

**Tourists, gorillas and guns:  
Integrating conservation and development  
in the Central African Republic**

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I, Chloe Hodgkinson, 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.

Signed: .....

## **Abstract**

Integrated conservation and development programs (ICDPs) are aimed at addressing both conservation and development issues through the involvement of local communities in the process of wildlife management. Typically this involves providing park-adjacent communities with conservation-related benefits to induce pro-conservation behaviour. The Dzanga-Sangha ICDP Project (DSP), southwest Central African Republic, has coordinated the management of a protected area complex since 1990. Its activities include traditional conservation measures such as anti-poaching patrols, a developing gorilla tourism programme, and focused development activities. This study adopts an interdisciplinary approach to evaluate its efficacy at meeting both local development and conservation goals, with a strong focus on how these two areas interact.

Evaluation of the DSPs impact on poverty alleviation in the reserve community suggests that the considerable opportunity costs caused by park formation largely fail to be compensated by the benefits provided. This effect is augmented by the high level of in-migration into the reserve. Examination of discrepancies between cost/benefit provision and recognition show that community-level benefits are particularly undervalued by local residents. Attitudinal surveys suggest benefit recognition to be strongly linked to pro-conservation attitudes. However, results from a 12-month market survey, a concurrent household consumption survey, participant observation and key informant interviews showed that conservation-related behaviour, in terms of both wild-food extraction and consumption, is largely unrelated to either benefit receipt or attitudes. Furthermore, evaluation of conservation efficacy suggested the main prey species are being hunted at unsustainable rates.

This empirical study takes its place in a growing literature addressing not only the direct social and environmental implications of ICDPs but, crucially, the interactions between the two. It provides both applied management recommendations in addition to further contributing to our theoretical understanding of the dual development-conservation approach.

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## Acronyms

<b>ADMADE</b>	Administrative Management Design (Zambia)
<b>AME</b>	Adult Male Equivalent
<b>ANOVA</b>	Analysis of Variance
<b>ANCOVA</b>	Analysis of Covariance
<b>CAMPFIRE</b>	Communal Areas Management Programme for Indigenous Resources (Zimbabwe)
<b>CAR</b>	Central African Republic
<b>CARE</b>	Cooperative for Assistance and Relief Everywhere, Inc.
<b>CBC</b>	Community Based Conservation
<b>CBNRM</b>	Community-Based Natural Resource Management
<b>CI</b>	Confidence Interval
<b>CPUE</b>	Catch Per Unit Effort
<b>CV</b>	Contingent Valuation
<b>CWN</b>	Community-Based Wildlife Management
<b>DFID</b>	UK Department for International Development
<b>DNP</b>	Dzanga National Park
<b>DRC</b>	Democratic Republic of Congo
<b>DSP</b>	Dzanga-Sangha Project (Also referred to simply as the 'project')
<b>DSR</b>	Dzanga-Sangha Dense Forest Special Reserve
<b>FAO</b>	Food and Agricultural Organisation of the United Nations
<b>GLM</b>	Generalised Linear Model
<b>HAS</b>	Household Attitudinal Survey
<b>HCIS</b>	Household Consumption and Income Study
<b>HIV</b>	Human immunodeficiency virus
<b>IBP</b>	Incentive-Based Programs
<b>ICDP</b>	Integrated Conservation and Development Project
<b>LIRDp</b>	Luangwa Integrated Resource Development Project
<b>NFTP</b>	Non-Timber Forest Product
<b>NGO</b>	Non-governmental Organisation
<b>NNP</b>	Ndoki National Park
<b>PRA</b>	Participatory Rural Appraisal
<b>RRA</b>	Rapid Rural Appraisal
<b>SD</b>	Standard Deviation

<b>SPSS</b>	Statistical Package for the Social Sciences
<b>USAID</b>	US Agency for International Development
<b>US\$</b>	United States Dollar
<b>WCED</b>	World Commission on the Environment and Development
<b>WCS</b>	Wildlife Conservation Society
<b>WWF</b>	World Wide Fund for Nature
<b>XAF</b>	Communauté Financière Africaine Franc (Central African Republic)



## Chapter one

### Introduction

#### ***1.1 Natural resources and development***

The exploitation of the world's natural resources, such as minerals, fuels and timber, has played an important role in the development of almost every society in the world. At the national level they may provide raw materials for industry, or generate revenue through their sale to other nations. At the local level the exploitation of natural resources, whether for subsistence or sale, can underpin livelihoods, with an estimated 150 million of the world's poorest people dependent on wild resources for both livelihood and food security (DfiD, 2002).

This dependence on the environment to provide goods is particularly prevalent in the low and middle-income countries of Africa, Asia and Latin America. Wild animal meat, often termed 'bushmeat', frequently offers a valued source of protein, above all in rural populations where alternative sources may be unaffordable or unavailable (Milner-Gulland et al., 2003, Kumpel, 2006, Anstey, 1991, Fa et al., 2002, Chardonnet et al., 1995). In rural Equatorial Guinea, wild plants and animals were found to be consumed by households on over 50% of days (Allebone-Webb, 2008), whilst in the highlands of Sarawak wild meat was found in 67% of all meals (Bennett et al., 2000). Wild resources may also provide an important source of income for households- one study of wild resource use by households in rural Democratic Republic of Congo (DRC) found that over 90% of bushmeat and fish produced by households was sold at market rather than consumed (de Merode et al., 2004).

The value of natural resources does not always lie solely in their economic importance (Abbot et al., 2000). Other livelihoods, such as jobs with short term logging concessions, can be extremely unpredictable and forest resources often provide a reliable fallback (Fimbel et al., 2000, Hart, 2000, de Merode and Cowlshaw, 2006), particularly during the lean agricultural period (Dei, 1989). The use of wild foods may also be closely linked to cultural tradition, prestige or ceremony (Sullivan, 2005, Sabater-Pi and Groves, 1972, Mitchell and Tilson, 1986)- for the BaAka of the Central African Republic, communal net hunting has historically formed an integral part of their social

organisation, encouraging close co-operation and an elaborate system of reciprocal obligations (Bahuchet, 1992).

The importance of the exploitation of natural resources for livelihood strategies has received growing attention in the development arena. The term ‘sustainable development’ was first brought to prominence by the United Nation’s Brundtland Commission in 1983, defined as development that “...meets the needs of the present without compromising the ability of future generations to meet their own needs”, and included calls for environmental sustainability (UN, 1987). From assuming that environmental issues could be addressed once economic development had been achieved, it began to be increasingly recognised that environmental and development issues are actually closely inter-dependent (Adams et al., 2004, Adams, 2001). As Barbier, perhaps somewhat optimistically, asserts:

*“... it has now been recognized that the environment is not a “luxury” for economic development, but contains natural “capital” fundamental to growth and development in poorer economies.”*

(Barbier, 2005)<sup>1</sup>

This rising interest in sustainability in development coincided with a change in emphasis from concentrating on national growth to focusing on poverty alleviation at the local level. Donor-imposed Structural Adjustment Programmes, generally encouraging “free market” programmes and policies, fell into disfavour in the late 1990’s, replaced by Poverty Reduction Strategy Papers, theoretically drawn up by the country in question (UNCTAD, 2002). As a result, projects aimed at addressing both poverty alleviation and biodiversity conservation at the local level grew increasingly popular with development workers and their funding bodies (Chambers, 1983).

Roe and Elliot argue that linking poverty reduction and conservation is both a moral and practical imperative and can result in benefits for both (Roe and Elliot, 2006). However, they highlight the need for a better understanding of the links between livelihoods and wild resources, emphasising the paucity of knowledge of the role that wild foods play in providing nutrition, food security and income. It is often unclear as to how households will cope if access to natural resources is denied or supply is exhausted (DfiD, 2002, Bennett, 2002, Wilkie and Godoy, 2001), seriously restricting the potential for the success of programmes aimed at achieving ecologically sustainable development in

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<sup>1</sup> Although see also Sanderson and Redford (2003) and Sanderson (2005) who argue that that current poverty alleviation strategies are moving away from an emphasis on biodiversity conservation.

a region. There is also growing scepticism in the literature that development and conservation goals are compatible (Adams and Hulme, 2001)- where tradeoffs do occur, they are frequently at the expense of the poor and disenfranchised (Homewood et al., in press).

This increasing interest in the integration of conservation and development goals coincided with a similar movement in the conservation arena. Focus shifted from the conventional protectionist model, developed during the colonialist era, into a more people-focussed approach, known as community conservation. The history of conservation efforts is reviewed below, before critically discussing the efficacy of the dual conservation/development approach for both biodiversity and poverty alleviation.

## ***1.2 A history of conservation efforts***

### **1.2.1 Protectionism**

Traditional conservation efforts are deeply rooted in the idea of preserving natural areas in what is believed to be an untouched state. Frequently termed ‘fortress’ or ‘fences and fines’ conservation, the underlying assumption of this top-down approach is that human exploitation would pose a threat to both species and ecosystems (Adams, 2004). The protected land, gazetted into a park or reserve, is managed by strictly controlling or prohibiting exploitation- in many cases, residents are actively expelled and consumptive use is excluded (Brockington and Igoe, 2006, Turton, 1987).

Since the creation of the world’s first protected area, Yellowstone National Park, in 1872, park formation has continued to be the main response by the international conservation community to the threat to biodiversity. An estimated 113,713 protected areas exist in the world today, an increase of around 11% since 2003 (UNEP & WCMC, 2007). Over half of this area (or 6% of the worlds total land area) is classified in the IUCN protected area management categories 1 to 4 - categories that allow for little to no exploitation or occupation by humans.

While suggested to be effective under certain conditions (Bruner et al., 2001, Naughton-Treves et al., 2005), protectionism as a management approach began to come under increasing criticism. Ethical, moral and legal considerations began assume more importance from the 1980’s onwards. The isolation of ‘natural’ areas from both their social and political context has been heavily

criticised as impeding any understanding of effective conservation measures and as having serious social implications for the local communities concerned (West and Brockington, 2006, Adams and Hutton, 2007). Social and cultural costs, often ignored in conventional cost/benefit analysis of protected areas (e.g. Kramer et al., 1995, James et al., 1999), are in many cases likely to be substantial, with potentially far-reaching consequences (Coad et al., 2008). The formation of many protected areas often involves the forced displacement of any residents in the area. Although the extent of such incidences remains unknown due to poor documentation (Brockington and Igoe, 2006), there is frequently clear potential for serious repercussions to be visited on already impoverished peoples (Ghimire and Pimbert, 1997, Brockington, 2002, Turton, 1987, Neumann, 1998). A now infamous example of this is the removal of the San from their ancestral lands in the Central Kalahari Game Reserve, Botswana, in order to develop tourism in the area, facilitated by cutting off both their food and water supply in 2002 (Taylor and Mokhawa, 2003). This was later ruled as illegal by the Botswana High court in 2006, although harassment has continued (Survival, 2008, Survival, 2006).

The social repercussions of displacement often reverberate far beyond landlessness, frequently leading to social and cultural dislocation, high levels of unemployment, food insecurity and increased mortality rates (Adams and Hutton, 2007). There have been a number of cases where, when access to protected areas was restricted to certain ethnic groups, residents or immigrants belonging to different groups responded by changing their ethnicity to facilitate access (Kuper, 2003, Brockington, 2002). The psychological impact of being evicted, in many cases forcefully, from ancestral lands, and the sometimes violent enforcement of park regulations by its guards must also not be underestimated.

The economic costs associated with the loss of access to forest resources by park creation alone can also be considerable (Coad et al., 2008). Bwindi Impenetrable National Park, Uganda, home to half the world's remaining mountain gorillas, has been estimated to cost the surrounding communities US\$ 5.3 million annually just in lost agricultural production (Hatfield and Malleret-King, 2003), while Emerton estimates that the opportunity costs of the loss of access to forest resources for households living around Mount Kenya to be worth around 250 US\$ per household, or 18 US\$ million overall (Emerton, 1995, Emerton, 1999b).

The negative impacts of living near a protected area may also spread outside the park, most notably by the movement of forest-dwelling animals. Crop raiding of park adjacent fields is a well documented and sensitive issue (Hill, 2000, de Boer and Baquete, 1998, Weladji and Tchamba,

2003)- Emerton estimates that crop damage may cost forest adjacent dwellers up to US 1 million a year in the Mount Kenya forest region (Emerton, 1999b). Loss of livestock due to predation by forest dwelling animals can also incur significant costs (Naughton-Treves et al., 2003, Zimmermann et al., 2005). More serious is the potential for human fatalities (Karanth and Madhusudan, 2002), with Packer et al. reporting at least 563 Tanzanians killed by lions between 1990 and 2005 (Packer et al., 2005). That these costs occur at the local level, exacerbating poverty, while the benefits of conservation accrue at the global scale, is recognised as a considerable injustice associated with protected area management (Weladji and Tchamba, 2003, Hulme and Murphee, 2001, Brockington, 2002, Adams et al., 2004, Balmford and Whitten, 2003).

Concerns regarding the efficacy of the protectionist approach with regards to biodiversity conservation also arose at much the same time. A fundamental complaint has been the failure of conservationists to recognise that much of the landscape classed as ‘wilderness’ may have been formed and maintained by human activities (Wolmer, 2007, Turton, 1987, Neumann, 1998, Ghimire and Pimbert, 1997). The removal of humans from such areas therefore immediately runs counter to conservation efforts. Financial concerns also became more prevalent. Protected areas are often costly to establish and maintain, and developing countries in particular have competing demands for their money. It can therefore be extremely problematic to spend large sums of money on conservation of biodiversity, particularly when there may be more economically favourable ways of land use (Adams & Infield, 2003, Norton-Griffiths & Southey, 1995). As a result, protected areas often lack financial and human resources to ensure efficient functioning, frequently resulting in what are known as ‘paper parks’- existing in legislation yet with little attempt at management on the ground (Wilkie et al., 2001, Wilkie and Carpenter, 1999a). Hand in hand with inefficient park enforcement measures came the recognition that more coercive and punitive measures could be used to halt illegal activities within the park by local communities (Adams & Infield, 2004, Liu *et al.*, 2001, Mukherjee & Borad, 2004, Western & Wright, 1994).

Faced with this combination of both practical and complex ethical issues, the 1980’s saw the development of a more participatory, people-centred approach to conservation, often coined ‘community conservation’(Adams, 2004).

### 1.2.2 Community-based conservation

Brought to prominence by the World Conservation Strategy (IUCN, 1980), and the Third World Congress on National Parks in Bali in 1982 (McNeely and Miller, 1984), community conservation emerged as an ideological framework within which programmes should be designed to meet both conservation and development needs by involving local communities, to a range of extents, in the process of wildlife management (Western and Wright, 1994, Hulme and Murphee, 2001). This is frequently attempted through trying to develop the sustainable use of natural resources, with the now oft repeated mantra that wildlife should ‘pay its way’ (Eltringham, 1994, Pearce and Moran, 1994).

Approaches to community involvement in programmes can differ greatly, with local community input varying from passive, to consultation and on to full community-led projects (Barrow and Murphee, 2001). Projects themselves may range from the simple distribution of tangible benefits to park adjacent communities (where local people have no input into park or program management), to projects such as community controlled and managed common pool resources. The highest achievement for such projects is where initiatives are designed, implemented and policed by local communities with little input from outside agencies, as seen with the community-led protection of the sacred groves in Ghana (Ntiama-Baidu, 1991).

Within the community conservation narrative, a number of initiatives arose, including Community-Based Natural Resource Management (CBNRM), Community-Based Forest Management (CBFM), Incentive-Based Programmes (IBP), Community Wildlife Management (CWM) and Integrated Conservation and Development Programmes (ICDPs) (Menzies, 2004, Wells et al., 1992, Barrow and Murphee, 2001). This thesis focuses on this final approach.

ICDPs were developed to meet the dual objectives of biodiversity conservation and sustainable economic development. While sharing many key features of community conservation- namely attempting to address the social and economic requirements of local residents, compensate them for conservation-incurred costs and improve relations with the park authorities, ICDPs differ from what can be considered ‘true’ community conservation in a number of key areas. Firstly, ICDPs are nearly always externally motivated, with programmes usually initiated by international conservation organisations and/or development organisations. Secondly, there is rarely any attempt to devolve control of the protected area or exploitation of its resources to local communities (Hughes and Flintan, 2001).

Such a top-down, or passive participatory, approach is held by some critics to be contradictory to the community conservation approach, in which collaboration, active participation and co-management of resources should form the central theme to programmes (Hed, 1994). Others take a wider, more inclusive view. Barrow and Murphee classify such programmes- in which ownership of both the land and resources belongs to the state who also determine their use- as a form of community conservation known as protected-area outreach (Barrow and Murphee, 2001). For a programme to qualify, however, it must both produce benefits of real use to people and have some form of collaborative management agreement for the use and access to natural resources- nevertheless they may be classified as conservation *for* the people, rather than *with* or *by* the people (Barrow and Murphee, 1998). By focussing on the successful creation of the link between conservation and poverty alleviation, rather than the means by which it is achieved, ICDPs clearly should be included in the community conservation narrative (e.g. Adams, 2004)<sup>2</sup>.

The popularity of community-based conservation (CBC) initiatives has been such that, as one author observed, “*Soon it may be difficult to find a rural conservation project that does not define itself as community-based*” (Hackel, 1999 :730). Indeed, community conservation has become such a powerful icon that, in Kenya, many purely private commercial enterprises have adopted the label, irrespective of its relevance to reality. Yet there is frequently a large gap between the rhetoric and the reality: as Hackel also noted, “... *it is easier to advocate CBC than to implement it*” (Hackel, 1999 : 730). We go on to discuss ICDPs in more detail, before critically examining how effectively such programmes have met both conservation and development goals.

### **1.2.3 Integrated conservation and development programmes**

#### **1.2.3.1 The ICDP paradigm**

IDCPs are based on the premise that local development and biodiversity conservation are inextricably linked- the success or failure of one will inevitably impact on the success or failure of the other. Projects therefore attempt to create a link between conservation and development, whereby pro-conservation related benefits are provided to simultaneously contribute directly towards local development, compensating for costs incurred, and encourage pro-conservation

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<sup>2</sup> Nevertheless there is a strong argument to be made that such a link cannot be created without the active participation of local people (e.g. West and Brockington, 2006), discussed later in greater detail.

behaviour (Brown and Wyckoff-Baird, 1992). Pro-conservation behaviour, in turn, leads to longer-term benefits for local residents in its support of sustainable use of natural resources in the area.

Within this general brief, however, the remit of an ICDP remains broad and just as subject to trends as most theoretical program designs. The unfocused nature of the underlying premise that programmes must include both conservation and development components has led to a range of interpretations. Adams et al. (2004) offers the following typology of community-focused approaches: i) Conservation is the primary goal, with poverty reduction undertaken only to achieve more effective conservation, ii) Conservation may be the recognised goal; however it should not compromise poverty reduction, iii) Conservation is only undertaken as a means of achieving poverty reduction and iv) Conservation and poverty reduction are seen as completely independent goals. According to this scheme, therefore, ICDPs may range from projects where the emphasis on rural development may be prioritised to the point that the ICDP becomes indistinguishable from a sustainable development programme, to those where their development ‘lite’ approach may be considered a ‘funder-friendly’ PR component, with little serious attempt to alleviate poverty (Chapin, 2004).

The roots of ICDPs lie firmly in the conservation arena, so it should not be surprising that its most common interpretation has been as a conservation tool with rural development components (Hughes and Flintan, 2001), with sustainable management of the environment identified by Brown and Wyckoff-Baird (1992) as the “*..ultimate goal of the [ICD] project*”. The first ICDPs were formally instigated by the World Wide Fund for Nature (WWF) in 1985 as part of their Wildlands and Human Needs Program (Hughes and Flintan, 2001). There are now thought to be hundreds of programmes being implemented across the world (McShane and Wells, 2004, Hughes and Flintan, 2001), with WWF in particular embracing the approach, claiming to devote “*... as much as half of its “ on the ground” annual budget to ICDPs..*” (WWF, 2008).

Projects are usually instigated and supported by a non-governmental organisation (NGO), with permission, and often staff support, from the host nation’s government (Alpert, 1995). These supporting NGOs may be national or international but are usually conservation-focused organisations, although it is not uncommon for development NGOs to be consulted or directly involved in the development activities of the ICDPs. One of the earliest ICDPs, the Impenetrable Forest Conservation Project, which worked with communities surrounding the Bwindi and Mgahinga National Parks in Uganda, partnered CARE Uganda with WWF (Adams and Infield, 2001).



### **1.2.3.2 The ICDP tool box**

At their most basic, ICDPs are designed to provide benefits to compensate for the costs of conservation and/or provide alternative income sources to reduce or replace the exploitation of natural resources. A range of approaches may be employed to achieve this, including profit sharing with, or direct payments to the local communities, the creation of local employment, the provision of social services or community-based infrastructure and supporting alternative means of income generation (Barrett and Arcese, 1995, Barrow and Murphree, 2001). To this end, each programme is individually designed, but usually involves a combination of the following schemes.

#### **Benefit sharing**

ICDPs are deliberately designed to provide conservation-linked benefits, intended both to compensate for any costs imposed by conservation-related activities in the area, and to provide a direct incentive to encourage pro-conservation behaviour. To this end, many programmes attempt to generate revenue or other benefits through the sustainable use of natural resources. Some, or all of these benefits are then distributed to members of the local community. A number of projects have managed to raise significant amounts for their revenue distribution programme through tourism—most notably the gorilla tracking programmes in Uganda (Archabald and Naughton-Treves, 2001, Sandbrook, 2006). Revenue may also be generated using resource management such as sport hunting, as seen in the CAMPFIRE project in Zimbabwe and the ADMADE program in Zambia (Mwenya et al., 1990, Frost and Bond, 2008), whilst at the Selous game reserve, Tanzania, game meat was distributed directly to the communities as a park-related benefit (Gillingham and Lee, 1999).

#### **Provision of community services**

Projects may choose to provide local communities with public services, and/or develop community infrastructure. This is often meant as a compensatory gesture, rather than any intent that it be directly linked to the benefits of conservation activities (Brown and Wyckoff-Baird, 1992). While the types of development activities may vary between communities, depending on both community need and project scope, the typical project focuses on one or more of four areas: education, such as providing schools or school equipment; water, such as digging wells; health, such as clinic construction and/or maintenance; and transport infrastructure, such as roads and bridges.

**Alternative use**

A frequent component of ICDPs is the active encouragement of alternative means of livelihood generation, intended to directly reduce pressure on natural resources. Given the rural setting of most protected areas, efforts commonly focus on agricultural intensification and diversification, with farmers being given seeds, tools and advice. However, it may also include the introduction of new initiatives, such as apiculture, mushroom farming, aquaculture or the captive rearing of butterflies (e.g. Wright and Andriamihaja, 2002, Malleson, 2002).

**Law enforcement**

While the aim of ICDPs is to encourage sustainable use of natural resources through economic development, park laws are frequently enforced by punitive measures. These measures usually take the form of park authorities restricting access to the protected area by means of specially trained guards. Anti-poaching patrols, often armed, have proven effective at controlling rates of illegal resource use in particular sites (Lewis et al., 1990, de Merode, 1998, Rowcliffe et al., 2004), with cash bonuses for the guards and patrol frequency suggested to be particularly influential factors (Arcese et al., 1995, Jachmann and Billiow, 1997, Leader-Williams and Milner-Gulland, 1993). Penalties such as fines and prison sentences are suggested to be less effective, not least because the courts, often separate from the wildlife authorities, frequently place a lower priority on wildlife protection (Leader-Williams and Milner-Gulland, 1993).

**Ecological monitoring**

Some level of monitoring of the protected area ecosystem is usually attempted, although limitations of time and money have meant that efforts tend to vary greatly in scale and frequency (Hughes and Flintan, 2001, Brown and Wyckoff-Baird, 1992). In most cases monitoring takes the form of assessing the population dynamics of one or more indicator species, chosen either for their assumed vulnerability or their high rates of extraction. Habitat alteration may also be monitored. However, interpreting results from ecological monitoring is often complicated by a lack of baseline data, the length of time required for some changes to become clear, and problems with untangling the effects of project-instigated change from other contributing factors (Kangwana, 2001, Kremen et al., 1994, Margoluis and Salafsky, 2001). Combining indicators may provide a clearer picture (Cowlshaw et al., 2005a).

**Local employment**

Significant employment opportunities are frequently provided as a result of park management decisions. For example, in the three national parks making up the Virunga massif, the park

authorities and NGOs employ over 150 people from the local community for work within the park alone (MGVP, 2004), whilst around Komodo National park, park related tourism fully or partially supports 574 local jobs (Walpole, 1997).

#### **1.2.4 Win-win, or lose-lose? A critique of the ICDP approach**

ICDPs, with their promise of win-win for both poverty alleviation and biodiversity conservation, were enthusiastically seized upon in the 1980s by both development workers and conservationists, with their numbers continuing to grow to this day (McShane and Wells, 2004). Yet, puzzlingly, there has been a distinct scarcity of in-depth, empirical assessments of how effective ICDPs or, indeed, other community conservation initiatives have been at achieving either development or conservation goals<sup>3</sup> (Kremen et al., 1994, Ferraro and Pattanayak, 2006, Newmark and Hough, 2000, Hughes and Flintan, 2001). A recent review of ICDP outcomes found only one study which had quantitatively measured the ecological, economic, attitudinal and behavioural outcomes of an ICDP, and only two which had measured success in three of these areas (Brooks et al., 2006).

Where assessments are conducted, they may take place too early in their implementation- as with rural development projects, ICDPs may require considerably longer than the usual 3-5 year project cycle to meet objectives (Newmark and Hough, 2000). This is supported in an empirical study of project life cycles in the Annapurna Conservation area, Nepal, which concludes that success in generating interest in conservation within local communities took nearly a decade (Baral et al., 2007).

The evaluations that have been conducted reveal a number of areas of serious concern, identified by biologists, development workers and theorists (e.g. McShane and Wells, 2004, Blaikie, 2006, Newmark and Hough, 2000, Gibson and Marks, 1995, Alpert, 1996, Barrett and Arcese, 1995, Adams and Hutton, 2007). Issues raised relate both to programme implementation, and potentially more seriously problems connected to the assumptions underlying attempts to integrate conservation and development goals. These are discussed in detail below. Many of these issues also apply more generally to all community-focused initiatives.

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<sup>3</sup> Nevertheless, as donor demand has grown for comprehensive project reviews, an increasing number of evaluations are being conducted, both internally and externally (see for example the Project Evaluation Tool developed by the Cambridge Conservation Forum, (CCF, 2008), and WCS's study of the impact of protected areas on human welfare in Gabon, (Wilkie et al. 2006)).

### 1.2.4.1 Implementing an ICDP

#### *'Creating' communities*

One of the more frequent charges laid at the door of all community-focused conservation programmes is the simple lack of understanding of, or the failure to account for the complexities or needs of the target population (Gibson and Marks, 1995). Communities are not homogenous and a significant diversity of interests and/or stakes in the resource may exist, making designing a universally satisfactory management plan complex or unachievable (Bauer, 2003, Jones, 2001). Attempts to provide viable and sustainable economic alternatives to the exploitation of protected park resources are frequently found to be unsuccessful due to a lack of understanding of the local implications of policy changes, such as insufficient or inaccessible markets for proposed alternative products (Swanson & Barbier, 1992), including tourism (Wilkie et al., 2001). Furthermore, where non-locals conduct or financially support the exploitation of natural resources, creating local economic alternatives is unlikely to influence their behaviour (Milner-Gulland and Leader-Williams, 1992).

#### *Generating benefits*

A review of the literature reveals numerous examples of programmes that have failed to generate sufficient and relevant benefits for local populations: even fewer may prove sustainable over the long term (Wilkie and Carpenter, 1999b, Brown, 1998). Moreover, even significant benefits may fail to compensate costs. Adams and Infield (2003) calculated that even if the entire revenue from gorilla tracking in Mgahinga National Park, Uganda, were donated to local communities, they would not be equal to their lost opportunity costs, even without taking into account the fickleness of the tourist industry (Honey, 1999). There may also be political dimensions to benefit distribution, with governments potentially unwilling to relinquish revenue to local communities (Nelson et al., 2007). Amboseli National Park, Kenya, brings in around \$15 million in revenue each year, of which local communities receive just 1% (Norton-Griffiths & Southey, 1995).

#### *Distributing benefits*

Problems may also occur with benefit allocation, whereby benefits generated in relation to a project may be distributed in a manner unconnected to the distribution of costs, limiting their effectiveness as cost reparation (Balmford and Whitten, 2003, Gillingham and Lee, 1999, Walpole and Goodwin, 2001). This may be exacerbated by the misuse or misappropriation of funds within a community, with such misfeasance often aided by such things as low levels of accountability, transparency and technical capacity at all levels of fund administration (Ashley & Roe, 1998, Nelson, 2004).

Employment opportunities with the project may be limited by educational requirements, gender, age and domination by local elites (Sandbrook, 2006, Jurowski and Gursoy, 2004). Benefits may be provided in a form which individuals fail to value, or in a form inappropriate as compensation, such as the provision of public goods (Gibson and Marks, 1995)- a school that has been built using tourism-generated revenue will fail to fill the livelihood gap caused by removal of hunting rights within a household. Furthermore, time horizons may be uneven, meaning that even considerable long-term benefits may fail to exceed small, short term costs (Casse et al., 2005).

Problems may be related to poor communication, where people simply do not have sufficient information regarding the existence, scale and availability of either relevant costs or benefits (Gursoy et al., 2002, Sandbrook, 2006). Additionally, even if benefits are provided, in many cases local communities lack meaningful input into the decision-making process or project development. This, in turn, can lead to disempowerment and an undermining of development (Ribot and Larson, 2005). Problems may also be encountered with the long-term sustainability of programmes, particularly compensation orientated ones, such as in the case of an unstable tourism industry. Failure of the project to fulfil promises in the long term may result in communities reverting to previous unsustainable behaviour (Wells, Brandon, & Hannah, 1992).

### ***Tourism-related problems***

Many integrated programmes actively encourage tourists to the area in a bid to generate revenue in what is assumed to be a sustainable manner. However, the growth of park-related tourism may bring with it associated economic, social and cultural impacts well-documented in the literature (Honey, 1999, Lindberg and Enriquez, 1994, Lindberg and Hawkins, 1993, Stronza, 2001). Such impacts include significantly altering the local economy (Mansperger, 1995), strengthening or weakening local traditions (Van den Berghe, 1994, Greenwood, 1977) and introducing or encouraging potentially harmful practices such as the use of drugs or prostitution (Oppermann, 1998, Clancy, 2002). Even where sex tourism is not a major issue, local populations may still be drawn into commercial sex with tour drivers of military or security personal associated with the tourism enterprise, potentially aiding the spread of HIV (Sandbrook, 2006).

### ***The promotion of in-migration***

There are also strong suggestions of cases where ICDP development activities may have been responsible for inducing human migration into the area (Scholte, 2003, Wittemyer et al., 2008, Wells et al., 1992, Barrett and Arcese, 1995), including the Dzanga-Sangha project in the Central African Republic (Noss, 1997). The recent study by Wittemyer et al. (2008) showed that not only

was the average human population growth rates on the borders of both African and Latin American protected areas almost double the average rural growth, but also positively correlated with donor investment in national conservation programmes.

### ***Law enforcement efforts***

The effectiveness of anti-poaching patrols at controlling poaching has been found to be limited, particularly when considering either prey with a high market value such as elephants (Milner-Gulland and Leader-Williams, 1992), or where there is a low risk of detection and/or light penalties (Abbot and Mace, 1999). One study of the levels of bushmeat extraction during periods of political instability and warfare in the Democratic Republic of Congo found local social institutions in the region to be more influential than the anti-poaching patrols (de Merode et al., 2007). Responses may also be more complex, with increased law enforcement resulting in an alteration in hunter tactics and prey rather than a decrease in overall activity (Gibson and Marks, 1995). Furthermore, patrol efforts tend to focus on the hunters, whereas in many areas poaching may be financed by high-level entrepreneurs based away from the site who go unpunished and are free to recruit other hunters.

### **1.2.4.2 Convergent or divergent interests? Questioning the compatibility of conservation and development goals**

While there is no doubt that project implementation has often been beset by problems, there is increasing disquiet that there are deeper, more fundamental problems associated with the integration of conservation and development goals (e.g. Menzies, 2004). Current literature shares concerns that conservation and development goals are frequently contradictory and can result in conflict between the two (Sanderson and Redford, 2003, Agrawal and Redford, 2006, Adams, 2007). These problems may arise from the start when stakeholders enter a community-based project with very different motivations and goals (Adams et al., 2004).

There are numerous examples in the literature of cases where development efforts in a region have resulted in the facilitation of activities that run counter to conservation efforts. A clear example of this is the CAMPFIRE project in Zimbabwe, where much of the revenue earned from wildlife conservation has been invested in such things as the expansion of agriculture- directly contradictory to conservation objectives (Murombedzi, 1999). In the Democratic Republic of Congo, increased wealth was linked to increased hunting efforts, allowing access to more efficient

hunting methods (de Merode et al., 2004). Barrett and Arcese (1995) also highlight how, in a number of African case studies, improvements in transport infrastructure often serve to increase illegal offtake by opening up routes to previously inaccessible markets.

ICDPs work on the assumption that local people will respond to benefit transfers by voluntarily ceasing wild resource exploitation (Infield & Namara, 2001). Yet there are surprisingly few empirical studies examining links between benefit receipt and behavioural changes at the individual and/or household level (Holmes, 2003). This is due at least partly due to the frequent lack of pre-project baseline surveys, making the measurement of changes problematic. As a result, most studies have tended to take a static point in time and attempted to identify factors linked to pro-conservation attitudes or behaviour by local residents.

### ***Linking development and pro-conservation attitudes***

Given the greater difficulties associated with measuring behaviour, a large number of evaluations have used conservation-related attitudes as a proxy. A number of these studies have succeeded in linking more positive attitudes towards conservation- measured both in terms of project activities or to the protected area itself- to the distribution of conservation-related benefits (e.g. Gillingham and Lee, 1999, Fiallo and Jacobson, 1995, Infield, 1988, Bauer, 2003). Specifically, benefits from tourism (Mehta and Kellert, 1998, Sandbrook, 2006, Mehta and Heinen, 2001), employment in a wildlife-related industry (Parry and Campbell, 1992), community-development efforts (Herrold-Menzies, 2006, Abbot et al., 2001, Mehta and Heinen, 2001, Infield and Namara, 2001), and project outreach efforts (Holmes, 2003) have been found to be associated to pro-conservation attitudes.

Yet other ICDPs appear to have had little influence on attitudes towards the park and conservation activities. One study of the impact of developmental initiatives on local conservation attitudes in Kalakad-Mundanthurai Tiger Reserve, India, found 6 years of project implementation had had no impact on local attitudes towards conservation, attributed by the authors to the project's failure to effectively address the most important of the local people's livelihood concerns (Arjunan et al., 2006). Factors identified as being associated with negative attitudes related largely to exposure to both park and project related costs, including anger at lost opportunity costs (Newmark et al., 1993, Heinen, 1993), crop damage and/or livestock depredation by wildlife (Arjunan et al., 2006, Oli et al., 1994, Parry and Campbell, 1992, Heinen, 1993). It is clear, therefore, that any analysis of project impact should take costs into account as much as benefits, which must be both equal to costs and directly compensate for them.

There are, however, a number of criticisms aimed at the use of attitudes as a proxy for behaviour. Attitudes are hypothetical constructs, and must therefore be measured by indirect means, usually via verbal expression- notorious for the difficulty of applying it accurately (Oppenheim, 1992). Such methods are reliant on factors such as respondent frankness, which may be misrepresented through fear, misunderstanding or a desire to be seen in a favourable light. Furthermore, behaviour may be changed without any underlying attitudinal change (Abbot et al., 2001).

### ***Linking development and pro-conservation behaviour***

Given the difficulties of assessing the scale of an individual's participation in the (often illegal) exploitation of natural resources, very few studies have attempted to link the receipt of ICDP-related benefits with pro-conservation behaviour. While Holmes (2003) found local support of the Katavi National Park, Tanzania, to be significantly related to the exhibition of more ecologically sustainable wood extraction methods, the wood itself was collected outside the park- no attempt was made to measure activities within the park. A study by Abbot et al. (2001) suggested that a livelihoods program conducted with communities around the Kilum-Ijim Forest, Cameroon, did improve both (self-reported) conservation-related attitudes and behaviour. In Ranomafana National Park, Madagascar, however, providing employment to local poachers served to increase hunting levels in the area as employees used their wages to expand hunting efforts (Kramer et al. 1997). Furthermore, data on hunter offtake collected over 6 years in the central Luangwa valley, home to the ADMADE ICDP, showed no noticeable drop in yields since programme inception, although the poaching of larger mammals, such as elephants and rhinos, is suggested to have decreased (Gibson and Marks, 1995).

Other studies have suggested the link to be largely lacking, as seen in evaluations of the ADMADE program in Zambia (Gibson and Marks, 1995) and ICDPs in Bwindi Impenetrable Forest, Uganda (CARE, 2004, Baker, 2004), Lake Mburo National park, Uganda (Infield and Namara, 2001) and the Royal Chitwan National Park, Nepal (Straede and Helles, 2000). The latter two case studies are particularly interesting as, in both cases, conservation-related attitudes were found to be more positive following the implementation of the ICDP. Indeed, projects have also been known to backfire completely, such as when encouraging sustainable use- by permitting the limited use of forest resource- led to raised expectations and an increased demand for exploitation (Songorwa, 1999, Adams and Infield, 2003).

The reasons why attempts to link benefits to behaviour have largely failed are complex and likely to include site-specific factors. Nevertheless, some general observations can be made. It is clear that it



is unlikely that pro-conservation behaviour will be pursued by the rural poor if there are more economically favourable options available (Thompson & Homewood, 2002). Furthermore, a repeated concern regarding linking benefits to behaviour has been the suggestion that people may view the new income sources as complementary, rather than substitutes, for traditional methods (Wells et al., 1992). In such cases there would appear to be little incentive not to engage in both types of activities. Behaviour may clearly be affected by factors other than the purely economic, including cultural and social pressures (McKenzie-Mohr and Smith, 1999). There may also be a strong political component in the failure to engage in conservation-friendly behaviour, regardless of attempts to alleviate poverty locally. In Southern Thailand, Vandergeest argues that it is not poverty which is driving conflict with park authorities but anger that traditional claims on the gazetted land are ignored (Vandergeest, 1996).

### **1.2.5 Back to the barriers, or sticking to sharing?**

Adams and Hulme argue that, based on past experience in Africa, community conservation as a strategy is incapable of achieving both conservation and developmental objectives in full, and tradeoffs must be agreed which are dynamic and alterable over time (Adams & Hulme, 2001a). Yet deciding who sets these objectives and who decides the tradeoffs is clearly far from an easy prospect. An emphasis on development goals may lead to a de-emphasis on conservation goals and vice versa, with the result that one or the other is no longer seriously addressed (Adams & Hulme, 2001b).

Others go further. The frequent failure of community conservation to meet either conservation or development goals effectively has led many conservationists to call for a return to the protectionist approach (Oates, 1999, Terborgh, 1999, Brandon et al., 1998). Pointing out the numerous failures of community conservation to link development to biodiversity protection, its proponents argue that we are morally obliged to meet the current tremendous threats to biodiversity with extreme measures, supporting a return to protected areas and practices such as authoritarian law enforcement (Wilshusen et al., 2002). Such calls appear to have been heeded to a certain extent by donor agencies, with both the US Agency for International Development (USAID) and the UK Department for International Development (DFID) significantly reducing funding for community based conservation over the last 10 years (Hutton et al., 2005). Indeed, the protected areas approach can also be seen to be reflected in the recent Millennium Development Goals (MDG), whereby

success in achieving MDG 7- environmental sustainability- uses the area of land designated as protected as the only indicator (Adams and Hutton, 2007).

Yet the reasons for the abandonment of the fortress model- both ethical and practical- are still highly significant. As Hutton et al. point out “*Accepting the moral argument for biodiversity conservation does not mean that it should take priority over the separate moral claims of people with rights to land and resources*” (Hutton et al., 2005 :357). Furthermore, the effectiveness of protected areas in conserving biodiversity any more successfully is highly questionable (e.g. Hayes, 2006, Western et al., 2006).

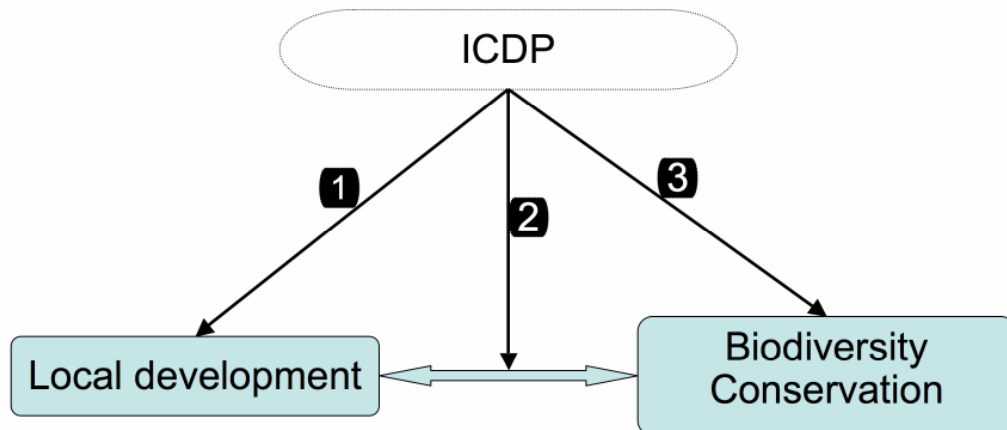
While there are numerous shortcomings associated with community-based conservation, its abandonment is widely felt to be premature (Hutton et al., 2005, Jones, 2006), prompting a new wave of literature focussing on improving its effectiveness. Political ecologists argue that conservationists have paid only ‘lip service’ to community conservation efforts, and call for programmes to devolve much greater responsibility for governance to local communities and more open forums to help manage the different expectations of stakeholders, in addition to empowering the weak and disenfranchised groups (Blaikie, 2006, West and Brockington, 2006, Hutton et al., 2005, Menzies, 2004). Others have shown a tendency to focus on the conditions under which projects are implemented, rather than how they are implemented. Conditions suggested as promoting the successful implementation of projects include: strong national political support, high potential for sustainable extraction, low population growth, low immigration and cohesive communities, where the threat to the resources is local, the site is remote and laws governing natural resource exploitation are effectively enforced (Salafsky et al., 2001, Abbot et al., 2001, Borgerhoff Mulder and Coppolillo, 2005, Barrett and Arcese, 1995, Adams and Hulme, 2001)<sup>4</sup>.

### **1.3 Study Aim**

A successful ICDP must act at two levels. Firstly, it should have a direct and positive effect on both development and conservation. Natural resources in the area must be exploited at, or below, a sustainable level, whilst benefits provided to the local community must be relevant, valued, and exceed costs. Secondly, there must be clear links between development and conservation activities, whereby the receipt of benefits is clearly associated with both pro-conservation behaviour and attitudes in local residents.

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<sup>4</sup> Although see also Agrawal, 2001, who highlights the dangers inherent in idealizing a community in this way



**Figure 1-1** Theoretical model showing where an ICDP is designed to act **1)** Directly on local development, **2)** Inducing pro-conservation behaviour in residents through the provision of benefits and **3)** Directly on biodiversity conservation.

The aim of this thesis is to evaluate the efficacy of a Central African ICDP in achieving local conservation and development goals, both directly and indirectly. Located in the southwest corner of the Central African Republic, the Dzanga-Sangha Project (DSP) has coordinated the management of two national parks and an associated reserve zone since gazetted in 1990. Its activities include orthodox conservation measures such as anti-poaching patrols, alongside activities aimed at local development such as a revenue sharing scheme, the encouragement of alternative forms of food generation and the provision of community infrastructure.

This study site was selected for a number of reasons. Sandwiched in between Congo and Cameroon, the Dzanga-Sangha protected area complex is a relatively enclosed system, with just one road running the length of the reserve, making it a good study site in terms of self-containment. It had also been up and running for 16 years by the time my study commenced, allowing a reasonable amount of time for any changes to be detected. The surrounding forests have been identified as a biodiversity hotspot, making them important in conservation terms, whilst the chequered history of commercial extraction in the reserve, covered in more detail in chapter two, had encouraged a strong reliance on natural resources by residents of the reserve. Such a challenging set of circumstances presented a good opportunity to explore the validity of the fundamental principles of an ICDP, as well as implementation issues.

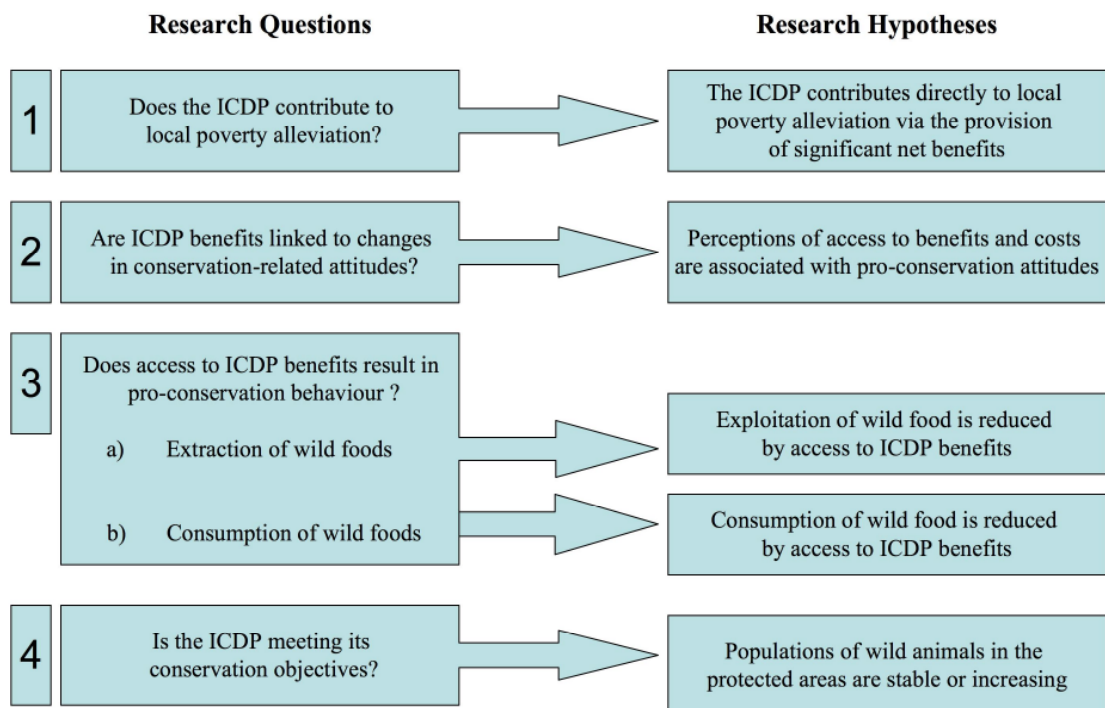
The complex also hosts one of the few tourist programmes in the world based on the tracking of lowland gorillas in the world. Used as a deliberate conservation tool for three out of four gorilla

sub-species, and suggested for the fourth (Blom, 2001a, Oates, 2004, Tutin and Vedder, 2001), gorilla tourism has been found to contribute significantly to both local and national economies (Wilkie et al., 2001), improve the attitudes of both local communities and governments towards gorillas and their conservation (Archabald and Naughton-Treves, 2001), and has funded both management of the gorilla parks as well as other, less productive parks (Adams & Infield, 2003). However, doubts as to the suitability of gorilla tourism as a conservation tool as well as for development have been expressed (Butynski & Kalina, 1998, McNeilage, 1996), with problems including significant behavioural alterations in the gorillas visited by tourist groups, (Steklis et al., 2004, Goldsmith et al., 2006, Muyambi, 2005) and the increased potential risk for human-gorilla disease transmission (Homsy, 1999). Furthermore, many of the benefits may be captured by the state or foreign tour companies rather than accruing at the local level (Adams and Infield, 2003) .

To date there has been little attempt to evaluate project effectiveness at meeting either conservation or development objectives. Without understanding how particular interventions are functioning and their impact on the area it is impossible to evaluate their efficacy. This thesis combines a variety of approaches to examine the effectiveness of a Central African ICDP in meeting conservation and development goals, paying particular attention to the projects tourism programme. This study is conducted with the specific intention of providing applied management recommendations in addition to further contributing to our theoretical understanding of the dual development-conservation approach.

## 1.4 Thesis outline

This study focuses on evaluating the Dzanga-Sangha Projects efficacy in meeting both conservation and development goals, both directly and indirectly. To address these issues, the following questions were asked, presented with their hypotheses:



**Figure 1-2** Study research questions and hypotheses

**Chapter two** provides an in-depth introduction to the Dzanga-Sangha region, including its biological, social and historical context. **Chapter three** discusses the range of methodologies involved in such a cross-disciplinary study, outlining the strengths and weakness of both original and existing data sets.

Chapters four to eight address the central questions of the thesis. **Chapter four** examines the contribution of the DSP to local development, examining costs and benefits accruing to the local communities, and discussing the distribution and access to each. **Chapter five** then goes on to consider which of these costs and benefits are recognised and/or valued by local residents, before

examining links to pro-conservation attitudes in the area. **Chapter six** focus on the exploitation of natural resources in the area, asking whether exposure to ICDP benefits is linked to reduced exploitation, whilst **chapter seven** looks at whether access to ICDP benefits is linked to reduced consumption of wild foods. **Chapter eight** takes a direct look at the effect of the ICDP on the conservation of local wildlife, examining both the sustainability of current exploitation levels, and the population dynamics of some of the main prey species in the area. Finally **chapter nine** pulls all these strands together to discuss the overall effectiveness of the DSP at integrating conservation and development.

## Chapter two

### Study site

*“Man is a child of his environment”*

Shinichi Suzuki (1898-1998)

#### **2.1 Introduction**

It is impossible to effectively evaluate any system without considering the setting within which it takes place. This chapter introduces the Dzanga-Sangha Protected Area Complex, the study site upon which this thesis is based, and places it in its historical, biological and social context.

A brief introduction to the host country- the Central African Republic, is given (2.2) before focussing in on the Dzanga-Sangha region (2.3). Knowledge of the physical and biological characteristics of the area is reviewed (2.4 - 2.5), including a brief summary of the biodiversity of the area. Focus then shifts to the human population, looking at the history of human settlement in the region (2.6) and discussing the non-Aka/BaAka ethnic division (2.7). The three focal villages- Bayanga, Yandoumbe and Mossopoula are then introduced in more detail (2.8). Past and current livelihood strategies in the area are discussed in general (2.9), looking at the local exploitation of the area’s natural resources in particular (2.10). Finally, the history of conservation and development efforts in the area is reviewed (2.11), paying particular attention to the tourism programme (2.12).

#### **2.2 The Central African Republic**

The Central African Republic is a landlocked country in Central Africa, bordered by Chad, Sudan, the Democratic Republic of Congo, the Republic of Congo, and Cameroon. Claimed by the French during the ‘scramble for Africa’ in the late 1800’s, it was known as Ubangi-Shari and governed largely through granting private companies large concessions for exploitation. Becoming an autonomous territory within the French community in December 1958, it was renamed the Central African Republic before achieving independence on the 13<sup>th</sup> of August 1960. Governance of the

country since independence has been unsteady, with power predominantly taken through force. The first fair and democratic elections were held in 1993, bringing Ange-Félix Patassé to power until he was overthrown by Francois Bozizé in 2003. President Bozizé won a democratic election in May 2005 and remains in power at the time of writing.

The Central African Republic, with an average life expectancy of 40 and a gross national income per capita of US\$350 (World Bank, 2007), is currently ranked by the UN as one of the least developed countries in the world (UN-OHRLLS, 2008). With little formal industry outside of logging, the economy is dominated by the cultivation and sale of food crops such as cassava, peanuts and maize. The country is 622,984 km<sup>2</sup> in area, and ranges from desert in the North to tropical forests in the South. While the official languages are French and Sango, the Central African Republic is home to an estimated 79 ethnic groups, each with their own language (Gordon, 2005).

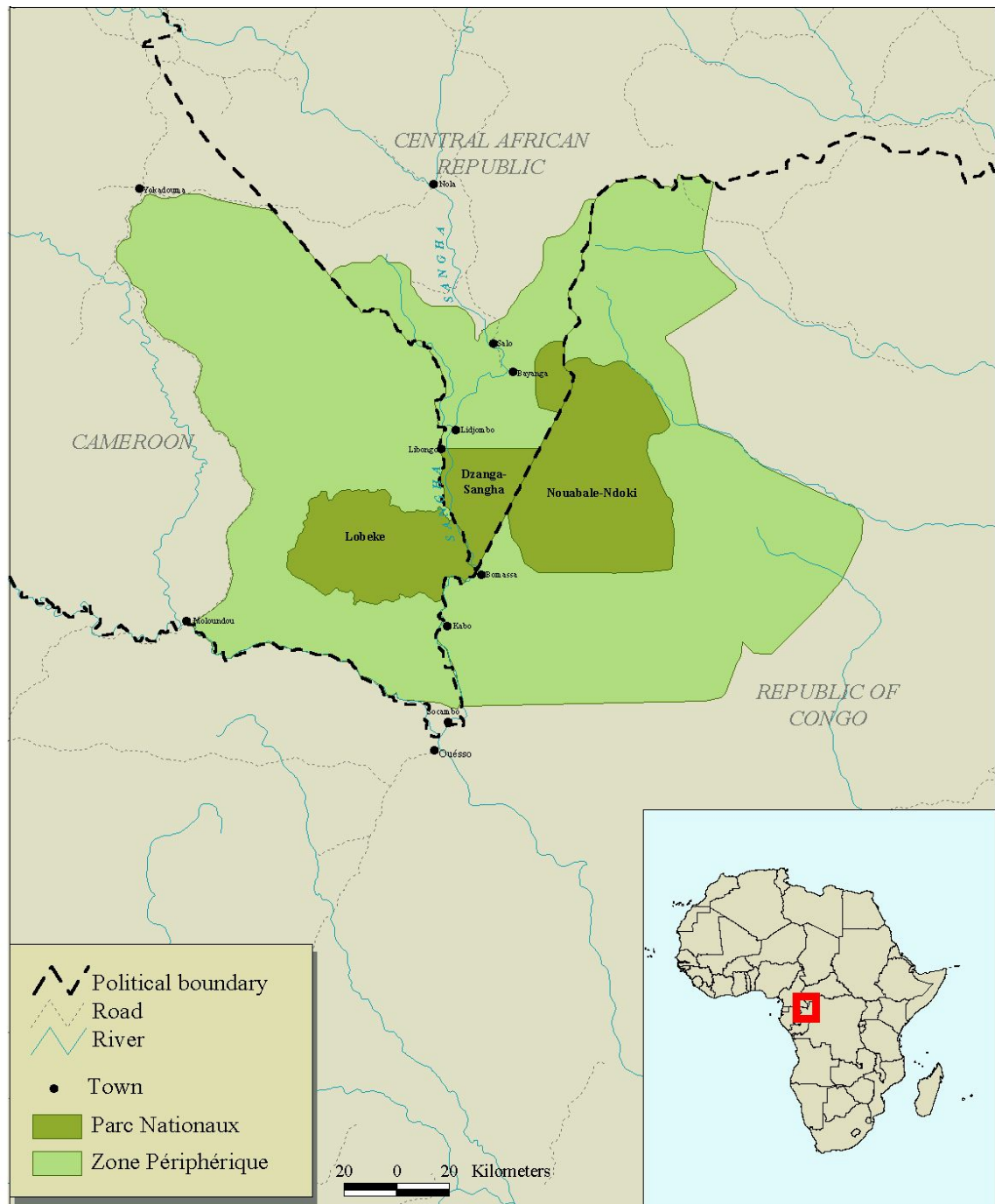
### **2.3 Study site location**

This study was conducted in the Dzanga-Sangha protected area complex, in the extreme South West of the country (latitude 2°13'-3°24', longitude 15°30'-16°35'). Created in 1990, the Dzanga-Sangha protected area covers 4589km<sup>2</sup> of land, divided into three management units: Dzanga National Park (495 km<sup>2</sup>), Ndoki National Park (727 km<sup>2</sup>), and the Dzanga-Sangha Special Reserve (3359 km<sup>2</sup>). Dzanga-Sangha is adjacent to the Nouabalé-Ndoki National Park, Congo and the Lobéké National Park, Cameroon, which together form a tri-national conservation zone (fig. 2.1).

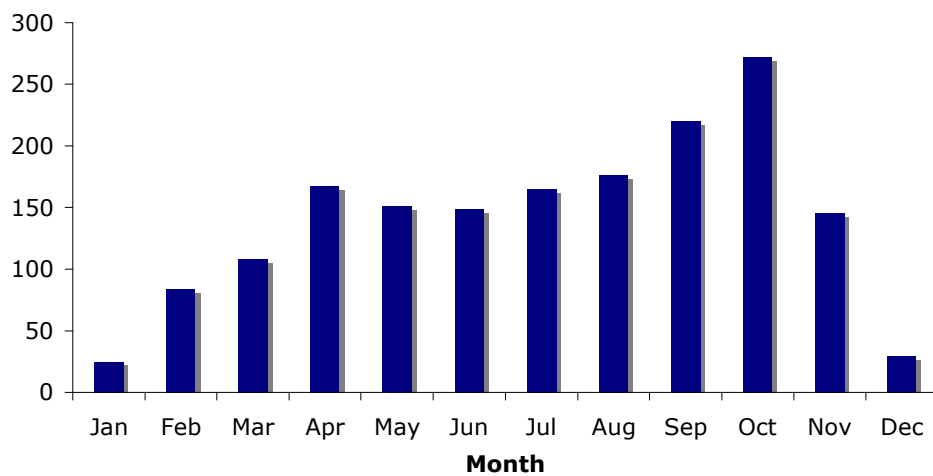
### **2.4 Physical characteristics**

The Dzanga-Sangha complex falls between two climatic zones- subequatorial climate and Congolese equatorial climate (C.T.F.T., 1967). As a result, the area experiences a dry season spanning early December to late February, with occasional rain during this period (fig. 2.2). The nine-month rainy season features frequent heavy rainstorms with a drier period in June and July. Precipitation ranges from 1400 to 1600 mm (Carroll, 1996b) and seasonal variations in temperature are slight (fig. 2.3), creating relatively constant climatic conditions.

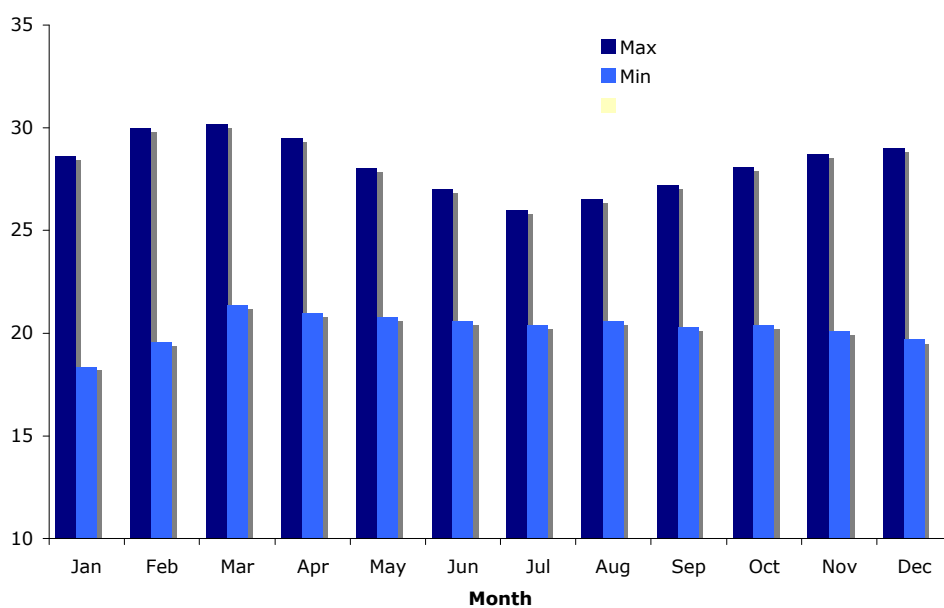




**Figure 2-1** Map showing the position of the study site, Dzanga-Sangha, within the Central African Republic.  
 Source: GTZ.



**Figure 2-2** Average monthly rainfall patterns in Dzanga National Park (1999 – 2006). Presented in millimetres. *Source: Bai Hokou long-term records.*



**Figure 2-3** Average monthly variations in temperature (°C) in Dzanga National Park (1999 – 2006). *Source: Bai Hokou long-term records.*

The region rests on a sandstone plateau and soils are classified as sandy alluvial soils (Boulvert, 1986, Juo and Wilding, 1994). Soil fertility is extremely good, particularly directly after forest clearance, although it can quickly become exhausted. There are a few areas where small enclaves occur, notably around Lindjombo, featuring clay schists- a rich soil good for cultivating coffee (Juo and Wilding, 1994). The region is relatively flat, ranging from 400 to 690 m above sea level, with gently sloping valleys and poorly defined riverbeds.

The entire region drains into the Sangha river, the second largest river in the country, which in turn drains into the Congo river. The flow of the Sangha is notable for its irregularity- water level ranges from 0.2m in April to 5m in October and can reach up to 500m in width as it passes Bayanga (Carroll, 1996b).

## **2.5 Biological characteristics**

Part of the Northwest congolian lowland forest ecoregion, forest type in the area includes both primary forest (particularly Ndoki park) and secondary, more depleted forests (Boulvert, 1986) that have been subjected to varying levels of exploitation in the past. Closed forest cover was estimated to account for 94% of the region's land area in 1986 (Carroll, 1996b). Whilst logging has taken place in the Dzanga-Sangha Reserve since this time (1987-1988, 1992-1997 and 1999-2004), it has been selective, estimated at around 0.8 stems per Ha, and focused on four high value species; Ayous (*Triplochiton scleroxylon*), Limba (*Terminalia superba*), Sapeli (*Entandrophragma cylindricum*) and Sipo, (*Entandrophragma utile*) (Carroll, 1986b, Noss, 1995).

Predominant habitat types include forests of *Gilbertiodendron dewevrei*, forests of *Guibourtia demeusii*, dense forest on marshy soil, dense forest on well-drained soil, *Raphia hookeri*, secondary and depleted forests and numerous clearings known as 'bais' by the BaAka (or 'yangas' if there is no water source within the clearing). These clearings tend to have heavy mineral contents in the soil, and are widely thought to be formed and maintained by wildlife, particularly the forest elephants, excavating for minerals. Some areas of savannah are found to the northeast of the region.

The Dzanga-Sangha area is rich in wildlife diversity. There are thought to be over 105 species of non-volant mammal in the area (Blom, 1993), including 15 primate species such as the chimpanzee, *Pan troglodytes*, the near-endemic sun-tailed monkey, *Cercopithecus solatus*, and the black colobus monkey, *Colobus satanas* (Blom et al., 2001, Noss, 1995). Ungulates include forest buffalo,

*Syncerus caffer nanus* (a dwarf form of the African buffalo), bongo antelope, *Tragelaphus euryceros*, sitatunga, *Tragelaphus speksi*, seven species of duiker, *Cephalophus* spp., and two species of pig, *Potamochoerus porcus* and *Hylochoerus meinertzhageni* (Fay et al., 1990, Turkalo and Klaus-Hugi, 1999, Klaus-Hugi et al., 2000). A number of carnivorous species are also known to live in the area, including the leopard, *Panthera pardus*, and the golden cat, *Profelis aurata*. Reptiles and amphibians, although never exhaustively surveyed in this area, are known to include the Gabon viper, rhino viper and the royal python, as well as the endemic gray chameleon, *Chameleo chapini*, crested chameleon, *Chameleo cristatus*, Grant's African ground snake, *Gonionotophis grantii*, and Fuhn's five-toed skink, *Leptosiphos fuhni*, (Blom, 2001b). The area is also thought to host 379 species of bird of 66 different families, including endemic species such as the forest robin, *Stiphornis sanghensis*, (Beresford and Cracraft, 1999, Green and Carroll, 1991, Rondeau and Christy, 1999).

At least thirteen species of mammal are near-endemic and three are strictly endemic to this ecoregion, including the shrew, *Sylvisorex konganensis* (Ray and Hutterer, 1996). Intensive censuses in the area have focused on animals at the centre of conservation efforts- namely the African forest elephant, *Loxodonta africana cyclotis*, estimated at 0.6 individuals/km<sup>2</sup> in the parks (Blake, 2005), and the western lowland gorilla, *Gorilla gorilla gorilla*, estimated at between 0.66 and 1.45 individuals/km<sup>2</sup> (Fay, 1989, Carroll, 1996b, Blake, 2005). The latter is currently classified as critically endangered, due to a population reduction of more than 80% over three generations throughout its range countries (IUCN, 2008). Given the relatively stable climatic conditions, seasonal migration is rare amongst the reserve's fauna, although forest elephants have been found to range considerable distances (Blake et al., 2001).

## **2.6 History of human population**

There is little evidence of the history of the area before European arrival, making dates of early migration necessarily vague. While it is thought Bantus may have begun to settle in the area before 500 BC, probably moving down from the Benoué region of Nigeria (Harms, 1981), the upper Sangha region is likely to have been already populated by the Ubanguian peoples, along with the 'pygmies'<sup>5</sup> (Vansina, 1990). By the 19<sup>th</sup> century, the middle and upper Sangha region hosted a complex ethnic mosaic, including Fulbe pastoralists and traders who introduced slave trading to the

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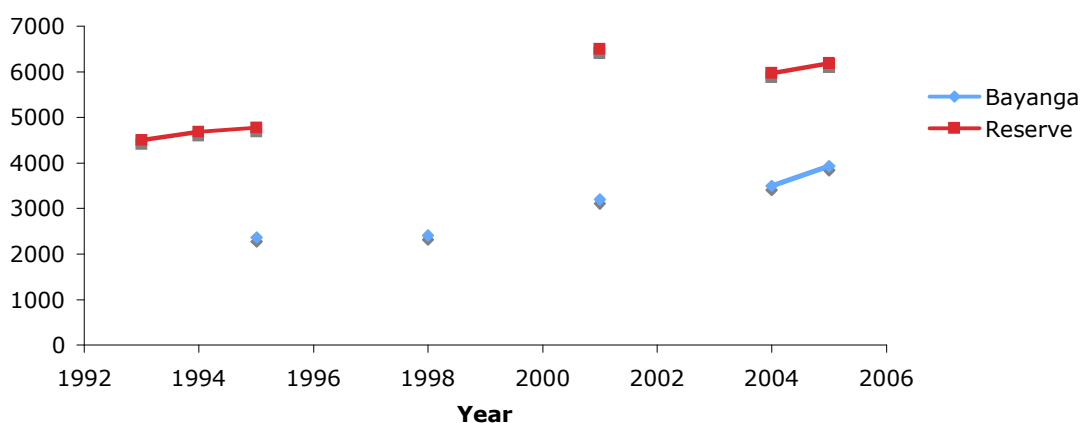
<sup>5</sup> Term, dating back to Homer, used to refer to a group of African peoples, traditionally forest dwelling hunter-gatherers (Demesse 1978).

region in the 1840's (Copet-Rougier, 1998, Giles-Vernick, 1996). The Sangha river also appears to have facilitated a dynamic trade in products such as ivory and firearms, involving predominantly Congolese traders (Giles-Vernick, 2002). Pre-colonial inhabitants of the lower Sangha region, now the site of the Dzanga-Sangha Reserve, are thought to be primarily the Mbimu, Ngundi and Sangha-Sangha fisher people, and the BaAka pygmies- forest based hunter-gatherers (Demesse, 1978, Bahuchet, 1985a).

Europeans arrived to the Sangha area in the late 19 century, with the French explorer, Savorgnan de Brazza, beginning permanent settlement of the region in 1892 (Copet-Rougier, 1998). Originally colonised by both the Germans and the French, keen to exploit the forests' considerable resources, the Treaty of Versailles in 1919 saw all German territories ceded to the French. As with much of the country, the French governed the area through concessionaires, with exploitation rights exchanged for rent and the promotion of local development. Treatment of the local populations was often brutal, including forced labour (Coquery-Vidrovitch, 1972, Kalck, 1992, Gide, 1927) and led to a number of revolts, all quickly suppressed by the colonialists (Kretsinger and Zana, 1997).

Since colonisation, the area has been home to a number of boom and bust industries, including rubber and ivory in the early 1900's, coffee and diamonds in the 1930's and timber in the 1970's. The growth of industry in the area- predominantly the development of the timber industry- has ensured a significant migration into the area of both nationals and non-nationals in search of economic opportunities. Bayanga, the largest settlement in the Reserve, has grown from several dozen inhabitants prior to the establishment of the logging company (Noss, 1997, Kretsinger and Zana, 1997, Fay, 1993) to its current level of nearly 4000 people (fig. 2.4). Current population densities for the region are estimated at around 1.3 people per km<sup>2</sup>, up from 0.5 people/km<sup>2</sup> in the 1960's (C.T.F.T. 1967). Although the most recent logging company went bankrupt in 2004, the population of the region continues to grow.

The Dzanga-Sangha region today is characterised by its mixed ethnicities and high proportion of in-migrants (Noss, 1997). The most recent census of the Reserve's human population revealed 36 ethnicities with 84% of household heads resident in Bayanga not born in the Reserve (2005 DSP census).



**Figure 2-4** Population estimates in the Reserve as a whole, and in Bayanga, the largest settlement within the area (1993-2005). Data sources- (Kretsinger, 1993, Noss, 1995, Loudiyi, 1995, Renner, 1998, Renner and Yarrissem, 2003).

Two main speaking groups are represented in the region- the Obangian speaking group, which includes the Nbaka, Yangere, Bofi and Biyanda, and the Bantu speaking group, including the Ngando, Mbatu, Pande, Pomo, Mbimu and Kako (Hardin, 2000). Ethnic groups are, however, based on factors other than linguistic background, such as subsistence and residential patterns. As a result, ethnicities are often grouped differently and separate speaking groups may be placed in the same ethnic group. Within the Reserve, the majority of the population fall into four major ethnic groups- BaAka, Gbaya, Mpiemu and Sangha-Sangha (Carroll, 1996a).

Human populations are concentrated in eight villages and camps in the Reserve, spread along the main road that snakes the length of it (fig. 2.5). Internal regulations mean no new villages can be formed. Bayanga, the central town, is home to well over half the population of the Reserve. It is also the home to the headquarters of both the logging concessionaire and the ICDP.

While Bayanga also hosts the headquarters of a number of political and law enforcement authorities, including the gendarmerie, the police station and the mayor's office, law enforcement in the area tends to be weak. Despite becoming the 100<sup>th</sup> signatory to the United Nations anti-corruption convention, there are continuing suggestions of widespread corruption amongst public servants and the misappropriation of public funds (Bureau of Democracy, Human Rights and Labor, 2008).

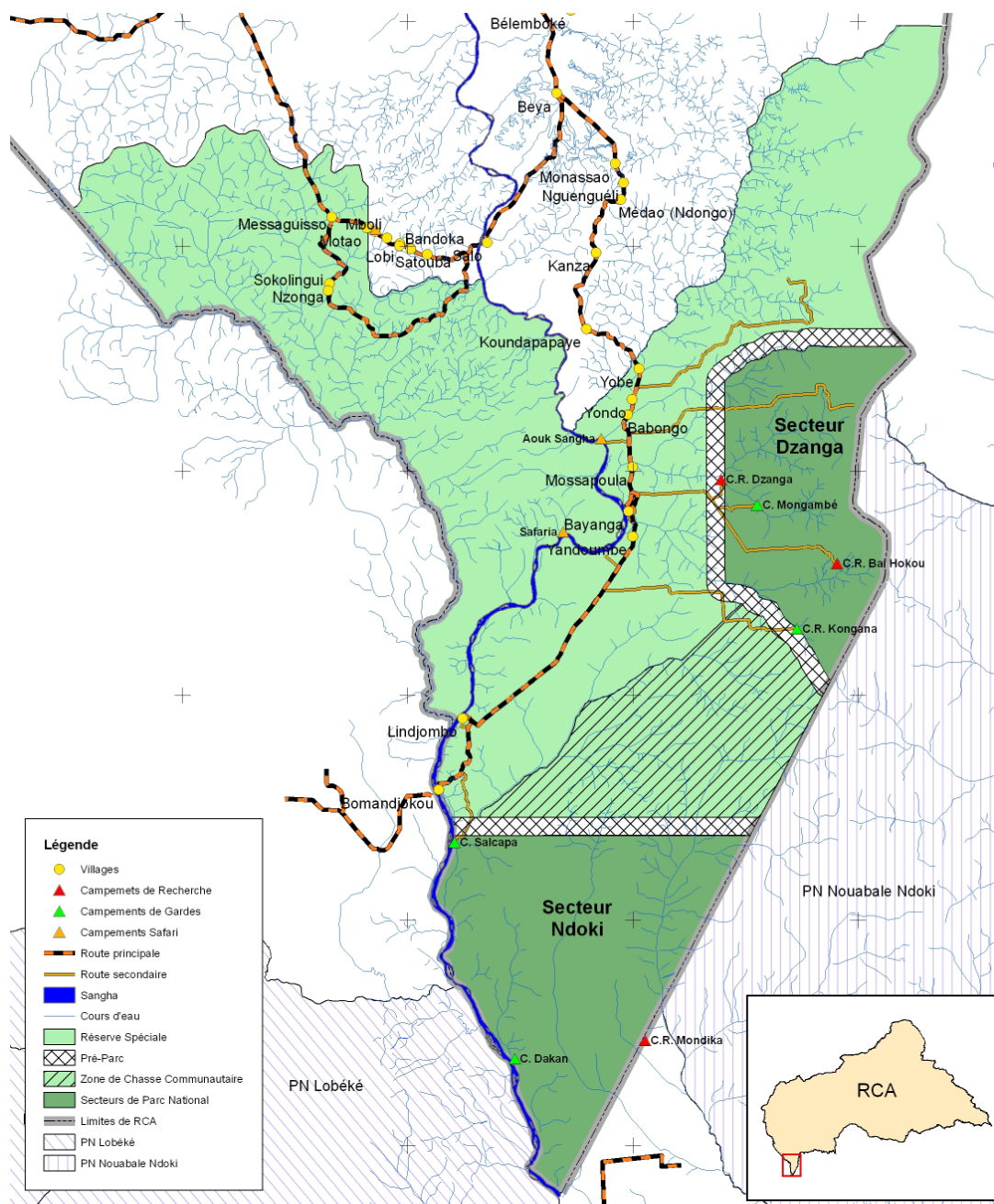


Figure 2-5 Map of villages within the Dzanga-Sangha Special Reserve. Source: Dzanga-Sangha Project

## **2.7 BaAka and the 'Bilo'**

While a wide range of ethnic groups are found in the Reserve, residents are most commonly separated into two groups: BaAka and non-Aka. These divisions are both self imposed by residents and used by governments, NGO's and researchers alike when working in the region. In the area, non-Aka residents are most often known as 'Bilo', a BaAka term (Kretsinger, 2002, Sarno, 1998, Noss, 1995). Following Noss (1995), I found other terms used in the literature to describe similar non-Aka groups, such as 'Bantu', 'Villagers' or 'Farmers' to be inaccurate or incorrect. The BaAka themselves speak a Bantu language and are becoming both increasingly sedentary in roadside villages and increasingly active in cultivating fields (Bahuchet, 1985a, Sarno, 1998).

The division of residents into BaAka and non-Aka is done on the basis of the radical differences between the subsistence and residency approaches of the two groups. Non-Aka residents, or Bilo, usually reside in permanent settlements with rectangular, multi-roomed houses constructed from bamboo or wood. While livelihoods are extremely varied (see section 2.9) there is a history of a strong reliance on subsistence agriculture; cultivation, rather than reliance on forest resources, is the mainstay of livelihood activities.

BaAka is the name given to the pygmy peoples residing in and around the forests of Southern Central African Republic and Northern Congo (Bahuchet, 1992). All share a single Bantu language and are culturally distinct from other pygmy groups, including the Baka of Cameroon, Gabon and Republic of Congo, and the Mbuti of the Democratic Republic of Congo. Traditionally semi-nomadic hunter-gatherers, livelihoods of the BaAka of the Dzanga region continue to be closely involved with the forest, although the arrival of formal job opportunities and close affiliation with non-Aka agriculturalists has resulted in the adoption of a more sedentary lifestyle (Bahuchet, 1991, Noss, 2001). As a result, semi-permanent BaAka settlements have developed, often on the periphery of non-Aka settlements. Within these settlements the traditional dome-like BaAka house made from branches and leaves are seen less and less, replaced by the more durable bamboo or wood framed square housing favoured by the non-Aka. However the BaAka retain their close links with the forest, through either day hunts or forest trips lasting months at a time. Their renowned skills as trackers also make them much in demand for forest-based work with conservation organisations, researchers and non-Aka hunters.

The historical relationship between the BaAka and non-Aka agriculturalists remains largely unknown. While Bahuchet suggests pygmies are capable of fulfilling much of their carbohydrate



needs from wild yams, and therefore living without farmers (Bahuchet et al., 1991), in the recent past they are known to have been largely inter-dependent (Bahuchet, 1985a, Demesse, 1978). Before the arrival of the logging company in the 1970's, bringing with it the rush of in-migrants, the BaAka had a close relationship with the Sangha-Sangha people, in which non-Aka 'patrons' had exclusive relationships with certain moAka and their families. Meat and other forest products were provided by the BaAka in exchange for items such as cassava or salt. BaAka would also work for the non-Aka as hunters or in the fields. The Sangha-Sangha were also largely responsible for the BaAkas' political representation, now replaced by the new political hierarchy of the official triumvirate of mayor, police and commissariat.

The arrival of the new economic opportunities through coffee plantations and logging, coupled with the high level of in-migration and development of a cash economy, has resulted largely in the breakdown of these exclusive relationships, and the BaAka now work largely when and where they wish. In the present day the BaAka are still largely viewed as primitive people (Kretsinger, 1993) and frequently exploited by the non-Aka for work, money and loans, with debt recovery often achieved by demanding work or BaAka belongings often in excess of the original debt (Sarno, 1998). Only granted 'citizen' status by the Central African Republic government in 1998, most BaAka residents continue to lack both birth certificates and identification cards, disqualifying them from voting in national elections (Kretsinger, 1993).

## ***2.8 Background and structure of three study villages in depth***

There are eight villages in the area, all adjacent to the main road that stretches the length of the Reserve. Limitations of both time and resources meant it was impossible to conduct thorough work in all eight. I therefore decided to focus work in Bayanga and its two neighbouring villages- Yandoumbe and Mossopoula. These villages were chosen for three reasons. Firstly, Bayanga is home to both the IDCP headquarters and its tourism programme and therefore may be expected to experience the greatest impact of project presence. Secondly, a number of previous studies in the area have focussed on these three villages, making comparisons over time possible. Finally, the close proximity of the three villages, and hence exposure to my work, allowed a greater familiarity to develop informally between residents, my work and myself.

**Bayanga**

Bayanga is the largest settlement in the region, currently home to over 4000 people. Situated on the banks of the Sangha river, it was, historically, a small fishing village of about 100 people (Kretsinger, 1993, Fay, 1993). However, the arrival of the logging company and road in the 1970's resulted in a massive influx of people, swelling the village population to its current level. Both the sawmill and the headquarters of the ICDP are located in Bayanga, as are the main hospital and school in the Reserve, the gendarmerie, the police station and the mayor's office. There are no BaAka living in Bayanga, hence when I discuss Bayanga residents, I am referring to non-Aka residents only.

**Mossopoula**

Mossopoula, five km to the North of Bayanga, is home to over 100 BaAka and 30 non-Aka residents. It was founded in the mid-1980's following the deliberate relocation of a BaAka settlement on the periphery of Bayanga, prompted by problems with non-Aka Bayanga residents and a distant water source (Kretsinger, 2002). Both BaAka and non-Aka Mossopoula residents practise agriculture, although levels of elephant damage in this area are reportedly high (Noss, 2001). Livelihood options mirror those outlined in section 2.9, and a number of Mossopoula BaAka residents are employed by both the ICDP and a hunting safari company that operates in the area on a seasonal basis. Bayanga women also visit Mossopoula every evening to trade goods such as manioc and pre-cooked food with forest products collected that day by the BaAka. When referring to Mossopoula residents, I am referring only to the BaAka residents.

**Yandoumbe**

Yandoumbe was founded in 1990, 3km to the South of Bayanga, again by a deliberate mass relocation of BaAka from a site on the outskirts of Bayanga. The move was encouraged by the American musicologist, Louis Sarno, living with the BaAka in the area since 1986, for reasons relating to both the high levels of disease and alcoholism amongst the BaAka and poor relations with non-Aka creditors (Sarno, 1993). What began as one village has since splintered into several smaller settlements. Altogether there are estimated to be around 90 residents, all of whom are BaAka aside from Sarno (2005 DSP census). Livelihood options again mirror those outlined in section 2.9- in addition many men in the village are employed by the project's gorilla habituation program as trackers. The village is also visited by non-Aka women from Bayanga most evenings, trading manioc or pre-cooked food for forest goods. The majority of Yandoumbe BaAka cultivate land around the village, an area much coveted by the non-Aka due to the low levels of elephant incursion. A period of mass land sale by the BaAka to the non-Aka, often for minimal prices, was

halted to a certain extent by the ICDP, with one side of the road eventually reserved for BaAka fields (Sarno, 1998).

## **2.9 Local livelihood strategies**

### **Non-Aka livelihood options**

The 'boom and bust' growth and then failure of successive industries, including rubber, coffee and timber, has resulted in a history of uncertain economic opportunities in the area. While the majority of non-Aka residents were attracted to the area in search of work, the closure of the most recent logging company in 2004 has resulted in little formal employment in the area outside of the DSP. The scarcity of employment opportunities combined with an uncertain future has led to the development of diverse and flexible livelihood portfolios- economic activities may shift on a monthly, weekly or even daily basis, and may be aimed at subsistence or income generation, or both (Hardin, 2000, Noss, 1995).

There exists, as in much of Africa, a strong gender segregation in the division of work. Women of the reserve tend to engage in more trade-orientated work, including the preparation and/or sale of food or alcohol, the sale of wild foods or field produce and the sale of gun cartridges. Men, however, are more likely to be engaged in work such as net or line fishing, snare or gun hunting or carpentry, the collection of raphia wine or in the manufacture of roof shingles. Artisanal diamond mining is also practised on a small scale and conducted primarily by hand- exact figures are difficult to obtain given its illegal status within the reserve.

Formal employment within the reserve is available, albeit on a limited scale and almost exclusively involving men. Opportunities include work with the ICDP, including the tourism programme, as well as seasonal work with a hunting safari company. Such job opportunities are rare, however, and much sought after- formal employment in Bayanga has dropped from 52% of men in 1994 when a logging company was open locally, to 7% of household heads in 2005 (Garreau, 1996a ; DSP census).

These varied economic opportunities, however, are almost always underpinned by subsistence swidden agriculture, with nearly all households in the reserve owning some area of cultivated land. A recent census by the ICDP revealed that 75% of households identify agriculture as their primary

income generating activity (although the potential for misrepresentation of the contribution of participating in illegal activities such as hunting may render these results questionable).

### **BaAka livelihood options**

Traditional forest hunter-gatherers, links with the forest continue to be strongly maintained by the Dzanga-Sangha BaAka. While a number of semi-permanent BaAka villages have become established alongside the main road, residents continue to make frequent forest hunting trips, ranging from one day, *mulongo*, to establishing hunting camps in the forest for several months at a time, *kumbi*. The forest is used to source many things, including food, building equipment and medicine. BaAka women gather forest flora, such as the leaf of the koko vine, *Gnetum* spp., or fish by hand in forest streams or pools. BaAka men, meanwhile, are more likely to hunt with snares, crossbows or spears. Both men and women, of all ages, take part in net hunting, a communal activity.

An increasingly wide range of non-forest based economic and subsistence strategies are also being pursued at both the individual and community level. Both men and women labour in non-Aka fields and take part in tourist activities. Formal employment opportunities, again open mainly to the men, include tracking or research work with the ICDP, safari hunting companies or independent researchers. Informal work is also available for the BaAka men as hunters or porters for non-Aka hunters. A high proportion of BaAka also own and cultivate their own fields, although high levels of theft in the area has discouraged the growth of crops that can be easily eaten direct from the field, such as sweet potato, corn, groundnuts and tobacco (Sarno, 1998).

## **2.10 People and the forest**

### **A history of industrial exploitation**

The forest in the Dzanga-Sangha region has a long history of exploitation, ranging from the small scale, subsistence level to the wide-scale exploitation at international level. The first concession rights were granted to the French 'Companie des Caoutihoues et produits de la Lobay' in 1902 for 32,400 km<sup>2</sup>, followed by a number of other French and German companies (Carroll, 1996b). Exploitation was intense and focussed on ivory and rubber- between 1913 and 1928, one colonial company exported over 88 tonnes of ivory from the reserve region (Fay, 1993). In the 1920's and 30's coffee plantations began to be developed, attracting the first Gbaya in-migrants into the region, although falling coffee prices and the bankruptcy of the CAR coffee marketing board in the early

1990's resulted in many farmers abandoning coffee cultivation (Giles-Vernick, 1996). Gold and diamond mining began to develop as serious economic activities in the 1940's, with the first diamond mines opened to the north of Dzanga-Sangha in the mid-1960's (Kretsinger and Zana, 1997). Artisanal gemstone mining continues to the present day.

### **Logging**

The most significant development in the Sangha region has been the timber industry, which arrived with the issuing of the first forestry permits in 1967. With extraction focussing on the Sapele Mahogany, *Entandrophragma cylindricum*, Sipo, *Entandrophragma utile*, and Limba, *Terminalia superba*, four logging companies have operated in the area in turn. Slovenia bois, operating 1970 - 1986, featured the largest sawmill in Africa at the time, employing, at its peak, over 1000 people (Blom, 2001a). It became insolvent and closed in 1986, although was revived briefly as Sangha-Bois (1987-1988) before being shut down by the government for non-payment of debts. In 1992 the concession opened under the management of Sylvicole Bois on a considerably smaller scale, with 121 people employed full time in 1994 (Noss, 1995), before closing in 1997. The most recent concessionaires have been la Société de Bois de Bayanga (SBB) who logged the area from 1999-2004.

All four logging companies that operated the concession closed citing financial difficulties. While the wood harvested in the area generally has good commercial value, the country's landlocked state and distance from the international market has limited the industry- the cost of transport may account for up to 60% of the cost of the final product, making it extremely uncompetitive. Operation costs are further exacerbated by high fuel taxes and the difficulties of sourcing replacement parts (Fay, 1993).

While employment figures have varied considerably, depending on the scale and status of operations, it is clear that significant numbers of jobs are generated in the area (TELESIS, 1991). Historically logging companies in the area have also built and maintained community level buildings and services, including health clinics, schools and roads. They also paid considerable amounts of tax to the local and national government. As a result they are extremely popular at both the local and national level, and have attracted a huge influx of immigrants into the area. The concession is currently dormant while the government accepts bids from potential operators. The population of the reserve, rather than diminishing after the closure of SBB, is growing, with just the rumour of the sawmill reopening proving more attractive than other, scarce, economic opportunities available in the area. This has resulted in the current high levels of unemployment.

### **Safari hunting**

Started in Bayanga in 1986, safari hunting was seen as an integral component of the ICDP, primarily for its revenue generating potential. Three safari hunting companies have rights to hunting concessions in the Dzanga-Sangha region, although only one, Aouk-Sangha, is currently active. The primary attraction for hunters is the Bongo, *Tragelaphus eurycerus*, a large bodied antelope. Extremely shy, they are hunted using dogs, which allows selective hunting- only the males are killed. Quotas are set by the Minister in charge of wildlife in light of suggestions made by DSP. Considerable fees and taxes are paid by the safari hunting company to the Central African Government both for their registration and rent- between 1988 and 1993 it was estimated 10 million XAF was accrued by the mayors office through taxes alone (Fay, 1993). While this money was intended for use in the local community, there were accusations of local corruption (Fay, 1993). One safari company also pays the heads of villages situated near its concession a bond, nominally for helping to conserve the animals, although this was withheld in 2006 due to high levels of evidence of poaching in the area- no Bongos were found without evidence of snare-related injuries on at least one leg (Aouk-Sangha, pers. comm.).

### **Exploitation for subsistence- non-timber forest products**

A vast number of non-timber forest products (ntfp's) are exploited at the household level and play a vital role in local subsistence strategies. Raphia palms, which tend to grow in mono-dominant stands by streams and rivers, are exploited for both roofing material and palm wine. The contribution of both to the local economy is significant, estimated to represent over 50% of the total value of locally produced goods, wild meat included (Garreau, 1996b). While roofing tiles may be constructed and exported for sale, palm wine tends to be sold locally due to its short shelf life. Harvested throughout the year from wild palms, methods employed to extract palm wine in particular are extremely destructive. While the short lifespan of the individual palm shoots suggest they are generally well suited for this activity (Fay, 1993), studies in other areas suggest the popularity of palm wine can make exploitation unsustainable (Mollet et al., 2000). In the region, access is open to all with a boat and the necessary skills, and there are currently no replanting schemes.

Other commonly harvested ntfp's include payo, *Irvingia excelsa*, various types of mushrooms, koko leaves, *Gnetum spp.*, seasonal fruits such as mavundu, *Landolphia spp.*, and mbe, *Anonidium manni*, wild yams, *Dioscorea spp.*, caterpillars, snails, beetle larvae, cord, rattan, medicines, poisons for crossbows and fishing and a variety of building materials. Honey is also collected when hives have been spotted, almost always by BaAka men- access is gained by either climbing the tree or

simply cutting it down. BaAka women also fish the small forest streams during the dry season when the water is low. The streams are dammed with moss, mud and bark before being bailed dry, with the stranded fish and crustaceans then simply picked up off the riverbed.

There is a long history of both legal and illegal extraction of wild animals for meat in the Dzanga-Sangha area, which continues to the present day (Noss, 1995). All wildlife in the country officially belongs to the state, and the Central African law is explicit with regards to the hunting of wildlife (République Centrafricaine, 1984). Within Dzanga and Ndoki national parks no hunting is allowed. Within the Dzanga-Sangha Special Reserve, however, subsistence hunting may be conducted legally with weapons made from natural materials, including crossbows, nets or spears, or registered guns. Snare hunting is illegal throughout the country due to its indiscriminate and wasteful nature.

All prey animals are placed into three categories: A- Protected, B-partially protected and C- Unprotected (Appendix 3). Animals placed in category B, such as most of the duiker spp. may be hunted only by those with a license and are subject to a head tax per animal killed. Those in category C, primarily smaller animals such as giant rats, *Cricetomys emini*, or brush-tailed porcupines, *Atherurus africanus*, may be hunted for food using only traditional methods. While the head taxes, theoretically payable for all animals larger than a rodent, are considerable (often exceeding the market value of the animal) in practise they are rarely, if ever, collected (Noss, 1995).

Non-Aka hunters tend to specialise in one form of hunting, usually using either wire snares or guns, although spear hunting is not unknown. Snare hunting is relatively cheap to undertake, with outgoing expenses limited to 5000 XAF for 35m of wire, recovered with the sale of just two large duikers. Hunters tend to set a line of snares in the forest, stretching over as much as 3km, which they return to check every 2-5 days. Snare hunting is illegal in both the parks and reserve but nevertheless widespread.

Gun hunting may be done by buying a gun, or by hiring someone else's, although by law this is subject to a number of taxes. This includes a one-time weapon tax (30,000 XAF), and annual permits to bear a firearm (5,000 XAF), hunt small game (5,000 XAF) and hunt large game (20,000 XAF). While registered guns are legally permitted to kill certain animals within the hunting zone between dawn and dusk, a high proportion of hunting is done illegally, through either targeting protected animals, using unregistered guns or hunting at night, using torches to detect prey more easily using eyeshine.

Both snare and night gun hunting are indiscriminate of age, sex and type of animals, and both are done exclusively by men. While a number of BaAka residents have a few snares around their fields, and may be hired as porters or hunters, both snare and gun hunting are primarily organised by non-Aka hunters.

The BaAka primarily practise net hunting, although men may also take spears or crossbows with them for larger animals, or set traps for smaller ones. Net hunting parties tend to be made of families, although this is fairly fluid, and contain both men and women of all ages- Noss (1995) reports children from the age of five to a lady of at least 60 hunting regularly in Mossopoula. There is little territoriality within the forest- while particular families may have affiliations with certain areas, any family can, and does, go anywhere. Animals are hunted using communal nets, each averaging 18m long, where five to over twenty nets are linked into a semicircle. Nets are traditionally made from 'kosa'- the inner bark of *Manniophyton fulvum*, although nylon cord is becoming increasingly popular due to its strength and durability. Animals, usually small duikers, are then chased into the net using shouts and calls. Any meat is divided using a complex system of rules, although both the net owner and the hunter who caught the animal receive the largest share.

The function of net hunting is nearly always subsistence and is conducted all year round. If a hunt goes well, however, the excess meat is often sold. Net hunting, when compared to gun and snare hunting, is relatively unproductive- an average of 8 animals were killed per hunt in a Mossopoula based study, averaging 440 g of edible meat per hunter (Noss, 1995). There appears to be no selecting for either age or sex- all captured animals are killed, and current levels of net hunting are unlikely to be ecologically sustainable (Noss, 1998a).

The gazettement of Dzanga and Ndoki National Parks has meant the loss of large amounts of hunting ground. Whilst the BaAka are permitted to practice net and crossbow hunting within the community hunting zone, they suffer from high levels of competition from non-Aka hunters, and often great distances to walk to reach the zone.



## **2.11 The Dzanga-Sangha Project- Integrating conservation and development**

### **History of the DSP**

The Sangha region, long known for its richness in biodiversity, was proposed as a Bongo sanctuary in 1981 (Spinage, 1981). Subsequent in-depth field studies, requested by the Central African Republic government and funded by the Wildlife Conservation Society (WCS) and the World Wide Fund for Nature (WWF), revealed an area containing the most intact fauna and flora in the country (Carroll, 1986b). On the 29<sup>th</sup> December 1990, guided and funded by WWF-US, USAID and the World Bank, the Central African Republic government created the Dzanga-Sangha protected area complex, simultaneously forming the Dzanga-Sangha Project (DSP) to manage it. The Dzanga-Sangha project is run by government appointed nationals and advised by representatives from WWF and the German development Agency (GTZ). Funding is provided by donor agencies, primarily WWF and GTZ.

The Dzanga-Sangha protected area covers 4589 km<sup>2</sup> of land, divided into three management units: Dzanga National Park (DNP) (495 km<sup>2</sup>) Ndoki National Park (NNP) (727 km<sup>2</sup>), and the Dzanga-Sangha Special Reserve (DSR) (3359km<sup>2</sup>). Both parks are strictly protected and permit entry for tourism or research purposes only, while the reserve is a multi-use zone intended to meet local economic and subsistence needs.

### **Project aims and activities**

The long-term, and largely unchanged central aim of the DSP is the conservation of the forest and its wildlife, through both direct protection efforts, and the promotion of the sustainable use of its resources. To this end, DSP engages in both conservation and development related activities.

A long-term biodiversity monitoring team intermittently monitors the population dynamics of the larger park mammals. The DSP also features a strong unit-poaching enforcement component, active since the park was formed, involving both armed patrols and a road barrier. Growing from 10 to over 50 permanent national park guards, patrols are conducted in both the parks and the reserve, by river and road. A barrier across the only road leading North out of the reserve is also guarded 24 hours a day by a minimum of two guards, with passing vehicles searched.

Responses to illegal hunting focus primarily on confiscation of hunting equipment and meat. Snares are always removed and buried. Unregistered guns, or registered guns being used improperly, such as at night, are always confiscated, although registered guns are later returned to the owner. Hunters found with large amounts of meat from un-protected species will have the meat confiscated- small amounts such as one or two animals often receive just a warning. People found with the meat of an endangered animal, such as gorilla or elephant, are arrested and handed to the local authority, although follow-up enforcement is weak. If the confiscated meat is from a protected species, such as a gorilla, it is destroyed. If not, it is taken to Nola, the district capital, and sold, with proceeds going to the state.

Development activities include encouraging the sustainable use of the reserve's natural resources, provision and support of community infrastructure, including building and supporting schools and a number of health clinics, employment with the project, encouraging alternative means of food production through agriculture and financing micro-projects. Specific emphasis is placed on supporting the BaAka, assisting “... *BaAka's self-determined integration into the socioeconomic environment at the same time as protecting their desire to retain a portion of their cultural uniqueness*” (DSP promotional literature). Within the reserve there is a zone specifically for community hunting, in addition to a number of concession areas for safari hunting and logging- deliberately designed to provide the local residents with sustainable economic opportunities. Field cultivation is permitted up to 1km either side of the main road running from the north to the south of the reserve.

The DSP operates a tourism programme, with the associated revenue distribution intended to encourage pro-conservation behaviour, outlined in more detail below. It also runs an environmental education program, aimed primarily at children, although occasionally working with pre-formed groups of adults, such as church groups.

## **2.12 Tourism**

Tourist groups are known to have visited the area since the mid 1970's, often in conjunction with the logging company (Hardin, 2000). Forming an integral part of the park management plan, a more formal structure to facilitate and encourage tourism was set up in 1989 for which tourist guides were recruited and trained. By 1995 a visitor centre and a tourist lodge had been constructed by the

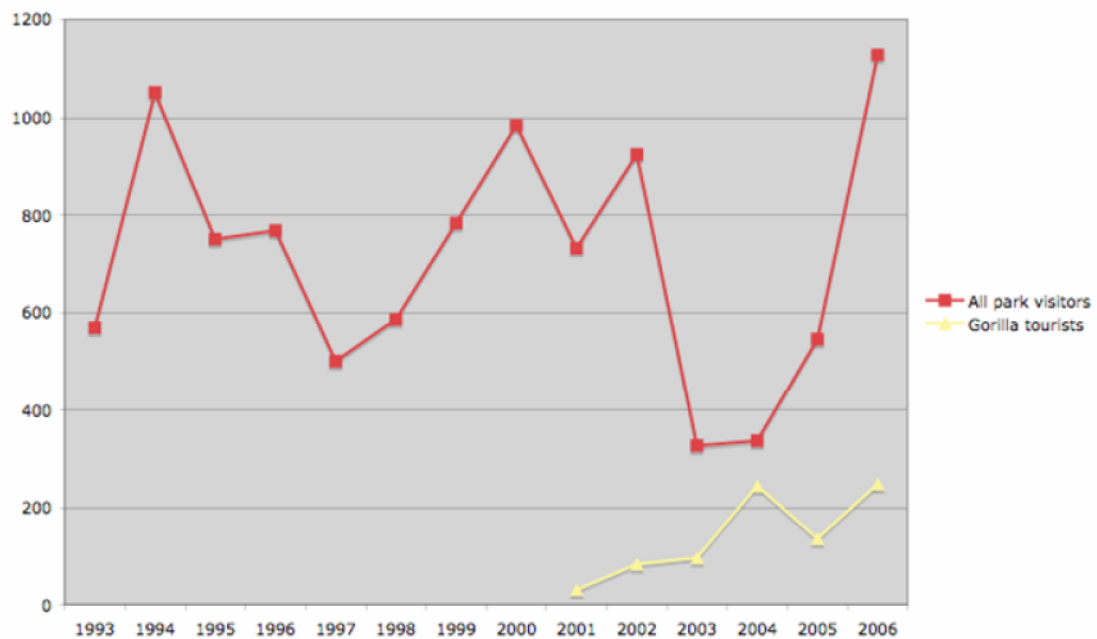
DSP, situated in a quiet spot by the river between Bayanga and the DSP headquarters. The tourist lodge was then handed over to an external tour company to be run as a private enterprise.

Tourist activities organised by the DSP include those both inside and outside the park. Within the park, attractions include the viewing platform at Dzanga bai, a spectacular clearing visited by a high diversity of forest wildlife, (Turkalo and Fay, 2001, Turkalo and Klaus-Hugi, 1999), and gorilla tracking. All village-based tourism is run in conjunction with local residents. Fishing, palm wine collection, pirogue rides and traditional dances are run with the non-Aka of Bayanga, whilst net and cross bow hunting, medicinal plant walks, hut construction and traditional dancing are conducted with the BaAka of Yandoumbe and Mossopoula. Tourism based in the village can be conducted independently of the project, although most visitors prefer the ease of the organised packages offered by the project.

While tourism has been suggested in the past to present a serious economic alternative to logging (Blom, 2001a, TELESIS, 1991), its development in the area has been beset by difficulties. The Central African Republic has suffered frequent bouts of political insecurity, off-putting to all but the hardiest of travellers, combined with high travel costs relative to other African destinations. Arrivals at both the airport and borders also frequently suffer harassment from customs and police officers. Dzanga-Sangha itself is relatively remote, with a poor transport infrastructure and very high airfares from Europe. It also suffers from a faltering education system, limiting the availability of guides who have the ability to speak French or English.

Despite these difficulties, the area has been visited by an average of 800 tourists a year (figure 2.6), interrupted at various intervals by political insecurity in the capital. By 1995 the project had begun to recover the direct salary costs of guides from tourism revenue, although tourism related revenue accounted for only 3% of total project costs (Hardin, 2000).

The main motivation behind project promotion of tourism in the area was to provide conservation-related economic benefits to community members, both through providing employment and through the revenue distribution programme. A longer-term aim, however, is to cover the wages of tourism personnel, i.e. make the running of the tourism program self-sustaining. To this end, park entrance fees are divided three ways: 10% is given to the government as part of a national forestry and tourism fund to finance the conservation activities in other parts of the country, 40% to the local community and 50% is put towards park management costs. All revenue produced by tourist activities outside the park and the gorilla-tracking fee is put towards park management costs.



**Figure 2-6** Visitor numbers to both Dzanga National park and to track purposefully habituated western lowland gorillas (1993-2006)

### Gorilla tourism

The successful habituation of western lowland gorillas in the area has resulted in Dzanga-Sangha being one of the few places in the world where tourists may track and view this gorilla sub-species in the wild. While some tracking of wild gorillas took place prior to deliberate habituation efforts, this was poorly controlled and unpredictable. Groups were hard to find, compounded by BaAka trackers deliberately avoiding them due to the considerable dangers involved in approaching unhabituated gorillas (Hardin, 2000). On occasions they made contact with gorillas, poor practises resulted in allowing the use of flash photography and numerous incidences of ‘treeing’ the gorillas, where tourists clustering around the base of a tree effectively trap the gorilla in the canopy. This resulted in the death of at least one young gorilla who fell as he tried to jump to another tree (Hardin, 2000).

The deliberate habituation of gorillas for the purposes of tourism began in 1997 and the gorilla tracking programme opened to tourists in 2001. The programme is in the process of habituating two gorilla groups, although only one is currently visited by tourists. A maximum of three tourists may visit a group at one time for a maximum of 60 minutes visibility, although up to two groups may visit in a day. The visits are governed by strict rules, including no loud or sudden noises, no flash

photography, a minimum distance of 7 m to be maintained from the gorillas<sup>6</sup>, no littering, smoking, spitting or defecating in the forest. In addition, no tourists with visible signs of illness are allowed to visit the gorillas.

The poor visibility and difficulties both tracking and habituating western lowland gorillas suggest the site may never enjoy the popularity of the mountain gorillas. However, while East Africa may be the easier place to visit gorillas, Bai Hokou is one of the few places that offers views of western lowland gorillas. As a result the area attracts many gorilla specialists, many of whom have already visited other gorilla habituation camps, and there has been a steady growth in gorilla tourists since the programme opened in 2001 (figure 2.6).

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<sup>6</sup> Distance recommended by Homsey, J. (1999) in *Ape Tourism and Human Diseases: How Close Should We Get?* IGCP

## Chapter three

### Methods

#### 3.1 Introduction

To address the broad set of questions outlined in chapter one, original data collection focussed on a range of areas. The thesis also makes use of a number of existing data sets, allowing insight into temporal patterns within the Dzanga-Sangha region. As much of these data are used in more than one section, this chapter introduces and outlines the main datasets used, both self-collected (3.2) and pre-existing (3.3). It also includes an appraisal of the strengths and weaknesses of each. Where necessary, more detailed methods are provided in the relevant chapters. This chapter goes on to consider issues that arose during the fieldwork period (3.4), including practical issues such as informant rewards and language considerations. Finally I provide an outline of the research programme as a whole (3.5).

**Table 3-1** Summary of both original and pre-existing datasets used in each chapter. Information generated through both informal and semi-structured interviews and participant observation was used throughout. HAS= Household Attitudinal Survey, HCIS= Household Consumption and Income Survey, BMS= Bayanga Market Survey.

Chapter	Area investigated	Original dataset			Pre-existing dataset
		HAS	HCIS	BMS	
Four	Costs and benefits	x			Financial records (DSP, private enterprises)
Five	Attitudes	x			
Six	Replacing livelihoods	x	x	x	Law enforcement patrol records
Seven	Wild food consumption	x	x	x	
Eight	Biodiversity conservation		x	x	Animal survey records Law enforcement patrol records

## 3.2 Original datasets

### 3.2.1 Household Consumption and Income Survey (HCIS)

A household consumption and income study was conducted to determine the importance of natural resources in both diet and income of reserve households, and largely follows that used by de Merode (1998, 2004). For each participating household, the following information was collected from a household representative:

**Consumption:** For every meal consumed by the household that day, the following data was recorded:

- i) Ingredients
- ii) Ingredient quantity (weight/no. of local units/market price)
- iii) Ingredient source (grown/gathered/gift/exchanged/bought)
- iv) Number of adults and children who consumed the meal

**Income:** For every household member, the following data was recorded:

- i) All work<sup>7</sup> activities conducted that day (formal and informal)
- ii) Duration of work activity (if known)
- iii) Income for work activity (cash/goods/debt relief)
- iv) Any gifts received during the day

Due to the seasonality of many food resources, the data collection period focused on three characteristic periods in the year: peak dry season (January), low rain season (July) and high rain season (October). In each month, every household was visited for 7 consecutive days, designed to capture weekly variation. For logistical reasons, the households sampled were spread out throughout the month.

The questions were addressed to a household representative, frequently the person in charge of meal preparation. If no one was available, the house was revisited later in the day or the following day. Given issues relating to recall accuracy, no data was recorded if more than 48 hours had elapsed since the day designated for data collection.

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<sup>7</sup> Work was carefully defined as a physical activity, rather than necessarily an income-generating one. This section was also intended to capture field production data: if a household member had visited their field, the quantity of crop both harvested and sold was requested.

It was decided not to record food consumed by household members outside the main meals. This was done for a number of reasons. During preparatory work with the non-Aka, participant observation and informal interviews with reserve residents showed food consumed outside of mealtimes was minimal and tended to focus on a small number of non-forest food items, such as macala (small fried dough balls), maize and palm nuts. Such snacks also tended to be eaten on an individualistic and opportunist basis. I therefore felt it unlikely that one household member would be able to accurately account for all household members.

With the BaAka households there was likely to be a much greater range and quantity of food consumed outside meal times- there is a general tendency to quickly consume food that doesn't need preparation, particularly when walking in the forest. However the impossibility of accurately accounting for food eaten in this way by all members of a consumption group led to the decision to concentrate on the main meals.

Finally, the emphasis of my work is on relative consumption values, rather than absolute values (as would be required in a study of nutrition). It is therefore assumed that the exclusion of snacks affects all households equally and does not affect overall patterns.

### **Defining a household**

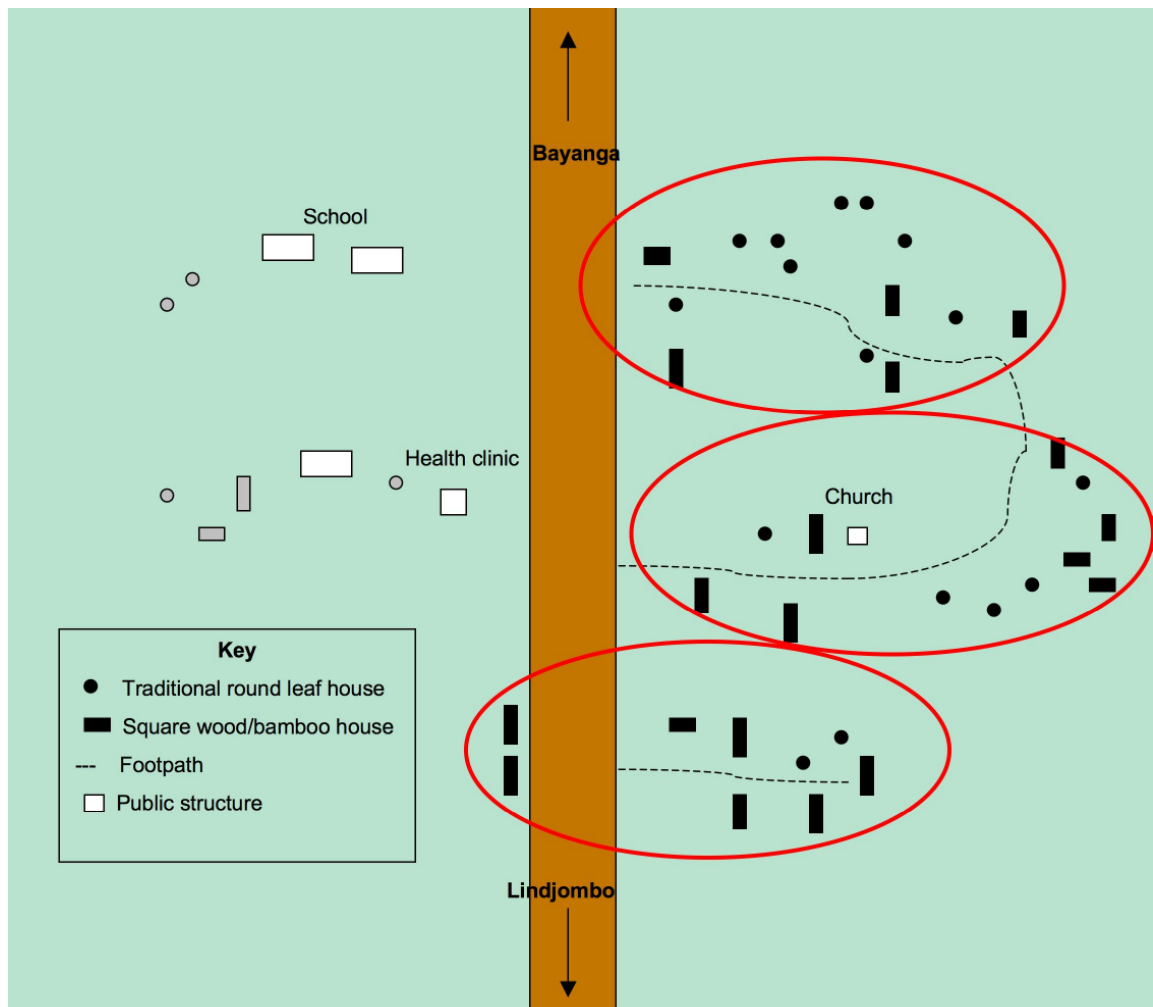
A household, as defined by the UN, is “A *multi-person household, defined as a group of two or more persons living together who make common provision for food or other essentials for living*”. This includes all resident family members and house staff, but excludes children away at school. Polygamous men, with two or more families living in separate compounds, are considered a member of all these households.

While this definition proved straightforward to apply to non-Aka households, difficulties arose when considering the BaAka, for whom a larger collection of related families, joined as a camp, make up a socioeconomic unit (Bahuchet, 1992). This acephalous unit both hunt together and share food, before and after cooking (Bahuchet, 1985b). While a man-wife unit tend to have their own separate house, this is not always the case.

I defined a BaAka household primarily by living arrangements, whereby the majority were a man-wife unit with their own house. Although most of these households had their own cooking fire and tended to cook their own meals, there was also a large amount of food sharing within a family unit, both pre and post cooking. Following Koppert and Hladik (1990), I approached this problem by



including all households within a family group in the study. The households selected formed a geographically distinct group within the village of Yandoumbe (fig. 3.1) and were divided into three family groups. Given the little food sharing outside of these family groups, it is assumed all meals recorded represented consumption within each family group.



**Figure 3-1** Map of Yandoumbe village, indicating households included in the HCIS (shaded black) and their family groups (circles)

### Sampling frame

The high mobility and problems defining a BaAka household raised concerns about capturing the correct proportion of this semi-nomadic community within the sample. I therefore conducted my own census of Yandoumbe and Mossoupoula to create a recent and accurate sampling frame. The

two village surveys were completed by myself and two BaAka assistants over two days in May, mapping out every house in both villages using a GPS unit and noting the name of the head of the household. Three family units were selected, involving 35 separate houses.

For the non-Aka residents of Bayanga, I used the 2005 DSP census to create a sampling frame. 85 households were randomly selected by assigning all recorded households a number and using a random number generator to produce the required sample size.

Every study household was visited in the week prior to the study by myself and one assistant. We introduced the work and outlined the protocol before asking if the household would be interested in participating. 79 non-Aka and 35 BaAka households initially agreed to participate. Over the course of the 9 month study, 13 of these households dropped out, for reasons given below (table 3.2). In total, 1334 consumption days were recorded for non-Aka, and 590 consumption days recorded for BaAka households. See section 3.4.3 below for details on informant rewards.

**Table 3-2.** Reasons given for selected households failure to participate for the full nine months of the HCIS

Reason for drop-out	BaAka N	Non-Aka N
Moved away from area	4	0
Compensation for time deemed insufficient	0	5
Unknown	0	4

### **Areas of weakness: Household consumption**

#### ***Deliberate misrepresentation by informants***

I was concerned that there may have been some reluctance to report certain ingredients or their source, particularly if it was known to be illegal. This may result both from suspicion regarding my motives or from a simple misunderstanding of the precise nature of the data required. There was also a concern that quantities may be either underestimated, in the hope that we would provide resources, or overestimated out of embarrassment. Consequently a great deal of time was spent assuring respondents both of the confidential nature of their results, and my lack of connection with the Dzanga-Sangha Project. Locally based and known research assistants were also used to collect the data, and over the nine months a good working relationship was built with all of the households.

***Accidental misrepresentation by informants***

While 24 hour recall is one of the most common methods adopted to examine human diets (Quandt, 1987), it is also known to be prone to inaccuracies (Smith et al., 1996, Johnson et al., 1996). This was minimised in two ways. Participant observation showed that many Bayanga households tended to plan and cook their main meal in the middle of the day, with any remainders often reheated and eaten in the evening. Households were therefore visited in the afternoon, following the preparation and consumption of the main meal, in an attempt to reduce accidental recall error. For the BaAka, the main meal tended to be prepared later in the evening, therefore Yandoumbe residents were visited early evening, often when cooking was underway and some weighing of ingredients was possible. Secondly, when visiting all households the next day, the household representative was asked to quickly confirm the previous days data- highlighting the importance of precision to the respondents and quickly improving recall accuracy.

For the BaAka households, ingredient quantities were problematic to assess, primarily as much tended to be gathered rather than purchased or traded on the market, precluding the use of market prices as a measurement unit. As a result, self-reporting of quantities was found to be highly prone to error. Consequently, quantitative data collection was restricted to occasions when ingredients were found in a pre-cooked state and could be weighed using scales.

***Misreporting by research assistants.***

There is a danger that in relying on large teams of researchers, surveys of this kind leave themselves open to misreporting by research assistants. This was particularly a concern in this case as 4 of the 6 research assistants had not previously collected systematic data. To help counteract this, I adopted a number of measures. An intensive training period of 3 weeks was conducted, including a one-week pilot study, during which data collection was practised at a number of friendly households. Following the commencement of data collection, each individual researcher was accompanied by myself at least once a week in order to check the quality of their work. Before each day of work, a team meeting was held to discuss any issues arising from the previous day's work and data collected by all team members was checked by myself on a daily basis for inaccuracies. Finally, no researcher worked alone (although on a handful of occasions illness made this necessary), improving both researcher accuracy and morale.

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**Areas of weakness: Household income*****Deliberate misrepresentation by informants***

The high likelihood of misrepresentation of participation in illegal hunting activities gave serious cause for concern with regards to recording work activities. While information regarding overall household involvement in hunting in 2006 could be independently verified by two hunters resident in the area, specific information on day-to-day involvement and offtake rate could not be. Direct hunter follows were tried but found to be impossible due to high levels of suspicion from hunters and DSP employees. Additionally, there were a number of aggressive demands for money from participating hunters. As a result, Noss's mean offtake rates for a snare hunter (Noss, 1995), and 2006 market prices were substituted for this information. No data on offtake rates by gun hunters were available.

***Accidental misrepresentation by informants***

There are some serious concerns relating to the exhaustiveness of the income data, in particular relating to work activity time budgets. In asking one household representative to fully report the activities of all household members we are assuming perfect knowledge. However, it was often the case that the interviewee, usually the female head of the household, did not know the activities of other household members, nor the income generated. As these members were frequently absent from the house during the interview, it was not possible to question them directly. As a result, data regarding household participation on particular work activities should be considered a minimum rather than absolute.

A number of difficulties were faced when questioning representatives about salaries for waged household members. For five households, the respondent either didn't know the salary in question (as it related to another household member) or they felt uncomfortable telling us. In these cases a detailed description was taken of the job. It was possible in all cases to match the job to an identical or very similar job reported by another respondent who had given us the monthly salary. The reported salary was then applied to both households.

### 3.2.2 Household Attitudinal Survey (HAS)

A structured questionnaire was used to collect information in the following areas:

For the respondent:                      Socio-demographic details (age, gender, education level, profession)  
    Conservation-related cost/benefit recognition  
    Conservation-related attitudes

For the respondents' household: Gender, age and profession of all household members  
    Household wealth assessment

In addition, a meat ranking exercise was conducted to determine both species preferences and species consumption rates for 2006. The full questionnaire is presented in appendix 1. More details on the structure and approach of the specific questions are provided in the respective chapters.

#### **Sampling**

The attitudinal questionnaire was deliberately conducted towards the end of the fieldwork period, allowing qualitative research conducted in the preceding months to help in the design of a relevant questionnaire. The 114 households that had participated in the household consumption study were also approached for the attitudinal questionnaire, with 81% completing both. The remaining households had either moved from the area, were away in forest hunting camps, or declined to participate.

A further 140 households were selected using a) the 2005 DSP census for Bayanga, and b) a 2006 census completed for this study for Yandoumbe and Mossopoula (outlined earlier in this chapter). All households were selected using the random number generation program approach outlined earlier. Once identified, households were approached and the survey was explained in detail. It was stressed that the work was being conducted independently of the DSP, and that all responses would be treated confidentially. If permission was granted, interviews were conducted with the household head by myself and my research assistant. If the head was unavailable or declined to participate, another senior representative, usually the wife of the household head, was interviewed.

Questionnaires took between 30 and 70 minutes to complete. At the end the respondent received a small gift of coffee as a gesture of thanks. The attitudinal questionnaire was piloted in January with 20 households. These questionnaires were then discarded and the questions refined on the basis of lessons learned. Data collection was conducted over a three-month period from February until April, 2007. 211 questionnaires were completed in total.

**Table 3-3** Sample size and location for respondents for the household attitudinal survey. % village represents the percentage of households sampled in that village, as represented by the PDS 2005 census (Bayanga) and a census conducted for this study (Yandoumbe and Mossopoula)

	Also completed HSIS	New households	Total	% village
<b>Bayanga</b>	71	64	135	18
<b>Yandoumbe</b>	21	21	42	37
<b>Mossopoula</b>	-	34	34	33

#### **Areas of weakness**

This survey will inevitably provide only an estimation of the prevailing knowledge, attitudes and behaviour of the current reserve population. However, it is possible to identify potential areas of error and attempt to minimise these.

**Guiding responses:** Questionnaires are extremely efficient in terms of both time and money, and in this study allowed a much wider sampling of society, particularly useful considering the heterogeneity of the reserve's population in terms of both ethnicity and residency length. Structured questionnaires frequently suffer the criticism that they constrain understanding, constricting respondents responses (Oppenheim, 1992). These biases were minimised as far as possible by the use of open questions, with the intention of allowing people to say what they liked. Where closed questions were used, probing was used for qualifying or follow-up comments- remarks that often proved invaluable in interpreting answers. We were also careful to spend a great deal of time explaining the study and its applications and to assure respondent anonymity. Finally, the questionnaire was only attempted following 10 months residence in the reserve, which assured a certain level of familiarity between the respondents and myself. Participant observation and both formal and informal interviews of community members and project staff complemented and guided both the design of the survey and response interpretation.

**Sampling error:** Caused through sampling frame deficiencies and sample selection bias, a failure to represent the population by your sample can have serious repercussions for the wider validity of results. For this study the sampling frame used for Bayanga was created from a DSP 2005 census. It therefore failed to represent any members of the community who moved to the reserve after that date. In addition, a number of households were difficult to locate. While the census list gives the name of the household head and the area of Bayanga in which they were living, on occasion the household was found to have moved to another area, left the reserve completely, or the name was found to be incorrectly recorded. As a result a great deal of time was spent trying to locate some of these households; in some cases, they were never found.

The high mobility and problems defining a BaAka household, outlined earlier, raised concerns about capturing the correct proportion of this semi-nomadic community within the sample, in addition to problems relating to the accuracy of the 2005 DSP household census. Therefore quota sampling was employed in order to capture a representative proportion of BaAka within the sample. A household census was also conducted before sampling began of both Yandoumbe and Mossoupoula, using the household definition outlined in section 3.2.1, to create a recent and accurate sampling frame. To minimise inaccuracies introduced by the semi-nomadic nature of village residents, the household surveys were conducted during the peak of the wet season in October, when families were most likely to be found in the roadside villages.

**Translation problems:** A number of problems relating to question construct and translation had to be addressed, primarily through the translation-re-translation technique using two main research assistants, and extensive pilot testing. By the time sampling got underway, these issues had been resolved. This exercise also acted as an excellent way to familiarise my research assistants with both the purpose and finer details of the questions.

**Deliberate misrepresentation by informants:** Attitudes and behaviour towards wild resources may be deliberately misrepresented by the respondent for a number of reasons, including suspicion of my motives, fear of repercussions and embarrassment. Respondents may also hold the belief that their responses may influence events, causing them to misrepresent the facts. For example, elephant damage to crops may be exaggerated in the hope that I might help with, or influence, monetary compensation. There may also be less intentional misunderstandings of the precise nature of the data required. This was minimised by a careful explanation of both the confidentiality of their responses, and my independent research status, in addition to conducting the surveys following 10 month's residence in the area.

***Accidental misrepresentation by informants:*** There exists the potential for accidental misrepresentation through recall error- for example, when the respondent is asked about main economic activities conducted throughout all of 2006. While the majority of respondents appeared confident about reporting this data, these results must inevitably be considered estimates.

***Misreporting by research assistants:*** Questionnaires were administered by my main research assistant and myself. While this minimised issues relating to misreporting by research assistants and data collection accuracy, it may have increased levels of suspicion regarding the questionnaire by involving a western outsider, influencing responses. This was minimised as far as possible both by my long-term presence as a village resident and also by the high-profile nature of my market survey, which introduced my study to the wider community and showcased its acceptance by the market women.

### **3.2.3 Market survey**

Data on the type and quantities of wild meat sold in the region were estimated through a survey of Bayanga market, the only formal gathering of independent traders in the region. Bayanga market was open every day of the year except for national holidays. Whilst there were no official hours of trade, nearly all the sales were conducted in the morning. The market was housed in an open-sided building with a corrugated iron roof, situated in the centre of Bayanga. Regular vendors used tables inside the building; others displayed their goods on the ground around the outside of the building.

For a twelve-month period, for selected study days, all meat, fish and vegetables on sale in Bayanga market were recorded and the following data noted: Food type, presentation (fresh/smoked/dried), quantity, method of production, village of producer and price per unit. The weighing of every food item recorded was avoided as it was clear it would have been disruptive, making our presence unpopular, particularly as the work was highly repetitive and often involved the same people. Consequently quantities were recorded in locally relevant units, identified during the pilot study. Each month an average weight for each local unit was calculated by weighing 15 samples of each unit in total, taken from no less than 5 different vendors. The mean weight for each local unit was re-calculated every month to avoid possible seasonal bias.



While meat was sold both smoked and fresh, data is presented here only as fresh. As all meat was measured in locally relevant units, whatever state it was in, the average fresh weight of each unit was calculated and applied to all.

The method of hunting was ascertained either through simply asking the vendor or through examining the meat- both snare and gun injuries are distinct and often easy to observe.

Identification of smoked meat was made either by asking the vendor or by examining the meat. The size of the bones, texture of the meat and frequent patches of hair made it possible to accurately identify the meat. Animals sold in Bayanga market were almost always dead, with the exception of tortoises. No produce was sold frozen, due to the absence of electricity in the area.

A pilot study was conducted in April for four weeks, during which we rehearsed our data collection protocol, modifying it where necessary. It also allowed us to take the time to introduce and explain the study to the market vendors, many of whom didn't visit the market every day. This leisurely introduction, free from any pressure on us to collect rigorous data, was, I believe, an important factor in the acceptance of our study by the market vendors and consequently their customers.

Data collection took place from May 2006 until April 2007 and covered 44% of market days (N= 160 market days). Data was collected for a total of fourteen days a month, including the first seven days, and a further seven days chosen randomly from the rest of the month. This was to minimise any bias introduced by the anticipation of researchers presence and therefore any avoidance of the market by particular vendors. Sampling hours were set between 7.30 am and 1pm to allow cross-period comparisons, although the market was generally most active between the hours 9am-11am. A research assistant recorded the market data. For the first two months I accompanied him full time to the market to ensure accurate data collection. After this period he worked primarily alone, although I would usually visit him for the final hour of work to review the day's data and discuss any issues that may have arisen.

### **Data Limitations**

Following Cowlshaw et al. (2005a), this survey does not attempt to represent all meat sales in the area. A large proportion of meat is sold informally from the houses of hunters and traders, either displayed on a table outside or concealed within. Given the secretive nature of some of the sales and the bias introduced by missing quick sales, any attempt to measure informal village sales could not hope to be completely accurate or comprehensive. A survey of this kind would have also created a

high profile focus on wild meat, something I wished to avoid given the mistrust surrounding the issue.

It is expected that a large proportion of wild meat is exported out of the area for sale, either by road or by river. In the mid-1990's, when the sawmill was functioning, export was estimated to account for 42% of total wild meat sales (Garreau, 1996b). While the closure of the sawmill has resulted in fewer vehicles on the road and reduced public transport to a single bus, which arrives approximately every 3-4 days, it is likely that meat continues to be exported using the river, particularly at night. Attempting to capture exports was beyond the scope of this project, particularly given the many docking areas for boats on the river bank. It would also have given my work a strong association with the anti-poaching patrol, who do attempt to monitor wild meat export in this way.

#### **Potential areas of bias**

A number of potential sources of inaccuracy were identified and addressed during the course of the survey.

***Double measuring:*** A chief difficulty proved to be the potential for recording the same goods twice. This can occur in two ways. Occasionally produce that had failed to sell on the previous day was returned to the market the next day. In addition, meat for sale in large portions was occasionally purchased by another vendor, divided and then sold on in smaller portions. Both these events were addressed through the careful questioning of the vendor about the source of their produce. Produce which was on sale for two or more consecutive days were still recorded in order to accurately represent what was available in the market on that day- however it was marked as a repeat measure and included only once in monthly totals. Any produce that had previously been registered that day with another vendor was not counted.

***Vendor avoidance:*** Given the sensitive nature of the work, there was a strong potential for the researchers presence in the market to deter sellers of illegal meat. A number of precautions were taken to ensure data collection captured a representative picture of the presence and activity of vendors, and the meat supply and demand. Great emphasis was put on the independent nature of my work, to disassociate myself with anti-poaching authorities. An extensive pilot study was conducted to create familiarity with both research and researchers, anonymity was assured and a local research assistant, unrelated to the DSP, was used. 50% of the study days were also chosen randomly to ensure researcher presence could not be predicted. While it is impossible to know for sure what the impact our presence in the market was, it should be noted that illegal meat was often on sale in the

market and the majority of vendors appeared happy to allow us access. The regular market women also quickly became ambassadors for our cause, explaining on our behalf the study to new vendors, and urging their participation.

**Stated vs. actual price:** Prices recorded are those being asked by the vendor. Given the high degree of haggling over prices that occurs in the market place, there is the strong possibility that the price asked is an overestimate of the eventual price paid. However, two other studies conducted in central African market places (Democratic Republic of Congo- de Merode (1998) and Equatorial Guinea- Kümpel (2006)) compared stated to actual prices and found them to be strongly related. Furthermore, as price is used as a comparative rather than absolute measure the assumption may be made that this bias affects all prices equally and therefore does not affect results.

**Weights and carcass conversions:** In the Dzanga-Sangha region there are standard ways to divide the carcass of different species. Smaller bodied monkeys and duikers, such as the blue duiker, *Philantomba monticola*, are divided into halves; medium sized duikers, such as Peter's duiker, *Cephalophus callipygus*, are divided into quarters; larger ungulates, such as the sitatunga, *Tragelaphus spekei*, are divided into 8-12 portions. The division of large mammals, such as elephants, gorillas and buffalo remains unknown, due both the variation in their sizes and to the secrecy surrounding their hunting.

Most of the meat enters the market either as an entire carcass (particularly for the smaller bodied animals) or as a 'morceaux', a local name for a portion of the carcass. For the smaller mammals, it is therefore relatively straightforward to calculate the minimum number of individuals entering the market by adding up the number of entire and divided carcasses. For the very large mammals, however, a minimum estimate was made by assuming all the meat from that one species appearing in the market at the same time belongs to the same individual (in all cases the meat weighed less than the equivalent of an adult female). Meat was considered to come from a different individual if two samples appear in the market more than 5 days apart.

### 3.2.4 Wealth ranking

Wealth, particularly in western countries, has a tendency to be defined in strictly financial terms, (e.g. Samuelson and Nordhaus, 2004), reducing to one facet what is, in fact, an extraordinarily complex and multidimensional concept. Wealth should encompass both access to economic resources and control over these, (Grandin, 1988), a multi faceted concept which may include factors as diverse as authority, access to education or health. Ellis (2000) expands on this to encompass all aspects of human wellbeing, which he defines as the human capability of being and doing. This view is echoed by Sen who highlights the importance of freedom above all other factors (1999).

The complexity of the wealth concept means it is notoriously difficult to measure (Homewood, 2005b, Ellis, 2000). The reductionism approach of income/expenditure measurement, as seen in the much quoted \$1 a day extreme poverty line introduced by the World Bank, is straightforward to measure and readily allows within- and cross-country comparisons. Yet this approach fails to account for non-financial aspects of wealth, such as health, political influence and authority, which may be valued above income (Chambers, 1997, Sen, 1999). Its over-simplistic approach may also make it vulnerable to biasing factors, such as seasonal variations (Ellis, 2000).

In assessing wealth, therefore, it has become increasingly common to include quantification of easy-to-measure traits such as material assets and land tenure. While these may help develop a clearer understanding, deciding which indicators should, and indeed can, be used to measure wealth is complex- there are numerous examples of professionals selecting wealth indicators which have missed or misinterpreted major elements in wealth and income, leading to misclassification (Chambers, 1997). As a consequence, wealth ranking using participatory rural appraisal/rapid rural appraisal (PRA/RRA) methodology has grown increasingly popular. In its use of community members to rank known households in terms of their wealth status, the researcher assumes the role of facilitator rather than a leader, allowing local people the freedom of expression to create locally relevant wealth indicators, rather than outside imposed ones. (see Grandin, 1988 , for more details).

Wealth ranking using PRA is not without its weaknesses. One of the main charges is its tendency to oversimplify. The relatively rapid method of appraisal provokes the criticism of superficiality, and runs the risk of failing to grasp the complexities of the issue. For example, it may be capable of detecting and measuring indicators but miss linkages, or indeed lack of linkages, between them

(Homewood, 2005b). It may also miss site-specific social and historical circumstances, biasing both the process and findings. In the specific case of wealth ranking, it may provide a household generalisation to which not all household members will have equal access. PRA exercises in general may also be prone to influence by external interests, leading to such biases such as ‘what they think we want to hear’. The methodology also suffers from charges of replication and representation- the wealth indicators suggested by this method are locally specific ones and hence cannot be generalised to other geographical areas, limiting inter-community study replication. The use of a handful of key informants to represent the community is also not without risk of serious bias. Nevertheless, while not without its weaknesses, PRA wealth ranking is a distinct improvement on focussing on economic considerations alone.

Understanding the implications of wealth for both conservation related attitudes and behaviour will help identify and define the links that exist between rural development and conservation efforts. This in turn will facilitate a much clearer understanding of project impact in both areas. For this study the wealth of participant households was explored and assessed for its relationship to a number of factors, namely cost and benefit knowledge (chapter 4), conservation-related attitudes (chapter 5) and wild food consumption (chapter 7). While the analysis for each is conducted in their respective chapters, this section outlines the methodology behind creating the wealth categories.

### **Measuring wealth in the Dzanga-Sangha reserve**

Assessing wealth in the Dzanga-Sangha community was done in two stages. An initial PRA-based approach was used to produce locally relevant wealth indicators. Following this, a structured questionnaire based on these indicators was then used to evaluate the wealth rank of participating households. This mixed approach was designed to produce locally relevant results that could be extended and quantified.

### **Participatory wealth ranking**

The participatory wealth ranking technique was based on Grandin (1988). Here, however, the approach was employed to elicit poverty indicators rather than directly rank participating households. While this left the approach more open to the risk of oversimplification, in that selected indicators needed to be quantifiable using a questionnaire approach, it was necessary for a number of reasons. The high number of participating households, combined with the large size of the sampled communities made it unlikely that key informants would have the knowledge, time or will to rank each one individually. Bayanga households involved in both the HCIS and the HAS were also spread out between five administrative sections of the town, and drawn from a pool of over 700

households. Initial questioning confirmed it was not feasible to expect Bayanga key informants to have in-depth knowledge of the wealth status of all. In addition, when households were initially approached for possible involvement in both surveys, it was crucial in most cases to assure household confidentiality, particularly with regards to the DSP. I felt this study would have been on dubious ethical ground revealing household identity to the four key informants, particularly as two were also employed by the DSP.

The village surveys undertaken for this thesis took place in two very distinct communities- namely BaAka and non-Aka. It was therefore necessary to conduct wealth ranking exercises in both the mixed ethnicity village of Bayanga, and the BaAka village of Yandoumbe. Given the high rates of familial overlap between Yandoumbe and Mossopoula, results from Yandoumbe could be extrapolated between the two.

### ***Bayanga***

For the initial wealth ranking exercise, four key informants were consulted, comprising one agriculturalist, one schoolteacher and two local development professionals. All four informants, as well as the households named in the wealth ranking exercise, were from the Beretia quarter within Bayanga, ensuring informant familiarity with the wealth status of households in the area. For each consultation, an initial discussion of what constitutes local wealth was conducted, following which the informants were asked to group cards with the names of 15 households into groups of similar wealth status. The similarities between groups were discussed, as well as differences between the groups. Finally, lists of characteristics for each group were drawn up.

As the informants were consulted individually, households were given their final ranking by averaging their wealth ranking given by the four informants. The degree of agreement between individuals and the final rank is shown in table 3.4 below. Results show a high level of agreement between all four respondents.

Indicators common to the ranking system of all four respondents were used to draw up an overall ranking system, shown in table 3.5 below. All four respondents agreed on three fundamental indicators of wealth, namely field ownership, means of income generation and presence and number of particular household assets. Agricultural production was held by three of the four respondents to be the most important in characterising wealth, with one informant commenting “*If people can eat, the rest will follow*”. Field cultivation in the area is used to both produce food and generate income through the sale of surplus crops.

**Table 3-4** Percentage agreement between wealth ranks allocated to 15 households by four informants and the final ranking.

	<b>Informant</b>			
	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<b>Number ranked differently from the final average ranking</b>	3	2	5	2
<b>% agreement with final ranking</b>	80	87	67	87

Income generation in Bayanga may be achieved either through formal employment or through informal means such as hunting or fishing. Ownership of an income-generating asset such as a cassava-grinding machine is also highly valued. With regards to indicating wealth, preference was given to a means that provided a steady and reliable income. For example, a permanent job with the DSP was ranked above a permanent job with the mayor due to reliability of salary payment, and both were judged a better indicator of wealth than self-employment. However, informant opinions differed slightly with regards to the wealth generating potential of wild meat extraction, with one informant placing gun and boat ownership above a DSP job in terms of income generation, pointing out that there is no limit to the income generating potential of wild meat extraction.

Household assets were divided into those that may be used to generate income, and those that could not. As would be expected, there was also further ranking within these categories, which seemed to be strongly related to that asset's market value.

Other local wealth indicators were suggested by one or two informants but not agreed on by all. These included access to education, presence of a concrete floor in the house, close proximity to a water source, access to regular meals and owning more than one house. The biggest disagreement between the four respondents was with regards to household members. While three informants commented that a wealthy family would have lots of children, one added the proviso that the father should be able to provide for them. If he could not afford them (in terms of food, clothes and education), he should not have them, hence indicating meals, clothes and education to be more accurate assessors of wealth than the number of children. There was also disagreement on whether having more than one wife added to or detracted from household wealth, held by two respondents to be heavily reliant on whether they had their own field or not. The impact of the number of adult males in the household was generally held to be dependant on employment status.

**Table 3-5** Wealth ranking criteria for non-Aka.

	<b>Rank 1 (wealthiest)</b>	<b>Rank 2</b>	<b>Rank 3</b>	<b>Rank 4 (poorest)</b>
<b>Field number</b>	Usually 3 or more	Usually 2 to 3	Usually 1	No field
<b>Employment</b>	At least one household member has a permanent job	Usually no permanently employed household members. If one, the household ranks poorly in other wealth categories. Might be a tradesmen but profession with uncertain income	No permanent job. Might be a tradesman but profession with uncertain income and household ranks poorly in other wealth categories	No permanent job. No trade
<b>Other income sources</b>	Usually at least two other sources of income, such as a gun	Usually one or two informal means of wealth production, such as fishing equipment	No informal means of wealth production. If one, household ranks poorly in other wealth categories	No informal means of wealth production
<b>Livestock</b>	Usually keeps livestock, often larger animals such as pigs or goats	May keep livestock, usually smaller animals such as chickens	Usually no livestock	No livestock
<b>Household assets</b>	Owns two or more expensive commodities*	May own some less expensive commodities**	May own a radio but little else	No household commodities

\* Includes television, bicycle, motorbike, 12 volt battery, generator and a manioc grinding machine

\*\* Includes radio, peanut grinding machine, sewing machine and a one wheeled cart.



As a result of this assessment exercise, three indicators were chosen- namely the means of income production (formal and informal employment of all household members in 2006; ownership of wealth generating household assets such as a manioc grinding machine) and ownership of non-wealth generating household assets (radio, kitchenware etc.). The relevance of these indicators to the rank given by the informants was verified using Spearman's correlation coefficient statistical test (table 3.6).

**Table 3-6** Correlation of wealth rankings (i- allocated by key informants and ii- overall average) to individual indicators of wealth. Relationships tested using Spearman's correlation coefficient. <sup>†</sup> p<0.1, \* p<0.05, \*\*p<0.01

	Informant				Average rank
	A	B	C	D	
<b>No. income sources</b>	-.614*	-.646*	-.153	-.744**	-.561 <sup>†</sup>
<b>No. fields</b>	-.677*	-.563 <sup>†</sup>	-.755**	-.467	-.652*
<b>No. household assets (non-income generating)</b>	-.623*	-.574 <sup>†</sup>	-.313	-.704*	-.574 <sup>†</sup>
<b>No. domestic animals</b>	-.592*	-.329	-.707*	-.521 <sup>†</sup>	-.581*

While all four categories are rather simplistic (for example the category 'number of income sources' allows for no weighting between stable and unstable sources), the exercise reveals good correlations with the ranks awarded to them by all four respondents, confirming the importance of the selected indicators.

### ***Yandoumbe***

The BaAka are known for their relaxed attitudes to popular measures of wealth, such as material assets (Bahuchet, 1985a), and it was clear from the start that non-Aka values of wealth could not be applied. Money tends to be quickly spent, gifted or stolen, with little long-term saving towards more expensive household commodities, whilst material goods are treated casually, frequently sold, traded, lent, stolen or claimed in lieu of a debt.

While most residents of Yandoumbe have fields that they have cleared from the forest, few are seriously cultivated and there is little sale of field produce. Forms of income generation such as net hunting, the sale of coco and casual labour in non-Aka fields are open to, and practised by, nearly all community members on an ad-hoc basis. As one informant said, “ *If we need salt, we work.... If we have salt, we don't need to*”.

Wealth ranking exercises conducted with three individuals from Yandoumbe produced very different results. There was little consensus between the values of short-term and long-term wealth, with one informant basing his ranking on cash income generated in the preceding few weeks. The importance of formal employment for income generation was also disagreed upon, with one informant criticising BaAka who worked for the project as wasting their money, claiming that, following the hasty spending of their wages, they quickly become ‘the same as us again’. The difficulties of defining a BaAka household also become apparent, with one informant basing the wealth of one ‘household’ (for the purposes of this study defined as an immediate family unit that shared a house- see earlier for more details) on the income generated by extended family members.

The lack of consensus on wealth indicators amongst the BaAka resulted largely in a failure of the wealth ranking exercise. An attempt to conduct the exercise with all three informants present also failed in that two informants deferred to the opinions of the third.

Given the lack of consensus on wealth indicators, in addition to the large amount of sharing of both goods and money within and without family groups, it was decided that any attempt to wealth classify BaAka households would produce erroneous results which would not be locally relevant. It was therefore not attempted.

### **Collecting wealth indicators**

The exercise then moved onto the final stage- quantifying wealth indicators of surveyed households. Wealth assessment questions were included in the household attitudinal questionnaire, outlined earlier in this chapter.

To investigate household income generating activities, a household representative was questioned on the main profession of all household members over the age of 12, as well as being asked to name any other income generating activities for each member during 2006. The respondent was then given a list of household assets, generated through the previous wealth ranking exercise, and asked

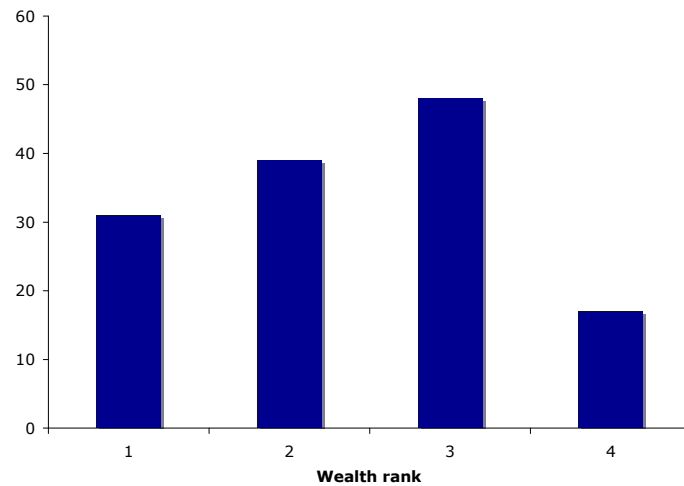
if, and how many, they owned. Respondents were also asked to give the number of fields owned and cultivated by the household (few respondents knew the precise dimensions of their fields).

It was originally planned to measure the dimensions of all 396 fields reported by respondents. However, it quickly became clear that this would not be feasible. Fields were measured using a tape measure and GPS unit. Unevenly shaped fields were divided into rectangles to ensure accurate representation. However, the walking of the borders, particularly in fields that were overgrown with weeds, was time and labour intensive, and could require up to two hours path cutting with a machete to measure a single field. Work was further slowed by the necessity of having to accompany the owner to the field to correctly identify it. As villagers tended to disperse to their fields at around the same time every morning, it was often impossible to measure the fields of more than one household per day. As a result it was necessary to restrict field measurement to households participating in the consumption study only. For these households, however, field number was found to be loosely correlated with the total area cultivated (Pearson's correlation coefficient  $r=0.459$ ,  $p=0.093$ ), making it feasible to use field number as a proxy for area under production.

Based on the suggested wealth indicators, participating non-Aka households were then assigned a wealth ranking. To verify the accuracy of these rankings, Analysis of Covariance (ANCOVA) was used to evaluate the contribution of the individual wealth indicators to the final wealth ranking (table 3.7 below). Again, despite the simplistic approach to grouping the categories, all three indicators (number of income sources, number of assets and number of fields) strongly predicted the overall wealth rank of the household.

**Table 3-7** Results of ANCOVA model showing wealth indicators predicting wealth ranking. R Squared = .667

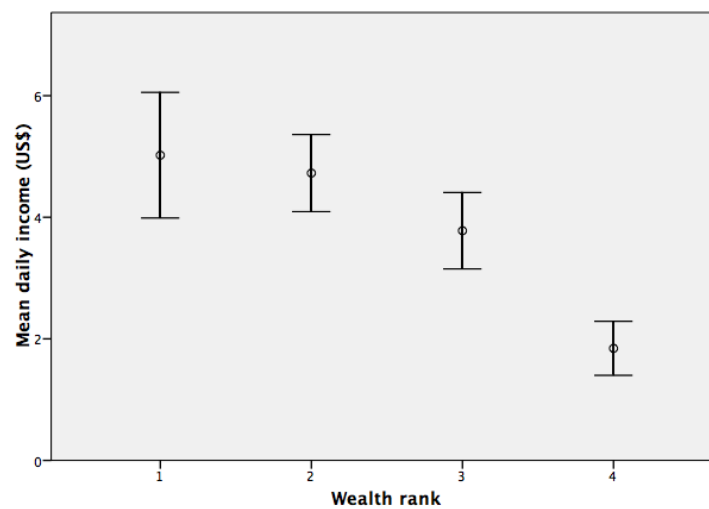
	Type III Sum of Squares	df	Mean Square	F	p
<b>No. income sources</b>	18.845	1	18.845	57.722	<0.001
<b>No. assets</b>	2.167	1	2.167	6.638	0.011
<b>No. fields</b>	2.764	1	2.764	8.466	0.004



**Figure 3-2** The distribution of the surveyed non-Aka households amongst the four wealth categories, where 1 represents the wealthiest households, through to 4 for the poorest.

### Relating household wealth rank to household income/expenditure

For the households involved in the HCIS, it was also possible to calculate the mean daily income and the mean daily expenditure on food for each. While neither income nor food expenditure should be used to fully represent wealth, they nevertheless contribute, and it is interesting to see the extent to which the measures correlate. For the 71 households who completed both surveys in Bayanga, wealth ranking was significantly correlated with both mean daily income (Spearman's  $\rho = -.277$ ,  $p = 0.019$ ) and daily food expenditure (Spearman's  $\rho = -.422$ ,  $p < 0.001$ ). Mean daily income was also correlated to mean daily food expenditure (Pearson's  $r = 0.210$ ,  $p = 0.063$ ).



**Figure 3-3** Relationship between a non-Aka households wealth rank and mean daily income. N=79.

**Calculating mean daily income for the \$1/day poverty line**

While wealth ranking is conducted on the grounds that it is highly locally relevant, it is often difficult to make cross-site comparisons. In 1990 the World Bank introduced an international standard for world poverty, whereby extreme poverty was defined as individuals living on less than US\$1 a day. While this concept is clearly flawed- not least as it fails to reflect the differing costs of meeting essential human requirements- it nevertheless lends itself to ease of comparison with other countries.

Given the different prices of goods and services between countries, it is not possible to simply use real currency exchange rates. Rather, purchasing power parity (PPP) is used to calculate an alternative exchange rate, based on the relative prices of basic goods available in both countries. In 2006, the period during which most of the field work was done, the standard exchange rate was 1 US\$= 481.8 XAF, whilst for the PPP exchange rate, 1US\$= 147.55 XAF (United Nations, 2008). I used this latter figure to convert figures from XAF into US\$.

Household production is used as the poverty indicator, including monetary income and the value of all goods produced or gifted. While differing household compositions are accounted for by calculating production per capita, this measure does not take into account either household size (for example, a larger household may be able to purchase goods in bulk at cheaper rates, known as economy of scale), or intra-household inequalities of distribution (Coudouel et al., 2002, Hentschel and Lanjouw, 1996).

Mean daily income (PPP) per capita for a non-Aka household was US\$ 1.99 (range \$0.04- 10.18, SD 2.09), with 30 of the 79 surveyed households living on under the equivalent of US\$1 per day.

For BaAka households, while work-related income was relatively straightforward to collect, the value of goods gathered in the forest relied on the researcher being present to weigh them. Data for the value of gathered and gifted goods was limited to 186 out of 590 consumption days but sufficient to calculate production rates per household. Mean daily income (PPP) per capita for a BaAka household was US\$ 0.93 (range \$0.03- 2.76, SD 0.63), with 26 of the 34 surveyed households living on under the equivalent of US\$1 per day.

### 3.3 Existing datasets

#### 3.3.1 Law enforcement patrol records

Access was granted by the Dzanga-Sangha Project (DSP) to their long-term records for anti-poaching activities. Based on patrol summary sheets, information includes patrol type (water/land, general or informant driven), patrol duration, the number of park guards participating, region of the park or reserve the patrol took place, and the cost. If a confiscation or arrest took place during the patrol this was also noted, along with the type and number of item/s confiscated. If meat was confiscated, the species (if known) and weight was recorded. While anti-poaching efforts had been conducted since park formation, detailed written records were available from August 1996 up to my departure in May 2007.

*Data bias:* There are a number of areas in which this database may provide an inaccurate picture of events in the park. Following Abbot and Mace (1999), and taking into account the large area needing to be patrolled, it is extremely unlikely that the anti-poaching team encounter anything but a small proportion of the hunters extracting wild meat. Furthermore, the projects policy of tolerance of small scale or first time hunters means encounters with such people frequently result in a verbal warning and no confiscations. Unlike other studies (e.g. Leader-Williams and Milner-Gulland, 1993), these encounters are not recorded on the patrol sheets. The database should therefore be considered a record of serious illegal infractions rather than of all hunting activity. However, assuming this bias remains constant throughout the data collection period, patterns in confiscation rates should remain accurate.

Finally, there are frequent accusations by reserve residents of corruption amongst park guards, particularly in terms of confiscating meat that is then taken to a park guard's house to be privately consumed, rather than reported to the DSP. The degree to which this occurred proved impossible to estimate, not least due to the extremely sensitive nature of the subject. If this bias is assumed to be constant throughout the data collection period, then patterns in illegal wild meat extraction may be held to be true. However, also taking into account that much of the measurement of meat has been made using local units rather than weighed, meat confiscations are considered with caution, and are not included as an indicator of illegal activity.

### **3.3.2 Wildlife population census data**

A number of ecological censuses have been conducted in the Dzanga-Sangha region, focusing primarily on measuring elephants and gorilla population densities. Employing a range of methodologies, these are compared in detail in chapter 8.

## **3.4 Implementing research**

### **3.4.1 Obtaining research permission**

Before fieldwork commenced, I applied for, and was granted, permission to work in the Dzanga-Sangha region by both the Central African Republic government and the Dzanga-Sangha project. When I arrived in Bayanga, I also took the time to visit the Gendarmerie, Mayor and Police to introduce myself and explain the work I would be doing in the area.

While I had originally planned a number of village meetings to introduce both myself and my work to the community in general, the size and spread of Bayanga made this both an inefficient and impractical idea. Instead, I adopted a more informal approach, whereby all potential informants, including market traders, key informants and households involved in the HCIS and HAS were visited before the work commenced by myself and my research assistant. We explained the work and emphasised my independence from the DSP, before asking them if they would be interested in participating in the study.

For the 16-month fieldwork period, I rented a house in the centre of Bayanga, 3km from Yandoumbe and 5km from Mossopoula. Transport was mainly by foot, although midway through my fieldwork I purchased two bicycles for myself and my primary research assistants, cutting down on the commuting time to both the fields and the surrounding villages.

There had been a limited amount of research conducted in the area previous to this study, predominantly in the Bayanga region (e.g. Mayer, 1993, Blom, 2001a, Noss, 1995, Giles-Vernick, 1996, Hardin, 2000) and very limited contact with tourists. As a result residents tended to associate Westerners with either the logging company or the DSP. Both my presence in the village and my work were initially viewed with a great deal of suspicion, and it was necessary to spend a large portion of my time both assuring people of my independence from DSP, in addition to the confidentiality of their responses. It is a testimony to the generosity of the human spirit how many

people chose to help me under these circumstances. I also gained the friendship of many residents by participating in public events, including attending public parties, church meetings and weddings. I also socialised, shopped and ate locally. My team of researchers participated in a march celebrating a public holiday, raising the profile of our work and emphasising its independence from the DSP. Finally, my residence in Bayanga in a basic, locally constructed house also set me apart from western employees of the DSP and logging companies, all of whom lived in brick houses with running water and electricity some distance out of the village.

### 3.4.2 Research assistants

Two main research assistants worked with me throughout the work period. RA1, Bayanga-based, participated in the HCIS, the HAS (non-Aka only) and the market survey. RA2, Yandoumbe-based, helped with the BaAka HCIS and HAS. Both were local residents, male and in their early 30's.

Due to the large and intensive sampling required for the Bayanga-based HCIS, I required additional assistants. While I initially planned to employ two locally-based, university-educated men, it became clear that this had the potential to be very unpopular with the husbands of my female informants. I consequently recruited and trained four female assistants, all educated to secondary level and able to read and write French competently.

Only RA1 had prior research experience; consequently intensive training in both interview and survey techniques were conducted, involving both role playing and extensive piloting of protocols amongst friendly households.

### 3.4.3 Informant rewards

The issue of informant rewards was one that took a great deal of time and resources to explore. The statement of ethics, prepared by the American Anthropological Association, states "*There should be no exploitation of individual informants for personal gain. Fair return should be given them for all services*". Given the effort and time required by informants to respond to the HCIS in particular, it was widely expected that I would give people a cash reward for their services. However, the paying of informants has both ethical and practical implications, in addition to seriously affecting the consumption and work patterns of a household. In the end I decided to give a small gift at the end of each study period as a gesture of thanks. This was explained to the respondents before the work



commenced. The gift was either soap or coffee for the non-Aka, and salt and stock cubes for the BaAka and was always greatly appreciated. I also tried to compensate informants in other ways: each participant in the HCIS was presented with a photograph of themselves and their family (if desired). In addition, each HCIS household was also given a printed sheet showing the dimensions of their field, measured for study purposes but which also proved to be of keen interest to respondents. I also held a party at the end of the fieldwork period to thank the market women, all of whom had patiently answered some very repetitive questions over the course of the 12-month study.

#### **3.4.4 Language**

While the official languages of the Central African Republic are French and Sango, it is Sango that tends to be the more widely spoken, particularly in rural areas and amongst those with low levels of education (and therefore little exposure to the francophone education system). I spoke fluent French before arriving in Bayanga, and learned Sango during my fieldwork. My decision to learn Sango rather than BaAka was for primarily practical reasons. Sango was spoken by almost all of the residents in the study area, particularly in Bayanga where I was living, and written learning materials were also available. It was therefore easier to learn and more widely applied than the BaAka language. However, many BaAka, particularly the older women, either did not speak Sango or were more comfortable speaking BaAka. While an attempt was also made to learn the basics of the BaAka language, all BaAka interviews were conducted with a BaAka assistant who translated responses into French and Sango. An intensive training period was held with this assistant to encourage accurate and precise translation, as well as completing the translation/back-translation exercises for the formal questionnaires.

#### **3.4.5 Currency**

The Central African Republic uses the Communauté Financière Africaine Franc (XAF). All prices are reported in this local currency as well as being reported in United States Dollars (US\$) for ease of comprehension. Conversions were calculated using an exchange rate of 481.8 XAF to 1 US\$, appropriate for the 2006 period.

### 3.4.6 Statistical Analysis

All statistical analysis was conducted using the SPSS 16.0 statistical package. Parametric tests were used as standard where data was normally distributed. Where necessary, data was log-transformed to improve its fit to normal distribution. Where transformation was not possible, non-parametric tests are used. All statistical tests were two-tailed.

## 3.5 *Work timetable*

**Table 3-8** Work timetable

<b>Phase</b>	<b>Dates</b>
Literature review and development of field methods	Oct 2004- Sept 2005
Pilot study	Oct 2005- Dec 2005
Upgrading and reappraisal of methods	Jan-Feb 2006
Main fieldwork period	March 2006- June 2007
Data analysis and write-up	July 2007- Dec 2008

## Chapter four

### ICDPs and local poverty alleviation

*“...the local communities most strongly affected by the passive costs of developing country conservation are generally among the poorest of the poor; it is both inequitable and impractical to expect them to continue to bear these costs into the future.”* (Balmford and Whitten 2003: 241)

#### 4.1 Introduction

Park creation continues to form the main response by the international conservation community to the threats facing biodiversity (Adams, 2004). While parks can generate significant benefits, primarily through non use and indirect use (Balmford et al., 2002), considerable costs frequently accrue to communities living in or near protected areas as a direct result of conservation efforts (Coad et al., 2008, Ghimire and Pimbert, 1997, Brockington, 2002, Neumann, 1998, Brechin et al., 2003).

Such costs may be both direct, such as the displacement of residents from the park and the loss of access to its resources (Emerton, 1999a, Ghimire and Pimbert, 1997, Brockington, 2002, Turton, 1987, Neumann, 1998), or the indirect costs associated with park-adjacent living, such as crop raiding or livestock predation by forest dwelling animals (Zimmermann et al., 2005, Weladji and Tchamba, 2003, de Boer and Baquete, 1998). Non-use costs, such as the loss of access for religious or cultural reasons, may also be considerable (Neumann, 1998). The focus of conservation-related costs at the local level is at odds with the concentration of benefits at the global scale- a disparity acknowledged as a considerable injustice associated with protected areas (Wells, 1992, Balmford and Whitten, 2003, Ferraro, 2002).

At their most basic, ICDPs are designed to provide benefits to compensate for the costs of conservation and/or provide alternative income sources to reduce or replace the exploitation of natural resources. A range of approaches may be employed to achieve this, including profit-sharing with, or direct payments to, the local communities, local employment, provision of social services or community-based infrastructure and supporting alternative means of income generation (Wells et

al., 1992, Barrett and Arcese, 1995, Barrow and Murphree, 2001). Implementation of these different schemes, however, has met with mixed success. Few tangible benefits may be realised, of which even less may prove sustainable over the long term (Wilkie and Carpenter, 1999b, Brown, 1998). While some schemes generate significant benefits, such as tourism revenue or game meat (Gillingham and Lee, 1999, Archabald and Naughton-Treves, 2001, Sandbrook, 2006), they may still fail to compensate imposed costs (Adams & Infield, 2003).

Factors such as the spatial and temporal distribution of costs and benefits are also crucial. Considerable long-term benefits may still fail to compensate relatively small short-term costs (Casse et al., 2005). Equally, if costs are accruing to a different section of the community than the benefits, then projects are unlikely to be successful. Projects should also have a firm understanding of the value or appropriateness of benefits provided to the local community, for which an in-depth understanding of the complexities and needs of the population in question is critical- benefits need to be both recognised and valued at the local level (Gibson and Marks, 1995). They should also be provided in an appropriate form- new income sources are frequently viewed as complementary livelihood strategies, rather than substitutes for less conservation friendly behaviour (Wells et al., 1992, Ferraro and Kiss, 2002).

Natural resource use often underpins the livelihood strategies of the rural poor, and intervening in non-timber resource exploitation can have serious repercussions (Homewood, 2005a). The sustainable livelihoods framework suggests interventions may directly and indirectly impact the lives of poor people in five groups of assets: physical, human, financial, social and natural, all of which may impact the wealth status of an individual or household (Ellis, 2000). Without understanding how particular interventions are functioning and impacting on local communities, it is impossible to evaluate their effectiveness, particularly with regards to poverty alleviation.

WWF summarises the Dzanga-Sangha Project's objectives with regard to local participation as "*..the local community contributes to sustainable natural resource management in the Dzanga-Sangha protected area and receives benefits from the protected area management by improvement of their standard of living*" (WWF, 2007). In its literature regarding the project, tourism features prominently as a key tool in achieving these objectives, intended to provide not only funds for project management but also local community micro-projects, as well as mobilizing further economic returns for the local community by encouraging development of local tourism service providers. There has, to date, been no in-depth empirical evaluation as to how far these goals have been met.

This chapter provides a comprehensive evaluation of conservation-related impacts, both positive and negative, accruing to the residents of the Dzanga-Sangha area. The first section provides a qualitative review of all major conservation-related costs and benefits imposed on the local community, paying particular attention to the potential consequences for local livelihoods. The chapter then focuses in on the economic impacts, using quantitative data to contrast project-related direct economic benefits with the opportunity costs at the level of the reserve and the village. The subsequent implications of these results for poverty alleviation are then discussed.

## 4.2 Research questions

The chapter will test the following hypothesis:

⇒ **The ICDP contributes directly to local poverty alleviation via the provision of significant net benefits.**

To investigate this, the following questions are asked:

- 1) What costs and benefits accrue as a result of the park, the ICDP and the tourism programme?
- 2) How are these impacts distributed within the reserve communities?
- 3) How may these impacts affect local livelihoods?
- 4) How do direct economic benefits compare to opportunity costs at both the  
i) reserve and ii) village level?

Investigation was divided into two main stages. The first half of the chapter provides an in-depth, qualitative review of all major conservation-related costs (4.4.1) and benefits (4.4.2) imposed on the local community. I focus in particular on distribution issues and how these impacts may affect local livelihoods.

The second half of the chapter then adopts an economic valuation approach, whereby both positive and negative impacts are presented in financial terms, allowing a direct comparison of impacts. This section compares direct economic benefits accruing from conservation-related activities with opportunity costs as a result of park formation at both the community and village level (4.4.3). Finally the two results sections are pulled together and discussed in terms of their implications for

local livelihoods and poverty alleviation (4.5). Both sections examine impacts relating to the park, the ICDP and the tourism programme individually.

Omitted from the economic valuation are the benefits associated with both indirect use (e.g. carbon sequestration, flood control) and non-use values, such as bequest value. This is done for two reasons. Firstly, non-market traded services such as bequest value cannot be directly measured in monetary terms, requiring indirect methods to place a value on them. This most commonly involves contingent valuation (CV) methods, whereby a hypothetical market is constructed and respondents are asked to bid to achieve a certain outcome. However, its reliance on people's views rather than evidence of observed market behaviour leave it vulnerable to misrepresentation, as well as its assumption of a certain level of understanding of the environmental issues by respondents. This, combined with the extreme poverty seen in the study area, made CV unlikely to function accurately as a market replacement tool. There is a paucity of data for the Central African Republic with regards to attempted valuation of non-market services, precluding use of 'plug-in' values. Secondly this chapter focuses on examining the impacts of poverty alleviation. By focussing on the direct economic benefits of project presence and the opportunity costs of park formation, we are able to draw a clearer picture of direct, short term, economic impacts, and hence those most likely to impact the livelihoods of the rural poor.

### **4.3 Methods**

The range and complexity of this chapter- in particular the need to consider factors ranging from the economic to social and environmental- meant no single set of methods was sufficient to address the issue adequately. As a result, a range of complementary approaches were employed, incorporating both qualitative and quantitative methodology. Investigation was divided into two main stages, namely 1) the identification and exploration of the main park/ICDP/tourism related impacts and 2) the quantification of the direct economic benefits and opportunity costs.

#### ***Identifying impacts***

Initial identification and further exploration of conservation-related impacts were investigated using a combination of key informant interviews and participant observation. My residency in the village meant I was frequently party to both public and private opinions expressed in an informal manner, with shared conversations in the market or other communal areas often leading to new lines of enquiry. Community-focussed tourist trips, such as BaAka net hunting, were also accompanied wherever possible, during which participants, guides and tourists alike were observed and

informally questioned. Key informants were identified within the local community, the local authorities and the project. Both informal and formal semi-structured interviews were conducted with them over a period of 10 months, comprising both open and specific questions regarding both problems and benefits relating to the park, the ICDP and the tourism programme.

### ***Economic valuation***

Both direct economic benefits and opportunity costs associated with the Dzanga-Sangha Protected Area Complex were calculated for a single year- 2006. While this permits the collection and use of objective and original data of a known quality rather than relying on secondary sources, it also makes the assumption that 2006 is a representative year. Focus is on impacts at the local level. For this reason, revenue accruing at the national and international level, such as to the Cameroonian-managed tourism lodge, are omitted. For the same reason, only net returns generated by the project are considered- the costs required to generate this revenue, as accruing to the project rather than to the local community, were not included.

Data for the economic valuation exercise were obtained from a variety of sources. In some cases primary data was available in the form of written records, kept either by the DSP (tourist numbers and revenue; employee salaries; development programme costs; poacher informant payments; confiscations; gun license costs), or by others (pirogue<sup>8</sup> tip records- kept by the chairmen of the pirogue association; shop sales to tourist lodge- kept by the owners of the town's two main shops).

Where no written records were available, data were obtained either through the HAS (craft sales; local food sale to tourist lodge) or through intensive interviews with the individuals concerned (tourist donations; tourist village expenditure in bars; restaurants and markets), corroborated by two or more sources where possible. Some sections entailed more complex calculations requiring data from a number of sources (opportunity costs and crop raiding costs)- more details are given in the relevant sections.

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<sup>8</sup> A pirogue is a locally-produced dug-out canoe

## 4.4 Results

### 4.4.1 Conservation-related costs

#### Costs associated with park formation

##### *Displacement*

When the park and reserve area were gazetted, the design was such that no village would have to be relocated. There exists one semi-permanent camp situated deep in the Ndoki sector of the park, home to diamond miners, which is permitted by the state on the basis that it acts as a guard post for both the Cameroonian and Congolese borders. However, the Dzanga-Sangha region is also home to approximately 280 BaAka, historically semi-nomadic forest dwellers. The forest is the focus of BaAka livelihoods, rather than a supplementary resource, and families may leave their roadside villages for forest hunting trips lasting from a few hours to several months (Bahuchet, 1992, Sarno, 1998). The gazettement of the park has restricted the range of such forest subsistence trips and, with little concept of territoriality, there is frequent anger by the BaAka when anti-poaching guards chase them from traditional hunting grounds now located within the protected area.

The DSP and the Central African Republic government recognised this displacement to a certain degree, and designed a community hunting reserve with the BaAka in mind, whereby only traditional hunting methods are legally permitted. However they face long walks to this reserve and high levels of competition for access, and are frequently chased from their camps by non-Aka hunters (Sarno, personal communication). While it is clear the BaAka have lost considerable natural and environmental capital, with no baseline data for pre-park formation it is difficult to assess the degree to which BaAka livelihoods have been altered<sup>9</sup>.

##### *Opportunity costs- exploitation of non-timber forest products (ntfp's)*

The forest is relied on by all ethnic groups in the reserve to extract a wide range of resources, most commonly meat, leaves from the koko vine<sup>10</sup>, mushrooms, fish and firewood. The gazettement of the parks in 1989 reduced the area available to exploit for ntfp's within the reserve by around 26%, including the more 'untouched' areas and traditional hunting grounds of the BaAka. The potential for a serious impact on peoples livelihoods is clear. This applies to the BaAka in particular, who

<sup>9</sup> Although Chapter 7 compares information on the diet of the Dzanga-Sangha BaAka, collected during the HCIS, with those of other Central African Pygmy groups.

<sup>10</sup> Koko, *Gnetum africanum* and *Gnetum buchholzianum*, is a staple subsistence leaf in the area for all ethnic groups.



have traditionally relied on the forest to provide almost all their nutritional needs in addition to producing income through sale of its resources.

There is a lack of baseline data on pre-park exploitation levels of ntfp's, again making it difficult to quantify the impact of conservation measures on extraction levels. In addition, the reserve and the community hunting zone provide areas where most ntfp's may be extracted legally. Given the frequent suspicion regarding my motives, the use of sample follows to see how regularly people sourced ntfp's from the park (illegal) versus the reserve (legal) proved unreliable. On the 11 occasions that I accompanied an informant into the forest to gather ntfp's, we remained in the reserve zone.

Key informant interviews and participation observation work suggested that the reserve is used to provide most of the sourced building materials such as bamboo and palm leaves, both of which are abundant in certain patches in the reserve close to the Sangha and Mossopoula river, near to the main villages. Firewood is sourced primarily from fields and field margins- many still contain forest remnants that are chopped down for firewood as required, and over 50% of the agricultural zone, close to the road, is still covered by (degraded) forest.

Food staples such as mushrooms and the leaves of the koko vine are available in abundance close to the forest border and along field margins. The light-loving koko vine, in particular, thrives in a wide range of habitats, including farm fallow, secondary forest and closed forest. Most koko leaves collected for consumption, therefore, tend to be harvested from sources close to the village, although collectors wishing to gather sufficient quantities to sell tend to walk further into the forest and are therefore more likely to enter one of the national parks. Much gathering of ntfp's by the BaAka is also done during net hunts, therefore the area of forest will be more likely to be determined by hunting rather than gathering requirements. When investigating the opportunity costs of koko harvesting, at no point during my fieldwork did I encounter any suggestion of a shortage of koko in the area, despite it featuring in over 20% of reserve meals<sup>11</sup>, suggesting opportunity costs to be minimal.

The main cost of park formation appears to be the loss of access to wild meat, whether for consumption or income generation. The importance of this issue is underlined by its regular appearance in the, often emotional, conversations regarding the parks or the DSP. Anti-poaching records over the last 10 years also show high levels of illegal hunting activity in both Dzanga and

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<sup>11</sup> See chapter 7

Ndoki National Parks. Estimates of the proportion of households in the reserve taking part in hunting activities in 2006, generated through the HAS and corroborated independently by two hunters, showed high levels of involvement (table 4.1).

**Table 4-1** Percentage of respondents involved in various forms of hunting in 2006. Categories are independent aside for one non-Aka man who was involved in both gun hunts and snares, and 4 non-Aka men who acted as gun porters but also had their own snares. The three BaAka respondents who did not go net hunting in 2006 claimed to be too old and sent their children instead.

% households containing:	Non-Aka		BaAka	
	Women	Men	Women	Men
<b>gun hunter</b>	0	19.8	0	{17.0
<b>gun porter</b>	0	8.8	0	
<b>snare hunter</b>	0	18.7	0	50.0
<b>net hunter</b>	0	0	97.4	94.7
<b>% sample involved in wild meat extraction</b>	0	41.8	97.4	100
<b>Total sample size</b>	44	91	38	38

When considering the opportunity costs of hunting, however, several points should be taken into account. Firstly, the high level of illegal hunting conducted in both the reserve and parks means that not all opportunity costs are fully imposed. While anti-poaching teams patrol the parks and area, it is clear from household questionnaire results, market survey data and anti-poaching patrol data that there is still a large amount of illegal hunting activity within the protected areas. Secondly, there are many people living within the reserve villages that lack forest skills and would consider it too dangerous to enter the forest to exploit forest resources. This applies particularly to in-migrants into the area, two of whom were lost in the forest, presumed dead, while I was resident in the area. Thirdly, around 35% of the current residents of the reserve moved into the area after the park was formed- hence they arguably have not suffered opportunity costs as at no point was use of the park resources legal for them.

#### ***Opportunity costs- clearance for agriculture***

There are strict restrictions on land available for agricultural use, namely within 500m of the main road. However, a preliminary review suggests that this area may be sufficient to meet local needs. A 2005 survey by the DSP showed that around 43% of the agricultural zone is currently cultivated, rising from 35% in 2003. Furthermore over 90% of 211 HAS respondents owned fields, and few

respondents deemed it necessary to de-gazette the park for this purpose. During both formal and informal conversations with reserve residents regarding the possibility of clearing the park for fields, a number of people also remarked on the impossible distance that would have to be covered from the village and the high risk of crop raiding by forest dwelling animals, making it an unpopular option.

**Table 4-2** Range and means of field number and area of 114 HCIS respondents (see chapter three for methodology). SE = standard error.

	<b>Non-Aka</b>	<b>BaAka</b>
<b>% sample with fields</b>	91.2	94.3
<b>Field number- range</b>	0-12	0-2
<b>Field number- mean</b>	2.2 (SE 0.13)	1.1 (SE 0.05)
<b>Range area cultivated (Ha)</b>	0.04-51.2	0.04-0.55
<b>Mean area cultivated (Ha)</b>	1.63 (SE 0.75)	0.17 (SE 0.02)

No data exists for the Dzanga-Sangha area on the minimum area of cultivated land required to support a household, particularly given the need for fallow periods. Food security may also be defined in terms of the absence of need to carry out casual work for others specifically to complement ones own cultivated food resources- however no relationship was found, for either BaAka or non-Aka households, between field area cultivated and labouring in the fields of others. This may occur for a number of reasons. For the BaAka particularly, who have no history as agriculturalists, land areas may be theoretically sufficient but owners lack the skill and/or indeed motivation for land cultivation. Secondly, distinguishing between casual work undertaken for others to provide food and that done to provide money for such things as school fees would be difficult to assess with any degree of precision- there is clearly a considerable difference between being food poor and cash poor.

The under-development of land currently set-aside for cultivation and the general lack of enthusiasm for clearing the forest suggests current opportunity costs relating to land for cultivation are currently low. However, given the population growth seen within the reserve, there is the strong possibility this may change in the future.

### ***Crop raiding***

Crop raiding is the subject of considerable tension between the community and the DSP, although the actual degree of damage inflicted is hotly debated. The layout of the reserve means a large proportion of the agricultural zone lies close to the forest and fields are raided by forest dwelling animals such as porcupines, giant rats, sitatunga, monkeys and elephants. Gorillas are rarely seen in the fields. The impact of crop raiding animals is unevenly distributed across the reserve, and there are well known crop raiding hot spots, with those fields closer to the forest margin and lying on elephant migration paths more affected. Other agricultural areas go largely untouched. Near the BaAka village of Yandoumbe there has been little elephant activity in the fields and, as a result, there is extremely high demand for fields in the area.

While crop raiding existed pre-park and pre-project, park adjacent communities argue that project-implemented measures such as anti-poaching patrols have directly resulted in increased levels of elephants and therefore crop damage. Problem animals such as elephants are viewed as the responsibility of the DSP and community members assert that, as owners of the wildlife, the project must be accountable for the damage, particularly in view of the project imposed ban on killing problem animals. However, the DSP stresses that the crop raiding animals, and the laws protecting them, are the responsibility of the state. Crop raiding also occurred in the area long before the projects arrival.

While the project has offered assistance in the past to farmers who have lost crops, it was emphasised aid should not be considered as compensation. The project has been responsible for fencing fields that lie on elephant routes with both barbed wire and a solar panel electric fence. Both were quickly dismantled, trampled by elephants and stolen by humans. Money has been distributed in the past to farmers who have reported crop damage with the intent of providing a means to purchase replacement seeds. These payments were perceived to be too little, infrequent and poorly distributed, with accusations of corruption in DSP employees. The project is currently offering to provide alternative land away from troubled hot spots to those most seriously affected by crop raiding.

Little data exists on either pre-park or post-crop raiding levels, making it difficult to calculate park-incurred costs. Questioning regarding crop raiding damage was prone to respondent exaggeration, presumably in the hope that I would assist in compensation. The project is attempting to encourage livelihoods based on intensifying and diversifying agricultural efforts, theoretically reducing reliance on forest produce. The potential for losing produce through crop raiding, however, is perceived to be high, making farming undesirable as a sole form of income.

## **Costs associated with the Dzanga-Sangha Project**

### ***Confiscations***

While the laws regarding forest exploitation are set by the Central African government, their enforcement is coordinated and implemented by the DSP. Project anti-poaching patrols operate within the park, hunting zone and reserve using both proactive and reactive methods. Responses to illegal hunting focus primarily on confiscation of hunting equipment and meat. Such confiscations impact local livelihoods both directly through the loss of household assets such as meat or a gun, and also indirectly by increasing the risk associated with this strategy. People found in the possession of the meat of an endangered animal, such as the gorilla or elephant, are arrested and handed to the local authority, although follow-up enforcement by the state tends to be weak.

In 2006, 66 guns, over 28,000 snares, 559 kilos of meat, 1323 cartridges and 10 tusks were confiscated in 195 separate incidents, although the number of individuals affected is not known. The costs of the snares alone, using the 2006 market value of snare wire, is estimated at 1,400,000 XAF, or 2,905 US\$. An unlicensed gun is non-reclaimable and can cost the hunter the equivalent of 300 US\$. The level at which most of these costs accrued is local- interviews with local hunters, members of the anti-poaching squad and anti-poaching patrol records suggest there is little poaching activity by non- nationals in the area. As one local hunter pointed out, hunters from both Cameroon and the Democratic Republic of Congo would have to walk a considerable distance through their own forest to reach similar forest in the Central African Republic, increasing effort for identical rewards.

## **Costs associated with tourism**

### ***Cultural impacts***

Commodification of culture is a risk closely associated with community-based tourism, involving the changing of traditional practices into tourist friendly activities. While unstructured contact between tourists and villagers in the Dzanga-Sangha region is rare, the tourism programme, run through the project, offers tourists a number of village-based activities that are run in conjunction with local residents. The small-scale nature of tourism to the area, as well as the mature age of the average tourist (mean age = 43 years, range 15-79 years<sup>12</sup>) generally means tourist activities are carried out sensitively and respectfully.

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<sup>12</sup> Information collated from questioning 97 tourists to the area between July 2006 and January 2007.

River based tourist activities, such as fishing and palm wine collection, are organised through the 'Association des Piroguers' (Association of Boatmen), based in Bayanga. Palm wine collection and fishing with tourists bears little resemblance to these activities as carried out without tourists, the most remarked upon difference being the reduced time and distance travelled. However, accompanying tourists is generally well regarded due to the frequently high tips and presents of western clothing.

Tourist trips based around BaAka activities are a popular activity amongst residents of both Mossopoula and Yandoumbe, and participation is on a purely voluntary basis. Net hunting trips with tourists differ slightly from traditional BaAka trips in that they are much less likely to be conducted with family members than would be usual, although this seems to cause few problems. The tourist car is used to drive further away from the village, thereby accessing areas less intensively hunted. Hunts are usually shorter, lasting 2-3 hours rather than all day, and any animals captured during the hunt may be kept alive longer than usual to enable tourists to take photographs. As few BaAka have a good grasp of the French language, any communication between the BaAka and tourists tends to be translated by the project tourist guide, and thus is limited.

Giving of gifts of shoes or clothing to guides and community in general has occurred, although not on a large scale. While this may be said to encourage dressing in Western clothes, in reality this practice is generally widespread in Bayanga already, although less so amongst the older BaAka. Other potential cultural costs include encouraging demands for money or presents by children or older, usually inebriated, men. However, these demands are often conducted in such an assertive manner that the term begging seems inappropriate.

There does exist a certain amount of corruption regarding the tourism industry. Members of the gendarmerie have been known to make demands for money for unnecessary permits, on one occasion threatening tourists with a gun. Other local government representatives have also frequently requested fees to allow tourists to walk around their village and photograph residents.

### ***Health related issues***

Health risks, such as the potential for sexually transmitted diseases, are thought to be low. There was little evidence of a tourist-orientated sex trade at the time of the study, although in the past, particularly with the high rates of military tourism in the area, it was more prevalent (Hardin, 2000). While in other areas, such as around Bwindi Impenetrable National Park, Uganda, a commercial sex trade may be supported by service personnel, such as guides or drivers (Sandbrook, 2006), no

evidence was found of this in Dzanga-Sangha, probably not least due to the low frequency of tourist group visits.

### ***Photography***

Photography is recognised as one of the main areas of conflict between tourists and Bayanga residents, although less so with the BaAka. As the majority of tourists stay at the Doli lodge, a purpose built tourist hotel located outside Bayanga, contact with the villagers is often restricted to a guided village walk, usually led by a DSP employed guide. The walks provide only limited cross-cultural interaction, further restricted by language barriers. Tourists, keen to record their trip, frequently try to take photos of village residents without asking prior permission. While some residents are uncomfortable having their photographs taken at all, others see it as a way to profit from the presence of tourism, and request a 'present' in return, usually in the form of money. This in itself may be done in an aggressive manner and, as a result, the taking of photographs is actively discouraged by project guides- although as one guide noted, many tourists often fail to follow instructions until they find themselves in trouble. In the past tourists have been fined or assaulted for taking unauthorised photographs of local fishermen. One individual also had his camera confiscated by the police, released after payment of a substantial fine.

## **4.4.2 Conservation-related benefits**

### **Park-related benefits**

The benefits provided by a protected area include both use and non-use of the forest, each divided into current and future benefits. Given that, at the local level, no direct use of the national parks is permitted, here we consider only indirect and non-use benefits. However, an attempt is made to quantify direct-use values later on.

### ***Indirect Use***

Indirect benefits accruing at the local level consist predominantly of ecosystem services, including watershed and erosion protection, carbon sequestration and climate stabilisation. Their value therefore lies in the reduction of costs accrued outside the park, rather than the direct provision of benefits. Values placed on indirect use may be considerable (Balmford et al., 2002). For example, the value of the role of a forest in carbon sequestration, assessed by looking at the damage it would do if it were released into the atmosphere as CO<sub>2</sub> following land conversion, has been estimated at between US\$320 to US\$3500 ha/yr (Panayotou, 1992, Pearce, 1990, Brown, 1992). However, they

may also be negligible- one study of field erosion due to excessive run off pre- and post-land conversion suggests that erosion levels returned quickly to near those of the original ones (Norton-Griffiths and Southey, 1995). Such benefits are also strongly context dependent- there are currently large amounts of forest not included in the park that can also fulfil these roles, significantly reducing the role of the park in providing such benefits.

### ***Option Use***

Option use is intended to represent the future possibility of use- both direct and indirect- made possible through the present conservation efforts. An example frequently quoted in this area is the potential of finding pharmaceuticals of value that would be lost in the event of biodiversity reduction. While there is little data from the Congo basin regarding the potential for this, Africa tends to be poor in diversity compared to Asia or South America. Considering also that the tropical forest in the area stretches far into many other Central African Countries, the sale of any potential products could face competition, reducing prices (Norton-Griffiths and Southey, 1995).

### ***Non-use***

Bequest value, or the value of leaving the protected area for the future generations, may be the non-use value most applicable at the local level, largely concentrated on the potential for future use. However, the lack of resource ownership (all land in Central African Republic is owned by the government), combined with the high mobility of the population, may reduce the potential bequest value.

The intrinsic, or existence value, is that of knowing that particular animals survive in the wild. While this is one of the main benefits of biodiversity conservation, existence value tends to concentrate mainly at the international level- the intrinsic value of wildlife may be something the rural poor cannot afford.

## **Project-related benefits**

### ***Employment***

In 2006 the DSP employed 114 Central African Republic nationals on permanent contracts, with an additional 8 government employees working within the project receiving a top-up salary. A further 66 people, the majority BaAka, worked full time on a rotational system with no contract. The



flexibility allowed by using a voluntary rotational system from a core group of employees allows the BaAka the option of engaging in forest trips with their families when preferred.

Of these 188 people, 49 people were employed as anti-poaching guards. Tourism accounted for a further 17 permanent jobs- 8 with the visitor information centre and 9 with the tourist lodge. The gorilla habituation programme employed 44, consisting of 7 guides, 2 camp guardians and 35 BaAka trackers.

The baseline annual wage for a project employee in 2006 was US\$1815, compared to a US\$260 household income national average for the Central African Republic (World Bank, 2007). In addition to a regular and reliable salary, all project employees are also offered free health care and performance-related bonuses.

The closure of the latest logging company in 2004 greatly reduced formal job opportunities in the area- the next largest employer in the area is the mayor's office, which offers 28 permanent positions. A job with the DSP is therefore a much sought after opportunity. All non-government jobs within the project that become available are advertised locally and attract hundreds of candidates. All of the BaAka trackers are recruited locally, usually through word of mouth and recommendations from other trackers. 4 of the 5 tourist guides were recruited locally, as well as all of the Bai Hokou research assistants.

Despite the demand for jobs, it is important to note there are also certain costs incurred with project employment. Workers in the gorilla habituation programme may spend months at a time living at camp away from their families. They also suffer the threat of physical harm from the frequent gorilla charges. Tourist guides may be harassed by members of the local community, as well as the local authorities, for a portion of the tourist dollar. Every member of the anti-poaching squad lives in the local community and they or their families may often face reprisals for any confiscation in the forest, such as their family being temporarily denied access to their nearby well. Nevertheless, project employment offers local community members a lucrative substitute livelihood option.

### ***Temporary work***

Temporary work in tourism is available accompanying tourists on community-based trips. Such trips, organised by the DSP, include palm wine collection, pirogue rides and traditional dances with the non-Aka villagers of Bayanga, and net and crossbow hunting, medicinal plant walks, hut construction and traditional dancing with the BaAka of Yandoumbe and Mossopoula.

All river-based tourist activities are conducted through the Bayanga based 'Association des Piroguers'. Membership is open to all who own a boat and currently stands at 31 members, with tourist work allocated by the chairman. Boatmen receive 1000 XAF (2.08 US\$) per hour worked, with a tip and/or a present usually added on top. As a result, work with tourists is generally popular, with the most frequently heard complaint being its infrequency. In 2006, 44 community river-based trips took place, generating 44,000 XAF, (91.32 US\$) in collective salary spread across 31 households. While such work is generally valued, therefore, it is viewed as a supplementary rather than a central income generating activity.

BaAka tourist activities, conducted only with residents of Mossopoula and Yandoumbe, are generally well regarded by the residents of those villages. Tour groups usually recruit BaAka participants simply by driving into the village on the morning of the trip, making work unpredictable. As all BaAka share the necessary forest skills, trips are usually open to everyone. Recruitment is usually on a 'first come, first served' basis, and there is much good-natured competition to be first into the car. With net hunting trips, people are nearly always turned away, although it is not unusual for unsuccessful contenders to throw their nets to a family member in the car, thus ensuring a share in any meat harvested. Successful participants, usually 10-12 per trip, receive payment of 500 XAF each (1.04 US\$) and usually presents such as salt or rice. In addition they keep any meat caught, although there were some complaints that the non-Aka tourist guide occasionally demands a share.

Medicine walks are usually done with two or three BaAka women, although a BaAka man may accompany them as a chaperone. Again, visits are rarely prearranged on the basis that most BaAka women possess the required knowledge, although the walk is frequently conducted with specific women who are known for their botanical knowledge. Crossbow hunting, house building, tree climbing and searching for honey can also be organised for tourists, although with much less frequency than either net hunting or medicine walks. Traditional BaAka dances are also performed for tourists and usually involve the same group of dancers from Mossopoula. These now take place at the tourist lodge following a few unpleasant incidents in Mossopoula where non-Aka villagers made aggressive demands for money.

Potential earnings for BaAka participating in tourist activities ranges from 500 to 5000 XAF (1.04-10.38 US\$). Gifts such as salt or peanuts are frequently given and are often cited before money when discussing tourist related benefits. The relatively lucrative nature of tourist related work can be directly compared to payment for a day working in a non-Aka field (200 XAF/ 0.45US\$) or

collecting koko to sell ( 100-300 XAF/ 0.21-0.62 US\$), both all-day activities, making tourism highly valued as a form of income generation.

*“If the tourists arrive tomorrow, we are ready to go”*

Wanda Modenge, Yandoumbe resident

However, the low level of tourism in the area and its unpredictability means that it is largely added to a livelihood portfolio as a complementary rather than substitute activity. In addition to tourism work, temporary work for the project is occasionally available, usually in the form of unskilled labour. The HAS revealed that 20% of respondents worked in a temporary capacity for the project in 2006, the majority involved in a road building scheme which employed 400 people from the reserve.

### **Community development programme**

It is an integral part of the project mandate that direct conservation efforts take place alongside local development efforts. Historically, the logging companies operating in the area have been largely responsible for providing and supporting social infrastructure, including funding the construction of schools, a gendarmerie, a police station, setting up a health care system and maintaining a transportation infrastructure. The most recent logging company went bankrupt in 2004 and the state has largely failed to take over the running of these institutions. Although the project sees the running of these social institutions as the responsibility of the government, it also acknowledges that while these are lacking there can be little interest in forest conservation.

***Health programme:*** The original aim of the health programme was to establish a health clinic in each village that would be run by community members and funded by receipts. The project has provided building and labour for the construction of five health clinics in the reserve, handed over to state control in 2003. However, a number of these health posts have fallen into disuse, attributed to poor community participation, unfinished treatments, and passive responses to illness particularly prevalent in the BaAka (Renner and Yarrissem, 2003). The project has continued to provide technical equipment, furniture, medicine, training material, occasional top-up salaries for medical staff, emergency evacuation to a larger hospital in Nola by means of a specially purchased community car and full funding for BaAka health care clinics in Yandoumbe and Mossopoula. The DSP also runs its own on-site clinic where employees and their families can receive free health care. A number of vaccination programmes have also been conducted in the reserve for polio and

yellow fever, with nearly 3000 children vaccinated against Polio by 1999. Over the past 19 years, 11 wells have also been drilled throughout the reserve.

**Education programme:** Since 1989 the project has funded the construction of three schools, handed over to state control in 2003. Two of the constructed schools, Mossapoula and Yandoumbe, were intended as Aka language schools where pupils would be trained to a basic level before sent to the main school system. However, the frequent closure of Bayanga school due to wage shortages have resulted in an influx of non-Aka children, notably to Yandoumbe school. All schools in the reserve have been provided with equipment, teacher training and the occasional top-up funding for teachers. Since 1997 environmental education has been integrated into the curriculum of schools in the reserve. A number of adult literacy courses were run in three reserve villages between 1999 and 2001. A number of environmental education films, some generated by members of the local community through a DSP organised scheme, have also been shown throughout the reserve.

**Micro-finance projects:** Three microfinance schemes have been in operation in the reserve, whereby community members were loaned money to help develop local initiatives. All three failed, largely due to a failure to recover the initial loans made.

**Alternative use:** Over the past 19 years, there has been an emphasis by the DSP on encouraging alternatives to forest exploitation. Work has focussed on promoting crop cultivation, particularly amongst the BaAka, as well as diversifying and improving the diet through the provision of seeds and training for a variety of crops, such as manioc, maize, peanuts, yams, potatoes and vegetables. Initially a mass approach was tried but found to be ineffective, attributed to a high mobility of population making it difficult to develop a productive relationship. The project now works with 40 'motivated and stable individuals' (Renner and Yarissem, 2003).

The raising of domesticated livestock has also been encouraged with a view to reducing the community consumption of wild animal meat. Animals, including goats, sheep, chickens, ducks and fish, have been provided over the years, as well as training, veterinary advice and vaccinations. Pilots for cow husbandry were also conducted in Bayanga, Lindjombo and Mossopoula. After many years of work this arm of the project was deemed unsuccessful, attributed to high levels of labour required, lack of outside support such as veterinary supplies and construction material, and high levels of theft within the village (Renner and Yarissem, 2003). Results from the HAS show 70% of Bilo and 22 % of BaAka households currently keep livestock, most commonly chickens, goats and

pigs, although with no baseline data it is impossible to know how much of this is due to DSP influence.

The failure of the state to take over the funding of these public institutions following handover by the DSP suggest that, rather than the project's presence preventing government input, little support would be forthcoming upon project withdrawal, a view upheld by the chronic under-funding of public institutions such as schools and hospitals through the country<sup>13</sup>. The provision and support of community infrastructure such as schools and wells within the reserve can be considered to positively influence livelihoods through improving human capital- supporting the successful pursuit of different livelihood strategies. However, attempts to directly encourage alternative livelihoods to hunting- primarily agriculture- appear to have been largely unsuccessful.

#### ***Poacher informant bonuses***

Open to both anti-poaching guards, and members of the community, cash rewards are offered by the DSP in return for equipment or information leading to the capture of an illegal hunter, illegal hunting equipment, or illegal meat or tusks. Rewards can range from 50 XAF per snare (0.1 US\$), to 40,000 XAF (83 US\$) for an illegal shotgun. The secrecy involved in being a project informant means the scale of involvement within the community is almost impossible to investigate.

Preliminary discussions with hunters suggest a handful of men are known as informants and are suggested to make a relatively good wage through this alone. It may also be conducted on an opportunistic basis, with one snare hunter suggesting gun hunters who have not shot anything may, if they encounter traps in the forest, take the meat for themselves and 'sell' the traps to the project. This suggests that such a pursuit can easily be added to a livelihood portfolio, although as a complementary rather than replacement activity. It may also undermine trust within a community, potentially reducing support for other collective action.

#### ***Project support- the 'trickle down' effect***

The indirect economic benefits of DSP presence may be just as important, if not more so, than the direct benefits. The trickle down effect occurs when economic benefits, such as project salaries or hotel revenue, make their way indirectly into the local economy, through such routes as house rental or food purchasing by project employees. In the reserve there is also a large proportion of wage sharing, where family and friends of a project employee request a regular share of wages. While this may be resented, and rarely offered voluntarily, it is not often refused. As one respondent

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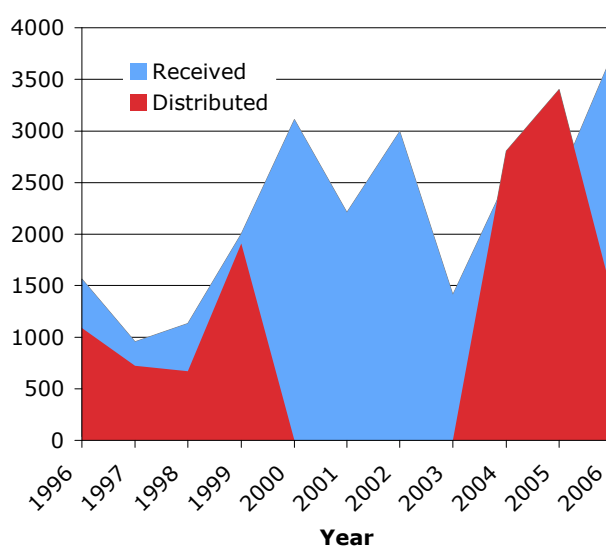
<sup>13</sup> The World Health Organisation reports 2006 government expenditure on health per capita as US\$4.2, compared to a central African average of US\$ 46.

commented “ *You can refuse [your parents] but then your relationship is broken*”. It is particularly prevalent amongst the BaAka, where wages are quickly distributed amongst the community as money or presents.

## Tourism related benefits

### *Tourist revenue sharing- the 40% fund*

Since park gazetting in 1989, the DSP has operated a tourist revenue sharing scheme, involving 40% of park entrance fees. However, low tourist numbers combined with the growth in the local population through in-migration has resulted in little actual benefit being generated per household- if all of the 2006 revenue was distributed equally through the reserve, each household would receive 2887 XAF, or 5.99 US\$ a year.



**Figure 4-1** Revenue received and distributed by the 40% community revenue sharing scheme. Due to gaps in project records, figures for revenue distributed should be considered as a minimum figure.

Moreover, distribution of the 40% has proved problematic. Initially given to the community via the *administration municipal*, problems with transparency of transaction soon arose. Thereafter, a series of community-based organisations, created by the project primarily to increase dialogue and address conflicts between the project and local communities, served the function of revenue distribution

(table 4.3)- all ultimately failed. As a result, the 40% fund is viewed more frequently as an object of dispute rather than of appreciation.

**Table 4-3** Review of the approach and outcome of organisations set up to administer the 40% revenue distribution scheme in Dzanga-Sangha reserve

Year	Organisation	Approach	Members	Outcome
1991-1992	Association Communautaire de Yobe-Sangha (ACYS)	Administer funds as one-off donations to local business enterprises. Funded by tourist revenue and \$6000 McArthur grant	Representatives from the project and local community. Members chosen to represent different areas of economic activity in the reserve. Local and regional authorities not included.	Unpopular with local and regional authorities (Hardin 2000) Misappropriation of funds; Only minority of community received a grant, leading to discontentment; Use of grants not always compatible with conservation goals (e.g. used to buy wire cable for snares) (Fay 1993)
1995-2000	Comité de Développement de Bayanga (CDB)	Donations for local community infrastructure. Loans also given to business initiatives	Project and local authority representatives. Representatives from each village and all main professions in the reserve. Totalled over 50 members. Monthly meetings.	Responsible for funding number of local development projects, including wells, road and bridge repairs, a pharmacy building and developing fish-farming. However poor transparency, low attendance rates, internal conflicts and misappropriation of funds led to its closure in 2000 (Hardin 2000)
2004 -2006	CAL/DSP	Donations to community development projects;	11 members including representatives from the project and local and regional authorities, including village chiefs. Met twice a year	Contributed to a handful of projects including well drilling and school supplies.
2007	Law passed by the Central African Government stating the 40% fund is to be administered to community projects using a committee headed by the local authorities. Outcome is, as yet, unknown.			

### ***Other tourism benefits***

The majority of tourists arrive in the area with a non-national tour operator and organise their activities through the project-run tourism centre. As a result, much of the potential tourist revenue is 'leaked' out of the area. There are a few limited opportunities for members of the local community to benefit from the tourist dollar in some way, namely through employment or related service industries.

**Accommodation:** Accommodation in the area is limited to a hotel run by a Cameroonian-based travel company (originally built by the DSP) and two locally run guesthouses. The hotel, while

more expensive, tends to attract the majority of tourist business. Situated in a picturesque spot on the river away from the village and more tailored for the tourist trade, it is widely advertised and capable of catering for larger groups. The locally run guesthouses, in contrast, attract a very limited number of budget travellers, with the most popular guesthouse, Chez Robert, hosting an average of just 12 western tourists a year. A general lack of advertising, the basic nature of the accommodation and a poor reputation for room security are all suggested to contribute to the lack of tourist trade. In 2006 one female tourist organised a night staying with a family in the village to experience village life. The night was deemed to be a great success by both tourist and family, although it has yet to be repeated, not least due to language issues and the basic nature of accommodation in the village.

***Shops, bars and restaurants:*** Tourists tend to eat at the tourist lodge, for which little of the food is sourced locally. Tinned goods are purchased through two Mauritanian-owned stores and fresh goods are usually driven in from Bangui or Yaoundé, with the associated high transport and (in the case of Yaoundé) taxation costs, due to difficulties guaranteeing a source of fresh goods of a reliably high quality from the village. However, ad-hoc sales of locally produced fresh food such as fruit, livestock or fish are made by local women calling at the lodge. 26% of Bayanga HAS respondents reported selling food to the Doli lodge in 2006, earning an average of 23,469 XFA (48.7 US\$) each over the year. Project-organised schemes to encourage local production of vegetables and fruit have largely failed, blamed on problems with soil fertility, theft and a perceived poor return on the required labour. The demand for such produce is also unpredictable due to the low and intermittent tourist demand.

***Craft sales:*** Amongst the residents of Bayanga there is little tradition of craft making. There are currently four artisans who produce goods intended for sale to tourists: two woodworkers, one tee-shirt printer and one card maker. All are originally from the capital Bangui. Lacking a stall or shop, sales are limited and frequently restricted to commissions through tourist guides. While there are plans to develop a craft market based at Doli lodge, this has yet to be developed- artisans are discouraged from visiting the site due to a number of heated exchanges with tourists in the past. Sales are also affected by language barriers as few residents speak a language besides Sango or French.

In the villages of Yandombe and Mossopoula the majority of BaAka residents are involved in craft manufacture involving traditional forest skills. Many of the crafted items, such as hand carved crossbows, are historically used by the BaAka and sale is frequently of used items which are afterwards replaced. Other items, such as necklaces made from the vines and seeds of the forest,



were developed specifically for sale to tourists. HAS results suggest that nearly half of Yandoumbe and Mossopoula residents were involved with both the manufacture and sale of crafts to tourists in 2006, the majority being necklaces and miniature baskets. Craft items can command relatively high prices, with a single BaAka necklace usually sold for 2000 XAF (4.2 US\$), the equivalent of two days wages.

**Gifts:** Tourist groups may also choose to make direct donations to the local community, particularly common in tour operators with a long-term history with the area. Gifts in the past have included funding a new basketball court situated in the centre of Bayanga. Tourists and tour operators have also supplied pens and books to schools, and distributed tee-shirts to the community. Yandoumbe school is funded privately by Louis Sarno who regularly receives private donations from tourists keen to contribute. In 2006 a cash donation was also made to Bayanga hospital.

**Pride:** A number of tourist guides, when questioned about benefits arising from tourism, mentioned the pride of knowing that visitors to the area would return to their home countries and tell people of the Central African Republic.

### **4.4.3 Conservation-related costs versus benefits**

In this section, an economic valuation approach is taken to represent quantitatively the direct impacts outlined in preceding two sections, allowing a direct comparison between positive and negative impacts. For reasons of both accuracy and relevance, I focus on two areas- opportunity costs suffered due to park formation and the direct economic benefits provided by the DSP.

#### **4.4.3.1 Calculating opportunity costs**

##### **i) Agricultural production**

The maximum potential for opportunity costs relating to agriculture is calculated by assuming both Ndoki and Dzanga parks could be fully converted for crop cultivation (1220 km<sup>2</sup>). It is known that 98% of fields measured as part of this survey (n=140) were predominantly cassava, a staple subsistence crop for the area. Therefore, yield calculations are based on all of the land being used to produce cassava and using an annual cassava production figure of 2973 kg/Ha<sup>14</sup> (FAO, 2007). By

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<sup>14</sup> This is based on FAO (Food and agricultural organisation of the United Nations) 2006 statistics for average yield of cassava throughout the Central African Republic

using the average yield, an attempt is made to include both yields from newly cleared soils, and lower yields from older fields where nutrients may have been lost. Current market prices for cassava are taken from this study, and calculated as a yearly average to avoid seasonal variations.

**Figure 4-2** Calculating the total opportunity cost of foregoing conversion of the parks for the purposes of agricultural production

<b>Total opportunity cost for agriculture</b>	=	Area lost (Ha)	x	Average cassava yield kg/Ha	x	Current cassava market price (XAF/kg)
	=	1220	x	2973	x	96
	=	<b>348,197,760 XAF (722,702 US\$)</b>				

This calculation makes a number of assumptions that should be borne in mind. Firstly, it assumes that all the park would be suitable for cultivation. As this is highly unlikely, it results in a potential overestimate. Secondly, the costs accrued to the agriculturalist in cultivating the crop (seeds, labour, tools etc.) are unknown and thus omitted- other studies have found these costs may account for 10-16 % of total income for crop production in central Africa (Hatfield and Malleret-King, 2003), or 36% for arable farmers in Kenya (Norton-Griffiths and Southey, 1995) (although such costs may be reduced due to DSP donation of seeds and equipment). Finally, while cassava is the main crop cultivated, it is not the only one- maize, yams and bananas are also commonly grown, albeit on a much lower scale- which have the potential to increase revenue generated off the land. Nevertheless the exercise remains useful in its estimation of foregone opportunity costs.

## ii) Wild meat production

In order to accurately assess the opportunity costs associated with banning the extraction of meat, it is necessary to estimate:

- a) How many households would engage in hunting activities if the park were degazetted
- b) The production rates of these households.

Conducting an empirical study in this area is complex, due firstly to the difficulties in asking people to anticipate their decisions in a hypothetical reality and, secondly, the risk of deliberate misrepresentation by respondents due to the current illegal status of hunting in the park. An attempt at assessing which households would wish to hunt if the forest was open was made by including a question regarding this topic in the HAS. However, the piloting of this question soon led to its

abandonment due to the high level of misrepresentation by respondents. Consequently, it is necessary to create two scenarios, one that represents the maximum possible hunting pressure, and one that represents the minimum. *Scenario one* is based around the assumption that, in the event of the de-gazetting of the park, all households would hunt. *Scenario two* is based on the assumption that only the households currently engaged in hunting activities would wish to hunt in the park.

**Figure 4-3** Calculating the total economic value of wild meat exploitation for households in the reserve- maximum and minimum estimates are made

<b>Total opportunity cost for hunting</b>	=	$\left( \begin{array}{l} \text{(No. net hunting house. x average house. yield/kg)} \\ + \text{(No. snare hunting house. x average house. yield/kg)} \\ + \text{(No. gun hunting house. x average house. yield/kg)} \end{array} \right) \times \text{current market price for wild meat XAF/Kg}$
<b>Scenario one</b>	=	$((285 \times 55.4) + (455 * 837) + (478 * 837)) * 780$
	=	<b>621,433,800 XAF (1,289,816 US\$)</b>
<b>Scenario two</b>	=	$((285 * 55.4) + (177 * 837) + (187 * 837)) * 780$
	=	<b>249,956,460 XAF (518,797 US\$)</b>

For both scenarios, two assumptions are made: 1) That one household would contain one hunter and 2) That in the event of park de-gazettement hunter type would maintain the current ratio- i.e. all BaAka households would hunt, and the current ratio of gun:snare hunting in non-Aka households remain constant, currently 1.05:1 (table 4.1). 2006 market prices for wild meat were taken from this study, and were calculated as an average of both season and meat type as 780 XAF (1.62 US\$) / kg. Average household yields for snare and net hunting offtake were taken from a previous study conducted in Dzanga-Sangha area (Noss, 1995). Gun hunting offtake was calculated by looking at the ratio of snare:gun meat in the market, and multiplying snare hunting offtake by this.

The community hunting zone was designed to meet some of this hunting pressure. Therefore, calculations of opportunity costs should take into account offtake from the hunting zone. An algorithm designed by the US National Marine Fisheries Service (NMFS) is used to estimate the sustainable offtake of the hunting zone of two main hunted species in the area, *Philantomba*

*monticola* and *Cephalophus dorsalis*, within the hunting zone<sup>15</sup>. It is therefore likely to be an underestimate as it fails to take into account other hunted species, whether legal or otherwise. Given the variation in estimates of both population densities for the area and the intrinsic rate of interests of both of these prey species, a maximum and a minimum offtake figure is produced, in line with the precautionary principle. The NMFS algorithm is explained fully in section 8.3.2. Calculations can be found in appendix 5.

**Figure 4-4** Calculating the total opportunity cost of stopping wild meat exploitation within Dzanga and Ndoki national parks, controlling for legal extraction from the community hunting zone..

<b>Total sustainable harvest from the 491 km<sup>2</sup> hunting zone</b>	=	4,311 kg	(Minimum)
		35,872 kg	(Maximum)
<b>Scenario one Maximum possible offtake</b>	=	(285 x 55.4) + (455 x 837) + (478 x 837 )	
	=	796710 kg /year	
<b>Scenario two Minimum possible offtake</b>	=	(285 x 55.4) + (177 x 837) + (187 x 837)	
	=	320457 kg/ year	
The matrix below shows suggested hunter offtake (maximum and minimum) (kg/year) minus the quantity of meat that can be supplied from the community hunting zone			
		<b>Sustainable harvest</b>	
		<b>Maximum</b>	<b>Minimum</b>
<b>Offtake</b>	<b>Maximum (S1)</b>	760,838	792,399
	<b>Minimum (S2)</b>	284,585	316,146
The matrix below translates this lost offtake into its market value (US\$)- i.e. this shows the lost opportunity costs for hunting under different conditions (maximum and minimum offtake rate) and subtracting sustainable offtake from the hunting zone (maximum and minimum).			
		<b>Sustainable harvest</b>	
		<b>Maximum</b>	<b>Minimum</b>
<b>Offtake</b>	<b>Maximum (S1)</b>	1,231,743	1,282,838
	<b>Minimum (S2)</b>	460,723	511,818

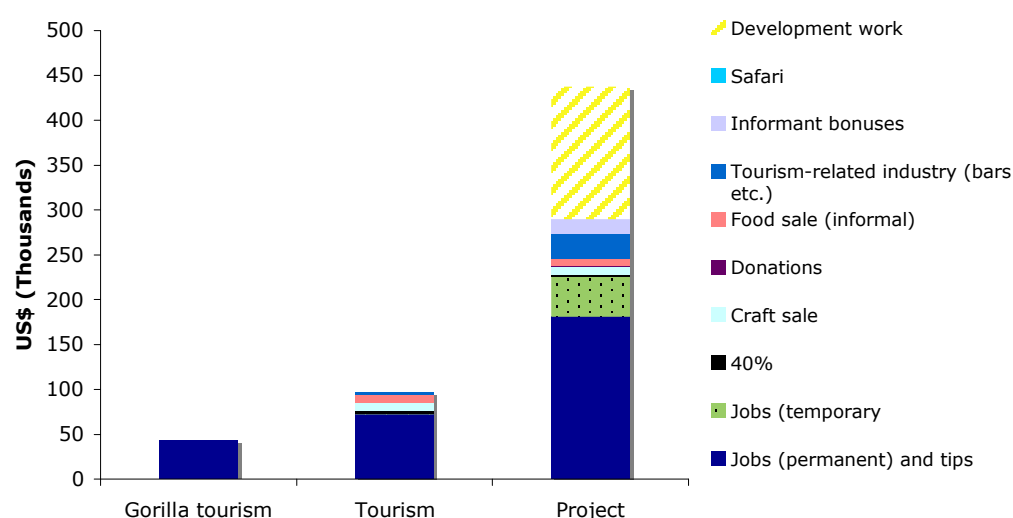
<sup>15</sup> These two species make up 83.5% of the total biomass sold in Bayanga market and 58.4% of the total biomass consumed by Bayanga households.

### 4.4.3.2 Calculating economic benefits

Direct and indirect benefits arising from conservation and project-related activities (omitting indirect, option and non-use values) were calculated in financial terms, concentrating on those that accrue at the local level. Economic benefits were examined in three areas: gorilla tourism, tourism overall and the DSP as a whole. Table 4.2 gives a brief summary of constituent benefits. For a full list of benefits broken down into its constituents, see appendix 2.

**Table 4-4** Factors included in the overall calculation of economic benefits related to conservation activities in the Dzanga-Sangha area

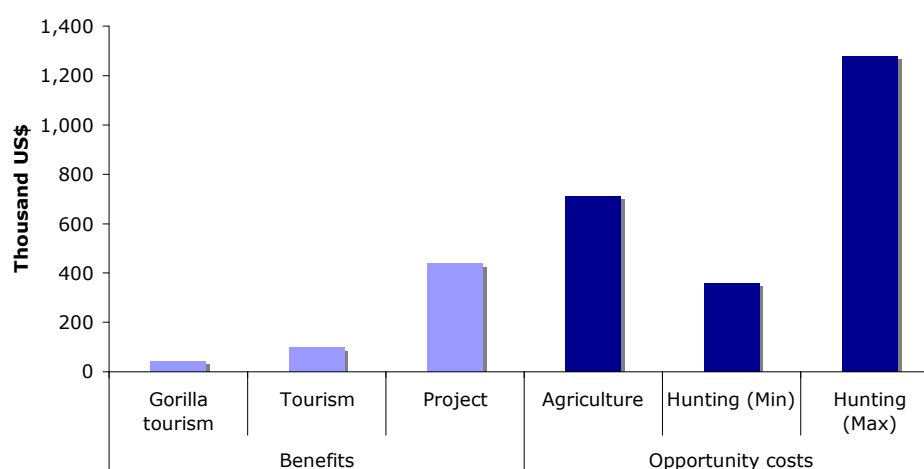
Economic benefits included	
<b>Gorilla tourism</b>	Salaries and tips for all employees at the gorilla habituation camp
<b>Tourism</b>	Salaries and tips for all permanent staff; salaries for all temporary work; 40% fund; tourist donations to the community; tourist related income to local bars, restaurants and shops; craft sale; food sale by local community to tourist lodge
<b>Dzanga-Sangha Project</b>	All tourism related benefits; all safari hunting related benefits; all other permanent project jobs; informant primes; salaries for temporary work offered with the tourists (such as BaAka net hunting); development activities; house rental costs by DSP



**Figure 4-5** Direct and indirect economic benefits accruing at the local level from gorilla tourism, tourism overall and the project as a whole.

### 4.4.3.3 Comparing costs and benefits at the reserve level

A direct comparison of the cost of losing both hunting and agricultural ground with economic benefits provided by DSP shows clearly that tourism fails to compensate for the economic opportunities of park exploitation (fig. 4.6). Furthermore, economic benefits provided by the Dzanga-Sangha Project probably fail to compensate these costs.



**Figure 4-6** Comparing economic benefits generated through the project with economic opportunities forgone due to park gazettement.

However, several issues regarding the nature of these impacts should be considered. The first is the timeframe. This exercise was conducted over the period of one year. If we were to consider the long-term sustainability of the impacts, whilst DSP benefits are likely to remain the same, the exploitation of wild animals in the parks and hunting zone at current levels is unlikely to be sustainable. The second is that indirect use and non-use benefits are not included and may be considerable. Finally, it is crucial to consider the level at which these impacts are acting- this is discussed in the following section.

### 4.4.3.4 Comparing costs and benefits at the village level

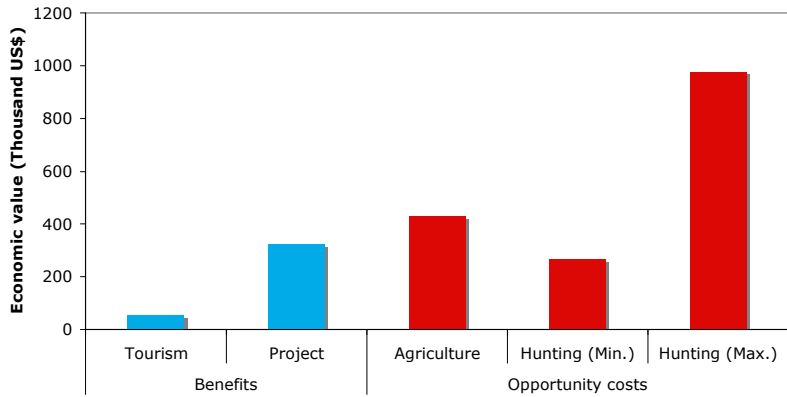
While gazettement of the parks meant that all reserve residents lost the opportunity to exploit those areas of forest, conservation-associated benefits have tended to be more focussed. Each village in

the reserve has its own development plan, and has received some level of development of its infrastructure. However, tourist activities tend to be focussed in and around Bayanga- the location of both DSP headquarters and the closest point to the main entrance into Dzanga National Park- including Mossopoula and Yandoumbe. In addition, while DSP jobs are open to all of residents of the reserve, there is a tendency for project employees to live in Bayanga (non-Aka) or Mossopoula/Yandoumbe (BaAka). All BaAka salaries were therefore attributed to either Mossopoula or Yandoumbe, and all non-Aka salaries to Bayanga.

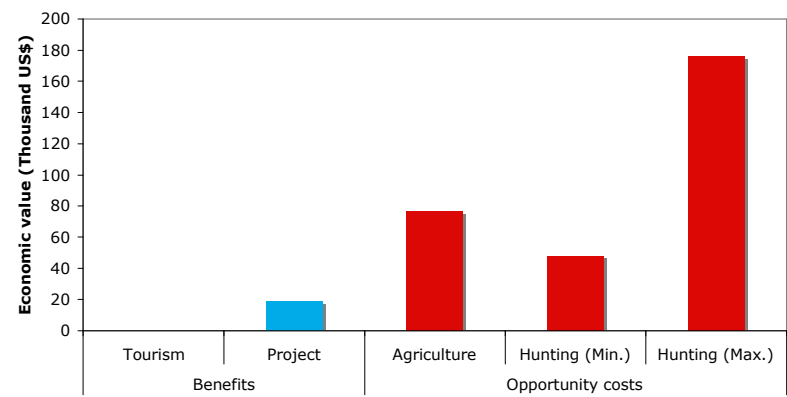
Four villages were used for this exercise- two BaAka villages- Yandoumbe and Mossopoula and two non-Aka villages, Bayanga and Babongo. Babongo, a village of around 130 households located to the north of Mossopoula, was used to illustrate the cost-benefit balance in a village situated some distance from Bayanga, and therefore gaining little benefit from tourism and employment. For each village their share of the opportunity costs was calculated by controlling for the proportion of households in the village compared to the reserve total. It was assumed that only the BaAka households would net hunt, and only the non-Aka households would snare and gun hunt. Benefits known to accrue to a particular village only, such as tourist boat rides (which only took place in Bayanga), were placed only in the benefit category for that particular village. For benefits theoretically open to all reserve members, such as the 40% revenue distribution, the proportion accruing to a particular village was again calculated using the proportion of households in that village.

For Bayanga, home to the majority of project employees and some tourist activity, project-related benefits appear to approach lost agricultural opportunities, although they probably do not compensate for lost hunting opportunities (Fig. 4.7). Project benefits for Babongo and other outlying villages fail to compensate for any type of opportunity cost.

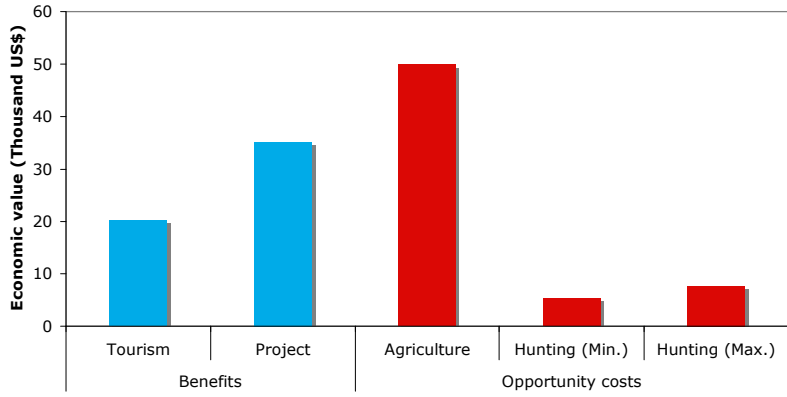
The two BaAka villages, Mossopoula and Yandoumbe, due to the low offtake of net hunting, have been subjected to relatively low opportunity costs. They are also host to the majority of the village-based tourist activities. As a result, tourism alone appears sufficient to compensate the village financially for lost hunting opportunities. This does not take into account the cultural costs of losing traditional hunting grounds. Furthermore, while the relative open-access nature of both net hunting and work with tourists means both should be distributed equally throughout the communities, the potential for disparity in the distribution of costs and benefits cannot be discounted without more detailed data collection.



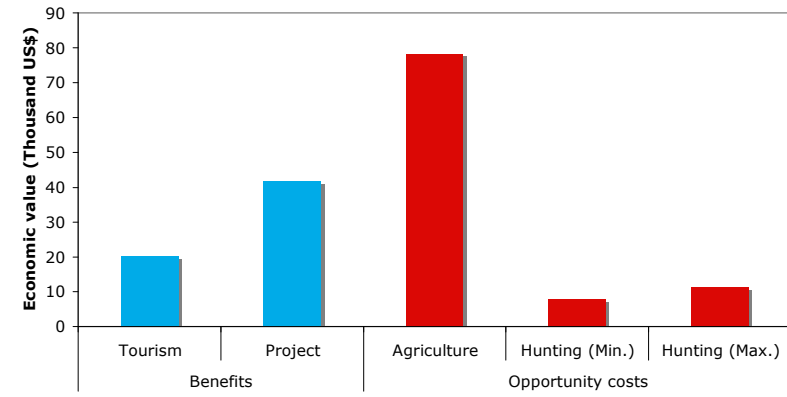
a) Bayanga



b) Babongo



c) Yandoumbe



d) Mossopoula

Figure 4-7 Cost and benefit breakdown per village. a) Bayanga, b) Babongo, c) Yandoumbe d) Mossopoula



## 4.5 Discussion

With their roots firmly in the conservation arena, ICDPs have a tendency to address development issues in so far as they can support conservation goals (Brown and Wyckoff-Baird, 1992). With this end in view, they aim to produce incentives- primarily economic- for local people to engage in pro-conservation behaviour. By definition, these incentives must be more beneficial for local residents than other, less pro-conservation, activities: consequently they should improve the standard of living of park-adjacent communities. This chapter evaluated the extent to which these aims have been met by the Dzanga-Sangha ICDP by comparing, both qualitatively and quantitatively, costs and benefits associated with the tourism programme, the ICDP and the park respectively.

### **Imposing costs through conservation**

The gazetting of the protected areas in 1990 by the Central African Republic government designated 1220 km<sup>2</sup> of forest as strictly protected park, placing it off-limits for any local exploitative use. Given the high level of reliance on forest resources by the local communities, the setting aside of this land has incurred considerable opportunity costs, notably hunting access and clearance for agriculture. Acknowledging these losses, a 491 km<sup>2</sup> community hunting zone was designed, intended to provide an area to conduct traditional hunting livelihoods. While this area is heavily exploited, it suffers from poor positioning in terms of distance and access from many of the villages. Additionally, even under the most optimistic estimates regarding off-take and animal reproduction rates, the zone appears unable to sustain the local demand for meat, a result supported by the high levels of illegal hunting in the parks. This is, in part, due to the human population of the reserve increasing by over 35% since park formation, in addition to the high level of hunting by snares and unlicensed guns, rather than the 'traditional' methods stipulated by Central African Republic law. This situation has resulted in considerable illegal hunting, and consequently high numbers of confiscations by the project's anti-poaching squad.

The BaAka, traditionally semi-nomadic forest dwellers whose culture, economy and diet are heavily entwined with the forest, are particularly affected. Losing much of their traditional hunting ground, they face high levels of aggressive competition in the hunting zone from non-Aka hunters. A lack of baseline data prevents us from quantitatively assessing the impact of park formation on such factors as levels of nutrition and income generation. However, comparing the diet of the Dzanga-Sangha BaAka with those with other Central African pygmy groups shows the BaAka consume much lower quantities of wild meat (chapter 7). Due to the relatively poor returns from net hunting, economic

costs accrued to the BaAka appear relatively low. However, they have also suffered displacement from traditional grounds, and the social and cultural impacts of this may be considerable.

### **Compensating costs**

The DSP approached offsetting these costs in three key ways- encouraging alternative livelihoods, compensation through community development, and the tourism-revenue distribution scheme. However, the economic valuation conducted showed the majority of economic benefits generated through the project were as a result of project employment and community development activities, whilst only project employment (all ethnicities, Bayanga and surrounding area) and participation in tourism activities (BaAka of Mossopoula and Yandoumbe) had the potential to be serious alternative livelihood strategies.

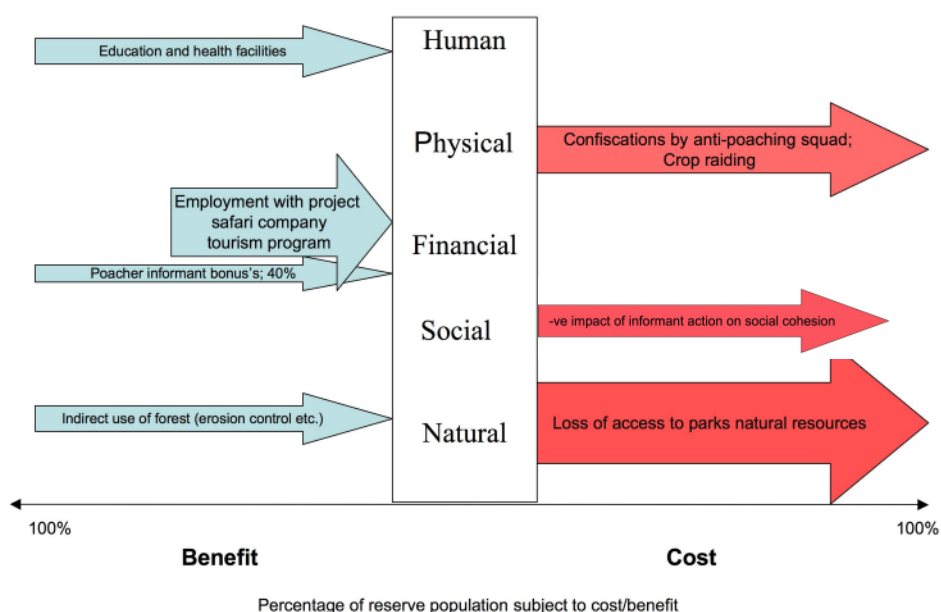
Developing a tourism industry in Central Africa as a serious income generating tool has been treated with scepticism in the literature (Brown, 1998, Wilkie and Carpenter, 1999b). Although tourism has been suggested as a possible revenue generating tool potentially on a par with logging (TELESIS, 1991), the projected tourist numbers have failed to materialise. High travel costs relative to other destinations in Africa, poor infrastructure such as roads, frequent political instability and a deficit of other close tourist attractions such as beaches have all had the effect of depressing potential tourist numbers. This is despite the obvious attractions of the area, which include the fact that it hosts one of only two programmes that have successfully succeeded in habituating western lowland gorillas, *Gorilla gorilla gorilla*, for tourism. Low revenues, combined with high leakage, high in-migration into the local communities and considerable difficulties in distributing revenue amongst the local community largely refutes Blom's (2001a) suggestion that tourism is having a significant economic impact on the Dzanga-Sangha community, with the exception of the BaAka villages of Yandoumbe and Mossopoula. Significant revenue is generated, to which the majority of community members have access. However, as a source of income it is intermittent and unreliable.

### **The implications for poverty alleviation**

The presence of the project has restricted livelihood choices by increasing the risk of costs associated with hunting activities- a main income generating activity for a high proportion of households in the area. With little other industry in the area, this impact is assumed to accrue equally throughout the reserve. While the project has attempted to encourage alternative livelihood strategies, primarily through intensifying and diversifying agricultural cultivation, these have largely failed, attributed to the high mobility and poor social cohesion in the local population (Renner and Yarrissem, 2003). Education and health benefits, while likely to have a positive impact

on livelihoods, are both indirect and long-term, and unlikely to be associated with conservation efforts, let alone be considered suitable compensation for lost hunting opportunities. Tourism has a very limited scale and unpredictable and localised benefits, making it more likely to act as a complementary livelihood option, rather than a substitute. This is also likely to be true of the poacher informant bonus scheme, which may, by its nature, undermine many possible local social institutions important in collective action. As a result these impacts are unlikely to have the direct effect on conservation anticipated, particularly in light of their relatively small scale (Ferraro and Kiss, 2002, Wells, 1992, Wells et al., 1992).

While the impact of project employment is limited to an estimated 15% of reserve households, concentrated in Bayanga, Mossopoula and Yandoumbe, the potential for ‘trickle down’ effect should be noted. While direct employment is limited, there is no doubt that the impact on the village economies through salary sharing and expenditure will be much more widespread, and particularly notable due to the lack of any other major industry in the area.



**Figure 4-8** Conservation related impacts, positive and negative, on livelihoods assets.

The finding that it is primarily project-generated employment that provides overall benefits to the local communities bear out results from a number of previous studies (Wells et al., 1992, Barrett and Arcese, 1995). The general failure of traditional ICDP tools, such as promoting alternative

livelihoods, appears strongly related to a failure to relate them to the complexities of the local population. Perhaps most importantly, the reserve shows high levels of in-migration, increasing the potential number of hunters in the area and hence opportunity costs. While this in-migration in the past has been attributed to the jobs offered by the logging companies, the fact that since the closure of the logging companies in 2004 the population has continued to grow may be potentially linked to the highly prized job opportunities offered by the project. The lack of social cohesion resulting from the high level of in-migrants in the area has been held to be a major contributing factor in the failure of a lot of the community-based development schemes, including the failure of the agricultural projects. However, crucially, linking benefits to both attitudinal and behavioural changes depends not just on assessing impacts, but also how these impacts are perceived and valued by the local community. This is addressed in the following chapter.

## **4.6 Conclusion**

Park formation, for the purposes of conservation, has resulted in significant opportunity costs, although a moderate proportion are currently realised through illegal hunting. Significant benefits provided by DSP are limited to those relating to tourism, community development and project employment. While all three have the potential to impact poverty at some level, only project employment (all) and intermittent tourist work (BaAka only) offers a serious livelihood alternative. Furthermore, these opportunities are extremely localised in distribution, concentrated primarily in just three out of eight villages in the reserve. Results highlight the need to consider the complexities, and suitability of both the local population and development approaches when designing ICDP projects.

## Chapter five

### ICDP benefits and the promotion of pro-conservation attitudes

#### 5.1 Introduction

An underlying assumption for the successful implementation of programmes integrating conservation and development is that local communities will be encouraged to support conservation through the receipt of related benefits. Attitudinal surveys have become increasingly common as a tool to measure such changes, although vary greatly in approach (Browne-Nunez and Jonker, 2008).

A handful of studies have succeeded in linking pro-conservation attitudes to the provision of significant benefits to local communities (Wild and Mutebi, 1996, Sandbrook, 2006, Abbot et al., 2001). Indeed, respondents may show more positive attitudes to a conservation-related project even when receiving no benefits, in the hope that in the future such benefits may flow to them (Alexander, 2000). Plumtre also reminds us of the need to consider more than just economic forces when considering attitudes and behaviour, citing the importance of pride felt by local park staff who continued to patrol the parks of the Virunga region during periods of extreme insecurity (Plumtre, 2003).

Yet frequent difficulties associated with programme implementation have led to considerable doubt as to the strength of the benefit-attitude link, undermining the validity of the ICDP rationale (Wells et al., 1992). As discussed earlier, benefits may be poorly distributed, inadequate when compared to costs, or simply fail to meet expectations (Songorwa, 1999). Furthermore, the distribution of even considerable benefits may do little to improve attitudes towards parks and conservation activities due to such factors as being delivered in ways that are undervalued or unrecognised by the target community (Gibson and Marks, 1995, Parry and Campbell, 1992). External factors, such as the behaviour of park staff, can also have serious impacts on local attitudes to conservation efforts (Infield and Namara, 2001, Fiallo and Jacobson, 1995). In certain cases, benefit provision has even produced a negative effect through the raising of expectations which projects then fail to meet (Adams & Infield, 2003, Songorwa, 1999).

The huge range of ICDP approaches, site conditions and, not least, approaches to attitude assessment mean that any attempt to extend results between countries, regions or even adjacent sites must be done with extreme caution. However, a number of key points emerge when considering the published literature. Firstly, benefits must always be considered in terms of the costs that they are compensating- conservation-related activities may be supported only up to the point at which the personal interests of the individual start to be threatened, through events such as high exposure to crop raiding or loss of land (Archabald and Naughton-Treves, 2001, Gillingham and Lee, 1999, Parry and Campbell, 1992, Newmark *et al.*, 1993, de Boer and Baquete, 1998). It is also crucial to recognise the heterogeneous nature of most communities- this may not only affect where costs and benefits accrue, but socio-demographic factors such as ethnicity, age, gender, education level and residency length of the individual are often strongly linked to conservation-related attitudes (Gillingham & Lee, 1999, Heinen, 1993, Hill, 1998, Holmes, 2003, Marquardt *et al.*, 1994, Mehta & Heinen, 2001, Newmark *et al.*, 1993).

Care must be taken when considering what constitutes a ‘pro-conservation’ attitude; respondent attitudes may alter markedly when considering different aspects of the same programme. For example, schemes distributing revenue from park-related tourism may improve local attitudes to tourism yet struggle to extend this to improving attitudes to conservation (Mehta and Kellert 1998; Walpole & Goodwin, 2001). Similarly, benefits from a protected area may fail to be associated with the external institution in charge of park management (Sandbrook, 2006).

This chapter, acknowledging that the perception of impacts may be more influential than actual impacts, follows on from chapter four’s objective review of costs and benefits by investigating how these are perceived and valued by local community members. Focus then moves to exploring local attitudes to conservation, examining perceptions of the forest, the IDCP, and the tourism programme in turn. Finally, the chapter draws the two strands together by investigating the relationship between cost/benefit recognition and attitudes towards conservation.

## **5.2 Research questions**

This chapter will test the following hypothesis:

⇒ **Perceptions of access to benefits and costs are associated with pro-conservation attitudes**

To investigate this, the following questions were asked:

- 1) Which of the costs and benefits identified in chapter four are recognised at the local level?
- 2) How is impact recognition distributed within the community?
- 3) What are the attitudes of local community members towards the forest, the DSP and the tourism programme?
- 4) How are these attitudes distributed within the community?
- 5) How is the recognition of costs and benefits related to pro-conservation attitudes?

The first half of the chapter investigates how the objectively measured costs and benefits outlined in chapter four are perceived and valued by the local community (5.4.1), evaluated using a structured questionnaire, informal interviews and participant observation. The relationships between impact recognition and socio-demographic factors, such as residency length, are explored using a statistical approach (5.4.2). The second half of the chapter examines conservation-related attitudes in the reserve (5.4.3), looking in turn at attitudes towards the forest, the DSP and the tourism programme. Finally the distribution of these attitudes within the community and their relationship to impact recognition are investigated (5.4.4).

### **5.3 Methods**

Both cost/benefit recognition and attitudes were assessed primarily using a structured questionnaire known as the Household Attitudinal Survey (HAS). However, participant observation and formal and informal interviews of community members and project staff complemented and guided both the design of the survey and response interpretation. Tourist visits involving members of the local community were also accompanied where possible, with local and tourist participants observed and informally questioned.

The sampling approach adopted for the survey, together with potential areas of bias, are discussed in depth in section 3.2.2. The full questionnaire is presented in appendix 1. Questions focussed on three areas- establishing socio-demographic factors such as respondent age and wealth rank, establishing recognition of impacts relating to conservation and, finally, establishing respondents attitudes to conservation, here subdivided into forest, project and tourism related attitudes.

### 5.3.1 Establishing socio-demographic factors

Respondents were asked to give the following information:

***For all adult household members***<sup>16</sup>: Gender, age & principal income-generating activities in 2006

***For respondent only***: As above, and length of residency in the Dzanga-Sangha reserve.

Non-Aka respondents were also questioned on the presence/absence and number of certain wealth-defining commodities within their household, identified as locally significant during the wealth ranking exercise (see section 3.2.3). These were: livestock, fields, a television, a bicycle, a motorbike, a 12-volt battery, a generator, a manioc grinding machine, a radio, a peanut grinding machine, a sewing machine, a one-wheeled cart, a shotgun and fishing equipment.

For BaAka respondents it proved difficult to record ages, residence lengths or number of years of education accurately due to a cultural tendency to show a complete indifference to dates. While it might have been possible to estimate dates using such techniques such as an event calendar, or through ranking the ages of children (Howell, 1979, Kretsinger, 2002), the time involved in making potentially inaccurate estimates led me to abandon these three categories for BaAka respondents

### 5.3.2 Assessing knowledge of conservation-related costs and benefits

Given the potential for misrepresentation due to fear of reprisals, I asked questions about costs and benefits accrued at both the community and individual level separately (although grouped together below for convenience). This was done on the premise that respondents may feel less personally threatened when reporting sensitive impacts at the community level, and therefore more likely to report them. Following chapter four, questions were asked about costs and benefits relating to tourism, the project in general, and the forest. Questions were structured as below:

#### ***Tourism***

- For your community/you personally, are there any benefits from tourism? What?
- For your community/you personally, are there any problems because of tourism? What?

#### ***Project***

- Why is the project here?
- For your community/you personally, are there any benefits from the project? What?

<sup>16</sup> See chapter 3 for definition of 'household'. An adult is defined as an individual aged 12 or over.



- For your community/you personally, are there any problems because of the project? What?

### **Forest**

- For your community/you personally, are there any benefits from the forest? What?<sup>17</sup>

- For your community/you personally, are there any problems because of the forest? What?

### **5.3.3 Assessing the distribution of cost-benefit recognition within a community**

Given the often unequal distribution of conservation-related costs and benefits across a community, a quantitative approach was used to explore the relationship between cost/benefit recognition and certain socio-demographic variables, shown below.

**Table 5-1** Type and grouping of independent socio-demographic variables for statistical analysis

<b>Socio-demographic variable</b>	<b>Data type</b>	<b>Grouping for statistical tests</b>	<b>Non-Aka N</b>	<b>BaAka N</b>
Gender	Categorical (2)	Male/Female	91:44	38:38
Age*	Continuous		-	-
Residency length*	Continuous		-	-
Education*	Ordinal categorical (3)	None/ Prim./ Second.	17:64:54	-
Wealth rank *	Ordinal categorical (4)	See chapter three	31:39:48:17	-
Pirogue ownership <sup>†</sup>	Categorical (2)	Yes/No	43:92	-
Project job	Categorical (2)	Yes/No	16:119	22:54
Snare hunter 2006 <sup>†</sup>	Categorical (2)	Yes/No	21:114	38:38
Gun hunter 2006 <sup>†</sup>	Categorical (2)	Yes/No	25:110	30:46
Tourist work 2006 <sup>†</sup>	Categorical (2)	Yes/No	4:131	49:27

\* Non-Aka respondents only

<sup>†</sup> Includes all household members, not solely the respondent

The recognition of a) costs and b) benefits at either the community or personal level (with regards to tourism, the project and the forest in turn) were coded as the bivariate outcome (YES/NO) for each respondent. I began by looking for differences in cost and benefit recognition between

<sup>17</sup> Most of the BaAka respondents found the two versions of the questions regarding forest use (i.e. community/personally) repetitive and gave identical answers- any forest-related benefits for the community were also open to them personally, similarly the costs. As a result, this question was only posed in terms of costs/benefits for the community as a whole.

respondents from the three villages, using Pearson's chi-square statistical test. I then constructed a number of logistic regression models, using the forced entry method, to see which combination of socio-demographic variables best predicted whether a cost or benefit was recognised or not. Individual models were constructed for each of the four impacts (community cost, community benefit, personal cost, personal benefit). This was repeated in each of the three areas- tourism, project, and forest. In total 22 models were attempted. However, three models could not be constructed due to insufficient variation in the dependent variable (Non-Aka personal costs from tourism, BaAka community benefits from the forest and BaAka personal costs of tourism). For a further ten models, none of the independent variables entered acted as significant predictors of outcome.

**Table 5-2** Using socio-demographic variables to predict impact recognition: successful and unsuccessful attempts at constructing logistic regression models

	Non-Aka			BaAka		
	Forest	Project	Tourism	Forest	Project	Tourism
<b>Community costs</b>	x	yes	x	yes	x	x
<b>Personal costs</b>	x	x	x	n/a	x	x
<b>Community benefits</b>	yes	yes	yes	x	x	x
<b>Personal benefits</b>	yes	yes	yes	n/a	x	yes

It was also interesting to look at whether recognition of a specific impact was related to socio-demographic factors- for example, as well as asking if pirogue ownership was related to a tendency to report personal benefits from tourism, it is possible to test if it was related to a specific personal benefit, such as the receipt of presents. All specific costs or benefits in any area that had been mentioned by over 5% of respondents (to ensure a sufficient sample size) were therefore tested for any relationship to socio-demographic variables, again using logistic regression.

### 5.3.4 Assessing attitudes

An attitude, defined as "...a state of readiness, a tendency to respond in a certain manner when confronted with certain stimuli" (Oppenheim, 1992), may be affected by a range of extremely complex factors, including cognitive (knowledge and belief) and affective (feeling and emotions).

As hypothetical constructs, attitudes must therefore be measured by indirect means. This is most commonly done via verbal expression- an approach notorious for the difficulty of applying it accurately.

While quantified attitudinal scaling, employing fixed response attitude statements, may be used, the construction of such statements is complex and widely open to error and bias (Oppenheim, 1992). Furthermore, they are reliant on factors such as respondent frankness, which may be misrepresented through fear, misunderstanding or a desire to be seen in a favourable light. A trialling of 50 attitudinal statements, relating to conservation, the ICDP, tourism and the protected areas, was conducted with 10 residents during the pilot study. It quickly became clear that incidence of misrepresentation was high, with respondents going for the ‘right’ (i.e. pro-conservation) response even when informal comments pre and during the questionnaire suggested quite different attitudes. As a result I decided to use open questions and to classify full responses to questions as positive, negative or neutral.

While the questionnaire was structured, care was taken to allow the respondent time and support to expand on their responses, with probing used where necessary. Questions were divided into attitudes towards tourism, the project and the Dzanga National Park, and were structured as below;

#### ***Tourism***

- What do you think of tourism in Bayanga/Yandoumbe/Mossopoula?
- In the future, would you prefer the number of tourists to increase, decrease or stay the same?

#### ***Project***

- What do you think of the project?
- Would you like the project to stay, go or don’t you mind?

#### ***Dzanga National Park***

- Do you think we should open DNP a little, all or not at all for agriculture?<sup>18</sup>
- Do you think we should open the DNP a little, all or not at all for hunting?

Attitudes were scored using responses to the questions above. Care was taken to consider the whole of the response to questions, rather than just the opening words. Comments qualifying a response were always recorded and coded for analysis. Hence for the question ‘What do you think of the project?’, the response “*Good. They protect the animals for our children and the tourists*” was marked as positive, the response “*I think nothing. It is just their work*” was marked as neutral, and

<sup>18</sup> This question was not posed to the BaAka in light of their low interest levels in agriculture.

the response “*They don’t help people, only animals*” was marked as negative. People occasionally responded to a question with both positive and negative points, such as one respondent who, when asked what she thought of the project, said “*The little work that is there is good. It is also good that they [the project] conserve the forest. However, they don’t give enough work and stop people hunting in the forest*”. Such responses, featuring both positive and negative points, were marked as neutral.

Given the sensitive nature of some of the questions, there is clear potential for respondents to misrepresent their true feelings, discussed in detail in section 3.2.2. This includes the possibility of respondents giving ‘neutral’ answers for reasons of diplomacy. While considerable efforts were taken to minimise this, including a careful explanation of both my independent research status and the confidentiality of any responses, results are analysed with this in mind.

Due to the need to consider responses to more than one question, overall attitudinal categories were awarded using the following guidelines. While the original intention was to create three attitudinal categories- namely positive, neutral and negative- it soon became clear there was need for a category for people who didn’t feel they benefited now but hoped to in the future, coined ‘optimism’.

#### *For attitudes to tourism*

		What do you think of tourism to [village]?	Would you like to see more, less or the same number of tourists to [village]?
Attitudinal class	Positive	Positive	More or don’t mind
	Optimistic	Neutral/negative	More
	Neutral	Neutral	Don’t mind
	Negative	Negative	Don’t mind/less

#### *For attitudes to the project*

		What do you think of the project?	Should the project stay/go/don’t mind?
Attitudinal class	Positive	Positive	Stay or don’t mind
	Optimistic	Positive/Neutral/negative	Stay but change
	Neutral	Neutral	Don’t mind
	Negative	Negative/neutral	Go

*For attitudes to the protected areas*

		Open for agriculture?	Open for hunting?
Attitudinal class	Positive	Responds 'No' to both questions	
	Neutral	Responds 'Don't know' to both questions OR one question as 'Don't know' and one question as 'No'	
	Negative	Responds 'Yes' to one or both questions	

Assigning the overall attitude class therefore depends on interpreting responses to two questions. To ensure responses to both questions were fairly represented in the overall attitude score, correlation coefficients between the attitudinal score, and both question one and two were calculated. Responses to each question, and the overall score were re-coded on a scale of 'positivity', where negative=0, neutral = 1, optimistic=2 and positive = 3, and an R-matrix was created, using the Spearman's correlation co-efficient statistical test, for attitudes to tourism, the project and the protected area in turn.

### 5.3.5 Assessing the distribution of conservation-related attitudes

A quantitative approach was adopted to investigate the relationships between the respondent's attitude towards conservation and both socio-demographic factors and costs/benefit recognition. Data was initially explored by comparing the distribution of attitudinal scores between the three villages using Pearson's chi-square test. I then constructed a number of predictive models, using logistic regression, to determine the extent that i) socio-demographic factors and ii) cost/benefit recognition predicted a respondent's attitude to tourism, the project and the protected areas in turn.

Two types of bivariate models were constructed. The first asked which variables predicted whether a respondent would be actively positive, as opposed to optimistic/neutral/negative. The second asked which variables predicted whether a respondent would be actively negative or neutral, rather than positive/optimistic. This grouping approach has an advantage in that, by grouping neutral with positive and negative attitudes in turn, we can explore the implications of assuming that neutral responses were actually diplomatic answers.

As attitudes for the park were only classified as positive/neutral/negative, this second model was modified to negative vs. positive/neutral. For tourism, the number of respondents displaying negative attitudes was very small- only 4 people, or 2% of the sample, therefore it was placed with 'neutral' for analysis. For the project, only three respondents displayed 'neutral' attitudes- these were grouped with 'negative' for analysis.

Predictor variables were the socio-demographic variables outlined in table 5.1, and respondent recognition of i) costs and ii) benefits were each entered as the bivariate YES/NO. Recognition looked at costs and benefits individually at both the individual and community level, and for the three separate areas- tourism, the forest and the project. Variables were added to the model using the forced entry method.

Where a relationship was found, ad hoc tests were performed using Pearson's chi-square statistical tests to further investigate the nature of the relationship. Where impact recognition was found to be linked to attitude, any relationship to a particular type of cost or benefit was also investigated in this way.

## **5.4 Results**

### **5.4.1 Local perceptions of conservation-related costs and benefits**

#### **Perceived costs and benefits of the forest**

Within the residents of the Dzanga-Sangha reserve, there is a strong recognition of forest benefits, with an emphasis on its extractive resources. The most recognised forest product, by far, is foodstuff, with meat, koko and mushrooms the most frequently mentioned food items<sup>19</sup>.

*"If there is nothing in the house, we can go and find food there"*

Bayanga non-Aka respondent

Amongst the non-Aka there was little recognition of benefits unrelated to resource extraction, either indirect use of the forest such as flood control, or non-use such as intrinsic value- one Bayanga

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<sup>19</sup> The degree to which these are valued for subsistence or income-generating purposes is examined in more detail in chapters six and seven.

resident commented that the forest has little real value without the presence of the logging company. There is, however, a real appreciation for the fertile fields that forest clearance can produce, very important in an area heavily reliant on subsistence agriculture for both food and income.

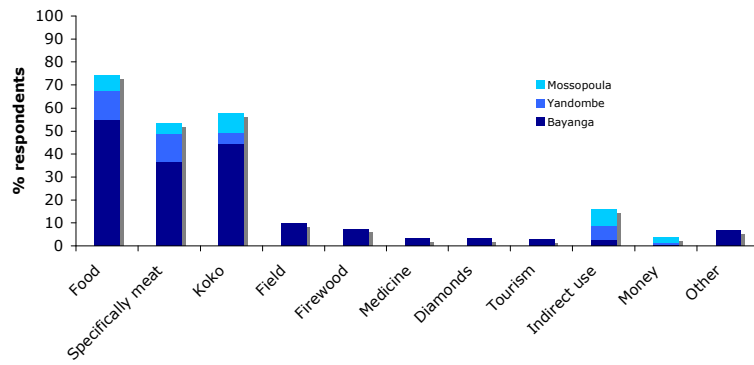
This section provides only the very briefest of treatments of the complex inter-relationship that exists between the forest and the BaAka. This was on many occasions pointed out by my BaAka respondents, both directly and indirectly. Questions regarding how they (the BaAka) benefit from the forest were, on more than one occasion, greeted with snorts, with one man simply saying ‘ *It gives us everything*’.

*“It is our home, our village. It is the place of our ancestors”*

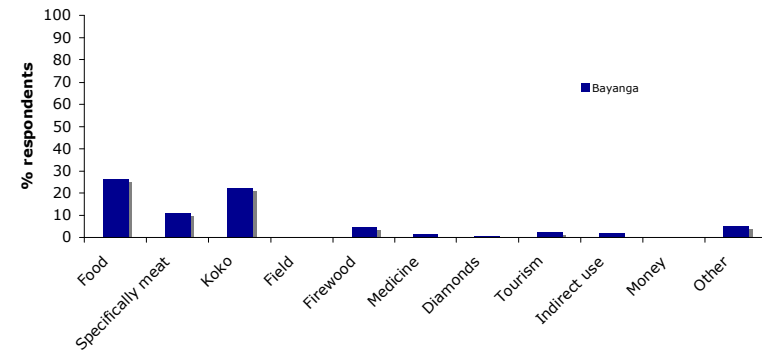
Yandoumbe BaAka respondent

While the forest’s role as a provider of food was much cited by the BaAka, there was also a much greater appreciation of the forests non-extractive values, with many BaAka respondents referring to the cool temperatures and peaceful nature of the forest, citing it as a place they could go to ‘escape’ both the heat of the roadside villages and the attentions of the non-Aka.

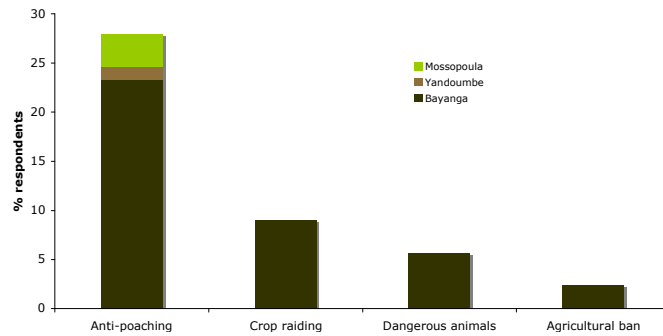
Despite the focus of the questions being very much on the forest in general rather than the park, the main cost associated with the forest by non-Aka and BaAka alike was the DSP anti-poaching team. Few people spontaneously mentioned crop damage by wild animals as a forest-related problem, despite the frequent complaints voiced, and indeed damage observed, during my fieldwork. This is perhaps particularly surprising considering a later question on whether respondents had suffered crop raiding had 65% of all respondents reporting some degree of damage in 2006. Given the high level of interest in cultivation- most households cultivate land- this may be interpreted as either an over-reporting of exposure, or perhaps an indication of the low levels of damage done.



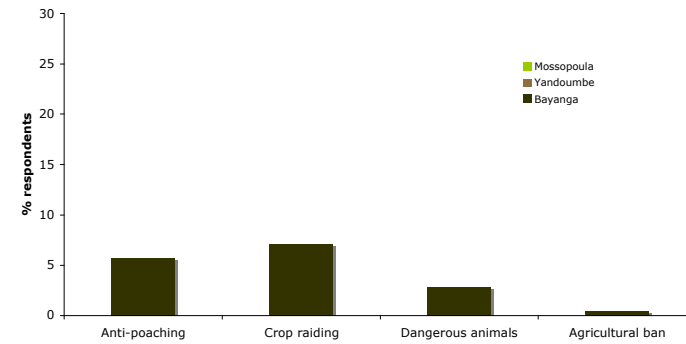
a) Forest-associated benefits at the community level



b) Forest-associated benefits at the personal level



c) Forest-associated costs at the community level



d) Forest-associated costs at the personal level

**Figure 5-1** Forest-related costs and benefits cited by HAS respondents. Responses are presented as the percentage of interviewees spontaneously citing the impact. Respondents may be represented in more than one category. Bayanga n=135, Yandombe n=42, Mossopoula n= 34.



## Perceived costs and benefits of the Dzanga-Sangha Project

Confirming the strained relations between the local community and the ICDP suggested by more informal investigation, the majority of respondents reported DSP-related problems at the community level, although few were prepared to admit to encountering personal problems. For both the BaAka and non-Aka, DSP anti-poaching efforts are the main cause of tension, with residents angry at the frequent confiscation of meat and hunting equipment. Many people commented that they felt people had no choice but to hunt- there was little alternative work in the area. By stopping people hunting, therefore, the project is seen as directly responsible for preventing people making a living.

*“It [our relationship] is bad. The project is messy. They stop people working in the forest but don’t give them jobs. People here need to live. If they gave them jobs they would not go to the forest”*

26 year old Bayanga resident

While the majority of people appear to be aware that the Central African Republic government created the protected areas, it is popular belief that if the DSP were not in the area, there would be little enforcement of extraction laws. At no point during my fieldwork did I encounter instances where the Central African Government was held directly responsible for any conservation-related problems.

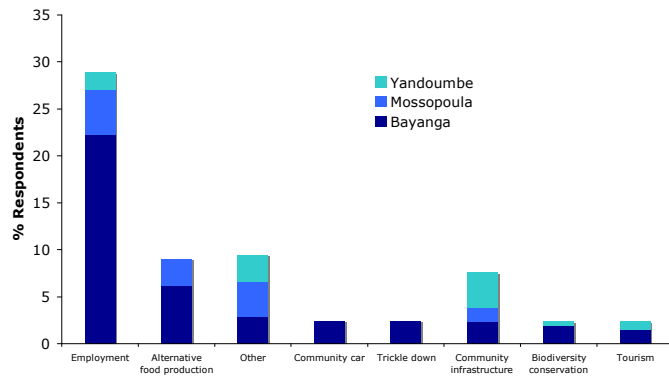
Both during the course of the questionnaire and during other, more informal discussions, I frequently heard complaints from both the BaAka and non-Aka regarding the general failure of the DSP to help either the community or the individual. About half way through the HAS period I began to respond by asking interviewees the follow-up question ‘How do you want the project to help you?’. While a handful of people requested either a job or community infrastructure, such as a secondary school, the vast majority told me they would ask for money or household commodities, indicating a preference for relatively short-term benefits which go directly to the individual or the household, rather than to the community.

Questioning reserve residents on benefits associated with the DSP provoked mixed reactions. Around half of all questionnaire respondents, BaAka and non-Aka alike, could see no benefits of project presence at the community level, rising to three-quarters at the personal level. Of those who did identify benefits, project employment was the most cited by a considerable margin, with

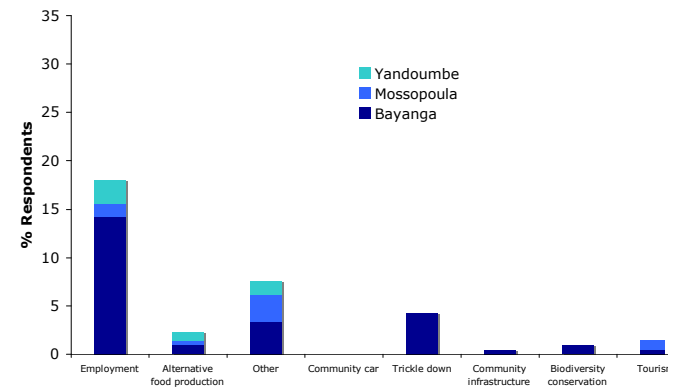
frequent comments both during the survey and during other informal interviews to the effect that the only people who benefited were those with jobs.

There appears to be only a limited appreciation of development efforts in terms of the provision of community infrastructure- in one case we interviewed a man who failed to recognise any project-related benefits whilst sitting in the shade of a sign proclaiming the project's involvement in the construction of a local well. Amongst the BaAka of Yandoumbe and Mossopoula, while there was a slightly greater appreciation of community infrastructure, focussing on the school and health clinic constructed in both villages, this was again limited- only 10 of the 76 respondents mentioned it as a benefit to the community. Amongst both the BaAka and non-Aka, nobody mentioned DSP-funded community infrastructure as benefiting them personally. Informal questioning of reserve inhabitants regarding the source of particular wells or medical posts indicated that most people knew of the project's involvement in infrastructure construction. This suggests that such community-level development projects are either not valued or, after years of being funded by the logging companies, simply taken for granted.

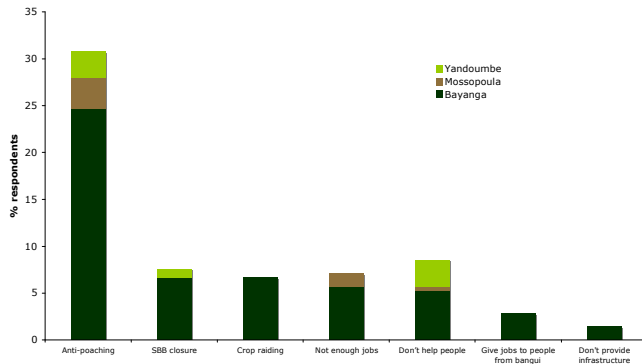
The tourism industry, forest conservation, the community car, and the trickle-down effect of project employees spending salaries in the village were only rarely mentioned as benefits. There was no recognition of the benefits provided by the poaching-informant scheme, presumably not least due to the unwillingness to admit to such activities in front of myself, as a western outsider, and my assistant, a local hunter.



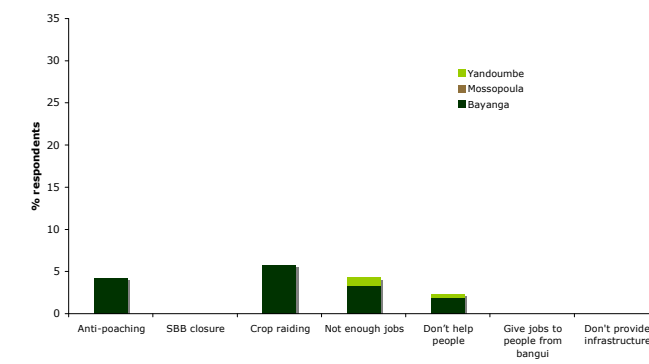
a) Recognition of project-related benefits at the community level



b) Recognition of project-related benefits at the personal level



c) Recognition of project-related problems at the community level



d) Recognition of project-related problems at the personal level

**Figure 5-2** Project-related costs and benefits cited by HAS respondents. Presented as the percentage of interviewees spontaneously citing the impact. Respondents may be represented in more than one category. Bayanga n=135, Yandoumbe n=42, Mossopoula n= 34.

## Perceived costs and benefits of tourism

Tourism in the area is generally well regarded in all three sampled communities and there seems to be little association of tourism with the closure of the forest. There is a strong perception that tourists bring significant benefits to the area, economic benefits in particular. Over 55% also reported personal benefits from tourism, perhaps surprising given the limited access to tourist related work seen in Bayanga.

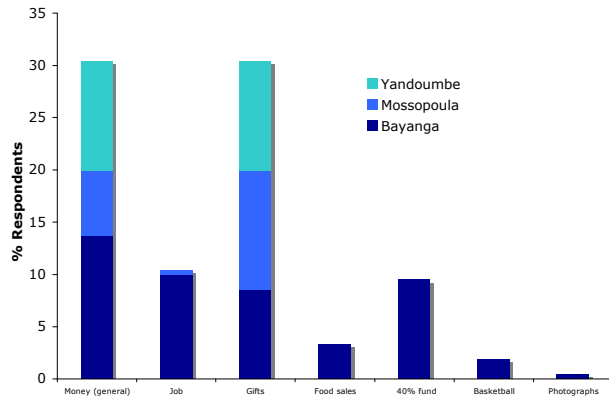
The BaAka, in particular, seem to have adapted to tourism with ease, with one of the few complaints expressed by Yandoumbe and Mossopoula residents being the high level of competition for tourism-related work. Observations made both whilst accompanying tourist net hunts, and questioning BaAka participants afterwards, suggest there is generally a very positive attitude towards tourist forest trips, with no mention of problems relating to cultural impacts. One Yandoumbe resident commented “ *Why wouldn't we like it? If we go [hunting] with BaAka we get meat. If we go with tourists we get meat and money.*” The BaAka also appeared much more at ease with photographs than Bayanga residents, although a few young enterprising males in Yandoumbe occasionally request a present in return for a photo. The language barrier means that much of the tourist- BaAka interactions are conducted through a project-appointed non-Aka guide, and many BaAka expressed mistrust in the guide's representation of their interests, particularly with regards to money transactions.

Few tourism-related problems were reported by the non-Aka, although a number of Bayanga residents commented this was largely due to the lack of contact between tourists and the community.

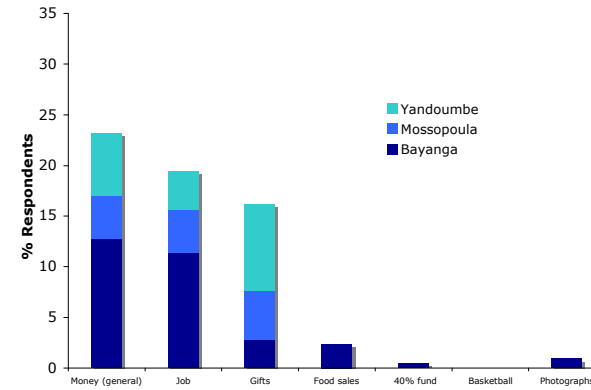
*“ What relationship? We only see them [tourists] when they pass in the car”*

Bayanga resident in response to a question regarding the relationship between tourists and the community

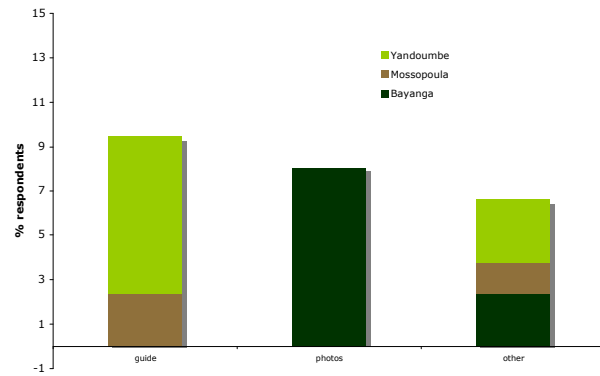
Amongst the non-Aka population of both Mossopoula and Bayanga there also seems to exist a degree of jealousy at the level of contact that the BaAka have with the tourists, and hence access to the tourist dollar. It was, however, pointed out by a number of non-Aka women that it was possible to benefit from this money by selling food to the BaAka, acknowledging the ‘trickle down’ effect.



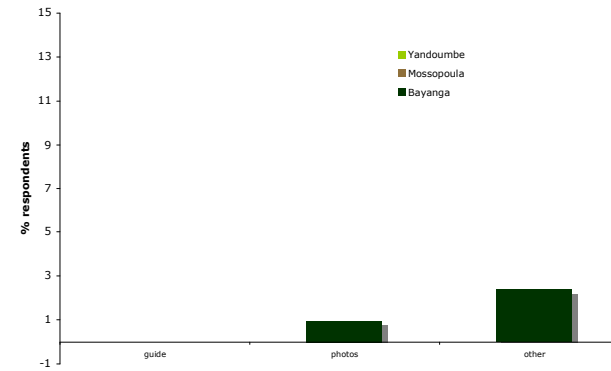
a) Benefits associated with tourism at the community level



b) Benefits associated with tourism at the personal level



c) Costs associated with tourism at the community level



d) Costs associated with tourism at the personal level

**Figure 5-3** Tourism-related costs and benefits cited by questionnaire respondents. Responses are presented as the percentage of interviewees within each village spontaneously citing the impact. Respondents may be represented in more than one category. Bayanga n=135, Yandoumbe n=42 and Mossopoula n= 34.

Few people voluntarily mentioned the revenue-sharing programme as a tourism-related benefit, although later questioning revealed over 40% of respondents had heard of it. Even fewer could name any of its uses. There appeared to be a widespread perception that either the project or local government representatives were keeping the money, leading to a certain degree of bad feeling at what was seen as a breaking of promises by the project.

#### 5.4.2 The distribution of cost/benefit recognition in the community

I then explored the relationship between cost/benefit recognition (with regards to tourism, the project and the forest) and particular socio-demographic variables. The results for the two BaAka populations, Yandoumbe and Mossopoula, were found, using Pearson's chi-square statistical tests, to be distributed in a similar way in all categories (table 5.3). They were therefore combined in an overall 'BaAka' dataset and analysed together. Non-Aka responses (Bayanga population) were found to be significantly different to BaAka responses (Mossopoula and Yandoumbe) in 5 out of 7 categories and were therefore analysed separately.

**Table 5-3** Results of chi-square tests for degree of similarity between costs/benefit recognition in the three sampled populations: Yandoumbe (n=42), Mossopoula (n=34) and Bayanga (n=135). \* p<0.05, \*\* p<0.01

		Mossopoula vs. Yandoumbe BaAka	BaAka vs. Bayanga non-Aka	Description of difference: BaAka recognise...
		$\chi^2$	$\chi^2$	
<b>Tourism</b>	<b>Community costs</b>	3.708	11.352 **	..more costs
	<b>Community benefits</b>	0.336	18.655 **	..more benefits
	<b>Personal costs</b>	no variation	2.883	
	<b>Personal benefits</b>	3.162	10.627 **	..more benefits
<b>Project</b>	<b>Community costs</b>	0.051	34.526 **	..less costs
	<b>Community benefits</b>	3.162	2.537	
	<b>Personal costs</b>	0.665	13.070 **	..less costs
	<b>Personal benefits</b>	0.122	5.086 *	..less benefits
<b>Forest</b>	<b>Community costs</b>	0.703	41.504 **	..less costs
	<b>Community benefits</b>	no variation	4.107 *	...more benefits

### a) The distribution of forest costs/benefit recognition

Of the non-Aka respondents, results suggest that respondents from households containing one or more snare hunters were much more likely to be aware of the forests benefits. It also appears to be the more recent in-migrants and the less well-educated residents who show a greater appreciation for the forests resources, although these relationships were weaker.

**Table 5-4** Three logistic regression models showing socio-demographic variables predicting non-Aka recognition of forest benefits (community and personal level) and BaAka recognition of forest costs (community level). Only variables significant at the 10% level or below are shown. N= 135 (non-Aka). N=76 (BaAka). †p<0.1. \*p<0.05, \*\*p<0.01, \*\*\*p<0.001

		Model	Variable	B	SE	Model R <sup>2</sup> (Nagelkerke)	Model $\chi^2$
Non-Aka	Community Benefit	1	Snare 2006	2.899*	1.232	0.398	18.857*
			Education	-2.094†	1.091		
			Residency	-0.071†	0.041		
	Personal Benefit	2	Residency	-0.055*	0.021	0.133	10.677
BaAka	Community Cost	3	Hunt 2006	2.622**	0.88	0.349	18.849**
			Project job	5.185*	2.321		
			Snare 2006	1.850*	0.811		

Confirming results in the previous section, the BaAka recognised significantly more forest-related benefits and noted less problems than the non-Aka. Within the BaAka sample, the respondents with a household member who was involved in gun or snare hunting or, interestingly, project employees, were much more likely to mention forest-related problems at the community level.

When looking at which socio-demographic variables predicted recognition of particular costs and benefits, appreciation of the forest as a provider of food was significantly higher amongst younger, less well-educated in-migrant men (see below).

**Table 5-5** Logistic regression model showing socio-demographic variables predicting non-Aka recognition of food as a community level forest benefit. Only variables significant at the 10% level or below are shown. N= 116. †p<0.1. \*p<0.05, \*\*p<0.01.

	Variable	B	SE	Model R <sup>2</sup> (Nagelkerke)	Model $\chi^2$
<b>Food as a community level forest benefit</b>	Snare hunt 2006	2.262**	0.78	0.288	22.798*
	Education	-1.998**	0.67		
	Gender	1.885*	0.85		
	Age	-0.062*	0.031		
	Residency	-0.046†	0.024		

### b) The distribution of tourism-related costs/benefit recognition

Recognition of benefits arising from tourism was strongly predicted by access to tourism related work, both formally, as a project employee, and informally, through involvement with the village based tourism programme. BaAka respondents, most of whom have access to tourism-related work, were much more likely to recognise benefits than the non-Aka.

**Table 5-6** Three logistic regression models showing socio-demographic variables predicting non-Aka recognition of tourism-related benefits (community and personal level) and BaAka recognition of personal benefits. Only variables significant at the 10% level or below are shown. N= 135 (non-Aka). N=76 (BaAka). †p<0.1. \*p<0.05, \*\*p<0.01, \*\*\*p<0.001

	Model	Variable	B	SE	Model R <sup>2</sup> (Nagelkerke)	Model $\chi^2$	
<b>Non-Aka</b>	<b>Community Benefit</b>	1	Project job	2.32**	0.89	0.257	26.843**
			Tourism work 2006	1.40†	0.73		
			Gun hunt 2006	0.95†	0.49		
	<b>Personal Benefit</b>	2	Project job	2.72**	0.84	0.403	42.746***
			Tourism work 2006	1.58*	0.64		
			Age	-0.05 *	0.03		
<b>BaAka</b>	<b>Personal Benefit</b>	3	Tourism work 2006	1.04†	0.56	0.232	14.515*

Within the non-Aka sample, it was the younger respondents who were more likely to recognise personal benefits, mentioning tourism related work in particular. A strong model was constructed



for the recognition of the 40% amongst the non-Aka, found to be significantly higher amongst project employees, more educated respondents and those that have lived in the reserve longer.

**Table 5-7** Logistic regression model showing socio-demographic variables predicting non-Aka recognition of the 40% revenue distribution and tourism related work as tourism-related benefits. Only variables significant at the 10% level or below are shown. N= 116. †p<0.1. \*p<0.05, \*\*p<0.01, \*\*\*p<0.001

	Variable	B	SE	Model R <sup>2</sup> (Nagelkerke)	Model χ <sup>2</sup>
<b>Recognition of the 40% revenue distribution fund as a community benefit</b>	Project job	4.55 **	1.39	0.614	54.886***
	Education	2.24*	0.90		
	Residency	0.08*	0.04		
<b>Recognition of tourism related work as a personal benefit</b>	Project job	2.78*	1.12	0.512	46.424***
	Tourism work 2006	1.98**	0.77		
	Age	-0.07†	0.04		

### c) The distribution of DSP-related costs/benefit recognition

Appreciation of the advantages of the DSP is strongly related to project employment, with respondents from households with project employees more likely to mention both community and personal level benefits. Gender also appears linked, although less strongly. At the community level, non-Aka men were much more likely than women to recognise DSP-related impacts, whether negative or positive. Respondents from wealthier households were more likely to recognize personal benefits from the project.

**Table 5-8** Three logistic regression models showing socio-demographic variables predicting non-Aka recognition of project-related costs and benefits. Only variables significant at the 10% level or below are shown. N= 135. †p<0.1. \*p<0.05, \*\*p<0.01, \*\*\*p<0.001

	Model	Variable	B	SE	Model R <sup>2</sup> (Nagelkerke)	Model χ <sup>2</sup>	
<b>Non-Aka</b>	<b>Community Cost</b>	1	Gender	1.30*	0.62	0.223	19.80*
	<b>Community Benefit</b>	2	Project job	2.38**	0.87	0.262	27.549**
			Gender	0.90†	0.54		
	<b>Personal Benefit</b>	3	Project job	5.22***	1.09	0.517	60.139***
			Wealth rank	1.01**	0.37		

Problems relating to anti-poaching patrols, whether at the community or personal level, were significantly more likely to be reported by men. Respondents from households involved in snare hunting and those with a lower wealth ranking were also much more likely to cite problems with the anti-poaching team at the personal level. Respondents who directly benefited from project employment were much less likely to complain about the closure of SBB- the most recent logging company- and hence the loss of jobs. Finally, the recognition of employment as a project-related benefit was strongly predicted by a household member being employed in tourism and/or project work. Interestingly, residents who had more recently migrated into the reserve were more likely to suggest employment as a benefit.

Within the BaAka population, there were no strong relationships between recognition of project impacts and the socio-demographic variables measured.

**Table 5-9** Logistic regression model showing socio-demographic variables predicting non-Aka recognition of particular cost and benefits associated with the ICDP. Only variables significant at the 10% level or below are shown. †p<0.1. \*p<0.05, \*\*p<0.01, \*\*\*p<0.001

		n	Variable	B	SE	Model R <sup>2</sup> (Nagelkerke)	Model $\chi^2$
<b>Community cost</b>	<b>Anti-poaching</b>	52	Gender	1.276*	0.566	0.182	18.053†
	<b>SBB closure</b>	14	Project job	-1.939†	1.002	0.118	7.435
<b>Personal cost</b>	<b>Anti-poaching</b>	9	Snare hunt 2006	2.170*	0.977	0.395	21.857 *
			Wealth rank	-1.270*	0.642		
			Gender	2.701†	1.433		
<b>Community Benefit</b>	<b>Job</b>	47	Tourism work 2006	1.243*	0.569	0.169	16.618§
			Residency	-0.032†	0.018		
<b>Personal Benefit</b>	<b>Job</b>	30	Project job	5.403***	1.241	0.633	67.930***
			Residency	-0.062†	0.032		

### 5.4.3 Conservation-related attitudes

#### a) Attitudes to the protected areas

A respondents attitude to the protected area, specifically Dzanga National Park, was assessed by whether they wished to see it de-gazetted or not, either for the purposes of agriculture or hunting. For the non-Aka the two questions revealed very similar results, with nearly half of the respondents wishing to remove park boundaries for either reason.

**Table 5-10** Attitudes of respondents from each village towards opening the park. Displayed as % of the overall village sample. Bayanga n=135, Yandoumbe n=42 and Mossopoula n= 34.

		Response category		
		No	Don't know	Yes
<b>Open park for agriculture?</b> <sup>20</sup>	<b>Bayanga</b>	61	6	33
	<b>Mossopoula</b>	-	-	-
	<b>Yandoumbe</b>	-	-	-
<b>Open park for hunting?</b>	<b>Bayanga</b>	65	5	30
	<b>Mossopoula</b>	13	7	80
	<b>Yandoumbe</b>	21	10	69
<b>Open park overall?</b>	<b>Bayanga</b>	49	7	44
	<b>Mossopoula</b>	13	7	80
	<b>Yandoumbe</b>	21	10	69

Reasons given for keeping the park limits in place were mainly due to the belief that there is already sufficient space for both agricultural purposes and hunting. Given the high levels of illegal activity in the park and the widespread dislike of the project's anti-poaching activities, it is possible these numbers underestimate local desire to see the park opened up, with people misrepresenting their actual feelings for fear of repercussions. This highlights the difficulties inherent in questioning respondents on such a sensitive issue. The BaAka, however, were more vocal about wishing the park to be opened for hunting, particularly residents of Mossopoula, situated further away from the hunting zone. Some appreciation of the conservation function of the park was shown, however, with a number of BaAka respondents asking for just a portion of the park to be opened, or opened just for net hunting, on the grounds that the non-Aka gun hunters would quickly empty the forest.

*“If we opened all [park], all the Bilo [non-Aka] would go there and make noise and chase the animals far away”.*

Yandoumbe BaAka resident

<sup>20</sup> This question was not posed to the BaAka in light of their low interest levels in agriculture.

## b) Attitudes to the Dzanga-Sangha Project

Spearman's  $\rho$  statistical test was used to ensure responses to both questions on attitudes to the DSP were fairly represented in the overall attitude score. The results, shown below, show a high degree of correlation between the score for individual questions and the overall attitudinal rank.

**Table 5-11** R matrix showing correlation between responses to individual questions and the overall attitudinal score. Responses were coded on a scale of positivity, where negative=0, neutral = 1, optimistic=2 and positive = 3

	Q1	Q2	Attitudinal score
Q1	1.000		
Q2	0.378 **	1.000	
Attitudinal score	0.790 **	0.681 **	1.000

Results for both responses to the individual questions, and the overall attitudinal rank awarded are shown below.

**Table 5-12** Attitudes of respondents from each village towards the DSP. Shown as the percentage of the overall village sample. Bayanga n=135, Yandoumbe n=42 and Mossopoula n= 34.

		Response category			
		Positive	Optimistic	Neutral	Negative
<b>What do you think of the project ?</b>	<b>Bayanga</b>	44	-	15	41
	<b>Mossopoula</b>	56	-	11	33
	<b>Yandoumbe</b>	55	-	7	38
<b>Would you prefer the project to stay, go, or don't you mind ?</b>	<b>Bayanga</b>	82	-	11	7
	<b>Mossopoula</b>	76	-	13	11
	<b>Yandoumbe</b>	69	-	26	5
<b>Overall rank</b>	<b>Bayanga</b>	35	49	1	15
	<b>Mossopoula</b>	53	24	4	18
	<b>Yandoumbe</b>	48	26	0	26

The first open question, (*‘What do you think of the project?’*), split the sample in two. Careful probing regarding reasons for a negative response to the question echoed earlier results on project-associated costs, with complaints about anti-poaching activities and the under-provisions of jobs predominating. Interestingly, however, when asked if they would prefer the project to stay or go, most respondents from all three villages wished the project to stay, primarily for development-focussed reasons such as employment opportunities. There was also a strong awareness of the projects positive impact of the project on the local economy, particularly in the absence of a logging company.

*“If they [the project] go, the village will die”*

Bayanga non-Aka respondent

A limited number of references were also made with regards to the conservation value of the DSP, focusing largely on the bequest value of project work, with comments such as *“It is the grace of the project that animals are still in the forest for our children”*. A small number of BaAka also mentioned the role of the project in encouraging tourism and hence providing another source of income.

### **c) Attitudes to tourism**

Spearman’s  $\rho$  statistical test was again used in order to ensure responses to both questions on attitudes to tourism were fairly represented in the overall attitudinal score. Both question one and two showed a strong correlation with the overall attitudinal score, ( $\rho = 0.886$ ,  $p < 0.001$ , and  $\rho = 0.261$ ,  $p < 0.001$  respectively). Correlation between question one and question two was also present, although it was not statistically significant ( $\rho = 0.083$ ,  $p = 0.116$ ).

Attitudes to tourism in all three villages were overwhelmingly positive, with the majority of both negative and neutral responses related to problems of accessing the tourism industry, rather than the industry itself. Interestingly, given the problems of accessing the industry, the majority of comments qualifying a positive response were related to the economic benefits linked to tourism, such as job creation or craft sales.

**Table 5-13** Attitudes of respondents from each village towards the tourism programme. Displayed as % of the overall village sample. Bayanga n=135, Yandoumbe n=42 and Mossopoula n= 34.

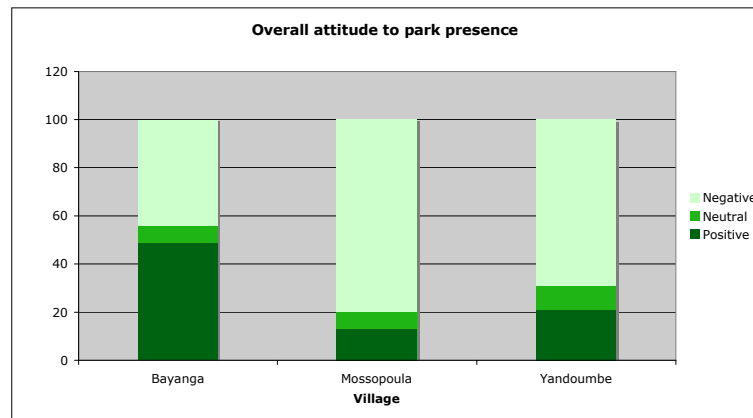
		Response category			
		Positive	Optimistic	Neutral	Negative
<b>What do you think of tourism in your area?</b>	<b>Bayanga</b>	75		22	3
	<b>Mossopoula</b>	82		9	9
	<b>Yandoumbe</b>	96		2	2
<b>Would you prefer to see more, less or the same number of tourists to your area?</b>	<b>Bayanga</b>	76		24	0
	<b>Mossopoula</b>	87		13	0
	<b>Yandoumbe</b>	45		0	0
<b>Overall attitudinal score</b>	<b>Bayanga</b>	56	19	23	2
	<b>Mossopoula</b>	71	16	11	2
	<b>Yandoumbe</b>	95	5	0	0

#### 5.4.4 Using cost/benefit recognition to predict attitudes

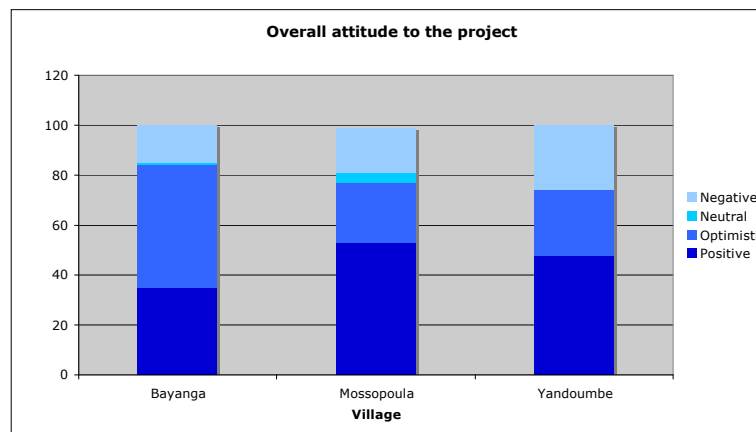
A quantitative approach was adopted to investigate the relationships between conservation-related attitudes (with regards to tourism, the project and the forest) and both costs/benefit recognition and certain socio-demographic variables (see table 5.1.)

##### Comparing attitudes between villages

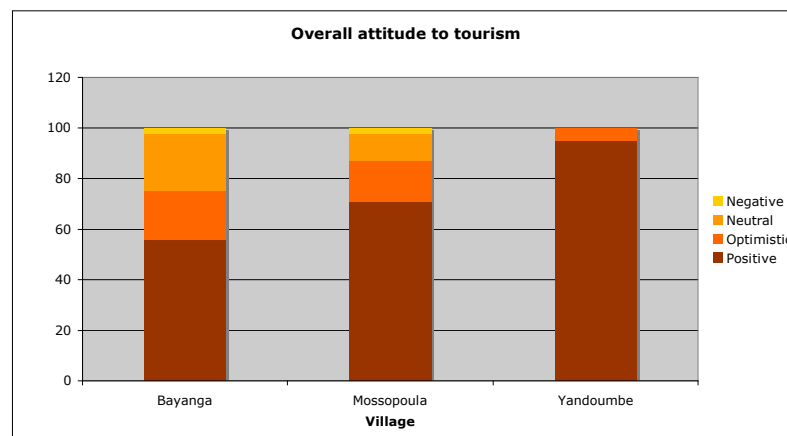
Using Pearson's chi-square tests, the distribution of attitudinal scores for BaAka respondents from Mossopoula and Yandoumbe were not found to vary with respect to tourism ( $\chi^2 (2) = 1.666$ ,  $p=0.435$ ), the project ( $\chi^2 (2) = 1.559$ ,  $p=0.459$ ), or park de-gazetting ( $\chi^2 (2) = 4.344$ ,  $p=0.114$ ). Consequently all BaAka respondents' results were pooled for analysis. When comparing BaAka attitudes to non-BaAka attitudes, significant differences were found in attitudes to tourism ( $\chi^2 (3) = 10.658$ ,  $p=0.014$ ), the project ( $\chi^2 (3) = 13.478$ ,  $p=0.004$ ) and park de-gazetting ( $\chi^2 (2) = 25.381$ ,  $p<0.001$ ). Consequently results for the BaAka and non-Aka were analysed separately.



(a)



(b)



(c)

**Figure 5-4** Distribution of conservation-related attitudes within each of the three villages sampled (a) attitudes to park presence (b) attitudes to the ICDP (c) attitudes to tourism. Bayanga n=135, Yandoumbe n=42 and Mossopoula n= 34.

12 logistic regression models were constructed to evaluate which combination of variables best predicted the attitude of a respondent towards the park, the project and the tourism programme. However for 5 of the models none of the independent variables entered acted as significant predictors. These are shown in the tables below in pale grey.

#### 5.4.4.1 Non-Aka

##### a) Predicting attitudes to the protected areas

A positive attitude to protected areas - here represented by a wish to keep Dzanga National park- appeared to be strongly linked to recognition of the advantages of tourism, in addition to the perception of personally benefiting from DSP presence. Attitudes towards the park were also predicted by a respondent's recognition of forest-related costs occurring at the community level, although no one particular problem (such as crop-raiding) appeared to be more influential than another in promoting a positive attitude.

None of the independent variables entered into the model appeared to be strong predictors of what would make a respondent actively negative, as oppose to neutral or positive, towards the protected area.

**Table 5-14** Two logistic regression models showing variables predicting non-Aka attitudes to de-gazetting the park. Only variables significant at the 10% level or below are shown. N= 135. †p<0.1. \*p<0.05, \*\*p<0.01, \*\*\*p<0.001. CB= community benefits, PB= personal benefits, CC=community costs

	Model	Variable	B	SE	Model R <sup>2</sup> (Nagelkerke)	Model $\chi^2$
<b>Never de-gazette</b> (Positive vs. neutral/negative)	1	CB tourism	1.42**	0.54	0.317	33.142†
		PB Project	1.28*	0.64		
		CC forest	0.91†	0.51		
<b>Always de-gazette</b> (Negative vs. neutral/positive)	2				0.274	28

##### b) Predicting attitudes to tourism

A strong model was constructed for predicting which respondent would display an actively positive attitude towards tourism, rather than simply optimistic or neutral. Respondents involved in tourism



related work (either formally through the project or informally through village based tourism activities), those recognising community benefits accruing from tourism, in particular the 40% fund ( $\chi^2(1) = 3.194, p = .074$ ) and, interestingly, more recent in-migrants, are all much more likely to be actively positive about tourism. None of the independent variables entered into the model appeared to be strong predictors of what would make a respondent only neutral rather than optimistic or positive towards tourism in the area.

**Table 5-15** Two logistic regression models showing variables predicting non-Aka attitudes to tourism. Only variables significant at the 10% level or below are shown. N= 135. †p<0.1. \*p<0.05, \*\*p<0.01, \*\*\*p<0.001. CB= community benefits.

	Model	Variable	B	SE	Model R <sup>2</sup> (Nagelkerke)	Model $\chi^2$
<b>Positive or not?</b> (Positive vs. optimistic/neutral)	1	Residency	-0.06*	0.03	0.477	48.650**
		Tourism work 2006	2.81*	1.25		
		CB tourism	1.45*	0.64		
		Project job	2.68†	1.42		
<b>Neutral or not?</b> (Neutral vs. positive/optimistic)	2				0.332	15.329

### c) Predicting attitudes to the Dzanga-Sangha Project

An actively positive attitude towards the DSP appears strongly linked to those respondents recognising personal benefits from it, in particular project employment ( $\chi^2(1)=14.211, p<0.001$ ). More recent in-migrants are also more likely to think more positively of the project.

**Table 5-16** Two logistic regression models showing variables predicting non-Aka attitudes to the ICDP. Only variables significant at the 10% level or below are shown. N= 135. †p<0.1. \*p<0.05, \*\*p<0.01, \*\*\*p<0.001. CB= community benefits, PB= personal benefits

	Model	Variable	B	SE	Model R <sup>2</sup> (Nagelkerke)	Model $\chi^2$
<b>Positive or not?</b> (Positive vs. optimistic/negative)	1	PB project	1.237†	0.659	0.397	41.027**
		Residency	-0.045†	0.023		
<b>Negative or not?</b> (Negative vs. optimistic/positive)	2	CB forest	-2.830*	1.212	0.482	43.107**
		Education	-1.557*	0.641		
		CB tourism	-1.239†	0.708		
		Gun hunt 2006	1.633†	0.84		

An actively negative attitude towards the project is strongly predicted by a failure to recognise benefits from the forest or from the tourism programme, in particular the recognition of tourism-related work ( $\chi^2(1)=6.200$ ,  $p=0.013$ ). Respondents with a lower level of education and from households involved with gun hunting were also significantly more likely to view the project negatively

#### 5.4.4.2 BaAka

##### a) Predicting attitudes to the protected areas

While a model was constructed for predicting a BaAka respondent's attitude to the protected areas, it is a relatively weak one. Nevertheless, it suggests that respondents who fail to recognise any personal benefits from the project, particularly if they don't have a job ( $\chi^2(1)=3.703$ ,  $p=0.076$ ), are more likely to want to de-gazette the park. While all BaAka participate in net hunts, a much smaller percentage of BaAka men are involved in gun hunting, either as a porter or hunter for a non-Aka patron. Interestingly, respondents involved with gun hunting are more likely to want to keep the park in place, although the B is unreliably large.

**Table 5-17** Two logistic regression models showing variables predicting BaAka attitudes to de-gazetting the park. Only variables significant at the 10% level or below are shown. N= 76. † $p<0.1$ . \* $p<0.05$ , \*\* $p<0.01$ , \*\*\* $p<0.001$ . PB= personal benefits

	Model	Variable	B	SE	Model R <sup>2</sup> (Nagelkerke)	Model $\chi^2$
<b>Never de-gazette</b> (Positive vs. neutral/negative)	1				0.33	14.311
<b>Always de-gazette</b> (Negative vs. neutral/positive)	2	Project PB	-2.392*	1.106	0.452	23.553 <sup>†</sup>
		Gun hunt 2006	-4.154*	1.634		
		Snare hunt 2006	2.710 <sup>†</sup>	1.405		

##### b) Predicting attitudes to tourism

It was not possible to construct any logistic models predicting BaAka attitudes to tourism using the specified variables as predictors. This is primarily due to the overwhelmingly positive attitude to tourism (84% of BaAka respondents).

### c) Predicting attitudes to the Dzanga-Sangha Project

Cost and benefit recognition was strongly related to attitudes to the DSP, with respondents much more likely to be actively positive towards the project if they recognised project benefits at both the personal and community level, and less community costs from the projects presence.

A strong model was produced when examining predictors for an actively negative attitude- again suggesting that recognition of the project community level costs and benefits are linked to a less negative attitude, in particular failure to cite the anti-poaching team as a problem ( $\chi^2(1)= 8.495$ ,  $p=0.008$ ).

**Table 5-18** Two logistic regression models showing variables predicting BaAka attitudes to the ICDP. Only variables significant at the 10% level or below are shown. N= 76. <sup>†</sup> $p<0.1$ . \* $p<0.05$ , \*\* $p<0.01$ , \*\*\* $p<0.001$ . CB= community benefits, PB= personal benefits, CC= community costs, PC= personal costs.

	Model	Variable	B	SE	Model R <sup>2</sup> (Nagelkerke)	Model $\chi^2$
<b>Positive or not?</b> (Positive vs. optimistic/negative)	1	Project CB	1.88**	0.72	0.408	25.571*
		Project PB	2.10*	0.98		
		Project CC	-1.28 <sup>†</sup>	0.67		
<b>Negative or not?</b> (Negative vs. optimistic/positive)	2	Project CC	3.23*	1.36	0.61	36.766**
		Project CB	-2.98*	1.29		
		Tourism CC	-2.67*	1.23		

## **5.5 Discussion**

It is an integral part of the ICDP remit that, by providing conservation related benefits, local communities will be encouraged to support conservation-related activities in the region. While this link has been suggested to be successful in some cases (Abbot et al., 2001, Mehta and Heinen, 2001, Gillingham and Lee, 1999, Archabald and Naughton-Treves, 2001), other projects have struggled (Infield and Namara, 2001, Gibson and Marks, 1995, Wells et al., 1992). This chapter investigated the validity of this assumption by examining, firstly, how conservation-related impacts are perceived by the local community and, secondly, how these perceptions are linked to pro-conservation attitudes. Conservation was disaggregated into different dimensions, namely the forest, the ICDP and the tourism programme.

### **5.5.1 The Park**

#### ***Balancing the costs and benefits:***

The importance of the forest to the community as a whole is clear, with appreciation for its benefits focusing very much on extractable resources, in particular meat. Recognition of the forest as a supplier of food is particularly high amongst the more recent in-migrants. While there appears to be some level of appreciation of the conservation value of the park- particularly as a means of ensuring future exploitative use- community members rarely see this as something that benefits them personally. As a result, the primary advantages of the park for the local community- namely its indirect and non-use values- go largely unrecognised.

Compounding this, recognition of the long-term benefits of the forest, particularly in terms of future use, are likely to be seriously influenced by both the lack of any traditional management systems in the area and the high mobility of the population. Furthermore, there appears to be very little sense of territoriality within the forest, either for the BaAka or non-Aka hunters, adding to the lack of sense of ownership. These conditions, it seems, are unlikely to prove conducive when asking people to make a long-term investment in terms of biodiversity conservation in the area.

In Dzanga-Sangha the magnitude of forest resource exploitation at the local level, coupled with a perceived lack of other livelihood options, have made the short-term costs of abstaining from hunting high. The situation has been exacerbated by the massive influx of people in the last 30 years, greatly increasing pressure on forest resources. The traditional ICDP tool of attempting to

provide alternative livelihoods to hunting, here primarily through agriculture, have so far failed to have much impact, whilst the constant rumour of the reopening of the logging mill discourages serious development of alternative livelihoods. As a result there is considerable anger about the anti-poaching activities of the project, which is seen as preventing reserve residents, with no other employment options, from making a living.

***Linking forest benefits to attitudes:*** Most of the BaAka interviewed for this study belonged to families present in the area before the park was formed and who lost a considerable portion of their traditional hunting grounds. It is unsurprising that most wish the park de-gazetted, and the forest returned to them. Park support appears to be present most commonly in respondents who personally benefit from the project, in particular through employment, one of the few ICDP benefits to support a significant alternative livelihood (chapter 6). This suggests that the benefit-attitude link is supported where the benefit is direct, short-term and equivalent to the costs.

Despite the support for de-gazetting amongst Mossopoula and Yandoumbe residents, the role of the park and the anti-poaching patrols in protecting forest animals from the non-Aka gun-hunters<sup>21</sup> is appreciated to a certain extent, and many BaAka are keen to create an area just for BaAka net hunting- in effect create a protected area for their personal use. While on paper this may be desirable- net hunting is both a central component of traditional BaAka culture and known to remove fewer animals than either gun or snare hunting (Noss, 1995)- in reality it appears difficult to enforce- the current hunting zone itself was intended to support traditional hunting methods only, yet in reality is subjected to high levels of both snare and gun hunting, with the BaAka frequently harassed by non-Aka hunters (Sarno, 1998).

Surprisingly, given the widespread anger with regards to the anti-poaching squad, around half of the non-Aka respondents appeared to wish to keep the park in place. Support for the park is again strongly linked to the receipt of benefits- both personally from the project and those seen to accrue to others from tourism- as well as there being no perception of park-related problems. While it is possible that either the opportunity costs imposed as a result of park gazettement are lower than suggested or that the perceived benefits of the park may be higher than revealed- for example, a hunter may appreciate the anti-poaching teams effectiveness at controlling his competitors- the high level of illegal extraction of ntfps and the considerable anger against the anti-poaching team appear

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<sup>21</sup> Whilst certain BaAka men may be hired to hunt with a non-Aka owned gun, no Aka currently own a gun themselves

to contradict this. It should also be considered that a high level of misrepresentation, possibly motivated through fear of repercussions, caused people to falsely claim they support the park.

### 5.5.2 Tourism

***Balancing costs and benefits:*** The extremely slow development of the tourism industry in this area and the many problems associated with it have been well documented (Hardin, 2000, Wilkie and Carpenter, 1999b). Whilst the economic review in chapter four fails to support Blom's claim, following his study of the local economy in Dzanga-Sangha, that "*The impact of tourism on the local economy is substantial.*" (Blom, 2001a), tourism nevertheless has garnered a great deal of support, particularly amongst the newer in-migrants and poorer households, both through the direct access to benefits as well as the perception of benefits accruing to others. The BaAka, in particular, enjoy locally significant tourist-related benefits with seemingly few perceived problems aside from competition for work. However, the lack of infrastructure to capture the tourist dollar at a local level means local level benefits are generally limited to working directly with the tourists. Furthermore, within the reserve, access to tourism work is extremely limited, with access by those villages outside the three included in the study almost non-existent.

There appears to be little conceptual linking of tourism to the gazetting of the park, and hence associated opportunity costs. This may well be due to the majority of community-tourist interactions taking place within the village. As a result, there appears to be few problems associated with the industry outside of its limited scale and therefore people's access to work.

The revenue sharing scheme, dogged with problems, including low tourist numbers, local corruption and low community interest, is largely unrecognised as a park, project or tourism related benefit, although over 40% of respondents had heard of it when questioned directly, particularly the better educated or those connected to the project. Archabald and Naughton-Treves (2001) suggest that there need to be four key components to enable revenue sharing schemes to succeed: long-term institutional support, appropriate identification of the target community, transparency and accountability and adequate funding. DSP has highlighted the 40% scheme as one of the key components of the ICDP and, as such, they are committed to its long term running. Considerable financial and logistical support has already been given to the set up and running of the tourism programme and this is planned to continue. However, the problems encountered with establishing a local NGO capable of efficiently distributing the money has seriously undermined community

confidence in the scheme. Low tourist numbers, resulting in poor revenue generation, further exacerbates the situation. Finally, the inclusion of all reserve residents as beneficiaries of the scheme has resulted in long-term reserve residents, present in the area before park formation, being entitled only to the same level of benefits as a recent in-migrant to the area. Regardless of the ethical implications of this working definition, the steady increase in the reserve's population has resulted in a concurrent decrease in an individual's share of the benefits, whilst conservation-related costs remain the same.

***Linking tourist benefits to attitudes:*** Tourism is a popular ICDP tool, included due to its non-extractive nature and perceived ability to produce significant revenue, thus influencing attitudes. However, in the reserve community, amongst the non-Aka particularly, tourism seems popular *despite* producing little in the way of benefits. Support for the tourism programme is, again, strongly linked to the recognition of benefits provided by the industry, almost all of which are direct and short term in nature, e.g. work, presents or craft sales. While these benefits accrue at the personal level, recognition of them accruing to others in the community also appears sufficient to support positive attitudes. This support is undoubtedly aided by the lack of problems associated with the industry- despite the small returns, tourism is still seen as delivering net benefits.

Given the importance placed on developing the industry by the ICDP and its popularity amongst the reserve population, tourism appears to have considerable potential for development. Yet the logistical problems of developing the industry in such a site remain. Its potential for providing sufficient revenue to compensate opportunity costs seems extremely doubtful, particularly considering the ever-increasing population of the reserve (Wilkie and Carpenter, 1999b, Wilkie et al., 2001). Furthermore, the problems associated with the distribution of the revenue, both in terms of ensuring accountability and transparency and identifying the target community, seen in numerous other sites is problematic (Archabald and Naughton-Treves, 2001). The recent government decision to distribute the money through local government structures raises concerns that the money will not be separated from other funds, hence the link between the production of the revenue and pro-conservation practices may fail to be emphasised. Previous attempts at distributing funds in this way also suffered serious problems regarding transparency and misappropriation of funds (Fay, 1993).

The popularity of tourism with the main stakeholders and, crucially, its apparent link to support of the park, encourages its continuing support and development. However, it should be viewed realistically. Tourism will probably never be capable of offsetting all opportunity costs in the

region, particularly in the light of the increasing population. It may, however, complement other benefits and, as such, contribute. Increasing tourist numbers is undoubtedly the most direct way of increasing benefits- this would both increase current opportunities such as work and craft sales and, in addition, may encourage the involvement of others by increasing predictability. For example, food sale to the tourist lodge is accessible to all yet due to the unpredictability of tourist arrival, not currently recognised as a reliable source of income. Attention should also be paid to possible ways to increase access to current benefits. For example, tourist activities involving non-Aka women may be possible, such as cooking local food. The economic impact of the tourism industry at the local level could potentially be improved by developing the sale of crafts, particularly amongst the BaAka. The unpredictability of this source of income may be evened out to a certain extent by forming a central co-operative, run by a paid professional, which purchases and stockpiles proffered crafts. Given the popularity of BaAka crafts, the necklaces in particular, it may also be feasible to investigate creating an international market using the internet or pre-existing fair-trade organisations.

### 5.5.3 The Dzanga-Sangha Project

*Balancing the costs and benefits:* Of the actual benefits associated with the project's presence outlined in chapter four, only project employment emerges as widely recognised and valued. This focus on short-term, direct benefits provided by the ICDP means the majority of project-related benefits, namely community development, the creation of alternative livelihoods, and the indirect and non-use values of park protection, are essentially not valued.

Crucially, given their traditional role at the heart of most ICDPs, there is little recognition or valuing of the project's community development activities, such as the provision of educational or medical services, particularly at the personal level. The history in the reserve of outside organisations, primarily logging companies, building and operating public institutions such as schools and hospitals in the place of the state appears to have led to the assumption that it is the project's responsibility to provide these services. Furthermore there is frequent anger when residents are asked to contribute work or money to a community project, as is common practice in the development sphere. It appears, therefore, that while the failure to support community infrastructure may lead to negative reactions, their support will not necessarily result in positive reactions. The frequent failure of community level benefits to be seen as compensatory for costs



accrued at the individual level results in their having little impact as an incentive (Gibson and Marks, 1995, Parry and Campbell, 1992).

Problems associated with the project continue to focus on the direct, short-term costs- namely the anti-poaching activities- with snare hunters, poorer households and young men in particular most likely to report problems with the anti-poaching team. The frequent complaint that the project fails to help the population appears to refer to its failure to provide households with either money or assets, illustrating the very different goals of the local community compared to the ICDP.

Throughout my fieldwork, suggestions as how the ICDP could function better focussed almost exclusively on halting anti-poaching activities, confirming the general lack of interest in, or understanding of, the project's conservation goals. This mismatch between community and project prioritisation may undermine the fundamental principles upon which ICDPs are based, and is discussed in greater detail in chapter nine.

***Linking project benefits to attitudes:*** From a strictly economic viewpoint, project employment is the only ICDP tool that offsets opportunity costs at the household level. It is also clear that access to jobs is extremely limited. It would therefore be anticipated that the imbalance of perceived costs and benefits in all but the employed would result in negative attitudes. This appears to be true to a certain extent- for both the BaAka and non-Aka positive attitudes towards the project appeared to be strongly linked to the receipt of personal benefits, especially employment. However, negative attitudes to the project are also strongly linked to the failure to recognise both tourism and forest related benefits at the community level. These benefits themselves are not acting at the community level- rather they are direct, short-term benefits (such as employment) seen to accrue to other community members. Hence, while actually receiving significant benefits from the project results in a positive attitude, perceiving others to receive these benefits is sufficient to produce an optimistic, rather than negative view of the project. This may be explained in two ways. The first is simply that a more positive attitude is encouraged by the possibility that, in the future, the individual may also access the benefits he or she sees accruing to others. However, this optimism also appears to be strongly linked to the project's support of the local economy, highlighting the importance of the 'trickledown' effect in encouraging positive attitudes (or indeed more horizontal sharing in the case of the BaAka).

#### 5.5.4 Who do we mean by community?

While the Dzanga-Sangha project attempts to treat all reserve residents equally with regards to the distribution of benefits, there are clear cases where impacts accrue in specific areas, as outlined in chapter four. For example, tourist activities are conducted in only three out of the eight villages in the reserve. When looking at how socio-demographic factors affect both impact distribution and pro-conservation attitudes, five factors appeared to be influential, namely ethnicity, residency length, wealth, age and education.

***Ethnicity:*** Ethnicity, with its associated implications for resource use patterns, is often one of the strongest socio-demographic factors affecting attitudes to conservation (Mehta and Heinen, 2001, Holmes, 2003). While it was not feasible to compare non-Aka ethnic groups, results showed very clear differences in attitudes between the BaAka and non-Aka residents of the reserve. BaAka residents are less supportive of the park, yet conversely more supportive of the project managing it, particularly the tourism project. While, arguably, it is the BaAka who have been the most affected by the formation of the park, the focus of the project on BaAka communities, such as the support of a long running BaAka health project and employment through the tourism programme appears to have resulted in greater levels of support.

***Residency:*** It is to be anticipated that people resident in the reserve before the park was gazetted may be more aware of the costs of losing access to the forest. While residency length doesn't appear to affect attitudes to the park significantly, more recent in-migrants are more likely to have a positive attitude towards both the tourism programme and the project overall. Interestingly, they also seem to show a greater appreciation of the advantages to living in the area, both of the forest as a source of food but also of project employment opportunities, suggesting the advantages of both are clearer if moving from an area which may have neither. Surprisingly, however, there appear to be no significant differences in terms of recognition of problems relating to the park or the project- both permanent residents and pre and post park in-migrants appear equally angry about park law enforcement activities.

***Wealth:*** Wealth also appears to be a stratifying factor, with poorer household receiving fewer benefits from the project, jobs in particular. Probably not unrelated to this, in terms of hunting activities being conducted in the absence of other employment, poorer households are more likely to encounter problems with anti-poaching patrols. While this may be a clear case of poorly distributed costs and benefits- the wealthy accrue the most significant benefits, whilst the poor suffer the costs, it may also be a product of it- project employees earn a guaranteed significant

salary and hence may become richer than households relying on the less predictable snare hunting. This issue will be investigated in more detail in chapter six when examining wild meat extraction in more detail.

**Age:** As found in other areas (Sandbrook, 2006, Liu and Wall, 2006), amongst the non-Aka, younger residents have greater access to tourism benefits, particularly work. As the majority of tourism work in Bayanga is river based, the physical nature of the work may limit participants to the younger residents. Conversely, younger people appeared much more aware of problems associated with the anti-poaching patrols, because they either personally experience more problems, or simply feel more comfortable talking about them.

**Education:** Education has frequently been found to influence attitudes (McClanahan et al., 2005, Mehta and Heinen, 2001, Kideghesho et al., 2007), in some cases exerting a greater effect than conservation-related costs, such as crop raiding levels (Heinen, 1993). In the Dzanga-Sangha reserve, it appears to be the less educated respondents who show a greater appreciation of the forest as a source of food. Perhaps related to this, they are also more likely to have negative attitudes towards the project and show less recognition of the 40% fund. While it is possible that more education leads to a greater understanding of conservation-related issues, (McClanahan et al., 2005), it is also likely that this relationship is a result of increased education permitting greater access to alternative livelihood strategies, and to the project's benefits in particular. For example, project employment usually requires production of a school certificate.

### **5.5.5 Linking benefits to pro-conservation attitudes**

The park, tourism and the project: all three are components of the same system whereby the ICDP programme, and the tourism segment in particular, are intended to provide benefits to improve support of the park and the associated conservation activities. In contrast to other studies (Mehta and Kellert, 1998, Walpole and Goodwin, 2001, Gillingham and Lee, 1999), there appear to be several strong links between the three conservation-related aspects- amongst both the BaAka and the non-Aka- recognition of personal benefits associated with the project, in particular employment, strongly predicted a reluctance to de-gazette the park. For the non-Aka, recognition of tourism-related benefits also predicted support for the park. In turn, a negative attitude to the ICDP appeared strongly predicted by a failure to recognise benefits accruing from both tourism and the forest to the community.

These results strongly agree with a growing literature indicating communities are unlikely to support conservation where their livelihoods are threatened, except where significant benefits are offered (Archabald and Naughton-Treves, 2001, Gillingham and Lee, 1999, Brockington et al., 2006). Nearly all the recognised and valued costs and benefits, particularly when discussing how a respondent has personally benefited, are tangible and immediate (Sibanda and Omwega, 1996). There is also a clear distinction between seeing those impacts accrue to other community members, and those accruing personally. Broadly speaking, recognition of both may predict attitudes, with the personal receipt of benefits most likely to produce positive attitudes, and the knowledge that others in the community receive them most likely to produce optimistic attitudes. There are exceptions to this- in particular tourism-related benefits seen to accrue to other community members strongly predicts a positive attitude to both the park and tourism. The effect of optimism regarding future access to these benefits should not be discounted with regards to attitudinal change.

This chapter also highlights the different goals of the project and community as stakeholders in the reserve. The community, consisting predominantly of the rural poor, tend to value direct and short term economic benefits and there is little interest in the project's long-term conservation goals. While there is a general wish throughout the community to see the project stay, both frequent comments and quantitative analysis suggests an overwhelming preference for it to stay without the park and/or conducting anti-poaching activities i.e. keeping the economic benefits without suffering the costs. It would be interesting to investigate how people would decide between these two choices- park and project, or no park and no project.

The population of the reserve continues to grow and, as a result, the opportunity costs accrued to the reserve population can only increase, and, in the dearth of both interest in, and availability of, other livelihood options, hunting, with its open access nature and immediate rewards, will undoubtedly continue. It is likely the park will only be supported if opportunity costs can be met using just the reserve, yet this is clearly unlikely to happen unless the population decreases or alternative livelihoods are developed. Even in the event of job creation, such as the return of the logging company, it is likely the demand for meat will remain, or potentially increase with the wealth status of households.

## **5.6 Conclusion**

Recognition of both conservation related costs and benefits is concentrated on those that are both immediate and tangible. These results highlight the need to consider local perceptions of impacts, rather than objectively measured ones. While attitudes do appear to be linked to the perception of personal benefits, the perception that these benefits are accruing to other community members may also support a more positive attitude, either through appreciation of the trickle-down (or across) effect, or of potential future access. Contrary to other studies, a clear link appears to exist between attitudes to the park and producing benefits through the ICDP. Results also highlight the need to carefully consider the heterogeneity of communities.

## Chapter six

# Linking benefits to behaviour- exploitation

### 6.1 Introduction

Following on from linking benefits with attitudes, we now go on to examine what impact the ICDP has had on altering conservation-related behaviour in terms of wild food extraction (this chapter) and consumption (chapter seven).

ICDPs provide communities with incentives in the expectation of promoting pro-conservation behaviour. As seen in previous chapters, ICDP-related benefits vary widely in both approach and scope, yet commonly follow two key themes- promoting alternative means of livelihood generation, such as increased/improved field cultivation, or promoting the benefits of sustainable forest use, such as sharing the meat of culled species. Yet the complex and often poorly understood relationship between wild resource extraction and livelihoods (Bennett, 2002) make linking such benefits to behavioural changes far from straightforward.

Wild food extraction is not always necessarily limited to the extreme rural poor, for whom it may be seen as the only livelihood option (Loibooki et al., 2002). In a number of studies, higher rates of extraction have been linked to wealthier households in a community (Kumpel, 2006, Starkey, 2004), whereby increased wealth allows access to more expensive, and more efficient, forms of hunting, such as guns. Greater wealth also allows the purchase of high-value meat sold on by poorer hunters (de Merode et al., 2004). Furthermore, while the level of wild food exploitation may depend heavily on access to alternative livelihoods, very often it forms part of a 'livelihood portfolio' where it acts as a fallback profession in times of need (Bassett, 2005, Fimbel et al., 2000, Hart, 2000, de Merode and Cowlshaw, 2006), with its value lying in its reliability as much as its economic value (Solly, 2001, Kumpel, 2006, Homewood, 2005a). The arrival of alternative economic opportunities in the area, such as the opening of a logging company, has also been found to stimulate wild meat extraction rates, as higher incomes result to an increase in the demand for meat- logging roads and trucks may also improve hunter access to the forest and to markets (Auzel and Wilkie, 2000, Wilkie et al., 2000).

Wild meat extraction and consumption is not only affected by economic factors. The value of wild food extraction may be greatly influenced by considerations such as cultural tradition, prestige (Gibson and Marks, 1995, Sabater-Pi and Groves, 1972, Barrett and Arcese, 1995) and ceremony (Mitchell and Tilson, 1986). The desire to control crop-raiding pests may also play a strong role (Naughton-Treves et al., 2003).

When considering patterns in wild meat extraction, it is also necessary to consider the impact of the disincentive approach typically run simultaneously, namely wildlife law enforcement. These measures usually take the form of park authorities restricting access to the protected area by means of patrols of specially trained anti-poaching guards, frequently armed. While found to be effective at controlling rates of illegal resource use in particular sites (e.g. Democratic Republic of Congo- de Merode, 1998, Rowcliffe et al., 2004), its effectiveness has also been questioned, particularly when considering either high value prey such as elephants (Milner-Gulland and Leader-Williams, 1992) or where there is a low risk of detection and/or light penalties (Abbot and Mace, 1999). Other, less formal, measures regulating the extraction of wild meat should also be considered- in the DRC, traditional authority was found to be more effective than park authorities during periods of conflict (de Merode et al., 2007).

Studies evaluating the efficacy of integrated conservation and development programmes are scarce (Holmes, 2003), and the link between the provision of benefits and behavioural changes largely lacking (Straede and Helles, 2000, Infield and Namara, 2001, Baker, 2004, Gibson and Marks, 1995). This chapter investigates the extent to which access to ICDP benefits has reduced or removed the incentive to hunt wildlife within the Dzanga-Sangha region. I also compare different livelihood options in the region and consider how DSP benefits, in particular direct employment and involvement in the tourism programme, may supplement or replace other work activities, in particular wild meat extraction. The focus in this chapter is on two specific areas- namely access to, and the income generating potential of, different livelihood options in the region. Other considerations, such as social implications, are also discussed. The chapter then goes on to explore the influence that the presence of alternative economic options, here represented by the presence of a logging company, has on rates of extraction within the reserve.

## **6.2 Research questions**

This chapter will test the following hypothesis:

⇒ **Exploitation of wild food is reduced by access to ICDP benefits**

To investigate this, the following questions were asked:

- 1) Can ICDP benefits replace extraction in local livelihoods?
- 2) Do ICDP benefits replace extraction in local livelihoods?
- 3) Is wild food extraction related to the presence of other economic opportunities? If so, how?

In section **6.4.1** I compare and contrast project employment and involvement in the tourism programme to other livelihood options in the area, including hunting, focussing in on issues relating to access and income. In section **6.4.2** I then look at the impact that the presence of an operating logging company has had on hunting patterns in the region, using long-term data on gun and snare confiscation rates in the region as a proxy for extraction rates.

## **6.3 Methods**

### **6.3.1 Replacing extraction in local livelihoods**

To examine the effect of ICDP benefits more closely at both the household and the individual level, and, more specifically, to explore how they compare to the benefits of natural resource extraction, it was necessary to adopt a number of approaches. In-depth interviews were conducted with key informants throughout the study, exploring the topic of livelihoods in the Dzanga-Sangha region and focussing on availability and access issues. Quantitative data on both individual and household participation in different work activities was collected during the household attitudinal survey (HAS) and the household consumption and income survey (HCIS). Given the very different livelihood approaches of the BaAka and non-Aka, the two groups are considered separately.

Analysis is divided into three areas- firstly I identify different livelihoods options, their popularity and their income-generating potential. I then discuss access issues before moving on to discuss the extent to which livelihoods may overlap.



### **6.3.1.1 Livelihood options in the reserve- identifying work activities, their popularity and their income-generating potential**

#### **Data collection**

The household attitudinal survey (HAS), described in detail in chapter three, was used to obtain the following information: number, age and gender of all household members<sup>22</sup>, and the participation in work activities of all adult household members in 2006. I defined work as a physical activity rather than necessarily an income-generating one. An adult was defined as 12 years or over. Household participation in hunting related activities was confirmed separately with two local hunters, whose independent listings were in 100% agreement<sup>23</sup>.

The more detailed household consumption and income survey (HCIS) was used to provide the following information: time allocated to different work activities by participating households, and the income generated through each, whether cash or goods (the economic value of goods were calculated using 2006/7 market prices).

#### **Data analysis**

All work activities reported by the 211 households during the HAS were grouped into general categories, defined at the end of the study period. The proportion of the households involved in each was calculated. The income-generating potential of each work activity was assessed using data generated through the HCIS as follows; For each work activity, the households known to participate were separated out. For these households, the proportion of survey days during which the activity was undertaken and the mean daily income were calculated. Seasonal differences in both participation and income were checked for using the non-parametric Mann-Whitney U test.

The economic costs associated with each work activity were not included in the analysis for a number of reasons. Firstly, for many of the work activities the majority of costs tend to be start-up rather than recurring. For example, while a snare hunter may have recently had to purchase a new roll of snare wire, he may also be reusing wire which has been used on a number of previous occasions and which has already paid for itself. When calculating mean weekly income, it therefore becomes a matter of subjective assessment as to which costs have been incurred for each individual. Secondly, tools or equipment may be borrowed, hired or gifted- for example, the DSP runs a seed-

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<sup>22</sup> See chapter three for definition of household member

<sup>23</sup> 42 % of hunting households interviewed voluntarily admitted to participating in hunting-related activities in 2006.

distribution scheme whereby seeds for certain crops are given to farmers free of charge. The daily costs, economic or otherwise, of participating in particular activities are impossible to accurately quantify without detailed interviews taking place.

### **6.3.1.2 What determines participation in work activities?**

#### **Data collection**

The relationship between an individual's socio-demographic status and their participation in certain work activities was explored using both statistical tests and through a wider qualitative discussion. For the non-Aka, the HAS was used to collect the following information for the respondent: ethnicity, residency length, gender, age, education level and involvement in work activities in 2006. For the BaAka, only ethnicity, gender and involvement in work activities could be reliably collected. More qualitative data were collected both through key informant interviews and participant observation.

#### **Data analysis**

Insights gained through the key-informant interviews and participant observation were used to discuss access to the six most common occupations in turn, including project employment and work based on the extraction of natural resources. Particular attention was paid to entry costs and the skill base required.

Using multivariate regression, I then investigated how the socio-demographic status of participants in certain work activities differed to that of the general populace. Individual logistic regression models were constructed for each of the main work activities (snare hunting, gun hunting, hunting porter, fishing, project job, palm wine tapping and the collection of non-meat forest products). I used socio-demographic factors to predict an individual's participation in 2006, coded as the bivariate YES/NO. Residency length, gender, age and education level of the respondent were entered as predictor variables, coded as below. Models were constructed using the forced entry method.

**Table 6-1** Socio-demographic variables used to construct models predicting non-Aka participation in a work activity

<b>Variable</b>	<b>Format</b>	<b>Entered as</b>	<b>N</b>
<b>Residency status</b>	Categorical	Resident/In-migrant	25 : 110
<b>Gender</b>	Categorical	Male/Female	91 : 44
<b>Age</b>	Continuous	Number of years	-
<b>Education</b>	Categorical	None/Primary/secondary	17 : 64 : 54

Quantitative analysis was limited for the BaAka for a number of reasons. Due to concerns relating to accuracy, information regarding the age, education level and residency length of BaAka respondents was not collected. All belong to the same ethnic group and very few were not born in the reserve. This leaves us with gender, for which statistical analysis is scarcely necessary. Nearly all of the work activities tend to be gender segregated, with the exception of net hunting, tourism and labouring in fields, in which males and females participate equally. Formal employment and all other hunting types tends to be men, whereas the sale of forest produce, such as koko leaves, tends to be done by women.

### **6.3.1.3 Have benefits replaced extraction in local livelihoods?**

To investigate the extent to which project employment, as a conservation-related benefit, is capable of replacing wild food extraction as a livelihood source, Pearson's chi-square test was used to investigate whether households containing project employees were more or less likely to participate in other work activities. Analysis used self-reported activity patterns during 2006 for 211 households, collected during the HAS (corrected for misreporting of involvement in hunting activities- see above for details).

### **6.3.2 The influence of alternative economic opportunities on extraction rates**

Regulation of wildlife extraction in the region primarily takes the form of anti-poaching squads patrolling the protected areas. The poacher encounter and confiscation rates of these patrols can provide a useful reflection of levels of illegal extraction taking place (de Merode, 1998), whereby

higher levels of illegal extraction of wild meat are assumed to result in a higher confiscation rate of hunting equipment. For this analysis, the anti-poaching records of the Dzanga-Sangha project (1996-2007) are used as a proxy for rates of illegal extraction in the area. Their relationship to the presence of alternative employment opportunities in the region, here represented by the presence/absence of the logging company, is explored.

## **Data collection**

### **Anti-poaching activities**

Access was granted by the DSP to the long-term records of their anti-poaching activities, detailing all patrols conducted since 1996. Data type and areas of potential bias are outlined in chapter three.

### **Presence of logging company**

During the period covered by the law enforcement database, two logging companies operated in the area. Sylvicole Bois (SB) operated from 1992 to 1997 and la Société de Bois de Bayanga (SBB) operated from 1999 until its closure in 2004. For the analysis, data was divided into four categories.

- 1- SB logging (August 1996- December 1997)
- 2- No logging (January 1998- December 1998)
- 3- SBB logging (January 1999- December 2004)
- 4- No logging (January 2005- April 2007).

## **Data analysis**

Between August 1996 and April 2007, 5543 separate anti-poaching patrols were documented in the Dzanga-Sangha region. Of these, 3306 were general patrols, or pro-active patrols, which took place with no prior information as to the location of illegal activities. Data analysis focused on these patrols only, as the success of informant-driven patrols were likely to be heavily influenced by factors other than extraction rates.

### ***Calculating confiscation rate***

As the number and length of general patrols altered over the period of data collection, it was necessary to calculate confiscations per unit effort, here measured as number of confiscations per patrol day. General patrols deliberately followed a random timetable- consequently patrols frequently ran across consecutive weeks or months. A patrol was therefore classified as taking place

in the month that it commenced. Unlike other studies (Jachmann and Billiouw, 1997, Baker, 2004), here patrol days are not divided into travel days and actual patrol days, as guards were active in their pursuit of poachers whether travelling through the forest to a camp site, or patrolling around it.

Confiscation rates were calculated as monthly averages using the following formula:

$$\text{Monthly confiscation rate} = \frac{\text{Total number of confiscations}}{\text{Total number of patrol days in that month}}$$

Confiscation rates were calculated separately for guns and snares, to represent the two main forms of non-Aka hunting in the area. Throughout the period of data collection, there was no record of any confiscation of BaAka hunting equipment, such as hunting nets or crossbows.

#### ***Controlling for patrol effort***

It is highly probable that confiscation rates are also affected by various measures of anti-poaching patrol effort. Other studies have found anti-poaching patrol success to be significantly affected by the number of patrol days, the number of individual rangers in a patrol (Baker, 2004, Leader-Williams et al., 1990, Bell, 1986) and the distance covered per ranger (Jachmann and Billiouw, 1997). While distance covered was not recorded for the Dzanga-Sangha patrols, the relationships between the number of confiscations within a patrol and patrol duration and guard numbers were investigated.

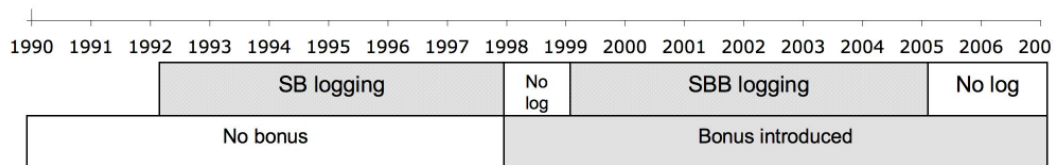
Two logistic regression models were constructed with the outcome- patrol success- measured as i) confiscation of snares and ii) confiscation of gun/s. Two predictor variables were entered into each model- namely duration of patrol and number of guards participating. Models were constructed using the forced entry method. Patrol data for 1997-1999 were missing patrol durations so analysis was conducted using data from the years 2000-2007.

Both patrol duration and the number of guards participating was positively correlated with patrol success (see section 6.4.2). The number of patrol days is already controlled for through the method of calculating confiscation rates. The number of guards is therefore included in the model below as a covariate.

Finally, in 1998 a bonus system was introduced for both the anti-poaching guards and also for members of the public. Intended to provide motivation, individuals are rewarded for either the capture of illegal hunting equipment and/or illegal wild meat, or for information that leads to a capture. These bonuses were increased in 2001 and again in 2004. Guard bonus is therefore also added to the model as a covariate.

### *Constructing the predictor model*

The relationship of confiscation rates to the three test variables- logging status, presence/absence of guard bonus system and average number of guards per patrol- were investigated using Analysis of Covariance (ANCOVA), a multivariate modelling tool which allows for interactions between test variables. Two models were constructed- the first to predict patterns in confiscation rates of snares, the second to predict patterns in confiscation rates of guns. Logging status was entered as four categories (see fig. 6.1). Guard bonus system was entered as a bivariate (presence/absence). The mean number of guards/patrol was entered as a co-variate. Model adequacy was confirmed using post-hoc tests of homogeneity of regression slopes and Levene's test of equality of variance.



**Figure 6-1** Time line of external factors potentially affecting wild meat extraction rates in the Dzanga-Sangha region

## **6.4 Results**

### **6.4.1 Replacing extraction in local livelihoods**

#### **6.4.1.1 Non-Aka livelihood options in the reserve- identifying work activities, their popularity and their income generating potential**

Livelihood options in the reserve are characterised both by their diversity and their flexibility, with the majority of individual respondents involved in two or more activities over the study period, and nearly three quarters of sampled households involved in four or more different work activities.

**Table 6-2** Participation in different work activities by Bayanga households in 2006. Households may be represented in more than one category. N= 135.

	<b>Work type</b>	<b>% households participating</b>
<b>Formal employment</b>	DSP employment	11.9
	Mayor's office	3.5
	Missionary station	1.3
<b>Informal-natural resource based</b>	Fishing	45.8
	Search & sale of non-meat forest products	12.7
	Tapping palm wine	9.6
	Gun hunting	18.5
	Snare hunting	15.5
	Hunting porter	8.1
<b>Informal- other</b>	Agricultural work	94.7
	Food preparation and sale	10.4
	Alcohol brewing and sale	32.0
	Artisanal work*	20.0
	Manioc grinding machine	1.4
	Small shop	5.3
	Informal tourism work	2.9

\*Includes building, carpentry, furniture construction, roof tile construction, pot making and radio repairs

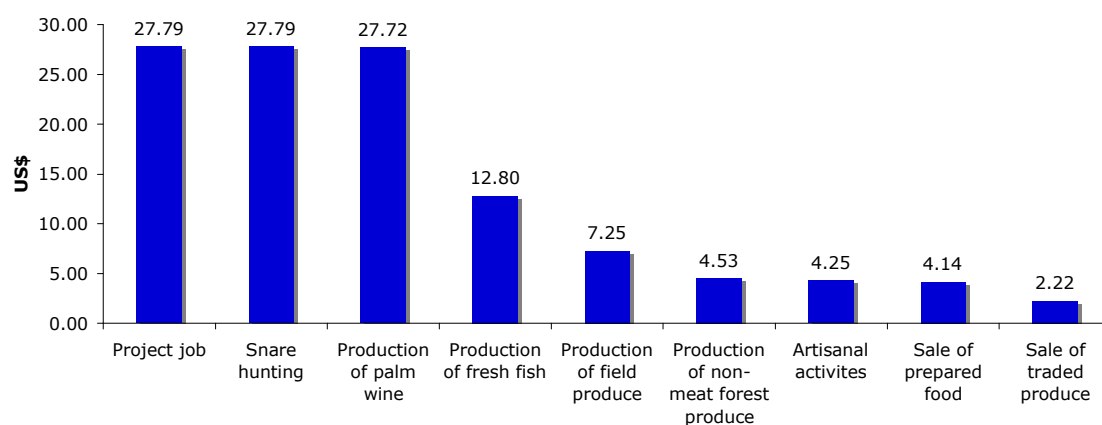
The commonest form of work by far was agriculture, with nearly all of the surveyed households cultivating their own field/s. There was also shown to be a strong reliance on the extraction of wild resources, with 68% of the households relying on river or forest products to some extent, and 45 % relying on the extraction of forest resources in particular. The two ICDP-related benefits outlined in chapters four and five as the most significant- project employment and tourism- are both represented in the sample (table 6.2), although to markedly different degrees. While DSP is by far the largest formal employer in the area, it should also be noted that this sample is restricted to Bayanga, the village of residence of the majority of DSP's employees. The small scale of the tourism industry in the area is again underlined, with only three individuals finding employment in this way during the study. No individual counted it as his or her main occupation.

The mean daily income of different informal work types for a participating household is shown below (table 6.3), averaged over the nine-month study period. Informal work in the region is very rarely conducted on a daily basis- for example, field produce may only be sold in times of excess- therefore figure 6.2 below compares mean weekly income, based on mean daily income and mean number of days spent conducting an activity. Results suggest that project employment is on a par with both snare hunting and production of palm wine in terms of income generation- all three are

markedly more lucrative than other work forms. Fishing earns approximately half the weekly income of these three professions, whilst the collection and sale of non-meat forest resources earns less than a fifth.

**Table 6-3** Mean daily income generated by, and time allocated to, different work activities by non-Aka households. Averaged over the nine-month study period, and includes only individuals known to have participated

Informal income source	Mean daily income			Mean no. days per week undertaken by households	
	XAF	US\$	N	No. days	N
Production of forest meat	4479	9.96	12	2.8	12
Production of palm wine	2956	6.57	123	4.2	15
Production of fresh fish	1939	4.31	52	3.0	14
Production of non-meat forest produce	1839	4.09	36	1.1	21
Production of field produce	1259	2.80	305	2.6	62
Artisanal activities	1339	2.98	23	1.4	12
Sale of prepared food	892	1.98	57	2.1	20
Sale of traded produce	679	1.51	20	1.1	13
Work with tourists	3000	6.67	3	<1	3



**Figure 6-2** Mean weekly income for non-Aka households for the most popular work activities. All incomes except for hunting are calculated from the household study conducted for this survey.



Seasonal variations in the weekly income generated by certain work activities were tested for using the Mann-Whitney U test. Only four work activities had sufficient data to test between seasons, here divided into dry, low rain and high rain (January, July and October respectively). Only non-meat forest produce collection showed a seasonal effect, with households generating significantly more income this way during the low rain season (June) as oppose to dry (January) or high rain (October). Post-hoc testing showed that this was due to the higher frequency of participation rather than any change in the amount harvested per day. This increase of collection trips into the forest during the rainy season by the non-Aka is most likely to be due to the seasonal appearance of forest mushrooms during this time.

**Table 6-4** Results of non-parametric tests for seasonal differences in weekly income generation of different work activities in the reserve. All relationships tested using the Mann-Whitney U test. Only significant relationships are reported. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Informal income source	Weekly income of participating households					
	n	Dry vs. Low rain	n	Dry vs. High rain	n	High rain vs. low rain
Production of palm wine	23	n/s	24	n/s	27	n/s
Production of fresh fish	42	n/s	42	n/s	44	n/s
Production of non-meat forest produce	29	U=50.0, p=0.014 *	26	n/s	31	U=43.5, p=0.001**
Production of field produce	104	n/s	105	n/s	111	n/s

#### 6.4.1.2 What determines non-Aka participation in work activities?

##### Snare hunting

Snare hunting is known in the reserve as being particularly open access. While there are certain entry costs, these are relatively low- a roll of snare wire, purchased for 5,000 XAF, can make around 150 reusable snares, recoverable by the sale of two small blue duiker. While a certain level of skill is required to navigate the forest, many people claim that these skills can be easily acquired by first working as a hunting porter, seen as an apprentice role. Snare hunting is valued for its ability to provide food and income as well as its flexibility- many informants mentioned its

usefulness in times when no other work was available. Few comments relating to the positive aspects of snare hunting referred to non-economic issues, while the ability of a hunter to provide his family with both food and money raises his social status within his community, hunting does not appear to be considered prestigious per se. There are a number of dangers associated with this work, primarily the possibility of attack by wild animals such as elephant or gorilla. Falling branches and being hit in the eye by a snare snapping back were also mentioned as risks, but the risk of being caught by the anti-poaching squad was mentioned relatively infrequently.

### **Gun hunting**

Gun hunting involves a range of participants, usually including a gun owner, a hunt organiser, a hunter and one or more porters. These roles may or may not be fulfilled by the same person. Access to these different roles is highly varied. For a gun owner, start-up costs are extremely high, with a shotgun costing 150,000 XAF and above. For a hunt organiser, however, entry costs may be as little as a box of 25 cartridges, costing around 5000 XAF, of which five are usually given to the gun owner as rent. In addition, food must also be supplied to the hunter and porters for the duration of the hunt. Hunting with a shotgun is also appreciated for its provision of both food and income and can be extremely lucrative. However, gun confiscation by the anti-poaching squad if the team is caught hunting illegally can be extremely expensive, as when the gun is not registered it is not returned to the owner.

### **Fishing and palm wine tapping**

Both of these river-based activities are acknowledged to be highly skilled work, involving in-depth knowledge of the Sangha river. Access is also limited to those with a boat, often constructed by the fisherman himself. Palm wine tapping is one of the few activities which appeared to show a degree of territoriality- once a palm had been marked by an individual, it could not be tapped by anyone else without his permission. River-based activities are also extremely risky, with many people citing the dangers of both wild animals and entanglement in fishing nets. Climbing up the palms in particular is renowned as hazardous work. There is no regulation by the DSP of the exploitation of these resources.

### **Collection of non-meat or timber forest resources**

Over 12% of the sampled households also relied on forest plants at least once during the 21 days each were surveyed, using it to provide both food and income, particularly in the rainy season. As an income source it compares unfavourably in economic terms to other work activities, yet crucially it is one of the few work activities open to women, particularly those with little education. It is also

prized for its zero entrance costs and short-term pay off, although a lack of forest skills can prove fatal- one non-Aka woman was lost, presumed dead, whilst collecting mushrooms in the forest during my stay.

### **Project employment**

Project employment offers individuals a stable, guaranteed and relatively lucrative income. It also comes with associated benefits, such as free health care, access to transport and loans. Access issues may vary between the different jobs offered- some education is usually required and for fieldwork forest skills are useful. Ex-hunters are frequently hired as anti-poaching guards. Currently 182 jobs are offered by the project, 127 full time. Assuming these jobs are spread equally throughout the community, with one per household, project employment offers an alternative livelihood for 15% of the community. Whilst there is undoubtedly a certain level of wage sharing amongst relatives of project employees, it is unlikely that one salary is used to fully support more than one household. While all jobs are advertised locally, a number of people commented that jobs often went to Bangui friends and family of current project employees. With no exhaustive data on the origins of project employees it is not possible to test this. While there are considerable social advantages within the community to having access to a regular salary, there are also a certain number of disadvantages. This is particularly so for the members of the anti-poaching team who frequently face temporary social exclusion from their community when returning from a confiscation. Nevertheless, there are few community members who would refuse the security of income that project employment offers.

### **Links to socio-demographic factors**

The involvement of individuals in any particular work activity was predicted using logistic regression, with residency length, gender, age and education level of the respondent entered as predictor variables. For the seven main work activities, the socio demographic status of participants was compared with all non-participants.

Men were more likely than women to participate in nearly all work activities with the exception of the collection of non-meat forest products- predominantly a woman's job. Less educated people were more likely to search for forest products, whether meat or non-meat, whilst project employees are more educated than average in Bayanga. Age also appears to be significantly linked to work access, with younger residents more likely to undertake the dangerous work of palm wine tapping, and also to work as a hunting porter, widely viewed amongst the non-Aka as an apprentice position. Finally, the number of years a resident has lived in the area appears strongly linked to profession, with newer residents more likely to hunt with snares, and people resident in the area longer more

likely to undertake water-based work, such as fishing and palm wine tapping. However, it appears residency length does not predict whether or not an individual is employed by the project- therefore, while it cannot be concluded that the project favours employing people from outside the reserve, there is also no suggestion that they favour the longer-term, or original, residents of the reserve.

**Table 6-5** Seven logistic regression models showing socio-demographic variables predicting non-Aka participation in particular work activities. Only variables that significantly improve the fit of the model are shown. N=135. † p<0.1, \* p<0.05, \*\* p<0.01, \*\*\* p<0.001

Work	Variable	B	SE	Model R <sup>2</sup> (Nagelkerke)	Model $\chi^2$	Description Work is more likely to be conducted by-
<b>Snare hunting</b>	Gender	20.487***	.491	.308	22.588 **	Men
	Education	1.588 *	.674			People with no secondary education
	Residency length	.051 †	.029			More recent in-migrants
<b>Gun hunting</b>	Gender	19.242***	.989	.269	20.759 **	Men
<b>Hunting Porter</b>	Gender	20.072***	1.109	.318	19.854*	Men
	Age	-.116 *	.500			Younger people
<b>Fishing</b>	Gender	3.981***	.774	.295	25.148***	Men
	Residency length	.073**	.027			People with longer residency
<b>Project</b>	Gender	19.298***	.719	.321	27.665***	Men
	Education	-1.949**	.705			People with secondary education
<b>Palm wine tapping</b>	Gender	19.611***	.899	.493	30.422***	Men
	Age	.249 **	.095			Younger people
	Residency length	.213 *	.086			People with longer residency
<b>Non-meat forest products</b>	Gender	2.354*	1.115	.387	24.613***	Females
	Education	1.311*	.666			People with lower levels of education

### 6.4.1.3 BaAka livelihood options in the reserve- identifying work activities, their popularity and their income generating potential

There are a range of livelihood generating options open to the BaAka, loosely divided into self-organised, whereby forest products are gathered with excess sold/traded with the non-Aka, or work for others, which may or may not be natural-resource based. Work activities conducted by surveyed Yandoumbe households<sup>24</sup>, their income and frequency are outlined in table 6.6 below.

**Table 6-6** Income sources for BaAka households. Calculated from 590 study days divided between 33 houses. Mean daily income calculated only from those households known to participate

		Mean daily income			Mean no. days/week undertaken	
		XFA	US\$	n	No. days	n
<b>Formal employment</b>	<b>Gorilla tracker</b>	1500	3.33	66	6.0	8
	<b>Cook at missionary station</b>	1000	2.22	1	1.1	1
<b>Informal – natural resource based</b>	<b>Tourism work</b>	1000	2.22	2	<1	1
	<b>Hired gun hunter</b>	700	1.56	13	1.9	5
	<b>Self org. spear hunt</b>	1750	3.89	4	1.1	1
	<b>Self org. net hunt<sup>25</sup></b>	621	1.38	23	2.5	34
	<b>Production of non-meat forest products*</b>	200	0.44	214	5.0	30
<b>Informal-other</b>	<b>Work in BaAka field</b>	500	1.11	5	1.0	3
	<b>Work in non-Aka field</b>	250	0.56	130	3.8	24
	<b>Field produce*</b>	300	0.67	5	<1	7
	<b>Work with film crew</b>	-	-	1	<1	1

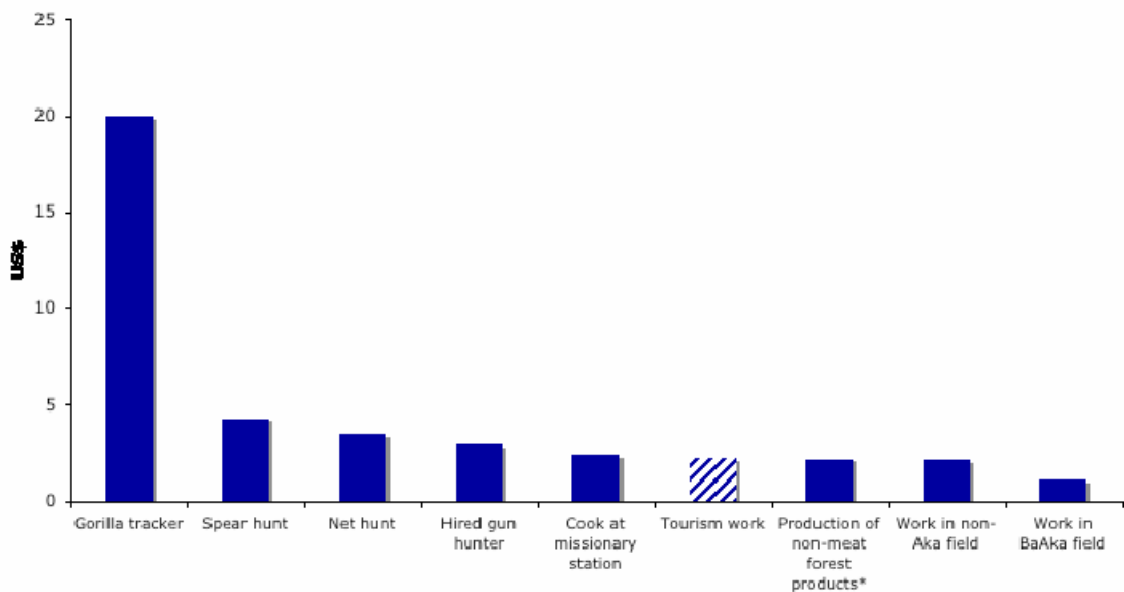
\*For field and forest produce, only products that could be weighed by the researcher were included in income calculations.

Again, as informal work in the region is very rarely conducted on a daily basis, figure 6.3 below compares mean weekly income, based on mean daily income and mean number of days spent

<sup>24</sup> See chapter 3 for definition of a BaAka household

<sup>25</sup> 621 XAF is equivalent to 400 g of meat. Noss, in his 1995 study of Mossopoula hunters, calculated an average return per net hunter of 507g, suggesting either yields have decreased or my relatively small sample size has produced a slight underestimate.

conducting an activity. It can be clearly seen that, while income generated through being employed by the DSP as a gorilla tracker greatly exceeds that generated by all other work, that produced through tourism, even assuming maximum participation by a household, does not. Seasonal variations in the weekly income generated by certain work activities were tested for using the Mann-Whitney statistical test. Only four work activities had sufficient data to test between seasons, namely gorilla tracking, net hunting, production of non-meat forest products and working in non-Aka fields. No seasonal differences in weekly income was found for any of these activities.



**Figure 6-3** Mean weekly incomes for different activity types for BaAka households. All incomes calculated from HCIS with the exception of the figure for tourism. This is added for the purposes of comparison only and is based on the mean weekly income expected if one individual took part in all BaAka based tourism activity- it therefore represents a theoretical maximum.

#### 6.4.1.4 What determines BaAka participation in different work activities?

##### Net hunting

Net hunting is a skill learned by all BaAka from an early age. While levels of skill may vary, it is truly open access, although families require their own net, usually made from forest-sourced materials. As an activity it generates a large proportion of the meat consumed by the BaAka. However, as a co-operative activity it also promotes social cohesion. In fact one of the main complaints about net hunting by the BaAka I talked to was the community discord provoked by an

unsuccessful hunt or poor division of meat. While the BaAka occasionally encounter problems with the anti-poaching squad if they are caught net hunting in the national park, this was a relatively infrequent complaint.

### **Hunting with the non-Aka**

BaAka men are frequently hired as gun hunters due to their hunting skills. It may therefore be limited on the basis of skill, and also requires a good relationship with the hunt organiser. Hunters tend to be paid in both money and meat, and are often given the head or skin of any prey caught in part payment. However, the work is not considered particularly easy, with complaints about the necessity of walking long distances and also having to work at night.

### **Project employment**

For the BaAka this predominantly involves working as a tracker at the gorilla habituation site, although a number of BaAka are employed as trackers/porters for the anti-poaching and tourism programme. In addition, one man from Yandoumbe has a position as an anti-poaching guard. Employment as a gorilla tracker is reliant on word of mouth recommendation by current trackers, as well as a proven ability to work with wild gorillas. As some BaAka have, quite sensibly, a fear of wild gorillas, the work should not be considered open access. A gorilla tracker is expected to spend a minimum of two weeks at the camp, involving periods of separation from their family. This didn't appear to bother either the husbands or wives, although a few women commented on problems generated by the spread of malicious gossip of a wife's activities from the village to the camp. While the return of a tracker from the gorilla site with accumulated wages garners considerable attention within the community, wages are usually quickly spent or given away. The individual's status then appears to return to the egalitarian state prescribed by BaAka society.

### **Sale of forest products**

Primarily involving the sale of koko leaves, this activity is generally conducted by the BaAka women, although all BaAka possess the skills necessary. Leaves are either sold to non-Aka market women or traded directly for cassava. While the BaAka are habituated to the forest however, such work is by no means risk free, with many women commenting on the dangers of the forest, such as gorillas and snake bites.

### **Labouring in a non-Aka field**

Relatively unskilled, this work is also open access. Again, it may be used to generate money or manioc. Risks cited include machete injuries and being harassed by the non-Aka supervisor.

### 6.4.1.5 Have benefits replaced extraction in local livelihoods?

Pearson's chi-square statistical test was used to investigate if households containing project employees were more or less likely to participate in other work activities. One household was found to contain both a project employee and a snare hunter, and one household a project employee and gun hunter- given the relatively small sample size of project households, this was sufficient for the test to conclude households containing project employees were not less likely to also contain hunters. Results do suggest, however, that project households are significantly less likely to participate in both fishing and palm-wine extraction.

**Table 6-7** Results of chi-square tests to see if households containing project employees were more or less likely to participate in other work activities. Non-Aka households with project employees n=16 , without project employees n= 119 . BaAka households with project employees n= 22, without project employees n= 54.

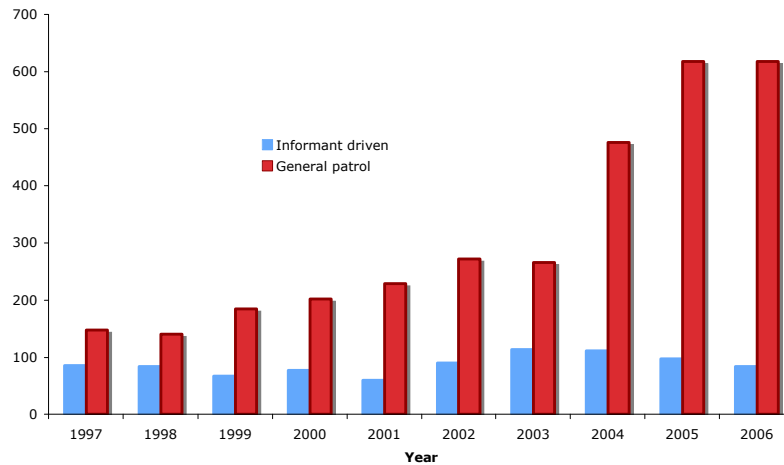
		$\chi^2$ (df)	P
Non-Aka	<b>Gun hunting</b>	2.346 (1)	Ns
	<b>Snare hunting</b>	3.249 (1)	Ns
	<b>Collection of non-meat forest products</b>	0.029 (1)	Ns
	<b>Palm wine collection</b>	3.447 (1)	0.073
	<b>Field cultivation</b>	1.083 (1)	Ns
	<b>Fishing</b>	6.539 (1)	0.009
BaAka	<b>Snare hunting</b>	0.003(1)	Ns
	<b>Net hunting</b>	0.532 (1)	Ns
	<b>Collection of non-meat forest products</b>	0.669 (1)	Ns
	<b>Work in non-Aka field</b>	1.406 (1)	Ns
	<b>Work for non-Aka hunter</b>	1.957 (1)	Ns

### 6.4.2 Is extraction linked to alternative economic opportunities?

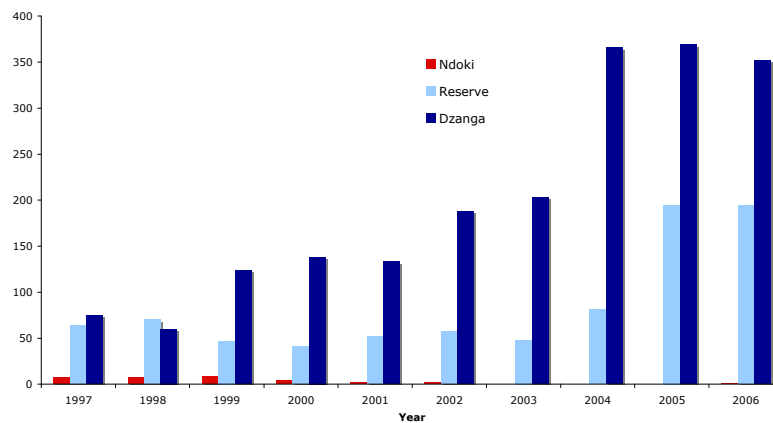
#### *Patterns in confiscation rates*

While the number of informant-driven patrols has remained relatively steady over the ten years of data collected, the number of general patrols has risen sharply (fig. 6.4). General patrols involved an average of 4.2 guards (range 1 - 11) and spanned an average of 5 days (range 1 - 30), capturing an average of 0.6 guns (range 1-6) and 42 snares (range 0-3500) per patrol.





(a)

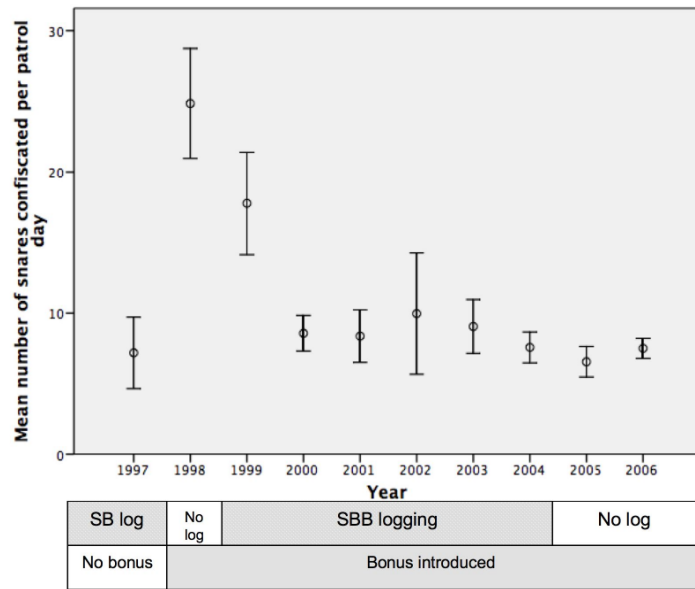


(b)

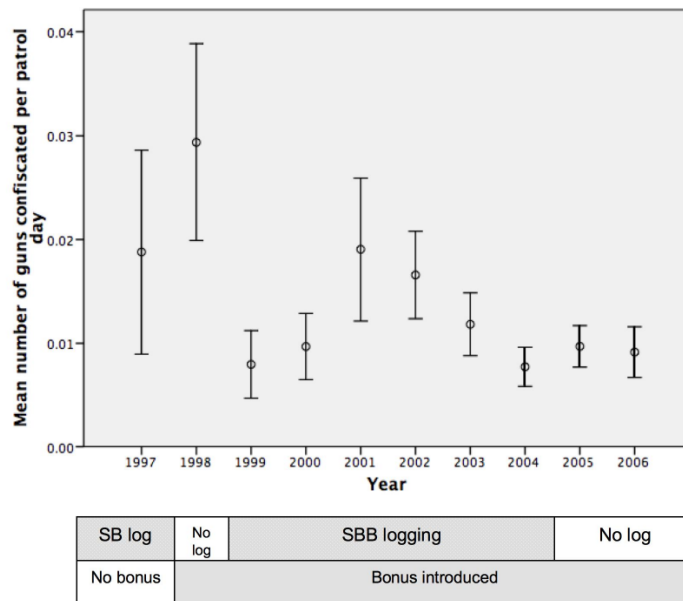
**Figure 6-4** Yearly totals for the number of anti-poaching patrols conducted. (a) Informant driven and general patrols (b) General patrols broken down into region. Data for 1996 and 2007 are omitted due to being incomplete.

The steady increase in the number of general patrols reflects the growth in the size of the anti-poaching team, from 10 guards in 1990 to 49 in 2007. Fig. 6.5 (b) shows that this extra patrol effort has tended to concentrate in the Dzanga National Park and, to a lesser extent, the Dzanga-Sangha Reserve, whereas relatively few patrols are conducted in the Ndoki National Park. Fig. 6.4 (a) above also illustrates that the number of informant-driven patrols has remained relatively constant throughout the past 10 years, including, interestingly, 1997- the year before the introduction of the informant-bonus scheme. Annual patterns in confiscation rates are plotted below for both snares and

guns. The confiscation rates of both appear to show similar trends over the past 10 years, including a distinctive increase in 1998. The implications of these are investigated statistically below.



(a)



(b)

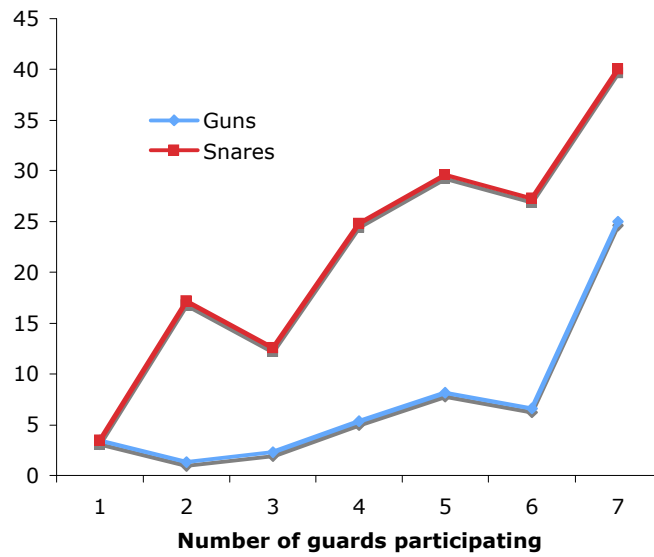
**Figure 6-5** Mean confiscation rates per patrol day of hunting equipment in the Dzanga-Sangha complex. (a) snares (b) guns. Timeline of independent variables included. Standard errors are shown.

***Controlling for patrol effort***

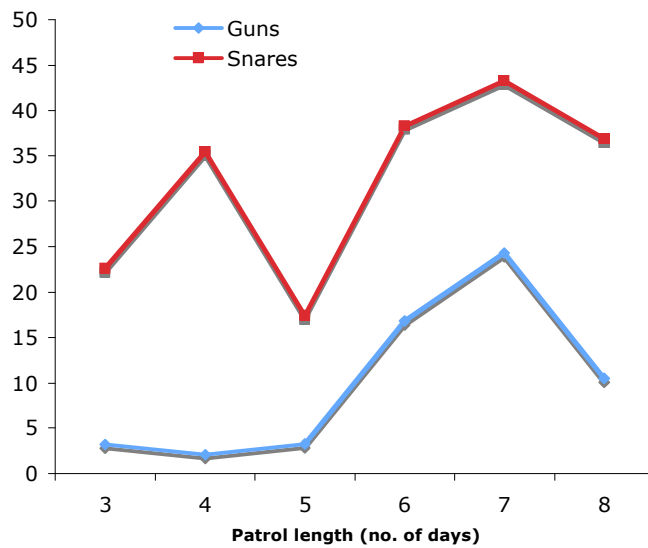
It is highly probable that confiscation rates are affected by various measures of anti-poaching effort. Therefore two variables potentially affecting patrol efficacy, namely the number of participating guards and patrol length, were analysed for their power at predicting the success of a patrol. Results below (table 6.8) show that patrols are significantly more likely to confiscate both snares and guns if they involve more guards and more patrol days.

**Table 6-8** Two logistic regression models showing variables predicting anti-poaching patrol success. Only variables that significantly improve the fit of the model are shown. N=2224. \*\*\* p<0.001

Measure of patrol success	Variable	B	SE	Model R <sup>2</sup> (Nagelkerke)	Model $\chi^2$	Description Patrol is most likely to be successful with-
Snares confiscated	No. guards	.572***	.075	0.08	66.420***	More guards
	Patrol length	.184***	.038			More days
Gun/s confiscated	No. guards	.332***	.042	0.045	79.206***	More guards
	Patrol length	.145***	.242			More days



(a)



(b)

**Figure 6-6** The effect of (a) guard number and (b) patrol length on patrol success, here measured as the confiscation of (i) guns or (ii) snares. Number of guards participating  $N=29, 379, 1098, 706, 416, 121$  and  $20$  for 1 to 7 guards respectively. Patrol length  $N=31, 48, 2501, 107, 37$  and  $19$  for 3 to 8 days respectively.

### *Predicting confiscation rates*

ANCOVA was used to investigate the relationship between the confiscation rates of snares and guns and the presence/absence of the logging company. The first model was designed to predict confiscation rates of guns, the second of snares. The predictor variable, logging status, was entered as four categories (fig. 6.1). Variations in anti-poaching effort were controlled for by entering the average number of guards per patrol and the introduction of the guard bonus, the latter entered as present/absent. Due to considerable monthly variations in confiscation rates, analysis was conducted at the annual level.

For gun confiscations, none of the three variables significantly predicted confiscation rates. For snare confiscations however, logging status significantly predicted confiscation rates.

**Table 6-9** Results of ANCOVA showing logging as a predictor of snare confiscation rate. *Levene's test*  $p=0.651$ , *Homogeneity of regression slopes*  $F=2.102$ ,  $p=0.218$ . Only variables that significantly improved the minimal model are reported

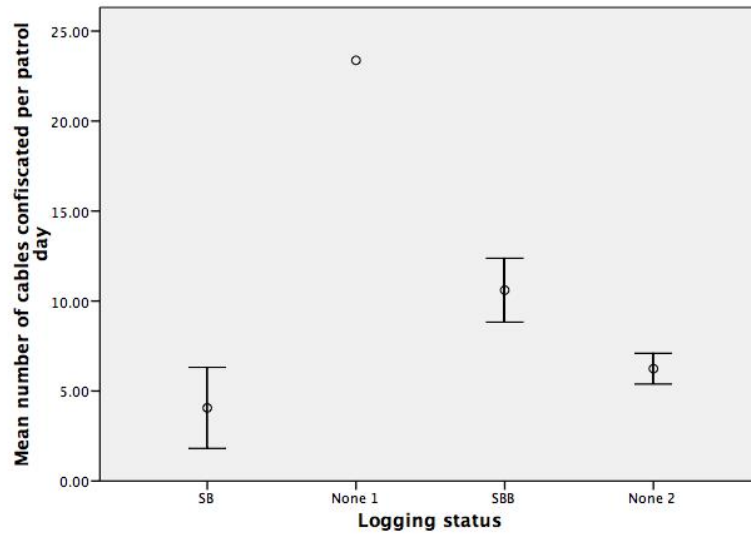
Parameter	F	Sig.
Logging	7.746	0.013

Overall model: Adjusted  $R^2 = .686$ ,  $F = 7.010$ ,  $df = 11$ ,  $p = 0.014$

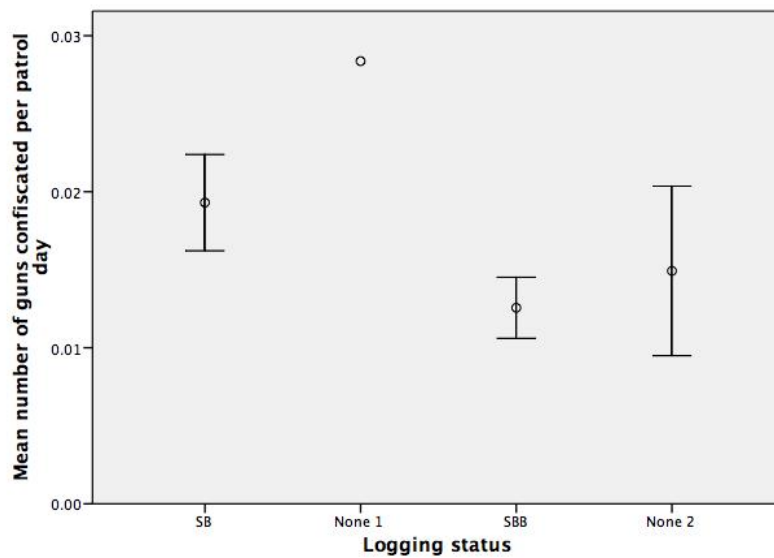
Post-hoc testing, using the Mann-Whitney U test, was used to explore the influence of logging on snare confiscation rates. Results, shown below, showed the greatest difference to lie between the period when SB was operating and the year following its closure, when the confiscation rate of snares significantly increased. While gun confiscations appeared to follow the same trend (fig. 6.8.b), this was not found to be significant.

**Table 6-10** Significance of mean differences for snare confiscation rates- pairwise comparison for each logging state. Adjusted for multiple comparisons using Bonferroni correction

	None 1	SBB	None 2
<b>SB</b>	0.027	.681	1.00
<b>None 1</b>	-	.146	.125
<b>SBB</b>		-	.437



(a)



(b)

**Figure 6-7** Mean confiscation rates of hunting equipment in the Dzanga-Sangha complex, divided into logging status. (a) snares (b) guns. Standard errors are shown.

Confiscation rates of snares increased significantly following the closure of SB and before the arrival of SBB. This result supports the hypothesis that the availability of alternative economic opportunities, here represented by employment offered by the logging company, is linked to a reduction in wild meat extraction rates in the area. It also underlines the importance of wild meat extraction as a fallback livelihood alternative, particularly the more accessible snare hunting.

However, it is also interesting to note that the closure of SBB in 2004 does not result in a similar increase in confiscation rate of either snares or guns. There are two possible explanations for this. Between the two non-logging periods, the number of annual anti-poaching patrol days increased almost fourfold (fig. 6.4), resulting in either a greater area being patrolled and/or the same areas being patrolled more frequently. It is possible to theorize that either the extraction rate has increased but the effect is being lost due to the higher number of patrol days OR extraction rate has not increased, possibly due to the deterrent effect of the increased patrols. Without knowing the efficiency of the anti-poaching team- i.e. the proportion of hunting activity they detect, and the areas they covered during each year, it is difficult to distinguish between these two hypotheses.

It is also possible to theorise that the dramatic increase in the confiscation rate of both snares and guns in 1998 was as a result of the introduction of the guard and informant bonus- this effect may not have been maintained due to possible social retaliation against informants. However, the relatively constant number of informant-driven patrols throughout the 10 year period, including pre- and post-bonus introduction, would appear to discourage this theory.

## **6.5 Discussion**

The underlying assumption of an ICDP is that if it makes a significant contribution to local livelihoods, pro-conservation behaviour will be encouraged. Following on from our previous examination of costs and benefits at the reserve and village level, this chapter focuses in on how these incentives act at both the household and individual level, investigating the extent to which access to ICDP benefits may reduce or remove the incentive to hunt wildlife. It then goes on to investigate the influence that two other key factors- namely the presence of other livelihood alternatives and the impact of anti-poaching patrols- have on wild meat extraction rates in the Dzanga-Sangha region.

### **6.5.1 Can benefits replace extraction in local livelihoods?**

#### **Non-Aka**

As seen elsewhere in west and central Africa (e.g. de Merode, 1998, Kumpel, 2006, Cowlshaw et al., 2005b), in the Dzanga-Sangha region extraction of natural resources offers a number of viable and attractive livelihood options and features strongly in the livelihood portfolios of households. While river-based work activities, such as fishing and palm wine extraction, are lucrative, they are

also strictly limited on the basis of skill and equipment and show a tendency to be dominated by people who have lived in the area longer. Snare hunting, however, with its relatively low start-up costs and easily learnt skills offers a relatively lucrative and flexible work activity to residents of the reserve, and is particularly popular amongst the more recent in-migrants. Gun hunting, in contrast, incurs heavy start-up costs, particularly for gun owners. The rewards are, however, also greater- gun hunting, particularly when conducted at night by torchlight, is a very efficient form of hunting, allowing the killing of larger prey and in greater quantities. The gun can also generate income by being rented to other hunt organisers. While the income generated through gun hunting is not known, in other studies it has equalled or exceeded that of snare hunting (de Merode, 1998).

The social status acquired by hunters has been found to vary between sites- Gibson and Marks (1995) argue that by providing their family with meat, money and crop protection, a hunters social status is increased, whereas Kumpel found in Equatorial Guinea there was little prestige attached to hunting, with hunters considered the paupers of the village (Kumpel, 2006). In the Dzanga-Sangha region, the advantages of both snare and gun hunting focused largely on the economic benefits, in terms of its ability to provide both food and money. Therefore, while hunting may not be considered prestigious in itself, the ability of a hunter to provide for his family does appear to raise his social status within his community.

Project employment, as one of the few recognised and valued project-related benefits (see chapter five), offers a serious economic alternative to all other reserve livelihoods. Both lucrative and dependable, such jobs are highly valued within the community and come with an associated higher status in the community as a result. There are, however, significant issues relating to job access, including the limited job availability- around 11% of Bayanga households benefited directly from project employment, whereas 68% relied to some extent on the extraction of natural resources for food and/or income. That these issues were discernible in Bayanga, home to the majority of the project employees, suggests that this effect is likely to be even more pronounced in the other villages of the reserve. Results also suggest that educational requirements for project employment may form a significant barrier to many of the reserves residents- this is particularly worrying in the case of snare hunters who show a tendency towards lower levels of education, suggesting they would be unable to access project jobs.

Tourism is often held up as the ultimate tool to match or exceed the economic benefits of less sustainable exploitation of wild resources (Pet-Soede et al., 1999). Yet, as seen elsewhere (Brockington, 2002) and contrary to previous claims (TELESIS, 1991, Blom, 2001a), tourism, at



its current level, clearly offers no serious alternative to wild meat extraction. Tourist visits are both irregular and unpredictable and are conducted too infrequently to generate sufficient income to support a family.

While the agricultural scheme is also designed to promote alternative livelihoods, it has largely failed to attract large numbers of committed participants. While the reasons for this are unclear, households in the region appear unwilling to rely solely on one source of income, particularly one which is so vulnerable to external environmental shocks. The distance of the villages from any sizable urban market combined with poor transport links also limits the potential buyers for such goods. It is also clear from the results above, that the income from cultivating fields, both in terms of cash and goods, is relatively small when compared to project employment, hunting and fishing.

### **BaAka**

The BaAka, as with all pygmy groups, are known for their forest-based livelihoods (Bahuchet, 1985a, Bahuchet, 1992, Bahuchet et al., 1990, Bahuchet et al., 1991). It is part of the mission statement of the DSP that the ICDP conserves these livelihoods to a certain extent, aiming to “... *protect their [BaAka] desire to retain a portion of their cultural uniqueness*” (Source: DSP promotional literature). As a result, traditional BaAka hunting methods, such as net and spear hunting, have never been openly targeted by the law enforcement bodies, and there is no record of BaAka hunting equipment being confiscated by the anti-poaching squad from 1996 to 2007. If we also consider the BaAka community tourism programme, whereby tourists pay to go hunting with the BaAka, such wild meat extraction activities are actively encouraged by the project

However, while such activities are permitted in the reserve, if found hunting in the National parks, the BaAka are told to leave, and there were numerous verbal reports by Yandoumbe residents of being harassed by anti-poaching guards. This loss of traditional hunting grounds has caused them to concentrate their efforts on a much smaller area of forest, potentially adding to its lack of sustainability (Noss, 1998a). While there appears to be little intent to replace BaAka extraction activities with project-related benefits, therefore, the loss of hunting land may foster an interest in other economic opportunities. There is also a long history in the area of principally foreign-owned enterprises moving into the region to exploit its natural resources, stretching back from the present day interest in logging and diamonds way back to the rubber and ivory extraction of the colonial era, and even before this (Noss, 2001). The BaAka’s knowledge of the forest and its resources has ensured their involvement in such industries, either voluntarily or otherwise. The BaAka of Yandoumbe are therefore no stranger to the short-term exploitation of alternative economic

opportunities. Indeed, money is increasingly desired for goods for which there is no forest alternative, or simply for convenience.

The BaAka of Yandoumbe use both traditional (sale of forest produce) and less traditional means (paid labour) to generate both food and money, through both formal and informal channels. When comparing the income-generating potential of different work activities, tracking for gorilla habituation project clearly outstrips all other alternatives. While access is again limited, with 40 gorilla tracking jobs divided between 215 households, the high degree of wealth sharing within the BaAka communities make it likely that the economic benefits of individual's employment are spread widely throughout the community.

However, it is necessary to consider more than income-generation potential. While relatively large sums may be made from project-related activities such as tourism and work with film crews, the infrequency of this work make them poor livelihood substitutes. In terms of regularity of income, it is koko sales and informal labouring in non-Aka fields which form the bedrock of the BaAka economy. As the former is conducted almost solely by women, it is unlikely to be replaced by project employment. The strong social role of net hunting also makes it extremely unlikely that hunting will be replaced by other forms of income generation. All project-related benefits, therefore, are more suitable as complementary forms of livelihood generation, rather than replacement.

### **6.5.2 The influence of law enforcement efforts on extraction**

Anti-poaching patrols have proven effective at controlling rates of illegal resource use in particular sites (e.g. Democratic republic of Congo- de Merode, 1998, Rowcliffe et al., 2004), with cash bonuses for the guards and the frequency of patrols suggested to be particularly influential factors (Arcese et al., 1995, Jachmann and Billiouw, 1997, Leader-Williams and Milner-Gulland, 1993). Penalties, such as fines and prison sentences, are suggested to be less effective, not least because the courts, often separate from the wildlife authorities, frequently place lower priorities on wildlife protection (Leader-Williams and Milner-Gulland, 1993). However, the effectiveness of armed patrols at controlling poaching has also been shown to be limited, particularly when considering either high-value prey such as elephants (Milner-Gulland and Leader-Williams, 1992) or low risk of detection and/or light penalties (Abbot and Mace, 1999).

Law enforcement efforts in the Dzanga-Sangha area face unenviable odds, with 50 park guards protecting 4589km<sup>2</sup> rainforest against an estimated 315 gun and snare hunters<sup>26</sup>. This is far from the optimum rate of one guard per 20km<sup>2</sup> of protected area suggested as necessary for effective law enforcement (Leader-Williams et al., 1990), particularly in the more challenging conditions presented by working in a tropical forest environment. While the quantity of hunting equipment confiscated by the anti-poaching squad is clearly substantial- over 28,000 snares and 66 guns were confiscated in 2006 alone- the results of this study shows that reserve residents are still conducting a significant amount of illegal hunting. As a consequence, the effectiveness of law enforcement activities in the area remains unclear.

Modelling anti-poaching efficacy suggests that an increased risk of detection may act as a greater deterrent to poachers than increasing penalties does, particularly given the short time horizon and relatively high discount rate (i.e. valuing the present over the future) prevalent in the African rural poor (Leader-Williams and Milner-Gulland, 1993). While results show patrol efficacy does improve with increasing patrol length and the number of guards involved, both detection rate and deterrent effect remain uncertain. To act as an effective deterrent, penalties must exceed the potential benefits achievable by illegal hunting (Clarke et al., 1993, Leader-Williams and Milner-Gulland, 1993). Penalties in the Dzanga-Sangha region are clearly not severe, particularly for snare hunters, who at worst risk losing a days catch and easily replaceable snares. Prosecution is only attempted for the most serious infractions, such as the killing of a gorilla or elephant, whereby the accused is reported to the local authorities by DSP. In the central African courts wildlife protection is not a priority, and they have a poor record at penalising poachers. This lack of commitment by the state was reflected in a speech given by a government representative to Bayanga residents in 2007, condoning hunting until the logging company re-opened.

Examining law enforcement efficiency in terms of detection rates is clearly problematic. Other studies have used various proxies, including focal follows of offenders (Abbot and Mace, 1999), carcass counts (Jachmann and Billiouw, 1997), changes in animal population densities (Milner-Gulland and Leader-Williams, 1992) and the ratio of poacher sightings to arrests (Arcese et al., 1995). The degree of suspicion and aggression surrounding enquiries into wild meat extraction activities, and the particular problems involved in measuring prey population dynamics in the tropical rainforest, meant detection rate could not be calculated. However, whilst there is clearly a strong dislike of the anti-poaching squad amongst the park-adjacent communities, when discussing

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<sup>26</sup> Calculated by multiplying percentage of surveyed households currently engaged in gun or snare hunting by number of non-Aka households

problems associated with hunting residents are much more likely to discuss forest-related dangers, such as being attacked by elephants, rather than problems associated with the anti-poaching squad. In addition, the degree of participation of Bayanga households in wild meat extraction suggest the anti-poaching squad does not act as a sufficient deterrent for almost half the sampled households. This is further supported by the relatively steady rate of snare and gun confiscations over the past 7 years, despite a three-fold increase in patrol frequency. There was no evidence to suggest that social institutions in the region play a strong role at controlling rates of wild meat extraction in the Dzanga Sangha region, unlike de Merodes work in the Democratic Republic of Congo (de Merode et al., 2007). This is perhaps not surprising, given the general lack of social cohesion promoted by the high level of in-migration into the area (Noss, 1997).

### **6.5.3 The influence of the availability of other livelihood options on the extraction rates of natural resources**

The arrival of alternative economic opportunities in a region reliant on wild meat for both income and protein may be hypothesised as having three very different effects.

*Scenario one*- the alternative income source will exceed the rate of return offered by hunting wild animals, resulting in a decrease in extraction rates in the area.

*Scenario two*- a given individual will decide to conduct both activities simultaneously, maximising income and maintaining meat extraction rates in the area.

*Scenario three*- increasing household income will increase that households demand for meat, thus supporting increasing extraction rates in an area.

Past studies on the impact of logging on hunting pressure are limited and, due to the difficulties of pre-empting a logging concession, have a tendency to look spatially rather than temporally. However, there appears to be a general consensus that the introduction of a logging company to an area increases hunting pressure, attributed to three factors; i) Logging roads increase access to the forest, ii) logging-related transport improves local access to markets and iii) increased income stimulates increasing demand for wild meat (Auzel and Wilkie, 2000, Wilkie et al., 2000, Peres and Lake, 2003).

In Dzanga-Sangha, four logging companies have operated in succession since 1970. While employment figures vary according to the source and varying scales of operation (see chapter 2), the importance of the employment opportunities they offer to the local community is clear,

particularly in light of the dearth of other formal employment opportunities. Given the often considerable gaps between logging operations, the region offers a natural experiment on the effect that providing alternative economic opportunities has on wild meat extraction rates.

Contrary to the other studies reported above, it appears that the closure of a logging company may aggravate wild meat hunting in this region. In 1998, the year in-between the closure of one logging company and before the opening of another, confiscation of snares, the most accessible form of hunting, increased dramatically. There are two possible explanations for this:

- i) Consumption needs were already being met by previous levels of hunting. The increase was to generate income lost by the closure of the logging company
- ii) Consumption needs were being met by domestic alternatives, purchased through salaries. Hunting increased to replace this lost source of protein.

Two informal market surveys conducted in 1994 (Noss, 1995) and 1995 (Garreau, 1996b) while the Sylvicole Bois saw mill was operating suggest little sale of domestic meat during these years. While neither of these surveys claimed to be exhaustive, they indicate that wild meat was still the predominant source of protein while the logging company was operating, suggesting the first explanation to be the most fitting.

#### **6.5.4 Fitting project benefits into the livelihood portfolio**

The general belief in ICDPs is that the provision of more attractive livelihood alternatives will reduce reliance on less conservation-friendly activities. However, the livelihoods of the rural poor in Africa are characterised by their flexibility and risk-spreading through livelihood diversification (Homewood, 2005b), and it is essential to examine to what extent benefit recipients, in this case, project employees, have desisted from the exploitation of natural resources, both personally and within their household.

Project employment is, in most cases, a full time activity. However, this is not always a sufficient reason to assume no participation in the extraction of natural resources, either by the individual or by the household to which they belong (Gibson and Marks, 1995, Sievanen et al., 2005). While no project employees were known to hunt, one belonged to a gun owning household and one to a snare-hunting household, suggesting the abstention from hunting to be on the grounds of time rather than ethics. Furthermore, several households containing project employees were also involved in

extraction of non-meat forest resources. Finally, as seen elsewhere (Gibson and Marks, 1995) there is evidence that some anti-poaching guards may collaborate with hunters, or simply act in their stead, selling on or consuming confiscated meat.

There is also a serious risk, particularly in a country as poorly developed as the Central African Republic, that the creation of attractive alternative livelihoods can draw people into an area, thus increasing pressure on natural resources (Sievanen et al., 2005). Despite the closure of the logging company in 2004, the human population in the reserve continues to rise (chapter 2), suggesting the ICDP to be providing a draw of its own. This level of in-migration is particularly worrying in light of the results above showing in-migrants are more likely to work as snare hunters. If livelihood alternatives to wild meat extraction are to be taken seriously, they must be open access, provide similar economic benefits that are also short term and direct, and be accessible by all household members. However, given the high levels of poverty within the Central African Republic as a whole, as well as the high mobility of the population, it is likely that the creation of such opportunities would result in an influx of in-migrants looking to exploit such an opportunity. As in-migrants appear more likely than long-term residents to undertake snare hunting, it is feasible that the creation of economic alternatives to natural resource extraction, if it fails to keep pace with in-migration as logging appears to have done, may exacerbate natural resource extraction.

## **6.6. Conclusion**

ICDPs provide communities with incentives in the expectation of promoting pro-conservation behaviour, yet the relationship between wild resource extraction and livelihoods remains complex and poorly understood. While project employment appears capable of meeting or exceeding the income generated by the extraction of natural resources, such jobs are few and far between, limiting access for the majority of reserve residents. Access is further restricted by educational requirements. Furthermore, no evidence was found to suggest that project employment replaces natural resource extraction within a household portfolio- rather it is used as a complementary activity, particularly amongst the BaAka for whom communal hunting also plays a strong social role.

While anti-poaching patrols have some impact on hunting behaviour, with efficacy improving with increasing patrol length and the number of guards involved, both detection rate and deterrent effect remain uncertain. However, the large proportion of households involved in illegal hunting, and the low levels of fear of the anti-poaching squad compared to other hazards associated with the work suggest anti-poaching activities fail to deter many hunters. Furthermore, a four-fold increase in

patrol number over the past 10 years has failed to reduce the confiscation rates of either snares or guns. There are also concerns that the opportunities provided by the project may be attracting in-migrants into the area, shown to be the most likely residents to take up snare hunting.

## Chapter seven

### Linking benefits to behaviour- consumption

*“What people say, what people do, and what they say they do are entirely different things.”*

Margaret Mead (1901-1978)

#### 7.1 Introduction

Following on from linking benefits to extractive behaviour, we now go on to examine what impact the ICDP has had on altering patterns of wild food consumption.

The diversity and volume of the food resources provided by the African rainforest is well recognised, as is the long history of their exploitation (Hladik et al., 1990, Hladik et al., 1993, Pimentel et al., 1997). People require a certain level of nutrition to survive and, in many rural areas, wild food provides a cheap and readily available source. The meat of wild animals in particular, commonly known as bushmeat, fulfils much of the protein needs of the rural poor, often in areas where there are few substitutes (Bennett et al., 2006, Bennett, 2002, DfiD, 2002, Wilkie and Carpenter, 1999a). There has, however, been increasing concern as to the sustainability of the rate at which many of these resources are consumed (Milner-Gulland et al., 2003, Wilkie and Carpenter, 1999a).

ICDPs provide local communities with conservation-related incentives in the expectation that this will promote more conservation-friendly behaviour. Given the unsustainable levels of harvesting of many species of wild animal in the Dzanga-Sangha area, the common use of illegal methods of extraction such as snares and the frequent hunting of animals within the national park (This study; Noss, 1998a, Noss, 1998b), it is expected that conservation-friendly behaviour would include decreased levels of consumption of wild foods, or a switch to less threatened species.

An increasing number of studies, however, examining both what people are eating and the factors that may affect this serve to highlight the complex interactions of the variables involved in making consumption decisions. Households dietary choices have been found to be strongly affected by, not only the pricing and availability of wild foods, but also substitute goods, in particular domestic



alternatives, shown both spatially (Apaza et al., 2002, Milner-Gulland et al., 2003, Wilkie et al., 2005) and temporally (Brashares et al., 2004). Household wealth is also likely to play a strong role in consumption decisions, with studies showing higher levels of reliance on wild resources in the poorest households (Allebone-Webb, 2008, Wilkie and Godoy, 2001, Albrechtsen et al., 2006), and, conversely, that increasing wealth results in increasing expenditure on wild food (East et al., 2005, Wilkie et al., 2005). It would also be short sighted, however, to consider only economic factors. Wild foods may simply be preferred above all other substitutes, for reasons of prestige, tradition (Wilkie and Carpenter, 1999a, Njiforti, 1996) or taste (East et al., 2005, Rose, 2001, Chardonnet et al., 1995, Schenck et al., 2006).

To examine how ICDP benefits affect consumption patterns in the Dzanga-Sangha reserve, the investigation follows three stages. Firstly, basic patterns in wild food consumption by reserve residents are explored, looking at food type, quantity and source (7.4.1). I then move on to look at how these three variables alter in households which have received significant conservation-related benefits (7.4.2), as well as the relationship between bushmeat consumption and conservation attitudes (7.4.3). Finally, to help interpret these results, I explore more generally the influence of other factors on household consumption patterns, including household wealth (7.4.4), patterns of preference (7.4.5) and economic factors such as food availability and food price (7.4.6).

## 7.2 Research questions

The chapter will test the following hypothesis:

⇒ **Wild food consumption is reduced by access to ICDP benefits**

To investigate this, we need to know not only what people are eating, but why they are eating it.

The following questions were asked:

- 1) What are the patterns of wild food consumption amongst households in the reserve?
- 2) How are these patterns related to exposure to ICDP benefits?
- 3) How are these patterns related to conservation-related attitudes?
- 4) How are these patterns related to household wealth?
- 5) How are these patterns related to consumer preference?
- 6) How are these patterns related to food pricing and availability?

## 7.3 Methods

### 7.3.1 Evaluating patterns of wild food consumption

#### Data collection

An in-depth household consumption and income study (HCIS) was conducted for 114 households, during which detailed information was collected on all household meals. See chapter three for a full review of methodology.

#### Data analysis

For the HCIS, 79 non-Aka and 35 BaAka households were surveyed, with 1334 and 590 individual consumption days recorded respectively over the study period. Given the frequent reheating of the midday meal for the evening meal, data are presented as per day rather than per meal, and analysed as follows:

#### Consumption patterns

All wild foods consumed during the HCIS were classified as ‘fish<sup>27</sup>’, ‘forest meat<sup>28</sup>’ or ‘forest non-meat<sup>29</sup>’. Cultivated foods were classified as ‘domestic meat’ or ‘cultivated leaves’. The consumption of cultivated roots, in particular manioc (*Manihot esculenta*), occurred on 100% of consumption days and was not included in the analysis.

Consumption frequency was explored by calculating both the mean proportion of days, and the mean daily quantity consumed by a household for each food class. Seasonal differences in the latter were explored using the Wilcoxon signed-rank test. Differences between BaAka and non-Aka households in terms of consumption frequency and daily consumption rate were assessed using the Mann-Whitney U test. The protein provided through the different food types was examined, as was the relationship between consumption rates of wild foods with their domestic alternatives, conducted using the non-parametric Spearman’s correlation coefficient.

I then went on to look at how forest products were obtained, classified as hunted/gathered by a household member, purchased at a market (formal/informal), given as a gift or received in payment for work. All analysis was conducted separately for BaAka and non-Aka households. It was also

<sup>27</sup> Includes all water-based animals, such as fish and aquatic crustaceans.

<sup>28</sup> Includes all wild meat, including caterpillars, but not including water-based animals.

<sup>29</sup> Includes all non-meat forest products, but predominantly consisted of *Gnetum* spp. (koko) and various species of mushrooms.

possible, using market data on the proportional origin of meat sold there, to estimate the proportion of meat consumed by BaAka and non-Aka households that is hunted by each of these ethnic groups.

### ***Calculating mean daily household consumption rates***

Household consumption patterns are affected by the number of household members, and it is customary to standardise households by calculating consumption per capita (Deaton, 1997). While this may be done simply by dividing the total household consumption by the number of individuals within that household (Shackleton and Shackleton, 2005, Wilkie and Godoy, 2001), this approach assumes that all members receive the same. Given the often different energy requirements of household members (FAO et al., 1985), a more refined approach using adult male equivalents (AME) is often adopted, whereby different age and sex groups are allocated different consumption units. Adult males are usually held to represent 1 unit, and all other age and sex groups are represented as a fraction of this.

How these units are calculated, however, is a matter of little consensus and lacks both a theoretical and empirical basis (Deaton, 1997). This is clearly illustrated by the handful of studies looking at wild meat consumption. Kumpel (2006) in her Equatorial Guinea consumption study uses AME units based on east African pastoralist communities (Sellen, 2003), whereby an adult male, defined as 16 years or older equals 1.0 AME unit, an adult female equals 0.86 units, and children are represented by 0.96, 0.85 or 0.52 units depending on their age. Another study, examining wild meat consumption on Bioko Island, Equatorial Guinea, uses different values, whereby an adult male, defined as over 10 years, equals 1.0 unit, females aged 20 years or over equals 0.72 units, females 10-19 years equals 0.84 units and all children under 9 equals 0.6 units (Albrechtsen et al., 2006). Other studies of wild meat consumption in central Africa, while using units of conversion, fail to specify exact values (Wilkie et al., 2005, de Merode, 1998, de Merode et al., 2004).

Koppert et al. (1993), in a study of consumption patterns of forest-dwelling populations in South Cameroon, rather than looking at energy requirements of the different age/sex classes and assuming consumption is distributed the same way, estimated dish-sharing coefficients of the different classes based on empirical measurements. These were calculated as adult men (over 19) as 1.0 unit, adult females as 0.87 units, children aged 10 to 19 as 0.62 and children 1-9 as 0.46. The authors go on to note that these results are different to those that would be recommended by FAO recommendations for calorie intake (FAO et al., 1985). Given the similar consumption patterns between Cameroon and Central African Republic, in terms of both ingredients and the communal dish methods of serving food, I will adopt these AME values for this study. It should also be noted these values are

similar to those adopted by both Kumpel (2006) and Albrechtsen et al. (2006) with the exception of a slightly lower value for the children.

To record the number and type of consumers present, each household was questioned on the age/gender of resident household members at both the beginning and the end of the study. To verify that the consumption of household meals was restricted to household members, a household representative was also asked each day to report the number of people who had consumed each meal. This revealed both a large variation in the number of individuals consuming at a particular house from day to day, and between the numbers of daily consumers and reported household members. Actual consumption rates (per AME) were therefore calculated using the mean number of consumers per day, rather than the number of reported household members.

For the non-Aka, quantities of ingredients were usually reported in terms of economic value. If they had not been purchased, respondents were asked to estimate the value if they had chosen instead to sell that ingredient. While other studies have used the value of the food items in the analysis (e.g. de Merode, 1998), here I use metric weight, converted from economic value using market weight/price conversion ratios calculated from market data in the same month. This was done for two reasons. Firstly, in aiming to evaluate the ICDPs impact on conservation-related behaviour, we are primarily interested in the absolute quantities consumed rather than relative consumption value. Secondly, representing food in weight rather than its local monetary value allows cross-site comparisons.

Calculating mean daily consumption rates (per AME) for the BaAka was more complex. The potential for inaccuracy in asking respondents to make a reliable estimate of the market value of gathered foods, particularly foods which are rarely sold in a market environment, meant that quantitative data was limited to occasions where the weighing of pre-cooked ingredients was possible. Of 590 consumption days, it was possible to weigh the ingredients of 186 meals. Given that the BaAka, on 94% of household consumption days surveyed, had also eaten a morning meal (unweighed), it was necessary to scale up the meal measurement to provide an estimate of the daily quantities consumed. Given that the morning meals had a similar composition to evening meals in terms of ingredients, I estimated BaAka daily consumption by doubling the weight of the evening meal. However, using these figures as absolute, rather than relative values should be done with care for three reasons. Firstly, it is assumed the weighed ingredients represent one meal: however, on around one third of consumption days, a portion of the evening meal was saved and eaten again the following the morning- therefore in a third of the cases the weighed ingredients already represent

two meals. Secondly, counteracting this, on 29% of consumption days a midday meal was also consumed, meaning three meals were prepared during the day. Finally, there is known to be a large degree of food sharing amongst BaAka households, although predominantly within the family group. However, as this study deliberately samples all households within a family group, it is assumed that all food consumed within the unit is captured.

### *Dressed versus undressed weights*

All cost/weight conversions were made using the weight of meat sold in the market, which was generally sold eviscerated but frequently including skin and bones. While a number of studies use a conversion rate for wild meat ranging between 60% -70% to convert undressed meat to dressed (i.e. the proportion of the meat which is actually consumed) (Kumpel, 2006, Fa et al., 2002, Albrechtsen et al., 2006), this would produce somewhat erroneous results in this case. Firstly, particularly in the case of the BaAka, much of what elsewhere may be considered inedible is eaten- this includes all organs, the skin, and the bone marrow. Secondly, conversion factors may vary depending on the animal species, age and even sex. There is often little agreement about conversion figures, and often a failure to report the figures used in the literature. Therefore all meat weights are presented as undressed.

### **7.3.2 Is wild food consumption related to project benefits?**

To test whether households that receive conservation-related benefits show different consumption patterns I focus on project employees, community members who arguably benefit the most (see chapters four and five). Of the 79 non-Aka households surveyed for the HCIS, 20 contained a project employee. For the BaAka, households surveyed, 10 of the 35 contained a project employee.

Consumption patterns of wild foods were again evaluated in two ways- the proportion of days consumed and the mean daily consumption rates (per AME). Wild foods were divided into i) forest meat, ii) forest non-meat products and iii) fish. The consumption rates of each were analysed in turn. Consumption rates (per AME) of both forest meat and fish were non-normally distributed, even when log transformed, therefore the non-parametric Mann-Whitney U test was used to look for differences in the consumption rates of households containing project employees and those that do not. I also examined differences in how wild food was sourced, again using the Mann-Whitney U test. The influence of project employment on species choice was explored in the later section on meat preference.

### 7.3.3 Is wild food consumption related to pro-conservation attitudes?

#### Data collection

Consumption levels of wild food were examined for their relationship to attitudes to both the DSP and the protected areas in turn. For details on attitudinal measurements, see chapter five. Analysis was possible for 92 households that had completed both the HAS and the HCIS (BaAka n= 21, non-Aka n=71).

#### Data analysis

One-way independent Analysis of Variance (ANOVA) was used to investigate to what extent respondents' attitudes to both (i) the park and (ii) the Dzanga-Sangha project predicted household consumption of wild food. Models were run to predict consumption rates of i) forest meat, ii) forest non-meat and iii) fish, and constructed for the BaAka and non-Aka separately. 'Attitude' was entered as a categorical predictor variable, divided into positive, optimistic, neutral or negative. Mean daily consumption rate (per AME) was the continuous dependent variable. One dataset- BaAka consumption rates of forest meat- violated the assumption of homogeneity required for ANOVA- therefore the non-parametric test equivalent- the Kruskal-Wallis test- was used in its place. It should, however, be remembered that consumption is measured at the household level, whereas attitudes are those of a single household representative who may or may not be responsible for food purchasing.

### 7.3.4 Is wild food consumption related to household wealth?

The wealth rank of non-Aka households<sup>30</sup>, assigned using participatory techniques, was examined for its links to wild food consumption rates. I then went on to examine the influence of particular aspects of wealth, including household expenditure, on food<sup>31</sup>, the ownership of domestic animals and the ownership of foraging equipment. All data were collected during both the HAS and the HCIS; the methodology for each can be found in chapter three.

#### Data analysis

The Kruskal-Wallis test was used to investigate the relationship between household wealth rank and household consumption patterns. Wealth rank was entered as a categorical predictor variable (1-4),

<sup>30</sup> As wealth ranking could not be done for BaAka households, this section looks at non-Aka households only

<sup>31</sup> Given the correlation between household income and household food expenditure (see chapter three), it was not possible to use both as predictor variables due to the risk of multicollinearity. As the more reliable of the two measures, household food expenditure was used to represent both.

with the dependent variable being the mean daily quantity consumed (per AME) of i) forest meat ii) forest non-meat products and iii) fish in turn.

Analysis of covariance (ANCOVA) was then used to examine the influence that certain individual aspects of wealth have on household consumption rates of forest meat, forest non-meat and fish. A model was constructed for each type of wild food. The dependent variable was mean daily consumption (per AME) of that wild food. Predictor variables were mean daily food expenditure (per AME), ownership of domestic animals (YES/NO), gun ownership (YES/NO) and fishing equipment ownership (YES/NO). Household food expenditure was entered as a continuous variable (log transformed), whilst domestic animal ownership, gun ownership and fishing equipment ownership were all entered as bivariate categorical data.

Models were constructed for BaAka and non-Aka households separately. No BaAka households owned guns or fishing nets and all had hunting nets and spears. The predictor variable ‘ownership of foraging equipment’ was therefore omitted. The validity of the models’ assumptions were confirmed by looking at homogeneity of variance and regression slopes.

### **7.3.5 Is wild food consumption related to consumer preference?**

This section focuses in on meat, and asks to what extent the consumption rates of particular species are influenced by consumer preference. I first explored which species are consumed by reserve households, using information from both the HCIS and the HAS meat ranking exercise. I then went on to compare results from each of these with the stated preferences of the respondent, before discussing these results in view of insights gained from interviews and participant observation.

#### **Data collection**

An in-depth household consumption study (HCIS) was conducted for 114 households, during which detailed information was collected on household meals (see chapter 3). Simultaneously, a meat-ranking exercise was conducted with 211 households as part of the household attitudinal study (HAS). All participants in the household attitudinal survey (HAS) were asked to identify and rank, in order of both consumption frequency and preference, photographs of animals commonly eaten in the area. Both rankings and comments made during the exercise were used to explore issues of consumer preference for particular meat types

#### ***Meat-ranking exercise***

Household representatives were given 25 cards with photographs of locally available food items. Food items included both meat (18) and non-meat (7), as well as wild (16) and domestic (9). All meat items were represented by a clear photograph of the entire animal. Photos of non-meat food items were taken of samples in Bayanga market. Participants were first asked to identify, in turn, all the food items in the photographs. This was done to ensure respondent familiarity with the food items in the exercise, as well as a relaxed introduction. Twelve photographs of the more commonly consumed animals were then spread out on the ground in front of the respondent, who was asked which had been eaten the most in the year 2006, then the next most common and so on, until all had been ranked. If a particular meat hadn't been eaten at all, the card was placed in a separate pile. Respondents were then asked why they hadn't eaten these.

For the final exercise, the twelve meat cards were again spread out on the ground before the respondent. The respondent was asked to imagine a situation where they had lots of money and all the animals pictured were found in the market. They were then asked which they would prefer to buy, then their second choice, and so on until all the cards were ranked. If any meat would not be purchased, they were placed to one side and asked for a reason why.

It was possible that some respondents would not be comfortable with identifying animals from photographs. This was monitored by including a number of photographs of locally familiar animals, such as the domestic chicken, to check image recognition ability. On two occasions the elected household representative excused themselves from ranking the photographs on the grounds that their eyesight was not good enough. On both occasions a younger household member conducted the exercise in their place and their socio-demographic details were also recorded. Identifying and ranking food items on the cards was generally considered to be highly entertaining, up to the point that other family members or passers-by also frequently became involved. It was sometimes necessary to gently remind people not to 'help' the respondent with identifying the photographs.

## **Data analysis**

### ***Which species are consumed?***

Results on the consumption of both wild and domestic species are summarised, both in terms of whether or not they were consumed in 2006 by each household, and the frequency with which they were consumed.

Given the two different approaches this study has taken to measuring household consumption of wild animals- namely an in-depth household consumption survey and a rapid self-ranking approach-



it is interesting to see how the results from each compare. Both can be said to have their strengths and weaknesses. The HCIS, while relying on self-reporting to a certain extent, adopts a systematic approach and relies on short-term recall (24 hours or under). It also provides detailed information on quantities and sources. On the downside, as a technique it is extremely labour intensive, and this tends to limit its reach- for each household included in this study, only 6% of consumption days could be surveyed within a 12-month period.

In contrast, the self-ranking approach was quicker and easier to implement, in addition to being less intrusive for the respondents. While it also asked for respondents to assess eating habits over a 12-month period, it deliberately focuses on relative rather absolute assessment to reduce the potential for accidental misreporting. However, this method is also heavily dependent on a thorough pre-understanding of local consumption patterns, as respondent choice, rather than being open, is restricted to the animals presented on the cards. It also relies on respondents to report consumption of protected species truthfully without the benefit of their being familiar with the researchers. Finally, it can only provide us with relative measures of consumption, whereas the HCIS can provide estimates of absolute quantities consumed.

The two approaches were compared in terms of the consumption rankings produced for each species- the exercise was therefore restricted to those animals which had featured in both (n=12). For each survey, the animals were ranked by being placed in order of mean consumption rank and frequency of consumption. The highest was given a rank of 12, the second a rank of 11 and so on. Correlation between the ranks given by the two methods was assessed using Kendall's tau statistical test.

### *The role of preference*

Initially I ran a number of simple correlations to assess the relationship between the mean preference rank of a species and the following: mean consumption rank (HAS), actual consumption frequency (HCIS), and market availability (measured as the mean daily volume sold in Bayanga market). Analysis was run separately for the BaAka and non-Aka. All correlations were conducted using Kendall's tau test of correlation for non-parametric ranked data.

I then focussed on the influence of the presence of a project employee in a household on the consumption rank, preference rank and consumption rates of four different species- blue duiker (unprotected wild animal), gorilla and elephant (protected wild animals) and cow (domestic animal), using the non-parametric equivalent of the t-test, the Mann-Whitney U test.

A series of generalised linear models (GLMs) were then run to investigate the influence of preference on consumption rates whilst controlling for certain socio-economic factors. For the modelling exercise three animals were chosen in particular- blue duiker, gorilla and elephant. Models were constructed to predict i) the consumption rank and ii) the consumption frequency of each animal separately, and for the BaAka and non-Aka in turn. The dependent variable, consumption rank/frequency, is represented by (i) the consumption rank given during the HAS and (ii) the proportion of days that species was consumed by a household during the HCIS. Hence, 12 models were constructed in total.

Predictor variables were as follows- preference rank (continuous), wealth rank (1 to 4), age (continuous), gender (male/female), education level (none/primary/secondary), residency length (in-migrant/resident) and project household (yes/no). Given the difficulties accurately assessing BaAka age, education and wealth rank, these categories were omitted for BaAka models. All BaAka were born in the region, therefore length of residence was also omitted.

The dependent variable, consumption rank, was entered as ordinal ranked data. Ordinal logistic models were constructed, whereby link function was specified as cumulative logit. The statistical significance of the predictor variables in improving the minimal model was assessed using the Wald statistic. To predict consumption frequency, linear models were constructed. Results are discussed in light of comments made by informants during and after the ranking exercises regarding their choices.

### **7.3.6 Is wild food consumption related to price and availability?**

#### **Data collection**

By comparing meat sale records from Bayanga market with known consumption rates, it is possible to investigate the interaction of meat availability and pricing of the meat of different species with their consumption rate. The methodology used for the market survey (meat availability and pricing) and HCIS (consumption rate) are outlined in chapter three.

#### **Data analysis**

I used multiple linear regression to see to what extent meat consumption could be predicted by the availability and pricing of that meat. Consumer preference could not be included in the model due

to its strong correlation with market availability (discussed later). Due to the infrequency of the inclusion of meat in the BaAka diet, and the limited quantitative data, this analysis was only possible for the Bayanga non-Aka households.

The dependent variable- meat consumption rate- was represented by the mean daily weight (per AME) consumed within households. Predictor variables, entered blockwise, were the mean daily weight available for sale in Bayanga market<sup>32</sup> (kg) and mean monthly price per kilo<sup>33</sup>.

Each data point represented one species. Given the potential for seasonal differences in meat availability and consumption, three models were constructed, representing each of the study periods- July (low rain), October (high rain) and January (dry season). All continuous data was log transformed to give a normal distribution, confirmed using the Kolmogorov-Smirnov test. Market and consumption data was available for all three seasons for 10 different animal species, namely fish, blue duiker, Peter's duiker, monkey, gorilla, elephant, red river hog and the domestic pig, chicken and cow.

Pricing was further explored by comparing the distribution of mean monthly sale prices, per kilo, of different species sold in the market. Given the non-parametric nature of the data and the small sample size, the Kolmogorov-Smirnov Z statistical test was used to examine potential differences.

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<sup>32</sup> Results from the HCIS show nearly two-thirds of meat consumed within Bayanga households is purchased from Bayanga market

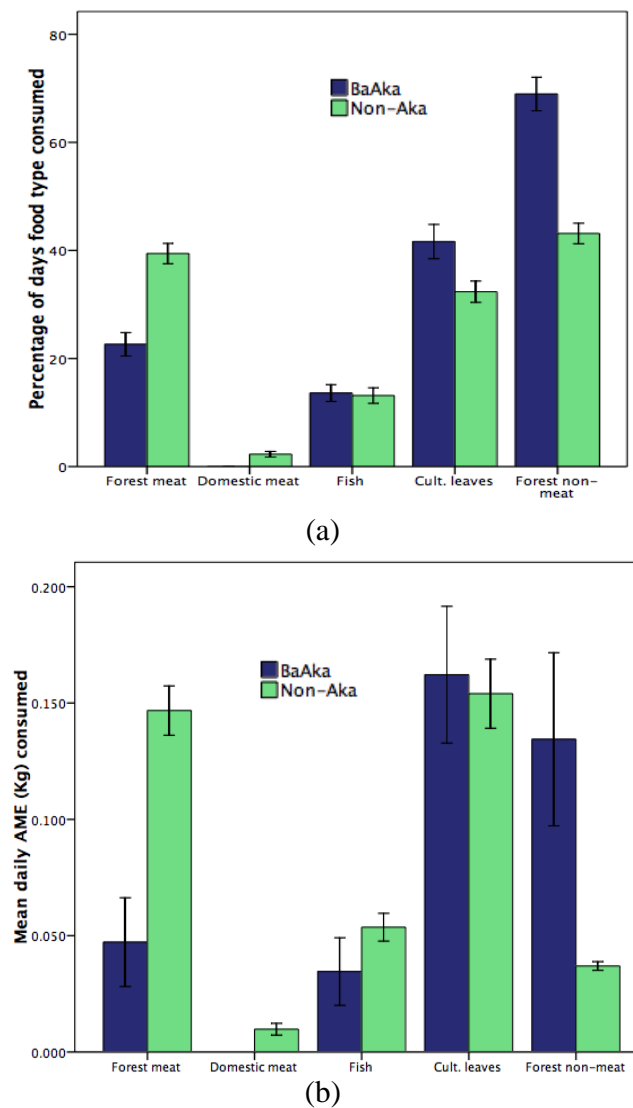
<sup>33</sup> Pricing is represented as the mean price asked for one kilo of fresh undressed meat for each species

## 7.4 Results

### 7.4.1 Evaluating patterns of wild food consumption

#### *Domestic versus wild food resources*

The strong influence of both meat and vegetable forest products in the diet of reserve residents is clear, illustrated below both as a) the proportion of days consumed and b) mean daily consumption rates (fig 7.1). For both BaAka and non-Aka residents, wild foods were consumed on over three-quarters of study days, with forest products particularly valued.



**Figure 7-1** Comparing consumption rates of different food types. (a) Proportion of days (b) Daily mean quantity consumed (per AME). Shown separately for the BaAka (N= 590 consumption days from 35 households) and non-Aka (N= 1334 consumption days from 79 households). Shown with error bars.

For the BaAka residents, while forest meat and fish were consumed fairly regularly, forest vegetables were the most frequently used resource in meals. The koko leaf in particular acted as a staple food, consumed on over 60% of consumption days. For the non-Aka, forest meat, although consumed with an equal frequency to forest vegetables, was consumed in much greater quantities. Both the non-Aka and BaAka consumed forest meat much more frequently than domestic meat- in fact at no point during the study was a BaAka household recorded as eating domestic meat. Such meat preferences are examined in more detail later in this chapter.

The diversity of edible plant products available from the rainforest is well documented elsewhere (e.g. Hladik et al., 1993, Bahuchet, 1985a, Bahuchet et al., 1988) and is not the focus of this section. However, it is interesting to note the dominance of just a few particular types of vegetable in the diet, namely koko (leaf of the *Gnetum* vine), Payo (*Irvingia* spp.) and various species of mushrooms. For the non-Aka, koko was responsible for about 70% of the weight of non-meat forest products consumed, and mushrooms for a further 29%. For the BaAka, while a much greater diversity of forest products was eaten, focus again was on koko (67 % of total weight), mushrooms (16% of total weight) and payo (7%). Note that these figures apply to ingredients used in cooked dishes only (weighed before cooking).

For the BaAka, fish is very much a forest resource, nearly always hunted by damming small forest streams, bailing out the water from the resulting pool, and collecting the fish or other aquatic animals left on the bottom. For the non-Aka on the other hand, fish comes primarily from the large Sangha river, or some of the smaller tributaries, and is fished using a net or a line and hook. Fish, while consumed by both ethnic groups, was consumed at generally lower rates than forest meat, particularly for the non-Aka.

For vegetables, both ethnic groups showed a heavy use of cultivated crops, although this was equalled in BaAka households by the consumption of forest vegetables. The sedentarisation of many pygmy groups, and the increasing embracing of agriculture has been well documented in the literature, and all the BaAka households included in this study owned and cultivated fields, although to varying degrees of intensity. Cultivation efforts focused primarily on the manioc plant (*Manihot esculenta*), of which both the root and the leaf are staple foods in the area- Ngunja, a local dish made from the leaf, is consumed on around 35% of days by the BaAka. A number of Yandoumbe residents also reported sourcing some of the cultivated leaves that they consumed from unprotected non-Aka fields, a source of considerable tension between the two groups in the area.

***Comparing BaAka and non-Aka consumption patterns***

It is clear that there are significant differences in the diets of BaAka and non-Aka households- the Bayanga non-Aka consume forest meat at over twice the rate of BaAka households, as well as significantly more domestic meat (table 7.1 below). While consumption of cultivated vegetables appears similar, BaAka households show a tendency to consume forest vegetables in greater quantities (fig. 7.1b).

**Table 7-1** BaAka vs. non-Aka food consumption rates (frequency and mean daily quantity). BaAka n= 35, non-Aka n= 79 (Mann-Whitney U tests). ns= non-significant

	Proportion of days consumed		Mean daily quantity (per AME)	
	U	P	U	p
<b>Domestic meat</b>	1003.0	0.001	1003.0	0.001
<b>Wild meat</b>	531.5	<0.001	357.0	<0.001
<b>Fish</b>	1190.0	Ns	1313.5	ns
<b>Forest non-meat</b>	396.5	<0.001	665.5	<0.001
<b>Cultivated leaves</b>	966.5	0.018	1326.5	ns

***Seasonal variations***

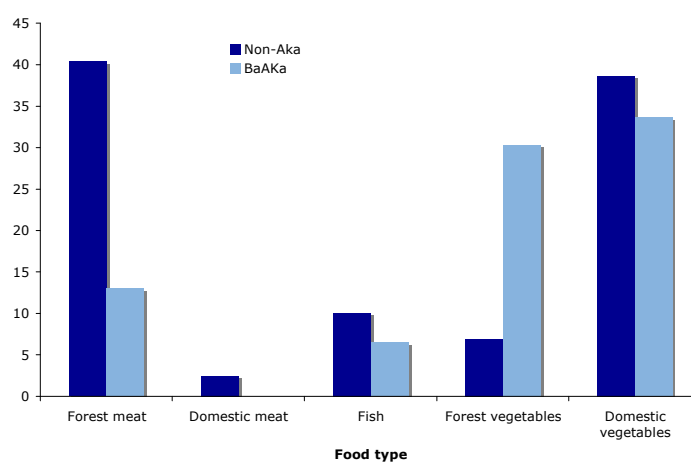
There were also some interesting seasonal variations in the mean daily amounts consumed for different food types. During the high rain season, BaAka households appear to eat less of both forest meat (Wilcoxon signed-rank test, DRY/HIGH RAIN,  $W_s = -2.549$ ,  $p < 0.001$ ) and forest fish (DRY/HIGH RAIN  $W_s = -2.310$ ,  $p < 0.05$ ). This can be largely attributed to difficulties capturing them rather than fluctuation of availability. Fishing by damming forest streams becomes increasingly arduous, if not dangerous, with the rising water level in the rainy season. Net hunting is also less favoured in the rainy season- not only do animals become harder to hear and see in the rain, but the forest also becomes more dangerous to move about in as elephants are harder to hear. The hunting nets also become particularly cumbersome and heavy when wet. There appears to be no significant seasonal difference, however, in the difference in mean daily amounts consumed of either forest or cultivated leaves.

For the non-Aka, in contrast, there was little seasonal difference in the mean daily consumption of forest meat- as illustrated by the dynamics of wild meat sold in Bayanga market (chapter six), the combination of gun and snare hunting, although individually prone to seasonality, together provide a steady supply of meat. However, during the dry season non-Aka households do appear to consume less of both forest vegetables (DRY/HIGH RAIN  $W_s = -2.566$ ,  $p < 0.05$ , DRY/LOW RAIN

$W_s = -3.316$ ,  $p < 0.01$ ) and cultivated leaves (DRY/HIGH RAIN  $W_s = -3.670$ ,  $p < 0.001$ , DRY/LOW RAIN  $W_s = -3.472$ ,  $p < 0.01$ ).

### ***Protein availability***

By using generic values for the protein content of different food types, it is possible to estimate the proportion of protein provided by each. Conversion factors for each, and their sources, are as follows: following Albrechtsen et al. (2006), forest meat (or bushmeat) is taken as providing 27.5g protein per 100g of meat; beef, pork and chicken as 25g and fish as 18.8g. For vegetables, *Gnetum* spp. was taken as 16 g protein per 100g dry weight (Mialoundama, 1993), mushrooms 25.2g (Manzi et al., 1999), and the manioc leaf 25.1g (Rogers and Milner, 1963)<sup>34</sup>. As the leaf of the manioc plant accounted for over 60% of all cultivated vegetables consumed, its protein values are used to represent all.



**Figure 7-2** Mean mass of protein consumed per day for each food type (per AME). BaAka and non-Aka shown separately

For the non-Aka, the vast majority of their protein requirements are met through forest meat and domestic vegetables. For the BaAka, meat plays only a small role, with forest and domestic vegetables providing most of the protein in their diet. In total, the average BaAka male consumed

<sup>34</sup> The differences in protein obtained from vegetables and that from meat are discussed in more detail in section 7.5.

an estimated 83g of protein a day, only 20g of which is from meat. In contrast, the average non-Aka male consumed around 98g of protein a day, of which 52g is from meat.

#### ***Food type- substitutes or complementary?***

Simple correlations using the non-parametric Spearman's  $\rho$  were run to examine the relationship between consumption rates for a wild food type, and its domestic equivalent. For the non-Aka households included in the survey, both domestic meat and forest meat consumption was positively related to fish consumption- if one was consumed more, consumption of the other was also likely to be high (Spearman's  $\rho = .236$ ,  $p = .035$ ;  $\rho = .328$ ,  $p = .003$  respectively). However, consumption rates of domestic and wild meat did not appear to be related (Spearman's  $\rho = -.378$ ) nor consumption rates of domestic vegetables and those of wild vegetables (Spearman's  $\rho = .185$ ).

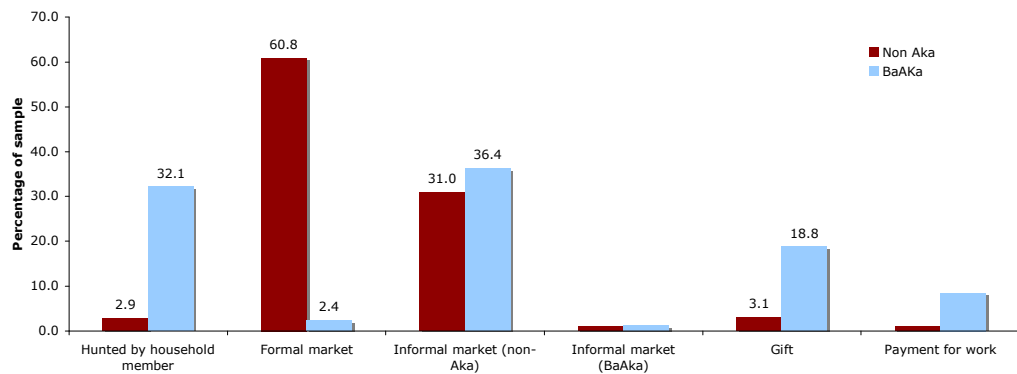
For the BaAka, the consumption rates of forest meat were unrelated to those for fish (Spearman's  $\rho = .011$ ). While the consumption rate of forest vegetables did show a loose negative relation to those for domestic vegetables- i.e. as the consumption rate for one increased, it decreased for the other (Spearman's  $\rho = -.320$ ,  $p = .061$ ), this was not statistically significant.

#### ***Source of wild food***

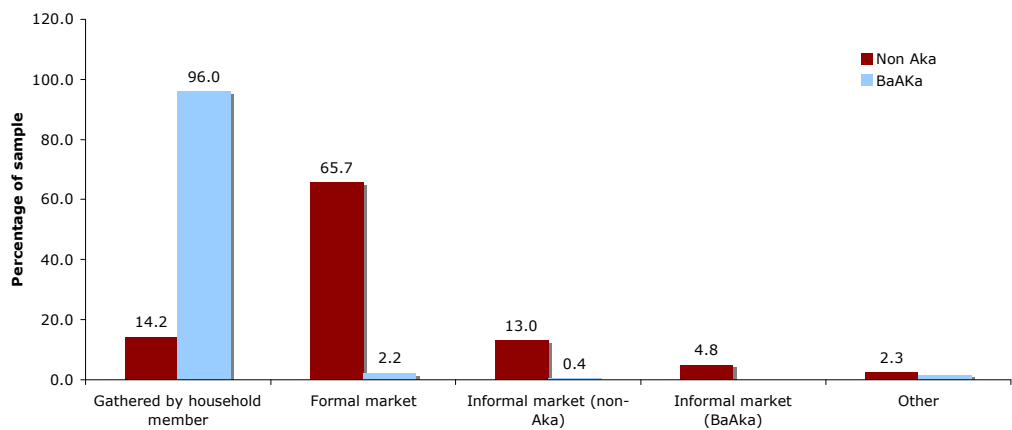
There are clear patterns in the sourcing of many of the wild foods for both BaAka and non-Aka households (fig. 7.3). Most forest meat consumed by the non-Aka is purchased through the market place, either formally or informally. The BaAka, on the other hand, tend to obtain meat from a greater variety of sources, with a third hunted by a family member, a third purchased and most of the remainder either given by a family member or as a reward for work. It is relatively common for BaAka working for non-Aka to be paid with small pieces of meat, often the skin, or a share of the animal if hunting, usually the head.

For both fish and non-meat forest products, predominantly leaves and fungi, the BaAka nearly always gather their own. In contrast, non-Aka households tend to buy most of theirs, predominantly from Bayanga market, although a smaller proportion is gathered from the forest. Non-Aka forest forays tend to be done by the women of the household, and concentrate on koko leaves and mushrooms- as a result they are conducted most frequently in the wet season when mushrooms are abundant. Such walks, in contrast to the wide-ranging BaAka, tend to concentrate on known paths or field borders and require few forest navigation skills.

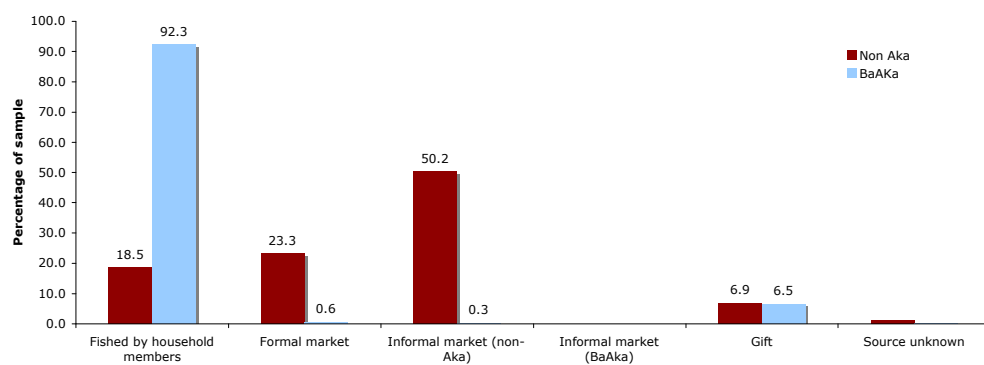




(a) Source of forest meat



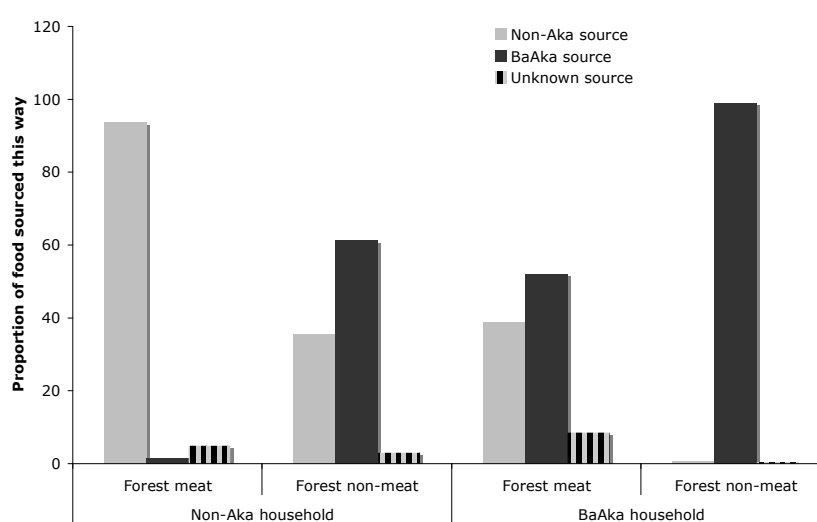
(b) Source of non-meat forest products



(c) Source of fish

**Figure 7-3** Source of wild foods consumed by surveyed households. (a) Forest meat (b) Non- meat forest food (c) Fish. Displayed as proportion of total sample weight over the study period.

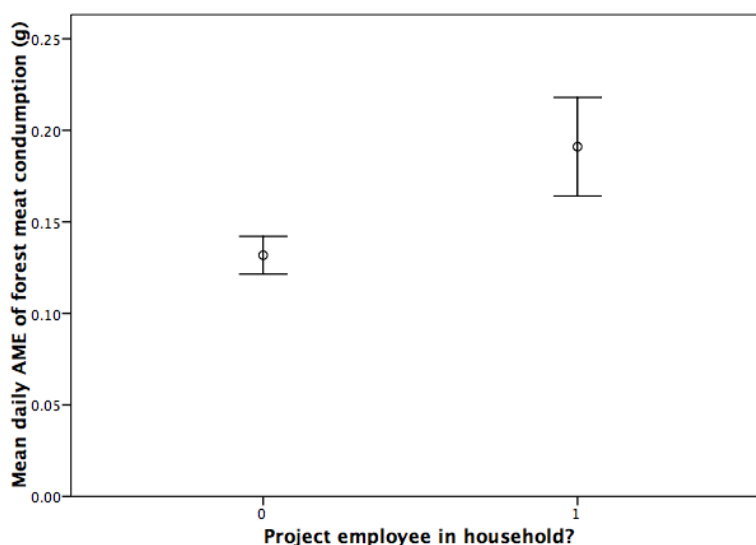
There is a traditional narrative that exists concerning the relationship between the hunter-gatherer BaAka and the agricultural non-Aka, whereby the BaAka provided the farmers with forest resources in exchange for domesticated crops. Using market data, it is possible to trace back market purchased goods to their original extractor. Shown below is the percentage of forest goods consumed by households that was extracted by BaAka and non-Aka individuals (fig. 7.4). This shows that the majority of forest meat consumed within Bayanga is actually hunted by the non-Aka, as is nearly half of that consumed by the BaAka within Yandoumbe, showing a reversal of the traditional relationship. The BaAka do, however, continue to supply the majority of non-meat forest products.



**Figure 7-4** Proportion of food consumed (per food type) extracted by BaAka or non-Aka (represented by dark and light grey respectively). Shown for both non-Aka and BaAka households (x-axis)

#### 7.4.2 Is wild food consumption related to project benefits?

The consumption patterns of households containing project employees were contrasted to those without. Given the strong differences between BaAka and non-Aka consumption patterns, these populations were analysed separately. Only the mean daily quantity of forest meat consumed by non-Aka households was significantly different between project and non-project households (Mann-Whitney U,  $Z = -2.097^*$ ,  $p < 0.05$ ), whereby project households were found to consume wild meat in significantly greater quantities.



**Figure 7-5** Project household (1) vs. non-project (0) household mean daily forest meat consumption. Error bars shown.

The possible reasons for such a relationship, such as the increased levels of wealth produced by a project salary, are explored later. Given the lack of variation in the sourcing of many of the foods, there were few potential ways that project employment could influence how food was sourced. The one possible statistical test was examining whether the presence of a project employee in a BaAka household meant forest meat was more likely to be bought rather than hunted or gifted. While the proportion purchased was slightly higher in project households, this was not statistically significant (Mann-Whitney U,  $Z=1.352$ ,  $p=.176$ ).

### 7.4.3 Is wild food consumption related to pro-conservation attitudes?

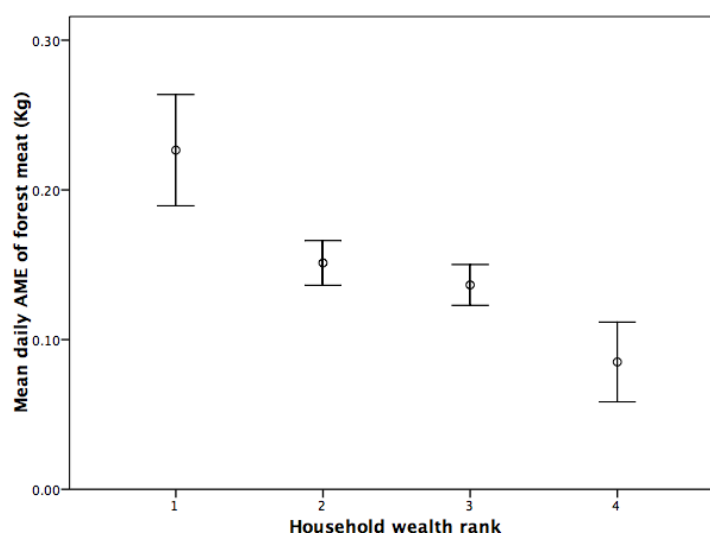
The mean daily consumption rates (per AME) of different wild food types were examined for their relation to conservation attitudes. ANOVA models were used in all cases, except for predicting BaAka consumption of forest meat, where the non-parametric test equivalent- the Kruskal-Wallis test- was used in its place. For none of the models did the respondents attitude to either the park or the ICDP accurately predict consumption rates of different food groups. In other words, pro-conservation attitudes appear to have little relation to pro-conservation behaviour<sup>35</sup>.

<sup>35</sup> It should, however, be remembered that consumption is measured at the household level, whereas attitudes are those of a single household representative who may or may not be responsible for food purchasing.

#### 7.4.4 Is wild food consumption related to household wealth?

##### Linking household consumption of wild food to wealth rank

The wealth rank of a non-Aka household (1-4) was tested for its relationship to mean daily consumption rates (per AME) of meat (forest and domestic), forest non-meat and fish in turn. Only forest meat was significantly linked to wealth rank, whereby the richer households were found to be eating significantly more forest meat than the poorer households (Kruskall-Wallis,  $\chi^2=8.881$  (3),  $p<0.05$ ) (fig. 7.6 below). Rates of consumption of both fish and non-meat forest products (including leaves and fungi) appear unaffected by wealth.



**Figure 7-6** Relationship between household wealth rank and mean daily consumption (per AME) of forest meat by the household. Households ranked 1 (wealthiest) through to 4 (poorest). Error bars are shown.

##### Investigating links with particular aspects of wealth

Different aspects of household wealth were used to predict consumption rates of (i) forest meat, (ii) fish and (iii) forest non-meat products in turn. Six ANCOVA models were attempted- three for non-Aka and three for BaAka households. The household wealth variables only predicted consumption patterns in two areas- non-Aka consumption of forest meat and non-Aka consumption of fish.

**Table 7-2** Results of ANCOVA showing aspects of wealth predicting consumption rates of forest meat and fish for non-Aka households. Only variables that significantly improve the fit are shown. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

Model	Parameter	F	df	Overall model
<b>Forest meat</b>	Food expenditure	24.027***	1	Adjusted $R^2 = .277$ , $F(9) = 2.981$ ***
<b>Fish</b>	Food expenditure	17.083***	1	Adjusted $R^2 = .264$ , $F(5) = 6.024$ ***
	Fishing equipment	4.090*	1	

For the non-Aka households, food expenditure (used here as a proxy for household income- see chapter three) was positively correlated with increased consumption of both forest meat and fish, while ownership of fishing equipment also resulted in an increased consumption of fish. Given the large proportion of forest meat purchased through the market, it is perhaps not too surprising that the presence of hunting equipment, either guns and snares, does not appear to result in higher consumption rates of meat. Interestingly, ownership of domestic animals was also found to be unrelated to the consumption rates of wild meats. (In a separate analysis, the ownership of domestic animals was also found to be unrelated to the consumption rate of domestic meat; Spearman's  $\rho = -.051$ ,  $p = .658$ ). Neither mean daily food expenditure nor ownership of domestic animals significantly predicted BaAka consumption of any of the wild food types.

## 7.4.5 Is wild food consumption related to consumer preference?

### 7.4.5.1 What species are people eating?

Results from both the HCIS and the HAS meat ranking survey are tabulated below. The HCIS, with its open approach, recorded a greater range of animals consumed. Its temporal limitations, however, mean that the figures estimating the percentage of households who had eaten a particular meat at least once in a 12 month period are all lower than those produced by the HAS meat ranking exercise.

Both surveys agree on the four species most commonly eaten by all households- namely fish, blue duiker (*Philantomba monticola*), Peter's duiker (*Cephalophus callipygus*) and monkey. Caterpillars

are also recorded as frequently eaten during the HCIS, although as a very seasonal food, this is likely to be an artefact of the timing of the survey<sup>36</sup>. Whilst many respondents confirmed they had consumed protected species, such as elephant or gorillas, as well as domestic meat, due to their infrequency they were rarely recorded during the HCIS.

Comparing results for the BaAka and non-Aka households it is clear again that the non-Aka consumption of domestic meat is much higher, although, again, domestic meat is consumed much less frequently than wild meat.

### ***Comparing approaches to assessing consumption patterns***

The two approaches to measuring household consumption of wild animals- namely an in-depth household consumption survey and a rapid self-ranking approach, were compared by testing the correlation between the two independent consumption rankings produced for 12 of the most popular species. For both the non-Aka and the BaAka households, datasets showed a strong correlation (Kendall's tau  $\tau = .822$ ,  $p < .001$  (non-Aka):  $\tau = .947$ ,  $p < .001$  (BaAka)), suggesting both approaches to produce similar results in terms of the relative frequency of consumption of different species.

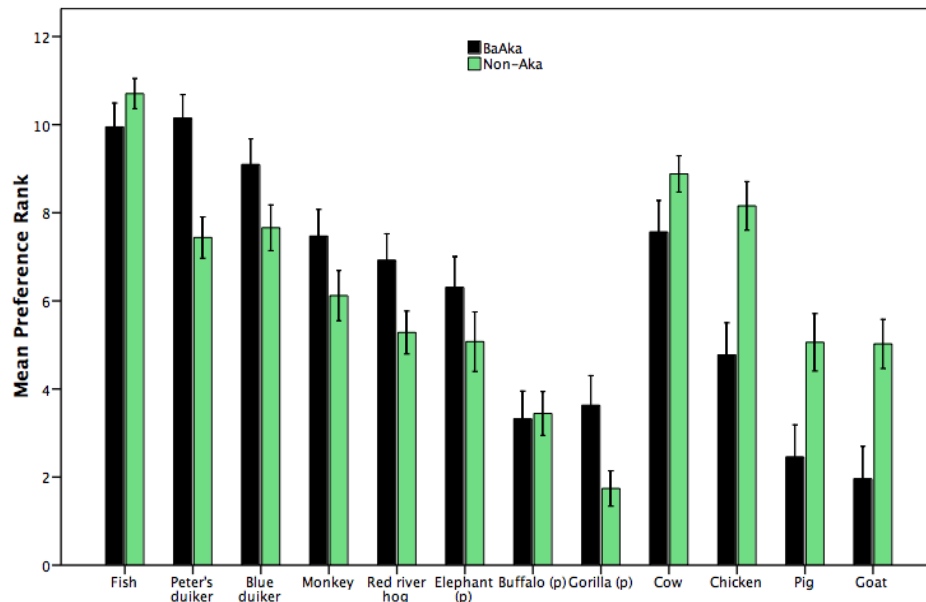
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<sup>36</sup> Caterpillars are a highly seasonal resource in the rainforest, appearing briefly for a few weeks during the peak of the wet season. They therefore featured strongly in the October phase of the household survey

**Table 7-3** Percentage of households that consumed the meat of particular animals during the study period, and their consumption frequency. Data collected through both the household attitudinal survey (HAS) meat ranking survey<sup>1</sup> and the household consumption survey<sup>2</sup>. Results shown separately for the BaAka (HAS n=76, HCIS n= 35) and the non-Aka (HAS n=135, HCIS n= 79). Note the HAS asked respondents to rank species consumption for all of 2006, whilst the HCIS reports 21 days for each household from July 06-January 07. The names of the animals are given in English- refer to appendix 3 for their Latin names.

	BaAka			Non-Aka		
	% households ate <sup>1</sup>	% households ate <sup>2</sup>	% days consumed <sup>2</sup>	% households ate <sup>1</sup>	% households ate <sup>2</sup>	% days consumed <sup>2</sup>
Fish	100	83	14	99	92	13
Blue duiker	100	69	14	97	71	11
Peter's duiker	99	63	9	95	96	7
Monkey	81	6	1	86	27	1
Caterpillars	0	23	3	0	32	11
Pangolin	0	6	1	0	4	1
Porcupine	0	6	1	0	4	1
Sitatunga	0	0	0	0	3	0
Yw-bk duik.	0	3	1	0	0	1
Civet	0	0	0	0	1	0
Giant rat	0	3	1	0	1	0
Tortoise	0	0	0	0	1	0
Red river hog	73	0	0	79	14	0
Elephant	55	0	0	45	1	0
Gorilla	39	0	0	23	0	0
Buffalo	27	0	0	11	0	0
Chicken	48	0	0	81	6	0
Goat	23	0	0	49	0	0
Cow	55	0	0	81	4	1
Pig	27		0	0	67	10

### 7.4.5.2 Which species would people prefer to eat?



**Figure 7-7** Mean preference rank for 12 species included in HAS meat ranking exercise. 12 represents the most preferred, 1 represents the least. (p) represents a wild species protected from hunting.

#### Non-Aka

Preference patterns for the wild species shows similar trends to consumption. Fish was an extremely popular choice, as was the blue duiker (*Philantomba monticola*) and Peter's duiker (*Cephalophus callipygus*). Monkeys were ranked slightly lower, due at least partly to Muslims who expressed concerns about the non-Halal nature of their killing (monkeys are generally killed by shotgun rather than snares, which doesn't allow animals to be captured alive and slaughtered correctly). Three respondents also expressed concerns about Ebola.

Of three protected species included in the ranking exercise, elephant proved the most popular, with 81 % of respondents saying they would eat it if offered, through to only 56% who would eat gorillas. For the elephant in particular, many people commented on how difficult it was to buy, both for reasons of rarity, attributed by many to the project's anti-poaching activities, and due to the secrecy surrounding much of the sales. Of the 26 people who said they wouldn't eat it even if available, its protected status was given as the most common reason- this appeared to be very much a negative reinforcement rather than positive- the elephant was not eaten because of fear of repercussions rather than for any particular appreciation of its alternative non-use values.



Gorillas, while reported as being eaten by a quarter of households in 2006, were generally one of the less preferred meats. Interestingly, the majority of women interviewed claimed that they did not eat it, many stated they would buy it for their husbands if available. There didn't appear to be a unifying reason for this, although it appeared to be related to traditional taboos rather than for reasons of taste.

Of the four domestic species included in the survey, cow and chicken were ranked consistently highly, pig and goat less so, although there were few respondents who said they would refuse to eat any of the four if offered. Domestic pork was the least popular domestic meat. Reasons varied, but focused on unavailability, expense and the propensity of pigs to eat rubbish, making them too dirty to eat. Women in particular were less likely to eat pork, although again reasons varied, some women stating it was a tradition of their village, others claiming taste and one claiming it made her sick. Reluctance to eat goat meat appeared linked to both to having no history of its consumption, and suspicion regarding how the goat had died- two people voiced concerns that vendors often try to sell the meat of a sick goat. Conversely, beef was extremely popular- all respondents said if they had the money they would buy it. Its relative rarity in diets was attributed to expense rather than access or taste.

Chickens, kept by over 60% of Bayanga households, are generally highly rated, although fairly uncommon in diets. This appears due to both the relative expense and the difficulties in finding one for sale. A number of people commented that, although they owned chickens, they preferred to conserve them for times of hardship, when they would be sold to earn money rather than eaten.

### **BaAka**

The BaAka showed very similar patterns, with the key exception that wild species were generally ranked higher and domestic species lower. Indeed, while the majority of the BaAka said they would eat chicken or beef if it were available, only 48% of respondents said that they would eat pork, dropping to 36% for goat. The unpopularity of both goat and pig meat are largely due to the perception of these animals as very dirty, known to eat rubbish lying around the villages. In addition goats, having a damp nose, are thought to have flu, adding to their perceived noxiousness.

Beef was the most popular of domestic meats available, and not eaten mainly for reasons of expense. Chickens weren't eaten in 2006 for both practical and taste related reasons. Many respondents pointed out chickens were expensive and, as they didn't raise them, they couldn't eat them. However a number of BaAka also said that if they did raise them they still wouldn't eat them,

but rather keep them to sell. Because chickens were seen to wander around the village and eat faeces, nearly a quarter of respondents said they wouldn't eat them even if offered.

Of the wild meats, fish, blue duiker and Peter's duiker were all popular choices- this focus on the smaller, less protected species appeared to be due to practical reasons as much as any fear of repercussions- monkeys and red river hog were mentioned as being harder to find than the smaller animals, primarily as they could not be captured during net hunts.

Of the three protected species, again elephant was the most popular meat, with nearly all respondents saying they would eat it if offered, and that a failure to do so in 2006 was mainly due to problems obtaining it from a non-Aka gun hunter, as elephant hunting is now done almost exclusively with guns. The few who said they wouldn't eat it even if available attributed it to fear of the DSP. Problems were also reported in finding gorilla and buffalo meat, much of which is purchased from non-Aka gun hunters, although one gorilla had been killed by a BaAka spear in 2006 and shared amongst some of the respondents. However, the majority of people who said they would not eat it even if offered (25% of the sample) said it was due both to being dangerous to kill, and a fear of the project. Buffalo meat was also said to be bad for children, making them sick.

### **7.4.5.3 The role of preference in meat choice**

I initially ran a number of simple correlations to assess the relationship between the mean preference rank of a species and its i) mean consumption rank (HAS) ii) actual consumption frequency (HCIS) and iii) market availability. Results are tabulated below (table 7.4), and show strong correlations between preference and consumption measures, suggesting preference may play a significant role in the decision to eat certain meats. However, there is also a strong relationship between the preference rank given to a species with the availability of its meat in Bayanga market, suggesting that, rather than preference influencing consumption, it may be availability, and therefore familiarity, affecting preferences.

**Table 7-4** R-matrix for measures of preference and measures of consumption. All conducted using Kendall's tau. N=12. † p<0.01, \* p<0.05, \*\* p<0.01

		Mean consumption rank (HAS)	Consumption frequency (HCIS)	Mean daily volume sold in Bayanga market
		$\tau$	$\tau$	$\tau$
<b>Non-Aka</b>	<b>Mean preference rank</b>	.576**	.459 <sup>†</sup>	.689**
<b>BaAka</b>	<b>Mean preference rank</b>	.636**	.639**	.378

### *The influence of project employment*

I then looked at how preference and consumption rates differed between those households containing project employees and those without. For the BaAka, project households showed no significant differences in their preferences or consumption rates to non-project households. Non-Aka project households, however, ranked both the domestic cow and the blue duiker significantly higher than non-project households in terms of preference, although I found no difference in terms of consumption rank or known consumption rate. While both the gorilla and the elephant were ranked significantly lower in terms of both preference and consumption rank by project households, there was insufficient data to confirm the consumption ranking with known consumption rate.

Both during formal and informal interviews during the study period, few project employees admitted eating elephant, although there were frequent accusations from residents that the protected meat confiscated by the guards was taken home to eat rather than taken to the project headquarters. Interestingly, few employees offered conservation-related reasons for refraining from eating it—many employees said they would eat it if they didn't work for the project, and one particularly candid employee said he would like to eat it, but people often refused to sell it to him for fear of repercussions.

**Table 7-5** Non-Aka project households vs. non-project households for preference and consumption of different animals. (Mann-Whitney U tests). IS= Insufficient data. \* p<0.05, \*\* p<0.01, \*\*\*p<0.001

	Preference rank	Consumption rank	Consumption rate	Project households...
<b>Blue duiker</b>	299.00*	441.00	392.00	Prefer blue duiker
<b>Cow</b>	316.50 *	446.00	432.00	Prefer beef
<b>Gorilla</b>	230.00***	333.00**	IS	Dislike gorilla and say they eat less
<b>Elephant</b>	130.5 ***	296.50 *	IS	Dislike elephant and say they eat less

Yandoumbe is home to many of the gorilla trackers employed by the habituation program, and to a certain extent there appeared to be a reluctance from BaAka employees to eat gorilla meat. A number of employees stated that since they now they worked with the gorillas they no longer had an appetite for their meat, although others simply said they didn't eat them as they didn't want to lose their jobs. Interestingly, however, there was no difference in the mean consumption or preference rank for gorilla between project and non-project BaAka households.

#### *The influence of socio-demographic factors*

A number of generalised linear models were constructed using the following variables to predict consumption rank and mean daily consumption rate (per AME) of three particular species within a household- blue duiker (unprotected wild animal), elephant (protected wild animal) and cow (domestic animal). Predictor variables were preference rank, wealth rank, age, gender, education level, residency status (in-migrant/resident) and whether or not the household contained a project employee.

Of the 12 models constructed, the predictor variables only significantly predicted consumption ranks for two (table 7.6). For the BaAka, none of the variables significantly improved the minimal models. For the non-Aka households, none of the variables predicted mean daily consumption rate (per AME). Results for models predicting the consumption frequency rank given by non-Aka respondents suggest that it is overwhelmingly preference for a certain meat which determines its consumption rank, rather than socio-economic variables such as wealth or employment status. It

should be borne in mind that consumption rank is a relative measure that takes no account of actual frequency of consumption, nor quantities consumed.

**Table 7-6** Results of generalized linear models showing variables predicting consumption rank/rate of three species. Only variables that significantly improve the fit are shown. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ . BaAka  $n = 76$  (HAS),  $n = 35$  (HCIS). Non-Aka  $n = 135$  (HAS),  $n = 79$  (HCIS).

		Consumption rank (HAS)		
		Predictor	Wald	Model fit: LR $\chi^2$
Non-Aka	Cow	Preference	10.349*	22.034* (df=10)
	Elephant	Preference	13.659*	37.633*** (df=10)

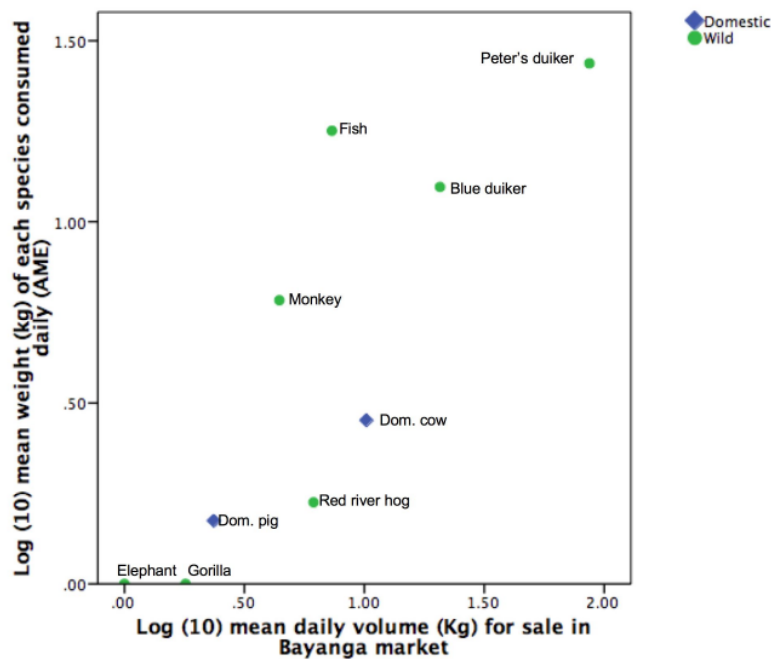
#### 7.4.6 Is wild food consumption related to price and availability?

Multiple linear regression was used to investigate to what extent the consumption rate of each species could be predicted by meat availability and pricing. Consumption was represented by mean daily household consumption rate (per AME) for a particular species. Given the seasonality involved in meat availability, a model was constructed for each study period- July (low rain), October (high rain) and January (dry season). Each model was constructed from 10 data points, each representing a different species. Results, tabulated below, show that, for all three seasons, market availability is a strong predictor of the rate at which a particular meat is consumed.

**Table 7-7** Results of multiple regression showing variables predicting mean daily meat consumption rate (per AME). Only variables that significantly improve the minimal model are shown. †  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$ .

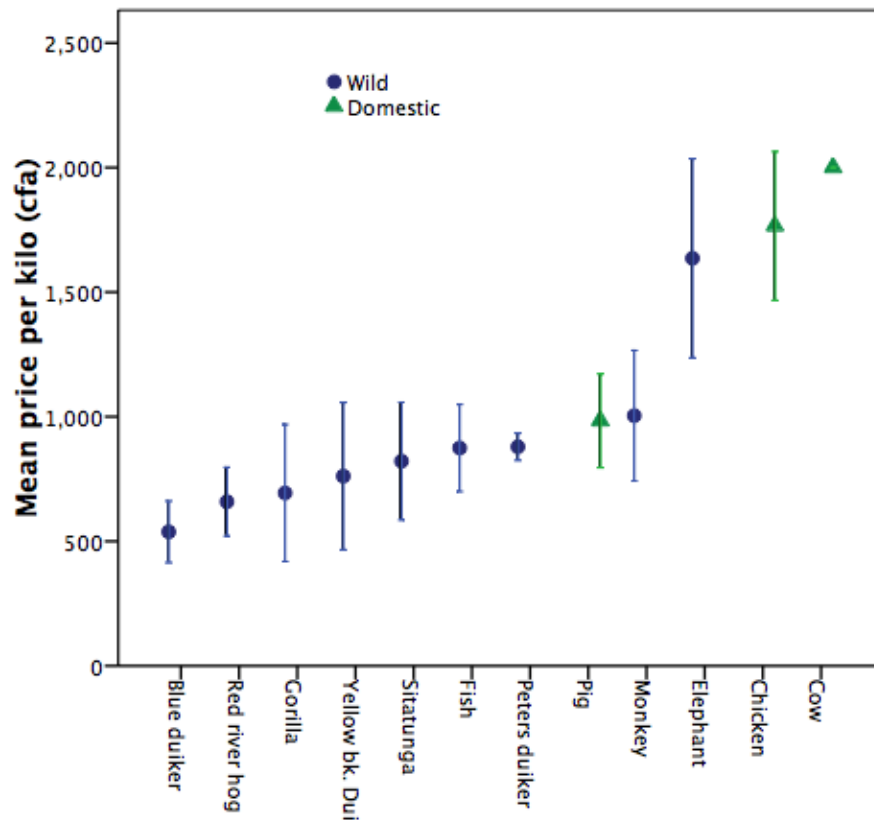
		Predictor	B (SE)	Model fit
Non-Aka	Dry	Availability	.186 <sup>†</sup> (.094)	$R^2 = .502$ , $F = 3.524$ <sup>†</sup>
	Low rain	Availability	.265 * (.072)	$R^2 = .752$ , $F = 9.101$ *
	High rain	Availability	.400** (.005)	$R^2 = .871$ , $F = 11.048$ **

This relationship is illustrated below for July (fig. 7.8), whereby consumption rate of the meat of both domestic and wild animals appears strongly correlated with its appearance in Bayanga market. Note that market figures represent 52% sales of domestic meat, 60% sales of wild meat, and 24% sales of fish to Bayanga households- the remainder is sold informally from houses.



**Figure 7-8** Scatterplot showing relationship between volume of meat for sale in Bayanga market and volume of meat consumed by Bayanga households in July.

Availability was an issue that was mentioned repeatedly by residents in regard to the low consumption ranking of nearly all species, but particularly when discussing the meat of protected animals and domestic animals. The meat of protected animals, such as elephants, was mentioned as being particularly hard to get hold of for reasons both of supply but also because the secrecy surrounding its sale made it hard to advertise. Figure 7.8 also serves to illustrate the infrequency of sale of domestic meat relative to wild meat.



**Figure 7-9** Mean price per kilo asked for each meat type (undressed\*) in Bayanga market. Means calculated by dividing monthly mean unit weight by monthly mean price per unit. For all species N= 12, with the exception of sitatunga and pig (n=5), elephant, goat and yellow backed duiker (n=4) and gorilla (n=3). Price of beef remained constant throughout, therefore error bars not included.

\*While considered 'undressed', weights were calculated using, with the exception of chicken and fish, carcasses that had already been divided into locally known units. Therefore none of the weights included organs or head. They did include bone and skin, with the exception of the beef which was solely meat. Chicken was sold entire- if only the dressed weight was to be considered, the price per kilo would rise considerably.

Using the Kolmogorov-Smirnov Z statistical test, domestically-reared beef was found to be more expensive than all other meats. Chicken was found to be more expensive, kilo for kilo, than every other meat except elephant. Interestingly, elephant meat was found to be more expensive than most other meats. While this may be linked to a combination of its popularity and rarity, there appeared to be no overall relationship between meat price and availability in the market.

**Table 7-8** Differences in the mean monthly price (per kilo) of different meats (using the Kolmogorov-Smirnov Z statistical test). See fig. 7.10 for a graphical representation of these results.

	<b>Cow</b>	<b>Chicken</b>	<b>Elephant</b>	<b>Monkey</b>
<b>Domestic chicken</b>	1.414*	-	-	-
<b>Elephant</b>	1.664**	ns	-	-
<b>Monkey</b>	2.058***	1.801**	1.429*	-
<b>Domestic pig</b>	1.793**	1.594*	1.491*	ns
<b>Peter's duiker</b>	2.121***	2.121***	1.664**	ns
<b>Fish</b>	1.984**	1.687**	ns	ns
<b>Sitatunga</b>	1.793**	1.664**	1.414*	ns
<b>Y. bk. duiker</b>	1.664**	1.664**	1.414*	ns
<b>Gorilla</b>	1.500*	1.500*	ns	ns
<b>Red river hog</b>	2.121***	2.121***	1.664**	1.601**
<b>Blue duiker</b>	2.121***	2.121***	1.664**	1.801**



## 7.5 Discussion

This chapter explored patterns of consumption of wild food within two distinct populations within the reserve- the BaAka and the non-Aka- with a view to evaluating the impact of the ICDP on these patterns. To this end, an extensive household consumption study was run in parallel to a survey of meat sales in the only public market in the reserve. The preferences of reserve residents were also explored using interviews, participant observation, semi-structured interviews and a meat ranking exercise.

### 7.5.1 BaAka consumption of wild resources

The BaAka of Yandoumbe are traditionally hunter gatherers. While the formation of the park has seriously restricted the area of forest open to them, traditional hunting methods are permitted and it is clear that forest resources continue to play a crucial role in household diet. A minimum of 82% of consumption days relied to some extent on forest products, predominantly non-meat products such as leaves from the koko vine (*Gnetum* spp.) and mushrooms. While there appears to be a certain shift towards domestically cultivated leaves, in particular the leaf of the manioc plant, there was no consumption at all of domesticated meat during the HCIS (although it was occasionally seen to occur outside of data collection days). While one or two households did raise chickens, these are seen more as an investment, to be redeemed for money in times of need, rather than a sustainable source of meat, and domestic animals are generally viewed with mistrust- dirty and unhealthy in comparison to animals of the forest.

The lack of baseline data mean it is not possible to compare pre-park consumption levels to current ones, and thus empirically assess the nutritional impact of park formation. There is clearly still a great deal of anger regarding the gazetting of their traditional hunting grounds and frequent complaints of mistreatment by park guards, even when hunting legally within the reserve or community hunting zone. Although less vocal than the non-Aka at linking anti-poaching efforts with food shortages and hunger, the implications of reducing hunting land for people who are reliant on the forest for food is clear.

When comparing wild food consumption rates to a study conducted with the BaKola pygmies of Cameroon, the Yandoumbe BaAka show a much lower mean daily intake of forest meat- 47g (per

AME) as compared to the BaKolas 216g (per capita)<sup>37</sup> (Koppert et al., 1993). It is, however, not known how much of the BaKola study was based in forest camps, where it is recognised that both a greater diversity and a greater quantity of forest resources are consumed<sup>38</sup> (Ichikawa, 1993, Bahuchet, 1985a). Ichikawa's study of Mbuti consumption patterns in village camps, DRC, showed similar patterns to the Yandoumbe BaAka- of 308 meals observed, 70% were based around cultivated plants and 30% on wild plants. Wild meat, namely termites and duiker were consumed only 12 and 8 times respectively (Ichikawa, 1993). Other studies based in forest camps show a much higher rate of meat intake- 360g per capita/day for the Congolese BAka (Kitanishi, 1995) and 400g per capita/day for the Mbuti (Ichikawa, 1983).

The Yandoumbe BaAka, rather than obtaining their protein from meat, appear to be getting much of it from both wild and cultivated plants- primarily the leaves of the wild-growing koko vine and the cultivated manioc plant, *Manihot esculenta*. This reliance on wild leaves in particular is much higher than has been seen previously both with the BAka (Kitanishi, 1995) and Mbuti pygmies (Ichikawa, 1983). However, plants cannot provide the range and balance of amino acids that meat can, and any attempt to use them as a serious substitute to meat is likely to result in nutrient deficiencies, with the resultant detriment to health. Culturally too, vegetables are not seen as a substitute for meat- it is only the latter which can truly satisfy, and its deficiency results in 'meat hunger', linked to tiredness, lack of strength and eventual illness (Bahuchet, 1985a, Motte-Florac et al., 1993). The situation is particularly serious in the wet season when significantly smaller quantities of both wild meat and fish are consumed.

Given the historical role of pygmies as suppliers of meat, as well as other forest products, to their neighbouring agriculturalists (Ichikawa, 1986, Bahuchet and Guillaume, 1979, Demesse, 1978), it is surprising to see to what degree the BaAka obtain their meat from the non-Aka rather than hunt it themselves<sup>39</sup>, underlining the role of net hunting as a subsistence, rather than an economic activity. This has also been seen in the village camps of the BAka, where over 60% of meat was sourced from villagers (this contrasts to 2.9% in forest camps), primarily as a reward for participating in gun hunting but also in return for labouring in non-Aka fields (Kitanishi, 1995). Of the meat that was

<sup>37</sup> Both studies used identical methodology with the exception of the Bakola study also estimating the consumption of snacks outside of mealtimes. However, meat, requiring cooking, is unlikely to be eaten as a snack.

<sup>38</sup> It should be noted, however, that it was the BaAka who dictated where the study was conducted, with little time spent by households in forest camps over the course of the study.

<sup>39</sup> Although, again, this result should be considered in light of the fact that the HCIS took place in the roadside villages rather than forest camps- Noss (1997) estimates the average daily hunting yield per hunter to be double in hunts from forest camps rather than from the village, thereby increasing the proportion of saleable meat.

sourced from the non-Aka in this study, most was purchased in the form of small quantities of pre-cooked meat sold by Bayanga women visiting Yandoumbe in the evening. Many BaAka who had spent the day either gathering koko leaves to sell, or working in the fields of a non-Aka resident, used the proceeds to purchase small portions of meat from these women. On only 10 occasions during the study period was a whole or partial carcass purchased from a non-Aka hunter, 5 of which were by project employees newly returned from the gorilla habituation site with their accumulated wages.

There are two possible explanations for the BaAka changing from providers to consumers of wild meat- for reasons of convenience or to compensate poor hunting yields. Both gun and snare hunting are more efficient than net hunting and therefore more likely to produce meat from an over-harvested forest. With no record of hunting success pre-park, it is not possible to empirically assess changes in yields from net hunting, although anecdotal evidence suggests prey densities to be falling near the village (see chapter 8). However, net hunting is far from a risk-free activity and success is never guaranteed. For many BaAka, working for a (usually) guaranteed salary from the non-Aka or outside organisations, which may then be used to purchase meat, must be an appealing option. It is therefore likely that the answer lies somewhere in-between the two explanations.

Given the large amount of food sharing conducted amongst the BaAka (Bahuchet, 1985a), it is perhaps unsurprising that few inter-household differences in consumption were found. This also applies when considering the implications of a project employee living in a household- there appeared to be no difference in the actual consumption rates, the consumption ranks or the preference ranks of wild foods for households linked to the ICDP. While a number of project employees or members of their households stated that they had lost their appetite for gorilla meat since beginning to work as trackers, there was no significant difference in the ranking of gorillas in terms of either consumption or preference, suggesting project employment makes little or no difference to BaAka consumption patterns, except for making it financially easier to buy meat.

### **7.5.2 Non-Aka**

Non-Aka households also showed a heavy reliance on forest resources, utilised in main meals on two-thirds of consumption days- indeed forest meat featured in 40% of consumption days- nearly double the frequency of that consumed by BaAka households, and dwarfing domestic meat contributions.

There is a great deal of anger expressed by local residents on the curtailing of their harvesting of natural resources. However, the actual impact on nutrition levels is unclear, particularly when taking into account the large amounts of illegal hunting and lack of baseline data. Comparing the results above to those elsewhere however, suggests that consumption levels of forest meat are similar to other, forest dwelling Central African populations. Indeed, the mean daily quantity consumed by an adult male is alone sufficient to meet the recommended daily allowance (RDA) of 52 g protein a day (FAO et al., 1985, Fa et al., 2003).

**Table 7-9** Summary of consumption rates of certain food groups by different populations. All figures represent the mean weight, in grams, consumed per day (presented as either per capita or per Adult Male Equivalent).

Population	Forest meat	Fish	Domestic meat	Source
Non-Aka hunter/agriculturalists, this study (per AME)	146.8	53.6	9.8	This study
Mvae hunter/agriculturalists, Cameroon (per capita)	185.0	41.0	Unk	(Koppert et al., 1993)
Urban mixed, Bioko island, Equatorial Guinea (per AME)	78.8	116.3	121.0	(Albrechtsen et al., 2006)
Ituri forest, DRC (per capita)	160.0	Unk	Unk	Bailey and Peacock, 1988. Cited in Wilkie and Carpenter, 1999a
Ogooue-Ivindo, Gabon (per capita)	100-170	Unk	Unk	Lahm 1993. Cited in Wilkie and Carpenter 1999a

The heavy reliance on forest meat, independent of seasons, suggests it to be a year around mainstay rather than a safety net in agricultural lean seasons as seen elsewhere (de Merode, 1998). Rather, it is the wild vegetables which prove seasonal, also recorded in other areas (Ogoye-Ndegwa, 2003), probably due to the BaAkas unwillingness to gather saleable quantities in the rain- forest forays which require much more distance to be covered than those required for subsistence.

That the quantity of forest meat consumed increases both with increasing household wealth and increasing food expenditure (used here as a proxy for household income) echoes other consumption

studies (East et al., 2005, Wilkie et al., 2005). Economic theory predicts that as household production rises, substitutes become more affordable and hence begin to replace wild food (Milner-Gulland et al., 2003)- however no such switch was seen in the Dzanga-Sangha reserve, suggesting either substitutes are either too expensive, even for the wealthiest families, unavailable or simply that wild meat is preferred.

The results of the preference ranking study fails to support this final theory- cows and chickens in particular were as, or more popular than most forms of wild meat. However, kilo for kilo, they were also significantly more expensive than all forms of wild meat with the single exception of elephant meat, suggesting that pricing may play a role in the access to substitutes. This relative expense of domestic substitutes has been found elsewhere in Central Africa, with forest meat costing as little as 10% of the price of substitutes (Wilkie, 2001). Modelling the influence of price and availability, however, consistently suggested that meat availability is a major factor in determining consumption patterns, with the quantities in which different animals are consumed being strongly predicted by the volume available for sale, seen also in Bioko Island, West Africa (Fa et al., 2002). Both formal and informal discussions with Bayanga residents confirmed this, with problems in accessing both wild and domestic meat a recurring theme in conversations relating to consumption choices. These results suggest that for the non-Aka, shown to be the main consumers of wild meat in the area, forest meat appears to be a normal good for which demand is elastic- therefore if substitutes were made available at prices relative to, or lower than forest meat, consumption would switch (Robinson and Bennett, 2002, Wilkie and Carpenter, 1999a). For example, in Bolivia a 10% decline in the price of beef correlated with a 74% decrease in consumption of bushmeat (Wilkie and Godoy, 2000).

Problems accessing wild meat substitutes, interestingly, do not appear to be alleviated by owning domestic animals. While domestic animals are kept, as in many forest villages, they are seen as a walking savings bank, to be redeemed in times of need (Milner-Gulland et al., 2003, Wilkie and Carpenter, 1999a). While the ownership of fishing equipment does appear influential in promoting higher levels of fish consumption, crucially it is not linked to an associated decrease in forest meat consumption rates.

In terms of the preference ranking exercise, while the mean preference rank for a particular species was strongly correlated with both its consumption rank and consumption rate within that household, it was also strongly correlated with market availability. At no point during the study did I encounter any indication that particular animals were being targeted for the popularity of their meat- indeed

snare hunting and gun hunting at night preclude any kind of species selection except on a very crude scale (elephant versus duiker, for example). Therefore it seems unlikely that popularity was affecting market availability, suggesting that it may be the availability of particular species that affects consumption rates and, in turn, preference. This relationship has also been found in both Liberia, where preference for bushmeat was found to decrease as consumption frequency decreased (Anstey, 1991) and Equatorial Guinea (East et al., 2005). The inference from such a relationship is that if any specific meat is made widely available, it will be both favoured and consumed.

Exposure to a conservation-related benefit, such as employment, may be expected, as a significant ICDP benefit, to promote conservation friendly behaviour. In this chapter I looked at whether project employment was related to a decrease in overall consumption of wild foods, or a switch to more sustainable species. In fact, results appeared to suggest the opposite, with households containing project employees found to consume the same quantities of both fish and non-meat forest products and significantly more forest meat. Moreover, there was no difference in actual consumption rates of the blue duiker, a non-protected wild species- indeed it was ranked higher generally as preferred by project households. While meat ranking tests suggested protected species such as the Western lowland gorilla, *Gorilla gorilla gorilla*, and the forest elephant, *Loxodonta cyclotis*, were less consumed by project households, they were consumed too infrequently during the HCIS to test actual consumption rates, and there were many unsubstantiated allegations regarding project guards confiscating protected meat for their own personal consumption.

Of great interest were the reasons given for not consuming protected species. There was, amongst project employees, a strong link made to project benefits, in that most employees refrained from eating the meat through fear of losing their job. This fear of repercussions from the project was echoed by the wider population, with only three respondents claiming they didn't eat elephants and gorillas so that tourists could come and see them. No-one recognized any conservation value in refraining from eating these slow breeding and protected animals- addressed in more detail in the next chapter. Implications of these findings are discussed in greater depth in chapter 9.

## **7.6 Conclusion**

Wild foods play an important role in the consumption patterns of residents of Dzanga-Sangha. Non-Aka residents, in particular, rely heavily on forest meat, whilst the BaAka receive most of their protein from wild and cultivated vegetables. The presence of a project employee in a non-Aka

household is linked to a significant increase in the consumption of forest meat, as is household wealth. The strong preference by the non-Aka for domestic meat- both expensive and rarely available- combined with a strong relationship between market availability and consumption rates suggest both fish and domestic meat may act as acceptable substitutes for forest meat if made more available and affordable. For the BaAka however, wild meat is an irreplaceable good for which domestic meat provides no substitute. Furthermore, project households share similar consumption and preference patterns to non-project households.

## Chapter eight

### Evaluating the effectiveness of ICDPs at maintaining animal populations

#### 8.1 Introduction

ICDPs are intended to conserve wildlife, both through strict protection and through the encouragement of sustainable or alternative use. Attempts at monitoring or evaluating the biological aspects of these programmes, however, are frequently neglected, often suffering from prohibitive time and financial limitations. (Hughes and Flintan, 2001, Brown and Wyckoff-Baird, 1992). In addition, ecological monitoring often faces considerable logistical difficulties- sites may be remote, animals shy and elusive and experienced surveyors few and far between (Milner-Gulland and Rowcliffe, 2007). Deciding what we wish to measure in terms of ecological impact is also far from straightforward. Conservation is most frequently interpreted as the maintenance of biodiversity, encompassing fauna, flora and their associated ecological processes. Given the impossibility of monitoring all such factors separately, the assessment of project efficacy often relies on selecting indicators and then assessing these, either at a single point in time, or patterns of change.

The choice of ecological indicator is crucial. They must be simple enough to be accurately and routinely monitored, but they also need to be able to capture the complexities of the system (Dale and Beyeler, 2001). Such indicators, whether at the genetic, species or ecosystem level, may be chosen to represent either biodiversity as a whole, or those species specifically targeted by humans, known as impact monitoring (Kremen et al., 1994). The focus at the species level, rather than the genetic or habitat level, is common when monitoring biodiversity- however, it should not be taken for granted that it represents the other two levels (WCMC, 1996). The monitoring of indicator species may involve more direct approaches, such as measuring changes in population numbers, or less direct, such as analysing the sustainability of hunter offtake. The interpretation of results, however, is often made more complex by factors such as a lack of baseline data, problems separating out the effects of project-instigated change from other contributing factors, and the length of time that it takes for some effects to become apparent (Kangwana, 2001, Kremen et al., 1994, Margoluis and Salafsky, 2001). As a consequence, combining indicators may provide a clearer picture (Cowlshaw et al., 2005a).



This chapter evaluates the efficacy of conservation efforts carried out by the Dzanga-Sangha project, combining a number of approaches. The profile of the different species sold and consumed in the reserve, population surveys of large mammals and, in addition, hunter and consumer interviews are used to explore both the population dynamics of key indicator species and the sustainability of current exploitation levels of wild meat.

### Population surveys

Direct counts, even of large mammals, are notoriously difficult to do, particularly in the dense tropical rainforest (although see Turkalo and Fay, 2001, Turkalo and Fay, 1995, Turkalo and Klaus-Hugi, 1999). In such cases, researchers concentrate on surveying indirect signs in order to estimate population numbers. Indicators commonly used include nests (e.g. apes; Tutin and Fernandez, 1984, Tutin et al., 1995, Schaller, 1963, Morgan et al., 2006, Jones and Sabater Pi, 1971) and dung piles (e.g. forest elephants, ungulates; Barnes, 2001, Barnes and Jensen, 1987, Merz, 1986, Nchanji and Plumptre, 2001, Plumptre and Harris, 1995).

Sign-based surveys adopt a two-stage approach to calculate animal densities. The densities of the signs are measured, most frequently using a line or strip transect approach. Sign density is then converted into individual density using conversion factors based on the rates that they are created and degrade. For elephants and gorillas, the following set formulae are commonly employed to convert nest/dung density into individual density (Tutin and Fernandez, 1984, Barnes and Jensen, 1987):

$$\text{Density of elephants/km}^2 = \frac{\text{Density of dung piles/km}^2 \times \text{Decay rate}}{\text{Defecation rate}}$$

$$\text{Density of weaned gorillas/km}^2 = \frac{(\text{Nest group density/km}^2 \times \text{Mean group size})}{\text{Mean nest decay time}}$$

Which figures to use for conversion factors are, however, hotly debated. There have been relatively few studies conducted on both sign creation and degradation, and the ones that do exist are widely extrapolated. For example, studies requiring degradation rate of gorilla nests nearly always draw on a study by Tutin and Fernandez (1984) in Gabon, yet the frequency of creation and longevity of nests may be strongly influenced by factors such as habitat type, climate and food availability, making extrapolation between sites or countries problematic (Tutin et al., 1995, Todd et al., 2008).

The gorilla algorithm is also criticised for its assumption of one nest per night being made by a weaned gorilla- there is considerable evidence to suggest that weaned individuals do not always make a recognisable nest, termed a bare nest. Bare nests are suggested in one study to account for up to 45% of total nests (Mehlman and Doran, 2002). Decay rates of elephant dung have also been found to vary by up to 66.7% between seasons (Nchanji and Plumptre, 2001).

The biases associated with sampling methods, observational error and production and decay rates are difficult to calculate and, consequently, rarely reported. Furthermore, even if the variance of density estimates are known, precision issues in the statistical sense usually result in a large degree of uncertainty in density estimates. One study suggests that, if comparing two surveys of indirect signs using identical methodology, a change of 30%-50% of population size, in either direction, would be needed to ensure it was detected (Plumptre, 2000). Such accuracy may be improved by large scale, repeated testing, and minimizing the use of conversion factors (Plumptre, 2000, Blake, 2005).

### **Hunter offtake versus sustainable yield**

For many species, particularly smaller ones, population surveys are either not feasible or not practical. In such cases, comparing current hunter offtake with the theoretically sustainable harvest levels allows an indication as to the sustainability of current levels of hunting, and hence the likely impact on the prey population.

### ***Calculating hunting offtake***

There are considerable difficulties associated with measuring total hunter offtake, not least the scale and spread of operations. While it may be extrapolated from hunter follows (Noss, 1998b, Muchaal and Ngandjui, 1999, Fitzgibbon et al., 1995, Kumpel, 2006), such studies are both very time and labour consuming. They are also only feasible in areas where a researcher is accepted by hunters. As a result, a number of studies have chosen to use market sales as a proxy measure (Fa et al., 1995, Cowlshaw et al., 2005a).

Relatively quick and economical to undertake, market surveys can provide information on meat type and availability within a community, allowing insight into both longitudinal trends and a static examination of the proportion of large to small bodied prey species (Fa et al., 2000, Crookes et al., 2006, Rowcliffe et al., 2003, Cowlshaw et al., 2005a). This latter approach, known as ‘hunting down the size class’ is based on the premise that overexploitation will result in smaller and more

productive species gradually replacing larger bodied and less productive species (Rowcliffe et al., 2003, Jerozolinski and Peres, 2003).

The use of markets to infer hunting sustainability must be done with caution, however, given that changes in hunter behaviour such as altering hunting area, effort and methods may produce a steady supply of what may, in fact, be an increasingly endangered species (Clayton and Milner-Gulland, 2000, Crookes et al., 2006). In addition, markets may fail to represent hunting effort in the region, either in terms of species type or total harvested (Holbech, 1998, Davies et al., 2007, de Merode and Cowlshaw, 2006, Rowcliffe et al., 2003, Cowlshaw et al., 2007)- for snare hunting in particular, there is a great deal of wastage in the forest, estimated for Dzanga-Sangha snare hunters to be around 26.7% of the total number of animals captured (Noss, 1998b). Additionally, if a low value species is killed it may be consumed by the hunter or given away rather than sold, resulting in larger-bodied species being over-represented in the market (Fa and Garcia Yuste, 2001). Finally, as seen in chapter seven, much of the wild food sales may be informal- for protected species in particular, there is a strong incentive for vendors to seek a less exposed sales arena than a public market (pers. observ.).

Another, less explored, alternative to estimating hunter offtake is through household consumption surveys, generating information on species and quantities consumed. In contrast to market surveys, data would incorporate informal sales, gifts and direct consumption by hunters. However, as with market data, such an approach fails to incorporate both hunter wastage and meat exports and should be treated as a minimum estimate of local hunter offtake. However, this is an effective tool only in regions where there is little or no importation of wild meat.

### *Calculating sustainable harvest levels*

To give an indication of whether offtake rates are sustainable, it is possible to generate an estimate of the maximum sustainable harvesting rate for a particular species, given its population density and life history characteristics. A simple and widely used method is that designed by Robinson and Redford, an algorithm based on population densities and rates of increase, shown below (Robinson and Redford, 1991).

$$\text{Maximum sustainable offtake (P)} = 0.6 K (R_{\max} - 1)F_{RR}$$

where  $R_{\max}$  is the intrinsic rate of population increase<sup>40</sup>,  $K$  is the density of carrying capacity and  $F_{RR}$  is used as a weighting for natural mortality, varying from 0.2 to 0.6 for long to short lived animals respectively.

This method has been subjected to some criticism, primarily for its propensity to overestimate the sustainable yield, both through its oversimplification of survival rates and its use of the intrinsic rate of population increase rather than actual population growth rates (likely to be lower due to density dependence) (Milner-Gulland and Akcakaya, 2001).

A more conservative method is an algorithm designed by the US National Marine Fisheries Service (NMFS), which uses a minimum estimate for abundance, rather than carrying capacity (Wade, 1998). This therefore accounts for cases when populations may already be low and yields calculated using normal carrying capacity would not be sustainable, providing a slightly more cautious estimate (Milner-Gulland and Akcakaya, 2001, Cowlshaw et al., 2005a). The NMFS algorithm is below, where  $N$  is the minimum estimate of the current population size.

$$P = 0.5 N (R_{\max} - 1) F_{\text{NMFS}}$$

It should be noted that both of these algorithms greatly oversimplify a complex system. For instance, both fail to take into account human components of the system, and the interactions between prey (Ling and Milner-Gulland, 2006, Rowcliffe et al., 2003). Moreover, parameter estimation is extremely prone to error, with often the most basic information on a common prey species unknown- for example the age of first reproduction for the blue duiker, *Philantomba monticola*<sup>41</sup>, a very common prey species in Central Africa, is reported in the literature as ranging from 0.9-1.7 (Fitzgibbon et al., 1995, Noss, 1998b, Fa et al., 1995). Furthermore, density estimates of prey species, usually shy, forest dwelling animals which may have been hunted to very low densities, are time consuming, expensive and highly susceptible to error.

### Local perceptions of wild animal dynamics

Local knowledge of natural ecosystems can be an invaluable source of information, providing empirical data on temporal trends in prey type, availability and ranging behaviour (Berkes, 1999, Jones et al., 2008). Indeed, where other quantitative data are scarce, local residents may be the only

<sup>40</sup>  $R_{\max}$  is usually generated from Cole's formula based on age at first and last reproduction and the number of female young produced a year (Cole, 1954). See also (Slade et al., 1998).

<sup>41</sup> Previously known as *Cephalophus monticola*

source for knowledge of historical population dynamics and changes in environmental conditions. An underused resource, local knowledge of resource dynamics has mainly been applied in fisheries management, although primarily to complement scientific observations (Ruddle, 1994, Johannes et al., 2000). As with all the other methods outlined above, this approach should be used with caution. It is possible that residents may deliberately mis-report historical events, perhaps due to a belief that their responses may influence events, or through suspicion of a researcher's motives. Past events may also be accidentally misreported, due either to the fallibility of the human memory, or 'shifting baseline syndrome' where current events are only compared to the respondent's initial experience, which may be significantly different to the original state of the system (Pauly, 1995, Pinnegar and Engelhard, 2008).

Without ecological monitoring, it is not possible to evaluate the effectiveness of management approaches. Given the multifarious difficulties associated with obtaining accurate and representative data, this chapter combines a number of approaches to give both a clearer and more reliable picture of events within the Dzanga-Sangha forests. I investigate the conservation efficacy of the DSP firstly by using past large-mammal surveys to examine temporal patterns in prey population dynamics, paying particular attention to pre and post -park levels (8.4.1). I then go on to investigate the population dynamics of the main prey species by evaluating the sustainability of current hunter offtake levels for the most exploited prey species in the region, as well as temporal patterns in prey species (8.4.2). I finish by looking at local perceptions of prey population dynamics (8.4.3).

## **8.2 Research questions**

The chapter will test the following hypothesis:

⇒ **Populations of wild animals in the protected areas are stable or increasing**

To investigate this, the following questions were asked:

- 1) What are the spatial and temporal patterns in the population densities of the large bodied mammals?
- 2) Are the current exploitation levels of the small-bodied prey species sustainable?
- 3) Is the current prey profile similar to that in the past?

- 4) What are local perceptions of temporal changes in species abundance?

## 8.3 *Methods*

### 8.3.1 Population dynamics of large mammals

#### *Data collection*

A number of ecological censuses have been conducted in the Dzanga-Sangha region, focusing primarily on measuring elephant and gorilla population densities. These have been intermittent, however, and have used a variety of methodologies, making direct comparisons complex. The four main surveys in the Dzanga-Sangha region, conducted between 1986 and 2005, are summarised in table 8.1.

While the earlier, pre-park surveys by Richard Carroll and Mike Fay used strip transects to estimate densities, later ones used line/distance sampling instead, with the 2004/5 survey also employing travel-recces (also known as ‘the path of least resistance’ survey routes) (Barnes et al., 1989). All methods have particular assumptions and biases associated with them (Milner-Gulland and Rowcliffe, 2007). Furthermore, varying numbers of researchers were used for locating signs, potentially affecting detection rates.

Another serious issue is that of the varying habitats and regions in which the various surveys took place. The Dzanga-Sangha complex covers over 4500 km<sup>2</sup> and incorporates an estimated 12 major habitat types (Carroll, 1996b) as well as distinct use zones (Blom, 2001a). Given the strong effect that both habitat use and type can have on the distribution of both gorillas and elephants (Carroll, 1986a, Barnes et al., 1997, Carroll, 1996b), it is desirable to be able to control for these variables when comparing population patterns. Unfortunately, not only have many of the surveys been conducted in different areas, but most employed either different habitat classifications, or failed to report them. Particularly problematic is the pre-park survey conducted by Richard Carroll which classifies survey results by habitat rather than geographical location, making it impossible to break down densities into the divisions used later by other researchers (Dzanga-Sangha Reserve, Ndoki and Dzanga National parks)<sup>42</sup>. Conversely, no other study reported population densities for different habitat types.

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<sup>42</sup>Unfortunately the original data were not available to be reclassified.

**Table 8-1** A summary of past ecological surveys conducted in the Dzanga-Sangha region, summarising methods and conversion factors used. 'Unk' is used to indicate where the value was not reported by the source.

	Year	1986/7	1997	1996/7	2003/4	
<b>Census</b>	<b>Source</b>	Carroll (1986, 1988) Fay (1989)	Remis (2000)	Blom (1999, 2001); original data	Blake (2005)	
<b>Methods</b>	<b>Location</b>	DSR, DNP & NNP	DSR & DNP	DNP	DSR, DNP & NNP	
	<b>Transect type</b>	Strip	Line	Line	Line	
	<b>Transect length (km)</b>	5 or 10	4-5	20	0.3 or 1	
	<b>Total transected (km)</b>	997.4	81.2	100	57.5	
	<b>No. observers</b>	Minimum 2 trackers and 1 observer	Unk	Minimum 2 trackers and 1 observer	Unk	
	<b>Number of habitat classifications</b>	12	7	Unk	Unk	
	<b>Observer efficiency</b>	Assume 100%	Unk	Assume 100%	Unk	
<b>Conversion factors</b>	<b>Gorilla</b>	<b>Gorilla nest duration rate (days)</b>	54	66.9	50	50
		<b>Gorilla nest construction rate</b>	Assume 1 nest per weaned individual per night			Unk
		<b>Proportion of bare nests</b>	0%	22-38%	9%	Unk
		<b>Mean gorilla group size</b>	5.1	4.7	2.6	2.7
	<b>Elephant</b>	<b>Elephant defecation rate</b>	17	Unk	19.77	19
	<b>Dung decay rate</b>	80 days	unk	0.0233 (daily disappearance)	90 days	

Where conversion factors have been used, such as scat decay rate, these are often either different or simply not reported. For example, when converting density of nesting groups into density of individual gorillas, the mean group size used has ranged from 2.6 to 5.1 gorillas, thus instantly doubling the gorilla population density.

A number of these problems might have been overcome by going back to the original data. Unfortunately this was only available for one of the surveys. Furthermore, a number of problems, such as biases introduced by different methods, habitat and season, could not be overcome.

Consequently, census results are compared and contrasted in light of both existing and potential biases, and results should be considered tentative rather than conclusive.

### ***Data analysis***

Results, in terms of population densities, are compared both between past surveys and across the three areas- the Dzanga-Sangha Reserve, Ndoki and Dzanga National Parks. Means and confidence intervals are presented where available. Both the temporal and spatial patterns in the population dynamics of the two species- the forest elephant, *Loxodonta cyclotis*, and the western lowland gorilla, *Gorilla gorilla gorilla*- are discussed.

## **8.3.2 Assessing the sustainability of prey species offtake**

This is assessed in two ways. I calculate current hunter offtake level for the main prey species using both the market and the household consumption (HCIS) surveys, comparing results for each. Given the lack of information on population density for the smaller prey species in the region, I use the NMFS algorithms to generate figures on the population densities required to make HCIS offtake rates sustainable. Complementing this, temporal changes are examined by comparing a static examination of prey profile with a previous study in the area, conducted 12 years before this study (Noss, 1995). Full methodologies for both the market and household consumption survey can be found in chapter three.

### **8.3.2.1 Calculating hunter offtake**

Offtake is calculated in two ways- using market data and using household consumption data. Both approaches are prone to error and neither purport to capture meat that is wasted or exported out of the reserve. Therefore, results generated using either method should be considered estimates of minimum offtake.

#### ***a) Using market data***

Offtake for Bayanga is calculated from the market data as follows: The total number of carcasses recorded for each species ( $C_{ms}$ ) over the study period (160 days) is scaled up to represent an annual total. For the variably sized animals, such as fish, the very small animals, such as the caterpillar, and the large, rare animals, carcass counts were more difficult to do. For the first two categories only weights are provided. For the last category, a minimum estimate for carcass number was made by assuming all the meat from that one species appearing in the market at the same time belongs to the



same individual (in all cases the meat weighed less than the equivalent of an adult female)<sup>43</sup>. Meat was considered to come from a different individual if two samples appear in the market more than 5 days apart.

For each species, I then incorporate external sales by controlling for the proportion of sales known to have occurred within the formal market ( $S_m$ ), calculated from the household consumption study<sup>44</sup>. For a number of species, consumption levels were so low that data were too few to calculate the proportion of sales that occurred outside of the formal market. In such cases, totals are calculated using a mean value of the proportion of market sales for other species (57%). For the protected species this is probably an underestimate as informal sales are likely to be preferred by vendors—they should therefore be considered a minimum value.

Hence the total number of carcasses sold,  $C_{tm}$ , (formally and informally) for each species in Bayanga is calculated as follows:

$$C_{tm} = (C_{sm} \cdot 365) / (S_m \cdot 160)$$

Carcass number is converted into total weight by multiplying the total number of carcasses by mean carcass weight during study period. For the larger and/or rarer animals that lacked reliable carcass number estimates, weight sold is calculated by multiplying the number of local units available for sale by mean weight of that local unit.

***b) Using household consumption data***

Species offtake for Bayanga is calculated from the household survey as follows; the total volume of meat known to have been consumed by households during the HCS ( $V_{hs}$ ) during the study period ( $n=1334$  consumption days) is scaled up to account for all households in Bayanga for the year (727 households for 365 consumption days each) ( $V_{ht}$ ):

$$V_{ht} = (V_{hs} / 1334) \cdot (727 \cdot 365)$$

Results from the two estimates for Bayanga (market and household consumption) are compared and discussed. Consumption totals for all the reserve households are then calculated separately for the

<sup>43</sup> This approach produces an absolute minimum figure as it is unlikely, particularly in the case of gorillas, that only one group member is killed at a time.

<sup>44</sup> Note that the proportion of meat sold informally ranged from 11% for caterpillars, through to 77% for fish.

non-Aka and the BaAka households (given their different consumption patterns) and added together. The volume consumed by non-Aka households (n= 933) is calculated as below;

$$V_{rt(NA)} = (V_{hs(NA)} / 1334) \cdot (933 \cdot 365)$$

The volume consumed by BaAka households (n=285), is calculated as follows:

$$V_{rt(BA)} = (V_{hs(BA)} / 590) \cdot (285 \cdot 365)$$

Volume is then converted into carcass number by dividing total weight by mean carcass weight, calculated during the market study. As it is highly unlikely all animals were divided perfectly, this provides a minimum carcass number.

### 8.3.2.2 Calculating sustainable yield

Using even the simplest algorithms to calculate sustainable yield requires knowledge of the density of prey species, yet surprisingly little is known of the biology of the more common prey species for Central Africa, including optimum population densities. Furthermore, there are no data for current population densities of any prey species in the Dzanga-Sangha region, with the exception of the forest elephant, *Loxodonta cyclotis*, and the western lowland gorilla, *Gorilla, g. gorilla*.

For the forest elephant and the western lowland gorilla, the NMFS algorithm was employed to calculate suggested sustainable offtake rates, based on the most recent population density estimates. These are then compared to known minimum offtake rates during the study period.

Given the absence of data regarding current population densities for the smaller prey species, I use the NMFS algorithm to predict the population densities that would be required to support current levels of offtake for the two main prey species- the blue duiker, *Philantomba monticola* and Peter's duiker, *C. callipygus*, who between them account for 84% of market sales of forest meat.

Therefore the NMFS algorithm,

$$P = 0.5 N (R_{max} - 1) F_{NMFS}$$

is transformed into:

$$N_{\text{NMFS}} = \frac{P}{0.5 F_{\text{NMFS}} (R_{\text{max}} - 1)}$$

The likelihood of prey species existing in the required densities is then discussed, based on evidence from past population density surveys in the Central Africa region. The robustness of results to changes in parameters is also explored.

### ***Estimating hunting area***

Calculating the current rate of offtake per km<sup>2</sup> requires knowledge of both absolute offtake (no. individuals) and the total area over which this hunting takes place. Minimum offtake values are provided by the HCIS. With regards to hunting area, three scenarios were created;

- i) Hunting is restricted to the Dzanga-Sangha Reserve (DSR) (including the community hunting zone, legally designated as a hunting area),
- ii) Hunting takes place in both the DSR and Dzanga National Park (DNP)
- iii) All of the protected area complex is used- the DSR, the DNP and Ndoki National Park (NNP).

The reality is probably a combination of the latter two scenarios- we know from both resident reports and anti-poaching records that a certain degree of hunting is conducted in all three areas- however the close proximity of the DNP to the main villages in the region (fig. 2.6) means it is also more accessible than NNP. There appears to be little interest in, or evidence of, travelling to the adjacent Nouabalé-Ndoki National Park (Congo) and Lobéké National Park (Cameroon) to hunt.

### ***Defining parameters***

There is often considerable variation in the intrinsic rate of increase ( $R_{\text{max}}$ ) for a particular species reported in the literature, calculated using varying values for life history parameters. I investigate the influence of such variation by running the analysis using both the maximum and minimum  $R_{\text{max}}$  reported. All values used have been calculated using Cole's equation (1954) and are based on reasonable figures for life history parameters. Little data exists on the life history of the forest elephant, *Loxodonta cyclotis*. Therefore it is calculated using the life history characteristics of the closely related African elephant, *Loxodonta africana*.  $F_{\text{NMFS}}$  was set at 0.5 for all species (Cowlshaw et al., 2005a, Milner-Gulland and Akcakaya, 2001).

**Table 8-2** Maximum and minimum values used for the intrinsic rate of increase ( $R_{\max}$ ) for four prey species

		$R_{\max}$	
		Minimum	Maximum
Blue duiker	<i>Philantomba monticola</i>	0.49 (Fa et al., 1995)	0.603 (Rowcliffe et al., 2003)
Peter's duiker	<i>Cephalophus callipygus</i>	0.22 (Muchaal and Ngandjui, 1999)	0.399 (Rowcliffe et al., 2003)
Forest Elephant	<i>Loxodonta cyclotis</i> *	0.0215 (Moss, 2001)	0.07 (Calef, 1988)
Gorilla	<i>Gorilla g.gorilla</i>	0.038 ** (Steklis and Gerald-Steklis, 2001)	0.0725 (Fa et al., 1995)

\* Few data exist on the life history of the forest elephant, *Loxodonta cyclotis*. Therefore figures are based on the life history characteristics of the closely related African elephant, *Loxodonta Africana*.

\*\*Similarly for the western lowland gorilla, *Gorilla g.gorilla*: this figure is based on a long-term study of the closely related mountain gorillas, *Gorilla beringi beringi*.

### ***Incorporating export and waste into offtake levels***

Current levels of offtake are calculated using basic consumption rates for the reserve households. I also run the same algorithms incorporating wastage through snares, calculated by Noss to be 27% of total snare captures. Wastage through guns is assumed to be zero. The proportion of meat exported is unknown and therefore difficult to factor in. However, I discuss briefly the implications of having an export rate of 26% hunter offtake, as reported by Noss in 1994, a period when the logging company was in full operation in the area. Offtake figures should be considered a minimum, primarily due both to the lack of data regarding hunter exports and the assumption of the perfect division of carcasses amongst households. Under these conditions, calculations will be interpreted with extreme care.

### **8.3.2.3 Temporal changes in prey profile**

If hunting is unsustainable, it is to be expected that the larger bodied, slow-breeding species would gradually be replaced in the market by smaller bodied, more robust species. To this end, I compared results from this study to other surveys in the region. Two previous attempts have been made to examine wild meat sales in Bayanga, both taking place 1994/95. Andrew Noss, an independent researcher, looked at both formal and informal market sales within Bayanga, in addition to hunter

offtake (Noss, 1995, Noss, 1998b). He also reports early results of a DSP survey, headed by Jean Marc Garreau, who looked at informal sales and exports from the reserve (Garreau, 1996b).

The profiles of animal carcasses sold per annum are compared for 1994 and 2006. Given the presentation of Noss' data, it is only possible to do this for four animal groups- red duikers (all), monkeys (all), *Philantomba monticola*, and *Potamochoerus porcus*. Changes are discussed in relation to both changes in hunting methods, here represented by the proportion of animals hunted by guns, and the prey body size.

### 8.3.3 Local perceptions of prey population dynamics

Both formal and informal interviews were held with Bayanga and Yandoumbe residents regarding the sustainability of current levels of exploitation of wild resources. Informal interviews, where questions were introduced opportunistically into a conversation, were held with residents, ad hoc, throughout the study period. In the HAS, respondents were asked whether, compared to current levels, there were more, less, or the same levels of forest animals since 5 years ago. They were then asked to speculate as to what they expected to happen to levels of the same resource 5 years in the future. For those residents who had not lived in the reserve 5 years previously, the first question was omitted. Results from respondents known to hunt are discussed separately.

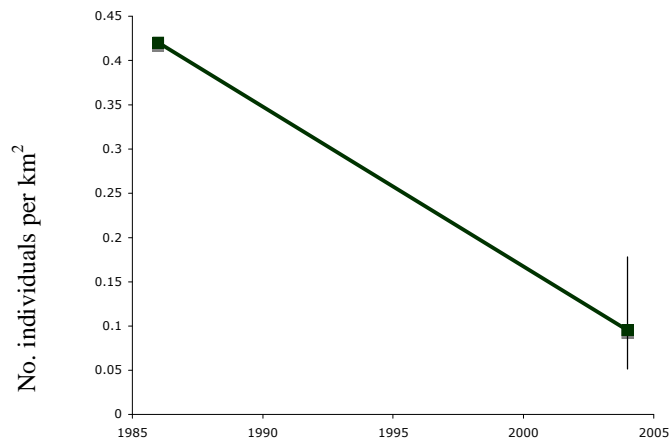
## 8.4 Results

### 8.4.1 Population dynamics of large mammals

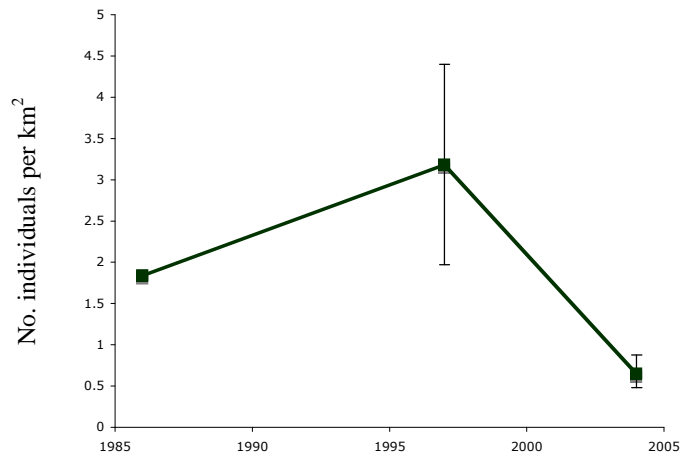
Survey results are presented separately for gorillas and elephants. For each of these species, results are further sub-divided into the different regions of the protected complex, namely the Dzanga-Sangha Reserve and the two National Parks- Dzanga and Ndoki<sup>45</sup>. Comparing survey results from the past 20 years suggests that population densities of elephants have fallen sharply in both the Reserve and Dzanga National Park, and risen in Ndoki National park (fig. 8.1).

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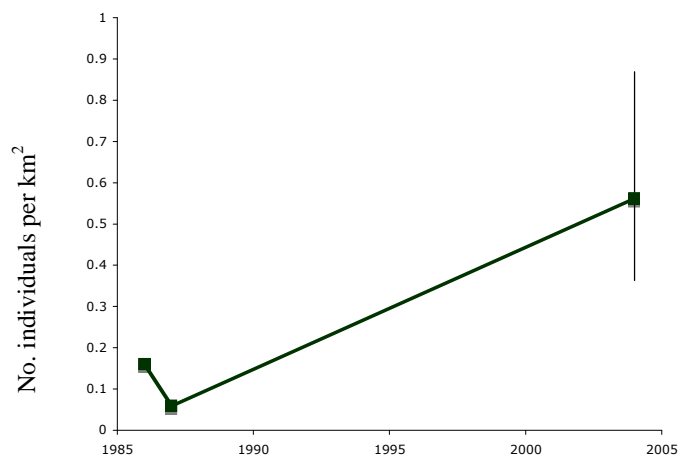
<sup>45</sup> Although note that for gorillas, results from the pre-park survey were available only as an overall figure for the entire region



(a) Dzanga-Sangha Reserve



(b) Dzanga National Park



(c) Ndoki National Park

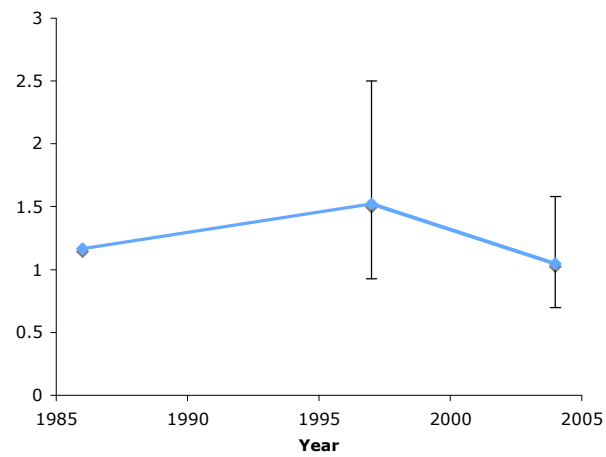
**Figure 8-1** Comparing results from past elephant surveys in the Dzanga-Sangha region. (a) Dzanga-Sangha Reserve (b) Dzanga National Park (c) Ndoki National Park

In the Dzanga-Sangha Reserve (DSR), the population density of elephants is thought to have dropped from 0.42 to less than 0.1 individuals per km<sup>2</sup> over the past 20 years. In Dzanga National Park (DNP), the drop has been more pronounced, from 1.84 to 0.65 elephants per km<sup>2</sup>. A survey in 1997 found a density of over 3 individuals per km<sup>2</sup>, suggesting that this dramatic drop has occurred in the past 8 years. While population densities have increased in Ndoki National park (NNP), the initial survey in 1986 found such low densities (0.16 individuals per km<sup>2</sup>), that they have only risen to just over 0.5 individuals per km<sup>2</sup>.

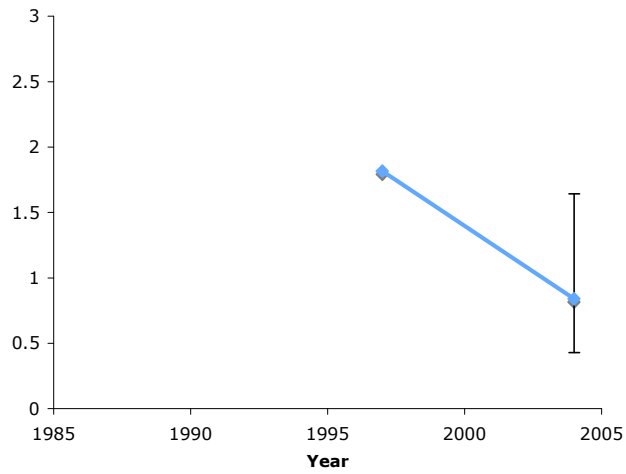
Comparing between regions, the two protected parks, NNP and DNP, currently show similar elephant densities, estimated at around 0.5 individuals per km<sup>2</sup>, whereas the Dzanga-Sangha Reserve, an area of relatively low protection, has an estimated elephant density of around a fifth of the National Parks.

In a comparison of estimated elephant densities in various Central African sites conducted by Blake (2005), both DNP and NNP are placed in the second quartile from the top. While it is not possible to compare sites without first taking into account the suitability of the ecosystem for supporting elephant populations, this suggests the two sites are faring relatively well. Yet the key term here is relative- if all sites are suffering heavy hunting pressure, being the best of a bad bunch is a somewhat dubious achievement.

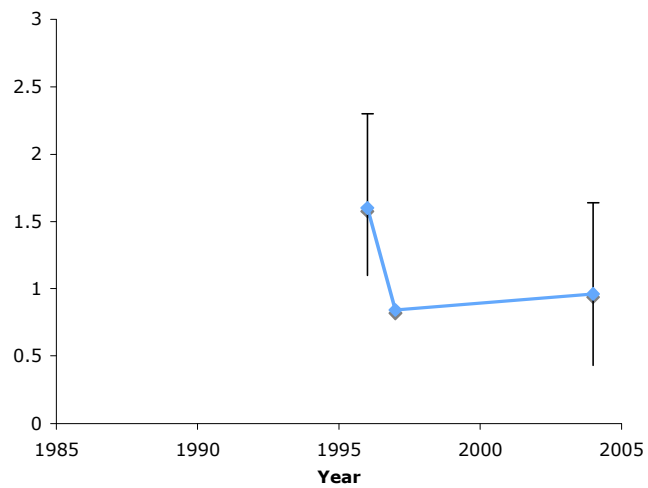
Comparing results from past gorilla surveys produces rather different results. Gorilla densities measured in 1986, pre-park formation, were compared with more recent surveys (1997, 2005). Results show a strong overlap in the 95% CI, suggesting little significant change in population density estimates, either overall or within the different regions. It is perhaps also surprising that population densities of gorillas appear to be similar in both the Dzanga-Sangha Reserve and Dzanga National Park, with Remis finding no significant differences in her 1997 survey of gorilla nest densities between the DSR and DNP (Remis, 2000).



(a) Overall



(b) Dzanga-Sangha Reserve



(c) Dzanga National Park

**Figure 8-2** Comparing results from past gorilla surveys in the Dzanga-Sangha region. (a) Overall (b) Dzanga-Sangha Reserve (c) Dzanga National Park. No results are available for Ndoki National Park



Interestingly, survey results also suggest a drop in mean group size, from 5.1 in 1986 (Carroll, 1988) to 2.6 in 1996 (Blom et al., 2001) and 2.7 in 2004 (Blake, 2005). This decrease is perhaps all the more surprising given that Carroll assumed that no bare nests were made, likely to result in a serious underestimate of group size. It may, however, be a product of missing nesting sites made by smaller groups or lone silverbacks if they were made with a high proportion of bare nests. Unfortunately, the data were not available to test if these differences were significant.

Gorilla densities appear to compare relatively favourably to those found in other areas (table 8.3), showing some of the highest gorilla densities in central Africa. Again, however, such a comparison should be done with care, given the strong influence of habit type, as well as the dangers of assuming higher means high.

**Table 8-3** Density estimates for the western lowland gorilla, *Gorilla g. gorilla*, in Central Africa (adapted from Blake, 2005).

Place	Individuals / km <sup>2</sup>	Source
Dja reserve, Cameroon	1.71	Williamson & Usongo, 1995
<b><i>Dzanga National Park</i></b>	<b><i>0.96</i></b>	<b><i>Blake, 2005</i></b>
<b><i>DS Reserve, CAR</i></b>	<b><i>0.84</i></b>	<b><i>Blake, 2005</i></b>
Ma'an forest, Cameroon	0.8-1	Matthews & Matthews, 2004
Rio Muni region, Equatorial Guinea	0.45	Gonzalez-Kirchner, 1997
Northern Republic of Congo	0.4	Fay and Agnagna, 1992
Ngotto forest, Central African Republic	0.34-0.40	Brugiere & Sakom, 2001
Lope Reserve, Gabon	0.3-1.0	White, 1994
Campo forest, Cameroon	0.2	Matthews & Matthews, 2004

A number of past censuses have attempted to link animal population changes with areas of human activity, either looking at the proximity of animal signs to roads or villages, or with human signs, such as hunting camps, snares etc. The 2004/5 MIKE (Monitoring of Illegal Killing of Elephants) survey found a highly significant negative correlation between elephant dung abundance and human sign abundance, concluding elephants appear to be largely confined to the national parks (Blake, 2005), also seen elsewhere in Central Africa (Blake et al., 2007). Blom also produces some evidence that elephant dung density is negatively correlated with both density of human signs and the proximity of roads (Blom et al., 2004). However, there appears to be no link between gorilla nest densities and either road proximity or human sign density (Blom et al., 2004, Remis, 2000).

## 8.4.2 Assessing the sustainability of prey species offtake

### 8.4.2.1 Hunter offtake

Hunter offtake, in terms of both species type and volume, was calculated from both market and household consumption data (table 8.3).

Results show both sales and consumption of wild meat are concentrated primarily on five main prey types, namely Peter's duiker, *Cephalophus callipygus*, the blue duiker, *Philantomba monticola*, the red river hog, *Potamochoerus porcus*, and various species of monkey and fish. Together, these species account for 95% of biomass sold and 97% of biomass consumed respectively. Of the forest animals, the blue duiker is exploited at the highest rate, with over 6500 individuals estimated to be traded annually in Bayanga alone, whilst the larger-bodied Peter's duiker provides the most meat- 59% of wild meat biomass sold in the market, and 38% of the wild meat consumed. Fish is also consumed in high quantities, making up 32% of the wild meat consumed. As fish sales tend to be conducted outside the market environment, it has a tendency to be underrepresented in market surveys.

Overall, it is estimated that nearly 13000 wild animals carcasses are sold, formally or informally, in the Bayanga region per year, with a minimum of 7600 consumed by Bayanga households. Extrapolating this to all reserve households, a minimum of 10,000 animals are estimated to be consumed per annum. Including fish, this amounts to around 118,000 kg of wild meat consumed within the Dzanga-Sangha protected area complex per year, around 19.07 kg per person.

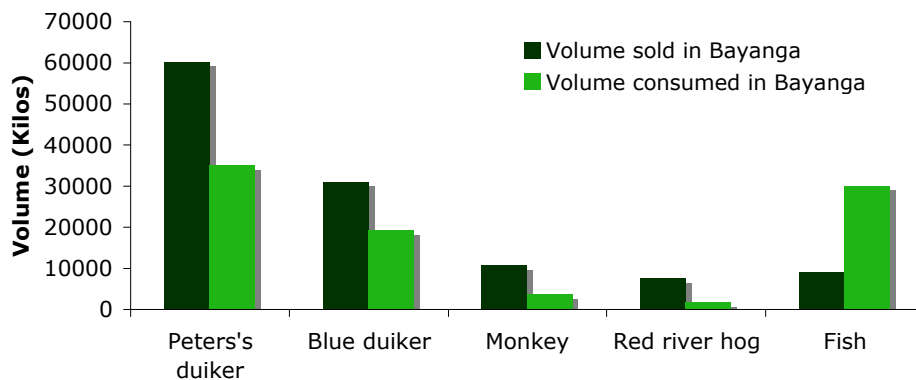
English name	Formal market sales					Formal and informal market sales (Bayanga) <sup>3</sup>		Household consumption data			
	% days present	No. carcasses sold <sup>1</sup>	Kilos sold <sup>2</sup>	% total biomass	% consumed bought in market	No. carcasses sold	Kilos sold <sup>2</sup>	Kilos consumed (Bayanga)	Kilos consumed (reserve)	% biomass consumed (meat)	No. carcasses consumed (reserve) <sup>4</sup>
Peters's duiker	98	2200	39159	58.50	65	3385	60244	35177	45145	37.64	2536
Blue duiker	85	3563	16744	25.01	54	6598	31008	19377	24868	20.74	5291
Grey-cheeked mangabey	13	82	439	0.66	25	328	1756				
Moustached monkey	13	69	226	0.34	25	278	905				
White-nosed guenon	31	190	840	1.25	25	760	3359				
De brazza's monkey	2	14	60	0.09	25	55	239				
Red colobus	1	2	10	0.01	25	9	40				
Crowned guenon	11	47	119	0.18	25	187	476				
Black-and-white colobus	4	22	94	0.14	25	86	378				
Agile mangabeys	2	10	70	0.10	25	41	278				
Unknown monkey	39	188	817	1.22	25	751	3281				
Monkey (total)	64	623	2675	4.00	25	2493	10710	3749	4812	4.01	1203
Red river hog	49	109	3210	4.80	42	260	7644	1863	2391	1.99	81
Caterpillars	24	unk	556	0.83	89			940	1207	1.01	Unk
Sitatunga	18	(30)	500	0.75	57	unk	877**	560	719	0.60	19
Western lowland gorilla	14	(16)	609	0.91	57	unk	1068**	-	-	-	-
Brush-tailed porcupine	12	59	189	0.28	67	88	283	678	871	0.73	272
Yellow backed duiker	11	16	581	0.87	57	28**	1020**	-	-	-	-
African forest elephant	8	(8)	193	0.29	57	unk	339**	60	76	0.06	0
Tortoise	4	30	50	0.08	57	52**	88**	119	153	0.13	90
Bongo	3	(1)	183	0.27	57	unk	321**	-	-	-	-
Chimpanzee	2	(3)	30	0.04	57	unk	53**	-	-	-	-
African civet	2	16	38	0.06	57	28**	67**	179	229	0.19	95
Buffalo	1	(1)	56	0.08	57	unk	98**	-	-	-	-
Giant forest hog	1	(1)	76	0.11	57	unk	133**	-	-	-	-
Giant rat	0	0	0	0	unk	unk	unk	60	76	0.06	69
Lizard	0	0	0	0	unk	unk	unk	155	199	0.17	Unk
Pangolin	1	5	9	0.01	unk	unk	unk	357	458	0.38	241
Fish	73	unk	2079	3.11	23	unk	9039**	30172	38721	32.29	Unk

**Table 8-4** Annual sale and consumption estimates for different wild meats. Shown separately for Bayanga and the Dzanga-Sangha reserve as a whole.

<sup>1</sup> Figures in brackets were from animals too large to translate local units into carcasses. A minimum estimate for carcass number was made by assuming all the meat from that one species appearing in the market at the same time belongs to the same individual. Meat was considered to come from a different individual if two samples appear in the market more than 5 days apart.

<sup>2</sup> Calculated by multiplying total number of carcasses by the mean carcass weight recorded during the study. <sup>3</sup> Calculated from formal sales by controlling for the proportion known to be sold informally, recorded during the HCS. \*\* Given the infrequency of the consumption of this meat, data were too few to calculate the proportion of sales that occurred outside of the formal market. These figures are calculated using a mean value from other forest meat species (57%). <sup>4</sup> Calculated by dividing weight consumed by mean carcass weight recorded during the study

Given the difficulties involved in accurately measuring hunter offtake rates, it is often estimated through the use of a proxy. Here I have used two approaches- the volume of meat sold and the volume of meat consumed. Estimates produced from each are compared for the most common meat types below;



**Figure 8-3** A comparison of approaches (sales vs. consumption) to measuring wild-meat offtake rates for the most common meat types

For the forest-dwelling animals, the amounts consumed by Bayanga households are consistently lower than the amounts suggested to be sold in both formal and informal markets. This difference may be attributed to a number of factors- the HCIS failed to account for both sales to households in surrounding villages and sales for export. Differences may be further exaggerated by market totals being based on the weight of undressed meat, whereas household consumption is based primarily on dressed meat. Carcass number for the HCIS is also generated by converting the total weight consumed into carcass number, assuming perfect division of an average size carcass- this is likely to provide a slight underestimate.

For fish, interestingly, consumption levels are much higher than market sales would suggest, primarily as over two thirds of sales are conducted outside the market environment. Fish is greatly preferred fresh, and most of the sales in Bayanga are conducted on the riverbank when the fishermen return, or at the fisherman's house. Additionally, given the market also closes at around midday, much of the mornings catch would arrive in the village too late to sell this way. This highlights the sensitivity of market surveys to informal sales- fish sales would have been greatly underestimated in the region if only market data were used. It would also be misleading to use a single correction factor to scale up to include informal sales, as the proportion of meat sold formally and informally varies greatly between species.

### 8.4.2.2 Assessing the sustainability of current offtake

The population dynamics of four indicator species were examined, directly or indirectly, in this chapter- these were the blue duiker, *Philantomba monticola*, Peter's duiker, *Cephalophus callipygus*, the forest elephant, *Loxodonta cyclotis* and the western lowland gorilla, *Gorilla gorilla gorilla*. The first two represented the two most exploited species in the region, the latter the two slowest breeding prey species. As such, they represent the two most potentially vulnerable groups.

#### a) Small prey species- population densities unknown

For the two main prey species- the blue duiker, *Philantomba monticola*, and Peter's duiker, *Cephalophus callipygus*- I used the NMFS algorithm to calculate the densities suggested to be required to ensure current offtake rates were sustainable. These calculations were made assuming either (i) that hunting was restricted to the Dzanga-Sangha Reserve, (ii) that hunting took place in both the DSR and Dzanga National Park (the park closest to the villages) or (iii) that hunting took place throughout the entire protected area. They were also run assuming i) no snare wastage or exports, ii) 27% of snared meat is wasted and iii) 27% of snared meat is wasted and 26% of all captured meat is exported.

**Table 8-5** Population densities required to ensure current estimated hunter offtake is sustainable for two duiker species, as calculated using the NMFS algorithm. Offtake is presented with different weighting for snare wastage and exports. Data is also presented considering both a maximum and a minimum intrinsic rate of increase ( $R_{max}$ ) for each species.

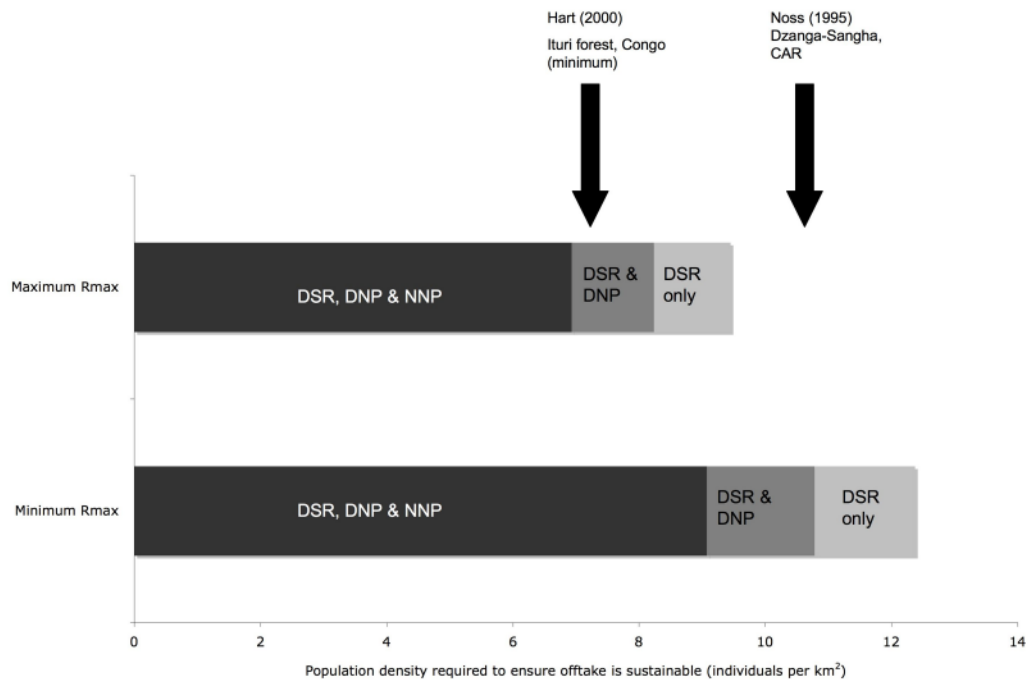
	Area hunted	Blue duiker		Peter's duiker	
		Minimum $R_{max}$	Maximum $R_{max}$	Minimum $R_{max}$	Maximum $R_{max}$
Offtake = Quantity consumed only	DNR	10	8	12	6
	DNR & DNP	9	7	11	5
	DNR, DNP & NNP	7	6	9	5
Offtake includes weighting for snare wastage (27%)	DNR	12	9	23	12
	DNR & DNP	11	8	20	10
	DNR, DNP & NNP	9	7	17	9
Offtake includes weighting for snare wastage (27%) and hunter exports (26%)	DNR	15	11	28	14
	DNR & DNP	13	10	24	12
	DNR, DNP & NNP	11	8	21	10

If we consider the minimum possible offtake for the blue duiker, whereby we consider only meat consumed by households and assuming a maximum intrinsic rate of increase, the minimum density of individuals required for the DSR, including the hunting zone, is 8 individuals/km<sup>2</sup>. This drops to 6 individuals/ km<sup>2</sup> if assuming both national parks are also fully exploited alongside the reserve. Taking a more conservative approach, assuming 27% of snared meat is wasted, 26% of captured meat is exported and using the minimum intrinsic rate of increase, the populations densities suggested to be required increase to 15 and 11 individuals/ km<sup>2</sup> respectively.

***Comparing the required population densities to known population densities***

The current population density of the blue duiker, *Philantomba monticola*, in the Dzanga-Sangha region is unknown. In the much-hunted Bayanga region in 1994, densities for the blue duiker were estimated from line transects as 10.5 individuals per km<sup>2</sup> (Noss, 1995, Noss, 1998b). Given the high levels of hunting conducted since this survey took place (see chapter 6), it is extremely unlikely populations have increased since this time. However, these figures are based on individual sightings along a 2m wide strip transect, and assumed both perfect detection, no double counting and detection of their original position before moving away from the observer. In likelihood these assumptions are almost certainly violated. For example, rather than flee, duikers are known to often freeze when disturbed by an observer. In thick vegetation this makes them often impossible to spot. They may also move away too quietly to be detected. These population density figures should therefore be considered a minimum.

A study of blue duiker density in comparable mixed and old secondary forest in the Congo basin found un hunted densities to be 20.6 animals/ km<sup>2</sup> (95% CI 14.7-26.5 /km<sup>2</sup> ) (Hart, 2000). Population densities in hunted areas were, unsurprisingly, significantly lower, ranging from 6.9 to 17.8 individuals/ km<sup>2</sup> depending on the proximity to human settlements.

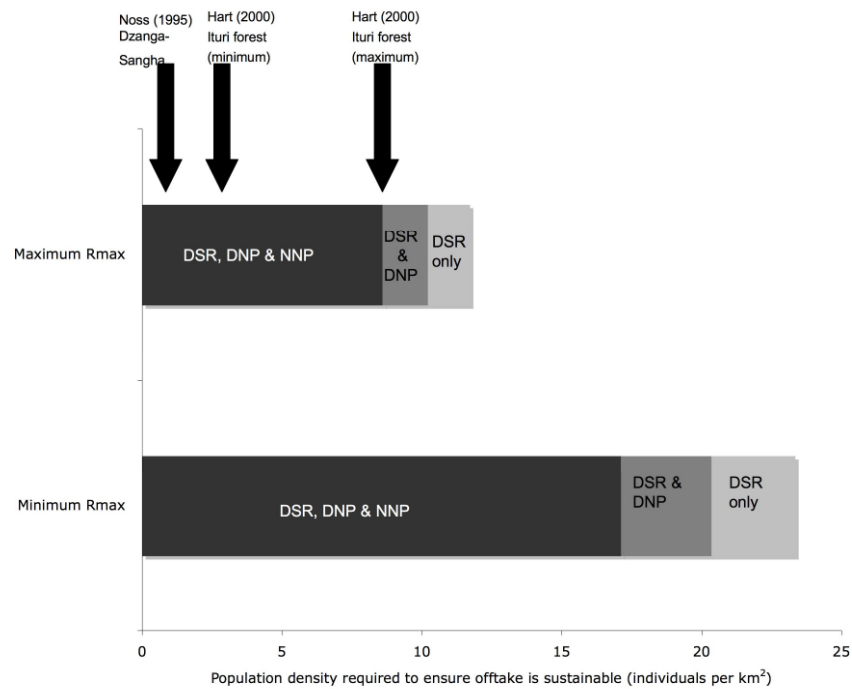


**Figure 8-4** Comparing the population densities of the blue duiker, *Philantomba monticola*, required to support current offtake (quantity consumed and 27% snared meat wasted) with known population densities in other hunted areas.

Population densities of any species can be greatly dependent on both external factors, such as habitat type or season, and internal factors, such as survey methodology. Duiker populations, in particular, have been found to fluctuate greatly even in non-hunted areas, showing different rates of both dispersal and predation (Hart, 2000). Estimates of both offtake and sustainable hunting rates are therefore highly prone to error and should only be interpreted with great care. However, if we assume, based on both anti-poaching records and key informant interviews, that hunting is more prevalent in the DSR and DNP, and controlling for snare wastage but not exports, a population density of 8 to 10 individuals would be required. This is extremely close to the populations densities suggested by both Noss (1995) and Hart (2000) to exist in hunted areas. Given that offtake estimates assumed perfect division of a carcass, and there is known to be some export (although unquantified), it is likely the current offtake rates exceed the proportional offtake limit defined by the NMFS threshold.

The picture is somewhat clearer for Peter's duiker, *C. callipygus*. If we consider the minimum possible offtake, whereby we consider only meat consumed by households and assuming a maximum intrinsic rate of increase, the minimum density of individuals required for the DSR,

including the hunting zone, is 6 individuals/km<sup>2</sup>. This drops to 5 individuals/ km<sup>2</sup> if assuming both national parks are also fully exploited alongside the reserve. Taking a more conservative approach, assuming 27% of snared meat is wasted, 26% of captured meat is exported and using the minimum intrinsic rate of increase, these populations densities increase to 28 and 21 individuals/ km<sup>2</sup> respectively.



**Figure 8-5** Comparing population densities of Peter's duiker, *C. callipygus*, required to support current offtake (quantity consumed and 27% snared meat wasted) with known population densities in other hunted areas.

Noss (1995) estimated 1994 *C. callipygus* densities in the Bayanga region as around 0.9 individuals/km<sup>2</sup>. Hart (2000) in his study of red duiker densities in hunted areas of the Ituri forest found them to exist at between 2.2-8.7 individuals individuals/km<sup>2</sup>. Both density estimates suggest that even if the current offtake was spread throughout the entire region, including all protected areas, it is unlikely that current offtake rates are sustainable. This becomes even less likely when considering that animal offtake figures, estimated through the HCIS, represent an absolute minimum, given the assumption of perfect carcass division.



***b) Large prey species- population densities known***

For both elephant and gorilla, the situation is reversed somewhat, in that while recent surveys can give us estimates of population densities, current consumption rates are much harder to estimate. Due to the illegal nature of the sale of such meat, much is sold and consumed out of the public arena. However, minimum offtake estimates can be provided by the market survey and then discussed in conjunction with sustainable rates of offtake suggested by the NMFS algorithm, shown below;

**Table 8-6** Values used to calculate sustainable offtake of the western lowland gorilla, *Gorilla g. gorilla*, and the forest elephant, *Loxodonta cyclotis*, using the NMFS algorithm

	Estimated population size (95% CI) <sup>1</sup>	Estimated sustainable yearly offtake (95% CI)	
		Minimum $R_{max}$	Maximum $R_{max}$
<b>Elephant</b>	1319 (673-1662)	13 (7-16)	25 (13-31)
<b>Gorilla</b>	3993 (1969-7509)	72 (36-136)	75 (37-141)

<sup>1</sup> Taken from the most recent survey in the area by MIKE- Blake (2005)

Over the 12 month study period, an estimated 16 elephants and 32 gorillas were thought to have been killed in the region- these figures should be considered an absolute minimum as i) they consider sales in the public market only ( it is likely that much illegal meat is sold informally, exported or wasted), ii) if different portions of gorilla/elephant meat were sold within 5 days of each other, it was assumed to come from the same individual and iii) it was assumed that only one individual was killed at a time- for gorillas in particular, this is highly unlikely. Furthermore, both elephants and gorillas have a highly complex social system, and there is considerable potential for the death of a single group member to cause considerable social disruption, including upsetting the breeding structure.

Looking at results for the forest elephant- if we adopt a lower intrinsic rate of increase, the recorded offtake levels exceed those suggested as sustainable using the NMFS algorithm. The minimum estimate of elephant offtake in 2006 also lies with the 95% CI for maximum sustainable offtake even if we use one of the highest, and therefore most optimistic, intrinsic rates of increase reported in the literature. For gorillas the picture is slightly less clear. If market sales represent all hunted

gorillas, then such a level of offtake could be sustainable. However, this is almost certainly not the case. Unfortunately the lack of reliable data precludes any attempt to control for informal sales of illegal meat, much less attempt to translate this into the number of individuals.

### 8.4.2.3 Temporal changes in prey profile

Market survey results from this study were compared to results from studies conducted by two researchers in 1994/95- Andrew Noss, an independent researcher, and Jean-Marc Garreau, a project employee.

Detailed information on prey type was only given for snare and net hunted offtake. Comparing this with market sales or consumed animals would likely produce erroneous results, as the smaller animals are more likely to be eaten while still in the hunting camps. However, Noss provides some information on the main species sold during a survey of informal sales in the village. This is compared below to data from this study.

**Table 8-7** Comparing prey profile of animals sold in Bayanga, 1994/5 and 2006/7. Mean weights taken from weighing of fresh, whole carcasses in Bayanga market with the exception of *Potamochoerus porcus*, which is taken from Kingdon (1997).

	Mean body weight	Informal market 1994/5	Formal market 2006/7	Trend
<i>Philantomba monticola</i>	4.7	33.6	53.8	Increase
Monkeys <sup>2</sup>	4.4	18.6	9.4	Decrease
Red duiker <sup>1</sup>	18.1	41.0	33.2	Decrease
<i>Potamochoerus porcus</i>	30.5	2.2	1.6	Decrease
Other		4.0	1.9	Decrease
N		2200	6619	

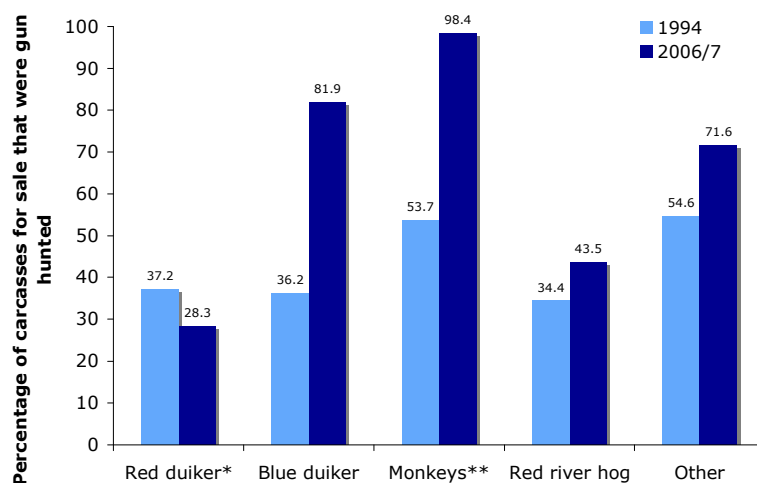
<sup>1</sup>Includes *Cephalophus callipygus* (both studies), *C. dorsalis*, *C. nigrifrons* and *C. leucogaster* (1994 only)

<sup>2</sup> Includes *Lophocebus albigena*, *Colobus guereza*, *Procolobus badius*, *Cercopithecus cephus*, *C. nictitans*, *C. neglectus*, *C. pogonias* and *Cercocebus agilis*

In the past 12 years, prey profiles suggest a decrease in the proportion of larger bodied mammals and primates, which have a much lower intrinsic productivity than other mammals for a given body

mass (Robinson and Redford, 1986, Hennemann, 1983). Concurrently, there appears to be a greater dependence on the smaller bodied, and faster reproducing blue duiker, *Philantomba monticola*. It is also interesting to note that in 1994 the Bay duiker, *Cephalophus dorsalis*, was the third most frequently caught duiker, making up 6% of all animals captured by snare and 6.8% of net hunted animals (Noss, 1995). However, in 2006/7 it was not recorded in either market or household consumption surveys. Furthermore *C. nigrifrons*, the black-fronted duiker, and *C. leucogaster*, the white-bellied duiker, already poorly represented in the 1995 sample, failed to appear in either the market or household consumption surveys during this study.

Comparison of the proportion of animals killed by gun, as oppose to snare hunting, or other means, (fig. 8.6) suggests that, with the exception of the red duiker, the proportion of animals killed by guns has increased.



**Figure 8-6** Comparison of proportion of different animals killed by gun hunters. 1994 data taken from Noss (1995, 1998). 2006/7 data from this study.

\*Includes *Cephalophus callipygus* (both studies), *C. dorsalis*, *C. nigrifrons* and *C. leucogaster* (1994 only)

\*\* Includes *Lophocebus albigena*, *Colobus guereza*, *Procolobus badius*, *Cercopithecus cephus*, *C. nictitans*, *C. neglectus*, *C. pogonias* and *Cercocebus agilis*

This is confirmed by government records on firearm registration- in 1994 8 guns were legally registered in Bayanga. By 2006 this had risen to 30.

### 8.4.3 Local perceptions of prey population dynamics

Structured and unstructured interviews were conducted throughout the study period, exploring local perceptions of natural resource abundance. Both BaAka (Yandoumbe) and non-Aka (Bayanga) residents were questioned regarding both past patterns, and predictions for future availability of forest meat.

Within Bayanga, there was generally perceived to have been a steady supply of wild meat over the past 5 years. Rather than this being an implicit assumption of the inexhaustibility of supply, however, it was often attributed to simply a lot of people going out to catch the animals.

*“To find them [wild animals] is no problem – there are lots people hunting because SBB [logging company] is shut. Lots of people with the torch and the gun”*

Response of a female Bayanga resident when asked if it is easier or harder to find meat now than 5 years ago.

A number of hunters mentioned that it was now necessary to walk further to find animals. One elderly hunter in particular talked about the past when animals used to walk through the village, lamenting that now it was necessary to walk for up to a day for a successful hunt, strongly suggesting local depletion of popular prey species.

This message is repeated by the BaAka- nearly everyone questioned about the ease of finding forest animals now said that while they could still be found, it was necessary to travel much further from the village. While a number of reasons were given for this, including simply that it was Gods will, the vast majority of people blamed it on animals being chased away by the noise generated near villages, above all by non-Aka gun hunters. The general perception appears to be that the animals have actively moved away, rather than any recognition of resource limitation.

Both BaAka and non-Aka residents blamed local depletion largely on gun hunters. The BaAka commented on the noise of the guns scaring the animals away, whereas the non-Aka recognised guns as a highly efficient harvesting method. Snare hunting, when mentioned, was held to be a low impact form of hunting. On two occasions, net hunting was mentioned as ‘destroying’ the forest close the village, although in general it was held to be relatively innocuous.

When questioning people about patterns in the future, a widespread prediction amongst the non-Aka was of future depletion. Nearly two thirds of Bayanga respondents interviewed for the HAS claimed that, if forest animals continued to be extracted at their present rate, there would be fewer animals in five years. Yet while the threat of over-hunting is widely recognised, people appear to feel disempowered to address the issue. The lack of alternatives to hunting for as a source of both food and money was frequently mentioned.

*“ Much harder. The animals are already far away. But we are obliged to hunt as there is no other meat”*

Response of a male Bayanga resident when asked if it will be easier or harder to find wild meat 5 years in the future.

For the BaAka, however, almost no-one felt that animals might be harder to find in the future, although a few people remarked that they might be further away. A common response was simply that animals will always have children. Interestingly, amongst the non-Aka when discussing the future availability of forest animals, some residents also referred to their reproductive rate- however it was always to suggest poor replication rates, comparing them unfavourably to fish, known to produce a large number of eggs.

## **8.5 Discussion**

Developed within the conservation arena, ICDPs combine a number of approaches to protect biodiversity, ranging from encouraging sustainable use to strict protection efforts. Ecological monitoring is essential in order to evaluating the effectiveness of management approaches, yet is often neglected. This chapter evaluated the conservation efficacy of the Dzanga-Sangha ICDP by exploring both the sustainability of current offtake levels by hunters and the temporal patterns in prey population dynamics.

### ***Conservation of larger mammals***

Larger mammals are known to be particularly vulnerable to hunting pressure due to their relatively slow reproduction rate. It is clear from previous chapters that, despite efforts by the anti-poaching squad, there is a large amount of illegal hunting in both the reserve and the two national parks. The anti-poaching squad confiscated both gorilla and elephant carcasses in 2006-7, and both species

were sold in the market during the 12 month survey conducted for this study, estimated to represent 32 gorillas and 16 elephants. The MIKE (Monitoring of Illegal Killing of Elephants) survey also reported particularly high levels of human sign in the Dzanga-Sangha region- with the Dzanga-Sangha Reserve, Dzanga National Park and Ndoki National Park showing 3 out of the 4 highest densities of human signs in the Central African region, with sign encounter rates of 6.89, 4.28 and 2.92 per km<sup>2</sup> respectively<sup>46</sup> (Blake, 2005). Furthermore, 10 elephant carcasses were found over the period of the census, most within Dzanga National Park.

A number of surveys have been conducted in the region over the past 22 years, focussing on elephant and gorilla population numbers. Whilst the employment of a variety of methodologies and conversion factors mean that any comparison of results should be interpreted with care, some broad patterns can be seen.

Elephant populations in both the Dzanga National Park and the reserve appear to be decreasing, with the decline suggested to have occurred since 1997. Elephant densities were also found to be strongly negatively related to the density of human signs, such as hunting camps. It is feasible that such a decrease may be due to high levels of migration out of the area- forest elephants are known to range widely (Blake et al., 2001) and the proximity of both Nouabale-Ndoki National Park in Congo, and Lobeke National Park in Cameroon make it relatively easy for the DS forest elephants to travel to areas known to be less intensively hunted (Blake, 2005). However, the frequent appearance of elephant meat in Bayanga market and carcass encounter rate suggest that it is likely that current rates of offtake are exceeding birth rates, resulting in on-going overhunting, and subsequent depletion of the population.

Conversely, there appears to be little change in gorilla densities since park creation, and no evidence that gorilla distribution is linked to distance to roads or signs of humans. Furthermore, gorilla densities appear to compare relatively favourably to those found in other areas. Care should be taken in interpreting these result however- Plumptre (2000) suggests that, given the variation around estimating group densities from transecting nests, a total of 349 nests need to be found to detect a 20% difference in population size, increasing to 1395 for a 10% change. While the pre-park survey recorded 1420 nests (Carroll, 1996b), subsequent surveys have based population estimates on as little as 46 nests (Blake, 2005), making it quite possible population changes may have been missed through under-surveying.

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<sup>46</sup> Although some of these signs may also be attributed to anti-poaching patrols and researchers.

Results from the market survey produced no evidence that gorillas were being over-hunted, although given the likelihood that much of this illegal meat is sold informally, presented figures are likely to be a serious underestimate. In addition, the close social cohesion of gorilla groups and the protective role of the silverback also make it extremely unlikely that only one gorilla could be removed from a group at one time without injury to others. There may also be less direct consequences from removing group members; for example, if the silverback is killed, the infants and juveniles are left particularly vulnerable to attack from predators. Infanticide is also known to occur opportunistically amongst gorillas (Watts, 1989, Harcourt and Greenberg, 2001).

### ***Conservation of smaller prey species***

In the absence of any clear indication of population densities, it was necessary to calculate offtake through consumption records. These figures were also presented after scaling up for likely snare-wastage and export rates in the area. For Peter's duiker, *Cephalophus callipygus*, the population densities which are required to support the current rate of offtake are highly unlikely to exist in an area which has been subjected to both high and prolonged rates of hunting. This would be the case if all of the protected complex were opened up to exploitation, but is particularly likely if hunting were restricted to the currently permitted areas only. For the blue duiker, *Philantomba monticola*, if one assumes no exports and a maximum intrinsic rate of increase, population densities suggested to be required to support current levels of offtake have been found in other heavily hunted areas. Taking a more conservative view, however, by adopting a minimum intrinsic rate of increase and assuming a 26% export rate, current offtake is likely to lie outside that deemed sustainable by the NMFS algorithm. These two duiker species make up over 84% of meat sold in the market, and 58% of meat consumed, making them extremely locally important in terms of both economy and diet.

These findings are further supported when looking at temporal patterns in prey profile. Since 1994, the proportion of larger-bodied mammals (red duikers, monkeys, *Potamochoerus porcus*) has fallen, while the proportion of the relatively small-bodied blue duiker, *Philantomba monticola*, known to be more resistant to hunting (Hart, 2000) has risen. Furthermore the bay duiker, *Cephalophus dorsalis*, was totally absent from the market over the study period, in contrast to its strong representation in 1994. In fact I only came across a bay duiker once during the study when out on a day hunt with the Yandoumbe BaAka, when I was told by one of the hunters that they were very rare. The bay duiker is known to be sensitive to over-exploitation, with local depletion in North east Gabon also attributed to hunting (van Vilet et al., 2007)- combined with Noss's warnings that they were being exploited at an unsustainable rate (Noss, 1995) suggests that the bay duiker has been locally depleted through over-hunting.

Interestingly, however, there does not yet appear to be much consumption of the very small-bodied animals, such as porcupines, rats and squirrels, seen elsewhere in West and Central Africa (Kumpel, 2006, Fa et al., 2000, Cowlshaw et al., 2005a). While these smaller mammals are found in the reserve (Blom, 1993, Blom, 2001a), their densities are unknown. While it is feasible, therefore, that they are not consumed due to natural rarity, it is more likely that, given the current high levels of consumption of larger mammals, it has not yet been necessary to switch to consumption of the less preferred, high reproducing, smaller mammals.

Local historical knowledge suggests a strong recognition that hunting is impacting local population levels of the main prey species. Within both the BaAka and non-Aka, although the supply of meat appears to have been relatively constant over the past 5 years, there is widespread perception of local depletion of the main prey species, with hunters telling how now they have to go much deeper into the forest to find game. However, with the BaAka in particular, there appears to be little perception of the longer-term potential of removing all the animals from the forest. For the non-Aka, this appears to be recognised, yet short-term concerns of finding food and money preclude any attempts at conservation-friendly behaviour.

### ***Putting the C into ICDP?***

Combined results suggest that neither the smaller prey species, nor larger mammals are being exploited at sustainable levels, with the possible exception of the lowland gorilla. As a result, conservation objectives are largely failing to be met. Cowlshaw et al. (2005) make the important point that where forest animals have been hunted for centuries without being exhausted, some level of sustainability is indicated. However, Dzanga-Sangha is notable for its relatively recent human population growth, making it a possibility that hunting levels exceeded sustainability only relatively recently. This apparent failure to meet conservation objectives has its roots in many issues, discussed in more detail in chapter nine.

While this chapter offers no attempt to assess the sustainability of a particular hunting method, results suggest that the rise in gun use in the area may be implicated. The number of registered guns has almost quadrupled since 1994, with the proportion of many species killed by shot gun also rising- of the 3563 blue duikers sold in Bayanga market during the study period, over 80% were known to have been killed by shot gun- this can be contrasted to just 36% in 1994. Both BaAka and non-Aka residents also held gun hunters responsible for perceived prey population declines. However, it is also worth bearing in mind that a 1994 study in Dzanga-Sangha suggested that both



net hunting and snare hunting in the region were likely to be unsustainable (Noss, 1998a, Noss, 1998b). Snare hunting in particular is known for its lack of selectivity in terms of sex and age of the prey- juveniles and pregnant females are equally likely to be killed as mature males. Similarly I found no evidence during this study that any animal was spared on the basis of its age or sex during either net or gun hunting- indeed if gun hunting takes place at night, the hunter is unable to make that decision.

It is possible that the gazettement of parks may encourage unsustainable behaviour by focussing hunting efforts on particular areas. However, even assuming the current rate of offtake of two of the indicator species- Peter's duiker, *Cephalophus callipygus*, the forest elephant, *Loxodonta cyclotis*, (and possibly the blue duiker, *Philantomba monticola*)- is spread equally throughout the entire Dzanga-Sangha region, current offtake levels are unlikely to be sustainable. Furthermore, if all enforcement were to cease, it is probable that hunting would intensify and further exacerbate this effect. It is therefore unlikely that de-gazetting is the answer to conservation issues.

#### ***The need for more complete information***

This study provides detailed baseline information on the exploitation of prey species in the Dzanga-Sangha reserve. Whilst it also brings together results of all previous population and market surveys, detailed analysis was prevented by the different approaches to groupings and methodologies used. This underlines how crucial it is that future surveys within the Dzanga-Sangha region should maintain surveying methods. These methods should be, straightforward to apply, repeatable, cost-effective and above all robust (Balmford et al., 2003, Jenkins et al., 2003).

For the larger mammals, such as elephants and gorillas, this may most easily be achieved by reusing transects, thus reducing the variation around the estimate (Plumptre, 2000). Transects cut for the most recent survey by MIKE would provide an ideal starting point for this. Milner-Gulland and Rowcliffe (2007) caution, however, that repeated use of the same transects may bias population distributions, through such things as habitat alteration- care should therefore be taken to minimise disturbance. Biases surrounding conversion factors may be reduced by conducting local studies of production and decay rates, incorporating seasonal changes. For the gorillas, one group is sufficiently habituated to allow detailed studies of nest construction rates, although dung production rate by forest elephants would be harder to calculate given their highly aggressive behaviour towards humans (pers. observ.). Decay rates for both nests and dung should, however, be relatively straightforward to conduct. When reporting results, it is also crucial to report the density of signs in addition to the density of individuals. This would allow researchers interested in comparing survey

results to apply similar conversion factors across the board, thus cutting down further on potential areas of error.

Population densities for smaller prey species are somewhat harder to ascertain. Duikers, the main prey in the area, are both quiet and secretive, making them very difficult to see in dense vegetation. Furthermore, they have a known tendency to avoid researchers attempting direct counts, resulting in serious data bias (Newing, 1994). While this bias may be reduced by working at night and using torch light to pick out eye shine (Milner-Gulland and Rowcliffe, 2007), this method is too dangerous to use in an area known to be heavily hunted at night, in addition to the risk of encountering forest elephants. While a mark/recapture approach may work, it is extremely costly in both time and money to implement, particularly when considering it is recommended at least 50% of the population are initially captured for marking (Milner-Gulland and Rowcliffe, 2007). Surveying of indirect signs is also difficult given the similarity of signs left by different duiker species.

Net drives have been used to calculate densities of duikers in a number of studies previously (White and Edwards, 2000, Noss, 1995, Hart, 2000). This involves surrounding a known area with a net, before using a set number of people, often with dogs, to make their way through the quadrat (or circle), beating the vegetation and driving wildlife towards the net where the animals are captured and counted. As a survey tool, this approach has the serious disadvantage of resulting in the disturbance, injury or often death of the surveyed (and indeed, non-surveyed) species. When considering prey species that are already under serious hunting pressure, conducting net drives solely for surveying purposes is clearly unacceptable. Net hunts that would have taken place anyway, however, may be useful as a 'Catch Per Unit Effort' tool, outlined below.

Rather than monitoring *absolute* densities of prey species, an alternative approach is to instead monitor *trends* in populations (Rowcliffe et al., 2003). One of the increasingly popular ways of doing this is using a Catch Per Unit Effort (CPUE) approach (Rist, 2007, Noss et al., 2005). This is based on the theory that as the population density of a prey species rises or falls, the CPUE for a hunter rises and falls proportionally. Hunter effort is most commonly measured by time, but may also include factors such as the type, number and efficiency of the weapon/s used, habitat hunted in, hunter skill and distance travelled from the village (Rist, 2007, Milner-Gulland and Rowcliffe, 2007, Kumpel, 2006). While making several, often uncertain, assumptions, the most fundamental of

which is that CPUE is directly proportional to true population abundance<sup>47</sup>, such an approach is both relatively cost effective and relies on data that is reasonably easy to obtain (Milner-Gulland and Rowcliffe, 2007, Rist, 2007). Who should implement this technique, however, must be carefully considered. While the basic information is generated by local hunters, it is highly unlikely that, given the general distrust of conservation activities in the area, Dzanga-Sangha hunters will be motivated enough to regularly provide accurate data without some level of support by an outside agent. As a party distrusted by hunters and with a vested interest in the outcome, it is suggested the DSP should not directly attempt this role. Ideally, an independent third party should be employed at regular intervals to work with local hunters to generate information on CPUE and hence monitor trends. Such monitoring should involve community participation as far as possible, with both the approach and the results discussed openly with community members. Ideally, this would encourage greater interest in self-monitoring.

Regular market surveys, adopting similar methodology to this study (see chapter 3), will also allow valuable insight into the temporal dynamics of, not only prey profile and volumes, in addition to any changes in hunting methods (Fa et al., 2000, Cowlshaw et al., 2005a, Crookes et al., 2006). Given the poor relationship between the DSP and the residents, such work should also be undertaken by an independent third party, with the identities of vendors protected. The large amount of variation shown for formal versus informal sales underlines the serious problems associated with using market data to generate quantitative information on hunter offtake. Household consumption data can go some way towards correcting for this, yet it is also time and labour intensive to collect. Both approaches also omit meat exports. Results from both should therefore always be considered an estimate of minimum offtake. Bias relating to wastage, gifting and exports can be reduced by working more closely with hunters rather than relying on market vendors- such an approach, however, clearly takes time and sensitivity to implement.

The importance of local historical knowledge should not be underrated. It is invaluable in interpreting quantitative data as well as in independently revealing population trends- results from this study suggest that the flow of meat into the market has been regular over the past five years- yet insight gained through resident interviews suggest that hunters are now having to travel further to return with the same quantity of meat, indicating local depletion. Conducted carefully, interviews

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<sup>47</sup> This assumption may be violated in two ways- hyperdepletion, where CPUE drops faster than animal abundance, and hyperstability, where CPUE fails to drop as fast as actual animal abundance. Reasons for this include factors such as prey and hunter behaviour- readers are referred to Rist (2007) for more information.

have also been shown to provide accurate quantitative data on prey population trends (Jones et al., 2008).

Without careful and regular monitoring of indicator species, here suggested to be chosen to represent both the most sensitive and the most heavily hunted species, it is impossible to evaluate the effectiveness of management interventions. It is also clear that some species are more resilient to hunting pressure than others (Hart, 2000, Cowlishaw et al., 2005a)- therefore better information on specific prey dynamics can also help target interventions more effectively. Given the many biases associated both with assessing population densities and hunted offtake, combining census work with market surveys and hunter interviews can provide a clearer overall picture.

## **8.6 Conclusion**

A comparison of past population surveys suggests a dramatic decrease in elephant populations over the past 22 years. The effect on gorilla population densities remains uncertain, possibly due to under-surveying. Current offtake rates of the two main prey species- Peter's duiker, *Cephalophus callipygus*, and the blue duiker, *Philantomba moticola*, are likely to be unsustainable, whether they are restricted to the hunting zones or spread throughout the entire protected complex. Changes in the prey profile over the last 12 years suggest an increase in the proportion of the smaller-bodied mammals hunted at the expense of the larger-bodied, slower breeding mammals. This suggestion of local depletion is echoed through testimonies of local hunters, who report having to walk much further than in the past to find prey within the forests of Dzanga-Sangha. Combined, these results are strongly suggestive of a failure to maintain the population densities of at least three of the four indicator species examined, and therefore a failure to meet conservation objectives. Possible reasons for this are explored in detail in chapter nine. More efficient and cost effective ways of monitoring prey population trends, and hence the consequences of management interventions are discussed.

## Chapter nine

### Discussion

#### **9.1 Introduction**

In this thesis I critically evaluated the effectiveness of a Central African ICDP, the Dzanga-Sangha Project, at meeting conservation and development goals, paying particular attention to the project's tourism programme. The need to consider social, economic and environmental issues involved designing and implementing an interdisciplinary study, linking social science methods with an ecological approach. Results are reviewed below (9.2), before deconstructing the ICDP approach to consider how effectively conservation and development objectives have been addressed simultaneously in the Dzanga-Sangha region (9.3). Results are examined in the context of the wider literature, considering issues relating to both ICDP implementation as well as its underlying assumptions. The more general contribution of this work to both research and policy are discussed (9.4), before outlining suggestions for future work (9.5).

#### **9.2 Evaluating project effectiveness**

##### **9.2.1 Contributing to local development**

ICDPs aim to provide benefits at the local level both to compensate conservation-related costs and to encourage pro-conservation behaviour. Given the often considerable costs imposed on local communities by protected area formation, chapters four and five investigated the extent to which the Dzanga-Sangha Project has succeeded in its aim of improving standards of living in the area.

Local opposition to conservation efforts in the Dzanga-Sangha region was found to focus almost exclusively on the loss of access to hunting grounds through the gazetting of the national parks, although not all these opportunity costs are realised- there are currently high levels of illegal hunting in both Dzanga and Ndoki National Parks. Attempts made by the DSP to compensate for these costs include developing and maintaining community infrastructure, encouraging agricultural

diversification and animal husbandry and developing a tourism-revenue distribution scheme.

However, the majority of the population receive little direct economic benefit from the presence of the ICDP. An economic valuation exercise conducted for 2006 showed that the direct economic benefits accruing at the local level largely fail to compensate for lost opportunity costs for hunting, particularly when looking at villages other than Bayanga, Mossopoula and Yandoumbe- home to project employees and all tourism-related activities.

Attempts to develop alternative livelihoods in the region have largely failed- this is suggested to be due in part to poor long-term support by the DSP, as well as a general failure to relate schemes to the interests and needs of the local population. For example, a workshop in 2006 focussed on teaching local women how to make jam from local ingredients although there appeared to be almost no market for such a product in the area. The on-going in-migration of people into the area in search of work serves to inflate lost opportunity costs whilst simultaneously reducing each individual's share of project benefits, widening the gap between costs and benefits. The general failure by local residents to value community-level benefits such as health services further reduces appreciation of the advantages of the DSP, with benefit recognition focussing almost exclusively on tangible and immediate impacts at the individual level, such as employment, as seen elsewhere (e.g. Gibson and Marks, 1995, Wells et al., 1992, Barrett and Arcese, 1995).

There are also serious issues associated with the distribution of ICDP-related benefits. Access to DSP jobs is limited by educational requirements, whilst access to tourism benefits is restricted by both geographical location and ethnicity. Furthermore, the bodies in charge of distributing the 40% fund- whether local government or NGOs set up deliberately for that purpose- have all been accused at some point of lack of transparency and misuse of funds. The recent decision by the state to put the distribution of this revenue back into the hands of the local government raises concerns that much of the 40% will again be absorbed by community elites, and any link to conservation activities lost.

This study also serves to illustrate the limited ability of tourism, often heavily relied upon by ICDPs, to generate significant benefits in certain areas (Kiss, 2004, Wilkie and Carpenter, 1999b). High travel costs relative to other destinations in Africa, poor infrastructure such as roads, frequent political instability and a deficit of other close tourist attractions have meant tourism has been seriously limited as a revenue-producing tool in the Dzanga-Sangha area, in addition to making it intermittent and unreliable as a livelihood option.

## 9.2.2 Changing attitudes and behaviour in park-adjacent communities

ICDPs attempt to provide conservation-related benefits in the belief this will improve support for conservation initiatives (Infield & Namara, 2001). This support is often assessed as either (and most commonly) an improvement in pro-conservation attitudes and/or an improvement in pro-conservation behaviour. This study assessed both, exploring not only their links to ICDP benefits but also their links to each other.

### Linking attitudes and benefits

Conservation was disaggregated into three components of the same system- the national parks, tourism and the Dzanga-Sangha Project- revealing strikingly different attitudes to each. There was little support for the two national parks in the area, particularly amongst the BaAka- unsurprising when considering the wide-scale reliance on the forest's extractable resources, and the poor recognition of its indirect and non-use values. Conversely, tourism is surprisingly popular amongst residents, especially given both its limited scale and rewards- in all likelihood linked to its lack of perceived costs.

Attitudes towards the DSP were more complex. The focus on short-term direct impacts meant that project employment was one of the few recognised benefits, with anti-poaching efforts the most recognised cost. Given both the widespread impact of restricting hunting in the area and the highly limited access to project jobs, it is unsurprising that the DSP is widely unpopular. Yet few people wanted DSP to leave- despite many people not benefiting directly there was a clear recognition of both the strong role that it plays in supporting the village economy and the possibility of future benefits.

### Replacing natural resource extraction in livelihoods

Natural resource extraction, particularly snare hunting, offers reserve residents a livelihood option that is both lucrative and relatively stable, as well as being open access with low start-up costs. In contrast, project employment, the only DSP-related benefit that provides a serious economic alternative, offers few jobs relative to the size of the reserve population, with many hunters potentially excluded through educational requirements. Moreover, there appears to be little evidence that the presence of a project employee in a household restricts illegal extraction activities by other household members- the different income sources are used to complement rather than replace each other (Gibson and Marks, 1995, Sievanen et al., 2005). Hunting in the Dzanga-Sangha reserve also appears to play a strong role as a fall-back profession (de Merode and Cowlshaw,

2006, Fimbel et al., 2000, Hart, 2000), highlighted by the rise in illegal hunting during the closure of logging operations in the area.

### **Changing consumption behaviour**

The failure to link project benefits to more conservation-friendly behaviour continues when we consider consumption patterns within the reserve. Wild foods, whether forest meat, fish or forest vegetables, clearly play a big role in the diets of both the BaAka and non-Aka. The non-Aka, in particular, consume large quantities of forest meat, above all in wealthy households and those containing project employees.

A study of market dynamics and consumer preferences suggested that, for the non-Aka at least, this appears to be related to poor access to alternatives- domestic meat, whilst generally popular, is rarely available to purchase. Unlike other studies (e.g. East et al., 2005, Wilkie et al., 2005), domestic alternatives were also found to be significantly more expensive than almost every type of wild meat. For the BaAka, the situation is more complex. The high degree of food sharing within and between family groups means that any changes in consumption behaviour will be conducted at the village, rather than the household level, and will therefore be both slower and harder to detect. The central role of the forest and its resources in BaAka society, and the strong suspicions regarding the meat of domestic animals, all offer significant barriers, practical and ethical, to the replacement of bushmeat in their diets.

### **9.2.3 Meeting conservation goals**

Exploration of the efficacy of conservation efforts in the area suggested that three of the four species examined (blue duiker, *Philantomba monticola*, Peter's duiker, *Cephalophus callipygus*, and the African forest elephant, *Loxodonta cyclotis*) are extremely likely to be being exploited above the rate that the NMFS algorithm suggests as sustainable. For the forest elephant this is reflected in an overall reduction in population density since the protected areas were created. The profile of prey sold informally in Bayanga since 1995 shows an increasing representation of smaller bodied species. Results also suggest that the bay duiker, *Cephalophus dorsalis*, one of the larger duikers found in the area, may have been locally extirpated. Finally, local hunters report having to walk increasing distances to locate prey species. These results suggest that conservation goals are largely failing to be met in the Dzanga-Sangha region.



The steady increase in the number of guns registered in the area, the increase in the proportion of prey for sale that has been shot and testimonies by both BaAka and non-Aka hunters suggest that the superior efficiency of this hunting method may be largely responsible for these declines- particularly for the forest elephant. This does not, however, mean that either snare or net hunting should be considered to have little impact on prey species. Both methods have been suggested to be unselective in terms of prey type, age and sex, and to be conducted at unsustainable rates across the whole region (Noss, 1998a, Noss, 1998b, pers. observ.).

### **9.3 Deconstructing the ICDP approach in Dzanga-Sangha**

#### **9.3.1 Meeting conservation goals through development**

The central objective of the Dzanga-Sangha project is to “... *conserve the country’s last lowland tropical rain forest through the management and protection of the National Park and by promoting the sustainable utilization of natural resources in the Special Reserve.*” (Promotional literature, 2006). While the DSP conducts development activities in the region, it is with the expected aim that they will contribute towards conservation goals. For local residents, however, many of whom can be classified as living in extreme poverty, motivations are very different, with a strong focus on economic development.

The conflict arising from the frequent contradiction between these very different goals are clear, illustrated above all by the often violent reactions of local residents towards project enforcement of hunting laws. The majority of residents do not recognise the project as benefiting them personally, yet all have suffered significant costs with the closure of the forest. Furthermore, where benefits are provided, there is an overall failure to link benefit receipt to pro-conservation behaviour, whether it be abstaining from hunting or consuming wild resources. This appears to be for two reasons. Firstly, pro-conservation options may not be offered- for example, domestic meat as an alternative to bushmeat. The second, and most concerning, reason is that even significant benefits appear to be seen as complementing rather than replacing natural resource use (Gibson and Marks, 1995, Sievanen et al., 2005, Wells et al., 1992).

As a result, anti-poaching patrols are heavily relied upon to restrict illegal hunting activities in the region. Such activities clash directly with what local residents see as their integral right to supply their families with food and money. Perceived as unfair and unpopular, law enforcement efforts

serve only to alienate local residents from the DSP. Conversely, they are also probably the only management tool that currently has any impact on hunting levels.

### **9.3.2 Being realistic about reconciling conservation and development**

While it is possible to suggest ways to improve meeting individual project aims in certain areas, there needs to be serious consideration of whether it is fundamentally possible to achieve both conservation and development goals simultaneously in the Dzanga-Sangha region. To answer this, we need to first establish whether the problems faced by the DSP stem from ineffective implementation or have deeper roots.

#### **Replacing livelihoods in a risk-spreading portfolio**

As is the case for many other initiatives and areas, the DSP has struggled to provide livelihood alternatives that are able to compete, both in terms of access and revenue generation, with hunting opportunities in the region. Results suggest that any alternative livelihoods must be accessible to all households in all villages (but hunters in particular) and provide significant short-term and direct economic benefits. It is also clear that proposed livelihoods need to be both locally relevant and financially, socially and environmentally sustainable (Milner-Gulland and Rowcliffe, 2007, Homewood, 2005b).

Yet assuming that livelihoods can be developed that are relatively lucrative, locally relevant, widely accessible and sustainable in the long-term, results suggest that such opportunities will tend to complement, rather than replace, natural resource extraction. Rural households are known to depend commonly on a diverse portfolio of activities and income sources, whether by necessity or choice (also termed survival and accumulation) (Ellis and Freeman, 2005, Ellis, 2000). Such portfolios may serve a number of purposes- crop production levels may be affected by seasonality, labour markets may vary or a single source may simply be insufficient to support a household (Ellis, 2000). Yet one of the single most important motivators behind livelihood diversification amongst the rural poor is risk (Bryceson, 2002, Bryceson and Jamal, 1997). Put simply, where income sources are unstable rather than guaranteed, it makes little sense to rely solely on a single economic activity. Livelihood diversification can help buffer vulnerable households against both environmental and economic changes, such as market failures and seasonality, allowing 'consumption smoothing' throughout the year (Ellis, 1998). Bryceson & Jamal (1997) note that the prospect of crop failure, or the 'agrarian risk factor' also strongly encourages the seeking of non-farm income sources. Problems with soil fertility, the unpredictability of the weather, limited

markets and the threat of crop raiding make reliance on field cultivation as a sole source of food and/or income an unattractive proposition in terms of risk.

The economically and ecologically unpredictable conditions prevalent in the Dzanga-Sangha region all strongly support risk-spreading behaviour among the poor and vulnerable, particularly given the very narrow margin for error. A large proportion of the population can be classified as living in extreme poverty, and there is considerable risk of illness (including HIV/AIDS), accidents and death<sup>48</sup>. The unpredictable nature of industry in the area, including the abrupt closure of many organisations, has also contributed to an unwillingness to rely solely on income generated through an outside agency. Furthermore, the constant rumours that logging operations will soon resume in the area also appears to discourage any serious investment by local residents in developing alternative livelihoods. As a result, any benefits provided by the DSP fit into, rather than replace, the flexible and diverse livelihood portfolios displayed by both the BaAka and the non-Aka of this region. Such varied portfolios mean that if one resource or livelihood option becomes exhausted, an individual is then able to simply switch to another.

Using project benefits to complement rather than replace the extraction of natural resources is also encouraged by the apparent ineffectiveness of law enforcement efforts. Modelling anti-poaching efficacy suggests that an increased risk of detection may act as a greater deterrent to poachers than increasing penalties does, particularly given the short time horizon and relatively high discount rate (i.e. valuing the present over the future) prevalent in the poor rural African societies (Leader-Williams and Milner-Gulland, 1993). While results show that patrol efficacy does improve with increasing patrol length and number of guards involved, both detection rate and deterrent effect appear low. Furthermore, there is no evidence of any local regulation of wild resource extraction rates, and a clear lack of commitment by the state with regards to enforcing wildlife protection laws.

### **Economic opportunity and in-migration**

The intermittent presence of logging operations in the reserve since the 1970s has encouraged a high influx of CAR nationals into the Dzanga-Sangha area searching for work. That this migration continues following the closure of the most recent logging company in 2004 appears to be testament to the strength of belief that logging will resume soon. The high levels of unemployment and extreme poverty seen throughout the rest of the Central African Republic- indeed, much of Central

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<sup>48</sup> The World Health Organization sets life expectancy for an average male living in the Central African Republic as 40 years. Although the incidence of HIV/AIDS is unknown in the Dzanga-Sangha region, nationwide it accounts for a third of deaths (WHO, 2006).

Africa- combined with the high population mobility, suggest that if poverty alleviation attempts were successful in the Dzanga-Sangha region, they would quickly be followed by a steady stream of in-migrants looking to access such opportunities, as seen elsewhere (e.g. Scholte, 2003, Wittemyer et al., 2008, Wells et al., 1992, Barrett and Arcese, 1995).

High migration rates therefore work against the project on two levels, affecting the successful implementation of both conservation and development initiatives whilst simultaneously ensuring that were such initiatives successful, they would quickly be overwhelmed by migrants hoping to benefit from such opportunities. Whether local revitalisation can occur without broader national or pan-African revitalisation must therefore be strongly questioned.

### **Creating support for conservation**

The general failure to adopt pro-conservation behaviour also appears to be encouraged by an underlying lack of interest in, or appreciation of the need for, conservation activities. For the BaAka, while it is recognised that animal populations have been depleted locally, this is largely attributed to their being scared away by gun hunters. This may be explained by a fundamental lack of belief in the limitation of natural resources: traditional resource-use patterns have been to exploit an area then to move on, allowing each area time to recover, and there is a prevailing attitude that the forest will always provide. For the non-Aka, however, there is a strong recognition of the limitations of prey populations, as well as of the unsustainability of current hunting levels. Nevertheless, there appears to be little interest in foregoing short-term benefits for greater long-term benefits, even if significant short-term benefits are being generated in other ways. For all ethnic groups, and all forms of hunting, I found no evidence of any deliberate conservation efforts by hunters, such as a targeting of males, adults or less vulnerable species.

Such a response may be strongly predicted from the theoretical literature, given the specific conditions of the area. 'Economics of extinction' thinking predicts that, in many cases, it makes more sense from the economic point of view to liquidate all natural resources immediately and re-invest the money in something with higher yields (Caughley and Gunn, 1996, May, 2002). This is particularly relevant where the intrinsic rate of increase of the resource in question is less than the economic rate of interest: for example, with a high value, slow breeding animal such as elephants, it makes economic sense to kill them all now and reinvest the money from the sale in something with higher returns (Caughley, 2003). Tragedy of the commons thinking makes the additional point that, when considering the harvesting of common property resources that are also open access (i.e. no property rights are enforced), the incentive operates to convert natural resources immediately into

something more personally beneficial- if left, there is no guarantee you will be able to benefit from them in the future (Ostrom et al., 1999).

I could find no evidence of any enforcement of property rights amongst the hunters of the Dzanga-Sangha forests. Even the idea of territoriality seemed non-existent, most surprisingly amongst snare hunters- while they regularly set their snares down in the same area of the forest, they do not consider this area 'theirs' and appear at ease with other hunters also setting their snares in the same region. This strongly supports the idea that the forests of Dzanga-Sangha are truly an open access resource, with no collective management by reserve residents. Amongst the non-Aka this is likely to be caused, at least partially, by the poor social cohesion apparent in the area. For any group management of common property resources to work there needs to, amongst other things, both similar interests in the resource amongst users and initial trust between users that others will keep their promises (Baland and Platteau, 1996, Ostrom et al., 1999). The history of in-migration into the Dzanga-Sangha region has resulted in extremely heterogeneous communities, with different resource use patterns and little sense of social unity. Even the very basic treatment of dividing communities into BaAka and non-Aka revealed hugely different interests and needs, without taking into account the diversity of ethnic groups grouped together under 'non-Aka'. With the population of the reserve continually swelled by the high levels of in-migration into the area, establishing collaborative relationships between individuals and groups with no history of such a thing is clearly problematic.

### **The role of environmental education**

ICDPs nearly all attempt to include some degree of education and awareness raising, usually focussing on promoting the non-use values of wildlife in the area. Such attempts are both relatively cheap and aim to effect long term-term changes. The education programme in the Dzanga-Sangha region has focussed primarily on school children and after school clubs. Whilst laudable, the extent to which messages of conservation are absorbed when constantly contradicted by the priorities and behaviour both of the parents and of the community as a whole is questionable. There is growing scepticism in the literature as to the extent to which education can succeed in changing behaviour where it is simply not economically favourable to do so. As Milner-Gulland and Rowcliffe (2007) state:

*“... goodwill gestures and raising concern for the environment are mainly likely to be useful in situations where the costs of refraining from a damaging activity are low.”*

This is stated more starkly by the World Commission on the Environment and Development in their 1987 report, 'Our common future':

*"It is both futile and an insult to the poor to tell them that they must remain in poverty to protect the environment."* (WCED, 1987)

### **Local involvement in resource management**

There is a growing literature focussing on the failure of community conservation programmes in general to make any serious attempt to devolve decision-making abilities or control over project development to local residents (Blaikie, 2006, West and Brockington, 2006, Hutton et al., 2005, Menzies, 2004). Local participation is often seen as simply another requirement to be met, rather than being integral to the process. As a result, it is often reduced to attempts to limit opposition to an outsider-imposed project, rather than on any genuine attempt to create an equitable relationship (Sayer and Wells, 2004). This, in turn, can lead to disempowerment and an undermining of both development and conservation (Ashley & Roe, 1998).

In keeping with the majority of ICDP projects, there has been little attempt by the DSP to devolve any control of natural resources to the local community (Hughes and Flintan, 2001). The design of the protected areas, location of the hunting zone, rules governing extraction of natural resources and rule enforcement have all been imposed by higher authorities- namely the Central African Government acting in partnership with the Dzanga-Sangha Project. The DSP is aware of this issue and has attempted to address it in a number of ways. As outlined in chapter 4, a number of organisations were set up to both distribute the 40% fund and provide a more open forum for local residents. For all of these, villages were represented by their chiefs and government representatives, rather than being open to all community members. Meetings, however, appear to have focussed on informing residents of goals previously set by the DSP rather than any genuine attempt to involve local residents in park management. As a result, community members appear discouraged by the lack of evidence of engagement or benefit accruing from the gatherings, both to them personally and to the community, and meetings have suffered from poor attendance and abuse by community representatives. As Adams and Hulme remark

*"...if ... the conservation agency starts from a position that they will not deviate from pre-determined conservation goals, 'community participation' is effectively reduced to propaganda and explanation. Where there is no genuine prospect of changing anything, attendance at meetings to discuss conservation is unlikely to be attractive to local people.."*  
(Adams and Hulme, 2001:197)

There has been no attempt at devolving governance of natural resource management to the local community. Without devolution of control, there are well-founded concerns that project-people relations will never change from competitive to collaborative (Hutton et al., 2005, West and Brockington, 2006, Blaikie, 2006, Menzies, 2004). Devolving the management of conservation goals in the Dzanga-Sangha region, however, would be asking local residents to enforce rules which they had no voice in setting and which are far from a local priority. This is particularly the case in such a heterogeneous community where high levels of in-migration have resulted in a number of user groups, each with different motives and interests. Given the past history of the misuse of funds by community-based committees, there also appears to be a high potential for corruption, with benefits captured by local elites, as seen elsewhere (e.g. Brockington, 2007, Archabald and Naughton-Treves, 2001, Child and Dalal-Clayton, 2004). There are also warnings that decentralisation may be unpopular with central authorities and elites who may fear loss of both power and access to resources (Ribot and Larson, 2005).

Yet whether local residents will feel engaged and motivated to conserve local resources without some level of control, even if significant benefits are provided, is strongly questioned (Brooks et al., 2006, Menzies, 2004). As Brockington (2007) observes, while such a path may be hard, this is no excuse not to attempt it, and there is evidence that the devolution of governance can significantly improve both livelihoods and environmental management (e.g. the Luangwa Integrated Resource Development Project, Zambia- Child and Dalal-Clayton, 2004). Childs and Dalal-Clayton (2004) caution, however, that to function properly, local level institutions must be accountable, transparent, democratic and equitable.

### **9.3.3 Conditions for success?**

As reviewed in chapter one, evaluations of ICDPs have been scarce, and success stories scarcer. Nevertheless, mounting attempts to identify the conditions under which conservation and development activities can be successfully combined have led to “...an ever-growing number of ever-growing lists.” (Blaikie, 2006:1948). Summarised in table 9.1, findings from other studies strongly support the results of this thesis: under the existing social and economic conditions (poor national political support, high level of in-migration, poor social cohesion and little to no traditional or community regulation of national resource extraction), conservation and development goals cannot be achieved simultaneously. Indeed, they suggest that the DSP has been implemented in some of the most difficult conditions possible, making its limited achievements all the more respectable.

**Table 9.1** Factors commonly suggested as necessary for the successful implementation of an Integrated Conservation and Development Programme, with reference to the Dzanga-Sangha Project

<b>Factors suggested as necessary for ICDP success</b>	<b>With reference to the DSP</b>	<b>Source</b>
Benefits (inc. alternative livelihoods) are financially, socially and environmentally sustainable	All current significant benefits/alternative livelihoods require continual input from project (e.g. employee salaries, medical supplies for clinic). Tourism very unstable.	Milner-Gulland and Rowcliffe (2007); Hughes and Flintan (2001); Adams and Hulme (2001)
Cohesive communities	Poor social cohesion due to high rates of in-migration	Borgerhoff Mulder and Coppolillo (2005); Abbot et al. (2001)
Effective enforcement of laws regulating natural resource exploitation	No regulation of natural resource extraction by traditional or community institutions. Anti-poaching patrols appear overwhelmed.	Abbot et al. (2001)
Locals exploit natural resources for economic gain only	Probably true for the non-Aka. Not true for the BaAka for whom hunting has strong cultural role	Gibson and Marks (1995); Barrett and Arcese (1995)
Local involvement in resource management	No local involvement in resource management	Brooks et al. (2006)
Long-term commitment (time softens impact of land alienation for conservation)	16 years of implementation appear to have had little effect on sense of injustice at loss of hunting access. In-migrants who did not directly experience loss of access appear equally angry, likely to be in part political resentment of imposed restrictions	Abbot et al. (2001)
Low population growth and low immigration	High rates of in-migration and steady growth in population size since the 1970s	Borgerhoff Mulder and Coppolillo (2005)
Remoteness	Remote from large urban settlement. May limit market for bushmeat but also limits markets for alternative livelihoods	Alpert (1996)
Strong national political support	National and local political support poor	Borgerhoff Mulder and Coppolillo (2005); Barrett and Arcese (1995)
Threat to the resources is local	Major threat is local subsistence use, rather than non-local hunters or commercial exploitation	Abbot et al. (2001); Barrett and Arcese (1995)



Issues as fundamental as nationwide poverty and high unemployment levels cannot hope to be addressed by a lone ICDP project- rather they are issues more integral to the development of the Central African Republic as a whole. Past attempts by the DSP to halt in-migration by purchasing the logging concessions have been unsuccessful, largely due to a failure to convince the Central African Government that an ICDP can generate similar levels of benefits for the nation and the local residents. Rumours that the DSP were attempting to halt logging operations in the area also angered local residents to the extent that several project employees were physically attacked.

These results do not support the withdrawal of the project. While, at the local level, its direct economic benefits are limited, the widespread recognition of its indirect economic benefits, predominantly the 'trickle-down' effect, has resulted in the majority of local people wishing the DSP to stay in the area. It is also clear that, although extraction levels of forest animals are suggested to be currently unsustainable, given the large amount of hunting equipment confiscated in 2006, they would probably be a lot higher if no law enforcement activities were conducted in the region.

However, it is also clear that conservation and development needs cannot be met simultaneously and in full by the ICDP. Such a conclusion therefore leads directly to questions about what the tradeoff between objectives should be (Adams and Hulme, 2001, Sanderson and Redford, 2003, Brockington and Schmidt-Soltau, 2004). While this thesis does not, and cannot, provide all of the answers, it is hoped that it will allow a realistic re-assessment of what can and cannot be achieved in the Dzanga-Sangha region and aid in the identification of clear, appropriate and feasible goals. Such goals must be flexible- both successes and failures in the short-term should be learned from and used to adapt programmes to help achieve long term goals. Crucially, there must be serious consideration of the implications of trade-off options for all stakeholders, not just the most powerful or better funded (Brown, 2004). This means taking local participation in the process seriously and not just paying them 'lip service', whether prioritising conservation or development goals. It is also important that the long-term nature of what the DSP is trying to achieve is recognised, rather than thinking in 2-5 year cycles and expecting immediate results. This is particularly the case when considering fostering local participation and developing local capacity. Given the high turnover rate of staff at the management level, with most senior staff employed on 2 year contracts, substantial handover periods should be encouraged to ensure previous efforts, results and discoveries are learnt from, rather than the same mistakes being repeated.

## **9.4 Wider lessons learned**

While this thesis focussed on the integration of conservation and development within the specific environment of the Dzanga-Sangha region, many of its findings are equally applicable to wider debates in this area.

Conservation can be disaggregated into many different components and at many different levels: for example, protected areas, park authorities, park-based tourism programmes and community out-reach programmes have all been lumped together as ‘conservation’ in the past. However, it is clear that park-adjacent communities may perceive these separate components very differently, with radically different attitudes being displayed towards individual components. Extreme care should be taken to clearly and transparently define which aspect of conservation is being explored, and extrapolations avoided. Crucially, it should not be assumed that links between different components are locally recognised. It has been widely supposed in the past that benefits from tourism will be recognised as compensating in some way for the loss of access to natural resources, with many ICDPs attempting to alter both attitudes and behaviour towards protected areas this way. Exploring the validity of this pervading assumption should be considered a priority.

Results highlight the need to assess conservation-related costs as well as benefits in any programme evaluation- even small benefits may produce more positive attitudes if related costs are small. Similarly, even large rewards can fail to compensate an individual or a household that has suffered considerable opportunity-use costs. This study also further contributes to the growing literature addressing issues relating to the distribution of benefits. Even where significant benefits are provided, a failure to distribute them in the same manner as costs will repeatedly undermine any attempts at cost reparation. In this case, snare hunters are being largely excluded from the recognised livelihood alternative (project employment) on the grounds of educational requirements. Furthermore, recognised conservation-related benefits accrue to just three villages nearest to the project headquarters, while the remaining five villages see little in the way of benefit from the ICDP.

This study also highlights the difficulties inherent in attempting to compensate costs accrued at the individual level with community level initiatives. As Gibson and Marks (1995) point out, goods which are available to all members of the public are unlikely to alter the behaviour of an individual as he/she would gain from a community-level benefit whether they hunted or not. Furthermore, while community level goods can contribute to livelihoods in the longer term by adding to the human capital (through improving health and education), they cannot be used to

directly generate food and/or income. As a result, community-level goods are unable to replace natural-resource extraction in the livelihood portfolios of the rural poor.

Most significantly, this thesis challenges the pervading assumption that conservation-related attitudes can be used as a reliable proxy for conservation-related behaviour. As hypothetical constructs, attitudes are notoriously difficult to measure. This is particularly the case when focusing on an issue as delicate as the illegal exploitation of natural resources or as emotive as the loss of livelihoods. Crucially, behaviour is also strongly motivated by factors other than attitudinal: when considering rural communities living in extreme poverty, it is clear that economic considerations are likely to be prioritised when making livelihood decisions. When exploring the implications of development initiatives for conservation, there can be no substitute for studying what people are actually doing (rather than what they say they do), whatever the logistical difficulties involved.

This empirical study of the efficacy of an ICDP takes its place amongst the growing literature that detail the numerous and expensive failures of attempts at integrating conservation and development goals (e.g. McShane and Wells, 2004, Hulme and Murphee, 2001, Homewood et al., in press). It is becoming increasingly hard to ignore that, despite the funder-friendly rhetoric, ICDPs cannot be all things to all people- becoming instead '*Jack of all trades and master of none*' (Robinson and Redford, 2004). Projects must be honest with themselves and funders about what can realistically be achieved in an area, and what tradeoffs may be necessary. The large amount of literature outlining conditions that may minimise tradeoffs between conservation and development objectives (table. 9.1) may be useful when selecting sites, but provide little comfort to established projects.

Results of this thesis should not be used to support calls to return to a protectionist approach (e.g. Oates, 1999, Terborgh, 1999, Brandon et al., 1998). Such an approach continues to be associated with serious moral and ethical issues as well as practical ones, as seen in chapter one. Furthermore, results of this study should not be used to dismiss integrating conservation and development initiatives as a concept and practice. As Hutton et al (2005:365) remarked, scepticism "*should ...be part of a learning process, not a campaign for extinction*". Rather, results should be used to work towards a greater understanding of both the limitations, and the conditions and circumstances that support the more successful integration of conservation and development initiatives.

## 9.5 Future work

During both the fieldwork section and the writing of this thesis, a number of areas that demanded development or further exploration were uncovered. These are outlined below. Firstly, the limited scope of this work should be acknowledged, both in terms of time and scale. Of the 8 villages in the reserve, the labour intensive methods employed meant it was possible to conduct work in just three (albeit containing over 75% of the reserve's residents). It would therefore be interesting to assess the reliance on forest resources and conservation-related attitudes and behaviour in the remaining five villages, particularly considering these outlying villages are without many of the limited benefits provided by the ICDP. Increasing the scale of the HICS, here limited to 21 consumption days per household, would also be more likely to capture consumption rates of the less available meats. The study would also have benefited from being able to get accurate hunter offtake data at the household level, rather than use that from another study. It would also be interesting to conduct a consumption study in the BaAka hunting camps, to compare meat intake with village-based volumes.

Secondly, despite the huge sums of money invested in ICDPs, there is a widespread failure to monitor programme outcomes, either developmental or biological (Brooks et al., 2006, Abbot et al., 2001, Hughes and Flintan, 2001). Given the many difficulties involved in simply the day to day running of ICDPs, both logistical and otherwise, it is easy to understand how evaluation may be neglected, yet it must be considered a priority: without the on-going evaluation of the effectiveness of interventions, overall programme efficacy is unlikely to be improved. To this end, regular density surveys of the most popular and the most endangered prey species should be conducted. In the Dzanga-Sangha region, continuing the market survey initiated by this study would also allow patterns in prey ratios to be detected, flagging when a particular species is in decline. A repetition of the HCIS in 3-5 years would show whether DSP efforts are impacting local pro-conservation attitudes and behaviour. Finally, there can be no substitute for simply talking to people to gain a better understanding of perceptions and attitudes towards the ICDP. As discussed in chapter 8, monitoring of outcomes should ideally be done by an independent third party, as data collected under the auspices of the DSP could be subject to bias.

Thirdly, the failure of reserve residents to consume significant quantities of alternatives to forest meat, such as fish and beef, is strongly linked to the limited availability and expense of these products. Further work should be conducted on developing access to such alternatives. This would include investigating options such as developing subsidies for beef, exploring the sustainability of current fish offtake levels in the region and investigating the feasibility of importing dried fish from elsewhere. All of these possibilities may have serious problems

associated with them and should therefore be explored with extreme care- for example, fish may be as prone to over harvesting as forest animals as dramatic crashes in the international fisheries have shown (Brashares et al., 2004, Rowcliffe et al., 2005)-. Given the heavy reliance of many households on natural resources to generate income, the social impact of introducing alternatives should also be explored in detail.

## **9.6 Conclusions**

This thesis critically evaluated the effectiveness of a Central African ICDP, the Dzanga-Sangha Project, at meeting conservation and development goals, focussing in particular on the effectiveness of attempts to promote local support for conservation through benefit provision. Results suggest that development goals are being realised for only a small proportion of the population, whilst conservation goals are not being met. Although there is some evidence that the provision of benefits promotes pro-conservation attitudes, no evidence was found to suggest that either benefits or attitudes were linked to pro-conservation behaviour. This project is implemented under extremely complex social and economic conditions. The constant rumours that the logging operations will resume discourages commitment by local residents to DSP initiatives, whilst high mobility and the lack of resource tenure discourage long-term sustainable use of natural resources. Furthermore, if the ICDP does succeed in significantly improving local living standards, there is a serious potential for it to encourage high levels of in-migration into the area. Under these conditions, it is suggested to be unlikely that both conservation and development goals may be satisfactorily met simultaneously. It is hoped these results will be useful in identifying realistic and flexible objectives in the area, in addition to adding to our growing understanding of the conditions, circumstances and tradeoffs that support the more successful integration of conservation and development objectives.

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## Appendix 1. Household Attitudinal Survey (HAS) question sheet

### Section 1 Socio-demographic data

- 1) *Gender of respondent noted down*
- 2) What is your age? \*
- 3) How many years have you lived in the reserve? \*
- 4) What year did you complete your education? \*
- 5) What is your main profession?
- 6) How many people live in your household? What is their age/sex/profession?
- 7) In 2006, what other work have you done to find money?
- 8) Do you have the following items in your household? *If yes, how many?*

Field	Goats	Radio	Peanut machine	Pirogue
Garden	Pigs	Tv	Manioc machine	Hooks
12v battery	Chickens	Bicycle	Sewing machine	Nets
Generator	Ducks	Motorbike	Cart	Guns

### Section 2 Meat preferences

- 1) If possible, please give the name of the food items in the photographs
- 2) In 2006, which of the food items have you eaten the most? Please put in order
- 3) (*For those not eaten*) Why did you not eat [name of food item]?
- 4) If money was not a problem, and all the food was available, which of the food items would you like to eat the most? Please put in order
- 5) (*For those not chosen*) Why do you not eat [name of food item]?

### Section 3 Assessing attitudes to the forest

- 1) In [*Insert name of village*] you live very close to a forest. For your community, are there any benefits from the forest? What?
- 2) For your community, are there any problems because of the forest? What?
- 3) For you personally, are there any benefits from the forest? What?
- 4) For you personally, are there any problems because of the forest? What?
- 5) Some of the forest has been made into the Dzanga National park. Do you think we should open DNP a little, all or not at all for agriculture? Why?
- 6) Do you think we should open the DNP a little, all or not at all for hunting? Why?

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\* Only the non-Aka were asked these questions- see chapter three for an explanation why

**Section 4 Assessing attitudes to tourism**

- 1) Sometimes tourists visit [*Insert name of village*]. Why do they visit?
- 2) What do you think of tourism in Bayanga? *Note response in full*
- 3) For your community, are there any benefits from tourism? What?
- 4) For your community, are there any problems because of tourism? What?
- 5) For you personally, are there any benefits from tourism?
- 6) For you personally, are there any problems because of tourism?
- 7) In the future, would you like to see more, less or the same number of tourists in [*insert name of village*]
- 8) Have you ever heard of the 40% fund? What is it?
- 9) In 2006 did you sell any food to the Doli lodge?
- 10) In 2006 did you sell anything directly to the tourists?

**Section 5 Assessing attitudes to the Dzanga-Sangha Project**

- 1) In Bayanga there is the office of the Dzanga-Sangha Project. Do you know why the project is here?
- 2) What do you think of the project?
- 3) For your community, are there any benefits from the project? What?
- 4) For your community, are there any problems because of the project? What?
- 5) For you personally, are there any benefits from the project? What?
- 6) For you personally, are there any problems because of the project? What?
- 7) If you think about all of these problems and benefits, would you like the project to stay, go or don't you mind? Why?

**Appendix 2. Direct and indirect benefits accruing at the local level from gorilla tourism, tourism and the Dzanga- Sangha Project in 2006**

	Benefit type	Benefit	Amount (XAF)	Access	Subtotal	
<b>Gorilla tourism</b>	<b>Direct</b>	Gorilla habituation- Non-Aka salaries	6,634,284	Bayanga		
		Gorilla habituation- BaAka salaries	13,822,000	Moss/Yan		
		Tourist tips	519,200	Bay/Moss/Yan	<b>20,975,484</b>	
<b>Other Tourism</b>	<b>Direct</b>	40% revenue distribution	1,330,900	All reserve		
		Doli lodge: salaries, bonuses and tourist tips	8,969,337	Bayanga		
		Project tourist centre (Centre d'Accueil): guide salaries and tips	5,242,576	Bayanaga/Moss		
		Pirogeur salaries	188,000	Bayanga		
		Bayanga village dancer salaries	55,000	Bayanga		
		BaAka tourist salaries	383,000	Yan/Moss		
		Tourist donations- school	150,000	Yan/Bayanga		
		Bayanga hospital cash donation	20,000	Bayanga resident	<b>16,338,813</b>	
		<b>Indirect</b>	Restaurant	360,000	Bayanga	
			Market	15,000	All reserve	
			Shops	1,052,800	2 non-nationals	
Local hostel	80,000		Bayanga			
Bars	20,000		Bayanga			
BaAka craft sales	3,901,000		Yan/Moss			
Non-Aka craft sales	540,000		Bayanga			



		Photos	16,155	All Bayanga	
		Food sale to tourist lodge	3,833,713	All reserve	<b>9,818,668</b>
<b>Safari hunting</b>	<b>Direct</b>	Hunting permit sales 25% community in safari hunting zone	2,860,000	Safari hunting zone	<b>2,860,000</b>
<b>Project Dzanga-Sangha</b>	<b>Direct</b>	DSP jobs (include all gorilla and tourism related jobs)	88,455,492	All reserve	
		Temporary work	21,189,000	All reserve	
		Poacher bonuses: AP guards	3,933,925	All reserve	
		Poacher Informant bonuses: BaAka	1,117,700	All reserve	
		Poacher Informant bonuses: Non-Aka	2,817,650	All reserve	
		DSP development projects: Health	34,231,340	All reserve	
		DSP development projects: Agriculture	2,366,965	All reserve	
		DSP development projects: Fish farm	121,000	All reserve	
		Women's training workshop	1,013,450	Bayanga	
		Local government support (teachers salaries etc.)	3,265,000	All reserve	
		Community car	30,000,000	All reserve	<b>188,511,522</b>
	<b>Indirect</b>	Repair public buildings	254,000	All reserve	
		Renovate basketball field	951,750	Bayanga	<b>1,205,750</b>
		House rental for DSP staff	12,129,557	Bayanga	<b>12,129,557</b>

### Appendix 3. Meat type and quantity found in Bayanga central market

Total weight given as representative fresh weight and for survey days only (n=160). To estimate the annual total, multiply total weight by 2.28. Similarly, to estimate a daily average weight, divide total weight by 160. For protected status, a = fully protected with no exploitation allowed, b = partially protected, whereby adults of that species may be hunted only by those with a valid hunting license, c = unprotected.

	Latin name	English name	Protected status	Total weight (Kg)	% days present
Forest meat	<i>Cephalophus callipygus</i>	Peters's duiker	B	10620	98
	<i>Philantomba monticola</i>	Blue duiker	B	6551	85
	<i>Cercopithecus nictitans</i>	White-nosed guenon	B	304	31
	<i>Lophocebus albigena</i>	Grey-cheeked mangabey	B	147	13
	<i>Cercopithecus cephus</i>	Moustached monkey	B	84	14
	<i>Cercopithecus pogonias</i>	Crowned guenon	B	43	11
	<i>Colobus guereza</i>	Black-and-white colobus monkey	A	41	4
	<i>Cercocebus agilis</i>	Agile mangabey	B	26	2
	<i>Cercopithecus neglectus</i>	De brazza's monkey	B	19	2
	<i>Procolobus badius</i>	Western red colobus	B	4	1
		Unknown monkey		338	37
	<i>Various</i>	Monkey	B*	1005	64
	<i>Potamochoerus porcus</i>	Red river hog	B	915	49
	<i>Various</i>	Caterpillars	C	244	24
	<i>Tragelaphus spekei</i>	Sitatunga	B	220	18
	<i>Gorilla gorilla gorilla</i>	Western lowland gorilla	A	268	14
	<i>Atherurus africanus</i>	Brush-tailed porcupine	C	78	12
	<i>Cephalophus sylvicultor</i>	Yellow backed duiker	B	144	11
	<i>Hyemoschus aquaticus</i>	Water chevrotain	A	25	9
	<i>Loxodonta cyclotis</i>	African forest elephant	A	85	8
	<i>Kinixys sp.</i>	Tortoise	C	10	4
	<i>Tragelaphus euryceros</i>	Bongo	B	80	3
	<i>Pan troglodytes</i>	Chimpanzee	A	13	2
<i>Viverra civetta</i>	African civet	C	9	2	
<i>Syncerus catter nanus</i>	Buffalo	B	25	1	
<i>Hylochoerus meinertzhageni</i>	Giant forest hog	B	34	1	
<i>Manis sp.</i>	Pangolin	C	25	1	
Aquatic meat	<i>Various</i>	Fish	C	914	73
	<i>Various</i>	Freshwater shrimp	C	4	4
	<i>Various</i>	Freshwater snails	C	10	4
	<i>Various</i>	Eels	C	2	1

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<b>Domestic meat</b>	Chicken	n/a	60	20
	Cow	n/a	1708	18
	Pig	n/a	107	9
	Goat	n/a	77	9

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\*with the exception of *Colobus guereza* which is fully protected.

#### Appendix 4. Prices (per kilo) and mean adult carcass weights of animals most commonly recorded in Bayanga central market

	Latin name	English name	Mean price per kilo of fresh meat (undressed)		Mean weight of adult carcass (kg)
			XFA	US\$	
Ungulates	<i>Cephalophus callipygus</i>	Peters's duiker	879	2.0	17.8
	<i>Philantomba monticola</i>	Blue duiker	552	1.3	4.7
	<i>Cephalophus sylvicultor</i>	Yellow-backed duiker	761	1.7	36.5*
	<i>Hyemoschus aquaticus</i>	Water chevrotain	632	1.4	9.1
	<i>Tragelaphus euryceros</i>	Bongo	580	1.3	210*
	<i>Hylochoerus meinertzhageni</i>	Giant forest hog	unk	unk	100*
	<i>Potamochoerus porcus</i>	Red river hog	659	1.5	29.4
	<i>Syncerus catter nanus</i>	Buffalo	unk	unk	250*
	<i>Tragelaphus spekei</i>	Sitatunga	514	1.2	38.7*
	<i>Loxodonta cyclotis</i>	African forest elephant	1386	3.1	4000*
Primates	<i>Gorilla gorilla gorilla</i>	Western lowland gorilla	694	1.6	100*
	<i>Pan troglodytes</i>	Chimpanzee	unk	unk	34*
	<i>Lophocebus albigena</i>	Grey-cheeked mangabey			5.4
	<i>Cercopithecus cephus</i>	Moustached monkey			3.3
	<i>Cercopithecus nictitans</i>	White-nosed guenon			4.4
	<i>Cercopithecus neglectus</i>	De brazza's monkey			4.3
	<i>Procolobus badius</i>	Red colobus monkey			5
	<i>Cercopithecus pogonias</i>	Crowned guenon			2.5
	<i>Colobus guereza</i>	Black-and-white colobus			4.3
	<i>Cercocebus agilis</i>	Agile mangabey			7
	<i>Various</i>	Monkey	1004	2.3	4.3
Other	<i>Various</i>	Caterpillars	1011	2.3	
	<i>Atherurus africanus</i>	Brush-tailed porcupine	468	1.1	3.2
	<i>Kinixys sp.</i>	Tortoise	598	1.4	1.7
	<i>Viverra civetta</i>	African civet	667	1.5	2.4
	<i>Manis sp.</i>	Pangolin	unk	unk	1.8
Fish		Fish	731	1.7	
Domestic		Chicken	1765	4.0	
		Cow	2000	4.5	
		Pig	983	2.2	
		Goat	632	1.4	

Unk = where samples were unavailable to weigh.

\* Where no entire carcass was sold in the market, average adult biomass taken from Kingdon (1997)

All monkey species grouped together for calculating mean price per kilo

## Appendix 5. Calculation of meat yield which can be harvested sustainably from the community hunting zone.

Conducted for the two main prey species- Peter's duiker, *Cephalophus callipygus* and the blue duiker, *Philantomba monticola*.

		<i>P. monticola</i>	<i>C.callipygus</i>
<b>Population density (individuals/km)<sup>1</sup></b>	Max	66.9	3.7
	Min	10.5	0.9
<b>Intrinsic rate of increase (<math>R_{max}</math>)<sup>2</sup></b>	Max	0.603	0.399
	Min	0.49	0.07
<b>Annual offtake suggested as sustainable from the community hunting zone (no. individuals)<sup>3</sup></b>	Max	6795	221
	Min	815	27
<b>Mean adult bodyweight</b>	Mean	4.7	17.8
<b>Annual offtake suggested as sustainable from the community hunting zone (kg)<sup>2</sup></b>	Max	31939	3933
	Min	3830	481
		<b>Total</b>	
<b>Annual offtake suggested as sustainable from the community hunting zone (kg)<sup>2</sup></b>	Max	35,872	
	Min	4,311	

<sup>1</sup> Minimum and maximum density estimates taken from Noss's 1995 census work in the Bayanga area.

<sup>2</sup> See table 8.2 for sources

<sup>3</sup> Calculated using the NMFS algorithm outlined in chapter 8. Maximum offtake is calculated using maximum reported intrinsic rate of increase, minimum offtake is calculated using the minimum reported intrinsic rate of increase.