18.SU16

Traffic
Library

Survey of Wildlife Management Regimes for Sustainable Utilisation

A Darwin Initiative Project

Timothy M. Swanson and C. Fernandez Ugalde
Faculty of Economics and Politics
Cambridge University

R.A. Luxmoore
Habitats Unit
World Conservation Monitoring Centre

January, 1996

The views expressed in this report are those of the authors only and do not necessarily reflect the views of the Darwin Initiative nor those of the Department of the Environment of the UK.

Part II Literature Studies

1	The Irula Venom Centre in India: adapting traditions and retaining investments in human capital in conservation projects	43
2	Lokta harvesting and paper making in Nepal: establishing markets and local incentives	47
3	The National Biodiversity Unit in Costa Rica: a new approach to increase and capture wildlife values	51
4	The CAMPFIRE programme in Zimbabwe: empowering local people.	54
5	The Plan Piloto Forestal programme in Mexico: new community management approaches to tropical forestry management	58
6	The fur trade and furbearer harvesting in Canada: sustainability of consumptive and non-consumptive uses of wild species	63
7	Medicinal plants in Africa: appropriating value from the *Prunus africana* bark in the Cameroon	68
8	Social forestry in India: regional differences and the importance of underlying social and economic conditions	72
9	Forest Certification: The Smart Wood Certification programme and the Forest Stewardship Council.	76
10	Promoting the Tagua Palm in Ecuador: conserving biodiversity through community support and product marketing	79
11	Ecotourism in Costa Rica: reconciling conservation and development interests	82

References 84

Part III Case studies

1. Conservation and develeopment in the Monarch Butterfly Special Biosphere Reserve, Mexico. *Carlos Fernandez* 95

2. Sustainable tourism development in the Ras Mohammed National Park, Egypt. *David Medio* 145

3. Conflicts in wildlife conservation - the role of property rights in their resolution: the Southern African Conservancies. *Timothy Swanson, Jon Barnes and Johan V. de Jager* 191

4. The crocodile industry in Papua New Guinea. *Carlos Fernandez and Richard Luxmoore* 233

5. Commercial utilisation of Vicuna in Chile and Peru. *Carlos Fernandez* 277

Chapter 1

Introduction

The use of wild animals by humans has been a controversial issue on both ethical and practical grounds. Not only has the right of humans to use wildlife for their own purposes been questioned, there is also the question whether its use furthers or hinders conservation (Robinson and Redford 1991a). Despite these dilemmas, the fact is that many people throughout the world are dependent on wild harvests for subsistence and cash income. Poor countries are for the most part biomass-based subsistence economies, in that their people eke out a living from products obtained directly from plants and animals (Dasgupta 1993). Many wildlife products are in significant demand worldwide for various uses, ranging from medicines, clothing, food and so on, some of which do not have a close substitute.

Evidence suggesting that many of these resources were being over-exploited raised concern and gave rise to the present conservation movement. In many cases, harvesters and hunters of natural resources were portrayed as enemies of wildlife and conservation (Kalland 1993). However, it was often the case that the exploiters themselves were the most concerned about the conservation of the natural resources, as indeed was the case with early wildlife protection groups being organised by hunter's associations (Eltringham 1994; Des Clers 1993). Likewise, societies who evolved heavily dependent on natural resources have in many cases also developed management practices in order to ensure the conservation of their natural resources (Edwards 1993).

In contrast, when natural resources are not of significance or do not have a use value for people, they will not invest to ensure their conservation. Land may even be converted to other uses, resulting in the destruction of natural habitats and its biodiversity. If wildlife is to survive, the needs of animals have to be reconciled with the legitimate aspirations of the human population (Eltringham 1994). If the value given to wildlife is reduced the incentives to conserve it will be eroded, particularly in cases of high socioeconomic pressures and where wildlife is limiting productive capacity, either by taking up land or by actively destroying agricultural crops. By recognizing value of wildlife, what was seen as a liability turns into an asset that has to be protected to ensure benefits to the people who interact with it (Taylor 1994).

Preservation of wildlife and biodiversity is in the interests of society. However, those interested in preservation are rarely those who have to pay the costs (Eltringham 1994). This is at the centre of the problem of biodiversity conservation. It is unlikely that preservation of biodiversity will be sustained in the long term unless those carrying the burden are compensated. The use of wildlife and biodiversity is the most direct way of demonstrating a value. Unless wildlife is of value to people, the wildlife and its habitat will be destroyed to make way for other land uses (Robinson and Redford 1991a).

Once use is accepted, it is necessary to ascertain whether it is sustainable. The concept of sustainable use however has proven to be difficult to apply in the field. The various interpretations given to the term reflect the complex nature of the issues involved. IUCN, for instance, defines sustainable use in its Guidelines for ecological sustainability of non-consumptive and consumptive harvests of wild species as

> use that does not reduce the future use potential, or impair the long term viability, of either the species being used or other species; and is compatible with maintenance of the long term viability of supporting and dependent ecosystems. (Edwards 1993)

This definition is essentially ecological and implies that wildlife use must be compatible with biodiversity conservation. However, it does not explicitly include explicitly a human dimension. WWF's own working definition is

> the use of natural resources that always remains within the limits of environmental capacity and, on that basis, meets the needs of present generations, particularly those of the poor, without compromising the ability of future generations to meet their own needs. (WWF 1993)

This definition makes a multi-dimensional statement about the concept. It recognises the need for ecological sustainability and explicitly addresses the issue of using resources to meet human needs, thereby adding a social and economic dimension (Sheng 1993).

Difficulties with conservation programmes in the field have led to the recognition of the need to deal with social, economic and legal factors as well as biological to ensure real sustainability. In other words, a human dimension has to be incorporated into management. The Convention on Biological Diversity incorporates the human dimension in sustainable use by stating that there should be a 'fair and equitable sharing of the benefits arising from the utilisation'.

The extent to which sustainable use of biodiversity is being accomplished in the case of current commercial uses of genetic resources was the central question addressed in the two earlier reports prepared under the present study. They analysed these issues in the cases of the plant breeding and pharmaceutical industries. Such biotechnological applications, however, are only one type of commercial use of natural habitats that place a value on biodiversity. Other commercial uses of wild species, such as forestry, ecotourism and the whole range of wildlife markets, are all activities that have an impact on natural habitats and can provide significant incentives for conservation of both wildlife and its supporting habitat.

Historically, the commercial use of a few commercial species has led to the modification of their natural habitat in order to increase efficiency and productivity, at the expense of biodiversity (Swanson 1992). There are, however, cases of use of wild resources where no over-exploitation nor modification of habitat is taking place and new innovative ways of structuring wildlife use projects have made them more compatible with conservation. These experiences provide useful insights into the role of the biological, technical and socioeconomic conditions needed to make wildlife use compatible with biodiversity conservation.

The purpose of this report is to identify and analyse the set of conditions under which various commercial wildlife utilisation programmes can be a tool for or are compatible with biodiversity conservation. To this end, a number of case studies of commercial

wildlife utilisation are reviewed, involving a wide range of uses, like ecotourism, forestry, wildlife ranching and captive breeding operations. We also comment on the extent to which these commercial uses conflict with efforts to internalise other biodiversity values, such as option and existence values.

The report is divided into two parts. Part I reviews the different factors that may affect sustainable wildlife utilisation schemes and the appropriation of the benefits at the community, national and global levels. In Part I a theoretical framework for analysing sustainable wildlife use projects is covered including the biological and technical aspects of resource utilisation (Section 1), the socioeconomic considerations at the local level (Section 2) and the market structure and final demand for wildlife products (Section 3). Part II surveys a range of wildlife management projects in different countries and analyses their long-term impact.

Part I

Framework for the sustainable use of wildlife

Chapter 2

Biological and technical aspects of resource utilisation

Any consideration of the productivity of wildlife and of possible ways of exploiting the products for human use must be based on ecological principles (Eltringham 1984). Wildlife management is by no means a proven science and the existing biological knowledge base gives little more than a basic framework for managers to work with and design their own practices for their own particular purposes. This section highlights the relevance of biological factors in determining the capacity of commercial uses to provide incentives for conservation.

2.1 Information, uncertainty and the precautionary principle

Biological knowledge of the harvested species and their habitat form the basis on which to establish adequate harvesting levels to ensure a biologically viable and commercially profitable operation. Ultimately, such knowledge is also the only way of verifying that the existing regime is sustainable, but the knowledge is often non-existent or patchy at best. In these situations, the only source of biological data is the harvest level and the population characteristics of the harvested species.

These limitations put a strain on management, requiring it to be flexible enough to adapt to new conditions and feedback from the previous and current characteristics of harvested species. Likewise, the regulating authority enforcing wildlife protection laws has to be able to collect and analyse these data in order to assess the sustainability of commercial operations.

A reasonably clear understanding of the dynamics of harvested species and their interaction with the surrounding habitat is difficult to obtain. Such knowledge has been developed mostly for relatively simple ecosystems, like coniferous forests, altiplano or savannas. They are well documented and provide a sound basis for the design of management plans for their constituent species. It is not surprising that some of the best-documented examples of sustainable management come from these ecosystems (Freese and Saaverda 1991). In contrast, complex ecosystems like tropical forests are little understood and our capacity to design adequate management plans or strategies for them is limited. It is these regions which host an important proportion of the world's biodiversity. Effective management designs for such environments represent the greatest challenge both for wildlife management and biodiversity conservation.

Variability is more the rule rather than the exception in biological systems, both short and long term, and our limited understanding of there processes makes it more difficult to forecast. Hence, estimates of sustainable harvests today may prove to be infeasible in the future. Biological, as well as the socioeconomic conditions, may change rapidly. The questions are: What is the best insurance against these risks?, then: Can we afford the insurance?

One attempt to cope with biological uncertainty, both intrinsic and that due to lack of knowledge in research and management, is the so-called the 'precautionary principle'

(Freese et al.. 1994). In its broadest sense, the principle is meant to establish a minimum level of risk to the habitat and the species from its use. It calls for a conservative approach, minimising the impact on the habitat when greatest uncertainty about its resilience prevails.

Although the application of the principle in its biological dimension can result in greater assurance that the operation is biologically sustainable, it may also reduce the profitability of the operation by creating higher costs or by reducing productivity. In the absence of external support, this low profitability may cause socioeconomic pressures to build up and reduce the socioeconomic sustainability of the operation.

Hence, there is sometimes a trade-off between ensuring biological sustainability and socioeconomic sustainability. The precise type of balance will have to be sought by assessing all the risks involved. It is likely that in highly variable ecosystems the application of the principle will call for low harvests. On the other hand, relatively more resilient ecosystems will be more inclined to incur the risk of over harvesting.

Clearly, it is this second type of operation that will need supporting strategies to achieve greater assurance of long-term biological sustainability, strategies such as biological research, management practices to minimise negative effects, environmental education and improved rent capture mechanisms.

There is also an equity dimension to the application of the precautionary principle highlighted by Freese et al.. 1994: under the principle, more information and understanding of ecosystems is rewarded by a greater allowable harvest since a greater degree of certainty about the sustainability of harvests is assumed. The necessary investments in research, however, can only be afforded by rich countries or large corporations. Hence, a strict application of the principle may result in the species rich but economically poor getting poorer.

These aspects emphasise the need for a flexible approach to management and an integrated approach when assessing the relative risks to natural habitats, i.e.,, if no use poses a greater risk to land conversion than an attempt to sustainably use natural resources with limited knowledge, it might be necessary to incur the risks of untilisation under uncertainty.

2.2 Ecological considerations

The characteristics of both the ecosystems and the species set the constraints on the commercial activity. Some of the main factors that determine the commercial viability are: (1) the density of the exploited species, (2) its rate of growth or production per hectare, (3) the temporal availability of products, and (4) the species and ecosystem sustainability.

The density of the species affects the return on the harvesting activity. First, it directly determines the yield per unit of land and hence, how land rents compare to other

alternative uses.[1] Low densities would also increase overall harvesting costs by increasing search and transportation costs (Salafsky et al.. 1993). Density of individual species tends to be inversely related to biodiversity, hence, high biodiversity areas are likely to be less profitable when producing a single species. One way to solve this problem is to increase the density of commercially important species by increasing the density through management, just as has happened historically with agriculture. This, however, may result in heavy alterations to the ecosystem. Another strategy would be to widen the range of commercially valuable species. Despite its obvious advantages, this diversification, puts additional strains on the system on account of the knowledge and management skills required to harvest sustainably multiple species.

The rate of growth has been among the most discussed characteristics of harvested species. Multiple studies have argued that low-population growth can lead to extinction. The idea being that it is more profitable to harvest the entirety of the low-growth population today and invest returns in higher yielding alternatives in the economy. The population decline in Blue Whales has been an often quoted example.

The temporal availability of products is key to the design of sustainable practices. The phrenological cycle of species together with market characteristics (e.g.,, seasonal peak in demand, seasonal availability of substitutes) can alter significantly the distribution of returns across time. Once again, the lack of control over these biological factors effectively constrains potential revenues from commercial use. In some cases, durable products[2] can be stored and the economic constraints can be solved, and products released in times of high demand.

Long phrenological cycles and short periods of harvesting activity may also create other perverse effects on the sustainability of the management regime. They may create additional pressures to convert land to other uses in cases of the short-term need for additional income. Also, monitoring and enforcement of property rights may be more difficult if the periods of intensive activity are short and little attention is being paid to the resource at other times.

The sustainability of harvested species and its supporting ecosystem depends on the nature of the use and its effects on the species and the habitat. Some uses will convey minimum direct damage to the species (e.g. viewing on ecotourism safaris), with some direct damage to the habitat (e.g. building roads and other infrastructure in the habitat, creating waste), whereas other uses will damage significantly both the species used (i.e. killing the individuals) and the habitat (e.g. clear cutting whole areas to extract the few commercial species). Each type of use poses a different set of potential negative effects and hence a distinct challenge to management.

---

[1] In a strict sense, the opportunity cost of land is only one of the variables that has to be taken into consideration to decide on the best land use. Other variables include the labour and capital needed for each of the alternative activities.

[2] These can also be perishable products with some degree of processing to increase their durability (i.e.,, salted and dried skins, dried fruits).

Harvesting

Direct harvesting in the form of hunting and gathering is the most widespread form of economic activity in wild areas. In recent years the belief that natural habitats compare unfavourably with more intensive production processes in simplified biological systems has been challenged by research on the market potential of non-timber products, particularly in neotropical regions. Various estimates of the economic value of non-timber products showing the high profitability of extraction systems over alternative land uses (Peters et al.. 1989; Balick and Mendelsohn 1992) have fuelled such expectations (Salafsky et al.. 1993).

The high market values of some exotic species and its products show that there is scope for these species to pay their way to conservation. Sport hunting, for instance, is a sound economic alternative for some regions. Trophy hunting is a major earner in Zimbabwe, representing over 90 percent of wildlife generated income between 1989 and 1992 (Bond 1994). The live animal trade, mainly for the pet market, in birds, fish, reptiles and even large mammals are all markets in which end retail prices would surely be sufficient to cover a significant proportion of management costs.

Harvesting entirely from wild populations with minimum intrusions into the environment, although beneficial for biodiversity, often carries a cost in terms of lower yields and less control of the harvest level. In some cases, adequate management can reduce the negative impact of harvests on the species. In the case of the turtle egg harvests in the Playa Ostional in Costa Rica, egg collection is confined to the early stage of the arribada, thus eggs are harvested that have lower chances of successful development (Almengor et al.. 1994). This practice reduces the impact on the reproductive capacity of the species.

Ranching

Ranching, as defined by CITES, implies a regime of commercial use that is sustained by the periodic input of wild resources. Levels of harvest may be controlled by quotas which allow the authorities to limit the impact on the wild population. Ranched species are taken from the wild to be reared in captivity. In contrast to harvesting directly from the wild, ranching operations have greater control on the quality of the harvest while controlling the uncertainties about the impact of operations on population levels.

Ranching operations are subject to greater variability than captive breeding ones but lower than wild harvesting. Biological factors can lead to annual variations in catch. Moreover, political pressures can influence the annual quotas, so planning of annual intake is limited. There is no such thing as a reliable wild source (Vernon 1994).

An interesting case of ranching is the Iguana Verde Project in Costa Rica. By controlling the environment in which iguanas breed and grow, the project is not only able to increase the survival rate of iguanas, but also increase their growth rate. Their later release into the secondary forests means that incentives to protect the forests are created. This type of management offers interesting alternatives, since it manages to keep the link between habitat and harvested species while avoiding the problem of low growth and reproductive rate.

Captive breeding

In contrast with ranching, captive breeding is a closed system where species are completely detached from their natural habitat, in other words, it requires some degree of domestication of the species. These operations typically convey a greater degree of control over the species and thus a greater capacity to control the market. However, not all species can be captive bred.

These type of operations play a very important role in the maintenance of some species with critically low population levels; however, they have been criticised because they provide limited incentives for the maintenance of the remaining wild populations and their supporting habitat. For that reason, some consider that captive breeding does not constitute sustainable use of a species (Jenkins 1994). What then is the role of captive breeding in conservation?

Captive breeding has contributed to the conservation of some endangered species. It can provide an insurance against the failure of other approaches, like ranching or harvesting, which, despite the high popularity and attributed advantages, are by no means proven approaches to achieve long-term sustainability. In that sense, it is essential to keep options open, and captive breeding is one of them. If population numbers become dangerously low, it would be inappropriate to 'leave it to nature' to ensure survival of the species (Lever 1994).

Captive breeding operations have been useful in some cases as a complement to ranching, providing the necessary additional supply to keep operations profitable, as in the case of some Australian crocodile farms (Jenkins 1994). In some cases, captive breeding can also be a focal point for research, in order to keep a genetic reserve and even to provide funds to develop ranching operations (Lever 1994). As a commercial operation, the main advantage of captive breeding over ranching lies in the increased capacity of the managers to control growth and numbers. By creating an artificial environment, these operations allow for a controlled method of production, something that cannot be done with ranching. There is however, a limit in these domestication process where the compatibility with wild-populations stop. For instance, the captive bred populations in *Alligator mississippiensis* in Louisiana has produced low and highly volatile prices in all crocodile skins. In the case of *Crocodyle porosus* in Papua New Guinea, the gradual move to captive bred operations will lead to reduced incentives to keep the wild population.

With regard to their capacity to provide incentives for conservation of habitats, small operations, in association with rural communities which rely on wild populations as a source of stock (ranching), confer greater conservation value than large-scale enterprises located away from the resource and deriving stock from captive breeding operations (Jenkins 1994).

Ecotourism

Tourism is an important source of foreign exchange. Undoubtedly, it is one of the fastest

growing industries worldwide. Projections indicate that spending on international tourism will increase at a rate of 4.5-5 percent per year through 1999 and faster in developing countries (Giannecchini 1993). Closely linked to income growth, it has grown by a factor of ten over the last two decades (Swanson 1990). By 1990, tourism represented 5 percent of all international trade.

Although an appropriate definition of ecotourism has not been found in the literature, the following one highlights, if not the reality, the expectations of the conservation community regarding the nature of ecotourism:

> a form of tourism inspired primarily by the natural history of an area, including its indigenous cultures. The ecotourist visits relatively undeveloped areas in the spirit of appreciation, participation and sensitivity. The ecotourist practices a non-consumptive use of wildlife and natural resources and contributes to the visited area through labour or financial means aimed at directly benefiting the conservation of the site and the economic well-being of the local residents. (Ziffer 1989 in Giannecchini 1993)

With the recent boom in environmental awareness, ecotourism or nature related travel has realised a growing share of world tourism and many wildlife management projects are seeking to introduce ecotourism as a component. A survey by WWF indicated that 47 percent of travellers in Latin America cited nature as an important factor in vacation planning (Giannecchini 1993).

Despite this trend, ecotourists are distributed unequally among countries. For example, Kenya alone captured about 90 percent of Sub-Saharan Africa's wildlife tourism market (excluding South Africa). This is indicative of the high pay-off to coordinated efforts in the marketing of wildlife resources, and also of the substantial competition between tourist sites.

2.3 Compatibility of wildlife use and biodiversity conservation

Commercial use of wildlife will by definition affect the used species. However, it is not always obvious whether this intervention will have negative impacts on the surrounding habitat or whether its use can be compatible with the conservation of the natural ecosystem. In general, high intensity of use will be more likely to have a negative impact on the supporting habitat.

Wildlife use can affect the surrounding habitat through (1) its impact due to population management activities such as culling, predator control and other practices to improve species' commercial value; (2) the construction of the necessary infrastructure for the operation (roads, buildings, factories) and their related impacts such as pollution (noise, sewage, solid waste, air pollutants); (3) through the use of other habitat resources as inputs in the commercial operation (fuelwood, water from local sources, food for gatherers/hunters, use of other complementary wildlife products); (4) the unavoidable damage to the habitat produced by the harvesting technology; and (5) accidental damage due to other human factors (e.g.,, ignorance).

Road building can result in the fragmentation of the habitat and alter its dynamics significantly, and buildings and factories can disrupt the local behaviour of wild populations. More importantly, infrastructure can reduce the cost of alternative unsustainable activities, such as poaching or uncontrolled gathering.

Inputs needed for wildlife operations can put a significant strain on the habitat. In the fishery cooperatives in the Sian Ka'an Biosphere Reserve, for example, local fishermen use wood to build fishing equipment. As a result, populations of two palm species have declined so significantly that the use of such species has been banned in the Reserve (César-Dachary and Arnaiz 1989). Ecotourism projects, like other programmes, need local resources, like water, land and materials. Additionally, the negative impact of tourism can be quite significant depending upon the type of habitat and the activities carried out by tourists. Waste, pollution and erosion have been cited as common concerns by park personnel and local people (Boo 1990). Even noise can be quite disruptive and have a significant effect on the habitat: in the Monarch Butterfly Reserve, loud noises can trigger an alarm, and many butterflies can be crushed when personnel try to escape (Fernandez 1995a).

Technologies used in the operations can sometimes be responsible for the negative effects on the habitats. Selective logging, for instance, is less disruptive than clear cutting, at least in the short term. Appropriate technological changes can help to alleviate pressure on the natural habitat and reduce the damage caused by wildlife use projects. Fuelwood harvesting is a common source of pressure on many natural areas. Ecotourism and its related industries is no exception to this; in Shagarmatha National Park, Nepal, the rise in trekking and mountaineering caused excessive pressure on local wood, and the introduction of kerosene stoves and improved insulation for dwellings reduced fuelwood demand (McNeely 1988).

Education is also an important factor for controlling negative impacts on the habitats, particularly in cases where the damage is caused inadvertently. The environmental education study at Ras Mohammed, for example, found a significant reduction in the level of contacts between divers and the coral reef after a small briefing with the divers about the ecology of reefs and reef structure (Medio 1995).

Wildlife use can be compatible with the conservation of its supporting habitat depending on the set of management practices and the characteristics of the habitat. It is also important to know how this is linked with biodiversity conservation. Ecosystems with low species diversity tend to host large bodied animals like capybara, caiman or vicuna and other species which have been commercially exploited in the past. For these species, the current level of knowledge allows for a better understanding of the ecosystem and of ways to minimise negative impacts on biodiversity. In contrast, in high biodiversity ecosystems, such as tropical forests, the level of knowledge is lower and there is limited capacity to design appropriate management to ensure full protection of biodiversity.

Chapter 3

Socioeconomic considerations: the horizontal dimension

Here we consider the potential of individual species of wildlife to provide a sustainable source of products for society, depends on whether this use may or may not be compatible with the conservation of the habitat, which in turn depends on the biological characteristics. However, this biological restrictions are only one part of the whole story. Mankind and its societies are the other part, equally important and complex. Perrings et al.. have phrased the relevance of the social dimension quite clearly:

> What is ultimately driving biodiversity loss [and overexploitation of wildlife] are the independent decisions of the billions of individual users of environmental resources worldwide. Hence, the underlying causes of the problem are to be found in the parameters within which those decisions are made: the objectives that motivate decisions, the preferences that lie behind demand for goods and services and the individual rate of time preference, the property rights that define individual endowments, the set of relative prices that determine the market opportunities associated with those endowments, the cultural, religious, institutional and legal restrictions on individual behaviour, the underlying world view of society influencing the individual user that prescribe the range of admissible actions and so on. (Perrings 1992)

In this section we will attempt to extract these various parameters and discuss their implications for the sustainable commercial use of wildlife. Although not intended as a proof of the validity of the hypothesis, examples will be offered throughout to illustrate the kind of phenomena being explained.

3.1 Identifying claimants on resources (Who values the resource?)

All natural resources generate different values. Conceptually, the total economic value of a resource consists of use values and non-use values. Use values can be classified as: (i) direct use (where output is consumed directly), (ii) indirect use (where resources have a functional value) or (iii) option value (potential future direct and indirect values). Likewise, non-use values may be broken down into (iv) existence value (value from knowledge of continued existence) and (v) bequest value (value of leaving use and non-use values for future generations) (Munasinghe 1992).

A claimant on the resource is anyone who is currently deriving some of these values from the resource and who would then have an interest in conserving such values. These claimants may be individuals, groups or corporations. Moreover, these values can also be 'negative' in the case of claimants actually receiving a 'cost' or 'disutility' from the resource.

Potential claimants may include the people interacting directly with the resource, which we will classify into harvesters and locals, end consumers, intermediaries and processing industries, organisations, the state and society at large, both present and future.

Harvesters

Harvesters are the agents with a direct economic interest in the resource. They may harvest/hunt/ranch wildlife whether they are the legal owners or not. They are usually the claimants with the most direct impact on wildlife and its supporting habitat. Besides a direct use value, they may hold a bequest value on the resource. The term harvester in this work accommodates a wide range of agents, from individuals to communities, corporations or states.

Owners

Owners of the resource are the legal owners of the resource who may or may not have sufficient power to enforce their property rights. They may not necessarily be the harvesters. Types of owners can be individuals, communities, corporations or states and may place a direct or indirect, option and bequest value on the resource.

Locals

Locals are the communities surrounding the natural resource being used and are often the recipients of the spill-over effects from the use, both positive and negative. They do not harvest the resource, but may be, for instance, farmers who see their crops affected by the reduced recharge of water bodies due to clear cutting or whose crops are damaged by wildlife. They are also the people who are employed either in the extraction industry or in one of the industries servicing it (e.g., transport, catering) but who, unlike harvesters, are not coordinating wildlife harvests and do not capture rents from wildlife directly. They may also benefit from improvements in infrastructure or incur costs in the form of pollution or competition for resources (e.g., water, fuelwood). Locals will typically place an indirect use value on the resource.

End consumers

End consumers are the people who derive the use benefits from the resource. Harvesters are influenced primarily through their willingness to pay for the different goods and services provided by wildlife at source. End consumers can be agents in local, national or international markets. They may place any type of value on the resource.

Processing industries and middlemen

Processing industries and middlemen are agents who serve as intermediaries between harvesters and end consumers, either adding a tangible value to the product (processing) or simply transporting the product to the final market (service provider). Their interest in the resource derives from their capacity to generate rents from it.

Society at large

Society at large comprises agents who place both bequest and existence values on the resource and its supporting habitat (which also carries biodiversity). They do not consume the resource directly. Their main channel of action is though non-governmental organisations, governments and other institutions. Depending on their particular views, they may oppose uses of wildlife by believing that they reduce existence values.

In some cases, a single individual could play several roles in the typology of agents presented above. For example, rural villagers who gather wild resources for subsistence are not only harvesters but also end consumers and perhaps manufacturers in the event that they process the wild harvest into other products. It is easier, however, to treat these different agents and their motives separately for analytical purposes.

3.2 Issues of tenurial structure (resource appropriability and ownership)

Ownership is an important factor affecting the allocation of resources and the way in which some assets are used in local economies. Economic theory predicts that a full specification of property rights over resources will result in the efficient allocation of resources. However, these conditions are not often achieved in the context of natural resources. Markets for some wildlife values are simply non-existent, resulting in failing markets and sub optimal resource allocations.

By creating completely defined property rights, market performance is improved, and the discrepancy between private and social costs is reduced. An adequate definition of property rights, however, is not costless and is not trivial. It involves the creation of both rights and efficient mechanisms to enforce those rights. Besides it also implies the creation of the institutions needed to carry out the necessary transactions to internalise all costs and benefits of wildlife use.

In this sense, legal ownership may be an ingredient of but not a sufficient condition for full ownership. In fact, the absence of legal rights can coexist with a strong sense of ownership. Traditional societies, for instance, control the use of resources by norms and rules without a specific notion of legal ownership.

Suppose for instance that only one individual had access to a resource, either because he is the only one capable of reaching it or because others respect some set of implicit norms. Even if he were not the legal owner, he would still have absolute power to decide the future of the resource. Hence, we would say that he has full resource appropriability, i.e., de facto ownership.

Similarly, if property rights could not be enforced and many individuals had unrestricted access to the resource, the fate of the resource would be determined by many different uncoordinated agents. In this case, resource appropriability would be fully dissipated, i.e., we would have de facto open access. In this sense, ownership can be defined as the affective capacity to achieve full resource appropriability by any individual, community or institution.

When full resource appropriability is ensured to the legal owners, we would have a sound base to build markets and ensure efficient use of resources. If however, there are mismatches between agents with resource appropriability and those with legal ownership, the result will be conflict. This conflict will not lead to adequate levels of investment in the resource. Harvesters would poach on the resource without investing in it, while owners would be receiving a diminished benefit from the resource given these leakages. Even if actual leakages are not taking place, the perceived threat of such, either by other individuals or by the government, would lead to dissipation of resource appropriability and hence sub optimal investments in management of the resource by the owner. In other words, full resource appropriability by resource owners across time is a necessary condition to promote socially desirable decisions concerning resource use.

Hence, identifying harvesters (agents with resource appropriability) and matching it with legal owners is a key initial step towards creating efficient local institutions to ensure the sustainability of wildlife uses. This match can be achieved either by redefining legal ownership or by empowering legal owners with the means to enforce their property rights.

It is often tempting, and sometimes compulsory, for new sustainable use programmes to use preexisting local institutions which have created a set of property rights as their launch pad for their programme without questioning the possible incompatibilities. In the case of the Monarch Butterfly Reserve (Fernandez 1995), for instance, the management system was created around the 'ejido'[3] because it was an established and accepted institution. However, this decision created conflict within the community as 'ejidatarios' began to exert their legal control, excluding their sons and the rest of the community. In a forestry operation, the young are the physically able and the ones who de facto acquire control of the harvesting long before their parents pass their land rights to them. Hence, land rights succession occurs when it is 'naturally commanded' (by the nature of the production process) as old people lose their resource appropriability. In the new ecotourist resort however, old people retain resource appropriability until a very old age, hence, an intergenerational conflict begins to brew.

In other words, by not recognising the resource appropriability of the members of the community, the Monach project did not incorporate all potential harvesters into the management. Unless otherwise stated we will assume that harvesters have ownership in the remaining of the discussion.

3.3 Resource appropriation and rent appropriation: conflicts between owners and claimants

The 'rents' of a resource are the returns derived from its intrinsic value. The sale price charged for a resource reflects the sum of several components, including the value of the labour involved in the resource's management and harvest, the value of the equipment

[3] 'Ejido' is a form of communal management of land in Mexico. Typically, agricultural ejido lands are parcelled whereas woodlands are managed commonly. Decemberisions within the ejido are taken by the Assembly, comprised only of legal 'ejidatarios', typically old people in the community who will in future pass their title down to their sons.

required for harvests, storage and transport, etc. Over and above the value of these investments is the intrinsic value of the resource itself, the resource 'rents'. In general, subtracting all of the costs from the actual price would leave the intrinsic value of the resource as a remainder. The generation of rents usually requires sufficient control over production and over the market to be able to restrict output and increase price.

Usually, resource rents are captured by producers alone because they have the capacity to control the rate of output, which in turn determines the amount of rent. It is not easy to create and appropriate rents from a natural resource when one is not the party with control over the production of the resource. This process is further troubled by disorganisation at the producer level leading to open access, over-production and/or competition to sell the resource. These consequences of disorganisation lead to reduced sale prices for the resource as well as to the costs that were invested in its capture, thus dissipating all the rents. By definition, harvesters have some degree of resource appropriability, since they are able to exploit the resource. If they had full resource appropriability they would have full control of harvests in that given habitat. In contrast, if there is 'open access', appropriability is completely dissipated and there is no control over production levels. Harvesters with positive resource appropriability can, in principle, control production to restrict output and generate market rents from the resource.

However, in order to effectively increase prices, they need not only to be able to control their own resource harvest, but also require coordination with other harvesters supplying the market with the same product from other lands. If there are other uncoordinated harvesters, they will sell to the market at a lower price to out compete each other, effectively eliminating the rent of the resource. As a result, resource rents would dissipate.

Coordinated production enables the successful creation of rents. If harvesters are also the legal owners, these rents provide an efficient system of incentives for the protection and rational use of the resource, both static and dynamic. Unfortunately, legal owners of the resource, sometimes governments, have in many cases limited resource appropriability due to the high costs associated with property rights enforcement. Hence, the rents are then available to other agents. This failure to appropriate resource rents at the level of habitat-manager and wildlife-producer lies at the core of the problem of habitat destruction and species endangerment.

Investments in the protection of national parks and other 'protected' areas have shown that enforcement is very costly, particularly in the absence of the support of the local community. Hence, local involvement is necessary to improve resource appropriability. One option is to involve harvesters with legitimate claims on the resource within the management system, i.e., transforming legitimate resource appropriability into ownership and targeting at harvesters without legitimate claims. This is the basis for the 'participatory' approach to resource management which has been so successful: it has achieved full resource appropriability and coordination among legitimate harvesters and limited market competition by reducing illegal activities. Examples of community involvement in wildlife management with devolution of resource ownership can be found in many countries in Southern Africa, like the CAMPFIRE programme in Zimbabwe (Child 1994; Muir and Boj 1994) and similar programmes in Botswana and Namibia (Barbier et al.. 1990).

This is not to say that individual ownership, as opposed to community ownership cannot be feasible. If adequate enforcement of property rights can be sustained and an appropriate environment created, the outcome should also be efficient. Evidence of such contracts can be found in the Namibian Conservancies that have effectively joined private habitats and created rent sharing mechanisms (Swanson 1995). Lobster fisheries in Mexico are organised under a private property regime, with each fisherman having full resource appropriability in designated plots but they coordinate production by the creation of a cooperative (César-Dachary and Arnaiz 1989).

In some cases, commercial operations are owned entirely by a single individual or corporation, as in the case of hotels or farms. They are often the property of wealthy businesses which possess the necessary financial resources to establish operations. In this case, full resource appropriability accrues to the single owner, as well as rent appropriability. This is the case of ecotourism projects where there is one or a few private hotels in each zone, as in Sharm el Sheikh (Medio 1995). In the case of species such as crocodiles or elephants, they have been considered pests or public hazards by the people that have to coexist with the species (Jenkins 1994; Thouless 1994). However, such perceptions have changed in instances where commercial use of the species has been allowed and they are then seen as economic assets (Taylor 1994). Likewise, political administrators become sympathetic to conserving the wild resource when the public perception changes (Jenkins 1994). Hence, locals that would have to be compensated to bear the burden of the wild animals are transformed into harvesters/owners who are remunerated through resource and rent appropriability.

Rents at this stage are only the rents that can be extracted from selling on to the next stage of the industry downstream, which in many cases is the processing industry or a middlemen. In many of these markets, however, the market power of these agents limits the rents being captured by harvesters, while most of the rents are generated and captured by intermediaries. They play a key role in shaping conservation incentives upstream and have to be taken into consideration in every sustainable wildlife use project. We will, however, postpone the discussion of these issues of vertical organisation and integration to the next section.

Also, it should be noted that if markets are not created for certain values (e.g., existence value), markets for direct uses of wildlife will fail due to the resulting externality.

3.4 Management regimes (from incentives to decisions)

The last sections developed the standard theory of resource allocation and identified both resource appropriation through ownership, and rent appropriation through market power, as the two necessary conditions to ensure that market forces would produce conservation incentives. These two conditions, however, can be achieved under a variety of property regimes: private, common, state or even combinations of these. In this section we discuss the nature of the different management regimes available and their relative capacity to promote sustainable uses of wildlife.

Managers of resources are those responsible for the decisions concerning the way in which wildlife resources and their habitat should be used and cared for. Management capacity

is limited by the available knowledge and the resources available to achieve and sustain adequate practices. From previous discussions we have identified harvesters/owners as the agents with the necessary incentives to implement a management regime in the first place.

Ecological considerations derived in the first section highlight some of the desirable characteristics of effective management regimes. Management should be able to (1) accommodate new knowledge and adapt to new circumstances, (2) change the perception of resource as a liability into an asset, (3) enforce property rights, (4) generate and capture rents from the resource and (5) distribute these rents equitably among all resource owners. With these aims and the basic biological and socioeconomic conditions, an adequate management regime can be designed. Three main forms of management can be distinguished: private, communal and cooperative or state.

3.4.1 Private management

The idea that individual harvesters/owners could efficiently manage their own resources and develop the necessary controls was based on Coase's idea that efficient contracts can reestablished and externalities internalised under full property rights (Coase 1960). These private contracts are sometimes required to meet the needs of wildlife since migratory patterns and habitat needs make discrete private holdings sub optimal (Rasker 1992). In Namibia, these precise contracts have appeared. Conservancies have conserved wild game on fully private property for trophy hunting. Moreover, agreements among private game owners have enabled, over time, the merger of their properties to create a greater unfragmented habitat and the design rent sharing contracts among them (Swanson 1995).

Two characteristics of wildlife resources are of vital importance in the determination of management regimes: density and predictability. The first one refers to the average density of valuable species, i.e., it is a measure of the average wildlife value produced per unit of land; the second characteristic refers to the variance involved in the distribution of these values across land. According to resource allocation theory, we would expect to see a greater incidence of common property in regions of low density and low predictability, whereas private property would prevail in cases of high density and high predictability (Dasgupta 1993). The idea being, under low densities, large amounts of land have to be aggregated to achieve scale economies, and several agents can more easily enforce rights. Similarly, low predictability increases the risks for individual harvesters, who may find it convenient to pool risks and ensure themselves a share of the average yield of the resource. In contrast, a high density of value makes it easier to reach optimal scales of production on reduced land holdings and reduces protection costs. Moreover, high predictability eliminates any gains from association to reduce uncertainty.

Examples of private management as a result of density and variability factors can be found in the captive-bred crocodile farm operations, generally owned by individuals, and the ranching of iguanas in Costa Rica, where individual farms have a significant control over population densities and face a low variability.

3.4.2 Community management

Common property regimes lie somewhere in between open access and private property

regimes, with the rights to use the resource shared by a limited number of individuals. These rights to use are limited to community members and are enforced by a set of norms and conventions. Often, what appears at first as open access in reality is common property with subtle but complex sets of rules that specify rights and obligations for resource use.

Historically, community management of resources has emerged from the perceived advantages of joint management and, although it has proven to be a stable and sound form of resource management in some societies, factors such as population growth, technological change, ecological changes and socioeconomic forces have destabilised many of these institutional arrangements (Runge 1986). In some cases, these destabilising factors have eroded traditional institutions and their remains are of limited relevance for current wildlife management, resulting in over-exploitation, degradation and depletion of common pool resources.

Common property can emerge as the preferred type of management in some projects for a variety of reasons. The relative poverty of participants, for example, can reduce their set of available opportunities when acting alone, whereas cooperation can create a set of more efficient opportunities. Joint management and ownership can also help to reduce the costs of enforcing property rights and can be pooled (Runge 1986). Community management also allows harvesters to achieve needed political power to guarantee their access to resources, as in the case of the Brazilian rubber tappers union.

Ensuring sustained cooperation of all parties involved in the maintenance of natural habitats is one of the key objectives and challenges of a common property management regime. Under common property, the management faces the difficult task of identifying the distorting factors that impede coordinated action, removing or counteracting these constraints, and making use of community rules and traditions to facilitate cooperation. In the absence of strongly held ideological or religious commitments, solidarity by itself cannot act as a long-term substitute for economic incentives (Quiggin 1993).

The initial distribution of wildlife resources also shapes the potential for cooperation. Intuitively, the more equally the initial resources are distributed, the more likely a common property management regime will succeed given that both responsibilities and returns will be more easily agreed upon and some degree of equal commitment is more likely to develop. Differences in initial endowments can lead to differences in incentives to cooperate (Quiggin 1993), and may put pressure on the revenue sharing schemes. Equal distribution of income has been cited as a key factor for the successful development of a community forest management programme in Nuevo San Juan, México (Saucedo and Acosta 1989), where villagers claim that strong feelings of solidarity grew faster and agreement was easier after the rich local land owners left town.

3.4.3 State management

Sole state management of wildlife use projects has been often criticised on the grounds of its incapacity to coordinate efforts and response to management needs can be slow. Since rents are generally not shared with local harvesters (not owners), there is some resentment against intervention. Not surprisingly, one of the most cited reasons for failure of some wildlife use projects was the lack of involvement of local communities. government

bureaucracy, projects imposed on people and lack of revenue sharing schemes were all factors that limited community participation and hindered project success (Eltringham 1994).

States, however, do incur many of the management costs in protected areas, and wildlife use is a way of capturing some of the rents and paying for the management. Clearly, this type of management is most likely to succeed in areas where there is little external pressure, since otherwise it would be necessary to incorporate all claimants into the management.

However, probably the most common form of state intervention is 'co-management'. governments often subsidise projects, such as through technical assistance, by which they have a say in the decision-making process and continuously monitor activities. On the one hand, such co-management makes sense particularly in places where significant government assistance is needed, e.g., to redefine property rights in an area.

In the Monarch Butterfly project, a committee composed of several state departments, NGOs and representatives of the communities meet regularly to assess management practices (Fernandez 1995a). This support, however, is gradually being reduced, along with subsidies and other aid.

3.5 Economic aspects of production

Experience of many wildlife resources, both plants and animals, shows that uncontrolled use driven by market forces has resulted in unsustainable levels of harvest. Historically, for instance, crocodilian populations were hunted with the idea of capturing as many as possible as rapidly as possible (Jenkins 1994). Similar experiences can be seen in the extraction of tropical wood like mahogany, non-timber products and many animal species.

Operations to extract individual wildlife resources rapidly are usually part of a wider set of forces rebalancing society's portfolio of assets, including wildlife and the supporting habitat. Not only will cattle ranching or agriculture replace the natural habitats, but often revenues from natural products will serve as the initial funds to carry out the necessary investment. In a world of competing land uses, wildlife has to prove profitable if it is to be preferred to other alternatives.

Given human impatience, projects need to show significant profits at an early stage if they are to keep the support of all harvesters. This is sometimes not possible due to the heavy investments required at first (see below) and which result in depressed short-term profits. To counterbalance this effect, some projects have chosen to over harvest initially (e.g., the Lotka paper project (Chitrakar 1994)) or have injected additional funds at initial stages of the project to ensure participation.

These strategies, however, create false expectations on the part of the harvesters, who rapidly become accustomed to an inflated level of profits or additional gifts in exchange for participation. If wildlife is to pay its way in conservation, it has to be able to 'convince' harvesters/owners as it is and not with perpetual subsidies. Schemes proposed

to capture some of the less tangible values of biodiversity like existence and bequest values at the international level do involve transfers to the owners of the resource; these, however, are not subsidies and are linked to the quality and quantity of the resource provided. In the next subsections, we will discuss several aspects of wildlife markets at the producer level to identify additional sources of conflict.

3.5.1 Technological aspects

The ownership of adequate capital resources represents a technical and market barrier for the owners of the resource to appropriate the rents accruing to the resource. This is particularly true in those cases where the owners live largely in poverty and there are limited financial opportunities. If the capital and technology needed to harvest the resource cannot be divided, only the wealthier owners would be able to afford to participate in the absence of any communal management regime. When capital is indivisible, or can only be so at high prices, then a community managed approach can be a feasible solution to acquire the necessary equipment, but, even then, other market failures such as imperfect credit markets can add more barriers for community managed enterprises. In this case, only wealthy individual owners who possess the necessary financial resources to establish operations will engage in the activity, whereas marginal local communities are unable to obtain sufficient credit even if the project is profitable. This has been the case in some of the crocodile farms, where initial investments are very large.

Sawmills, large fishing boats or large processing factories are all examples of relatively indivisible capital that has to be used intensively to be economically profitable. Harvesting of vicugnas is a neat example of this sort of technical barrier, where the type of machinery capable of processing fibre into high quality thread and cloth has enormous capacity relative to the annual estimated vicugna harvests (Fernandez 1995). In this case, not even a common property regime can overcome the technological barrier and make the purchase of the machinery economical. However, contracts have arisen which effectively 'lease' the machines services without necessarily giving up all rents accruing to the resource.

Another issue in harvest technologies relates to the capacity of individuals to harvest the species. It has been argued for instance that the use of shotguns as opposed to more traditional methods of hunting leads to larger harvests and to overall greater negative impacts on the target species. Alvard's study on this precise question for the case of subsistence and commercial hunting in Manú National Park in Perú (Alvard 1995) showed little difference in offtake from the wilds despite the higher productivity of shotguns. However, it showed a sharp reduction in the effort needed to harvest. In the study of the illegal Palm Heart Extraction in Brazil, existing technology is capable of a much larger harvest rate than the one actually observed (Galleti, M. pers. comm) and harvesters have large periods of inactivity. Hence, it would appear that technology improvements do not necessarily translate into higher harvests, but may be used to provide other benefits such as more free time to take on waged employment or other activities. An interesting counterargument, which also highlights the importance of the wider economic environment, comes from Collier 1992, who argues that increases in the income of rural peasants in southeast Mexico led to the use of new agricultural technologies which led to permanent cropping systems and the expansion of the agricultural frontier.

3.5.2 Financial independence and investment requirements

As mentioned above, poorly functioning credit markets increase the difficulty with which poor resource owners meet the necessary initial investments. It is for these expenses that NGO's or government agencies often provide invaluable assistance in providing the funds for this initial phase. Many of the reviewed projects are known to have received significant external funding to acquire the necessary initial capital for programmes such as the Green Iguana Project in Costa Rica, the Lokta paper making project in Nepal (Chitrakar 1994), the Monarch Butterfly Reserve in Mexico (Fernandez 1995a), or the Ras Mohammed National Park (Medio 1995). Some have received non monetary subsidies in the form of free technical assistance and personnel, while others sold a fraction of their initial resource endowment to purchase capital as in the case of the San Juan Nuevo Forestry Project in Mexico (Saucedo and Acosta 1989).

There is a tendency for projects to have a 'bell' shaped distribution for the injection of external funds across time. Initial funds tend to be small while some preliminary research is done, once the technology is chosen and investment is necessary, a large disbursement is made. After that, the funds start to decline as funds gradually move towards other projects in early stages of development. Hence the availability of external funds sometimes sets the date by which projects must show some sustainability

3.5.3 Economies of scale and scope

Economies of scope refer to the low cost of engaging in activities related to the main purpose of an already initiated activity. Economies of scale refer instead to the lower average costs attained if production levels are increased. Both play an important role in the management of wildlife use projects. The existence of economies of scope is indicative of the potential to diversify output. By exploiting such economies, wildlife projects can increase their returns. A simple example of these kinds of economies is the increase of species harvested in a tropical forest; once the harvesters are in the forest, it is easier to harvest additional species than it is to make a separate trip.

Sometimes, economies of scope are created by intangible inputs, such as entrepreneurial skills and community management capacity. In the case of the Nuevo San Juan project (Saucedo and Acosta 1989), activities have expanded using the same administration; tree harvesting, fruit orchards and even public transport are all managed under the same organisation.

However, there is a trade-off between the resources spent on the biological(wildlife and wildland management) and vertical (marketing, demand analysis, integration) dimensions and the capacity to engage in additional wildlife markets. For some projects it may be better to avoid covering a wide range of wildlife resources since they would not only dilute their financial and technical resources (Freese and Saavedra 1991) but would also limit the potential revenue from all other resources.

Economies of scale can easily be exploited if demand expands; by the same token, however, costs will increase if production is to be reduced. A classic example of such economies is the existence of large capital investments in machinery with large capacity:

while it is very efficient for large volumes, it could prove non-economical for small quantities. Such indivisibilities were discussed previously where it was argued that it is possible that various forms of community contracts could solve the problem.

3.5.4 Opportunity cost of resources

The opportunity cost of resources used in wildlife use projects refers to the forgone return from not applying resources such as land, labour and capital to their best alternative use. Clearly, this cost has to be justified by the additional revenue to be gained from wildlife use, otherwise, the resource will eventually be removed. Successful management incentives should aim to minimise the opportunity cost of sustainable wildlife uses. In order to achieve that, some knowledge of the relative scarcity of local resources is needed to ensure that no heavy burden is placed on the local economy.

In cases where there is heavy pressure on wildlife and the natural habitat as a source of income, the development of alternative economic activities can reduce the pressure on the resource if these activities are sufficiently remunerated. An example of a combined approach could for instance, include the hiring of local population to protect the natural habitat or to help in park management. The Environmental Protection Society in Thailand's Kao Yai National Park represents an example of successful application of this 'carrot and stick' approach by involving the local villagers in the park's activities and providing subsidised credit and training to boost local agriculture (McNeely 1988). 'Food for work' programmes have also managed to achieve a reduction in pressure on natural habitats, as in the case of the Wolong Nature Reserve, China (McNeely 1988). The 'Good Neighbour Policy' of the Natal Parks Board provides local communities with sales outlets within park boundaries and gives preferential treatment to locals in park hiring decisions. Some projects take this even further as in Nuevo San Juan, where a full employment policy forced administrators to expand activities, integrate vertically and even engage in new activities to create adequately remunerated jobs (Saucedo and Acosta 1989).

3.5.5 Infrastructure

The lack of adequate infrastructure not only increases the costs of production but also creates niches for middlemen who provide the needed services. This allows the resource rents to be captured by individuals unable to invest in the resource. In the case of the Monarch Butterfly ecotourism project, the lack of adequate communications led to the emergence of transport operators who charged excessive prices to take tourists up to the reserve, capturing a share of the reserve's rents (Fernandez 1995a). In the illegal palm heart harvesting in Brazil, middlemen provide means of transport for the palm jars (Galleti, M. pers. comm.). Middlemen also travel around the isolated towns in the Andean Chile to collect the Alpaca wool (Fernandez 1995) . In Kenya, tourists often pay in excess of US$250 per day for touring in game parks, while the parks department was capturing only about US$10 of this; the remainder of these rents flowed to hotel operators and tour organisers unable to determine the level of investment in the wildlife resources.

3.6 Revenue sharing schemes and other distributional issues

The size of the rents from a commercially used resource determine, among other factors, the incentives that those receiving the rents will have to invest in the resources in order to enlarge and maintain these rents. If rents are low or null, those incentives will be small, since it is likely that alternative uses of the resources themselves or the resources on which they depend, will have more attractive rent levels. The various agents involved in the use of natural resources make different choices that affect the conservation of the resource. Some of these effects are quite direct, like harvesters deciding to increase their harvest effort, hunters choosing to targetting females or selecting techniques that are damaging the ecosystem supporting the species. Likewise, middlemen may be willing to provide the credit necessary to engage in new less damaging techniques, place higher orders to harvesters, change the prices offered or expand their area of operation. Processors may switch to domesticated alternatives to wild products or demand a different ingredient from the wild.

Of course, some of the most direct effects from stakeholder's decisions come from those closest to the harvesting, however, some pervasive effects derived from middlemen's actions can also have long term detrimental effect on the species and its habitat. For instance, when markets for wildlife products are heavily concentrated at the middle stages of industry, middlemen usually concentrate most of the rents, leaving harvesters with little or no incentive to protect the resource, moreover, they may actively seek to prevent any coordinated effort by harvesters to extract the rent, hence maintaining the monopsony.

As a result, the distribution of the rents from the resource affect to a varying degree, the economic incentives to seek sustainable use practices. This distribution is determined by the property right structure in place, the technological requirements to harvest, process and distribute the products and the owners of such technologies. The owners of these technological requirements have a greater capacity to approrpiate rents from the resource. This is the case in some illegal markets, where smugglers have the monopoly over distribution channels, or in some processed wild products, where the processors have the control over the choice of inputs and may substitute the wild product if producers increase prices. In cases of credit market imperfections, the providers of formal or informal credit have control over the interest rate at which they lend to producers, thereby having power to capture some of the rents.

Across time, property right arrangements and other factors interact to shape the different rent sharing arrangements. Indeed, within local communities, revenue sharing systems are influenced by social and cultural factors; for instance, in some cultures tribal suprems predetermine the flows of revenue, in some others, informal rules apply.

There is no clear rule as to which is the best rent sharing mechanism to encourage adequate management, however, the rents must be shared across the agents who can, through their actions, best aim to reach and maintain biological and socioeconomic conditions for a sustainable use. This means that, while not all rents must flow to hunters and harvesters, a sizeable part of them have to flow to them if they are to be discouraged from depleting the resource and converting the land to other uses.

Management regimes specifically desgned to seek sustainability have developed different criteria and mechanisms to share revenue. Further research is needed in order to understand how they affect resource management (Freese et al. 1994). There are several channels in use to distribute revenues but we will highlight four:

a) Single direct payment in cash or goods to each harvester

Harvesters may receive a single payment from the overall revenues in each harvest. Additionally, in parcelled forest land, a royalty may be paid to the owner of the land where the resource was harvested, this is the case, for instance, of many Community forest areas in Mexico and the Nature Conservancies in Namibia and Zimbabwe (Saucedo and Acosta 1989; Swanson 1995). In terms of criteria, payment is sometimes given according as an equal share of total revenue as in the case of the ecoturism proyect at the Monarch Butterfly reserve in Mexico (Fernandez 1995a).

The time between payments is also one important factor to consider when assessing the complementarity and competitiveness of different alternative uses of the resources available to the various resource owners and appropriators. For instance the seasonal nature of some economic activities may inhibit or induce others. In the Monarch butterfly reserve, the fact that tourism takes place during the dry months inhibits timber extraction activities and restricts them to the wet season, increasing extraction costs (Fernandez 1995a). In the case of the Vicuña use in Peru, the communities are expected to receive payment every two years, which corresponds to the peridiocity with which wool will be put out for tender (Fernandez 1995).

b) Wages above prevailing local wages

An alternative means to distribute the rents of the resource are through linking them to the quality and quantity of labour devoted to the activity, i.e. by offering wages above the regional average. This not only enhances the sense of welfare and solidarity with the scheme, but also allows for returns to be distributed automatically in a transparent way and allows effort and skills to be compensated individually within the production process. This is the case of Nuevo San Juan Parangaricutiro, where most members of the community are employed by the cooperative and receive very attractive wages (Saucedo and Acosta 1989)).

c) Through investments in public infrastructure and other public goods

There are times when the distribution of benefits is best achieved by investments in public goods which can be enjoyed by everyone. This does not prevent differential benefits by the community members, but they are often goods that are often not subject to significant abuse by individual members. Examples of this are drainage, roads, water pipelines and public lighting. The decisions to invest in public infrastructure may be the result of a single decision by the authority or the result of a democratic decision by the various resource owners. For instance, in Nuevo San Juan Parangaricutiro, the community members voluntarily decided to reinvest profits in increased capacity in the cooperative (Saucedo and Acosta 1989), while communities under Zimbabwe's CAMPFIRE program decided to invest in improvements like mills and schools (Child 1994)). The motivation

for such investments may stem from lack of state investment, but it may also arise when there are high risks of fraud with other forms of distribution and there is the need to make more transparent the amount and use of revenue (see vicuña (Fernandez 1995)).

d) 'Sharecropping' and other mix-input arrangements

While the above cases arise where all members provide a similar mix of inputs (labour and resources), a different situation arises where each agent provides a different input. In these situations of asymmetric participation, a wide range of sharing arrangements have emerged. These type of contracts are quite well known in the agrarian literature of sharecropping. These type of intermediate arrangements also ocurr where producers and middlemen and processors have significant market and bargaining power, and are therefore able to negotiate a share of the rents.

The negotiating power may come by regulation of a third party, e.g. the government, or by the capacity to enforce exclusive rights by the producers. Example of the first type is the marketing scheme for crocodile skins created in Papua New Guinea, where middlemen where forced to offer better prices if they wanted to stay in bussiness (Fernandez and Luxmoore 1995).

Chapter 4

Market structure and demand for wildlife products: the vertical dimension

There are two general features common to many wildlife markets: unacceptable negative impacts on wildlife populations and inequitable distribution of revenues derived from trade. For example, parrots are clearly being over exploited and the mortality of birds during trade is excessively high, while at the same time the price paid by end consumers exceeds by several orders of magnitude that received by harvesters and resource managers.

In this report, we will argue that these are symptoms of the same problem, i.e., the failure of producers to capture rents. Moreover, sustainable wildlife use projects are generally not exempt from this problem and often find themselves with limited capacity to capture significant rents from the market.

This third section will deal with the relative capacity of the various agents along the vertical industrial structure and how this affects the sustainability of commercial wildlife uses. We will start by analysing the intermediary and processing sector and, later on, final demand for wildlife products.

4.1 Vertical structure

4.1 Intermediaries

Intermediaries are agents who purchase the product from the harvester and later sell it without making any alteration to the nature of the product.

4.1.1 Market power upstream/downstream

Intermediaries are able to generate rents and capture them by establishing a niche in the market as providers of goods and services with limited substitutes. For instance, harvesters in remote areas find it difficult to take their products to the market, particularly due to the lack of adequate infrastructure. This also contributes to the monopsonistic[4] power of intermediaries and enhances their power to capture rents. Competition among intermediaries, in contrast, gives them less market power, allowing harvesters to capture a greater share of rents.

Niches due to lack of infrastructure can sometimes be removed relatively easily with adequate investments. In the Monarch Butterfly Ecotourist Reserve in Mexico, transporters are exploiting the bad state of the roads, being able to charge high prices for an unnecessary service (Fernandez 1995a). A relatively small investment in road improvements would reduce the need for the service and would erode their market niche.

[4] Just like a monopolist is a single provider of a product, who has control over the amount supplied to the market, a monopsonist is the unique buyer of a product. Therefore, a monopsonist has control over the total amount traded.

Besides infrastructure, middlemen may provide credit and/or supplies to enable harvesters to operate. For instance, middlemen in the Brazilian Amazon provide palm harvesters with glass flasks for the preparation of the palm, an investment that they would not otherwise be able to afford (Galleti, M. pers. comm). In Peten, a well-established patron-client system facilitates organisation and financing. Harvesters also buy food on credit from the patron (Salafsky 1993). The creation of such nets of interlinked markets serve to enhance the dependence and loyalties of villagers on intermediaries and diversifies the channels of rent appropriation, not only by offering harvesters low prices and wages, but also by charging high interest rates. 'The very nature of the rationale for personalised interlinking...may at the same time act as a formidable barrier to entry for third parties and is thus a source of additional monopoly power for the dominant partner in such transactions' (Bardhan 1989, 12: 237-42).

Markets for wildlife products typically experience sharp rises in prices as you move downstream towards the end consumer. Part of the price increase represents rents to the middlemen for the goods and services they provide.[5] However, a share of the price represents rents accruing to the resource, that are captured by the middlemen through their monopolistic/monopsonistic power over the market.

4.1.2 Alternative marketing

Given the role of intermediaries in both the search for new markets and the creation of rents, some NGOs have worked to eliminate the power of intermediaries in the market and have attempted to get more direct marketing channels for wild products (Stiles 1994; Prance 1990). These efforts play an important role in the push towards diversification of markets and greater rent capture. Cultural survival, for instance, seeks to assist indigenous groups living in areas bordering tropical rain forests to market forest products directly to companies in North America and Europe.

4.1.3 Illegal and legal markets

Although not strictly a problem of the vertical structure, it is worth noting at this point something about the interrelationship of legal and illegal markets. Strictly speaking, illegal products will remain as almost perfect substitutes for legal stocks in the absence of any successful 'eco-labelling' programme. Hence, the demand for them will be the same. Revenues from these uncontrolled wildlife exports remain largely in the hands of black market traders, transferring almost no benefit to local communities or national governments or indeed to the wildlife itself or its habitat.

A commonly heard argument, however, is that legal trade in some valuable wildlife products will result in the growth of the illegal trade. The basis for this assessment is that open trade will lower the costs of smuggling and reduce chances of detection. Moreover, it is thought that the market for the resource will reactivate. However a recent work on the

[5] Apart from performing some processing to the wildlife products they receive, middlemen often provide additional services to both ends of the market. They may provide credit, information, quality assurance, transport, distribution, classification of the product, among others.

rhino horn trade, Swanson and Fernandez modelled the behaviour of speculators in the trade and showed that a controlled legal market can erode incentives to poach illegally if an alternative credible supply of rhino horn appears (Swanson and Fernandez 1995a). Empirical evidence of this phenomenon has been seen in other markets as well, as in the case of turtle egg trade in Costa Rica (Almengor et al.. 1994). A growing body of evidence derived from crocodilian trade monitoring also suggests a reduction in illegal trade, although it may be too early to draw any conclusions (Hemley 1994).

With regard to the impact of the illegal trade on the legal one, illegal markets can undercut efforts to manage wild populations sustainably through (1) lower end prices and (2) bad public perceptions of all trade in the species. An example of the first effect is the dumping of cheap tropical timbers from Guatemala into Mexico, causing a drop in price in all tropical woods. The second effect has to do with the level of conservation awareness. The South American Caiman crocodilus, for instance, has probably been more of a barrier to conservation than a benefit to the sustainable operation, due to the bad reputation resulting from publicity in the Italian and European markets, where three quarters of all trade is believed to be illegal (Hemley 1994).

4.2 Rent appropriation

All too often, vertical integration has been quoted as a viable alternative for sustainable use programmes to capture a greater share of the rents. Not only would they be able to skip some middlemen in the process, but they would also capture the rents accruing to the processing itself. Moreover, control over the processing industry can increase the control over harvests and hence, increase the share of the rents being captured by the processing segment.

Many of the management systems reviewed were found to keep control of some part of the processing industry which allowed them to centralise and control production and add transparency to the process. Examples include the ownership of the printing company by the Lokta Paper Project (Chitrakar 1994), the single processing plant of the Irula Venom Centre (Whitaker 1994), Purchases of sawmills and furniture plants by both the Plan Piloto Forestal (Richards 1992) and Nuevo San Juan (Saucedo and Acosta 1989) forest projects.

The Iguana Verde project and the Vicugna (Fernandez 1995) are trying to achieve the same effect not by directly owning the processing industry, but by owning the licence and creating contracts that allow them to extract rents from downstream stages of industry.

The downside to integrating vertically downstream are the difficulties involved in marketing and delivering a high quality product while remaining competitive and adapting to the tastes of consumers. In other words, the projects have to effectively substitute the services that the middlemen provided.

Ecotourism often has many rent leakages and, as a result, only a small fraction of rents is targeted to conservation. In the Monarch Butterfly Reserve, rents are dissipated due to the poor coordination among the various complementary service providers (transporter, food

stalls). Transporters take advantage of poorly informed visitors and charge excessive fares, while food stalls owned by the community members are so numerous that only a few recover expenses (Fernandez 1995a). Tour operators rarely make significant contributions to the conservation of the areas where they offer their services. Park administrators often complain that tour operators do not appreciate protected areas (Boo 1990).

A common practice to capture rents is by charging entrance fees; however they tend to be relatively small and the demand can be quite elastic if there are similar alternatives. Tourism is now the second largest export industry in Costa Rica. In order to finance conservation, the authorities charge an entrance fee to the National Parks which, by 1988, captured some US$ 168,000 in revenue (McNeely 1988), however, this represented only around 0.1 percent of all tourism expenditure in the country. At the same time, surveys show that protected areas were the main reason for visiting Costa Rica for 14 percent of tourists and an important one for an additional 27 percent (Boo 1990).

4.2 Final demand for wildlife products

4.2.1 Characteristics of demand

The true limit to potential revenues from wildlife use is given by the demand for the final use, which in turn will depend on the nature of the use, the availability of substitutes and complements and the level of income. High elasticity of demand, which is the result of the availability of substitutes, puts pressure on wildlife use projects since they have to keep costs low to be able to compete. This effectively sets a ceiling on prices and on the potential rents that can be generated.

Inelastic demand, on the other hand, is indicative of a product without perfect substitutes and tends to produce more stable markets and, more importantly, increases the scope for generating rents in the market. This is, for instance, the case of wildlife products with medicinal applications for which there are no close substitutes.

Thin markets are also a problem of wildlife harvest. Some species with specific applications will face a finite demand that may be too small compared with potential supply. This is the case for some non-traditional tropical hardwoods that only have specific applications such as ship building and only a small proportion of production has a market (Foerster 1991). Income can also affect demand significantly for some wildlife products such as carved ivory, high-quality leather and textiles.

Demand for wildlife products is not only influenced by traditional uses, but more recently animal welfare and preservationist groups have influenced public opinion, leading to changes in demand. Examples of reduced demand due to publicity campaigns can be found in the reduced demand for seal products, whale products and more recently, ivory and crocodile products. Whether these changes are permanent is difficult to assess, specially as the publicity campaigns lose impetus. For the crocodile leather industry, public perceptions are causing negative impacts on demand such as in Louisiana (G. Webb in IUCN 1994), and anti-illegal trade in Europe, particularly in the caiman trade ((D. Jelden in IUCN 1994).

4.2.2 Volatility of demand

The volatility of demand puts additional pressures on management systems because it adds to the already important biological uncertainties that often exist in wildlife utilisation systems. The source of volatility can be due to factors outside of the control of the projects. For instance, the Gulf War virtually closed down the Sharm el Sheikh Resort in Egypt, resulting in huge losses for the operators (Medio 1995).

Likewise, sharp increases in demand brought about by changes in fashion, technology or exhaustion of substitutes can also increase pressures to over harvest and stress the control systems. For instance, the success of the reduced availability of palm heart from the single stemmed Euterpe edulis triggered a shift of the industry to the Amazon to harvest the multi stemmed Euterpe oleracea. Likewise, the success on the market of the Rain forest Crunch ice-cream by Ben & Jerry's caused the firm to increase the demand of brazil nuts well beyond the Kayapo's project potential.

In the case of the seal fur market, the demand decreased significantly as a result of the concern over the harvesting practices of puppy seals. As such, the drop affected all markets for fur, regardless of their marketing practices.

4.2.3 Competition between markets: substitutes and complements

Sustainable projects face competition from illegal substitutes, which are normally cheaper because they do not incur any management costs (see discussion above). However, they also face competition from other sustainable projects producing the same services.

Most markets will only be able to accommodate a limited number of similar projects and the continuous addition of similar projects globally or regionally could result in lower final prices. Competition will mean that only those projects which are efficient with low production costs and better quality products will survive (Jenkins 1994; Vernon 1994). Evidence of this competition is already taking place in the crocodile leather industry, where declining prices have forced some producers to scale down operations, cease production of low value skins or shut down completely (Jenkins 1994). Other wildlife use industries where competition among sustainable operations in the long term could imply closure include ecotourism and trophy hunting.

So far, there is little effort being made to coordinate production at a global level. In the crocodile skin industry, some estimates indicate that (given the ever increasing number of crocodile farming operations being established around the world) there will soon be an excess supply that will drive prices down (Jenkins 1994). Symptomatic of this is the fact that, in today's market, there is little demand for skins that are not of top quality (Vernon 1994). Moreover, competition between captive breeding and ranching operations currently works against the latter, as captive breeding has greater control over production and marketing practices, that tend to favour operations isolated from wild populations.

Whereas this increases the efficiency of the industry, it does undermine further efforts to promote crocodile ranching. It also decreases the willingness of the local community to engage in new projects and reduces the bargaining power of individual producers with the

processing industry. This creates incentives for the poorly regulated operations to seek cheaper illegal supplies. Uncoordinated production at higher levels of industry will simply exchange the dissipation of rents at ground level for that at the global level.

In the case of ecotourism, the nature of much of the investment in tourism infrastructure, however, can serve only to redistribute tourism revenues, i.e., new hotels, restaurants or resorts that provide the same service will compete, reducing their profits. Therefore, investments for the replication of the same service can be anticipated to generate very low returns unless demand grows faster than supply (Swanson 1990). Being tied to income and fashion trends and severely influenced by factors like political instability, weather and exchange rates, it is not possible to predict whether the most specialised ecotourism resorts to will be able to maintain their current levels of customers.

Such competition not only takes place at the local level among neighbouring resorts, but also at the international level, since potential tourists face an ever growing choice of destinations. Sharm el Sheikh's Tourism Resort, in Egypt is certainly competing with similar resorts in Australia and the Caribbean. The Monarch Butterfly Ecotourism project in Mexico has managed so far to maintain their monopoly over the local industry and to capture some rents. However, pressure is mounting and could result in the opening of more areas, leading to the dissipation of rents (Fernandez 1995a).

There are many factors affecting the relative advantages of one particular place as a tourist attraction. Accessibility, infrastructure and some specific irreversible investments to cater for tourists are limits to the success of ecotourism in specific areas. Remote areas in particular are bound to have limited potential. One solution is to develop good contacts within the various wildlife industries to exchange information in the same way as their buyers (Vernon 1994), thereby increasing their bargaining and coordinating capacity.

4.2.4 Local vs. external markets

Wildlife products can be traded either locally, nationally, internationally or in various markets simultaneously. Local markets, although generally small, offer the least cost monitoring and enforcement of trade. International trade in wildlife products has been estimated at between US$2 billion and US$8 billion a year (Hemley 1994).

Dependence on international markets as opposed to local markets brings forth wider issues of macroeconomic policy, trade policy and international pressure groups affecting the way in which trade takes place. Monitoring of trade, demand and control of illegal trade becomes more difficult when more countries are involved in the trade. Demand becomes more volatile due to political and economic factors.

In the case of NAFTA, Rose (1992) suggests that reductions in tariffs may lead to increases in both legal and illegal trade in wildlife products, both through direct price reductions and through easier smuggling due to the increased volume of trade. Moreover, with poorly developed 'green markets' the products of natural habitats will not be able to compete with substitutes from intensive production systems or from unsustainable

extraction systems. Examples of this are the poor competitiveness of Mexican woods compared with their American counterparts and the cheap precious tropical woods from Guatemala being dumped upon the Mexican internal markets (Belausteguigoitia and Fernandez 1994).

International markets also create competitive pressures from quite distinct production systems. The market failures inherent in unsustainable wildlife use projects can add unfair competition and greater stress to the sustainable operations.

Crocodilians are a group of species in international trade for which conservation programmes based on sustainable utilisation principles are well advanced. The high commercial value of crocodilian products has linked these programmes to the global market (Hemley 1994). Illegal trade, however, has damaged the sustainable industry twofold, by directly loosing revenue to illegal harvesters and by creating a bad reputation.

4.2.5 Malleability of demand marketing strategies product differentiation eco-labelling

After years in which the government rhetoric in many countries has been in favour of non-use, a change towards use will take some time. Rao (IUCN 1994) warned that it can take a while to get people to accept sustained use after convincing them not to use wildlife.

Campaigns against wildlife use seem to have been successful in reducing demand for some wildlife products. Equally, it can be expected that such views could be reversed in cases of sustainable wildlife uses. However, this change is not costless. On the one hand it requires that the public accept that the use of wildlife can be beneficial where they have previously been told the contrary. Secondly, it needs adequate signals to consumers about which products are sustainable and which are not. This requires adequate monitoring systems and certification procedures to verify authenticity.

For many wildlife products, it is almost impossible to distinguish sustainably from unsustainably produced ones. Differentiation can only be achieved through credible means that uniquely distinguish between products, such as the ones proposed for crocodile leather, or through unique manufacturing practices that lead to unique products. This is the case of fine vicugna-made cloth that can only be produced by a small number of factories worldwide or special designs that can be detected in specialist markets. This last solution, however, requires close links between harvesting and the processing plant to prevent illegal supplies being filtered down into the market.

Some eco-labelling programmes are also being developed to differentiate sustainable products from unsustainable ones. In principle, these strategies should divert rents towards the sustainable projects and capture some of the existence values on the resources. The Smart Wood Certification programme reviewed here is an example of this approach to marketing.

Other companies, such as The Body Shop, Ben & Jerry's Ice Creams and The Food Business are developing and selling products under a 'green' label, and hence are able to capture higher rents from their products, which they share with harvesters, usually through

direct marketing channels, thereby minimising rent losses. There is a general need for governments to intervene to standardise and legitimise commercial 'labelling' programmes.

4.2.6 Long-term prospects

One major challenge for the opening of new opportunities for sustainable wildlife use will be the development of more markets and the improvement of the functioning of existing ones. At present, the pace of introduction of new products into the market is very slow (despite the claims by some researchers who suggest that there is potential for new products such as new fruits and nuts from tropical rain forests) (Prance 1990). NGOs, such as Cultural Survival, are providing marketing skills to harvesters and are trying to introduce new products into the market, while providing a better deal to harvesters (Stiles 1994). In principle, technological and scientific development could also open new applications and markets for wild products.

In tropical timbers, despite the fact that manufacturers have had to substitute traditional woods with lesser known ones as their availability has diminished, there has been increasing difficulty in finding a market for non-traditional tropical woods. A marketing study by Giordano (1987) suggests that, in terms of their technical substitutability, there is scope for the expansion of the market for tropical timbers in Italy. However, market responses are more difficult to achieve, with customers being used only to a handful of species and reluctant to take new ones. Moreover, the growing availability of cheap fibre and particle boards and laminated veneers will likely reduce future demand for tropical woods.

In Mexico, efforts to market non-traditional tropical timbers by the Plan Piloto Forestal have faced significant problems, primarily because, apart from the specialised small markets for a handful of species, mass markets are reluctant to accept new species. Despite the wide range of colours, density, resistance and other technical characteristics of wood, the Mexican internal market is not demanding such characteristics as yet (Foerster 1991). One way round this problem has been the creation of contracts forcing the processing industry to purchase some of the less-known species. In general, market resistance will provide a ceiling on the capacity of sustainable utilisation to contribute to conservation for some time to come. A potentially more effective solution would involve investments in marketing so that more species become known by consumers. However, the investment necessary is often beyond the capacity of producing units, national industries and even countries.

Chapter 5

Conclusions

Effective biodiversity conservation through wildlife use depends on a delicate balance between a series of biological and socioeconomic factors, some of which are under limited control of individual management programmes. At present, individual programmes provide only some of the relevant data and knowledge needed to perform a thorough analysis. This reflects, partly, the particular history and aims of individual programmes, sometimes stressing only social or biological factors. Although wildlife utilisation has proven to be capable of providing significant returns in several environments, it would be unwise to suggest that it can effectively protect biodiversity in all cases. Throughout the study, we have identified a number of issues that limit the capacity of such programmes to capture rents and create incentives for conservation.

On the biological side, management programmes are often started without sufficient knowledge of the ecology. This limits the ability to determine the adequate harvesting level and the right practices, while at the same time making it difficult for the regulating authority and certification programmes (eco-labelling) to evaluate the relative sustainability of any individual programme. Flexible criteria to identify projects with potential to be sustainable are yet to be developed.

Initial socioeconomic pressures have forced some projects to follow a path of initial over harvest in order to create credibility and support for the project by the local community. This, however, could result in the reduction of future harvest potential. Alternative mechanisms to increase support for the management programmes at the community level have to be developed where the profitability of the project seems to be insufficient. Mixed approaches that create revenue from a pool of activities (e.g., taking advantage of economies of scope), with less dependency on the harvest level, have some potential to be effective. This strategy also allows a spread of risks and permits natural variation.

Attempts to increase returns through improvements in rent capture, such as vertical integration, are successful only if appropriate knowledge of the processing sector is available. While enhancing the degree of control over production levels and increasing rent capture, vertical integration increases the dependency of the local economies on the sustained harvest.

Ownership and resource appropriability show significant mismatches in several case studies, leading to dissipation of rents accruing to resource owners/managers. These tenurial problems are sometimes only solved by modification of current institutions or the creation of new ones. While reliance on existing social organisations at ground level is a low cost alternative, they are not always appropriate launching pads. Already existing organisations, sometimes designed for different production technologies, may not accommodate the new kind of harvesting proposed. Design and change of institutions needed to regulate access and create resource rents with effective rent sharing mechanisms will, however, require greater involvement of all levels of government. 'Successful' stories are often those backed by special concessions and legal status, which grants them

Table of contents

1 Introduction 4

Part I Framework for the sustainable use of wildlife

2 Biological and technical aspects of resource utilisation 8
- 2.1 Information, uncertainty and the precautionary principle
- 2.2 Ecological considerations
  - Harvesting
  - Ranching
  - Captive breeding
  - Ecotourism
- 2.3 Compatibility of wildlife use and biodiversity conservation

3 Socioeconomic considerations: the horizontal dimension 15
- 3.1 Identifying claimants on resources (Who values the resource?)
- 3.2 Issues of tenurial structure (resource appropriability and ownership)
- 3.3 Resource appropriation and rent appropriation: conflicts between owners and claimants
- 3.4 Management regimes (from incentives to decisions)
  - 3.4.1 Private management
  - 3.4.2 Community management
  - 3.4.3 State management
- 3.5 Economic aspects of production
  - 3.5.1 Technological aspects
  - 3.5.2 Financial independence and investment requirements
  - 3.5.3 Economies of scale and scope
  - 3.5.4 Opportunity cost of resources
  - 3.5.5 Infrastructure
- 3.6 Revenue sharing schemes and other distributional issues

4 Market structure and demand for wildlife products: the vertical dimension 30
- 4.1 Vertical structure
  - 4.1.1 Intermediaries
  - 4.1.2 Rent appropriation
- 4.2 Final demand for wildlife products
  - 4.2.1 Characteristics of demand
  - 4.2.2 Volatility of demand
  - 4.2.3 Competition between markets: substitutes and complements
  - 4.2.4 Local vs. external markets
  - 4.2.5 Malleability of demand marketing strategies product differentiation eco-labelling
  - 4.2.6 Long-term prospects

5 Conclusions 38

the needed flexibility.

One of the main market problems encountered in management programmes is their limited marketing capacity within their vertical structure and the lack of better market conditions than those prevailing for illegal harvesters. On the one hand, middlemen are capturing a significant part of the revenue, particularly in relatively isolated or fragmented producing areas. Moreover, middlemen are sometimes exerting pressure to harvest the stock to extinction. On the other hand, competition with unsustainably produced wildlife products is limiting the capacity of management programmes to generate rents. Therefore, an integrated approach to demand management is needed to enhance rent appropriability by management programmes over middlemen and illegal harvesters.

In general, the market characteristics of wildlife products will set a ceiling on the capacity of management programmes to capture rents. Creation of new markets for sustainably produced wildlife products is needed as management programmes expand and increase production. Unfortunately, this has proven to be a slow and difficult process. It requires some degree of coordination among management programmes to effectively manage demand and the collaboration of the processing industries to accept relatively unknown species into the market.

This discussion has addressed primarily the need to increase rents from use values. However new instruments have to be developed to capture other values, such as option or existence values, particularly where is limited compatibility between ecological characteristics of the habitat and the proposed direct use or where the market provides limited revenue and cannot on its own prevent habitat conversion. In the long term, sustainable utilisation should become only one aspect of a diversified portfolio of income in order to enable management programmes to avoid the fluctuations inherent in both ecosystems and socioeconomic conditions, while at the same time improving the compatibility of the programmes with biodiversity conservation.

Part II

Literature studies

In this section we present a brief description and analysis of some background case studies reviewed. The analysis is centred around the framework developed in Part I, separating the different biological and socioeconomic factors (horizontal and vertical). Table 1 illustrates the range of aspects to be analysed in each of the case studies presented. At the end of each case study, a table presents an analysis of the key features following the structure of table 1.

Table 1: MATRIX OF FACTORS INFLUENCING THE SUSTAINABILITY OF WILDLIFE UTILISATION SCHEMES

Characteristics and knowledge of the	Horizontal Coordination: influences on coordination and cooperation.	Vertical Coordination and marketing influences	Overall
· resource type (eg. animal, plant, insect, fungi). · biological characteristics (eg. population status and carrying capacity; distribution; migration; seasonality) · knowledge of ecosystem (traditional, biological research) · population being subject to use and effect of use on species (e.g. does it involve killing the individuals). · Compatibility of wildlife use with habitat/biodiversity maintenance	Failure to achieve cooperation in the horizontal dimension may result in open access exploitation · Property rights structure over resource and its habitat (open access, common property, private and state ownership) · Establishment of exclusive rights (e.g. capacity to prevent poaching) · Characteristics of resource owners/managers (number, cultural and ethnic bonds, relevant traditional practises and social customs, socio-economic conditions, knowledge of the resource) · Nature of community involvement in wildlife use (initial motivation, employment and revenue generation at local level) · Economic viability of production (degree of external support; other subsidies; short and long run profitability; economies of scale and scope, opportunity cost of resources employed) · Revenue sharing and other distributional issues (equal or skewed distribution of initial endowments and sharing of costs and benefits of the project) · Characteristics of production technology (cost, indivisibility, transferability) · Institutions supporting the community and nature of involvement (training, management, financial support) **Regulatory Framework Governing Resource Use:** · International agreements (eg. environmental and trade agreements) · National regulations (eg. consumption and production bans, quotas and licences, environmental charges and taxes, protected areas) · Community based rules and practices	Failure in vertical structure incentives may lead to sub-optimal rent appropriation. · market characteristics (nature of demand, legal status, size, consumers, other sources of market failure) · role of intermediaries and processing industries (degree of monopolistic power and rent appropriation in end market and degree of monopsonistic power over resource harvesters) · malleability of final demand (degree of product differentiation, potential of eco-labelling and advertising) · product characteristics (eg. luxury or esential good; importance to local community, rate of growth) · status of supporting infrastructure (transport, marketing)	biological, economic and social indicators of sustainability

1 The Irula Venom Centre in India: adapting traditions and retaining investments in human capital in conservation projects

One of the key areas of concern in wildlife utilisation projects is their relation with local traditions and the retraining and education that are prerequisite to the projects. Encompassing existing skills and traditions into new sustainable uses of wildlife can be an effective way of introducing alternatives to local communities. In the case of the Irula people, they have managed to retain their skills as snake hunters and yet have a different end-product: snake venom.

India was an important supplier of reptile skins until 1976, when an export ban was introduced to preserve the snakes and their ecological role as rodent predators. The main suppliers of snake skins to the industry were the Irula tribesmen of Tamil Nadu, numbering over 200,000. It is estimated, that between 5 and 10 percent of the total population where regular catchers when the skin trade was flourishing. Once the ban was imposed, these Irulas and their families, were greatly affected as their survival was still largely dependent on hunting and gathering.

The Irulas have an almost legendary expertise in hunting deadly snakes and the ban would effectively have meant in the long run that this expertise would have been lost. However, in 1978 a group of Irulas formed a registered Cooperative Society. The objective of the cooperative was to establish a venom centre to offer the Irulas an alternative income source that would utilise their snake hunting skills. Under the system, the Irulas would be issued with licenses by the Forest Department to bring freshly caught venomous snakes to the Centre for venom extraction. The venom would then be dried and sold to the Indian anti-venom serum manufacturers and the snakes would be released back into the wild after three weeks in captivity.

Fifteen years later, the Irula Cooperative Venom Centre is still in operation enabling the 101 Irula members to maintain their traditional skills and lifestyle in a way that renders no threat to snake populations. Since 1984, the Cooperative has been financially self-sufficient, showing profits every year with the exception of 1991 and 1992. By now, the Irulas control most of the operations, from the capture of snakes to the freeze drying of the serum, a skill that was learnt during the programme.

It is estimated that between 30,000 and 40,000 people die annually of snake bites, 10,000 of which occur in India alone. The only effective cure for serious bites is the anti-venom serum, thus creating a need for stocks of snake venoms of the medically important species. In India, the four most important snakes are the cobra (Naja naja), krait (Bungarus caeruleus), Russell's viper (Vipera russelli) and sawscaled viper (Echis carinatus).

Manufacturers of anti-venom serum worldwide depend upon wild populations of snakes for

their serum. This is typically made by involving specialised local people in collecting the snakes. Once caught, they are kept in captivity until they die, generally after a few months. This scheme clearly poses some threats to the species since it involves killing the snake. The innovative aspect in the Irulas' approach is to release the snakes after capture in order to minimise the impact on snake populations. This system has convinced the government that the Irula approach would only marginally affect the wild snake population. The Irulas have managed to achieve a mortality rate of less than 1percent in snakes while in captivity, and recent studies suggest that most of them survive after release. A tagging scheme is used ensure that snakes are not recaptured too frequently and the cooperative will not buy juvenile specimens and gravid females.

The 101 cooperative members are issued with annual harvesting permits from the licensing authority. Compared with the millions of snakes caught and killed prior to 1976 for the skin trade, the Irulas now catch only an average of 6,000 every year. The Irulas normally spread their snake catching quota over the year, concentrating on hunting food animals and plants for the most part.

Unlike the Irulas, other locals do not share the same skills, nor the same respect for the snakes and they kill them on sight. The Irula Cooperative has tried to increase public awareness and knowledge of snakes through local campaigns so that locals can identify the dangerous ones and appreciate their beneficial effect on rodent control.

Snakes proliferate in disturbed habitats, like farmlands, degraded forests and hedgerows. The reason for this is the higher abundance of prey animals like rodents and amphibians. Three of the four snakes used by the Irulas live in this type of habitat, which means that, for them, the habitat is increasing rather than decreasing. Upon release, snakes have to be relocated to the Reserved Forest because usually the owners of the plots where the snakes were captured do not want them back. As yet, no clear impact of this practice on snake populations has been documented, but, as said, preliminary studies on mortality after release show a very low mortality rate.

Given the specific skills required for snake capture, it is difficult to see it as a project that could be extended easily in other regions unless it is carried out by Irulas or other people with similar traditional skills. However, there has been some horizontal diversification as the Irulas have also been hired by farmers to get rid of rats in their farms, which not only produces rat meat for the Irulas (for whom they represent the main source of protein) and grain is saved, but it also saves on the use of chemical pesticides.

This case study presents a very interesting example of coordinated effort by the government, the locals and manufacturers. In the horizontal dimension, the coordination among the Irulas was facilitated by several factors. First, the group of people involved was easily identified and the legal framework ensured the granting of exclusive rights in the form of licenses. Further, these licences were based on a sustainability criteria, which provided the right conservation incentives to the Cooperative members. Although the harvesting quotas were calculated

arbitrarily given the lack of knowledge of population dynamics, the Irulas had to provide evidence that their techniques did not harm to the snakes, which were protected species.

Enforcement of these exclusive rights for the capture of live snakes was facilitated by the Irula control of the venom centre, which could effectively monitor harvest levels and quotas by individual members. The scheme was therefore relatively accountable and transparent. In addition, the specific skills required for the activity effectively created barriers of entry both for the locals and for people in other parts of the country. In fact, the government's strict requirements limited the establishment of other venom centres and only two others exist in India, both run by the state. The Irula people effectively have a monopoly on the supply of snake venom in India.

The initial measure to ban skin trade was to protect snake populations. By offering the Irulas an alternative activity, the project has removed the pressure that Irulas imposed on snake populations. However, other individuals can affect populations either by hunting or by illegal harvesting for the skin trade. The local education and awareness raising campaigns, together with the close contact of Irulas with local people minimises these activities. Thus, the set of incentives have not only managed to maintain cooperation among the Irulas but has also created incentives for extending such cooperation to other locals, thereby improving the monitoring and ensuring exclusivity rights. Cooperation by the locals has also been possible by the indirect benefit they receive from getting rid of both pests and of the snakes.

With regard to the vertical dimension, by owning the venom centre, the Irulas have integrated vertically to the point where they can monitor all members activities, including individual captures. Since they are one of the few suppliers of venom, their position in the market is strong, and with the continuous demand for venom, there is a guaranteed market for their product.

Source: Whitaker and Andrews (1994) and Gorman (1992).

Irula Venom Centre, India				
	Knowledge of Resource	Horizontal Coordination	Vertical Coordination	Overall
Pros	-Irulas possess traditional knowledge on snake behaviour and ecology. -Snakes live in disturbed habitats; thus habitat encroachment is not an issue. -Use does not involve killing individuals. -Use produces positive effects on pest control. -Some evidence of low mortality and double catching of snakes. -Little impact on overall biodiversity, but induces better ecological balance in disturbed areas.	-Well defined tribal group. -Traditional knowledge used is a strong barrier to entry. -Owners of disturbed habitat are compensated indirectly by benefits on pest control. -Transforms previous poachers into organized harvesters, hence effectively reduces pressures on resource. -Financial self-sufficiency. -Irulas have tried to change attitudes of farmers to snakes. -Use has allowed Irulas to maintain traditional customs. -Central control allows accountability.	-Resilient demand, given its medical applications. -Shortage of supply of antivenom in India. -Better quality serum is produced by using freshly caught snakes. -Little competition from other sources. -Forest Department Licensing Scheme allows control over harvests. -Gradual vertical integration of scheme, allowing a greater share of rents being captured. -Central control by Venom Centre prevents diverted sales of serum.	-Provides a sound basis for long term profitability of the scheme. -Sustainability seems viable in a regional scale. -Rent being appropriated by resource owners.
Cons	-Little knowledge of snake populations.	-Only a small proportion of Irula ex-catchers directly involved in the scheme. -Difficult to enforce property rights on specific snakes or regions. -External poaching for snake skins not direclty discouraged.	-Dependence on State enforcement of regulation to maintain licence scheme and the snake skin trade ban. -Difficult to apply same program in other parts of the country.	

2 Lokta harvesting and paper making in Nepal: establishing markets and local incentives

Lokta is the local name for two wild species of Daphne whose bark is used for the manufacture of handmade paper. This paper offers unique beauty, strength and durability. During the past decade, population pressures have diminished habitats and uncontrolled harvests have reduced the population of Lokta. Following the closure of the Chinese market in 1959, UNICEF promoted a local project for the production of greeting cards and other products. Fourteen years later, the project has grown, but there is still some evidence of unsustainable harvesting.

Lokta has been used in the production of handmade paper for over 800 years in Nepal. Monasteries in Tibet used it for the block printing of Buddhist scriptures which represented an important export market for Lokta paper. In 1959, with China's closure of the border with Tibet, lokta paper producers lost their main export market. In addition, the domestic market was being flooded with cheaper machine-made paper from India. The only domestic uses that remained for lokta paper were for judiciary, loan, deed and registration documents that required long-lasting paper.

Businessmen and middle agents would go to the villages and offer cash for harvesting lokta and processing it into paper. The paper would then be used to make various products, including UNICEF cards and Body Shop bags. However, in the horizontal dimension, lack of coordinated effort at the village level has meant that harvests of lokta are unsustainable and densities of lokta have reduced dramatically over the past decades. The manufacturing of paper requires large amounts of firewood for the drying and cooking of Lokta, adding additional deforestation pressures.

The Nepalese government has centralised control over natural resources, which discourages local initiatives. However, Nepal is still a largely rural country, with over 90 percent of its population living in small isolated villages with limited access to roads, markets and electricity. In these conditions, government enforcement of rules is limited and there is plenty of scope for abuse of resources.

UNICEF launched a community development campaign in 1981 to help to sustain the local industry and people's livelihoods. Its aim was to promote community development through income generating activities associated with lokta paper-making. The project initially involved the production of greeting cards, but it has now diversified into other products. Operations were initially based in three harvesting rural villages and one town, where the printing was to be carried out by Bhanktapur Craft Printers (BCP), which is fully owned by UNICEF.

An initial important step in the project was the creation of exclusive rights over the resource, which took the form of the government granting the rights to BCP for the harvesting of Lokta in five major forests around the project area. The project also included investments in training local people in sustainable harvesting techniques of Lokta bark.

The lack of a management programme for the harvests in the initial years resulted in significantly reduced stands within reasonable distances around the participating villages. Between 1985 and 1986, the harvest area for each district was divided into blocks where harvests were to be rotated. Each panchayat within the district would receive a specified harvest quota in each block. The initial four year rotation schedule was lengthened after some studies and BCP's paper-buying procedure was changed so that it would only buy paper in quantities compatible with the assigned quota. The quota system is administered by the Agricultural Development Bank in Nepal which distributes Lokta harvesting permits to registered groups.

To improve the energy efficiency of the paper-making process, new stoves were installed and a process using caustic soda was introduced. The soda was sold at cost through the Agricultural Development Bank of Nepal. Other assistance included the tree nurseries established by the Forest Department, the provision of wooden frames to farmers and various related training programmes including recycling and energy saving schemes.

The profits from BCP's operations were channelled back to the communities in the form of community development and welfare funds, which amounted to US$39,000 per annum between 1982-9. The projects in community development and welfare are put forward by the community and are approved at the annual workshop. Communities are expected to contribute to 40 percent of the project's costs. However, this does not take into consideration the financial cushion that UNICEF continues to provide to the project. On average, UNICEF has provided some US$30,000 per annum in marketing assistance and BCP continues to benefit from tax privileges as it is owned by UNICEF.

The UNICEF project provides a secure market for the paper, buying all the greetings cards produced by BCP. Until 1984, all BCP production was bought by UNICEF alone, but market diversification was seen as necessary and efforts were made to capture more markets. Despite these efforts, by 1989 UNICEF still bought over 70 percent of BCP's total production. It is worth noting that marketing efforts have been directed at both local and international markets and the project has been able to take advantage of recent shifts in demand for sustainably produced products.

From the three rural villages and one printing centre, the project has grown to include 67 panchayats in three districts, four paper-producing panchayats and one central printing centre in Bhaktapur. Employment generated by the project has grown significantly from 26 full-time BCP workers in 1981 to 100 in 1989. Likewise, part-time workers increased dramatically over the same period; harvesting families increased from 62 to 519, Lokta and paper transporters expanded from 30 to 128; and paper-making families from 180 to 237 over the same period.

The sharp increase in the number of families involved, coupled with restrictions on the amount of paper that can be made, has resulted in large fluctuations in income for harvesting and paper-making families. In contrast, Lokta and paper transporters have experienced smaller fluctuation in income. For the BCP workers, the project represents a full-time job, but for all the families involved in harvesting and paper making, the activity is only a part-time occupation mostly to supplement income and it is not related to any essential need.

At present, BCP is a UNICEF trust fund, but future plans include transforming it into a private limited company with half the shares owned by the Agricultural Development Bank of Nepal, 5 percent by BCP staff and 45 percent initially by UNICEF. There are plans to distribute the UNICEF shares amongst the participating communities in order to achieve further involvement in the management.

Even with the system of exclusive rights and harvesting licenses, and the fact that BCP offer prices between 33-46 percent above that of other buyers, villagers are in some cases still harvesting above their specified quota and producing paper that they sell directly to local merchants in exchange for loans. If these practices continue, it is doubtful whether the project will continue to be sustainable in the long term.

The fact that people do not adhere to their allocation and sell paper directly to local merchants is a sign of poor commitment to the project in view of other needs. Since there is a limit to the amount of paper they can sell to BCP, any additional cut has no additional value within the framework of the project. In principle, over-harvesting should carry a penalty, as this will lower future harvests. If future harvests are worth less than the present illegal harvest, then there will continue to be an incentive to over-harvest today.

Another factor that reduces cooperation at the horizontal dimension is the fact that all members benefit from BCPs profits regardless of their individual effort and commitment. From 1981 to 1985, BCP's surpluses were not enough to fund community development activities on any scale, and UNICEF decided to supplement these funds with the aim of accelerating community development benefits from the project. However, the communities have come to expect additional development funds, independent of their own project efforts. Thus the important link between individual actions and project success has been eroded.

The diversion of sales to other markets is threatening the system of exclusive rights on the lokta harvests granted to UNICEF. Accountability and effective enforcement of exclusive rights are a necessary ingredient to ensure continued cooperation. The present system of centralised production could also impact on the commitment of the individual harvester to the project. Alternative schemes in which management and production are more decentralised and there is a greater sharing of project income have achieved a stronger sense of unity between individual actions and the sustainability of the overall project.

Source: Chitrakar (1994) and Prescott-Allen (1992).

Lokta Harvesting and Paper Making in Nepal				
	Knowledge of Resource	Horizontal Coordination	Vertical Coordination	Overall
Pros	-If properly harvested, bark can regenerate. -Investments in technology increased efficiency of production.	-Exclusive rights on resource granted to BCP. -Project generated employment has increased (mainly part-time). -Rents channelled back to communities.	-Control of harvests by UNICEF through BCP. -Some control over BCP will be handed over to communities through distribution shares. -There have been efforts to diversify markets.	Rents are being captured by project.
Cons	-Slow regeneration -Little knowledge on populations -Overharvested populations in initial years.	-Poor law enforcement by government -Financially not self-sufficient -High dependence on UNICEF's investments and subsidies. -Large investments at early stages created false return expectations. -Rents to each family dissipated by increased number of participants. -Violation of assigned family quotas and diverted sales. -Revenue not linked to adherence to management.	-Limited scope for expanding market. Very competitive substitute (industrially made paper). -Highly monopsonised demand structure(UNICEF). -Local merchants still get part of the harvests.	Poor commitment to the project. Limited control over resource harvests. Small market for product.

3 The National Biodiversity Unit in Costa Rica: a new approach to increase and capture wildlife values

Costa Rica's National Biodiversity Unit (INBio) has created innovative ways of capturing the information value of biodiversity which directly involves the local communities in their operations and ensures returns from biodiversity conservation. The project has managed to improve monitoring in national parks, increase public awareness and create incentives for cooperation with INBio's objectives at the international level.

The collection and classification of specimens in Costa Rica's Conservation Areas requires specially trained parataxonomists. INBio's strategy emphasises local knowledge and education, and selected local people have undergone a six month training course in parataxonomy. The newly trained parataxonomists are assigned to biodiversity field offices near or around the conservation areas to collect botanical and arthropod specimens. At the end of each month, the parataxonomists transport the collected material to INBio's headquarters, where specimens are classified.

The parataxonomists serve as the contact point between the larger INBio project and the local communities. The parataxonomist have easy access to the local communities which facilitates a two-way exchange of knowledge and increases local awareness and appreciation of the work of the INBio. Although only anecdotal evidence exists, it is believed that parataxonomists have induced a positive change in attitude among the locals. Even to the extent that there has been a reduction in illegal hunting, poaching and bush fires. In many cases the local community has more knowledge about using wild plants and animals than the trained parataxonomists. In these situations, the parataxonomists have become repositories of local information, thus protecting it from being lost through cultural erosion.

The employment opportunities offered by INBio itself reduces land conversion pressures both by serving as direct employment and by offering an alternative to other locals. With some parataxonomists taking on positions at other institutions, the team has to be replenished with new local people.

INBio's Biodiversity Prospecting Division has the mandate to demonstrate the economic value of biodiversity. Its activities focus on commercially oriented activities, including local capacity building in biotechnology. At present, the Division has engaged in two major collaborative research projects, one with the MacArthur Foundation and the other with Merck

The initial success of INBio has its roots in various strategies and institutional arrangements. For instance, the initial efforts to develop an inventory greatly improved INBio's ability to attract research contracts with commercial and non-commercial entities like Merck and Cornell University. Likewise, INBio's close relationship with Conservation Areas and government officials has made it an officially recognised partner, adding to the legal security of its contracts. In some sense, INBio has achieved a commercially viable comparative advantage in biodiversity protection and research.

Moreover, INBio has managed to create some spillover benefits in other areas like ecotourism and local education, research, and public awareness around the protected areas. Although some of these benefits are difficult to measure, it is hoped that the complementarity between activities will lead to a greater appropriation of the total value of biodiversity.

Source: Aylward et al.. (1993), INBio (1994).

The National Biodiversity Unit in Costa Rica				
	Knowledge of Resource	Horizontal Coordination	Vertical Coordination	Overall
Pros	-Knowledge is being generated through INBio's activities in a systematic way. -Use requires the maintenance of full biodiversity.	-Parataxonomists convey biodiversity values to locals neighbouring reserves. -Education programmes by the INBio increase public awareness. -Potential benefits to local farmers if they get concessions to cultivate successful plants in a large scale.	-Potential rents could be captured through the established royalty agreements. -Gradual vertical integration by increasing local skills and knowledge. -Nationwide knowledge spill-overs.	-Biodiversity values are being made transparent through explicit contracts.
Cons	-Poor compatibility with other extractive uses which reduce biodiversity.	-No rents are transferred to local population.	-Correct value of genetic information difficult to assess.	-Natural habitats still dependent upon external enforcement of their protected status.

4 The CAMPFIRE Programme in Zimbabwe: empowering local people

Zimbabwe's approach to sustainable wildlife utilisation in private lands has now been extended to the communal areas by the CAMPFIRE programme. Communities have been granted the management and the means to capture the benefits from wildlife use. Since its introduction, CAMPFIRE has managed to promote cooperation among village members and has enhanced the institutional capacity of other community programmes.

During colonial times and up to 1978, legislation in Zimbabwe prohibited all utilisation of wildlife for commercial use as well as traditional hunting. Locals were even relocated to make way for National Parks. As a result, many communities have been disenfranchised from their natural resources, and wildlife became not only valueless, but a symbol of oppression and its destruction was encouraged. This alienation of people from wildlife was clearly unsustainable. In 1955, the Department of National Parks and Wildlife Management allowed farmers (mainly white) to utilise their wildlife commercially. Consequently, farmers began to benefit from wildlife and started to look after it. The value of wildlife products combined with the marginal economic viability of conventional agriculture induced a shift from livestock to natural ecosystems accommodating a wide range of species. While cattle could only be sold for meat, wildlife could be photographed, sold as hunting trophies, as well as being sold as meat. At present, some 75 percent of Zimbabwe's commercial ranches now participate in the wildlife industry.

The first attempt to extend this system to communal areas was a programme called WINDFALL. The programme involved allocating revenues from wildlife culling in National Parks and from safari hunting to district councils, but overall wildlife management remained with the State. The results of this programme where disappointing since the councils kept all the money and local people saw few benefits. In 1975, a further step was taken which granted councils the same rights as private landholders to appropriate the value from wildlife. In order to increase the accountability of the councils the CAMPFIRE programme was established. The programme ensured that producer communities rather than councils, managed and benefited from wildlife.

CAMPFIRE at the local level: the case of Chikwarakwara

Chikwarakwara is a small village. Its population is exceedingly poor, largely uneducated and aging, since many of the young people have migrated out of the area in search of work. As with many other villages, disenfranchisement from its resource resulted in open access and over-exploitation of the wild resources. Chikwarakwara was characterised by the erosion of traditional controls on resource use, growing population pressure, open access resources and unsustainable resource use.

In 1989, there was a major step towards the implementation of the CAMPFIRE principles including the appropriation of wildlife revenues by the villagers. In the process, special care was taken to ensure that villagers related the revenues they received to the actual value of wildlife in their area. Moreover, the revenues were allocated to individuals rather than to the community as a whole. This not only helped to increase the perception of the

important individual revenues to be gained from wildlife management, but also boosted the accountability of the project.

As a result of this approach, more positive attitudes were fostered towards wildlife and towards the management of the wildlife revenues. Villagers were able to carry out better resource trade-offs and gained self-esteem. New institutions were created including wildlife committees to ensure accountability and transparency. With stronger community unity, a number of new opportunities began to open. Snaring was reduced as informal social controls were established and strengthened. Entrepreneurial skills learned in wildlife management were transferable to other projects such as the expansion of the irrigation system and the management of the grinding mill.

To control levels of wildlife use, each council develops a sustainable hunting quota in collaboration with the state departments. Middle agents who have the capital and skills are employed to attract international clients. In order to avoid excessive monopoly power and appropriation of the wildlife rents by the middle agents, a system of tenders was established. Through time, the communities have improved their marketing skills, managing to double their incomes between 1989-93. In fact, they have managed to capture better prices than the government in key safari areas in Zimbabwe. The programme has shown that communities have rapidly learnt the necessary skills for natural resource management despite the limited capacity of the state to provide technical assistance. In fact, districts with donor support tended to be slower to develop and have suffered from excessive overhead costs.

The philosophy of CAMPFIRE has been to set initially the conditions right for sustainable wildlife management by local communities. The communities have started to cooperate and build institutions for the management of resources. The programme is now at the stage of consolidation and fine tuning of those institutions and management practices.

Project sustainability

Both the CAMPFIRE and WINDFALL programmes have shown that providing adequate incentives at the state level and allowing individuals to respond to those incentives can generate cooperation for wildlife conservation. In both private and communal lands, wildlife enterprises have proved to be more financially viable than cattle ranching, thus ensuring an economic incentive for cooperation. The long-term sustainability of the project depends on the international market for trophy hunting. Poorly developed markets, macroeconomic distortions and bans on trophy imports by foreign countries have diminished the economic viability of the scheme (Muir and Bojo 1994).

The sole dependence on the safari hunting market has increased the vulnerability of communities to changing economic conditions. Big game, is not very competitive for meat production due its low growth rate and yields (Eltringham 1984). Moreover, some community management institutions have been threatened by new settlements, making poaching a continual problem.

These problems pose new challenges both to the state and to the local communities. Ways of increasing the appropriation of wildlife and diversifying sources of income will have

to be developed, as well as the means to incorporate new settlers. There is no doubt that CAMPFIRE has proven a success in achieving cooperation at the private and community level. The current problems can now be tackled by the existing institutions and their dynamics will be central in adapting to new challenges.

Source: Child (1994), Barbier et al.. (1990), Dean (1990), Muir. and Bojö (1994)

The CAMPFIRE programme in Zimbabwe				
	Knowledge of Resource	Horizontal Coordination	Vertical Coordination	Overall
Pros	-Comparatively good knowledge of mammal ecology and habitat. -Use requires the maintenance of natural habitats. -Some uses do not involve killing the species.	-Communities were granted ownership of the resource. -Revenue sharing rules are decided at community level. -Creation of new institutions. -Greater commitment to the project leading to less poaching. -Limited reliance on external funds. -Revenues effectively linked to wildlife. -Project served as catalyst for other ventures.	-Middlemen's capacity to capture rents was diminished by establishing a system of tenders. -Improved bargaining power in communities.	-Project provides a sustainable alternative in areas with limited new settlements and attractive wildlife and landscape.
Cons		-Rent dissipation through more communities entering the scheme. -Inability to produce an homogeneous product among participating communities.	-Tourism/trophy hunting markets have significant variability. Particularly vulnerable to changes macroeconomic/political conditions. -Limited scope for diversifying wildlife markets.	-Rent dissipation through inter community competition and new settlements in existing management areas act against sustainability of the program.

5 The Plan Piloto Forestal programme in Mexico: new community management approaches to tropical forestry management

This project provides an important and relatively successful example of new community management approaches to tropical forest management. A recent study of the project reports its distinguishing characteristics and gives vital lessons for similar forestry projects in the region.

The most important lessons for natural forest management approaches elsewhere seem to be the following: the vital role of tenure security; the creation of autonomous and flexible institutional structures; a marketing strategy which views the forest resource as the basis for capitalisation and industrial development rather than as an opportunity to supply an already existing market, and which actively promotes the acceptance of secondary species essential to the viability of sustainable yield management; an appropriate policy environment; the absence of paternalism - technical assistance should be paid for by beneficiaries as soon as possible, loans and grants kept to a minimum, and decision-making left to the beneficiaries; continuity of financial and high quality technical assistance; and last but not least the need for strong producer organisation especially vital in forest planning and administration. (Richards 1992)

The Plan Piloto Forestal (Pilot Forest Plan - PPF) was built on the 'ejido' system of community land holding and explicitly recognised the potential role of the rural community as the means to forest conservation. The pilot project was initiated in 1983 as a result of negotiations between the ejidos and the state and replaces a conventional forest development policy based on concessions to logging companies, state subsidised local timber and the policing of concessionaires and illegal agricultural encroachment by the Forestry Authority. The local community was largely excluded from the forestry benefits except for the payment of a nominal forest rights rent from the logging companies and some employment benefits. By the 1980s almost half of the original forest area had been lost due to unsustainable logging practices, and the allocation of ejido rights to campesinos through land clearance as part of government policy towards agricultural self-sufficiency.

The establishment of the Plan Piloto Forestal in 1983 represents a radical change in the forestry management strategy in the Quintana Roo State and the emerging evidence suggests that the PPF is moving towards sustainability. The project arose out of successful negotiations between ejido community groups and the state. The government has supported the initiative by allocating long-term resource use rights to the community and providing well targeted and appropriate technical assistance. The central role of the rural community in forestry conservation has required the development of new flexible institutions and a different role for state involvement emphasising effective technical support and a move away from policing and recording activities. The main components of the strategy are reviewed within the 'Sustainability Framework' outlined in Part I of this report.

Knowledge of the resource and management strategy

Each ejido has defined a Permanent Forest Area which forms the basic unit of management and administration. A forestry management plan is developed at the ejido level based on the results of an annual forestry inventory. The management plan specifies maximum allowable timber harvests for different commercial species and allocates annual quota cuts to each ejido in accordance with the inventory calculations.

The management strategy has encouraged commercial diversification into ten instead of two species, although in practice each ejido extracts its maximum annual cut of mahogany and only a small proportion of the annual allowable cut of secondary species such as amapola, jobo and chacah.

The programme recognises the crucial role of training and research in all aspects of forest ecology, planning and management. Technical assistance covering forestry management, marketing and organisation is provided by the state forestry authority, the Secretariat of Agriculture and Water Resources (SARH). However, the technical assistance programme has a unique system of in-built incentives to ensure effective, targeted and responsive support to the ejido community. Of the seven foresters allocated to the project, three were state funded but the remaining four are paid out of ejido profits. In addition, the foresters receive a bonus commission payment from the ejido to which they were assigned. Under this system the technical advisors are answerable and responsive to the needs of the ejido community. The ejidatarios have now developed a sound ecological and economic knowledge of the key commercial species, and technical assistance is increasingly being employed in ecological and phenological research.

Regulatory framework governing resource use

The PPF system represents a transfer of user rights from the logging companies towards resident community groups. In addition, the role of the state forestry department has been transformed from one of policing and keeping out illegal encroachment to one of technical support. The PPF has also played an instrumental role in pressuring the government to remove timber subsidies which were acting as a disincentive to investment. The new system is based on well-established community rules and practices which have been further developed and refined with government technical support. It has also involved the establishment of a new legal identity - the Society of Ejido Forest Producers of Quintana Roo, which is an autonomous non profit organisation, financed out of forest profits and a concession from SARH.

Vertical dimension and marketing influences

There are well-established local markets and considerable potential for exporting secondary species, as well as the traditional species of mahogany and Spanish cedar. The adoption of an active and cooperative marketing strategy has given the PPF powerful bargaining strength enabling negotiation of higher prices and diversification into secondary species. For example, the PPF has been able to negotiate contracts in which the buyers agree to purchase double the volume of secondary species for every unit of mahogany.

The marketing strategy of the PPF has therefore been influential in promoting the acceptance and marketability of secondary species. The relative success of this diversification strategy has been a key component in the development of a sustainable management strategy for the traditional, but slow-growing mahogany hardwood. In addition, the ejidos community working together has effectively become a monopsonist in the local timber market. This means they have become price-makers as opposed to price-takers and effectively have altered the structure of the local forestry industry. Since the establishment of the PPF, the forestry industry has been transformed from one based on the provision of subsidised locally supplied timber towards a commercially viable system based on sound social and environmental principles.

There are also interesting developments in the international market which should benefit schemes like the PPF in the future. Over the past decade, there has been a growing international demand for timber from 'sustainably managed' sources. This change in consumer tastes and willingness to pay reasonable timber prices has been pioneered by organisations such as the Ecological Trading Company in the UK and the Rainforest Smart Woods Certification programme in the USA.

Horizontal dimension: influences on cooperation and coordination

Members of the Quintana Roo forestry project have strong ethnic bonds and the project itself is built on the well-established 'ejido' system. The PPF is composed of ten 'ejido' groups and covers a combined forest area of 117,000 hectares, managed by and supporting a total of 11,000 people (ejido members and their families). Under the ejido system the 'land belongs to the people who work it' and use rights pass down through the male line under the discretion of the General Assembly of each ejido. The land tenure system is therefore a good example of common property with well-defined use rights and strong supporting traditional practices and social customs. The harvesting quota allocations are well defined and democratically and equitably determined. In addition, the community members live in or near the forest, which keeps monitoring and protection costs to a minimum. The net income is sometimes distributed as profits to individual members or is ploughed back into the project, or is invested in community development projects such as education, health and rural infrastructure. Each ejido makes these decisions under a democratically elected body.

One of the interesting features of the project is the nature of the management systems and the evolution of new appropriate institutional structures. The Society of Ejido Forest Producers of Quintana Roo (SPFE) was established in 1986 as an autonomous non-profit organisation, financed out of forest income and SARH concessions. The SPFE has its own separate technical forestry division (DTF) which is supported by a council of elected representatives from each ejido. Management, planning and marketing activities are the responsibility of the newly created SPFE and DTF. Each ejido grouping creates its own General Assembly which allocates tasks to members who may work in groups or as individuals depending on the nature of the task. A crucial aspect of the PPF model is the creation of appropriate new institutional structures and the deliberate marginalisation of inadequate existing ones, such as the state forestry department.

Another important feature of the project is its economic autonomy and relative

independence from external financing and technical support. The economic viability of the project stems from a number of factors including an active marketing strategy, horizontal diversification into ten as opposed to two species, vertical integration into the processing and production of forest products, risk pooling between members, and economies of scale in capital investments and technology. A rough estimate of the return on capital is in the region of 15 percent per annum which compares favourably with alternative investment opportunities in the area.

Project sustainability

The study concludes that the project is moving towards sustainability, but it would be misleading to suggest that it has achieved economic, social and biological sustainability. The project has certainly reduced the rate of resource depletion and has secured considerable economic and social benefits for the project members. However, there is still a serious concern that mahogany is being over-exploited and suspicions that the inventory brigades are over-stating the inventory in order to increase the annual allowable cut. General observations suggest that the present mahogany harvest may not be sustainable in the second and third cutting cycles (2010-60). It is therefore crucial that horizontal diversification into secondary species continues which will depend crucially on the development of local and international markets for these species.

Source: Richards (1992), Foerster (1991) and Galleti (1992).

The Plan Piloto Forestal in Mexico				
	Knowledge of Resource	Horizontal Coordination	Vertical Coordination	Overall
Pros	-Easy to establish property rights on resource. -Community training programmes have increased local skills and knowledge of commercially valuable species. -Technical assistance is moving towards providing wider ecological knowledge.	-Strong ethnic bonds among communities. -Builds on pre-existing institutions, i.e. 'ejido' a well established common property tenurial system in Mexico. -Harvest quotas democratically and equitably allocated to each ejido. -Ejidos coordinate actions through a newly created association. -Communities decide if revenues are shared or reinvested. -Relatively self-sufficient financially. -Differential treatment of each ejido.	-Marketing strategy has given powerful bargaining strength to the communities. -Commercial diversification has been accomplished to some degree. -Eco-labelling is being introduced as a means to differentiate product in the international market. -Communities have integrated vertically into processing and production of final products.	-Socio-economic factors strongly point towards sustainability of the scheme.
Cons	-Limited knowledge on optimal rotation period for harvested species. Mahogany could be being overexploited.	-Concern over possible overestimation of maximum allowable cuts.	-Despite efforts, there are limited market opportunities for the lower-value high volume tropical timbers. -Local markets are unresponsive to eco-labeling and are reluctant to accept high variety of species.	-There are good reasons to believe that biological sustainability has not been accomplished so far.

6 The fur trade and furbearer harvesting in Canada: sustainability of consumptive and non-consumptive uses of wild species

Canada's involvement with the fur trade dates back to the mid-seventieth century, when furs obtained from the native Indian population were bought by trading companies and sold in European markets. Pressure on the most valuable species such as the beaver and sea otter decimated populations and prompted the government to enact laws controlling harvests and numbers of trappers. The effectiveness of these regulations remains a controversial issue with some studies reporting sustainable management of wild species through fur harvesting:

Today, in the Yukon and across Canada, management practises have allowed furbearer populations to rebuild to the extent that none are endangered, except where non-trapping related impacts, such as habitat changes from agriculture and forestry are taking their toll. (Slough 1994)

Whereas fur trade critics such as the World Society for the Protection of Animals (WSPA) report that 'laws to protect wildlife are poorly enforced by government agencies that support the fur trade and receive millions of dollars every year in fur royalty payments' (Sleeper 1988).

This case study investigates the management of wildlife by aboriginal communities in the Yukon and Northwest Territories in Canada where wildlife trapping is an important social, cultural and traditional activity. In the Yukon, some 500-800 persons (70 percent of whom are aboriginal) are eligible to harvest furs. Indigenous people form the majority of the population in the Northwest Territories and their lifestyle and local economy has a long history of dependence on the wildlife resource. In these areas, the resident population has used wildlife mainly for food and clothing and has derived cash income from the sale of furs to middlemen and fur traders. In recent years, income in these communities has suffered from import bans on certain wildlife products and from market dumping, particularly by Scandinavian wildlife farms. The failure to diversify into other wildlife related sources of income has made the communities vulnerable to changes in international demand for wildlife products, and in the longer term may threaten the conservation of wildlife habitats.

To a large extent the conservation of habitat will depend on the value that wildlife has to the local people. The local people will have enormous influence over land and water management decisions largely because of the provisions of the three comprehensive land claims which span all of the Northwest Territories. If wildlife does not continue to hold a strong comparative value, then land and water use decisions will favour other opportunities, which may not be as friendly to the environment as renewable resource harvesting is. (Lloyd 1990)

Historically, wildlife management in these areas is governed by national regulations and international agreements. However, the success of recent land claims in aboriginal community areas has been associated with the devolution and delegation of authority for

a whole range of responsibilities including wildlife management. This has involved the creation of new institutional structures allowing greater representation of community interests in wildlife management. Other recent influences on wildlife trapping include the introduction of new technologies such as the snowmobile and specialised traps; and the introduction of educational programmes both for trappers and as part of a public relations and education exercise involving the national and international community. These key influences are analysed under the framework for sustainable wildlife use developed in Part I of this report.

Knowledge of the resource and educational programmes

Furbearer populations may have been depleted in the early/mid twentieth century partly due to over-harvesting for European markets. However, populations of many of the threatened species have now been restored since the implementation of management regimes involving restricted hunting seasons, and hunting bans and quotas.

The sensitivity of particular species to trapping depends on several factors including abundance, harvest pressure and ease of capture. Furbearer populations are constantly monitored and licensed trappers are requested to provide information on prey abundance and population dynamics. Additional regional studies are regularly conducted particularly focusing on vulnerable species and to answer trapline management concerns. This information is made available to individual trappers as part of the state-run educational programme for sustainable furbearer management.

In recent years a significant effort has been devoted to trapper education encouraging sustainable furbearer management and the move towards species specific traps to replace non-discriminating sets and the phasing out of inhumane trapping methods. Trapper educational programmes are designed to complement the incentives instilled by the 'Registered Trapping Concession' system, i.e., the legal framework that limits open season lengths and harvest quotas. As part of the marketing strategy under the newly formed 'Wild Fur Council' efforts are also being made to provide information to the international community involving product labelling and public relations and education programmes.

Regulatory framework governing resource use

At the national level, furbearer management began with the Game Ordinance Act which established trapping seasons in 1920, and continued with the licensing of trappers in 1937, and the registration of traplines in 195 The legal framework has recently been updated with the Wildlife Act (1982), the Environmental Act (1991) and amendment to Trapping Regulations (1993). Under the 'registered trapping concession' system, trapping concessions are granted to individuals and groups of trappers for specific land areas with renewable five year terms. Some claim that this legal framework is both supportive and effective (Slough 1994), whereas others claim that the laws are poorly enforced, partly because the government is a direct beneficiary of the fur trade (Sleeper 1988).

Perhaps the most effective management tool is the system of export permits introduced under the CITIES agreement for key species, such as wolf, lynx, wolvertine and otter. According to Lloyd and Graf (Lloyd 1990), since 90 percent of furs are exported from the

territory by fur dealers or trappers, only a small percentage of the harvest remains unaccounted for.

Vertical dimension and marketing influences

The aboriginal community suffers from a number of weaknesses in the vertical dimension. Firstly, there is a shrinking market for traditional wildlife products such as wild furs. The market is largely external since 90 percent of furs are exported from the territory, and is controlled by fur dealers and trading companies. The growing number of import bans on certain wildlife products and the stricter import quotas for others, increases the potential for illegal markets and poaching to develop. For example, the US Fish and Wildlife Service reports that 'for every game animal bagged legally by a hunter, another is killed by poachers' (Sleeper 1988). In addition, failure to diversify into other wildlife related products or to reap additional value added from horizontal integration has made the aboriginal communities extremely vulnerable to changes in external market conditions and the monopolist power exercised by fur trading intermediaries.

Horizontal dimension: influences on cooperation and coordination

The most interesting developments in the furbearer management system arise out of the recent land claims by the aboriginal community. Various land claims are at different stages of development including the Inuvialuit claim involving land in the Western Arctic. The Final Agreement was signed with the Federal government in 1984 and is currently being implemented. This involves the establishment of a new resource management structure. Each of the six communities in the area has a Hunters and Trappers Committee (HTC) to deal with wildlife issues within communities. The presidents of these committees make up the Inuvialuit Game Council (IGC) which deals with wildlife issues among communities. IGC representatives also sit on intergovernment bodies such as the Wildlife Management Advisory Council and Environmental Impact Review Boards. These new institutions provide important co-management structures through which the community can effectively participate in wildlife management and have enormous influence on every aspect of the management of fish, wildlife, migratory birds and marine animals. The new land settlements are seen as the first phase in the devolution and delegation of authority to the local level for a whole range of responsibilities including wildlife management.

Project sustainability

Although it is claimed that current management practices in the Yukon and across Canada have allowed furbearer populations to rebuild to the extent that none are now endangered from trapping related activities (Slough 1994), it is doubtful whether the current system of wildlife trapping will provide the security of long-term sustainable income for the aboriginal community.

The economic sustainability of community wildlife management in these areas will very much depend on their success in gaining greater control over wildlife related markets through expansion and diversification. Some efforts are being made at promoting and marketing wild furs through public education and labelling programmes. For example, the

Wild Fur Council was formed in 1992 to promote and market wild furs, nationally and internationally through marketing, advertising, public relations and public education. The flagship of the Wild Fur Council is their 'Northern Supreme' label which assures the consuming public of sustainable wildlife harvesting. However, perhaps the greatest potential for economic diversification which can also be compatible with northern community lifestyles and environmental conservation rests with the development of the ecotourism industry. The gradual devolution of responsibility for wildlife management as a result of the new land settlements provides an ideal opportunity for communities to assume a more active role in the management of wildlife to assure sustainable community income from wildlife related activities.

Sources: Lloyd and Graf (1990), Sleeper (1988), Slough, B.G. and Harvey Jessup, R. (1994).

The Fur Trade and Furbearer Harvesting in Canada				
	Knowledge of Resource	Horizontal Coordination	Vertical Coordination	Overall
Pros	-Aboriginal communities have traditional knowledge of population dynamics. -State run educational programmes increase this knowledge. -Species specific traps are being introduced.	-Aboriginal communities have been delegated authority over wildlife management in their territories. -New institutions have been created to deal with wildlife issues within and among communities. -Wildlife trapping is an important, social, cultural and traditional activity. -Trapping concessions are granted on an individual basis for specific lands.	-Product differentiation efforts at national and international level through information to consumers and eco-labelling. -An additional control is created by the CITES export permits.	-Possible potential for diversification in eco-tourism.
Cons		-There are concerns of poor enforcement of concessions.	-Import bans on wildlife products and market dumping have reduced the share of the market for canadian furs. -Failure to diversify their products has made them vulnerable to fluctuations in wildlife markets. -High dependence on foreign markets (90%). -Intermediaries have monopolistic power over trappers.	-It is doubtful whether the system of wildlife trapping will provide long term sustainable income unless they manage to obtain greater control over wildlife markets and diversify production.

7 Medicinal plants in Africa: appropriating value from the *Prunus africana* bark in the Cameroon

Afromontane (Prunus africana) is a hardwood tree with multiple uses including timber, fruit, fuelwood and crafts. However, its most important commercial use comes from its bark, the extracts of which are used in the treatment of benign prostatic hyperplasia in older men, largely in Western Europe and North America. Besides these immediate use values, the afromontane forests provide an important forest habitat for endemic birds, mammals and plants. Commercial bark harvesting has been taking place in all of Cameroon's three most important forests for bird conservation. In recent years, concern has been expressed about the over-harvesting of this species from a wide range of different groups including the resident communities who rely on the tree for a number of subsistence needs (including fuelwood, timber and fruits), traditional healers who also harvest the bark for medicinal purposes, government departments in East and Central Africa and environmental groups such as the Worldwide Fund for Nature (WWF) and Birdlife International.

Before 1985, the French-owned company, Plantecam Medican, had a monopoly in harvesting, processing and export rights. Employees of the company were well trained in de-barking methods which minimised damage to the forest stock, but despite attempts at sustainable bark harvesting, some degradation did occur over this period. However, additional stress was put on the forest resource after 1985 when fifty additional harvesting licences were issued to Cameroonian entrepreneurs. Licensed quotas were issued for short-term commercial purposes and without adequate knowledge of the resource or without reference to a sustainable harvesting strategy. The loss of monopoly control has resulted in opportunistic scrambling for wild stocks and also the adoption of damaging de-barking practices such as the felling and/or complete stripping of trees by some bark harvesters.

Concern about over-harvesting resulted in the partial ban on bark extraction in 1991, which was later lifted in 1992. The ban was completely ineffective due to its poor monitoring by the Forestry Department. In fact, bark extraction increased over the ban period. Although licensed holders pay a 'regeneration' tax (2 percent of the value of raw material) this is insufficient to cover even the direct costs of replanting and does not take into account the additional social and environmental costs largely borne by the local community.

In this case study it is important to stress that the main beneficiaries of bark harvesting are the legal holders of the licences to harvest, process and export the bark products. The local community receive some benefits from temporary employment contracts, but permanent harvesters are not recruited from the local area. Nonetheless, the local community suffer a large part of the costs of forest degradation as they depend on the trees for a number of subsistence needs including timber, fuelwood, fruits and medicinal extracts. There is some concern that the recent increase in commercial bark harvesting has changed the local perceptions of the forest from being a community asset to being a resource to be exploited for personal gain. This may account for the additional pressure on the forest resource from

forest clearance for subsistence agriculture.

Given the resultant scarcity of bark, it would be economically viable for local residents to cultivate Prunus africana from seed for sale to the bark extract processing plants. If small farmers are to become involved in Prunus africana cultivation there needs to be a guaranteed market for the bark they produce at a price that makes production profitable. The feasibility of this option remains doubtful as there is much uncertainty about the future international demand for the bark extracts from Prunus africana, given the growing competition from new treatments for benign prostatic hyperplasia.

Characteristics and knowledge of the resource

Although Prunus africana is a relatively resilient species, it has not been able to withstand the increasingly destructive methods used to harvest the bark. In addition, the recent increase in harvesting licences has been governed more by short term commercial considerations rather than with reference to a sustainable management strategy based on biologically determined sustainable yields.

Regulatory framework

Includes a system of licences covering harvesting, processing and export. Licence holders pay 'regeneration' and 'transformation' taxes to the Forestry Department but these are insufficient to cover replacement and external social and environmental costs. A recent ban on harvesting proved completely ineffective due to its poor enforcement, and it was lifted a year later. The Prunus africana bark extract was patented in 1966, but the benefits accrue to the foreign-owned French processing company.

Horizontal dimension

The main issues revolve around the allocation of resource rights and the nature of community involvement. Until 1985, harvesting, processing and export rights were allocated solely to a foreign-owned company. Monopoly control of the resource was more sustainable from a biological standpoint, but was not socially sustainable as it excluded the local community from the majority of benefits from the resource. After 1985, resource rights were allocated to fifty entrepreneurs from the Cameroon. However, enforcement of the harvest quotas was poor, and the increased competition between harvesters resulted in over-harvesting and the adoption of increasingly damaging harvesting methods. Again, the vast majority of the local community was excluded from the benefits of bark harvesting, and in addition they began to bear many of the costs of forest degradation. This may have prompted them to take their own toll on the forest by massive increases in clearance for subsistence agriculture after 1985.

Vertical dimension

The main issue for concern is the long-term existence of the international market for bark extracts from Prunus africana. Growing competition from new treatments for benign prostatic hyperplasia make the long-term future of the market uncertain, and consequently reduce the economic viability and increase the risk of investing in long-term cultivation

of the species.

Project sustainability

It is clear that current rates of bark harvesting are unsustainable from an environmental perspective; neither do significant benefits accrue to the local community who depend on the resource for many of their subsistence needs. Cunningham and Mbenkum (1993) suggest the following four alternatives to the current destructive harvesting of Prunus africana bark:

First, managed sustainable use of wild populations after stock assessments and preparation of management plans. This could only take place if the management capacity of the Forestry Department was strengthened. Second, a complete ban on bark harvesting from wild populations, rather than the unsuccessful partial ban instituted in 1991. Third, phasing out harvesting of wild stocks in favour of cultivation. Fourth, promotion of other medicinal treatments to Prunus africana to treat prostrate gland hypertrophy.

Sources: Cunningham and Mbendum (1993).

Medicinal Plants in Africa: Afromontane (*Prunus africana*) bark in the Cameroon.				
	Knowledge of Resource	Horizontal Coordination	Vertical Coordination	Overall
Pros	-Afromontane forests provide important habitat to native species. -Bark can be extracted with minimum damage to the tree. -Monopoly employees were trained in debarking methods.			
Cons	-Little knowledge of the resource biology.	-Monopolist company did not transfer revenues to local communities. -Dismantling of monopolistic control led to opportunistic harvests. -Licence quotas were issued for short term commercial purposes. Royalties were set too low to cover regeneration costs. -Poor monitoring of bans after 1991. -Local communities only benefit from temporary employment contracts. -Local communities are not being compensated for environmental damage. -Forest is less seen as an asset.	-Medicinal applications create resilient demands but new treatments make prospects of future markets uncertain. -Prunus africana extract was patented, but benefits accrued to the french processing company.	Harvesting of Prunus africana is unsustainable both from an environmental and social point of view.

8 Social Forestry in India: regional differences and the importance of underlying social and economic conditions

The social forestry programme in India provides a good case study as there has been noticeable difference in uptake and success of the programme across different regions and states. According to recent studies (Sharma 1993; Contreras 1993) this trend can, to a large degree, be explained by differences in socioeconomic conditions. The primary aim of the social forestry programme was to provide for the basic consumption needs of rural communities, such as fuelwood, fodder and timber for domestic construction. The Indian tree planting programme was promoted by government via a range of policy incentives including subsidised seedlings and credit, extension services and investments in supporting infrastructure. The programme emphasised community participation in forestry. management and was based on the mutual interests of the villagers and the government to create sustainable resources to satisfy common interests.

In spite of the rhetoric, the social forestry programme has largely been adopted in the wealthier and more commercially developed regions, making little impact on the vast subsistence areas of India. The search for financial profits appears to have been a major motivating force behind farm forestry plantings, particularly in regions characterised by commercial agriculture such as in the northern states of Punjab and Haryana, the western state of Uttar Pradesh and in southern and western India in Gujarat, Maharasthtra, Andhra Pradesh and Tamil Nadu. The higher adoption rate in these areas can partly be explained by the better-developed infrastructure, the ability amongst the richer farmers to take higher risks, and access to a large market for construction timber (particularly in industrially developed regions). Thus against official expectations that trees would be planted to satisfy household subsistence needs, farmers have instead planted trees for the market and for profit (Contreras 1993).

The less-developed rural regions in Eastern, Northeastern and parts of Central India have been unable to take advantage of this market opportunity due to socioeconomic constraints characteristic of the regions including insecure land tenure, debt bondage, scarce technical and managerial expertise, and dependence on merchants and traders for market access. Even in these areas, there has been relatively little adoption of social forestry to satisfy subsistence needs, despite the fact that these areas were targeted for higher government investments in subsidies and extension services. This can partly be explained by the uncertainty of land tenure, arbitrary distribution of the programme outputs and an expectation that forestry management is the responsibility of the government. The study by Contreras-Hermosilla goes further to argue that government incentive policies have played a marginal role in the decision to invest in tree planting; of greater importance was the existence and access to markets and credit, and the ability to take risks. In addition, government efforts to encourage horizontal and vertical integration in forest related products (such as tasar silk, pine resin, bidi leaves, turpentine) would appear to have increased incomes for the government more than for the village communities involved in harvesting and processing.

In terms of the 'sustainablity framework' developed in Part I, the following factors are of greatest importance in the case of social forestry in India.

The regulatory framework governing resource use is very much determined by the constitution of India which gives the Central and State governments concurrent jurisdiction over forestry resources. Use of forest products is regulated under the Indian Forest Act (1927). Under this Act a wide range of forest products are harvested through a system of rights, concessions and licences. Although policies in India were originally designed to increase tree planting on under-productive, non-forest government and community lands, greater importance was soon accorded to 'farm forestry', whereby farmers were encouraged to plant trees on their own land. This involved an array of government policy incentives including subsidised credit and seedlings, laws governing harvesting and transport of forest products and investments in infrastructure and extension services.

In the horizontal dimension there are a number of factors that can help explain the differential success of the 'social forestry' programme across India. Of particular importance is the nature of property rights and land tenure arrangements governing forestry land. The recorded forest area is 75.18 million hectares, of which 66.65 million hectares are government controlled, and 8.53 million hectares community and privately owned. Nearly 40 percent of the former category are not directly managed by the State and are given in usufruct to village communities under a variety of arrangements. In many areas, these public forests are effectively open access resources which generates a powerful disincentive for the individual to grow trees on these lands. There is also much uncertainty surrounding the ownership of the trees themselves. For example, Saxena (1990) reports that 'there is a widespread impression in the villages that if trees are planted on private lands, not only will the trees belong to the government but land on which such plantation takes place may also revert to the government...the fear is not baseless as the Bihar Private Forest Act and similar enactments did precisely this in the past, by "nationalising" private trees'.

Despite the official rhetoric, effective community involvement and participation has not been achieved except in a limited number of cases. In the successful cases, the existence of strong community bonds and village level institutions was found to be a significant distinguishing factor.

> The existence of village level institutions such as community centres and schools were found to be strongly correlated with the level of social forestry success. A possible reason for this result is that a bond of community feeling is largely responsible for engendering the cooperative efforts required for the success of social forestry. (Sharma 1993)

Other studies point to the inadequate institutional structure of the Forestry Department to effectively integrate villagers' concerns, values and constraints in planning forestry-related activities. For example, the institutional division of responsibilities between government agencies is not conducive to the effective implementation of multi-dimensional, integrated programmes. In addition, joint management projects involving the Forest Department and rural communities have often been constrained by doubt and suspicion surrounding the distribution

of the product which in many cases is arbitrarily determined.

As the earlier discussion indicates, the economic viability of investments in tree planting is one of the key factors determining the adoption of farm forestry in India. Greater profits and hence higher adoption rates were to be found in the more commercial regions characterised by well-developed infrastructure and relatively close access to a growing market for forest products, particularly construction timber.

This leads the discussion in to the vertical dimension and marketing influences. This case study clearly shows that the existence of a dynamic local market is a crucial factor explaining the success of farm forestry in the relatively developed States in India. The lack of market access in many rural subsistence communities was typically compounded by the monopolist power, rent appropriation and debt bondage exercised by many of the intermediate traders and merchants that 'serviced' the more remote areas. Finally, government attempts at promoting vertical integration in the collection, processing and marketing of non-timber forest products (such as tasar silk, pine resin, turpentine, bidi leaves) have more often than not benefited the government more than the rural communities at whom the programme was originally targeted.

Project Sustainability: The above discussion indicates that the social forestry programme in India is clearly not sustainable in its current format. Unfortunately, the studies reviewed in this summary did not give information on ecological sustainability, but the fact that they have proved unable to effectively engage people's participation and provide a sustainable resource for the vast subsistence areas of India, strongly suggests that the programme is not sustainable in the social and economic dimensions.

Sources: Contreras-Hermosilla (1993) Saxena (1990) Sharma (1993).

Social Forestry in India				
	Knowledge of Resource	Horizontal Coordination	Vertical Coordination	Overall
Pros	-Maintenance of forest will conserve some form of biodiversity.	-Program was largely adopted on wealthier and more commercially developed regions. -Profits appear to have motivated farm forestry plantings -Successful cases of community involvement appear to have been associated with strong community bonds and institutions.	-Some of the products generated by the program were for self-consumption like fuelwood, fodder and timber. -There is also a dynamic local market for farm forestry.	
Cons		-Insecure land tenure, debt bondage, little expertise limited development in poor areas. -Heavy government involvement. -Arbitrary rent sharing schemes.	-Limited direct access to market for producers in less developed rural areas. -Efforts to encourage vertical integration appear to have benefited government rather than communities.	The lack of involvement of communities in the programme indicate that socio-economic requirements for sustainability have not been met.

9 Forest Certification: The Smart Wood Certification programme and the Forest Stewardship Council

A study commissioned by WWF investigating the environmental claims made by various UK retailers in their timber product's labels found that most of them were not supported by hard evidence and misled the public into believing that they came from sustainable sources. The results indicate a that although producers perceive the demand for environmentally conscious products, the means of verification and assurance are poorly developed. This state of affairs calls for the creation of agreed sustainability criteria, reliable and efficient means of monitoring such practices and credible to convey such information to consumers.

With this in mind, the Rainforest Alliance launched their Smart Wood program. The Rainforest Alliance is a voluntary organisation based in New York that established the first independent forestry certification programme in the world, Smart Wood, in 1990. Its main aim is 'to provide objective third party assessment of forest products sources and companies, enabling the public to identify good forest managers and companies whose harvesting does not contribute to the destruction of forests'. The programme has a worldwide scope and covers products from natural and plantation forests, as well as from agroforestry and small-scale community forest projects.

The specific criteria for certification used by Smart Wood include the following broad principles:

1 maintenance of environmental functions, including watershed stability and biological conservation

2 sustained yield forestry production

3 positive impact on local communities

The programme also provides expertise in developing forest management guidelines for interested parties, which includes comprehensive consultation with local people, governments and non-government organisations. Costs of the certification certificate are borne by the forestry organisation, but funds are available to subsidise organisations or companies that are committed to sustainable forestry but cannot afford the certification costs.

Once the forest operation complies with the sustainability criteria, Smart Wood issues a certificate, which can then be used by the operation to proof the environmental qualities of their timber. By following the timber along the processing line through a process called "chain-of-custody", the label can then be used in finished products at the retail level.

Despite the apparent benefits of Smart Wood, the overall effects will very much depend on the robustness of their criteria, their degree of scientific and political acceptability and, their credibility among consumers. So far, the Smart Wood programme is the largest and oldest certifier, with 7 certified forests covering 3,066,836 ha and producing some 817,000 m3. The long-term success of the programme depends on its credibility with consumers, and its ability to provide to producers preferential access to international markets.

Although several willingness to pay study show that consumers in some developed countries are willing to pay a premium for "sustainable" timber, the question still remains whether the provision of information and increased market access will provide sufficient incentives to move towards more sustainable forestry management and whether timber operations will be willing to invest in getting certified. In many cases the programme may also need to be supported by action on the underlying pressures that were leading to unsustainable resource management in the first place to complement the market incentives.

By now, other timber certification bodies have also started operations, like the Scientific Certification Systems (675,154ha), SGS Forestry (515,764ha) and the Soil Association's Woodmark (157ha). Although using similar criteria to identify sustainable sources, the fact that there are different labels and criteria can lead to confusion and reduced credibility.
In an attempt to unify these efforts, the Forest Stewardship Council (FSC) was created in 1993 as an accreditation body that aims to set widely accepted standards for good forest management. By monitoring the work of certification bodies like Smart Wood, the FSC ensures that FSC's criteria are met despite the differences in certification procedures being applied. In this respect, FSC represents an important step forward towards unification.

A potential drawback, however, is the lack of consensus in the wider community over the sustainability criteria. This lack of consensus evident in the number of parallel processes under way to design such sustainabiity criteria. Examples of this are ITTO, the Helsinki and Montreal Protocols and the Forest Stewardship Council. Once again, despite the wide similarities in the criteria, they represent partially connected parallel efforts that require greater coordination if they are to be efficient and effective.

The creation of the various certification and accreditation bodies provides an international framework to influence both producers and consumers of forest products with the mutual goal of moving towards sustainable forest management. The programme revolves around increasing knowledge of the resource, to producers in the form of forest management guidelines and to consumers in the form of product labelling. Besides the educational component, the programme also improves the functioning of the market by ensuring a supply of sustainable products to consumers and by providing an 'exclusive' market outlet for producers.

Source: Upton and Bass (1995), 'Smart Wood Certification programme'. Rainforest Alliance. New York.

Forest Certification: the Smart Wood Certification Programme and the Forest Stewardship Council				
	Knowledge of Resource	Horizontal Coordination	Vertical Coordination	Overall
Pros	-Contributes to the acquisition of knowledge through their certification procedures.	-Provides expertise in developing forest management guidelines. -Some of the criteria address the issue of socioeconomic conditions in the timber operations.	-shapes demand by informing consumers -favourably differentiates products from sustainable harvesting operations. -improves functioning of markets	-Program appears to be a useful tool if it manages to secure preferential access to international markets.
Cons	-Puts the burden of proof on the producer, which in many cases may not have the economic and technical capacity to get such knowledge. This barrier may limit the benefits of certification.	-Does not tackle market failures at the local level. -May create additional barriers for poor communities who have limited NGO support by reducing their market access and rising the necessary investments.	-certification increases the costs of the final product by the administrative costs of the program and the necessary practices.	-Increases costs along all stages of industry.

10 Promoting the Tagua Palm in Ecuador: conserving biodiversity through community support and product marketing

"People cut trees to pay for such essentials as food, clothing and health care. Until those essentials are met, forest conservation can seem like an unecessary luxury." (Tangley 1993) With this philisophy in mind, Conservation International launched the Tagua Initiative project in the Esmeraldas Province, in Ecuador, a region historically important in the tagua trade that had continued selling tagua to button-makers in Europe. The project emphasises the integration of economics with conservation and community development. Conservation International services producers by developing international markets for tagua and related products. Among other activities, it has provided training in accounting, management, and product sales to the 16 communities involved in the project. It also helps producers explore the potential for horizontal and vertical integration by developing new products such as jewellery and carvings.

This contributes considerable added-value to the tagua resources which are harnessed by the community itself. It also encourages diversification so that communities are not solely dependent on one or two products or markets. One important characteristic of the programme is that it is economically viable for all parties involved and does not rely on aid or subsidies. In some cases, Conservation International will financially assist producers but this is strictly in the form of loans, not grants. The economic success of the project is exemplified by their revenue, which by May 1993, nearly three years after the project began, had reached $1.5 million and some 900 tons of tagua had been sold in Ecuador and abroad. Likewise, social success is reflected in the demonstrated interest of the communities in improving their harvesting forest to conserve the forest.

Seed Vantures, CI's department running the Tagua Initiative, is actively involved in developing, implementing, and marketing non-timber products. After the encouraging results in the Tagua Initiative, they have expanded their range of products to include: Potpourri, Brazil nuts, Carrageenan, Essential oils and Cacao.

The primary role of CI is to be an intermediary to increase the bargaining power of producers and ensure them a fair price. CI also receives a royalty of 5% on gross sales, which is used to run the Seed Venture program. In future, Seed Ventures plan to expand their activities into other support activities such as financing, credit assistance, technical enterprise, and marketing. From their success in the marketplace, interest is developing in 'green labelling'.

The project is therefore aimed at increasing international demand for sustainably managed resources and reducing their supply cost, while ensuring that revenues are targeted to producers rather than to middlemen. It stresses the role of marketing and increasing information to the consumer. Critical rain forest sites and harvest practices are regularly monitored on behalf of Conservation International to ensure their sustainability. Some manufactures and retailers explain the conservation effort through a hanging tag. Others choose not to do so for fear of diluting their brand image or bringing attention to other industry practices with potentially undesirable environmental implications.

A next stage of the Tagua Initiative strategy is to diversify production in order to insure the communities against fluctuations in a single market. Tagua resulted a good initial choice given

factors such as:

i) it was an already existing market

ii) tagua is available all year round

iii) there was a long local tradition of harvesting and selling tagua

To assess overall project sustainability requires further information. The source report does not give details about the proportion of the profits that accrue to the community producers nor does it give information about the impact of the programme on biodiversity conservation and harvesting practices. However, it would appear that the project has achieved their objective to share the rents along all the industrial chain, from producer to retailer, in order to make it sufficiently profitable for every player in the economioc chain to maintain their conservation incentives.

Tagua Initiative is another example of a project that emphasises demand creation and consumer education about forest products but does not explicitly address underlying supply constraints that may lead to over-harvesting, these considerations are left to the capacity of the project to satisfy increased demands by a more diversified market.

Sources: Caldero Hidalgo (1992), Carr, Pedersen and Ramaswamy (1993), Tangley (1993), Steve Dunn (pers. comm).

Tagua Palm in Ecuador				
	Knowledge of Resource	Horizontal Coordination	Vertical Coordination	Overall
Pros	-Monitoring is carried out regularly by third parties to ensure sustainability.	-Royalty fees are used to support local conservation and community development programmes. -Financially self-sufficient. -Conservation International provides loans, not grants.	-Producing communities have a coordinated marketing strategy, which strengths bargaining power of local communities. -New international markets have been opened. -Vertical integration is promoted by encouraging locals to develop new products.	Demand creation and consumer education are important elements of sustainability, but biological sustainability needs to be ensured.
Cons		-The running of the initiative has significant costs (5% according to the royalty size) that reduce the available rents of the activity.	-Increased costs reduce competitiveness of sustainable products unless a strong environmental awareness drives demand.	

11 Ecotourism in Costa Rica: reconciling conservation and development interests

Ecotourism has been defined as 'purposeful travel that creates an understanding of cultural and natural history, while safeguarding the integrity of the ecosystem and producing economic benefits that encourage conservation' (Ryel 1991). In Costa Rica nature tourism has boomed in recent years, increasing by 80 percent between 1987 and 1990, and growing by a further 25 percent to become Costa Rica's third largest source of foreign exchange.

However, the development of ecotourism in Costa Rica has not fulfilled its original objective of reconciling conservation and development interests. The strategy of sustainable development through ecotourism was placed in the hands of the private sector. The programme has been successful in tapping into the growing international demand for ecotourism. A large number of ecotourism operators has sprung up and the consequent growth of the ecotourism industry has put strains on the fragile resource base. 'For example, the large number of visitors at popular parks is causing such problems as erosion and water pollution. Given the attraction of tourist revenues and the danger of overcrowding, environmental entrepreneurs are finding it difficult to create ecotourism programmes that are consistent with the principles of sustainable development' (Boo 1990).

The issue of scale and the public good nature of the resource are two issues which seem to have been neglected in private sector ecotourism strategy in Costa Rica. Nonetheless, some firms are striving to maintain the balance between revenue generation, community participation and resource conservation. For example, International Expeditions an Alabama based company which has adopted a conservation ethic in its business practices in Costa Rica. Firstly, it includes public education programmes to increase environmental awareness. Secondly, activities are designed to ensure community participation and to maximise the benefits for local people. For example, to create a flow of money into the local economy, the company uses the host country's airline when possible, employs local tour operators and uses other services within the rain forest community, including accommodation. These efforts ensure that about 50 percent of the revenues from tours and workshops organised by International Expeditions go to Costa Rica.

However, the overall sustainability of ecotourism in Costa Rica remains in doubt. The recent expansion of demand for ecotourism services has stretched the capacity of the resource to supply these services without damaging the resource base. Some operators are voluntarily pursuing more sustainable practices including education and community participation programmes. However the underlying issue of rights and access to the resource have not been adequately addressed.

Sources: Ryel and Grasse (1991) Boo (1990).

Eco-tourism in Costa Rica				
	Knowledge of Resource	Horizontal Coordination	Vertical Coordination	Overall
Pros	-Ecotourism can have little impact on natural habitats if properly managed. -Public education programs have increased public knowledge and awareness of resource values.	-Few ecotourism operators have a policy to ensure that a fraction of rents are captured by Costa Rica.	-The most common form of local benefit has been through local employment. -Activity generates significant revenues.	
Cons		-A very small percentage of revenues from ecotourism are captured by the communities living next to the resource.	-Variability of demand creates uncertainty. -Recent tourist boom has led to negative impacts on natural habitats. -Limited downstream integration means that few rents are channeled through to local communities. -The majority of rents are being captured by foreign firms.	-Sustainability of current arrangements is doubtful given that little revenue is being channeled to communities.

References

Almengor, M.A., C.L. Mo and E. Vargas (1994) 'Turtle eggs as a sustainable natural resource'. Oryx, 28(3, July): 143.

Alvard, M. (1995) 'Shotguns and sustainable hunting in the neotropics'. Oryx, 29(1, January): 58-66.

Aylward, B.A., J. Echeverria, L. Fendt and E.B. Barbier (1993) 'A case study of Costa Rica's national biodiversity institute'. In The Economic Value of Species Information and its Role in Biodiversity Conservation: Case Studies of Costa Rica's National Biodiversity Institute and Pharmaceutical Prospecting. London Environmental Economics Centre and INBio.

Balick, M.J. and R. Mendelsohn (1992) 'Assessing the economic value of traditional medicines from tropical rain forests'. Conservation Biology, 6(1, March): 128-30.

Barbier, E.B., J.C. Burgess, T.M. Swanson and D.W. Pearce (1990) Elephants, Economics and Ivory. Earthscan publications Ltd., United Kingdom.

Bardhan, P. editor (1989) The Economic Theory of Agrarian Institutions. Claredon Press, Oxford, United Kingdom.

Belausteguigoitia, J.C. and J.C. Fernández (1994) 'Los bosques en México. Situación actual y perspectivas ante la Nueva Ley Forestal y el TLC: Un Análisis a partir del mercado de la madera'. Technical report, Instituto Tecnológico Autónomo de México.

Bond, I. (1994) 'The importance of sport-hunted African elephants to CAMPFIRE in Zimbabwe'. TRAFFIC Bulletin, 14(3): 117-19.

Boo, E. (1990) 'Ecoturismo: Potenciales y escollos'. Report, WWF and The Conservation Foundation, Washington DC.

Caldero Hidalgo, R. (1992) The Tagua Initiative in Ecuador: A community approach to tropical rain forest conservation and development. In Plotkin and Femolare *Sustainable harvest and marketing of rainforest products*, Conservation International, Washington.

Carr T.A., Pedersen H.L., and S. Ramaswamys (1993) 'Rain forest entrepreneurs: Cashing in on conservation'. Environment, 35(7).

César-Dachary, A. and S. M. Arnaiz Burne (1989) Sian Ka'an, el hombre y su economía.. Centro de Investigaciones de Quintana Roo (CIQRO), Chetumal, Quintana Roo, August.

Child, B. (1994) 'Using Zimbabwe's CAMPFIRE programme to assess the value of IUCN's proposed guidelines for the ecological sustainability of nonconsumptive and consumptive uses of wild species'. In IUCN 1994a, Buenos Aires, Argentina, 12-14 January.

Chitrakar, A. (1994) 'Lokta harvesting and paper making in Nepal'. In IUCN 1994a, Buenos Aires, Argentina, 12-14 January.

Christoffersen, N.D. and C. Lippai, eds. (1993) Responsible Wildlife Resource Management: Balancing Biological, Economic, Cultural and Moral Considerations. Brussels, Belgium, 29-30 November 1993. EBCD, European Bureau for Conservation and Development.

Des Clers, B. (1993) 'Game species in Europe and North America'. In Christoffersen and Lippai.

Coase, R.H. (1960) 'The problem of social cost'. Journal of Law and Economics, 3: 1-44.

Collier, G.A. (1992) 'Deforestation, energy development and the transformation of peasant agriculture Southeastern México: An unexpected outcome of "dutch disease"'. Technical report, Stanford University, Department of Anthropology, August.

Contreras-Hermosilla, A. (1993) 'Forestry policies in india'. Technical report, The World Bank.

Cunningham, A.B. and F.T. Mbenkum (1993) 'Sustainability of harvesting Prunus africana bark in Cameroon: A medicinal plant in international trade'. People and Plants Working Paper. UNESCO, France, May.

Dasgupta, P. (1993) An Inquiry Into Well-Being and Destitution. Claredon Press, Oxford, United Kingdom.

Dean, P.B. (1990) 'Game ranching in Zimbabwe: Wildlife as an agricultural commodity'. Mimeo.

Edwards, S.R. (1993) 'Sustainable use: A model for conservation with development'. In Christoffersen and Lippai.

Egede, I. (1993) 'The hunters perspective'. In Christoffersen and Lippai.

Eltringham, S.K. (1984) Wildlife Resources and Economic Development. John Wiley and Sons, United Kingdom.

Eltringham, S.K. (1994) 'Can wildlife pay its way?'. Oryx, 28(3, July): 163-72.

Fernández, J.C. (1995) 'Commercial Use of Vicuña in Chile and Perú'. Technical report, Cambridge University/WCMC. Case study for Darwin Initiative Project on Sustainable Wildlife Use for Biodiversity Conservation.

Fernández, J.C. (1995a) 'Conservation and Development in the Monarch Butterfly Special Biosphere Reserva, México'. Cambridge University/WCMC. Case study for Darwin Initiative Project on Sustainable Wildlife Use for Biodiversity Conservation.

Fernández, J.C. and R.A. Luxmoore (1995) 'The Crocodile Industry in Papua New Guinea'. Cambridge University/WCMC. Case study for Darwin Initiative Project on Sustainable Wildlife

Use for Biodiversity Conservation.

Foerster, R., M. Del Angel, F. Montalvo and R. Terrón (1991) 'Estudio del mercado nacional de maderas corrientes tropicales'. Technical report, Fideicomiso del Fondo Forestal, México, December.

Freese, C., C. Alho, B. Coates, A. Fernhout, J. Habrovsky, G. Hemley, B. Hoskinson, K. Lyonette, T. McShane, F. Sheng and M. Sutton (1994) 'The commercial, consumptive use of wild species: Implications for biodiversity conservation'. A WWF International interim report, World Wide Fund for Nature, Gland, Switzerland, October .

Freese, C.H. and C.J. Saavedra (1991) 'Prospects for Wildlife Management in Latin America and the Caribbean', chapter 7.28, pages 430-44. In Robinson and Redford.

Galleti, H.A. (1992) 'Aprovechamiento e industrialización forestal, desarrollo y perspectivas'. In César-Dachary et al. 1992. Chapter VI. Centro de Investigaciones de Quintana Roo (CIQRO), Quintana Roo, Mexico.

Giannecchini, J. (1993) 'Ecotourism: New partners, new relationships'. Conservation Biology, 7(2, June): 429-32.

Giordano, G. (1987) 'Pilot study of markets of high-value tropical timber products in Italy'. Technical report, International Tropical Timber Organization, Rome, Italy.

Gorman, P. (1992) 'Snakes alive'. Wildlife Conservation, pages 60-5, January-February.

Hemley, G. (1994) 'Monitoring the international crocodilian trade: Useful tool or useless bureaucracy?'. In Proceedings of the 2nd Regional Meeting (Eastern Asia, Oceania, Australasia) of the Crocodile Specialist Group of the Species Survival Commision of IUCN-The World Conservation Union.. Convened at Darwin, Northern Territory, Australia. Unedited and Unreviewed.

INBio (1994) 'Annual report 1994'. Technical report, Instituto Nacional de Biodiversidad, Costa Rica.

IUCN (1990) Sustainable Use of Wildlife. Perth, Australia, 28 November-5 December.

IUCN (1994) Crocodiles. Gland, Switzerland, 12-19 March 1994. Unedited and Unreviewed.

IUCN (1994) Proceedings of the First Meeting of the IUCN/SCC Special Group on the Sustainable Use of Wild Species. Convened at Buenos Aires, Argentina, 12-14 January.

Jenkins, R.W.G. (1994) 'Sustainable use of crocodilians - conservation benefits'. In Proceedings of the 2nd Regional Meeting (Eastern Asia, Oceania, Australasia) of the Crocodile Specialist Group of the Species Survival Commision of IUCN-The World Conservation Union. Convened at Darwin, Northern Territory, Australia. Unedited and Unreviewed.

Lloyd, K. and R. Graf (1990) 'An overview of wildlife management in the Northwest

Territories, Canada. In Proceedings of the 18th Session of the General Assembly.

Kalland, A. (1993) 'Seals, Whales and Elephants: Totem animals and the anti-use campaigns'. In Christoffersen and Lippai.

Lever, J. (1994) 'Captive breeding and conservation. allies or enemies?'. In Proceedings of the 12th Working Meeting of the Crocodile Specialist Group of the Species Survival Commision of IUCN-The World Conservation Union. Convened at Pattaya, Thailand. Koorana Crocodile Farm, 2-6 May.

McNeely, J.A. (1988) Economics and Biological Diversity: Developing and Using Economic Incentives to Conserve Biological Resources. IUCN, Switzerland.

Medio, D. (1995) 'Sustainable Tourism in the Ras Mohammed National Park, Egypt'.Technical report, Tropical Marchine Research Unit, York University. Case study for Darwin Initiative Project on Sustainable Wildlife Use for Biodiversity Conservation.

Muir, K. and J. Boj (1994) 'Economic policy, wildlife and land use in Zimbabwe'. Environment Working Paper 68, The World Bank.

Munasinghe, M. (1992) 'Biodiversity protection policy: Environmental valuation and distributional issues'. AMBIO, 21(3, May): 227-36.

Saxena N.C. (1990) 'Farm forestry in North-west india'. Studies in Sustainable Forest Management 4, Ford Foundation, New Delhi.

Perrings, C., C. Folke, and K.-G. Maler (1992) 'The ecology and economics of biodiversity loss: The research agenda'. AMBIO, 21(3, May): 201-1

Peters, C.M., A.H. Gentry and R.O. Mendelsohn (1989) 'Valuation of an amazonian rainforests'. Nature, 339: 655-6.

Prance G. (1990) 'Fruits of the rainforest'. New Scientist, pages 42-5.

Prescott-Allen, C. and R. Prescott-Allen (1992) 'Handmade paper production'. In IUCN 1994a.

Quiggin, J. (1993) 'Common property, equality, and development'. World Development, 21(7): 1123-38.

Ryel R. and T. Grasse (1991) 'Marketing ecotourism: Attracting the elusive ecotourist'. In Whelan T., editor, Nature Tourism. Washington DC, Island Press.

Rasker, R., M.V. Marchtin and R.L. Johnson (1992) 'Economics: Theory versus practice in wildlife management'. Conservation Biology, 6(3, September): 338-49.

Richards, E.M. 'The forest ejidos of South-east México: A case study of participatory natural forest management'. Paper 13c, Rural Development Forestry Network, Overseas Development Institute, England.

Robinson, J.G. and K.H. Redford, editors (1991) Neotropical Wildlife Use and Conservation. University of Chicago Press, Chicago, United States.

Robinson, J. and K. Redford (1991a) 'The Use and Conservation of Wildlife', chapter 1, pages 3-5. In Robinson and Redford.

Rose, D.A. (1992) 'Free trade and wildlife trade'. Conservation Biology, 6(1): 148,150, March 1992.

Runge, C.F. (1986) 'Common property and collective action in economic development'. World Development, 14(5): 623-35.

Salafsky, N., B.L. Dugelby and J.W. Terborgh (1993) 'Can extractive reserves save the rainforest? an ecological and socioeconomic comparison of nontimber forest product extraction systems in Petén, Guatemala, and West Kalimantan, Indonesia'. Conservation Biology, 7(1, March): 39-52.

Sharma, R.A. (1993) 'The socioeconomic evaluation of social forestry policy in India'. Ambio, 22(4).

Sheng, F. (1993) 'Sustainable use: A balanced approach to conservation'. In Christoffersen and Lippai.

Sleeper, B. (1988) 'The high price of fur'. Animals, November-December.

Slough, B.G. and R. Harvey Jessup (1994) 'Case study on the ecological sustainability of consumptive and nonconsumptive uses of wild species: Furbearer harvesting in the Yukon Territory, Canada'. In IUCN 1994a, Buenos Aires, Argentina.

Saucedo Soto, A. and B. Acosta Villa (1989) 'Modelo de organización para la producción forestal de la comunidad indígena de Nuevo San Juan Parangaricutiro, Michoacán'. Master's thesis, Universidad Michoacana de San Nicolás de Hidalgo.

Stiles, D. (1994) 'Tribals and trade: A strategy for cultural and ecological survival'. AMBIO, 23(2, March): 106-1

Swanson, T. (1995) Conflicts in Wildlife Conservation- The Role of Property Rights: The Southern African Conservancies. Technical report, Cambridge University, 1995. Case study for Darwin Initiative Project on Sustainable Wildlife Use for Biodiversity Conservation.

Swanson, T. and J.C. Fernández (1995) 'Regulating the rhino: Addressing the stockpilers problem'. Unpublished report, Cambridge University.

Swanson, T.M. (1990) 'Wildlife utilisation and biological diversity'. In Proceedings of the 18th Session of the General Assembly IUCN/SCC.

Swanson, T.M. (1992) 'Economics of a biodiversity convention'. AMBIO, 21(3, May): 250-7.

Tangley, L. (1993) *Marketing Biodiversity Products: The Tagua Initiative, Lessons from the Field II*, Conservation International, Washington DC, 1993.

Taylor, R.D. (1994) 'Elephant management in Zimbabwe - urning a liability into an asset'. Oryx, 3(3, July): 145-6.

Thouless, C.R. (1994) 'Conflict between humans and elephants on private land in Northern Kenya'. Oryx, 28(2, April): 119-28.

Upton, C. and S. Bass (1995) *The Forest Certification Handbook*, Earthscan, UK.

Vernon, B.P. (1994) 'The economics of crocodile farming'. In Proceedings of the 2nd Regional Meeting (Eastern Asia, Oceania, Australasia) of the Crocodile Specialist Group of the Species Survival Commision of IUCN-The World Conservation Union. Convened at Darwin, Northern Territory, Australia. Unedited and Unreviewed.

Whitaker, R. and H. Andrews (1994) 'The Irula venom centre-India'. In IUCN 1994a, Buenos Aires, Argentina, 12-14 January 1994.

WWF (1993) 'Sustainable Use of Natural Resources: Concepts, issues and criteria'. A WWF International Position paper, World Wide Fund for Nature, Gland, Switzerland, August.

Personal communications

Steve Dunn, Marketing Assistant, Seed Ventures.

Part III

Case studies

1

Conservation and development in the Monarch Butterfly Special Biosphere Reserve, Mexico

Carlos Fernandez

Table of contents

Acknowledgements

1 Introduction

2 Biology of the Monarch butterfly and its habitat requirements
- 2.1 Overwintering areas
- 2.2 Habitat requirements of the Monarch butterfly
- 2.3 Status of the overwintering habitats
  - 2.3.1 Cerro Pelon
  - 2.3.2 Cerro Altamirano
  - 2.3.3 Cerro El Campanario
  - 2.3.4 Cerros Chivati y Huacal
  - 2.3.5 Sierra Chincua

3 The human population: conservation and development demands

4 The socioeconomic conditions in the region
- 4.1 Social Indicators
  - 4.1.6 Population characteristics
  - 4.1.7 Indigenous population
  - 4.1.8 Education
  - 4.1.9 Marginality and poverty
  - 4.1.10 Infrastructure
- 4.2 The regional economy
  - 4.2.1 Agriculture and livestock rearing
  - 4.2.2 Industry and services
  - 4.2.3 Government investment

5 Forestry as a conservation strategy
- 5.1 Illegal logging: incentives and control
- 5.2 Competitiveness of the local industry
- 5.3 Other economic activities within the forest
- 5.4 Monarch butterfly - forest industry interactions
  - 5.4.1 Current and future trends

6 Tourism as a conservation strategy
- 6.1 Community participation
- 6.2 Social institutions and tourism
- 6.3 Vertical coordination: Dissipation of rents outside the community
- 6.4 Competitiveness of the tourism industry in the region

7 Conclusions

8 Abbreviations

Acknowledgements

This project would not have been possible without the kind support of many people, specially Enriqueta Velarde, Director general at the Instituto de Ecología for granting me access to their files. In particular, I would like to thank Guillermo Trejo for his useful comments and Joel Delgadillo, who provided useful insights into the current management practices and trends at the reserves.

Finally, I would also like to thank the people of El Rosario for their kind support and collaboration during the brief survey carried out in December 1994.

1 Introduction

The Monarch butterfly, *Danaus plexippus*, undertakes one of the most outstanding examples of animal migration. Its annual migration is the most spectacular of the insect world and has been described as 'a unique biological phenomenon' (Brower 1985). Each winter, hundreds of millions of Monarchs coalesce from a continent wide distribution to overwinter at as many as 129 colonies in California and approximately 10 small sites in central Mexico that range in area from 0.03 to 3.34 hectares of oyamel fir forest. The work of Fred Urquhart since 1937 has provided many useful insights into this migratory pattern of the Monarch butterfly, and the discovery of their overwintering habitat has led to a steady stream of research given their value as testable ecological, evolutionary, behavioural, and physiological models (Malcolm an Zaluki 1993, Chapter 1).

Despite the fact that the Monarch butterfly as a species is a common insect in the American continent and Oceania, its unique migration in temperate environments makes it vulnerable to habitat perturbations. Its migration to tightly aggregated overwintering sites makes this phase of the Monarch's life history especially vulnerable. Hence, the conservation of these overwintering aggregations and its habitat is crucial to ensure the continuation of the migrations. Although the species is not considered in danger of extinction, under IUCN classifications the Monarch migration in North America has been classified as a 'threatened phenomenon'. The fact that the Monarch remains for up to 5 months in these heavily packed aggregation poses considerable problems for their conservation, particularly in Mexico, where socioeconomic pressures for land use are greatest.

In California, the Xerces society secured funding for the Monarch Project in 1984 and started negotiating protective easements and landowner registrations. In 1988, $2 million dollars were assigned by the state government for Monarch habitat site acquisitions, this has been the closest to a mandate for preservation in the US legal system, since the Monarch was not protected because it is not an endangered species. At present, the Xerces society has been involved in habitat enrichment in the purchased and eased overwintering sites.

Unlike California, Mexico's overwintering sites are mostly located in communal and ejido land under community management, and socioeconomic pressures make the creation of private reserves an unfeasible strategy for most sites. In fact, only one fraction in one of the five biosphere reserves created to protect the Monarch is owned by a conservation organisation, Monarca A.C. The oyamel fir forest, used exclusively by the Monarch has been exploited both for commercial and consumptive use in Mexico to a point that only 40,000-50,000 ha. are thought to be left, and even those are known to be qualitatively much more degraded that 20 years ago and even the forested areas within the reserves show signs of overexploitation (Malcolm 1993, chapter 9). The main legal instrument for the protection of the Monarch Butterfly was given in 1980 when a decree gave it protected status and in 1986, when the Monarch Butterfly Special Biosphere Reserve (MBSBR) was formally created.

As a means to involve the local community and help alleviate the negative impacts of the restrictions on logging, Monarca AC and the government have encouraged the affluence of tourism in one site open to the public. Since 1994 a new site was allowed to be open for tourist and the revenues will also be directed to the communities as in the other site. At the same time,

controls to ensure a sustainable amount of logging have imposed a heavy burden on all communities in the region and illegal activity has increased in some areas.

With population pressures and the need to allow the local communities to make a living with their resources, there is a need to ensure that an adequate balance is reached between land use by the communities (forestry) and by the society at large (conservation). Moreover, new biological data suggests that the two activities may not be mutually exclusive, and that some kind of forest management is even desirable from a conservation point of view.

The present report will analyse the balance reached between these social pressures and the conservation objectives and will analyse the current and future prospects for the conservation of the phenomenon and the development of the also vulnerable local population.

The report is organised as follows: the next section will present a description of the legal status of the reserve and of the various agents affected, positively or negatively, by its conservation; sections 3 and 4 will then characterise the two main agents at the local level: the human population and the Monarch butterfly and its overwintering habitat. These sections lay the foundations for the discussion in sections 5 and 6 of the forestry and tourism activities carried out in the region and their compatibility with the conservation objectives.

We end with a set of conclusions regarding the compatibility of the social and biological objectives in the area of influence of the MBSBR.

2 Biology of the Monarch butterfly and its habitat requirements

Perhaps the most impressive characteristic of the Monarch butterfly is its capacity to migrate long distances and coalesce to a small area every year. There are three main routes used by the Monarch (see Map 1): the Pacific Ocean route used by populations in southwest Canada and northwest USA to overwinter along the coast between San Francisco and San Diego in California; a second route is used by butterflies crossing the Gulf of Mexico from southeast Canada and northwest USA through Florida, Cuba and Yucatan to hibernate around Chiapas and Guatemala; however, no hibernation colonies have been located in this region (de la Maza and Calvert 1993). The third and main route, however, is the one entering Mexico through the east mountain range (Sierra Madre Oriental) and gathering in the same overwintering sites between the States of Michoacan and Mexico. The method of navigation is not fully understood, but is believed that magnetic ones may be used.

The butterflies arrive at the colonies in Mexico as early as mid October and remain until mid March, largely coinciding with the dry season in the region (see Figure 1). This is of considerable importance for the forestry activities as will be discussed below.

2.1 Overwintering areas

The permanent overwintering areas of the Monarch butterfly are located in a relatively small region of the Transvolcanic Belt in central Mexico in an arc of approximately 143 km.. (See Map 2 and Calvert and Brower 1986). The main five areas are within the MBSBR: Cerro Pelon, Cerro Altamirano, Cerro El Campanario, Sierra Chincua, Cerros Chivati-Huacal.

In the overwintering areas in Mexico, six vegetation types have been identified by Soto and Vazquez (1993). The most important of them is the Abies forest, dominated by the oyamel (Abies religiosa). This is the most important plant in the Monarch overwintering area. The dense canopy regulates the microclimate, reducing variations in temperature and maintaining the moisture levels. This favourable climate may account for the Monarch's selection of these Mexican forests. The diversity in these forest is relatively high, particularly in disturbed areas.

In a study between 1979-84 by Soto and Vazquez (1993), the El Rosario site was found to have the greatest disturbance, with remaining areas of natural forest restricted to the highest peaks. Chincua had the lowest disturbance followed by Chivati.

Other vegetation types present are upland cloud forest and the mixed Abies-pinus forest. The cloud forest is used by some butterfly colonies. The mixed forest is heavily disturbed and occurs mostly between 2,800 and 3,000 m, extending over the vast area of Chivati and almost all of El Rosario. In Chincua it is almost non-existent.

At around the same altitude range, areas of pine forest (Pinus) occur, generally in areas of strong human influence and usually at lower altitudes than the fir.

Potentilla meadow and Juniperus shrubland also occur around clearings and around watercourses.

2.2 Habitat requirements of the Monarch butterfly

Monarchs require conditions of stable temperatures and humidity in order to conserve energy, avoid predators and have access to an adequate supply of water (Calvert and Lawton 1993, Alonso et al.1993, Arellano et al.1993).

While there is a general consensus regarding the climatic parameters, considerable debate has arisen recently regarding the habitat requirements implied by these factors, particularly with respect to the role of the disturbed forests as opposed to undisturbed ones.

On the one hand, undisturbed forests offer adequate thermal regulation, moisture and lighting conditions, but they do not have a understory as rich and dense as the disturbed forests, and hence have less nectar availability and offer less protection against predators than disturbed forests.

Whether these factors balance out among the different areas is unknown, however, empirical evidence seems to indicate that Monarchs prefer forests with intermediate tree densities, i.e. disturbed forests (Hoth 1993) (see also Figure 2).These findings can further strengthen the case for a greater role of forest management as a requirement to conservation as will be discussed below.

2.3 Status of the overwintering habitats

The Monarch Butterfly was declared protected in Mexico in 1980, but it was not until 1986 that

the Monarch Butterfly Special Biosphere Reserve (MBSBR) was formed by decree and its boundaries established. In total, the reserve covers some 16,110 ha. in the Mexican states of Mexico and Michoacan. The objective of the reserve was to protect the Monarch butterfly, its overwintering refuges and its migratory behaviour. The five areas comprising the reserve differ significantly in size and degree of restrictions (Buffer and Core reserve proportions) as can be seen in Figure 3.

2.3.1 Cerro Pelon

In terms of area, Cerro Pelon is by far the largest, with more than half of the total reserve area (8,132 ha), although most of the area consists of buffer zones. Almost 68 percent of the reserve is located in the State of Mexico, which currently has a permanent ban on logging. There are reports of significant illegal logging, particularly in the north region. The local population is engaged in primary activities and there are various towns near the boundaries of the reserve.

Land use patterns in the region appear to have been altered only slightly between 1982 and 1990, with a net reduction of 164.5 ha. (2.1 percent) of dense forest converted to open forest (see Table 1 and Figure 4, SARH 1993). From the 1994-5 season the Ejido of El Capulin was allowed by the Government to receive tourists.

Table 1. Areas and land use patterns in the five areas ofthe MBSBR (ha).

RESERVE	Campanario	Chincua	Chivati Huacal	C. Altamirano	C. Pelon	Total
VEGETATION COVER 1982/84						
Dense Forest	948	2,108	1,775	1,075	5,471	11,377
Closed Forest	518	426	199	262	1,283	2,688
Open Forest	195	38	0	14	1,110	1,356
Meadows and shrubland	130	3	8	21	115	276
Agricultural and livestock grazing	99	121	33	7	153	413
VEGETATION COVER 1989/90						
Dense Forest	948	1,914	609	1,037	5,307	9,814
Closed Forest	518	526	975	221	1,288	3,527
Open Forest	195	84	382	99	1,306	2,065
Meadows and shrubland	130	54	19	16	113	332
Agricultural and livestock grazing	99	119	31	6	119	373
Total	1,889	2,696	2,016	1,378	8,132	16,110

Source: SARH 1993.

2.3.2 Cerro Altamirano

This is the smallest of all reserves, with 1,378 ha. The nearest human settlements are scattered, although there are major towns nearby, particularly Contepec. As in the case of Cerro Pelon,

more than half of the reserve is in the State of Mexico (60 percent).

Most changes in land use between 1983-4 and 1989-90 have been the conversion of dense and closed forest to open forest, with a net increase in open forest of 85.4 ha. (6.2 percent).

2.3.3 Cerro El Campanario

This reserve has 1,889 ha, with 900ha. in the core of the reserve. This reserve was the most disturbed at the time of its creation, and only half of the area was dense forest in 1983-4. There is also a significant area of shrubland, arable agriculture and livestock grazing.

The initial degree of disturbance probably explains the absence of net variation in vegetation cover found in the land use study undertaken by SARH (1993). This section of the reserve offers the best access to the Monarch colonies and the nearby town of El Rosario has been the centre of the tourism developments to exploit this.

2.3.4 Cerros Chivati y Huacal

This area has been subject to the greatest alterations in land use. In 1982-4 the area had 1,774.8 ha. of dense forests which represented 88 percent of the total area of the reserve, however, by 1989-90, the area had been reduced to just 608.5 ha, with most forested land being thinned to either closed (975.2 ha) or open forest (381.6 ha).

This area has significant areas of relatively gentle slopes which allow easy access to forested areas and have some agricultural potential. Human settlements tend to be scattered, with only one village close to the reserve (Francisco Serrato).

2.3.5 Sierra Chincua

The complex topography has limited the human settlements around the reserve. Extensive cattle grazing and subsistence agriculture, mainly of maize, takes place in low lying parts of the reserve. After Chivati-Huacal this reserve has experienced the most significant alterations in land use, with 194 ha. of dense forest converted to closed (99.7 ha), open (45.8 ha) forest and shrubland (51.8 ha).

Inside the reserve there was a private property plot of some 700 ha. which was bought by SEDUE and, together with Monarca AC, it has established both a tree nursery and a research station in the reserve.

3 The human population: conservation and development demands

Conceptually, the total economic value of natural resources consists of a mix of use and non-use values. Under some circumstances, all values are captured by the owner of the resource. However, the values are often perceived by different agents and, in the absence of negotiating channels, the externalities persist, calling for alternative means to solve them.

The MBSBR directly affected 37 ejidos 11 communities and 5 small private properties (SARH

1993). Of the total area, the Government of Michoacan has expropriated 80 ha. and SEDUE has bought 700 ha. from a private landowner in Ex. Hacienda Chincua.

The five separate areas of the MBSBR present particular problems with regards to land tenure status. Table 2 shows individual areas and the number of communities affected. As can be seen, the social conflicts created by the reserve are much greater in Michoacan, where a total of 37 units under social ownership where affected, whereas in the State of Mexico, this number is only 11. Chincua and Chivati Huacal present the greatest conflict, with 15 and 10 ejidos and communities affected by the reserve.

Table 2. Number of different land plots and their status in the MBSBR

State	Tenure status	Campanario	Chincua	Chivati Huacal	C. Altamirano	C. Pelon	Total
Michoacan	Communities	0	0	6	0	3	9
	Ejidos	4	15	4	1	4	28
	Private	0	1	0	0	0	1
	Total Area (ha)	824	2696	2015	557	2637	8729
State of Mexico	Communities	0	0	0	0	2	2
	Ejidos	4	0	0	0	4	8
	Private	0	0	0	0	3	3
	Total Area (ha)	1065	0	0	821	5495	7381

Source: SARH 1993.

Recent work by Chapela and Barkin (1995) has found substantial divergence between the reserve boundaries established by the Decree and the boundaries used by the local UCODEFO in Michoacan, the latter being the one used for forest management activities. This lack of precise boundaries to the reserve is a cause of conflict among the local communities and increases the tenure and ownership problems in the region.[1]

The establishment of the reserve created significant stress on the local communities, some of which depended heavily on the forest. Logging was not allowed in the core reserve but some limited logging was permitted in the buffer zones. The Secretariat of Agriculture issued some ten-year forestry permits shortly after the declaration of the reserve. Hence, since its creation, the reserve has been the centre of a political and social battle between ecological groups, scientists, government secretariats and the local communities.

[1] Incidentally, the authors also found significant differences in boundaries and size between the maps used by the Forestry Commision in Michoacan and those established by the National Agrarian Register, an added factor creating insecurity in property rights.

Additionally, there has been a significant flow of tourists to the region, creating a small local tourist industry and providing income for some of the inhabitants. The Monarch butterfly has also been a strong centre of political interest and has even been used as a symbol for the North American Free Trade Agreement.

Hence, there is a wide mosaic of views and objectives of the various stake holders in the region which have to be taken into consideration in any development strategy being put forward. Biological data are providing new insights into the behaviour of the migratory phenomena which could open new areas of compatibility between rural development through commercial timber extraction and ecotourism and conservation of the Monarch butterfly.

The socioeconomic factors, however, are still in embryonic state and important new initiatives are only seen in a few ejidos in the region. To clarify the nature of the different actors involved Table 3 presents a simplified description of the various stake holders. In the next sections, we will describe to what extent the conflicting interests of these agents have and can be reconciled.

Of these stake holders, the ones receiving the most direct impact on their livelihoods are the ejidos and communities who have faced additional restrictions on the use of their resources.

The need to seek compromises between local rural development and conservation was unavoidable in the case of the MBSBR since the area covered by the reserve was under social ownership and there existed limitations on land uses and transactions. The strategy applied in California could not be implemented widely, and the only land purchases for the creation of a reserve were a 700 ha. private plot in Sierra Chincua bought by SEDUE and 70 ha. bought by the state of Michoacan.

After the reform of the agrarian law in 1992, expropriation was contemplated as an alternative. A study by SARH indicates that compensation for ejido lands or purchases from private landowners could cost some N$30,000 per ha. in forested land and N$15,000 per ha. in agricultural plots and N$1,000 in grazing land (SARH 1992). These values, however, are likely to be understating the real market value since no active land market exists in Mexico given the restrictions on land markets that were in place until 1992. This initiative, however, has not been undertaken and there has been no socioeconomic study concerning the potential impact of the measures. Even if purchases were made, it is still not clear that adequate enforcement could take place.

Table 3. Stakeholders in the MBSBR

Stakeholder	Description
Ejidos and communities	Legal "users" of forested area. It is estimated that some 50,000 people are affected. The ejidos want either the right to use the forest or other equally productive alternative. It is important to distinguish between ejidatarios (legal land users), their
Forest industry	There are many sawmills (43 legal) in the region, wooden box factories (42), furniture (2), chipboard (1), railway sleepers (1) and two resin processing plants. Industrias RESISTOL, tranforms some 160,000 m3 per year, 25% of which come from Michoacán.
Illegal loggers and middlemen	There are numerous accounts of illegal logging in the region. Middlemen are known to 'launder' wood and sell it to the regional forest industry.
Local NGO's	Monarca AC has played an important role in shaping the early stages of the reserve. They have been active since 1980 and have provided technical assistance to the local communities. Its role has diminished.
International NGO's	Several NGO's and trusts have supported various parts of the program, mostly in coordination with either SEDUE/SEDESOL or with Monarca A.C.. WWF, for instance, has provided some US$437,180 since 1981 for the conservation of the area and some US$50,000 as
Government	Several ministries and institutes deal with the area of influence of the MBSBR, including: INI, INIFAP, SARH, SEDESOL (+INE), UCODEFOs 1 and 2. Various government programs, including various PRONASOL initiatives are also active, mainly on forest regenerat
Scientific community	The scientific community has repeatedly expressed the great value of the migratory phenomenon as a model for research in animal behaviour. This could be one of the clearest sources of option value of the butterfly. Not quantified.
Society	Around half a million people have visited the overwintering habitat in El Rosario since 1980, with some 4 percent foreiguers. The existence value of conservation is thought to be significant but not quantified. The media and NGO's have spread the view of

4 The socioeconomic conditions in the region

In order to analyse the impact the MBSBR has had on the local community and on the potential participation of the local community in conservation efforts it is necessary to characterise the socioeconomic conditions in the region and their dynamics. There are at least two important recent efforts in this respect: one major research by Hoth von der Meden (1993) and other by Chapela and Barkin (1995), dealing exclusively with the Monarch butterfly reserve. This section presents an extract from their findings.

4.1 Social indicators

4.1.1 Population characteristics

Michoacan has traditionally been one of the states with the greatest concentration of the population and one where migration movements have been very significant. Population data in the region show that population in the region fell from 1970 to 1980 around Chivati-Huacal,

Chincua,and Campanario (see Table 4). This could be explained by heavy regional migration mainly to the State of Mexico and Mexico City, which is also reflected in the higher share of people between 15 and 65 as reported in Chapela and Barkin (1995). Between 1980-90 there was an increase in population around the three reserves, probably due to lower migration opportunities and the growth in the main local towns of Anguangueo and Ocampo. Around Chincua, the reported population growth with Anguangueo was of 81 percent, whereas growth excluding Anguangueo was only of 33 percent. In Campanario, the situation is similar, with percentage growth including and excluding both Anguangeo and Ocampo was 71 percent and -42 percent respectively. Chivati Huacal remained unaffected with a 22 percent population increase. The ejidos of Angangueo and Ocampo, on the other hand, experienced growth rates of 339 percent and 89 percent.

This also suggests that population pressures in the reserves actually decreased in Campanario, whereas in Chivati-Huacal and Chincua experienced similar population pressures. In terms of population density, Chivati-Huacal has the lowest, with 79.3 per km^2, Campanario has 95 per km^2 and Chincua has the highest with 116 per km^2. The Michoacan state average of 131.8 per km^2.[2]

4.1.2 Indigenous population

Ethnically, the area has an Otomi and Mazahua influence, however, strong cultural traits, particularly the language, have been almost lost in most communities. Native language speakers have reduced in number judging from data in the 1980 population census.

On the Michoacan side of the reserve, only two communities had more than 40 percent Indian language speakers in 1990, with all Indian speakers accounting for 7 percent of the population. This influence of indigenous culture is particularly concentrated around the reserve of Chivati Huacal, where 17 percent of the population speaks an indigenous language, whereas in the other reserves, the proportion is less than 0.3 percent, which is low in comparison with the state average of 2.8 percent.

[2] Estimates for Chivati-Huacal include only data for seven ejidos. Hoth (1993) quotes data that could not be accounted for in his table on population density. He quotes Chivati Huacal as having the largest population density, with 255.2 hab./km.2, followed by Campanario and Chincua, with 105.2 and 86.2 hab./km.2 respectively.

Table 4. Population data from the localities (ejidos and communities) associated to the MBSBR of Chivatí-Huacal Chincua and Campanario in the State of Michoacán, Mexico

RESERVE	Year	Chivatí-Huacal	Chincua	Campanario	Total	Mpal.	Michoacán
No. of Localities		(10)	(14)	(4)	(26)	(5)	(1)
POPULATION							
Total	90	10,960	11,991	8,399	26,009	169,103	3,548,199
	80	9,012	6,597	4,901	18,120	140,965	2,868,824
	70	8,938	10,173	6,763	21,157	119,969	2,324,226
EDUCATION (%)							
Child 6-14 yrs Literate	90	75.5	87.2	87.6	81.8	84.2	83.4
Assist to school	90	74.4	85.9	85.2	80.3	81.6	79.3
Adults 15+ Literate	90	62.6	81.9	84.9	74.3	80.6	82.7
Adults 15+ Without Schooling	90	32.2	20.2	14.6	24.0	18.0	19.3
OCUPATION (%)							
Pop. in 3 main ec. sectors	90	20.7	19.9	21.1	20.5	23.1	23.8
Primary sector	90	61.1	32.2	19.8	43.6	33.8	35.9
Secondary sector	90	17.9	34.5	38.7	28.1	27.5	24.5
Tertiary sector	90	21.0	33.2	41.4	28.3	38.7	39.6
Pop. in 3 main ec. sectors	80	22.2	22.3	18.6	21.6	22.5	22.1
Primary sector	80	77.5	58.5	47.6	66.7	49.5	54.4
Secondary sector	80	9.3	19.7	22.9	14.8	21.4	17.5
Tertiary sector	80	13.2	21.9	29.4	18.6	29.1	28.1

Given that two ejidos overlapped simultaneously with two reserves (Angangeo and Asoleadero), they were counted twice, once for each reserve.

Source: Reproduced from Table 1 in Hoth (1993)

4.1.3 Education

Literacy rates among the population 15 years and older in the communities around Chincua and Campanario are 81.9 and 84.9 respectively, which compare favourably with the state average of 82.7 percent literate. However, Chivati-Huacal lies behind the rest with only 62.6 percent literate.

In terms of schooling, Chivati has significantly lower levels than the other two reserves, which are very similar to the state average. This situation generally reflects the greater urbanisation and commuting to urban areas for work in Chincua and Campanario.

4.1.4 Marginality and poverty

Welfare of rural communities has suffered significantly by the adjustment programmes in the Mexican economy in the last decade. Various indicators of public services are found to be well below state levels, indicating an area of significant poverty. Chapela and Barkin 1995 report that average income per family in two ejidos, Ocampo (Campanario) and El Paso (Chivati-Huacal), was N$11,720 and N$16.510 respectively in 1993. In Ocampo, around 13 percent of income was derived from forestry and 23 percent from paid work. In contrast, El Paso derived 51 percent of its family income from forestry and only 6 percent from paid work.

To obtain a rough idea of the extent of poverty in the region we can compare the average income per capita in these two communities with the average income per capita needed to buy an essential goods basket (EGB) compiled by Boltvinik (1993). He estimated the cost of the basket for an average family (4.9 members) at N$ 30,155 in 1993, representing N$ 6,154 for each person's minimum needs. Using the average family size of families in the two ejidos we see that their average income *per capita* is only N$1,560 in Ocampo and N$ 3,060 in El Paso. Such levels of income have also been reported in other sources; SEDESOL (1993) indicates that per capita income in the region fluctuates between N$2,000 and N$12,000 per year.

Such levels of income would indicate a flexible poverty gap[3] of 61.1 percent for Ocampo and 45.2 percent for El Paso, which compares favourably with the flexible poverty gap for Mexico City in 1993 of 66 percent. Hence, the region shows significant levels of poverty where cash income can only compensate for about half of the EGB, clearly enhancing the role of subsistence agriculture and livestock rearing as a key complement to increase household income and reduce risks.

4.1.5 Infrastructure

Mining and forestry have historically been the main activities in the region, and were the sources of employment and much of the investment in infrastructure in the region. The area has a good road network, with a major paved road connecting with the Mexico-Morelia motorway and since 1994 another connection links the region with Guadalajara.

---

[3] Calculated as the percentage of the cost of the essential goods basket not covered by the family's income.

The railway line, heavily used by the now closed mine, still runs occasionally, but it is uncertain that the service will continue. It is at present one of the means of transport for wood to the RESISTOL conglomerate plant.

In general, the whole region is poorly supplied with common services such as electricity, drainage and health services (Chapela and Barkin 1995). Amongst the reserves, Chivati Huacal again has the worst conditions. For instance, more than 45 percent of houses did not have running water; the corresponding data for Chincua was 39 percent and Campanario was better than the state average (27), with 21 percent.

The road network within the reserves varies significantly. Chivati-Huacal has the largest network of paths and roads both in the core and buffer zones with a road density of 17 m/ha, followed by Campanario with 10 and Chincua with only 6 m/ha[4].

4.2 The regional economy

The regional economy has not only been affected by the migration processes, but also recently by the closure of the main sources of employment. The two main firms in the region, the Minera de Anguangeo (800 jobs) and CARIFLOR greenhouses (200 jobs) closed in 1991 and 1993 respectively. Some of the assets of these industries have been used by the PRONASOL with limited success. The overall impact of these changes is still unclear.

The structure of the EAP reveals sharp contrast among the various reserves. In Chivati Huacal, 61 percent of the population is engaged in activities in the primary sector[5], whereas in Chincua the proportion is 32.2 percent and 19.8 percent in Campanario.

Agriculture and forestry are the main primary sector activities. Agriculture is largely rain fed. In the municipalities of Anguangeo and Ocampo, 89 percent and 93 percent respectively of all agricultural area was rain fed. The Municipality of Senguio had the greatest proportion of irrigated land (40 percent) (see Table 5) (INE 1993).

---

[4] Most of the data available refer to these three segments of the reserve, hence, most of the discussion in the report will be center around comparisons of these three areas unless otherwise stated.

[5] Agriculture, livestock rearing, silviculture, hunting, fishing and related services.

Table 5. Agricultural land and maize cultivation in the municipalities in the area of influece of the MBSBR

Municipality	Rainfed (ha)		Irrigated (ha)	
	Maize	Other	Maize	Other
Coconteepec	15,275	110	3,363	360
Senguio	5,000	200	3,330	120
Angangueo	1,612	30	208	0
Ocampo	4,746	30	376	0
Zitacuaro	8,118	44	1,414	879
Total	34,751	414	8,691	1,359

Source: SARH 1992.

4.2.1 Agriculture and livestock rearing

The main crop in the region is maize both in irrigated and rain fed land. This trend is particularly true in the municipalities of Anguangeo and Ocampo, where 98 and 99 percent of the land was devoted to maize cultivation. Zitacuaro had the lowest share of maize cultivation, with 91 percent of maize.

Crop diversity in rain fed areas is extremely limited, with wheat, oats and beans as the main crops. Irrigated land, on the other hand, not only permits two crops per year but also some 27 different crops, hence providing more stable incomes to farmers.

Maize cultivation in and around the reserve is typically on steep slopes which precludes the use of machinery. Yields are also very low; several sources in the literature indicate average annual yields of between 0.5 and 1 ton/ha. (Hoth 1995, Snook 1993).

Placing a market value on subsistence agricultural production is not easy, given the apparent multiple roles that it plays in the communities. Chapela and Barkin (1995) point out that there are uneconomically high levels of labour devoted to agriculture, and that forestry incomes very often subsidise maize cultivation. This apparently wasteful behaviour can be explained by the importance of maize and other cultivars as insurance in conditions where part of the family migrates to urban centres where income is volatile. Cattle are also important for the yoke and as a means of savings.

In an effort to provide a value to the subsistence agriculture we can use the average maize prices which where N$618/ton in 1990 (World Bank 1993), implying a value of between N$309 to

N$618 per hectare.[6]

4.2.2 Industry and services

The proportion of people engaged in the secondary sector production[7] is greater than the state average (27.5 percent) in Chincua (34.5 percent) and Campanario (38.7 percent), whereas in Chivati Huacal (17.9 percent) this proportion is over-shadowed by the great importance of the primary sector.

The local businesses are mostly small and family in character (Chapela and Barkin 1995). Most of these businesses are in the food and beverages or in the wood processing subsector. The closure of the mine in Angangueo and the flower greenhouse in Ocampo has limited even further the local economy's capacity to absorb the regional labour force.

The proportion of people engaged in the tertiary sector[8] is most significant in El Campanario, with 41.4 percent of the population, reflecting the changes in the major towns in the region and the increase of tourism related services in El Rosario and neighbouring towns.

4.2.3 Government investment

The area has been subject to various forms of state investments under a wide range of institutions. Of particular relevance have been the reforestation programmes that have been promoted extensively by a number of institutions including the National Indigenous people Institute INI, SARH, Michoacan State Forestry and Agrarian Development Secretariat, UCODEFO and the Solidarity programme under their Ecologia Productiva (Productive Ecology) programme created in 1991. Approximately 51 percent of their joint budget has been allocated to reforestation projects.

Reforestation projects, however, have had limited impact due to the inadequacy of the techniques and the lack of incentives for protection and proper plantation of the ejidatarios.

Other projects have been intended to create alternative sources of income to reduce pressure on the land, including trout farms, sewing, a brick factory, orchards, tree nurseries and intensive mushroom cultivation.

5 Forestry as a conservation strategy

The nature of the soil composition and the slopes in the area limit the number of possible uses, and the only large-scale activity that can be performed is forestry. Only a few ejidos affected by the reserve have a significant amount of land suitable for mechanised agriculture.

---

[6] It should be noted that this price does not reflect true market clearing prices nor market prices of locally purchased maize. It also ignores the value of subsistence agriculture as an insurance. These factors considered, it is likely that these values understate the true value of the crop.

[7] Mining, manufacturing, electricity, water and construction industries.

[8] Commerce, transport, communication and services.

At the state level, a ban on all logging had been in place since the 1940s and up to the 1960s in Michoacan, and still continues in the State of Mexico, where extraction permits are only granted for forest health reasons.

Forestry was open in the Michoacan-side of the region through the regional credit society Melchor Ocampo, but the firm was mostly administered by the Bank of Ejido Credit and the unsustainable levels of extraction coupled with poor administrative practices led to the decay of the activity.

The long ban had left a significant illegal wood industry, where communities were receiving extremely low prices for their resources and in some cases no income at all. The decline of the Melchor Ocampo project led to a revival of the illegal trade so that the area now has the greatest incidence of illegal extraction.

At present, forestry activities are coordinated around the Forestry Conservation and Development Unions (UCODEFOs), supervised by SARH. Ejido members of the UCODEFOs have to pay a quota for their services. UCODEFOs undertake the management plans for the authorisation of logging permits by SARH. They handle the administration and mark the trees to be felled. The effectiveness of the UCODEFOs as regulators of forestry activities has been questioned and the cost of their services is relatively high (Chapela and Barkin 1995).

After the creation of the reserve, SARH issued some 10 and 12 year extraction permits to some ejidos affected by the reserve. Although most legal logging has been restricted to outside the reserve and in the buffer zones, some logging has taken place within the core area of the reserves for sanitation purposes. In 1992, permits in the region represented 11,477 cubic meters. A total of 89 forestry development permits were renewed in the area of influence in Michoacan and 12 clean-up permits in the State of Mexico. In the same year, ejidos affected by the reserve extracted 11,477 m^3 (SEDESOL 1994).

In the buffer zones, 5 forestry development permits were issued in Michoacan and 6 clean-up and sanitation permits in the State of Mexico (SEDESOL 1993). Reforestation is mandatory in the extraction zones and, coupled with the reforestation projects, added a total of 1491 ha. reforested within the reserve and the area of influence since its creation.

Nonetheless, the wood extraction has experienced increasing restrictions due to concerns over the Monarch butterfly colonies. This was further fuelled after an unusually high mortality of Monarchs in 1992, due to a series of particularly cold days. By 1994, only 9 of the 38 communities has forest extraction activities[9] (SEDESOL 1993). There are various sawmills in the region: 5 private sawmills in Ocampo and three in Angangueo, plus sawmills in various ejidos.

Wood extraction is organised in various ways in the communities. In ejidos like El Rosario, extraction is individually organised and without heavy machinery. The final destination of the

[9] The nine were in Sierra Chincua: ejido Emiliano Zapata, Arroyo Seco, Cerro Prieto, Remedios y Anguangeo (also in El Campanario); in El Campanario: ejidos El Rosario and El Asoleadero (also in Chivati Huacal) and, in Chivati Huacal: ejido El Paso and community San Cristobal.

wood is unknown, but it is thought that some of it is sold in Mexico City. In contrast, El Paso manages the forest extraction activities collectively. Both ejidos own a sawmill. Other ejidos like Cerro Prieto do not extract the wood themselves and sell their wood 'standing', to intermediaries, receiving in exchange a Derecho de Monte (stumpage fee). Prices of 'standing' wood fluctuate around N$150 per cubic meter (Chapela and Barkin).

Local wood is generally processed by the industry in the region and taken to the main consuming centres in Michoacan and Mexico City. Another significant local buyer is the RESISTOL-owned conglomerate plant. This plant enables ejidos to have a market for secondary products, which are left unmarketed in other areas of the country. Prices per cubic meter of wood in 1992 were around N$30 (Cortes 1992).

5.1 Illegal logging: incentives and control

A significant problem in the region has been the illegal felling of trees. An illegal network of intermediaries is still in operation, particularly in areas where the forest is not managed by the community. Intermediaries pay loggers differential prices depending on whether the wood is legal or not. Loggers may even be members of the communities (Gurza 1989). The wood is then taken to some local sawmills to be processed and 'laundered'. Even the conglomerate factory has been involved in dealing with illegal wood (Cortes 1993).

There are various reasons for the persistence of illegal felling in the region; one of them is the long-term ban imposed in Michoacan which is still in place in the State of Mexico. The resulting black market has created strongholds in the region and is difficult to eliminate. More specifically in the MBSBR, illegal activities are also induced by the alienation of the communities from their resources, which has reduced the incentives to protect them.

Not surprisingly, the most forceful community opposition to illegal felling has come from the areas where the communities have, despite the reserve, a strong dependence on the forest. Crescencio Morales, El Paso San Cristobal and San Felipe de los Alzati, all around Chivati-Huacal, have strongly denounced illegal felling and have formed an organised front against logging (Aridjis 1993).

Undoubtedly, the dense road network, the relatively milder slopes and the poverty of the communities have all contributed to the intense logging in the region. Being the poorest communities in the MBSBR, the ejidos and communities around Chivati Huacal have had limited power to combat illegal logging on their own as has been seen in the case of El Paso, which has been actively threatened by illegal loggers (Ortiz 1992) and members of other communities have received death threats or actual beatings (Aridjis 1993).

In contrast, in Sierra Chincua there are a large number of ejidos with boundary conflicts between each other and with the reserve, which has diminished the sense of resource ownership in their inhabitants. Moreover, a smaller proportion of their land is affected by the reserve, and, hence, they have a lower stake in its conservation or development. Illegal logging has been denounced by the communities in at least 2 ejidos and reported in at least two more of the 14 ejidos in the reserve. The reserve has a relatively low impact on these communities, which are more subject to the migration patterns and urbanisation as explained above. Additionally, the difficult access

to the forested areas in the reserve have limited somewhat the impact of population growth on the forest.

El Campanario has seen reports of illegal logging in El Rosario by members of other communities (Aridjis 1993). Nonetheless, El Campanario has experienced the least illegal logging, partly because the ejido members have directed efforts towards the local tourism industry and partly because the flow of tourists probably deters some of the illegal loggers during the overwintering season.

In the 1992-3 overwintering season alone, over 130 cases were reported. The Secretariat of Defense, the PGR and the PROFEPA had up to 1992 132 illegal felling complaints 104 loggers had been indicted and 104 vehicles and 3,475 m^3 of timber had been seized (SEDESOL 1993). Additionally, the verification programme of legal supplies to the local industries operating in the 17 municipalities within the region of influence of the MBSBR has resulted in 70 clandestine industries dismantled and 30 fined (SEDESOL 1993). Such controls are essential to redirect and resize pressures on the forests away from illegal loggers and as a precondition to develop local community enterprises with vested interests in conserving the resource (Fuentes 1993).

The fight against illegal logging has also caused some violent reaction by the loggers. Between April and May 1993 more than 20 fires were detected in the reserves, and technical reports indicate that virtually all of them were started to cover up illegal logging operations. These fires resulted in nearly 100 ha. being deforested (Riquelme 1993). With only 12 forest inspectors paid by SARH, community surveillance and protection needs to be increased in the area, a target that can only be achieved by greater vested interests in the community on the conservation of the forest.

5.2 Competitiveness of the local industry

Mining and forestry activities fuelled much of the infrastructure development in the region during this century. Communication infrastructure in the region is outstanding compared with other similar regions in Mexico (Chapela and Barkin 1995). This represents a key competitive advantage for the industry, since transport cost has been the single most important cost in wood extraction in Mexico.[10]

On the other hand, years of uncontrolled exploitation have reduced the profitability of the forests in the region and resulted in a marked overcapacity which is largely in the hands of non-resource owners. In this respect, the efforts to restructure the industry by dismantling the illegal mills should help to reduce the industry's pressures to a more appropriate level with greater revenues flowing to resource owners. The recently signed NAFTA has placed greater importance on this process, as the increase in wood products imports has led to a significant reduction in prices, reducing the profitability of Mexican forestry.

[10] In Durango, the state with the second largest wood production, transport costs represent 60 percent of extraction costs, with the industry having to supply itself from forests up to 400 km. away, whereas the equivalent distance in Ocampo is 10km..

Significant losses are now being experienced as a result of the inefficiency of the processing industry and the dissipation of the rents through the chain of intermediaries in some of the ejidos. Ejidos like El Paso, El Rosario and Ocampo, which posses their own sawmill, are able to add greater value to their wood and generate employment.

In El Paso, members of the ejido currently extract some 1,100 m^3 of timber per year, which represents a stumpage value of some N$165,000. Once sawn, the wood can be sold for around N$425 000 per cubic meter and provides employment to some 50 people in the community (Chapela and Barkin 1995). Hence, direct extraction of wood can generate a gross income of some N$382/ha. for unprocessed wood and N$ 986/ha. for sawnwood in forests outside the core of the reserve. These estimates strongly suggest that forestry competes favourably with agriculture, which generates between N$309 and N$618 per hectare only where a processing industry is in place, while there is little incentive to protect forests when timber is sold 'standing'. For communities without a forest industry, the income from forests commonly subsidises maize production and livestock rearing, with little or no investment being made in the forests.

5.3 Other economic activities within the forest

Apart from commercial extraction of wood there are other commercial and non-commercial activities supported by the forest. One of the most important is the extraction of fuelwood. Snook (1993) has recorded that about 35m^3 of wood was used per household in areas of Veracruzthe with similar environmental conditions. She suggests that up to 75,000 m^3 could be being used annually in the ejidos around the reserve, which represents significant levels of extraction.

Soil is extracted to supply the nurseries and for sale in local markets. There is also a seasonal gathering of mushrooms both for local consumption and sale. The various streams in the reserve are used occasionally for trout farming, irrigation and drinking water.

On a smaller scale, there is also some collection of flowers, such as orchids, and around Christmas time several forest products are sold, such as Christmas trees, moss and pine cones.

5.4 Monarch butterfly - forest industry interactions

The degree of compatibility between the Monarch butterfly conservation and the development of the forest industry has to be analysed in two dimensions, the ecological and the socioeconomic one.

As explained before, the current ecological debate is trying to establish the precise nature of the links between forest extraction and the conservation of the overwintering habitats. On the social side however, the question is whether community forest extraction provides incentives for conservation of the Monarch butterfly.

On the ecological factors, Chapela and Barkin (1995) stress that one of the key functions of forest management, apart from providing a source of income to the local communities, is the reduction of fire risks. Undisturbed forests tend to burn more violent and uncontrollably than forests under some form of extraction regimes. While fires are a normal part of the forest cycle,

the relatively small area of the reserve means that fires pose a real threat to the survival of the overwintering habitats.

If Monarch butterflies prefer disturbed habitats, as has been suggested by Hoth, there is an additional degree of compatibility between wood extraction and conservation, particularly in dense fir forests. Besides, non-fir forests, or pine dominated forests, appear to be at an altitude range that does not overlap with the Monarch butterfly's colonies. Figure 5 illustrates this using data from Calvert and Lewton (1993) and Hoth (1993). As can be seen, the colonies of Monarchs tend to use, but not exclusively, fir dominated forests with intermediate tree densities and basal areas. As a result, pine dominated forests can be exploited with limited impact on the Monarchs. Additionally, some form of limited management could take place in areas of dense fir forest, provided that impact on areas of known colonies was restricted.

Evidence of a colony site being displaced by excessive logging is documented in Hoth (1993), who found an extinct colony site in Chivati Huacal with basal densities below those in most other colonies. However, further evidence is needed to establish an adequate safety margin to ensure the conservation of the overwintering sites.

Such detailed management requires detailed knowledge and redefinition of the reserve areas in such a way that they reflect the current vegetation structure. In this respect there seems to be wide support for the view that a redefinition of the boundaries of the reserve is needed to reflect true habitat requirements of the Monarch and minimise social conflict (SEDESOL 1993).

On the socioeconomic side, the reserve has imposed strict limitations on forestry activities in the region, increasing costs, encouraging illegal logging and generally transforming the regional economy by inducing migration and land conversion. These factors create a strong antagonism between forestry development and conservation.

Chapela and Barkin (1995) estimate that communities around Chivati Huacal, Chincha. and El Campanario have around 30,774 cubic meters that could be extracted annually with a market value of some N$3'271,000,[11] representing a gross measure of economic loss due to the establishment of the reserve.[12] From an economic point of view, the social value of the Monarch butterfly needs to exceed such losses (minus the extraction costs) to justify the restrictions on forestry activities and adequate transfer mechanisms to compensate landowners.

Compensation for this loss has so far only been granted to El Rosario by allowing an alternative activity linked to the conservation of the forested land; however, all other ejidos have been affected without formal compensation (but see below about rent dissipation in El Rosario).

Although not representing a direct compensation, the development of the forestry activities have the potential to create forest conservation incentives in the communities. Evidence among communities in the region suggests that population pressures, coupled with tenure problems have

[11] This value assumes a 20 year rotation period, a price of N$150 per cubic meter of wood, no extraction at the core zones and only 50 percent extraction in the buffer zones.

[12] Net value is likely to be much lower particularly in highly inaccesible reserves where cost of extraction is significant. In this respect, Chivati-Huacal is likely to have the greatest opportunity cost.

shaped different degrees of incentives to conservation that are reflected in the changes in land use and in the reaction of communities against illegal logging.

For instance, in Chivati-Huacal, the high dependence on forest products makes them most receptive to forest projects (see below on El Paso) and to adopt protection measures. In the Sierra Chincua, unlike Chivati Huacal, ejidos have limited forestry activities and have experienced a greater link to the growing urban centres; on the one hand, reducing pressures on the land, but also reducing the incentives to protect it and creating opportunities for illegal logging.

Some studies show that forests under community management, despite their problems, seem to be in a better condition than forests where no utilisation exists and open access dominates; in fact, land conversion and not logging is a primary deforestation force. Hence, community commercial use of wood is preferred to uncontrolled illegal logging by anonymous agents. So far, the fact that El Paso and Ocampo have taken a strong position denouncing illegal logging, and improving their forest extraction techniques is evidence that better control and commitment to the resources can take place. El Paso has 62 percent of its area affected by the reserve, much of it in the core zone. However, it has not had the support of alternative activities like tourism or experienced significant migration like in the other regions, resulting in the build up of pressure for forest use or land conversion. Hence, controlled community-based logging operations can provide conservation benefits to the reserves, both biologically, by reducing risks and improving habitat, and socioeconomically, by improved protection from uncontrolled logging, higher income to the communities and reduced incentives for land conversion.

Unfortunately, the costs of conservation borne by the forest industry have extended beyond the areas of the reserve, mainly by informal restrictions imposed by SARH and other bodies as a result of political pressure from environmental groups. For instance, pressures to restrict forestry activities have resulted in many cases in a ban during the overwintering months of the butterfly. This has resulted in additional extraction costs being borne by the ejidos and communities, as the non-overwintering months correspond to the rainy season, which increases the extraction costs (see Figure 1). As a result, authorised volumes have not been fully extracted, as can be seen in the case of the ejido Cerro Prieto in Table 6. Furthermore, survival of the reforested areas is reduced since reforestation is carried out after the extraction activities, i.e., at the end of the rainy season and at the onset of winter.

Hence, the lack of clear and enforceable guidelines and proper integration of forestry activities within the protection of the reserve has resulted in excessive costs being borne by the local communities engaged in forest activities.

5.5 Current and future trends

In an effort to bring greater private investment to the region, reforms to the Constitution and the Agrarian and Forestry Law in 1992 allowed ejidos and communities to freely contract their technical services and to create joint ventures with private entrepreneurs.

So far, only Ocampo(El Campanario) and El Paso(Chivati) have taken advantage of the opportunity, breaking their ties with the UCODEFO, expanding their tree nurseries. Efforts are currently being made to integrate vertically to add greater value and to generate employment in

the community. These can be achieved by expansion of the local carpentry in Ocampo and the installation of driers to process the oak in lower altitude forests, currently underutilised in many forests throughout Mexico.

Direct compensating mechanisms other than tourism development are being developed in El Paso and Ocampo, where certification of the programme is being projected under one of the major forest certification programmes to create transfer mechanisms both fiscal and industry derived to pay for environmental protection. These, however, are still in their early stages.

Even without these compensating mechanisms, improvements in marketing and efficiency can help to create 'additional' value and incentives to adhere to sustainable forestry practices like the ones being developed in Ocampo and El Paso.

6 Tourism as a conservation strategy

Visitors have been coming to the area to watch the butterflies since the sites were discovered in 1976. However, early tourism was low in volume and not coordinated. Only the reserve known as El Campanario has attracted a significant level of visitors, partly due to the relative accessibility of the overwintering sites and the regular influx of tourists since the early years after discovery. By 1980, the influx of tourists to the region had increased significantly but remained uncontrolled, and early signs of degradation due to misbehaved tourists were beginning to cause concern (Ortiz Monasterio 1980). Hence, tourism was a growing activity that had to be tolerated and that could provide some income rather than an activity which had to be encouraged from scratch.

The activities of Monarca AC and the media rapidly increased the popularity of the site, which received some 7,500 visitors in 1984 and up to 30,000 in 1986, the year when the limits of the reserve were formally established. This made El Rosario the ideal ground for the ecotourism development for the Monarch butterfly (see Table 7). Most national visitors come from either Michoacan, the State of Mexico or Mexico City, whereas most foreign tourism comes from the United States.

Table 6. Volumes harvested from Cerro Prieto (Chincua) between 1979-1989

(volumes in m3)

		Fir		Pine	
Year	Annuity	Authorized	Harvested	Authorized	Harvested
1979	3	1,742	125	156	42
1980	4	1,742	960	156	49
1981	5	1,742	471	156	0
1982	6	1,742	864	156	0
1983	7	1,742	1,074	156	0
1984	8	1,742	794	156	0
1985	9	1,742	2,397	156	0
1986	10	87	694	78	0
1987	1	900	863	156	0
1988	2	779	779	0	0
1989	3	779	774	0	0
1990	4	1,214			
1991	5	1,214			
1992	6	1,214			
1993	7	1,214			
1994	8	1,214			
1995	9	1,214			

Source: Moreno1990

Shaded area denotes requested autorized volumes

Table 7. Number of visitors (national and foreigners), total income and entrance fee to the El Campanario Sanctuary during the seasons 1984-94.

Season	Visitors			Gross Income \2	Entrance fee
	National	Foreigners	Total	'000 N\$	N\$/adult
1984-85			7,500		
1985-86					
1986-87			30,000		
1987-88	37,192	1,508	41,644	50	1
1988-89			44,172	98	2.5
1989-90 \1			70,000	325	5
1990-91	61,822	8,179	70,000	301	5
1991-92	55,136	3,896	59,032	506	5
1992-93	56,612	2,278	58,890	438	10
1993-94	53,801	2,120	57,321	429	10

\1 Records incomplete, estimate produced by SEDUE

\2 Includes sales in local shops and food stalls

Source: INE, 1992; SEDESOL 1994.

Most visitors to the area spend one or two days in the region as there are relatively few additional attractions to induce longer visits. Its relative closeness to large urban centres like Mexico City, Toluca and Morelia make it an ideal place for weekend trips for inhabitants of those cities.

The first control posts were established between 1986/7 and visitors were not explicitly prohibited in the other reserves until 1992, coinciding with the creation of the INE and PROFEPA. The need to provide a suitable area for visitors led to significant investments in infrastructure, partly financed by the community, partly by the government which includes:

(i) Restaurant

(ii) Audiovisuals centre

(iii) Ejido shop

(iv) Interpretive trail

(v) Ticket office

(vi) Parking place

(vii) Food stalls area

(viii) Ejido Restaurant (now closed)

Despite these efforts, the high volumes of visitors have caused additional pressures on the

reserve. Among the negative impacts of tourism reported by INE are the dust generated, trespassing into the reserve area outside of the interpretive trail to collect butterflies, solid waste, pets and localised erosion. Measures have been taken to control the negative impact of tourists, but evidence seems to suggest that 70,000 visitors a year is probably beyond the carrying capacity of the area. Even commercially, the area is starting to show signs of reduced appeal and in view of the crowding problems at El Rosario, some travel agents are offering tours to other unprotected parts of the reserve.

In other reserves, SEDESOL provides park personnel and field technicians. In Sierra Chincua, there are also two research modules, but these are largely unused because of the lack of funding for research (INE 1992).

6.1 Community participation

The need to control tourists in the area induced the SEDUE (now SEDESOL) to train local ejidatarios as interpretive guides and vigilantes. This system has been in operation since 1988 and although the early guides were paid by SEDUE, by 1993 the INE paid only nine (half the total), and in 1994/5 they were expected to pay for all guides. Training is still provided by INE free of charge.

Other alternative employment opportunities were opened in the emerging ecotourism industry; Monarca AC opened food and trading concessions and designed souvenirs to be made locally and sold to tourists. Some 40 ejidatarios are directly involved in various community activities during the tourist season, such as guides, souvenir shop attendants, ticket office attendants, car park attendants and the tree nursery. All posts are distributed on a rotation basis per season and all wages are paid by the ejido, which receives income from the entrance fee to the interpretive trail.

For the 1994/5 season, the flat wage rate for all ejidatarios was N$20 per day for 6 days a week work, which compares favourably with the minimum urban wage, which in 1993 was N$14 per day (Boltvinik 1994 in Moncayo and Woldenberg). For the six months of the season, this provided N$4,351.8 for each worker during the season 1992/3.

Most of the employment created by tourism is seasonal and mostly weekend oriented, since the butterfly arrives in November and departs in April (see Figure 6), although most visits take place during February and March. Most visitors go to the reserve in day trips at weekends (over 70 percent of tourism visits the reserve at weekends).

Aided by both government and NGO campaigns, tourism to the area kept increasing, reaching a maximum of 70,000 in 1990. In recent years, however, tourism has been gradually declining, possibly due to the 'wearing off' of the publicity campaigns. Revenue from tourism has also been affected by the decline in affluence, as can be seen in Table 7.

Gross revenue to El Rosario represented N$441 per hectare affected (core and buffer) in the 1993-4 season. Revenue is used to pay salaries to ejidatarios working in the reserve and occasionally to undertake social investments. However, most years revenues have been distributed among ejidatarios. In 1987, the distribution amounted N$ 100 per

ejidatario; in 1988, the rents per ejidatario were N$ 287, and by 1993 they had reached N$700. This excludes the salaries also paid to ejidatarios depending on the tasks they perform on the reserve. This net revenue that is distributed represents just N$ 188 per hectare affected by the reserve both in the buffer and in the core zone.

6.2 Social institutions and tourism

Under the Agrarian Reform, there are three types of property in Mexico; ejidos, small private property and communal property. Ejidos and communities are a land grant to a population group whereby the government allows the use of the land, but prohibits all forms of land markets and exchanges (sale, hire, sharecropping). Small land holdings are effectively private property provided they comply with certain size limits depending on the type of economic activity to be performed with the land.

The maximum authority within ejidos and communities is the Assembly, which is composed of all legal landowners, ejido members and comuneros (community members). Given the restrictions on land transactions and transfers, ejidatarios do not normally update the status of their land and land is simply de facto passed on to their children, who will get firm possession when the ejidatario dies. As a result, many ejidatarios and comuneros are elderly people who do not necessarily work the land directly, but who still hold the claim on the land.

In the case of El Rosario, there are 261 ejidatarios, with a total population of 1,296 according to the census of 1980. The economically active population was 366, with 45 percent of them in the primary sector. The protection of the Monarch butterfly and tourism, however, brought about drastic changes to the social composition of the community.

Informal succession generally occurs as the elderly are not able to work the land. However, the emergence of tourism and conservation has brought about several changes:

a) the assembly gained unusual impetus as it was the focus of dialogue with the government and NGO's.

b) the elder ejidatarios could still engage in tourism activities which are less demanding than agriculture, grazing or forestry.

c) the local economically active population had fewer profitable opportunities.

Unlike other equally affected communities, El Rosario did not form a common front against the establishment of the reserve, but rather, the tension arose within the community between land owning parents and landless children. This conflict is probably partly responsible for the fall in population between 1980 and 1990, from 1,296 inhabitants to 853. The EAP also fell from 28 to 23 percent of total population.

Only 10 percent of the stalls outside the reserve are managed by ejidatarios, while 90 percent are managed by their sons. Revenues for sons of ejidatarios are highly variable and

there is clear lack of coordination among the different food stalls, resulting in over supply and dissipation of rents.

The degree of commitment to conservation among sons of ejidatarios is somewhat limited, since income from the reserve is seen as insufficient. The distributed N$700 per ejidatario in 1994 represents only about 50 percent of the monthly family income in the ejido of El Paso as reported by the survey of Chapela and Barkin (1995) and the per hectare revenue is between 30 and 60 percent of the value of average maize yields per hectare.

The conservation incentives appear to be lower than under forestry management. The greater mobility of the local population has induced sufficient migration to compensate for alternative sources of income. However, the price to pay in terms of conservation has been the weaker social institutions at El Rosario and the increase in internal conflicts.

6.3 Vertical coordination: Dissipation of rents outside the community

Despite the significant income derived from tourism in El Rosario, a significant proportion of the income is being captured by agents with limited commitment to the conservation of the area, hence dissipating the resource rents. Among the various agents outside El Rosario who are extracting part of the revenue from tourism there are transporters, the neighbouring communities who charge entrance fees, various vendors and the suppliers of manufactured souvenirs to the various souvenir stalls in the reserve.

6.3.1 Transport

There is a transport service which takes visitors from Ocampo or Angangueo to the Sanctuary. The service is run mainly by people from Ocampo who take tourists in pick-up trucks to save them the rough ride up the 12 km. from Ocampo by private car.

Despite efforts to coordinate their activities, they behave largely under open access and their pricing policy remains highly discretionary. In 1994, prices fluctuated between N$100 and N$180 per truck or N$10 to N$20 per person and as early as December there were as many as 41 trucks organised in groups ready to take tourists up to the reserve. In 1989 prices were around N$50 and N$65 per truck and a total of 26 trucks were reported in Angangueo and the same number in Ocampo.

A couple of years ago there were complaints that trucks were taking visitors to other food stalls on the way to the sanctuary, posing a significant competition to the people at El Rosario. At present, such collusion appears to have occurred with a few stalls in El Rosario itself (pers. obs.). Estimates for revenues from the visitors book and a personal survey suggests that around 40 percent of tourists used either a truck or bus to reach the sanctuary in the 1994 season. However, this number is reported to have fallen from around 70 percent in 1992.

6.3.2 Right of way fees

The other major source of dissipation is the right of way fees that the neighbouring ejidos

are charging. For instance, El Asoleadero, with 266 ha. affected, is charging N$10 per vehicle allegedly for maintenance of the road and to compensate for the loss income. In the 1993-4 season, total income distributed from the right of way was N$ 19,200, or N$72/ha, the individual shares per ejidatario was N$300 to each of the 64 ejidatarios.

The other point of access to the reserve crosses the village of La Salud, in Angangueo, where another right of way fee has been established at the same rate as in El Asoleadero. In this case, however, the fee is justified as a contribution to rebuild the local church.

Estimates carried out in December 1994 of the expenditures by tourists in entrance fees to the reserve and the right of way and/or truck fee indicate that around 57 percent of total expenditure by tourists (excluding food and travel costs to Anguangeo or Ocampo) goes in entrance fees to the Sanctuary, 36 percent in truck trips and 7 percent in the right of way fees.

These activities have been the source of conflict between El Rosario and the neighbouring communities, who see El Rosario as excessively privileged and demand to be compensated. However, as a result of El Rosario's own internal conflicts (see above), its negotiating position is relatively weak.

6.3.3 Other activities

There are also other smaller sources of rents being dissipated, like the various vendors who come to El Rosario to sell souvenirs or to offer various services (e.g., horse rides to the ticket office of the reserve). Again, ejidatarios in El Rosario have limited power to stop or control these.

Some years ago, Monarca A.C. helped in the design and marketing of some souvenirs that they sold to ejidatarios at cost price to be resold at the ejido shop. At present, the shop is still operating and the revenues are added to the entrance fee revenue to be distributed among the ejiatarios. However, the souvenir stalls run by the sons of ejidatarios sell mostly manufactured products that are purchased from intermediaries.

These rent dissipating activities may create some income and employment to the local communities, but, unfortunately, unlike revenues to El Rosario, these are not linked to conservation activities in the reserve and have little incentive value. Rather, they are seen as a means to recover their expropriated resources.

6.4 Competitiveness of the tourism industry in the region

The visitor centre at El Rosario has a relatively wide range of services on offer and attracts visitors from a wide area. Its main source of visitors, however, is Mexico City. The unique nature of the butterfly overwintering sites means that there are no close substitutes for these services. However, the area does compete in the nature weekend tourists market with other national parks and biosphere reserves. Table 8 presents a list of the main National Parks in central Mexico for which visitor data are available.

Table 8. Protected areas potentially competing with the MBSBR and annual visitors

		State	Area (ha)	Visitors/year	Distance from Mexico City (km)	Other non nature related activities	Services Index \1
National Parks							
	Miguel Hidalgo y Costilla	DF/Mexico	1,750	500,000	21	Horse riding	9
	Tula	Hidalgo	99	180,000	120	Archeological site	8
	Iztla-Popo	Mexico	25,679	100,000	70	Mountain trekking	9
	Lagunas de Zempoala	Morelos	4,669	80,000	80		9
	El Chico	Hidalgo	2,739	80,000	130		12
	El Tepozteco	Morelos	24,000	78,000	90	Archeological site	2
Special Biosphere Reserves	Monarch Buterffly	Michoacan, México	16,110	57,473	150		8

Source: CSERGE, 1993; Mexico Desconocido, 1992.

\1 This index was constructed by simply adding up the number of services available in a category range of 20 including: administration, restaurant, playground, food stalls, camping areas, research station, toilets, visitors centre, hostels, lodges among others.

As can be seen, the MBSBR is at the limit of the range of options within travelling range at a weekend. Access is good apart from the last 12 kilometers and publicity has been extensive. However, the rate of repeat visits is relatively small as reported in the visitor books. In terms of regional tourism services, there is relatively little else besides the Monarch. Hence expansion of tourism from Mexico City would require the increase of services in the region in order to develop truly multipurpose tourism with a wider economic impact in the region. However, the prospects for this in the short term are limited.

Being the only ejido which has been at least partially compensated for the restrictions on use imposed by the reserve, El Rosario has attracted the attention of all ejidos and, by now, all ejidos affected by the reserve have expressed the desire for some ecotourism in their area.

The ejido El Capulin (Cerro Pelon) has already been granted permission to receive camping tourists starting in the 1994/5 season. Despite the fact that it is seeking to attract a different kind of tourism, it is unlikely that it will match El Rosario as a destination given its limited marketing and more difficult accessibility to the overwintering sites.

One potentially negative effect of the opening of new sites is the further dissipation of rents and the greater risk of failure in new ventures. As estimated above, the level of

revenue obtained per ejidatario in El Rosario is not very high compared with the average income per family and migration is the rule rather than the exception to compensate for lost income.

Table 9. Compatibility of Economic activities and conservation

Activity	Socioeconomic sustainability	Ecological sustainability
Ban on all logging	(-) Limited support of communities, heavy burden on an already impoverished area. Income loss could add up to N$3.27 million per year if all areas were sustainably harvested. (-) Non overwinering habitats affected by the current reserve areas.	(+) Conservation of forest densities ensures adequate insulation for butterfly. (-) Greater risks of fire and illegal uncontrolled logging.
Tourism	(+) Provides compensation for the communities that see the use of their forests restricted. (+) Provides conservation incentives in the community. (-) Limited scope in all areas, since rents would likely dissipate (-) Changes local relations of power.	(+) Prevents logging of the area and helps maintain the habitat. (-) Increases noise, dust and rubish to the area, threatening the habitat of the butterfly.
Forestry	(+) Provides income to the community (+) Provides significant employment for wide range of members of the community (+) Promotes community participation and strengthens institutions. (+) Enhances enforceability of property rights and discourages illegal	(+) Reductions in fire risks (-) Reduces insulating capacity of the forests

7 Conclusions

There seem to be some encouraging developments in the MBSBR regarding the reappraisal of forest management as a source of both rural development and conservation of the Monarch butterfly. Economic activity, whether tourism or forestry, appears to be better than a total ban on both activities (see Table 9), particularly in areas where there are few sound alternative economic activities for the local communities.

Evidence suggests that risks from community managed forest extraction may be offset by the wider benefits in terms of reduced risks from illegal logging and fire, community participation in protection activities and a more solid base for adaptive management. The conservation incentive stemming from dependence on the resource appears to be strong, as in the case of Chivati Huacal in the 1990s, whereas weak links with the resource and land tenure conflicts create a poor social base for management, as in the case of Chincua.

Although not pure compensation schemes, the vertical integration of the industry and the resulting greater income and employment in the community appear to have enhanced the responsiveness of communities to responsible forest management and active participation in the protection of their forests.

The relatively high yield of forest activities and the lack of alternative employment for the impoverished areas around Chivati-Huacal imply that the forest activity is the best strategy for encouraging the participation of the local community in conservation activities.

The certification schemes proposed at El Paso are encouraging steps towards the creation of forestry linked compensation. However, the strong competition in the wood market, particularly after the signing of NAFTA; makes it unlikely that the industry can maintain the 'green' price. Besides, 'green' markets are poorly developed in Mexico, the main consumer market of the wood from the MBSBR. Greater chances of success exist in fiscal rebates, were the premium is less linked to market conditions and more to sustainability goals.

Effective development of the forestry activities, however, requires a clearer government policy at all levels that can efficiently issue timely permits and prosecute illegal loggers. The dismantling of illegal sawmills is a positive step towards legalising the industry and scaling the market pressures to the real potential of the forest.

Tourism development appears to be of more limited potential than forestry given, on the one hand, the difficulties in attracting more visitors and the relatively low spending in the area. The opening of new areas may dissipate rents to the extent that conservation incentives in El Rosario are diminished. It appears that El Rosario has succeeded in accommodating tourism by a significant increase in migration of the ejido population, reducing conversion pressures on the forest leaving only those of tourism. So far, strategies centred on alternative employment have had some success in reducing, at least seasonally,pressure on the forests by local communities. However, it has not prevented the process of alienation from their resources and has eroded the emerging forestry culture in the region. An exception to this is the ejido El Rosario in the El Campanario reserve, which has generated employment for ejidatarios and a proportion of the community,

producing reduced pressure on the forest while keeping a commitment to conservation. Nonetheless. this has created significant internal conflicts in the ejido.

8 Reference

Allen M. and K. B. Snow. (1993) The Monarch Project: A Program of Practical Conservation in California, chapter 9.VIII, pp. 393-4; in Malcolm and Zalucki 1993.

Alonso, A., J.I. Glendinning, and L.P. Brower. (1993) The Influence of Temperature on Crawling, Shivering, and Flying in Overwintering Monarch Butterflies in México, chapter 8.IV, pp. 309-14. In Malcolm and Zalucki 1993.

Anon. (1987-94) Libro de visitantes del santuario el campanario.(Visitors' book) 1987-94, El Rosario, México.

Anon. (1992) Parques nacionales. Guía México desconocido no. 2. México D.F., August.

Arellano, A., J.I. Glendinning, J.B. Anderson, and L.P. Brower. (1993) Interspecific Comparisons of the Foraging Dynamics of Black-Backed Orioles and Black-Headed Grosbeaks on Overwintering Monarch Butterflies in México, chapter 8.V, pp. 315-22. In Malcolm and Zalucki 1993.

Aridjis, H. (1992) 'Mariposas, mentiras y medidas', La Jornada,11 September.

Aridjis, H. (1993) 'Grandeza y miseria de la mariposa monarca', La Jornada, 17 February.

Aridjis, H. (1993a) 'Mariposa monarca: santuarios talados', La Jornada, 26 October.

Barbier, E., J. Burgess, M. Collins, and C. Clancy. (1993) Mexico: Forestry and conservation sector review. sub-study of economic issues for implementation of the new forestry policy. World Bank Latin American and the Caribbean-country department ii, London Environmental Economic Centre, London.

Calvert, W.H. and R.O. Lawton. (1993) Comparative Phenology of Variation in Size, Weight, and Water Content of Eastern North American Monarch Butterflies at Five Overwintering Sites in México, chapter 8.III, pp. 299-308. In Malcolm and Zalucki 1993.

Chapela y Mendoza, G. and D. Barkin (1995) Monarcas y Campesinos. Centro de Ecología y Desarrollo, México.

Chavez Martínez, O. and G.M. Orihuela Quintero.(1990) 'Informe de los meses de Noviembre y Diciembre de 1989 de la Reserva Especial Mariposa Monarca'. Technical report, INE.

Cortes Ramírez, A.(1993) 'Detienen a 2 funcionarios de industrias Resistol'. La Voz de Michoacán, 3 June.

CSERGE.(1993) México forestry and conservation sector review, substudy of economic evaluation of forests. World Bank Latin America and the Caribbean-country department ii, CSERGE.

De la Maza, J. and W.H. Calvert.(1993) Investigations of Possible Monarch Butterfly Overwintering Areas in Central and Southeastern México, chapter 8.II, pp. 295-8. In Malcolm and Zalucki 1993.

Fuentes, S. (1993) 'Grupo de los cien: Talamontes destruyen santuarios de la mariposa monarca'. La Jornada, 7 May.

Gurza, T. (1988) 'Las Monarcas ya no llegarán más si continúa la tala del bosque'. La Jornada 18 January.

Gurza, T. (1993) 'Si no nos dejan talar, quemaremos el bosque con todo y monarcas'. La Jornada, 4 June.

Gurza, T. (1993) 'Uso industrial a la madera del Santuario de la mariposa'. La Jornada, 28 February.

Hoth von der Meden, K.J.(1993) 'Rural development and protection of the Monarch butterfly (*Danaus plexippus*) in México: A sustainable development approach'. Technical report, School of Rural Planning and Development, Guelph, Ontario, Canada.

INE.(1991) 'Necesidades de concertación en la REB Mariposa Monarca (Ejido El Rosario)'. Technical Report, INE.

INE.(1992) 'Datos de las temporadas turísticas del Santuario Sierra El Campanario'. Technical Report, INE, México.

INE.(1993) 'Datos básicos para el diagnóstico de la Reserva Especial de la Biósfera Mariposa Monarca'. Internal report, INE, México.

INE.(1994) 'Perfil del proyecto productivo 'Empresa Turística Ejidal' del Ejido El Rosario, Municipio de Ocampo, Michoacán'. Technical report, INE, México.

Malcolm S.B. and M.P. Zalucki, ed.(1993) Biology and Conservation of the Monarch Butterfly, California, USA. Natural History Museum of Los Angeles County.

Mejia, M.(1990) 'Informe de las actividades del programa operación y conservación de la REB Mariposa Monarca'. Technical report, INE.

Mejía, M.(1990) 'Reporte de actividades realizadas durante la temporada 1989-90 de la Reserva Especial de la Biósfera Mariposa Monarca en Sierra Chincua'. Technical report, INE.

Moreno, J. (1990) 'Aviso de acción preliminar para aprovechamientos forestales en el Ejido 'Cerro Prieto', Mpio. de Angangueo, Mich'. Solicitud enviada por el Comisariado Ejidal de esa entidad al INE.

Moreno, J. (1990) 'Manifestación de impacto ambiental (general) Ejido 'Cerro Prieto', Municipio de Angangueo, Michoacán'. Documento presentado por el Comisariado Ejidal.

Muñoz, C. (1992) 'Forest or no forest: A logit analysis of deforestation'. Master's thesis. University College London.

Ortíz Alcantara, J. (1992) 'Compromiso millonario para la creación del primer proyecto de desarrollo ecológico productivo estata'. La Voz de Michoacán, 3 June'.

Ortíz Monasterio, F.(1980) 'Investigación y análisis del plan de urgencia para la protección de la mariposa monarca (*Danaus plexippus*) durante el periodo de hibernación 1980-81 en la Zona de Angangueo, Michoacán'. Technical report, Aleph, S.A. Consultores Asociados, México.

Pérez, L.(1993) 'Devastan Santuario de la Mariposa Monaca en Michoacán: Talamontes provocaron 20 incendios en 30 días'. Excélsior, 6 May.

Riquelme, E.(1993) 'Exige G-100 cedan a ejidatarios el santuario de la mariposa monarca'. Excélsior,9 May.

Rojas González de Castilla, S. (1993) The Importance of Alternative Sources of Income to 'Ejidatarios' (Local residents) for Conservation of Overwintering Areas of the Monarch Butterfly, chapter 9.VII, pp. 389-91. In Malcolm and Zalucki 1993.

SARH.(1992) 'Zonificación y clasificación de los terrenos forestales y del área de influencia del área de la reserva especial de la biósfera de la 'Mariposa Monarca''. Technical report, Subsecretaria Forestal y de Fauna Silvestre, Dirección General de Política Forestal, Michoacán and México.

SARH (1993) 'Meeting on the Mortality of the Monarch Butterfly in México', Avándaro, México 1993. SEDESOL, SARH.

SEDESOL (1993) 'Programa de manejo de la Reserva Especial de la Mariposa Monarca'. Technical Report, SEDESOL Internal Report.

SEDESOL (1994) 'Programa emergente de la Reserva Especial de la Mariposa Monarca'. Technical Report, Dirección General de Aprovechamiento Ecológico de los Recursos Naturales y Areas Protegidas. Unidad de Coordinación Técnica, GEF.

SEDUE (1986) 'Reserva Ecológica Mariposa Monarca. Subprograma Turismo Ecológico, Temporada: Noviembre 1986 - abril 1987'. Technical report, Dirección General de Conservación Ecológica de los Recursos Naturales, México.

Snook, L.C.(1993) Conservation of the Monarch Butterfly Reserves in México: Focus on the Forest, chapter 9.II, pp. 363-376. In Malcolm and Zalucki 1993.

SOLIDARIDAD (1992) 'Conservar el bosque, compromiso en Michoacán'. Gaceta de SOLIDARIDAD, 31 September.

SOLIDARIDAD (1993) 'Mariposa monarca, fenómeno migratorio singular'. Gaceta de SOLIDARIDAD, 31 May.

Soto Nuñez, J.C. and L. Vázquez García.(1993) Vegetation Types of Monarch Butterfly Overwintering Habitat in México, chapter 8.I, pp. 287-94. In Malcolm and Zalucki 1993.

WWF (1989-93) Approved projects, Latin America. Technical report, World Wildlife Fund for Nature 1989-93.

9. Abbreviations

EAP Economically Active Population

INE Instituto Nacional de Ecologia. National Institute of Ecology (dependent of SEDESOL)

PROFEPA Procuraduria Federal de Proteccion al Ambiente. Federal Environmental Protection Attorney

PRONASOL Programa Nacional de Solidaridad. National Solidarity Program

SARH Secretaria de Agricultura y Recursos Hidraulicos. Secretariat of Agriculture and Water Resources

SEDUE Secretaria de Desarrollo Urbano y Ecologia (now SEDESOL). Secretariat of Urban Development and Ecology

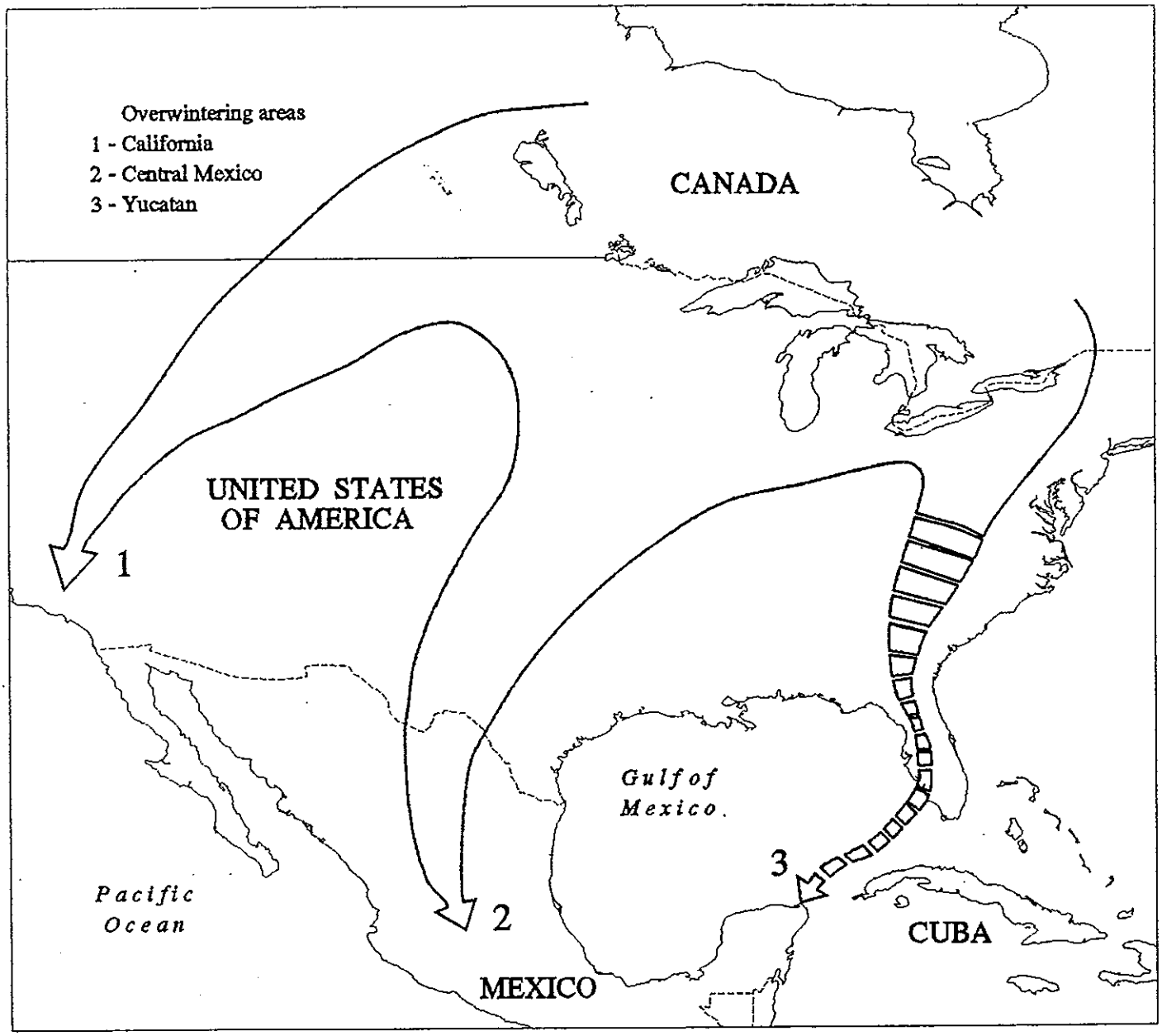
SEDESOL Secretaria de Desarrollo Social. Secretariat of Social Development

SOLIDARIDAD see PRONASOL

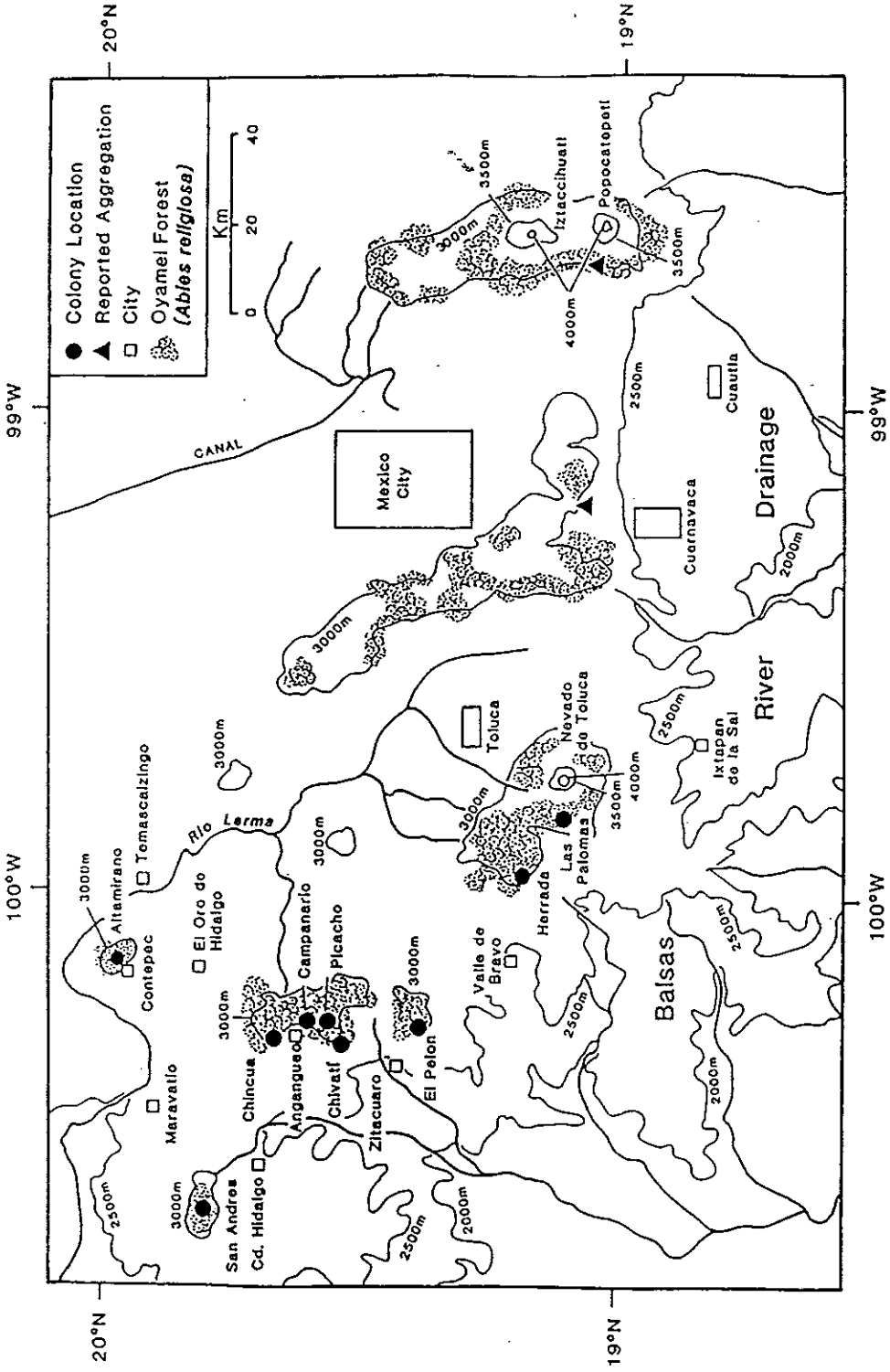
UCODEFO Unidad de Conservacion y Desarrollo Forestal. Forestry Conservation and Development Unions

The national currency is the Nuevo Peso (N$). N 3.3 = USD 1 $ (Dec. 1994) N 6 = USD 1 $ (August 1995)

Map 1. Main migratory routes of the Monarch butterfly



Map 2. Location of Monarch butterfly overwintering areas.



Location of monarch butterfly overwintering areas in relation to topography, drainage patterns, and oyamel (*Abies religiosa*) forest of Mexico's Transvolcanic Belt. Most sites are located along an arc stretching from the western slopes of the volcano Nevado de Toluca, in the state of México, northwest to the town of Zitácuaro, in the state of Michoacán, and then north, past Angangueo to Contepec, Michoacán. The total length of the arc from the most easterly colony, Palomas, to the most northerly colony, Altamirano, is approximately 143 km. Colonies are indicated by solid black dots; cities by open squares. Contour interval = 500 m (from Calvert and Brower, 1986).

Figure 1. Average rainfall at meteorological stations in or near Monarch Butterfly overwintering areas. Recreated from Calvert and Lawton(1993).

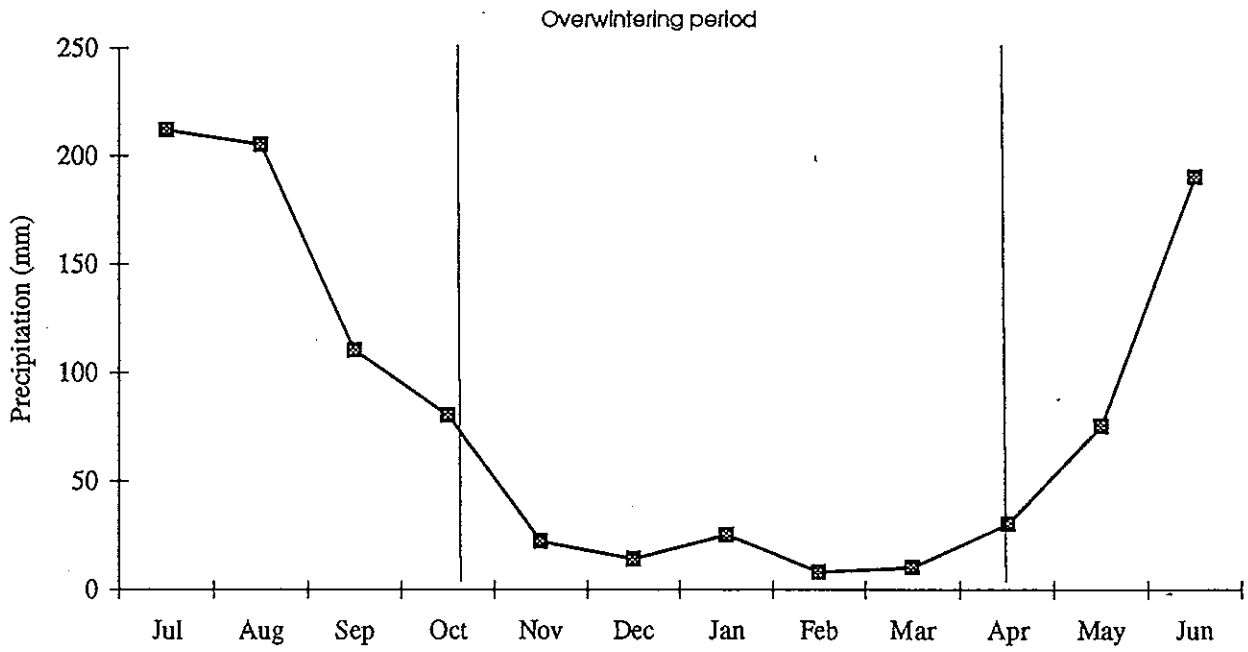


Figure 2. Physical characteristics of forests in and around the overwintering colonies. Data reconstructed from Calvert and Lawton (1993) for 1985-86 and Hoth (1993) for 1992. Different icons indicate the reported status of monarch butterfly colonies.

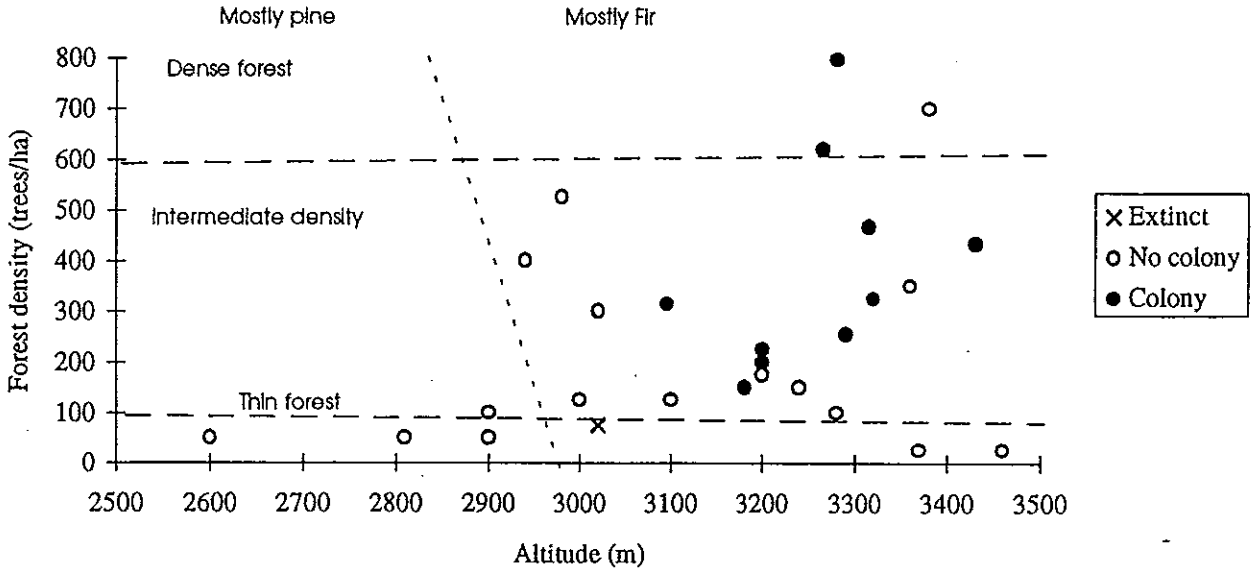


Figure 3. Size of the core and buffer zones of the different reserve areas.

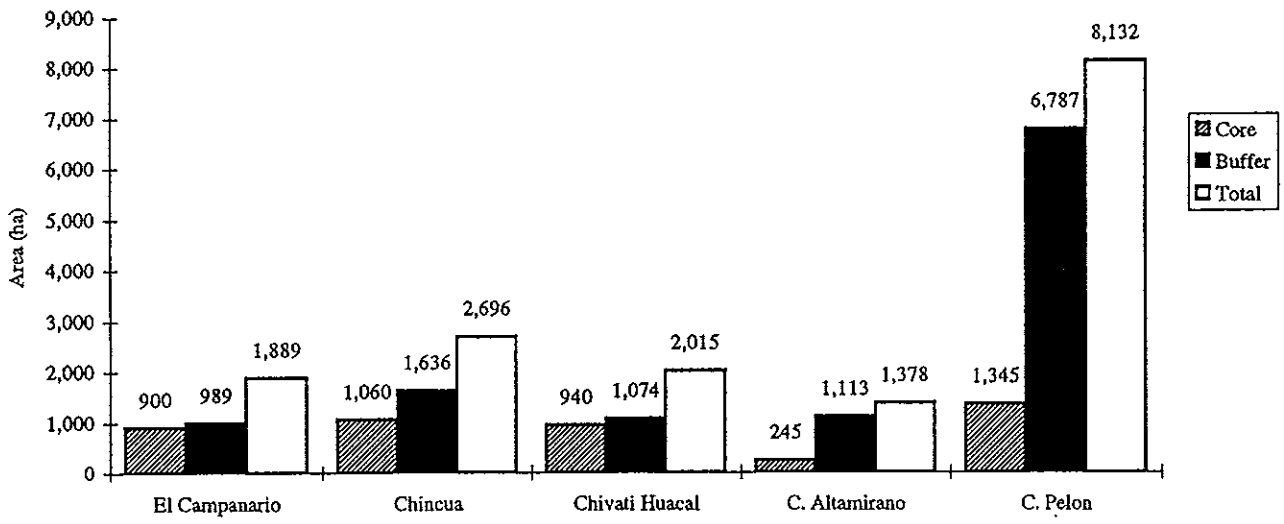


Figure 4. Changes in land use patterns in the five polygons of the reserve between 1982/84 and 1989/90. Taken from SARH 1992.

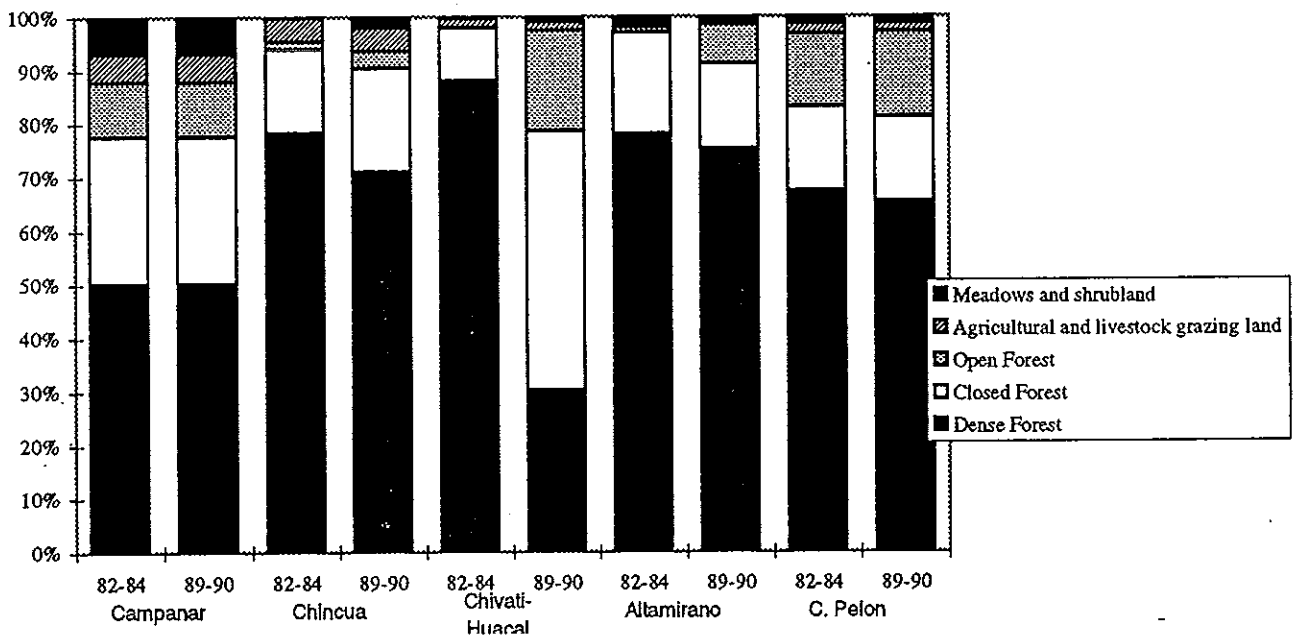


Figure 5. Physical characteristics of forests in and around the overwintering colonies. Data reconstructed from Calvert and Lawton (1993) for 1985-86 and Hoth (1993) for 1992. Different icons indicate the reported status of monarch butterfly colonies.

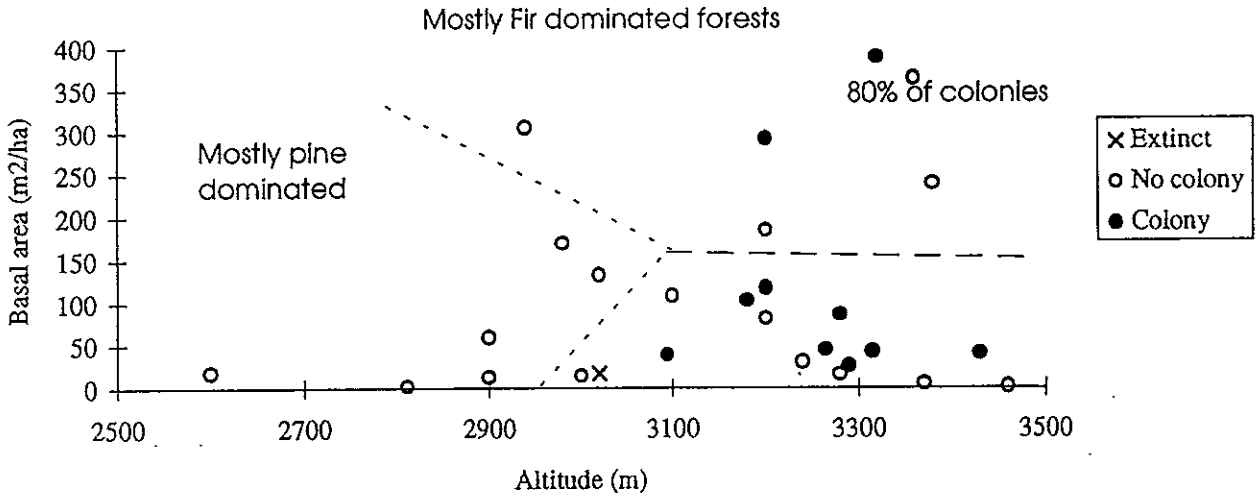
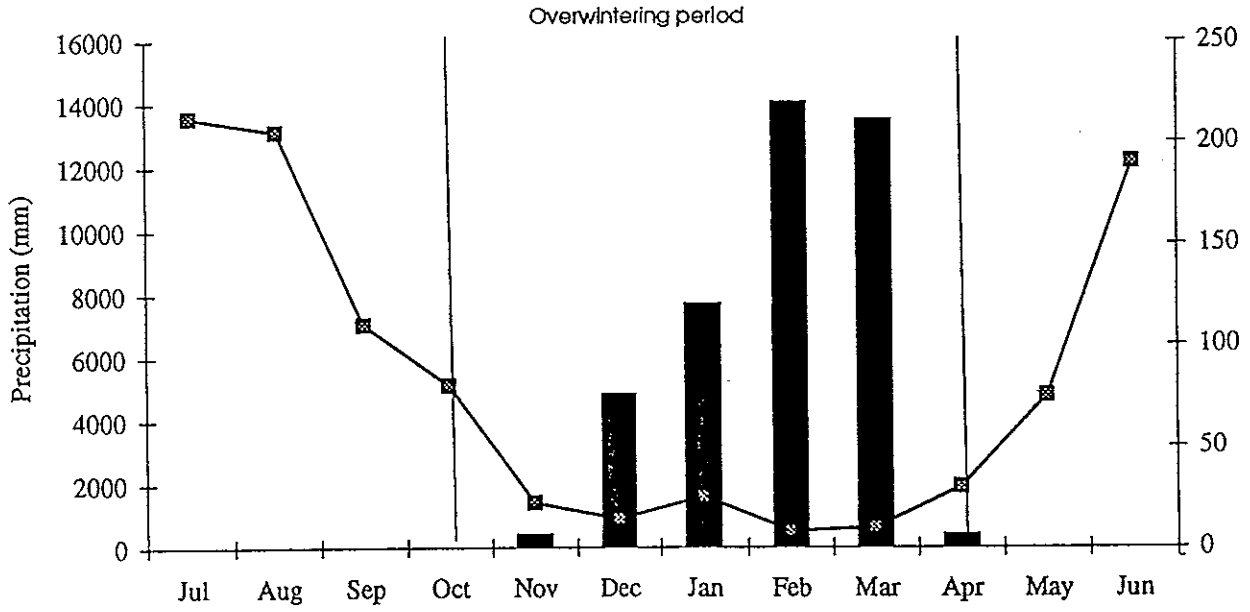


Figure 6. Relationship between rainfall, overwintering period and visitors to El Rosario. Legal forestry activities face higher costs by being pushed to the months in between the overwintering and the rainy season.



2

Sustainable tourism development in the Ras Mohammed National Papk, Egypt

David Medio[1]

[1] Tropical Marine Research Unit, York University.

Table of contents

Acknowledgements

1 Introduction
- 1.1 The Sinai Peninsula
- 1.2 Tourist development
- 1.3 Ras Mohammed Marine Protected Area: its establishment and evolution.
- 1.4 Economics of marine parks and protected areas.
  - 1.4.1 The role of marine parks and protected areas.
  - 1.4.2 Benefits and costs of protection.

2 Ecology of the Ras Mohammed National Park Sector
- 2.1 The reefs in the Ras Mohammed Sector
  - 2.1.1 Diver and visitor survey
  - 2.1.2 Underwater Monitoring
  - 2.1.3 Results of the structured surveys
  - 2.1.4 Results of the monitoring survey
  - 2.1.5 Carrying Capacity and Management Interventions

3 The Economics of the Ras Mohammed National Park Sector
- 3.1 Costs of protection
  - 3.1.1 Costs of establishment
  - 3.1.2 Current annual operating costs
  - 3.1.3 Opportunity costs
- 3.2 Benefits of protection
  - 3.2.1 Hotel and Dive operators
  - 3.2.2 Tour operators
  - 3.2.3 Government revenues
  - 3.2.4 Employment
  - 3.2.5 Who benefits?
- 3.3 Conservation costs: the future

4 A survey of an unmanaged Red Sea Tourist Resort

5 Discussion
- 5.1 Conservation
- 5.2 Replicability
- 5.3 Training
- 5.4 Current trends and threats

6 Conclusions

7 Figures

Acknowledgements

I would like to thank all the people who provided invaluable assistance to this study. In particular Dr Michael Pearson, Ras Mohammed National Park Project Manager, Br Gen Omar Hassan, RMNP Park Manager. In Hurghada, I wish to thank Mr Philip Jones, Manager at HEPCA.

I would also like to express my gratitude to Mr Noam Meshi, Director Nature Reserves Authority Dr Nourit Gundermann, Biologist Nature Reserves Authority in Eilat.

Finally, I would also like to thank Dr. Rupert Ormond, Director of the Tropical Marine Research Unit at the University of York for his support in this study.

1 Introduction

1.1 The Sinai Peninsula

The uplifted Sinai peninsula, located at the northern-most part of the Red Sea (between 27N and 30N), is embraced by the Gulf of Suez to the west and Aqaba to the east (Map 1). The latter, a segment of the Afro-Syrian rift system, is 170 km long, 14 to 26 km wide and close to 2,000 metres deep, and separated from the Red Sea proper by the straits of Tiran, a 250m deep, narrow passage. The Gulf of Aqaba is bordered by a luxuriant fringing reef which extends along almost the whole 200 km shoreline from Eilat (Israel) in the north to Ras Mohammed (Egypt), the southernmost tip of the peninsula, interrupted only by shallow bays. The width of the fringing reef flat depends on the steepness of the inorganic slopes on which the corals rest. At most sites this base is formed by the descending and submerging mountains of the uplifted Sinai peninsula. On several northern sites, such as between Dahab and Ras Abu Galum and on the eastern shores of the Ras Mohammed peninsula, these rocks descend directly into the sea, thereby presenting a very narrow reef flat (1-5 metres) and an abrupt drop-off into deep waters. In more southern parts however, such as north of Sharm el Sheikh, the mountains retreat revealing uplifts of coral reefs often exposed above the current coastline. These exposed terraces are between 20,000 and 200,000 years old (Friedman, 1965).

The climate in South Sinai is extremely arid with rainfall averaging less than 5 millimetres a year. The high temperatures guarantee tourism year round: mean values range between 18C in January and 33C in July. Dry northerly breezes render the high summer temperatures more agreeable.

The reefs of the Gulf of Aqaba are subject to few natural disturbances. The Red Sea is a narrow and enclosed body of water with generally small waves and very rare storms; the lack of river runoff, low planktonic primary production and extremely low rainfall result in very clear water. These features have all contributed to the biological uniqueness of the area: a relatively high diversity of corals (Loya, 1972, 1976; Sheppard, 1980) and over one thousand species of fish living in transparent, warm waters have formed the basis for the region's popularity as a tourist destination. This became evident in the late 70s and, in a preliminary study on the proposed establishment of protected areas in Sinai, Fishelson (1980) stressed the fact that it was possible to develop a tourist industry centred around Sinai's coral habitats so long as these were actively protected and that benefits would eventually outweigh the costs of reef conservation. "This concept", he emphasised, "should be the basic premise for developers". Ironically a World Bank report at the time had dismissed the Red Sea/Sinai area as potentially suitable for international tourism because of its inhospitable climate, remoteness and lack of infrastructure.

1.2 Tourist development

The proximity of Sinai's reefs to the European tourism market and Egypt's economic needs have led to an unprecedented increase in tourism and associated infrastructure. Since 1988 the number of hotels in South Sinai has increased from 5 to 36, the number of diving centres from 5 to 26 and the number of boats from 23 to over 200 (Table 1). The rate of development in the past two years has increased even faster: the percentage increase from 1988 to 1995 has been almost twice that of the period between 1988 and 1993. The number of visitors to the Sharm el Sheikh area

in 1994 was 205,000; if the development ceiling for this area, currently set at 23,000 beds in 1996 and the average annual occupancy rate of 70 percent (National Park Survey, 1994) are reliable statistics, then the expected number of visitors for 1995 will be in excess of 500,000. These figures do not include the newly developed areas of Dahab and Nuweiba where hotel development is taking place albeit at a different pace from that seen in the Sharm area.

Table 1. Tourism trends in the Ras Mohammed Sector between 1988 and 1995.

	1988	1989	1990	1991	1992	1993	1994	1995
Hotels	5	7	8	15	18	27	36	40
Rooms	565	694	805	1,492	1,662	2,578	4,050	6,124
Beds	1,030	1,276	1,358	2,906	3,306	5,190	8,234	12,248
Dive Centres	5	6	10	14	16	18	26	27
Boats	23	25	47	60	89	120	200	240
Shore Dive Sites	22	22	18	14	10	6	4	1

Source: Ras Mohammed National Park.

Table 2. Number of visitors to Sharm El Sheikh and the Ras Mohammed National Park, 1988-1994.

Year	Sharm el Sheikh		Ras Mohammed	
	Egyptians	Foreigners	Egyptians	Foreigners
1988	7,270	13,627		
1989	39,546	47,024		
1990	23,762	38,829	8,333	6,414
1991	28,889	55,491	9,307	6,000
1992	37,077	96,986	10,372	28,834
1993	53,549	110,928	8,305	40,945
1994	60,599	145,029	6,488	62,638

Source: Ras Mohammed National Park

Such an increase in tourism-related development can have several direct and indirect impacts on coral reefs and other delicate marine ecosystems. Some of the more common effects are siltation due to construction, as seen at Eilat in the Gulf of Aqaba (Mergler, 1981) and in the Caribbean (Stafford-Smith, 1990), and waste water discharge, as highlighted by White (1987) in the Philippines and Mergner (1981) in the Red Sea. Altering the coastline by constructing artificial beaches can also have devastating effects (Naim, 1981; Kenchington, 1985; Fawzi, 1995). A particular case in Sinai involved a sand-fill in order to create a 4,000 m^2 artificial beach. The consequences, which are still being investigated, include increased sedimentation, beach erosion and possibly an altered fish community structure (Medio, pers. obs.). Damage from collecting, fish feeding, over-fishing, anchoring and diver damage has been reported from numerous

locations world-wide (Salvat, 1981; Tilmant, 1987; Rogers *et al* 1988; Wood and Wells, 1989; Ward, 1990). These man-made disturbances are, for the most part, absent from within the boundaries of the Ras Mohammed National Park Management Sector. It is, however, the less well documented diving-related forms of abuse which are increasingly becoming a cause for concern in South Sinai. A number of studies recently undertaken within the Ras Mohammed Sector have shown that at heavily used sites divers cause significant damage to the fore-reef slopes, causing a significant decrease in coral cover and diversity (Hawkins and Roberts, 1992, 1993) and may be responsible for up to 35 more or less damaging impacts to corals per m^2 per year (Medio *et al.*, in press).

1.3 Ras Mohammed Marine Protected Area: its establishment and evolution

In 1983 the Government of the Arab Republic of Egypt, recognising the link between coral reef conservation and the potential economic benefits derived from tourism development in South Sinai, declared the Ras Mohammed peninsula, at the southern extremity of Sinai, a 'Marine Protected Area' (Law 102). The protected area initially covered 97 km^2 and 0.6 percent of the Egyptian littoral on the Gulf of Aqaba and the Island of Tiran. The rapidly encroaching tourism led the Egyptian government to request a study in order to determine the feasibility of, and the technical assistance for, the development of the RMMPA. Its recommendations proposed: upgrading its status to that of National Park, thereby adding a terrestrial component to the protected area, increasing its area to cover 210 km^2, the establishment of a coastal zone management plan and a monitoring programme to evaluate and modify management measures (Pearson, 1988). As a result, technical assistance from the EU led to the establishment of an initial development phase which provided essential equipment, recruited and trained local staff and introduced a basic monitoring programme. This first phase, lasting two and a half years, demonstrated, among other things, that strict management of marine resources was not meant to hinder development in South Sinai. One of the objectives of the management in place at Ras Mohammed was to show that all development in the area was resource dependent and that the degradation of coral reefs and other marine ecosystems would limit the area's economic potential.

Subsequently, in 1992, following acceptance of the second phase of the development for the National Park, the government of Egypt extended the boundaries even further (Law 1511) to include:

(a) the National Park, a coastal and terrestrial protected area with very limited access, about 70 percent is still off-limits, and no development. Since it was declared (1989), the park has been provided with a visitor centre and a laboratory complex: this includes state of the art laboratories, a workshop, a diving centre for park staff and accommodation for visiting scientists.

(b) the coastal managed areas, the jurisdictional limits of which are defined as the highest equinox tide line, fronting the Sharm el Sheikh development zone. These include the military and commercial harbours, the larger proportion of built-up areas and ca. 90 percent of hotels in the area. This section of the protected areas has witnessed the greatest tourism development expansion and most of its 24km coastline northeast of Sharm el Sheikh has already been sold to developers. The park, responding to the regulatory

procedures established by the Egyptian Environmental Affairs Agency (EEAA), the government body responsible for protected areas, has effectively regulated tourism activities and related development. All development projects such as hotels and diving centres must be approved by the EEAA through its park management: some of the development constraints include minimum distances from the shoreline, maximum height of buildings and the inclusion of walkways or promenades to guarantee public access to the State-owned shores. Waste water discharge into the sea from urban or development areas, for example, is absent from the Egyptian littoral within the protected areas in the Gulf of Aqaba. All sewage is treated either at municipal biological facilities or by individual hotel operators. In order to implement these and other regulations in place within the protected areas continuous patrolling by park staff and monitoring programmes have been established by the park management.

(c) the Nabq and the Ras Abu Galum Managed Resource Protected Areas: two multiple use areas, with a preliminary zoning plan comprising scientific reserves, buffer zones, controlled access zones, traditional settlements and potential tourism development areas. These areas are linked by the Dahab Coastal Managed Area. This network of protected areas is presently known as the Ras Mohammed National Park Management Sector (RMNPMS) covering 2,000 km^2 of surface (marine, coastal and terrestrial) and 52 percent of the Egyptian Gulf of Aqaba (Map 1) (Pearson, 1995).

The oasis of Nabq contains the northern-most mangrove forests of the Red Sea (*Avicennia marina*), further emphasising the uniqueness in biodiversity of the Gulf of Aqaba. Apart from the sparse mangrove at Ras Mohammed, four mangrove stands of considerable density are found along a 20km stretch of coast northeast of Sharm el Sheikh. The mangrove oasis of Nabq is a critical zone which includes dunes, seagrasses, lagoons, coral reefs and, most important, Bedouin settlements which have used Nabq as a fishing area for centuries; the nearby wadis are currently used to graze sheep, goats and camels. Its recent protection is part of the commitment by the Egyptian authorities to not only preserve critical marine environments but also render the local communities, quite often the owners and/or users of the resource an integral part of the protected areas.

The area of Ras Abu Galum contains unique back reef areas with important mollusc and invertebrate populations. Much of the area remains unknown but those parts which have been explored and inventoried do have an economic value both in terms of artisanal fisheries and tourism. By including Abu Galum in the Management Sector, the authorities have, de facto, efficiently separated two development areas (Dahab and Nuweiba) with a large Protected Area providing space, undisturbed natural systems and economic resource based opportunities.

1.4 Economics of marine parks and protected areas

1.4.1 The role of marine parks and protected areas

The Ras Mohammed National Park Management Sector comprises the Ras Mohammed National Park and the Managed Resource Protected Areas of Nabq and Ras Abu Galum. The Management Sector is therefore a multiple use managed area (IUCN, 1993) combining strictly controlled scientific reserves, recreational facilities and areas which have been set aside for coastal tourist development. The main objective of such a multiple use area is to supply sustained economic activities and recreation. Likewise, some of its area may be set aside for scientific and educational purposes.

The interdependence of a marine protected area with any of a number of land-based activities has become clear in many parts of the world. Hence, sewage discharge, agricultural runoff and industrial activities may cause serious impacts to an area set aside for conservation and/or recreational activity. Despite the absence of most of these man-made forms of disturbance in the Ras Mohammed Sector, a rapid increase in coastal tourism and the potential degradation of the reefs in South Sinai have called for an integrated management of coastal zones aimed at striking a balance between conservation and economic development. A brief comparative survey undertaken at Hurghada provides a striking example of unregulated coastal development and some of its direct and indirect consequences on the fragile reef ecosystem.

1.4.2 Benefits and costs of protection

The range of benefits afforded by protected areas such as the Ras Mohammed Sector include the protection of genetic resources and biological diversity, the economic development through the exploitation of tourism and recreation, creating and maintaining employment, and providing opportunities for scientific research and education.

A brief general overview of the costs and values associated with protected areas is presented below. It should be noted however, that Ras Mohammed illustrates a non-standard reality within a traditional protected area because of the absence of alternative uses of the resource, i.e. the economy of the South Sinai peninsula is strikingly undiversified. It is de facto a tourist destination, based almost exclusively on the diving and snorkelling industry.

There are three commonly acknowledged forms of values derived from the benefits of protected areas. Direct use values refer to the benefits derived by people currently making use of a resource. For example, consumptive (extractive) or non-consumptive (in situ) uses of a resource are typical direct use values. Indirect-use value is exemplified by people not currently making use of a resource but simply preserving it for future use. Lastly, the existence value of a resource, such as a unique environment, is independent of its current or future use.

Three different types of costs related to the establishment and management of protected areas are commonly recognised. Direct costs, arising from the initial establishment of parks and protected areas. Indirect costs are usually borne by people as a direct result of the establishment and operation of the park. For example, wildlife from a protected area trampling or consuming crops outside the park is a typical example of such a cost. The opportunity costs of a protected

area are, generally speaking the benefits forgone as a result of protection. They include, for example, the lost outputs such as animals, timber etc.

Dixon and Sherman (1990) have investigated the benefits and costs of protected areas in some detail. In particular they illustrate the difficulties in trying to estimate the value of, amongst others, biodiversity, education, and research. In the present study the benefits and associated values due to the direct use of the resource will be examined. In particular, how benefits may accrue to the local economy through the tourist industry and, to a lesser extent, to visitors to the park and how these might differ in an area of unregulated coastal development such as Hurghada. A number of structured surveys have provided some useful information on how users value protected areas and the associated resources and the extent to which they may be involved in bearing the costs of protection and management (willingness-to-pay): a brief analysis of the proposed 'recovery fee' and its application to covering the costs of conservation at Ras Mohammed is included.

2 Ecology of the Ras Mohammed National Park Sector

Coral reefs are colonial calcareous structures formed by the skeletons of scleractinian corals and other organisms. The single animal, the polyp, contains symbiotic dinoflagellate algae which contribute to the nutrition of the corals via their photosynthetic compounds and to the deposition of calcium carbonate by the polyp. The symbiosis determines the corals' need for light: coral reefs are thus found in clear shallow waters in tropical and semi-tropical parts of the world. Coral reefs are arguably the most productive and diverse marine community, in many ways similar to tropical rain forests. Reefs are important sources of food (fisheries), building materials, medicines and even provide an efficient protection against wave-action and storms throughout the tropics. The recent rapid population growth in tropical coastal areas has led to the widespread degradation of coral reefs due in part to dredging, sewage and pollution from coastal development and a general over-exploitation through the use of explosives and poisons to enhance fish catch. The significant decline in the health of coral reefs world-wide has highlighted the need to protect and sustainably exploit reefs if they are to survive and provide a livelihood to tropical coastal communities.

2.1 The reefs in the Ras Mohammed Sector

The health of the reefs in the Ras Mohammed Sector was evaluated through a structured user survey and an underwater visual and photographic monitoring. The results analyze the overall user perception of the reefs, provide data on coral cover and diversity at a number of key sites in the area and attempt to assess the carrying capacity of the reefs in South Sinai.

2.1.1 Diver and visitor survey

A total of 127 visitors (95 divers and 32 snorkellers) from 16 countries were interviewed during a ten month period between July 1994 and May 1995. The most relevant questions dealt with their perception of coral cover, fish abundance, water visibility and pollution. A considerable number (76) of the interviewees had also visited other coral reef resorts and some (42) had been to Sinai before. This would provide a good indication of how they rated the reefs in South Sinai

with respect to other destinations and if and how these reefs had changed since their last visit.

2.1.2 Underwater monitoring

A monitoring programme to evaluate coral cover and quantify the extent of damage (both natural and human) to corals was established in the Sector in 1993. Over the past 2 years a considerable amount of data has been collected from 4 sites (11 stations, see Table 3) within the boundaries of the Sector (see Map 2). All of these sites have been re-surveyed to test for changes in cover and damage.

Table 3: Monitoring Sites and their Status

Site	Stations	Status	Monitoring Status
Venta Club	2	Existing Hotel Site	1993-1994
Sheikh Coast	4	Hotel Site opened after first survey	1994-1995
Marsa Bareka	3	Closed site partially opened in April 1995	1993-1994-1995
Turtle Beach	2	Control Site	1993-1994

The site at the Venta Club Village is exposed to wave action and receives moderate diving pressure (approximately 20,000 dives per year) since its opening in late 1992. It is located half way between Naama Bay and Sharm el Sheikh within the coastal managed area of the Sector.

Sheikh Coast is a recently inaugurated (6/94) resort in a relatively sheltered bay north of Sharm el Sheikh within the coastal managed area of the Sector. The first survey took place during the construction of the hotel. The village provides accommodation for about 800 guests per week. Little used before June 1994, it has become a moderately dived site, about 5,000 to 10,000 dives per year, but is used by about 300-400 snorkellers a day. The installation of a number of user constraints such as walkways, demarcated access lanes and floating pontoons to reach the reef edge and beyond might prove sufficient in preserving the coral communities at this site. Preliminary data from a recent survey (5/95) suggest that the extent of human damage to the coral community has not increased since the opening of the resort. (See section on Management Interventions).

Marsa Bareka is a large sheltered bay within the National Park. It has been a closed area for over a decade but was recently opened (1/4/95) as a limited access boat diving area. The site was monitored in 1993, 1994 and 95 to test for changes in coral damage due to a very moderate and strictly controlled diving pressure (3,500-7,000 dives per year).

Turtle Beach is a closed area of the National Park and is to act as a control site. The percentage of damaged corals is very low and the site has witnessed no significant change over a period of one year.

The two stations at Turtle Beach are comparable to the ones at Venta Club: an exposed station with high coral cover and a more sheltered one with a greater degree of sedimentation. Both these sheltered stations (Sharm and Turtle) are also comparable in coral cover and sediment rates to one of the stations at Sheikh Coast and one at Marsa Bareka respectively.

The monitoring technique comprised a visual survey using 70m belt (quadrat) transects at three separate depths: reef crest, 5 and 15m. A photographic analysis of these quadrats at three of the four sites above has produced a permanent record of the monitored area. This study has generated data on key biological parameters such as coral cover, substrate type, coral growth forms and genera as well as quantifying the extent of natural and human damage to corals.

A plot of the cumulative number of coral genera and the number of quadrats revealed that after 12-13 quadrats there was no significant increase in the number of genera. Fifteen sequential quadrats seemed therefore an adequate number. Previous community structure studies in the Red Sea using only 10m line transects had taken place in smaller and less diverse study areas (Loya, 1972). The coral cover and coral damage estimates were obtained using the REEFWATCH underwater survey slates developed by the Tropical Marine Research Unit at the University of York. A statistical software programme, SPSS, evaluated a number of univariate statistics and two diversity indices: Shannon (H') as an index of richness and Pielou (H'/H' max) as an index of evenness. Differences in cover, diversity and damage within and between sites were tested using non-parametric ANOVAR (Kruskal-Wallis) and Mann-Whitney's U test. Various transformations had been unsuccessful in normalising the data.

2.1.3 Results of the structured surveys

Assessing the health and rating of coral reefs by interviewing its users is extremely important to the management of any protected area. In South Sinai divers and snorkellers represent over 95 percent of the tourist market further emphasising the importance of their feedback. On the other hand, the well documented inability of untrained observers to assess ecological parameters and changes has led to the exclusion from this survey of any specific questions relating to coral diversity and reef species. An example: an usually high rating of a particular dive site in the Ras Mohammed Sector is due to the striking dominance of soft corals at this site: a photographer's and underwater artist's delight but not an indication of high hard coral cover or diversity. In this particular survey approximately 16 percent of all respondents declared some knowledge of biology.

For a sounder interpretation of tourists' feedback a few useful considerations should be borne in mind.

(i) The respondents' answers may be biased when they are interviewed on the spot.

(ii) When questioned about present/past ratings, people, in general, tend to say that 'things are not what they used to be'.

(iii) Tourists' answers are influenced by their experience, extent of knowledge in biology and/or coral reefs and changing interests.

The most relevant questions in the structured survey addressed the issue of the quality of the diving and snorkelling in the Ras Mohammed Sector both objectively and comparatively. The latter approach aimed to assess how the reefs in South Sinai compared with others and if and how they had changed with time.

The majority of visitors rated the Ras Mohammed Sector reefs and associated marine life very

highly (Table 4). The variety and abundance of corals was described as excellent by 42.1 percent of the respondents, very good (28.9 percent) or good (18.2 percent). The variety and abundance of fish life was rated excellent (35.5 percent), very good (35.5 percent) and good (19.8 percent). Visibility was rated highly by 81 percent of the respondents (38.8 percent excellent, 21.5 percent very good and 20.7 percent good). Water clarity may be affected by pollution and coastal development but when asked about signs of pollution, 68.1 percent said there were none, 23.4 percent pointed to some and only 8.5 percent said there were many.

Table 4. Diver/snorkeller rating of the condition of corals, reef fish and visibility within the Ras Mohammed Sector on a scale of 1 to 5 (5 = excellent and 1 = poor). Values are percent of sample, n = 121.

	5	4	3	2	1
Reefs	42.1	28.9	18.2	9.1	1.6
Fish life	35.5	35.5	19.8	4.1	4.9
Visibility	38.8	21.5	20.7	12.4	6.6

Such feedback confirms some of the renowned features of the Red Sea. Its corals, not as varied and abundant as in other locations, remain among the least impacted world-wide. Its fish life, perhaps lacking some of the larger, more spectacular fish, provides great variety and a high degree of endemic species. Almost 70 percent of the respondents rated the visibility as excellent confirming the reputation of the Red Sea.

A considerable proportion (ca. 60 percent) of the interviewees had visited other coral reef destinations including the Maldives, different Caribbean islands, Thailand, the Philippines, the Great Barrier Reef, Micronesia, Polynesia, the Galapagos Islands and Zanzibar. Table 5 summarises the feedback of 76 users. Between 42.1 percent and 63.2 percent rated the South Sinai reefs better than other destinations when describing corals, fish life and visibility respectively. 13.2 percent to 32.9 percent found these equivalent and between 17.1 percent and 25.0 percent thought they were worse when comparing the same three parameters.

Table 5. Comparison of the condition of the reefs, fish variety and abundance and visibility in the Ras Mohammed Sector with other diving resorts visited. Values are percent of sample, n = 76.

	Better	Same	Worse
Reefs	63.2	13.2	23.6
Fish life	42.1	32.9	25
Visibility	51.6	31.3	17.1

A smaller fraction of the respondents had been to the Ras Mohammed Sector on previous occasions. Table 6 summarises the views of these 42 visitors. Between 10.6 percent and 14.6 percent thought the coral reefs, fish life and visibility to be better than before; 53.4 percent to 56.6 percent said these parameters had not changed while between 22.0 percent and 36.0 percent declared that some degradation had occurred. An apparent improvement affirmed by some may be due to a better understanding of the marine environment and a greater appreciation of the variety of reef life as more time is spent paying attention to the environment than in getting used

to the new surroundings.

The overall rating of the reefs in the Ras Mohammed Sector is very high. Its favourable reputation is strengthened by the fact that the return rate to Sinai is very high. Figures from two separate surveys show that approximately 50 percent of foreign respondents had been to Sinai once before, 32 percent were on their third visit and 21 percent on their fourth visit. Approximately 62 percent of foreign visitors to Sinai had been informed and encouraged to visit the area by a former visitor (El Hawary, 1995). The overall rating of the reefs in Sinai is high, especially when compared to a wide variety of resorts. Some degradation appears to have occurred but the analysis in the next sections examines its ecological and management significance. The high profile provided by a quasi-pristine environment and its implications on the benefits and costs of the Ras Mohammed Sector will be investigated in the next chapters.

Table 6. Comparison of the conditions of the reefs, fish life and underwater visibility in the Ras Mohammed Sector with that of the users' previous visit. Values are percent of sample, n = 42.

	Better	Same	Worse
Reefs	14.6	56.6	28.8
Fish life	10.6	53.4	36
Visibility	12.6	65.4	22

2.1.4 Results of the monitoring survey

The objective of the monitoring survey was to assess hard coral cover, diversity and the frequency of natural mortality and man-made impacts to corals at the four different sites within the Ras Mohammed Sector.

The baseline data highlight a number of differences between the four sites (Table 7 and 8). The Venta Club Village, a moderately used site within the developed section of the Sector, shows a significantly higher coral cover ($P < 0.001$) and higher diversity indices (Shannon: $P < 0.001$; Pielou: $P < 0.001$) than all other sites. This site also shows significantly higher frequencies of natural forms of damage ($P < 0.001$) and human damage ($P < 0.001$). Of the other sites, Sheikh Coast has significantly higher diversity indices than Marsa Bareka and Turtle Beach (Shannon: $P = 0.04$; Pielou: $P = 0.02$). The interpretation of these differences is obviously not clear cut. However, Venta Club and Sheikh Coast, two recently developed tourist villages, may have been chosen as ideal tourist resorts in view of their 'richer' reefs. Secondly, Marsa Bareka and Turtle Beach are both more sheltered sites with higher sedimentation rates than Venta Club or Sheikh Coast. High sediments are known to limit both coral cover and diversity (only some corals can withstand high sediment loads). Lastly, but perhaps most importantly, moderately disturbed reef environments, both physically and anthropogenically, have been associated with higher diversity (Loya, 1976; Dollar, 1982; Grigg, 1983). Venta Club, and less so Sheikh Coast, are in fact exposed to wave action and to moderate diving and snorkelling pressure.

The four sites have been re-surveyed (at least a year after the initial survey) to test for changes in coral cover, diversity and damage (both natural and human). With the exception of Venta Club, no significant differences in the amount of human caused damage to corals have been

recorded. At Venta Club the amount of corals broken by human activities has in fact decreased significantly ($P < 0.001$) since the area was first surveyed in 1993; I have reason to believe that this may be due to, in part, to the management interventions described in a later section. Both Turtle Beach and Marsa Bareka show no significant difference in the amount of human induced damage to corals. In the case of the control site (Turtle) this was to be expected. Marsa Bareka has only recently been opened to as strictly controlled number of boat dives (no shore diving or snorkelling yet) and the 6 months' may not have been enough to record any significant change in overall damage. The site at Sheikh Coast was surveyed 16 months after its opening in 1994. No significant changes in human caused damage have been recorded. It must be pointed out that all management interventions at this site took place prior to its opening. It is interesting to note that natural forms of damage have decreased significantly at the most heavily used stations at Sheikh Coast, in particular damage attributable to fish ($P < 0.001$). A possible explanation may be that a high number of divers and snorkellers might scare certain species of fish away from the corals which they normally graze: great caution is urged in drawing any conclusion and further research is needed to fully understand such interactions. One year is possibly not enough for significant changes in cover and diversity to be observed in the absence of natural or man-made catastrophes. Further monitoring, based on the permanent baseline data currently available, will investigate changes over longer periods of time.

Table 7. Mean percentage of coral cover (hard coral present) and Shannon and Pielou diversity indices at four main sites within the Ras Mohammed Sector, Sinai, Egypt. In brackets number of stations. See text for details on site features and diving pressure.

Sites	Wave Exposure/ Dive pressure	Hard Coral present	Shannon Weaver H'	Pielou's Eveness H'/H'max
Venta Club (2)	Exposed /Moderate	28.1	1.6	0.74
Sheikh Coast (4)	Sheltered /Low	21.57	1.36	0.65
Marsa Bareka (3)	Sheltered /Very Low	19.34	1.16	0.55
Turtle Beach (2)	Exposed /Closed	22.96	1.22	0.59

Table 8. Mean percentage and SE of damage to corals due to natural agents and human activities at the four main sites within the Ras Mohammed Sector, Sinai, Egypt. In brackets number of stations.

Site	Total Natural		Total Human	
	Mean	Std Error	Mean	Std Error
Venta Club (2)	3.5	0.18	0.61	0.06
Sheikh Coast (4)	1.55	0.06	0.12	0.02
Marsa Bareka (3)	1.3	0.07	0.12	0.02
Turtle Beach (2)	1.58	0.09	0.11	0.03

2.1.5 Carrying capacity and management interventions

The reefs within the Ras Mohammed Sector, seen by many of their users as quasi-pristine and better than many of their counterparts world-wide, are currently under threat from increasing tourism (see Table 1 and 2) and diving-related tourism is now accepted as the major cause of damage to corals in the Sector. The data available on coral cover and diver related damage need to be investigated in the context of whether there appears to be a 'carrying capacity' for diver use or else a gradual decline in coral cover and abundance as human impacts increase. To achieve this, it is necessary to investigate the actual rates at which divers impact the reef rather than quantify the existing amount of man-made damage and also the rates of coral recruitment at the various sites affected by such rates of diver damage.

With a view to mitigating damage to corals by divers and snorkellers two separate studies were undertaken in the Ras Mohammed Sector in 1993 and 1994. Their findings are described below.

In a recent experiment to quantify the actual rates of damage by SCUBA divers at Ras Mohammed, Medio *et al* (1995), concluded that the current rates of impact were not sustainable. The data in Table 9 show how a single diver impacts the reef approximately 8.3 times per dive. Hence the 200 boats operating in the area and carrying between 2,000 and 3,000 divers each carrying out an average of 2 dives per day, lead to at least 32,000 impacts a day. The current diving pressure at the various sites within the Sector (10,000 to 40,000 dives per year) would suggest a potential rate of between 83,000 and 332,000 impacts per site per year. Developing this estimation further, and assuming the average site to be about 10,000 square metres (500m X 20m), every m^2 of reef could be impacted up to 33.2 times a year. These rates refer to a coral colony being broken in part or abraded, not the whole colony being knocked over and/or killed. In order to understand fully the significance of such rates of damage to corals it will be necessary to investigate the rates of coral recruitment. Furthermore, recent research on coral population dynamics has shown how fragmentation, potentially higher at high rates of human damage, is understood to be a common mode of reproduction particularly among the more easily damaged branching forms of coral. Preliminary data from the Ras Mohammed Sector (Medio, in prep.) and less recent research indicate that typically on reefs in the Gulf of Aqaba the number of coral colonies is of the order of 1 to 10 colonies per square metre (Loya, 1972) and the rates of recruitment of new colonies 1 to 5 per square metre per year (Loya, 1976). Comparison with the above figures on the rates of contact suggests that the rates of damage to living corals at heavily used sites may be approaching the capacity of the coral cover to sustain itself. Data in a recent report would appear to suggest that the amount of broken coral increases with diving intensity (Figure 1).

Table 9: Mean (SE) number of contacts per diver per seven-minute observation period and the expected number of contacts per diver per dive, per site per year and per m² per year. Also shown is the mean number of damaging contacts i.e. leading to breakage or abrasion of corals.

	Per 7 min.	Per dive	Per Site/yr	Per m2/yr
Contacts	1.97 (.34)	8.3	83,000-332,000	8.3-33.2
Structurally damaging	1.86 (.33)	7.8	78,000-312,000	7.8-31.2

This experiment was also designed to verify whether diver education could reduce the rates at which the reef was being damaged. A single environmental briefing reduced the number of impacts from 8.3 to 1.5 per diver per dive. Further data analysis showed that the number of damaging impacts (those contacts actually breaking or abrading live corals) prior to the environmental lecture was 6.7 per dive, i.e. about 80 percent of all impacts, whereas following the briefing only 0.3 impacts per dive, i.e. 20 percent of all impacts, were causing structural damage to corals. At the current diving intensities, 10,000 to 40,000 dives per site per year, this much reduced rate of contact would lead to between 0.3 and 1.2 damaging impacts per square metre per year. The one-hour interactive lecture on reef biology, diving techniques and park management, made the divers aware of the different reef elements. In the 11 experimental weeks the change in the number of impacts following the briefing was significant (t-test, P= 0.02 to 0.001) while no significant change occurred in the control weeks where no briefing took place. The experiment also confirmed that underwater photographers are the worst offenders: representing only 23 percent of all divers they are responsible for over 70 percent of all damage.

In the absence of any environmental awareness briefing, more than 30 impacts per square metre per year may be recorded at some of the most heavily dived sites, a figure well above the known rate of coral recruitment in the Red Sea. However, diver behaviour may be influenced by the use of educational tools and SCUBA divers' physical impact on corals considerably reduced. If environmental briefings resulted in a decrease in the number of impacts to corals of only 50 percent of those observed in this experiment, the rate of *damaging* impacts would be far lower than the known rates of recruitment in the Red Sea.

A separate study investigated the damage caused by reef walkers and snorkellers, which currently represent over 60 percent of all tourists in the Ras Mohammed Sector (Pearson, 1995). According to the latest estimates, the narrow fringing reefs in the area will attract about 300,000 users in 1995. The damage caused by visitors on a reef flat has been well documented in Sinai (Hawkins and Roberts, 1992) and elsewhere (Bryceson, 1981; Liddle and Kay, 1985,1987; Kay and Liddle, 1989). These authors were unanimous in concluding that overall coral cover and diversity decreased on the reef flat and crest at popular sites. The recommendations made included the use of walkways i.e. well marked routes for reef walkers, snorkellers and, indeed, divers.

In an experiment designed to test the benefits of such a walkway, a rudimentary entry point was installed at a recently opened tourist village in the Sharm el Sheikh development area (see Map 2). Prior to the installation of the walkway, coral cover and coral damage were evaluated using three parallel 70m belt transects on the reef flat at approximately 20, 30 and 40m from the shore line. Analysis of the data showed that damage to corals was evenly distributed on the reef flat reflecting the users' tendency to spread out on the flat.

A year after the entry point was put in place the same area was re-monitored to test for changes in coral damage. The overall incidence of broken and abraded coral due to trampling had decreased significantly on the reef flat area fronting the tourist village as most of its guests made use of the easier access to the reef crest and the open sea. The beneficial effects of the walkway were further demonstrated by the analysis of the data. A highly significant proportion of broken corals, up to 40 percent, was confined to 2m on either side of the walkway (Mann Whitney U test P=0.001) (Medio and Ormond, 1995).

In response to the findings of the above studies a training programme was established in late 1994 designed to provide the dive guides operating in the area with an adequate amount of information on coral biology and park management. With over 90 percent of all diving in South Sinai taking place from locally chartered boats, where at least one dive guide is compulsory, such a training scheme should be highly beneficial and, in the short term, greatly reduce damage to coral reefs. Likewise, the management at Ras Mohammed strongly encourage hotel developers and diving centres to install entry points and demarcated access lanes prior to the opening of their tourist facilities. Furthermore measures have been introduced to limit diver intensity at some of the key sites in the Sector. Until 1994 perhaps as many as 65 percent of all dives in the Sector took place at 5 of the available 36 dive sites, because of differences in popularity and accessibility. The ten-fold increase in the number of dive-boats since 1988 and the rates of diver damage illustrated above would soon have lead to an unsustainable diving pressure at some of the more heavily dived sites. As a result over the past 18 months the Park management has increased the number of accessible dive sites in the Ras Mohammed Sector. In order to efficiently distribute divers and hence reduce direct damage to corals, more than 120 fixed mooring buoys (anchoring is illegal throughout the Sector) have been installed by the Park management in the past year or so. At the more popular dive sites a timetable determines the maximum number of boats allowed in one place at any given time.

An increasing proportion of the visitors to South Sinai are not divers. Whereas in the 80s and early 90s over 80-90 percent of the few thousand tourists visiting the area were divers, the recent increase in tourism has led to a significantly higher proportion of snorkellers and reef walkers in the Ras Mohammed area. The importance of this trend on the overall impact to Sinai's reefs was briefly examined in the above experiments. Could such a change in the type of tourism influence the overall impact on the reefs and affect the existing management policies?

Despite the fact that most questionnaires and surveys carried out show great similarity in how divers and snorkellers alike appreciate coral reefs and understand the roles of marine protected areas, the impact of a significantly increasing population of non-divers to the narrow fringing reefs of South Sinai has already influenced Park management policies and led to the introduction of management interventions (see above). However, whereas diver education programmes may ultimately be managed by dive centres, effectively involving most divers, a more comprehensive management programme will be needed to address the rapidly increasing non-diving community. Environmental education, and management interventions such as walkways, floating pontoons and entry lanes on the back reef will require the full collaboration and active involvement of numerous elements within the tourist community: tour operators, hotel developers and hotel management and indeed the Park management will have to devote man-hours and investment if a comprehensive policy is to be successfully implemented.

The measures and regulations described above introduce the controversial and often simplistic

issue of carrying capacity seen as the maximum number of dives per site before irreversible degradation ensues. Data from other studies (Dixon *et al* 1993; British Ecological Society, 1995) confirm an exponential trend in the amount of damaged corals as a function of diving intensity. In order to formulate a simple model on whether a 'carrying capacity' for diver use can be attained, data on the rates of coral recruitment must be included. We may then be able to fully determine the combined effects of human damage and natural mortality on coral reefs. An investigation into the apparent rates of larval recruitment at a number of sites in the Sector will be carried out in the summer and autumn of 1995. The results from this programme may help to address the issue of whether there appears to be a carrying capacity for diver use or else a more gradual decline in coral abundance and diversity as human impacts increase.

3 The Economics of the Ras Mohammed National Park Sector

The protected status of the Ras Mohammed Sector attracts a large number of tourists thereby generating considerable benefits to a wide range of public and private enterprises. The aim of this section is to provide some basic information on the extent of some of these benefits and on the costs associated with the protection of coral reefs in South Sinai. Also of importance is to estimate what fraction of these benefits accrues to the national Government, to local investors and what share of these revenues is transferred overseas. Some of the results outlined in the previous section point to a high degree of satisfaction by the users. The rapid growth of tourism development and associated infrastructure has, on the other hand, highlighted the potential degradation of the resource which generates this satisfaction and the associated financial revenues. A number of management interventions have shown how such degradation may be successfully contained. Further scientific research might help in defining a sustainable 'carrying capacity' for diver use and thereby achieving a balance between economic development aspirations and the conservation of critical marine resources.

The data in this section have been compiled using two different approaches. Data on the cost of establishing and running the Ras Mohammed Park have been provided by the Ras Mohammed Sector through its government agency, the EEAA. Data relating to benefits accrued to private enterprises such as hotels, dive centres and tour operators have been gathered through direct interviews and structured surveys. Opportunity costs are very hard to identify and quantify. Ras Mohammed is a multiple use managed area providing a wide variety of activities and as a result opportunity costs are low. Their evaluation has therefore been approached more informally than would have been the case in other circumstances.

3.1 Costs of protection

3.1.1 Costs of establishment

The Ras Mohammed Marine Protected Area was established in 1983 and subsequently upgraded to National Park in 1989. The Government of Egypt has committed approximately LE 10 million ($2.96 million at current exchange rate) for the first two phases of the project (1989-1995).[2] These funds have been used for a variety of infrastructure, including a tarmac road linking Sharm el Sheikh to the Ras Mohammed Peninsula, a visitor Centre, audio visual theatre, offices, toilets, library and parking facilities, a laboratory, a jetty at Ras Mohammed and purchase of land for staff housing. The European Community (now EU) contribution as Technical Assistance for the first two phases (June 1989 - April 1995) amounted to ECU 3,345,000.

3.1.2 Current annual operating costs

The current annual operating costs for the Ras Mohammed Sector, not including depreciation[3] (estimated at 15 percent), amount to approximately LE 2,071,711. This value does not include future development, maintenance, replacement of essential equipment etc.

3.1.3 Opportunity costs

It is the very nature of Ras Mohammed which attracts a large number of tourists seeking a well preserved environment. An estimate of what revenue is lost due to the restrictions placed on the area is hard to evaluate. Coastal development in the Sector has taken place, in full respect of regulations and enforced by the EEAA and the City Council of Sharm el Sheikh, with the aim of developing the area without modifying the natural landscape and seascape in South Sinai. For example, all construction in the area is at a minimum distance from the shore (30-100 metres) so as not to impact the back reef. The height of any building has limits in relation to its distance from the shore. A simple system of 'rows', quite visible on the spot, limits the maximum height for the 'tallest' row to about 10 metres.

The treatment of sewage could be considered an 'extra' cost in most protected areas world-wide, particularly in the Ras Mohammed Sector where strict regulations have forbidden the discharge of effluents in the marine environment since it was declared a marine reserve in 1983. In Sinai, however, the extremely arid conditions have made water a very scarce commodity and the treatment of sewage as a means of producing water was recognised in the early 1970s when municipal biological facilities were set up to deal with the problem of waste waters. The treatment of sewage within the large decanting tanks at Sharm el Sheikh have since provided 'liquid by-products' for agricultural purposes. Recently though, the trend in tourism development has greatly increased the demand for water for domestic uses and inevitably exacerbated the issue of sewage treatment potentially threatening the delicate coral reefs. The closely correlated issue of water demand and sewage treatment has, in part, been 3solved by (a) the introduction of several de-salination plants providing water for domestic uses, (b) the construction of 'State

---

[2] Source: Ras Mohammed National Park Sector Development Project.

[3] Source: Ibid.

of the Art' sewage treatment plants at some of the larger hotels tackling the issue of waste waters and also providing large amounts of water, arguably the dearest commodity in Sinai, for agricultural uses, aesthetic purposes and potentially drinking water and (c) strict Park regulations.

The mechanisms in place at Ras Mohammed are by no means standard in the region. At other Egyptian coastal tourist resorts such as Hurghada, for example, the problem of water supply is, in part, resolved by a pipe-line coming from Qena in upper Egypt via Safaga, a smaller tourist resort south of Hurghada. The treatment of sewage on the other hand is dealt with in a highly 'diversified' manner. According to HEPCA (Hurghada Environmental Protection and Conservation Association) most hotels have septic tanks and irrigate their vegetation with the waste waters while some of the larger hotels have first stage treatment facilities. Despite this infrastructure, there are widespread signs of pollution caused by sewage all along the coast (see section on Hurghada). The problem of solid waste is still without solution and uncollected piles of rubbish are a common site throughout Hurghada.

Some of the user constraints described above such as walkways and jettys, may be disputably interpreted as extra costs to hotels and dive centres. Unlike sewage treatment plants, however, hotel developers are not forced to install these. Ultimately it is a trade off between the extra cost of their installation (up to $31,000 each in the case of floating walkways), the survival of the back reef, where up to 80-90 percent of all hotel guests spend their time (independent surveys) and the medium and long term benefits provided to hotel developers through, for example, return guests.

The structured surveys have provided useful information and insight on how developers (hotel, dive centres and tour operators) view the above described limitations which might be taken as an estimate of opportunity costs. Of the 6 hotel managers, 10 dive centre managers and 5 tour operator managers interviewed only 2 managers (representing 2 of the smaller dive centres) admitted to their activities being limited by Park Management restrictions and that they would possibly benefit from an unregulated diving scene. In a separate interview, the managers of the three largest dive centres in South Sinai (accounting for 25 percent of all divers/year) were unanimous in pointing out that lack of diving intensity limitations would increase their revenue by 10-15 percent per year but only for two-three years at most. At present a strictly implemented timetable limits the number of boats and divers/snorkellers which can access what are considered and marketed as the 'best' destinations in the area. Complete deregulation would at first generate more revenue by increasing the number of users to such destinations but an inevitable environmental degradation of these sites would subsequently lead to a long-term decrease in revenue. The managers interviewed all referred to Hurghada as an example of an inevitable environmental and economic collapse avoided only by the fact that all dive operators in that area are (a) selling dive packages for up to 50 percent less than in Sinai, thereby providing a lower quality service and (b) increasingly taking their dive boats further south along the Egyptian mainland in search of less degraded reefs.

3.2 Benefits of protection

Revenues afforded by the tourism industry in the Ras Mohammed Sector benefit the hotel and diving industry, the central Government and the work forces through employment.

3.2.1 Hotel and dive operators

The data relevant to this section were obtained through structured surveys. Many of the quantitative data have been cross-checked, but caution is recommended in the interpretation of the figures provided concerning gross revenue.

Table 10 provides a summary of basic information concerning hotel operators. The 6 hotels included in this survey account for 30 percent of all rooms in the Sharm area and approximately 70 percent of the total room-nights. Based on these figures the hotel industry probably generates close to $48 million/year.

Table 10. Summary of selected information from structured surveys of Hotel Operators in Sharm El Sheikh.

	HOTEL					
	A	B	C	D	E	F
Number of rooms	95	350	348	200	380	150
Guest /yr	10,300	26,000	11,760	13,520	28,000	
Staff	157	500	560	250	600	240
% foreign	9.6	1	1.8	0.8	1.7	0.8
% egyptian	90.4	99	98.2	99.2	98.3	99.2
% Packages sold Offshore	100	95	100	90	90	
Gross revenue /yr ('000US$)	3,290	10,500	14,800	4,142		4,142
Average value of package (US$)	850	1,250	1,220	1,200	1,470	880
Average stay (days)	7	7	5.4	14	7	7

An estimate of the revenues generated by the diving industry is made on the basis of the data from Table 11. The 9 centres which provided revenue data account for approximately 40 percent of the diving market (in terms of divers/year). Based on these data the total gross revenue for the 26 existing diving centres has been estimated to 'e about $30.3 million/year.

Table 11. Summary of selected information from structured survey of Dive Centres in Sharm el Sheikh.

	DIVE CENTRE								
	1	2	3	4	5	6	7	8	9
Ownership	Joint	For.	Joint	For.	Joint	Egypt.	Joint	Egypt.	For.
Offshore	yes	yes	no	yes	yes	yes	yes	no	yes
Boats	3	2	10	3	3	5	1	6	2
Instruc./Divemaster	7	2	25	8	4	8	11	8	4
Divers /yr	3,000	800	21,900	5,475	800	--	2,507	2,500	2,000
Avg. package cost	33	60	42	66	44	45	--	45	53
Staff:									
Foreign	5	0	16	6	4	7	10	12	4
Egyptian	21	3	30	4	5	10	13	13	4
% Package sold abroad	36.6	95	60	60	100	75	19	76	0
Gross rev./yr ('000 US$)	600	---	---	360	200	---	468.3	700	450

SOURCE: Interviews and structured surveys.

3.2.2 Tour operators

Revenues generated by tour operators in the area are difficult to estimate as the largest share of their income originates abroad (i.e. at headquarters). Typically a tourist buys a package from an operator which includes return airfare, accommodation, transport and meals all financial transactions taking place outside Egypt. The representatives of the six largest tour operators working in South Sinai confirm that at least 75 percent of the package value changes hands at headquarters. The local hotel and agency receive vouchers which amount to approximately 20-25 percent of the original value of the package. Tour operators, on the other hand, benefit the economy by providing jobs for thousands of Egyptian citizens (see section 3.2.4).

3.2.3 Government revenues

A number of different taxes can be seen as additional revenue generated for the Government through the indirect use of the Ras Mohammed Sector. It is difficult to place a value on these taxes which include visa fees at the airport and immigration police, airport fees and council taxes. With visa fees at about $20 per person and local and council taxes at 9 percent of all bills in hotels, shops and restaurants, the revenue generated in 1994 by 220,000 visitors is estimated to be close to $10 million. However, this revenue should be considered a 'benefit transfer' rather than as an additional benefit generated by the use of the Park.

3.2.4 Employment

Employment may be seen as a cost of generating gross revenues rather than a benefit. However, employment of Egyptian nationals is possibly the best long-term benefit to the local economy. The data in Table 12 provide an estimate of the labour force associated with the tourism industry in South Sinai. There are currently estimated to be about 14,000 people employed in the tourism

industry in South Sinai. The diving industry, typically requiring imported skills such as instructors and dive guides, with 'only' 61.7 percent Egyptian nationals makes up just 5 percent of the labour market whereas the hotel industry with over 95 percent Egyptian staff represents close to 70 percent of the total labour force. The remaining share of the market is accounted for, in great part, by tour operators who employ tour-guides, drivers and agents locally. According to the data in Table 12 activities in the Sector will create an extra 40,000 jobs, largely in the tourist industry as opposed to the hotel industry, for a total of just over 55,000 by the year 2002.

Table 12. Estimate of the number of workers (Egyptians) employed by the Hotel and Tourism industry in South Sinai. Source: Ministry of Planning.

Year	Hotel	Tourism	Total
1997	9,700	7,275	16,975
2002	31,825	23,870	55,695
2017	64,450	48,335	112,785

Other similar studies have related employment figures (seen as benefits) simply with the number of divers visiting a protected area. In the Ras Mohammed Sector, divers currently represent less than 40 percent of all tourists, down from over 89 percent in 1989 (Ras Mohammed Sector Survey), a proportion which is decreasing rapidly with increasing numbers. According to a recent structured survey (El Hawary, 1995) over 76 percent of visitors to the area are attracted to South Sinai principally by the quality of its 'snorkelling' rather than diving. The 300,000 (60 percent of total visitors) snorkellers expected in 1995 will benefit from the protection afforded by the Sector as much as, if not more than, divers themselves. The uniqueness of the South Sinai protected areas, in particular its undiversified economy, as highlighted at the beginning of this report, would seem to suggest that virtually all employment is due to park-related activities. The Gulf War in 1991 illustrates this rather well: the absence of tourists from the area caused most of the tourist infrastructure to shut down for the entire duration of the conflict. Seen by some as potentially beneficial to the natural resource, the crisis had catastrophic consequences for the local work force.

3.2.5 Who benefits?

A number of reports on protected areas in developing countries have highlighted how a large share of the associated benefits does not accrue to the local economy. In the case of the diving industry in Sinai, it is difficult to estimate what proportion of the revenues stays in Egypt. Some key facts might assist in showing that the majority of these benefits probably stays within the country and generates wealth at a local level.

All hotels in South Sinai are either fully Egyptian owned or joint ventures in which the Egyptian share is almost invariably at least 51 percent of the capital. Furthermore, even the large hotels such as Hilton International, Sonesta, Movenpick and Novotel have an Egyptian staff quota of at least 98 percent (see Table 10) i.e. only the top echelon of the management is usually foreign.

Approximately three of the smaller diving centres are foreign-owned while the rest are joint ventures. The diving industry employs a higher proportion of foreign nationals (approximately

35 percent of the total diving centre staff) as it is still hard to find a sufficient number of Egyptian instructors and dive masters. Recent trends however indicate a growing proportion of Egyptian staff in the diving industry.

3.3 Conservation costs: the future

A number of studies have looked at the complex and often controversial issue of placing a value on nature (Dixon and Sherman, 1990; Hampicke, 1994). Species and ecosystems can indeed be looked at as peculiar economic resources: they can be irreversibly destroyed, their future use is uncertain, their services are often irreplaceable and are increasingly seen as directly beneficial to mankind. Attempting to place a monetary value on a species is, however, meaningless.

The costs associated with the conservation of the natural resources at Ras Mohammed have, on the other hand, been estimated quite accurately as illustrated in a previous section. The establishment and operational costs have so far been shared by the central Government and the European Union. Most environmental projects world-wide have a similar funding pattern with the long term aim of becoming self-financed. The issue of who pays for these costs though is, in general, highly controversial.

The present fee structure in place at Ras Mohammed generated 1,163,000 LE in 1994. The charge, $5 for foreigners and 5LE for Egyptians applies only to visitors entering the National Park, approximately 32.8 percent of the total number of visitors to South Sinai (see Table 1). According to National Park Surveys, close to 500,000 visitors will access the protected Sector in 1995. With 32.8 percent of these entering the park and based on a foreigner/Egyptian ratio of 60/40 the total income from the current fee structure would be approximately $590,000 or 1,994,200 LE, not enough to cover the current running costs which do not include, among other things, depreciation, future development and maintenance costs (see above).

EEAA conservation initiatives have, throughout the different changes in status in 1989 and 1992, preserved resource integrity, coastlines subjected to tourism development and nature reserves throughout the whole Sector and not just the National Park. As a result, all visitors currently benefit from the management policies in place within the protected areas network. Recognising the link between protection of South Sinai and the economic development of the area, a system by which all users contribute to the conservation of natural resources should be sought. Similar user fee policies have been investigated elsewhere in tropical resorts (see Dixon et al, 1993).

Two separate and independent surveys carried out in the Ras Mohammed Sector in 1994/1995 investigated the user's willingness to contribute to the costs of conservation. In one survey (El Hawari, 1995) most respondents said that they were willing to pay to defray the costs of conservation and environmental management and 80 percent of these indicated that $2 per day would be an adequate contribution. The current survey found that not only were 92.3 percent of the respondents aware of the existence of the National Park and its management prior to their arrival but when asked about their willingness to contribute funds for reef conservation, in terms of an annual tax levied during their stay in the Ras Mohammed Sector, over 86 percent were in favour and only 10.4 percent were strongly against any such scheme. More specifically, 25 percent of the respondents in favour would contribute $5, 27 percent of them $10, 25 percent opted for $20 and 13 percent chose $50 per year towards the operational and management costs

of the Park (Chart 1). In both surveys the total potential contribution by users would exceed the current annual operating costs of the Sector.

In a similar study in Bonaire Dixon *et al* (1993) first described a potential 'tank tax', i.e. a small charge on SCUBA tank refills. Such a scheme was replaced in 1992 by a more easily applicable annual reef tax charged to all users at the airport upon entry into Bonaire. The current survey, based on a questionnaire similar to the one by Dixon *et al*, did not address the concept of 'existence value' i.e. the value an individual places on the mere existence of a species or a natural resource but rather the issue of how much users would be willing to pay to preserve and manage a resource such as a coral reef, which they were enjoying at the time of the survey. Most respondents indicated an amount (in US$) per year rather than per trip, per dive or per tank.

The Park Authorities will soon establish a cost recovery charge system in order to cover the operational and management costs of the Ras Mohammed Sector. The optimum option would be based on a direct daily charge to be levied by hotels during check-out procedures. Assuming a daily charge of LE/US $ 0.50 per person, the 12,248 beds expected by the end of 1995 would generate, at the current 70 percent occupancy rate and a 7 day average stay (Park Survey), approximately LE 4 million/year, fully covering the costs of the protected areas in South Sinai and also enabling support of selected environmental projects in the area.

4 A survey of an unmanaged Red Sea Tourist Resort

A brief survey recently carried out in Hurghada has provided some interesting insight on the realities of unmanaged coastal development linked to tourism. Comparing different coastal zones is not just simplistic but often meaningless and, for this reason, the information in this section should not be seen necessarily as a direct comparison with Sinai, but perhaps as a model which should not be replicated elsewhere along the Egyptian coastline.

The resort of Hurghada was established nearly 30 years ago and rapidly became a tourist destination for Europeans. Its coastal development has undoubtedly been influenced by its early start and by what were at the time considered safe and acceptable environmental practices. The existence of a coastal road led to massive hotel development which took place between the road and the shoreline and, in particular, on the back reef itself. The present survey has been made possible by the assistance provided by HEPCA (Hurghada Environmental Protection and Conservation Association), now a fully recognised NGO trying to raise national and international awareness to the environmental problems facing Hurghada and, increasingly, other parts of the Egyptian coastline. A structured survey, similar to the one issued to different users in Sinai, provided some useful data, a coastline survey investigated the extent of infilling and land reclamation and a brief underwater survey at four key sites assessed the extent of anchor damage and pollution.

There are about 78 hotels along the 54-kilometre shoreline at Hurghada. The 64 hotels that were investigated all showed infilling and land reclamation which in some cases had removed all reef-associated elements. The back reef has been wiped out to accommodate the hotel infrastructure and various jetties, piers and marinas (South Sinai has only one single infamous case of infilling). The impacts on the reef ecosystem due to construction and infilling are well documented in scientific literature (Woodland and Hooper, 1977; White, 1987; Maragos, 1993). The most obvious sign in Hurghada, apart from the alteration of the landscape, is the excessive sediment load and decrease in visibility. Visibility readings were taken at the main beach of ten hotels along the coastline: in nine cases the visibility was less than one metre and there were no visible signs of life in the water column.

The alteration of the landscape and subsequent obliteration of the back reef has also affected the diving industry in Hurghada: virtually all dive sites are now located on off-shore islands. The diving pressure at some of these is increasingly leading to environmental degradation. There are currently about 85 diving centres and over 400 boats in the Hurghada area making use of approximately 30 dive sites. The five most popular sites accommodate between 50,000 and 75,000 dives per year. During this survey four representative sites (in terms of number of dives per year) were investigated. Obvious signs of degradation above water include: wide-spread discharge of untreated toilet effluents (as a rule there are no septic tanks on boats) and discharge/change of engine oil. A brief underwater survey revealed that at three of the four sites the extent of anchor damage is wide-spread. In two cases, with a diving pressure of up to 25 boats a day and 50,000 to 75,000 dives a year, large areas measuring 60 to 80 m^2 of massive coral (Porites spp. and Goniopora spp.) had been reduced to rubble by uncontrolled use of anchors. This practice has diminished recently following the installation by HEPCA of 65 mooring buoys at the most popular dive sites (Jones, 1995). Fish counts may also have been affected by both the removal of reef substrate through anchoring and daily fish feeding. At the most heavily dived sites, fish counts are high only in the area surrounding boats; their density

drops quite suddenly 10-20 metres beyond the mooring point.

Other signs of degradation include the presence of 15 well stocked shops selling a wide range of curios and marine souvenirs including puffer fish, turtles, rays, sharks, dolphins, corals and shells. According to HEPCA, these curios are being purchased by large number of tourists as an independent survey recently showed.

A survey carried out in Hurghada (47 divers and snorkellers) illustrates, on the one hand, a lower degree of satisfaction than in Sinai, in particular among the 26 respondents who had been to both resorts but, on the other hand, highlighted how Hurghada possibly caters for a different share of the tourist market.

> Pollution: 27 respondents (57 percent of total) said there were many signs of pollution, 19 (40 percent) admitted to some signs and the rest (3 percent) said they could not see any.
>
> Satisfaction: Overall a lower percentage rated the reefs, fish life and visibility as good as Sinai. In particular, there were 20 visitors who had spent their holiday in both Hurghada and Sinai. Of these, 18 (90 percent of total) admitted that Sinai was overall a better resort when comparing reefs, fish life and visibility.
>
> Comments: About 30 (64 percent of total) pointed out some dive boat practices as being incompatible with the marine environment. These included, the lack of diver briefings, discharge of sewage effluents, oil pollution, anchoring and fish feeding.

Data from tour operators and dive operators seem to indicate that, in general, there is little cooperation among the different operators in the area and this may be a consequence of an environment which is increasingly being degraded by the tourist industry and its practices. The quality of the reefs seems to be inferior if compared to Sinai and other tropical destinations as pointed out by the users and the underwater survey. As a result, tour and dive operators are presumably being forced to undercut the price of their services. This is illustrated, for example, by the fact that the average holiday package in Hurghada, offering the same range and quality of services and hotels, is 30-40 percent cheaper than South Sinai when based on data provided by the 6 largest tour operators in the area; a dive package is up to 65 percent cheaper than its counterpart in Sinai and prices in Hurghada are up to 50 percent cheaper for a wide range of amenities such as restaurants, shops etc. The price of chartering dive boats is 80-120 percent cheaper perhaps explaining the overcrowded and often guide-less boats at some dive sites.

The coral reefs at Hurghada appear to be degraded, far more than is the case in South Sinai. Thirty years of unregulated tourism development have irreversibly altered the landscape and in many cases the seascape as well. A more comprehensive study would be needed to fully investigate the extent of the impacts on the reefs. The 'economic' data obtained from the diving and tourist industry seem to indicate a highly competitive and deregulated market with the average holiday package costing 25-40 percent less than its equivalent in South Sinai.

The quality of the services being offered is arguably lower than in Sinai. However this has not led to a drop in the number of visitors as might have been expected. The data from the surveys and the feedback from the questionnaires seem to indicate that Hurghada possibly caters for a

different market than Sinai: mass tourism, i.e. a low spending and environmentally less aware tourist than those opting for Ras Mohammed. This trend is further demonstrated by the fact that a significant proportion (over 90 percent) of the visitors to South Sinai were aware of the existence of the protected areas at Ras Mohammed when they chose their holiday destination: a more expensive but more pristine resort. In the case of Hurghada, the gradual disappearance of the fringing reef through infilling and land reclamation and a diving intensity which would be considered well above the sustainable level in many coral reef resorts in the Red Sea and elsewhere have led to a rapid degradation of the typical dive sites in the area, the off-shore reefs. According to data from HEPCA, 65 (76 percent of the total) of the 85 diving centres are increasingly making use of the more remote reefs and especially those further south, such as Safaga and Qoseir (50 to 100 kilometres down the coast) unfortunately with the same poor environmental practices.

Hurghada provides a good example of unregulated coastal development. Table 13 illustrates some of the key differences between Hurghada and the protected coastal zone of Sharm el Sheikh both from a biological and reef management point of view. Despite the fact that biological parameters are often difficult to compare, the numerous parameters reported indicate well the different realities of the two resorts.

In principle, successful management at Sharm needs to be able to prevent the resort from following the same course as Hurghada. From an economic point of view, the rents to resource 'appropriators', i.e. the tourism industry, have to be maintained to cover the increased cost of management. In Hurghada, rents appear to have been almost dissipated and the open access in the industry has eroded all incentives to protect the reefs at the level of the individual firm.

This contrast is illustrated in Figure 3, where the differential positionings in the market are presented. In the figure, a demand curve for diving and diving sites is presented. While Sharm caters for the specialised tourism and currently offers X_m dives per year in a regulated environment, currently set at between 3,500 and 20,000; Hurgada caters for the 'mass tourism', with a supply of X_u dives per year currently well above those in Sharm, between 50,000 and 75,000 dives per year.

Table 13. Some key parameters at Sharm el Sheikh and Hurghada. Most data from RAS MOHAMMED NATIONAL PARK (SHARM) and Fawzi (1995), HEPCA , and Medio (pers. obs.).

	SHARM	HURGHADA
Government Intervention		
Urban Planning /1	yes	no
Monitoring Programme	yes	no
Public Awareness Programme	yes	no
Fishing Regulations	yes	no
Development Density Indicators		
Hotels	40	127
Beds	12,248	40,000
Dive Centres	27	85
Boats	220	400
Investments		
Dive sites	37	30
Fixed Moorings	108	65
Diver Briefing (% dive centres)	65	3-5
Benefits		
Sewage Pollution	no/2	yes/2
Infilling /3	1/40	64/75
Underwater visibility /4 (m)	15-30	1-2
Anchor damage at 5-key sites	negllg.	extensive
Rents from conservation		
Average price of a dive package	$45	$27

/1 Controlling sewage, height of buildings and their minimum distance from the back reef, location of main roads, public access to beaches, infilling, landfilling, garbage collection and disposal, etc.

/2 In Sharm sewage is either treated at Municipal biological facilities or at treatment plants within hotel sites. In Hurghada there are evident signs of pollution despite strict regulations.

/3 In Sharm, there has been only one case of infilling. Existing laws have been strictly implemented ever since. In Hurghada, despite the prohibition on urban development within 200m of the reef, 112 of the 175 tourist facilities have been built on the back reef itself.

/4 Measured at the main beach of 5 key tourist resorts.

Apart from the differences in quantity, there is also a significant difference in quality among the

two sites. As can be seen in the lower figure, damage to corals is directly related to diving intensity,[4] damage of corals at Sharm D_m is much lower than damage at Hurghada D_u. Also associated with this function we have some regeneration capacity of the coral which can offset the damages by divers, a sustainable strategy is to ensure that damage to corals by divers is maintained within the limits of this natural regeneration capacity, as illustrated in the shaded area linking the two figures.

This indicates that any increase in diving will be associated with coral degradation given constant diving practices. However, investments in quality changes in diving practices, such as environmental briefings and spreading of use, can effectively shift the damage function to the right, increasing the carrying capacity of a given Sector. Regulations at Sharm are inducing both types of investments: those directed to reducing the number of divers and those directed to reducing of the impacts per diver. Hurghada, however, has not controlled diver quality nor quantity hence falling in this vicious circle of degradation-lower rents-lower prices-more divers-more degradation.

The significant differences in package prices indicate the extent of rent dissipation in Hurghada, with Sharm operators charging prices P_m, well above marginal costs C_m, thereby capturing rents equivalent to the area P-A-C-C_m in Figure 3, while rents in Hurghada are almost dissipated (illustrated as dissipated in Figure 3 as the marginal costs of the unregulated operators, C_u, are equal to the market price in the unregulated area, P_u).

Quantitative and qualitative supply restrictions appear to be critical for the maintenance of appropriate rent levels. Current management at Sharm addresses both areas by limiting the number of boats per site, passengers per boat, number of diving sites (quantitative), while also providing environmental awareness talks to the visitors, requiring appropriate sewage systems and infrastructure designs to minimise damage per visitor (qualitative).

Despite the fact that current levels of diving intensity are much lower in Sharm than in Hurghada, Sharm is only an eight-year-old development, while Hurghada has been in operation for 30 years. The forecast of rapid growth in Sharm will pose a challenge to the existing regulatory system and will test the extent of the tradeoffs between quality and quantity of divers. The incentives to maintain current protection practices at the tour operator level will depend not only on the enforcement capacity of the management authority, but also on the continued existence of positive rents to be gained from conservation investments.

HEPCA has drawn the attention of many research institutions, international organisations and environmental groups to the resource degradation which has taken place. A recent workshop on Hurghada, called for a reduction in further damage, the establishment of a monitoring programme, the increase of public awareness and the need for better collaboration among the various competent authorities involved in coastal development (Fawzi 1995).

Recovery of Hurghada is now more difficult due not only to irreversibility of some of the damages, but also to the higher investments needed and the long investment recovery periods

[4] Although the relationship is widely believed to be positive, the exact nature of the relationship, i.e., linear, exponential, quadratic, etc., has not yet been determined.

from a private point of view, effectively reducing the incentives in the tourism industry to invest in conservation. This is an economic rationale for the application of the precautionary principle: small (profitable) savings in conservation investments today translate into large (unprofitable) clean-up operations tomorrow).

This brief survey highlights the danger of allowing development similar to that experienced at Hurghada elsewhere along the Egyptian coastline. There is already extensive coastal development taking place at Safaga and Qoseir, and, despite strict environmental regulations in place since early 1994 (Law 4), many of the mistakes made at Hurghada can be recognised at some of these resorts. HEPCA could certainly play a role in increasing public awareness, establishing a diver education programme and acting as a liaison with scientific institutions to establish a monitoring programme.

5 Discussion

This study has described some of the ecological, economic and management aspects of tourism development within the Ras Mohammed Sector, a network of protected areas in South Sinai.

5.1 Conservation

Having recognised the link between reef conservation and economic development, the management plan in place within the Sector has demonstrated how:

> Resource-based tourism is limited by the health of the resource itself and its degradation would inevitably lead to decreased economic potential and rapid depreciation of existing investments.
>
> A resource management policy, coupled with strict protection measures, do not imply, and have not acted as, a deterrent to development activities.
>
> Protected areas can be a well-managed common property resource which benefits both tourists, the general public and private investors.
>
> The high profile afforded by the protection of the resource and its consequent high economic potential is maintained by the protection measures established by the EEAA.

The operational and management costs of protection in the Sector are high. The present funding arrangement will, as in any successful project, have to be modified in the near future. The acceptance that all parties benefit from the protection measures established by the EEAA may result in the achievement of economic self sufficiency through a fee structure to be levied on all users.

5.2 Replicability

The coastal zone management plan at Ras Mohammed could be replicated in other parts of Egypt or elsewhere in the Red Sea. There are 11 protected areas in 5 countries with littoral sections on the Red Sea. The Ras Mohammed model is transferable to some if not all of these sites. The key issues behind such transfer of expertise are typically sufficient funding and willingness by the local government in recognising resource protection as part of a long term plan of economic development. An example comes from Eritrea which has shown interest in implementing a coastal management strategy to attain long term economic development.

In Egypt itself, two key areas may benefit from the model of protection afforded by the Ras Mohammed Sector: the remaining section of the littoral on the Gulf of Aqaba and parts of the coast on the Egyptian mainland between Hurghada and the border with Sudan. The interdependence of marine protected areas with land-based activities or practices which occur outside the protected areas has been demonstrated in numerous parks and reserves world-wide. To achieve full success, the management strategy in place at Ras Mohammed should be extended to the remaining 60 kilometres of coastline. The current plans for this sector of the Gulf of Aqaba envisage the construction of numerous resorts providing accommodation for several thousand visitors per year (see Table 14). As outlined above, the strategy Implemented by the EEAA has not limited development but has allowed a resource-based form of coastal development, designed for long term economic benefits.

Table 14. Forecast number of hotel rooms at different sites in the Gulf of Aqaba for the period 1995-2017. Figures for Sharm el Sheikh not expected to exceed 23,000 as per EEAA plan.

SITE	1995	2002	2017
Sharm el Sheikh	6,124	23,000	23,000
Dahab	241	10,000	15,000
Nuweiba	595	15,000	20,000
Taba	426	4,000	6,000
Eilat*	7,200	40,400	N/A
Aqaba	500	3,500	5,000

Source: Ras Mohammed National Park and Ministry of Planning.

*Source: Negev Tourism Development Administration (12/92).

The area south of Hurghada to the border with Sudan is likely to witness a considerable amount of development over the next decade. The example of the environmental degradation in Hurghada has been instrumental in the recognition of the problem of unregulated development. Recent legislation has given 'Protected Area' status to the shoreline between Marsa Alam and the Sudanese border, including the islands and off-shore reefs (up to 70km) and to the Wadi Allaqi Biosphere Reserve near the eastern

shores of Lake Nasser (see Map 3). The section north of Marsa Alam to Hurghada, including Safaga and Qoseir on the other hand is unlikely to receive protection status. Jones (1995) has pointed out that the future development of this area could learn from the mistakes made at Hurghada and that NGOs, such as HEPCA, may play a key role in limiting future degradation to the fringing and off-shore reefs at both Safaga and Qoseir. The declaration, establishment and management of protected areas is very costly. The limits of national governments and international donors are such that choices have to be made on where to use the available funds. In Egypt, the uniqueness of the Sinai Peninsula, the biological diversity of its reefs, its geographic location and accessibility have led to the successful implementation of a multiple use protected area. The protected areas network at Ras Mohammed, a well funded and successfully managed protected area, is already being looked at, only six years after its establishment, as a potential model for replication in Egypt and in other countries bordering the Red Sea.

5.3 Training

At present, Egyptian academic and research institutions may not be able to supply the necessary staff to manage protected areas such as Ras Mohammed. Data provided by the NIOF (National Institute of Oceanography and Fisheries at Alexandria) and the faculty of Oceanography at Alexandria University, indicate that approximately 25-35 marine biologists graduate from institutions throughout Egypt every year, but only 3-5 have any practical experience in the field. In the light of this, the Ras Mohammed Management has initiated two separate training programmes in reef management with academic centres in the UK and Australia. The long term goal of these inter-disciplinary programmes is that newly established protected areas in Egypt and elsewhere in the Red Sea may eventually benefit from trained Egyptian staff.

5.4 Current trends and threats

Some estimates concerning the extent of the coastal development expected in the Gulf of Aqaba in the next two decades are provided in Table 14 According to government figures and the agency responsible for tourism development in Egypt, over 40,000 hotel rooms will be built between 1997 and 2017 for a total investment of LE 8.2 billion. This growth in tourist infrastructure must be addressed regionally and not simply from the point of view of the protected areas network in place.

The resort of Eilat, at the northern most part of the Gulf of Aqaba, is a case in point: the 6.5km long shoreline has, at present, over 6,000 rooms. Figures presented in Table 14 indicate how this resort is likely to undergo a dramatic growth in the next two decades and reach the same number of rooms as the whole of the 230km long stretch between Taba and Ras Mohammed. The variety of infrastructure in place at Eilat, namely a phosphate factory, oil refinery, military harbour and commercial port, coupled with the untreated sewage outlet on the northern outskirts of the city, have already affected the marine life along its reefs (Loya, 1976; Fishelson, 1980). The Nature Reserve, the only stretch of reef with some protection, receives up to 100,000 dives a year and the rest of the resort up to 300,000 dives a year.

Effective protection of the marine must surely be addressed by all nations bordering the Gulf of Aqaba. Jordan, which shares some of the economic aspirations of Egypt, has established a marine reserve and is increasingly seeking a more ecologically sustainable form of coastal development.

6 Conclusions

The success of the Ras Mohammed Sector is due in part to sound government policies and legislation, increasing awareness of the private sector and their determination to preserve the natural resources on which they have invested and to adequate funding. The collaborative and community based management policies have shown that involving as many elements of the community as possible leads to a more widespread appreciation of the resource.

The growth of tourism-related activities has led to some degradation of the resource. The present upwards trend in tourism, and associated growth in infrastructure in the region, may exacerbate this degradation unless a more holistic policy is pursued.

Scientific monitoring programmes in place at Ras Mohammed have shown that diver education and adequate management interventions can considerably reduce the rates of damage to corals by divers and other visitors, and a carrying capacity for diver use. However, more data are needed on the rates of recruitment by corals.

The recognition that all users benefit from the protection of the resource should lead to the establishment of a mechanism by which the protected area achieves financial stability and ceases to rely on government or donor funding. The management at Ras Mohammed has achieved this by opting for a daily charge which, by 1996, should fully cover management, operational and future development costs.

7 References

British Ecological Society (1995) 'The exploitation of coral reefs'. Ecological Issues Booklet No. X. Ormond, R.F.G. and Douglas, A. eds..

Bryceson, I. (1981) 'A review of some problems of tropical marine conservation with particular reference to the Tanzanian coast. *Biological Conservation*, 20(3): 163-71.

Dixon, J. A. and P.B. Sherman (1990) *Economics of Protected Areas: A New Look att benefits and costs*. Washington, DC: Island Press.

Dixon, J. A., L.F. Scura and T. van't Hof (In press) 'Ecology and microeconomics as "Joint Products": The Bonaire Marine Park in the Caribbean'.

Dollar, S.J. (1982) 'Wave stress and coral community structure in Hawaii'. *Coral Reefs* 1(2): 71-81.

El Hawari, M. (1995) 'Socio-economic survey of Ras Mohammed National Park'. EEAA, Cairo, Egypt.

Fawzi, M.A. (1995) 'Towards integrated coastal zone management in Egypt: "Hurghada Casestudy"'. EEAA Workshop on Integrated Coastal Zone Management.

Fishelson, L. (1980) 'Marine reserves along the Sinai Peninsula (northern Red Sea)'. Helgolander Meeresuntersuchungen, 33: 624-40.

Friedman, G. M. (1965) 'A fossil shoreline reef in the Gulf of Eilat (Aqaba) Israel'. *Journal of Earth-Science*, 14: 86-90.

Grigg, R.W. (1983) 'Community structure, succession and development of coral reefs in Hawaii'. *Marine Ecology Progress Series*, 11: 1-14.

Hampicke, U. (1994) 'Ethics and economics of conservation'. *Biological Conservation*, 67: 219-31.

Hawkins, J. and C.M. Roberts (1992) 'Effects of recreational scuba diving on fore-reef slope communities'. *Biological Conservation*, 62(3): 171-8.

Hawkins, J. and C.M. Roberts (1993) 'Effects of recreational scuba diving on coral reefs: trampling on reef-flat communities'. *Journal of Applied Ecology*, 30(1): 25-30.

Jones, A.P. (1995) HEPCA - Hurghada Environmental Protection and Conservation Association, February.

Kay, A.M. and M.J. Liddle (1989) 'Impact of human trampling in different zones of a coral reef flat'. *Environmental Management*, 4: 509-20.

Kenchington, R.A. (1985) 'Coral reef ecosystems: a sustainable resource'. *Nature and Resources*, 21(2): 18-27.

Liddle, M.J. and A.M. Kay (1985) 'Resistance, tolerance and resilience of trampled corals on the Great Barrier Reef'. *Journal of Applied Ecology*.

Liddle, M.J. and A.M. Kay (1987) 'Resistance, survival and recovery of trampled corals'. *Biological Conservation*, 42: 1-18.

Loya, Y. (1972) 'Community structure and species diversity of hermatypic corals at Eilat, Red Sea'. *Marine Biology*, 13: 100-23.

Loya, Y. (1976) 'Recolonisation of Red Sea corals affected by natural catastrophes and man made perturbations'. *Ecology*, 57: 280-9.

Maragos, J.E. (1993) 'Impact of coastal construction on coral reefs in the US - Affiliated Pacific Islands'. *Coastal Management*, 21: 235-69.

Medio, D., M.P. Pearson and R.F.G. Ormond (1995) 'Effect of briefings on rates of damage to corals by divers' (In press).
Medio, D. and R.F.G. Ormond (1995) 'Monitoring and minimising damage to coral reefs by SCUBA divers and other visitors at the Ras Mohammed National Park, Egypt'. TMRU Reports and Papers No 95/4.

Mergner, H. (1981) 'Man-made influences on and natural changes in the settlement of Aqaba reefs'. *Proceedings of the 4th International Coral Reef Symposium* 1, pp. 193-207.

Naim, O. (1981) 'Effect of coral sand extractions on the small mobile fauna association with the algae of a fringing reef (Moorea- French Polynesia)', In *Proceedings of the 4th International Coral Reef Symposium* 1, pp. 123-7.

Neil, D. (1990) 'Potential for corals stress due to sediment resuspension and deposition by reef walkers'. *Biological Conservation*, 52: 221-7.

Pearson, M. P. (1988) 'Progress report for the Ras Mohammed National Park'. Egyptian Environmental Affairs Agency, Cairo, Egypt.

Pearson, M. P. (1995) 'The role of marine parks and reserves as a mechanism for large scale management of coastal resources' (In press).

Rogers, C.S., L. McLain and E.S. Zullo (1988) 'Damage to coral reefs in Virgin Islands National Park and Biosphere Reserve from recreational activitie'. *Proceedings of the 6th International Coral Reef Symposium*, Townsville, 62: 405-10.

Salvat, B. (1981) 'Preservation of coral reefs: scientific whim or economic necessity? Past, present and future'. *Proceedings of the 4th International Coral Reef Symposium* 1, pp.

225-8.

Sheppard, C. R. C., (1980) 'Coral cover, zonation and diversity on reef slopes of Chagos Atolls, and population structures of the major species'. *Marine Ecology Progress Series* 2: 193-205.

Stafford-Smith, M.G.(1990) 'The effect of sediments on Australian Scleractinian Corals'. Ph.D. Thesis, University of York.

Tilmant, J.T. (1987) 'Impacts of recreational activities on coral reefs'. In *Human impacts on coral reefs: Facts and recommendations*, ed. B. Salvat. Antenne Museum EPHE, French Polynesia, pp. 195-214.

Tipton, Eleanor M. (199?) 'Conflict and Change in Egypt's Red Sea/Sinai Tourism Development'. Bachelor dissertation. University of Wales, Centre for Development Studies at University College of Swansea.

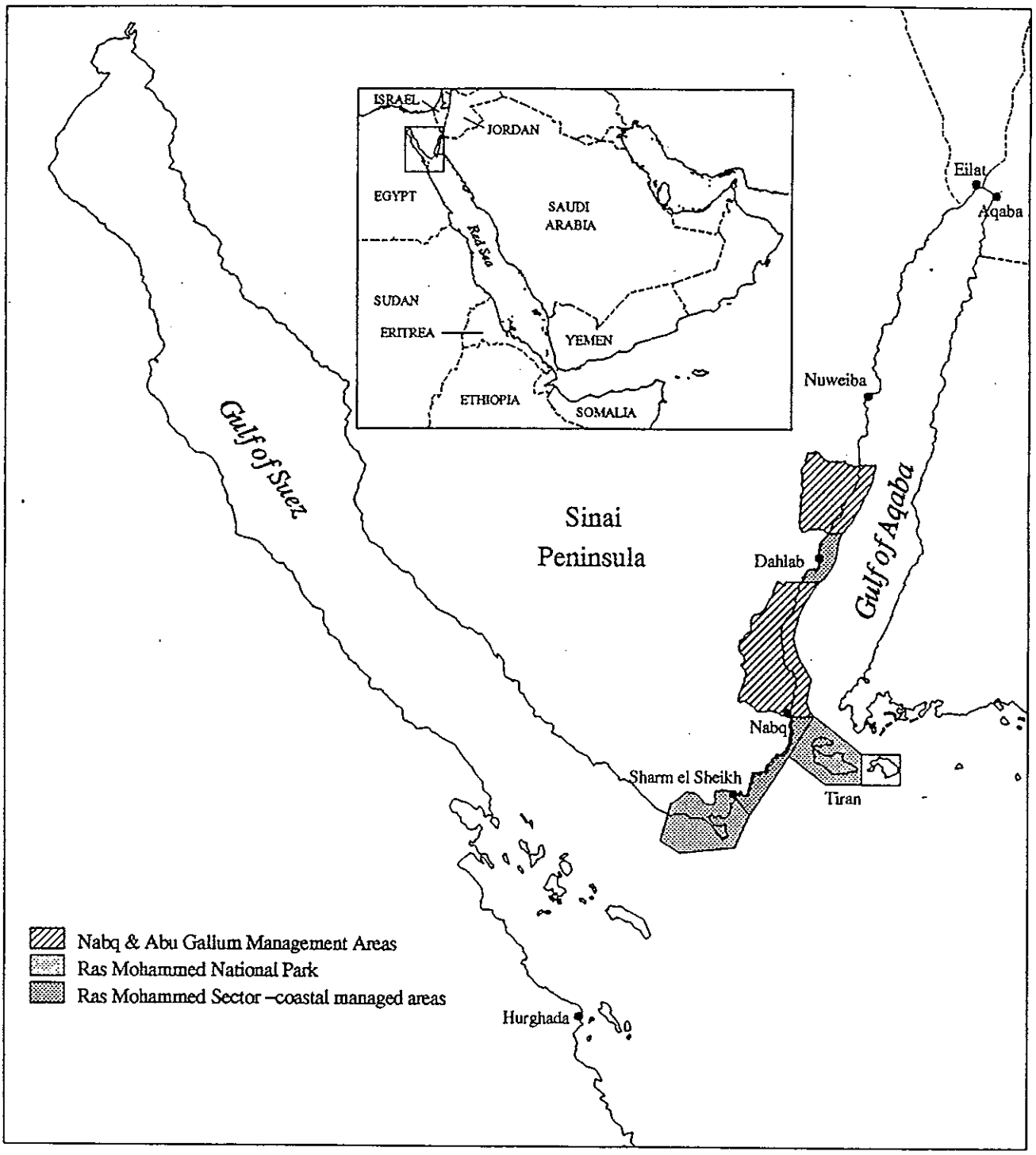
Ward, F. (1990) 'Florida's coral reefs are imperiled'. *National Geographic*, July: 115-32.

White, A. T. (1987) 'Effects of construction activity on coral reef and lagoon systems'. In *Human Impacts on Coral Reefs: Facts and Recommendations*, ed. B. Salvat. Antenne Museum, EPHE, French Polynesia, pp. 185-193.

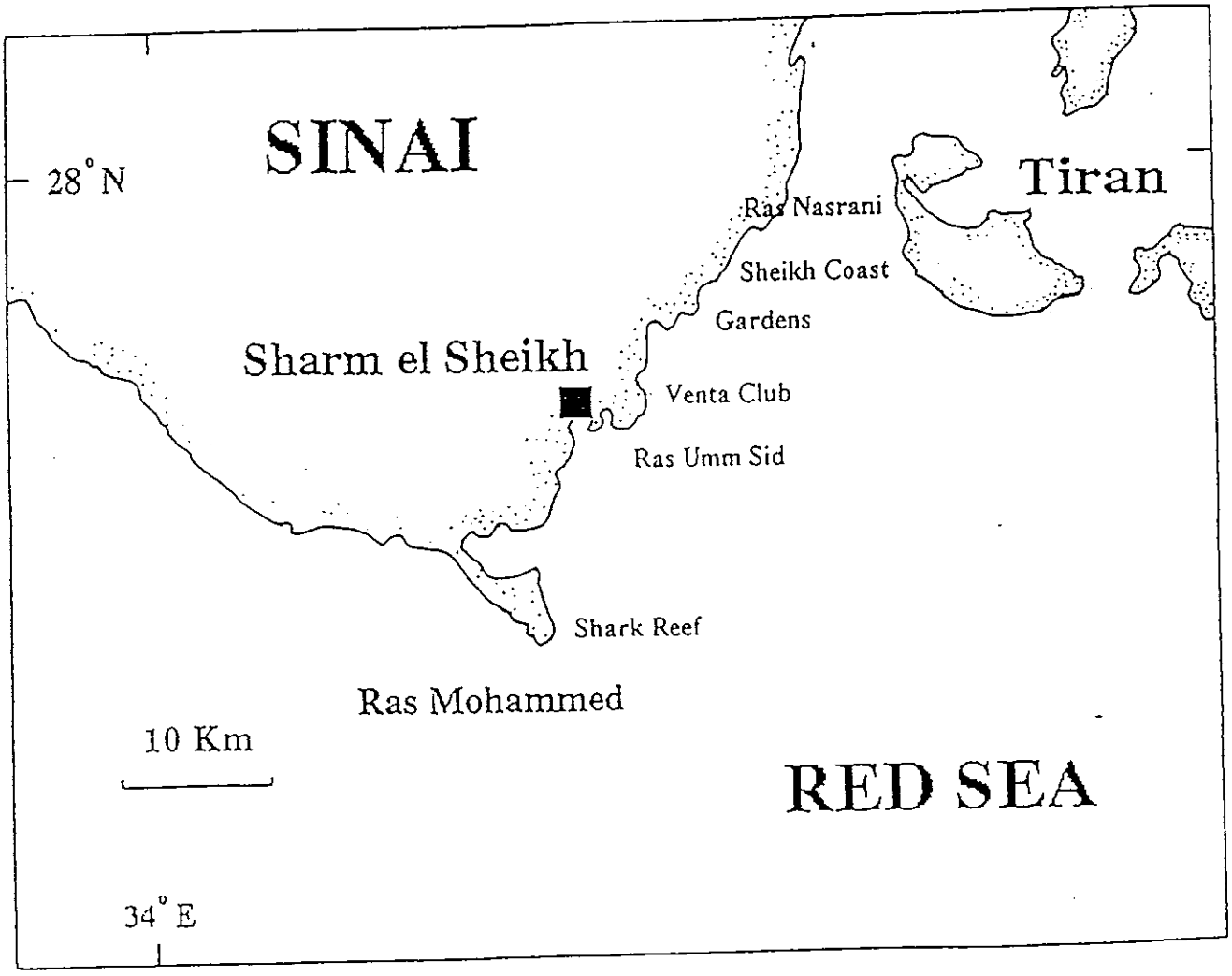
Wood, E. M. and S.M. Wells (1989) 'The marine curio trade conservation issues'. Marine Conservation Society, Ross-on-Wye, UK.

Woodland, D.J. and J.N.A. Hooper (1977) 'The effect of human trampling on coral reefs'. *Biological Conservation*, 11: 1-4.

Map 1. The Sinai Peninsula and its protected areas.



Map 2. Location of Study Sites



Map 3. The Red Sea

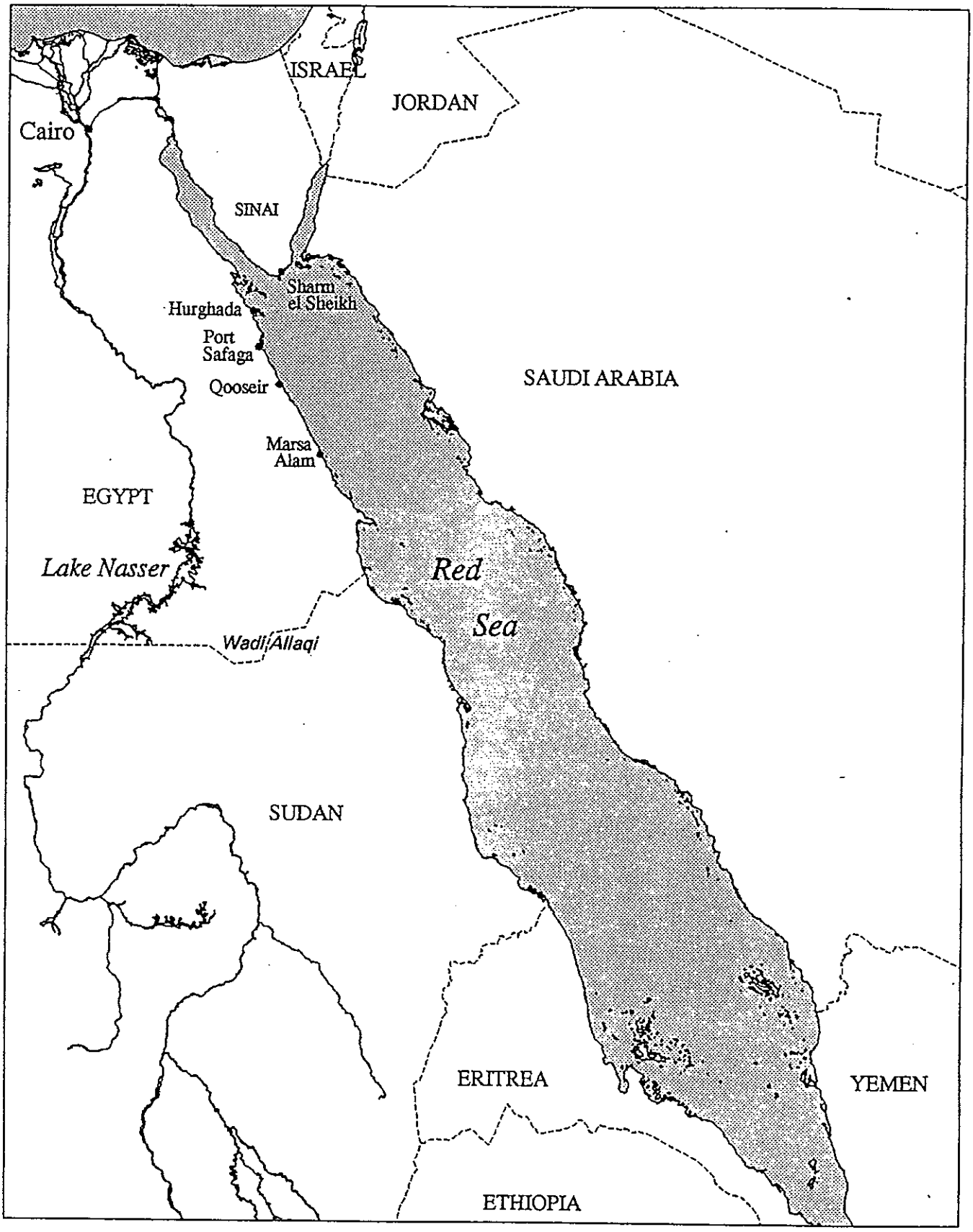


Figure 1. Relationship between the number of dives per site and broken coral.

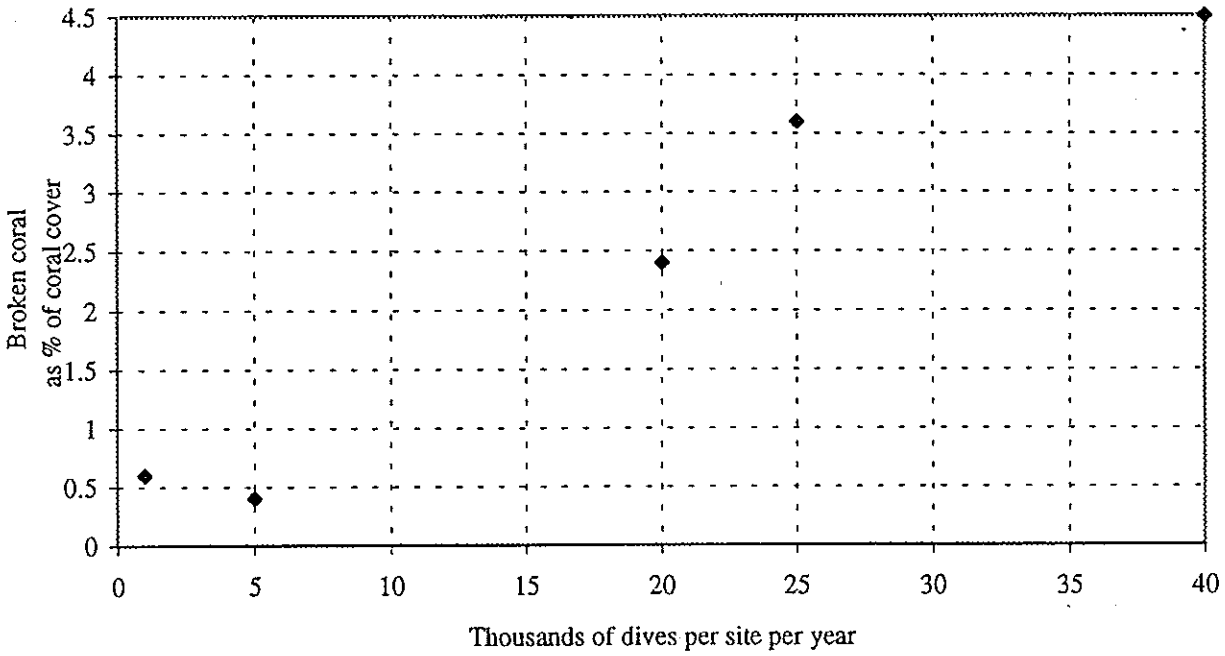


Figure 2. Willingness to pay for conservation in the Ras Mohammed National Park Area.

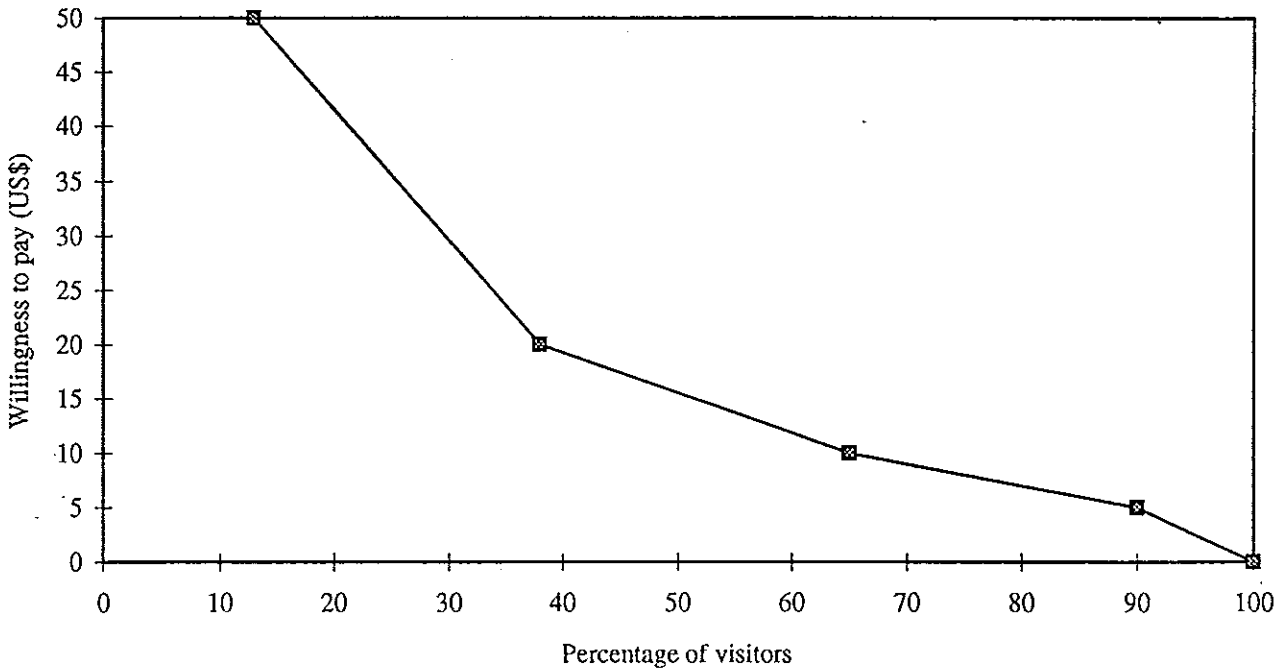
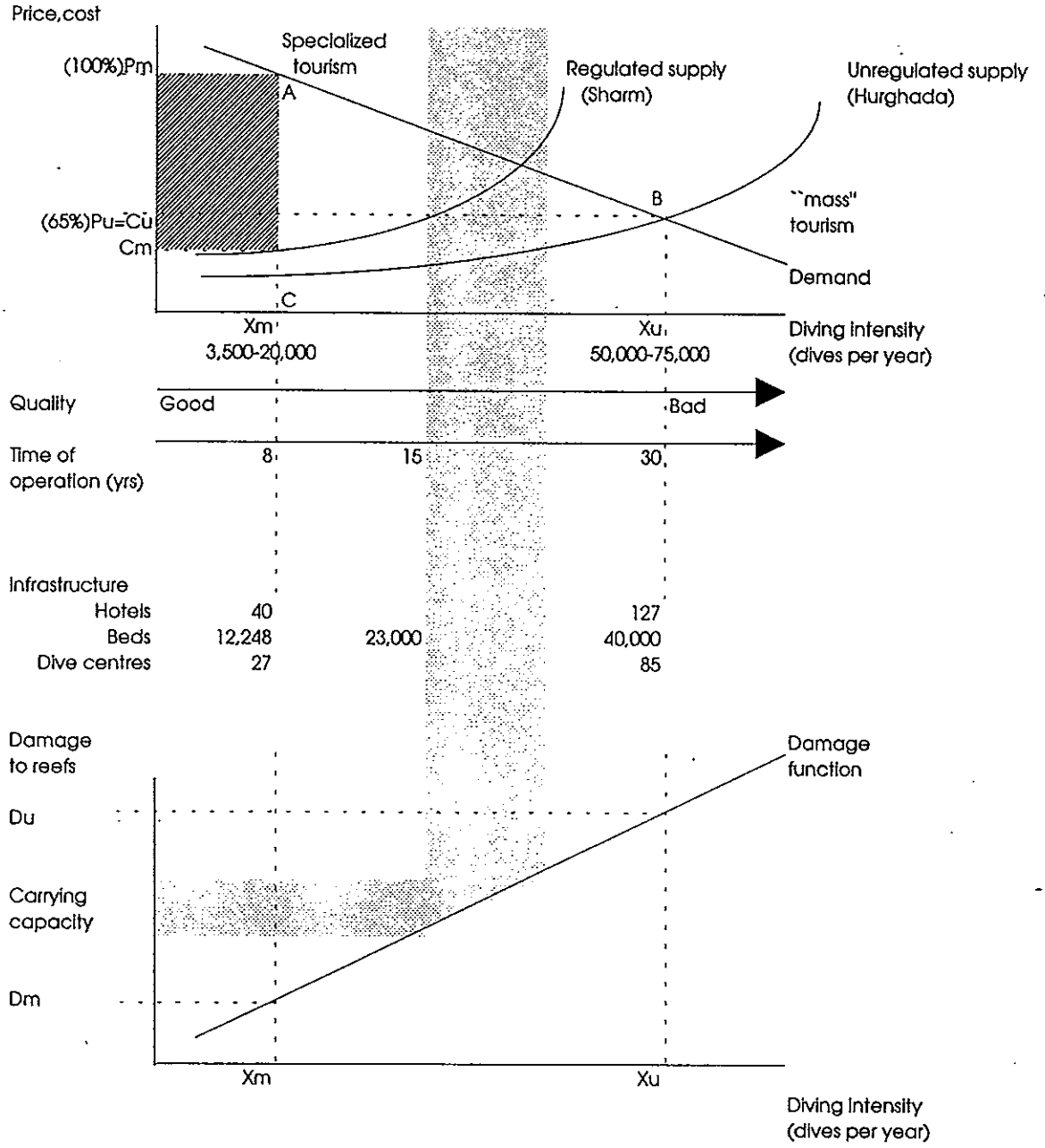


Figure 3. The regulated (Sharm) versus unregulated (Hurghada) tourism.



3

Conflicts in Wildlife Conservation - The Role of Property Rights in their Resolution: The Southern African Conservancies

Timothy Swanson[1], Jon Barnes[2] and Johan V. de Jager[2]

[1] CSERGE & Faculty of Economics and Politics, Cambridge University.

[2] Department of Environmental Affairts, Ministry of Environment and Tourism, Republic of Namibia.

Table of contents

1 Introduction: Wildlife at the Centre of Conflict

2 The Values of Wildlife

3 The Southern African Conservancy Concept
- 3.1 A description of the Namibian conservancy system
- 3.2 The impact of the conservancy system on land use in Namibia
  - 3.2.1 Land use systems analyzed
  - 3.2.2 Financial and economic efficiency
  - 3.3.3 Impacts- Wildlife populations
  - 3.4.4 Economic value of wildlife use
- 3.3 The impact of the Namibian Conservancy Movement - Conclusion.
- 3.4 The conservancy movements in Zimbabwe- further and future developments
- 3.5 Conclusion: The impact of the Southern African Conservancy Movement

5 Government Interventions in Wildlife Management
- 5.1 Interventions at the National Level
- 5.2 Interventions at the Conservancy Level

5 Conclusion: Conflicts in Wildlife Management

7 References

Annex A (at the end of the entire report)

Annex B (at the end of the entire report)

1 Introduction: Wildlife at the Centre of Conflict

Wildlife has long been at the centre of conflict between competing cultures and between competing land uses. Almost every legal system dating back to the formation of Roman law has recognised the competing claims to wildlife, terming it **res nullius** ('unownable'). Given this indeterminate relationship between wildlife and the individual, wildlife was implicitly rendered into one of the very first wards of the state. The state was made the guardian of wildlife, charged with the regulation of the peoples' taking of any wild species. It fulfilled this role by acting as the arbiter of the many competing claims upon wildlife resources, and as the enforcer of these allocations. There was little doubt that these functions were exclusively within the domain of the state, and so the state's monopoly in the area of wildlife regulation became enshrined.

The state's role in allocating and enforcing competing claims to wildlife is apparent throughout the English-speaking world. In England itself, where the state was manifested in the form of the monarchy and its representatives, wildlife became 'the property of the sovereign'. The competing claims upon the wildlife resource often took the form of a contest between the local community and a more distant elite. The sheriff and game keepers worked together to prevent local communities from 'poaching' all of the wildlife before those claiming title through the king could prosecute their claims. The contest was between different interest groups over the wildlife resource, and the state was arbitrating between these groups.

In colonial America, wildlife remained within the received common law framework as res nullius: one of the earliest American cases confirmed that wildlife could not be considered the property of the individual land owner. On the American frontier, wildlife (especially big game) was hugely depleted by competing claimants. This occurred not as a result of competition over the resource so much as a subsidiary to a more general general conflict over land, and land uses. For example, the vast populations of Plains Bison were annihilated primarily for the purpose of displacing the indigenous peoples, and replacing them and their food crops with Europeans and more European systems of land use. In the context of such an overarching struggle, much of the pre-existing wildlife was depleted even before the territorial claims were finally determined. Here the conflict between interest groups was preeminent, and the contest over wildlife was subsidiary to that conflict.

Conflicts over wildlife do not disappear however once the general allocation of lands between species is completed. Once the conflict between cultures was determined in America, a system for regulating the various uses of wildlife was put into place. One of the first acts of the newly established states often was to regulate the taking of game. Even prior to independence from Britain, the first hunting regulations were adopted in Rhode Island as early as 1646, and had spread to most of the other colonies by 1720. Shortly after statehood, Iowa (in 1878) introduced the first set of regulations governing the quantity of game that could be taken by an individual (Edwards 1995). In these instances the state had assumed the role of manager of the wide range of uses made of the remaining wildlife, even on privately held lands.

With spreading colonisation, these perspectives on wildlife management were transferred to many other parts of the world. In Africa, for example, wildlife was seen as a reservoir of disease and grazing competition. It was often eradicated as part of the agricultural development policy of these regions (Cumming 1990). For colonial Africa the London Agreement of 1933 formally translated the western tradition in wildlife management to this continent. The state assumed the

role of wildlife guardian. This role was to be executed through the establishment of game reserves and national parks set aside for the sole purpose of wildlife uses and preservation. Large areas of the colonial world (e.g., 10 per cent of southern and eastern Africa) were placed within such a 'protected area' preservation framework. Once again this manner of management constituted the determination of a land use conflict. In most of these newly designated protected areas the local peoples were forcibly removed from the designated zones and anti- poaching police patrols were instituted to protect the wildlife from any use by the remaining communities (Marks 1977). After the designation and protection of these lands for wildlife, the role of the state became one of managing the allowed uses.

Thus has the relationship between wildlife, state and citizen become enshrined: the state stands between the two, initially deciding the allocation of lands to wildlife and thereafter determining the conflicting claims upon the same. In both cases the state is acting in its role as the arbiter of competing claims upon national resources. Determining which lands to allocate to which species has in the past implicitly determined which people will have the use of that land. After the land use decision is made, the various uses to made of wildlife once again determines which constituencies interests (conservationists, sport hunters, preservationists, welfare groups) are being recognised.

Wildlife management by the state has usually taken the form of making land use and resource use determinations in favour of one constituency or another, but not both. Not only has land become designated as either wholly protected or wholly agricultural, but also the uses made of the wildlife estate has usually been restricted to the recognition of only a small range of its potential uses. Once the resource allocation decision was made (e.g., allocating specific lands to specific uses or designating specific uses for specific species), policing (i.e., anti-poaching) has been the primary instrument utilised to protect these allocations. Since the determination of competing claims and the subsequent enforcement of this allocation has always been recognised as the sole province of the state, it has always been assumed that wildlife regulation would remain within the control of the.

This policy framework is no longer a tenable approach to the conservation of wildlife in southern Africa; the fundamental basis upon which earlier determinations were made is in flux. Many of these previous land use allocations are now in dispute. Simply because it is the assumed role of the state to make and enforce property right distributions does not mean that the state has performed this role fairly or efficiently, and blatent injustices will sooner or later rise to the surface. In each of the jurisdictions surveyed above property right distributions were previously made in the sole interests of particular constituencies, usually ignoring completely the interests of others. When these latter groups come to have the legitimacy of their claims recognised, the previous land use allocations will be brought into question. A wholly state-determined system for allocating resources will always be subject to political ebbs and flows, and hence land use determinations made on this basis alone are necessarily built upon insubstantial and impermanent foundations.

The market system provides an alternative basis for allocating resources between competing uses. It is a more substantial approach to allocating resources because it does so by putting them in their 'most-valued' use, as represented by individuals' willingness and ability to pay for the use. It does so through the mechanism of individual ownership which recognises the comparative profitability of alternative land uses, and channels land use into those uses which are

recognisably most profitable to the land owner. Such an approach allows for a wide variety of mixed land uses to arise in recognition of the fundamental values attached to these uses by all of the various interest groups within the society.

This points out one of the fundamental problems with the state-managed approach to wildlife: the state sometimes fails to recognise that wildlife needs the aggregate support of the entirety of its constituencies, and to recognise and implement all of the claims to the maximum rather than deciding in favour of one over the other. In order to conserve wildlife effectively, it is necessary to channel all of the demands for wildlife into conservation, not simply arbitrate between the completing claims of conflicting users. Wildlife management is a matter of striking the correct balance between the needs of developers (agricultural, industrial and otherwise) and the demands for wildlife (use, conservation and preservation). Wildlife conservation is now and has always been rooted within the larger problem of selecting a society's path to sustainable development.

Wildlife conservation, especially in the poorer countries, must be perceived as a question of the choice of the appropriate path for a country's development. For this reason, valuation must be at the core of the decision-making process. This will place the resulting resource allocations on a firm foundation (based upon the aggregate social value that these resources yield) and it will place the emphasis on harnessing all the values of wildlife, rather than arbitrating between them. When viewed from this perspective, the appropriate mix of private/public regulation in wildlife conservation is far less certain. This will depend entirely upon the nature of the organisations that are most effective at recognising, reconciling and supplying the public's various demands for wildlife. This means that the traditional role of claim arbiter needs to be deemphasised (but not dismissed); the need now is for dynamic and productive forms of organisation that are able to harness all of the various values of wildlife and channel them into conservation.

This paper addresses this general question concerning the nature of the best organisational structure for conserving diversity through a series of subsidiary questions: What is the nature of the public's various demands for wildlife? How might these various demands be best supplied by organisations? What sorts of public (i.e., state) interventions are desirable and/or necessary in order to make these organisations the most effective possible conservators of wildlife? The first question is addressed initially in the context of a general discussion of economic principles, and then the latter two questions are considered in the context of a case study focusing on the conservancy movement in southern Africa.

2 The values of wildlife

What is it that distinguishes wildlife from other species? It is usually assumed that the need for the collective management of the so-called wildlife species determines their denomination, and that this emanates from their fugacious nature, i.e., the wildlife species are by their own nature those which are least able to be confined to restricted territories under sole ownership. This rationale might perhaps have been true long ago in very specific localities, e.g., in Medieval Britain where the size of land holdings and the paucity of ferile species probably made it the case that most non-domestic species did cross land boundaries on a regular basis. If an individual species does cross many boundaries, and is incapable of having its domain restricted, then joint management makes sense. It is a case in which a commons problem (demanding collective action) is generated by the nature of the beast. In some locales for some species, their natural

characteristics probably did engender their separate management as 'wildlife'.

It is clearly not the case that such a rationale provides a justification for state-based regulation of many of these same species (or their relatives) in all of the other regions of the world in which it has been applied. For example, in the colonial regions of America and then Africa many of the landholdings were sufficiently large to coincide with the ranges of many of the species that resided there, and yet these species retained their denomination as wildlife. Even more importantly, with the technological change embodied in the adoption of barbed wire fencing across nineteenth-century America, it was thereafter possible to counteract the fugacious nature of many wildlife species with an adequately constructed fence. Such game-proof fences are now common throughout parts of Africa. Despite these changes, and the consequent blurring of the line distinguishing between domestic and wildlife species, wildlife legislation continues to regulate the same species as previously.

Why is it the case that wildlife regulation continues in place with regard to a particular species, even after technological change renders its isolation feasible? The answer to this question is that in the interim period the species has become 'clothed in the public interest'. That is, a now potentially private good has attracted public good characteristics. Certain groups in the society have attached values to the species simply because it has previously been denominated as wildlife. This socialisation process makes the subsequent privatisation of the species problematic.

Table 1 Total Economic Value for a Wildlife Species (e.g. Rhinoceros)

Total Economic Value =

Use Value		+	Non-Use Value	
<---------->			<---------->	
(1)	(2)	(3)		(4)
Direct + Value	Indirect Value	+ Option Value	+	Existence Value
Sustain-able De-horning	Keystone Species (?)			
Viewing & Tourism	Ecosystem Contribs.	Future Uses & Irreversibility		Wildlife as of intrinsic value.
Recre-ational Hunting				

Adapted From: Brown, Pearce, Perrings and Swanson, 1992. The Economics of Global Biological Diversity, GEF Paper.

To see that this is the case, it is only necessary to consider the various components of what is often termed *the total economic value* of any natural resource (Pearce 1991). Consider the example in Table 1 concerning the total economic value of a wildlife species (e.g., the rhinoceros) and Box 1.

It is clear that any species of wildlife, such as the rhinoceros or the elephant, exhibits values under each of the categories described above. Sports hunters and tourists spend vast sums of money each year in order to engage in the direct use of the wildlife of African countries; for example, Kenya earned approximately US $349 million in 1988 from primarily wildlife-based tourism activities while the financial contribution of trophy hunting to Namibia in 1991 was approximately N$25 million (Cumming 1990; Barnes 1995). Equally clearly, the non-use values on the right side of the table are also quite substantial. Appeals for conservation funds for these species by organisations such as the World Wide Fund for Nature provide funding for vast conservation programmes across these same countries. These programmes are usually being funded by means of donations from persons living on the other side of the globe from the

1. The Components of Total Economic Value for a Wildlife Species

The total benefits of a natural resource are measured by total economic value. Total economic value (TEV) for a particular wildlife species (e.g. the rhinoceros) might be categorised as follows.

TEV comprises use and non-use values. The first form of use value listed is direct use, and this incorporates both consumptive and non-consumptive utilisation. Consumptive utilisation involves any use that is exclusive and exhaustive, i.e. it consumes a unit of the resource. Use values regarding the rhinoceros include sustainable de-horning (consumption of the horn) and sport hunting. Non-consumptive use would include such activites as viewing and tourism, which leave the wildlife resource available for others' use.

Indirect use values correspond to the ecologist's concept of 'ecological functions'. Most species play some role within the system within which they live, e.g. by alterring the habitat in a manner that makes it more usable by others. A keystone species is one on which many other species depend for their existence.

The non-use values concern demands for the resource that do not involve any current individual use whatsoever. Option values relate to the amount that individuals would be willing to pay to preserve the resource future use. That is, no use is made of it now but use may be made of it in the future. Option value is thus like an insurance premium to ensure the supply of something the availability of which would otherwise be uncertain. Quasi-option value is a term that is applied to the demands for the retention of a resource, given the irreversibility involved in its loss and the possibility of future needs. The extinction of the rhino raises questions concerning is possible future values, and these values are distinct from the other values listed above.

Existence value relates to valuations of the environmental asset unrelated either to current or future use. Its intuitive basis is easy to understand because a great many people reveal their willingness to pay for the existence of environmental assets through wildlife and other environmental charities but without taking part in the direct use of the wildlife through recreation or tourism. Empirical measures of existence value, obtained through questionnaire approaches (the contingent valuation method), suggest that existence value can be a substantial component of total economic value.

Total economic value can be expressed as:

TEV = Direct Use Value (consumptive and non-consumptive) + Indirect Use Value + Option Value + Existence Value

From: Brown, Pearce, Perrings and Swanson, 1992. The Economics of Global Biological Diversity, GEF:Washington,D.C.

wildlife, with little or no prospect of ever actually seeing one of the animals in its native country. In 1990, donations to wildlife conservation organisations in the US alone amounted to at least US $273 million, with $85 million of this flowing to the Nature Conservancy and $42 million flowing to the WWF (WCMC 1992).

2. The Various Motivations for Non-Use Values

The various motivations behind non-use values for a wildlife species might include.

1. *bequest motive* - the importance of providing the species for the use and enjoyment of future generations of human societies.
2. *vicarious enjoyment motive* - the importance of knowing that other individuals than yourself are currently enjoying the species.
3. *animal benefactor motive* - the importance of providing an enjoyable style of life or existence for individuals of a particular species.
4. *option retention motive* - the importance of providing the species for your own unplanned but possible future use given that circumstances change to make this desirable.
5. *impression motive* - the importance of impressing upon others your own particular set of beliefs about a given species.
6. *group identification motive* - the importance of identifying yourself as a member of a particular class or group of individuals identified by a particular set of beliefs regarding a given species.
7. *community preservation motive* - the importance of retaining certain goods and services, including a given species, that are wholly communal (non-private and non-exclusive) in nature.

Therefore it is apparent that this form of accounting (under a wide range of values) makes sense for many species denominated 'wildlife'. People around the world are willing to pay for wildlife based on a wide range of motivations. Some do so for the particular function that the wildlife species is able to perform for themselves, e.g., providing enjoyment in the course of recreation or providing products (leather, medicines) for their personal use in everyday life. Others do so for a wider and more complex range of reasons corresponding to the non-use values listed above. Some of these reasons are listed in Box 2.

All of the motives listed above are possible reasons why an individual would be willing to pay something toward the continued existence of a particular species, even though that same individual is making no current use of that species himself. It is apparent from the wide range of possible motivations that many wildlife species would have at least some positive non-use valuation given to them by at least some individuals. It is equally the case that simply denominating something as a 'wildlife' species will bring some of these values into existence. In order to demonstrate this effect, it will first be necessary to discuss each of the motives in turn.

The first four motives listed might be termed *individual-based motivations*, i.e., these motives would exist even within a societal vacuum as they are based on individual preferences alone. *Bequest motives* and other *vicarious motivations* (even including the animal benefactor motive) derive from the individual enjoyment that individuals derive from knowing that others are enjoying themselves. The three different vicarious motives correspond to the individual enjoyment procured by different groups: descendants, the species itself, and others. The fourth motive listed corresponds to the *option value* discussed previously. It derives from the fact that individuals do not have adequate information about the future to make irreversible decisions in the present. In particular it is apparent that either individual preferences or the environmental circumstances might change in the future to render current decisions (based on existing values) suboptimal. Given the knowledge that decisions are made in this dynamic context, individuals will attach a value to retaining an option for possible future use.

The remaining motives are distinguishable because they derive from the social context within which they occur. Some individuals will derive enjoyment from impressing their ideas upon others, and will be willing to pay for the promotion of their ideas. This is termed *impression motive*. It is apparent whenever a person contributes money for the promotion of a particular idea within society.

The last two motives listed are even more group dependent. *Group identification motives* are based in the human need to form identifiable groups of individuals with common beliefs and joint agendas. This is apparent when individuals assemble in these groups to undertake activities, and when they acquire identifying markings for the purpose of making socialisation with other members of the group possible. Some people are willing to pay to acquire the markings of a particular grouping. *Community preservation motives* are similar to group identification but based on the idea that the wildlife species itself identifies the pertinent group. Maintaining certain goods as public goods ensures that a community continues to exist, in the sense that there remain non-private shared resources on which a group of people depends. It is this recognised mutual interdependence that then defines the community.

Hence the range of motivations that can support a positive non-use valuation is very broad, ranging from the most individualistic motivations to the most communalistic. It is apparent that a wildlife species, such as the rhino, might be the basis for attracting non-use valuations under any of these motives. For example, individuals may take vicarious enjoyment from others' enjoyment of rhinos, or individuals may wish to impress upon others the importance that they place on a highly endangered species such as the rhino and/or may wish to identify with the group who display endangered species as their banner.

More importantly, and less obviously, there is the distinct possibility that the mere labelling of a species as 'wildlife' may be sufficient to induce positive non-use values for that species. This is clearly the case with regard to the sorts of existence values that are attributed to species such as the rhino by individuals in very distant regions. In order to see this, consider that there is a much lower likelihood of obtaining positive non- use values for a species of domesticated livestock, such as a cow, sheep or pig than there is for a species of 'wildlife'. The average willingness to pay by the US population for the existence of various wildlife species in that country has been estimated at, e.g., $11 for the bald eagle, $7 for the northern elephant seal and $15 for the grizzly bear (Pearce 1991). The prospects for receiving similar average bids for the continued existence of the Guernsey cow or even the relatively uncommon but still domesticated

Jacob's sheep is probably much poorer, and is evidenced in part by the fact that no one has even thought to conduct such experiments. For the domesticated species, it is probably generally recognised that the use values dwarf any non-use value that might accrue to them.

One of the distinguishing characteristics of 'wildlife' species in some countries is that they are the only species likely to attract non-use values. Why is this the case? It is likely that the designation of certain species as wildlife has allowed constituencies and groupings to form around them, and it is the value of these groupings that is then represented in the willingness to pay for the non-use of the species. Communities need things in common in order to continue to exist as communities, and shared natural resources can fulfil this function. Rhinos are given values by peoples in distant lands in part to conserve the communities of which they are part.

This example demonstrates two very important points regarding conflict over wildlife species. First, it indicates that there will always be resistance to the alteration of the already existing state-based management structures pertaining to wildlife. In essence, there are groups who assemble around certain publically provided goods to support their view that not all resources should be privatised, even if it would be more efficient to do so. The desire to retain wildlife species as a collective good is one of the motives for positive non-use values.

These collectivist motives are dependent upon the continued state regulation of the species. In the North, these valuations flow from the existence of arms-length non- exclusive mechanisms for regulating the resource, more so than from the existence of the resource itself. If all of the rhinos in the world were placed in zoos or in farmers' pens, these individuals would probably withdraw the non-use values they had previously placed upon the species. Existence value in these cases does not hinge upon just any form of existence but rather on the existence of a particular form of management system, i.e., one based upon common ownership.

Similarly, this confusion of the value of the management system with the value of the species exists locally as well, but in a reciprocal fashion. Consider the problem of land use systems in southern Africa, where tribal lands were expropriated and placed under central governmental control. Where the lands were denominated for wildlife utilisation, the results were usually to remove the people, their stocks of animals and their social systems from the demarcated territory. This was the process under which the existing systems of parks and protected areas were established across Africa. With the current process of reform underway there is a movement to return these lands to their previous owners, but it is hoped that very different forms of land use will be implemented. This is because it is now perceived to be the case that the most efficient use of some of these lands is in diversity, such as the development of wildlife-based tourism. The problem is that it is unlikely that lands can be transferred without changing both management systems and the species under them. The local peoples have collectivist traditions which are based upon specific non-wildlife species, primarily cattle, whereas wildlife is seen locally as a divisive good. That is, wildlife was used formerly as an instrument to deny these societies their use of their lands, whereas domesticated livestock has been the instrument upon which the societies' complicated collectivist traditions have been built (bride prices, chieftancy shares etc.) The higher 'community' based values are given in this case not to wildlife but to cattle.

This confusion of management system with wildlife species creates a problem with regard to the choice of the optimal management system regarding rhinos or any other wildlife species because now individuals are attaching value not only to the conservation of the species, but also to the

system under which it is conserved. Except under extremely fortuitous circumstances, it is necessarily the case that this will introduce further conflicts between wildlife constituencies. Generally speaking it is the case that the total economic value given to a particular species will not be independent of the management system applied to it.

In summary, there are many different forms that the willingness to pay for a wildlife species may take, and all of them need to be harnessed if the greatest amount of diversity is to be retained. This is problematic, however, because many of the values attributable to wildlife are in potential conflict with one another. For example, some individuals may value the rhinoceros for the medicinal properties of its horn while others may appreciate its role in the ecosystem or the animal's own enjoyment of its existence. Obviously it may be very difficult to aggregate across all of these valuations.

Equally, there are cases where the management regime under which the species is held will itself engender conflicts. Some of the values that flow to a wildlife species do so because of the appreciation of that particular species, while others flow on account of the more general appreciation of 'wildlife' and all that this concept entails. In particular, one commonly perceived aspect of wildlife is its character as a common resource. It is difficult to reconcile the values that flow from these 'public good' characteristics of wildlife with the increasing privatisation of the resource, even if such privatisation is the best means of aiding the other flows of value. Importantly, these forms of collective value may change completely for different constituencies, and the case of the rhinoceros in southern Africa is a good example. Certain groups place the higher collectivist values on the wildlife species while others in southern Africa place these same collectivist values not on wildlife but on its competitors, the domesticated livestock.

As described in the introduction, wildlife policy must ultimately be grounded in the values that the society within which it lives is able to appropriate. This is the only firm foundation on which land use determinations may be constructed. The problem is to create efficient management systems that are best able to recognise, reconcile and implement these values. This is not an easy task, but it is especially difficult when the management system is itself a part of the value-engendering process. In section 3 we will consider some of the most innovative wildlife management systems now in existence, and in section 4 we will consider how these might be managed in order to reconcile all of these various facets of value.

3 The southern African conservancy concept

The southern African conservancy movement was sourced initially in the legislation passed in 1967 by the South West African (now Namibian) assembly (Ordinance 31). Ordinance 31 stated that the Division of Nature Conservation and Tourism was to 'give the owner and occupier of a farm full ownership of all game, other than specially protected and protected game, while such game is lawfully upon such farm and while such farm is enclosed with a sufficient fence'. The ordinance also made provision for that person to lease his rights (Joubert 1983). It was this 'privatisation' approach to wildlife that generated an entirely different management system for the wild animals in what is now Namibia. Subsequently nearly identical legislation was adopted in Zimbabwe, extending these rights of ownership to commercial farmers in 1975 and then to communal areas after independence in 1982 (Bond 1993).

Prior to the adoption of privatisation, wildlife had been managed in the more traditional style in southern Africa. There were designated protected areas where wildlife was to constitute the primary land use, and outside of these areas there were explicit and implicit (veterinary fencing) eradication programmes (Cumming 1990). By the middle of the twentieth century most of the game had been removed from the private lands in southern Africa. Game was restricted to the protected areas, and with independence coming to the territory the future of these areas was increasingly in doubt.

3.1 A description of the Namibian conservancy system

Once private property rights in game species were in place, the individual landowner had the capacity to capture the use values of wildlife on his land. The immediate problem facing these individuals was that in many cases the individual landholdings were insufficient to support the range of the wildlife species. Much of the Namibian territory is extremely arid and wildlife must range across large territories in order to browse successfully and to locate water supplies. Although individual ranches are usually very large (c. 5-10,000 ha.), the range of many of the wildlife species in these arid districts is often even larger.

The solution to such problems has come with the establishment of a contractual relationship between neighbouring landowners providing for the join management of the wildlife species that range across their lands. In such agreements, between ten and twenty landowners join together to establish a common outside boundary around a more substantial land area, and principles for the joint management and use of the wildlife. In Namibia there are at present four conservancies: Ngarangombe (100,000 hectares), Waterberg (150,000 hectares), Khomas Hochland (130,000 hectares) and Black Nossob (130,000 hectares). Each of these conservancies has been registered with the Namibian Ministry of Environment, and has agreed to certain regulations governing its registration; such a registration is necessary in order for the landowners to have their land designated for joint management (de Jager 1995).

These conditions for the establishment of a conservancy constitute a solid groundwork for the joint management of game species. The problems of joint management are well documented (Ostrom 1992). The most concise statement of the nature of such commons problems would probably be: 1) the determination of the aggregate amount of resource use that is available; 2) the allocation of that amount between individual members; and 3) the monitoring and enforcement of that allocation (Young 1995). The failure to implement any of these three objects is sufficient to cause the degradation of the common resources.

The conservancy concept addresses the commons problem by both getting the individual users involved in the development of the control policy and by having an outside presence involved in the implementation of that policy. The former element is important in making the policy acceptable, and thus enforceable at least cost (Hanna 1995). The latter element is essential for providing the assurance that all parties are complying with the agreement, removing the incentive to free ride on the others' compliance.

Consider the Khomas Hochland conservancy, whose constitution is set out in Annex A to this document. This conservancy of eighteen landowners comprising about 130,000 hectares has developed a firm foundation for joint cooperation and wildlife management. Its objective is to jointly manage wildlife species in order to capture the values that sport hunting of these species

will generate. This has changed the landowners' perception of wildlife completely. Species which were virtually or entirely eradicated previously are now being brought back in substantial numbers.

The key to this programme is the values that these species generate, and the benefit sharing system that has been implemented. Each hunter must pay a trophy fee for any animal bagged on the conservancy property as well as for lodging and a licensed guide. The hunter is recruited from Europe or the US and his lodging fee is kept by the landowner who recruits and lodges him. However, once the hunter is within the conservancy, the individual conservancy member is welcome to hunt on any of the conservancy property. The landowner on whose property the game is bagged is entitled to a specified share of the trophy fee, and the conservancy itself receives a further 5 percent of this specified fee; the recruiter conservancy member is entitled to the residual of the trophy fee as well as the lodging fee.

3. Benefit Sharing within the Khomas Hochland Conservancy

The trophy fees for various conservancy game species and the landowners' share are as follows (the conservancy itself levies a 5% fee of the landowners' share to cover administrative expenses):

Species	Trophy Fee (DM)	Landowners' Benefit (N$)
Kudu	1100	1500
Leopard	3000	3000
Cheetah	2000	3000
Warthog	350	450

This benefit sharing arrangement allows for the various landholders to share in the benefits of game ownership, even if they do not themselves engage in recruiting and lodging trophy hunters. All that is required is that they participate in the joint management actions that enable the use of their land by game species. In addition, the levy collected by the conservancy itself is being used to fund jointly beneficial management activities, including restocking of game species and the construction of exterior game-proof fences.

Therefore, as a direct result of the financial incentives inhering from the privatisation of wildlife within Namibia, private landowners are actually in the process of removing fences erected earlier this century and restocking species that were eradicated in the process of these earlier conversions. In addition, it is clear that these are only the first steps down the road towards wildlife-based land uses. The conservancy continues to look for members (hoping to expand to the boundary of a game reserve in the proximity) and it is in the process of importing other wildlife (giraffe, impala) in the hopes of developing the ecotourism-based values of its lands as well.

4. Joint Management Actions of the Khomas Hochland Conservancy

The joint management actions taken by the Khomas Hochland conservancy thus far (since its initiation in September 1992) have included:

- the reduction of the cattle stocking levels on the conservancy lands;
- the opening of waterholes to game during the dry season;
- the removal of the two wire strands from the interior fences;
- the erection of game proof fences on some of the exterior boundary;
- the stocking of new wildlife species (hartebeest);
- the development of common marketing organisation (brochure, agent).

3.2 The impact of the conservancy system on land use in Namibia

What is the impact of these innovative organisations on land use in Namibia? The authors working at the Ministry of Environment and Tourism have investigated the impact that this new system of governance has introduced within Namibia both with respect to wildlife populations and the economic contribution to the Namibian economy. This section summarises their findings; the full report is available from the authors on request (Barnes and de Jager 1995).

3.2.1 Land use systems analysed

Barnes and de Jager have examined three basic-farm-scale models and two conservancy-scale models in an attempt to identify economic forces affecting wildlife use on commercial land. Two of the ranch systems represent typical livestock production enterprises incorporating supplementary wildlife cropping and trophy hunting. One is representative of the northern, wooded savanna farm land area, and the other is representative of the southern, karroid shrub savanna farm land areas. A third farm-scale model, set in the northern /savanna, involves a pure wildlife operation, where the land is stocked with a relatively diverse population of wildlife and income is derived through an bed wildlife viewing lodge. The initial capital investment here amounts to some N$3 million.

Two models depicting conservancies in the northern, savanna farm land areas were developed. One represents a grouping of ten cattle - game production ranches similar to the ranch-scale model of this type. The other represents an amalgamation of seven pure wildlife ranches similar to the ranch-scale model of this type, aimed at non-consumptive wildlife viewing.

The southern mixed sheep and game ranch system (model 1)involves dorper sheep breeding for lamb production, combined with use of springbok and some gemsbok and kudu for culling, trophy hunting, biltong hunting and own use. The ranch size is 11,520 hectares, the initial capital investment is N$ 1.6 million and sheep make up 88 percent of the animal biomass, stocked at a rate of 32 hectares per LSU equivalent. Off-take rates are those possible with a reasonable amount of herd management, *viz*: 60 percent for sheep, 27 percent for springbok, 16 percent for gemsbok, and 17 percent for kudu. 18 trophy hunter days are sold per annum and 13 percent of the game off-take is taken as trophies. The staff requirement consists of four

unskilled labourer and one semi-skilled labourer besides the owner - manager. A land rental cost to the farmer of N$ 0.78 per hectare is assumed.

The northern mixed cattle and game ranch system (model 2) involves beef cattle breeding and rearing for slaughter combined with use of gemsbok, kudu and some springbok and warthog for culling, trophy hunting, biltong hunting and own use. The ranch size is 9,024 hectares, the initial capital requirement is N$ 1.6 million and cattle make up 75 percent of animal biomass, stocked at a rate of 14 hectares per LSU equivalent. Off-take rates are those possible with a reasonable amount of herd management, *viz*: 25 percent for cattle, 16 percent for gemsbok, 17 percent for kudu, 27 percent for springbok and 10 percent for warthog. Thirty trophy hunter days are sold per annum and 15 percent of the game off-take is taken as trophies. The staff requirement consists of six unskilled labourer and one semi-skilled labourer besides the owner-manager. A land rental cost to the farmer of N$ 0.89 per hectare is assumed.

The third ranch model (model 3) is also set in the northern savanna, and involves production of a diverse community of game for non-consumptive wildlife viewing. The ranch size is 14,401 hectares and the initial capital required is N$ 3.2 million. This is largely made up of the costs of stock purchase, fencing and lodge construction and 25 percent of capital is assumed to be financed from foreign sources. Some 12 species, including black-faced impala, eland, gemsbok, giraffe, hartebeest, kudu, plains zebra, springbok, roan, blue wildebeest, warthog and white rhino are assumed to be present, stocked at a rate of 20 hectares per LSU equivalent. The 18 bed lodge has a daily tariff of N$ 375, an annual occupancy of 40 percent and caters to up-market clients, some 60 percent of whom are from overseas. Staff requirements consist of 15 unskilled labourers, three skilled labourers and two managers besides the owner-manager. A land rental cost of N$ 0.89 per hectare is assumed.

The first conservancy model (model A) consists of ten units of the northern cattle game ranch system (model 2), within which farmers manage their game in combination, but retain individual management of their livestock. Conservancy size is 90,239 hectares and the initial capital amounts to N$ 12.8 million. The system allows some economies of scale with regard to wildlife investments and management, in particular, fencing costs are reduced through sharing and the need for one less strand on internal fences. Greater diversity of shared species and greater scale of operation allow improvement of the value of the trophy hunting by 30 percent.

The second conservancy model (model B) consists of ten units of the northern pure game ranch (model 3), within which farmers manage their game in combination for wildlife viewing through seven lodges and tented camps with a combined bed capacity of 126 beds. Conservancy size is 100,809 hectares and the initial capital investment is N$ 18.2 million. The system allows some economies of scale with regard to wildlife investments and management, in particular, fencing costs are reduced. The larger scale allows the stocking of a greater diversity of species so that mountain zebra, sable, tsessebe and black rhino or elephant are present in addition to those listed for model 3. This makes it possible for tariffs to be 7 percent higher than they are in model 3.

3.2.2 Financial and economic efficiency

Table 1 shows the base case *financial* characteristics for the three ranch-scale financial models analysed, *viz*: the southern sheep with game system, the northern cattle with game system, and

the northern non-consumptive game system. The results generally indicate that ranching systems on private land in Namibia have low profitability. All systems have financial rates of return below the 8 percent discount rate and the net present values, over ten years, are negative. The southern sheep-game system appears to be more profitable than the northern cattle-game system. Although this is not evident in the table, it was found that in both systems the livestock production component was financially more profitable (with higher gross margins) than the game production component. The pure game wildlife viewing ranch system (model 3) involves both investment and turnover (gross income) which are significantly higher than the those of the other two systems. It does not however appear to offer a better incentive for investment than model 2 for the northern savannas.

Table 1 Key financial characteristics for three ranch scale land use systems on private land,involving wildlife (N$, Namibia 1994)

Land use system*	1 Southern sheep/game	2 Northern cattle/game	3 Northern game lodge
Ranch extent (hectares)	11,520	9,024	14,401
Stock on hand (no. LSU)	360	668	465
Static financial measures**			
Initial capital investment	1,553,151	1,565,542	3,189,813
Capital investment per hectare	135	173	222
Annual gross income	309,638	257,125	1,000,283
Gross income per hectare	27	28	69
Annual variable costs	78,663	66,281	317,548
Variable costs per hectare	7	7	22
Annual fixed costs	167,172	153,403	553,615
Fixed costs per hectare	15	17	38
Annual net cash income	63,803	37,442	129,120
Net cash income per hectare	6	4	9
Annual return on initial capital	4%	2%	4%
Financial worth over ten years			
Financial Rate of Return	5.8%	3.9%	4.2%
Financial Net Present Value (@ 8 percent)	-184,984	-364,187	-718,306
Net Present Value per hectare	-16	-40	-50

* 1 Southern sheep production with supplementary game use for venison and trophies
2 Northern cattle production with supplementary game use for venison and trophies
3 Northern game production and lodge development for non-consumptive wildlife viewing tourism (see also text)

** Measured after enterprise has attained stability (full production)

Table 2 shows the financial characteristics for the two conservancy scale models, A and B. The results here can be compared directly with those for the two northern savanna models in Table 1 (models A and B) to determine if the larger- scale results in greater efficiency. This indeed, appears to be the case since the financial rates of return for both conservancy systems are more than twice as high as those for the ranches practising the same land uses. That for the pure wildlife system is also above the 8 percent discount rate and the system thus has a positive financial net present value over ten years. It can be seen that capital investment per hectare is lower for the conservancies than it is for the ranches. Similarly, gross income is higher and fixed costs are lower per unit area.

Table 2: Key financial characteristics for two conservancy scale land use systems on private land, involving wildlife (N$, Namibia 1994)

Land use system*	A Northern cattle/game	B Northern game lodge
Concession extent (hectares)	90,239	100,809
No. of ranch units	10	7
Stock on hand (no. LSU)	6,684	3,255
Static financial measures**		
Initial capital investment	12,847,242	18,188,620
Capital investment per hectare	142	180
Annual gross income	2,627,223	7,453,967
Gross income per hectare	29	74
Annual variable costs	650,549	2,182,817
Variable costs per hectare	7	22
Annual fixed costs	1,211,442	3,328,932
Fixed costs per hectare	13	33
Annual net cash income	765,232	1,942,218
Net cash income per hectare	8	19
Annual return on initial capital	6.0%	10.7%
Financial worth over ten years		
Financial Rate of Return	7.3%	10.0%
Financial Net Present Value (@ 8 percent)	-513,026	2,307,136
Net Present Value per hectare	-6	23

* A Northern cattle production with supplementary game use for venison and trophies
B Northern game production and lodge development for non-consumptive wildlife viewing tourism (see also text)

** Measured after enterprise has attained stability (full production)

Table 3 shows the economic returns for the two conservancy systems. These economic returns were calculated with the use of shadow prices, rather than market prices, of the primary factors of production in these systems; this attempts to capture to the real scarcity of the various factors of production within the Namibian economy (such as labour and capital) rather than artificial scarcities induced by reason of other policies (such as fixed wages and exchange rates). In both cases the economic rate of return is well above the discount rate of 8 percent and both investments have positive economic net present values over ten years. The ten year net present values and also the annual net value added contributions generated per unit of land in both systems are higher than those for the individual ranch models (models 2 and 3 in Table 1). The results in Table 3 again suggest that the economic contribution of pure wildlife ranching, for up-market wildlife viewing can contribute more to the economy than livestock and wildlife production for consumptive use. Hence, even where the financial incentives are weak, there is

a strong case to be made that the use values involved are much greater than is reflected within those financial incentives.

Table 3: Key economic characteristics for two conservancy scale land use systems on private land, involving wildlife (N$, Namibia 1994)

Land use system*	A Northern cattle/game	B Northern game lodge
Concession extent (hectares)	90,239	100,809
No. ranch units	10	7
Stock on hand (no. LSU)	6,884	3,255
Static economic measures**		
Initial economic capital investment	11,974,722	17,161,014
Economic capital investment per hectare	133	170
Economic capital investment per job created	190,075	129,713
Annual economic gross income	2,618,816	7,276,792
Economic gross income per hectare	29	72
Annual economic costs	596,884	3,735,371
Economic costs per hectare	7	37
Annual gross value added***	2,021,931	3,541,421
Gross value added per hectare	22	35
Annual net value added***	1,619,541	2,630,815
Net value added per hectare	18	26
Return in net value added/initial capital	13.5%	15.3%
Economic worth over ten years		
Economic Rate of Return	12.9%	19.5%
Economic Net Present Value (@ 8 percent)	3,391,193	11,782,437
Net Present Value per hectare	38	117

* A. Northern cattle production with supplementary game use for venison and trophies
B. Northern game production and lodge development for non-consumptive wildlife viewing tourism (see also text)

** Measured after enterprise has attained stability (full production)

*** Gross value added to national income less depreciation = net value added to national income

The general results from this analysis are as follows. First, there is a positive financial return to game ranching on Namibian land, even at the individual landowner level; however, it is apparent that this is not a socially beneficial use of capital as the rates of return are relatively low for this economy (i.e., in the region of 4-5 percent). The economies of scale realisable when several landowners work together in the provision of wildlife services changes this picture quite dramatically. At the scale of most existing conservancies (i.e., c. 100,000 ha.) the rates of return increase to economically competitive levels (i.e., 8-10 percent). This is the incentive for the creation of these large landholdings under joint management. Even more importantly, when the real social costs of the factors used in these operations is evaluated (rather than the prices actually paid) the rates of return to a conservancy escalate to a very impressive level (i.e., 13-20 percent). These studies provide a picture of privatisation-led land use determinations (through fiscal incentives) that are generating substantial value for the society as a whole.

3.2.3 Impacts: Wildlife populations

What has been the impact of wildlife privatisation within Namibia? There is now a solid history of experience with the new policy, since it has been in place for nearly three decades. Table 4 shows the changes in game populations estimated and the diversity of game species recorded between 1972 and 1992, based on the two questionnaire surveys of those years. Data from the 1982 survey generally showed values intermediate between those of 1972 and 1992 and have been left out for simplicity.

Certain points of interest emerge from the data in Table 1. First the wildlife numbers appear to have increased by some 70 percent over the 20 year period between 1972 and 1992. Second, and similarly, the biomass of game appears to have increased by some 84 percent. There appears to have also been an increase of some 44 percent in the diversity of species. A closer look at this reveals that in 1972 only one species recorded (the impala) was not indigenous to the commercial farm land areas, although it did occur in the north eastern Caprivi region of Namibia. In 1992 five of the new species found (black wildebeest, nyala, reedbuck, sable and tsessebe) were not indigenous to the commercial farm land areas, and two of them (black wildebeest and nyala) are exotic species in Namibia. In addition on of the miscellaneous species recorded in 1992, the blesbok, is exotic.

Therefore, the impact of privatisation in Namibia provides solid evidence for the incentives that this programme has created for the conservation of wildlife. Wildlife populations have increased dramatically (albeit cyclically) over this period, as has general diversity. In many areas, species are being returned to habitats in which they were systematically eradicated under government policies in place only a few decades before. In addition, economic incentives are allocating land uses in a manner very different than did the previous administrations. It is apparent from these studies and many others that mixed land uses are not only possible but also profitable. In Namibia the existing conservancies are all using wildlife only in combination with domesticated species, rather than one at the exclusion of the other. Landowners are transforming Namibian habitats by the removal of fences and the reintroduction of game, solely in response to the financial incentives created by privatisation.

Table 4: Estimates* of game numbers and biomass by species for all private land (commercial land) in Namibia in 1972 and 1992, based on questionnaire surveys made during those years

Year	1972		1992	
Species	**No. head**	**No. LSU****	**No. head**	**No. LSU****
Black wildebeest	-	-	7,177	2,009
Black-faced impala	-	-	2,144	300
Blue wildebeest	326	130	4,935	1,974
Dik-dik	13,011	520	15,783	631
Duiker	84,419	6753	75,518	6,041
Eland	10,338	10,338	29,150	29,150
Gemsbok	55,406	22,163	164,306	65,722
Giraffe	3,760	5,039	4,552	6,099
Hartebeest	16,302	4,076	50,804	12,701
Impala	1,006	141	4,919	689
Klipspringer	29,509	1,770	22,879	1,373
Kudu	148,211	59,285	203,087	81,235
Mountain zebra	22,531	13,519	34,398	20,639
Nyala	-	-	96	19
Plains zebra	1,214	765	4,170	2,627
Reedbuck	-	-	2,303	322
Roan	-	-	633	380
Sable	-	-	6,804	2,722
Springbok	221,955	22,195	286,113	28,611
Steenbok	18,741	1,124	138,941	8,336
Tsessebe	-	-	1,564	422
Warthog	67,207	12,097	121,250	21,825
Miscellaneous***	5,293	1,164	12,514	2,753
Total	699,227	161,080	1,194,042	296,583
Number of species	16		23	

* Conservative estimates, assuming that densities of game on land of non-respondents was half those of respondents

** Large Stock Unit equivalents calculated using method of Meissner (1982)

*** Miscellaneous other species, dominated primarily by two species: ostrich and blesbok

3.2.4 Economic value of wildlife use

How is this change in conservation practice impacting upon the Namibian economy? That is, is this change in private land uses something from which the Namibian society is benefitting generally, or is it a trend that is motivated only by the interests of the private farmers? Table 5

shows the estimated contribution of all wildlife use on private land in terms of annual net value added to the National Income. This is provided for 1972 and 1992. Sub-estimates are also provided for the southern shrublands and the northern savannas. The total annual net contribution appears to have risen from some N$ 31 million to some N$ 56 million between 1972 and 1992. The portion attributable to the northern savannas was estimated to be consistently some 72 percent of this. The annual net value added per square kilometre was more than twice as high in the northern savannas than in the southern shrublands, despite the finding that wildlife in the south apparently contribute almost 60 percent more per LSU. Using the same method we estimated the net value added attributable to livestock on private land for 1972 and 1992. The estimates amounted to N$ 634 million and N$ 487 million respectively. In 1972 the economic value of wildlife use would have been 5 percent of the value of livestock production. In 1992 wildlife use would have had an economic value amounting to 12 percent of the value of livestock production.

Table 5: Estimation of the net contribution to the economy of wildlife use on private land in Namibia in 1972 and 1992 (N$ million, 1994)

Year	1972	1992
Northern, predominantly cattle producing land*		
Total number of properties	2,757	2,757
Total extent (square kilometres)	192,237	192,237
No. of wildlife Large Stock Unit (LSU) equivalents	129,980	242,318
Annual net value added to National Income per LSU	170	170
Total net value added due to wildlife use	22,096,600	41,194,060
Net value added by wildlife per square kilometre	115	214
Southern, predominantly sheep producing land**		
Total number of properties	1,703	1,703
Total extent (square kilometres)	164,650	164,650
No. of wildlife Large Stock Unit (LSU) equivalents	31,100	54,265
Annual net value added to National Income per LSU	275	275
Total net value added due to wildlife use	8,552,500	14,922,875
Net value added by wildlife per square kilometre	52	91
All private land		
Total number of properties	4,460	4,460
Total extent (square kilometres)	356,886	356,886
No. of wildlife Large Stock Unit (LSU) equivalents	161,080	296,583
Annual net value added to National Income per LSU	190	190
Total net value added due to wildlife use	30,649,100	56,116,935
Net value added by wildlife per square kilometre	85	157

* Land in following districts: Tsumeb, Grootfontein, Outjo, Otjiwarongo, Omaruru, Karibib, Okahandja, Windhoek and Gobabis

** Land in following districts: Mariental, Maltahöhe, Lüderitz, Bethanie, Keetmanshoop and Karasburg

3.3 The Impact of the Namibian Conservancy Movement - Conclusion

There can be no doubt that the adoption of Ordinance 31 in 1967 has changed the pattern of land use across Namibia and alterred the fate of wildlife on private lands. Once this property right structure was in place, the individual landowners had the incentive to consider the relative advantages of wildlife as a land use. As the models in this section make clear, there are financial incentives for landowners to consider wildlife as an option, once an adequate scale of operation is reached. The government's instigation of the conservancy movement has allowed these joint management incentives to be recognised, and now these financial incentives are driving the expansion of wildlife as a land use in Namibia. The impact of these incentives is apparent both in terms of conservation and economic contribution. The number of species and their populations on these lands have nearly doubled in the twenty years after the adoption of Ordinance 31. This sector is now making a substantial and still-expanding contribution to the Namibian economy, and it remains very early days.

3.4 The conservancy movement in Zimbabwe - further and future developments

It is interesting to contrast these early developments of mixed livestock and wildlife operations with the more broadly based developments occurring in another southern African country, i.e. Zimbabwe. This country followed the Namibian example in its adoption of the Parks and Wild Life Act of 1975. This Act confers the rights and responsibilities of wildlife stewardship upon land holders, abolishing state controls on hunting and all licence fees and quotas with regard to private lands. This Act also made provision for the establishment of conservation committees which could act jointly as the appropriate management authorities for their landholdings.

In Zimbabwe, the Lancaster House agreement dictated that no lands could be taken from existing owners after independence except under normal contractual conditions ("willing seller, willing buyer"). This clause of the agreement expired in 1990, however, and since that time there has been pressure on existing landowners to demonstrate first-best use of the land from the societal perspective. For this reason much pressure has been put on those private landholders with wildlife on their lands, as the government does not perceive this to be first-best land use in any regions other than the most arid in the country. There has been concern that wildlife ranching may be simply a ploy for masking under-utilised lands that should be subject to government's land reform policies. This is one further example of the sorts of land use conflicts with which wildlife policy is always faced (du Toit 1992; Gore et al. 1992).

Nevertheless, wildlife use on private landholdings is expanding in Zimbabwe even in the face of these pressures. This is being driven once again by the financial incentives for the use of wildlife rather than cattle. One recent study found that the financial return on wholly wildlife-based enterprises in the arid parts of the country were in the region of 12% compared with only

2% return on cattle-based enterprises in the same region. (Jansen, et. al. 1992). It is these clear financial incentives which are driving the change to wildlife in much of the arid regions of Zimbabwe.

An excellent case study is provided in the analysis of the alternative land uses to be made of Senuko ranch now within the Save Conservancy in southeastern Zimbabwe. Given the arid nature of the environment, the recommended stocking ratio is only about one head of cattle per 10-20 hectares. The details of the analysis are incorporated within Annex B as are the Conservancy's objectives and its constituency. The conclusion of the study is that the wildlife enterprise is capable of returning an 11 percent return on capital while the cattle enterprises were only returning a 1 percent return. (Price Waterhouse 1994). In addition the economic returns to wildlife are much greater than in the case of cattle ranching because wildlife-based enterprises: 1) spend much greater sums of money in the local economy; and, 2) employ far higher levels of labour in the operation. Needless to say, there is also the conservation benefits to be derived from moving from a monocultural operation to one based upon more than twenty different species (Table 6).

Table 6 Wildlife Demographic Scenarios on Senuko Ranch: Current and Possible

Species	Population (1993)	Growth rate	Target pop.	time lag
Rhino	9	.07	25	15
Zebra	150	.12	400	9
Warthog	20	.20	340	9
Giraffe	6	.08	125	24
Buffalo	38	.09	360	15
Wildebeest	150	.12	360	8
Tsessebe	0	.15	50	7
Duiker	200	.30	285	1
Klipspringer	25	.30	30	1
Impala	3000	.20	3400	1
Sable	0	.12	90	11
Kudu	800	.14	700	0
Nyala	0	.18	50	4
Bushbuck	15	.20	40	5
Eland	100	.09	200	8
Waterbuck	0	.13	45	5
Elephant	10		50	
Leopard	20	.15	30	3

Initially the purpose of introducing and conserving wildlife on the Senuko ranch was for the use of the game for sport hunting. Many landowners in the same area had begun focussing upon wildlife as an alternative land use. In 1991 the owner of Senuko ranch joined with twenty other land holders to form the Save Valley Conservancy. This conservancy comprises 326,000 hectares and is the largest privately owned nature reserve in the world; it is roughly equivalent in size to two of the countries' largest national reserves (Mana Pools National Park and Gonarezhou).

The initial motivation for the establishment of the conservancy was the receipt of about 25 black rhinoceros under Zimbabwe's relocation programme. This programme was established to move the rhino away from the most heavily pressured parks where government efforts at preventing poaching had been singularly unsuccessful. Shortly after the establishment of the conservancy, however, the land holders were presented with the stark choice between their remaining cattle and their incipient wildlife populations by reason of the 1991/2 drought. At this time the remaining cattle on the conservancy were entirely destocked and the emphasis for the entire land area was shifted to the exclusive use of wildlife.

The Save Valley Conservancy has thus changed the land use from an area of over 3200 square kilometres from livestock to wildlife in the space of a few short years. This is an area that had been dominated by wildlife species until the 1920s and in which cattle ranching was a highly unreliable productive activity. With the introduction of privatisation, the land owners were able to recognise the more valuable land uses and without any coercion (and in the face of some governmental opposition) they are re-instituting the former wildlife-based land use.

The activities of the Save Valley Conservancy since its commitment to wildlife-based use of the designated 3200 square kilometres include:

- erection of exterior game-proof electrical fencing along 300 km. boundary
- removal of internal fencing
- re-stocking of lands with wildlife species
- establishment of landholder-based quotas on wildlife use
- acquisition of and translocation of surplus elephant populations from Gonarezhou National Park
- establishment of Community Trust with royalty from operations channelled to local communities and commitment to local hiring
- establishment of public stock offering in Save Valley Corporation for the immediate re-stocking of lands for the establishment of tourism

The most recent development at Save Valley Conservancy has been the creation of the Save Valley Corporation: a public offering in the amount of Z$70 for the re-stocking of the conservancy area. This public offering prospectus estimates that the existing wildlife is valued at about the same amount, but that the doubling of the scale of the wildlife operation would allow its extension into other areas, especially viewing and tourism. As indicated in Table 6, the object of this offering is the development of a Park-like environment in a much shorter amount of time than would otherwise be required. Some of the big game species, so important for tourism, would require decades to develop (e.g. 24 years for giraffe and 15 for buffalo). The acquisition

of this capital would allow the conservancy to compete as a high quality eco-tourism experience in the very near future.

3.5 Conclusion: The Impact of the Southern African Conservancy Movement

Although the use values depended upon for the development of most of the conservancies across southern Africa have been highly consumptive in nature (primarily sport hunting), this need not remain the case. As land owners recognise that they are able to combine their land holdings not only to jointly manage game but also to jointly manage the entirety of their assets for the greatest value, much more of this sort of development will occur. This was indicated in the Namibian case studies as well, as the tourism/game lodge option was by far the most valuable financial option available in that country as well. (Tables 2 & 3 above) It is only a matter of a small amount of time before these incentives are working there as well. Conservancies can be expected to cater to a wide range of the direct use values for wildlife in southern Africa.

These developments are not making minor contributions to land use determinations within southern Africa. The Save Valley Conservancy represents approximately 1% of the entirety of the land area in Zimbabwe, 3% of all of the private landholdings. More importantly, this private initiative has at a single stroke increased the land area dedicated to wildlife use by 6%. As of 1990, the total amount of private land dedicated to wildlife use (in whole or part) was 28,000 sq. km. compared to 49,000 sq. km. of national protected areas. (Cumming 1990). More importantly, the former area continues to expand while the latter must be brought into question by reason of the land reform questions being raised throughout the region.

Table 7 The Impact of Privatisation on Land Use in Southern Africa (1990)

Country:	Botswana	Zimbabwe	Namibia	South Africa
Wildlife Area (Sq. Km.)				
Communal Lands	120,074	12,000	50,000	0
Private Lands	1,000	28,000	22,725	160,000
Protected Areas	103,953	49,418	107,125	56,500
Total Area	225,027	89,418	179,850	216,500
(per cent.)	37.5%	22.9%	21.8%	17.7%

Source: (Cumming 1990)

In short, the conservancy movement of southern Africa is transforming land use in that region, substituting private incentives for previously state-based determinations of land use. The financial incentives are there for both the provision of a solid foundation for existing wildlife

areas and also for the creation and expansion of others. This is one part of the world where sustainable development provides the most solid foundation for wildlife conservation.

4. Government Intervention in Wildlife Management

If market-based mechanisms are so successful at channelling the demand for wildlife, then what is the role of government in the regulation of this good? This question was first raised decades ago by a prominent free market economist, Milton Friedman, in an essay entitled: "Why Not Privatise the National Parks?" At that time he argued that most of the demands for parks and park-related goods and services (wildlife) could be supplied by means of various user charges (park entrance fees and the like). He could see no reason why the market could not provide a solid foundation for a mixed land system. The southern African conservancy movement has, to some extent, fulfilled his vision.

However, it is important to ask what roles, if any, remain for the public sector in the management of land use for wildlife. In the face of the current conservancy movement in southern Africa, it would seem that the burden of persuasion must be met by those opposed to private systems of wildlife regulation. In that region, it was the state-based regulatory system that sponsored the eradication of wildlife earlier this century while it is the market-based one that is re-introducing it to its former range. This seems very persuasive evidence of the relative efficacy of the two regimes. What reasons remain for the government to intervene - if private financial incentives are to be relied upon primarily for the formulation of wildlife management policy?

4.1 Government Interventions at the National Level

It is important for land use determinations to have solid economic foundations. This provides the basis for socially optimal allocations of land between alternative land uses. This is one of the most important functions of market-based wildlife policies in a region such as southern Africa: it substantiates the land use policy as one that is beneficial from society's perspective rather than a single segment thereof. Financial incentives drive land use toward that which is best able to capture the maximum value per hectare of land. In many cases, this will also be the most socially beneficial use of the land.

It is nevertheless important to recall that the social and the financial incentives are able to deviate from one another. The studies described in section two illustrated this fact when they demonstrated that the economic value of wildlife-based utilisation was even greater than the financial value. In these studies the differences between the social and the financial analyses concerned the costs of the factors of production: labour and capital. On account of other governmental policies (concerning employment, taxation and currency control), these factors of production were priced above their social costliness. For the most part, these differences between the financial and the economic values were even more supportive of wildlife utilisation scenarios being analysed (because wildlife utilisation is more labour intensive for example).

These models are indicative of the social value of wildlife utilisation but they cannot be exhaustive in their consideration of all of the non-internalised impacts of these land use decisions. Land use decisions have other social implications. For example, the decision concerning cattle versus wildlife can have very important implications for the sustainability of

the land use, on account of the greater erosion damage inflicted by livestock. (Child 1990) Much of the land in the arid regions of Zimbabwe has been severely degraded by reason of only a few decades of conversion to livestock. (Price Waterhouse 1994). Private analyses of land use decisions may, or may not, incorporate such long term considerations when comparing alternatives; this depends upon the landholder's time horizon. The same consideration occurs in respect to "exotic species": those not naturally present within the ecosystem. There may be financial incentives to introduce these species, but the social costliness of these decisions needs to be considered as well.

Another problem concerns the relative appropriability of the values that flow from various forms of land uses. Private markets must necessarily be primarily concerned with the direct use values of wildlife, as these are the ones that are most easily appropriated by the landowner. This does not mean that other values are less important or substantial. It is simply one case in which the financial incentives are likely to deviate from the social.

Privatisation not only does not create mechanisms for recognising these values, it is also likely that it will destroy some of the values flowing from wildlife. This is where the conflicts between privatisation and maximum valuation are introduced. Some non-use values are being lost even while more use values are being appropriated. For example, there are many people who would support an operation that does not focus wholly or even partially upon consumptive use. This was the import of the CSERGE study cited in section 2 wherein the support of rhino conservation declined with the consumptiveness of the conservation scheme. (Moran 1994). A wholly privatisation-based policy for wildlife utilisation would necessarily ignore many of the important values of wildlife, and it would potentially erase many others.

Therefore, the financial incentives inherent in a privatisation based approach to wildlife has fantastic advantages as a concrete land use allocation mechanism, but it also has predictable drawbacks. There is no reason why financial incentives need necessarily align themselves with that which is socially optimal, in the absence of carefully constructed governmental intervention for that purpose. These interventions must be tailored for the purpose of internalising the full social costliness of alternative land use decisions (e.g. the erosion costliness of cattle versus wildlife) and for encouraging the appropriation of the full social value of these uses.

The most complicated intervention required of governments which are attempting to use financial incentives for attaining social objectives concerns the encouragement of mechanisms for appropriating non-use values. This is not a simple task, as it requires the creation of mechanisms that channel values to landholders for the primary object of non-use. How is this possible? The Nature Conservancy in the U.S. provides an interesting example of such a mechanism. It was previously mentioned as the leading wildlife organisation in the U.S., contributions of US$85 million in 1990. This funding is used for one primary purpose - the purchase of the non-use rights in particular pieces of land. At present the US Conservancy holds approximately 1500 reserves for exclusively non-use purposes, totaling over 1 million acres. It has conservation easements (limiting the uses of the lands) in a further 8 million acres. This mechanism channelled US$180 million into endangered species programmes in the US between 1984 and 1986 alone; this was more than three times what the federal budget on the same item. (Edwards 1995).

How can a government foster such channels for non-use values? In a southern African country

6. Governmental Interventions - Land Use Conflicts

Interventions Required for Market Determined Optimal Land Uses:

- Remove distortions in the market prices of factors used and products produced in alternative land uses (agricultural subsidies, labour-based taxes)

- Introduce charges for the internalisation of the social costliness of alternative land uses (e.g. erosion cost internalisation, pesticide accumulation internalisation)

- Install mechanisms that allow for all ranges of values to register with landholders, not only the most direct forms of use (e.g. land banking and compensated zoning schemes)

the primary non-use values are going to flow from northern countries (i.e. North America and Europe). If a country is going to allow financial incentives to play a role in land use determination, it is important for that country to also invest in the creation of credible mechanisms for transferring non-use values across its boundaries. This could take the form of internationally monitored reserves established with international contributions, of the general form of the debt-for-nature agreements. (WCMC 1992). The important point is that this is an important channel that must be developed if a nation is to genuinely base its land use determinations in economic conditions.

In conclusion, financial incentives are an important keystone for building a sound land use policy but they cannot be assumed to generate most socially beneficial outcomes. In order to accomplish this, it is necessary for the government to intervene in order to correct for obvious policy and market failures. The former will require the correction of certain prices (through the removal of distortions and the introduction of charges) while the latter requires the creation of certain prices (through the encouragement of mechanisms that render non-use values appropriable). With these interventions, a land use policy based in privatisation is a sensible approach to defusing societal level conflicts regarding wildlife policy.

4.2 Government Interventions at the Conservancy Level

The other level at which government intervention is appropriate in the management of wildlife policy is in aid of the conservancy movement. The conservancy movement is a fundamentally important instrument for the internalisation of wildlife-generated externalities, and it is important for the attainment of economies of scale. The Namibian case studies illustrated only part of the important benefits rendered by reaching the correct scale of operation in the wildlife industries. These contracts between landowners are a fundamentally important ingredient in insuring that national land use decisions are made optimally.

The problem with any sort of joint management institution lies in the incentives to cheat on the others involved in the agreement. This so-called "tragedy of the commons" has undermined many other potentially useful management regimes. (Hardin 1966). The nub of the problem

lies in monitoring costliness. To the extent that individual monitoring is costly, there will be incentives to engage in harvesting greater than the individual's quota. When each individual within the regime recognises that there is slack in the monitoring mechanism, then the entire regime may collapse under the incentives to overexploitation.

The state is in an excellent position to prevent such tragedies. It may do so via mechanisms that aid the conservancy in the enforcement of its assigned quotas. The conservancy should have the correct incentives to create the optimal aggregate quota, and to assign it in an equitable fashion between them, but there will persist individual incentives to cheat on the conservancy's targets. The government can aid in this object through assistance provided in the monitoring of both stocks and flows of wildlife within the conservancy. (Swanson 1992).

The Namibian conservancy regulatory framework is an economist's ideal form of interface with such private joint management regimes. The Namibian conservancy monitors "flows" of wildlife by means of the requirement of the retention of a government-licensed guide for any trophy hunt. This means that an independent observor is required for each hunt on the conservancy property, and that the licensed guides have an incentive (in order to keep their licenses) to report truthfully to the government agencies. A limit on the number of licensed guides within the country will maintain the fee per hunt at a level that will make it more worthwhile for the guide to answer to the government than to the individual landholder. The "stocks" of wildlife are also monitored by the government through attendance at annual game surveys. These surveys are required of the conservancy in order to maintain its registration, and the state requires that one of its employees be in attendance. Such a system ensures that the survey is done in a fairly rigorous manner, so that any cheating on the system is able to be detected at an early stage.

7. Government Interventions - Conservancy Level

Government Intervention - Conservancies

"Flow Monitoring" - Provide a state representative to monitor the rate at which wildlife is being used consumptively by individual conservancy members. The Namibian conservancy regulations accomplish this by the requirement that any hunter be accompanied by a state-licensed guide. This guide has the incentive to report truthfully on the results of the hunt in order to retain his license and the right to earn future guide fees.

"Stock Monitoring" - Provide a state representative to monitor the stock of wildlife periodically. The Namibian conservancy regulations accomplish this by requiring annual game surveys attended by a member of the staff of the Namibian wildlife department.

Therefore, the state has an important role to fulfil in the assurance of credible monitoring structures within private joint management regimes. These monitoring structures must be subsidised if they are to be substantial enough to deter the individual incentives to cheat on joint management. This role will ensure that the optimal level of contracting can occur within an

economy, so that land uses may be allocated at the appropriate and efficient scales of operation. The conservancy regulations in Namibia provide an excellent example of an efficient level of government intervention for these purposes. (de Jager 1995).

4.3 The Interface between National and Local Governments

The preceding sections took for granted an institutional structure that does not exist throughout much of southern Africa, i.e. a national government with a responsive local government managing lands under a private property rights regime. Much of the land thoughout southern Africa is held communally, and it is likely that more such lands will be created through the reform process. In these areas land holding relies upon tribal governance and communal land use, not private property rights.

This difference could be perceived as either an opportunity or an obstacle. It could be seen as an obstacle to the extent that the absence of private property rights removes the individual-based incentives for ascertaining the first best uses of the lands. It could be seen as an opportunity in that the communal landholdings creates the wide-ranging general contractual arrangement that is required to enable the best use of the lands as an aggregate. On the one hand, private property rights cause individuals to be more attuned to the signals that the market provides regarding optimal land uses; on the other, private property rights break the lands down into discrete units that seldom conform to the correct scale or nature of the optimal land use. Communal landholdings enable all possible scales of land uses to be considered, but obscure somewhat the incentives for pursuing them.

These problems with alternative local management structures may be overcome with minor investments in research by the central government. The greater problem originating from local structures hearkens back to the problems mentioned in the initial sections of this paper. In short, governance systems often develop their power base upon a particular set of resources, and it is the resistance to alterations in the governance system itself that generates the inertia around a given set of natural resources. In southern Africa, tribal traditions and structures are often founded upon cattle as the unit of currency, and many of the informal norms and mores of such local governance structures use cattle as the stated unit of exchange. Concern over the impact of alterring so fundamental component of the system as the currency unit may impede changes to alternative resource bases.

The central government must also recognise that alternative management structures carry with them alternative units of exchange. These governance structures must not only be informed of the relatively enhanced value of alternative methods of investment, it will also be necessary to assist in setting up the revised methods of taxation and benefit sharing within such societies. It will not be enough to simply demonstrate that aggregate wealth will increase through the use of alternative species. It will also be necessary to demonstrate that the current rights-holders will have a system of rights and authorities by which they will themselves be able to enhance their rate of appropriation (for example, through the vesting of local taxing authority within the existing chieftaincy, and the demonstration of the expected flow of revenues from uses such as tourism). To enable optimal land use changes to occur where local governance structures are variable, the central government must inform the existing power structure about both the alternative economic and governance structures.

5. Conclusion: Conflicts in Wildlife Management

Wildlife management has always taken place within the context of conflict - over land use and now increasingly over the use to be made of the wildlife itself. In an area such as southern Africa these conflicts are currently right at the centre of the debate about the future of these nations and their lands. It is fundamentally important that the land use allocation mechanism function in these places be seen to operate in a fair and socially beneficial manner. For this reason, a market-based approach to land use allocation has much to commend itself. Financial incentives regarding land use are often good guides to what is the most socially beneficial use of those resources, and there is little reason to believe {\it a priori} that market-based mechanisms (unlike political ones) will systematically favour one constitutencies' interests over anothers'. This market-based approach to wildlife conservation in southern Africa makes a lot sense as a relatively calm and rational manner for resolving some otherwise potentially explosive conflicts.

It remains important to recognise that the market-based approach to wildlife cannot ensure the attainment of socially beneficial outcomes, unless government intervention is carefully attuned to that purpose. Financial incentives need not match up with economic ones. In order to accomplish this, it remains important to create instruments that charge for discrepancies (e.g. regarding exotic species or erosion damages). These externalities to the individual landholder's decision making process must be addressed by the government, if that individual's decision is going to be made properly on behalf of society.

Another means by which externalities are internalised is through contracting between individual landowners. This is the driving force behind the conservancy movement, and it is an important movement to sustain. The government must once again intervene to keep such joint management regimes afloat; otherwise, the costs of monitoring are likely to lead to another tragedy of the commons. The Namibian government has devised a model scheme of intervention for its conservancy movement, by aiding in the monitoring of both individual and aggregate use of the conservancy's resources.

Finally, it must be remembered that financial incentives will not usually be independent of the management structure being applied to those lands. The optimal combination of species and management structures requires that both be varied. People will pay more for certain species managed under certain regimes. Optimal land use will require that individuals and communities be encourage to entertain the idea of alternative land use under existing management structures, but also the possibility of dramatically changing the existing management structures together with the land uses. Financial incentives will sometimes generate dynamic thinking regarding management structures (as is the case in the development of large scale conservancies in Namibia) but it is also important that this information is disseminated by government.

In conclusion, the conservancy movement in southern Africa represents one of the most dynamic and hopeful trends in wildlife management currently taking place. Southern Africa is probably the only region on earth that is currently expanding the amount of habitat that is available to wildlife species on a significant scale. It is interesting that this movement is occurring in an area that has abandoned traditional wildlife management practices in favour of a market-based approach. Here, the forces for development are encouraging the adoption of more wildlife-based uses of land. This does not mean that government regulation of wildlife is not necessary here,

or elsewhere, but it does indicate that the traditional forms of wildlife policies (''protected areas'' and ''res nullius'') require a complete rethink.

6. References

Barnes,J. and de Jager,J. 1995. "Economic and financial incentives for wildlife use on private land in Namibia", mimeo.

Bond,I. 1993. "The Economics of Wildlife and Land Use in Zimbabwe", WWF Multispecies Project:Harare.

Brown,K., Pearce,D., Perrings,C. and Swanson,T. 1993. Economics and the Conservation of Global Biodiversity, GEF Discussion Paper.

Cumming, D. 1990. "Developments in Game Ranching and Wildlife Utilisation in Southern Africa", Project Paper no. 13, WWF Multi-Species Project:Harare.

Dean,P. 1990. "Game Ranching in Zimbabwe", Zimbabwe Agricultural Sector Memorandum, World Bank:Washington.

Edwards,V. 1995. Dealing in Diversity, Cambridge University Press:Cambridge.

Gore,C., Katerere,Y. and Moyo,S. 1992. "The Case for Sustainable Development in Zimbabwe", ENDA/ZERO:Harare.

Hanna,S. and Munasinghe,M. 1995. Property Rights and the Environment, The World Bank:Washington.

Hardin,G. 1968. "The Tragedy of the Commons", reprinted in Dorfman and Dorfman, (eds.) Economics of the Environment, Collins:New York.

de Jager,J. 1995. "The Establishment and Operation of Conservancies in Namibia", mimeo.

de Jager,J. 1994. "A Community Based Natural Resource Management Programme in Namibia as Implemented through the Namibian Conservancy Concept", mimeo.

Jansen,D., Child,B. and Bond,I. 1992. "Cattle, Wildlife, Neither or Both", WWF Multispecies Project:Harare.

Joubert,E. Brand,P., and Visagie,G. 1983. "An Appraisal of the utilisation of game on private land in South West Africa", Madoqua, v. 13, n. 3, p. 197.

Ostrom,O. 1992. Governing the Commons, Cambridge University Press:Cambridge.

Pearce,D. 1991. "Economic Approach to Saving Tropical Forests", in Helm,D. Economic Approach to Environmental Policy, Blackwell:Oxford.

Price Waterhouse 1994. The Lowveld Conservancies: New Opportunities for Productive and Sustainable Land Use, Report to the Save Conservancy, 15 July 1994.

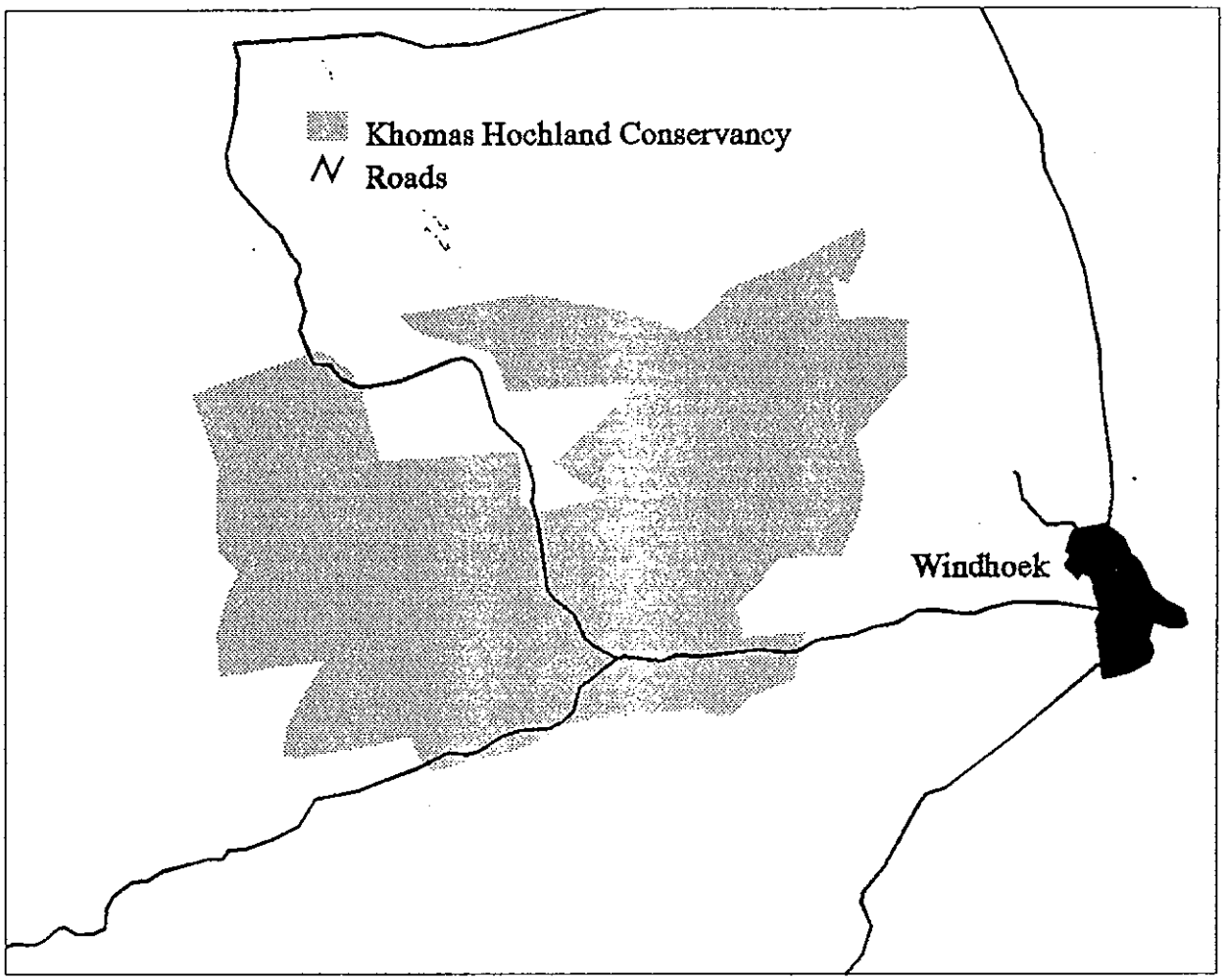
Swanson,T. 1992. "Sustainable Use of Wildlife", in Swanson and Barbier, (eds.), Economics for the Wilds, Earthscan:London.

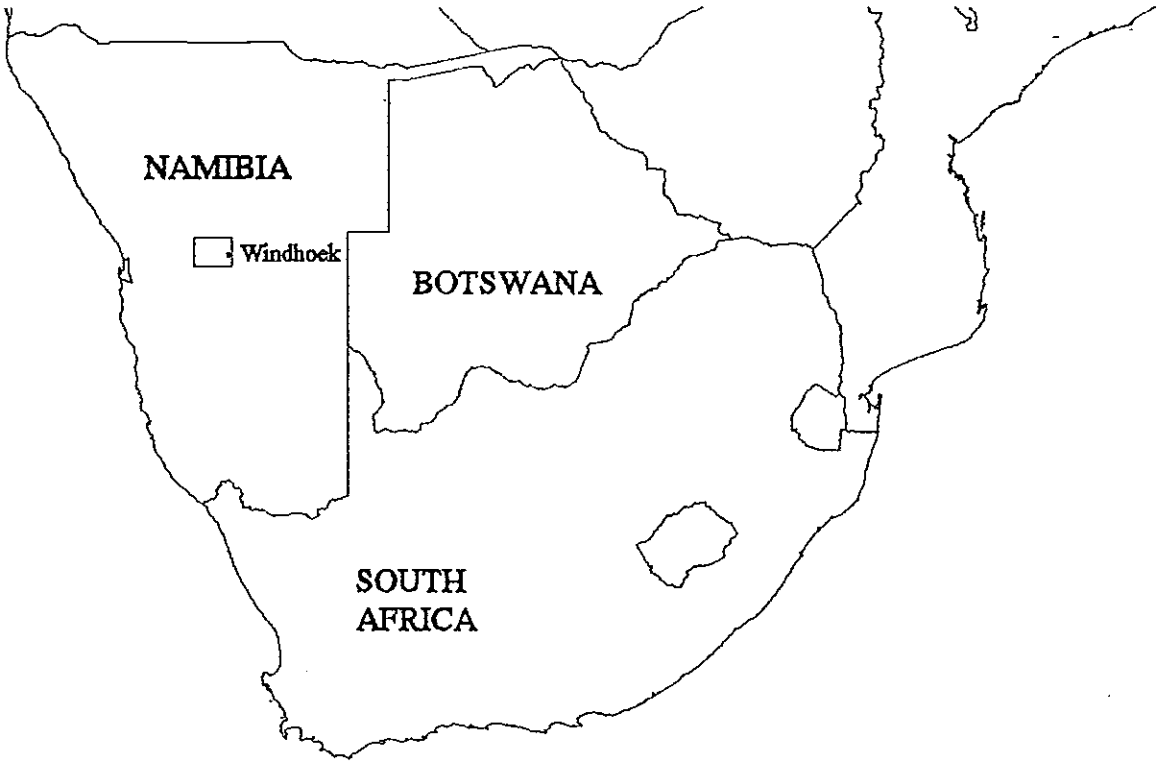
du Toit,R. 1992. "Large Scale Wildlife Conservancies in Zimbabwe", in van Hoven, et. al. (eds.), Wildlife Ranching: A Celebration of Diversity, So. African Game Organisation:Pretoria.

WCMC, 1992. Global Biodiversity, Chapman & Hall:London.

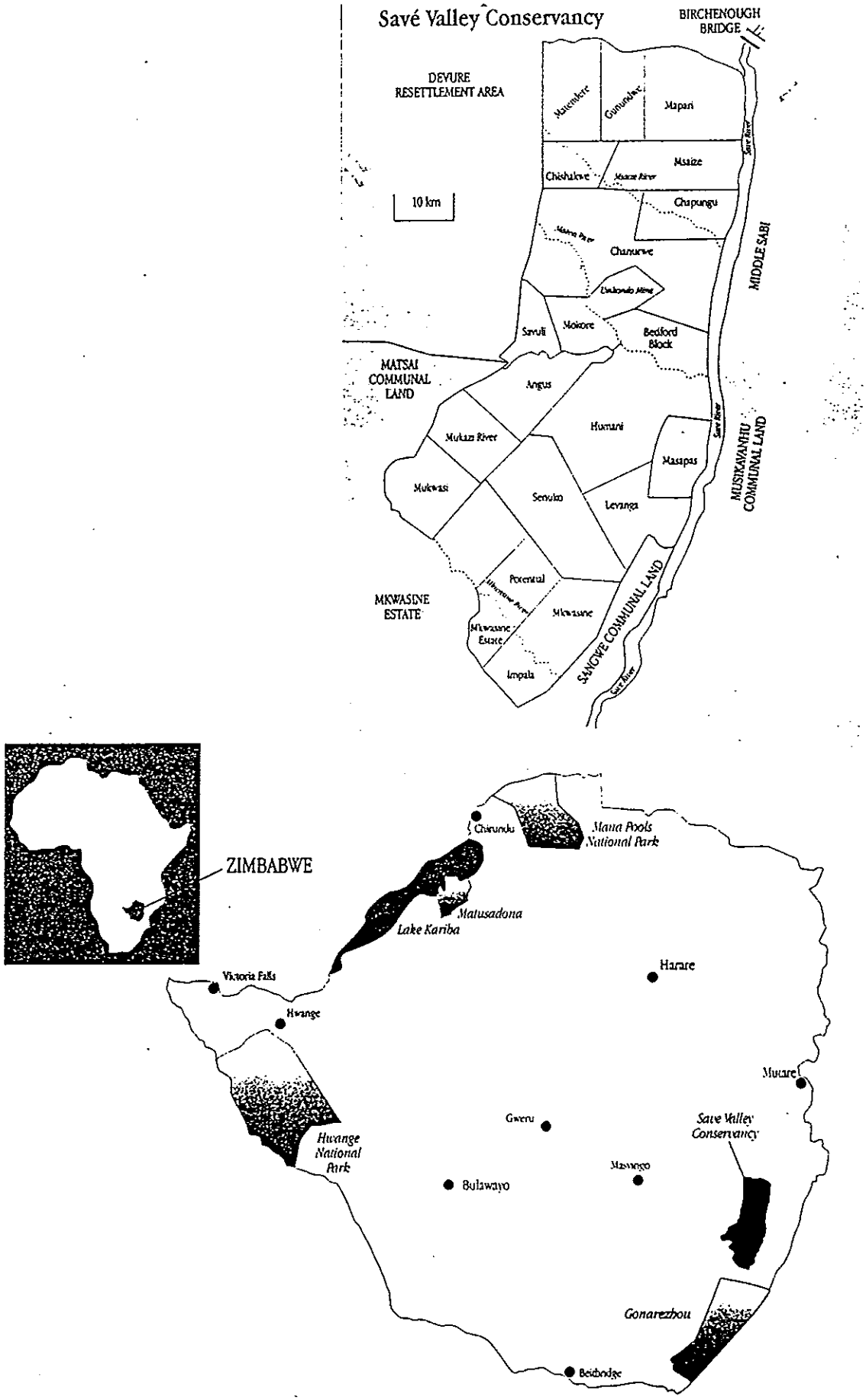
Young,M. and McCay,B. 1995. "Building Equity, Stewardship, and Resilience into Market-Based Property Rights Systems", in Hanna,S. and Munasinghe,M. 1995. Property Rights and the Environment, The World Bank:Washington.

Map 1. Plan of the Khomas Hochland Conservancy





Map 2. Zimbabwe, showing the Savé Valley Conservancy



4

The Crocodile Industry in Papua New Guinea

Carlos Fernandez and Richard Luxmoore

Table of contents

Acknowledgement

1 Introduction

2 Development of the management system
- 2.1 The Skin Marketing Service
- 2.2 The Ranching programme
- 2.3 The structure of trade in crocodiles and crocodile products
- 2.4 Farms/ranches
- 2.5 Trade in live crocodiles
- 2.6 Other sources of stock
  - 2.6.1 Captive breeding
  - 2.6.1 Egg harvests

3 International trade

4 Effectiveness of the management programme
- 4.1 Biological information
- 4.2 Economic information
- 4.3 Harvest controls
- 4.4 Funding sources

5 Hunter's incentives
- 5.1 Selective hunting
- 5.2 Protection of breeding nests
- 5.3 Restraint in skin harvests

6 Illegal trade

7 Conclusions

8 Implications for sustainable use of wildlife

Appendix
- A.1 Exporters/farms in PNG
- A.2 Selectivity coefficient
- A.3 Abbreviations used

Acknowledgements

This study would not have been possible without the various people and institutions who invested their time and resources; we are greatly indebted with them. In particular we wish to thank the Department of Environment and Conservation in Papua New Guinea, in particular to John Wilmot and Godfried Solmu.

We also want to thank Paul Stobbs, manager of Mainland Holdings Pty, Greg Mitchell, manager of Bush Development Pty, and Martin Hollands.

1 Introduction

There are two species of crocodiles occurring in PNG, one endemic freshwater crocodile, *Crocodylus novaeguineae* and the saltwater crocodile, *Crocodylus porosus*. Their habitat extends through most of the lowlands of the main PNG landmass, and *C. porosus* is believed to be the only species in the offshore islands (see Map 1 and Genolagani and Wilmot 1990). Prior to European contact, in the areas where crocodiles were plentiful the native people hunted them for food, with the eggs and younger population most heavily used (Downes 1971). Commercial shooting of crocodiles in PNG started in the mid 1950s, in particular, uncontrolled shooting of saltwater crocodiles from upwards of 150 cm in length, which over the period 1955-60 greatly reduced the adult population. This decline in saltwater crocodiles was followed soon after by increased hunting of the less valuable freshwater crocodiles (Downes 1971).

After the hunting peak of 1965-6, a management programme and legislation was introduced to maintain the crocodile populations and manage the skin trade. In 1968 a management system was introduced, which included a system of licences for hunters, traders and exporters and a ban on trade in large skins. The development of ranching operations was also encouraged, particularly through the support of an FAO project in the late 1970s, with a view to increasing the value of PNG's exports and reducing pressure on the wild population. However, the small village farms failed to meet the expectations and it was decided to move towards more efficiently managed, larger farms. Since then, the legislation has allowed for ranching.

Both populations of crocodiles in PNG are listed in Appendix II of CITES, which allows a controlled export trade. All other populations of *C. porosus* were listed in Appendix I of CITES, but PNG's population was retained in Appendix II in view of its relatively large remaining population and of the potential conservation benefits of management. The management programme in PNG has, from the start, had two objectives: on the one hand, the conservation of wildlife and, on the other, the improvement of the welfare of the communities dependent on such resources. In this report, we assess the achievement of these objectives and whether the current programme meets its early expectations as well as the future challenges for the industry.

2 Development of the management system

As a result of the heavy uncontrolled exploitation, by the late 1960s, the lack of skins had forced most Europeans out of the crocodile skin market, with few remaining as traders. During the early 1970s the trading structures were dismantled as trading co-operatives failed and skin buying societies experienced financial difficulties (Downes 1971). By 1973, the market was composed of native hunters with limited skills in skin preservation and expatriate traders who only reentered the trade in periods of high prices (see Figure 1).

Hollands (1987) identified four major problems in the industry at that time: overexploitation of both crocodile species reflected in the low average size of skins exported and the lower production; hunters targeted the remaining large breeding stock, greatly affecting the regeneration potential of the species; village hunters with limited market power; and poor international marketing, with most skins being shipped to trading houses in Singapore. These concerns shaped the efforts to manage the industry and, in 1966, the Crocodile Trade Ordinance

was enacted and later expanded to the Crocodile Trade (Protection) Act.

From the outset, it was believed that effective control of the hunters by the authorities would be impossible to achieve, given the extreme isolation of many rural communities. Instead, it was believed that by controlling the intermediate stages of the industry, namely, the traders and exporters, would affect hunters' behaviour in a positive way. At the hunter level, the legislation recognised the traditional system of landownership and granted the landowner the right to kill any crocodile on his land. Landownership in PNG is largely defined through a customary use system, and no effective central control exists over property rights in most of the crocodile habitat areas. Legal changes were therefore directed towards increasing the Papua New Guinean involvement in the intermediate stages of the industry and making it more accountable for the state of the wild population.

Would-be traders were expected to comply with some residency requirements as a means of promoting local participation in the industry. Trading licences were issued for particular local or council areas, with no limit on the number of licences in one particular area. This was expected to provide a greater commitment on behalf of the trader to maintain the local crocodile population than the old system of itinerant traders and at the same time allow for some competition among traders. Exporters were also required to have a licence and, together with traders, were required to provide periodic reports on their activities to the Management Authority. Export applications had to be submitted and approved prior to any skin being exported. So far, this has provided most of the baseline data for the industry and the level of wild harvests. This system was later expanded to comply with CITES, ratified by PNG in 1981.

A maximum size limit on skins was also imposed in order to provide some protection to the large animals comprising the breeding population. The restriction did not apply to hunting but to trading the skin. The limit of 20" (51 cm) was set to prevent harvests of breeders, but the southern race of *C. novaeguineae* is now known to breed at a considerably smaller size (Hollands 1987). A control on small size skins was initially seen as unnecessary due to their low price (Downes 1971). However, by 1981 a ban on skins of less than 7" (18 cm) was imposed to further encourage the small crocodiles to be either kept in the remaining village farms or sold to the larger farms. Legislative powers were also obtained by the Management Authority to impose quotas, close seasons or bans on the trade, but none of these has been used so far, and hence, their effectiveness has not been tested, a consideration that will be discussed below.

2.1 The skin marketing service

Given the need to increase the size and quality of the skins being exported, the government intervened directly at all levels of industry, not only through the regulatory system, but also through direct involvement as a trader and provider of extension services. One such channel of intervention was the Skin Marketing Service (SMS), a programme established in 1976 as part of the Government/FAO/UNDP project, whose primary aim was to provide better prices to rural communities and promote better trading practices. Among the objectives of the SMS were:

To promote competition among traders by directly purchasing skins from villagers at very competitive prices. It was targeted primarily at remote areas of the country where competition among traders would be lower. Once a minimum load was collected, a charter flight would collect the skins from the villages. Skins were also purchased by the Government stations.

Overall, it is estimated that the Skin Marketing Service handled up to 20 percent of exported skins (Hollands 1987). The programme was launched with a 50,000 K (US $68,000) grant to purchase skins from national crocodile buyers at the highest possible price landed in Port Moresby.

Establish direct trading contacts with tanneries worldwide to gain better access and prices for PNG's skins. Given the existing inefficiencies in trading routes, the SMS was able to quickly establish better alternatives and maintain support for its pricing policy in the rural areas. Singapore diminished in importance as trading centre and skins were exported mainly to tanneries in Japan and France. The move away from trading houses proved to be permanent, as the evolving regulated industry has taken advantage of the links initially developed by the SMS.

Other activities where the SMS was to be involved were the monitoring of world markets, improved shipment methods and the standardisation of the grading system.

2.2 The Ranching programme

Of particular concern for the Management Authority was the seemingly excessive killing of small animals, which was considered wasteful given the low value that they fetched in the world market. This gave rise to the idea of promoting a ranching programme to allow the crocodiles to increase in size prior to killing them while keeping a market for the smaller size animals at better prices than they would command as skins. Initial hopes were also centred on the idea that as effort would be greater in catching live crocodiles, the total crop would probably fall. Furthermore, the reduction in the average age of the crop would be beneficial to the wild population and allow recovery to take place (Hollands 1987).

The main launching pad for the programme was through the Government/FAO/UNDP project established in 1978. The long-term aims of the programme were (Papua New Guinea Government/UNDP/FAO 1978):

a) to retain all the small animals currently being exported as skins at a fraction of their potential value and to keep them alive in rearing pens until they reach their optimal value and,

b) to transfer the harvest of crocodiles from the adult breeding sector to an expendable portion of annual production of young.

The programme sought to create a large network of small-scale rural farms where villagers would keep crocodiles. The project provided technical assistance in husbandry, set up various demonstration farms and encouraged the establishment of small farms.

The initial response to the programme was extremely favourable, and patterns of harvest seem to have been affected by the initial efforts to stock the crocodile farms (Figure 1). Average size of harvest fell significantly in both species as effort was diverted initially towards stocking the village farms. By the end of 1978, there were some 200 Village farms, 9 small business farms and 23 community farms.

Despite this encouraging response, the programme soon faced serious difficulties. Some of the

villages could not provide adequate feed for the crocodiles while others could not adequately manage and administer the farms. It was estimated that only 15 percent of village farms were reasonably successful for more than one season. Hence, the decision was taken to allow larger and more efficient farms to be established in order to capture the live animal trade, boosted by the village farms, and to serve as back-up for the disappearing rural farms. Specific guidelines were drafted for the operation of such farms to ensure compatibility with management objectives. These guidelines included (Anonymous 1978) the following restrictions:

> Widespread operations. The farm was to ensure a wide area of supply to avoid excessive harvesting in a single area.
>
> Extension work. Technical and financial assistance had to be provided by the farms to the village to build and manage holding pens.
>
> National industry. Papua New Guineans only were to be involved as company buyers, and the farm to have a maximum of 49 percent foreign equity.
>
> Back up system. Commit to purchase all stock from farmers in difficulties.
>
> Accountability. The farms were to produce a detailed plan of the farm, a detailed report of operations and economic data after five years.
>
> Regulation. It was also established that the Management Authority would have full powers to set maximum limits in either the number of crocodiles to be bought in each area, year or to be kept in stock. However, this has not yet been applied.

The two initial large-scale farms were created around PNG's main poultry operations (Mainland Holdings Pty and Illimo Poultry Products Pty). During the early years of the farms there were large movements of live crocodiles as rural farms rapidly took advantage of selling their live stock to the farms (Hollands 1987) as can be seen from Table 1.

As the system was heavily subsidised (up to 40 percent of export value according to Hollands (1987)), most of the farms either closed or reduced activity once the funding from the FAO/UNDP project came to an end in 1982. Following the collapse of the demonstration farms, the large-scale farms had difficulty ensuring an adequate supply. However, trade directly to the large farms recovered rapidly in the subsequent years, partly due to the new regulation in 1981, which imposed a ban on trade in skins with less than 7" (18 cm) belly-width.

Table 1. Live Purchases by Major Ranches and farms in PNG

Year	*C. novaeguineae*	*C. porosus*	Total
1979	3,958	974	4,932
1980	7,669	2,141	9,810
1981	8,118	2,178	10,296
1982	8,602	2,799	11,401
1983	2,518	1,901	4,419
1984	3,329	1,469	4,798
1985	6,010	4,025	10,035
1986	6,531	5,310	11,841
1987	9,464	3,701	13,165
1988	5,500	4,300	9,800
1989	4,500	3,300	7,800
1990	1,000	200	1,200
1991	10,000	5,400	15,400
1992	9,624	1,127	10,751
1993	3,289	3,660	6,321
1994 /1	2,185	2,888	5,073

/1 Data for Mainland Holding during only three quarters of 1994

Source: Hollands (1987), Solmu (1994), Department of Environment and Conservation, PNG.

2.3 The structure of trade in crocodiles and crocodile products

After the major restructuring, shifting from uncontrolled hunting to village farming, the industry has now consolidated into a system of both hunting of wild animals for skins, and trapping of live animals for the large farms, where skins and live crocodiles often share the same marketing channels.

Crocodiles are hunted/trapped by individual hunters. They then sell their live crocodiles and skins to registered traders (normally one member of the village in villages close to collecting points) who then takes the skins and live crocodiles to the collecting town. It is difficult to ascertain the amount or rents accruing to registered traders. Skin prices to unregistered hunters seem to lie some 20 percent below traders' prices. With live crocodiles, registered traders are generally responsible for the maintenance of the holding pens (some of them built under government programmes) and provide the food for them until final sale. The price paid by traders to hunters for live crocodiles seems to lie around

50 percent below the price paid by the farms.[1] Skins are only salted prior to sale to traders and company buyers. Treatment prior to tanning is critical in the final quality of the skin and salt, a key input to preserve the skin, is traded using the same market links as those used for selling crocodiles and skins. Overall processing costs per skin would include labour and salt cost. It is estimated that a medium sized skin would need around 2kg. of salt, costing around 2 Kina.

Table 2. Annual licence fees for various agents in the industry

Type of Licence	Fee in kinas
Trader	20
Company buyer	50
Farm	200
Exporter	200

Source: Department of the Environment and Conservation, PNG.

Unlike the regulations in force in the early 1970s which required only a hunter's licence, the current licensing scheme requires separate licences for traders, company buyers, farms and exporters, with hunters being unregistered. Licences are renewed annually for a fee (see Table 2). Company buyers can only buy from registered traders, but a registered trader can buy from anyone in the area for which he is given the licence. In practice, many traders are simply one member of the community who administers the local holding pen and who takes the live crocodiles and skins to the collecting points. The fees are not the only barrier to entry: there are also the additional costs involved in active trading, such as transport cost and working capital for the purchase of the skins.[2] For this reason, some traders are also shop owners in the villages and trader density appears to be smaller in the more remote areas of the country, where only a few can afford the trip to the collection points. This is also reflected at province level, where trader activity concentrates around three provinces in PNG, the East Sepik, Gulf and Western provinces (see Table 3). Company buyers are generally attached to single farms/export companies.

[1] These quotes on price mark-ups should be taken as indicative only as they were derived from a limited number of interviews in the villages around Ambunti and may not represent the situation in other more remote areas of the country.

[2] There seems to be a floating number of inactive traders who buy a licence but do not use it, or at least whose activities are not recorded by the management authority. This behaviour may be due to speculative behaviour awaiting better prices, to failing traders or to the reported 'status' value of the crocodile trader licences (Greg Mitchell pers. comm.).

Table 3. Traders licences issued by Province

Province	1992	1993	1994	1995
East Sepik	23	21	9	18
Gulf		8	8	16
Western	24	32	32	40
Central		2		2
Oro		1		1
Madang		2	7	
Milne Bay			1	1
New Ireland		2	1	
Manus			1	1
N.C.D		1		
Sandaun		4	1	5

Note: records are incomplete and are only indicative of relative shares.

Source: Department of Environment and Conservation.

2.4 Farms/ranches

After the ending of the FAO/UNDP project, several large-scale commercial farms were established and expectations were that farming would eventually dominate wild skin trade. From their initial stock of 5,000 in 1978, stocks grew to 42,500 crocodiles in Mainland Holdings alone (Staton et al.1990). This, however, has not been sufficient to replace the trade in wild skins as expected. Moreover, commercial pressures in the last few years have forced some of them out of business or to scale down their level of operations. By 1994, the stock of crocodiles in all remaining farms in 1994 had reduced to 38,000 (Solmu 1994).

The concentration of the ranching industry has continued to a point where the major farming operation, Mainland Holdings Pty, held 85 percent of all saltwater crocodiles (*C. porosus*) and 82 percent of all freshwater crocodiles (*C. novaeguineae*) in stock in PNG farms in 1994 (see Table 4).

Table 4. Crocodile Stocks on Farms in PNG, 1994

Farm	*C. porosus*	*C. novaeguineae*	Total
Mainland Holdings, Lae	13,800	18,454	32,254
Geoffrey Ling, Kimbe	308	0	308
Illimo Farm, Port Moresby	513	1,307	1,820
Madang Crocodile Farm	130	1,200	1,330
Maningulai Imports/Exports, Angoram	206	853	1,059
Sita Crocodile Farm, Daru	692	630	1,322
Total	15,649	22,444	38,093

Source: Reproduced from Solmu (1994)

Table 5. Provincial share of supplies of live crocodiles for Mainland Holdings (%)

	Captive Breeding	Province						
		E. Sepik	Gulf	Madang	Morobe	Oro	New Britain	Western
C. novaeguineae								
1993	-	70.87	6.31	5.08	0.19	-	-	17.55
1994 /1	-	83.07	11.03	5.54	0.37	-	-	-
C. porosus								
1993	4.4	56.61	13.85	7.41	5.45	4.61	2.38	5.25
1994 / 1	49.12	34.51	8.85	3.15	1.27	1.11	1.99	-

Source: Mainland Holdings quarterly reports.
/ 1 1994 includes only data for three quarters.

Note: Sums may not add up to 100 due to rounding.

At the provincial level, trade has also concentrated in a few provinces. As can be seen from data for Mainland Holding presented in Table 5, its purchases concentrate around the New Guinea Region, and particularly around the Sepik region. In 1993, more than 75 percent of live purchases originated in the New Guinea Region, with 70 percent in the East Sepik alone. By 1994, this proportion rose to almost 89 percent from the New Guinea region of which 83 percent were from the Sepik in the case of the *C. novaeguineae*. For

the saltwater crocodile *C. porosus*, the supplies from Mainlands' own breeding farm overshadowed the live wild purchases. These figures are expected to reflect national trade from all farms, given that the level of operations of Mainland Holdings is by far the largest and also that only two of the six farms are located in the Papua region (Sita Crocodile Farm and Illimo Farm). This concentration of live trade activity in a single region appears to have had important implications for the hunting patterns across the country as will be discussed below.

2.5 Trade in live crocodiles

Trade in live crocodiles was initially encouraged by the ban on all trade in skins of less than 7"(18 cm) belly width which, as noted, started to have an effect by the mid 1980s. Another way to encourage trade has been through the pricing policy of the farms, which not only has significantly increased the value of small crocodiles, but has provided a more stable source of income to the villages where live trade is active.

Prices for wild skins are determined according to the species, belly width, and the quality of the skin (generally a scale of three grades). In contrast, prices for live crocodiles are estimated by length but there is no standardised grading. Skins can easily degrade within 4-5 weeks under village storage and treatment conditions, whereas live crocodiles can be kept for longer without much depreciation and, therefore, are a safer investment. By converting the average length into an average belly width using farm data it is possible to convert the price per live crocodile into price per skin equivalent[3]. Table 6 presents the prices of live crocodiles relative to the estimated price for their skins. The higher the value, the more profitable it would be to sell the crocodiles alive. Points worth noting from this table are:

1 relative prices for live animals are significantly higher if they have poor quality skins;

2 relative prices for live *C. porosus* are generally better than for *C. novaeguineae*; and,

3 there has been a general fall in the relative price of live crocodiles between 1991-4.

The fact that crocodiles with damaged skins are worth more alive than skinned (1) is also reflected by the high proportion of grade I composition of skins reaching the markets. Notice also the sharp decline in prices for live freshwater crocodiles between 1991 and 1994 as a result of the farm's attempt to increase the proportion of *C. porosus* in their stock (Figure 2-3). The increase in the share of grade I and grade II wild skin exports in 1994 illustrates how trade in live freshwater animals was substituted for freshwater skins as the relative price of live freshwater crocodiles deteriorated.

[3] Data used for the conversion is based on farm results from Lake Murray, quoted in Bolton (1989). The final regressions used were $BW_{fresh} = -4.6708 + 0.27407 * L_{fresh}$ ($R^2 = 0.985$) and $BW_{salt} = -2.7588 + 0.25033 * L_{salt}$ ($R^2 = 0.987$) $, where BW is belly width and L length, both in centimetres.

Table 6. Relative prices of live crocodiles versus skins according to grade and species in 1991 and 1994, (price of live / price of skin)

	Grade I		Grade II		Grade III	
	1991	1994	1991	1994	1991	1994
Crocodylus novaeguineae						
% of trade in wild skins between 18-29cm	**63.0**	**61.0**	**13.0**	**25.0**	**12.0**	**14.0**
Skin size equivalent (cm belly-width)						
18	5.0	2.3	6.7	3.5	10.0	14.0
19	4.3	2.3	5.4	3.2	8.6	8.0
20	3.6	2.0	4.8	2.7	7.2	4.0
21	3.4	1.8	4.4	2.6	6.9	3.6
22	2.0	0.8	2.6	1.2	3.9	2.0
23	1.8	0.8	2.4	1.1	3.7	1.8
24	2.0	0.8	2.6	1.2	3.9	1.8
25	-	8.8	-	1.2	-	1.9
26	-	0.3	-	0.5	-	0.7
27	-	0.3	-	0.5	-	0.7
28	-	0.3	-	0.5	-	0.8
29	-	0.3	-	0.5	-	0.7
Crocodylus porosus						
% of trade in wild skins between 18-29cm	**75.0**	**67.0**	**14.0**	**18.0**	**10.0**	**16.0**
18	6.6	4.1	8.8	6.6	13.3	13.3
19	5.3	3.8	6.6	5.3	10.6	10.6
20	4.7	3.5	6.2	5.1	9.3	9.3
21	4.2	3.3	5.4	4.9	8.4	8.4
22	1.6	1.3	2.2	1.9	3.3	3.3
23	1.3	1.4	1.8	2.1	2.6	3.3
24	1.2	1.5	1.6	2.2	2.4	3.5
25	-	1.5	-	2.2	-	3.5
26	-	0.6	-	0.9	-	1.3
27	-	0.6	-	0.9	-	1.3
28	-	-	-	-	-	-
29	-	-	-	-	-	-

Source: Department of Wildlife and Conservation, PNG.

Prior to 1991, Mainland Holdings had no restrictions on the crocodiles bought. However, the sharp drop in crocodile skin world prices in 1992 forced them to make adjustments in both prices and purchasing conditions. The changes have been primarily directed to (a) increase the survival rate of purchased stock and (b) increase the proportion of *C. porosus* in the farm in anticipation of further instability in the market for *C. novaeguineae*. Development in the breeding farm has also been part of this strategy.

Both the pricing policy and the purchase conditions are being set by Mainland without government intervention, as used to be the case in the early years of the programme. These conditions are only gradually having an impact on hunters' behaviour and so Mainland Holdings have a policy of accepting all consignments from first time traders who may not have been aware of the conditions.

2.6 Other sources of stock

Although the management programme in PNG has always placed a strong emphasis on ranching, captive breeding and wild egg collection programmes which have always complemented the supply of live wild crocodiles to the major farms.

2.6.1 Captive breeding

Only the two major farms (Mainland Holdings and Illimo Farm) maintain breeding populations of *C. porosus*. In 1988, breeders at Mainland Holdings produced 1,500 eggs and by 1989, they produced 2,500 (Staton et al.1990). These quantities more than double the number of eggs collected from the wild and purchased by Mainland Holdings.

At present, Mainland Holdings stocks around 400 breeders (3:1 female/male ratio) of *C. porosus* in pens next to the main farm. It is unclear why Mainland Holdings not switching completely to a full captive breeding operation, since operating cost per live crocodile are estimated to be half those of live purchase from the wild (Paul Stobbs pers. comm.). Costs are also indirectly reduced in full captive breeding operations from a more homogeneous-population with less mortality.

Given current capacity, Mainland could not satisfy all its needs with captive bred animals. However, the programme could expand if problems arise with the wild population. At present, the maintenance of the live trade allows Mainland to commit less investment into the acquisition of stock, as most of the infrastructure for the purchase of live animals is hired (charter, workers, company buyers), whereas a captive breeding operation carries a larger capital investment.

In 1993, the captive breeding programme at Mainland Holdings produced more than 2,700 hatchlings which were recruited to the main farm in 1994 (see Table 7) which represented 76 percent of total live stock purchases in 1993.

Table 7. Relative importance of stock sources for farms in PNG

Year	Live purchase	Captive breeding /1	Egg harvesting
C. novaeguineae			
1988	5,967	0	1,500
1989	4,875	0	2,000
1990	1,000	0	1,500
1991	10,000	0	0
1992	9,624	0	0
1993	3,289	0	0
1994	2,185	0	
C. porosus			
1988	4,375	0	647 /2
1989	3,235	0	1,198 /2
1990	200	0	1,400
1991	5,400	0	389
1992	1,127	0	2,461
1993	3,660	168	621
1994	2,188	2,789	

Source: Solmu (1994), Mainland Holdings quarterly returns (1994 data incomplete), Staton (1990).

/1 Eggs produced

/2 Eggs transferred to Mainland Holdings only.

2.6.2 Egg harvests

A third source of stock for the farm has been the purchase of wild eggs. Launched in 1985 for *C. porosus* and 1988 for *C. novaeguineae*, the egg harvesting programme was seen as a way to salvage nests that were at risk from flooding or human predation (Genolagani and Wilmot 1990a). These eggs are taken to the farms to be incubated. Eggs are collected primarily during the surveys conducted by wildlife personnel because of the technical difficulties involved in handling the eggs, thus ensuring good hatching success rates. However, this practice has met mixed responses at the local level (Solmu 1994). Some landowners claim that egg harvesting is detrimental to the wild population of crocodiles. After some consultation, it was agreed that the harvest should be carried out only

biannually. landowners were initially paid 1K per egg taken from nests in their land.and, in order to avoid any loss of protein in the diet of villagers who eat the eggs, a chicken's egg was also given as payment to the landowner. By the last collection in 1994, prices had risen to 2.5 K per *C. porosus* and 2K per *C. novaeguineae* (plus one chicken's egg). In terms of their potential as substitute for the live production, egg harvesting appears to be of minor importance, given the potential size of the harvest, the costs involved, the technical difficulties and the advance in the captive breeding programme at Mainland Holdings.

Apart from the egg harvests in the Sepik, Mainland also purchases eggs collected from the nearby Lake Wuanam. The eggs are collected by the villagers and are bought at a price of 1.25K per egg plus an additional 1.25K per successfully hatched egg. This price differential was meant to induce adequate handling practices to increase hatching rates. However, the farm is considering discontinuing this practice, as new harvesters with poor skills are entering the market and eggs collected by them have a poor hatching success ratio. There is also evidence of an excessive number of oversized females being hunted around Lake Wanam by local hunters, causing greater concern over the state of the local population.

3 International trade

After the establishment of the SMS, PNG's trade has shifted permanently away from Singapore as the main trading partner. Instead, it now exports directly to tanneries, mainly in Japan.

Both species of crocodile exported belong to the so called 'classic' skins, but each has a relatively distinct market, with the *C. porosus* occupying a special niche in the market due to its unique characteristics, which makes it more valuable. The market for *C. porosus* has been more stable than the less valuable *C. novaeguineae*. In particular, C. novaguineae has been more affected by the recent over production of *Alligator mississippiensis* in Louisiana (1992). This has also been reflected in the shift towards *C. porosus* in the farm stock and the captive breeding programme.

The expansion of captive breeding programmes in all crocodilian species has increased the competition in the international market. In the market for *C. novaeguineae*, PNG's share of net trade has fallen from virtually 100 percent in 1983 to 70 percent in 1991. Likewise, *C. porosus* share has fallen from 85 percent to 55 percent over the same period. When considering the world trade in skins, the impact is more significant; while 42 percent of all skins in trade came from PNG in 1983, the proportion fell to just 12 percent by 1991, clearly reducing PNG's market power and putting pressure particularly in the less valuable *C. novaeguineae*. The main source of these changes in the world market is the increasing production of A. mississipiensis, which has increased 7 fold its presence in trade between 1983 and 1991 (Figure 4).

Over production in *A. mississippiensis* from Louisiana appears to be the result of (i) significant increases in population levels and (ii) a high level of entry of producers, particularly farms.

When a farm closes, it sells off its stock, thus depressing the local market even further and forcing other farms out of business. Such uncontrolled industrial structure has caused negative impacts on management efforts for other species worldwide, including Papua New Guinea's programme.

The market for *A. mississippiensis* is more diversified than the one for PNG's crocodiles. As expected, farms in Papua New Guinea have diversified their exports in order to avoid excessive fluctuations, whereas exporters of wild skins run a lower risk, by specialising in certain trading channels. Production levels of alligators are also much larger than PNGs exports, with a production of 128,300 farmed skins and 23,500 wild skins in 1993 from Louisiana, whereas the corresponding numbers for total skins from PNG were 21,412 for *C. novaeguineae* and 36,412 for *C. porosus*.

Another impact of the instability in world prices, apart from concentration of exporters and the diversification of markets, has been the diversification of export products: Mainland Holdings, for example, is now also exporting meat, teeth and straps,[4] increasing the value per crocodile. In 1993, it is estimated that meat represents up to a 20 percent of net revenue per crocodile, with backstraps being 3-4 percent and teeth 1 percent (Paul Stobbs pers. comm.).

Although there used to be many exporters in PNG, many of them had very limited activity, with the vast majority of trade concentrated in just a few licence holders. Hall (1988) estimates that by 1980, 40 percent of all exports came from a single licence holder. By 1993-4, speculative exporters had disappeared from the market, possibly forced out by the more competitive environment with only those capable of building strong trade links remaining in the market. There were only six active exporters, with the main exporter of each species having a 40 percent share of the skin export market for *C. porosus* and 50 percent for *C. novaeguineae*.

4 Effectiveness of the management programme

An assessment of the overall management system requires a systematic analysis of the main components of the overall management strategy. Such an analysis, however, is constrained by the quality and availability of data. In this section, we attempted to provide an overall review of the current status of the management system in Papua New Guinea.

This assessment will be based on the guidelines prepared by David (1994) for Sustainable Use programmes of Wild Crocodilians. A summary of the programme components and their current status is presented in Table 8. Each of the items will be discussed below.

[4] From hardback skin.

4.1 Biological information

Early monitoring attempted to cover wide areas of the country, but at present, the system is mostly centred around the Sepik region. Methodology of surveys has been constant since the beginning of the programme, enhancing the comparability of the results across time.

The main monitoring tool of the wild populations has been the aerial surveys carried out twice a year (one for each species) in which nests are counted. Using Habitat weighted indices, the raw nesting data are converted into an overall index of wild population status. This procedure, however, appears to be partly responsible for the fluctuations in population shown in previous results. As discussed by Manolis (1995), this could be misleading and analysis of raw data is preferred. A recent assessment of the survey data suggests that nest counts of *C. porosus* have been increasing steadily over the survey area at rates between 2 percent and 6 percent (Manolis 1995).

As for *C. novaeguineae*, nesting indices suggest a stable or slightly fluctuating population, but an assessment similar to that made by Manolis is also desirable (see Figure 5).

Harvest data could provide additional indications of the current status of the wild population, and their analysis is also needed in order to complement the nest count data and obtain an overall assessment by region. Sources for these data could be both the docket information and quarterly returns provided by traders and company buyers. Unfortunately, such records are often incomplete and of limited value for analytical purposes. However, export data, if more difficult to aggregate by region, are more accurate with regard to the composition of the wild population harvest. An analysis of such data is attempted below, classifying the data by region using the exporting company's main area of activity.

Information on the other indicators of population status, such as habitat changes, are not gathered systematically and field patrolling is unfortunately being cut back due to budget constraints.

Table 8. Components of the management programme in PNG.

Component	Description	Status
Biological Information		
Population levels	Population status surveys	Nest counts are carried out by aerial surveys twice a year along the Sepik river (1994 included the Ramu river) since 1982. Night spots ocassionaly carried out in other crocodile harvesting areas.
Effects of Harvesting	Docket information and quarterly returns	Although incomplete, some data is collected on harvest levels by size and by region. Live trade is better documented than skins. No routine analysis of this data is carried out at present. Nest counts are targetted to areas of high hunting activity and
Habitat change	Visual surveys	Informal inspections are carried out by wildlife officials patroling the hunting areas. No data are collected from this. Proposed mining operation in the Upper Sepik is expected to have a negative impact, but no detailed study has been carried out.
Export levels	CITES records	Detailed and quite complete records exist for permits issued. All exported skins are visually inspected prior to issue of permits. No routine analysis of this data is carried out at present.
Economic Information		
Harvesting effort	Licence scheme. Return to hunters	Licence data provide some indication of activity in the industry, but no direct measure of hunting patterns exists. Docket information should provide some indication of the rents accruing to hunters, but data are often incomplete and misleading.
Illegal activity	Patrolling	Inspection of skins is done at exporters' request. No spot checks are carried out at present. Evidence of illegal trade suggests it is relatively small.
Harvest controls		
Level of harvest	Size limits	A ban on trade in skins greater than 51 cm or less than 18 cm is in place. Enforcement is done by not issuing export permits. No penalty exists for hunters and traders attempting to sell oversized skins.
	Quotas	Legal provisions exist for this, but have never been applied, their potential effectiveness is unknown.
	Seasons	Same as quotas
Funding sources		
Fees	Management Levy	A fee is charged to exporters to finance monitoring operations. Used to be channeled directly to the management authority, but now is consolidated revenue, making funding more insecure. Recent funding forced unit to reduce all activities.
Industry funding	Informal contributions	Major exporters cover expenses of skin inspecting officials or ship skins to Port Moresby to be inspected.

Assesment based on guidelines developed by David (1994).

Source: Department of Wildlife and Conservation, PNG.

4.2 Economic information

A key variable for the overall assessment of the harvesting programme is an indicator of harvesting effort. However, this variable is difficult to measure and at present it can only be inferred from population growth data and traders activity.

Data on the price obtained by hunters who sell their catch to traders are also limited to the incomplete docket information and to anecdotal information. In general, they tend to

follow closely the trends in prices offered by the large farms and exporters, given the competitive environment in which treaders operate.

Illegal trade has been known to exist at some level, both within the country and between PNG and Irian Jaya (Hall 1988; Hollands 1987). However, this trade is believed to be relatively small and specific efforts have been directed to the effective issuing of CITES permits rather than to the actual policing of hunting areas.

4.3 Harvest controls

Under current practices, undersized and oversized skins are simply returned to the owner, who in principle cannot trade them, but who can attempt to sell them again. This process could be encouraging some attempts to shrink the skins. Evidence of this is found in the significant number of skins being exported at the maximum size limit. The only direct monitoring done at the hunting level is the monthly trip of a wildlife officer up river to inspect the holding pens and to attend to any complaint or problem from the hunters and traders. In the Sepik region, however, government financial difficulties have resulted in a sharp reduction in current expenditure by the wildlife official, resulting in less frequent trips in the more distant parts of the river. Survey work carried out twice a year has served as a complement to the monitoring activities in the Sepik region.

4.4 Funding sources

Perhaps the most serious threat to the management system in PNG is that of the financial constraints on the Wildlife Division preventing adequate monitoring and enforcement activities. In 1976, the government imposed an export levy of 0.15 toya per inch of skin width, to be collected by Customs. However, at present the wildlife management levy is not earmarked revenue and is not spent directly on management. This has caused the industry to press for more direct ways of channelling resources. Particularly after the problems in financing the last surveys, which are seen as the backbone of the management system and the single most important instrument needed to certify PNG's programme as sustainable. In 1994 it is estimated that the government collected 60,000K through the wildlife management levy (fixed 0.45 K per centimetre, regardless of type and grade). Such funds could cover the current surveys, the estimated cost

of which is 28,000K each. These problems have so far been partially ameliorated by the industry's involvement and interests in continuing the trade. For instance, the industry has contributed to the costs of the surveys and Mainland Holdings currently pay the expenses of wildlife officials to travel to the farm to inspect the skins and issue the export permits. Other traders far away from Port Moresby usually ship their skins to be inspected. Such practices, although successful in maintaining part of system in place, do not give the required freedom of action to the management authority.

5 Hunter's incentives

As outlined above, direct control of regulations is limited by the significant costs of monitoring hunters' activities. By making downstream stages of the industry more accountable, and with vested interests in the wild population it is hoped that they will in turn affect hunting patterns.

An assessment of the effectiveness of the management system involves an analysis of the main channels through which the programme is affecting the various decisions at the hunter level, who are the ultimate determinants of harvest levels and patterns. There are three main changes in hunting patterns that the current management system is trying to promote and which are expected to have a beneficial impact on the wild population.

5.1 Selective hunting

By keeping within the limits, hunters could allow large crocodiles to breed, and hence a stable harvest could be maintained with smaller live crocodiles being absorbed by the large farms at competitive prices. What are the incentives to comply with these? Soon after enactment of the large skin limit, there seemed to be a reduction in the number of large crocodiles being hunted (Downes 1971). However, the reasons for this are not clear. Sound incentives to adhere to this depends on the capacity of hunters to target given size groups as well as on the availability of legal markets for large skins and the prices for small live animals. The relative prices for small live crocodiles versus skins presented in Table 6 indicate that the farm system has served to encourage hunters to devote more time in targeting small live crocodiles rather than the large animals. The effectiveness of such an incentive can be gauged by analysing the size distribution of harvests among areas with an active live crocodile trade and areas with no active crocodile trade.

To analyse the differences in harvesting patterns systematically we derived the selectivity coefficient by crocodile skin size and region.[5] This parameter allows us to detect possible patterns in the way hunters behave that may be determined by the technology used (e.g., net's mesh size) or hunting strategies to select certain individuals (e.g., choice of region, time of year/day). One major limitation of this analysis for the case of the crocodile is the absence of data on the structure of the naturally occurring population. The only source available is the harvest data for previous years.

In our study, we decided to use the average population structure for the period 1972-5 as a surrogate for the underlying distribution of the population (see Figure 6). This would assume that hunting effort was not selective over that period, and, if at all, it would be biased towards the large animals, as live trade had not started at that time. We therefore tested two sets of hunting effort estimators: a constant effort across regions and sizes, and the live and skin prices as a surrogate of the preferred catch for hunters. The results are presented in Figures 7-8[6]. As can be seen, there appears to be a significant difference

[5] The selectivity coefficient used here follows the work of Getz and Haight (1989), who define the selectivity coefficient as the proportion of the harvest from a particular age/size range.

[6] Notes on the precise mathematical derivation of these coefficients is presented in Appendix I.

between hunting patterns in Saltwater crocodiles across regions, with the hunters in New Guinea targeting smaller animals. In Papua, however, harvest is targeted at large animals. This could be due to the existence of a more

active live trade in the New Guinea region, Mainland's main supplier. This is further corroborated by the results in the case of the freshwater crocodile, where the two distributions are very similar except for the higher selectivity for very small crocodiles. The equal selectivity for large individuals may also have to do with the lower price offered for freshwater skins.

By using the price as a weight, we are eliminating from the selectivity coefficient any component that may have derived from the differential value of skins and their influence on hunter behaviour. The remaining coefficient, therefore, would pick up other factors (e.g., technology) and incentives (e.g., activity in live trade, prices of inputs, expected prices, desire to protect the specie, etc.). The result again shows a similar trend as the previous hunting effort factor. However, this sharpens the fact that (i) significantly more large animals are being caught in the large size range in Papua, (ii) effort catching small size animals in New Guinea is substituted for medium size crocodile hunting in Papua.

These results suggest that hunting effort is merely shifted to smaller animals in New Guinea. A more subtle effect, however, would be the actual discounting of the value of a large animal by the fact that it may in the future provide more valuable hatchlings. Whether this calculation actually takes place in hunter's behaviour is uncertain. The harvest of large animals in New Guinea is significantly lower than that in Papua, but there is no way to distinguish if it is due to an actual refrain from hunting or a reflection of the scarcity of large individuals in the wild population.

Overall, these data would support the view that the existence of an active trade in live animals is having a positive impact on the conservation of the species, at least by reallocating hunting effort and strategy, while the incentives to protect breeders would still have to be supported by more hard data.

5.2 Protection of breeding nests

The egg collection system was set up to ensure that landowners (i) did not lose out from protecting nests on their land and (ii) were penalised if they raided nests for eggs. To the extent that nest owners protect their nests and let the eggs hatch the wild population would benefit. In principle, there would also be benefits to the farmers from the eggs that are eventually hatched in their farms as their economic value is much greater (so far no reintroduction of artificially hatched eggs back into the wild has taken place). The enforcement of this system relies entirely on the periodicity of the surveys, which in principle ensure that once a year particularly vulnerable nests are visited and the landowner is encouraged to refrain from raiding the nests.

An interesting development has been the recent complaint from locals that egg harvesting was detrimental to the wild populations. If the concern is genuine, it would indicate that they are valuing more the future expected value of the hatchlings than the price being paid

for the egg. Assuming an average clutch size of 40, the value of the eggs would be about 100 Kina, while the value of the hatchlings at minimum sale size would be about 400 Kina if they are of saltwater crocodile. Hence, they would have to be expecting to catch at least a quarter of the clutch to be better off.

This calculation, although rough, does highlight the fact that protection of the eggs may be encouraged by the current market conditions (at least for saltwater crocodiles), and that some hatchlings may grow in the wild. Under the present system, however, the conservation value may be lower if hatchlings are not returned to the wild, i.e., there is zero additional recruitment in the wild.

The experiences in Lake Murray would further suggest that egg markets under free entry may be counterproductive, since new entrants will not be technically qualified, and the price and tenure status of the collection activity does not encourage such incentives.

5.3 Restraint in skin harvests

A third possibility is that landowners invest directly in the crocodiles in their habitat and restrain themselves from hunting at their previous rate. This however is highly unlikely as such behaviour would only come about if they had some certainty of future higher harvests. Factors such as the seasonality of the hunting and the unpredictability of crocodile densities in specific areas makes this effect unlikely to arise from any incentive scheme, other than providing alternative economic activities to crocodile hunting during the hunting season.

Interviews with locals in the villages nearby Ambunti indicate that hunting in very active and no restraint is taking place. People in two villages mentioned that they went hunting every day. An alternative restraint incentive could arise by direct ban or the creation of seasons, as provided by the legislation. However, such measures have never been put to the test because the population is estimated to be stable as evidenced by the survey work. Moreover, given current financial limitations of the programme, it is unlikely that such a ban could be adequately enforced.

6 Illegal trade

At present, no direct control over hunters is in place, with all the regulatory framework designed to affect their decisions indirectly. Hence, the only direct incentives are provided by the conditions in the legal market and the availability of an alternative illegal market. To the extent that the illegal market is relatively small, and that marketing conditions are more attractive in the legal market, the legal market conditions will predominate in influencing the hunters' behaviour. It was believed that uncontrolled outlets for skins were few with low profit; hence the amount of skins leaving the country illegally were estimated to be low (Downes 1971). There have however, been reports of illegal trade or transshipment of skins both within and outside PNG, in response to differential regulations (Hall 1988), particularly between Irian Jaya and PNG. However, the current state of the market is not known. It would seem that the only incentive to restrain the illegal market has been the better prices offered by the SMS, and later by the farms, than the past

unregulated trading scheme. However, it is unclear whether trade in skins outside the legal limits is taking place. The high levels of *C. novaeguineae* skins at the legal limit being exported from the Papua Region indicates that hunting behaviour in the region is targeting the large crocodiles, and that skins well above the legal limits may be either shrunk or traded trough alternative markets. With regard to *C. porosus*, the relatively low incidence of legal trade in large skins would indicate that (i) either the species is not left to grow to that size in hunting areas or (ii) there is an active restraint or diversion of effort in the hunting areas that allow large crocodiles to breed as suggested in the selectivity analysis. It is not clear which of these factors is playing the dominant role. Illegal trade is believed to exist on a small scale, but lack of funding prevents the wildlife authority from carrying out further checks. No random inspections are made and the only certification achieved is by the exporters requesting CITES permits. The level of reporting in CITES statistics appears to be relatively good. Discrepancies in trade reporting appear to be a general underreporting by the importing countries. The most severe discrepancies have occurred with Singapore, where for the period 1989-93 Singapore declared 682 skins of *C. novaeguineae* and 5,624 of *C. porosus* from PNG, while PNG reported 2,335 and 10,305 respectively.

7 Conclusions

Overall, the management system in Papua New Guinea appears to have created adequate incentives in the New Guinea region partly through the active live trade and the continuous monitoring. In contrast, the situation in Papua may be of concern as current patterns of exploitation suggest that hunting is not being selective in a desirable way and that new areas may be opening to trade, particularly of *C. novaeguineae* to account for the large skins being harvested. Some of the specific conclusions in the study are:

1 The management regime appears to have been successful in diverting the harvesting pressure on *C. porosus* towards a live harvest. There are some signs that nests are also being preserved in the expectation of future harvest of the live hatchlings. However, there is as yet no clear evidence that breeding adults are being protected by the landowners.

2 Although all the elements of the management system have been set up in terms of legislation, key elements of the control system such as quotas and seasons, have never been tested, and so, their effectiveness cannot be assessed. Concentration and co-ordination of the trading chain appears to have reduced hunting pressures by adding value to the harvest.

3 Farms appear to have contributed to the recovery by shifting hunting effort from large to small crocodiles and probably to increase the willingness to protect nests. However, the current world market conditions are forcing a projects to seek increases in efficiency. In PNG farms and exporters have reduced their activity, while Mainland Holdings has expanded their captive breeding operations and have been shifting emphasis from *C. novaeguineae* to *C. porosus*. Such developments could in the long term cast doubts over

the incentives for a legal market in the rural communities.

4 Evidence across species suggests that pressure on *C. novaeguineae* is already higher than that on *C. porosus*, reflected in the proportion of individuals caught around the maximum size limits. This increases the need to carry out wider survey work in the Papua region, which seems to play a greater role in trade in *C. novaeguineae* as reflected from the data analysed.

5 There is a need for greater financial independence of the Management Authority for monitoring and enforcement activities. It is unlikely that given the current budgetary constraints, the authorities would have the capacity to respond and effectively enforce auxiliary regulations such as regional bans, quotas or seasons. The devolution of the Management Levy as was previously the case as Appropriation in Aid to the DEC would contribute to greater independence and effectiveness of the regulatory system.

8 Implications for sustainable use of wildlife

The PNG experience with crocodile management seems encouraging in so far as the capacity of the market to partially contribute to provide conservation incentives at the local level. However, it does warn that shifting conditions in the market may shift the incentives at the community level.

In the skin market, it is true that there is a limit to which 'successful' market approaches to wildlife use can take over. The conflict for habitat conservation at the local level, becomes a conflict for market share and rent conservation at higher levels of industry. Additionally, the relative competitiveness of 'farmed' versus 'ranched' options is proven to be limited in the PNG case, where market pressures are accelerating the move towards specialisation and closed production systems, where greater control and lower costs can be attained.

In order to respond to such changing conditions, the capacity of the management and regulating authority must be maintained to ensure, not only that potentially threatening developments are occurring but that new policies can be put in place and enforced. If the formal market loses interest in the species, and illegal trade reactivates, a new approach will be needed.

While private investment can and has contributed to the funding of the regulatory regime, mechanisms must be put in place to ensure that those funds are maintained and effectively channelled to conservation.

9 References

Anon. (1978) Joint report of the Papua New Guinea Government/FAO Project 'Assistance to the crocodile skin industry'. In IUCN (1978). Papua New Guinea Government, Crocodile Management and Conservation Programme and UNDP/FAO.

Bolton, M. (1989) 'The management of crocodiles in captivity'. Technical report, FAO Conservation Guide 22.

David D.N. (1994) 'Harvesting wild crocodilians: Guidelines for developing a sustainable use programme'. In IUCN. Unedited and unreviewed.

Downes, M.C. (1973) 'Recent developments in Papua New Guinea'. In Proceedings of the Second Working Meeting of Crocodile Specialists, IUCN. Natal Parks Board, Zululand, 20-7 March.

Genolagani, J.M. and J. Wilmot (1990) 'The status of crocodile populations in Papua New Guinea'. In IUCN. Unedited and unreviewed.

Genolagani, J.M. and J. Wilmot (1990a) 'Status of *C. porosus* and C. novaguineae populations in Papua New Guinea: 1981-1990'. In IUCN. Unedited and unreviewed.

Genologani, J.M. (1993) 'Conservation, management and farming of crocodiles in Papua New Guinea'. In IUCN. Unedited and unreviewed.

Getz W.M. and R.G. Haight (1989) *Population Harvesting: demographic models of fish, forest and animal resources*. Princeton University Press.

Hall, P.M. (1988) 'Crocodile skin industry trade statistics for Papua New Guinea, 1969-1980'. In IUCN. Unedited and unreviewed.

Hemley, G. (1993) 'Monitoring the international crocodilian trade: Useful tool or useless bureaucracy?' In IUCN. Unedited and unreviewed.

Hollands, M (1987) 'The management of crocodiles in Papua New Guinea'. Chapter 8, pages 73-88. Surrey Beatty & Sons Pty Ltd. In association with The Conservation Commission of the Northern Territory.

Hutton J.M. (1993) 'International directions in the sustainable use of wildlife'. In IUCN. Unedited and unreviewed.

Hutton, J.M. and G.J.W. Webb (1993b) 'The principles of farming crocodiles'. In IUCN. Unedited and unreviewed.

IUCN (1978) Crocodiles. Proceedings of the 4th Working Meeting of the Crocodile Specialist Group of the Species Survival Commission of IUCN - The World Conservation Union, Madras, India, 6-12 February. Unedited and unreviewed.

IUCN (1988) Crocodiles. Proceedings of the 9th Working Meeting of the Crocodile Specialist Group of the Species Survival Commission of IUCN - The World Conservation Union, Lae, Papua New Guinea, 19-21 October. Unedited and unreviewed.

IUCN (1990) Crocodiles. Proceedings of the 10th Working Meeting of the Crocodile Specialist Group of the Species Survival Commission of IUCN - The World Conservation Union, Gainesville, Florida, USA, 23-7 April. Unedited and unreviewed.

IUCN (1993) Crocodiles. Proceedings of the 2nd Regional Meeting (Eastern Asia, Oceania, Autralasia) of the Crocodile Specialist Group of the Species Survival Commission of IUCN - The World Conservation Union, Darwin, Northern Territory, Australia, 12-19 March. Unedited and unreviewed.

IUCN (1994) Crocodiles. Proceedings of the 12th Working Meeting of the Crocodile Specialist Group of the Species Survival Commission of IUCN - The World Conservation Union, Pattaya, Thailand, 2-6 May. Unedited and unreviewed.

Jenkins, R. W. (1993) 'Sustainable use of crocodilians - conservation benefits'. In IUCN.

Jenkins, R.W. (1994) 'Conservation benefits of captive breeding - a CITES perspective'. In IUCN.

Joanen, T., L. McNease and R. Elsey (1995) 'The commercial consumptive use of the American alligator (*Alligator mississippiensis*) in Louisiana: its effects on conservation'.WWF case study, World Wide Fund.

Lever, J. (1994) 'Captive breeding and conservation. allies or enemies?' In IUCN.

Luxmoore, R. and L. Collins (1994) 'World trade in crocodilian skins, 1990-1991'. Technical report, World Conservation Monitoring Centre.

Manolis, C. (1995) 'Monitoring *Crocodylus porosus* nests in Papua New Guinea: A review with recommendations'. Wildlife Management International, April .

Manolis, C. (1995a) 'Papua New Guinea: Nest monitoring survey results', volume 14 of Crocodile Specialist Group NEWSLETTER, pages 9-11.IUCN - The World Conservation Union, Survival Species Commission, April-June. Extracted from C. Manolis 'Monitoring *C. porosus* Nests in Papua New Guinea: A Review with Recommendations', Wildlife Management International Pty.

Downes, M.C. (1971) 'Regional situation report - Papua New Guinea'. In Proceedings of the First Working Meeting of Crocodile Specialists. IUCN, Bronx Zoo, New York, 15-17 March.

Medem, F. (1976) Report on the survey carried out in Papua New Guinea in 1976. unpublished notes.

Pooley, A.C. (1976) Papua New Guinea - a report on crocodile farming. mimeo.

Solmu, G.C. (1994) Status of *Crocodylus porosus* and Crocodylus novaguineae population in Papua New Guinea 1981-94. In IUCN (1994). Unedited and unreviewed.

Staton, M., B. Vernon, G. Mitchell, and R. Sigap (1990) Processing yields from farmed crocodiles. In IUCN (1990). Unedited and unreviewed.

Staton, M.A., D.H. Wilken, and B.P. Vernon (1992) Invaluable crocodiles: Sustained use management of a renewable natural resource in Papua New Guinea. In PNG Annual Producers' Society Meeting, Lae. Mainland Holdings Crocodile Farm, June.

Thorbjarnarson, J., H. Messel, F.W. King, and J.Perran Ross, editors (1992) Crocodiles: An actionplan for their conservation. IUCN/SSC Crocodile Specialist Group.

Vernon, B.P. (1993) The economics of crocodile farming. In IUCN(1993).

Webb, G.J.W. (1993) The link between conservation and the sustainable use of wildlife. In IUCN (1993).

Appendix

A.1 Exporters/Farms in PNG

Origin of purchase The origin of purchase was not recorded in the export applications and so the companies most covered region of activity was used to estimate a possible origin to the skins. The exact derivation used was as follows:

Bush Development Pty. Based in Madang. Exporter of wild skins mostly in the Sepik region, although one major trader operates in the Western province.

Fairfax Pty. Exporter mainly of wild skins. Their operations centre in the Papua region.

Illimo Farm Products Pty. Considered as operating mainly in the Papua region. Farm is located in Port Moresby.

Geoffrey Ling. Relatively small exporter of both wild and farmed skins, mostly of *C. porosus* from the New Britain Province (New Guinea region). Crocodile stocks are about 308 saltwater.

Mainland Holdings Pty. The major farm exporting mainly ranched skins, located in Lae. It also buys wild skins at farm gate. Its main supply are is the New Guinea Region and the Sepik in Particular. Detailed quarterly reports allowed precise specification of origin of live purchases. Stocks are about 13,800 saltwater and 18,454 freshwater plus 200 saltwater breeders.

Northern Trading. Major exporter of wild skins. Acquiring supplies mostly from the Papua region.

Ludwig Shulze. Relatively small exporter operating mainly in the New Guinea Region.

Sita Trading. Exporter of both wild and farmed skins, has the third largest farm in PNG, with 692 saltwater and 630 freshwater crocodiles.

A.2 Selectivity coefficient

Unlike tree harvesting, where the age and size of the stand can be quite accurately determined and selected *prior* to felling, the age or size structure of the stock captured while hunting free ranging species such as crocodiles cannot be determined. When perfect discrimination of age and size can be performed prior to harvesting it is said that the harvesting exhibits *knife-edge* selectivity.

In empirical work analysing harvest data by cohorts, *knife-edge* selectivity is rarely encountered, as there are limits in the techniques used to select for a given cohort in the population.

In crocodile hunting there are several factors that affect the particular frequency distribution of a particular cohort being harvested:

Habitat specific searches. By intensifying search effort in particular habitats, e.g. around nests, open water, estuaries, vegetated swamps, it is possible to affect the probability of encounter of different species or cohorts.

Hunting season. Distribution of cohorts varies both geographically and across time depending on the nesting patterns of the species. Hence, some seasons will yield a higher proportion of a given size of individuals.

Gear specification. Spears and nets of different sizes determine the capacity of the hunter to successfully catch a crocodile of a given cohort.

Environmental disturbances. Environmental factors beyond the control of hunters are also a stochastic factor in determining the final frequency distribution of harvests from specific cohorts.

To calculate the selectivity coefficient we use the following expression (using Getz's notation):

Assuming that a hunting intensity v is exerted, the final crocodile harvest u_i from cohort i is determined by,

$$u_i = q_i \, v(P) \, x_i$$

where x_i is the number of individuals in cohort i, P is the price for skins from every cohort, and q_i is termed the *catchability coefficient.* By scaling and normalising this factor we obtain the *selectivity coefficient.*

From the above formula it should be noted that q_i is independent of the natural recruitment function that determines x_i, the cohort size. In the present exercise, we made the strong

assumption that the underlying population distribution was equivalent to the harvest distribution in the pre-regulation period (1972-75), with the known biases of harvest selectivity towards large individuals. Harvesting effort was either considered constant throughout species and cohorts, or assumed that price was shaping hunting effort directly.

A.3 Abbreviations used

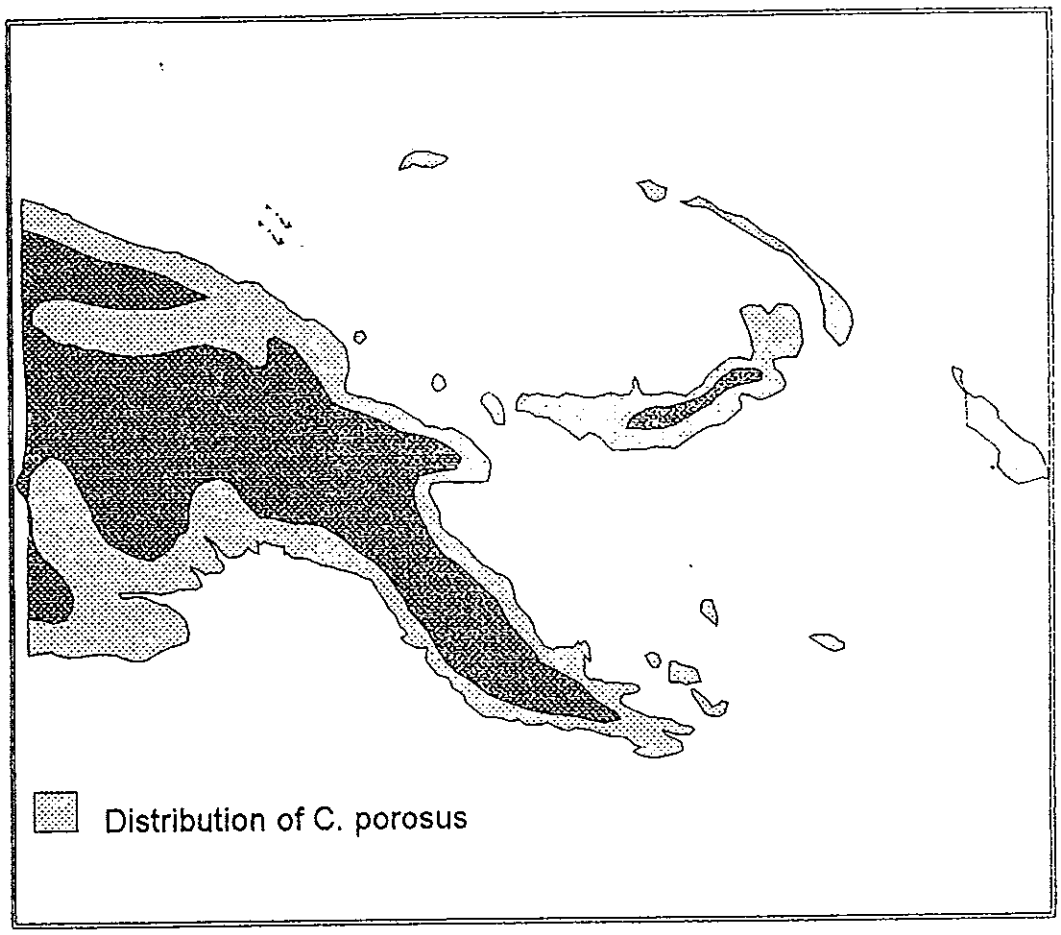
PNG Papua New Guinea

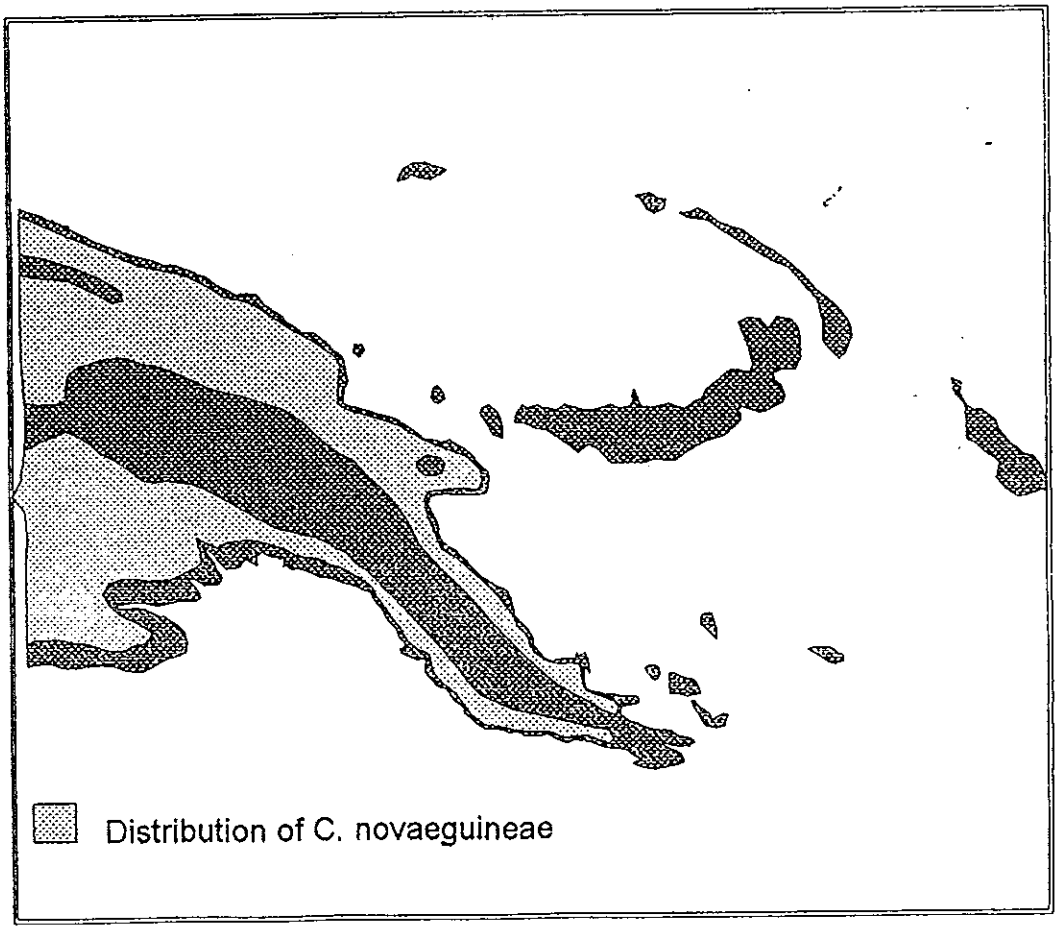
SMO Skin Marketing Service

DEC Department of Environment and Conservation

Kina (K) Papua New Guinea's currency (1 Kina = USD 0.85 approx.)

Map 1. Distribution of *C. porosus* and *C. novaeguineae* in Papua New Guinea.





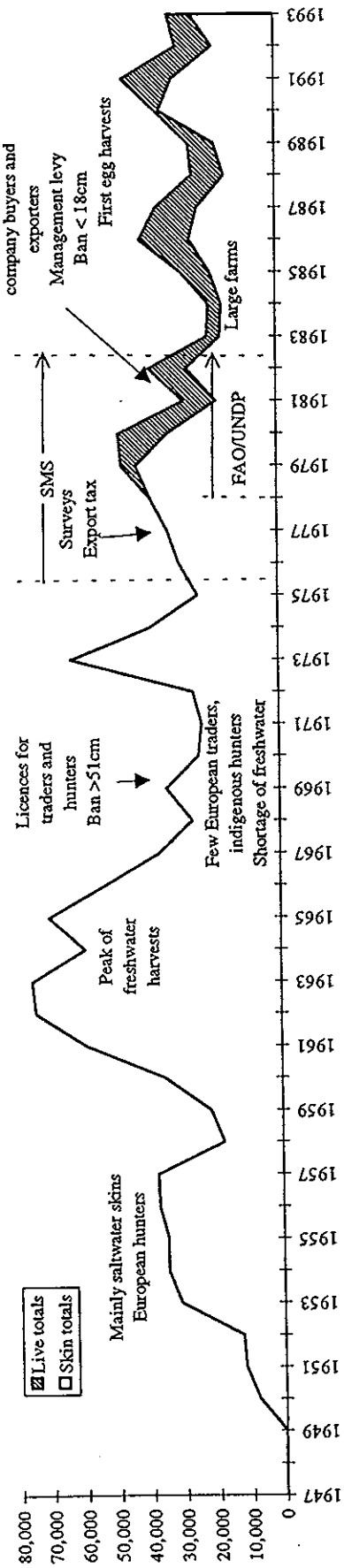


Figure 1. Historical development of crocodile harvests in Papua New Guinea, 1947-1993.

Figure 2. Price of skins and live C. porosus

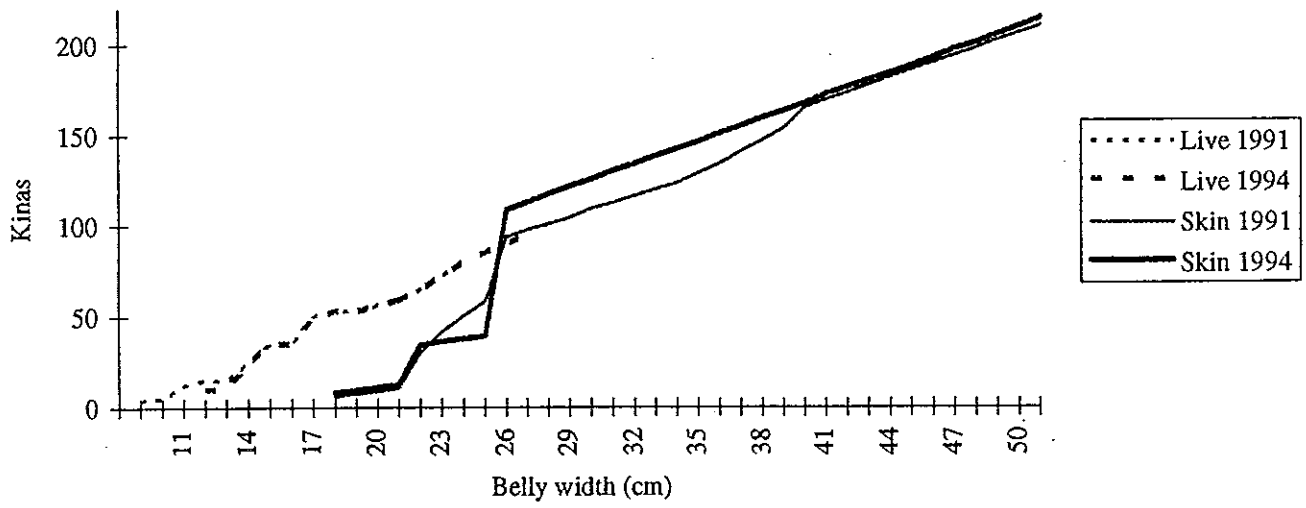


Figure 3. Price of skins and live C. novaeguineae

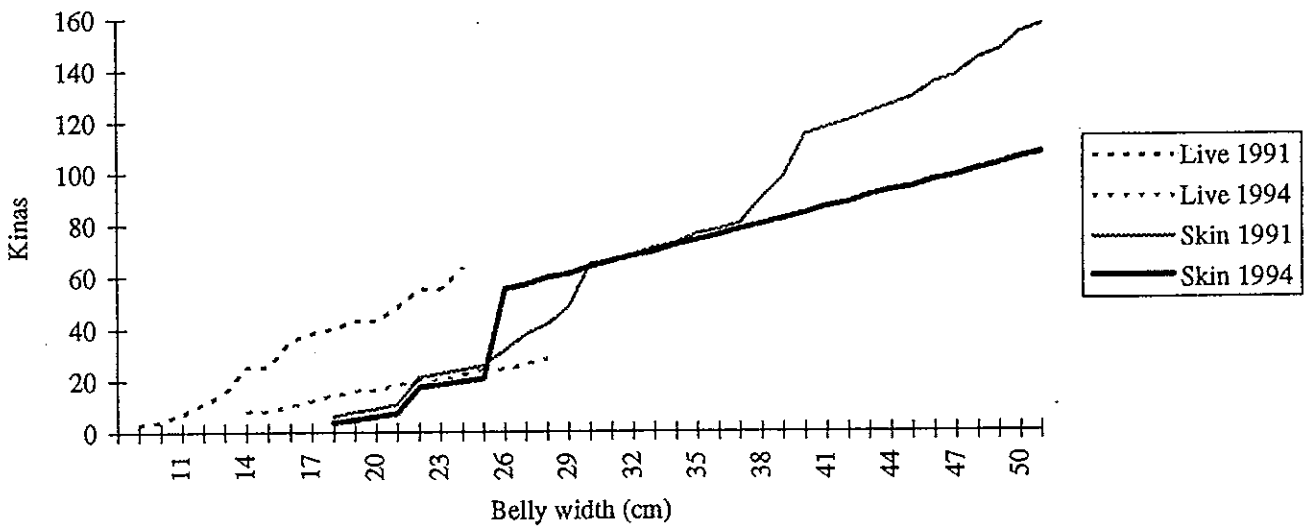


Figure 4. World net trade in crocodilian skins

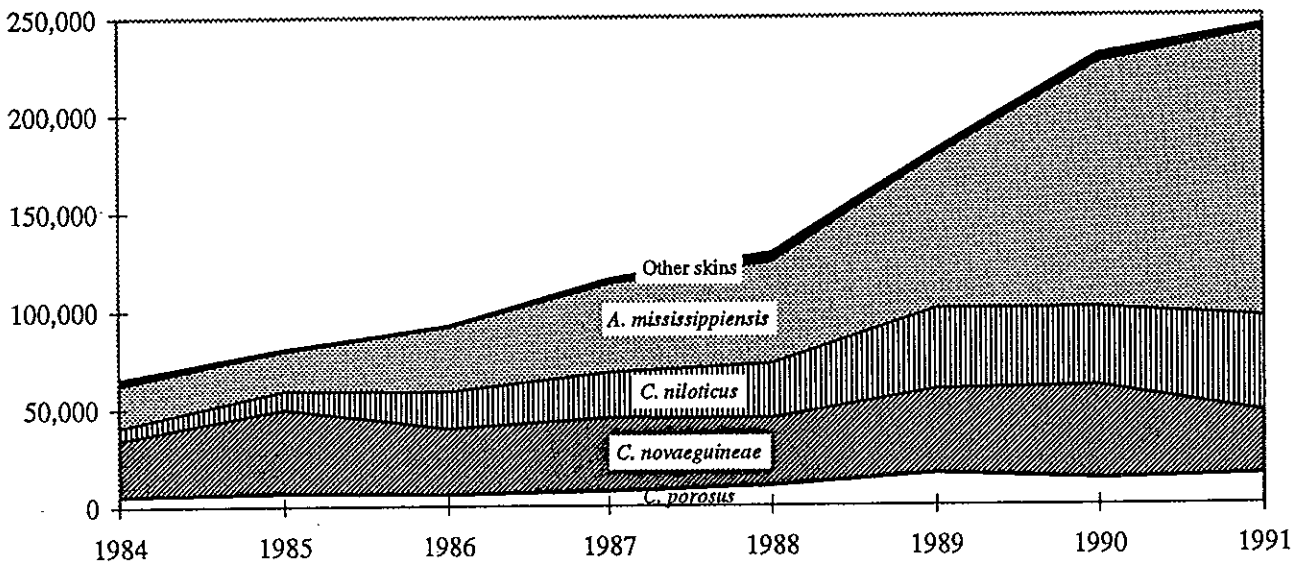


Figure 5. Habitat nesting indices of Crocodiles in the Sepik Region, PNG. 1981-1994

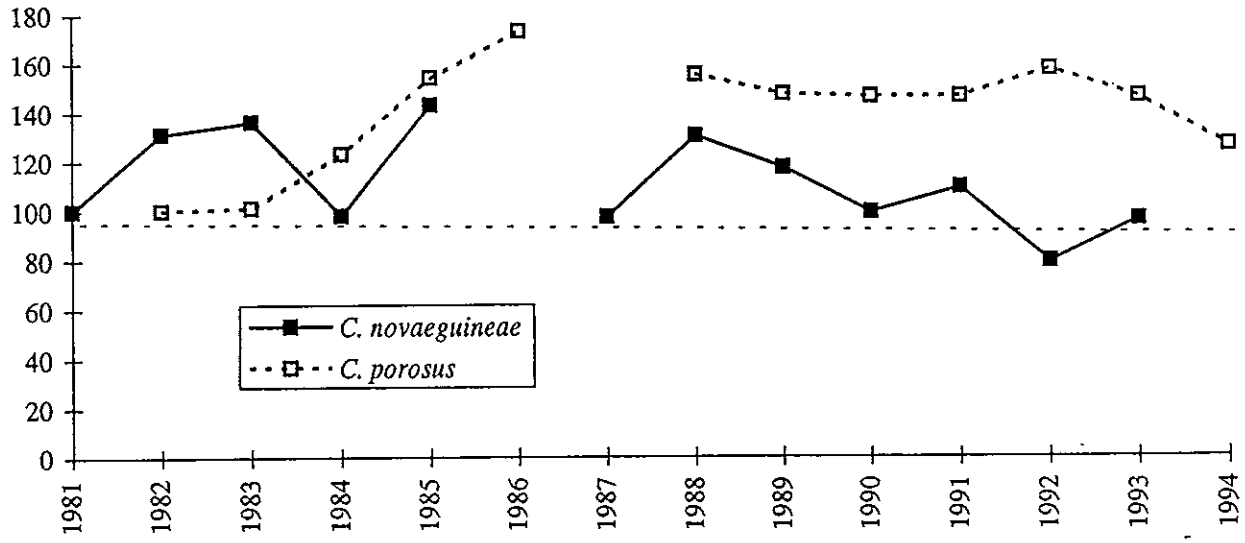


Figure 6. Average catch by size of crocodile harvests by region and by species between 1972-1975.

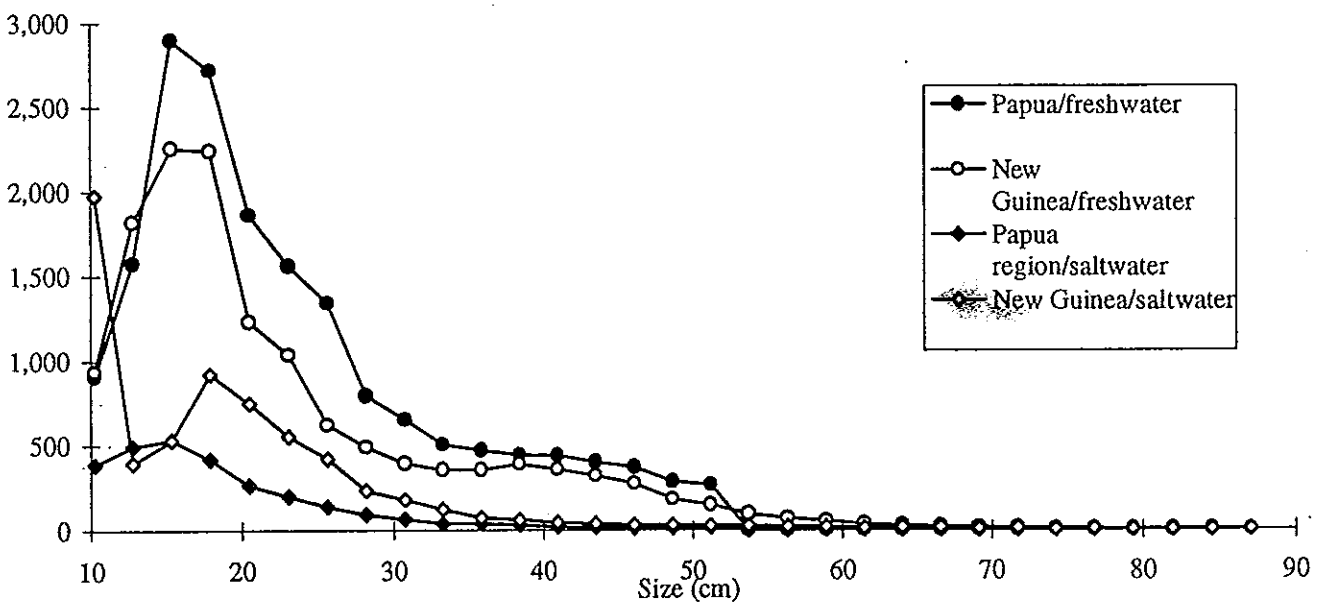


Table 7. Harvest effort on C. novaeguineae by skin size and region of origin. This frequency distribution attempts to eliminate the price effect and the population age-structure

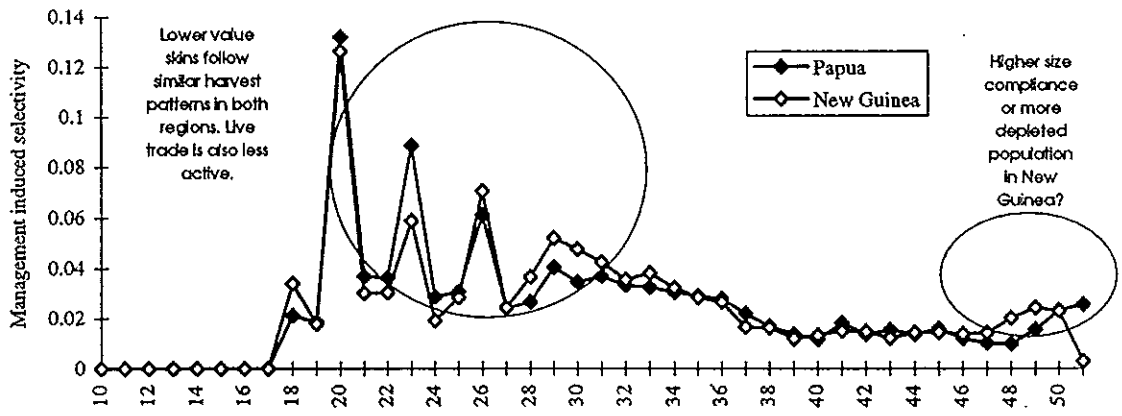
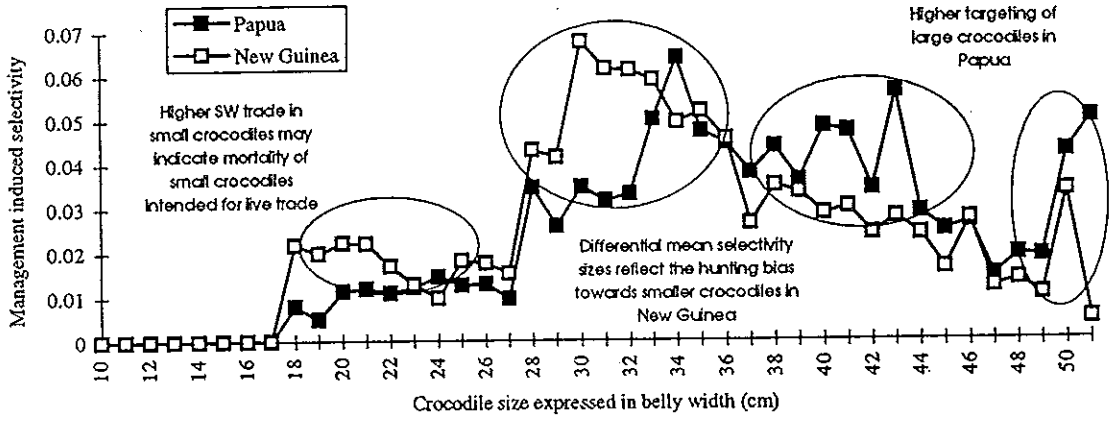


Figure 8. Harvest effort on C. porosus by skin size and region of origin. This frequency distribution attempts to eliminate the price effect and the population age-structure.



5

Commercial utilisation of Vicuña in Chile and Peru

Carlos Fernandez and Richard Luxmoore

Table of Contents

Acknowledgements

1 Introduction

2 Biological dimension: Ecology of vicuña
- 2.1 Historical decline of the vicuña
- 2.2 Current status of the species by country
  - 2.2.1 Chile
  - 2.2.2 Peru
  - 2.2.3 Bolivia
  - 2.2.4 Argentina
  - 2.2.5 Ecuador
- 2.3 Overall conservation achievements
- 2.4 Interaction with other species

3 Horizontal dimension (1): coordination across countries
- 3.1 Use versus non use countries

4 Vertical dimension: the market for vicuña products
- 4.1 The International market for luxury fibres
- 4.2 The Market for camelid products
- 4.3 Creating a legal market for the Vicuña fibre
  - 4.3.1 Processing
- 4.4 The marketing agreements
  - 4.4.1 Peru
  - 4.4.2 Chile
- 4.5 Trade controls and illegal trade in vicuña fibres and products
  - 4.5.1 Illegal trade
  - 4.5.2 Control mechanisms along the vertical structure
- 4.6 Conservation incentives along the vertical structure

5 Horizontal dimension (2): coordination across communities
- 5.1 Peru
- 5.2 Chile
- 5.3 Conservation incentives at the community level
  - 5.3.1 Vicuñas as assets
  - 5.3.2 Rent sharing mechanisms
  - 5.3.3 Protection incentives

6 Conclusions

Acknowledgements

There are many people who contributed their time and resources in the preparation of this study. In particular, we would like to thank Hernán Torres for his enthusiastic support from the outset of the study. In Arica, I would like to thank Eduardo Nuñez, for his useful comments and guidance. Don Juan Silva and his staff at CONAF provided invaluable assistance for this study. Particularly, Carlos Nasar and all the park rangers in the Chilean highlands.

I would also like to thank Héctor González at the Taller de Estudios Aymara for his valuable comments and support regarding the social changes in the highlands and the role of the vicuña.

In Perú, I would like to thank Alonso Burgos (Condor Tips), Domingo Hoces and Alfonso Martínez (Department of Agriculture) for their comments. We are also indebted with Raúl Tolmos, whose logistic support was timely and effective.

1 Introduction

There are cases were a no-use approach to conservation can have a significant positive impact on the population being targeted; however, the success of the conservation measures is coupled with an increasing cost being borne by the neighbouring community as restrictions on the use of resources take effect and competition for the habitat intensifies.

The Vicuña (Vicugna vicugna) is one such example. Hunted for their precious wool, which is the finest in the world, the vicuña was near to extinction by the late 1960s. Conservation measures based on non-use[1] allowed the wild populations of vicuña to recover. This has led to increased competition with domestic livestock and pressure from the local community to compensate them for their loses.

With a significant poaching of vicuñas and physical limits to the protection measures, the involvement of the local communities was seen as essential to curb the illegal activity. At various stages, the local communities in some countries have participated in conservation efforts as park rangers and guides, but their involvement was limited and did not target the underlying forces that created the demand for fibre downstream in the industry.

In recent years, initiatives to reopen a legal trade in vicuña fibre have taken concrete form and Peru and Chile are already exporting/processing vicuña fibre for commercial purposes. It is hoped that this step will provide both income to the local communities and the conservation effort and, provide incentives downstream in the industry to reduce illegal trade in the fibre.

A significant debate has arisen over the attempts to legalise trade in products from other species in the CITES appendices such as elephants and rhinos. The vicuña experience provides a unique example of the potential of commercial utilisation as a means to continue the conservation efforts within the framework of CITES.

The report is structured as follows: the ecological issues surrounding vicuña conservation are discussed in the first section; the issues of coordination at the country and community level are then discussed, placing particular emphasis on the interaction of the vicuña with the economy of the peasant communities of the Andean highlands. In the fourth section, the industrial structure generated by the commercial use of vicuña is presented (vertical dimension) and the role of international regulation (CITES) in the process. Throughout the analysis, we will contrast the experiences of Peru and Chile, the two range states with the most advanced utilisation programmes.

2 Biological dimension: ecology of vicuña

The vicuña (*Vicugna vicugna*) is one of four South American camelids along with the guanaco (*Lama guanicoe*), the llama (*Lama glama*) and the alpaca (*Lama pacos*). While vicugnas and guanacos are wild, the llamas and alpacas are domesticated, a process that appears to have

[1] Although they targetted use as an ultimate goal of the conservation project from an early stage, as will be discussed below.

started between 7,000 and 6,000 years ago.

The vicuña inhabits the Andean highlands, between 3,000 and 4,600 meters of altitude. It ranges from the 9° 30' to 29° 00' latitude south, distributed over four countries: Argentina, Bolivia, Chile and Peru[2] (see Map 1). It is a social animal, and is commonly found either in family groups, where dominant males protect various females and their young, or in groups of young males expelled from their family groups and aging groups who have lost their territories (Torres 1992). There are also some solitary males, but this group represents a very small proportion of the total population.[3]

2.1 Historical decline of the vicuña

Archaeological findings and ethnic history archives indicate three distinct phases of interaction between the vicuña and human populations. In a first stage, in the Arcaic era of the Central Andes (7,000 B.C.- 2,000 B.C.), human population in the highlands was significant and the vicuña was popular prey of the highland hunters (Hurtado 1987).

In the second stage, from the late Arcaic area to the advent of agriculture, in parallel, hunting and livestock rearing took place, with hunting being reduced in importance. Llamas and alpacas, both domesticated species, provided food, wool and fuel, and the llama could be used to carry loads. A more complex sociopolitical system emerged and the hunting of vicuña was banned for religious reasons. Wool was still obtained, although this was done through a management system imposed from political authorities. A live capture technique called chaku was used because it allowed the shearing and release of the animal with little impact on the population. These practices were clearly directed to the conservation and sustainable use of resources, where the vicuña wool was only used for special robes for the nobles and royals (Hurtado 1987).

The system, however, was affected by the European invasion, giving way to a third phase where the planned chaku was gradually dismantled and hunting of vicuñas increased, coupled with a regional land struggle between native communities and the Europeans. The few attempts to regulate the use of vicuñas failed (Hurtado 1987) and uncontrolled hunting continued until significant control measures were set in place in the 1950s by which time the population was nearing extinction, with just an estimated 10,000 individuals left (Torres 1992).

2.2 Current status of the species by country

2.2.1 Chile

The vicuña is distributed along the Chilean highlands in the regions of Tarapacá, Antofagasta and Atacama, and along part of the border with Peru, Bolivia and Argentina. However, the population is highly concentrated in the Tarapacá region, which holds 96 percent of the population. Population in 1992 was estimated in 23,586 for the Tarapacá region, and estimates

---

[2] There has been a recent effort to reintroduce the vicuña to some areas of Ecuador; however, this is still at an early stage.

[3] Data from the Chile indicate that around 79 percent of the population lives in family groups, 20 percent in male groups and only 0.9 percent are solitary males (Torres 1994).

for the other regions in 1990 were 1,564 (Antofagasta) and 123 (Atacama), making a total estimate of 25,273 (Torres and Nuñez 1994)

Conservation and patrolling of the reserves is the responsibility of the Corporación Nacional Forestal (CONAF), which patrols approximately 500,000 ha and carries out census work in some 1,500,000 ha (Glade and Cunazza 1992).

Chilean law prohibits any kind of use in the National Reserves. Hence, the status of the Lauca National Park was redefined in 1984 and two management zones were created to start management trials: The Caquena management zone and the Parque Nacional Las Vicuñas.

2.2.2 Peru

Peru has the highest concentration of vicuñas, with an estimated population of around 80,000 individuals[4] (Torres and Nuñez 1994), mostly concentrated around the Departments of Ayacucho (60 percent) and Puno (22 percent) (Hoces 1992). A recent census, however, shows a significant drop in populations particularly in areas were active poaching had been denounced by the communities (Torres and Nuñez 1994).

Being the pioneer with the first vicuña reserve in Pampa Galeras in 1965, Peru has accumulated valuable experience with protection and management of vicuña populations. Given the success of the recovery of the wild populations, the Pampa Galeras vicuña population was downlisted to Appendix II of CITES for the purpose of allowing international trade in industrial fabrics.

Poaching and illegal trade are still active, but the high protection costs have limited the capacity of the management authority to eradicate these activities. Nonetheless, the management authority is actively protecting the vicuña and has advanced community participation in protection activities.

Peru has already started to export textiles from its Appendix II populations through the Ministry of Agriculture's Special Project for Rational Utilisation of the Vicuña.

2.2.3 Bolivia

The overall situation of the vicuña populations in Bolivia is insecure, since conservation measures have been hit hard through budget restraints and restructuring. In 1989, the Instituto de Fomento Lanero, responsible for the National programme for the Vicuña was dissolved, leaving the programme in the hands of two institutions, but dismantling the park ranger staff and interrupting research (Villalba 1992). Poaching and health problems (scabies), have been detected but there is limited funding available to combat these.

The total population of vicuñas within protected areas in Bolivia is estimated at 12,047, with the largest concentration around the Ulla Ulla National Wildlife Reserve. This is the only population

[4] Previous estimates of vicuña population size are thought to be flawed methodologically and therefore relatively unreliable (Torres 1994). The number quoted above is a forecast based on the partial result of an ongoing census in Peru.

(2,900) with utilisation potential in the mid term (Villalba 1992). At present, Bolivia is negotiating some fabric trials.

2.2.4 Argentina

The vicuña inhabits the highlands of the northwestern section of the country. According to the 1990 census, there are around 23,000 vicuñas in their range area, with 15,900 within the six vicuña conservation areas (Cajal and Puig 1992).

Poaching has increased notoriously in the early 1990s, particularly in areas with large numbers of vicuñas. This has been attributed primarily to deficiencies in the protection system due to lack of funding. Some efforts to incorporate the communities in conservation efforts have been undertaken, particularly in the Laguna Blanca Provincial Reserve, Catamarca Province and in the Laguna de los Pozuelos Provincial Reserve, Jujuy province (Cajal and Puig 1992).

Utilisation, however, is not feasible in the near future as higher population levels are thought to be needed and funding is needed to start a programme of experimental capture and release. Nonetheless, there has been some work done to assess the potential impact of utilisation by Rabinovich, Capurro and Pessina (Rabinovich et al. 1991).

2.2.5 Ecuador

The vicuña is extinct in Ecuador. However, this country is a signatory to the Convention for its protection and some live animals have been reintroduced.

2.3 Overall conservation achievements

The vicuña has experienced an overall impressive recovery during the last 30 years. From an estimated 6,000 over the four range countries in 1965, the vicuña reached 10,000 by 1970, 101,215 in 1983 and around 154,000 by 1992 (Torres 1983) (Torres 1992). Management areas have also increased from 248,000ha in 1965 to more than 7,289,896ha in 1982 to some 20,800,000ha currently under protection status. However, the financial resources to protect those areas effectively have not grown at the same rate (Torres 1983), given the financial difficulties of the range states.

Conservation efforts have been particularly successful in Peru and Chile, where population levels increased significantly during the early years. The populations in Argentina and Bolivia have not recovered to the same extent and poaching, predators and diseases are threatening the local populations. Utilisation efforts and community involvement have been concentrated in regions where densities of vicuñas are largest, as can be seen in Table 1.

2.4 Interaction with other species

Although vicuñas have natural predators such as pumas and foxes, the most important limiting factors appear to be poaching by humans and the availability of food, for which they compete with other livestock, like llamas and alpacas. It is the first factor which motivated governments

to protect the species and ban all use; it is the second, however, which has caused most social conflict as communities resent the competition of the vicuña for the scarce bofedales in the highlands.

Table 1. Vicuña populations, densities and management status in conservation areas in the range states.

Country	Name	Province/ region	Hectares	Population of vicuñas	Density (#/km²)	Status
Argentina	San Guillermo PR \1	San Juan	981,460	7,100	0.72	
Argentina	Laguna Brava PR	La Rioja	405,000	1,100	0.27	
Argentina	Laguna Blanca PR	Catamarca	750,000	1,200	0.16	
Argentina	Los Andes PR	Salta	1,440,000	500	0.03	
Argentina	Olaroz PR	Jujuy	180,000	4,000	2.22	
Argentina	Lagunas de los Pozuelos PR	Jujuy	20,000	2,000	10.00	
Bolivia	Ulla Ulla Huaripampa Unit (incl. Ulla Ulla Nat.	North	242,000	2,900	1.20	
Bolivia	Mauri-Desauguadero Unit (incl. 10 protected areas)	Cantre	297,983	3,533	1.19	
Bolivia	Mauri-Sabaya Unit (incl. Sajama Nat. Park)	Cantre	1,495,160	997	0.07	
Bolivia	Desaguadero-Poopó Unit (incl. Huancarmona Wildlife	Cantre	1,900,022	777	0.04	
Bolivia	Patacamaya-La Matla Unit (incl. 4 protected areas)	Cantre	165,766	404	0.24	
Bolivia	Altamachi-Morochata Unit	Cantre	100,000	440	0.44	
Bolivia	Uyuni Unit (incl. Yurá Nat. Wildlife Res.)	South	4,445,500	210	0.00	
Bolivia	Lipez Chichas Unit (incl. Eduardo Avaroa Nat.	South	1,323,941	2,786	0.21	
Chile	Caquena management zone	Tarapacá	197,719	4,338	2.19	Utilization
Chile	Lauca NP \2	Tarapacá	137,883	10,082	7.31	
Chile	Las Vicuñas National Reserve, Salar de Surire Natural	Tarapacá	395,173	11,724	2.97	Utilization
Chile	Volcan Islunga NP	Tarapacá	174,744	90	0.05	
Chile	Census area of Licancabur volcano and Punta Negra	Antofagasta	1,211,940	905	0.07	
Chile	Los Flamencos National Reserve	Antofagasta	73,986	159	0.21	
Chile	Talio National Park (proposed)	Antofagasta	163,000	355	0.22	
Chile	Río Frío National Park (proposed)	Antofagasta	173,000	151	0.09	
Chile	Atacama high plateau management zone	Atacama	107,571	123	0.11	
Peru	Los Libertadores-Wari Region (subproject Pampa	Ayacucho	527,223	59,097	11.21	Utilization
Peru	Los Libertadores-Wari Region (subproject Pampa	Huancavelica	34,000	882	2.59	Utilization
Peru	Los Libertadores-Wari Region (subproject Pampa	Apurimac	55,202	1,168	2.12	Utilization
Peru	Inca Region (subproject Cusco)	Cusco	120,000	1,596	1.33	
Peru	Andrés Avelino Cáceres Region (subproject Huancayo)	Junín	133,440	3,474	2.60	Utilization
Peru	Andrés Avelino Cáceres Region (subproject Huancayo)	Huanuco	50,000	470	0.94	Utilization
Peru	Andrés Avelino Cáceres Region (subproject Huancayo)	Pasco	9,560	24	0.25	Utilization
Peru	Lima Region	Lima	1,038,800	3,667	0.35	
Peru	Arequipa Region (subproject Arequipa)	Arequipa	331,288	2,966	0.90	
Peru	José Carlos Mariátegui Region (subproj. Puno)	Puno	1,832,767	21,363	1.17	Utilization
Peru	José Carlos Mariátegui Region (subproj. Puno)	Tacna	181,190	2,196	1.21	Utilization
Peru	José Carlos Mariátegui Region (subproj. Puno)	Moquegua	76,530	438	0.57	Utilization
Peru	Gran Chavín Region (subproject Huaráz)	Ancash	28,000	259	0.93	
Peru	La Libertad-San Martín Region	La Libertad	5,568	70	1.26	

\1 PR - Provincial reserve
\2 NP - National Park

Studies in Chile suggest that the vicuña population has reached the carrying capacity of the habitat (given the existing livestock densities), which would account for the oscillating pattern in the population levels registered since 1990 (Torres and Nuñez 1994). As the Table 2 illustrates, every hundred vicuñas in the highlands eat the same quantity of food as 75 alpacas, or 61 llamas or 72 sheep.[5] The total stock of domesticated livestock in the management zones, is estimated to be the equivalent of 51,864 heads of vicuña. The 21,620.2ha of bofedal available

[5] Simulation models by Rabinovich et al. 1987 used 60, 60 and 90 respectively for the case of Pampa Galeras, Peru.

in the management areas of the Parinacota Province, is therefore estimated to be capable of supporting 25,969 vicuñas in the management areas of the Parinacota Province (see Table 3). However, in 1992 the vicuña population in the area was estimated in 26,144, indicating that it is at carrying capacity and is in competition with domestic livestock for food.

Table 2. Carrying capacity of bofedales in the Management Zones in the Parinacota province

	Vicuña	Alpaca	Llama	Sheep
Bofedales	21,620	21,620	21,620	21,620
Animals/ha	3.6	2.7	2.2	2.6
Theoretical Carrying capacity	77,833	58,375	47,564	56,213
Wool yield (kg) *	0.2	2.6	1.53	0.68
Price (USD/kg)**	180	7.5	5	
Rotation (yr)***	2-4	2-3	2-3	
Income per animal/year (max)	18.00	9.75	3.83	
(min)	9.00	6.50	2.55	
Income per ha. (max)	64.80	26.33	8.42	
(min)	32.40	17.55	5.61	

* Source: TEA 1991
** Prices to livestock owners. Vicuña prices are estimates of net revenue per kg.
*** TEA 1991 and Nuñez et al. 1994

Table 3. Carrying capacity and current stocks in the management zones

Management Zone	Carrying capacity (vic. units)	Current domestic stock (vic. units)	Potential Vicuña stock a	Current vicuña stock b	Additional capacity c=a-b
Caquena	19,778	16,274	3,504	5,127	-1,623
Lauca National Park	20,917	16,374	4,539	9,121	-4,582
Las Vicuñas National Reserve	37,138	19,212	17,926	9,310	8,616
TOTAL	77,833	51,860	25,969	23,558	2,411

Source: Reporduced from Nuñez et al. Table 2 and Table 28.

3 Horizontal dimension (1): coordination across countries

There are several legal and policy documents that effectively link the conservation efforts of all range states involved and create a negotiating table for current and future approaches in the region. In 1969 the first agreement for the protection of the vicuña (Convenio para la Conservación de la Vicuña) was signed by Peru and Bolivia, with Chile joining in 1973.[6] The agreement banned all international and internal trade in vicuña products and prohibited the export of fertile individuals to third parties (Anon. 1979). Ten years later, the Andean countries signed the Agreement for the Conservation and Management of the Vicuña (Convenio para la Conservación y Manejo de la Vicuña) This agreement explicitly commits the members to sustainable utilisation of the species for the benefit of the rural communities in the Andean region.

[6] Peru and Bolivia signed in 1969, with Argentina joining in 1971 and Chile in 1972.

Another legal instrument for the protection of the vicuña is the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), ratified by all range states. CITES initially listed all vicuña populations in Appendix I, which banned all commercial international trade in the species.

This status, however, was changed later to enable early experimentation with capture and shearing methods as well as processing trials for the fibre. In 1987, the trademark 'Vicuñandes' was registered in CITES for the purpose of identifying the fibre from management areas. Several populations in the range states were downlisted to Appendix II to allow export of fibre obtained from live animals. The populations downlisted were those in the Lauca National Park and seven areas in Peru including the Pampa Galeras National Reserve and the Salinas-Aguada Blanca National Reserve. Export of any other product was explicitly banned (Anon. 1986).

At the last Conference of the Parties in Fort Lauderdale in 1994 this was extended to include all Peruvian populations, and amendments to the conditions were made to allow trade in raw wool. More recently, Chile and Peru have signed additional agreements with regard to technical cooperation and information sharing for the protection of domesticated South American camelids, which sets a stronger basis for joint marketing and self regulation (Convenio de Cooperacion Técnica y Científica para el Desarrollo de los Pueblos Andinos y la Protección de los Camélidos Sudamericanos Domésticos, signed on 7 March, 1994). These agreements extended a similar agreement between Peru and Bolivia in 1990, and enables further cooperation in the marketing of domestic alpacas and llamas.

3.1 Use versus non use countries

The concept of utilisation for the benefit of the rural communities as a goal of conservation was made explicit by all range states through the various Vicuña Agreements, with Peru at the forefront of developments, having significantly larger populations. The exact nature of utilisation, however, has changed over the years, and considerable debate took place over culling and harvesting of wool by lethal methods in the Pampa Galeras National Reserve during the late 1970s and early 1980s (Otte and Hoffmann 1981; Eltringham and Jordan 1981). At present, however, there seems to be consensus that live capture and shearing is a feasible alternative.

Now that the utilisation projects have taken concrete shape in Chile and Peru, the other two countries may speed up their own programmes. Bolivia is already known to have started manufacturing trials with the view to trading in wool in the near future.

Populations under management up to now in Peru and Chile occur at relatively high population densities, at least in the main reserve component, thereby reducing the cost of capture and increasing the revenue per hectare. The number of other areas with relatively high densities is low. This effectively means that some areas will have to be excluded from management as it would be uneconomic.

While revenue from commercial utilisation will compensate communities for lost revenue in domestic livestock and their conservation efforts in areas where management is taking place, it is not clear that conservation efforts in areas outside of the utilisation management programme will be funded by a share of this revenue or through other means. Such investment in conservation efforts in areas with no utilisation potential at present will be required if these

areas are to be included in the utilisation programme in the future and not neglected. At the national level, the issue of these low vicuña population density areas has been approached by Peru and Chile in different ways as will be seen below.

4 Vertical dimension: the market for vicuña products

4.1 The international market for luxury fibres

Vicuña wool has been long praised for its softness and fineness. Its current scarcity also adds to the high prices commanded by the few items traded internationally. Unlike common fibres such as wool and cotton, vicuña wool occupies a niche in the market of the so-called luxury fibres which includes fibres like Alpaca, Angora, Cashmere, Camel hair, Mohair, Musk Ox and Yak wool. In this exclusive market, fineness, scarcity, unique appearance and status of the fibre largely determine their value (see Table 4 and Figures 1-2). Production of all luxury fibres represents less than 3 percent of annual sheepwool production by weight.

Among the luxury fibres, there are also significant differences which reflect in their final value. Mohair, for instance, is considered the most 'commercial', and the one which potentially competes most with more common fibres like wool (Buxton 1986). Its large production (28,820 kg. and growing) coupled with its relatively high diameter (24-40 microns) makes it less valuable.

At the other extreme of the market for luxury fibres is the fine Cashmere, with production under 5,000 tonnes/yr. With the exception of vicuña, this fibre has the strongest associations with luxury and fetches prices of around US$90/kg. Angora is also in relatively large and growing supply (7,000 kg.) and is even finer than cashmere; however, its image of a 'downmarket' fibre has depressed its prices well below those of cashmere (Figure 2).

Among all fibres, however, vicuña is considered the finest and rarest. Its fibre diameter fluctuates between 10-30 microns,[7] and its softness and colour are highly valued. These characteristics create a natural niche for the fibre, commanding the highest prices of any other fibre.

Despite the fact that vicuña has been officially out of the market for many years, the trade in vicuña products, wool, fabric and garments has continued, partly fueled by legal pre-convention stocks and illegal trade. CITES records illustrate the minimum size of this trade (see below). Current prices are also very high, owing primarily to the scarcity of the fibre. In 1986, a price of GBP1,200 per metre was reported in Japan (Buxton 1986), or about 17 times more expensive than the most expensive cashmere. When asked about the expected price of vicuña fabrics in a regular market, one analyst suggested that vicuña fibre could fetch from GBP 600 (Buxton 1986) to GBP 1,000 (Rowett Research Institute 1990). Final prices obtained by the Peruvian agreement indicate that actual prices will rather be in the lower side of the range. In fact, Loro Piana has

[7] Recent trials in Chile managed to obtain two classes of fibre with an average diameter of 10.82 and 14.40 microns.

suggested that the retail price of garments would be around 3-5 times greater than the cashmere equivalent.

While lower value luxury fibres suffer from increased competition from improved qualities of wool knitwear, the vicuña appears to be relatively secure given its unique qualities. Nonetheless, although the market exists for the fibre, prices for fibres are extremely volatile, given the uncertainty in production and the monopolist marketing in the producing countries.

4.2 The Market for camelid products

All South American camelids produce fibre for which there is some demand in the textile market, although guanaco and vicuña are restricted due to conservation measures. There is a legal market for Alpaca and Llama wool, but the latter is of much lower importance. The importance of their market stems from their abundance and hence their substitutability as investments for the local herders (see below)

In the market for alpaca, there has been a process of organisation of production during the last decade,particularly in Peru, where 90 percent of alpaca is produced. Direct marketing channels are being created for the rural communities, as well as certification schemes. For instance, the International Alpaca Association (IAA) was founded in 1983 to promote alpaca and its name through, among other things, a certifying trademark for various alpaca qualities and mixtures. Another development in the past years has been the development of a local processing industry in Peru, producing both yarn, cloth and finished products. At present, a few companies control trade in international camelid hair, Alpha Tops, Michelland Sarfaty (Peru) and Leers (Argentina), controlling both producer and consumer prices.

Despite these efforts, prices for Alpaca have been falling slowly but steadily over the last ten years, partly as a result of general trends in the fibre market and the changes in fashion, and the increasing competition from fine wools, factors that the small number of alpaca producers cannot alter. Additionally, social and political unrest have also had an adverse effect on the alpaca trade (Vinella 1994).

In Chile, the market for Alpaca wool is highly subject to the trends in the neighbouring countries, given its low production volumes and poor marketing (González et al 1991). Most Chilean production enters the world market through the Peruvian or Bolivian market or through the few traders in Arica. There is no major tradition of textiles in north Chile and no local industry in the main producing areas.

Table 4. Characteristics of major luxury fibers.

Fibre	Source animal	Major producing regions	Trend \2	World Production (tonnes) 1985/86	Prices to spinner (£/kg) avg.	range	Prices of UK fabrics (£/metre) min	max	Fibre diameter (microns) min	max	Staple lenght (mm) min	max
Alpaca &	S. Am. Camelids	Peru	S	4,000	10	9-15	50		22	34	75	
Angora	Angora rabbit	China, SA	G	7,000	30	25-40			11	12	25	50
Camel hair	*Camelidaes* fam.	China, Mongolia	D	< 1,500	13	10-15	40	50	19	26	29	125
Cashgora	Angora goat	NZ	G	50	30				20	22	50	60
Cashmere	Cashmere goat	China, Mongolia, Iran, Afgan	S	4,500	60	30-70	60	70	15	20	25	90
Mohair	Angora goat	S. Africa, Texas, Turkey	G	20,820	10	6-16	40	50	24	40	75	100
Vicuña	S.Am. Camelids	Peru		0.441 \1	200		600		10	30	30	50
Yak wool	Yak-*Bovine* fam.	Himalayan region	D	<< 1,000	13				19	20	30	50
Wool	Sheep	Australia, NZ	S	1,727,000	6	4-9	25		17	19		80

\1 Declared trade in hair and cloth in kg as declared in CITES permits.
\2 G-growing, S-stable, D-declining.

In terms of value along the vertical structure, raw fibre costs represent about 45 percent of final retail price of processed products, processing represents some 30 percent, with the remaining 25 percent being absorbed by shipping, customs and marketing. This suggests that more than half of the final cost is unrelated to the fineness of the fibre, and that up to 75 percent of the value is captured by the producing country (Vinella 1994). By volume, Italy consumes half of the camelid hair, followed by Japan (15 percent), Germany (10 percent) and the UK (10 percent).

The market status of the alpaca can play an important role in enhancing the economic value of the vicuña trade, since tenders for the marketing of vicuña have expressed interest in linking the marketing of vicuña to a general promotion of South American camelids.

The market outlook for South American camelid wool will depend primarily on the general trend in the world economy, which in turn affects the demand for luxury products, and on the promotion efforts as brand names are important in the textile industry (Russel 1990). However, significant increases in the market are unlikely.

4.3 Creating a legal market for the Vicuña fibre

One of the most common problems in marketing conservation is the lack of skills in the management authority to effectively capture rents from the industry and channel them down to the consumer. In the case of vicuña, it was clear that professional industrial processing was the only process that guaranteed a high value end product, as well as one difficult to copy (rent creation). This, however, does not guarantee a considerable share of the rents being captured by the local communities, a process which involves both effective market power in the industry (rent sharing at the vertical structure) and effective distribution channels at the community level (rent distribution at the horizontal level).

This process is clearly illustrated by the Peruvian experience of tendering the processing of their fibre. Early tenders in Peru, processed locally, offered between US$50 and US$100 per kilogram of fibre, the low price. A subsequent round for tender organised by the government resulted in US$175 being offered. The final tender, however, organised by the National Breeder's Society, fetched a price of US$300/kg. plus participation in the utilities of the company.

The negotiating process in Chile was clearly positively influenced by the Peruvian deal, as US$300/kg. became the benchmark for any deals made at this initial marketing stage.

4.3.1 Processing

Vicuña fibre is not an easy fibre to process given its fineness and relatively short staple length. Worldwide, only a handful of companies have the experience and technical capacity to process it. These characteristics encouraged management authorities to seek joint ventures with the industry, abandoning all efforts for a indigenous industry in vicuña products.

The dehairing process is slow and expensive and needs to be accurate to produce quality fibre. This process can be done mechanically (although less accurate) in industrialised countries, while, the more accurate hand sorting can only be afforded in countries with low labour costs, a key indicator of competitiveness in the textile industry. In 1994, while Italy's average hourly labour costs were around US$15.65 and the UK 10.74, Peru's were just US$1.70 (Anson and Simpson 1995). These differences and the resulting quality will come into stronger play in future tenders for the processing of vicuña fibre. At Condor TIPS, yields expected by hand sorting the fibre are expected to be well above the technical specifications, adding to the future merits of the company in the next tender.

4.4 The marketing agreements

The basis for the marketing agreements was set in the amendments to the Appendices in the VI Conference of the Parties to CITES in Ottawa (1987). There, the Parties resolved not only to transfer some populations from Appendix I to Appendix II, but also to allow trade in cloth made with fibre obtained from those populations by live shearing. Commercial trade was to be regulated by the use of the registered trademark 'Vicuñandes-country of origin'.[8]

The limitations where further lifted in the IX Conference of the Parties in 1994, where trade was allowed in raw fibre obtained under the same restrictions. Such a move was made to allow the range states to explore other alternatives to national processing but, most importantly, it was a necessary move for Chile, where no appropriate textile industry exists.

4.4.1 Peru

Peru's market strategy was to offer the volume of fibre in stock for tender, thereby guaranteeing the effective supply of fibre and reducing uncertainty in the buyers, rather than engaging in future markets. The final tender, organised in 1993 by the National Breeder's Society, offered a total of 2,000 tonnes of fibre and 200 metres of cloth from early trials. The tender was for a two-year participation agreement, requiring the applicant to guarantee a direct processing line to the final

[8] In december 1994, the Technical Commision of the Vicuña agreement decided to change the name of the trademark to Vicuña-'country of origin', as it was thought that Vicuñandes could cause confusion as to the origin of the fibre and the name was less familiar to the public.

consumer. It also excluded the possibility of mixtures. Hence, the resulting cloth had to be pure vicuña to guarantee the production of the finest yarn and to simplify the control mechanisms.

At the time of the tender, however, CITES regulations still prohibited trade in raw wool, forcing the tenders to require either national processing or non-commercial processing with reimport into Peru.

Tenders included CINSA (Peru), Piacenza (Italy), Zegua/Dawson (UK) and the International Vicuña Consortium (Condor TIPS (Peru), Agnona (Italy) and Loro Piana (Italy)). The latter tender was accepted. The Japanese did not participate. The International Vicuña Consortium (IVC) was partly a compromise to accommodate the needs of CITES. Hence, there may be changes in the next tender, when raw fibre will be traded.

The final agreement signed by the IVC and the National Breeder's Society (NBS) granted multiple revenue channels for the NSB: they received US$300/kg. of fibre, US$200/m cloth plus a royalty from the cloth and from final product revenues. There is also an efficiency royalty, whereby revenue from increases in sorting and washing efficiency will also be shared with the NSB by paying a higher price per kilogram of fibre. Additionally, the IVC will also pay for supervision and technical assistance, as well as for promotion activities in the final markets. Figure 3 illustrates the various aspects of the agreement.

4.4.2 Chile

No doubt, the Chilean agreement was accelerated and benefited from the negotiations in Peru. In this case, however, the agreement is more based on fibre, rather than cloth, given the lack of a suitable national industry. Chile has dealt directly with Loro Piana, who signed an agreement to process fibre with preference on any sale options when the final sale arrangements are made. The price per kilogram of fibre obtained by the Chileans is the same as the Peruvian, but no addition was made on participation of utilities and on technical assistance funds, at least at this stage.

The various differences between the two agreements is presented in Table 5, which also highlights the additional spillovers from the Peruvian agreements, like the local employment and the closer involvement of the NBS in the process. Of the 120 women sorting the fibre in Condor TIPS, at least 10 percent are from communities which are members of the NBS. Additionally, an official from the NBS is continuously supervising the sorting operation, ensuring that the fibre yields are legitimate. Such direct accountability of the programme may play a strong role in ensuring credibility and involvement. Alonso Burgos, representative of Condor TIPS, has indicated that training of local communities could allow on-site sorting, further increasing the community involvement in the programme and with the potential to be expanded to other species. The final impact on conservation however, is closely linked to the nature of current poaching (by community members or by external agents), and the strength of local communities to effectively protect their land (see below), although

no doubt the economic effect would be positive.

Nonetheless, the Peruvian government is committed to support any measure that can increase the bargaining power of the communities, as a means to guarantee the highest possible value from the species. For this purpose, they have not only supported the Chilean proposal to allow trade in raw fibre, but have strongly encouraged other Andean countries to support common marketing.

4.5 Trade controls and illegal trade in vicuña fibres and products

4.5.1 Illegal trade

Despite the ban on trade, vicuña and vicuña products have been present in international trade as can be seen in Table 6. In the period 1984-93 an average of 119 kg. of fibre and 407 kg. plus 3,986m of cloth were traded annually.[9] These data indicate that most recorded international trade transactions have taken place in processed products.

Few of the records declare country of origin, nonetheless, 30 percent of the declared trade in fibre came from Bolivia, while just 2.4 percent came from Peru. In meters of cloth, 63 percent came from Bolivia and 4.2 percent from Peru. In garment unit these percentages are 18.7 percent and 5 percent respectively (Table 7). These figures may reflect Bolivian stocks that were accumulated after CITES entered into force in other range states (1975) and before Bolivia joined (1979) or illegal stocks declared as pre-convention. In any case, these proportions are consistent with the extremely low population levels in Bolivia.

The main trade route is between Great Britain and Japan, with virtually all textile trade by piece, 70 percent of trade by weight and 89 percent of all trade in cloth by metre. Belgium, the second largest exporter does not deal with finished garments, accounts for 27 percent of all trade by weight and 6.3 percent of trade in cloth by metre. Virtually all its exports are destined for Japan. Other exporting countries include Italy and France, although no trade in fibre is recorded and most exports are in cloth (Table 8). Again, at least half of their exports go to Japan, and most of the other trade goes to the UK.

[9] The cloth statistics may be misleading since they also include mixures of fibre, inflating the effective vicuña volumes being traded. Such a flaw is particularly important in the Japanese statistics, were it has been documented that some shipments have misleading data.

Table 5. Current agreements for commercial utilization of vicuña

	Perú	Chile
National Fibre Provider	National Society of Vicuña Breeders	CONAF
Processing firm	International Vicuña Consortium	Loro Piana
Objective	Harvesting, processing and marketing.	Experimental trials with a view to market. Loro Piana seeks exclusivity agreement on a long term.
Volume of fibre	2,000kg of raw fibre and 400m of cloth over two years	100kg of raw fibre, with potential to expand it to 300-500kg/year.
Prices	US$300/kg of fibre and US$200/m of cloth.	US$300/kg once CITES permit is approved for commercialization
Royalties	10% on net revenue from cloth and 5% on finished product or US$440,000, whichever is greater.	none
Other revenue	US$30,000 for supervision costs and US$150,000 for technical assistance. Additionally, US$6/kg for every percentage point above the expected yield after dehairing and washing (expected at 69%).	US$12,500 to cover rearing costs.
Duration of the agreement	2 years	1 year
Additional benefits	Community participation in the sorting of the fibre and training being provided at Condor TIPS. Local accountability. Potential increase in demand for alpaca.	Potential market channel for alpaca.

Most of the reported imports were to Japan, almost all of it reexports from non-range states (Table 9). The strong position of Japan as an importer of the fibre that enters the international market, whether of legal or illegal origin, may have been a factor in their decision not to participate in the tender for the Peruvian stocks, as it would have required declaring all remaining stocks.

Existing levels of trade may pose a threat to legal trade in vicuña fibre products, particularly considering (1) the high levels of trade reported, (2) the fact that Japanese and British manufacturers are not involved in the project, and hence not directly accountable, (3) that between 6 and 10 tonnes of fibre may have entered the international market since 1991 mainly as a result of poaching in Peru (Caretas 1994).

Data on British stocks of vicuña wool and products are available for January 1981 and June 1983. While a total of 1,643 kg. of fibre was declared in the hands of 29 companies in 1981, by 1983, stocks had been reduced to 1,280kg.[10] This implies that 363kg. were either exported or sold to the internal market between 1981 and 1983. Declared exports account just for 112kg., suggesting that 250kg. were sold internally in the period.

Due to lack of data on internal consumption, an accurate extrapolation of the data to estimate current level of stocks based on declared exports is impossible. However, an upper boundary can be estimated assuming no domestic consumption of vicuña wool in the UK and limiting the analysis to raw fibre only to avoid mixtures. The result is shown in Figure 4. As can be seen, according to these data, stocks in the UK were exhausted by 1993.

Also in Figure 4, it can be seen that trade intensified significantly between 1986 and 1988, possibly as a reaction to the amendments in the CITES Appendices and to the end of the ten-year ban on vicuña exports in 1989, self-imposed by the range states through the Vicuña agreements. Such behaviour would be consistent from an economic point of view - prices are expected to fall once legal stocks appear on the market. If the Peruvian market is maintained as expected, it would produce a flow of 1,000kg. of fibre annually, a volume which most likely will impact the international price.

[10] Source: Department of the Environment. The purity of the stock is not confirmed, but 1,144 kg. of the 1983 stock were hair, pressumably pure vicuña, while the cloth and yarn may have mixures.

Table 6. Trade in *Vicugna vicugna* products, 1976-1993.

	Live			Textile products				Other products		
		Hair		Cloth		Garments	Bones	Skeletons	Skins	Skulls
Year		(kg)	(pieces)	(kg)	(m) \1	(pieces) \2	(kg)	(pieces)	(pieces)	(pieces)
1976	3	0	0	0	0	0	0	0	0	0
1977	5	0	0	1	393	11	0	0	0	0
1978	2	0	0	6	3	0	0	25	0	3
1979	4	0	0	0	0	4	0	44	75	2
1980	7	0	0	0	146	0	40	25	2	1
1981	10	0	0	14	2,980	2	0	0	0	0
1982	5	84	0	2	3,048	2	0	0	0	0
1983	9	12	12	0	5,234	0	0	0	0	0
1984	5	0	28	1,271	4,221	3,776	0	0	0	0
1985	4	0	2,006	156	2,058	2,006	0	0	0	0
1986	4	214	23	227	8,893	3	0	0	0	4
1987	4	386	773	703	12,178	801	0	0	0	0
1988	204	241	0	16	63	0	0	0	0	0
1989	6	43	356	248	4,538	2	0	0	0	0
1990	7	192	1,042	0	3,665	134	0	0	0	0
1991	12	113	67	0	2,738	1	0	0	0	0
1992	14	0	677	1,446	1,513	0	0	0	0	0
1993	92	0	341	0	0	0	0	0	0	0

\1 Estimated total converting square meters to meters from CITES database.
\2 Number for 1984 repoted as 80 kg by GB

4.5.2 Control mechanisms along the vertical structure

From a conservation point of view, the increase in monetary value for the local communities of protecting the vicuña may have a positive impact at the local level and at the producing end of the industry. However, effective controls require the involvement of everyone along the industry and intermediate markets (i.e., communities, traders and manufacturers) and of the final consumer. In other words, rent creation and sharing at the intermediate levels of industry play a role in conservation in so far as they are involved in protection activities at every relevant stage of the industry. There are several channels by which profit maximising activities in the industry can contribute to the protection of the vicuña, particularly with regard to minimising illegal trade. For instance, effective trademark protection is needed to increase rents for the IVC, and also help to reduce the market for illegal fibre, especially if the image of exclusivity and rarity is transferred to the trademark, something common in the fashion industry. Advertising will also help in this process, linking vicuña-conservation-vicuñandes, thus reducing the value of illegally caught vicuña.

On the other hand, proposed promotion investments by IVC, targeted not only at the vicuña, but also at other camelids, may increase demand for vicuña, regardless of the trademark. The extent to which these factors balance out will determine the final effect of resumed trade on the illegal market.

The potential stockpiling of fibre by speculators buying the final product is limited given that the technical characteristics of the fabric make disassembly very difficult and uneconomic. The final product is a pure consumer good that cannot be reprocessed into other items and hence, it is fully identifiable. The creation of pure vicuña cloth also facilitates identification, and perhaps more importantly, reduces the number of garments to control. At the national level, the tender requirement to declare stocks to CITES should also help to put a ceiling on the number of

CITES permits issued for alleged pre-convention stocks, as most post-1991 trade has been reported.

4.6 Conservation incentives along the vertical structure

The strength of the incentive to protect the fibre is directly related to two factors: (1) the amount of revenue that can be obtained directly from the sale of vicuña products and (2) the amount of increased revenue that may result from the sale of other products supported by the 'prestige' of having the exclusive marketing of vicuña. The intention expressed by IVC to launch vicuña as part of a wider South American camelid promotion campaign, the explicit interest of Loro Piana to engage direct with alpaca producers in Chile, and the fact that Condor TIPS' main business is alpaca wool, is a strong indication of the expectations that IVC and its member firms feel confident that the vicuña trademark will provide them with significant additional revenue from indirect promotions. This is further evidenced by the large promotion expenditure being prepared by IVC.

Whether this commitment is long or short term is difficult to assess. However, the very nature of the tender process does not guarantee them exclusivity for more than three years.[11] Clearly, the industry would have preferred to guarantee longer term exclusivity.

Therefore, prestige and the 'quality' of such prestige will play a key role in the commitment that IVC may have in conservation investments and the defence of the trademark and its legitimate use. The question is rather whether IVC has sufficient strength to directly enforce or demand enforcement. Another question is whether as time passes and the tender is granted to different manufacturers, the same degree of commitment to the trademark will exist.

While the tender serves to give negotiating power to the NBS, it may also reduce the protection and promotion incentives for the winner, as it will become less 'exclusive'. So far, exclusivity is only guaranteed in the long term to the NBS, and the trademark should signal exclusivity of origin, with no commitment in the higher vertical structure. However, the trademark will clearly serve more purposes for IVC. While scarcity and novelty will certainly generate high rents in this initial tender, prestige generated will only pay in the medium long term.

The Chile agreement, signed directly with Loro Piana and not the entire IVC, is the first step towards the diversification of manufacturers, part of the overall strategy of the Andean countries to seek the highest negotiating power by diluting that of the processing industry and ensuring autonomy of supply to avoid future markets and commitments. Steps taken in this direction is the intention to make joint tenders for all Andean country stocks in future.

5 Horizontal dimension (2): coordination across communities

One of the main pressures hindering the advancement of the utilisation programmes has arisen from complaints of local communities that the increasing competition with domestic livestock was very damaging for the local economy. The rural communities living within the vicuña distribution range are also among the poorest in their countries, and, so, conservation efforts were a particularly high burden for them. Despite the similarities in ecosystems across countries, the social interactions present particular characteristics that demand different approaches to community involvement in the utilisation projects. While Peru has a significant population in the highlands and the regional economies are still active, the highlands in Chile have gradually, but steadily, been de-populated, and the stable local population is mainly composed of old people.

In this section, the various social restraints and possibilities of Community involvement are discussed for the case of Chile and Peru, and the capacity of such involvement to create effective incentives for conservation.

---

[11] Two years with the option to negotiate a renewal for up to a year.

5.1 Peru

Peru's Andean human population is higher than that of Chile, and 90 percent of the vicuña populations are located in communal lands (Hoces pers. comm.). This produces significant pressures from the communities to be compensated for their protection efforts, particularly as competition for habitat increases. In addition, some of the areas have been affected by guerrilla activities, making conservation activities more difficult. Peru's protection measures have been largely handled by the government through the Ministry of Agriculture and the National Council for South American Camelids (CONACS). Although protection measures are largely based with park rangers, it has long been recognised the efficacy and need for community involvement to minimise poaching.

Communities have been involved at various stages, mainly as employees of the park authorities, being paid in cash or food. However, this situation changed significantly in 1991, when reforms altered the legal status of the vicuñas in communal lands, returning them to the local communities in usufruct and custody and enabling communities to use vicuñas under state regulation.[12] Since then, the Communal Vicuña Committees (Comités Comunales de Vicuñas) have been created as a means to protect, negotiate and regulate the utilisation of the vicuña, complementing state protection (Torres 1992). The long-term objective is to devolve most of the protection activities to the local communities.

The legal changes, coupled with the advance trials by the management authority signalled the imminent reopening of the trade in vicuña wool, which was reflected in the fast response of the communities to create the Communal Vicuña Committees. From 100 committees in 1991, the number rose to 261 in 1993 and 320 in 1994. It is expected that the number of committees could eventually rise to up to 700 across the country.

The committees are organised by District and Region in greater Associations. At present, there are three regional associations corresponding to the communities surrounding the three areas where the populations transferred to Appendix II are located. With the recent changes to the CITES listings, other areas will also be able to produce fibre. The National Society of Vicuña Breeders encompasses all regional associations and is the legal body that signed the agreement with the International Vicuña Consortium for the processing of the vicuña fibre for commercial purposes.

Another significant change in the early 1990s was the increase in poaching, which is estimated to have killed at least 30,000 vicuñas between 1991 and 1994.[13] This appears to have caused a dramatic drop in the vicuña population which seems to be highly localised, particularly in the areas of greatest concentration like Pampa Galeras National Reserve and Salinas y Aguada Blanca. In

[12] Decreto Legislativo No. 653, Ley de Promoción de las Inversiones en el Sector Agrario.

[13] There could be up to 14,000 more if we account for the expected population growth (Caretas 1994).

Pampa Galeras,from an estimated population of 23,400 in 1986 (Anon. 1986), the number fell to just 8,600.These reductions will not only imply greater rearing costs, but also lower income to the communities, two factors that may affect adversely the conservation incentives in the communities.

In contrast, other areas have experienced growth in their populations. Populations have increased in Apurimac and Lima to an estimated 10,467 and 12,286 respectively in 1994 from 700 and 1,365 in 1980. The reasons for the increase in poaching are unclear. One factor that may have triggered it is the drop in alpaca prices over the last ten years by more than 50 percent (Vinella 1994). Vicuñas may also have been seen as an alternative to compensate for the reduced income from domestic livestock. However, if this were the case, poaching would probably have increased earlier.

Another possible explanation is the expectation of a reopening of trade in vicuña, inducing speculative stock to be built either in Peru or other countries.[14] This explanation seems feasible to the extent that poachers thought that trade was going to be open for all, and that they would be able to easily market the fibre, or that even controlled trade would reduce the cost of smuggling fibre.

Communal Vicuña Committees will carry out the rearing and shearing of vicuñas by the use of the chaku, where members of the community create a line and slowly drive the herds of vicuñas into a funnel and into a holding pen, where they are sheared and later released. Such operations require the construction of the chaku, mostly with fishing nets, which costs between US$15,000-17,000 and depreciates over a three to five year period (Alfonso Martínez pers. comm.). Its construction requires about 30 workers and takes two weeks. For the actual rearing and shearing of the animals, the operation requires a minimum of 80 people. The necessary work force being available because of the high population densities in Peru and the tradition of community work in the region.

Early trials in capture resulted in very low yields, 15-20 individuals. However, current captures can result in more than one hundred individuals per rearing attempt in Pampa Galeras (Caretas 1994).

5.2 Chile

In addition to international agreements, Chile has reinforced the protected status of the vicuña with national legislation. In 1972, the Game Law banned all hunting and trade in vicuña products indefinitely. The redefining of the Lauca National Park was necessary to allow legal harvest of wool from live animals before the Chilean Law. At present there are two management areas surrounding the Lauca National Park where harvesting of wool from live vicuñas is allowed: the Caquena Management Zone and the Reserva Nacional Las Vicuñas. Estimated vicuña populations in these areas are shown in Table 3 (together with other camelid populations and potential carrying capacity).

---

[14] A significant amount of fibre and pelts are known to be exported mostly through Bolivia (Hoces pers. comm.).

These areas are inhabited by people of Aymara origin. During the last decades, however, migration has intensified, and the local economies have in some cases almost disappeared. Around the management areas, only 12 percent of all adults remain in the highlands (Aguilera et al 1990). Nonetheless, a considerable population maintains rights and claims in their local communities, not only as cultural attachments, but through ownership of livestock. In contrast to the agrarian economies of the valleys, the main asset in the highlands is the livestock, and a wide range of contracts have been created to regulate their ownership and usufruct.

Estimates from the south highlands suggest that the number of absent comuneros with livestock in the highlands could represent up to 56 percent of the resident units, i.e. around 36 percent of the total owners (Aguilera et al. 1990). Absent residents leave their livestock under the supervision of a relative or occasionally hire others to look after it.

The low human population density, forced the CONAF to seek different rearing technologies to those employed in Peru. They developed a more capital intensive technology involving the use of trucks and motorbikes. The operation needs about 16 people, two motorbikes and a pick-up van instead of the work force of 80 required for the Peruvian version of the traditional chaku. Costs per chaku are also lower (about US$6,250 each according to the estimates from the Chilean agreement).

Table 7. Trade in live and textile products of Vicuna by declared country of origin 1976-1993

	Bolivia				Peru				Undeclared origin			
	Live	Textile products \1			Live	Textile products \1			Live	Textile products \1		
Year		(kg)	(m) \2	(pieces)		(kg)	(m) \2	(pieces)		(kg)	(m) \2	(pieces)
1976	0	0	0	0	0	0	0	0	3	0	0	0
1977	0	0	0	0	0	0	0	0	4	1	393	11
1978	0	0	0	0	0	6	0	0	30	6	3	0
1979	0	0	0	0	0	0	0	0	125	0	0	4
1980	0	0	0	0	4	0	97	0	35	40	49	0
1981	0	0	0	0	0	0	94	2	10	14	2,886	1
1982	0	0	0	0	0	0	0	0	4	86	2,941	2
1983	0	0	0	0	0	0	0	0	7	12	5,154	0
1984	0	3	0	0	0	0	0	0	5	1,348	4,173	3,887
1985	0	2	68	6	0	0	0	0	4	149	1,808	4,006
1986	0	440	8,490	18	0	0	0	0	8	0	70	8
1987	0	1,060	11,768	1,573	0	11	0	0	4	17	410	1
1988	0	78	0	0	0	5	0	0	203	174	63	0
1989	0	1	3,260	30	0	1	0	9	5	289	1,278	319
1990	0	0	480	532	0	0	916	595	7	192	2,269	49
1991	0	0	1,125	0	0	113	450	0	10	0	2,363	68
1992	0	0	843	100	0	0	370	0	14	1,446	300	577
1993	0	0	0	0	2	0	0	3	368	0	476	338

\1 Hair, Cloth and Garments

\2 Estimated total converting square meters to meters from CITES database.

Table 8. Main exporters of textile products (\1) of Vicuna products, 1976-1993

	Belgium			Great Britain			Italy			France		
Year	(kg)	(m) \2	(pieces)	(kg)	(m) \2	(pieces)	(kg)	(m) \2	(pieces)	(kg)	(m) \2	(pieces)
1976	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	393	11	0	0	0	0	0	0
1978	0	0	0	0	3	0	0	0	0	0	0	0
1979	0	0	0	0	0	4	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	49	0	0	97	0
1981	0	0	0	14	2,836	0	0	50	0	0	94	0
1982	0	0	0	86	2,808	0	0	107	0	0	133	0
1983	0	25	0	12	5,091	12	0	63	0	0	55	0
1984	8	11	0	1,343	4,135	3,882	0	0	0	0	75	3
1985	0	299	0	156	1,759	4,006	0	0	0	0	0	0
1986	1	333	0	440	8,560	23	0	0	0	0	0	0
1987	1	220	0	1,088	11,958	1,573	0	0	0	0	0	0
1988	0	63	0	257	0	0	0	0	0	0	0	0
1989	5	14	0	286	4,524	356	0	0	2	0	0	0
1990	0	0	0	192	2,960	1,042	0	285	67	0	0	0
1991	0	1,163	0	113	2,775	64	0	0	0	0	0	0
1992	1,446	0	0	0	1,513	677	0	0	0	0	0	0
1993	0	476	0	0	0	341	0	0	0	0	0	0

\1 Estimated total converting square meters to meters from CITES database.
\2 Number for 1984 repoted as 80 kg by GB.

Table 9. Main importers of textile products (\1) of Vicuna, 1976-1993

	France			Great Britain			Hong Kong			Italy			Japan		
Year	(kg)	(m) \2	(pieces)	(kg)	(m) \2	(pieces)	(kg)	(m) \2	(pieces)	(kg)	(m) \2	(pieces)	(kg)	(m) \2	(pieces)
1976	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	390	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
1979	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	0	0	0	97	0	0	49	0
1981	0	0	0	0	94	0	3	0	0	0	65	0	0	2,771	0
1982	0	0	0	0	0	2	0	355	0	0	0	0	86	2,541	0
1983	0	0	0	0	0	0	1	0	0	0	5	0	11	5,229	12
1984	0	50	0	0	0	0	8	0	0	0	0	0	1,343	4,221	3,885
1985	0	100	0	0	0	0	0	441	0	0	0	0	154	737	4,006
1986	0	0	0	0	0	0	2	0	0	2	0	0	435	8,893	23
1987	0	0	0	0	0	0	73	0	0	0	0	0	1,013	12,178	1,573
1988	0	0	0	0	0	0	70	0	0	0	0	0	187	63	0
1989	0	0	0	0	0	0	2	0	0	0	0	0	288	4,538	358
1990	0	0	0	0	0	0	0	0	0	0	0	0	192	3,665	1,174
1991	0	0	0	0	0	3	0	0	0	0	0	1	113	3,938	64
1992	0	0	0	0	0	0	0	0	0	0	0	0	1,446	1,513	677
1993	0	0	0	0	0	0	0	0	0	0	0	0	0	476	341

\1 Estimated total converting square meters to meters from CITES database.
\2 Number for 1984 repoted as 80 kg by GB

5.3 Conservation incentives at the community level

5.3.1 Vicuñas as assets

It had been shown that vicuñas compete with domestic livestock, effectively limiting the expansion possibilities of the community's assets. It is expected that the cost borne by the private communities cannot only be compensated by the legal trade in vicuñas but that returns from vicuña will increase 'investments' by the communities in the form of protection and live capture techniques. However, this depends on the quality of the vicuña and alternative assets over a range of parameters.

Financially, vicuñas are an alternative to alpacas, the closest substitute asset, not only requiring the same inputs but also producing a similar product. From a private point of view, returns from vicuñas exceed those received by local producers of alpacas and llamas and even exceed the world export prices of alpacas and llamas (see Table 10), indicating that even if the intermediaries in alpaca trade were cut out, vicuñas would still provide a sound investment. By comparing the annual returns from vicuña and alpacas in Chile (adjusted for the rotation periods) vicuñas yield between US$9-18 per animal compared with US$7-10 per alpaca and between US$3 and US$4 for llamas.[15] If we consider the carrying capacity of the highlands, this difference increases. Per hectare of bofedal, vicuñas produce up to US$65 worth of fibre, while alpacas only yield US$26 and llamas US$8 respectively (see Table 2).

Despite this favourable assessment, there are other factors affecting the incentives to invest in vicuña protection. The most important difference between the two assets is the appropriability and tenure status. Alpacas are considered a private asset, where traditional rules define and enforce ownership.[16] With vicuñas, however, 'ownership' is necessarily communal, since it is not possible to assign effective custody over a particular group of vicuñas to a specific individual. Hence, actual return will have to be discounted by the lower appropriability and the risks of non cooperation.

---

[15] We assume a price of US$175 per kg. of fibre, allowing for US$125 capturing and supervision costs per kg. it is estimated that US$12,500 are needed to obtain 100 kg. of fibres. Considering the durability of some of the inputs and the expected improvements in skill, it is expected that costs will be reduced substantially.

[16] Colorful labels are sometimes used to identify the owner of each alpaca.

Table 10. Characteristics of south american camelid fibers

Name	Scientific name	Quality	Diameter (micras)	Fleece weight (kg)	Staple length (mm)	Price (USD/kg)
Alpaca	*Lama pacos*			2.6	75	
		Baby	20-22			18
		Superfine	25.5			15
		Suri	27			12
		Adult	27.5			10.5
		Huarizo	32			6.5-7
		Llama	34			6.5-7
		Coarse	34-36			6.5-7
Llama	*Lama glama*			1.5	75	6.5-7
Guanaco	*Lama guanicoe*			1.2	150	n.a.
Vicuña	*Vicugna vicugna*			0.2	30-50	300

Source: Vinella 1994, Buxton 1986, Nuñez et al 1994.

The relatively lower appropriability is further enhanced in the Chilean case if we add the multiple land tenure irregularities and the overlay of traditional successorial communities (comunidades sucesoriales)[17] that exists. In and around the management areas of the vicuña there are around 128 comunidades sucesoriales[18] involving a total of 1,237 families and population of 2,857 inhabitants. These communities partially contribute to the maintenance of rights claims in the highlands by the migrants.[19]

With regards to legal land ownership, some estimates suggest that in the Chilean management zones, only 43.04 percent of the land is legally assigned[20] and 56.96 percent where occupation is only recognised but is not legally boundered[21] (Torres and Nuñez 1994). These factors, coupled with the importance of livestock, for which traditional contract and ownership forms have emerged, could

[17] These communities can be defined as groups of people, variable in size, than own, administer and usufruct jointly from a given land in the Tarapacá region, where they maintain agriculture and livestock rearing activities. Membership is recognised by descendency and rights originate in one or more ancesters. Enforcement of this rights is through customaty and legal means (Gonzalez 1992).

[18] Including Putre and Gral. Lagos.

[19] The maintenance of rights does not normally involve rent or lease of resources.

[20] Either privatly owned (39.49 percent) or fiscal (3.55 percent) supported by the global inscription in 1935.

[21] These include fiscal lands occupied and land with no information.

make the latter more suitable as a surrogate asset for 'ownership' or degree of claim.[22]

Another difference in assets refers to their 'liquidity', while alpaca wool or meat can be sold or consumed at short notice, vicuñas are required to wait until the tender process is over every two years (in the Peruvian case). Therefore, the emergency insurance quality that the alpacas have as assets is lost, at least in the formal market.

A different problem is posed by the dissipation of rents among community members, particularly in Peru, where the population directly involved is high. In Peru, the actual income being distributed is likely to be an average of US$2,025 per community over a two year period, with an additional US$1,820 being invested in the various community projects, conservation activities and technical assistance. Whether this amount represents a sufficient incentive for conservation will depend on the revenue sharing mechanisms developed within each community. This estimate excludes the opportunity cost of labour used in the rearing and shearing operations, that are carried out by the community.

In the case of Chile, it is estimated that 5,980[23] vicuñas could be sheared in the management zone, requiring about 35 chakus. Allowing for the two year rotation, this suggests that 2,990 vicuñas would be sheared, or an estimated production potential of 598 kg. per year.

Such potential would represent a value of US$179,400 gross revenue, at a price of US$300 per kg., or about US$107,640 net revenue assuming 40 percent of gross revenue diverted to conservation and other costs just as in the Peruvian agreement. This amount would be distributed among the communities every year. This would represent about US$21,000 per Neighbourhood Unit (Unidad Vecinal) per year. Considering the number of livestock owners in the area, estimated at 168, the average income per year per owner would be US$ 640. This level of income almost matches their annual cash income, estimated between US$480 and US$744 . Income from vicuña would allow livestock owners to increase their income above the national minimum wage set in 1991 at US$ 960 per year.

While these estimates for Chile reflect a very positive incentive for conservation, the issue is whether they are all the people who should be compensated and whether they have sufficient manpower to effectively protect the vicuña. If the objective of revenue sharing is to compensate livestock owners for the lost revenue from the alpacas, absent owners who maintain livestock should be included in the estimate, potentially increasing the number of livestock owners to 298 and reducing the revenue share per owner to US$361.

---

[22] In fact, livestock can graze sometimes in other's territory with no compensation, but alpacas are purely private assets (Gonzalez, pers. comm.).

[23] Includes populations within reasonable radious of the capture sites and excludes the young.

However, if protection is the objective of revenue sharing, shares should target the population with the greatest capacity to protect the vicuña population. At present, the population in the Puna is made up of mostly old people with limited capacity both to protect and engage in rearing operations, hence, the gross revenue figure should be adjusted to incorporate the cost of these operations being carried out by third parties (up to now CONAF personnel). Wages could amount to up to US$22,240, and substitution in the near term is unlikely unless an effective repopulation of the highlands takes place.[24]

5.3.2 Rent sharing mechanisms

From an institutional point of view, the Peruvian approach has centred on newly created bodies, which have the advantage of having a relatively 'clean' record, but have yet to prove their strength in relation to other forces and existing institutions. The Chileans, in a more experimental phase, just as the Peruvians some years ago, have so far adopted more of a State approach, where CONAF has been carrying out most of the operations with little community involvement. However, this involvement is expected to increase in future, beyond simply receiving a share of the revenue.

By law, CONAF is required to have a strong presence in two of the management zones (NP Lauca and Las Vicuñas NR), and the organisation schemes being explored involve the creation of a Society between CONAF and Aymara organisations in the region. This requires that CONAF identify a suitable Aymara organisational base efficient enough to be (1) identified and accepted by all aymaras genuinely involved in the management of the vicuña; (2) with sufficient power to prevent others from influencing its decisions; and (3) with sufficient independence and impartiality to create the least uncertainty about appropriation. These requirements, however, seem difficult to obtain, either from existing organisations or from newly created bodies, for which a compromise has to be made.

Social organisations in the depopulated Chilean highlands are relatively weak, and no single organisational base has emerged. State created organisations, like Juntas de Vecinos (Neighbourhood boards) and the Centros de Madres (Mother's Centres) offer some alternative to link the benefits from utilisation to a specific community through well-recognised channels. While they have also adapted to local customs and can create a basis to effectively identify non-residents with legitimate claims on the highlands[25] they are sometimes dominated by this migrant population rather than by locals. Moreover, these bodies are often seen as instruments of the state to channel social demands (Gonzalez 1992) and therefore, most issues discussed in them are related to land or

---

[24] Policy efforts in the region have the repopulation of the highland as an objective, but the main limitation is the scarcity of emploment and 'urban like' services. In many villages, schools and churches have closed due to scarcity of people.

[25] Many migrants keep herds in the highlands that are kept by a relative or worker. In principle, they are also being affected by the vicuñas as have to be compensated.

water problems, the provision of services or infrastructure. The current attitudes of the local population, is to see the vicuña as CONAF's property, and that they ought to be compensated for the damage they receive. Many people in the highlands therefore see the Junta de Vecinos as the proper place to negotiate such conflicts, which are caused by the state. In other words, the thrust of the organisation would be one of compensation a posteriori, rather than one of management/investment in conservation a priori. Indeed, the vicuña has been used as a flagship for wider demands in the region, and the alienation of the local communities from the species has widened.

Other alternative organisations in the highlands are the existing producers societies. These are mostly designed for marketing rather than producing objectives and this has been seen as the main stumbling block for the market in camelid meat and wool in Chile. These organisations are more regional in nature. Most of them are located in the valleys, and there are only two in the highlands: AG Cosapilla and AG Asopecuario (Aguilera et al. 1990), the latter having 180 members (Torres and Nuñez 1994). Unfortunately, these organisations have tended to be manipulated by the military regime, in many cases paralysing any activity. The high migration and the maintenance of rights poses additional complications for the local organisation, as migrant members tend to dominate the rural organisations.

These two options could also lead to the dissipation of the conservation incentives designed for the vicuña. The third option is to create a new body at the community level which, although weak at the start, would be more independent and focus on the conservation of the vicuña. Trading in alpaca could also be included as part of the aims of the organisation (Loro Piana has already expressed interest in this), as the Peruvians have done. The creation of wider breeders' societies would effectively link conservation activities and create additional channels for the capture of conservation rents (alpacas could also benefit from the 'green' label as well).

5.3.3 Protection incentives

Economic rewards influence the willingness to invest in resources, in this case, in the protection of the vicuña. However, a key requirement is that effective protection must really be a feasible choice. In other words, if protection is beyond the control of the community involved in management, incentives will not result in protection.

There is a need to ascertain the capacity and motivations behind the poaching operations in order to control this activity. Poaching by community members can be most easily be stopped by strong local institutions. However, poaching by outsiders requires the empowerment of the community with both legal and physical means to defend their natural assets.

In more densely populated regions, such as in the Peruvian highlands, it may be easier to combat external poaching, but the financial return from vicuña per inhabitant is lower and this may,

therefore, not provide an adequate incentive to strengthen the emerging Communal Vicuña Committee. This problem is exacerbated as the human population increases. In Chile, on the other hand, smaller communities receive greater monetary incentives, which can effectively induce self-restraint on poaching, but will not prevent external poaching. This trade-off between incentives and the enforcement of exclusive rights to appropriate the resource is crucial when identifying the landowners who have the capacity legally or illegally.

Poaching is motivated primarily by the expected financial return which, up to now, has been inflated by the rarity value of the product. However, the extent to which poaching pressures from speculation can be effectively reduced depends on the capacity of management authorities to confine the higher value of exclusive marketing to the legal channels. This requires the creation of increased demand for the legal fibre as a result of the publicity campaigns and raising the cost of poaching through increased community policing. The perception of a more open market, coupled with a transition period from state, to more community based protection may have been responsible for the increase in poaching seen in Peru. This emphasises the need for accurate information on the nature of the utilisation proposed, both in countries which have started utilisation programmes and in other countries which have not yet started production.

6 Conclusions

The commercial utilisation programmes in Chile and Peru have managed to achieve the initial CITES goal: allowing vicuña populations to recover by temporarily prohibiting trade. This achievement was partly the result of political factors, such as the regional agreements and CITES, and economical, as significant national and international funds were invested in protection, and social, as the expectation of future utilisation of vicuñas for community benefit induced local populations to participate in protection programmes. To disentangle the different factors behind the recovery would be extremely difficult. However, the wearing-off of these factors is now demanding other sources to maintain and improve the state of vicuñas. While commercial pressures were largely responsible for the decline in the species, the heavy burden on the local communities and the limits to effective protection by the state now mean that a regulated commercial use vicuña can play a constructive role in conservation.

On the revenue side, the Peruvian agreement has succeeded in guaranteeing funds for conservation and supervision of the programme, while the Chilean agreement has at least managed to generate funds from the cloth trials. The incentive side, requires the setting up of effective rent creation and appropriation mechanisms that convey 'ownership' of the asset to the communities.

With regard to rent creation, the value of vicuñas in current agreements compares favourably with alternative livestock incentives from a private point of view. However, rent appropriation requires the introduction of effective rent sharing agreements that convey a sufficient sense of ownership,

while allowing for effective regulation.

The Peruvian model conveyed ownership through legal, as well as organisational means, mainly through the Comités Vencinales, and placing the government agencies as supervisors of the agreement. Initial response of communities to the scheme is very encouraging, although the main challenge of the scheme will be to avoid excessive rent dissipation within the communities. The uncertainty regarding the strength of the new committees, coupled with additional services from the private livestock (such as the relatively higher 'liquidity' than the vicuña), can also diminish the incentives to participate in the schemes.

In contrast, the Chilean model faces low population densities with high migration, and the problems stem from lack of sufficient population to ensure adequate protection and management. The alternative has been to provide significant government involvement, at least in the initial stages. The source of rent dissipation originates in the need to compensate migrants, with limited protection capacity. The high degree of government involvement, although providing it with funds to finance conservation, does not convey 'ownership' to the local communities, who still see vicuñas as a State problem.

For both projects, the prospects to boost incentives through the creation of a greater market for alpaca, linked to vicuña conservation efforts, can probably have some impact on the effective rents from vicuña being shared at the community level. However, a system would have to be designed to ensure that any measures resulted in additional rents being spent on conservation.

In the vertical dimension, there is a double need both to ensure adequate incentives to protect the trademark and promote the fibre, while at the same time prevent creating an unsustainable demand on wild populations. The approach of trading already held stocks only ensures that no additional pressure is created by future markets. However, the degree to which short term commitments will induce an adequate level of protection and promotion activities must be assessed.

Illegal markets will be significantly affected by the marketing. On the supply side, stockpiles should be reduced as protection incentives transfer into actions in the countries where there are utilisation projects and legal markets begin to supply demand. Evidence of the effect of the legal trade on the stocks can be seen from the rapid decline of stocks in the UK during the 1980, as discussed previously. Speculative poaching, like the one seen in Peru in recent years could still take place while illegal trading channels are reassessed for feasibility and profitability. This, however, can only be minimised through effective trademark protection and promotion (avoiding a growth in demand in illegal fibre) and if the nature of the exclusive marketing of vicuña fibre is explained in all range states at the community level.

Management areas may also experience reduced poaching because sheared vicuñas carry less fibre and are therefore less valuable, an effect that has also been observed in the case of the dehorned

rhino. Non-management areas, however, will still face the risks from both the lack of protection and the higher value individuals. To this effect, a lower-price more stable consumer market is crucial in eliminating the demand for fibre from poached vicuñas.

Overall, at this expanding phase of the project in the Andean region there are encouraging signs: direct marketing links being created, coordination among countries ensured through agreements, coordination at the community level either through protection schemes still in their early stages (e.g., Argentina) or schemes already trading in the fibre (e.g., Peru). There seems to be a strong basis for management, although care will have to be taken to maintain rent levels in future tenders once the novelty wears off, and to prevent dissipation of incentives at the community level.

7 References

Aguilera, J., R. Rojas, H. González and H. Gundermann (1990) Bases para la formulación de un programa tecno-productivo con ganaderos aymara,. Serie documentos técnicos, Taller de Estudios Aymara, Arica, Chile, February .

Anon. (1978) 'Utilisation of Vicunas in Peru'. GTZ, May.

Anon. (1979) Convenio para la Conservación y Manejo de la Vicuña., Suscrito en Lima el 29 December.

Anon. (1986) Enmiendas a los Apéndices I y II de la Convención, Proyecto de Resolución, June 1986. Segunda Reunión del Comité Técnico.

Anon. (1991) 'El mercado japonés de telas de pelo de animales'. *Tradescope*. EL MERCADO, pp. 6-8, 1991.

Anon. (1994) IV Reunión extraordinaria técnica del Convenio de la Vicuña, December, Acta Final. Comisión Técnica-Administradora del Convenio de la Vicuña.

Anon. (1994a) Convenio de Cooperación Técnica y Científica para el Desarrollo de los Pueblos Andinos y la Protección de los Camélidos Sudamericanos, 7 March.

Anson, R. and P. Simpson (1995) 'World textile trade and production trends'. *Textile Outlook International*, July: 10-35.

Buxton, A. (1986) 'Luxury fibres'. *Textile Outlook International*, November: 67-79.

Cajal, J.L. and S. Puig.(1992) 'Country report - Argentina'. In Torres 1992.

Caretas (1994) *FIBRAS del Nuevo Mundo: El Ensueño de la Vicuña*, Lima, Peru, October. Empresa Editora Caretas S.A. Caretas Informe, suplement of Caretas 1335.

CONAF (1987) 'Estado actual y perpectivas de las formas de tenencia y de aprovechamiento de la Vicuña en Chile'. September 1987. Prepared for the VIII Reunión Ordinaria de la Comisión Técnico Administradora del Convenio para la Conservación y Manejo de la Vicuña.

CONAF (1991) 'Estudio de factibilidad Tecnico-económica para el Aprovechamiento racional de la Vicuña, Provincia de Parinacota, I Region Chile'. Resumen Ejecutivo.

CONAF (1994) Propuesta de modificación de la nota 502 de la Sexta Conferencia de las Partes de la CITES con la finalidad de permitir la exportacion de fibra de Vicuña (*Vicugna vicugna*) para ser transformada en tela. Presented at IX Conferencia de las Partes, CITES, Ministerio de Agricultura, Chile.

Eltringham, S.K. and W.J. Jordan (1981) 'The vicuña of the Pampa Galeras National Reserve- the Conservation Issue'. In P.A. Jewell and S. Holt, ed. *Problems in Management of Locally Abundant Wild Mammals*, New York, Academic Press, pp. 277-90.

Glade, A. and C. Cunazza (1992) 'Country report-Chile'. In Torres 1992.

González, H., H. Gundermann, and R. Rojas (1991) 'Diagnóstico y estrategia de desarrollo campesino en la I Región de Tarapacá'. Technical report, Corporación Norte Grande, Taller de Estudios Andinos, Arica, Chile.

González Cortez, H.(1992) 'Desarrollo organizativo y participación política reciente entre los Aymara del norte de Chile'. Technical report, Taller de Estudios Aymara, Arica, Chile, December.

Hoces, D. (1992) 'Country report-Peru'. In Torres 1992.

Hurtado de Mendoza, L. (1987) 'Notas arqueológicas y etnohistóricas acerca de la vicuña en el antiguo Peru'. In Torres 1987.

Lewis, M. (1988) 'Profiles of italian textile and clothing companies'. *Textile Outlook International*, November: 19-37.

Morris, D. (1994) 'Interfibre competition in the 1990s'. *Textile Outlook International*, November: 115-28.

Otte, K.C. and R.K. Hofmann (1981) 'The debate about the vicuña population in Pampa Galeras Reserve'. In P.A. Jewell and S. Holt, ed., *Problems in Management of Locally Abundant Wild Mammals*, New York, Academic Press, pp. 259-76,

Rabinovich J., M. Hernandez, and J. Cajal (1987) 'Un modelo de simulación para el manejo de poblaciones de Vicuña'. In Torres 1987.

Rabinovich, J.E., A.F. Capurro, and L.L. Pessina (1991) 'Vicuña use and the bioeconomics of an Andean Peasant Community in Catamarca, Argentina'. In J.G. Robinson and K.H. Redford, ed., *Neotropical Wildlife Use and Conservation*, The University of Chicago Press, pp. 337-354.

Rowett Research Institute (1990) Camelid Conference 1990. Proceedings of the 1st conference of

the British Camelids Owner's and Breeder's Association. Macaulay Land Use Research Institute, Rowett Research Institute, Aberdeen, UK, May: 12-13.

Russel, A. (1990) 'Camelid fibre production'. In Rowett Research Institute 1990, Aberdeen, UK, May: 12-13 .

SNCVP (1994) Bases del Consurso Internacional de Méritos -Vicuña. Sociedad Nacional de Criadores de Vicuña del Peru, November.

SNCVP (1994a) Convenio de Asociación en Participación, para la transformación industrial, confección y comercialización de la fibra de la Vicuña del Peru. Sociedad Nacional de Criadores de Vicuña del Peru and the International Vicuña Consortium, 22 July.

Torres, H. (1983) Distribución y Conservación de la Vicuña (*Vicugna vicugna*). Special Report No.1. IUCN, Gland, Swtizerland, July.

Torres, H. ed. (1987) Técnicas para el Manejo de la Vicuña, Santiago, Chile, Grupo Especialista en Camélidos Sudamericanos, SSC/IUCN.

Torres, H., ed. (1992) South American Camelids: An Action Plan for their Conservation, Gland, Swtizerland. IUCN/SCC South American Camelid Specialist Group, IUCN.

Torres, H. (1993) Plan de Desarrollo de la Comunidad Aymara Mediante la Utilizacion Sustententable de la Vicuña. CONAF.

Torres, H. and E. Nuñez (1994) Informe del trabajo de supervisión del Censo de Vicuñas del Peru 1994. Technical report, SSC/IUCN South American Camelids Specialist Group, Lima, Peru, May.

Villalba, M.L. (1992) 'Country report- Bolvia'. In Torres 1992.

Vinella, S. (1994) 'The European market for South American camelid wool'. Fine Fibre News, Winter 1993/94: 26-7.

Map 1. Range and utilization areas of Vicuna.

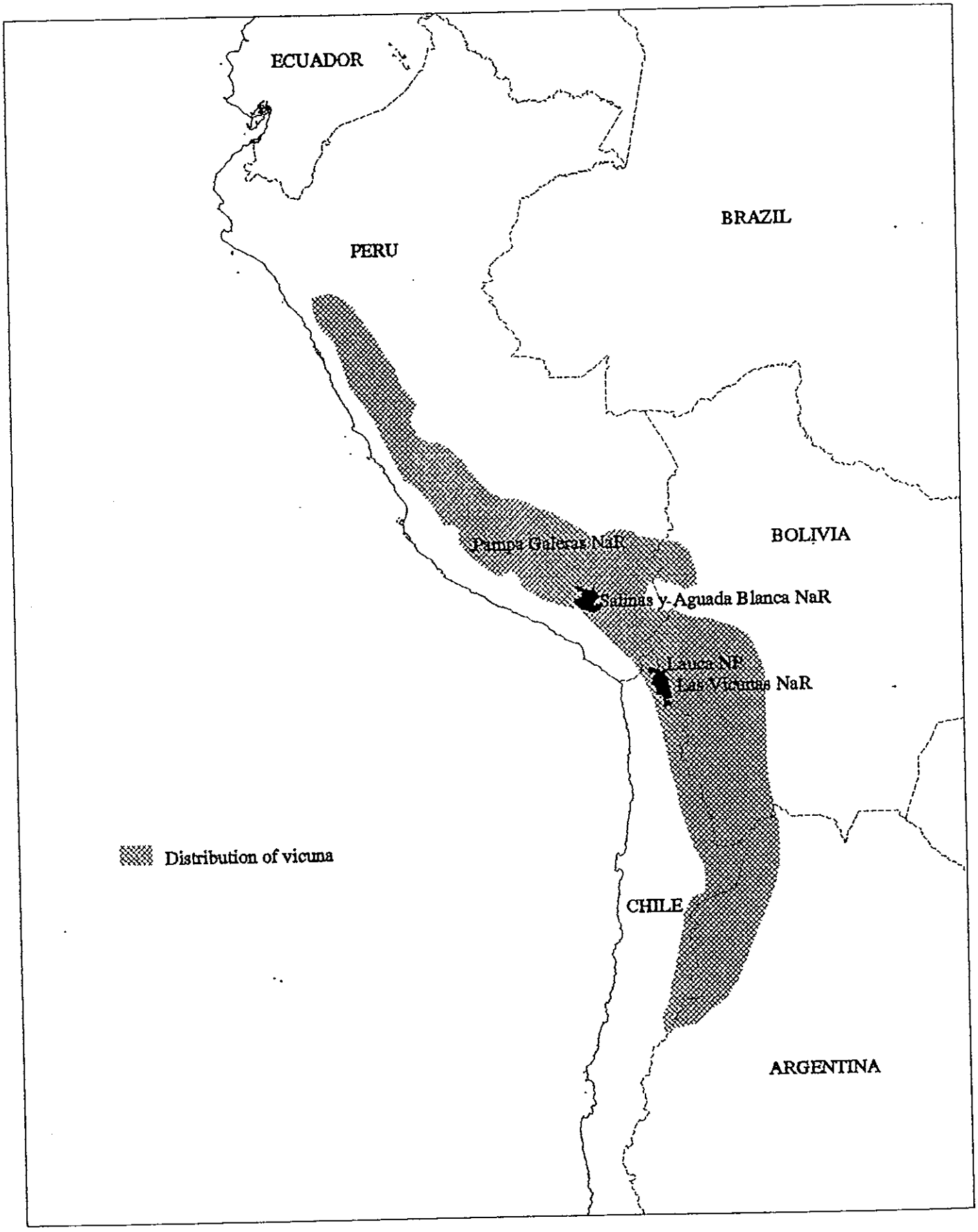


Figure 1. Price of luxury fibres and their scarcity.

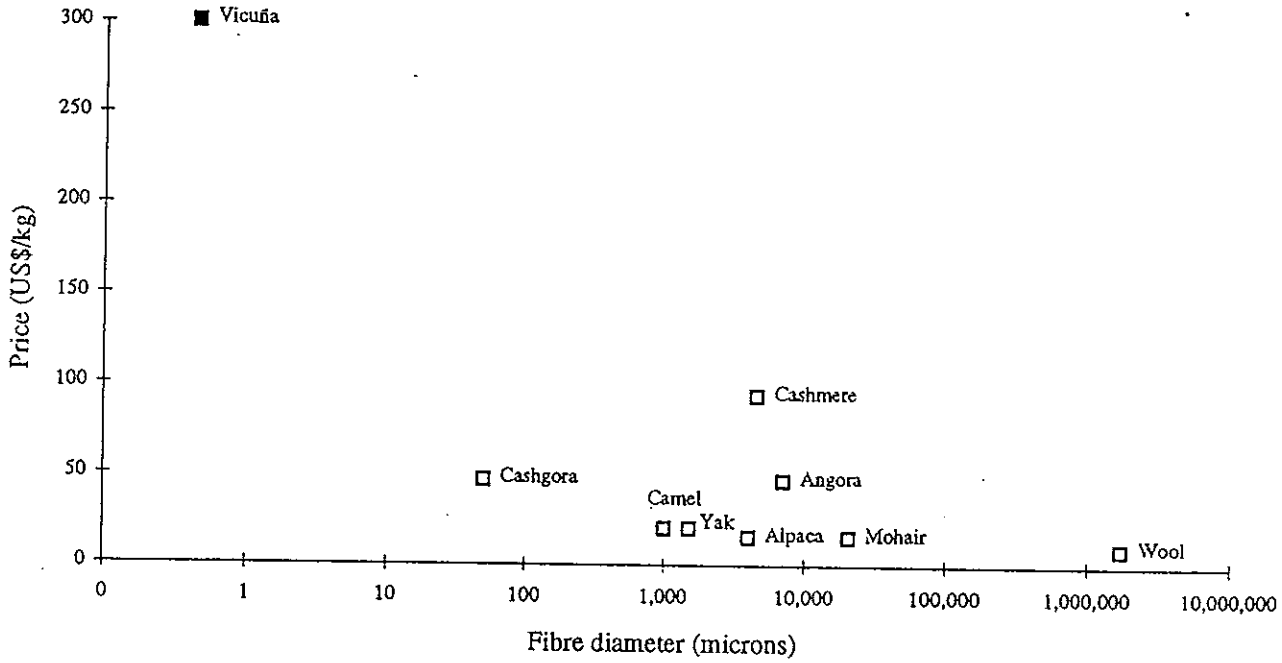


Figure 2. Characteristics and value of main luxury fibres.

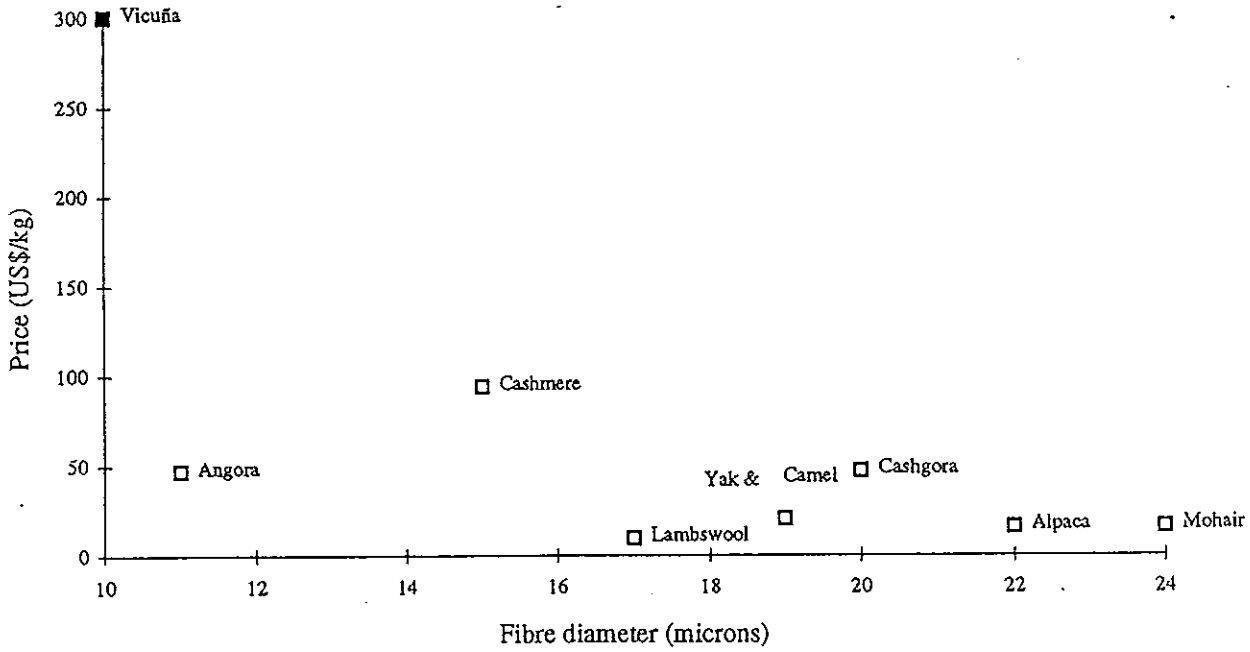
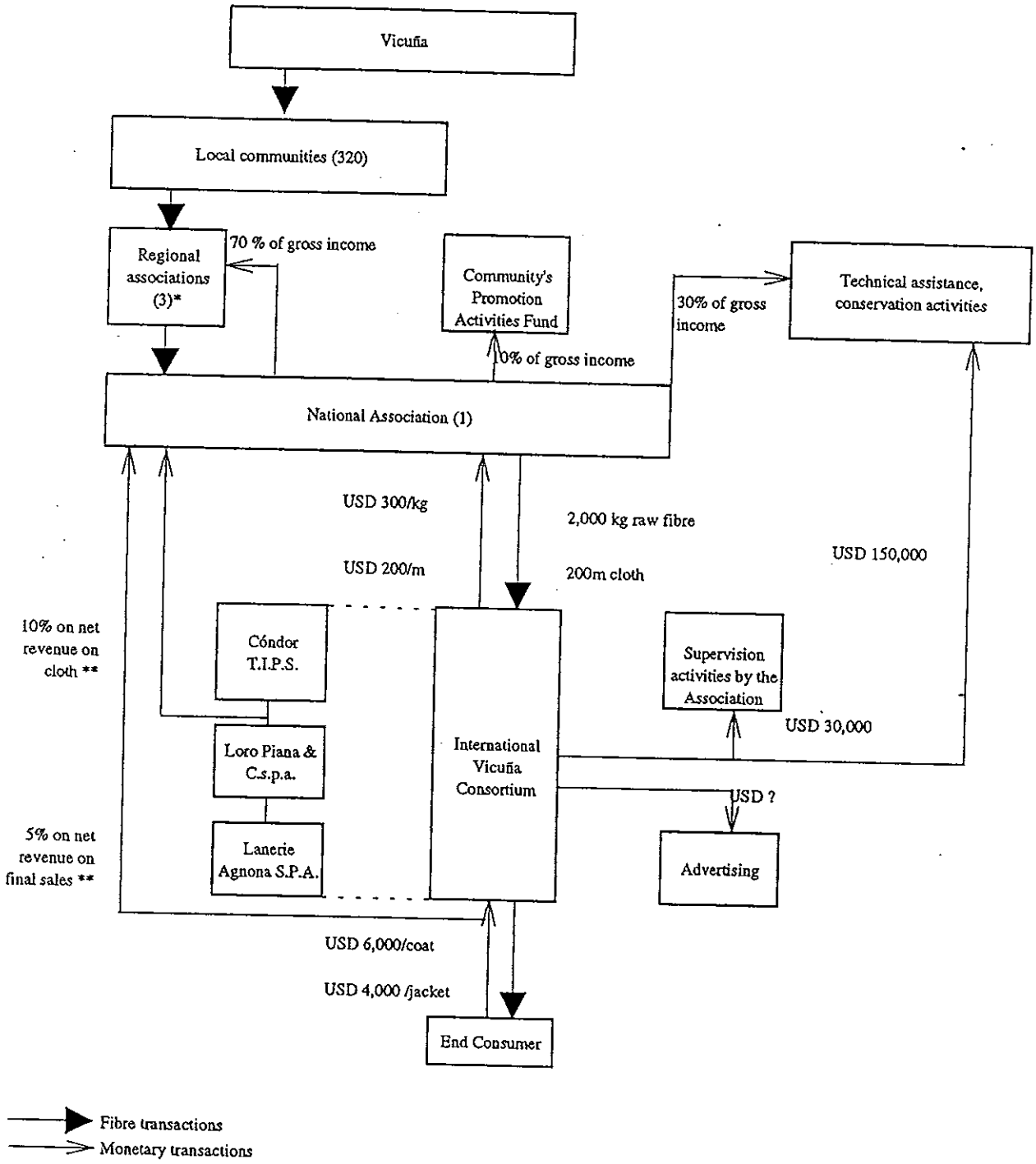


Figure 3. Market structure of the legal market for vicuna fiber and products as created by the Peruvian agreement. Management authority supervises agreement terms and conditions and advises breeders societies



* Asociación de Comunidades Campesinas Criadoras de Vicuñas y otros camélidos de la Región Los Libertadores-Wari
Asociación de Criadores de Camélidos-Vicuña de la Región Andrés Avelino Cáceres
Asociación de Comunidades Campesinas Criadoras de la Vicuña de la Región José Carlos Mariátegui

** Either the two percentages or USD 440,000, whichever is greater.

Figure 4. Estimation of stocks in the UK based on declared total stocks in 1983 and fibre-declared exports from the UK, 1981-1993.

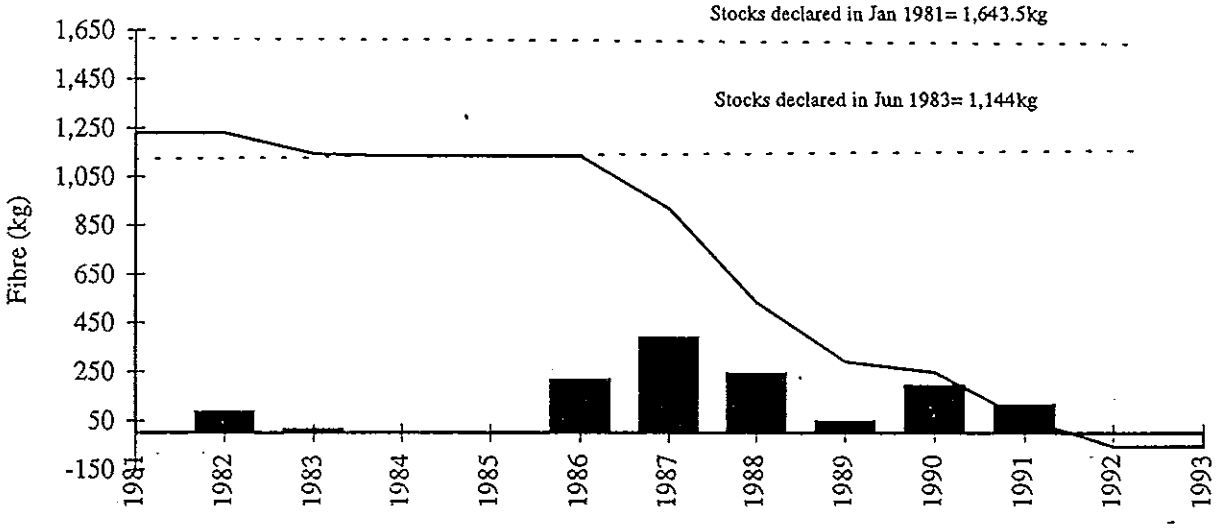
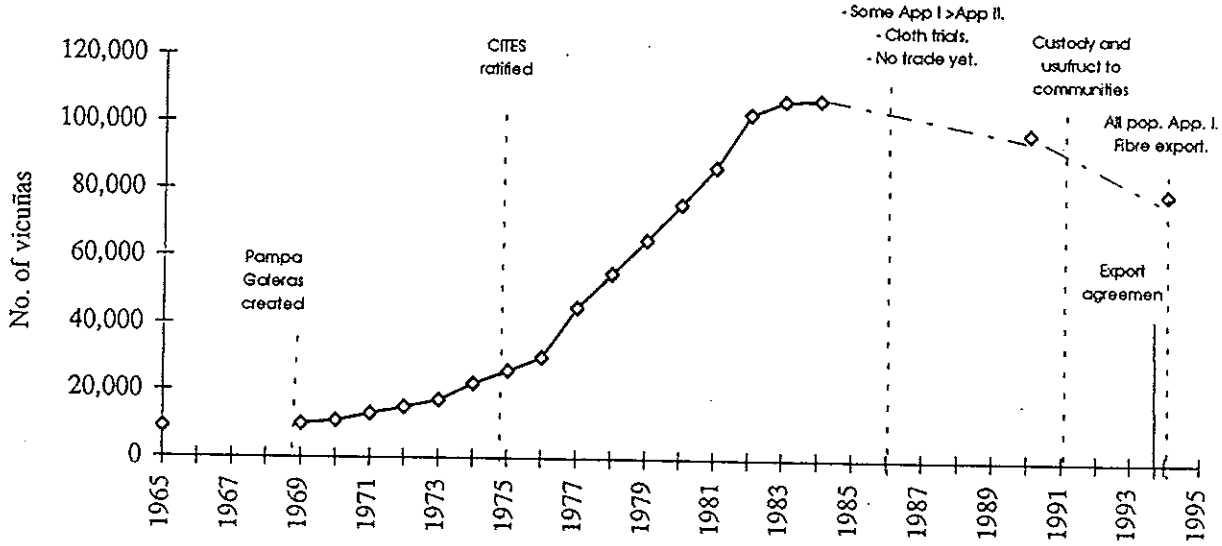


Figure 5. Estimated total vicuña population in Perú



Annex A

CONSTITUTION OF THE KHOMAS HOCHLAND CONSERVANCY

(established on

1. Name and Residence

The Name of the Conservancy is the ' Khomas Hochland Conservancy ' .

Residence of the Conservancy is Windhoek, Namibia.

The Conservancy is recognised and registered by the relevant authority.

2. Objectives :

a) To establish a sustainable co-operative game management and utilization strategy in the Conservancy area (specified on the map attached herewith)

b) To protect, regulate and improve the status and variety of wildlife in th Conservancy area. Wildlife meaning mammals, birds, reptiles, vertebrates, invertebrates, indigenous plants, wetlands and other habitats.

c) To initiate the reintroduction of wildlife into the Conservancy area whic has occured in (was indigenous to) the area or which can be adopted by the area.

d) To stabilize and increase the numbers of certain game species which are rare or endangered within this area.

e) To co-ordinate the sustainable utilization of wildlife in the Conservancy area, which includes private use, biltong hunting, trophy hunting, night culling, capture and shoot and sell.

f) To generate interest and active participation by landowners in Wildlife Conservation and Wildlife Management.

g) To promote conservation awarenesses amongst the local population.

These objectives will be specified in Conservancy rules and guidelines prepared by the committee and determined from time to time by the Annual Genera Meeting.

3. Membership :

a) Membership of the Conservancy shall comprise the following :

i All founding members representing land within the Conservancy area at the date upon which this constitution is adopted.

ii All landowners, his duly representative, tenant or manager of land within the Conservancy area who shall apply for membership and be accepted by the committee.

iii Such honorary members as may elected from time to time by the AGM.

b) Membership shall terminate :

i if the member contravenes the general idea of this constitution and its rules and will be expelled by a special resolution of members in a General Meeting passed by a two-third majority of the quorum upon 21 days notice of the proposed expulsion.

ii if a member is not anymore owner or the representative of land within the Conservancy area when stated by the AGM.

iii if a member leaves the Conservancy.

c) Membership Fees :

i Membership Fees to the Conservancy shall be fixed by the members in General Meetings from time to time and shall be due annually to the General Meeting.

ii An additional fee and income of the Conservancy depends on the utilization of game within the Conservancy area and will be specified through the rules about the utilization of the game.

4. Management :

a) The Management of the Conservancy shall be vested in an elected committee of officers, who shall retire annually at the General Meeting, but who shall eligible for re-election.

b) The officers of the Conservancy shall consist of a chairman and three committee members. The chairman has to run the entire business of the Conservancy under support and advice of the committee members.

c) The committee shall make such decisions as may necessary for the efficient running of the Conservancy.

5. Finance :

a) The financial year shall end on February the 28th (or 29th) of every year.

b) The chairman shall deposit all monies with an approved banking organisation.

c) The Conservancy accounts shall be submitted for approval at the A.G.M..

d) The committee can defray all reasonable expenses from the funds of the Conservancy.

e) The Conservancy is a non-profitable organisation.

6. Meetings :

a) Annual General Meeting (A.G.M.)

i The A.G.M. shall be held annually not later than the 1st of April.

ii Members shall be given 14 days notice of the meeting, together with notice of the agenda and proposals for consideration thereat.

iii The business of the A.G.M. shall be

- to recieve the Chairman's annual report
- to recieve the annual financial report
- to unburden the committee
- to elect office bearers
- to determine the Conservancy rules
- to conduct general business

iv A quorum shall comprise of two-thirds of the members. That includes the members who are absent and excused and who have given proxy of voting to one present member.

b) Special General Meeting (S.G.M.)

A S.G.M. may be called either by the committee or four other members.

c) Committee meeting

Committee meetings shall be held upon request of one of its members.

d) Voting

i The majority of the quorum shall make the decisions.

ii The Chairman shall have an ordinary vote and a casting vote.

iii Constitutional changes can be made by two-third of a quorum at a G.M..

e) Deferment

In the event that there is not a quorum present at a given meeting, that meeting shall be deferred for 14 days. The number of members present at the re-covened meeting shall constitute a quorum.

7. Legal

The Conservancy shall sue and be sued in the name of the Khomas Hochland Conservancy.

8. Dissolution

a) In the event of the proposed dissolution of the Conservancy on request of two-third of its members, its property and funds shall be disposed of and may be determined by a S.G.M. called for that purpose.

b) In the event of the sale of land within the Conservancy area the new buye will be asked to join the Conservancy. The selling member has to replace those expenses which were made by the Conservancy on this land. This will also be worth in the event of the termination of a membership.

9. Adoption

The above Constitution is as adopted by a Special General Meeting on the

and signed by all the present founding members. Further members also have to sign this Constitution.

All members shall be bound by this constitution and its rules.
The Conservancy rules and guidelines to run the Conservancy shall be set up in Annex A and B to this constitution.

10. Signatures of members and name of land they are representing :

KHOMAS HOCHLAND CONSERVANCY

RULES :

1. Combined game management and utilization strategy.

a) This will be done through wildlife management guidelines set up by the committe and shall include recommendations to the members for the sustainable utilization of wildlife.

b) Game censuses will give the base for these guidelines/recommendations. These game censuses shall be done by the members themselves twice a year on specific days organised by the committee and/or air censuses.

c) At the end of every year the members shall give to the committee a list of their utilised game, specified in species, sex and age.

d) The private use of game (for rations & own meat supply) will not fall under any restrictions by the Conservancy but should follow the guidelines and recommendations.

e) Biltong hunting will be organised by the members themselves and have to follow the guidelines and recommendations for the utilization of game.

f) If there is a reasonable need for night culling and/or capture within a specific area of the Conservancy the committee shall support or make the application to the Department of Nature Conservation. The committee shall find an agreement with neighbouring members to the culling or capture areas

A certain amount of the income which a member has recieved through culling/capture shall be given to the Conservancy funds as an additional member fee to support the objectives of the Conservancy.

g) Trophy hunting is subjected to the special co-ordination by the committee. Members who have Trophy-hunting on their land have to give a certain amount of their income on trophy fees as an additional member fee to the Conservancy funds to support the objectives of the Conservancy.

The certain amounts payable as additional member fees will be set up annually by the committee.

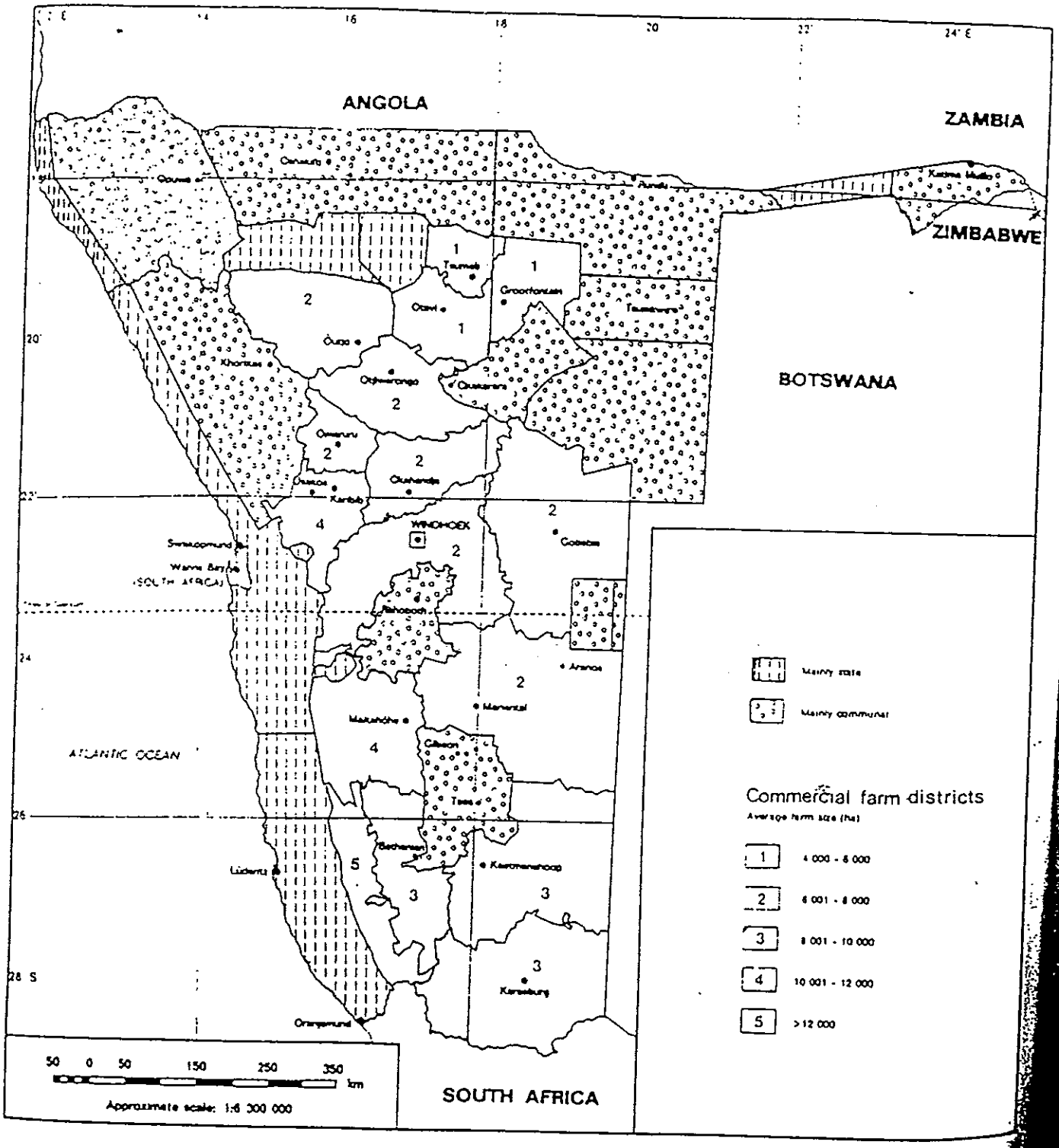
2. Reintroduction and stabilization of game species

a) The Conservancy shall settle or reintroduce game into its area. During the first years this game will be settled into game camps of the members until it has been stabilized and increased. During this time the game will fall under the authority of the Conservancy and no utilization may be done without its permission. Special management guidelines will be set up by the committee and the owners of these game camps.

b) Special game species, so as reintroduced game or game listed of in the guidelines, i.e. Hartebeest, Ostrich, Blesbok etc., may not be hunted by the members without the permission of the committee or until it is classified as normal game by the AGM (so as Kudu, Oryx, Mountain Zebra etc.).

Members who already have such game species occuring on their land or who will buy such game species on their own account will not be restricted.

MAP 3.1:
Geographical distribution of commercial farming districts



Source: Adapted from First National Development Corporation, Namibia: Development and Investment, Windhoek, 1989, p.[illegible].

Annex B

ANNEXURE E

OBJECTS OF THE SAVÉ VALLEY CONSERVANCY

The objects of the Conservancy shall be as follows:

1. To develop and maintain opportunities for the conservation and sustainable utilisation of natural resources in the Conservancy area and its environs, through coordinated and mutually supportive action between landowners, involving:

   1.1 the specification of, and strict adherence to, sound ecological management policies aimed at preventing:

      (i) degradation of the natural resources (declines in biological productivity and diversity);
      (ii) exploitation of the natural resources by any user, at the expense of other users;

   1.2 re-introduction of wildlife species that have either been eradicated or reduced to low numbers within the Conservancy area, provided:

      (i) any such species can be managed through fencing or other means to an extent sufficient to preclude unreasonable risk to neighbouring communities or their property;
      (ii) the founder population of any such species can be made large enough to constitute a viable breeding group, according to demographic and genetic criteria;
      (iii) any such species are ecologically suitable.

   1.3 construction and maintenance of perimeter game fencing to a specified standard, while limiting game fencing within the Conservancy to the minimum amount required for protection of crops, construction of holding bomas, or other basic management needs, as may be approved by the Committee thereby ensuring that:

      (i) small populations do not become fragmented and isolated, thus creating inbreeding problems;
      (ii) species with narrow habitat preferences are able to move seasonally between areas that are temporarily suitable for them;

   1.4 promotion of schemes, of mutual benefit to the Conservancy's members, for deriving economic returns from wildlife, through either consumptive means (e.g. game cropping and safari hunting) or non-consumptive means (e.g. tourism);

   1.5 development of a programme to enhance communication with neighbouring communities and to stimulate the economic and social advancement of such communities through durable linkages with the Conservancy's wildlife industry;

   1.6 development of an effective antipoaching system;

   1.7 full liaison between elected representatives or employees of the Conservancy and relevant local authorities and government agencies (such as the Department of National Parks and Wildlife Management and the Zimbabwe Republic Police) and non-governmental agencies (such as funding bodies, conservation organisations, and community development organisations).

2. To assist where possible in the attainment of national objectives for wildlife conservation, notably the protection and breeding of endangered species, in the hope that these species shall become components of a sustainable land-use system; however, the conservation of endangered species within the Conservancy would not be necessarily dependent upon economic incentives, and conditions outlined in 1.2 above shall also apply to endangered species.

3. To promote bona fide research into ecological and economic aspects of natural resource management (both to guide the development of the Conservancy and to yield information of relevance to land-use in similar areas) and to develop monitoring systems appropriate to the needs of Conservancy management.

The Conservancy Constitution is available on request.

CONSERVANCY CONSTITUTION

1 NAME

The name of the Conservancy shall be the . . CONSERVANCY.

2 INCORPORATION

The Conservancy shall be a voluntary organization and incorporated with the objects and powers hereinafter set forth and may exercise all the powers of a corporate body including the owning of assets and the right to conduct legal proceedings in its own name.

3 OBJECTS

The objects of the Conservancy shall be as follows.

3.1 To develop and maintain opportunities for the conservation and sustainable utilization of natural resources in the Conservancy area, through coordinated and mutually supportive action between landowners, involving:

3.1.1 the specification of, and strict adherence to, sound ecological management policies aimed at preventing:

- i. degradation of the natural resources (declines in biological productivity and diversity);
- ii. exploitation of the natural resources by any user, at the expense of other users;

3.1.2 re-introduction of wildlife species that have either been eradicated or reduced to low numbers within the Conservancy area, provided:

- i. these species are compatible with acceptable ranching activities;
- ii. their founder populations can be made large enough to constitute viable breeding groups;

3.1.3 construction and maintenance of perimeter game fencing to a specified standard, while limiting game fencing within the Conservancy to the minimum amount required for protection of crops, construction of holding bomas, or other basic management needs, thereby ensuring that:

- i. small populations do not become fragmented and isolated, thus creating inbreeding problems;
- ii. species with narrow habitat preferences are able to move seasonally between areas that are temporarily suitable for them;

3.1.4 promotion of mutually beneficial schemes for deriving economic returns from wildlife, through either consumptive means (e.g. game cropping and safari hunting) or non-consumptive means (e.g. tourism);

3.1.5 development of an effective antipoaching system, together with a programme to enhance communication with, and cooperation from, surrounding communities;