that is currently of interest both to timber companies and also to conservation organisations. Furthermore, insight into the long-term impacts of timber companies on the environment may be gained by considering past commercial extraction of natural resources.

Gabon's natural resources, landscapes, species, minerals, waters, etc. have been exploited and traded in one way or another for over 6,000 years (Clist, 1995; Vansina, 1990). To say that Gabon is one of Africa's last Edens, which has been untouched by people until the last hundred years is a gross misunderstanding of the impact that people have had, and continue to have, on shaping Gabonese landscapes and, in general, of the "resilience" of some of these ecosystems (Mumby *et al.*, 2014). The importance of anthropogenic disturbance in Gabon was described by Jeffery *et al*. (2014) and Palla *et al.* (2011) whereby the savannas of Lopé National Park would revert to forest without anthropogenic fire; it was also used by Engone Obiang *et al.* (2014) to explain the demography of tree species in Gabon. However, the Gabonese "Eden" hypothesis is prevalent, with carbon plots being carried out without factoring in historic anthropogenic variables, such as the carbon plots of Lewis *et al*. (2009) or, when anthropogenic variables are included, it is only for recent disturbances such as in the botanical plots of Sassen and Wan (2006).

As an example of this resilience, the chapter on the environmental history of Gabon (Chapter 3) showed how elephants had become locally extinct in different parts of Gabon since the 1600s (Battell, 1901; Dapper, 1686) and yet each time their populations managed to recover. It also showed that forested areas that were historically exploited, be it for firewood, timber, rubber, etc. are only visible in historic documents, old maps and old aerial photos while, on the ground, they are visible only to people trained in archaeology or botany.

The industrial exploitation of Gabon's natural resources also has a long history. The SHO concessions that were created at the end of the nineteenth century and covered a large part of central Gabon, including one of the study sites, came and went. These industries depended on various outside factors, both national and global, that change over time; this includes financial booms and busts, wars, and fashions. Once an extractive industry leaves a remote rural forest area the resilient “wilderness” returns, devouring evidence that these industries or even people were ever present (Clist, 1999).

It has also been assumed that the mechanisation of industries has increased environmental impacts, whereby “modern forestry methods have a much higher impact” (Brown, 1998, p.52) on the environment than manual techniques. In Gabon timber offtake steadily increased from the 1900s (Coquery-Vidrovitch, 2001; Gaulme, 1988, p.119; Jaffré, 2003b) due to mechanisation (Jaffré, 2003a, pp.263–266; Lasserre, 1955; Pourtier, 2010, pp.3, 6). However, when analysing how logging techniques have changed in Gabon (Chapter 3 and Appendix 11.10), it is apparent that the environmental impacts of manual logging may have been greater than that of mechanised logging (Chapter 3). For example, in the removal of timber after a tree is cut, mechanised logging uses bulldozers that create tracks which are three and a half meters wide (Brown, 1998, p.53). However, when removing timber in manual logging ten metre wide paths are created so as to allow the timber to be rolled out (Picture 3-1, Appendix 11.10). The largest environmental impact of manual logging could have been the size of the workforce, a workforce that needed feeding with products that were acquired locally. With the advent of mechanised logging the labour force was cut by half and food could be acquired from towns that are further afield, the result of which has been the transformation of the old work force plantations back to a forest that is part of the Gabonese patch dynamic landscape. How much environmental damage the mechanisation of the timber industry has on the forest is dependent on the density of timber species that are of interest to the timber industry in any one particular forest. In Gabon *okoumé*, the timber species that is of most interest to timber companies, is found in low densities, meaning that clear felling is rarely carried out even though loggers can now cut several trees a day with the use of a chain saw.

The factors behind the resilience of Gabon’s environment to anthropogenic disturbances are many and include a low rural population (due to disease, famine, a mobile workforce and colonial and post-colonial policies) (Chamberlin, 1977; Gray, 2002; Rich, 2007a), a population that is increasing only slowly (Figure 2-2), a culture where being a trader, office worker and civil servant are preferred livelihoods while working the land and other hands-on activity is for non-nationals (Chamberlin, 1977; Gray, 2002; Rich, 2007a; Rich, 2005). Furthermore, an economy based on off-shore oil has allowed Gabon to import much of its food without having to invest in agriculture (Pourtier, 1984; U. S. Department of State, 2009; United Nations Statistics Division, 2009).

These somewhat unique factors all play a part in outsiders' perceptions of the untouched wildness of Gabon, especially when forest sites are adjacent to a landscape that has recently been exploited by extractive industries such as timber, mining and now oil palm plantations[173]. In the Ikobey study site the most recent sites of timber exploitation with their roads, clearings, and remaining stumps, even though now abandoned, stand in stark contrast to the surrounding mature forest, which has biased the outsider's view of this landscape. This has resulted in the timber industry being seen as a threat to this environment as well as to the people who live and are reliant on the natural resources of the Ikobey area (Brainforest, 2010; Eisen, 2010; Rambaldi *et al.*, 2010). The same factors that have resulted in a "misreading" (Fairhead and Leach, 1998) of the landscapes in the study sites also applies to Gabon more widely and many parts of Africa.

9.2.2 Timber companies and access

Since von Thünen's "Isolated State" in 1826 it has been understood that access to an area has an influence on how natural resources and land are used (Lambin, 1994; Sinha *et al.*, 1989; von Thünen, 1966). The further a resource is located from a market town the more expensive it is to transport it from where it was collected or harvested to a market; this distance then influences the way land is used. This is in contrast to the current assumption by conservationists that access, such as that created by timber companies, results in long-term economic development (Wilkie *et al.*, 2000) of a remote rural forest area through "multiplier effects" (Sunderlin *et al.*, 2003) such as commercial hunting (Laurance *et al.*, 2008; Robinson *et al.*, 1999) and employment in the timber industry or to service it (Angelsen and Wunder, 2003; Arnold, 2001), as outlined in the chain of events in Figure 1-1. This assumption does not take into account the eventual departure of timber companies from these areas.

In the amendment (Figure 9-1) to the chain of logic it was proposed that access to remote rural forest areas in rentier states is dependent on timber companies, without whom transport infrastructure would collapse. It was proposed that the average speed of public transport increases with distance from a market town and that this is independent of the past presence of timber companies. This question was explored in Chapter 5 as was how transport infrastructure into the sites was created and maintained and how this changed with the departure of timber companies. This exploration showed the following: distance from the

[173] It is unlikely that the recent boom in palm oil production will be any different, especially due to the labour costs in Gabon which are significantly higher than neighbouring countries (African Development Bank Group, 2011), but also since the policy of major oil palm users is to move to synthetic alternatives (Disdier *et al.*, 2013; Fry, 2011).

nearest market had a constant impact on the speed of transport. When a timber company was present in a village in the past, transport became faster while the greater the time since the timber companies departed the slower transport speed became. It is likely that this is due to the degradation of transport infrastructure.

It would therefore seem that the presence of a timber company improves access to remote rural forest areas by reducing transport costs and transport time in such a way that von Thünen's rings expand out from the nearest market town. However, this thesis shows that once timber companies depart, the rings collapse back to the nearest market town with communities in the most remote rural forested areas finding themselves once more outside the rings. For these communities the transport costs will outweigh any profits that could be made from trading with the nearest market town (Figure 1-5).

Within the Ikobey study site the collapse of transport infrastructure has been compounded by the short-term duration of the more recent timber companies operating in this area (Chapter 4). While the first timber company stayed for decades, today's timber companies only stay a few years, and as a consequence they spend less effort and resources on maintaining the transport infrastructure, preferring to carry out quick-fix maintenance.

In countries like Gabon, and maybe other areas, where the majority of the population is found in urban areas, there is little economic or political reason for the state to invest in the maintenance of roads in remote rural forest areas. In this case access to remote rural forest areas is dependent on maintenance of the transport infrastructure by timber companies. For this reason, when timber companies abandon such areas the transport infrastructure that they helped to create starts to collapse (Chapter 5).

The collapse of transport to market towns may not always be the case, especially in non-rentier states (Yates, 1996) where "land hunger" (Park, 1992, p.50) has resulted in a "sea of rural poor waiting to invade its forest" (Miller and Tangley, 1991, p.95). In these cases using von Thünen's theory to help model deforestations and other spatial modelling methods, as summarised by Lambin (1994), may be suitable. However, in areas where von Thünen's theory is still applicable, such as rural Tanzania (Ahrends *et al.*, 2010), this theory can have major implications on the long-term success of conservation projects including those forming a part of the requirements for Forest Stewardship Council (FSC) certification or those which participate in Reducing Emissions from Deforestation and forest Degradation (REDD+). These implications include the choice of project sites or types of projects that are carried out, for if changes in transport costs due to the departure of a timber company are not factored in then the increased cost of transport can become a liability to projects due to increased costs in logistics.

9.2.3 Timber companies and direct development

As long as timber companies are present in the study sites local communities have been able to benefit from easy access to markets (Chapter 5). This is not the only benefit that communities are assumed to receive with the arrival of a timber company. It is also assumed that communities are able to gain access to education, health services and employment (Jaffré, 2003a; Sunderlin *et al.*, 2003) either indirectly due to improved transport or directly through policies that may be implemented by timber companies (Figure 1-1). However, if with the departure of timber companies transport systems start to collapse then it is also possible that development opportunities also break down (Figure 9-1). The impact that the departure of timber companies has on education and employment was explored in Chapter 6 where it was shown that the distance a community is from a market town has a larger impact on education and employment than the past presence of a timber company.

In this study distance from the nearest market town seems to have had a larger role to play in the development of education with, on average, two years of education being lost in the communities furthest from the market town. Furthermore, within the Ikobey study site the timber companies of the past seem to have been more active in the development of the Ikobey area than current timber companies, especially in the promotion of education (Chapter 6). However, even if timber companies promote education, this may not result in better education. In this study it was found that the presence of a timber company may reduce a teenager's education level, though children may benefit. This is because teenagers may prefer to work with the timber company rather that continuing their studies. Even if teenagers did want to carry on their studies, they may not have the access to facilities or teachers to do so, as these become scarcer with distance from a market, as von Thünen predicted, probably due to teachers not wanting to work in remote areas (Godoy *et al.*, 1998; Godoy and Contreras, 2001).

The creation of employment opportunities directly with timber companies is often assumed to benefit local communities (CBFP, 2005; Pinedo-Vasquez *et al.*, 2001). However, within the Ikobey and Koulamoutou study sites it was found that many of the jobs that local people were able to obtain from the timber companies present were low skilled with short-term prospects[174]

[174] This is not helped by Gabonese employment laws where it becomes difficult to dismiss long-term employees, resulting in employers preferring to give short-term contracts.

(Chapter 6) and for which there is usually a need for local knowledge of the area (e.g. forest guides). Indirect employment opportunities, such as servicing the employees of the timber companies, are also low skilled with short-term prospects, lasting only as long as the employees of the timber companies are present. The more technical jobs went to outsiders that the timber companies brought in. These findings are similar to the finding of others (Angelsen and Wunder, 2003; Arnold, 2001; Poschen, 1997; Scherr *et al.*, 2003; Whiteman, 2000).

When the timber companies depart so do the different employment opportunities. Local people then had to leave the area if they wanted to continue to be employed, whether with the timber companies or elsewhere. In the case of the Koulamoutou sites this was less of a problem for the village sites nearest to the market town, as reliable transport infrastructure has, among other things, meant it is easier for people to have access to the job market in town while also being able to keep in touch with their families (Chapter 5).

Advances in technologies has made the employment situation for local communities worse. Improvement with logging technologies (Chapter 3) such as chain saws and more reliable transport technologies has resulted in timber companies being less reliant on local communities. Improvement in logging technologies has also resulted in timber companies recruiting skilled personnel who are usually not found in local communities, creating a glass ceiling for local employment opportunities based around low skilled labour. The decrease in cost to buy, maintain and run vehicles for transport has allowed timber companies to access stable food supplies from towns and cities rather than from the seasonal food that is produced by the local community (Chapters 4, 5, 6 and 7) and so further reducing the dependency that timber companies have on local communities.

As timber companies become less dependent on local communities for either their labour or food supply then the previous development opportunities that opened up to local communities decreased. Furthermore, as the time that timber companies operate in remote areas decreases, from decades as seen in the early timber companies in Ikobey to a couple of years with the last timber companies in this area, and the duration between the departure of one timber company and the arrival of another increases, then the opportunities that timber companies have to participate in the long-term development of communities is reduced. For instance, in the Ikobey site, the early timber companies actively participated, over decades, in education, training, and the creation of a food market. By contrast any education participation by timber companies is minimal and for a short-period, there is no local food market, and little of the food needed to supply the timber companies workforce is from the local area.

These changes in the way timber companies help communities are occurring at a time when there is an interest for timber companies to be better integrated with nearby communities. This can be through development projects that are created with the collaboration of conservation and development organisations or through requirements of various certification schemes that a timber company is a member of, such as The International Tropical Timber Organization (ITTO).

It should be highlighted that none of the timber companies that have worked in the Ikobey area have ever been certified. Not being certified did not hinder the developmental efforts of the early timber companies. However, these early timber companies probably had no other choice as it would have been too expensive for them to source all their supplies and man power from outside the area.

9.2.4 Timber companies and migration

The permanent in-migration of people who are not associated with the local people has often been described in the conservation literature as one of the outcomes of the presence of timber companies in remote rural forest areas (Bryant *et al.*, 1997; Eves and Ruggiero, 2000; Geist and Lambin, 2001; Hodgkinson, 2009; Meijaard and Center for International Forestry Research., 2005; Nasi *et al.*, 2008; O'Connor, 2004; Poulsen *et al.*, 2007; Riddell, 2013; Riddell, 2011; Robinson *et al.*, 1999), even when the companies have departed (Hodgkinson, 2009). However, the assumption that the arrival of a timber company into a remote rural forest area brings in long-term in-migration (Figure 1-1) may not always be accurate, there being situations where in-migrants depart with the departure of timber companies as is proposed in the amended chain of logic (Figure 9-1). This short-term migration was explored in Chapter 4 where it was found that the communities in the study sites consisted of people who are traditionally associated with the areas, with others having migrated out at the time of the departure of the timber companies. This has also been found in other countries such as Belize (Chomitz and Gray, 1996).

Though there has not been long-term migration of people who are not traditionally associated with the study areas, timber companies, and commercial activity in general, have had a major impact on the migration of local people in the Ikobey site, especially in bringing out people from forest villages to road side villages; a similar process also occurred in the 1940s when the first roads were being constructed in Gabon (Sautter, 1966). The origin of some of these migrations was the boom and bust trade of various natural resources. At least since the mid-1800s there have been several waves of migrants into the Ikobey area (Chapter 4) and, though the waves of in-migration have been directly triggered by the trade of natural resources, out-migration has been due to conflict, politics and disease (Chapter 3 and 4), with all three partly being indirect outcomes of the trade of natural resources found in the Ikobey area. Twice have these out-migrations resulted in the Ikobey area becoming a "dead-zone" (Gray, 2002), empty of people. The dead zone that was created in the 1920s started to be re-populated from the 1960s with the in-migration of Bantu-speaking people followed by Pygmies, both of whom were living around the area.

"Land grab" in remote rural areas by migrants does not always have to be an outcome of the arrival of timber companies. In the study sites the in-migration of people who have no traditional links to the study sites due to the arrival of timber companies has not been permanent, with these in-migrants leaving at the same time as timber companies departs. Only the children born in the area from these people remain (Chapters 4 and 5). This migration pattern could be due to the lack of a skilled labour force in Gabon (Gardinier and Yates, 2006, pp.103–112; Gray and Ngolet, 1999; Rich, 2007a; Rich, 2005), with timber companies bringing in their own skilled workforce to carry out the majority of logging operations and it being economically advantageous for this workforce to move with the timber company to the next timber concession. Furthermore, as the requirement for some of the low skilled jobs available to local people is that they have knowledge of the area, e.g. as a guide, this knowledge is not transferable to other timber concessions; this also put barriers to in-migrants looking to take up such employment. As the result of the departure of timber companies and the ensuing degradation of the transport infrastructure, in particular bridges, there has also been an out-migration of the people who have traditionally lived in the Ikobey area (Chapter 4). Some areas, such as around Makoko and Ngondet, are once more becoming "dead zones".

One other finding from the Ikobey study site concerns the assumption by indigenous rights activists that Pygmy communities found in the area are "indigenous" to it (Brainforest, 2010; Eisen, 2010; Rambaldi *et al.*, 2010), with the additional assumption that all Pygmy communities live off the land and are very mobile. For this reason there are many conservation and development projects whose principal focus are Pygmy communities, while disregarding other communities (Rupp, 2011). In the Ikobey site these assumptions have created tension between the Bantu-population and the Pygmy population as, according to both Bantu and Pygmy oral migration histories, it is the Bantu-population that have lived in the Ikobey area the longest (Chapter 4). Furthermore, as with other research on the Pygmies of Central and Southern Gabon (Matsuura, 2009; Matsuura, 2006; Soengas, 2010; Soengas, 2009), it was found that the Pygmy communities of Ikobey are relatively sedentary when compared to other groups in the northern Congo Basin. In some cases the Pygmy communities of Central and Southern Gabon have been sedentary since at least the 1930s (Andersson, 1983; Fairley, n.d.; Le Roy, 1928; Trilles, 1933). Others have found similar trends in the Congo Basin (Rupp, 2011).

9.2.5 Timber companies and livelihoods

"The material development of Africa may be summed up in one word 'transport'" (Lugard, 1922, p.5).

Timber companies in remote rural forest areas are said to have long-term developmental impacts due to opening up areas to the commodification (Salzman and Ruhl, 2000) of natural resources, including agricultural (Laurance, Alonso, *et al.*, 2006) and wild products such as bushmeat (Auzel and Wilkie, 2000; Bennett and Gumal, 2001; Elkan *et al.*, 2006; Laurance *et al.*, 2008; Wilkie *et al.*, 2001; Wilkie *et al.*, 2000; Wilkie *et al.*, 1992). This is because the timber companies create a local market and through the improved transport infrastructure reduced the transport costs to other markets (Auzel and Wilkie, 2000; Laporte *et al.*, 2007). It also reduces the cost of equipment and technologies needed in the extraction of natural resources or to carry out agriculture (Laurance, Croes, *et al.*, 2006; Robinson and Bennett, 2000).

It is assumed that this commodification of natural resources results in local communities switching from subsistence livelihoods to ones that are more orientated towards commerce (Figure 1-1). However, this commodification of natural resources does not take into account long-term changes in transport infrastructure with the departure of timber companies and hence changes in production and transport costs resulting in the "fungibility" (Salzman and Ruhl, 2000) of the value of natural resources in remote rural forest areas whereby natural resources are given the same market value per unit no matter where they are extracted.

In the amended chain of logic (Figure 9-1) it was proposed that there can be situations whereby a local community may revert back to a subsistence livelihood with the departure of timber companies. Furthermore, it was proposed that the commodification of animals to supply the bushmeat trade also breaks down. This is explored in Chapter 7 where it was found that the long-term commodification of livelihoods based around the sale of natural products no longer occurs in communities found in remote rural forest areas.

While the trade in bushmeat seems to have been important in the study sites when timber operations were occurring (Chapter 7), it is not important in the communities furthest from the market after timber companies leave. Only in the villages near to markets is there commodification of natural resources, with hunters actively partaking in the bushmeat trade and with more bulky agricultural products being traded in the villages nearest to the market.

Within the remote rural Ikobey study site, at the time of the study, none of the local hunters were selling bushmeat or were involved in its commercialisation. The lack of commodification of livelihoods in the more remote Ikobey site resulted in dataset limitations where the majority of natural resources that were collected by the communities were consumed rather than sold. This consumption did increase with distance from the nearest market, probably reflecting the subsistence nature of their livelihoods whereby the communities furthest from the nearest market are more reliant on natural resources from their surrounding environment than on items that were bought.

The assumption by conservation practitioners that commercial bushmeat trade continues to have an environmental impact after timber companies depart has to be questioned in relation to the degradation of transport infrastructure. This is borne out in the study sites, whereby how far a village is from a market dictates whether bushmeat or other food products are commercialised.

The importance of good transport infrastructure is even more applicable in the Gabonese bushmeat trade due to the preference for fresh bushmeat. Because of the humidity which means that the meat has to be continuously smoked in order for it not to spoil, it is hard to transport the meat to markets. The trade in bushmeat is only possible in areas where there is reliable and cheap transport. In remote rural forest areas cheap transport is a by-product of the presence of timber companies, with production costs being temporarily reduced or even eliminated during the presence of a timber company or when conservation and development projects are running, especially when help is being given for the transport of products to markets (for an example see Wicander and Coad, 2015, p.30).

Livelihoods based on the trade of bulky or perishable food products, including bushmeat, are unlikely to succeed after the departure of the timber company as the degradation of roads, increased transport time and increased costs all make it uneconomical to trade these products. The upshot of this inability to trade natural resources in the Ikobey area is that the livelihoods of the people there have mostly gone back to a subsistence agriculture and hunting livelihood.

9.2.6 Timber companies and the environment

In general the direct long-term impacts of selective logging on the environment, such as on trees and animals species, are not thought to be high due to their ability to recover post disturbance if there is no other perturbation (Brugière and Gautier, 1999; Clark *et al.*, 2009; Park, 1992; Plumptre and Reynolds, 1994; Struhsaker *et al.*, 1996; White, 1992). However, the indirect impacts of timber companies are thought to have long-term impacts on forests (Figure 1-1) due to the bushmeat trade (Auzel and Wilkie, 2000; Fimbel *et al.*, 2001; Laurance, Alonso, *et al.*, 2006; Milius, 2005; Poulsen *et al.*, 2009; Robinson and Bennett, 2000; Robinson *et al.*, 1999; Wilkie *et al.*, 2000). It is likely that reality is much more complex than these generalisations, with the characteristics of an area playing a differentiating role. Among others, these characteristics can include ecological, geological, social, economic, political and historical ones, all interacting in different ways with each other.

The collapse of transport infrastructure after the departure of a timber company from remote rural forest areas may also play a role in the indirect long-term impacts of timber companies on forests and their wildlife. With the collapse of transport it becomes harder to trade in natural resources so that natural resources are no longer exploited for commercial reasons, with the result that patch dynamic recovery may occur as proposed in the amended chain of logic (Figure 9-1). Chapter 8 explores the impact of the departure of timber companies from remote rural forest areas on the forest by looking at signs of human disturbances and animal populations.

More signs of plantations are found around villages that are near market towns than villages in remote rural areas where more mature forests are found. In these study sites, it therefore seems that land use follows von Thünen spatial theory and is similar to the findings of Ahrends *et al.* (2010). Though hunting signs were found around all the village sites, they were more concentrated around the villages nearest to the market. Distance to the nearest market town was the explanatory variable that most explained the number of animal signs counted along the transects, though the past presence of a timber company and time since an area was logged also had a lesser but negative role.

It would therefore seem that though timber companies may have a long-term impact on animal populations, distance from markets and, more importantly, ethnicity may also have a role to play. The history of commercial natural resource exploitation in Gabon also puts into question the long-term environmental impacts that timber companies may have, whether they be direct or indirect, as the boom and bust cycles of the timber industry in an area can create an ecosystem with patch dynamic characteristics where different parts of the ecosystem are in various stages of recovery from past exploitation. It is recognised that this outcome of logging operations may not always be the case and may be an exception. An alternative outcome of timber company operations in remote rural forest areas is the transformation of forest ecosystems to agricultural or pastoral land. The outcome of the timber industry on a forest ecosystem is dependent on the characteristics of the area as listed above, which need to be considered before concluding that timber companies generally cause long-term damage to the environment.

9.3 Limitations to the study and further research

It is recognised that there are limitations to the methods used. Interviews are time consuming to undertake, take time to transcribe and analyse, can be disruptive to the community and are open to manipulation by either the interviewer, translator or interviewee (Bernard, 1994; Finana and van Willigen, 2002; Wolcott, 2005). Questionnaires may be faster but are limited to the questions posed, usually with binary or multiple response that may not reflect the answer that the interviewee would like or worse, multiple responses reflecting the culture of the interviewer rather than the culture of the interviewee[175]. The recording of natural resources that people bring to the village is dependent on collaboration of the community, which in turn depends on the relationship between the researcher and the community, as well as past research[176], and on whether the items are considered to be taboo either by the community or outsiders (such as law enforcement and NGOs) especially in the case of bushmeat (Davies, 2002a; Deaton, 1997; McKinney, 2000). Finally, animal transects are influenced by changes in climate which can be both seasonal and multi-year and are dependent on observation and correct identification, both of which are prone to individual abilities, fatigue and topography with the results being biased towards non-cryptic animals (Davies, 2002a; White and Edwards, 2000a).

There are also other limitations to this study not least concerning the sites chosen. In an ideal world a greater number of sites would have been used, which would include replicas and control villages at similar distances, villages where there was no ethnic diversity and the topography of the areas around each village was similar. A longitudinal study over a significant period of time would have also been preferable. Further research on the impacts of distance from nearest markets and past presence of timber companies should try to include all of these different situations. However, as seen in Gabon's Parks and Peoples project that sought to investigate the long-term impacts of parks on people's livelihoods, longitudinal studies are unlikely to be funded over several iterations of data collection.

[175] For example multiple responses that reflect a scale between yes and no rather than just a simple yes and no (McKinney, 2000).
[176] Research that I carried out in a remote area of Tanzania is a case in point. Sometime before my study medical students had been taking blood samples from people in the community without explaining their study. When I arrived to conduct an unrelated study shot guns were pointed at me as people feared I was another vampire.

For conservation practitioners embarking on projects that in one way or another are dependent on access to transport infrastructure, even if it is just for their own logistics, it is important for them to understand the transport infrastructure that they are going to use, including its history and its future. If conservation practitioners are interested in the commodification of community livelihoods so as to reduce their impact on the environment then research is also needed on changes in market prices, production costs and transport costs. For conservation practitioners embarking on such projects this sort of data can be easily collected through surveys on market prices, transport costs and production costs carried out at different times of the year, including all seasons. Looking at current trade in a community will also give the conservation practitioner an idea if the commodification of a specific livelihood is possible. How trade will be impacted by various events outside the control of the community also need to be factored in, especially possible changes in transport infrastructure and the arrival and departure of influential outsiders such as timber companies, conservation and development organisation.

9.4 Implications of this study on conservation practice

> “One of the anomalies of modern ecology is that it is the creation of two groups each of which seems barely aware of the existence of the other. The one studies the human community almost as if it were a separate entity, and calls its findings sociology, economics, and history. The other studies the plant and animal community, comfortably relegates the hodge-podge of politics to 'the liberal arts.' The inevitable fusion of these two lines of thought will, perhaps, constitute the outstanding advance of the present century” (Leopold, 2013, p.375, written in 1935).

> “The challenges ahead for biodiversity conservation will require a better understanding of one species: our own” (Saunders *et al.*, 2006, p.702).

The ever increasing scientific knowledge of ecosystems and their species has allowed an increased awareness of conservation issues (Balmford and Cowling, 2006; Lowe *et al.*, 2009; Mascia *et al.*, 2003; Schultz, 2011). However, the conservation literature is biased away from the practical aspects of conservation so that the outcome of conservation research does not lead to better conservation practice[177] (Mascia *et al.*, 2003; Schultz, 2011), resulting in conservationists "winning a few battles" but "losing the war" (Balmford and Cowling, 2006, p.692). This disconnect between conservation theory and conservation practice can lead to project failure, as assumption drag at various levels (Appendix 11.18) is created by local realties.

When thinking about sustainability, sustainable development and conservation we should be obliged to have a "long-term vision of goals and outcomes" (Marcucci, 2000, p.69; Ascher, 2006). Even if it is not practical, a five hundred year outlook may be needed if conservation is to succeed (Marcucci, 2000, p.69; Tonn, 1986). However long-term goals are complicated by assumption drag that increases linearly over time (Ascher, 1981, p.258) while short-term goals and projects (approximately three to five years) are less likely to be hit by assumption drag and are compatible with donor funding and time scales and short-term government policies (Ascher, 2001). These are the goals that conservationists are currently fulfilling.

The bias towards short-term studies has affected conservation research. In this study it has been shown that the current knowledge on the impacts of timber companies on the environment and development, including its impact on the bushmeat trade, has been affected by assumption drag due to the lack of research on the impacts after timber companies depart. For though research on the timber industry and the environment can be easily undertaken while logging operations are occurring, the collapse of transport infrastructure makes it difficult for researchers to have access to these areas once the logging operations come to a halt. This creates a research bias whereby research has usually been carried out while timber operation are occurring and transport infrastructure is in good condition (Chambers, 1983). This is exemplified by the research of Foerster, *et al*. (2011), who could not carry on their study to the north of Waka National Park in Gabon (the same study site used in this thesis) as the transport infrastructure that had been created and maintained by timber companies had become "impassable at that time" (Foerster *et al.*, 2011, p.349).

The use of one-size-fits-all theories that predominantly originate from conservation sciences as the basis of conservation strategies ignores the heterogeneous world in which we live and creates a heterotopia of understanding between different disciplines that results in misunderstandings that do not help conservation (Appendix 11.2). Furthermore, these theories predominantly originate in and then are applied to cultures with different philosophies, some of

[177] "One might offer an ironic definition of conservation as follows: Conservation is a series of ecological predictions made by laymen because ecologists have failed to offer any" (Leopold, 2013, p.512 written in 1946).

which may not be compatible (for example see the arguments on postcolonialism and Pan-Africanism as set out in Mbele, 2015). Without including history, philosophy, social sciences, economic theories and business models, conservation initiatives are vulnerable to assumption drag that are amplified by "*homo economicus"* (Jacobsen, 2001; Rees, 2002) resulting in conservation project failure, especially in the long-term (Giles-Vernick, 2002). Multidisciplinary conservation may not only lead to better conservation but also create new theories and ideas in conservation science as has been show for inventions (The Economist, 2015; Youn *et al.*, 2015) and increase the likelihood of scientific articles being published in high impact journals (Uzzi *et al.*, 2013).

The ever increasing number of habitats and species threatened, even after the long and concerted effort by conservationists to reverse this, points to a policy failure. Due to this "one has to explore whether the institutions of policy making can be modified so that they will generate better policy outcomes" (Ascher, 2007, p.143). Maybe a conservation revolution is needed whereby the conservation baton is passed to people who principally have a background in social sciences and so forming a conservation social science discipline that is no longer just playing a supporting role in biological conservation (Adams, 2007; Lowe *et al.*, 2013, p.207) but rather taking the leading role (Mascia *et al.*, 2003), with conservation biologists being relegated to a secondary environmental monitoring role[178].

This radical social science approach would need a shake-up of the way conservation is taught and implemented, with it being moved from the biological department at universities to the social science department and with NGOs hiring more social scientists. There are already a number of conservation orientated courses and research groups in social science departments (Adams, 2007; Balmford and Cowling, 2006; Clark *et al.*, 2011a; Clark *et al.*, 2011b; Fisher *et al.*, 2009; Heberlein, 2012; Lowe *et al.*, 2009; Mascia *et al.*, 2003; Newing, 2010), such as the Human Ecology Research Group (HERG) at the Anthropology Department of UCL, which has already helped in the training of conservation practitioners (Homewood, 2014). In this way the new conservationist would think "like a human" (Adams, 2007, p.276) and so better understand the

[178] Well, at least until the circle loops back and hopefully ends up with conservation being represented and served equally by both disciplines for "*Révolution, c'est un mot mal choisi, parce que ça veut dire un tour complet. Par conséquent, ceux qui sont en haut descendent jusqu'en bas, mais ensuite ils remontent à leur place primitive… et tout recommence*" (Pagnol, 1967, p.135). "Revolution, it is a badly chosen word, because it means a complete 360-degree turn. Consequently those who are on top go down to the bottom, but afterwards they rise back to their original position… and everything restarts".

challenges. However, just as conservationists are getting to grips with the social aspects of conservation and debating how far the social sciences should be integrated into conservation biology (Newing, 2010), the role of business has appeared, so maybe future conservationists will need to be primarily trained in business schools.

9.5 Final words

From a conservationist's view point Gabon is in an enviable position as multiple factors have resulted in a landscape that is biodiverse and resilient in the face of human exploitation. If conservation cannot succeed here (Laurance, Alonso, *et al.*, 2006) then it is unlikely that it would succeed in other areas such as in neighbouring Cameroon which has a high population and more pressure on natural resources. With the right policies it should be possible for the timber industry to continue their work, while contributing to the development of local communities, in a manner that has little impact on the environment in the long-term. However, the short-term crisis driven view that some conservation organisations in Gabon have has led to assumptions that may be hampering conservation there by diverting funds, activities and energies from areas that are at little long-term risk of environmental degradation. In framing the priorities for conservation in Gabon practitioners need to look at the assumptions behind some of the threats to the environment and be wary of blanket generalisations of environmental threat to the whole country. Though the assumptions of environmental degradation caused by timber companies on the environment may be true in certain parts of Gabon (e.g. coastal timber concessions or areas where there is major transport infrastructure), it is not true for the whole of Gabon.

The overall conclusion of this study has been to show that the chain of logic used by conservation practitioners when faced with timber companies (Figure 1-1) does not always lead to either long-term poverty alleviation or environmental damage. That this is not the case shows how the assumption that the environment is homogenous is incorrect and care needs to be undertaken when using generalisations. Based on this chain of logic if care is not taken then the creation of conservation projects to reduce poverty and protect the environment as measures undertaken when timber companies operating in a remote rural forest area, whether initiated by conservation organisations or timber companies, risk failure. The chain of logic proposed in this thesis may be more appropriate (Figure 9-1) in understanding the long-term impacts of the arrival of timber companies in remote rural forest areas and how conservation project can be designed to mitigate them.

Following the spatial theory set out by von Thünen's 1826 "Isolated State" (von Thünen, 1966) on land use and distance from market, this thesis showed how it is still applicable in the remote rural forest areas of Gabon. Because of this, and other spatial theories, a one-size-fits-all approach to conservation initiatives may hamper conservation outcomes. Such blanket approaches led to a process of "negative learning" whereby new technical information has "lead to scientific beliefs that diverge over time from the *a posteriori* right answer" (Oppenheimer *et al.*, 2008, p.155). With assumption drag the risk of project failure from a one-size-fits-all approach increases with time. In Gabon this has led to the false idea that if there is transport infrastructure into an area it means that there is long-term access. This assumption has hampered several conservation initiatives in Gabon as conservation project budgets did not take into account the high cost of transport into project sites[179].

The history of Gabon not only shows that "*L'Okoumé, fils du manioc*" (Aubréville, 1948) but also, in certain cases, manioc is the grandfather of foresters and conservationists, for would the forests of Gabon still be of interest to foresters and conservationists if it was not for its disturbance? The chain of events that led to the disturbance of remote rural forests does not start with the arrival of modern timber companies, and the transport infrastructure that they create, but rather they are part of a chain of events that spans centuries. With the departure of a timber company the chain continues with the forest eroding the traces of their past presence through its vigorous growth. Due to the length of time involved, this succession of events is hard to perceive, especially when it is persistently said that it is modern industries, such as timber companies, that are the catalyst. Yet a historical understanding, both recent and in the distant past, is vital to both the conservation and development of remote rural forest areas if one is to understand the linkages between the past and the present species composition of the forest and to the development of its people, industries and conservation, especially given the rapid way in which current research is undertaken from which a pin point in time is extrapolated to decades.

[179] This was the case of the headquarters of Waka National Park that was based in an old timber company base but then had to be moved when the transport infrastructure degraded. Eco-tourism projects, such as in Ivindo National Park have had to be abandoned due to the cost of road maintenance.

10 Bibliography

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11 Appendices

11.1 Results from literature search on logging in Africa and its impacts

For the non-exhaustive literature search (Laufer *et al.*, 2013) the following key phrases were used in Google Scholar and Metalib “Logging Africa” (resulting in 112,000 matches in Google Scholar and 13,469 matches in Metalib), “Bushmeat Logging Africa” (resulting in 5,390 matches in Google Scholar and 515 matches in Metalib) and “Logging Development Africa” (resulting in 81,200 matches in Google Scholar and 9,829 matches in Metalib). These searches were carried out between 12 and 13 of May 2014. From each of these searches the abstracts from the first 500 references from Google Scholar and the first 200 references from Metalib were looked at and if found relevant downloaded. Due to the current debate on remote sensing (Hansen *et al.*, 2014; Hansen *et al.*, 2013; Hansen *et al.*, 2008; Nasi, 2005; Roy *et al.*, 2005; Tropek *et al.*, 2014), articles that did not include ground-truthing were removed. The references retained were studies that looked at logging and its impacts on: 1) vegetation and carbon, 2) mammals, 3) other animals, 4) bushmeat and hunting and 5) social, development, health, migration and livelihoods. By looking at the abstract and methodology of these studies they were further grouped into studies that had looked at the impacts of logging: 1) before logging had started, 2) while logging was being carried out and 3) after logging had finished (Table 11-1).

	Research on the impacts of timber companies		
	Pre-logging exploitation	Logging exploitation	Post-logging exploitation
Vegetation / carbon	(Gourlet-Fleury *et al.*, 2013; Hawthorne, 1993; Medjibe *et al.*, 2013; Medjibe *et al.*, 2011; Ouédraogo *et al.*, 2011; White, 1994b; White, 1992)	(Alonso *et al.*, 2005; Gourlet-Fleury *et al.*, 2013; Hall *et al.*, 2003*; Hawthorne, 1993; Medjibe *et al.*, 2013; Medjibe *et al.*, 2011; Ouédraogo *et al.*, 2011; Swaine and Agyeman, 2008*; White, 1994b; White, 1992)	(Adie *et al.*, 2013; Asase *et al.*, 2014*; Asase *et al.*, 2012*; Brown and Gurevitch, 2004*; Chapman *et al.*, 2010*; Daïnou *et al.*, 2011*; Engone Obiang *et al.*, 2014; Gourlet-Fleury *et al.*, 2013; Hall *et al.*, 2003*; Lawes *et al.*, 2007; Makana and Thomas, 2006*; Ogbonnaya *et al.*, 2002; Ouédraogo *et al.*, 2011; Paul *et al.*, 2004*; Poulsen *et al.*, 2013*; Swaine and Agyeman, 2008*; Van Gemerden *et al.*, 2003*; White, 1994b; White, 1992)
Mammals	(Hicks *et al.*, 2009; White, 1992)	(Alonso *et al.*, 2005; Auzel and Wilkie, 2000; Clark *et al.*, 2009*; Hicks *et al.*, 2009; White, 1992; Wilkie *et al.*, 1992)	(Brugière and Gautier, 1999*; Brugière, 1998*; Chapman *et al.*, 2010*; Chapman *et al.*, 2000*; Clark *et al.*, 2009*; Gillespie *et al.*, 2005*; Hicks *et al.*, 2009; Jost, 2012; Marshall *et al.*, 2005*; Matthews and Matthews, 2002*; Milich *et al.*, 2013*; Plumptre and Reynolds, 1994*; Potts, 2011*; Poulsen, 2009*; Poulsen *et al.*, 2013*; Poulsen *et al.*, 2011*; Remis and Jost Robinson, 2012; Remis and Kpanou, 2011; Remis, 2000; Skorupa, 1986*; Struhsaker *et al.*, 1996*; van Vliet and Nasi, 2008b; White, 1994a*; White, 1992)
Other animals		(Adum *et al.*, 2013*; Alonso *et al.*, 2005)	(Adum *et al.*, 2013*; Dranzoa, 1998*; Gillespie *et al.*, 2009*; Gillespie *et al.*, 2005*; Nyafwono *et al.*, 2014*; Owiunji, 2000*; Walsh *et al.*, 2004)

Bushmeat / trade / hunting		(Auzel and Hardin, 2000; Auzel and Wilkie, 2000; Brugière and Gautier, 1999; Clark *et al.*, 2009; Eves and Ruggiero, 2000; Jost, 2012; Jost Robinson *et al.*, 2011; Poulsen, 2009; Poulsen *et al.*, 2009; Rayden and Essame Essono, 2011; Skorupa, 1986; Wilkie *et al.*, 2000; Wilkie *et al.*, 1992)	(Jost, 2012 £; Jost Robinson *et al.*, 2011 £; Sayer *et al.*, 2012 £)
Social / development / health / migration / livelihoods	(Tsanga *et al.*, 2014+)	(Alemagi and Nukpezah, 2012; Arnold, 2001; Auzel and Hardin, 2000; Jost, 2012; Jost Robinson *et al.*, 2011; Laporte *et al.*, 2007; Laurent *et al.*, 2004; Lescuyer *et al.*, 2012; Noss, 1997; Poulsen *et al.*, 2009; Riddell, 2013; Samndong and Vatn, 2012; Tsanga *et al.*, 2014+; Wilkie *et al.*, 2000)	(Jost, 2012 £; Jost Robinson *et al.*, 2011 £; Noss, 1997 £; Rist *et al.*, 2012 £; Sayer *et al.*, 2012 £)

Table 11-1: Articles found during the literature search with Metalib and Google Scholar using the key phrases "logging Africa, "bushmeat logging Africa" and "logging development Africa". NOTES *- studies where a control was used to compare with an area logged. £- these studies were carried out a couple of years after timber companies left, compared to the vegetation, mammal and other animal studies where some studies looked at impacts after 150 years.+- though Tsanga(2014) mentions in their methods that they interviewed people 3 years after logging finished, they do not discuss this in their results

11.2 Heterotopian view of a landscape as seen from different disciplines

"A biogeographer and a cultural geographer overlook a prairie. Each explains what they see. The biogeographer begins with the soil, describing it as 'an extended composite phenotype', the combined material expression of numerous metabolic relationships between, and among, living organisms and abiotic conditions. Examining the vegetation mosaic, this physical geographer describes how enormous underground root structures interact with microbes and invertebrates to sequester and make available water and different nutrients. Further, this scientist points out that the abundance and diversity of grasses and wildflowers is not the result of a predetermined step-wise succession pattern. On the contrary, it is just one of many possible assemblages resulting from contingent relationships between living organisms, the soil's seed bank, and abiotic conditions including pyrogenic factors and hydrologic fluctuation. For this geographer, the prairie is a resilient ecosystem whose current state is a site-dependent result of frequent disturbance and the current manifestation of changes and perturbations over a long history of flux.

The cultural geographer considers this explanation, then offers another perspective. Focusing on the social relationships embedded in the prairie, this human geographer sees a cultural landscape where discourses are materialized. Beginning with a historical view, this scholar comments on how the pre-colonial prairie was the result of Native American burning practices. This land use was displaced by colonial property regimes that facilitated grazing, ranching, and intensive agriculture, which maintained the prairie for the benefit of Europeans. To the human geographer, this landscape also embodies local social relationships. With the decline of the ranching industry, a government agency began managing the prairie with prescribed burns, but resident concerns over prescribed fires led to the formation of a new management regime. This regime allowed a Native American craft guild to harvest grasses in the conservation area, which reduced the necessary frequency of burns. This endeavour forged local social ties, challenged established forms of ecological knowledge production and expert management regimes, confronted normative assumptions of pristine nature, and created place-based environmental subjectivities. To our culturally oriented friend, this prairie embodies local discourses on ecological restoration and best-management practices, uncovers power dynamics within and between communities, and illustrates the value of the prairie landscape to livelihoods, regional identities, and people's environmental imaginaries.

Each geographer tries to make sense of the jargon infused descriptions of their counterpart, but eventually, with eyes glazed over, they just nod their heads in an unconvincing agreement and move on. A political ecologist, who is hiding in a resplendent patch of prairie blazing star, eavesdrops on their conversation. After writing their jargon down on a waterproof notepad, this scholar returns to the office to critique, borrow, and combine these seemingly disparate ideas into a narrative that simultaneously considers the grassland's ecology in its natural and political dimensions. A political ecology of the prairie shows that the biogeomorphologist and cultural landscape scholar had more in common than they may have realized. They used different units of observation, spatial-temporal scales, and theoretical frameworks to describe the landscape, but they both interpreted it as a non-equilibrium landscape" (Grabbatin and Rossi, 2012, pp.275–276).

11.3 The lie of the road[180]

Road access and the quality of roads not only have an impact on villagers and the environment but also on the assumptions and type of work outside researchers carry out, for example a researcher who is studying the impacts of the timber industry on the commercialisation of bushmeat would not choose a study site where no bushmeat is being traded, even though the site may once have had a timber company operating in it and bushmeat was being traded. Though this is well documented by, among others, Chambers (1983) it is still an issue in remote rural forested areas of places such as Gabon.

In Gabon remote rural areas abandoned by industries quickly become a logistical nightmare for researchers and projects as rapid access becomes difficult, if not impossible with the degradation of the transport infrastructure. This is unless they have the material and finances to repair the transport infrastructure, provide transport, or the time to walk. This is exemplified by the research of Foerster, *et al*. (2011), who, as part of the debate on the association between location, conservation initiatives and poverty, undertook research to look at the impacts of national parks on local people livelihoods. In one of their study sites, to the north of Waka National Park in Gabon (the same study site used in this thesis) road bias became an issue, as they noted, in a footnote to a table, "[s]tudy villages at Waka National Park could not be included in the intensive survey because roads to this part of the country became impassable at that time" (Foerster *et al.*, 2011, p.349), even though, at this time, unreliable transport into the area was still a possibility (see Chapter 5). A few years later another study, at the same time as the research for this thesis was being carried out and also in the same area north of Waka National Park, decided that local participants of a Participatory Mapping Project should be transported to the nearest town with easy access because transporting the equipment to the study site was deemed too difficult (Brainforest, 2010; personal observation).

[180] I would like to thank Professor Charles Romain Mbele of the *Département de Philosophie* in the *Ecole normale supérieure de Yaoundé* (Mbele, 2010) for his comments on this section. Additionally, my observations come from eight plus years of ferrying local villagers around in three different hard-to-reach localities in Gabon, Santa Clara –just thirty kilometres from Libreville, Ekouyi on the Batéké Plateau, and the villages around Ikobey, one of the places in Gabon most off the beaten track. In some cases this was done at the middle of the night during emergencies.

Project	Type of project	Area	Reasons for the abandonment of the project	Reference
Parks and People (Waka)	Research to look at the impacts of parks on peoples wealth	North of Waka national park (Gabon)	Difficulty in access	(Foerster *et al.*, 2011, p.349)*
Langoue Bai	Tourism	Ivindo national park (Gabon)	Too expensive to maintain access	(personal communication Nigel Orbell, 2008)
Operation Loango	Tourism	Loango national park (Gabon)	Access cut off as plane service could no longer run	(French, 2009; inyathi, 2014; Wildlife Extra News, 2014)
Mikongo Conservation Centre	Tourism and research	Lopé national park (Gabon)	Expense of logistics and transport making tourism financially unfeasible	(French, 2009; personal communication Sandra Ratiarison, 2010)
Great ape and forest elephant programme	Great ape and forest elephant conservation	North east Gabon	Expense of logistics and transport	(personal communication Sandra Ratiarison, 2010)
Waka Ethnobotany training program	Botanical inventory and training	North of Waka national park (Gabon)	Difficulty in access.	(personal communication Walters, 2014)
Landscape Land Use Planning	Research on land use	Maringa/Lopori-Wamba (Democratic Republic of Congo)	Difficulties of communication due to isolation of programme sites	(Dupain, Degrande, *et al.*, 2010, p.37; Wicander and Coad, 2015)
The boat project	Supplied boat for alternative livelihood away from bushmeat	Maringa/Lopori-Wamba (Democratic Republic of Congo)	Access to market for commercial crops broke down when the government impounded the boat	(Dupain, Bwebwe, *et al.*, 2010)
Appui aux initiatives du village d'Ayem	Help villagers to grow commercial crops as alternative from hunting	Ayem (Gabon)	Access to market too expensive for products to be sold	(Coad *et al.*, 2014; Endamana, 2014; Endamana, 2013)

Table 11-2: Examples of projects that have suffered or were stopped due to problems with access to the projects study sites. * It should be noted that the access issue in Waka is reported as a footnote of a table and that during this period access was possible throught the use of the sub-prefet's vehicle (see Chapter 5.5.3).

These two examples from the study site, as well as others (Table 11-2) demonstrates that in countries such as Gabon "learning about rural conditions is mediated by vehicles" (Chambers, 1983, p.13), with the interaction between researcher and local people in remote rural forested areas being dependent on the researcher arriving in their own 4 by 4 vehicle (Eisen, 2010) and so never get to know the reality of normal transport to the project site. The 4 by 4 forms an umbilical cord to the outside world that can be quickly used in case of an emergency or if supplies need to be procured. In this way the researcher may not realise the issues of day to day transport that occurs in the "walking world" that the rural populations inhabit (Cleaver in Barwell, 1996, p.vii; Bryceson *et al.*, 2008; Porter, 2002).

For many researchers, conservation practitioners and development professionals the journey to their project sites starts with vehicles in urban centres, it then continues on a network of roads that are usually in good condition and end where the tarmac or laterite ends. Further hindering the learning process on rural condition is the need to find "places for spending the night, and shortages of both time and fuel dictate a preference for tarmac roads and for travel close to urban centres" (Chambers, 1983, p.13). At the same time local staff may wish to impose comfort on their "distinguished visitors" by finding living conditions in hotels, or research camps (Brainforest, 2010) far from the site being visited with living facilities that preferably have electricity, water, air-conditioning, western food and drink. Furthermore, local staff may have difficulty in accepting that a researcher may want to stay overnight at a village site, "[t]he result is overlapping urban, tarmac and roadside biases" (Chambers, 1983, p.13).

The rural populations inhabit "a walking world" (Cleaver in Barwell, 1996, p.vii; Bryceson *et al.*, 2008; Porter, 2002), where they are "frequently marginalized and invisible, even to local administrations" (Porter, 2002, p.285), timber companies and NGOs. If they are recognised it is usually in token gestures (food and drink) during the meetings that are held by politicians, companies and NGOs for various reasons; to get elected, to show donors that they have sought local participation (personal communication Walters, 2012), or to show that they have complied with national or international regulations for the exploitation of natural resources.

Many outsiders, be they researchers, NGO workers and their consultants, employees of the timber industry, government officials, are dependent on 4 by 4 vehicles (Eisen, 2010), that are not readily available to local people. Furthermore these 4 by 4's have, nearly, prompt scheduling departures while rural people may have to wait several days, if not weeks, before they can get into a vehicle, usually over loaded, to the destination they want to go to (Porter, 1995; Porter, 2002). To initiate movement in these rural spaces may be as simple as getting up and going into the “walking world” (assuming there is little luggage), while in the world of the 4 by 4 preparation becomes an expedition.

This “white car syndrome” (since many of these 4 by 4s are white Land Cruisers, though the people inside may not be) takes outsiders into a Foucauldian discourse on heterotopia where there is a “juxtaposing in a single real place several spaces, several sites that are in themselves incompatible” (Foucault, 1986, p.25; Bishop, 1996). Unlike utopia, where an idea represents a place that is not real, heterotopia is when a real space has more than one meaning depending on a person, or persons, view point (Foucault, 1984). Roads and 4 by 4s are one such heterotopia, whereby the physical presence of a road or a 4 by 4 represents different things to different people. For example villagers in a remote rural forested area could see a new road as a potential development opportunity through which they can keep up social relations (Perz *et al.*, 2007; Porter, 1995; Van de Walle, 2002; Windle and Cramb, 1997) as well as bringing access to the wider world. A conservationists may see the potential damage that a new road may cause to the surrounding environment which may be partly based on a romantic view of nature (Adams and McShane, 1996; Adams, 2004).

The following tries to tease out some of the heterotopian meanings of both the road and the 4 by 4s to two groups of people, the outside researcher / NGO worker and the local person. There are of course other meanings for outsiders such as a forester or a government official, as well as for other local people subgroups such as women and men, elderly and young which I will not go into. Over time the heterotopia or roads can also change (Giles-Vernick, 1996), for instance in the Diboka village of the Koulamoutou site the elderly mention how roads were originally unwanted due to the forced labour required to create them, but today people are thankful for them due to the link that roads provide to towns, the wider world, jobs, education and family.

For the outside researcher / NGO worker, judgments are shaped, consciously or unconsciously, willingly or unwillingly, by a romantic view of nature (Adams and McShane, 1996; Adams, 2004) as emphasised in numerous, films, reality programs, nature programs, tourist safari brochures and adverts where a trip in a 4 by 4 creates, among other, “dreams drawn directly from the tradition of Empire and overseas exploration, with long range adventures and safaris in distant parts” (Bishop, 1996, p.259). In some cases the outsider can be blinkered by the mission, just as in 1881 when Thomson wrote:

> further marked by his profound ignorance, both of the work and the country before him. But that was nothing! As he said, his king had need of him in his philanthropic and enlightened designs for the opening of Africa. His Majesty had said, "Go to Zanzibar, and organise a caravan to travel in the interior." That was sufficient for him, and without considering such trivialities as whether he was fit for duty or not, he had at once set off (Thomson, 1881, in Fabian, 2000, p.24) [181].

As for the rural population, living along remote rural degraded forested roads, white car syndrome manifests itself in various sentiments depending on the history of interaction with the outsiders arriving in the 4 by 4's. This could range from hope that the outsiders may change their lives in one way or another "*on était en forêt, on pensait que l'autre côté de la forêt il peut avoir une certain bonheur donc on peut pas souffrir... mieux que vivre en forêt*"[182]*,* to the fear that the outsiders may come to take something away from them.

This heterotopia is not just represented by the physical 4 by 4 space, but also along the whole journey that is carried out by the 4 by 4 on remote rural degraded roads. On the journey itself the white car syndrome may get reinforced if the 4 by 4 gets stuck, either on a broken bridge, by a fallen tree or a mud pool. For the outsiders this event could have two outcomes, both of which reinforces the adventure aspect of the white car syndrome (Eisen, 2010). If they are by themselves then these outsiders will have to get dirty and dig the vehicle out, while if these outsiders are accompanied by a local person then the sense of adventure continues, in a more colonial style, as the locals push and shove the laden 4 by 4 out of its predicament.

For the local people the trapped 4 by 4 represents one more problem to overcome, while hampered by being dressed in their "Sunday best" on their way to the city. Not only to keep the tenuous link open to the wider world but also as it could result in "the total failure to get to market, [that] can also result in major losses through spoilage" (Porter, 2002, p.290), or a late arrival to the market where trade has already finished and people are leaving.

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[181] To give a modern day relevance replacing references to royalty and country with one of the following conservation, development, and company, while replacing caravan with 4 by 4.

[182] "we were in the forest, we thought that at the other side of the forest there could be a certain happiness, so we would not suffer … better than living in the forest" Nyoe II 22/04/10 [recording DS4000079; time 1:27:00].

During the trip, usually on the more remote extremes of roads running into and through forests, the outsider in the 4 by 4 will, from time to time, be surrounded by a wilderness (Rambaldi *et al.*, 2010). An impenetrable curtain of greenery plays on the white car syndrome. To the casual outside observer, this impenetrable curtain of greenery represents a “primary forest”, full of beasts and creatures “As seen on TV”, even when this greenery is only a couple of kilometres from an urban area and made up of secondary trees such as the common, colonising species of Umbrella tree, *Musanga cecropioides,* (personal observation, Santa Clara, Gabon). Yet to local people that same “primary forest” may represent an old village site, an old plantation, a cemetery where their ancestors are buried, or places where they may have once been employed in an old colonial commercial concession where natural resources were once, in a bygone era forgotten by the outside, exploited, or areas that was once forbidden by past administrations for them to enter, be it a park, water catchment area, military base, etc. (personal observation, Tanzania; Santa Clara, Ikobey in Gabon). In some cases a village site may represent a specific event in their history:

> *C’est la* [Mandji old village site] *ou les hommes, ils ont commencés pour boire le vin* [palm wine and honey wine] *déjà un peu un peu. - Oui c’est à ce moment imo … - avant le Madre ont ne buvais pas le vin heuh, avant il y a rien, c’est là que les gens ont commencé, ou ils ont commencé à faire mettre le bois amer* [*Garcinia* spp. to help ferment the wine] *chacun a pour lui son madokou* [wine], *il boit en cachet il prend seulement un verre*[183].

The arrival in the village by the outsiders in the 4 by 4 continues the white car syndrome, whereby the outsiders imagination are filled with a “fantasy construction of wilderness experience” (Porter, 2002, p.285). This fantasy will include rhetoric from their own disciplines, even when they themselves know it to be wrong; the anthropologists with Rousseau's supposed “Noble Savage” (Lovejoy, 1923), the ecologists with images of the environmental destruction that these villages can create (Foerster *et al.*, 2012), the developer aghast by the signs of poverty

[183] “It was there [at Mandji an old village site] where men started to drink wine [palm and honey wine], to drink it a bit. – Yes it was there imo … - before Madre we did not drink wine, before there was nothing, it was there that people started, where they started to put bitter wood [to help ferment the wine] everyone had their own madokou [wine], they drank in hiding, they only took with them a cup” Tchibanga 27/04/10 [recording DS4000084; time 1:02:55].

and development measures that could remedy it (Sayer *et al.*, 2012; personal observation, Ikobey)[184].

To local people the arrival of outsiders could represents potential possibilities not just for alcohol (Coad *et al.*, 2010; Oishi, 2012), but also for employment, development, gifts and even a means to migrate to a less rural area (personal observation, Ikobey). Or the arrival of the outsider in a 4 by 4, may represent inequality, where-by these rich outsiders have the power to take what little they have be it by taxes, the taking of natural resources, dominating and taking over ceremonial events, the hindering of their free access to land or even the ease of access that they have, while covering the local people in dust or mud, depending on the season (personal observation, Santa Clara, Ikobey, Ekouyi, all in Gabon). Interestingly the arrival of an outsider, especially a white one, into a village using local transport, brings different connotations for local people, such as the person is mad (personal observation, Ikobey), the person may marry one of them (personal observation, Ikobey, Ekouyi), or that they are from Peace Corps and their ilk and so do not have much money, but there will be plenty of partying (personal observation, Nigeria).

While in the village the 4 by 4 is a constant reminder of this white car syndrome. To the outsiders it reminds them of the outside world, the urban technological world dependent on transport infrastructure. The 4 by 4, and the road, is an umbilical cord to this world, one that can be quickly used in case of an emergency or if supplies need to be got.

To local people the 4 by 4 and the road, is also seen as an umbilical cord to the outside world, but not for the same reasons. Because local people are not as reliant on supplies from the outside world, but rather from the environment that surrounds them, the 4 by 4 and the road is more a link to potential opportunities such as keeping up social relations (Perz *et al.*, 2007; Porter, 1995; Van de Walle, 2002; Windle and Cramb, 1997) as well as obtaining access to education, employment, trade and in emergencies, health care, though there are many cures in the surrounding environment (Southworth *et al.*, 2011; Vasconcellos, 1997). For an elder in Nyoe II the forest is a hard place to move around in when trying to trade:

> *En forêt les gens se déplaçaient difficilement pour le vendre pour le acheter quelque chose donc l'idée de sortir c'est parce que près de la route il y a assez*

[184] For example a comment from an international aid agency personnel on the lack of food in Pygmy villages, when in fact the food was stored in the forest and not in a Western cupboard or fridge / freezer.

d'activités donc ils peuvent demande à leurs femme de creuse les timba [manioc root] *ou bien coupe une certain banane pour vendre*[185].

When the 4 by 4 goes the local people are once again left to their own devices (Bishop, 1996). If a 4 by 4 stays in a village for a long period of time, and the owner regularly helps local people's access to the wider world with it, the ownership of the 4 by 4 gets blurred, with local people claiming it as their own (personal observation, Ikobey, Santa Clara, Ekouyi all in Gabon; personal communication Walters (2010)). This blurring of ownership can also be seen during periods of elections where candidates or party members may each claim the arrival of a road and a 4 by 4 as being their doing, and "hijack" them to ferry people to political rallies (personal observation, 2010).

Finally while deteriorating roads may offer an opportunity for the outsider to see a wild wilderness away from the tame and manicured one that normally surrounds them, for the local person the thin meandering line running through the forest is a constant reminder of their daily struggle to make their mark on the environment that surrounds them. As for the 4 by 4, the heterotopia reinforces the difference between the haves and have not, the ability for a group of people to have easy access to both social and spatial ability, both of which are important to society.

In 1945 Briault gave a description of the forest which highlights how a heterotopia can form, in this case he compares walking through the forest of Europe and Africa, and how different the experience is:-

> *En France et en Europe occidentale, la forêt est aujourd'hui fort réduite par la culture et les champs. De plus, elle est, comme le reste du pays, percée de routes, de voies charretières, de layons, qui permettent au voyageur de circuler sous son couvert et de traverser en tous sens sans avoir à lutter contre elle. Même allant à pied, il a devant lui un large ruban de voie aplanie: à gauche et à droite, la végétation lui fait place nette et ne jette aucun obstacle devant ses pas. Si*

[185] "In the forest people moved to sell, to by something, with difficulty. So the idea of moving out of the forest was because near the road there is enough activity so that they could ask their wives to up root a manioc tuber or cut a hand of bananas to sell" Nyoe II 22/04/10 [recording DS4000079; time 1:29:09].

d'aventure un arbre y tombe, renversé par l'orage, c'est un accident que les forestiers réparent vite.

[…]

Pour ceux dont la vie se passe obligatoirement en marches à pied sous le bois [africains], le point de vue change. C'est une chose fort dure à subir que la pesée de ce couvert continuel, dense, noir à force d'être vert, lorsque vous portez cela pendant huit ou neuf heures de suite, tandis que se poursuit le monotone défilé des troncs d'arbres finalement tous pareils.

[...]

Renoncez à toute distraction, autrement voici des branches basses qui vont vous éborgner et voici des rameaux qui portent des épines, des lianes qui ont des hameçons, des herbes-rasoirs qui coupent la peau en font perler le sang. Gare aux nids de frelons ou de guêpés ! Gare aux tiques que laissent sur le chemin les éléphants et autre sauvagines ! [186] (Briault, 1945, pp.11–12,15–16).

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[186] In France and Western Europe, today's forest has greatly reduced in size by agriculture. Furthermore, it is, like the rest of the country, covered by roads, tracks, transects, that allows the traveller to go where ever they want in all directions without having to fight against the forest. Even walking, there is in front of the traveller a large ribbon of a path: to the left and to the right, the vegetation makes place so as to not become an obstacle. Even if a tree adventured to fall, knocked over by a thunder storm, it's an accident that the foresters repair quickly. …

For those whose lives have to pass by foot under the [African] forest, the perspective changes. It is something very hard to live with, the weight of a continuous canopy, dense, so green its dark, when one carries it continually for eight or nine hours, while passing by is a monotone parade of tree trunks, that at the end all look the same. …

Do not be distracted, otherwise low branches will spear you, and there is a branch that has spines, lianas that have hooks, razor grass that cuts the skin and makes it cry blood. Be careful of the nests of bees and wasps! Be careful of ticks left on the path by elephants and other wildlife".

11.4 Referring to Pygmies

> "Judge Boshoff: But now why do you refer to you people as blacks? Why not brown people? I mean you people are more brown than black.
>
> Biko: In the same way as I think white people are more pink and yellow and pale than white.
>
> Judge Boshoff: Quite... but now why do you not use the word brown then?
>
> Biko: No, I think really, historically, we have been defined as black people, and when we reject the term non-white and take upon ourselves the right to call ourselves what we think we are, we have got available in front of us a whole number of alternatives, starting from natives to Africans to kaffirs to Bantus to non-white and so on, and we choose this one precisely because we feel it is most accommodating
>
> Judge Boshoff: Yes but then you put your foot into it, you use black which really connotates dark forces over the centuries?
>
> Biko: This is correct, precisely because it has been used in that context our aim is to choose it for reference to us and elevate it to a position where we can look upon ourselves positively; because no matter whether we choose to be called brown, you are still going to get reference to blacks in an inferior sense in literature and in speeches by white racists or white persons in our society" (Biko, 1996, p.104).

Throughout history, especially recent history, various names have been used when referring to these "little people" as Battell called them in 1625 (Battell, 1901). Some, such as "Negrillos" used by Hamy (Flower, 1889), "Négrilles" (de Quatrefages, 1887) were used in colonial and taxonomy texts. For Leonhardt (2006) these names are "more definitely human [...] that moves it into association with the Negro" (Leonhardt, 2006, p.72), rather than with animals. However, these names are alien to the average person.

Earlier scholars referred to Pygmies as dwarfs and elves (Leonhardt, 2006). These were used in a fantastical manner, as if the authors could not believe their eyes such as the cries that Du Chaillu gave when he first met the Babongo, who he referred to as the Obango.

Some scholars have taken to referring to the Pygmies as the "first inhabitants of the land" (Knight, 2003, p.83). Others have argued the case for and against the use of the words indigenous peoples or autochthonous, for Leonhardt the difference between the two is that the latter "presupposes a state" (Leonhardt, 2006, p.73) while the former does not.

"Indigenous" has also become part of the human rights discourse, used when trying to win resource use rights for Pygmy groups from the state. Yet, certainly in the Gabon case, this has its own problems, for strictly speaking, neither Indigenous or Autochthonous can be used for the Baka in Gabon, since the Baka are recent arrivals to the country, coming from neighbouring Cameroon and Congo in the 1880s (Bahuchet, 1993a; Hombert and Perrois, 2007; Knight, 2003).

Even the word "Pygmy" has its problems. The first written use of the word Pygmy was by Homer in the Iliad. He used the Greek work *Pugmaios,* in turn this became *Pygmaeus* in Latin, meaning "*haute d'une coudée*" (Ballif, 1992, p.12). Today, the word Pygmy has, in some circles, acquired a derogatory connotation (Knight, 2003). As Bahuchet (1993) explains, at the end of his article on the invention of the word Pygmy:

> [e]*n vérité, les Pygmées n'existent pas. Les hommes qui existent ont noms Baka, BaBongo, BaKola, BaAka, BaSua, Ѐfè, Asua, BaTwa... Qui saura jamais ce qu'ils ont en commun, autrement que d'exciter l'imagination des Occidentaux?* (Bahuchet, 1993b, p.175).

But, then again, many of the names we give to populations are an invention of someone or other at various periods in time. Some classic example would be the use of English when referring to the population of Britain, rather than British; much to the disgruntlement of the Scottish, the Welsh and the Irish. And it is not just people outside Britain who use this nomenclature, but also people within Britain. Or calling the people of the United States of America, American, when, according to both their passports and the official administration, they are called U. S. Citizens or Citizen of the United State of America.

To get around this "Pygmy Problem" (Ballard, 2006), scholars have taken to creating even more names to describe the different populations of forest people with supposedly unique characteristics. Such as the name that Gusinde (1955) uses "Twides", or "hunter gather", (Gusinde, 1955), for Leonhardt (2006) this *has* "an economic concept with political implications" (Leonhardt, 2006, p.73). Some other scholars have started to use longer and a more descriptive name such as “Forest People” (Knight, 2003, p.81) or “African rainforest hunter gatherers” (Leonhardt, 2006, p.72).

Where will it stop! By going down the road of using descriptive names, we may end up with a word or phrase that becomes longer and longer, while becoming more and more explicit such as the Maori name *Tetaumatawhakatangihangakoauaotamateaurehaeaturipukapihimaungahoronukupokaiwhenuaakitanarahu* used as a name for a hill in New Zealand; translated into English it means “The summit where Tamatea, the man with the big knees, the climber of mountains, the land-swallower who travelled about, played his nose flute to his loved one.”

When generalising about Pygmy populations this thesis uses the word “Pygmy”, with the capitalisation to emphasise that I am using it as a name for a group of people. However, when dealing with a specific Pygmy population then I will be using the most recent and up to date, names available, such as the Babongo Pygmies.

There are several reasons to use “Pygmy” as a generalised term. Firstly it is the oldest known word used by scholars to describe these populations, “elbow height”. While this may not be a completely accurate definition, but, as Biko (1997) points out above, neither is Black or White. Historically this is the name that these populations have been given by Europeans, and it is up to these populations to give their own new names, if they desire so, rather than western scholars.

Secondly, Pygmy is a word known by a lot of people, not just within Africa but also around the world. Admittedly the word “Pygmy” has become a heterotopian word (Foucault, 1984), for it conjures up different images and reactions from different people, but the word itself has no original derogatory connotation, it has acquired this overtime (Knight, 2003) and if anything one should try to change these connotations by elevating the word “Pygmy”, “to a position where we can look upon” (Biko, 1996, p.105; see also Freire, 1996) the word in a positive fashion. Rather than using other names that allows “the liberals [to] make themselves forget about the problem or take their eyes off the eyesore” (Biko, 1996, p.22).

The final reason for using the word Pygmy in this thesis, is that it is the word that the Babongo Pygmies in the study sites prefer. They even prefer the word Pygmy over the use of Babongo. However, a similar quick survey in a Babongo Pygmy village several hundred kilometres away near Franceville found the opposite.

11.5 Forms used in demography questionnaires

Personne	Pers_ID		1)Pers_Enq_ID		2) Nom, Prenom de interlocuteur	

3) Date		4) Heure		5) Village		6) GPS		7)Lat. N/S)		8)Long. (O/E)	
9)Nom		10) Prenom		11) Sexe		12) Age		13) Age Approx.		14) Village Nee	
15) Ethnie		16)Ethnie Pere		17) Ethnie Mere		18)Nom, Prenom chef de sa menage		Relation avec chef			
19a)Depuis nee ou creation		19)		20)Dernier annee d'ecole		21)Village ou partir a l'ecole		No d'enfants			
Autre village habitez						Mariee a					

22)Emploi	23)Date Emploi	24a)Emploi a Duree	24b)Duree Temp Unite	25)Avec quelle compagnie	26)Dans quelle ville / village

Commerce ce dernier mois

27)Produit	28) Combien Vendu	29)Unite	30)No. fois / mois	31)Ou Vendu

Commentaire

Personne	Pers_ID		1)Pers_Enq_ID		2) Nom, Prenom de interlocuteur	

3) Date		4) Heure		5) Village		6) GPS		7)Lat. N/S)		8)Long. (O/E)	

Consommation dernier 3 jours

32)Jours	33) Chose Mangez	2Achetez / Plantation / Chasse / Piege	Origine (ou achetez / ou chasse /ou plantation
Hier			
Avant Hier			
Av. Av. Hier			

Activites de Semain

35)Jours	36) Activite	37a) HierDuree d'activite	37b)Duree unitee	38) Activite avec qui
1				
2				
3				
4				
5				
6				
7				

Commentaire

Personne	Nom, Prenom de interlocuteur							
Nom des enfants								
No. Maison / Village	Nom	Prenom	Age	Sexe	Niveau etude	Ecole, Ou	Marie a	No. Enfants

Commentaire

11.6 Form used in activity questionnaires

Retour au village	Rentreez_ ID		1) Enq_ID							
2) Date	3) Heure	4) Saison	5) Village	6) Nom, Prenom de Personne	7) Sexe	8) Ethnie				
9) Revint de			10) Revint de quelle village / ville							
Chose revint avec										
11)Produit	12a) No.	12b) Unite	13)Provenance	14)Produit Utilise pour	15)Achetez/ Collect/ Cadeau	16)Si achetez payee	17a,b) Si cadeau, de qui, Nom, Prenom, Ethnicite Village	18)Si cadeau, pourquoi	19a,b) Si cadeau, de qui, Nom, Prenom, Ethnicite Village	20)si donnais, raison

11.7 The use of statistics and modelling

> "The fact that the polynomial is an approximation does not necessarily detract from its usefulness because all models are approximations. Essentially, all models are wrong, but some are useful. However, the approximate nature of the model must always be borne in mind" (Box, 1987, p.424).

Overconfident statistics (Mannes and Moore, 2013) have been used to convey bad news that has led to the public being turned off by conservation doom and gloom (Balmford and Cowling, 2006). The use of statistics in this political way was why, on its creation in 1831, the British Association for the Advancement of Science, which later became the British Science Association, agreed that statistics was not a "science" (Poovey, 1993). In the early 1800s statistics, from the German *Statistik* "to describe efforts in the comprehensive description of political states" (Hilts, 1978, p.24), had been created by social scientists to address the rapid social changes that were occurring due to the industrial revolution (Goldman, 1983; Hill, 1984; Hilts, 1978; O'Brien, 2011; Poovey, 1993; Selleck, 1989; Willcox, 1934) using social methods that have not generally changed much (Selleck, 1989)[187]. When the Association did accept statisticians in their midst it was with the warning that "if they [the statisticians] went into provinces not belonging to them, and opened a door of communication with the dreary world of politics, that instant would the foul demon of discord find his way into their Eden of philosophy" (Adam Sedgwick in Poovey, 1993, pp.256–257).

Currently there is a growing trend to use modelling to base or partly compose analysis and the conclusions of environmental sciences. Through its "unique properties" (Ascher, 1981, p.81)

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[187] An example is this description of one of the first door to door surveys carried out in Manchester in 1834 "the Manchester Statistical Society, over one hundred and fifty years ago, had hit upon a durable research strategy: choose a trendy topic which involves working with people of low socioeconomic status, design a questionnaire, hire a research assistant, use him (now, it would probably be her) to do the fieldwork, appropriate the results with the minimum of acknowledgement, turn them into statistical tables, and deliver the findings as a paper to a learned society - like the AARE. The Manchester Statistical Society got all this right, first time, in 1834, with the help of an intelligent Irishman.
Even the manner of reporting has a familiar ring. The agent, 'research assistant', had trouble getting answers - some people refused him admittance to their homes and others were absent when he called. Heywood was undaunted - though 'the return was not as complete as we would wish' there was "no reason to dispute its correctness". It was a "fair and impartial" account of 4,102 families from 'the poorest class of the labouring population of Manchester'" (Selleck, 1989, p.6).

modelling has the potential to give great insight to environmental sciences and conservation, allowing the simplification of a complex system with the use of core assumptions. It is this potential that allows models to have an important role in understanding ecological systems that are being examined, for they allow the revelation of a “set of interactive relationships” that are often “not apparent to an analyst who examines these relationships one at a time” (Ascher, 1981, p.255). Relationships that may be counter intuitive or surprising, especially in cases when not much is known about a system being examined. Von Thünen’s model on land use (Mäki, 2011; Mäki, 2004; von Thünen, 1966) is an example of this, however, as von Thünen cautioned, the crude assumptions he made in the modelling process may not reflect reality and, for this reason, his theory is sometimes dismissed. However, even in a global economy where items can be shipped cheaply from one side of the globe to another so that costs are no longer an issue, this does not mean that von Thünen theory is no longer applicable. In certain areas transport cost still matter. For example in California it is cheaper to ship hay to China than shipping hay to the next valley (Leithead, 2014). Modelling therefore should not be seen as a miraculous conservation tool that can supply all the answers wherever in the world there are environmental threats, especially in the long-term. A parallel comparison can be seen in the field of economics where the predicting of the latest financial crisis has been compared to the “narrative approach” of the fathers of economics such as Adam Smith, John Maynard Keynes and Friedrich Hayek, an approach that was successfully used in the prediction of financial crises, such as by Hyman Minsky in the 1980s (BBC News Magazine, 2014; Dillard, 1984; Minsky, 1982).

The weakness of modelling is not due to the models themselves but rather due to the people behind such models, as well as the users who may not know all the assumptions behind a model. As in the early days of “forecasting” in the social sciences (Ascher, 1981; a similar debate occurred in the political sciences during a similar revolution in methodology in the 1980s see Brunner, 1982) the use of complex models is very reliant on the modellers themselves, a fact also noted by the British Association for the Advancement of Science in 1831 with their argument against the inclusion of statistics as a “science” (Poovey, 1993, p.256). Modellers can be “completely ignorant of the performance record, or are attracted solely by the promotional advantages of the scientific aura of modelling [sic]” (Ascher, 1981, p.247), or may be attracted to modelling due to the potential explanations that they may offer, though these are rarely verified, especially in the long-term (Ascher, 1981; Ascher, 1979; Brewer, 1983; Brysse *et al.*, 2013; Oppenheimer *et al.*, 2008). The explicit nature of modelling results in the rejection of factors where relevance may not be consistently clear-cut (Ascher, 1981, p.254; Westoby, 1984) while being dependent on the quantitative data, sometimes from second hand sources, for which the quality may not be up to scientific standards (Drury *et al.*, 2011, personal observation).

These weaknesses are comparable to the ones highlighted during the critique of the transformation of social sciences to a “true” science (Overholt, 2000), which was occurring in the 1970s (Overholt, 2000). This transformation was done through the creation and improvement of methodological techniques and tools (Overholt, 2000), much like current conservation biology, a relatively young discipline (Ehrenfeld, 1987; Mermet *et al.*, 2013; Soulé, 1985). However, Ascher (1979; 1978) showed that this narrow obsession in the social sciences lead to “unfortunate consequences” such as “assumption drag”. As an example of these consequences, Ascher (1981; 1978) compared the previous judgmental approach to “forecasting” Gross National Product with, the then new econometric modelling techniques. He found that when it came to short-term Gross National Product forecasting judgment was more successful than econometric models, however when it came to long-term predictions, there was little difference. He highlighted one of the problem with predictions based on judgments from past experience and knowledge is that there is no guarantee that past experience and knowledge would hold in the future, or in another place (Ascher, 1981), with the result that forecasts are likely to diverge from reality creating “assumption drag” (Ascher, 1979; Ascher, 1978; Brysse *et al.*, 2013; Oppenheimer *et al.*, 2008).

11.8 Pre- Atlantic trade – pre mid-fifteenth century

11.8.1 Metallurgical products traded during the pre-Atlantic trade - pre mid-fifteenth century

Unlike the historic and archival literature on trade and land use after the start of the Atlantic trade in Gabon, which has generally been ignored by conservation practitioners and ecologists, the archaeological literature is widely acknowledged by conservation practitioners and ecologists (Delègue *et al.*, 2001; Maley, 2001a; Maley, 2001b; Maley, 2001c; Ngomanda *et al.*, 2007; Oslisly *et al.*, 2013; Oslisly, 2001; Palla *et al.*, 2011; Schwartz, 1992; Schwartzman *et al.*, 2000; White, 1992; White, 2001; Wilks, 2003), for this reason this archaeological literature is not dealt with as thoroughly as the literature for later periods of Gabon's environmental history.

Small scale trade, such as iron and copper, is known to have existed on the coast and in the interior of Gabon well before the appearance of the Portuguese along the coast of Gabon in the mid-fifteenth century (Gardinier and Yates, 2006). Along the coast there may have been economic trade routes in the vicinity of the Gabon Estuary dating back to 6,000 BP where hunter-gatherers collected basalt, to use in tool making (Clist, 2005), either from neighbouring areas or from further afield (Clist, 1995; 1999, p. 131; 2005, pp. 426, 473, 707).

Iron production started in a couple of centres such as Moanda (in the south of Gabon, Map 2-1) around 2,400 BP (Clist, 1995, p.202; Clist, 2005, p.791). At first only the products from metallurgy were traded (Clist, 2005; Klieman, 1997, p.190), leaving artefacts which can still be found along these old trade routes. Only later did secondary smelting centres develop (Clist, 2005; Vansina, 1990), after a period of perfecting the techniques by trial and error (Holl, 2009), such as in the middle reaches of the Ogooué River (Map 2-1) between 2,200 to 2,100 BP (Clist, 2005, pp.623, 780; Dupré and Pinçon, 1997; Klieman, 2003; Klieman, 1997; Ngomanda *et al.*, 2007; Oslisly, 2001; Wilks, 2003, p.71). Linguistic studies suggest that these secondary trade centres sprang up through transfer of skills along trade routes as well as being passed through family (Clist, 2005; Klieman, 1997, p.147; Holl, 2009), it also suggest that the inland trade of 2,200 BP was occurring between communities hundreds of kilometres apart, including trading with Pygmy groups (Clist, 2005, p.788; Dupré and Pinçon, 1997).

The trade in metal products, that occurred at this time, would have had a major, but gradual (Ehret, 2002, p.200), impact on the culture of both agriculturalist and hunter-gatherer communities, the likely ancestors of today's Pygmy groups (Clist, 1999). The introduction of iron into the economy would have "increased [the] centralization of economic spheres" (Klieman, 1997, p.151), with people coming towards these smelting centres (Klieman, 2003; Klieman, 1997; Vansina, 1990) to participate in the emerging economy. The start of an iron based economy is likely to have promoted increased economic specialisation in resource use (Clist, 1995, p.198; Klieman, 1997, p.154), with people developing and exploiting new economic and ecological niches. All of this would have reinforced the links between agriculturalist and Pygmy groups (Klieman, 1997, p.180), with trade links being reinforced (Ehret, 2002, p.195), though the Pygmies, in 2,500 BP, would have still kept "economic and social autonomy" (Klieman, 1997, p.196).

11.8.2 The impact of the pre-Atlantic trade on the environment – pre mid- fifteenth century

The savannah landscapes of Lopé were last forest-free during a interglacial period that occurred between 2,500 BP and 2,000 BP, corresponding to the Bantu-speaking people's migration and to the introduction of iron (Maley, 2001c, p.79; Oslisly, 2001, p.102; Ngomanda *et al.*, 2007; Schwartz, 1992). Although "[u]*ne question que l'on peut cependant se poser est de savoir si le recul de la forêt observé … est purement climatique, où si l'homme y a également sa part*"[188] (Schwartz, 1992, p.359), what is certain is that the introduction of iron works would have had both direct and indirect environmental impacts on the landscape. Direct impacts on the environment would include clearance due to the demand for fuel for the furnaces whether as wood or transformed into charcoal (Wilks, 2003, pp.71–72). The trees used for fuelwood may have been selected for "slow-burning, dense, hard" species of trees which are usually slow growing, and may not have been sustainably harvested locally (Goucher, 1981, p.181; Dupré and Pinçon, 1997, p.172), though whether this fuelwood selection occurs is questioned (Picornell Gelabert *et al.*, 2011; Théry-Parisot *et al.*, 2010), and may not have had as big impact as swidden agriculture (Schwartz, 1992), as "no fuel collection occurs in vegetation catchments (i.e., the rainforest) that lay outside the socio-economic and cultural milieu of the villages" (Picornell Gelabert *et al.*, 2011, p.382). Whether this fuelwood demand would have resulted in an increase in savannah area (as is known to have happened elsewhere in the world (Kirch, 2005)) or just a

[188] "a question that we can however ask is to know if the observed retreat of the forest … is wholly climatic, or if humans also had a part to play"

slowing down of the natural re-colonisation of the savannas by trees, as is happening today, has not yet been investigated (Maley, 2001a; Schwartz, 1992).

Starting from 2,000 BP the climate became more humid and in some places the forest recovered (Maley, 2001c, p.79). In Lopé, evidence of fires deemed probably anthropogenic, can be found "20 km south of the current savannah-forest interface" dating to 1,400 to 1,500 BP (White, 2001, p.179; Oslisly and Dechamps, 1994). Trees used for fuelwood would have encouraged the growth of pioneer trees such as *Okoumé* when people abandoned areas (Biraud, 1959, p.4; Gaulme, 1988, p.117; Palla *et al.*, 2011).

The iron trade would also have had several indirect effects such as increased plantation size around settlements to feed the people who did not participate in agricultural activities, such as blacksmiths and traders. A trade would have sprung up for bushmeat and other forest products, not only for food but also as a sign of prestige, wealth and for ceremonial purposes, including items such as ivory and elephants tails. This trade in natural resources was not only focused on the smelting hubs themselves but would have also benefited from the trade routes used to transport the iron products (Klieman, 2003; Klieman, 1997, pp.186, 200), as well as supply the traders using these routes.

11.9 Atlantic Trade – mid-fifteenth century to mid- nineteenth century

11.9.1 Some products traded during the Atlantic trade - mid-fifteenth century onwards

The Portuguese, coming from their base in São Tomé, were the first Europeans to enter into contact with the Gabonese. They arrived along the Gabonese coast during the 1470s where they met the Mpongwe in an estuary that the Portuguese called "Rio do Gabâo" (Aicardi de Saint-Paul, 1987, p.6; Gardinier and Yates, 2006; Knight, 2003; Patterson, 1975a; Merlet, 1990, p.19; Gaulme, 1988, p.63). Up until 1886, the name "Gabon" referred to this estuary and the surrounding area, upon which Libreville would later be built (Merlet, 1990, p.20).

Trade between Europe and the Gabon Estuary started in mid-sixteenth century (Merlet, 1990, p.20; Patterson, 1975a, p.8) where it developed slowly (Gaulme, 1988, p.84). When Portugal came under Spanish sovereignty, the French, Dutch, English and Brazilians took over trading in the Gabon Estuary (Merlet, 1990, p.21; Pourtier, 2010, p.2), but still it was only at a small scale. By the time the first Europeans started to settle, in the late sixteenth century, the products traded had greatly increased (Table 3-1). In 1613 Battell described on the coast of southern Gabon where:

> … a great market every day, and it doth begin at twelve of the clock. Here there is a great store of palm-cloth of sundry sorts, which is their merchandizes; and a great store of victuals, flesh, hens, wine, oil and corn. Here is also very fine logwood, which they use to dye withal … and *molangos* [bracelets] of copper. Here is likewise a great store of elephants' teeth, but they sell none in the market place. (Battell, 1901, pp.43–44, edited by Ravenstein, E. G. in 1901, first printed in 1613; Martin, 1982, p.205).

Copper was also an important metallurgical product that was being traded. The first Europeans observed "fine copper jewellery" (Martin, 1982, p.206) worn by the local population. By the seventeenth century there was an extensive trade of copper from the Teke kingdom, where it was mined, to Loango and the Gabon Estuary (Martin, 1982; Martin, 1972). The Atlantic trade started to boom in the eighteenth and early nineteenth century (Gardinier and Yates, 2006; Sautter, 1966, p.729).

At the beginning of the Atlantic trade period, European traders were interested in acquiring natural resources rather than slaves (Merlet, 1990) (Table 3-1). At first old iron and old nails were being exchanged for the natural resources which the Gabonese esteemed to be worth "more than monies of gold" (Patterson, 1975a, p.8). In 1578 Portuguese traders were buying ivory, wax, honey, palm oil, dyewood / red wood (padouk), black wood (ebony) and, on a small scale, slaves for their plantations in São Tomé (Lasserre, 1955, p.126; Merlet, 1990, p.20; Patterson, 1975a, p.8; Pourtier, 2010, p.2; Wilks, 2003, p.72). The Gabonese traders were also buying slaves from the Portuguese for their own plantations. In 1611 Brun found that:

> the people of the Rio de Gabon 'desire no other goods than black slaves'. At Cape Lopéz, he was offered ivory, 'for which they desired no other goods than men and iron.'... At mid-century, the Dutch were selling Camerounian slaves in Gabon at a rate of one adult for 150-200 pounds of ivory in tusks of 30-40 pounds each. (Patterson, 1975a, p.14).

These slaves were brought from other parts of the African coast (Gaulme, 1988, p.84), and, in the seventeenth century, were being exchanged for ivory that Europeans cherished. This also occurred in the 1870s where ivory, per pound, was "five times more valuable than … an adult slave … A large tusk … was worth a near fortune in Central Gabon" (Chamberlin, 1977, p.160).

Before the mid-1700s several Portuguese companies and later French companies tried to deal in slaves, but all ended in bankruptcy, with two-week slaving parties, in 1770, coming back with only "five to six prisoners" (Patterson, 1975a, p.34). Certain ethnicities such as the Orungu refused to "deal in people" (Patterson, 1975a, p.33) with Europeans having to resort to the kidnapping of the people boarding their boats to trade, though this would usually result in retaliation by local rulers (Patterson, 1975a).

After the mid-1700s, and until the 1840s, slavery flourished in Gabon (du Chaillu, 1861; Gaulme, 1988; Patterson, 1975a, p.64; Sautter, 1966, p.726) and with it societies and kingdoms broke down (Ehret, 2002). After the 1840s slavery carried on clandestinely until the 1870s (du Chaillu, 1861; Pourtier, 2010, p.2; Sautter, 1966, p.726; Vansina, 1990, p.209). The slave trade in Gabon was not as big as that further up or down the coast (Gaulme, 1991; Vansina, 1990): only in southern Gabon and along the Loango coast did it have a major impact on the structure of societies of the time (Ehret, 2002; Martin, 1982; Martin, 1972).

In 1770 Europeans were buying other forest products from the Gabonese coast (Table 3-1) including wax, ivory, hippopotamus teeth, honey, parrots feathers, elephant's tail (Gray, 2002; Martin, 1972; Patterson, 1975a) and later, after the 1850s, wild rubber, ebony and dyewood in bulk quantities (Chamberlin, 1977; Pourtier, 2010, p.2; Rondet-Saint, 1911, p.101; Sautter, 1966, p.729). At first old iron and old nails were being exchanged for the natural resources that Europeans wanted. For Patterson, this was due to shortages of iron (Patterson, 1975a, p.9; Gaulme, 1988, p.60). As iron was already being produced about 2,000 years before the Portuguese came, the shortage probably marked its value, as the Gabonese "esteem [iron] more than monies of gold" (Patterson, 1975a, p.8). Later, as the Atlantic trade grew, there arose a growing demand by Africans, including the Gabonese, for other European goods (Vansina, 1990) (Table 3-1). The range of goods demanded included various metals, guns, beads, textiles and, of course, alcohol, all of which were being cheaply produced in Europe in the mid-1700s, as mass production of cheap goods had started during the European industrial revolution (Ehret, 2002).

The ensuing upsurge in coastal trade again drew people from the interior towards these new coastal markets (Sautter, 1966, p.752; Vansina, 1990, p.234). This migration would have had a profound impact on both the people and the environment. African political structures were weakened by the Europeans, as Africans jostled with each other to have access to the European traders (Gaulme, 1988, p.58; Vansina, 1990). New trade routes and relays formed allowing the distribution of the European goods inland (Vansina, 1990), from places such as the "Gabon Estuary/Ogooué river region" (Klieman, 1997, p.214; Martin, 1982), while smelting centres were being threatened by the new source of coastal iron.

Chamberlin's 1977 analysis of the evolution of trade networks during the Atlantic trade period split traders into three tiers depending on their interaction with the Atlantic shipping and the flows of natural resources, both from the interior, and European goods from the ships. The first tier consisted of traders that dealt directly with merchant ships, the second tier consisted of traders dealing with the first tier and not with the ships, and finally the third tier traders operated the stages between the producers and second tier traders (Chamberlin, 1977, pp.6–7).

Middlemen vied with each other to retain control of the prestigious first tier (Chamberlin, 1977; Gray, 2002, p.26; Patterson, 1975a; Vansina, 1990), the outcomes of this rivalry was depicted by Du Chaillu who wrote that:

> [n]one of these Shekiani fellows dare trade directly with the white men. They must all submit to the extortions of their neighbours who are so fortunate as to possess the seashore; and if Ogoula were to attempt direct trade-though he has

> the finest chances-his town would be burned down in a week. (du Chaillu, 1861, p.132).

A living could be made not only by being a middleman, but also by servicing the trade route. Fishermen were in direct contact with the commerce due to the then riverine nature of the trade routes. They gave up their fishing day jobs to become porters. Others turned to commercial fishing, hunting and agriculture to feed the traders and the porters, as well as to supply the European ships for their journey back (Martin, 1972; Merlet, 1990; Patterson, 1975a; Vansina, 1990, p.211). This trade in foodstuffs included bushmeat (Merlet, 1990, p.21). In some cases people inland were sending "their children to the coast to learn … boat building and iron working" (Patterson, 1975a, p.27).

The competition between traders was not only among the Gabonese but also between the Gabonese and the Europeans. The Gabonese living on the coast were "*très-jaloux des Européens visitant l'intérieur*"[189] (Walker, 1870, p.61) and in certain case were doing *"tout ce qu'il pouvait* [sic] *pour empêcher les Blancs d'y arriver"*[190] (Walker, 1870, p.62) up the Remboué River that led from the Gabon Estuary to the interior.

Not only were people moving to participate in the trade of natural resources but the competition between ethnicities resulted in the modification of routes used to move goods. Trade was sometimes halted at key points along the routes, such as riverine rapids, with onward passage contingent on payment (Sautter, 1966, p.727; Walker, 1870, pp.71–72). To get around these difficulties some traders would divert off the waterways onto land routes (Gray, 1998; Klieman, 1999; Vansina, 1990; Walker, 1870).

Over time Europeans gradually took over the different tiers from the Gabonese, until, during colonisation, Europeans were setting up trade factories in remote areas to which producers would directly bring goods that would then be shipped to Europe (Chamberlin, 1977). The people who were excluded from the first tier and could not trade directly with Europeans on the coast, suddenly found the Europeans in their villages with whom they could trade directly (Sautter, 1966, p.731). In certain places in Gabon this still occurs, for example the Babongo

[189] "very jealous of the Europeans visiting the interior"
[190] "doing all that they could to hinder the Whites from getting there"

Pygmies prefer to trade directly with white people, or other Bantu-speaking populations, rather than with their Bantu-speaking neighbours (personal observation, Geschiere, 2009)

11.9.2 The impact of the Atlantic trade on the environment – pre mid-fifteenth century onwards

11.9.2.1 Environmental impacts of the Atlantic trade and trade routes

Some of the direct effects on the environment of trade routes and their relays can still be seen in the forests of Gabon as discernible lines or patches of trees. Much like elephants (Blake *et al.*, 2009), people also distribute seeds in the forest, either directly by planting seeds such as breadfruit used to supply the slave trade and other traders with food (Vansina, 1990, p.211), or indirectly through other human activity such as in the case of Moabi (*Baillonella toxisperma*, Pierre) and *Okoumé* (*Aucoumea klaineana* Pierre).

An example of the indirect distribution of seeds is found with Moabi oil from the fruits of the tree, which is used for cooking or as a cosmetic (Bowdich, 1819). There is generally a high mortality and so low recruitment of these seedlings, as these fruits are much prized by both people and animals (Forests Monitor Ltd, 2001, p.6). In areas where there is a lot of hunting, such as along trade routes and around villages, animal populations are reduced allowing the Moabi seedlings to survive (personal communication M. Starkey, Wilks, 2003, p. 26).

A second example relates to the distribution of *Okoumé* in the Gabonese forest. There is a growing body of evidence that indicates that this distribution is determined by past anthropogenic activity (Biraud, 1959; Delègue *et al.*, 2001; Gaulme, 1988). As a light loving trees that grow quickly in clearings larger than a quarter of a hectare (Biraud, 1959, p.8), *Okoumé* seedlings do not survive well in the shady environment of a mature forest (Biraud, 1959, p.4; Delègue *et al.*, 2001). Clumps of *Okoumé* trees in mature forest therefore indicate places where there have been past clearings due to human activity. The rural to urban migration in Gabon, as described in Chapter 1, has resulted in a reduction in anthropogenic disturbance to the forest and a reduction of *Okoumé* regeneration (Engone Obiang *et al.*, 2014; Wunder, 2003).

The environmental disturbance resulting from trade routes was explored by Chamberlin (1977). Using archival data, Chamberlin explored the consequences of natural resources exhaustion along the trade routes, as well as conflict that resulted from the traders who vied to improve "their low or falling profits" (Chamberlin, 1977, p.viii). After the 1850s this became increasingly important with the first factories set up to store natural resources that could then be shipped to Europe, resulting in the rise of bulk exports (Chamberlin, 1977, pp.81, 86).

As with logging, the exploitation of these forest natural resources started off near waterways with exploiters slowly moving further inland as areas nearby waterways became exhausted (Chamberlin, 1977, pp.93, 101; Sautter, 1966, p.731). In the 1870s the "lower reaches of the Como, Bokoué, and Remboué were reported to be near exhaustion" (Chamberlin, 1977, p.101) with "dyewood, ebony and rubber" (Chamberlin, 1977, p.104) coming from areas far from waterways and then outside the Gabon Estuary (Chamberlin, 1977, p.110). The collapse of natural resources in the Gabon Estuary, in the mid-1890s, resulted in an exodus of traders to the Ogooué River and Ngounié River (Chamberlin, 1977, p.112), where the same process resulted in natural resources exhaustion along the Ogooué River starting in 1880s (Chamberlin, 1977, p.190) and for the Ngounié River in the 1870s (Chamberlin, 1977, p.239).

Rather than going into the details of the environmental impact of each of these traded products, two components which would have profoundly marked the landscape will be briefly examined. These are: the salt trade and the trade in ivory.

11.9.2.2 Environmental impacts of the Salt Trade

The early trade in salt would have had a major environmental impact on the coastal forest. Salt was extremely important for the people in the interior of Gabon. Nassu (1914) used salt to purchase food from local people, for whom salt was "worth almost its weight in gold" (Nassu, 1914, p.72; Bowdich, 1819, p.427; Sautter, 1966, p.726).

In the interior, potash was used as a substitute for salt, made by reducing the ashes of the sun-dried "skins of ripe plantains and bananas" (Nassu, 1914, p.71), this technique is still sometimes used as an alternative to salt (Raponda-Walker and Sillans, 2003, personal observation, Batéké plateaux). However the majority of salt was produced along the coast from ocean water (Nassu, 1914), this occurred in places such as Cap Santa Clara (Patterson, 1975a, p.59) and Loango (Martin, 1972, p.14). It was produced in "imported large brass pans called 'neptunes'" (Nassu, 1914, p.72) as depicted in this 1600s description of salt production along the Loango coast, where the:

> traditional process involved the evaporation of sea-water over a ***fire***. The beaches were dotted with ***rough sheds*** where the salt-making took place. Inside, stoves made of clay or the stuff of ***termite mounds*** were set up with the

> ***fire kindled*** inside. ***Fuel*** was pushed through the holes in the sides of the stoves. On top of each was a hole, on which was placed a brass or copper pot containing sea-water. This was boiled until only the salt remained. Sometimes the operation was a family affair; the children helped to collect the sea-water and ***firewood***. … These worked at the salt preparation for ***two or three weeks***, until enough had been collected to fill the baskets which they themselves carried to inland markets. Others then took their place at the salt-works. (Martin, 1972, p. 14, my emphasis).

Though the above description does not mention the impact of salt making on the environment, it does mention the natural resources needed in the process (the ***bold*** emphasis in the above quote), and it corresponds to impacts on the coastal forest area that Delègue *et al*. found to be "not only linked to palaeoclimatic history but also results from recent disturbances of anthropogenic origin" (Delègue *et al.*, 2001, p.112)[191]. Though it should be highlighted that how far inland people went to collect fuel wood is unknown, while the impacts of coastal erosion and deposition, which are different for different parts of Gabon, also needs to be taken into account.

This production of salt may have slowed down the advance of the forest into savannah areas such as in Mayumba, and promoted the growth of the economically valuable *Okoumé* trees (Delègue *et al.*, 2001), such as in the Mondah forest around Cap Santa Clara (Lasserre, 1955). Coastal *Okoumé* trees that would later be exploited by the first wave of loggers (Delègue *et al.*, 2001; Gaulme, 1988, p.117), in what is called today the "first zone" (Christy *et al.*, 2003; Nguimbi *et al.*, 2006).

11.9.2.3 Environmental impacts of the trade in ivory

Recent research on forest elephants decline has given rise to the fear that the "[l]oss of keystone species like elephants impacts the integrity of ecosystems and their services … [including the] long-term viability of the second most important carbon capture forests in the world " (Wasser *et al.*, 2010, p.1331) due to a "potential for a major wave of tree recruitment failure" (Blake *et al.*, 2009, p.466). In Gabon this has resulted in military intervention to protect elephants for:

[191] This history may have important implications for the various forest plots that are being used today to understand forest dynamics, regeneration and carbon sequestration (Dauby, 2012; Lewis, Lloyd, *et al.*, 2009; Lewis, Lopez-Gonzalez, *et al.*, 2009).

> [i]f we lose our elephants we will enter the same spiral that has seen wildlife and natural resources plundered elsewhere in Africa, with the inevitable consequence of political instability and conflict in dysfunctional ecosystems where man can no longer live sustainably in harmony with nature. Today I have undertaken to create an elite military unit that will be signed into law this month, which will support our National Parks Agency in their critical work to manage Gabon's natural treasures (Presidential press release: Parcs Gabon, 2011).

With this growing concern for elephant populations in Gabon it is useful to put the current ivory offtake into historical perspective. Historical documents on the ivory trade can give an indication of what could occur if the demand for ivory reduces, especially in a country such as Gabon where the rural population is low. The trade of ivory has been well documented before, after, and throughout the Atlantic trade (Barnes, 1996; Douglas-Hamilton, 1979).

European traders found that Gabon's ivory was of the highest quality (due to the density of forest elephant ivory, which takes longer to grow), and *"un des plus beaux de la côte"*[192] (Bouët-Willaumez 1850 in Sautter, 1966, p.729; Stanley, 1885, p.369; White, 1890). As this ivory was highly prized there are several accounts that mention where ivory could be found (Battell, 1901; Bosman, 1907; de Brazza, 1887; Dapper, 1686). Due to ivory being transported by slaves the historical literature concerning the slave trade also contains information on the ivory trade (Martin, 1972; Merlet, 1990; Patterson, 1975a; Vansina, 1990; White, 1890).

Ivory was used by the Europeans to make furniture, games, weapons, teeth and musical instruments. Historical studies such as Martin's 1972 "The External Trade of the Loango Coast 1576-1870", Patterson's 1975 "The Northern Gabon Coast to 1875" and Merlet's 1990 "*Le pays des trois estuaires*"[193] are full of references to the ivory trade, including the amounts being traded and guesstimates of the number of elephants this represented.

In the Gabon Estuary Bosman saw large herds of elephants in 1698 where "feveral Elephants being daily killed in the faid Place; and the wilder and lefs inhabited the Lands are, the larger Quantity of Elephants and wild Beafts are found" (sic Bosman, 1907, p.243, first printed in 1705).

[192] "one of the finest of the coast"
[193] "The county of the three estuaries"

Other writings in the 1600s also mention that there were large herds inhabiting "the south shore of the Gabon [estuary]" with good supply of ivory also at Cap Lopéz (Patterson, 1975a, p.13).

Along the Gabonese coast "Elephant's Teeth, of which this Country produces a great Quantity" (Bosman, 1907, p.399), were soon to disappear. While the trade for ivory may have been sustainable when it was only supplying local demand, the arrival of the Portuguese and the Dutch who supplied ivory to the European market, resulted in elephants becoming locally extinct (Martin, 1982, p.207). Mayumba, on the southern coast of Gabon, is an example of the local extinction of elephants. Ivory was readily available in this area during the early 1600s. In 1611, after two years of trading, a ship came back from the Mayumba, Loango and Kongo coast (Map 11-1) with 33 tonnes of ivory (Merlet, 1990, p.23). Yet by the mid-1600s the supply of ivory from around Mayumba, Sette-Cama and Mayombe was poor with ivory caravans having to go to the markets at Stanley Pool as well as the Bukkameale, "also known as, the Mountains of Ivory," (Martin, 1982, p.208), probably in the southern part of the Du Chaillu Massif (Martin, 1982, p.204; Martin, 1972, pp.17, 41), a walk of a month and a half, where ivory was exchanged for salt from the coast (Martin, 1982).

By the early 1800s elephants also become locally extinct in the Gabon Estuary with "[e]lephant herds visited the Estuary less and less" (Chamberlin, 1977, p.101). Walker, in 1866, went up the Remboué River, one of the rivers entering the Gabon Estuary, and observed that after a week walking away from Libreville, *"les trappes à l'éléphant devinrent très-nombreuse sans que nous vissions* [sic] *cependant un seul animaux* [sic]*"*[194] (Walker, 1870, p.64). At the same time the Fang had to go far to find ivory to supply the Mpongwe (Chamberlin, 1977, p.104; Gaulme, 1991, p.84; Patterson, 1975a, p.59) who then sold it to the Europeans.

[194] "the elephant traps became numerous, even though we did not see one single animal"

Map 11-1: Location of Dutch trade factories in Mayumba and Loango (Blue boxes) where Ivory ("Teeth" on the map) and Slaves ("Negers" on the map) were exported, circa 1685 (based on Thornton *et al.*, 1707, p.142).

In the late nineteenth century and early twentieth century Gabonese ivory was being sold in various European markets by a number of companies. By the twentieth century the French, by then the colonial power in Gabon had not started “a century of exploiting timber, ivory, crocodiles, and other wildlife” (Fay, 2004b, p.108), for they were not interested in trade, but rather colonial expansion and administration, only becoming interested in trade when they saw other countries benefiting from their colony (Rich, 2007a). Ivory trade was dominated by others including the British company Hatton and Cookson, a Liverpool based company who had a monopoly over ivory exports from the Gabon Estuary (Chamberlin, 1977, p.123; de Compeigne, 1876, p.226; Neuville and Ch. Breard, 1884, p.131), and the German company Francis Würmer and Company (de Compeigne, 1876, p.226), the Germans also dominated the timber industry until the First World War.

These current predictions of forest elephant population extinction are not new. In 1850 Bouët-Willaumez remarked that ivory was becoming *“de jour en jour plus rare”*[195] (Bouët-Willaumez in Sautter, 1966, p. 729), while Stanley in 1885 calculated that “[i]f 200 tusks arrived per week at Stanley Pool, or say £260,000 per annum, it would still require twenty-five years to destroy the elephant in the Congo basin” (Stanley, 1885, p.356). By 1890 *“L'ivoire a presque disparu des régions de l'Afrique actuellement accessibles”*[196] (Ratoin, 1890, p.176), much as it had during the seventeenth century. In 1904 the least pessimistic estimation on the disappearance of elephants in the Congo Basin was thirty to forty years. In 1903, 1,054 elephants were killed in the French Congo[197] (Rouget, 1906, p.862) while market data from London, Anvers and Liverpool, showed that there was an annual sale of 650 tonnes of ivory representing a destruction of 20,000 to 30,000 elephants a year (Cuvillier-Fleury, 1904, p.42; Rondet-Saint, 1911, pp.89, 93; Rouget, 1906, p.804), to supply a worldwide demand of 700 tonnes, with 600 tonnes coming from Africa (Rouget, 1906, p.792). This was not considered to be sustainable (Cousin, 1901; Périquet and Audoin, 1913; Rouget, 1906, p.792). For these reasons a 1900 international meeting, in London, on the protection of animals had elephants on its list of animals to be protected (Rouget, 1906, p.809) and in of 1904, it became illegal to trade or exploit ivory in the French Congo that was less than two kilograms (Rouget, 1906, p.794). This unsustainability encouraged the administration to help in the domestication of elephants that had started in the 1890s, primarily

[195] “becoming rarer day by day”
[196] “ivory has nearly disappeared from the regions of Africa that are currently accessible”
[197] On the basis that it takes 60 elephants for one tonne of ivory (Rouget, 1906, p.862).

to be used to replace human labour but also for their ivory (Cuvillier-Fleury, 1904, pp.41–44; Huffmann, 1931; Parc National de la Garamba, 2013).

Picture 11-1 : Domestication of elephants in the Belgian Congo (Parc National de la Garamba, 2013)

The accuracy of the offtake data for ivory from Gabon can be debated (Douglas-Hamilton, 1979; Milner-Gulland and Beddington, 1993; Rondet-Saint, 1911, p.100), as well as the geographical area which is represented by “Gabon” at the time, as this changed substantially during the nineteenth and twentieth century (Aicardi de Saint-Paul, 1987, pp.28–29). However, these figures, do confirm that large quantities of ivory were being exported from Gabon during the mid to late nineteenth century, and that these started to drop off during the early twentieth century (Figure 11-1). The disappearance of elephants, in these areas, would have changed the tree composition of the forest due to the role that forest elephants play in the distribution of seeds (Blake *et al.*, 2009). It would also have changed the forest structure, with elephant trails becoming overgrown and disappearing (Fay, 2004a).

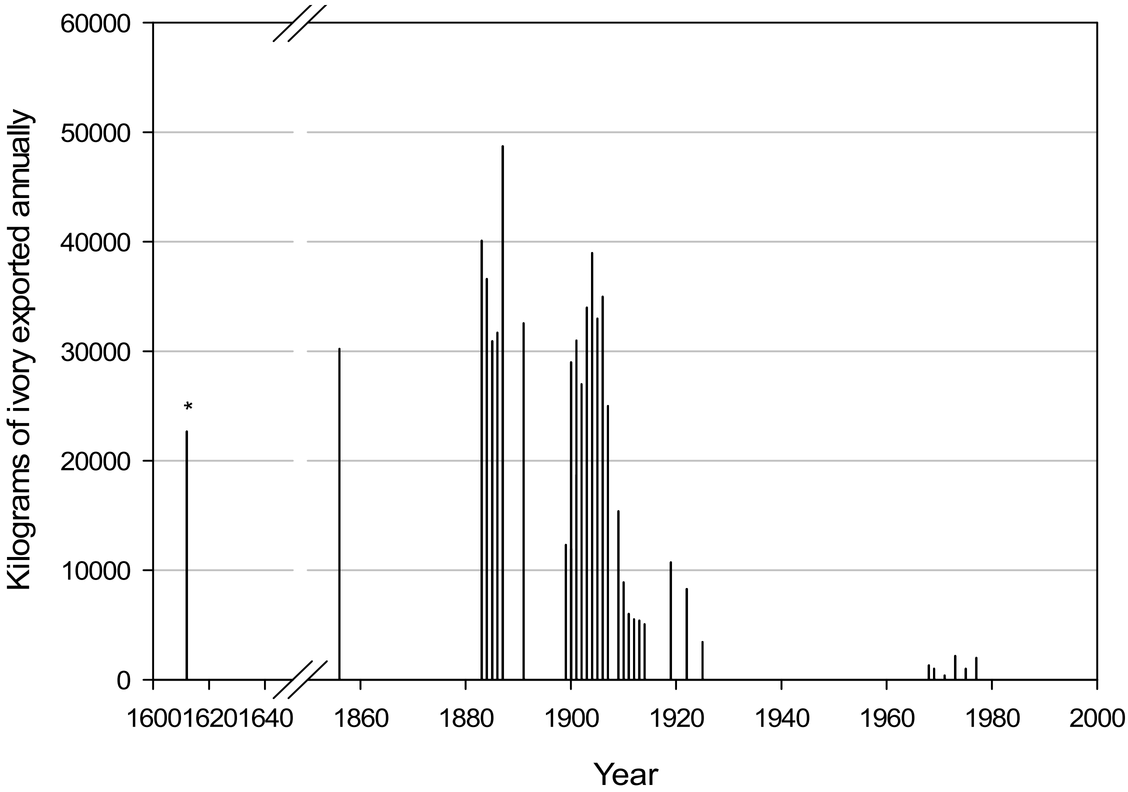

Figure 11-1: Recorded exports of ivory from Gabon over time. For the raw data see Table 11-3. Note * the first bar is with data that comes just from around Loango.

Year	Kg of ivory exported annually	Reference	Year	Kg of ivory exported annually	Reference
1612	22,680	From around Loango (Martin, 1982, p.204)	1906	35,000	(Douglas-Hamilton, 1979, p.82)
1856	30,240	(Anonymous, 1857, p.274)	1907	25,000	(Douglas-Hamilton, 1979, p.82)
1883	40,114	(Douglas-Hamilton, 1979, p.82)	1909	15,393	(Douglas-Hamilton, 1979, p.82)
1884	36,623	(Douglas-Hamilton, 1979, p.82)	1910	8,894	(Douglas-Hamilton, 1979, p.82)
1885	30,937	(Douglas-Hamilton, 1979, p.82)	1911	6,012	(Douglas-Hamilton, 1979, p.82)
1886	31,705	(Douglas-Hamilton, 1979, p.82)	1912	5,531	(Douglas-Hamilton, 1979, p.82)
1887	48,724	(Douglas-Hamilton, 1979, p.82)	1913	5,409	(Douglas-Hamilton, 1979, p.82)
1891	32,576	(Douglas-Hamilton, 1979, p.82)	1914	5,075	(Douglas-Hamilton, 1979, p.82)
1899	12,322	(Chailley-Bert, 1902, p.8)	1919	10,732	(Douglas-Hamilton, 1979, p.82)
1900	29,000	(Douglas-Hamilton, 1979, p.82)	1922	8,289	(Douglas-Hamilton, 1979, p.82)
1900	11,932	(Chailley-Bert, 1902, p.8)	1925	3,444	(Douglas-Hamilton, 1979, p.82)
1901	31,000	(Douglas-Hamilton, 1979, p.82)	1968	1,307	(Douglas-Hamilton, 1979, p.82)
1901	18,722	(Chailley-Bert, 1902, p.8)	1969	1,000	(Douglas-Hamilton, 1979, p.82)
1902	27,000	(Douglas-Hamilton, 1979, p.82)	1971	403	(Douglas-Hamilton, 1979, p.82)
1903	34,000	(Douglas-Hamilton, 1979, p.82)	1973	2,178	(Douglas-Hamilton, 1979, p.82)
1904	39,000	(Douglas-Hamilton, 1979, p.82)	1975	1,000	(Douglas-Hamilton, 1979, p.82)
1905	33,000	(Douglas-Hamilton, 1979, p.82)	1977	2,000	(Douglas-Hamilton, 1979, p.82)

Table 11-3: Exports of ivory from Gabon during the 19th and 20th century

Milner-Gulland and Beddington suggest that "[t]wo major factors are likely to have caused recent elephant population declines: carrying capacity reductions and hunting for ivory" (Milner-Gulland and Beddington, 1993, p.29), with "carrying capacity" [198] changing due to habitat change. In Gabon, the hunting of elephants has decreased compared to historic highs (Figure 11-1), though in the last decade or so it may once again be on the increase. During this period of time, as discussed in Chapter 3, there has also been an increase in elephant habitat, and this "carrying capacity", as a result of human rural depopulation caused by the famines and diseases of the early twentieth century (Rich, 2007a) as well as the latter migration of people from the forest interior both towards roads and urban centres (Sautter, 1966).

The abandonment of rural forest villages would have left behind old plantations and fruit crops which are much loved by elephants (Barnes *et al.*, 1991) "attracted to habitats that have been used by people in the recent past" (Walker, 2010, p.71). In some parts of Gabon this would have been occurring at a time before logging roads and the associated hunting were spreading and before their related impact on elephant populations (Blake *et al.*, 2008).

Though crop plantations would have been quickly overrun by the forest, the fruit trees would have lasted for decades. These old plantations may still have been attractive to elephants and, as elephants prefer to stay away from occupied villages, the existence of these old plantations could have resulted in fewer crop raids by elephants in the occupied road side villages, so reducing human-wildlife conflict.

Over 50 to 80 years these old village sites and their fruit trees would be consumed by the forest (Lasserre, 1955). When this occurred roadside villages could have once more become attractive to elephants and so human-elephant conflict could have increased (Walker, 2012; Walker, 2010). Unfortunately no study has yet looked at changes in perceived elephant populations and human-wildlife conflict by villagers. With all the methodological problems that it entails, the elders, in the study sites used in this thesis, recount that they do remember fewer elephants around their villages when they were young; a similar finding was reported by Walters (personal communication 2010, Batéké plateaux).

[198] Whether the theory of "carrying capacity" can be applied to the whole of Africa is debatable, see (Behnke *et al.*, 1993)

This is not to say that elephant populations in Gabon are not currently declining or threatened, rather, in Gabon, this may not be solely due to hunting for ivory, since ivory export have not reached the proportions of the late 1800s and early 1900s. It could be that the elephant population were hit so badly during this time that they have never recovered, and now cannot do so, however genetic studies in East Africa have shown that elephant populations have "rebounded" several times in the last century, even after they had been hunted for over two centuries, for example in Tanzania in 1933 (Bryceson, 1987, p.164) and then once again after the elephant hunting peak that occurred in between the 1970-1980s (Okello *et al.*, 2008, p.3788), while the largest loss of elephants occurred 2500 BP during the mid-Holocene (Okello *et al.*, 2008), the same has occurred in South Africa where elephants were nearly wiped out by the early 1900s (Hall-Martin, 1980).

The historic literature of Gabon also indicate a recovery of elephant populations as long as there is a viable source population (Okello *et al.*, 2008). Elephants can today be found in areas where they became locally extinct in the seventeenth century, in the 1950's elephants were "*abondant"* (Lasserre, 1955, p.121) in the coastal savannas of the Gabon Estuary and the Mayumba coast, even today elephants can be seen "strolling the beach" (Fay, 2004a), with a population of "a few thousand elephants in and around Loango today" (Fay, 2004a).

It must be emphasised that the above has to be taken and understood within the current context of Gabon, with its unique situation in Africa of having a low human population that is mostly urban as well as a high GDP. It cannot and must not be taken out of this context and applied to other African countries, where the situation is very different (Beaune *et al.*, 2013; Maisels *et al.*, 2013), though elephant recovery has been recorded in other parts of Africa (Okello *et al.*, 2008).

The above should also only be used as an indicator of the future survival of elephants in Gabon if current poaching levels do not increase and land intensive commercial agriculture, including palm oil does not occur. Though intensive commercial agriculture is not occurring in Gabon (Megevand and World Bank, 2013, pp.68–72) there has been a move to create oil palm plantations in areas that have already been degraded. Palm oil is used in many products such as cosmetics and food, in the last decade there has been a growing demand for palm oil, especially as an alternative to oil from soybean in the food industry (Sanders *et al.*, 2012). Oil palm plantations could threaten elephant populations, especially as forest elephants prefer secondary forests (Barnes, 1996; Barnes *et al.*, 1991). However, it is too early to say if this industry is going to grow in Gabon, especially in light of the growing international attention to the link between deforestation and palm oil plantations that has resulted in some plantations in Africa closing down (Greenpeace International, 2013; Hoyle and Levang, 2012) while major industrial players that utilise palm oil (e.g. Nestle, Unilever, Shell) are looking into ways to reduce and stop the use of oil palm oil in their products (Fry, 2011) due to consumer concerns (Disdier *et al.*, 2013).

Currently there is little data on elephants in Gabon, whether on the current population of elephants (Barnes *et al.*, 1995; Maisels *et al.*, 2013; Milner-Gulland and Mace, 1991), the amount of illegal ivory exported or the current number of elephants being killed through poaching. However, one estimate of elephant decline in a national park in Gabon has been of over 1,000 elephants being killed per year, though there were special circumstances and this may not be representative of other parks in Gabon (Agence Nationale des Parcs Nationaux, 2013; Fay, 2012; Maisels *et al.*, 2013). In comparison the offtake seen in the late 1880s and early 1900s peaked at around 2,305 to 6,620 elephants killed per year[199]. Currently elephant poaching is in the boom part of the cycle (Spinage, 1973) with demand currently being driven from China while in the 1970s and 1980s it was driven by Japan (Parker and Martin, 2009).

Historical trends in Gabon can give an indication of what could occur under the right conditions and if the right land management put in place. The current ivory demand from China adds further weight to the recent creation of the National Park network in Gabon and the need for this to be managed correctly, with modern law enforcement tools used to pinpoint poaching areas (e.g. Uno *et al.*, 2013; Wasser *et al.*, 2010; WCS, 2013). If this is carried out elephant population could once more expand in Gabon. Understanding these past recoveries of elephant populations is both essential for the conservation of elephants and other animals as well as the conservation of forest landscapes due to the role that forest elephants play in the distribution of seeds (Blake *et al.*, 2009) as well as being the conservation “focal species for other large mammals” (Epps *et al.*, 2011, p.603).

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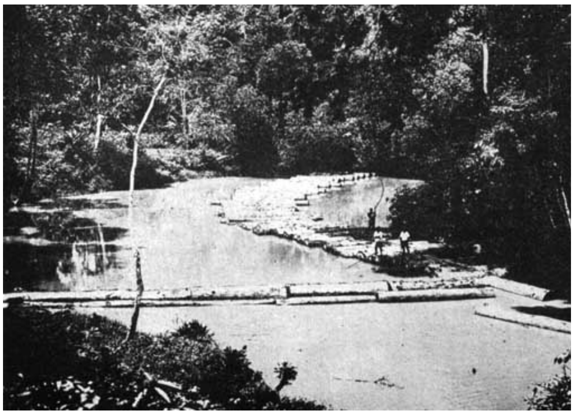
[199] This depends on the weight of elephant tusks. On the basis of 48,724 kg of legally recorded ivory exported at the peak of the trade in 1887 (Douglas-Hamilton, 1979, p.82). The lower number comes from an average tusk weight of 11.74kg (Milner-Gulland and Mace, 1991, p.217), with 1.8 tusks per individual and the second using the CITES estimation “of 6.6 kg ivory/elephant, 1.8 tusks per individual, and tusk weight of 3.68 kg” (Wasser *et al.*, 2008, p.1070).

11.10 Early transport of logs

The first logs were moved out of the forest by rolling them along these alleys (Pourtier, 2010, p.2)[200]. These alleys were ten metres wide so that logs between 2.5 to 4 metres could be rolled (Lasserre, 1955). The rolling of the logs took fifteen labourers *"armés de lianes et de leviers … sur des plateaux de rondins"*[201] (Picture 3-1) (Coquery-Vidrovitch, 2001, p.446; Cermak and Lloyd, 1962; Meye, 1969) who rolled and slid the logs to the river[202], in some cases taking half a day to drag the logs only a few hundred metres (Coquery-Vidrovitch, 2001). These would then be strapped together with lianas to make rafts[203] (Picture 11-2 and Picture 11-3) (Coquery-Vidrovitch, 2001, p.447; Lasserre, 1955) and, in 1904, floated down to sawmills which were then being constructed in Libreville and Cap Lopéz (Coquery-Vidrovitch, 2001, p.447).



Picture 11-2: Picture of logging raft used to transport wood on rivers. Picture from French Delegation (1947).

Picture 11-3: Picture of logging raft still used today, to transport wood on the Ngounié River at Sindara.

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[200] In a process described by Quilliard: "*L'arbre abattu était tronçonné, puis, au travers de la forêt, on ménageait sur une largeur au moins égale à la longueur maximum des billes obtenues une allée le long de laquelle elles étaient déplacées*[200] (Quilliard, 1920, p.646). ("The felled tree was stripped of its branches, then, a passage was made through the forest at least equal in width to the maximum length of the resulting logs, along which they were moved").

[201] "armed with lianas and levers … on a platform of wooden rollers"

[202] When there was a suitable wet season stream then *Okoumé* trees would be cut in the dry season, pushed to the bottom of the slopes and then, when the rains came, the logs would be taken by floods into the waterways (Lasserre, 1955; Meye, 1969; Quilliard, 1920).Because of the presence of suitable streams logging could even occur in rugged terrain, such as in the Mondah forest, to the north of Libreville.

[203] This rafting method is still sometimes used today in certain forestry concessions (personal observation, Picture 11-3).

11.11 The stacked deck: the demise of indigenous African logging

The rise of industrial timber companies came at the expense of the older system of trading timber. The new European timber companies were helped by the colonial administration who "stacked the deck" (Rich, 2005, p.151) against Gabonese and other African loggers. To increase the revenue from logging, the French administration, in 1919, put in place a permit system, with permits to be obtained for each *Okoumé* cut within a concession. For Europeans these concessions were between 5,000 to 10,000 ha while for Africans they were 100 to 500 ha (Jaffré, 2003a, p.203; Rich, 2005, p.153). Two years later African loggers were further charged 2,500 francs to renew their permits (Rich, 2005, p.158), while village logging, that until then had not required permits or fees, was no longer allowed. Banning local people from exploiting the forest was seen as a way to stop local people from their assumed tendency to "*saccager la forêt"*[204] (Angoulvant in Coquery-Vidrovitch, 2001, p. 455). Laws continued to change. Though some were relaxed to the benefit of local people, most were to the advantage of the French[205].

Head taxes further advantaged the European timber companies, through these Gabonese were forced to find paid work (Rich, 2005). Though it could also be raised by carrying out various activities such as the collection of rubber and other natural resources (Pourtier, 2010, p.2), it was most easily payable by working for a timber company (Coquery-Vidrovitch, 2001, p.458)[206].

Slowly the independent African timber companies were pushed out of the timber industry. Only Africans who were literate and had worked in the colonial administration were able to find ways to continue logging (Rich, 2005). By 1933, many of these went out of business either due to bankruptcy during the Great Depression, because their concession had run out of *Okoumé* (Rich, 2005, p.165) or because they could not keep up with the costly mechanisation of the timber industry (Lasserre, 1955). As the independent African timber companies lost their businesses so

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[204] "pillage the forest"

[205] Between 1926 to 1928 the forestry laws were once again modified to allow local people without means to log 1,000 ha for five years while European, and some Africans with a 2,500 franc deposit, were allowed permits to exploit 2,500 ha forest concession. These needed to be renewed annually and could be done so for up to ten times as long as a minimum of 500 to 750 tonnes were exported annually (Coquery-Vidrovitch, 2001, pp.452–453; Jaffré, 2003a, p.203). At this time a third type of permit was given only to French individuals or companies which consisted of *"un ou deux lots de 5 à 10 000 ha (30 000 ha en 1927)"*[205] (Coquery-Vidrovitch, 2001, p.453), these large concessions could last up to twenty-five years and could be renewed, provided the export quotas were respected (Lasserre, 1955). These concession could be extended by another 10,000 ha (later 30,000) if a Decauville rail system was installed in the concession (Coquery-Vidrovitch, 2001, p.453).

[206] In some cases the colonial administration allotted labour to European timber companies, allotments that were rarely offered to African timber companies.

they and their employees began to work for the European timber companies (Coquery-Vidrovitch, 2001, p.455).

Access to capital allowed European timber companies to obtain logging equipment either through monetary advances or advances of the equipment itself[207]. The access to capital was fought over by large timber companies at the expense of small European operations (Lasserre, 1955), with the result of the development of larger timber companies (Bouet, 1974). In this way the European timber companies left behind the villages that they had once helped to develop, including the villages that had grown up around them (Meye, 1969, p.58; Rich, 2005, p.163) and penetrate deeper into the forest.

[207] Advances that were coming from other timber companies (Coquery-Vidrovitch, 2001, p.452), the colonial administration or later the French government (Labrousse and Verschave, 2002, p.24).

11.12 Annual exports of *Okoumé* from Gabon.

Date	Cubic metre	Reference with page number	Date	Cubic metre	Reference with page number	Date	Cubic metre	Reference with page number
1896	3,375	(Quilliard, 1920, p.646)	1926	430,337	(Fournols, 1958, p.66)	1953	537,410	(Lasserre, 1955, p.161)
1898	4,870	(Jaffré, 2003b, p.263)	1927	516,101	(Sautter, 1966, p.762; Lasserre, 1955, p.161)	1953	624,411	(Fournols, 1958, p.66)
1900	12,981	(Hilling, 1963, p.157)	1927	516,405	(Fournols, 1958, p.66)	1954	767,857	(Fournols, 1958, p.66)
1902	8,438	(Coquery-Vidrovitch, 2001, p.442)	1927	518,092	(Coquery-Vidrovitch, 2001, p.454)	1955	778,890	(Hilling, 1963, p.157)
1902	8,914	(Jaffré, 2003b, p.263; Lasserre, 1955, p.161)	1928	602,472	(Coquery-Vidrovitch, 2001, p.454; Fournols, 1958, p.66)	1955	951,805	(Fournols, 1958, p.66)
1902	168,760	(Quilliard, 1920, p.646; Sautter, 1966, p.762)	1928	603,390	(Lasserre, 1955, p.161)	1956	853,924	(Fournols, 1958, p.66)
1903	15,009	(Lasserre, 1955, p.161; Sautter, 1966, p.762)	1929	455,651	(Fournols, 1958, p.66)	1957	1,046,310	(Fournols, 1958, p.66)
1904	9,064	(Lasserre, 1955, p.161; Sautter, 1966, p.762)	1929	498,444	(Lasserre, 1955, p.161)	1959	968,681	(Sautter, 1966, p.803)
1905	11,393	(Sautter, 1966, p.762)	1930	644,281	(Lasserre, 1955, p.161)	1960	1,059,811	(Sautter, 1966, p.803)
1905	11,536	(Jaffré, 2003b, p.263)	1930	642,974	(Coquery-Vidrovitch, 2001, p.442; Fournols, 1958, p.66)	1960	1,096,938	(Hilling, 1963, p.157)
1905	11,536	(Périquet and Audoin, 1913, p.31)	1930	644,281	(Sautter, 1966, p.768)	1961	1,243,759	(Sautter, 1966, p.803)
1905	13,081	(Lasserre, 1955, p.161)	1930	675,039	(Gaulme, 1988, p.119; Rich, 2007a, p.154)	1961	1,275,000	(Wunder, 2005, p.71)
1905	13,501	(Coquery-Vidrovitch, 2001, p.442)	1930	636,094	(Hilling, 1963, p.157)	1962	1,150,000	(Wunder, 2005, p.71)
1905	38,945	(Hilling, 1963, p.157)	1931	378,661	(Lasserre, 1955, p.161; Sautter, 1966, p.762)	1962	1,179,630	(Sautter, 1966, p.803)
1906	9,236	(Périquet and Audoin, 1913, p.31)	1931	379,709	(Fournols, 1958, p.66)	1963	1,250,000	(Wunder, 2005, p.71)
1906	40,939	(Lasserre, 1955, p.161; Sautter, 1966, p.762)	1932	420,212	(Fournols, 1958, p.66)	1964	1,350,000	(Wunder, 2005, p.71)

1907	23,515	(Périquet and Audoin, 1913, p.31)	1932	420,703	(Lasserre, 1955, p.161)	1965	1,275,000	(Wunder, 2005, p.71)
1907	75,942	(Coquery-Vidrovitch, 2001, p.442)	1933	467,464	(Fournols, 1958, p.66)	1966	1,275,000	(Wunder, 2005, p.71)
1907	77,035	(Sautter, 1966, p.762)	1933	473,202	(Lasserre, 1955, p.161)	1967	1,225,000	(Wunder, 2005, p.71)
1908	38,059	(Périquet and Audoin, 1913, p.31)	1933	506,279	(Sautter, 1966, p.768)	1968	1,375,000	(Wunder, 2005, p.71)
1908	89,443	(Coquery-Vidrovitch, 2001, p.442)	1934	561,970	(Fournols, 1958, p.66)	1969	1,525,000	(Wunder, 2005, p.71)
1908	90,756	(Jaffré, 2003b, p.263; Lasserre, 1955, p.161; Sautter, 1966, p.762)	1934	562,739	(Lasserre, 1955, p.161)	1970	1,500,000	(Wunder, 2005, p.71)
1909	53,443	(Périquet and Audoin, 1913, p.31)	1935	473,825	(Hilling, 1963, p.157)	1971	1,650,000	(Wunder, 2005, p.71)
1909	55,691	(Coquery-Vidrovitch, 2001, p.442)	1935	536,656	(Fournols, 1958, p.66)	1972	1,850,000	(Wunder, 2005, p.71)
1909	55,696	(Lasserre, 1955, p.161; Sautter, 1966, p.762)	1935	547,661	(Lasserre, 1955, p.161)	1973	1,800,000	(Wunder, 2005, p.71)
1910	66,608	(Périquet and Audoin, 1913, p.31)	1936	479,278	(Fournols, 1958, p.66)	1974	1,675,000	(Wunder, 2005, p.71)
1910	86,761	(Lasserre, 1955, p.161; Sautter, 1966, p.762)	1936	485,027	(Lasserre, 1955, p.161)	1975	1,050,000	(Wunder, 2005, p.71)
1910	97,361	(Hilling, 1963, p.157)	1937	686,852	(Coquery-Vidrovitch, 2001, p.444)	1976	1,100,000	(Wunder, 2005, p.71)
1911	153,571	(Coquery-Vidrovitch, 2001, p.442)	1937	687,191	(Lasserre, 1955, p.161; Sautter, 1966, p.762)	1977	1,275,000	(Wunder, 2005, p.71)
1911	154,368	(Lasserre, 1955, p.161; Sautter, 1966, p.762)	1937	688,540	(Fournols, 1958, p.66)	1978	1,225,000	(Wunder, 2005, p.71)
1912	145,133	(Fournols, 1958, p.66)	1938	391,522	(Fournols, 1958, p.66)	1979	1,125,000	(Wunder, 2005, p.71)
1912	145,459	(Lasserre, 1955, p.161; Sautter, 1966, p.762)	1938	391,595	(Lasserre, 1955, p.161; Sautter, 1966, p.762)	1980	1,175,000	(Wunder, 2005, p.71)
1913	219,388	(Coquery-Vidrovitch, 2001, p.443)	1939	236,264	(Fournols, 1958, p.66)	1981	1,000,000	(Wunder, 2005, p.71)

1913	225,358	(Jaffré, 2003b, p.263)	1939	236,569	(Lasserre, 1955, p.161)	1982	804,565	(Jaffré, 2003b, p.309)
1913	226,531	(Lasserre, 1955, p.161; Sautter, 1966, p.762)	1940	91,130	(Fournols, 1958, p.66)	1983	550,000	(Wunder, 2005, p.71)
1913	253,140	(Fournols, 1958, p.66; Quilliard, 1920, p.646)	1940	116,834	(Hilling, 1963, p.157)	1984	525,000	(Wunder, 2005, p.71)
1915	38,945	(Hilling, 1963, p.157)	1941	27,002	(Fournols, 1958, p.66)	1985	975,000	(Wunder, 2005, p.71)
1915	129,040	(Lasserre, 1955, p.161)	1941	94,742	(Lasserre, 1955, p.161)	1986	950,000	(Wunder, 2005, p.71)
1916	6,750	(Coquery-Vidrovitch, 2001, p.443)	1942	16,876	(Fournols, 1958, p.66)	1987	868,200	(World Resource Institute, 2000, p.37)
1916	27,157	(Lasserre, 1955, p.161)	1942	18,268	(Lasserre, 1955, p.161; Sautter, 1966, p.762)	1988	989,200	(World Resource Institute, 2000, p.37)
1917	8,438	(Fournols, 1958, p.66)	1943	28,689	(Fournols, 1958, p.66)	1989	944,000	(World Resource Institute, 2000, p.37)
1918	6,750	(Fournols, 1958, p.66)	1943	28,836	(Lasserre, 1955, p.161)	1989	987,406	(Jaffré, 2003b, p.303)
1919	11,813	(Fournols, 1958, p.66)	1944	45,565	(Fournols, 1958, p.66)	1990	1,031,025	(Jaffré, 2003b, p.303)
1920	56,307	(Lasserre, 1955, p.161; Sautter, 1966, p.762)	1944	63,327	(Lasserre, 1955, p.161)	1990	1,136,600	(World Resource Institute, 2000, p.37)
1920	64,908	(Hilling, 1963, p.157)	1945	61,604	(Lasserre, 1955, p.161))	1991	821,400	(Drouineau and Nasi, 1999, p.14; World Resource Institute, 2000, p.37)
1920	79,317	(Fournols, 1958, p.66)	1945	82,692	(Fournols, 1958, p.66)	1991	889,074	(Jaffré, 2003b, p.303)
1921	74,349	(Lasserre, 1955, p.161)	1945	103,851	(Hilling, 1963, p.157)	1991	1,029,994	(Jaffré, 2003b, p.309)
1921	84,380	(Coquery-Vidrovitch, 2001, p.454)	1946	139,925	(Lasserre, 1955, p.161)	1992	952,831	(Jaffré, 2003b, p.303)
1921	86,067	(Fournols, 1958, p.66)	1946	160,322	(Fournols, 1958, p.66)	1992	1,014,800	(Drouineau and Nasi, 1999, p.14; World Resource Institute, 2000, p.37)
1922	117,852	(Lasserre, 1955, p.161)	1947	193,633	(Lasserre, 1955, p.161)	1993	1,332,100	(Drouineau and Nasi, 1999, p.14; World Resource Institute, 2000, p.37)

1922	152,896	(Coquery-Vidrovitch, 2001, p.454)	1947	227,826	(Fournols, 1958, p.66)	1993	1,337,439	(Jaffré, 2003b, p.303)
1922	189,011	(Fournols, 1958, p.66)	1948	281,967	(Lasserre, 1955, p.161))	1994	1,332,440	(Jaffré, 2003b, p.303)
1923	147,450	(Lasserre, 1955, p.161)	1948	310,518	(Fournols, 1958, p.66)	1994	1,461,300	(Drouineau and Nasi, 1999, p.14; World Resource Institute, 2000, p.37)
1923	176,860	(Coquery-Vidrovitch, 2001, p.454)	1949	324,019	(Sautter, 1966, p.804)	1995	1,529,700	(World Resource Institute, 2000, p.37)
1923	177,198	(Fournols, 1958, p.66)	1949	345,038	(Lasserre, 1955, p.161)	1992	1,531,000	(Drouineau and Nasi, 1999, p.14)
1924	303,040	(Lasserre, 1955, p.161; Sautter, 1966, p.762)	1949	366,209	(Fournols, 1958, p.66)	1995	1,552,622	(Jaffré, 2003b, p.303)
1924	335,663	(Coquery-Vidrovitch, 2001, p.454)	1950	374,115	(Lasserre, 1955, p.161))	1996	1,779,000	(Drouineau and Nasi, 1999, p.14)
1924	335,832	(Fournols, 1958, p.66)	1950	376,464	(Hilling, 1963, p.157)	1996	1,780,900	(World Resource Institute, 2000, p.37)
1924	506,279	(Jaffré, 2003b, p.264)	1950	426,962	(Fournols, 1958, p.66)	1997	1,836,000	(Drouineau and Nasi, 1999, p.14; World Resource Institute, 2000, p.37)
1925	341,463	(Lasserre, 1955, p.161)	1951	381,397	(Lasserre, 1955, p.161)	1998	1,576,600	(World Resource Institute, 2000, p.37)
1925	365,533	(Coquery-Vidrovitch, 2001, p.454)	1951	502,904	(Fournols, 1958, p.66)	1999	1,562,763	(Jaffré, 2003b, p.309)
1925	369,584	(Fournols, 1958, p.66)	1952	297,017	(Lasserre, 1955, p.161)	2001	137,300	(Nguimbi *et al.*, 2006, p.189)
1925	389,445	(Hilling, 1963, p.157)	1952	410,086	(Fournols, 1958, p.66)	2002	1,037,964	(Nguimbi *et al.*, 2006, p.189)
1926	387,683	(Lasserre, 1955, p.161)	1952	1,024,371	(Sautter, 1966, p.806)	2003	935,942	(Nguimbi *et al.*, 2006, p.189)

Table 11-4: Exports of *Okoumé* from Gabon, with references. The 1896 to 1962 data was converted from metric tons to cubic metres calculated using Brunck et al. (1990, p.92) conversion factor.

11.13 Comparison of the Waka site with two other sites close by

	Waka	Koulamoutou	Franceville
Case study	this study	Coad and Starkey	Walters
Principal ethnicities	Babongo Pygmy and Mitsogho	Pove and Massango	Teke
Terrain	Mountainous with deep valleys	Foothills with flood plains	Rolling hills
Principal vegetation	Forest with some agriculture	Agricultural with some Forest	Savannah with riverine forest and some agriculture
Access	Track built in 1960s by loggers	Road built in 1930 to 1950s by administration with forced labour	Sand track “built” after independence
Effects of *regroupement*	People fled into forest	Regrouped during colonial administration into villages along road	Regrouped onto sand track and then some to the main road after Independence
Political representation	Babongo Pygmy - no representation Mitsogho - some representation including an assistant minister	At several levels of administration including some ministers	At all levels of administrations
Type of traditional rule	Babongo Pygmy and Mitsogho – Based around head of families	Based around head of families	Hierarchical with land chiefs.
Main economic livelihood	Babongo Pygmy - Subsistence Mitsogho - Labourers for logging companies / subsistence	Subsistence, commercial agriculture and commercial hunting	Hand-outs from elites, selling pineapple wine, jobs with army / police and subsistence
Access to markets	5 to 6 hours away	1 to 2 hours away	1.5 hours away
Spirituality	Both Babongo Pygmy and Mitsogho thought of as the originators of Bwiti in Gabon. Also known for their healing and sorcery powers throughout Gabon	Branch of Bwiti	Own religion, Njobi, Mungala that is not shared by others in Gabon but rather with the peoples of Congo
Literature on people and area	Dating back to late 1800s with early explores such as Du Chaillu and Raponda Walker	Little known	Dating back to late 1800s and early 1900s with de Brazza
Number of long term (>1 year) university researchers in last 10 years	3	3	1
Principal house building material	Mud huts with thatch roof	Mud huts with corrugated iron roofs	Corrugated iron walls and roof
Electricity	None	Solar from administration	Solar and generator from administration
Water supply	River	Hand pumps and solar pump from administration	River
Shops and bars in village	Usually none	Both	Both
Distance from park	5-10 km	50 km	30 km

Table 11-5: Comparisons of three study sites that are within one hundred kilometres from each other.

11.14 The recent migration of the Mitsogho into the Ikobey study site

The Mitsogho used two different migration routes to get to the Ikobey area, the principal route was down the Oumba River, with the Ikoy River route being only used by the Mitsogho of Divinde, a migration of 80 km overland through the forest. The migration from the Mimongo village started with a Fang Prefet (called Ekoga) trying to regroup them to Mimongo town. Some accepted, while others refused and started their migration towards the Ikobey area:

> *Depuis Ngoassa, il avait une chef, un rigolo, Ekoga, qui demande au parents quittez de la – donc au vieux village – au vieux village – quittez de la - retourne – retournant chez nous, retournant chez nous là-bas. Eux ils ont dit nous on ne part pas là-bas. Ekoga, qu'est-ce que il a fait, il a pris tous les chefs. Il y avait 6 villages, il avait 6 villages. Ekoga a pris les chefs de village, il dit bon c'est vous qui faites l'orgueil, c'est vous qui faites en sort que les populations ne vont pas de ce côté-là, donc moi je vous prends, allons-y ! Là-bas. Ils sont allés là-bas, ils étaient même présent, ils l'ont chopé, bien frappé, on les choppait. Donc ce sont eux que on a choppé, c'était le commandant Ekoga - donc on les a choppé. Mais eux aussi quand ils ont suivi comme ça ils ont dit 'Comme on nous a tapé donc obligatoire on doit descendre on ne part plus à Mimongo, il n'a pas fallu que il nous tape'. Voilà comment ils sont descendus.*
>
> *Ceux qu'ont descendu, de cette côté, l'Oumba, c'est nous là [Nyoe I]. Ceux que sont de l'autre cote de l'Oumba, ce sont-ceux qui ont accepté Ekoga leur brimade, mais a un certain moment ils sont revenus en disant que les autres, qui sont de l'autre côté, ont mieux réagit que nous*[208]*.*

The village of Ngoassa (Map 11-2), had a large community where "*les gens était trop au Ngoassa, les gens sont partir vers Divinde, les autre vers Nyoe … un avec l'Ikoy les autre suivre la river*

[208] "Since Ngoassa, there was a chief [Prefet], a joker, Ekoga, who asked our parents to leave – at our old village – leave there, go back, go back home, go back home, over there. They said we will not go over there. Ekoga, what did he do, he took all the chiefs, there were six villages, there were six villages. Ekoga took the chiefs of the villages, and said 'ok you are being arrogant, it's you who makes it that the population does not go over there, so I will take you, let's go! Over there'. They went over there, he himself was with them, he took them, beat them well. So they got hit, it was the commander Ekoga who took them. But they, when they saw how things were, they said 'as we were hit, we are obliged to go down, we will no longer go to Mimongo, he should not have hit us'. And that is why they went down.

Some went down one side of the Oumba River, that was us [people of Nyoe I]. Those who went down the other side of the Oumba River, were the ones who accepted Ekoga's beatings, but after a time they came back, saying that the others, on the other side of the Oumba River, reacted better than we did". Nyoe I, Mitsogho 09/05/10 [recording DS400093; 1:19:03].

Oumba"[209]. They first descended the Oumba and Ikoy by using the old trade and administration routes that ran nearby "*c'est la route là où les vieux passent avec le tipoi* [Picture 11-4] *la, qui ils ont suivi ... dans les rivières on coupait les arbres pour traverser"*[210]. Then, where the old trade routes turn back to Mimongo town, they continued through the forest down the Bakounga River, which leads into the Oumba River, while the people of Divinde went down the Ikoy River. By following these rivers they eventually came upon the roads of M. Madre and La SONG.

The Mitsogho who migrated down the Oumba River encountered La SONG at Ikobey. While the others, who migrated down the Ikoy River, met the road that the timber company had made at an old village near where Tchibanga village is today. In both cases their *"objectif c'était d'aller vers les Blancs, on voyait les layons* [Madre] *ils en profitaient déjà pour dire que quand les Blancs vont venir on va nous retrouver là*"[211]. Once on the Madre road they followed the timber companies up and down it.

Picture 11-4: Tipoi being used during the colonial period in Gabon reproduced from (Meyo-Bibang, 1975, p.51), this mode of transport is said to have been very uncomfortable (de Hillerin, 2005).

The Mitsogho of Nyoe II, predicting the La SONG were going to come, set up a camp near what today is the junction outside of Nyoe II. When La SONG left their camp at Nyoe II, the Mitsogho took over the camp and the buildings, recovering the materials to construct their own homes. For these people their migration took them 90 km overland partly through the forest and partly along the road.

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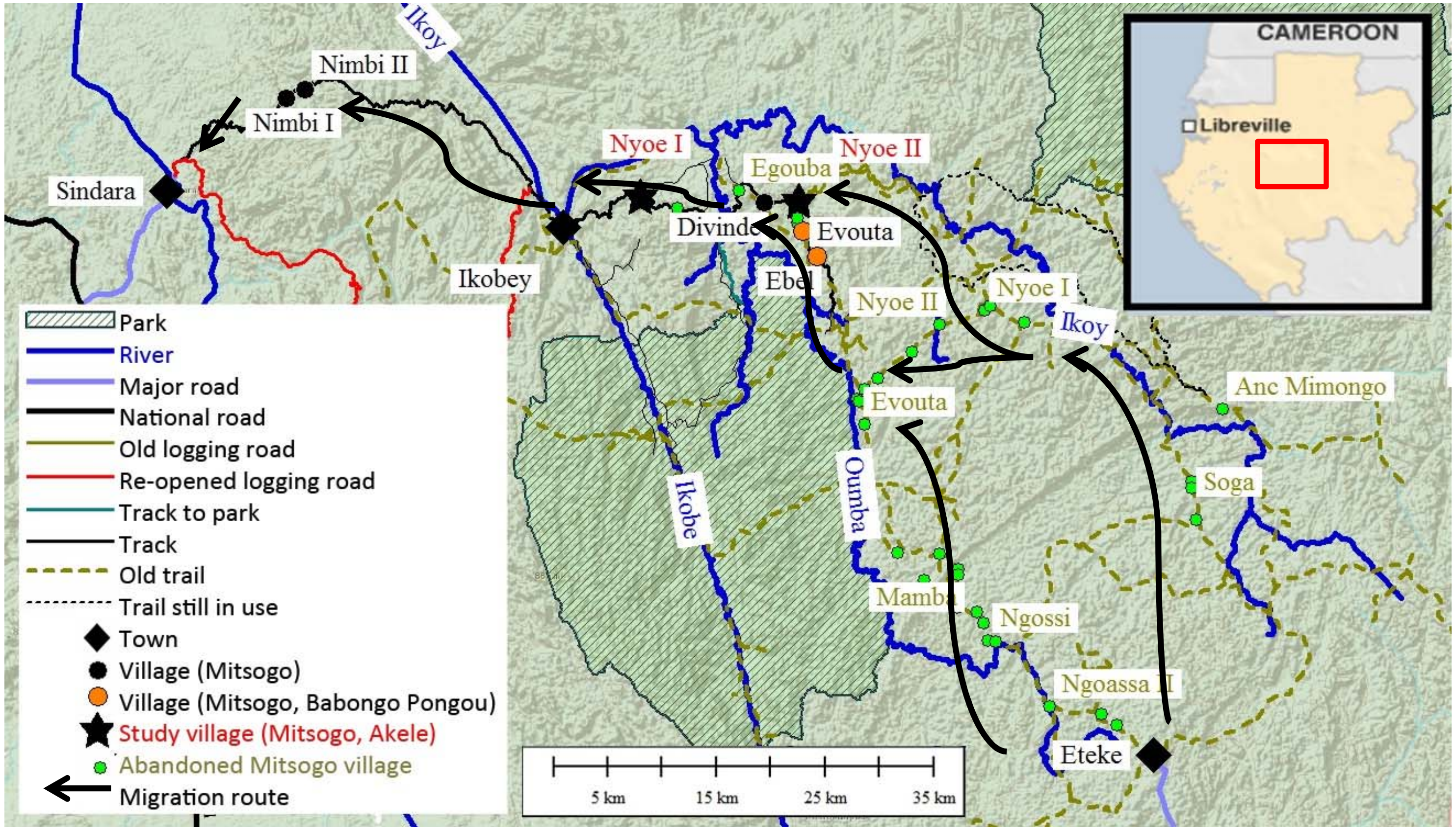
[209] "there were too many people at Ngoassa, people left for Divinde, towards the other Nyoe's … one with the Ikoy the others followed the Oumba river". Nyoe I, Mitsogho 09/05/10 [recording DS400093; 48:21].
[210] "it was the road where our parents passed, with the tipoi, they followed it … and then at rivers we cut trees to cross". Nyoe II, Mitsogho 23/04/10 [recording DS400080; 30:10].
[211] "objective was to go towards the Whites, we could see their transects [Madre's], they took advantage of the situation and said that when the Whites come they will find us here". Nyoe II, Mitsogho 23/04/10 [recording DS400093; 27:26].



Map 11-2: Current and past Mitsogho villages around Ikobey, with their migration route. Based on the following sources: Basemap - (ESRI, 2012), Park boundaries - (Institut Geographique National, 2008), old village sites, paths and roads from - (Army Map Service, 1966a; Army Map Service, 1966b; Army Map Service, 1966c; Institut Geographique National, 2008; Institut Geographique National, 1994; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1986; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1980; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1969; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1967a; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1967b; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1962).

It was due to the road that the different ethnicities of the Ikobey area started to migrate together and stay in the same villages:

> *quand ils reviennent depuis là-bas* [Mimongo]*, ils ne sont pas mélangés. Parce que les vieux leurs avaient dit que 'il ne faudrait pas que vous soyez mélangés avec les Tsogo.' ... Maintenant ils sont descendus, les Babongo d'un côté de l'Ikoy, les Tsogo aussi de l'autre côté de Ikoy. Quand il s'agit de, par exemple, de construire un village, qui soit même de la même cote, les Babongo sont de un peu plus loin et les Tsogo aussi un peu plus loin, mais dans le même secteur ils ne se fréquentaient pas. Donc l'interdit c'était que là où il y a une Babongo, le Tsogo n'arrive pas là. D'où il y a une Tsogo, le Babongo n'arrive pas. Mais après quand ils émigrent, ils viennent au fur et à mesure, voilà croisades ils se sont maintenant ensemble, ils se sont retrouvés tous ensembles. … chaque était de son côté. C'est maintenant après, que les routes, ont fait en sorte que ils se retrouvent donc après il y dite 'Oh ! Mitsogho', 'Oh! Babongo'*[212].

As with the other ethnicities, the migrations are not over, as access to a road has become important, they have moved slowly away from badly degraded roads, for the Mitsogho at Nyoe II:

> *les migrations ne sont pas encore fini, en fait à ce moment on ne voit plus rien de beau donc ce que est sûr ont va continuer juste à Ikobey ... puisque la route est en train de se fermer on attend encore un peu si il n'y a plus de sociétés qui arrivent on continue*[213].

[212] "when they came from over there [Mimongo], they were not mixed. As the elders had said 'you should not mix with the Tsogo'. … Now that they have come down, the Babongo on the Ikoy side, the Tsogo as well on the other side of the Ikoy. When, for example, they constructed a village, that was on the same side, the Babongo would do so a bit further on from the Tsogo, and the Tsogo a bit further, but in the same area they did not mix. So the interdiction was that where there was a Babongo the Tsogo could not go. Where there was a Tsogo, the Babongo could not go. But during their migrations, they came, then they crossed and where together, they found themselves all together … before they were apart, each to their own side. It was the roads that made it that they came together, and they said – 'Oh the Mitsogho!', 'Oh the Babongo!'". Motombi, Babongo Pongue 12/05/10 [recording DS400072; 12:33; 1:07:40].

[213] "the migrations have not finished, in effect at this moment, we no longer see anything good, if this continues we will go to Ikobey … as the road is starting to close, we will wait a bit more, if there are no longer any companies that come them we will move". Nyoe II, Mitsogho 23/04/10 [recording DS400093; 29:04].

11.15 The recent migration of the Akele into the Ikobey study site

Currently there are only three Akele living in the Ikobey area, all elderly, one lives in Ikobey and a couple in Nyoe II. All others have either died or migrated to Sindara and further afield. There were originally two general directions that had been used during the first Akele migration into the area, one was up along the Ngounié and the other along the Ogooué, details of which can be found in Ngolet (2003), Gray (2002) and Avelot (1905). While the names of rivers and mountains in the Ikobey area are Akele, by the 1960s the original Akele in-migrants had long gone and a new wave of Akele came into the Ikobey area at this time from around the town of Mimongo by following the Ikoy River (Map 11-3).

This second wave of Akele migrations started along the old trade routes that surround the town of Mimongo and the village of Eteke (Map 4-6, Map 11-3), at a similar time the Mitsogho were moving as a reaction to *regroupement* (Abitsi and Lepemangoye-Mouleka, 2009). The Prefet of Mimongo town, Ekoga, had asked people to move towards Mimongo town and although some Akele followed his demand, others refused and went into the forest. They first used the old caravan routes, and then followed the Ikoy down, at each step the Prefet urged them to go back to Mimongo town. As they went down the Ikoy they found no villages, or signs of old villages.

Due to the ferocious reputation of the Akele, the Babongo Pygmies and Mitsogho kept away from their villages. As the Akele explain:

> *nous sauvages avant, c'est-à-dire nous les Akele, c'est que on était trop méchant, quand les autres* [Mitsogho and Babongo Pygmies] *voit dans la route, qu'on a passé la route, ou on mangeait la casse à dent ' oh les Akele ont passés' pour les histoires de bagarre étaient parce que nous était trop mauvais ... ils évitent cette zone*[214].

At the time the Akele were telling the other ethnicities that:

> *la forêt ce n'était pas pour les Babongo donc quand il croise une de ces ethnies aller, TIMBAKA, pour dire buter, quoi. Maintenait que ils se sont mélangeait*[215].

[214] "before we were savage, that is us the Akele, we were too horrible, when the others [Mitsogho and Babongo] see in the road that we had passed, as we left behind traces of *casse à dents* [a type of food made from manioc tuber], 'Oh the Akele have passed through here and, due to past fighting as we were so bad, … they avoided these zones". Nyoe II, Akele 22/05/10 [recording DS400078; 31:42].

[215] "the forest was not for the Babongo, so when we crossed with them, there Boom, to say they shot us. Today we are mixed". Motombi, Babongo Pongue 12/05/10 [recording DS400072; 26:00].

When other ethnicities asked the chief if they could join their community the chief would refuse:

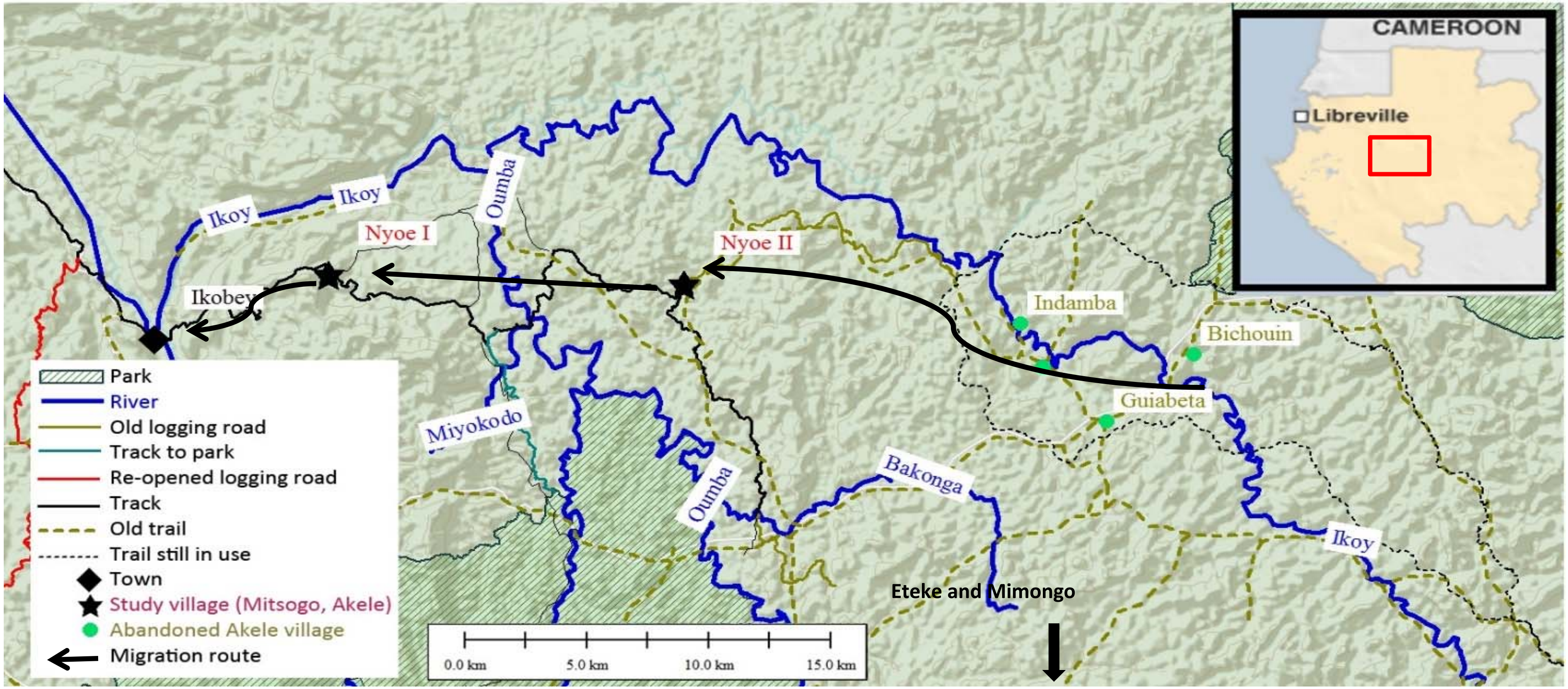
> *Les Tsogo à cette époque étaient à Ndjona* [also called Ngoassa-Moupaka], *et ils sont venu retrouves mon défunt papa pour qu'ils puisse vivre ensemble, et son défunt papa a dit 'non nous ne peut pas vivre avec vous parce que vous est des sourcelleries'*[216] .

Some of the communities that the Akele set up were along the Idemba River, where they started to create several villages including down to the Ikoy River in the area that is currently Makoko. It was at one of these villages that they met La SONG timber company. By this time disease and migration had once again resulted in the decimation of this second wave of Akele people. The Akele that remained decided to go and live with the Mitsogho in the Nyoe communities. Overall the Akele migrated 40 km overland through the forest, to end up in the furthest of these communities. As they migrated and abandoned villages so the Babongo Pygmies took over some of their old village sites, such as at Makoko. The Akele have continued to migrate down the road, up to Nyoe II, moving when the old bridges of La SONG collapse:

> *Par rapport aux ponts qui étaient coupés on a préféré de venir ce côté-ici. A l'époque La SONG était retourné, et on ne pouvait pas travailler ce pont, et les voitures pouvaient refuser de nous retrouves dans les villages*[217].

[216] "The Tsogo at that time were at Ndjona [also called Ngoassa-Moupaka], they came to see my deceased father [at that time he was the chief] so that they could live together, and my deceased father told them 'no we cannot live with you as you are all sorcerers'". Nyoe II, Akele 24/05/10 [recording DS400082; 10:34].

[217] "Due to the bridges that were broken, we preferred to come this side. At the time La SONG had gone and we could not repair the bridge, and cars would refuse to come to fetch us in our villages" Nyoe II, Akele 24/05/10 [recording DS400082; 1:17:02].



Map 11-3: Current and past Akele villages above Ikobey, with their migration route (the last Akele at Nyoe I passed away at the start of the field work). Based on the following sources: Basemap - (ESRI, 2012), Park boundaries - (Army Map Service, 1966a; Army Map Service, 1966b; Army Map Service, 1966c; Institut Geographique National, 2008; Institut Geographique National, 1994; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1986; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1980; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1969; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1967a; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1967b; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1962).

11.16 The recent migration of the Babongo Pygmies into the Ikobey study site

Above Ikobey, the Babongo Pygmies can today be found in the villages of Ngondet, Makoko, Motombi, Egouba, Sogha, Divinga, Tranquille, Tchibanga and Ossimba (Map 11-4). They can also be found mixed with the Mitsogho in the Mitsogho villages of Nyoe II, Evouta and Ebel. For the purposes of this study the Babongo Pygmies of Makoko, Ngondet, Motombi, Tchibanga, Tranquille and Ossimba were interviewed. All the Babongo Pygmies originate from an area around Mimongo town and Massima, *"tous près de Mimongo ville là-bas … Où c'était les maisons c'est les grands bois déjà"*[218].

As with the Mitsogho the Babongo Pygmies migrated in two groups, which, for the case of this study have been called the Babongo Ghebondgi (the Babongo Pygmies from the village of Ebondji) and the Babongo Pongue[219] (the Babongo Pygmies from the village of Pongou):

> *ils étaient ensemble, mais le problème avec les autres c'était parce qu'eux ils voulaient suivre les Simba, donc c'est pourquoi ceux des Ebondji sont retrouves avec les Simba, ils voulaient parler Simba. Mais lorsque ceux-là on a dit que, 'nous on ne part pas là-bas ont reste ici avec nous Bio', c'est les Tsogo. Voilà comment ils sont séparés. … Les Ebondji pour les Simbaka, les Pongo pour les Mitsogho*[220].

Through marriage, the Babongo Pygmies of Ossimba are a mixture of Babongo Ghebondgi and Babongo Pongue. For the last part of their migrations the Babongo Ghebondgi group followed

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[218] "very close to the town of Mimongo … Where there were houses there is already big wood". Tchibanga, Babongo Pongue 27/04/10 [recording DS400084; 21:05].

[219] Pongou seems to be an old name for Pygmies, it crops up in several historical documents, as is also used as an alternative to Libreville. A newspaper article in 1884 mentions the following (it should be noted that this is before du Chaillu's observations of "dwarfs" in the 1860s): "Conversing upon this subject with two most experienced persons, who had for many years traded all the important rivers of the Guinea coast, they informed me that those dwarfs were called Pongos, and were most numerous high up the Gabon river, nearly upon the equinoctial line and due west of the Juba river, so that when I heard of them in connection with the Juba I considered it a confirmation of these accounts. These merchants looked upon them as between men and baboons, and deserving the attention of naturalists. I observed in some maps the river Gabon is called the river Pongo, and Ponga, but without mentioning why it is so called." (Anonymous, 1884, p.1).

[220] "they were together, but the problem with the other was because they wanted to follow the Simba, that is why the people of Ebondji found themselves with the Simba, they wanted to talk Simba. But when we said 'we will not go over there, we are going to stay with our *Bio*', that is to say the Tsogo. That is how they separated. … the Ebondji with the Simbaka, the Pongou with the Mitsogho". Motombi, Babongo Pongou 12/05/10 [recording DS400072; 06:10].

the Ikoy River downstream, while the Babongo Pongou group crossed over to the Oumba River, via the Bakonga River (Map 11-5).

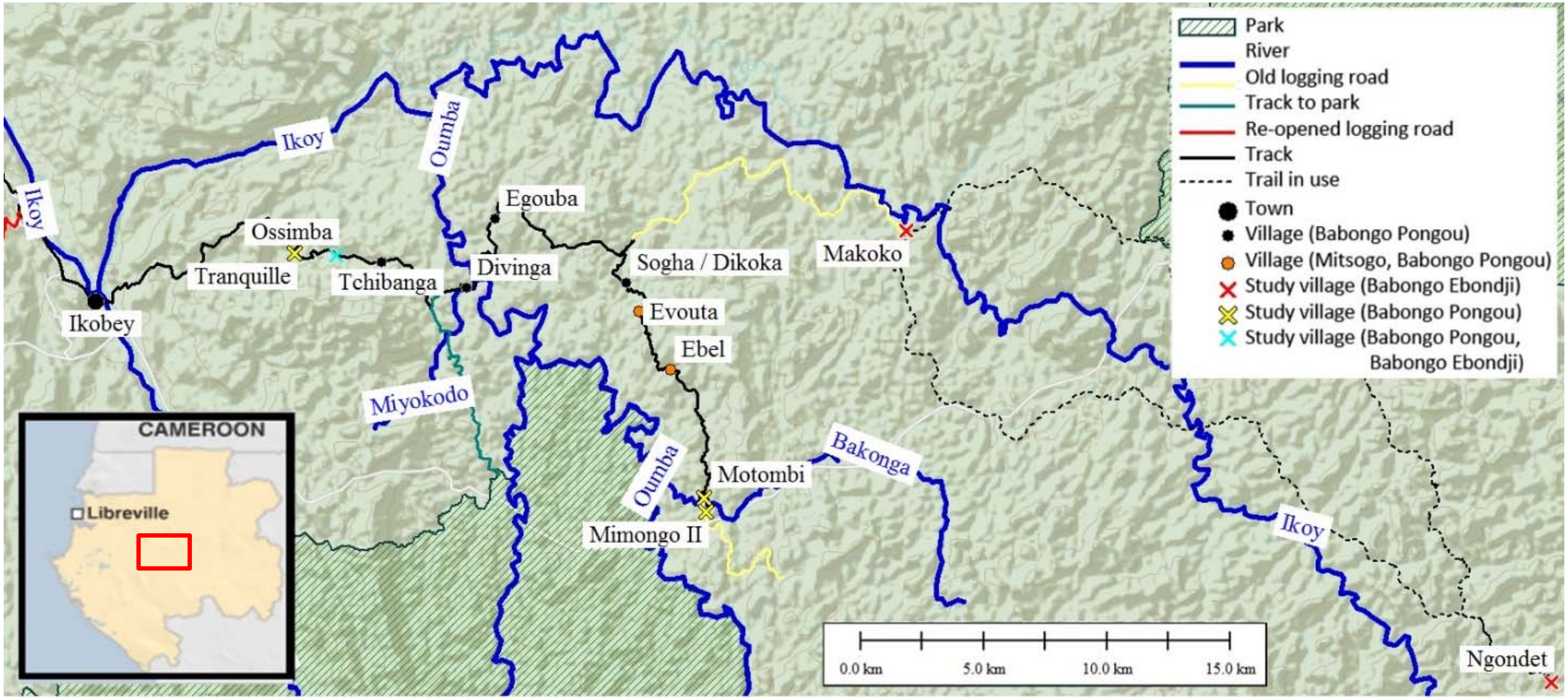
As with the Mitsogho and Akele, the Babongo Pygmies were also impacted by *regroupement*, the same Fang prefect asking them to move towards Mimongo town, once again some refused and carried on up the river, into the forest, to live in the various Ebondji villages near the headwaters of the Mimongo River. In some cases they used the old trade routes to move from village to village but in most cases they went through the forest and later followed the Ikoy River.

For the Babongo Pygmies, *regroupement* is still occurring, with local administrations still asking them to move closer to the road. Most recently the Babongo Ghebondgi, of Makoko and Ngondet, were asked to leave the village of Massika and come towards the road. Approximately ten years after La NEF, a timber company, had left Makoko, a group of Babongo Pygmies went towards Makoko via Carrié (near an old quarry made by La SONG), while others went to Ngondet. A few years later the people of Carrié moved to Makoko. This migration was due to their desire to get out of the forest for:

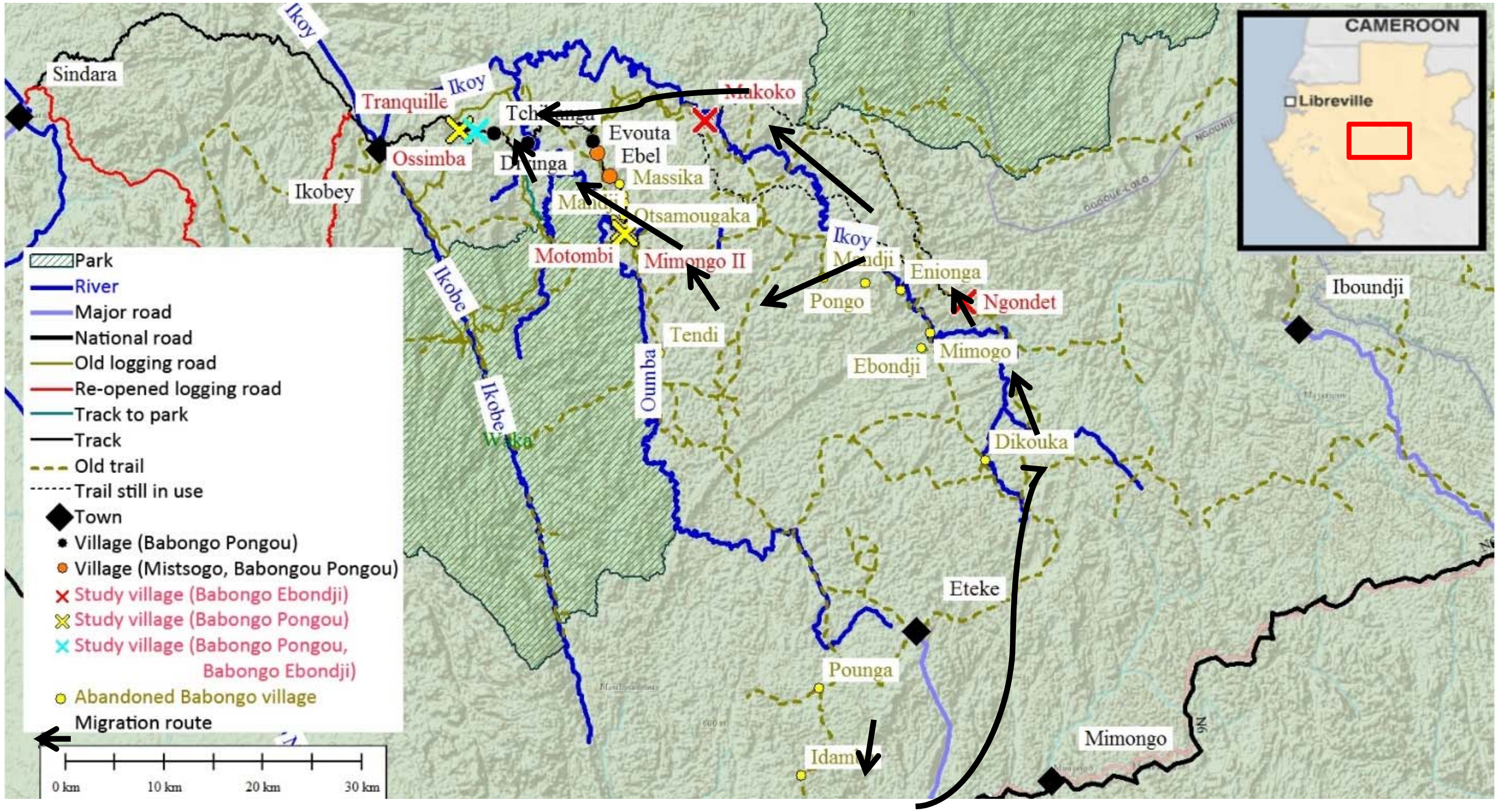
> *la souffrance, chercher le savon le pétrole les autres ont voulait approcher d'un village plus proche... on ne voulait plus rester où il y avait les éléphants et les gorilles ... [papa] il était fatigué de la forêt [maman] par rapport à l'approche pour certain nourriture, pour le savon et le sel*[221]*.*

Though both the Babongo Ghebondgi of Makoko and Ngondet have come closer to the road, having respectively, migrated approximately 100 and 70 km overland through the forest, they are still not on an accessible road. The people of Makoko have to walk approximately seven hours to get to Nyoe II, while the people of Ngondet have a day's walk to get to Massika. In the case of the route between Makoko and Nyoe II, this was mostly along the old La SONG road, a road that was so overgrown that the people of Makoko preferred to go through the forest. At the end of the field study, a Chinese logging company, SUNNLY, had re-opened part of this road to a river where one of their old hunting camps was located, and some of the people of Makoko migrated towards this site. By 2014 the village of Makoko had been abandoned with everyone moving down the road towards Nyoe II (personal communication Ndong, 2014).

[221] "suffering, to go get soap, kerosene, the other wanted to go closer to a village … we did not want to stay where there were elephants and gorillas … we were tired of the forest … due to the distance of certain foods, for soap and salt" Motombi, Babongo Ghebondgi 24/02/10 [recording DS400010; 02:41, 06:10].



Map 11-4: Current Babongo Pygmies villages above the town of Ikobey. Based on the following sources: Basemap - (ESRI, 2012), Park boundaries - (Institut Geographique National, 2008), trails, tracks, roads – track logs collected between 2008 to 2011.



Map 11-5: Migration of the Babongo from their old abandoned villages to the Babongo villages above Ikobey. Based on the following sources: Basemap - (ESRI, 2012), Park boundaries - (Institut Geographique National, 2008), old village sites, paths and roads from - (Army Map Service, 1966a; Army Map Service, 1966b; Army Map Service, 1966c; Institut Geographique National, 2008; Institut Geographique National, 1994; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1986; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1980; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1969; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1967a; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1967b; L'Annexe en Afrique Equatoriale de Institut Geographique National, 1962).

That the Babongo Ghebondgi of Makoko and Ngondet are still in the forest is due to the past conflicts that they have had with their Bantu-speaking neighbours, such as being blamed for the death of a Mitsogho or issues due to intermarriage with Bantu-speaking peoples. These conflicts have yet to be resolved but the young adults of Ngondet would like to continue their migration and move closer to Massika, so that they can have better access to education, and for the traditional doctors to be closer to their patients but:

> *de fait que je suis nganga Missoko* [traditional doctor], *beaucoup de mes étrangers, mes malades, n'arrivent plus à venir ici, par rapport à la distance … parce que, si j'étais au moins près d'une ville mes malades devraient venir à chaque fois. Je ne vais plus souffrir, en manquant du pétrole* [for hurricane lamp], *du savon ou autre article. … Le problème que me retarde, c'est parce que il y a encore mon père ma mère ici. Si je déplaçais plus loin, qui maintenant va garder mes parents*[222].

It was at the village of Indamba (on the Ikoy River) that the Babongo Ghebondgi came into contact with La SONG's road, it was here that

> *il y a eu beaucoup d'étrangers sont venus pour se faire soigner, et il y avez maintenant la joie, par rapport aux autres villages que ils ont franchi. Maintenait le savon, le sel qu'en venir donner. A parti de là ils ont fait la commerce de bois amer* [to ferment palm wine] *où les gens venir les payer*[223].

It was also along this old La SONG road that the Babongo Ghebondgi later migrated to Makoko and then, for some, to Ossimba.

Previously, the Babongo Pygmy elders had given an interdiction in Mimongo village where the people were not allowed to mix *"parce que les vieux leurs avaient dit que 'il faudrait pas que vous soyez mélanges avec les Tsogo'*[224]". This interdiction probably originated during the time of

[222] "as I am *Nganga Missoko* [traditional doctor], many of my strangers, my sick, cannot get to here, due to the distance … as, if I was at least nearer a town, my sick can come all the time. I will no longer suffer, not having kerosene [for hurricane lamps], soap or other articles. … The problem, and what is keeping me back, is because I still have my father and mother here. If I left to, go further away, who will now look after my parents". Ngondet, Babongo Ghebondgi 04/02/10 [recording DS400010; 02:10].
[223] "there are many strangers who come here to get treated, and there is now happiness, compared to other villages that we were in. Now there is soap, salt, that we are given. From here we started to trade *bois amer* [to ferment palm wine] where people came to pay for it". Ossimba, Babongo Ghebondgi 28/04/10 [recording DS400085; 1:04:41].
[224] "they did not mix. As the elders had told them that 'you should not mix with the Tsogo'". Motombi, Babongo Pongue 12/05/10 [recording DS400072; 12:33; 1:07:40].

slave raiding carried out by the Mitsogho on the Babongo Pygmies in the Eteke / Massima area (Klieman, 1999, p.96). Today the Babongo Pongue have reconciled their differences with the Mitsogho. The conflict that the Babongo Ghebondgi have with the Mitsogho has resulted in them trying to circumvent trading with the Mitsogho, preferring to wait for outsiders to come, or in some cases going directly to Sindara to trade, reminiscent of the migrations towards the coast carried out by different Bantu-speaking peoples in the 1800s to come into direct contact with the European traders (Chapter 3).

While the majority of the Babongo Ghebondgi in the Ikobey area are still in the forest and far from other neighbouring Mitsogho, the Babongo Pongue are found along the still functional road.

The Babongo Pongue who live in the Mitsogho villages of Nyoe II, Evouta, and Ebel and those who live by-themselves in the villages of Tranquille, Tchibanga and Motombi, all refer to a common village of Pongou, approximately a 130 km away overland through the forest (Map 4-6 near the town of Mimongo), as being the village from which their migration started. Once again their migration started at the beginning of independence with the Fang Prefet of Mimongo town asking the Babongo Pongue, now at Idamba (near Mimongo town), to move towards the town. They refused and moved away towards Divine and by doing so started their migration away from Mimongo town and into the forest.

The Babongo Pongue carried on their migration down the Ikoy River to Pongo (Map 4-6), they left the Ikoy River and went across the forest, sometimes using the old trade routes, till they reached the Bakonga River, which they followed down to the Oumba River. It was in the area around today's villages of Motombi / Mimongo II where the Babongo Pongue came into contact with the La SONG road and so the Bantu-speaking Mitsogho. It was also here that they started to split up into separate groups because the local administration were once again trying to bring the Babongo Pygmies closer to the road, though family conflicts also contributed to the separation.

Today the villages of the Babongo Pongue are found all along the road from villages of Tranquille to Mimongo II, and currently move when "*la route était tellement fermé, on abandonnait, partir pour route ouverte*"[225], but also when "*les éléphants ils venait descendre toujours au bord du de*

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[225] "the road was so closed, we left, left for the open road". Tchibanga, Babongo Pongue 27/04/10 [recording DS400084; 1:19:22].

village"[226]. Migration due to human-elephant conflict is not new, with Bouet writing in 1974 that "*devant les ravages habituels des éléphants, (surtout des "assala" ou petits éléphants de forêt), l'une des causes principales du découragement général et de l'exode de nombreux villageois gabonais"*[227] (Bouet, 1974, p.9).

If the road continues to degrade and becomes impracticable then some Babongo Pongue may stay but others will continue to follow the road towards Sindara "*Si la route est ferme est ce que ont pouvez vivre? – Na* [sic] *pas on continue, oui ont continuait ... juste au Sindara*"[228], "a*vant on a souffert pour débrousser la pistes à partir de la route, aider la migration car on souffre plus pour débrousser car ont suivre la route*"[229], indicating that the Babongo Pygmies are more interested in securing access to trade routes than forest resources.

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226 "the elephants were always coming to the village edge". Tchibanga, Babongo Pongue 27/04/10 [recording DS400084; 1:23:20].

227 "in front of the habitual ravages of elephants (especially the *"assala"* or small forest elephant), is one of the principal causes of general discouragement and the exodus of a number of Gabonese villagers"

228 "If the road close would we be able to live here – Na, we will continue … all the way to Sindara". Ossimba, Babongo Pongue 28/04/10 [recording DS400088; 02:20].

229 "before we suffered to clear the forest to make a path, since the arrival of the road this has helped our movement, as we no longer suffer to cut a path, we just follow the road". Ossimba, Babongo Ghebondgi 04/05/10 [recording DS400091; 38:45].

11.17 A short history of the "discovery" of Pygmies and the role of Gabon

Though Pygmies were rediscovered first in Gabon, having been previously been relegated to the myths and legends of the Ancient Egyptian, Greek and Roman Empires, until recently the only thing know about the Pygmies of Gabon is that they are more or less found throughout the county (Bahuchet, 2007) and very little is known about them (Bahuchet, 1993a; Knight, 2003; Mayer, 2007; Mayer, 1987). Before the 1980s "anthropological and ethnographical research was, with a couple of exceptions, not encouraged in Gabon" (Knight, 2003, p.82). Since 2000 this is being rectified by young anthropologists (Bonhomme *et al.*, 2012; Knight, 2006; Knight, 2003; Matsuura, 2009; Matsuura, 2006; Paulin, 2010; Soengas, 2010; Soengas, 2009; Ruyter, 2010; Ruyter, 2003; Weig, 2013).

Gabon had many Pygmy populations that lived next to the coast, and so within easy reach of the ears of the first trading ships from Europe. In contrast the Pygmy groups living in the heart of Central Africa were less accessible. It was along these Gabonese trading routes that the first second-hand reports of Pygmies were recorded by the likes of Battell (1625) and Dapper (1686). These second-hand accounts were published 200 years before the first-hand encounters by Du Chaillu (Touchard, 1861).

The first European to have a recorded face to face encounter with Pygmies in Gabon was Du Chaillu in 1861 (du Chaillu, 1867a; du Chaillu, 1867b)[230], the existence of Pygmies was confirmed by Schweinfurth, a German botanist and explorer, in 1870 (Bahuchet, 1993b; Ballard, 2006; de Quatrefages, 1887; Le Roy, 1928; Schweinfurth, 1969). Du Chaillu's first-hand encounter was quickly followed by other encounters at first or second hand including: Marche in 1877 (Marche, 1882; Marche, 1878), Fleuriot De Langle in 1868 (Bahuchet, 1993b), Crampel (Crampel, 1890), Mgr le Roy in 1897 (Le Roy, 1928), Migeod in 1921 (Migeod, 1922), Fleuriot in the 1930s (Fleuriot, 1942) Trilles around 1932 (Trilles, 1945; Trilles, 1935; Trilles, 1933), Andersson (1983) writing about his trips in 1931, 1934, and 1949 (Andersson, 1983), Fairley circa the 1940s (Fairley, n.d.) and Deschamps (Deschamps, 1965; Deschamps, 1962).

Behind these encounters was a race by explorers, missionaries and anthropologist to find the "ultimate pygmy", the "original human" (Frankland, 2001), holders of the first human culture, a "*culture primordiale*"[231] (Montadon, 1934 in Bahuchet, 1993b, p.170). This being judged on size,

[230] However, as du Chaillu was not a scientist his discoveries were ridiculed (Bahuchet, 2007; Bahuchet, 1993b; Hombert and Perrois, 2007).
[231] "primordial culture".

whereby the smaller the people the more "authentic" the population (Bahuchet, 1993b; Ballard, 2006) and "*pas d'agriculture, pas d'élevage, pas d'arme de frappe, pas de poterie, pas de fer, pas d'ornements corporels, pas de circoncision, pas de sépulture, pas d'instruments de musique, pas d'art plastiques, pas de chef, pas de totem*"[232] (Bahuchet, 1993b, p.170).

In the 1950s ethnographers such as Turnball (Turnbull, 1976), started to spend substantial amount of time living with, and studying the Pygmy groups in the northern Congo basin, which lead to a vast literature on these groups and their mobile way of life (Bahuchet, 1996; Bahuchet, 1993a; Bahuchet, 1985; Colchester, 2000; Colchester, 1999; Demesse, 1980; Demesse, 1978; Demesse, 1957; Dounias and Bahuchet, 2002; Hart, 1978; Hayashi, 2008; Thomas and Bahuchet, 1991).

[232] "no agriculture, no herding, no projectile weapons, no pottery, no iron, no jewellery, no circumcision, no cemeteries, no music instruments, no sculptures, no chief, no totems".

11.18 Some cases of assumption drag

The results in this thesis indicate that there are many inaccurate assumptions being made by conservation practitioners and development professionals who have worked in the Ikobey area (Table 9-1). This includes understanding of who is “indigenous” and “autochthons” peoples (Geschiere, 2009) to the area, whereby the presence of Pygmies in the area does not automatically mean that they are “indigenous” (Geschiere, 2009) to it, and so projects that include them as the principal focus of any development and conservation land management projects may incur resentment by other local populations, such as was the case of the 3D forest mapping undertaken in the Ikobey area (see Brainforest, 2010; Eisen, 2010; Rambaldi *et al.*, 2010), whereby the Mitsogho felt more attention being paid to the Babongo Pygmies.

This thesis also highlights the conservation myth that Gabon has only recently been touched by humanity (Fay, 2004a; Fay, 2004b) and because of this is one of Africa’s Last Eden’s (BBC Travel, 2013; National Geographic, 2007; Odendaal and Day, 1999)

These inaccuracies and myths that have been incorporated into the assumptions of conservation and development practitioners working in Gabon, with the consequence that assumption drag and negative learning have also been unwittingly integrated into the conservation of Gabon’s environment.

Assumption drag can be reduced[233], but not eradicated, through multidisciplinary methods, preferably by including people from different academic disciplines, which may not just include the usual suspects but also economists, historians and transport geographers. Some of these methods have been used in this thesis to highlight some of the issues when the simplistic chain of logic is used in conservation and development projects. For the study sites used in this thesis some of the assumptions in the original chain of logic have been found to be inaccurate (as summarised in Table 9-1), while the proposed chain of logic (Figure 1-3) may be more applicable. This has implications for the long-term success of conservation and development projects.

[233] Though the assumptions maybe inaccurate at the present time, these could change over-night due to multiple factors that cannot currently be predicted. For example in the Ikobey area they could include, but are not limited to, events such as: the discovery of a mineral that is important in future technologies e.g. rare earths, a hydro-electric dam built across the Ngounié River that also allows easier access to the Ikobey site, the long-term commitment by a timber company to exploit the forests in the areas and the creation of a cheap product that stops biting insects, which would open up the area to outsiders, including tourists, much as quinine did in the 1800s.

11.18.1 Assumption drag concerning Pygmies

An often made assumption in remote rural forest areas is that if a Pygmy population is in these areas they are not only “indigenous” to an area but are also the people who have lived in the area for the longest period of time. For this reason there are many conservation and development projects whose principal focus are Pygmy populations, while disregarding other people (Rupp, 2011). It is also assumed that because Pygmy groups live off the land and are very mobile so it is more important for them to have their land rights recognised (Frankland, 2001). In the Ikobey site these assumptions have created tension between the Bantu-population and the Pygmy population as it is the Bantu-population that have lived in the area the longest (Chapter 4).

Though the Babongo Pygmies, the group found in the study site, are slowly out-migrating with the Bantu-speaking population, this does not mean that they are a mobile people as described in the “traditional” Pygmy literature. This research and others on Pygmies of Central and Southern Gabon, have found that these Pygmy groups are relatively sedentary compared to other groups in the northern Congo Basin (Matsuura, 2009; Matsuura, 2006; Soengas, 2010; Soengas, 2009) and have been since at least the 1930s (Andersson, 1983; Fairley, n.d.; Le Roy, 1928; Trilles, 1933). Others have found similar trends in the Congo Basin (Rupp, 2011). That Pygmies are often thought of as mobile may be an artefact resulting from the approach used by the researchers that have studied them, which since the colonial period has been to find the most “authentic” (Frankland, 2001) Pygmy group which are those that are the least integrated into “modern culture” and live on hunting and gathering in remote forest areas away from outside influences in a “forest cocoon”, with little trade except with their direct neighbours (Bahuchet and Guillaume, 1982, p.189; Riddell, 2011, p.44; see also Rupp, 2011).

As Klieman and others (Klieman, 2003; 1999; 1997; Rupp, 2011) have shown, this lack of trade with outsiders could be one of the outcomes of the start of the Atlantic trade, stemming from fierce competition for a good position in the tiered structure of the trade in African resources with the Europeans (Chamberlin, 1977). This resulted in Pygmies being marginalised to the lowest rungs in the trade, only able to trade forest products to their patrons. This contrasts sharply with Battell’s 1600s encounter with Pygmies who fiercely guarded their status in the ivory trade of the time (Battell, 1901). However, and in sharp contrast to Battell, du Chaillu’s 1860s description of the Babongo Pygmies (du Chaillu, 1872) is similar to the description of the Pygmies in the northern part of the Congo Basin, implying that they had significant mobility. Assuming that these descriptions are accurate, it can be concluded that there has been a substantial shift in Pygmy mobility in Gabon during this two century period.

11.18.2 Implications of assumption drag on funding and communication

Funding is a hindrance to conservation. Though fundraising is a necessity (Adams, 2004; Balmford and Cowling, 2006; Martín-López *et al.*, 2009; Martín-López *et al.*, 2008), the practitioner needs to be aware how this diminishes the scientific basis of a project. As funding usually comes from outside donors, foundations, the public, governments, etc. the conservation practitioner is faced with a dilemma either to communicate accurate information, including uncertainty that arises from long-term detailed studies or just best guesses that originate from quick short-term studies that can be out by several factors. Due to funding cycles and the crisis driven way that conservation practitioners operates, the latter of the two sources of information is usually the norm, which in turn results in the conservation targets of projects being impaired by assumption drag, especially in long-term projects.

As the conservation practitioner needs to capture the publics and government's imaginations and attention this can lead to an "exaggerated forecast [that] might well capture attention better than a strictly accurate one" (Overholt, 2000, p.102; see also Fairhead and Leach, 1998) especially as more information gives political advantages and so the increases the temptation to distort it (Healy and Ascher, 1995, p.11). However, soliciting knee jerk reactions by using uncertain data may come at the cost of professionalism (Brewer, 1983, p.179) and can result in the loss of the public trust (Brewer, 1983, p.180) or manipulation by politicians (Ascher, 2004) as seen in the politics of world fisheries and climate change. All of which adds to assumption drag and the long-term likelihood of project failure as seen in the case of conservation in Gabon where unrealistic hopes were pinned on revenue from eco-tourism as a way preserve Gabon's environment while generating revenue for the state (WCS, 2007b).

Assumption drag is pervasive in conservation in Gabon, and probably elsewhere. As such practitioners need to be aware of their preconceived ideas. If active measures are not taken to check the assumptions made then assumption drag can result in the failure of conservation and development projects in the long-term. Assumption drag is made worse due to the scientific culture that surrounds it, for the assumptions behind theories and models are rarely checked with hindsight, as there are cultural barriers to "retrospective appraisals" (Ascher, 1981, p.258). The reasons for this include lack of funding for such work especially as it can be time consuming and the general lack of interest in academic journals to publish such material, especially at a time when scientific careers are largely dependent on publishing (Ascher, 1981; Brysse *et al.*, 2013; Oppenheimer *et al.*, 2008).

11.18.3 Implications of assumption drag for research

Assumption drag due to short-term research are not just limited to research on the impacts of timber companies. The need for a rapid research turn-over has resulted in studies that require time consuming data collect methods becoming increasingly rare. Leading to fewer detailed ethnographies (*a la* Burnham (1980) and Evans-Pritchard (1969)), long-term animal behaviour (*a la* Goodall (2010)), or studies in the long-term population dynamics of certain species (*a la* Peterson (1977) (see also Peterson *et al.*, 1998; Sand *et al.*, 2012)), all of which affect the base-line data upon which conservation practitioners can base their assumptions and hence the long-term objectives of their projects.

As the conservation of a landscape, habitat, species, is a complex undertaking, with factors from multiple disciplines interacting with each other to create the composition and dynamics of these landscapes, habitats and species (Fairhead and Leach, 1996; Milner-Gulland and Rowcliffe, 2007), it will never be possible to eliminate all the assumed ideas that a practitioner may have towards a certain environment or project. All the conservation practitioner and development professional can do is to minimise assumption drag before undertaking a project and continuously re-evaluate them during the project.

11.18.4 Implications of assumption drag for sustainable development projects

The possible failure of the development of remote rural forest areas through initiatives that involve timber companies, such as alternative livelihoods, Integrated Conservation and Development Projects (ICDPs), Reducing Emissions from Deforestation and Degradation (REDD+), Payments for Ecosystem Services (PES) and Forest Stewardship Council (FSC) initiatives, could be due to a variety of reasons, one of which is the way that development professionals, conservation practitioners and donors design projects to “increase local cash income” (Scherr *et al.*, 2003, p.1) through the timber industry, in the worst-case scenario without consulting the private sector or, at best, consulting them late in the project design. This process immediately limits the impact that any initiative could have. The development professional’s and conservation practitioner’s mind-set may come packaged with ideas that are rarely found in a corporate environment, resulting in the promotion of sustainable development while assuming that they understand the business and market realities of the timber industry as well as indirect economic impact of the conservationists or developers interventions themselves (Scherr *et al.*, 2003). It is the assumption that conservation practitioners understand business and market realities that has led to many alternative livelihood projects and their ilk to fail, it is therefore wrong to seek reasons for project failure due to some aspect within communities (see examples in Coad *et al.*, 2014; Wicander and Coad, 2015).

For sustainable development projects that involve market economies or commodification of natural resources, for example alternative livelihoods, there is a need to look at the assumptions of the project before it is undertaken, for this a business plan has to be drawn up. Like any business plan (Peterson, 2005) this includes base-line economic data[234] to see if the project makes economic sense (Ascher, 1994, p.23), the foreseeable market trend in the product that is going to be marketed or commodified, especially if boom and bust scenarios are to be avoided, and cultural acceptance of the product that is going to be marketed, both by the reseller and by the buyer[235]. Until the creation of such business plans are routinely carries out by conservation practitioner who want to undertake sustainable development projects then it is impossible to say that such project as alternative livelihoods (Roe *et al.*, 2014) have ever been tried.

11.18.5 Implications of assumption drag for environmental science

Conservation initiatives usually have their theoretical basis rooted in the environmental sciences, such as conservation biology and ecology (Balmford and Cowling, 2006; Mermet *et al.*, 2013). Because of this foundation conservation projects inherit aspects of its culture from these disciplines, which include: the choice of personnel employed who usually have a background in environmental sciences, the types of conservation initiatives carried out which are usually based on these biological sciences, and the intended project outcomes including data collected to evaluate them which are based on methods that collect "scientific" quantitative data at the expense of traditional knowledge (Pretty, 2011), all of which can contribute to assumption drag.

This approach introduces a weakness that a conservation practitioner needs to be aware of and includes the risk of generalisation from a broad but not in-depth quantitative data and theories, especially in the light of the "new ecology" (Grabbatin and Rossi, 2012, p.278) of non-equilibrium ecology where ecosystems may not be as stable as previously thought (Behnke *et al.*, 1993; Grabbatin and Rossi, 2012). The environmental science approach also reduces the role that humans have in shaping the environment, especially in Africa, to the one dimensional process of an outsider[236] that destroys other species and the environment. When the role of humans in

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[234] In the case of the marketing of a product this would include the cost of transport and production costs, including how seasons impact both and possible fines (e.g. in the case of when animals eat another person's crops). It would also need to considered the effects of major changes from outside the community, such as the departure of a timber company or conservation project.

[235] In certain cultures some products that could be marketed may be taboo in the community. While other marketable products that the community has access to may not be of the same quality that the consumer expect, e.g. some honey produced in Africa does not have the same taste as European honey.

[236] With, at the extreme, humans being "outside nature" – "Thus at every step we are reminded that we by no means rule over nature like a conqueror over a foreign people, like someone standing outside nature — but that we, with flesh, blood, and brain, belong to nature, and exist in its midst, and that all

shaping ecological landscapes is recognised, it is usually in a negative role on what was a "pristine environment" (Lowe *et al.*, 2009) rather than the recognition that since their appearance on earth "human cultures have shaped, and in turn been shaped by, local ecosystems" (Pretty, 2011, p.127). Humans cannot simply be wished away and treated as only an "ecological audience" (Lowe *et al.*, 2009, p.298). Doing so runs contrary to the Darwinian postulate that species in a particular environment, and even the environment itself, are a result of a natural co-evolution process in which each part has a role to play. Diminishing the role that humans have to one dimension reduces the important role humans have in both the co-evolution process and their role in shaping the environment, species and even species behaviour that we see today, especially in Africa where humans have inhabited the longest (McComb *et al.*, 2014).

Though the ultimate goal of conservation is the environment, and so in the biological domain, to achieve these goals the '''triple bottom line': economic productivity, environmental protection, and sociocultural integrity are all important" (Ascher, 2007, p.142). To achieve this conservationists need to be multidisciplinary in their thinking which includes political, social, economic, public awareness through communication etc., all of which are the domain of the social sciences, especially psychology (Clayton and Brook, 2005; Schultz, 2011). Multidisciplinary approaches have long been utilised but are usually initiated by a conservationist practitioner with a biological background (Campbell, 2005; Sievanen *et al.*, 2012). Only once this is done can the search for solutions to environmental threats be carried out.

our mastery of it consists in the fact that we have the advantage over all other beings of being able to know and correctly apply its laws" (Engels, 1940, p.292).

11.19 Modeling including the role of ethnicity on animal frequency

Though ethnicity would have a role in the frequency of animal signs, these models were rejected due to their complexity, with a high degrees of freedom (Table 11-6 and Table 11-7) (10 compare to 7 in the model that was finally chosen), and because the size of the dataset is problematic.

Model variables	Df	AIC	AIC differences	Akaike weight
Total_animals ~ Distance + Last_Logged + Ethnic + (1|Village/Tran)	10	9217.98	0	0.257
Total_animals ~ Distance + Last_Logged + (1|Village/Tran)	7	9219.4	1.42	0.126
Total_animals ~ Distance + Last_Logged + Ethnic + Camp + (1|Village/Tran)	11	9219.48	1.5	0.121
Total_animals ~ Distance + Last_Logged + Ethnic + Distance : Last_Logged + (1|Village/Tran)	12	9219.84	1.86	0.101
Total_animals ~ Distance * Last_Logged + (1|Village/Tran)	9	9221.26	3.28	0.05
Total_animals ~ Last_Logged + Ethnic + (1|Village/Tran)	9	9221.36	3.38	0.047
Total_animals ~ Distance + Last_Logged + Ethnic + Distance : Ethnic + (1|Village/Tran)	13	9221.44	3.46	0.046
Total_animals ~ Distance * Last_Logged + Ethnic + Camp + (1|Village/Tran)	13	9221.44	3.46	0.046
Total_animals ~ Last_Logged+ Ethnic + Camp + (1|Village/Tran)	10	9223.34	5.36	0.018
Total_animals ~ Last_Logged + (1|Village/Tran)	6	9225.32	7.34	0.007
Total_animals ~ 1 + (1|Village/Tran)	4	9225.62	7.64	0.006
Total_animals ~ Distance + (1|Village/Tran)	5	9225.76	7.78	0.005
Total_animals ~ Ethnic + Camp + (1|Village/Tran)	8	9226.06	8.08	0.005
Total_animals ~ Distance * Ethnic + (1|Village/Tran)	11	9226.42	8.44	0.004
Total_animals ~ Distance + Ethnic + (1|Village/Tran)	8	9226.5	8.52	0.004
Total_animals ~ Ethnic +(1|Village/Tran)	7	9226.52	8.54	0.004
Total_animals ~ Camp + (1|Village/Tran)	5	9226.98	9	0.003
Total_animals ~ Last_Logged + Camp + (1|Village/Tran)	7	9227.2	9.22	0.003

Table 11-6: AICs results from various Generalised Linear Mixed Model with a negative binomial distribution investigating how the frequency of animals signs (Total_animals) is impacted by variables that characterise each village site, namely distance from market (Distance), past presence of a timber base (Camp), ethnicity and time since the area around the village was last logged (Last_Logged – grouped into never, less than 5 years and greater than 6 years). Highlighted in orange are the model including ethnicity and the null model, while in green is the chosen model that is simpler.

glmmadmb(formula = Total_animals ~ Distance + Last_Logged + Ethnic + (1 | Village/Tran), data = Animals, family = "nbinom")					
AIC: 9218					
Coefficients:					
	Estimate	Std. Error	z value	Pr(>|z|)	Sig.
(Intercept)	1.267	0.511	2.48	0.01332	*
Distance	0.007	0.003	2.36	0.01841	*
Last_Logged - Less_5	0.009	0.257	0.04	0.97177	
Last_Logged - Never	-0.519	0.138	-3.75	0.00018	***
Ethnicity – Babongo Pongue	-0.198	0.188	-1.06	0.29048	
Ethnicity - Mitsogho	-0.449	0.183	-2.46	0.01401	*
Ethnicity - Pove	0.406	0.364	1.12	0.36439	
Significance. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1					
Number of observations: total=1600, Village=10, Village:Transect=80					
Random effect variance(s):					
Group=Village	Variance	StdDev			
(Intercept)	2.203e-09	4.694e-05			
Group=Village:Transect	Variance	StdDev			
(Intercept)	0.1553	0.3941			
Negative binomial dispersion parameter: 4.14 (std. err.: 0.27104)					
Log-likelihood: -4598.99					

Table 11-7: Results from Generalised Linear Mixed Model with a negative binomial distribution of Total_animals. In this model villages characteristics that concern distance, ethnicity and time since the area around the village was last logged are the predictor variables.