Preservation of endangered species by commercial enterprises: Where can it work?

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1. Wildlife conservation and economic self-interest.

1.1. Introduction. Today, the world's biological wealth is being depleted. Exponential population growth, along with a constantly increasing rate of consumption, is threatening natural ecosystems. Natural ecosystems are disturbed by human activities and finally altered for development, and their inhabitants are forced to extinction. An estimated 25 percent of the world species present in the mid-1980s may be extinct by the year 2015 (Reid 1989). The loss in number of species due to the destruction of rain forests is about 1,000 to 10,000 times that before human intervention (Wilson 1988).

It is generally recognized that a reduction of the biological resources will have an impact in human welfare (Myers 1983, 1986; Orians 1990). A number of attempts have been made to estimate the magnitude of this impact (Prescott-Allen and Prescott-Allen 1982, 1983, 1986; Oldfield 1989). These attempts have demonstrated that the avoidance of biodiversity loss will provide significant benefits to the human species. It can be argued that the economic justification for conserving biodiversity does exist and the preservation of species can be justified in economic terms. Biodiversity is simply a very valuable asset in the world's accounting sheets.

It would seem that a species with a commercial value would be the last one to become extinct. A species with commercial value should be expected to be well managed and preserved in order to preserve its value. It would be viewed as an asset similar to any other assets. Species that are of no value to humans should be expected to disappear due to lack of attention to them. What is happening though, is very often the exact opposite. Populations of species with commercial value are being depleted and the benefits associated with them are lost.

So why do people degrade this asset and deprive themselves from its benefits? In order to answer this, the ways that the degradation is taking place will be examined, the causes and mechanisms of this degradation will be outlined, and the ways that efforts to stop degradation are implemented will be discussed.

1.2. Why is wildlife threatened? Overharvesting and habitat alteration[1] are the two anthropogenic factors that put pressure on species and lead them to extinction. Overharvesting and habitat alteration are a result of the expanding human population and its development patterns. These patterns are implemented through the "free market", which today seems as strong as ever, since even most of the former communist regimes are rushing to adopt capitalist tenants, and developing countries have long been trying to implement its mechanisms.

1.2.1. Instruments of conservation. That market forces are driving a great number of species towards extinction is the crux of the conservation problem (Dasgupta 1982; Randall 1987; McNeely 1988; Goldstein 1990). Market forces, however, are not always being considered when a conservation effort is being made. Efforts to preserve endangered species have been moving on four fronts: direct regulation with a threat of sanctions, establishment of sanctuaries, conservation education and provision of conservation incentives (Hudson 1989). The provision of incentives may be a more effective instrument for conservation than the other three because it treats the disease and not its symptoms (McNeely 1990). The other three methods may curtail extinctions, but allow the incentives that cause these extinctions to remain latent in the environment of the system. Instead, the provision of incentives is aimed to counteract the forces that drive extinctions.

An effective effort to preserve species has to explicitly address causes or mechanisms that threaten them; an effort that ignores principal forces like the market will not be effective. Education may work in the long term, or under very fortunate circumstances, but it can always be forgotten in times of profit opportunities, or economic hardship (Hudson 1989). Sanctuaries are helpful, but their effect is limited and narrow by definition (Soul_ 1986). Regulation can occasionally work, but illegal harvesting still occurs, since the gain from harvesting a species can

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[1]Habitat alteration here takes a broad meaning to incorporate terms such as chemical pollution, climatic change, or introduction of new species (McNeely 1988), besides its more direct meaning of land-use changes such as deforestations or wetland conversions.

very often be higher than a loss caused by a sanction. Moreover, the costs of enforcement are usually high and the possibility of being caught is often small (Gavitt 1989; Goldstein 1990).

The prevalence of economic markets in today's world requires conservation efforts that anticipate and even utilize the market mechanisms. Often, a conservation effort fails because it did not consider the market forces or the market's responses. The prospect of ivory regulation, for example, has the perverse effect of driving the price up because of the uncertainty in the market, and as the price increases, increasing harvest pressure is put on elephant populations (Hallagan 1990). Speculation about the regulatory measures can create havoc in the market, especially since species that are protected by law become more valuable in the illegal wildlife market (Harrison 1974; Nilsson 1983). A conservation method that is coupled with the market mechanisms has far better chances to succeed than one that ignores them (McNeely 1988).

1.2.2. Overharvesting as a threat to conservation. Overharvesting is the first reason that leads species to extinction.[2] Overharvesting means that a species of interest is harvested at a rate high enough to prevent natural regeneration of the population to pre-harvest levels. If this rate of harvest is high enough, the population might reach numbers low enough to not permit it to reproduce effectively. Extinction of the population is then the result.

In economic terms, high rates of use that lead to degradation of the resource, in a sense that the species population cannot sustain the same amount of harvest for a long period of time, have the effect of converting the asset into current income. Future benefits (rents) resulting from its conservation are thus dissipated and lost forever. But why does a user of a resource choose to forgo the future benefits from it?

Explanations for the high rate of use of the species can be found in the conditions that exist in the environment of the user and influence his decisions. It has been argued that the fundamental constraint to the preservation of biodiversity is that some people earn immediate

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[2]Albeit not the major one. Most extinctions today are a result of habitat alterations.

benefits from its use, without paying the full social costs of its depletion (McNeely 1988). The social costs of resource use are the costs that do not enter the user's production function (Kapp 1950), and therefore do not influence his decision concerning the rate of use of the resource. These social costs associated with the depletion of biodiversity are also the benefits that society would be able to capture if biodiversity were present. Since these benefits are real, society would be willing to pay the owner of the resource an amount equal to the benefits which society could derive from biodiversity. The owner would then preserve the resource and reap its benefits.

But here is where the problem usually emerges. In a big number of cases the user of the resource is not the owner of the resource as well. Society would be willing to pay the owner an amount equal to the benefits of the resource *in the future*, when these benefits would accrue. And the owner would therefore be willing to conserve the resource *now*, since the costs of its depletion would incur to him, they would enter his production function. But the current user of the resource is not willing to arrest its depletion, because he will not be the one that would receive these benefits in the future. He does not have a property right in the resource that would enable him to capture future benefits of it, and he is indifferent to them. Only current benefits and costs are pertinent to his decision about the rate of use. If the user of the resource had a property right to it, he would also consider it as an asset and not only as a current income opportunity. "Wherever we have exclusive private ownership ....., there are incentives for the private owners to preserve the resource. Self-interest drives the private property owners to careful management and protection" (Smith 1981, p.456).

1.2.3. Habitat alteration as a threat to conservation. Besides overharvesting, habitat alteration is the other anthropogenic factor that leads species to extinction. But since the species that are lost might provide benefits to their users, why is their habitat altered? Why are the species forced to extinction while they could provide benefits?

As Alfred Gardner puts it, "they kill the goose that lays the golden eggs because they think they can use the nest" (Gardner, personal communication, 6/25/92). When the nest (the

piece of land) enters the picture, things get complicated. The nest can be used of course, but for what purpose and for how long? And what are the reasons that would make one preserve the nest (and save the goose)? It seems obvious that one would do this, if one can earn more from the goose (and the nest) than from the nest. But since in most of the world today it is not legally/institutionally possible to own the goose (Muir 1988), while it is possible to own the nest (especially if one "improves"[3] it), one cannot legally earn from the goose but only from the nest. But if one could own the goose and profit from harvesting the eggs, it seems obvious that one would have an incentive to conserve it.

1.3. Will privatization result in conservation? The discussion so far has shown that the assignment of private property rights in wildlife *can* promote conservation. But saying this is not equivalent to saying that the assignment of private property rights in wildlife *does* promote conservation. So the question for someone who is targeting conservation and considers privatization of wildlife as an instrument to achieve his objective becomes: "When will private property rights *do* promote conservation?"

The focus of this project is on identifying the conditions which should be present in the environment of someone who is vested with a private property right in wildlife to take the decision to preserve the goose (and the nest) *out of self-interest.*   The aim of this project is to assess the potential of the policy *instrument* of privatization to achieve the policy *objective* of conservation. Its target is to be able to evaluate the potential for conservation of a particular management system based on private property rights, by looking at the conditions existing in the environment of the system. At the policy level then, it will be possible to influence the general environment of a management system towards conservation by focusing on these certain conditions which do have an impact on conservation.

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[3]Practices that qualify for land "improvement" are usually such as deforestation, fencing, or cattle ranching, practices which are in conflict with wildlife conservation.

The exact issue this project addresses is *the degree of conservation that the owner of a wildlife resource will practice*. Is the "conservation" that a resource owner will practice the same as the "conservation" that the policy-maker has in mind when he will decide if he can assign property rights in the resource or not? Is the degree of conservation that the individual self-interested owner will practice the same as the degree of conservation that the State seeks when allowing commercial exploitation of the resource? Could they be different, and if yes, what are the conditions under which they will coincide? And what is exactly the meaning of "conservation"?

1.4. Some definitions.

1.4.1. On conservation. In economic terms, "conservation" of a resource and its logical corollary but economic opposite "depletion" are defined in terms of *changes* in the intertemporal distribution of resource use: "A change from one time distribution to another is called *conservation* if the redistribution is in the direction of the future and *depletion* if the redistribution is in the direction of the present" (Ciriacy-Wantrup 1985, p.209). In this respect, "State of conservation is merely a convenient shorthand expression for a given state in the intertemporal distribution of resource use" (Ciriacy-Wantrup 1985, p.209). An important special case of a state of conservation is the one which may be regarded the economically "best" for an individual resource user or for a social group. This is the *optimum state of conservation* (Ciriacy-Wantrup 1985). The optimum state of conservation for an individual owner is the one that will maximize the profits he can derive from the resource. Profit maximization can be accomplished by maximum use, no use at all, or any rate of use in between.

Economics focuses on the conservation of the means of production, but environmental concerns focus on the preservation of natural environments and biological diversity. A policy maker who is interested in the preservation of biological diversity (a "preservationist"), and wants to express himself in economic terms, will tend to find the optimum

state of conservation in a *sustainable* use of the resource, where sustainable means that the resource base is not diminished (IUCN 1980).   Thus conservation for the preservationist tends to mean the preservation of the resource base (the maintenance of the means of production). Sustainable utilization is the use of the resource (the means of production) so as to conserve it (IUCN 1980), and sustainable development is the process which results in increased societal benefits (increases in production) accomplished by sustainable utilization (Ledec 1988, p.36-37).[4]

The rest of this project proceeds with focus on the following question: What are the conditions needed for the self-interested owner and the preservationist to have the same optimum state of conservation?

1.4.2. On extinctions. Some clarifications of the scope of the term extinction in this project might also be in order. Extinction can be demographic or ecological. Demographic extinctions can be local or global. Local extinction refers to a particular population and global extinction refers to the entire species. Local extinctions do not have to be detrimental for the species as such, but the elimination of populations might as well imply danger for the species as a whole. A local extinction is of course equal to global when the local population represents the last reproducing unit of the species (Slobodkin 1986). In this project, extinction will tend to mean local extinction, and the focus will be on the local effect of a local enterprise to the species population. However, the effect of a local enterprise to the ambient population of the species will not be ignored.

Besides the demographic extinctions, extinctions can also be ecological. An ecological extinction can be defined as "the reduction of a species to such low abundance that although it is still present in the community it no longer interacts significantly with other species"

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[4]The above definitions are useful and adequate for the discussion that follows, but they are neither generally accepted nor free of semantic problems. "Loaded" terms such as "development", can be defined only as a result of a dialectical process and no definition of them can be independent from the culture and society which defines them. For a discussion of various definitions of sustainability and their problems see also Pearce 1990a,b; Barbier 1989; Collard 1988.

(Redford 1992, p.415). Members of the species population can still be able to reproduce effectively, so no threat of a demographic extinction is imminent, but the quality of the ecosystem is degraded. Ecological extinction can be as important as a demographic one from a conservation standpoint. Ecological extinction considerations focus on a unit that Redford calls "minimum ecologically operational population size" (Redford 1992, p.415), as opposed to the ecologically deficient "minimum viable population size".

    1.4.3. On wildlife utilization. Some further clarifications on the concept of wildlife utilization are also needed. Methods for wildlife utilization can be intensive or extensive. The spectrum of methods for wildlife utilization covers domestications (the most intensive), captive breeding and rearing of a species, ranching, and management and harvest in the wild (the most extensive) (Luxmoore 1992). "The fundamental distinction between the concepts of domestication and captive breeding versus ranching and wild harvest is that of interaction of the utilized animal with the wild population. It is this interaction that keeps the ecosystem intact, and provides the incentives to conserve the entire system rather that just the animal" (Luxmoore 1992, p.174). The interest in this project will be mainly in ranching and wild harvest, since these methods are the ones that have a stronger element of conservation, in the sense that they conserve the entire ecosystem and not the species by itself. However, captive breeding and domestication cannot be ignored as they relate to conservation as well.

    1.5. Organization of the rest of this study. The conditions that might exist in the environment of a wildlife management system based on private ownership will be discussed in Section 2. The variety of these conditions and the fact that factors exogenous to the system can induce change to them and reverse a conservation trend necessitates the development of a dynamic framework to analyze them and understand the ways they change. This framework is developed in Section 2. Three case studies, the African elephant, the Nile crocodile in Zimbabwe, and the green iguana in Panama and Costa Rica are used in Section 3 to show the

applicability of the framework in analyzing commercial exploitation of wildlife. Section 4 provides for a comparison of the case studies in relation to the general framework, and is trying to show the potential of commercial exploitation for each one, based on the analysis carried in the preceding Sections.

2. When will privatization result in conservation?

2.1. Implementation of the privatization process. Each policy recommendation has an implicit assumption. The recommendation to assign and secure property

rights in a resource like an endangered species (or wildlife) hinges on the assumption that clearly defined and enforced property rights provide a reason for conservation. Conservation is this way carried through the mechanisms of a market, which regulate the allocation of the resource.

The underlying theme of this study is conservation through self-interest. The establishment of exclusive ownership rights in the resource creates the incentive to conserve it. Exclusive ownership means that property rights are clearly defined by the collective (the State), where an owner can turn to have his right enforced. To have property over something is to be able to control the benefit stream that the object of interest can generate (Bromley 1991). "Property is a set of rights to control assets: to refuse use of them to others, to hold them intact, or to use them up. Property rights are consequently grants of authority made to persons and organizations, both public and private and acknowledged by other persons and organizations" (Santopietro 1992). So assigning a property right to someone does not mean to allow him to physically capture the object of interest (say a wildlife population), but to give him control over the benefit stream that this object can generate, and also to not allow anyone else to prevent him in any way to exercise this control (Bromley 1991).

The above definition of a property right might seem to leave too much freedom to the owner to decide about the use of the resource, and might raise questions as to whether this use will be socially desirable. But what is true here is that any use of the resource (wildlife) cannot be of significant benefit to the owner unless the products of this use are traded in a market and provide an income. Also, it is important to note that a market will not arise spontaneously after the property rights are assigned. Markets are instituted (Polanyi 1944; Swaney 1982), and need a set of rules adhering to a justice system in order to be effective. This justice system reflects the societal values, and results in rules and regulations that constrain the ability of the owner to implement socially undesirable practices. These rules and regulations would necessarily come from the national government which itself has to adhere to international rules and regulations (treaties, agreements), which are implemented by international organizations.

There is no other way for the implementation of the privatization process but to be carried by the *State*. And since international markets and concerns might exist, implementation must be assisted by *international bodies*.

2.2. CITES in relation to the privatization process. Today, the most widely accepted wildlife conservation agreement in the world is the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Fitzgerald 1989). CITES lists species in three appendices. Appendix 1 contains species that are threatened with extinction and may be affected by trade. All commercial trade in Appendix 1 is banned. Appendix 2 contains species that are not threatened with extinction but might become so if trade is not controlled. Also, countries have the option of listing any species in Appendix 3, if it is protected within their own borders. All 112 members of CITES are obliged to abide by the convention's mandates, usually by passing national legislation.

CITES allows exemptions to trade species listed in its appendices without the usual regulation. Two of the exemptions that are important for the scope of this project are the "captive breeding" and "ranched wildlife" exemptions. These exemptions are very useful in reminding us that CITES was created to *control* trade in wildlife and not to *stop* it.

Captive bred plants and animals that are listed in Appendix 1 are treated as Appendix 2 ones. The criteria for operations of the kind to make use of this exemption are that the "farm" must be able to produce second-generation offspring, known as the "F2 generation", and the breeding program must not rely on specimens from wild populations (Fitzgerald 1989).

Downlisting of specimens of a certain "ranching" operation to Appendix 2 is also possible if the operation meets certain criteria. These criteria require that the population no longer be endangered, and that the operation contribute to the conservation of the wild population. Wildlife ranching differs from farming in that eggs or young are regularly collected from the wild and then raised in a controlled environment. The survival rates of the animals in

this controlled environment are far better than in the wild, and some stock of the population is returned to the wild so that the wild population benefits. Two species populations that were downlisted when their countries utilized this exemption are the Nile crocodile population in Zimbabwe[5] and the saltwater crocodile population in Australia (Fitzgerald 1989).

2.3. Conditions that would favor privatization. Even if CITES is the most widely accepted conservation agreement in the world, the decision about wildlife use ultimately rests with the range States. So what are the issues that a State government needs to be aware of when deciding about the use of wildlife? What is the process in deciding if it should assign private property rights to a wildlife resource or not?

Before assigning property rights in wildlife, the State has to appraise the conservation potential of the proposed wildlife enterprise. It has to assess a series of conditions as to if the enterprise will be willing and able to practice conservation. These conditions are presented in the following pages, along with some remarks on their necessity, their importance, and the actions that might be taken by the State to remedy some of the negative effects.

These conditions are presented in the form of questions concerning the desirability of a privatization. There is a set of twelve questions that discuss the conditions that would favor or not privatization if existing or not in the environment of an enterprise. Questions 1-5 discuss the broader international/national feasibility of privatization. Questions 6-11 address factors that would influence the owner's decision of rates of exploitation, and the general desirability of the enterprise for the profit-maximising owner. Question 12 appears in the concluding section, and addresses the whys and hows a national government should assist or restrain an enterprise.

1. Is it acceptable to exploit the species and maybe kill the animals?

This question stems from another one very often asked: How can killing animals be good for them? However, this is only an oversimplification of the problem. Some forms of

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[5]See the second case study.

exploitation are harmful; so, where doubt exists, it is simplest, for safety and ease of enforcement, to assume that they all are (Luxmoore 1989). The animal rights movement assumes exactly this, but what impact can it have?

The emergence of a strong animal rights movement may have adverse implications to an effort of commercial exploitation of wildlife. Although not especially strong today, the animal rights movement might be capable of influencing decisions and launching a boycott of wildlife products.

The animal rights arguments move in two levels. The first level supports the belief that all sentient animals are equal. It is therefore immoral for humans to kill them and exploit them to profit. A counterargument is that all animals in nature use other ones in a resource context. Offtakes of animals by humans are therefore permissible, and they just have to be sustainable. The latter attitude is expressed, for example, in the World Conservation Strategy.

The second level supports animal welfare considerations. Animal welfare standards, if existing, might save an enterprise of a considerable reaction from animal rights groups and consumers. Standards that would ensure the well-being of the animals would probably improve the well-being of the enterprise as well, since production levels might be higher. Although it is generally accepted that conditions such as plenty of water or food for the animals, or opportunities to exercise, increase the welfare of the animals, standards for animal welfare are not so easy to propose here, especially since the publicity has focused on relatively few cases, while most of the cases remain invisible. Animals that have a physical appearance that can evoke public sympathy are the ones that become most visible (i.e. pandas). Some people might suggest the avoidance of unnecessary cruelty in the operations, but this suggestion does not answer what necessary cruelty is.

2. <u>Is it not prohibitively expensive for the resource to be claimed for exclusive use?</u>

There might be natural or technical considerations which can render it prohibitively expensive to claim and enforce the exclusive right of use. The resource should be appraised from a biological, ecological and technical standpoint.

Considerations might be disease resistance, behavior in the management system, predator and prey factors that might be positive or negative for the applicability of the proposed management system. Veterinary knowledge and services might be needed to ensure the well-being of the enterprise by ensuring the well-being of the animals. Veterinary knowledge is unfortunately small for most wildlife (Kiss 1990).

The natural habitat of the resource should also be manageable and monitored cost-effectively if needed. It should also be suitable for the needed operations. Many wildlife populations live in rough terrains, and, for example, the moving of large vehicles might be difficult (Eltringham 1984).

If the species has migratory traits, is highly mobile, and its range crosses political boundaries, it is unlikely that any property right assigned to it will be accompanied by the ability of the collective to enforce it (Goldstein 1991). This is the case with whales, for example. The advance of technology might assist enforcement in these cases. In the whales example, advanced detecting devices can make patrolling of large tracts of water possible and effective.

Another consideration is the existence of appropriate technology for the management of the resource in an inexpensive and readily available form. The enclosure technology (fences), the harvesting technology (firearms, trapping nets and devices, vehicles), or the monitoring technology are some examples.

3. Are there any international constraints on the enterprise?

If the products of the resource are not traded internationally, this question would seem not to be applicable. It might still be applicable though, since all known endangered species are supported in a bigger or smaller degree by international organizations, and the

existence of any species as it contributes to biological diversity is assumed to be an international resource by international treaties such as CITES.

Although biological diversity can be assumed to be an international resource, a locally restricted species cannot be anything more than a national resource. Developed countries and conservation NGOs have an interest in the preservation of these national resources, and by putting pressure (political or economic) on countries that do not manage biodiversity "successfully", they force these countries to get involved in conservation projects or conservation commitments which might be in conflict with national objectives for economic growth. And even when wildlife exploitation can result in economic growth, the international image of a country might be damaged if it implements a wildlife utilization program. It might sometimes be wise for a country to refrain from wildlife utilization opportunities in order to gain in other fields internationally.

Although this divergence of goals between international organizations and national governments can be carried to the population that lives near wildlife, this is not always the case. Sometimes joint goals can exist between conservation NGO's and local people, and the goals of both parties can be accomplished through a wildlife utilization scheme. A recognition of these joint goals is shown in the World Conservation Strategy, which calls for the sustainable utilization of species and ecosystems. The need for this call comes from the recognition that there is not merely a choice between exploiting wildlife and leaving it alone. Environmental manipulation is needed to support a growing human population. Conservation, in this respect, assists people to support themselves by using their native biological resources and seeks to eliminate or minimize long-term degradation (Luxmoore 1989).

A necessary precondition for the implementation of a wildlife utilization project that involves international trade is that the products of the enterprise can be legally traded. Trade should be permissible by CITES, and even if the host country of the operation is not a CITES

member, the marketing of a product would still be practically unattainable, since it would not be traded in the (currently 112) members of CITES.

4. Are there any national constraints?

    The goals of the government and the owner should not create conflicts of actions. The government will give substance to the owner's claim to the benefit stream of the resource, and it should make sure that it will protect this claim after granting it by making sure that the owner will not be inhibited in his actions.

    Since an enterprise might be facing controls from the national as well as from local governments, an efficient scheme of control should be designed. Centralized or decentralized control might be the appropriate solution, depending on the institutions of the particular country. The issue here is also the centralized or decentralized control of natural resources. Most of the countries have chosen centralized control, so they have developed the institutions to implement it. This system has been proven ineffective in many cases (McKay and Acheson 1987; Proceedings 1986; Kiss 1990). The relationships between the national government and the local communities must be understood, especially in a natural resource context. Factors like revenue sharing between the national government and the local communities and government have to be considered.

    Local people have often been alienated from their wildlife by government measures. Local people are often dependent on their wildlife as a protein source. When the government implements a conservation policy,local people might think that the government ignores their needs in favor of the needs of animals.

    The overall policies of a country can create factors that will impede an effective operation of the enterprise. For example, for tourist enterprises that are trying to attract

foreigners in the country, an over-valued exchange rate will have negative effects. An already existing infrastructure can be helpful for tourism oriented enterprises. Such enterprises will be helped by the reputation of a country for wildlife tourism, and for tourism in general.

5. <u>Is the prospective owner suitable for the specific situation? Does he have the knowledge needed to effectively manage the resource?</u>

The people that live with the resource are often the ones that know the most about it. They probably know how to utilize the resource effectively, especially in the context of the natural ecosystem where it is found. Small scale exploitation has probably occurred, and large scale exploitation may also have occurred, where local people were often poachers. By vesting the local people with the property right to their resources, the State can accomplish two different goals: It creates a group of people with an incentive for conservation of the resource by securing a benefit stream, and it removes the principal competition from the field (themselves, the former poachers) (Barbier 1990).

Especially in the case of trade occurring in remote markets, the costs of a species utilization are better internalized if the owner(s) belongs to the local community. This is true because species might have a higher value to the local community due to cultural and religious beliefs or subsistence use. A local owner would therefore tend to produce less and sell for a higher price than an expatriate investor. The asset character of the resource would take on the current income character of it. This might not be necessarily true though, since a local investor might have a very high rate of time preference, and economic theory suggests that this would lead him to exploit the resource more rapidly. A secured income stream (a secured claim to property), and, maybe most importantly, the secured provision of some basic services (food, medical assistance, housing) to the owner would lower his rate of time preference (discount rate). This is why management projects are less likely to succeed in places where immediate basic needs are still existing.

If the owner does not belong to the local community, a lot of consideration should be given to the behavior of the local community towards the owner. The contribution of the resource (of wildlife) to the local economy and culture need to be assessed. Local people might tend to be hostile to the enterprise, and even an indifferent attitude might render an enterprise unsuccessful. Local people should be given incentives to assist the owner in his management efforts through employment or government assistance. Otherwise, locals might collaborate with the poachers, seek employment there, or be poachers themselves. This is especially true if the local population has been at least partially responsible for the degradation of the resource, and now it might perceive the new owner as someone who came to take away what they always had a right at.

Another consideration should be the share of the benefits that the owner can capture, and a clear definition of them. If the share of benefits that the owner captures is small, due to an existence of a lot of middlemen, or a heavy tax burden from the government, then one might consider ways to reach the consumers by-passing the middlemen, or relief some of the tax burdens from the enterprise. A greater appropriation (share) of the resource's stream of benefits can give a more secure sense of ownership and result in better care of the resource and the operation. A large share of the resource's rents can be very important for the owner to capture for another reason: If the economic value of the resource is diluted through a lot of middlemen, the rent that the owner captures might not be enough to justify the resource's conservation.

Some management operations might require trained personnel to be effective. When consumptive use is involved, for example, "management of wildlife populations requires considerable knowledge of the population dynamics of the key species to determine sustainable offtake rates and desirable population structures (i.e. age structure, numbers of males vs. females) for maximum efficiency" (Kiss 1990, p.24). The owner has to have access to people that are able to do the job, or have access to training programs that would prepare people to do the job. He has to have the knowledge that would be needed to manage the system, the knowledge of the

biology, ecology or natural characteristics of the species and its population. The existence and appropriation of local knowledge might be a significant factor for the success of the enterprise (Prescott-Allen and Prescott-Allen 1992). A problem might arise when the local knowledge of management comes from times of abundance of the resource, with different wildlife and human populations or means of management. This knowledge might not be suited for current conditions (Kiss 1990). The knowledge and skills that are needed must be maintained over time.

Access to certain inputs might be essential, like inputs for processing trophies and curios for tourists. Supplying tourists with essential services might be essential as well. The overall policies of the country are likely to result in conditions that would be favorable or not to the wildlife enterprise. The existence of similar enterprises in the country can help since the access to equipment and knowledge, for processing skins, for example, might exist.

6. Are there prohibitively large investment costs? If so, is international funding available?

The cost of the initial investment might sometimes be prohibitively large for the owner to utilize the benefit stream. This is especially true in developing countries where poverty is high, and a local owner might not have the capital to invest. His access to capital markets might also be limited, and the only loans he could secure might require high interest rates.

Investment costs include the land of the utilization system as well. Land might be a significant factor, and might need to be purchased. The land might already belong to the investor, who has been using it for different operations. The availability of the land is especially important in cases where large pieces of land are needed for the implementation of the system. The land can be rented by the State, or given from the State to be used in this particular program. Since a lot of wildlife lives on marginal land, the opportunity cost of the land will tend to be low, or negligible in some cases. Future availability of land should also be secure, especially when alternative land uses are considered or are likely to be considered in the vicinity of the enterprise's operations.

Foreign currency might be scarce in the country but needed for the purchase of equipment. This might serve as a constraint. Occasional future shortages of foreign currency might also be detrimental in the operation of the enterprise. Foreign currency might be needed for additional purchases or maintenance of equipment.

The availability of international funding is highly related to condition 3. If there is a divergence of goals between the owner and the international sources of funding (developed countries, international development agencies, NGOs), then it is unlikely that international organizations would be willing to fund the program. If joint benefits can exist from the implementation of the program, then the international organizations might provide the funds for the initial investment and help towards the implementation of the program. What needs attention is how clear the initial agreement is between the funding source and the owner, and how clear the definition of the goals is. International funding, especially when it comes from conservation organizations, might impose controls on the operations of the enterprise that the owner would not be willing to meet. NGOs might also be reluctant to become directly involved in an enterprise like this, since they might lose support because their members in the developed countries might oppose wildlife exploitation of any kind.

7. Is the enterprise profitable?

A clear analysis of the costs and benefits of the enterprise needs to be done before the initial investment. A cash-flow analysis that will properly account for all costs and benefits of the operation is the usual procedure. Speculations will unavoidably enter the picture, but they should be kept to a minimum. Different scenarios might be analyzed, especially when a species has more than one use that can be utilized. Use and non-use benefits should be considered, and the capture of non-use benefits might be looked at if possible. All wildlife has non-use value, in the form of existence, option or bequest value. Although it might be extremely difficult for an individual owner to capture the benefits derived from non-use value, it might be possible and

extremely profitable sometimes. Tourism for viewing wildlife is a lucrative enterprise, and large NGOs from other parts of the world might be willing to make direct payments to conserve the species of interest.

Another consideration is the demand for the final products and the ability of the owner to influence this demand. If the demand is price inelastic, as it is the case for a lot of wildlife products, then a decrease in supply will not reduce profits, but merely increase the price. The availability of substitutes to the consumers might keep the price from increasing greatly, but substitutes for wildlife products are very rarely considered of equal quality to them.[6] A lot of wildlife products (furs, medicinal products, trophies, curios) are considered luxury goods, and a decrease in supply tends to affect the price in a way that profits increase, while the quantity demanded remains unaffected or even increases as well.[7] Demand for wildlife products is also income elastic, and, as international incomes increase, one can expect that the demand of these products will increase as well (Muir 1988). It has been suggested that products from natural habitats can draw a "premium" due to their diverse nature and a recognition of their source. Countries with products from natural habitats have therefore a comparative advantage in the production of such goods. The empirical record does not contradict this theoretical expectation (Luxmoore 1992; Muir 1988).

Although the substitutes might not play an important role, changes in preferences in the consumer countries might reduce demand and reduce or extirpate profits. The consumers of wildlife products in the developed countries have already showed signs toward this direction.[8]

Wildlife utilization techniques aim to increase the value of output from wildlife by refining supply techniques. The increase in demand and marketing efficiency is also essential

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[6]This is another way of saying that the demand for these products is price inelastic.
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[8]I will come back to this in condition 10.

to increase the returns to producers (Muir 1988), but a constraint might be the easy access of the owner to the market of the product. Marketing techniques can be utilized to expand the market of the product as well.

An additional problem might arise when small scattered production units cannot achieve economies of scale or utilize marketing techniques due to poorly developed infrastructure, technologies and institutions (Muir 1988). This leads to an inefficient marketing of the product and to an inability to influence demand.

The above problems are also addressed by Eltringham in relation to meat products. Eltringham addresses poor communication with markets and problems in observing processing regulations. Major difficulties might arise when the final product for consumption is meat: Cropping might occur hundreds of kilometers away from the big cities which provide the largest markets for the meat, and transportation costs, poor road systems, along with the hygiene requirements might make it unprofitable to take the meat to the market. Hygiene regulations in processing the product might make it unprofitable to take it to the market, since the cost of processing might be high. The meat can sometimes be sold in local markets, probably at a lower price (Eltringham 1984).

8. Is the project attractive to the investor?

Proper accounting of costs and benefits is needed so that the owner can decide if he prefers to manage the project sustainably or not. An obvious precondition for implementing the project in the first place is that the cost of managing the resource be smaller than the cost of taking from the wild (Goldstein 1991). This cost should be smaller before and after implementing the project. This means that one would not invest in the enterprise if it is less costly to directly take from the wild, and one would not stay in business if it will cost one less to cease management operations and take from the wild. A reversal of a trend for sustainable management can result from the relaxation of enforcement or the emergence of an advanced

technology. Factors largely exogenous to the immediate environment of the system can be significant.

If there are any alternative land uses that seem preferable, the owner might turn his operations towards them. One reason that land uses can become preferred might be changes in government policy to subsidize new endeavors and new land utilization. The overall government policy should be considered. For example, cattle ranching is currently preferred over other land uses in many developing countries largely because cattle ranching has subsidized veterinary support, market infrastructure, as well as producer prices that exceed the world price, all a result of government assistance to ranchers (Kiss 1990).

Liquidation of the enterprise, in the form of killing the animals and driving the species extinct might also be the expected result in particular cases. If the growth rate of the species is low, as in the case of the African megafauna or the whales, the sustainable yield might prove insufficient to maximize profits even if the asset character of the resource is properly accounted. Other investment opportunities with a similar risk level to the sustainable utilization of wildlife and with higher profit rates would be preferred. The existence of such opportunities creates the incentive to sell as much as one can from the resource and invest in the higher profit ventures as soon as the money comes in (Clark 1973, 1975; Fife 1971). Liquidation of the enterprise is the only wise choice that a self-interest motivated owner of a commercial enterprise would be expected to do.

Even when more profitable investments are not accessible, liquidation or overexploitation that might lead to extinction can also occur due to the high rate of time preference of the owner. In most developing countries poverty is a usual element of life. Basic needs are not met, and the concern of the people is usually how to secure the next meal, and not how to secure a long-term income stream from the sustainable use of a resource. In an environment of poverty the time frame of sustainability is in the order of days or months and not decades or centuries. A poor owner of a wildlife resource will thus tend to completely disregard

any future benefits in his decisions. Of course, the provision of basic health services and the accommodation of basic human needs should be a precondition to any project implemented in an area where these needs exist, and not only because it would lower the rate of time preference.

Imperfections in markets for assets and loans can also result in high rates of time preference. These rates are income dependent, in a sense that if markets for assets and loans are imperfect, as they are in the developing countries, a decrease in income levels will increase the time preference and lead to depletion; an increase in income levels will lead to conservation. The change in time preference will be more significant in low-income levels than in high-income ones, since as income increases, the effect of a given change in income level will be less and less substantial on the change of the time preference (Ciriacy-Wantrup 1985).

To summarize with a slightly different terminology, the species has to have a strong asset character as a resource to prefer to manage sustainably. If the current income character prevails over the asset character, it is expected that the resource would be overexploited. The income potential of the sustainable enterprise is not only the direct profit, but also the revenues from liquidating the enterprise and taking the money to the bank for interest, or invest elsewhere. If the rate of growth of the value of the resource results in less profits than the profits that can be captured by overexploiting or liquidating the enterprise, the asset character is extremely weak, and the incentives for conservation cease to exist.

9. Is the enterprise competitive with legal and illegal operations?

The ease with which others are able to enter the business should be examined. The existence of profits that would make the sustainable utilization attractive creates the incentives for others to enter the business. In the case of sustainable utilization of an endangered species that was threatened with extinction due to overexploitation, it should be expected that the demand for the products of the species will not be met by a sustainable utilization scheme. In the case of a single owner it might not be profitable to produce more than what a sustainable yield

permits. However, in the case of a lot of owners it most probably pays each one of them individually to overproduce, and no one of them if every one overproduces. An agreement for a sustainable quota must be reached, and efforts to enforce the quota might be needed. Visibility of the defector should be targeted, and incentives for a mutually binding agreement that would be self-enforcing and monitored should be sought. The role for an international regulatory body such as CITES, to administer and be involved in the process, might be important.

Besides legal competition, illegal competition might pose an even bigger threat to the financial health of the enterprise. Poaching is usually a lot cheaper than legal management operations, since its overhead costs are low. Poachers can also avoid tariff expenses by smuggling the product out of the country, or import taxes by smuggling the product into the country. The smuggler's premium can be extremely high, especially in strictly regulated and monitored products that become more valuable as they become more scarce due to these strict regulations that prohibit their trade.

Another problem with poaching is that it exacerbates the already difficult problem of calculating a sustainable yield[9] (Eltringham 1984). For a sustainable yield to be estimated, a lot of factors need to be considered. These factors include the age structure of the population, or variations in the numbers of animals in a population in time. These factors are more difficult to estimate when poaching occurs, especially since poaching is usually unselective cropping.

An example of a situation in which poaching is not possible would be the case where the illegal products were clearly distinguishable from the legal ones. Distinguishability of products can be achieved even in cases where the physical characteristics of the products do not help, as in the case of crocodile skins, which are required to be tagged for their trade to be permissible under CITES (IUCN 1992). Monitoring and enforcing technology should keep up with advances in harvesting and poaching technology over time.

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[9]Also look at condition 11.

10. <u>Can the enterprise be expected to be profitable in the future? Is the definition of property rights clear and secure in the future?</u>

        If there has been a number of government acquisitions of private enterprises in the past, the security of future ownership might not be strong for the owner. If the government is unstable, and the opposition has different views about wildlife or different priorities that would create disincentives for effective management, or if there are signs of war or military instability in the country, the owner might not feel secure in his investment. This insecurity will lead him to value current income more than potential future benefits, the asset character of the resource will be minimal, and the discount rate of the owner will be high, leading to overexploitation.[10]

        Another important issue is the existence of demand for the products in the future. Values in life change constantly, and human preferences change according to the changes in these values. Demand for ivory products, for example, fell dramatically after the mid-1980s and caused a major decline in the ivory trade.

        A further complication in most of the developing countries is that a "free enterprise" system has little chance of success because the social and political systems are rigidly stratified. Citizens in most developing countries lack the opportunity of upward mobility. When someone develops a profitable enterprise, others with greater political/social/economic power step in and usurp that enterprise unless it is protected through some enablement process or organization (Gardner, personal communication, 6/25/92).

11. <u>Will the enterprise promote conservation?</u>

        This question addresses the overall "success" of a privatization. A "successful" enterprise is one that uses the resource species at rates within their capacity for renewal and

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[10]Also look at condition 8.

maintains their habitat, without having an adverse impact on other species or ecosystems, while maintaining a profit.

A condition that would promote conservation can be that a reliable supply is needed to maintain commerce (Goldstein 1991). Thus, a steady sustainable yield would be in the benefit of the owner. A problem might arise because one rarely knows what a sustainable yield is. A sustainable yield of a biological resource cannot be defined on a yearly basis, nor does it stay constant through time. Furthermore, one-species oriented modeds to calculate sustainable yields might cannot reflect the copmlex effect of an offtake of a species to a multi-species ecosystem. Erring on the side of cautiousness might be an effective strategy here, and the owner has to be aware of this.

If there is a demand for a uniform or an enhanced product, conservation is likely to be promoted (Goldstein 1991). However, the need for a uniform or enhanced product will most likely lead to intensive management, and then it might be more difficult to talk about "wildlife" utilization.

A very important concern arises if additional pressure on the wild population is created. Trade in known endangered species is prohibited, but a sustainable utilization operation would be based on an elimination of the prohibitions in trade. Especially when the system results on lowering supply, demand would not be met. Incentives for poaching and illegal operations are then created, and the wild population might suffer.

An enterprise can also take pressure off of the wild population. An enterprise that would provide the market with additional supply of the product will tend to drive the price downwards, making exploitation of the wild population unprofitable (Luxmoore 1992). However, wild harvest operations and poaching might have a wider margin of profit than the enterprise, and the competition might be detrimental to the enterprise.

Conservation of the habitat of a species by a commercial enterprise can create benefits for other species as well. The establishment of a natural habitat for the relevant species would also attract other species, potentially endangered as well.

3. Case studies.

In the next section, three case studies, the African elephant, the Nile crocodile in Zimbabwe and the green iguana in Costa Rica and Panama are presented. The purpose of these case studies is to show the applicability of the framework developed in the previous section to analyze wildlife exploitation in relation to conservation, and to assess the conservation potential of a privatization policy in the case studies.

3.1. The African Elephant.

3.1.1. Introduction. The African elephant (Loxodonta africana) is one of the many species that are endangered due to their commercial value. The elephant is hunted due to

the value of its ivory. World demand for ivory had been constantly increasing for the last decades, mainly as a result of an increase in income in Japan and other Asian countries. The volume of international ivory trade had been constantly increasing until the mid-1980s. The tons of raw ivory traded were 204 in 1950, 412 in 1960, 564 in 1970 and around 1000 in 1980. Up to 1986, between 700 and 1000 tons of raw ivory were traded internationally each year, before a change in public opinion and the illegalization of trade decreased the volume of the trade. The price in that time has also followed an increasing path. Between 1979 and 1985 the price of ivory was around $60/kg, in 1987 it reached over $120/kg and in early 1989 it rose towards $300/kg (Barbier 1990). It is not surprising that the ivory trade is a highly lucrative activity.

Paralleling the above numbers, the elephant populations have decreased in numbers over the past years. From a review of all the available data in 1987, the African Elephant and Rhino Specialist Group concluded that "760,000 elephants remained in 1987 out of the original 1,300,000 estimated in 1979" (CITES 1989). In 1989, the Ivory Trade Review Group (ITRG) concluded that "the analysis of recent data and trends suggests that about 609,000 elephants remain in Africa (CITES 1989). The ITRG also concluded that "the steep decline in elephant numbers that has been observed over the last decade can be almost entirely explained by the quantities of ivory exported from Africa in that time" and that "the number of elephants killed for the ivory trade threatens the continued survival of the species in many parts of its range" (CITES 1989). The ITRG presented its conclusions to the seventh CITES Conference of the Parties in 1989, and it was decided that the elephant be moved to Appendix 1 of CITES from Appendix 2 where it had been since 1972. An Appendix 1 listing means that all commercial trade is banned.

The Appendix 1 listing was a decision that recognized that the ivory trade has created pressures on the populations of elephants. The level of elephant slaughter which generated the quantity of ivory demanded was not sustainable. It has been estimated, for example, that the 1985 sustainable yield of ivory was 329 tons, in a year in which almost 800

tons were traded internationally (CITES 1989). Another fact that shows the magnitude of the problem is that in 1979 one ton of ivory represented approximately 54 dead elephants, while in 1987 one ton represented 113 dead elephants. By 1987 most of the mature bull elephants have been shot, leaving cows and calves with a much lower average size of tusk (4.7kg instead of 9.3) to support the demand for ivory (Barbier 1990).

CITES provides for exceptions to trade, and one of them was utilized by five countries at the time, which took a reservation on the elephant Appendix 1 listing. Taking a reservation means that this country may act as though it does not belong to CITES concerning the species of interest. In the Tokyo convention in 1992, there were two proposals for downlisting the elephant to the Appendix 2, supported by countries which had elephant populations stabilized or increasing and wanted to "be rewarded for their conservation record". However, both proposals were withdrawn when it was evident that the vast majority of the members would not accept the downlisting, afraid of increased poaching in the rest of the range states (IUCN 1992).

The decision not to permit the downlisting seemed unfair to the countries with stable populations. In the CITES convention of the Parties in Lausanne in 1989, a series of stringent biological and managerial criteria had been established for a population to be treated as in Appendix 2. A Panel of Experts had been created to assess the success of proposals to meet the above criteria, and in 1992, the Panel reported that South Africa and Zimbabwe met the criteria (IUCN 1992). The reason why countries that had met these criteria were not granted permission to trade ivory stems from the recognition that there is an enormous amount of mixing between legal and illegal ivory in the world market (CITES 1989; Barbier 1990; IUCN 1992). The permission to trade, no matter how limited, would therefore induce poaching and create additional pressure to the unmanaged population.

Even though the ivory trade is currently illegal, the arguments for commercial exploitation of the elephant are still strong. The main problem for the trade to be legalized is the mixing of legal and illegal ivory in the world market. Keeping this in mind, and using the

framework developed in the previous section, the following pages discuss the conditions that influence elephant exploitation and try to assess exploitation's potential for conservation.

3.1.2. Conditions that would favor privatization.

1. <u>Is it acceptable to exploit the species and maybe kill the animals?</u>

 Elephants have been in the forefront of publicity over the last decade. Stories about the ivory trade and the threat that poses to the elephant frequently appear in national and international news media and have alerted the public to the threat of extinction of the elephant. This might hint to the direction of a declining demand, but this is not generally true. In some countries, like the U.S., the demand for ivory might be influenced by the efforts of conservation organizations like the World Wildlife Fund, which in a recently published book suggests to consumers not to buy ivory and to encourage others not to buy ivory (Fitzgerald 1989). The demand in Japan and the rest of the Asian countries that are major importers of raw ivory is not likely to decrease though, due to its income elasticity and the importance of ivory in these societies[11] (Barbier 1990). A substantial decrease in the U.S. demand has been argued to have happened after the mid-1980s, due to shifts in public opinion, causing significant decreases in the amount of ivory traded (Stephen Edwards, personal communication, 8/11/92).

2. <u>Is it not prohibitively expensive for the resource to be claimed for exclusive use?</u>

 The reason that elephant populations are not managed sustainably might be because it is not profitable to establish an enforceable ownership structure. There have been reports indicating that the cost of enforcement to the claim of ownership can be very high (Barbier 1990). Technology for poaching is cheap and readily available to poachers (heavy weaponry and vehicles) so the cost of poaching is low, while the mobility of the species populations make monitoring difficult. Also, heavily armed poachers make patrolling dangerous.

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[11]See also at condition 7.

Barbier cites a number of reports that show a close demonstrated correlation between the enforcement expenditures and the successful maintenance of elephant stocks across range states. But as Barbier warns, "it is evident that the least-cost method of monitoring elephants is not being utilized in most of the range states" (Barbier 1990, p.110).

There have also been attempts to show that the elephant populations can be managed for a profit in their natural habitat. These attempts have been successful in demonstrating their point (CITES 1989; Barbier 1990). It should not be forgotten that "some African states have been able to monitor and stabilize elephant populations in the context of the same technologies, while others have not" (Swanson 1989). This shows that there are other factors that render a stabilization effort in elephant populations successful or not.

3. <u>Are there international constraints on the enterprise?</u>

Elephants are a national resource, "in the sense that it is relatively apparent which state has the jurisdiction on the issues of property rights in the animal" (Swanson 1989). However, international attention to the status of elephants is large and emotionally loaded, and international considerations seem to influence the range States' decision-making. As Swanson says, "it simply would not be politically feasible to be held out to the international community as benefitting from the exploitation of the twentieth century's equivalent of the slave trade" (Swanson 1989). The country might not want to present itself as managing and exploiting the elephant. And this is probably true, since although seventeen range states submitted plans to trade government ivory in 1987, only three of them made any provisions for government culling operations (Barbier 1990). As Swanson again puts it, "It would be a nightmare for an African wildlife director to have a state culling operation make the cover of Time magazine" (Swanson 1989).

Although the international concern about the status of the elephant is large, CITES has not been successful in regulating the ivory trade. The regulations that were used by CITES until 1989 were based on sometimes not credible, vast, and therefore incomprehensible information, they were centralized, expensive, bureaucratic and slow, creating a lot of paperwork and difficult to implement. Good intentions were proven inadequate (Swanson 1989). Ivory trade is illegal at the moment, and all considerations about trading ivory require the CITES relegalization of it.

4. Are there any national constraints?

In every range state, legislation exists vesting exclusive title in the resource with the state or its designated agencies (Barbier 1990). The elephant is in a formal institutional structure managed as a State resource, but the lack of enforcement and the possible unwillingness to practice exploitation result in the exploitation of elephants under an open-access regime.

The agencies that are managing the elephants are either remote from the resource, or without the incentives to manage it effectively, or simply corrupted (Swanson 1989). Privatization of the resource is not the only way to solve the "agency problem" (high visibility of the agents' actions or enforced high penalties might suffice), and even then some state regulatory authority should exist. However, it should be expected that privatization would facilitate control and reduce the paperwork and the bureaucracy to a considerable degree, being one probable very effective way to solve the agency problem.

5. Is the prospective owner suitable for the specific situation? Does he have the knowledge needed to effectively manage the resource?   Ownership of the elephants is often very diffusely and diversely distributed. The elephant harvester is not the owner and he does not capture a

significant benefit from the use of the elephant, therefore he is not interested in the conservation of the resource. The following figures, taken from Barbier (1990) give some indication of the value that harvesters capture in various African countries, compared to the value of raw ivory in Japan:

Chad	CAR	Cameroon	Zaire	Zimbabwe	Japan
$7/kg	$6-8/kg	$15/kg	$7/kg	$63-76/kg	$85-99/kg

What these figures show is that "the rents of the African elephant have been captured by non-locals" (Swanson 1989). An owner[12] would be able to capture a large share of the resource's rents, if, of course, problems in the marketing of the products were not existing. But since the rights to elephant ownership are currently vested in the States, and the States are unwilling to practice exploitation[13], the rents are dispersed through a wide variety of entities. Barbier estimates that the share the actual harvester in Africa captures is 10-20 per cent, based on ivory prices received in most African markets (Barbier 1990).

Elephants are treated as an open access resource. The people who are currently exploiting it have an interest in maintaining it as an open access one, because they could not claim a right to its exclusive use themselves, since they are either foreigners, or locals who lack the political and economic power to influence the rights allocation institutions.

Local populations have been alienated from their wildlife, and from the elephant, due to the State's appropriation of them, and its inability to understand the dependence of these local populations on their natural resources. The local people's objectives have diverged from the State's ones, and a convergence of these objectives is needed to conserve the resources and the elephants. By vesting the local communities with ownership rights to the elephants, the State

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[12]As opposed to "a harvester".
[13]See condition 4.

could make these objectives converge. The local people, who have been exploiting the elephant would have an incentive to conserve it, since it represents their future well-being. The cost of enforcement would also be lowered for the State, since the owners, who would also live in the area, would have a strong incentive to practice enforcement themselves. The fact that ivory is traded internationally would create an additional incentive for the management of the elephant, since it can generate foreign currency, which is relatively scarce in Africa (Barbier 1990).

Examples of local ownership programs can be found in Zimbabwe and in Zambia. The Communal Area Management Programmes For Indigenous Resources (CAMPFIRE) in Zimbabwe has existed since 1986 and is probably the most noted program of successful elephant management. CAMPFIRE has, however, some distinct features that make it hard to transfer to another country. Elephant culling has been undertaken in Zimbabwe since 1965, because the elephant population has been large. Revenues from ivory have been a by-product of the culling operations needed to finance the system. Elephant management in Zimbabwe is thus concerned with reducing elephant populations and not increasing them (Barbier 1990).

In a management system that involves consumptive use, in order to achieve maximum efficiency and determine sustainable offtake rates, a knowledge of the ecological/biological traits of the elephant is needed. This knowledge is largely available in the literature (CITES 1989; Kiss 1990).

6. Are there prohibitively large investment costs? If so, is international funding available?

The opportunity cost of capital in Africa is in most places very high, and although base lending rates in sub-Saharan Africa is usually 10-15 per cent, formal credit markets are non-existent in many rural areas (Barbier 1990). Because of poverty, the level of savings is also low, and therefore the capital is scarce. Informal lending rates can be around 50-100 per cent, or even

much higher (Barbier 1990). That has the effect of discouraging investing in the first place, and rendering investments with a slow growth rate, like elephant management, not generally preferable.[14] Development agencies might help the situation, as they make loans at subsidized rates to very poor countries.

7. Is the enterprise profitable?

The commercial value of elephants has the following components: ivory, other products (hide, meat), tourism (both for elephants and for other species whose habitat is preserved or enhanced due to elephant conservation), and existence (as demonstrable willingness to pay for knowledge of the species existence and well-being) (Swanson 1989). Ivory is the component that has mainly provided revenues in the past. Hide and meat have also been marketed, but they have a lesser value. Tourism has recently provided significant revenues to certain countries. One report[15] has estimated the value of viewing elephants in Kenya to be $25 million annually (Barbier 1990). A decrease in elephant numbers would result in a decrease in income from tourism (Brown 1987). Safaris have also been a source of revenue for certain countries. The existence value of the elephants has generally not been captured.

Barbier also cites a preliminary analysis of the economic benefits of management of the elephant population undertaken in Botswana, that compared the benefits from game viewing only to those involving viewing combined with some sustainable consumptive uses. The introduction of consumptive uses reduces the benefits from game-viewing tourism by 10%, but almost doubles the total economic value of elephant populations, due to additional revenues from forward linkages to tanning/processing hides, ivory carving and meat for crocodile farming (Barbier 1990).

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[14]See also at condition 8.

[15]Gardner Brown Jr. and W. Henry, The Economic Value of Elephants, LEEC Discussion Paper 89-12, 1989.

The ivory trade is a highly attractive enterprise because the demand for ivory is price inelastic and income elastic (Barbier 1990). The income elasticity of the demand accompanied with the increasing income levels in Asian countries that are major importers of ivory means that the demand should not be expected to decrease. The causes of such a decrease can be: rising ivory prices, cheaper substitutes, public opinion, changing jewelry fashions, and alternative investments that are expected to produce higher returns (Barbier 1990). They are all considered in various parts of this section.

An elephant utilization operation is not constrained in ivory production. In the case of stabilized populations, the selling of ivory would probably provide the major revenue, but even in low population densities, a safari hunting operation is possible. Safari hunting is less demanding in infrastructure and animal populations, and can keep positive cash flows for some years. Later, tourism can also follow (Barbier 1990). Successful tourism will be assisted by the existing infrastructure and the reputation of the country for tourism, especially for wildlife tourism.

8. Is the project attractive to the investor?

The growth rate of elephant populations is low. The age at first calving is about 13 years and the interbirth interval is about 5 years. It takes a male elephant approximately 6 years to generate a 1kg tusk of ivory and a female one about 9 years (Renewable Resources Assessment Group 1989). Barbier cites two reports that have estimated the growth rate at 6% annually under favorable conditions the first, and 10% the second (Barbier 1990). Compared with the high rates of time preference in most of Africa, it might look as a textbook example of exploitation to extinction.

The rate of growth of elephants is indeed low relating to the rates of time preference that one would expect to find in Africa. However, the existence of an inelastic

demand for ivory[16] enables producers to earn the revenue that can come from the conversion of all the stock from the conversion of fractions of the stock (Swanson 1989). The existence of an inelastic demand for ivory by-passes the problem of the high rate of time preference in rural Africa. In Africa, average life expectancy at birth is 51 and infant mortality is 10% (World Resources Institute 1989). These figures are even more grim in rural areas, and thus the people are trying to secure sufficient means for survival today, and investing in the future is simply not an option that can be considered.

9. Is the enterprise competitive with legal and illegal operations?

A need for regulation and enforcement of an agreement between the range states is existing. Even if a quota is agreed to among the states, there are going to be incentives to not abide by the quota. There have been some systems proposed that can overcome this problem, like the Ivory Currency Unit System (Swanson 1989, Barbier 1990), the Ivory Tax System, and the Ivory Exchange System (Barbier 1990). All these systems can overcome problems as the monitoring of harvest, or the distinguishability of legal from illegal products. They might not be free of problems though, since "the objective of [the Ivory Currency Unit System] is the raising of the final end-use price by a factor of five or ten" (Swanson 1989). The incentives for poaching are of course multiplied by such an increase in price.

10. Can the enterprise be expected to be profitable in the future? Is the definition of property rights clear and secure in the future?

The uncertainty of future ownership in Africa is relatively high. Political instability is common, and the right to ownership might not be recognized by the new government of a state. Military activities in the area are also common, and revolutionary groups can hunt elephants to transform the revenue from the selling of ivory into weaponry.

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[16]See condition 7.

Demand should not be expected to decline, especially in Japan and Asia in general.[17] Demand for ivory is income elastic[18], and the increasing incomes in Japan and other Asian countries are a good indicator.

11. <u>Will the enterprise promote conservation?</u>

A system of commercial exploitation of the elephant through sustainable use should be expected to increase the pressure on the wild population since it would aim at supply decreases and price increases in the ivory market. Larger profits and more incentives to poaching would then be created. This is also why an international system of regulation is needed, like the ones mentioned in condition 9. There are reasons to believe that these systems can overcome the problem of distinguishing legal from illegal ivory (Swanson 1989; Barbier 1990), which is the main problem for the effective management of the elephant.

3.2. The Nile crocodile in Zimbabwe.

3.2.1. Introduction. The major threat to crocodiles is habitat destruction. The infeasibility of wetlands for agricultural use makes the habitat of crocodiles a major target for conversion. Illegal poaching by either local people or professional hunters is also a significant threat to the species. Human population growth has intensified the long existing competition of humans and their livestock with crocodiles, and the crocodiles were often exterminated as a result of this relation. The destruction of crocodiles was viewed as a service to the community. To a large extend crocodiles are threatened due to their commercial value (National Research Council (NRC) 1983; Brazaitis 1987). Of the 22 species of crocodilians generally recognized, about 15 are utilized commercially by the leather industry (Brazaitis 1987). Demand for crocodile skins has been rising since World War II, and it has far exceeded supply (NRC 1983).

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[17]See condition 1.
[18]See condition 7.

Harvesting of Nile crocodiles for their skins started at that time and peaked in the 1950's. Many populations were brought to the point of extinction. This was also the case with the Nile crocodile populations in Zimbabwe (Child 1987). In Zimbabwe, since 1961 the populations have been recovering in what is viewed as an effective legal protection scheme and a pragmatic management policy (Child 1987).

In Zimbabwe, habitat alteration had been partially offset by the appearance of numerous dams, especially after 1950 (Child 1987). However, it is the economic benefits which seem to provide the reasons to conserve the very fragile ecosystem where crocodiles live. As Child mentions, "attention was focused on crocodile management in the mid-1960s by requests from the private sector for authority to capture young animals and collect eggs, so that these could be "grown-out" to marketable size in captivity" (Child 1987, p.53).

"The present management of crocodilians encompasses a wide spectrum of approaches. It is influenced by the extent to which a species was hunted, the duration and effectiveness of protective legislation, the extent to which crocodile populations have recovered, and by people's perception of crocodiles in any particular region" (Jenkins 1987, p.27). In Zimbabwe, there are five enterprises which raise crocodiles commercially, and they do so from a mixture of ranching (eggs collected from the wild) and farming (eggs come from captive animals). Eggs from the wild are collected from nests and artificially incubated for part of the process in all of the enterprises (Hutton 1987, p.323).

Zimbabwe approached wildlife conservation in the 1962 *Wild Life Conservation Act* and the 1975 *The Parks and Wild Life Act*. The 1962 legislation increased the number and acreage of the protected areas in the country, and the 1975 legislation conferred the ownership of most wildlife onto the landholder on whose land it occurred (Child 1987). The Zimbabwean rationale in the 1975 legislation is demonstrated in the following excerpts from a policy document, quoted from Child: "Conservation of wild populations as applied in this section shall be directed towards the optimized exploitation of the population, wherever this is compatible

with legitimate human interests", and "it will be the aim ...... to encourage and promote a viable and interested industry based on captive crocodiles, which will not endanger wild population and which should enhance the status and conservation of the species in the wild" (Child 1987, p.52-3).

The following pages discuss the case of crocodile exploitation in Zimbabwe in relation to the conditions developed in Section 2 of this study, and try to identify the factors that enabled the system to operate, and be praised by some for its conservation success.

3.2.2. Conditions that would favor privatization.

1. <u>Is it acceptable to exploit the species and maybe kill the animals?</u>

Although crocodiles are not a group that has evoked large public sympathy, "people interested in the preservation of crocodilians often express an abhorrence of crocodilian skins, or anything to do with them" (Webb 1987 p.371). The demand for crocodile skins should not, however, be expected to decline, especially since the substitutes for crocodile skin products come from wildlife as well, like elephants, kangaroos, or lizards.

2. <u>Is it not prohibitively expensive for the resource to be claimed for exclusive use?</u>

"Reliable supplies of good water and suitable food are the most important considerations for establishment of a crocodile farm; the area selected must have both" (NRC 1983, p.34). Farms that are situated close to the wild are preferable for easy taking of eggs and young, unless they can be large and have their own breeding stock (NRC 1983). Ambient temperatures, hygiene and the quality of the food have all proved to be important husbandry considerations (Child 1987).

Crocodiles have modest food requirements. They also have low metabolic rates and are extremely lethargic, so their conversion rate is very high, in the hatchlings about 50 percent. After their first two years the conversion rate falls to around 20-30 percent, which still "makes crocodiles probably the most nutritionally efficient land animal for commercial

husbandry" (NRC 1983, p.4). Crocodile farming is also space efficient. As long as they are sorted by size, they can be penned together in a small area.

Eggs are collected from the wild 50 to 60 days after laying, so some mortality occurs between laying and collection, but collection may occur earlier. Hatchling mortality is probably more than 95 percent in all wild populations, but rearing stations could achieve 73.6 percent successful hatchlings in 1975, while in 1987 88.6 percent could be achieved. There are reasons to believe that this rate can also be increased to 90-95 percent. 70 to 80 percent of hatchlings normally survive into their second year, although occasions of higher mortality are not uncommon (Child 1987). This is low compared to a 95 percent mortality of this age class in the wild, but it is not regarded as a success (Child 1987; Foggin 1987). This mortality is also a significant factor in the economics of the firm, as it is not only considerably high, but it is also impractical to apply therapeutic measures to a large number of sick individuals. However, only in Zimbabwe has the occurrence of diseases had a serious effect on the viability of farming operations (Foggin 1987).

Crocodiles seem to produce antibodies readily and be quite resistant to external infections, so the need for veterinary services is relatively small, and this is a welcomed benefit in remote village farms. This is not to say that veterinary services are not needed, but that most diseases are a result of poor husbandry and can be easily treated as such. If not quickly diagnosed and treated though, diseases can wipe out the captive crowded animals in epidemic proportions (NRC 1983).

3. Are there international constraints on the enterprise?

The first permits for crocodile rearing stations in Zimbabwe were issued in December 1965 and were equal to ranching operation in terms of CITES. Several rearing stations are moving towards the CITES definition of "farms" (Child 1987). In the 1983 meeting

of CITES in Gaborone, Zimbabwe's proposal to list its population of Corcodylus niloticus on Appendix 2 and to continue ranching the species commercially was accepted (Jenkins 1987).

4. Are there any national constraints?

The promulgation of the *Wild Life Conservation Act* of 1961, along with the *Parks and Wild Life Act* of 1965 provided legal protection for the crocodiles and their eggs, and removed the opportunistic hunters replacing them with people that could own the resource and were able to realize its economic potential (Child 1987). Crocodile farming can result in better monitoring of the crocodile industry, while hunters are more difficult to regulate, since they operate in remote areas, often crossing borders as well (NRC 1983). Generally, crocodilians have been poorly protected because governments lack the manpower to monitor and enforce conservation regulations in the remote areas that crocodile populations live, and the legislation might have not been adequate, since the animal itself does not evoke public sympathy (NRC 1983; Brazaitis 1987). As Child mentions, "The rationale behind the Zimbabwean legislation ...... has a better chance of success than any dictatorial measures imposed by a central government treating wildlife as government property" (Child 1987, p.51).

The *Parks and Wildlife Act*, passed in 1975, conferred the ownership of most wildlife onto the landholder on whose land it occurred. Landholders have the discretion of using their wildlife as they deem best, and all benefits form such use accrue to them, although there are mechanisms that prevent abuses. The Zimbabwean government sets a quota of harvested eggs for any given season, and these quotas are issued through permits which allocate in essence a collection area and prevent local over-harvesting. The Zimbabwean government is also investigating the species biology and examines production, processing and marketing problems (Child 1987).

5. <u>Is the prospective owner suitable for the specific situation? Does he have the knowledge needed to effectively manage the resource?</u>

Since the commercial utilization of crocodiles can provide the only readily available income for some rural communities, their management by these communities can also improve their quality of life (Jenkins 1987). The Zimbabwean government recognized that "it is impractical to attempt to safeguard a species through legislation and law enforcement alone, unless local people are at least tolerant towards it" (Child 1987, p.51). As stated in an official Zimbabwean document cited by Child, "the Departmental Interpretative Service will seek to educate the public as to the biological and economic value of crocodiles and in so doing will aim to counteract the public stigma often directed against them" (Child 1987, p.52). However, the industry offers little in the way of tangible benefits to people that live near the operations, and these people still tend to destroy nests in retaliation to fishing nets damage (Hutton 1987a).

The industry is provided with extension services by the Department of National Parks and Wildlife Management, and the Department of Veterinary Services, although on-site research is limited. Two stations have acquired managers with scientific training (Hutton 1987a).

Knowledge to capture youngs and collect eggs is available and well-documented (Hutton 1987b). Knowledge about their behavior in the rearing stations also exists (Blake 1987). This knowledge is important. For example, the increase of hatchling success from 73.6 percent in 1973 to 88.6 percent in 1987 is a result of improvements in both selecting and handling live eggs (Child 1987). Handling production tasks is not easy. The eggs are delicate and the collection of crocodile eggs by rural people has proven unsatisfactory. Also, "the final value of a crocodilian skin can be greatly reduced by poor or casual management during skin preparation" (Van Jaarsveldt 1987, p.387).

"Most disease problems stem from poor sanitation, low water temperatures, and poor diet, all of which can be easily corrected" (NRC 1983, p.19). Diseases seem to be "mainly a secondary manifestation of sub-standard husbandry" (Child 1987, p.56), but "disease symptoms

can be easily overlooked if the observer is not familiar with the behavior of crocodiles under a variety of conditions" (NRC 1983, p.41).

Child notes a significant number of studies covering a variety of issues of the management of crocodiles (Child 1987). Research on crocodile farms is a major factor attributing to an increased knowledge of crocodilian biological characteristics (Webb 1987).

6. <u>Are there prohibitively large investment costs? If so, is international funding available?</u>

Crocodile farming "is not a get-rich-quick scheme. To build a stable national industry may require 10 years and an investment of at least $500,000 before it is biologically and economically successful" (NRC 1983, p.18). The farm should also have to operate for three to four years before starting to produce animals suitable for harvesting.

7. <u>Is the enterprise profitable?</u>

Heads and feet are used for tourist trophies and the carcasses are used to feed the rest of the crocodiles. Two stations offer tourist facilities including tours, displays and curios for sale. The location of one station is justified from these revenues, while otherwise it would be a sub-optimal environment for crocodile production (Child 1987). The profitability of stations is, however, ultimately dependent on the revenue derived from skins, since most farms are located in remote areas without access to revenues from tourism (Van Jaarsveldt 1987). The production of a uniformly presented, high-quality, crocodile skin product is one method through which marketing can be improved. A protocol for each stage in the preparation of skins has been prepared by the Crocodile Farmers' Association of Zimbabwe and the rearing stations are complying with the guidelines making marketing more efficient (Van Jaarsveldt 1987). Zimbabweans have no tradition of eating crocodiles or their eggs, so the market for food is very limited (Child 1987).

Markets for crocodile products are loosely understood, and the fluctuations in price can be such that an operation cannot cope with them (Onions 1987). "Lizard, snake, elephant, pangolin, kangaroo, buffalo and ostrich are all, in varying degrees, favoured exotic leathers whose supply, demand, and price relationship to crocodilians, as well as to one another, is not currently well understood" (Ashley 1987, p.401).

The farming operation will reduce the loss of a high proportion of hides from improper handling, since the handling process will be standardized and be carried by specialists and experienced workers (NRC 1983). The major factor that can limit the profitability of a crocodile farm is the availability of cheap quality food (Child 1987).

8. Is the project attractive to the investor?

Remote rural areas of the lowland tropics are most suited for crocodile farming. Alternative sources of income are scarce there, and possibilities of development and earning cash are limited. "Indeed, in some areas crocodiles may constitute the only readily saleable resource" (NRC 1983, p.3). The land is usually unavailable for other uses without extensive modification and large investments. That the area of operations is of low agricultural potential seems a decisive factor (Child 1987).

Hutton mentions one study which concluded that for species with low value skins, neither ranching nor farming is economically viable. However, for species with high quality "classic" skins, farming and ranching are in many ways preferred to direct hunting of wild populations (Hutton 1987a).

9. Is the enterprise competitive with legal and illegal operations?

Poaching can be more profitable since poachers have fewer operating expenses than farmers (NRC 1983). Hides and skins are difficult to be traced to their origin. Legally produced hides cannot be readily distinguished from illegally produced ones (NRC 1983;

Brazaitis 1987). A system to overcome this problem has been implemented in the United States, where all hides exported are tagged with a serially numbered plastic tag, issued by a conservation authority, which cannot be removed without breaking it. The tag remains on the hide until the hide reaches the manufacturer, who maintains a record of purchases (NRC 1983). However, even with such identification, wildlife inspectors should be trained in the products identification if they are to be effective (Brazaitis 1987). New marking and identification techniques can also be developed, as dyes, roll marking and infusion of detectable chemical tracers (NRC 1983). The problem is currently approached by a requirement for universal tagging of crocodile skins, decided in the Tokyo Conference of CITES in 1992 (IUCN 1992).

In Zimbabwe, permits for the sale or export of skins are issued only to persons who are managing and conserving the resource and are registered with the government agencies and monitored, under Section 65 of the 1975 *The Parks and Wild Life Act* (Child 1987). The regulations seem to work well, and as Child mentions "there has not been the slightest hint of any malpractices involving crocodiles for about five years" (Child 1987, p.57).

10. <u>Can the enterprise be expected to be profitable in the future? Is the definition of property rights clear and secure in the future?</u>

Farms can yield a regular harvest of a specific number of animals of a specific size (NRC 1983), and thus they can create a reliable supply to the industry. They can also produce a uniform product that would be more desirable to the industry than the large variety of skins it might receive otherwise. The quality of the product is an important factor for commercial enterprises to compete with illegal poaching (Webb 1987). Another benefit of farming operations is that crocodiles can be harvested in any given time period to take advantage of short-term market fluctuations (Hutton 1987a).

The industry is largely dependent upon readily available eggs from the wild population and inexpensive game meat for the nutritional needs of the crocodiles. Both factors are threatened to become less available due to the expanding population, and its needs. Social

pressure for divergence of food to humans is anticipated, and its availability is critical to the size of the crocodile industry (Hutton 1987a).

11. <u>Will the enterprise promote conservation?</u>

Early permits to commercially exploit crocodiles required the owners to supply the Department with well-grown individuals in a proportion of 10 percent of the number of eggs or youngs taken from the wild to use for restocking. The proportion was later reduced to 5 percent, and although the 5 percent requirement is still maintained, there is no need for restocking due to the stabilization of the wild populations (Child 1987). Released animals are free of intraspecific predation (Hutton 1987a), and have prospered in the wild, judging from subjective observations and the results of a mark-recapture program (Child 1987).

The uniform premium product that can be supplied to the industry from the farms can diminish the desirability of wild captured crocodiles' skins and take pressure off of the wild populations. The distinguishability of legal from illegal products is a decisive factor in the conservation of the wild populations, which might suffer otherwise (Brazaitis 1987).

As Child mentions, there can be no doubt that the concepts embodied in the 1975 act have favoured wildlife conservation on privately owned land, and that "in response to the management programme, numbers have increased significantly in suitable habitats" (Child 1987, p.57). Child is especially enthusiastic about the success of crocodile exploitation in Zimbabwe: "Crocodile conservation has benefited greatly in Zimbabwe through the commercial use of the species, mainly through crocodile rearing stations operated by private enterprise under strict Government supervision" (Child 1987, p.49). He goes on: "[I]f the 1975 legislation has produced a problem, it is that private land-holders have been encouraged to permit their land to become overstocked with wildlife through under-harvesting" (Child 1987, p.51). Other authors recognizing the success of Zimbabwe's program are Blake and Loveridge (1975) and Hutton and Van Jaarsveldt (1987).

The lack of understanding of the crocodile skin market makes it difficult to assess the impact of efforts to affect trade in the conservation of crocodilians and the applicability of management options to crocodilian resources (Ashley 1987). The increases in the population cannot be attributed solely to the management program since the construction of numerous dams has partially offset habitat losses and is of major importance to the species at altitudes below 1500 meters (Child 1987). The enactment of the 1962 *Wild Life Conservation Act* protected legally the habitat of crocodiles, and the populations had been recovering before commercial exploitation begun.

In the long-run, the existence of captive breeding operations, and the farming of crocodiles, can be expected to have antagonistic relations to the preservation of the species and its habitat in the wild. This is because the demand for crocodile products can be satisfied by the farming operations, and the incentive to conserve the wild populations would cease to exist.

3.3. Exploitation of the green iguana in Costa Rica and Panama.

3.3.1. Introduction. "In recent decades, rural development in the tropics has been invariably linked with deforestation" (Werner 1991, p.181). In Panama, for instance, farmers slash and burn 2 to 3 hectares of forest to cultivate crops such as corn, rice or yucca. Three years later, the soil is degraded and can no longer support the same crops. The land is then sold to cattle ranchers, and the campesinos move to slash and burn a new piece of the forest. Soil erosion caused by overharvesting and cattle trampling renders the land entirely useless within 15 to 20 years after deforestation. Much of the rural population of Central and South America suffers from protein deficiency exactly because of the low productivity of tropical soil, once deforestation has taken place (Werner 1986a). The belief that tropical forests cannot sustain large animal biomass is erroneous and based on the fact that the fauna in the existing forests has already been degraded (Gardner, personal communication, 6/25/92; Redford 1992). Game

animals that could survive in the forest suffer from increased hunting pressure and have become locally extinct in most places in Central America (Werner 1991).

In 1983, the Smithsonian Tropical Research Institute (STRI) initiated a program called Alternatives to Destruction that aimed at what its name suggests: Developing practices that would feed the human population by providing alternatives to cattle ranching and other destructive practices that had been responsible for much of the deforestation in South and Central America (Ocana 1988). The project involves exploitation of animal species that feed directly on forest vegetation, so there is an incentive to preserve some of the forest along with the animals. The Iguana Management Project (IMP) was a part of the STRI's effort, and it was implemented in Panama until 1988, when the project moved to Costa Rica due to the political instability in Panama.

The green iguana (*Iguana iguana*) has been a source of protein for humans for over 7,000 years (Ocana 1988; Asher 1990; Werner 1986, 1991). The iguana is a traditional protein source throughout its range. Many rural people still depend on the iguana for protein (Werner 1991). According to a survey by the National University of Costa Rica, iguanas are among the six most commonly eaten animals in Costa Rica (Asher 1990). Iguana meat and eggs are considered to be aphrodisiacs and delicacies in many areas (Ocana 1988; Asher 1990; Werner 1991). In Panama, 70 percent of the population would consume iguana meat and eggs if available, and although similar data are lacking for other countries, the concern about its extinctions as related to protein shortage shows that iguana meat is a significant nutritional source (Asher 1990; Werner 1991).

The green iguana has been drastically decreasing in numbers due to habitat destruction from slash-and-burn agriculture, conversion of forested land to pasture, increased use of biocides, and uncontrolled hunting (Ocana 1988; Asher 1990). In most countries where it occurs, the green iguana has been declared an endangered species (Asher 1990; Werner 1991).

The green iguana is listed as an endangered species under CITES throughout its range (Asher 1990).

The next pages discuss the conservation potential of iguana exploitation by analyzing the management system practiced, using the framework developed earlier in this study.

3.3.2. Conditions that would favor privatization.

1. <u>Is it acceptable to exploit the species and maybe kill the animals?</u>

A large number of people uses iguanas as a main protein source. Iguana exploitation has been traditionally practiced in Central and South America, and the local people are still willing to eat iguana meat, if available (Asher 1990).

2. <u>Is it not prohibitively expensive for the resource to be claimed for exclusive use?</u>

The species has several attributes that make it promising for management in wild, forested areas (Werner 1986b; Asher 1990). Management schemes for iguana exploitation that have been described include raising iguanas to harvestable size in confined conditions, management of wild populations, or combinations of captive rearing and management in wild areas (Werner 1991). The exploitation of free-living green iguanas requires tropical forest, the natural habitat of the species. Iguanas live in trees and eat plant material that is otherwise not exploited by domestic animals or humans (Werner 1991).

Reptiles differ in their metabolism from birds and mammals. The daily metabolic cost of an iguana is 3 percent that of an equal size bird and 6 percent of an equal size mammal (Werner 1991). This difference results in slow growth. To grow to a 3kg size, a wild iguana uses as much food as a chicken but needs three years instead of four months. Growth can be enhanced through management techniques and genetic selection, but it will never approach that of birds or mammals (Asher 1990; Werner 1991).

Iguanas display a yearly breeding cycle. One clutch of eggs is laid at the beginning of the dry season and the hatchlings emerge with the onset of the rainy season. Annual

hatching success is highly variable, ranging form virtually zero to above 80 percent. Success averages about 40 to 50 percent. The mortality rate of hatchlings is high. In the wild, 2.6 to 5 percent of the hatchings survive their first year (Werner 1991).

Considering the above biological characteristics, management of iguanas in the wild is problematic. Captive breeding of iguanas is also not easy (Werner 1991). Egg collection from the wild is probably a prerequisite to any successful reptile exploitation scheme. An attempt to use iguanas captured from the wild as reproductive stock has failed (Werner 1991).

An artificial nest developed by Werner and STRI is preferred by both captive and wild females and can facilitate egg collection. (Ocana 1988; Werner 1984, 1986, 1991) Werner also designed a seminatural incubation system (Werner 1991). A hatchling success of 95 percent was achieved using this design. Optimum incubation conditions also result in large hatchlings. Survivorship in the first year is 95 percent in captivity, and the mortality rate of iguanas older that 1 year is virtually zero (Werner 1991). After they are released in the wild, iguanas achieve a survivorship of about 60 percent, higher than in natural conditions (Werner 1986, 1991).

The reproductive output of iguanas can be enhanced. Iguanas born in 1985 had attained the same size at an age of 2 years as those born in 1983 at an age of 3 years. The difference was a result of an improved diet and thermoregulation assistance (Werner 1991). Faster growth rates can reduce maintenance (energy, food) costs since the growth time is shorter. They can also increase the survivorship of released iguanas in the wild due to their relatively bigger size. Clutch size also increases with an increase in size and there are also reasons to believe that fast-growing iguanas reach a larger final size than slow-growing ones (Werner 1991).

Iguanas can be managed only by households that still provide some trees in their premises. Feeding stations can be placed in the area of management, and can increase iguana densities more than fourfold compared to natural densities (Werner 1991). Farmers raise iguanas

in cages until they become 9 months old and then release them in the wild. Iguanas are easy to capture since they tend to sit on trees and not run away.

Disease resistance of iguanas is not largely known, and research is needed to generate data on this issue. Data on iguana diseases are currently lacking and an epidemic could wipe out the entire breeding population (Asher 1990).

3. <u>Are there international constraints on the enterprise?</u>

Since the green iguana is listed in the Appendix 2 of CITES, free trade is not possible. Costa Rican law also prohibits the hunting of iguanas as a species having reduced populations (Asher 1990). However, the iguana management operations described here can qualify for the exceptions that would allow commercial trade both domestically and internationally (Asher 1990).

4. <u>Are there any national constraints?</u>

Governments have been promoting deforestation by supporting development projects (Werner 1991). Emerging government regulations preventing people from cutting the forest cannot work because the blossoming population, with its concomitant demand for food and energy is forced to slash-and-burn agriculture, as the only proven way of exploiting the land (Ocana 1988).

However, several government and non-government organizations are conducting reforestation projects in Costa Rica. Technical and financial help to campesinos is provided for planting trees (Asher 1990). The Costa Rican government has indicated an interest in iguana management and is trying to work out ways that a market could be established, not only for meat but also for pets and for skins (Asher 1990).

5. <u>Is the prospective owner suitable for the specific situation? Does he have the knowledge needed to effectively manage the resource?</u>

Iguanas are hunted wherever found, and a campesino would say that if he does not take an animal someone else will (Werner 1991). The program in Panama was popular with local people (The Christian Science Monitor 1990; Asher 1990). Farmers were more than willing to accept new ideas and methods for the exploitation of iguanas and were showing concern for the recruitment of young to maintain the population. They were raising iguanas in their backyards, attending their feeding stations, and participating in egg collection and incubation (Werner 1991). But while cooperation has been high, farmers have not invested anything but their time, and thus safe conclusions about their attitudes towards a venture like this cannot be drawn until they get involved in the system in a way that would make not only benefits but also losses probable to them.

"Basic research at STRI has led to great increases in the knowledge of the biology of the green iguana" (Ocana 1988). In 1986, a 10-nation workshop on iguana management and conservation was held to disseminate the knowledge acquires thus far. Production of a predictable number of iguanas is attainable (Werner 1986). The management techniques are simple to understand and to implement: "Tending iguanas does not require more work than tending chickens" (Werner 1991, p.196). For example, village children can help to collect the eggs.

6. <u>Are there prohibitively large investment costs? If so, is international funding available?</u>

Although the artificial nest is low-cost (constructed of rocks, woods or brunches), and the food supplements are easily available and similar to the ones used for chickens (Werner 1991), campesinos frequently do not have the money to pay for the initial investment of materials and iguana food (Asher 1990; Werner 1991). Asher reports that to obtain loans from Costa Rican banks, the borrower must own a minimum of 80 hectares and title to the land, and this

requirement disqualifies most of the people that could benefit from the iguana (Asher 1990). Interest rates in Costa Rica for small industries and small agriculturalists, as issued by the Costa Rican bank, have been about 4 to 11 percent in real terms (Asher 1990).

The availability of land poses a problem as well. Campesinos are very often employed to large landholders and do not own any land (Asher 1990). Other campesinos own small pieces of land and are reluctant to plant trees on them (Werner 1991).

The international development agencies have only recently started to fund natural resource management projects. This is a trend that, if it continues, might help the campesinos to find the funds for the initial investments. The European Economic Community (EEC) has shown interest in the project, and the IUCN has shown specific commitment by supporting a pilot program in Talamanca (Asher 1990).

7. Is the enterprise profitable?

Iguanas can be exploited for eggs, meat, skins or for pets. Iguana populations can be reestablished in three years, after which harvesting can begin (Ocana 1988). There is no legal market for iguanas in Costa Rica (Asher 1990). Some trade occurs though in parts of the country. There is not a market for eggs either, but there is demonstrated willingness to pay for them if available (Asher 1990).

Iguanas can be managed only by households that still provide some trees on their premises. The planting of trees could provide more and bigger exploitation spots, and the trees could provide other benefits at the same time (fuelwood, timber, fruits, water, and soil protection) (Werner 1991). This design results in short-term income from harvesting iguana and fuelwood (5 years after planting), mid-term income from harvesting fruit, and long-term income form high-quality lumber (10 to 40 years). Trees will also protect soil and water resources. Other wildlife species can also be possible candidates for exploitation in the same area (Werner 1991).

Seventy percent of the population would consume iguana meat and eggs in Panama. Similar data for other countries are lacking (Werner 1991), but various restaurants offer iguana dishes in Central America (Christian Science Monitor 1990; Asher 1990). Inquires from restaurants in the U.S.A. for iguana meat have been reported (Christian Science Monitor 1990). Urban Costa Ricans have expressed their reluctance to eat iguanas (Asher 1990). In rural areas, the generation of income can be less or more important than the generation of protein, according to the part of the country (Asher 1990).

Production costs in Panama have been estimated at $0.66 per kilogram, and the meat was sold for between $1 and $6 per kilogram, while Asher has estimated a $3.75 price for iguana meat in Costa Rica (Asher 1990).

Asher (1990) and Werner (1991) have assessed the profitability of various management schemes and found that iguana exploitation can be profitable. For instance, the cost-benefit ratio for a production scheme that is sustained by a wild reproductive colony and does not use feeding stations is 2.2 and 3 for low and high sale prices. The drawback in a scheme like this is the need for a relatively large forest area (2.2 ha) to implement it, while a scheme with feeding stations sustained by a captive reproductive colony requires only one-fourth of the forest area, but achieves benefit-cost ratios very close to 1. Asher has also found that management schemes with no supplementary feeding have a positive cost-benefit ratio, while schemes with supplementary feeding seem unprofitable. This does not change if eggs and meat or only meat are sold (Asher 1990). However, this is a preliminary result and ways to reduce costs of supplementary feeding (food, construction of feeding stations) might be designed. Asher also notes that the management scheme without feeding stations results in lower densities of iguanas and therefore a probable greater effort to harvest them and that one fifth of the forest is needed to sustain the same iguana population in a system with feeding stations (Asher 1990).

Hatchlings can be also sold as pets. There is no local market for pets in Costa Rica, but iguanas sell from $35 to $100 per animal in the U.S. Pet dealers have been reported to

offer high prices for iguanas and are willing to buy large quantities (Asher 1990). Trade for pets and the involvement of international markets would take pressure off of wild populations, but a clear identification system and measures to regulate the trade would be needed. To evaluate such an alternative, information about mortality rates of iguanas in transit and transportation costs would be needed and they are not available (Asher 1990).

Markets for skins are very limited in Costa Rica, but international demand for exotic skins exists in Europe. Treating iguana skins is however difficult and few tanners in Costa Rica can handle them (Asher 1990).

Another problem arises because many farmers that might be able or willing to implement such a scheme live in remote areas without easy access to transportation. It would thus be difficult to sell any final products (Werner 1991).

8. Is the project attractive to the investor?

There are reasons to believe that meat production from iguanas may become cheaper than that of chicken, rabbits, or cattle, depending on the extent to which iguana management can be more profitable (Werner 1991). Calculations have showed that meat production from iguanas matches that of cattle. Beef production can be higher in the first years, but the annual cattle yield drops to 15kg per ha after 10 to 15 years, while the iguanas can provide a sustainable yield of more than 230 kg per ha annually (Ocana 1988). In one other estimate, Werner found that a 2.5 acre wooded area can produce about 800 kilograms of iguana meat per year, while in the same land, high-quality pasture produces about 300 kilograms and degraded pasture only about 15 (The Christian Science Monitor 1990).

Iguana exploitation is also preferable because of the simultaneous benefits from lumber and fruit production and soil conservation that keeps the price of the land high. Development of a reforestation scheme with plants which would support iguana populations allows benefits to start accruing from the harvesting of iguanas 5 to 6 years after the initial investment (Ocana 1988).

Iguana exploitation might not be attractive because of land considerations. Land in Costa Rica can be owned by the person who "improves" it, and two of the activities that qualify as "improving" the land are growing coffee and raising cattle (Asher 1990), which are of course conflicting with an iguana exploitation operation.

9. Is the enterprise competitive with legal and illegal operations?

Exploiting iguanas for skins would probably create incentives for poaching, because it is difficult to identify iguana skins, since there are no marks on the soft belly skin of iguanas (Asher 1990). The small scale of the described operations, along with their main purpose of subsistence and local marketing, renders iguana exploitation essentially harmless to the unmanaged population.

10. Can the enterprise be expected to be profitable in the future? Is the definition of property rights clear and secure in the future?

Due to the novelty of the venture, most of the national organizations would be wary of an operation like iguana exploitation. They would prefer to help operations like coffee or cattle ranching which are proven to be effective (Asher 1990). One way to improve the potential of the venture are studies of nutrition and disease control that are undertaken (Ocana 1986).

11. Will the enterprise promote conservation?

"Habitat improvement, reforestation and the preservation of tropical forest are essential for successful iguana management" (Werner 1986a). It comes naturally then, that

sustainable management of iguana populations will promote conservation, and achieve a much greater degree of land diversity than cattle ranching for example.

Reforestation with trees of commercial use would also take pressure off of virgin forests by producing wood which is in short supply (Werner 1986a). Additional conservation benefits are created because a large percentage of the iguanas from the operation escape the area and reestablish populations in adjacent natural areas (Asher 1990).

4. Discussion and conclusions.

4.1. Relations between the case studies. The case studies were analyzed with the focus on the following question: Will the establishment of enforced ownership rights result in conservation of the species and their habitat? The question was general enough to necessitate the inclusion of factors that belong to the broader environment of the management system applied. This section will try to compare the three cases, with point of reference the analytical framework developed in Section II, and assess the potential for conservation of each one, identifying the elements that seem to exist or not in the environment of each management system. The comparison might be a little unbalanced, since the Zimbabwe crocodiles can be said to be an example of "successful" implementation of a private property rights management regime, the green iguanas an example of potential "successful" implementation, and the African elephant an example where strong international regulation seems a prerequisite to "success" for any management scheme.

The case studies differ from each other on a number of issues (i.e. management system applied, causes of threat to the species, size of the market), but they share a common trait: The government(s) of the range State(s) is actively involved in the management of the resource, *by intention or by chance.* The issue that needs more analysis is that although all governments have an interest in the conservation of the resource, not all of them have policies that would aim to this direction. In Zimbabwe, the government has a policy which helps conservation. In the case of the African elephant, governments have a policy (in most countries) which is an obstacle

to conservation. In the case of the green iguana, governments have a policy that clearly opposes conservation but comes from agencies that are not concerned with conservation. The ultimate question is of course if the government *should* assist the implementation of a wildlife management system based on private ownership. And this question is the final one this project asks in order to assess if a system like this can be "successful".

4.2. The national government's role in the process.

12. Is there a role for the government? Why?

A country would need to assess the economic costs and benefits[19] that would result in a system like this. For an economic analysis, a proper accounting of these costs and benefits, current and future, with a proper social discount rate, should be performed. The total economic benefits might be higher than the total private ones, since wildlife does have an asset character, and the country is losing its assets due to overexploitation. A proper accounting of the lost assets is needed, incorporated in the national income accounts. The wildlife asset loss is not currently reflected in indicators such as the gross national product (GNP), widely used for assessing the performance of a national economy. Ecological benefits (such as soil conservation) might stem from the preservation of a species or from the preservation of its habitat. The complicated ecological interrelations and the recognition that the ecology of a country comprises an asset, calls for a more complicated and comprehensive accounting process than the current national accounting system which is biased towards overexploitation (Repetto 1988; Lutz 1988; Ahmad 1989).

The value of an asset is not its investment cost, as it is often perceived to be, but its income potential. Wildlife does have an income potential, therefore it should be considered an asset. National income accounting practices do not consider wildlife an asset, because they

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[19]*Economic* costs and benefits are the ones that accrue to the society as a whole, and are the sum of the costs and benefits that each individual incurs, owner's included.

were developed in a society of abundance, where natural resources were considered of zero marginal value (Repetto 1988). The marginal value of a species that becomes extinct is of course not zero, and the marginal value of scarce natural resources is not zero. This imbalance needs to be corrected to show that the depletion of a resource such as a species does have negative effects in the economy of a country. It may also show in some cases that species conservation is the preferred option from a national economic standpoint and that the country should try to provide incentives for enterprises that practice conservation.

The social costs of sustainable wildlife utilization are the forgone benefits for the country because of the sustainable utilization of its wildlife. These forgone benefits might come in the form of foreign exchange, and a need for foreign exchange in a developing country might have the same result in the national level as poverty in the at the individual level, a result of overexploitation. A country might push its assets towards degradation not because their sustainable utilization is less profitable in the long run, but because short term needs necessitate the generation of foreign exchange and lead to high rates of time preference. Social discount rates are likely to diverge from private ones anyway, and a proper estimation of the social discount rate is also a necessity.

If the overall result of the project for the country is positive in economic terms, it is wise that the country uses economic instruments to help the project advance. Subsidies, taxes, or other instruments might be used to assure that the project will be implemented and continue, as long as the subsidies do not outweigh the net benefits of the project.

4.2.1. The role of the government in the case of the African elephant.

Elephants can provide revenues to a country from the sale of ivory, hides, meat or other products. Safaris and tourism can also result in significant revenues. The multiplier effects of the tourist industry are particularly significant when a country is able to provide local commodities and services to the tourists (Muir 1988). Besides the direct monetary benefits, elephants can have a

high ecological value, acting as "keystone species" in the African savannas and forests (Western 1989). Elephants also have existence or option value (non-use values).

The social costs of maintaining elephant populations are the costs associated with the extensive crop and other economic damage the elephants cause when there are land-use conflicts between the species and human populations (Swanson 1989). Elephants are often competing directly with humans for food and habitat. This is a direct effect of the rapid population growth in Africa, which has reached doubling rates in 18 years.

It can be safely argued that the economic justification for the conservation of the African elephant does exist (Swanson 1989; Barbier 1990). Although the ivory trade has generally contributed to the decrease in elephant populations, in some countries the trade has resulted in increases in the populations. It is therefore not the trade per se that is deleterious for the species, but the inability of the institutional arrangements that direct this trade to utilize it effectively. One special institutional arrangement that can be effective is the establishment of an exclusive private ownership system for the management of the elephant.

4.2.2. The role of the government in the case of the Zimbabwean crocodiles.

Crocodile skins can represent significant income to developing countries (Jenkins 1987). The government would benefit from the farming industry not only with revenue from the sale of the products, but possibly also from a tourist flow to the country to see the crocodiles in their natural state in parks and preserves, where crocodiles would not be threatened by poaching (NRC 1983). Indeed, wild populations in Zimbabwe, in addition to representing a conservation insurance, are also tourist attractions, and some numbers of animals are offered as huntable trophies. Problem animals are caught and used as breeding stock in rearing stations, and annual quotas of eggs are harvested to provide the main stock in the rearing stations. Wild populations also have non-use values, such as existence. Crocodile farms can be used as sites for the scientific study of crocodilians.

Observers have also indicated that crocodiles benefit commercial fisheries: "Where crocodiles have been eliminated, reductions in the tonnage of fish caught for human consumption can usually be demonstrated", as in Brazil, Kenya and India (NRC 1983, p.18).

Crocodile predation on humans and their livestock is quite substantial, and they cause more deaths in Zimbabwe than all other wild animals combined (Child 1987). The availability of cheap quality food is important for the farm's operation, but food that is used to feed crocodiles is also suitable for human consumption. In a protein deficient country, it may raise moral issues about the need to generate foreign exchange versus improved nutrition of people. Population growth exacerbates this competition for food, and the applicability of a crocodile rearing station is thus limited (Child 1987; Hutton 1987a). Alternative sources of protein are being examined, and stations are looking to produce their own meat to feed the crocodiles (Hutton 1987a). In conclusion, crocodile management can be profitable and justify crocodile conservation, but the competition of crocodiles with humans for the same resources might create conflicts in the long run.

4.2.3. The role of the government in case of the green iguana. The Iguana Management Project brings together wildlife conservation, reintroduction of a wild species, reforestation, and economic development for the local community. Benefits could include the reestablishment of iguana populations and their conservation. Reforestation and soil conservation may also be significant benefits of iguana exploitation.

The underlying objective of the IMP is that the farm becomes productive enough so that the farmer does not have to leave it and cut the forest. To be implemented successfully, a system like this presupposes a national policy that would recognize the need to achieve development by sustainably utilizing the country's resources, and not assisting practices that result in degradation of these resources. It seems that such a policy would accomplish the IMP's objective, but since the system has not been fully implemented, the various feasibility

assessments should be viewed with caution, until there is more field experience with the various management schemes.

4.2.4. Are policy interventions needed? It appears that in the above case studies, the overall economic result of a conservation policy would be positive for the country. What has been shown in the previous section is that elephants, crocodiles and iguanas can be saved by a management system based on private property rights. If the government decided to implement a policy to assist conservation, many obstacles raised in the case studies would be removed. It will be argued that government assistance can render the management systems presented in the case studies "successful", in a sense that they would be profitable and promote conservation.[20] The case that is more institutionally complicated is this of the African elephant, where an international system of regulation and assistance is needed beyond national measures. The role of international organizations is also important in all the cases.

4.3. Potential of the case studies systems for conservation. The African elephant is threatened by overharvesting, the Nile crocodile by habitat destruction and killing due to its harm to humans and livestock, and the green iguana by overharvesting and habitat alteration. The exploitation system for the elephant assumes management of populations in the wild, while crocodiles are farmed or ranched but wild populations are needed to provide the initial stock, and iguanas are semi-domesticated and their habitat is managed and conserved.

Trade is illegal for elephant products, while the crocodile and iguana systems can qualify for CITES exemptions. International regulation is an essential part of elephant exploitation, mainly exists in the case of crocodiles, and is mainly not needed besides the one already existing in the case of iguanas unless their market expands. For elephants, international attention makes exploitation difficult to practice, while it does not play a significant role in the

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[20]A management system that would be "successful" is one that uses the resource species at rates within their capacity for renewal, maintains their habitats, and does not have an adverse impact on other species or ecosystems, while maintaining a profit.

case of crocodiles and iguanas. If international organizations help exploitation by recognizing it can lead to conservation, elephant management systems can easier be implemented or funded more easily. International organizations are probably needed to fund iguana management in its initial stages, while the demonstrated financial success of crocodile management would probably make formal lending available.

Local owners seem to be better suited for managing the populations in all cases, since they are the ones who have the need for exploiting the resources. If the owner is an outsider, local people's needs should be accommodated for the system to succeed. Knowledge about the venture is largely available for elephant management, while gaps exist for crocodiles and especially so for iguanas. Crocodile management started in Zimbabwe without a great deal of knowledge, and knowledge was acquired during its implementation. There was not enough time to acquire extensive knowledge before beginning to implement the system, and the trial and error method did not create unsurmountable problems (Child 1987; Hutton 1987a). The same can probably be done with iguana management.

All systems can generate substantial profits, and for elephants and iguanas, a multiple use system is desirable and possible. Multiple use, although might be necessary to justify conservation in some cases (i.e. most of the iguana management schemes), might be constrained by country or region specific considerations (i.e. view-tourism for elephants needs extensive infrastructure, not all people eat iguana meat).

Sustainable management of the African elephant is preferred to other practices only if a system of regulation can be established that effectively handles poaching, while crocodile farming is in most cases preferred to both alternative land uses and taking from the wild. Iguana management is generally strongly preferred if the forest provides other benefits as well, but still alternative uses should be deprived of the government assistance they receive. Poaching is sometimes less profitable than a farming operation for crocodiles, but a regulation is usually needed. For elephants, but especially for iguanas, poaching is largely solved by assigning

the right to property to previous poachers, but for elephants, there is also a strong need to preclude poachers from the market by an international regulatory scheme.

Demand for all products is not expected to decline substantially. The future security of the right to property might be threatened in the case of elephants due to the general political instability in parts of Africa. This instability can also create havoc to a system of regulation that might otherwise regulate effectively the ivory trade. The right to property of the crocodiles in Zimbabwe is established in the legislation, but the competition of an expanding population for food and land with the crocodiles can threaten the viability of the operations. Government practices concerning natural resource management are needed to change for iguana exploitation to be implemented for a long period of time.

In conclusion, exploitation through private ownership can promote conservation of the African elephant only if an international regulatory scheme is implemented effectively, and this is constrained by the existence of political, economic and social differences within and among the range States. These differences would permit some countries to implement the system, while others would not, and poaching would be transferred to the countries with the less resources to practice enforcement.

For crocodiles, conservation is promoted, but there are two issues that make the future unclear. First, the competition of expanding human populations for food and energy with the crocodiles quite often necessitates the conversion of the natural habitat of crocodiles to more productive land uses. A policy to accommodate the needs of the expanding human population might as well help the crocodiles to survive. Second, in the long-run, the existence of captive breeding operations, and the farming of crocodiles, can be expected to have antagonistic relations with the preservation of the species and its habitat in the wild. This is because the demand for crocodile products can be satisfied by the farming operations, and the economic incentive to conserve the wild populations would cease to exist.

For iguanas, preservation of the species and its habitat is probable if an overall exploitation of the ecosystem were practiced. This would ultimately depend on the implementation of a natural resource policy that recognizes the value of the forest and its inhabitants as economic assets. Costa Rican policies are currently not properly considering these assets, and lead to deforestation (Lutz 1990). Costa Rica should try to achieve development through sustainable utilization of these assets, and not through economic growth as it is largely defined today.   Subsidizing practices that are both detrimental for the long-term economic health of the country and conflicting with sustainable utilization of its assets cannot be good policy.

4.4. A concluding note. One of the conclusions of this study is that the State will often have the ultimate ability to render an exploitation system desirable to the profit maximizing owner or the preservationist. There are cases, like the African elephant, where one State cannot do a lot by itself, but an international recognition of common goals and an acceptance of common practices is necessary. Especially for the elephant conservation, international convergence is made difficult due to the magnitude of the trade and an emotionally heated debate. However, the State will always have a highly influential role in the resource allocation process. This is not something unexpected, it is what the State exists for. The State is directly involved in practically every market of the world, and any existing system of "free market" is likely to be extremely dependent on government regulations. A system of commercial exploitation of wildlife would always be dependent on regulations and laws. The State would ultimately, and sometimes unintentionally, decide on the outcome of the resource allocation process, even if this process will be carried through a "free market".

Even if the resource allocation process is such that conservation is temporarily achieved, the issue remains one of species competing for the same resources: food and energy. The one species that is the most fit to survive in this competition is the human species. The carrying capacity of the earth needs to be constantly augmented to accommodate a constantly increasing human population. The preservation of the environment in a "pristine" form cannot effectively

accommodate the needs of an expanding human population. Some kind of environmental manipulation is ultimately needed. Conservationists and developers very often think differently on how environmental manipulation will be practiced. Conservationists have not adequately recognized that profit can drive conservation efforts, or at least achieve conservation goals as a by-product of the market mechanism. Conservationists have, however, started recognizing the importance of wild plants and animals as resources exploited by commercial markets. Conservationists should realize the usefulness of market mechanisms to achieve their goals. Developers should realize that economic development goals should coincide with conservation goals, at least when some certain characteristics are present. One of the objectives of this project has been to show that conservation attitudes can be built into the market structure, and that profit can be incorporated in conservation efforts. Conservationists remain with the challenge to design the economic tools necessary to develop these attitudes.

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