COMMUNITY FORESTRY NOTE 13

WHAT ABOUT THE WILD ANIMALS?

Wild animal species in community forestry in the tropics

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Preface

Wild animals, from ants to elephants, represent a natural resource of great significance for most forest-dwelling communities, as well as for those living in many other rural contexts. In spite of this, most development projects ignore their role in subsistence as well as non-subsistence rural economies. The purpose of this Community Forestry Note is to fill the vacuum left by the fact that in community forestry, as well as in agroforestry and other development activities, the contribution of wildlife to rural livelihoods has been greatly undervalued. The intent is to raise wild animals to their rightful value in the community forestry development process, and to provide an input for designing projects in ways that better fit the reality of most rural people in the tropics.

Community forestry is more than tree planting and woodlots for fuelwood. It is time for community forestry and other development professionals to consider the significance of wildlife as another natural resource, both from the point of view of nutrition (mostly meat) and that of income generation, and to include wildlife among the resources which need to be managed sustainably for the benefit of local communities. By improving wildlife management and integrating it into development programmes, community forestry is better able to fulfil the dual objectives of improving the well-being of communities while simultaneously helping to preserve the diversity of the natural world.

Dr. Kent Redford, who recently moved from the Department of Wildlife and Range Sciences of the University of Florida, where he was director of the Program for Studies in Tropical Conservation, to an important U.S.-based NGO called The Nature Conservancy, has had extensive research experience in this field. Dr. Redford has concentrated his work mainly on Latin America, where he has studied the subsistence and commercial use of wild animals by both indigenous groups and other rural populations. In this study, in addition to giving the conceptual background, he has prepared a list of examples of both indigenous and acquired wildlife management practices from throughout the developing world. These can serve as a starting point for professionals interested in deepening their knowledge of this activity within the context of their own region.

This study is part of the Community Forestry Note series, which is a compilation of concept papers that seeks to develop understanding of the major issues in community forestry. The publication of this Note was funded by the multidonor trust fund that finances the Forests, Trees and People Programme (FTPP), which is devoted to increasing rural women's and men's livelihoods through sustainable self-help management of tree and forest resources. Within the FAO Forestry Department, FTPP is coordinated by Marilyn W. Hoskins, Senior Community Forestry Officer, Forestry Policy and Planning Division.

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Executive Summary

Community forestry aims to assist local people to improve their livelihoods by successfully managing their natural resources, particularly trees and forests, through forestry-related projects. Wildlife plays an important role in the lives of many of the people targeted by these projects.

Animals are everywhere, and everywhere they are valued by humans for a wide variety of reasons. Because animals are most frequently valued by humans for their meat, this study chiefly examines the use and management of wildlife species for food, and primarily for subsistence (which can also include limited barter or sale of the meat). Wild animals are also used for other products vital for subsistence, such as clothing, tools, medicine and material for handicrafts and art. Many of these animal products have acquired commercial value in local, national, and international markets. Game meat, including insects, is sold in many local markets. Some animal products, like elephant ivory, musk from musk deer and rhino horn, have been so valuable that their quest has shaped human history.

Wild animal species have other values that are non-consumptive in nature. These include religious and spiritual values, values due to the willingness of tourists to pay to see them, biotic function values, and ecological values in the equilibrium of their habitats. Though usually valued positively, some animals have negative values, such as the locust swarms of Africa and Asia. Sometimes the value placed on a certain animal species varies according to context, as in the case of the highly valued elephants of East Africa which become dangerous threats when crop raiding.

Just as animals are vital components of the forest ecosystem, so they are also indispensable elements of subsistence and non-subsistence economies. The fact that this aspect has been poorly studied and its importance poorly appreciated is a result of several factors, such as the distaste in many Western cultures for the aesthetics of hunting, or the common developed-world conviction that subsistence hunting is evidence of "underdevelopment."

The tremendous growth of human populations during the last 200 years has brought great changes in the ways people use wildlife. New technologies have dramatically altered traditional practices. Firearms are the most obvious example of such change, but even technologies such as the use of outboard motors, flashlights and headlamps have mitigated spatial and temporal constraints, allowing exploitation of riverine and nocturnal animals that previously were rarely harvested. Consequently, wild animals are becoming rare in many areas where they were plentiful in the recent past. This loss affects not only the animals but also the ability of people to live in these areas.

Besides the change in hunting practices, the global expansion of human activities during the twentieth century has taken an enormous toll on the wildlife populations upon which forest dwellers and rural farming communities depend. Major habitat alterations due to logging, mining, agriculture, pasture development, road construction and urbanization have steadily reduced the area suitable for many animal species. Changes in land use, such as demarcation of land for the use of tourists, have made many traditional food sources illegal for the hunters.

Community forestry, with its many past successes in ensuring that forests remain relevant to local communities, is a proven avenue for assisting rural populations to maintain and improve human interaction with nature. The challenge before community forestry planners and practitioners is to integrate modern expertise with the collective wisdom of local communities. Wildlife can be practically and profitably incorporated into projects when supported by appropriate policies to ensure the numerous uses of wild animals, as well as their very existence, are conserved and improved.

Where communities cannot afford to preserve their wildlife for its intrinsic ecological functions alone, the successful incorporation of wildlife into productive local enterprises may be an avenue to help achieve conservation goals with little need to modify land use patterns. At one extreme, in regions where the landscape is heavily settled, smaller species of animals such as rodents, reptiles and insects may be managed for human use in sacred groves, along riverine forests and in small woodlots. At the other extreme, where local people have rights to very large areas of relatively intact forest, management could focus on all types of animals up to large species of interest to tourists, such as okapi, large macaws or jaguars.

When local inhabitants are included in the decision-making process and given the responsibility for and the benefits from the sustainable management of local wildlife, projects are more likely to be assured of success and the resource is more likely to be protected. This emerges clearly in several of the cases presented in Chapter 5.

This document does not seek to make foresters or extensionists experts on wildlife. Rather, it seeks to raise issues and expand professional thinking on benefits from learning more about wildlife from local people. Community forestry is more than tree planting and woodlots for fuelwood. The professional, researcher or planner is someone who should support the local community in its efforts to enhance its resource base. By improving wildlife management and integrating it into development programmes, community forestry is better able to fulfil its dual purpose of improving the well-being of communities while simultaneously helping to preserve the diversity of the natural world. The study therefore tries to: (1) provide a framework for community forestry professionals to consider ways to integrate wild animal species into projects they manage or are proposing; (2) document ways in which humans interact with wild animal species in tropical settings; (3) provide a review of ways in which humans have managed animal species; and (4) propose ways that wild animal species could be successfully integrated into community forestry projects in the tropics.

The text is structured in the following manner: Chapter 1 investigates the biogeographical and ecological factors that influence the use of wildlife. Chapter 2 discusses the various socio-cultural values of wild animals, including the role of gender and the role of market forces in their management and harvest. Chapter 3 considers the effect of various property regimes and ownership issues, differentiating between the use and management of wildlife and paying particular attention to the concept of sustainability. Chapter 4 is designed to provide some guidelines to help project planners decide which types of animals might be appropriate for inclusion in community forestry projects. Chapter 5 provides a series of brief cases of innovative wildlife use and management in three geographical regions - Africa, Latin America and the Southeast Asian and Pacific region. Chapter 6 contains the summary and conclusions.

Introduction

In a recent review of 10 years of work in the field of community forestry, Arnold (1992) points out that community forestry originally comprised three main elements:

- the provision of fuel and other goods essential to meeting basic needs at the rural household and community level;
- the provision of food and the environmental stability necessary for continued food production; and
- the generation of income and employment in the rural community.

Community forestry was meant to include numerous linkages between people and the whole range of tree and forests outputs, but in practice most projects limited themselves to a focus on trees, especially tree planting. In this decade of work in community forestry, although wild animals were not excluded in the definition, the attention they received was minimal as was research on ways to incorporate them in rural development activities. In the field of forestry, the "forest" has traditionally been viewed as a cohabiting set of plants, mainly trees, with "trees and tree products" as virtually the sole focus.

The purpose of this paper is to fill the vacuum left by the fact that in community forestry, as well as in agroforestry and other development activities, the contribution of wildlife to rural livelihoods has been greatly undervalued. The intent is to raise wild animals to their rightful value in the community forestry development process and, to provide an input for designing projects in ways that better fit the reality of most of the people dwelling in rural areas in the tropics. Integration of human interaction with wild animal species has the potential, where appropriate, to improve ongoing projects and increase the chances of success for new projects.

All around the world there has been a gradually developing awareness of the existence of intricate, interdependent associations between forests and the wildlife they harbour, and between these and human populations. Animals are vital components of the forest ecosystem, and they are also indispensable elements of subsistence and non-subsistence economies. The fact that they have been poorly studied and their importance has remained poorly appreciated is a result of several factors, some of which are:

- division between disciplines that focus on different animals or their use;
- lack of appreciation of the multiple roles wildlife plays in the local ecology and economy;
- distaste in many Western cultures, particularly on the part of "conservation" organizations, for the aesthetics of hunting;
- the fact that hunting has been declared illegal in many countries;
- emphasis on agriculture without considering the supporting off-farm resources and income;
- a conviction that what is not normally marketed is not important; and
- the common developed-world conviction that subsistence hunting is evidence of "underdevelopment."

Community forestry, with its many past successes in ensuring that forests remain relevant to local communities, is a proven avenue for assisting rural populations to maintain and improve human interaction with nature. Hence the aims of community forestry encompass both improving the well-being of forest-dependent communities and simultaneously preserving the diversity of the natural world.

This paper was written to stimulate development professionals to rethink community forestry and agroforestry initiatives and the possibilities for incorporating wildlife in effective ways.

Values of forest wildlife

More than just residing passively in a forest, all wildlife is intimately involved with creating and maintaining the forest environment. Animals fulfil vital ecological roles: these include pollination (birds, bats, bees and other insects); decomposition (vultures, dung beetles, earthworms and other insects); seed dispersal (birds, monkeys, rodents, fish, ants); seed predation (rodents, birds, beetles); herbivory, or plant-eating (insects, mammals); and predation, or hunting of other animals (insects, mammals, reptiles, birds). Through these roles, animals influence such forest characteristics as composition and structure of vegetation. They also influence the reproductive success of plants, contribute to soil fertility and serve as regulators of pest populations.

Of the direct benefits to humanity, food is perhaps the most important contribution wild animals make. This "subsidy from nature" in the form of wildlife remains vital to the survival of many rural dwellers and forest-dependent people. For example, various indigenous hunting groups sharply distinguish being "hungry" from being "meat hungry." Wildlife provides a major part of the animal protein in the diets of rural people in a great many developing countries. A study of over 60 countries shows that game and fish contribute 20 percent or more of the animal protein in the average human diet (Prescott-Allen, 1982), and that percentage is much higher among rural and poorer parts of these countries' populations. Detailed studies are few, but Aisbey (1974) estimated that 75 percent of sub-Saharan Africa depends largely on traditional wildlife sources of protein. In Botswana, in spite of very large-scale cattle production, people still obtain about 80 percent of their meat from wild game sources (von Richter, 1979). In Zaire, 75 percent of the protein comes from wild sources (Sale, 1981). Substantial numbers of inhabitants in Latin America also depend on wild caught animal protein. Fish and game comprise 85 percent of the animal protein consumed by people in the Ucayali region of eastern Peru (de Vos, 1977).

Wildlife use and management

Many societies have developed complex, integrated wildlife resource use and management strategies. These are the culmination of long processes of cultural development founded on observation, experience and experimentation. Examples of effective traditional hunting techniques developed in this way include the use of bow and arrow, blowpipes and pitfall traps. Besides supplying food, wild animals have provided direct support to humans through other types of consumptive uses. These include, but are not limited to, the use of wildlife for:

- products such as skins and hides;
- materials for handicrafts or ceremonial use;
- oils and medicines;

- the live-animal trade;
- sport, be it hunting or tourism; and
- stock sources for domestication or improvement of domestic breeds.

In addition to their various nutritional and consumptive uses, wild animals have been valued throughout history for other important reasons. Wild animals have been central to religious customs, mythology and folklore. These symbolic or socio-cultural values of wildlife remain important today in nearly all communities worldwide.

Until very recently, none of these various uses of forest animals have been included in calculations of "forest value," nor have they featured in lists of benefits from the forest, nor even been acknowledged as relevant to most community forestry schemes (Peters *et al.*, 1989).

Recent developments

The tremendous expansion of human populations during the last 200 years has brought great changes in the ways people use wildlife. New technologies have dramatically altered traditional practices. Firearms are the most obvious example of such change, but even technologies such as use of outboard motors, flashlights and headlamps have mitigated spatial and temporal constraints, allowing exploitation of riverine and nocturnal animals that previously were rarely harvested. Consequently, wild animals are becoming rare in many areas forest areas. This loss affects not only the animals but also the ability of people to live there.

The global expansion of human activities during the twentieth century has taken an enormous toll on the wildlife populations upon which forest dwellers and rural farming communities depend. Major habitat alterations due to logging, mining, agriculture, pasture development, road construction and urbanization have steadily reduced the area suitable for many of the favoured animal species. Changes in land use, such as demarcation of land for the use of tourists, have made many traditional food sources illegal for the hunters. These changes in land use and tenure have also affected and diminished territorial holdings under traditional management systems.

Colonization schemes in some tropical countries increase pressure on wildlife populations by increasing the number of hunters. New immigrants rarely observe local hunting customs regarding food or species taboos, hunting seasons or protected areas, most of which are aimed at managing wildlife resources sustainably. As deforestation progresses, even less habitat is available for wildlife as well as for forest dwellers.

The challenge before community forestry planners and practitioners is to integrate modern expertise with the collective wisdom of local communities. Wildlife can be practically and profitably incorporated into projects when supported by appropriate policies to ensure the numerous uses of wild animals, as well as their very existence, are conserved and improved.

Constructing the future

This document does not seek to make foresters or extensionists experts on wildlife, but it does seek to raise issues and expand professional thinking on benefits from learning more about wildlife from local people. Community forestry is more than tree planting and woodlots for fuel-

wood. The professional, researcher or planner is someone who should support the local community in its efforts to enhance its resource base. By improving wildlife management and integrating it into development programmes, community forestry is better able to fulfil its dual purpose of improving the well-being of communities while simultaneously helping to preserve the diversity of the natural world.

It is therefore this paper's intent to: 1) provide a framework for community forestry professionals to consider ways to integrate wild animal species into projects they manage or are proposing; 2) document ways in which humans interact with wild animal species in tropical settings; 3) provide a review of ways in which humans have managed animal species; and 4) propose ways that wild animal species could be successfully integrated into community forestry projects in the tropics.

Structure of the paper

The paper is structured in the following manner.

Chapter 1 investigates the biogeographical and ecological factors that influence the use of wild animals.

Chapter 2 discusses the various socio-cultural values of wildlife, including the role of gender in relation to the participation and contribution of local women. It also briefly examines the role of market forces in the management and harvest of wild animals.

Chapter 3 considers the effect of various property regimes and ownership issues in relation to the use of fauna and differentiates between the use and management of wildlife, paying particular attention to the concept of sustainability.

Chapter 4 is designed to provide some guidelines to help project planners decide which species are appropriate for inclusion in community forestry projects and discusses the variety of purposes for which humans can utilize wild animals species.

Chapter 5 is divided into three sections and provides practical examples of innovative wildlife use and management in three distinct geographical regions - Africa, Latin America and the Southeast Asian and Pacific region.

Chapter 6 provides an overview of the publication, the summary and conclusions.

This paper draws on available literature and will be expanded and fine-tuned as more literature becomes available. Here, wild animal species are defined as all non-domesticated animals. Most of the literature deals with terrestrial vertebrates (mammals, birds and reptiles) and so they are also the main focus of this paper. Available data on invertebrates (including insects) has also been incorporated, though without an extended discussion of bees and honey for which a great deal of literature already exists. More than for other groups of animals, however, the literature on invertebrate use consists primarily of lists of species consumed for food.

Fish are extremely important in providing food to local peoples. However, to a large extent, both the ecological questions and the literature pertaining to fish and aquatic systems are entirely different, and therefore they are not considered in depth here.

This paper deals mostly with the use and management of wildlife species for food, and primarily for subsistence. Throughout, when subsistence use of game is referred to, this means the consumption of meat or other animal products by the hunter and his relatives. In many cases, though, there is limited barter or sale of the meat within the community, and there are numerous cases of people who could be referred to as subsistence hunters but who do sell meat to a wider community. An effort has been made to point out these cases as they are mentioned.

Biogeographical and ecological factors in the use of wild animal species

The goal of community forestry is to meet both short and long-term needs of local people for forestry and forestry-related activities. Until recently, these needs have been viewed as needs for products such as food, fodder and fuelwood. However, increasingly, community foresters are realizing that in addition to this, there is another category of needs which are based not on products in the usual sense of the word but on processes or services. Wildlife plays indispensable roles in the maintenance of complex, healthy ecosystems; as these ecosystems are indispensable to human well-being, the role of wildlife is also indispensable.

Biotic function values of wildlife are those values that result from the ways in which animals interact with the biosphere and the geosphere. These include pollination, nutrient cycling, pest control and many others. The greatest ecological values of wildlife are provided by a largely intact, healthy ecosystem - one that is capable of supporting significant populations of wild animals and particularly large vertebrates. As stated by one author: “The intact ecosystems which harbour wildlife also often provide essential environmental services for surrounding communities, such as a wide range of forest products, water catchment, moderating seasonal flooding, and serving as resource reserves for times of drought or other climatic stress. Local communities often are not aware of the full range of these environmental services nor the direct negative effects that losing them would have on their livelihood” (Kiss, 1990). The same could often be said for the forester-planner, especially as relates to production forestry.

This chapter discusses the different biogeographical and ecological factors affecting animals that must be taken into consideration when developing plans for integrating wild animal species into community forestry projects. In particular, “source faunas” (see below) are examined, including animals’intrinsic genetic and phylogenetic characteristics. The ecology of harvesting and the direct impacts of recent human activity are also discussed.

Source faunas

Different areas have different fauna. Some areas have high species diversity, others low species diversity; some have many large species and few small ones, and some the reverse. Therefore, humans living in different areas have different faunas available to them. The faunas available to a given population are referred to as “source faunas.”

The nature of source faunas has tremendous repercussions for the potential patterns of human use of wildlife and whether the incorporation of wildlife into community forestry projects is feasible. Considerations such as whether the animals will attract tourists and will be amenable to sustainable food production programmes or will have market value, necessitate that project planners develop a sound appreciation of the nature of the source fauna in their proposed project areas.

The three tropical regions discussed in this paper (Africa, Latin America and, Asia and the Pacific region) have fundamentally different source faunas. The variation in number and composition of source faunas can be explained by the three basic categories identified by Bourliére (1988): historical, physical and biotic.

Historical factors

In order to understand the composition, and therefore the human use, of the fauna at a given location, it is important to consider the evolutionary history of an area. The fact that primates are not found in Australia, nor rhinos in South America nor armadillos in Africa, is due to the evolutionary origins of these groups.

Continental differences are profound. For example, in African savannas, there are about 78 species of bovids - oxen, buffalo, antelope and their relatives (Sinclair, 1983) in addition to the "mega-herbivores" - giraffes, elephants and rhinos. By contrast, in South America, only about seven hoofed animals (ungulates) like the tapir, deer and peccaries occur in tropical savanna formations and there are no animals in the "mega-herbivore" category (Redford and Eisenberg, 1992).

The comparative poverty of species in South America is a geologically recent event. The dramatic difference between the two physiognomically similar savannas of Africa and South America is due to the fact that during the last glacial period, about 11 000 years ago, South America suffered extinction of at least 41 genera of large herbivores including all of its mega-herbivores (Owen-Smith, 1988).

Historical factors also include the phenomenon of dispersal of animals from their areas of origin. Deer provide an example: they did not evolve in South America but were one of the groups to move across the Central American land-bridge. Dispersal factors help to explain the pattern on islands, with continental islands bearing a fauna that is much more representative of the nearby continent than that of oceanic islands.

Physical factors

These include geological constraints such as the size, location and isolation of land masses, as well as the presence of mountain ranges, rivers and other shaping landscape features. For example, the ranges of some tropical mammals do not extend across Africa's Dahomey Gap.

This category also includes climatic parameters. For example, animal species diversity generally decreases with increasing aridity and with increasing altitude.

Biotic factors

This category refers to the ecological mechanisms that mediate the number and abundance of animal species, and therefore their availability for use by humans. It includes the external, envi-

ronmental influences together with internal, species-specific regulators such as an individual's phylogenetic make-up.

The first of the external, environmental regulators is plant species diversity itself. There seems to be a generally positive correlation between the number of species of plants and the number of animals. This is due not only to the fact that greater numbers of plant species provide greater sources of food, but also because the increased architectural complexity of the forest associated with more diverse vegetation seems to provide the variety of habitat that allows greater animal diversity. Increased environmental heterogeneity increases the number of microhabitats for animals and their prey.

Changing environments and changing patterns in faunal occurrence: The composition of a source fauna is also influenced by site changes and modifications to forest vegetation. It is important to understand some of these potential influences in order to help predict fluctuations in source fauna populations.

Variations in the presence and abundance of animal species within a site may be due to natural succession in the vegetation, to changing patterns of human use, or to a combination of both these factors. For example, when a one hectare patch of forest is cleared by a forest-farmer to plant a garden, the patterns of faunal abundance at this site are changed. The garden's changed biotic and other conditions will cause some species to become more abundant and others to become less abundant or absent. These microhabitat changes also extend into the surrounding forest because the biotic conditions along the forest edge change as well. Typically, the newly made garden will harbour a set of invertebrate species that favours warmer, drier conditions with a preference for the crop plants or the forest weeds that become more common at the site. Research in many parts of the tropics has shown that these changes in vegetation and insect populations are mirrored by changes in the bird, mammal and herpetofauna (reptile) populations.

After the garden is abandoned and as the vegetation structure and plant species compositions change once more, so too do the animal communities. Often, a few of the forest-dwelling species that were rare in the forest become very common in the garden fallow. This is a pattern that has been well documented for rodents (Peterson *et al.*, 1981; Medellin, 1992). In turn, these changes will affect the number of game animals available to a hunter, the nature of the animal-mediated pollination, the number and density of pest species, and many other factors of keen interest to the local humans.

The changing patterns of habitat use by game animals in response to the creation of forest gardens creates the opportunity for what the anthropologist Linares referred to as "garden hunting." Garden hunting describes the tendency of many game animals to be attracted to garden sites where they are killed by humans. In some cases they are attracted to crop plants, in others to the weeds that flourish under increased light and in other cases they may simply be easier to kill in gardens than in the forest.

Fallow gardens are important hunting sites for humans. In some cases the attraction of game animals to the fallow site is consciously encouraged by planting wild species that bear fruit attractive to game animals.

Changes in forest size and connectivity can also change the fauna of a given area. For example, as a forest is fragmented, the fauna loses those species whose area-requirements are now no

longer met, often the case for the large predators, large primates and large ungulates. Not only are these species no longer available for direct exploitation by humans, but their absence will change the remaining community of species (Redford, 1992). For example, in small forest patches in eastern Brazil where ocelots are absent, the rodent community is impoverished due to the increased abundance of *Didelphis* opossums (da Fonseca and Robinson, 1990). The construction of wildlife corridors can partially offset some of these loses.

The severity of the effects of forest fragmentation is dependent upon the scale of change. In the Ituri forest area of Zaire, where second-growth forests are bordered by vast areas of uncut forests, few game species inhabiting the secondary forests are scarce, largely due to the presence of the primary forest (Wilkie and Finn, 1990).

Intensive selective harvesting of forest products can also have implications for patterns of faunal abundance and their use by resident human populations. Johns (1985) reviews the effects of selective logging on tropical forest animal communities and concludes that some animal species are adversely affected, some are entirely unable to survive and others are able to maintain viable populations or to flourish. Of those species most frequently of interest to humans, many are negatively affected by large-scale selective logging.

The harvesting of non-timber forest products can also have effects on the fauna through factors such as the creation of competition between humans and animals for resources like fruit (Redford, 1992).

These factors are not simply matters of academic interest but must be carefully considered as they will influence the outcomes of any attempt to integrate the increased use of wild animal species into other ongoing activities.

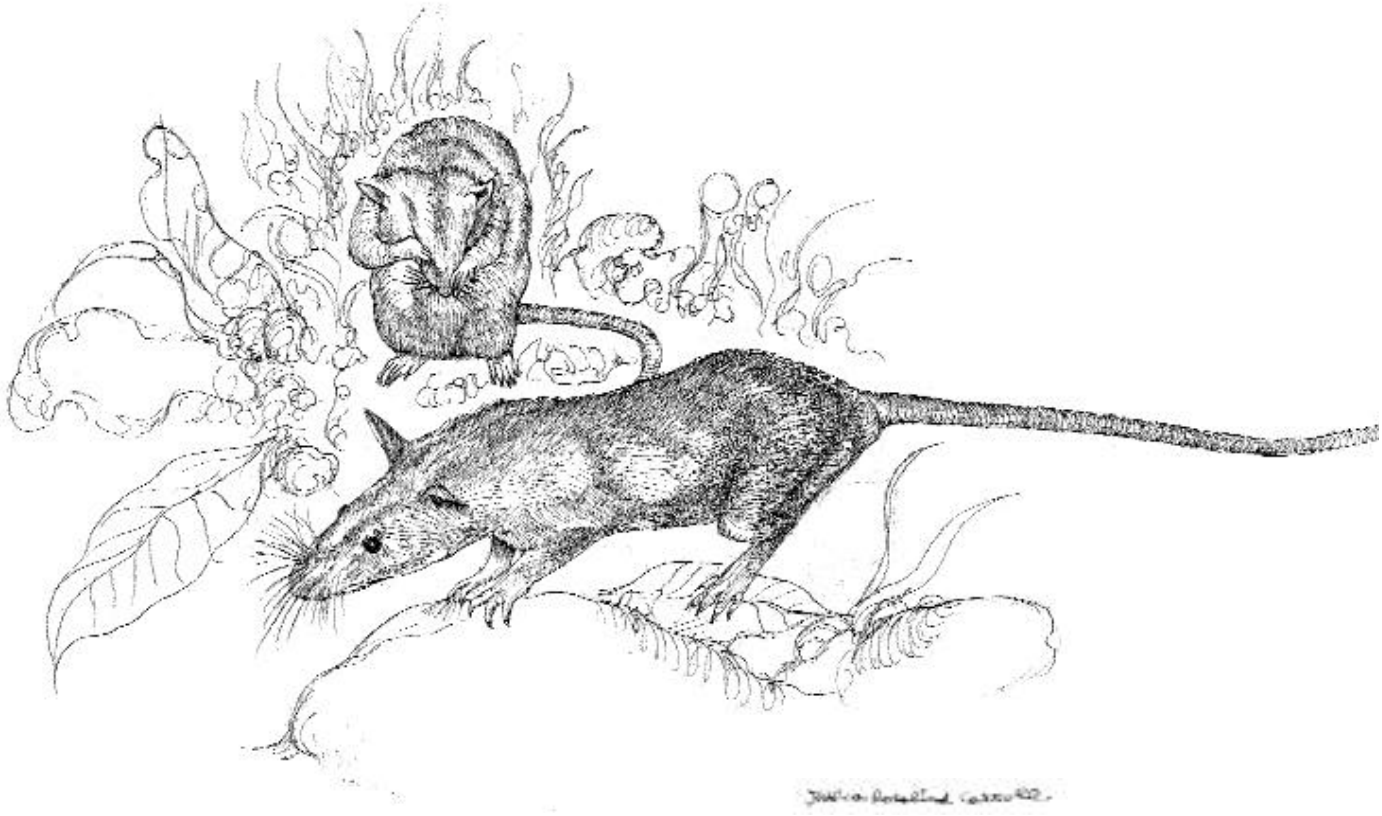
Phylogenetic constraints: When assessing the suitability of different species for sustainable human use, intrinsic, species-specific factors must also be considered. These refer to those characteristics of an animal's biology that are primarily determined not by environmental factors but by genetic heritage. Many of these factors can be modified slightly by environmental conditions, though only within genetically determined limits that cannot be surpassed. For example, by changing diet and light regimes, the onset of reproduction and litter size of some animals can be somewhat modified.

These characteristics are referred to as belonging to the animal's phylogenetic inheritance, and they include such basic traits as homeothermia (the nature of "warm-blooded" animals, such as mammals, which maintain a constant body temperature) and heterothermia ("cold-blooded" animals, such as reptiles, which do not maintain a constant temperature).

A basic understanding of the existence of phylogenetic constraints is essential when evaluating management plans directed at a single species or comparing the potential of two different species. The genetic difference between heterotherms and homeotherms is one of nature's most basic divisions between animals. This difference is related to many basic biological characteristics. For example, homeotherms typically have a small number of young. Each of these few offspring receives both a relatively large prenatal investment and a considerable postnatal investment in care and feeding. This compares with the much greater litter size of heterotherms and the virtual lack of parental investment. The result is that the reproduction of heterotherms is more rapid than that of homeotherms (Peters, 1983).

An example illustrates the importance of considering phylogenetic constraints when assessing different wild species for integration into community forestry activities. In West Africa, there has been a great deal of work devoted to the biology of giant forest rats (*Cricetinomys*) as they would appear to be ideal candidates for sustainable harvesting. These large African rodents belong to the family Cricetidae and can produce 24 young a year, a reproductive rate not uncharacteristic of species in this family. The successful experience with these large rodents has sometimes been used as evidence that similar work should be done with the large rodents of other tropical forests. However, in the Western Hemisphere, the large forest rodents are not cricetines, but belong to various families of Hystricognath rodents. For example, the paca (*Agouti paca*) can produce only 2.5 young per female per year. The other large rodent of these forests, the agouti (genus *Dasyprocta*) produces only about 3.0 young per female per year (Eisenberg, n.d.). This dramatic phylogenetic difference between reproductive parameters of different rodent families would be an essential component of any decision to manage these forest animals.

Body size and food habits: An evaluation of the suitability of certain species must address itself not only to its phylogeny (its genetic lineage) but also to another intrinsic, species-specific factor: body size. This factor is related to the food habits of an animal in many ways. Small body size allows exploitation of types of food that are not available to large-bodied animals. Large body size, conversely, allows animals access to more abundant food and to food of a wider range of sizes (Peters, 1983).



The giant pouched rat (Cricetomys gambianus) *attains a maximum length of about 75 cm, including its long tail. It is found in Central Africa, from Gambia to Sudan and in South Africa up to the Northern Transvaal. Pouched rats are characterized by cheek pouches in which they carry their food.*

Body size is greatly influenced by the difference between heterotherms and homeotherms. Most heterotherms are small (such as reptiles and insects) as compared to homeotherms (mammals and birds). Homeotherms of all sizes produce much less body weight per unit of energy ingested than do heterotherms, primarily because they burn the energy to maintain a constant body temperature and high rates of metabolism (Peters, 1983).

The importance of considering the interaction between body size, food habits and reproductivity is illustrated in an example originally given by Kleiber (1961) and expanded on by Peters (1983). If 10 tons of hay are fed to two half-ton steers and an equal amount to 500 two kilogram rabbits, both will reduce their food resource to 6 tons of manure while producing 0.2 tons of new tissue. In other words, assimilation efficiency and production efficiencies are independent of size. The remaining 3.8 tons will have been used to produce energy that was lost as respiration, in large part to maintain a constant body temperature. The major difference in the two species is that 1 ton of rabbits will eat all their food and produce all their growth in only three months, whereas 1 ton of cattle will require 14 months.

If this type of analysis were extended to insects, 10 tons of hay would support a population of 1 million grasshoppers for nine months, but at the end of that time they would produce 2 tons of new grasshoppers, or 10 times more new tissue than the homeotherms, leaving behind 6 tons of manure and burning off the energy in only 2 tons of the food (Peters, 1983).

In other words, from the perspective of production for human consumption, small heterotherms (insects) may very well be a better investment than large homeotherms with the same food habits (cattle). Though this example involves controlled feeding experiments, the larger point, in terms of maximizing food production, might be that in many circumstances *where both types of animals are in common use as food*, humans may wish to focus harvesting schemes on invertebrates rather than vertebrates.

Reproductive rates: Another clear concern for the human consumer is the pattern of reproduction of a candidate species. In addition to the factors discussed above, reproduction is also strongly influenced by body size. Larger animals tend to have fewer young than smaller animals. However, the young of larger animals tend to be larger, with the result that the total mass of the litter does not vary much among vertebrates or, perhaps, invertebrates of similar size.

When assessing different candidate species for community forestry projects, the following parameters of reproductive rate must be considered:

- age of first reproduction;
- litter/clutch size;
- size of neonate or egg;
- interbirth/clutch interval; and
- age of last reproduction.

Population density and carrying capacity: A large-bodied animal that produces many offspring might seem to be ideal for the purposes of human exploitation. However, individuals of such a species may not be common: they may occur at a low population density, decreasing their usefulness. The factors that control the density of animals can be divided into two major groups, intrinsic and extrinsic.

Intrinsic factors governing density are closely related to body size and food habits. As a general rule, population densities decline with: 1) increasing body mass (big mammals are less common than small ones); and 2) more specialized food habits (species whose diet allows them access to a greater variety of food resources are more common) (Robinson and Redford, 1986). The relationship of increasing density with decreasing body size is true across a tremendous range of sizes and animal groups. On average, smaller animals are always more abundant than larger ones (Peters, 1983).

The second group of factors governing population density are extrinsic ones, that is, environmental factors which are not phylogenetically based. Extrinsic factors are frequently related to the carrying capacity of a habitat - the ability of a habitat to provide a given species with shelter, food, water, etc. In habitats that contain abundant food or shelter, the density of a species would be greater than in a habitat with less food or shelter. These factors are sometimes modified by local communities.

Many other factors can influence and control density levels of a species such as disease, predators, exceptionally unfavourable weather or fire. Some species, like migratory locusts and adult moths, vary in density depending on season or rainfall.

The indirect effects of loss of fauna

When considering the harvesting of wild species, it is important to understand not only the impact on the target species but also the impact on non-target species. As stated by Naiman (1988): "... although less widespread and ecologically influential than in the past, within our remaining natural systems animals continue to play significant ecological roles that go far beyond their immediate requirements for food or habitat. In many cases they are responsible for bio-geochemical, successional, and landscape alterations that may persist for centuries."

Although many ecologists have documented the important roles played by large animals in seed dispersal, seed predation, herbivory, pollination and predation, until recently few have considered what would happen if these animals were removed from the system. There is a growing body of work which suggests that in tropical forest ecosystems, large vertebrates perform very important ecological roles, and that their removal would result in a changed forest. A more holistic approach should include consideration of these factors, which can be referred to as the *ecology of harvesting*. It is essential to consider it if long-term ecological sustainability is to be the result of community forestry activities. (For more detailed references see Redford, 1992.)

The concentration on large animals is by no means meant to dismiss the role of small animals in structuring ecological communities. Work on termites, earthworms and other insects, to mention a few, has shown the critical role these small species play in such processes as nutrient cycling and decomposition. Yet, the incorporation of large wild species into community forestry programmes has received the most attention for several reasons: 1) because of the obvious vegetation structuring role they play in ecosystems; 2) because they are frequently the major targets of human interest; 3) because there has been more work done on their ecological roles in this habitat; and 4) because the possible ecological effects of their absence are better understood.

Vegetation structure

The importance of large animals in structuring forests has been discussed for deer, tapir and peccary (Dirzo and Miranda, 1990), for rhinos in Nepal (Dinerstein and Wemmer, 1988), and for

elephants in the Ivory Coast and in Uganda (Alexandre, 1978; Chapman *et al.*, 1992). In more open vegetation formations of Africa, for example, elephants can transform woodlands into open grassland, accelerating the release of nutrients (Owen-Smith, 1988).

Seed dispersal

Many authors have documented the important role played by large birds and terrestrial mammals in the dispersal of the seeds of tropical plants. Based on his work in Panama, Howe (1984) stated that "animal-mediated dispersal is certain to be critical for the demographic recruitment of many or most tropical forest species." Large birds, particularly the cracids, hornbills and turaco, are among the most important seed dispersers. Many of the species of cracids, particularly the curassows, are the species whose local populations are most rapidly depleted by hunting. Because of the cracids' importance as seed dispersers and their susceptibility to hunting, Silva and Strahl (1991) have suggested that "human impact on the *Cracidae* may have irreversible long-term effects on the biology of neotropical forest ecosystems." Similar arguments have been made for other large birds in Africa, Asia and Australia.

The other group of important large seed dispersers are the primates, including chimpanzees, spider monkeys, orangutans and woolly monkeys. Like large birds, large primates are highly prized game animals and are very rapidly hunted out of a forest (cf. Peres, 1990). In the absence of these and other large primates, many species of plants may experience severely altered seed dispersal patterns and at least some trees would become locally extinct.

Predation

The role played by predators in structuring communities has been well studied in marine and intertidal systems. This work has shown that predators can increase the overall species diversity in a community by decreasing the abundance of smaller predators and competing herbivores, and by reducing dominance of prey species. Research of this sort has not been conducted in tropical forests, but biologists working in various locations have observed that the decrease in abundance of large predatory mammals is correlated with the increase in abundance of medium-sized terrestrial mammals. Absence of large predators such as tigers, jaguars, leopards and ocelots also seems to result in dramatic differences in densities of prey species, which are found in more regular numbers in the presence of these predators (cf. Emmons, 1987).

These large animals provide what Terborgh (1988) has referred to as a "stabilizing function." Animals like black caiman, jaguars and harpy eagles maintain the remarkable diversity of tropical forests through "indirect effects," a term referring to "the propagation of perturbations through one or more trophic levels in an ecosystem, so that consequences are felt in organisms that may seem far removed, both ecologically and taxonomically, from the subjects of the perturbation" (Terborgh, 1988).

In many tropical habitats, large animals are no longer present in numbers that even approach their past densities. They may not be completely extirpated, but they are only present in the area in very low densities. Even if elephants, bearded pigs, rhinos, mandrills or jaguars have not gone extinct in the wild, their populations may have been reduced to such an extent that they no longer perform their "ecological functions." In such habitats the animals are, in all probability, ecologically extinct. "Ecological extinction" is 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."

The animals that are the most popular game species, the ones most heavily affected by human activity and the ones whose populations have most likely become ecologically extinct, include the most important predators and the large seed dispersers and seed predators in tropical forests.

Invertebrate wealth

Invertebrates play a major role in the diets of many tropical people. Entomophagy (the eating of insects) has not received adequate attention by researchers for a number of reasons. Many investigators are concerned with consumption of highly visible, measurable vertebrate prey and dismiss the importance of invertebrate consumption, especially insects. Over 500 species of insects have been recorded worldwide as human food, which includes all major insect orders (DeFoliart, 1990). These are frequently eaten in the field as they are encountered and almost never quantified. These food items are generally overlooked or are merely reported as "grasshoppers" or "locusts" on food item lists, rarely identified to species (DeFoliart, 1989). Sometimes, researcher disgust and bias against entomophagy as a "primitive" practice may cause informants to hide certain food resources (Posey, 1987).

Edible insect food resources are incredibly varied. A study by Ruddle (1973) revealed at least 25 insect species in the diet of the Colombian Yukpa. Dufour (1987) reported 20 species for the Tukanoans of southern Colombia. In southern Zaire, a study restricted to caterpillars found at least 35 species were consumed (Malaisse and Parent, 1980). Mexico has diverse groups that eat insects, and more than 200 species are consumed there (DeFoliart, 1990). Honey is an important food item in many cultures and is collected from both wild and domestic sources. It is frequently consumed together with bee larvae, which provides additional benefits from protein and fat.

Various studies have been undertaken on the nutritional value of insects as a food source. Crude protein may range up to 60 percent or more (dry weight). High energy is derived from the high fat content. Tests were conducted on a termite (*Macrotermes subhyalinus*) and a palm weevil (*Rhynchophorus phoenicis*), commonly consumed in Angola. The caloric values were 613 and 561 kcal/1 000 g, respectively, and they also included many important vitamins and minerals. By comparison, corn provides only 320-340 kcal/1 000 g (Oliviera *et al.*, 1976). Comparable results were found for insects consumed in the Amazon (Dufour, 1988). Other invertebrates are also consumed and can be very important locally. The large West African land snails (*Achatina* spp and *Archachatina* spp) are eaten widely throughout their range. Protein analyses show their flesh to be similar to beef (Ajayi, 1971). This mollusk may prove to be an important species in low-cost production schemes. Other invertebrates widely consumed include crabs, crayfish, mussels and clams, which pertain to fishery issues. They are mentioned here only as a reminder of their importance in many tropical diets and the need to learn from local communities what range of wildlife enters their food preferences and habits.

Hunting patterns

The most highly sought after species are usually large-bodied prey, generally mammals (Redford, in press). These give the greatest return for time invested in hunting. Mammals are universally sought and most consumed, followed by birds, reptiles and then amphibians. An illustrative figure from Malaysia indicates that 96.8 percent of the game animals caught are mammals (Caldecott, 1988). However, significant numbers of smaller (non-game) animals are also consumed, including large amounts of invertebrates.

These preferences appear to narrow with acculturation and articulation with Western society and cash markets. This trend has been noted anecdotally but rarely quantified. A comparison of forest colonists (in closer contact with the "outside world") and indigenous peoples in South America shows these differences in their hunting patterns. Indigenous peoples hunted mammals, birds (and probably reptiles) at a higher rate and in a wider variety than colonists, with colonists hunting a small subset of the diverse group taken by the indigenous peoples. Some overlaps occurred with certain favoured species commonly hunted by both groups (Redford and Robinson, 1987).

Prey density is very important in determining potential hunting success. In general, smaller species are more common and reliable than larger species. Traditionally, indigenous groups moved as hunting returns and garden production diminished, but most of these groups today are no longer able to relocate. The increasing encroachments on hunting areas used by traditional societies have restricted their freedom of movement. As a result, they become increasingly sedentary. This is often encouraged or imposed by national government policies, social policies of non-government or missionary groups, and development agencies, as well as by changes in land tenure systems. This increased sedentariness leads to intensification of local resource depletion and eventually a dependence on agriculture and domestic stock. New technologies further accelerate this process. These technologies are not confined to manufactured tools. Yost and Kelley (1983) note an example where the recent introduction of dogs among Waorani tribesmen has allowed them to hunt species that were previously ignored or rarely hunted.

Wildlife or domestic stock?

Early European settlers began introducing their livestock almost as soon as they arrived in the tropical lands they colonized. These exotic breeds often proved to be poorly adapted to tropical climates and diseases. Still, because colonists were familiar with these animals, the introductions continued and most local sources of animal protein were ignored. Many development institutions continue this legacy today and fund programmes that promote widespread domestic livestock use. These livestock programmes often occur in inappropriate situations where local wild species might provide more positive results.

Alternative sources should be considered for community development schemes outside the traditional domestic species of chickens, goats, sheep, pigs and cows. Usually, cultural values and preferences for various wild foods are overlooked in development projects.

For example, cattle are strictly grazers that do not exist well on poor quality forage. As range quality goes down, exceedingly high amounts of pasture per head are required, or supplemental feed must be given. Increasing use of grain to fatten meat animals often diverts these foods from the rural poor. Farmland may also be shifted from human food production to crops, such as sorghum, for animal feed. The resultant meat products can be very expensive and are consumed by higher-income urban dwellers. Goats and sheep are superior producers to cattle in marginal environments but when overstocked seriously degrade these habitats.

In many instances, managing a mix of native wildlife species could provide similar production with less damaging effects. Some habitats are very inhospitable to conventional stock, and only wild species, better adapted to restricted plant and water resources, can be used without causing serious environmental degradation.

Wildlife has a number of advantages over domestic species. In addition to high consumer preference for wildlife, dressed carcass weight in wild species is usually a higher percentage of the live weight (Ajayi, 1983). This can mean comparable or less waste than with domestic breeds. Meat from wild species generally has a very high protein content. Native species are well adapted to local climate and disease and can efficiently utilize the native plant cover. Despite these advantages, use of wild species for meat production continues to receive insufficient attention.

The nutritional advantages of wildlife

There is an important consideration that is frequently neglected by those studying the nutritional relevance of animal protein: the regularity of the supply of protein is probably more important than overall average consumption. In other words, eating a small amount of animal protein each day may be better for nutrition than eating a great deal once every 20 days. In this regard, the use of non-domesticated animals, particularly wild animal species, assumes considerable importance for two reasons (Dwyer, 1985).

First, many wild animal species are small, particularly if invertebrates and small fish are included. These animals may be eaten frequently by children: Chavunduka credits insect consumption with preventing many potential cases of kwashiorkor among the young in remote rural areas of Zimbabwe (cited in DeFoliart, 1989). Because small animals are frequently eaten as snack food or caught and prepared away from the main kitchen, their consumption has been vastly underestimated by researchers. These small animals are consumed much more frequently than larger game animals and certainly more frequently than meat from domestic animals. Another example is the peri-urban areas of Zambia and the more densely settled farmlands in other parts of the country where mice, moles, gerbils and termite alates are extensively consumed (Pullan, 1981).

The second reason why meat from wild animals is frequently more important to nutrition than that of domestic species is their lesser market value. Only certain species of wild animals have a market value, while all species of domestic animals have such value. As a result, domestic animals are frequently not consumed by their owners but are reserved to be sold at market when cash is needed.

The result is that both domestic animals and larger game animals are rarely eaten by subsistence farmers or hunters and their families because of their market value. Instead, smaller wild species with little market value, particularly insects, often missed by researchers, may supply a very important source of nutrition.

Socio-cultural values of wildlife

Although the main focus of this study is the use of wild animals for food, it is important to examine how wild animal species are valued and how they influence the culture and belief systems of rural societies more generally. Thus the focus of this chapter is on the social, rather than technical or managerial, implications of wildlife in community forestry projects. It reviews the spiritual, symbolic and ceremonial importance of wild animals; examines the significance of wildlife in hunting societies and in indigenous systems of medicine; and considers the impact of gender roles on the use and management of wild fauna.

Studying socio-cultural values is important in two ways to foresters. On the one hand, past attempts to introduce forms of animal use that contradict local cultural or religious beliefs have resulted in failure. Thus, an understanding of these belief systems is vital before instituting development projects that target certain species which may be regarded as inappropriate by the social group involved. On the other hand, animals that are positively valued are quite often of interest to the community, which may wish to reintroduce, protect or manage such species.

Religion, mythology and folklore

Wildlife fills a myriad of roles in the belief systems of human societies. Both archaeological and ethnographic records show that nature, and especially wild animals, are central to the religious practices, mythology and folklore of many societies. As such, it is important to have an understanding of these dimensions in developing a strategy for community forestry and wildlife management.

Common to many societies is the belief that wild animals have superhuman or godlike powers. Early art, including palaeolithic cave painting, shows that the veneration of animals is an ancient form of worship (Marshak, 1972). Numerous early peoples practised religions in which wild animals featured prominently, and this pattern is still observed in many contemporary societies (Diamond, 1987). Several religions practised in Asia, Africa and among Native Americans, have retained the respect for other forms of life as a basic tenet. This idea is central to the ideology of animism, a cosmology found in many areas of the world, which posits that all creatures and objects possess souls (Hitchcock, 1962).

The association of major deities or spiritual beings with animals, in which creatures serve as the assistants, symbols or incarnations of religious figures, is characteristic of some of the world's major religions. The ancient Egyptian pantheon, for example, with its zoomorphic gods and the related remains of mummified animals in the cult of the dead, represents a virtual catalogue of the Nile Valley's fauna. There are parallels in Christian iconography, with early evangelists associated with animal symbols: Mark is represented by the lion, John by the eagle and Luke by the ox. In terms of current observance and imagery, Hinduism provides other pertinent examples of the important role of wild animals in religious practices. Here, all religious ceremonies or auspicious occasions begin with a prayer to the elephant god *Ganesh*. Wild animals are the mounts or chariot pullers of many Hindu gods and goddesses: *Durga* or *Kali* rides a tiger, *Murugan* rides a peacock, and the great Hindu god of the sky, the raptor *Garuda,* is believed to have brought the sun down on his wings.

Another belief in the spiritual relationship between humans and animals is that of the guardian-spirit animal. The creature may be a bird, a mammal or even an insect. In the various Native American and Asian societies where this belief is held, humans develop a special bond with a wild animal through a dream or vision in which the animal's spirit communicates with them. The spirit may endow the person with extraordinary powers, prayers or paraphernalia, which can then be drawn on in times of need or crisis.

Some American Indian and Aboriginal Australian shamans are also noted for their ability to tame as well as communicate with wild animals. This special attribute has likewise been associated with Buddha, Saint Francis, the prophet Daniel and other holy figures from larger societies. The taming of wildlife for spiritual purposes may have also played an early role in the process of animal domestication (Zeuner, 1963; Savishinsky, 1983; Tuan, 1984; Budiansky, 1991).

A different form of guardianship is expressed in beliefs that place animal spirits in the role of protecting wildlife against human abuse. For example, Hitchcock (1962) describes the role of the tabanid fly in regulating the fishing of the Montagnais of eastern Canada. The fly is considered overlord of salmon and cod, and hovers over the fishermen whenever the fish are taken from the river "in order to see how his subjects are being treated." Occasionally, the fly will bite the fisher as a punishment for wastefulness; the bitten man would expect poor fishing for a time as a further chastisement. Guardian animals may also punish those who disturb a forest or other ecosystem unnecessarily. Certain communities in the Peruvian Amazon fear and respect an "animal-demon" called *shapshico,* who shoots a tiny dart causing illness and hysteria "if you cut down a tree in his [rainforest] garden" (Kamppinen, 1988).

Another manifestation of the spiritual relationship with the animal world is the totem, a hereditary emblem-animal for a person, tribe or clan, which often gives the person or group its name. Taboos against eating one's totem animal are nearly ubiquitous among groups that have totems. Similarly, many societies forbid their people from eating a certain animal honoured for the legendary assistance it gave to the group's ancestors (de Vos, 1977). In totemic societies, relations to wild species are central to a sense of group identity and solidarity.

Taboos on the use of animals

The various symbolic and religious roles of wildlife exist side by side with the practical uses of animals. Practical uses in turn are determined by certain cultural beliefs, which were originally

derived from accumulated collective experience. Certain foods, for example, are "taboo" or forbidden in specific societies. Taboos are the social restrictions placed by a group on the consumption or use of certain species. Central Inuit groups, such as the Netsilik of Canada, Alaska and Greenland, strictly segregate the eating of sea and land mammals, and the sewing of the skins, into the different seasons of the year (Balikci, 1970). The best described food taboos are those of Islam and Judaism, which prohibit the consumption of a range of domesticated and non-domesticated species. These restrictions affect the behaviour of millions of practising Muslims and Jews throughout the world.

The significance of food prohibitions on wild and domestic animals has been the subject of various interpretations. Two main schools of thought have developed in recent years, one with a functional or materialist emphasis, the other with an emphasis on meaning and symbolism (Shanklin, 1985). The former school stresses the functional importance of these animal food taboos, that is, their utility for furthering people's material needs (Harris, 1975). Harris, for instance, argues that historically it made economic and ecological sense for Middle Eastern people to prohibit pigs because these animals were physiologically ill-adapted to the region's climate. People there were better off finding a way to resist the temptation to consume pork, he argues, and so the creation of the taboo on pigs allowed them instead to invest their energy and resources raising more suitable and productive animals.

The second school (symbolic interpretation) has emphasized, in contrast, the role of food taboos in maintaining the integrity of cultural categories and systems of meaning (Douglas, 1970). Douglas has argued that all people divide up the world and its contents, including its animals, into mutually exclusive categories. Such classifications lend coherence and system to the way members of a society order their experience.

These material and symbolic approaches thus indicate widely divergent interpretations of people's behaviour towards animals, though both schools agree that individuals are often not conscious of the "true" reasons behind their conduct. Indeed, as both Harris and Douglas note, followers of a cultural tradition often seize on secondary rationalizations, such as health concerns, to explain their tabooed beliefs and behaviours.

Gender-specific restrictions or taboos on animals form another common pattern. Among the Pedi of South Africa, 12 of the 37 species of wild mammals found in the area can only be eaten by men or boys (de Vos, 1977). Sometimes certain animals, such as rodents, are thought to be "impure" and are avoided, especially by pregnant or menstruating women or by girls at puberty. For this reason, women from some groups in Senegal do not eat bush rats during pregnancy. Among the Evodoula of Cameroon, pregnant women do not consume palm squirrels. The taboos imposed by some sub-Arctic peoples, forbidding women or dogs to eat the bones and flesh of certain animals, are viewed by them as an act of respect for those animals'spirits (Henriksen, 1973; Tanner, 1979).

Age as well as gender figures in some societies' wild animal consumption patterns. In parts of Zimbabwe, certain rodents are consumed by adults but not by children (de Vos, 1977). The Tsembaga Maring of New Guinea place various restrictions on the wild animals that men and adolescent boys can eat but impose no such taboos on mothers and children, effectively channelling most wild animal protein to the people who have less access to domestic meat (Rappaport, 1968). Among various communities in Zaire, a large number of species cannot be eaten by children and women, while some animals are reserved for older men (Pagezy, 1988).

There can also be some rather complex systems of taboos among peoples whose main food source is wildlife. For example, there may be guilds of hunters that specialize in certain types of prey or are subject to particular kinds of restrictions. In the case of the Valley Bisa of Zambia, the hunter's ability to placate the spirits of the game animals can determine which animals he is allowed to capture (Marks, 1984). The Sabuna of Brazil have very complicated systems in which people's age, sex and even number of children influence what kinds of animals they are allowed to consume (Taylor, 1981). Other taboos affect only the behaviour of specific individuals. For example, among the Etolo of New Guinea, a successful hunter cannot eat the animal he kills (Dwyer, 1974). The Hare of northern Canada require a successful moose hunter to give the slain animal to someone else in order to avoid incurring the envy of others (Savishinsky, 1994). Among the Cashinahua of Amazonia, individuals may choose to classify animals as edible or inedible for highly idiosyncratic reasons, such as a personal encounter with an animal in a supernatural experience (Kensinger, 1981).

Project planners and managers need to examine carefully all taboos and related beliefs, and to avoid making assumptions that ignore cultural variation within an area. To assume that one group's taboo on a particular type of fauna is shared by neighbouring peoples, or even among members of the same family, may cause community forestry planners to shun species of wild animals that might otherwise be excellent candidates for development projects. This point is particularly relevant when outside influences have combined to make previously forbidden foods acceptable, as with deer in the tropics (Redford and Robinson, 1987) or when previously acceptable foods have been discarded, as with mice and rats among the Maraca of Colombia (Ruddle, 1970).

Ceremonial uses of wild animals

Tradition not only prohibits the consumption of some animals, it also defines situations in which the use of certain animals is necessary or even indispensable. At a birth, death, marriage, coming-of-age ceremony or other highly significant moments in the social life of a community, the flesh, blood, skin, teeth, bones or other parts of animals may be required for the correct fulfilment of a ritual. Groups in China, as well as Native American groups, for instance, utilized deer scapulae in important divination rituals to guide various activities (Moore, 1957). The animals or body parts used in such ceremonies may be collected by family members, or bought or traded. For example, distribution of game at the time of a girl's first menstruation is vital among the Etolo of New Guinea (Dwyer, 1974) while sloths, not normally hunted otherwise, are essential for the "ceremony of the singing souls" among the Matses of Colombia (Romanoff, 1983).

Various African and Native American peoples celebrate, as a rite of passage, the first slaying of a large animal by a young man (Tanner, 1979). The most important ritual among the Naskapi of eastern Canada, *mokoshan*, focuses on the communal sharing of caribou marrow and meat, which emphasizes and renews the special relationship between hunters and the caribou's spirit (Henriksen, 1973). The indigenous peoples of the Pacific Northwest Coast hold a First Salmon ceremony to honour "the first catch from each important stream or area" (Drucker, 1963). Some tribes in this region offer the First Salmon to a sacred eagle to show it respect and to ensure prosperous fishing in the future.

The cultural significance of hunting

Hunting is fundamental to many cultures. The place of hunting contributes significantly to a community's self-definition, a phenomenon noted by anthropologists since the pioneering work

of Franz Boaz among the Chinuk over a century ago. The social role of hunting as a cohesive agent, especially among men but also between men and women (see section on "gender factors" below), may be of equal or greater importance than the actual food returned to the village. The process of distributing game can be essential to maintaining social cohesion through its affirmation of kinship and friendship bonds (Stearman, 1992).

Successful hunters accrue prestige. Several indigenous groups in the Beni region of Bolivia (Stearman, 1992) choose to describe themselves as hunters even though hunted game is not their most important source of food. A similar situation is found among the Dayak of Borneo (Caldecott, 1988).

A number of indigenous northern communities continue to combine hunting with another long-established use of wildlife: fur trapping. Recognition of this pursuit is especially important to a comprehensive assessment of the world's forest resources because many of the most valuable northern animals are native both to the boreal forest and to the transitional taiga-tundra ecozone, which together constitute one of the planet's most extensive forested regions. Economically valuable species, frequently hunted for their fur pelts, include varieties of fox, beaver, muskrat, ermine, lynx, mink and marten.

Medicinal uses of wildlife

Another important socio-cultural category is the use of animals or their products in traditional medicines. The vast realm of Chinese traditional medicine (compiled during the Ming Dynasty in a massive 168-volume encyclopedia) provides some examples: meloid beetles taken internally affect the kidneys; boiled cicada skins can calm migraine headaches and other pains; and mantid broth is given to bed-wetting children (Kritsky, 1987).

Traditional trading in medicines employing wildlife is still practised on many different levels, from local markets to commercial networks of great magnitude. Interestingly, many similar uses are common to widely separated groups. Oils from crocodiles are traditionally used in treatments of respiratory ailments in regions of Africa (Nichol, 1987) as well as Latin America. Preparations of dried poisonous snakes are administered for eye problems in both Latin America and Southeast Asia.

Thus, widespread medicinal applications exist for a variety of animal products, and a great deal more research remains to be done to explore and assess their physiological effectiveness. The potential value of such work for local people and other populations is suggested, in the case of medicinal plants, by recent and often spectacular finds in the better-developed field of ethnobotany. Applied research of this kind with wildlife could support efforts to maintain both the planet's biodiversity and the diversity of indigenous systems of knowledge and economics (Linden, 1991).

Gender factors: effects on traditional and potential wildlife use

Gender is an important consideration in all development and conservation work. While a lot is known about the nature and extent of gender roles with respect to agricultural and forestry planning, participation and decision-making, much less is known about the gender roles of local peoples with respect to management of wild animal species.

The traditional gender division of labour identifies women as child bearers, responsible for nurturing and healing within household and in the community as well. In order to fulfil this socially defined function, women have a special dependence, which often differs from that of men, on the natural resources around them that they use and often manage (Hoskins, 1980). Thus beyond their accepted traditional roles, women are also often the invisible managers and decision-makers within both the private sphere of the household and the public sphere of the community.

To ensure that both women and men are active participants in *and* beneficiaries of local community forestry efforts, it is imperative to consider them as equal partners from the outset. This becomes especially important when considering the incorporation of wild animal species into specific projects or activities. For example, in light of the food taboos examined earlier, one needs to ask whether the animals incorporated in the project will be beneficial to women or not. Will the animals be competing for the same resources used by men and women in the area of a project? Will they menace the home gardens for which the women have responsibility?

Project planners need to be aware of the various different and complementary tasks performed by women and men. In particular, adding one more chore to women's already heavy workloads could result in the failure of the project if there is no one to perform the added duties that women were unable to perform. As Hoskins (1980) and others suggest, it is important to consider the role of women and men in planning, participating and benefiting from forestry activities. Hoskins illustrates this point with an example of Kenya beekeepers: it was found that a beekeeping project in that country was receiving no support from women, until the project director realized that it was culturally unacceptable for women to climb trees and so they were not able to reach the hives. Once hives were placed close to the ground, the women became willing participants.

Women and men in rural societies interact with wildlife in other important ways. Studies of traditional gender roles with respect to forest utilization have yielded information on women as gatherers of forest products (usually non-animal products or small animals such as insects) and on men as the hunters of the larger wild animal species. Although men are the primary hunters of large game, women are frequently involved in the catching, butchering and transporting of animals, as well as in the cooking and preservation of their meat. In indigenous communities in sub-Arctic Canada, for example, it is usually women who snare or trap small animals, such as rabbits, for food and fur; it is they who clean, dry and smoke meat and fish; and it is they who scrape, clean and tan hides for clothing and rawhide (Helm, 1981). In Zambia, although women rarely joined men in actual elephant hunts, they performed many vital activities as part of the overall elephant exploitation process.

In other cases, women are the primary procurers of certain animals, despite being restricted to particular technologies. In many indigenous groups in Latin America, for example, fishing with bows and arrows, harpoons and hooks is the responsibility of men, but the use of nets, basket traps and poison fishing is frequently assigned to women and children. Women also identify and track animals in some societies, though this is another important and often overlooked female activity (Hunter *et al.*, 1990). In Nepal men always control the cast nets whereas women catch the same species in wiers.

Women's vital role in stabilizing local economies through flexible and adaptable marketing activities can also be greatly enhanced through access to wildlife as one more option in times of food scarcity.

Effects of market involvement

The effects of market involvement on local wildlife populations and the humans who depend on them are varied and complex. The trade of wild animals generates income and employment, for example, and it has the potential to help manage and regulate herd size and wildlife populations. These are useful by-products of wildlife marketing. On the other hand, poor management and overharvesting are two typical examples of the problems that can be exacerbated by market forces in wildlife trade. While a thorough analysis is beyond the scope of this study, it is important to mention some of the problems, as well as the opportunities and incentives, created by market involvement in order to find ways in which community forestry activities could maximize the positive aspects and minimize the negative impact of this involvement.

Market effects on subsistence hunters

Subsistence hunters, like most other subsistence producers, are being drawn into the market economy, integrating into their livelihoods many consumer goods that can only be obtained with cash or cash substitutes (barter). They enter into a system based on manufactured items, and they swap their game yields for trade goods. Active local markets develop with the growth of rural populations, and the wild animals sold by the hunters become consumer goods for urban populations as well. Non-hunters consume a broad range of wildlife products, most important of which are wild animal meats, which they often prefer to livestock meats. Some types of wild animals are also commodities in international markets, such as those that supply fur, or those in demand as pets or collectors'items (such as butterflies). The combined local, urban and international demands produce market pressures that can - in cases of localized, poor management of harvesting - accelerate the problem of wildlife depletion.

One situation in which this can occur is when hunting groups, in pursuit of trade items, become involved in raising cash crops or domestic animals to provide easily marketed goods. This leads to dramatic changes in lifestyles as these groups become more sedentary to spend time tending crops. Localized game depletion resulting from overhunting can become acute as previously nomadic or wide-ranging hunters change location less frequently but continue to hunt.

A different reaction to market involvement, which is less likely to produce problems of species depletion, is the evolution of cooperative arrangements between certain hunting groups and settled farming populations, allowing the hunters to rely on game meat to provide their trade needs. For example, the nomadic Mbuti of Zaire have developed an interdependent relationship with local swidden agriculturalists in which the Mbuti provide meat and other forest products in exchange for tobacco, iron implements and cultivated crops (Hart, 1978).

In a similar system, Agta hunters in the Philippines trade fish and game with Palanan farmers for carbohydrate foods. Up to half of the meat procured by hunter groups is traded for domestic cereals, while the farmers depend on the Agta for meat and fish. Hunting also provides a protective service to the farms, since deer and wild pigs damage fields (Rai, 1990).

Transactions in which cash is used generally increase with time, particularly as meat traders become involved in the bushmeat market and buying for the local urban markets. Again, in the case of the Mbuti, traders who used to exchange rice or cassava flour for game meat increasingly use money as payment, to the advantage of both hunters and traders. Traders obtain less complicated

At a roadside market in Ghana, hares, giant pouched rats and cane rats are traded or sold.

transactions and credit repayments, and the Mbuti are able to save money for the future and transport it easily (Hart, 1978).

The profits of cash transactions are used to purchase perceived "necessities" such as manufactured goods, sugar, coffee, or alcohol, or a high prestige item such as tinned meat. One case illustrative of the irony in some of these situations, described by Mandujano and Rico-Gray (1991), is that of some Maya hunters in Mexico who hunt white-tailed deer to sell the meat, primarily due to "the lack of enough money to buy pork."

In general, wildlife marketing helps to fuel the local economy and raise the incomes and living standards of subsistence hunters and rural communities. Hunters generally find ready markets, driven by urban demand. Wild animal products have great value compared to most agricultural goods and are more easily sold, and thus they are worth transporting over long distances. Hunting is not only the domain of traditional or subsistence hunters: settled farmers also very often hunt and sell game for supplemental income. Several levels of middlemen, processors and transporters are also involved in the wildlife marketing chain. Hence where wildlife meat markets are firmly established, the production and sales provide work and income for a large group of people.

It is important to recognize, however, that market hunting has often had detrimental consequences on local wildlife populations, primarily because this type of hunting can cause the harvest of certain animals at unsustainable levels. This problem needs to be addressed through the development of sustainable wildlife management systems, and community forestry activities can play an important role in this area.

Besides the problem of species depletion, the sale of wild meat often carries other less evident costs. Where incentives to generate cash are powerful, the nutritional status of hunter communities may be compromised by the sale of needed game meat for the purchase of non-edible goods or low-protein foods.

A more subtle effect of market pressure to sell hunted game is the disruption of mechanisms important to social cohesion in some traditional societies, such as sharing hunted meat through established rules which are not applied to the distribution of purchased food (Saffirio and Hames, 1983). In the case of the Mbuti, it is monetization that has produced some social problems, since the members of this group, who generally share all material possessions, do not share money (Hart, 1978). This has the effect of further impoverishing those who are poor. Market hunting may also induce the killing of tabooed species. Taboos are elements of social cohesion and regulation, and strong external pressures (such as market pressures) to go against the established order and break taboos are detrimental to the social harmony of hunter communities.

Urban demand

Urban populations in developing nations have shown rapid rates of increase over the last few decades. In addition to high birthrates, a major factor in this expansion has been migration from rural areas. This recent transition from rural life partly accounts for the fact that urban consumption of wild animal products in developing countries usually far exceeds that in industrialized countries, where city dwellers consume wildlife products less frequently. The newly urban population, which has been recently removed from a rural setting, often retains a preference for forest products, including wild meat, which it is no longer in a position to obtain for itself. Urban demand in these cases can quickly grow to levels that outstrip the ability of the surrounding environment to maintain the desired species, and alternative harvesting and management methods need to be developed to avoid provoking the extinction of these species.

Estimating the extent of trade in wildlife meat

Studies conducted in Africa have shown that the sale of bushmeat in some cities is very significant, and numerous species can be obtained freely in the markets. The meat is often preserved by smoking, allowing it to be transported long distances for sale at far-away markets. These studies show a general trend towards price increase over time in the region, reflecting increased

demand and dwindling supplies (Falconer, 1990). Urban-driven trade in these products in Asia and Latin America is also high.

However, estimating total wildlife trade is very difficult and few comprehensive studies have been undertaken. Most small species require no permits, hunting them is not controlled by government authorities, and consumption is not tallied by statisticians. Market surveys are often used to gauge the intake of large populations and to record the species consumed, but the resulting data, which tallies only the species sold, can be biased and lead to incomplete conclusions.

For example, thorough surveys in Zaire by Colyn *et al.* (1987) have shown that 77.5 percent of all the duikers (mammals the size of small pigs, highly prized for their meat) captured reach the market for sale, while only 13.7 percent of the miscellaneous small game is sold at the public markets. The majority of this other game remains within the community, traded or exchanged locally or consumed within the household, and this generally remains unreported. Thus, in this case, a survey of market sales would not reflect trade patterns on a broader scale. Market surveys may indicate numbers of animals disproportionate to their actual presence in trade.

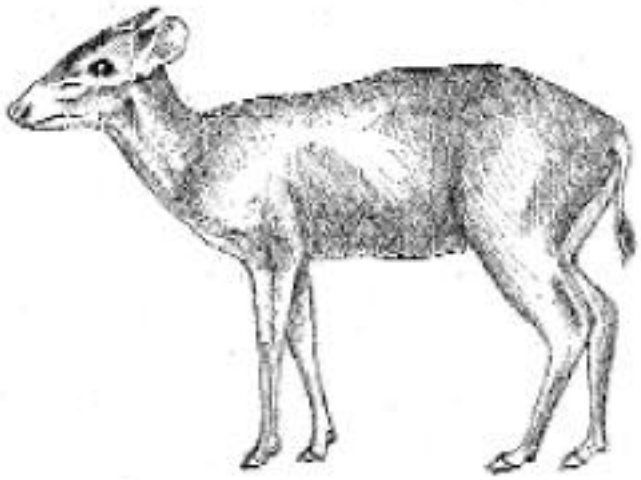
In spite of the limitations of such data collection, it can be used conservatively to illustrate the magnitude of trade. For example, a study of a single market in Accra, Ghana, traced the sale of 157 809 kg of bushmeat from 13 species in 17 months. This was valued at an estimated US$ 159 976, and the study did not include all transactions at that market (Aisbey, 1974). Data from 15 years (1970-85) of transactions at another market in Accra, the Kantamanto market, showed an average annual sale of 71 000 kg of bushmeat, representing 14 400 animals (Falconer, 1990).

International markets

Market incentives working on an international scale can also be very powerful at the local level. These markets are usually for non-meat products, such as furs, and they can rise and fall quite dramatically with the whims of fashion or the health of far-away economies. Various luxury and medicinal products are also highly valued on international markets. If given a high market value, species may be taken solely for various body parts. Hunting of many of these species is illegal under both national and international laws, but the extremely high value of certain products makes bans on hunting and trading them very difficult to enforce.

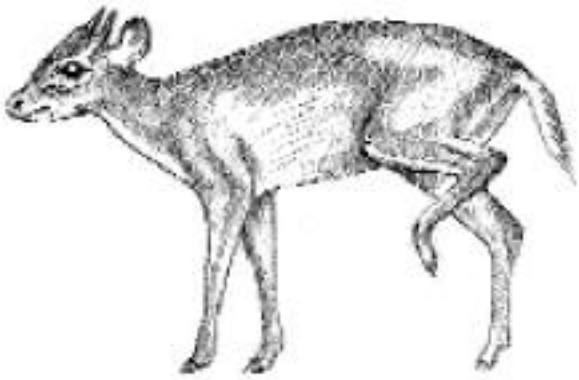
Rhinoceros, for example, are usually killed only for their horn. Horn from Asian rhinos, used in various medicinal preparations in East Asia, was reported in 1985 to be selling for as much as US$ 4 090 per pound (Fitzgerald, 1989). Elephants are killed mainly for the ivory in their tusks, and musk deer for the tiny amount of musk produced by the males. High value encourages poaching and continued hunting of these species despite diminished populations. This trend has been seen repeatedly on a large scale with certain valuable species such as crocodiles, elephants and the spotted felines (leopards, etc.), although international controls do appear to be having some limited effect in recent years.

The international pet trade is also very active, and quite lucrative. Bird fanciers pay very high prices for species of the parrot family (*Psittacidae*). Some individual birds sell for US$ 10 000 or more, and this fuels a large and partly illegal market. Up to 500 000 parrots may be traded annually on the world market, the majority being caught in the wild. In spite of significant levels of illegal capture and sales, the legal trade also operates lucratively: 312 467 parrots were imported legally to the United States in 1985, with retail sales valued at US$ 300 million (Fitzgerald,



Black-fronted duiker
(Cephalophus nigrifrons)

Blue duiker
(Cephalophus monticola)



Yellow-backed duiker
(Cephalophus sylvicultor)

1989). Similarly, international trade in tropical insects (mainly butterflies) for collectors is both active and lucrative.

Community forestry and wildlife markets

Many opportunities exist for community forestry to take advantage of existing legal national and international markets, and also for it to contribute to the regulation and rationalization of market hunting. Integrating hunting or raising of wildlife for meat into community forestry projects as an income generating activity is both feasible and advantageous. Supporting and encouraging community integration into marketing systems through training, marketing information systems, infrastructure development, or development of product processing and preservation techniques are some of the ways in which community forestry projects can promote income generation through wildlife markets.

The particular role of community forestry in the development of these activities would be to find ways to support wildlife management for sustainable harvesting to supply market demand. Sustainable resource management systems are badly needed in the area of wildlife for the marketing of meat. Community-based natural resource management, central to community forestry, is likely to be the best approach for wildlife management. This should ideally be combined with government policies to help local communities control harvesting (setting limits on extraction for specific species), encourage good management and, where appropriate, assert other controls over the market. Government assistance can also be used for relocation and restocking programmes to replenish supply in depleted areas.

Market hunting or animal raising for high value wildlife products sought by international markets can also be advantageously integrated into community forestry programmes. With appropriate management, many species of high value animals could be produced in community projects for international distribution. The parrots above are one example and fur animals are another. A highly successful community programme in Papua New Guinea supplies a variety of insects (mostly rare and beautiful butterflies) to collectors worldwide, providing an excellent example of a low-cost/high yield system (Hutton, 1985). This is also true for the live ornamental fish trade, with an annual world wholesale market valued at US$ 600 million, of which increasing quantities are bred in captivity (Fitzgerald, 1989).

It is evident that there is a great market demand for wildlife products, and effective management systems, as well as captive propagation programmes, are unquestionably needed. Market incentives clearly affect the course and magnitude of wildlife use in the tropics. The demand for game meat is significant in numerous countries and overhunting has caused many prized species to decline in numbers. The meat and various other products are highly regarded, widely consumed and usually bring high prices. International regulations, recent national wildlife protection laws and dwindling wild populations reinforce the need for controlled management and production. When integrated into community forestry programmes, the hunting, raising and harvesting of wildlife species could be one type of renewable resource management that would provide benefits to the community equal to or greater than other income generating activities, while at the same time providing important benefits at the level of national and international conservation efforts.

Property regimes and wildlife use

Historically, forest-based communities have generally followed communal property rules, with regard both to the land they lived on and to the wild animal resources they used. The customs and institutions that developed around common property regimes usually proved to be viable over the long term from ecological, economic and social standpoints, and they reflected the needs of the local people. Under the effect of rapidly spreading "modernization" over the past few decades, these traditional rules regarding tenure and natural resource use have undergone considerable change in most regions of the world, often losing much of their responsiveness to address overuse and social rules of distribution. In spite of these significant changes, however, contemporary community forestry, concerned with preserving the diversity of the natural environment while improving the welfare of local communities, still needs to consider the relevance of the various traditional forms of property management, particularly to productive and sustainable wildlife use.

Wildlife use and wildlife management

When considering the problems of ensuring the sustainable use of both forests and wildlife, it is important to make a distinction between the *use* of wildlife and the *management* of wildlife. "Management" in this context has to do with how species are controlled or directed as a resource, while "use" refers to the functions these species serve or the uses to which they are put. The distinction between "use" and "management" of wild animal species is critical when assessing their integration into community forestry activities. For community forestry to incorporate wild animals, provision must be made for their *management*, not merely their use.

Relatively little is known about the rules that govern the ownership and use of wildlife in local communities. These rules and the corresponding property regimes in local communities are important factors because ownership will determine who is allowed access and who actually benefits from an enterprise. People will not willingly participate in activities whose benefits do not accrue to them. Ostrom (1990) suggests that in order to apply management principles, it is important to make a distinction between a *resource system* and the flow of *resource units* produced by the system. Resource systems are "stock variables," capable of producing a certain maximum quantity of a flow variable without harming the resource system itself. Examples might be fishing grounds, irrigation canals, pastures, or communal forests and the wildlife they contain. Resource units, on the other hand, are what is taken from such a resource system: the fish from

the fishing grounds, the water from the irrigation canal, the fodder consumed by animals in a community pasture or the wildlife from a communal forest.

This model helps clarify the two keys for sustainable management: the *protection of the system*, that is, of the lands, resources and ecological conditions relevant to the system's sustained productivity; and the *maintenance of the flow* of products, profits and benefits taken from the resource system. Both must be carefully and continually monitored to ensure that sustainability is achieved. In a renewable resource system (such as a forest) long-term sustainability may be assured if the rate of withdrawal of resources, including wildlife, does not exceed the rate of replenishment.

Traditional use, where regulated by custom and taboo, is often geared to the sustainable, long-term management of wildlife resources. These traditional customs, however, have been partially or completely abandoned by local communities as populations have adapted to such new conditions as changes in tenure regimes, incentives provided by markets and pressure from increased population densities. It is now common to see both damaged habitat and "wildlife overuse," that is, use without regard to long-term sustainability, resulting in serious negative consequences to local resource systems.

Categories of property regimes

The traditional use and management of wildlife has been regulated by a variety of property regimes. Property is the basic institution by which individuals, communities and other actors are entitled to the benefits derived from a given resource and by which they may deny these benefits to others (Bromley, 1986). Conventionally, other than individual ownership, three distinct types of property rights are recognized: common, state and open access.

Common property

Many community forestry activities occur within the context of common property regimes, where ownership is communal and access is determined by the larger community. A common property regime can include indigenous reserves, properties owned and managed by a rural community or any resource for which management authority is invested in a group rather than in separate individuals. The rules and regulations governing the use of common property have both spatial and temporal components. Differential access to resources pertains to different community members at different times, depending on what part of the communal managed lands they occupy, what crops or animals they raise, the amount of water to which they have access and numerous other considerations. In a common property regime, local populations clearly define the individuals or households that have the right to use the resource units from the community forest. Such access may be limited by sex, age or other socially defined factors, including restricted use except by special individuals such as shamans or curers. In addition, local user groups may negotiate the rules that regulate the time, place, technology used and quantity of resource units in a particular setting.

Among the small-scale, tradition-oriented communities common in the tropics, access to wildlife is very rarely private property, falling instead under common property regimes, at least in part because most wild animals are fairly mobile. Even when a group claims access to game in specific forest areas and denies hunting rights to others, access to the wildlife for their members is

very often communal and not considered private property. Different norms and regimes for using forest resources are followed under different situations.

In most parts of Papua New Guinea, for example, the people are the traditional legal owners of land and wildlife. Among the Maring hunters of the highlands, clan clusters are the units that have rights to the wildlife resources in an area; members of other local groups have no rights over these resources except under special circumstances. Travellers may shoot game of little value if they do so along defined travel paths. Anyone from another clan found straying from paths is considered a poacher (Healey, 1990).

While the boundaries and complex rules of a common property system might be clearly defined for the local community, the surrounding society may often fail to recognize the legitimacy of such regimes. For this reason, common property regimes are often vulnerable to alterations in the rules of access and ownership by outside interests, most often the state. Common property regimes often break down due to ecological change, land shortages, emergence of market economics or other outside forces, and resource sustainability is often put at risk, resulting in resource use conflict. In these situations, it is important that new, locally compatible management strategies evolve, based on the principle that local benefits are necessary to encourage local cooperation and participation.

State property

In a great many countries of Latin America, Africa and Asia, wild animals are protected in national parks, national forests or wildlife reserves, which are all lands designated as state property. This often equates to a complete legal prohibition of wildlife use, except in some cases where regulated use of wildlife is permitted (West and Brechin, 1991). These may include hunting in buffer zones around core protected areas, subsistence hunting rights for indigenous groups and special hunting days or seasons in which normally closed lands are opened.

Whatever the accommodation made, the relationship between the state and local people over the use of wildlife is often one of conflict. In many cases, traditional hunters have been reclassified as poachers, especially in parks and reserves. Such conflict occurs especially where state properties and the common property regimes of tribal and rural peoples are in close proximity to one another.

Conflicts also arise when rights and responsibilities are not well defined. Hunting prohibitions are commonly imposed by governments for larger game animals or for protection of endangered species. When damage occurs to crops or dwellings, which can be considerable with species such as elephants or buffalo, it is often illegal to kill the offending animals. Compensation mechanisms for crop damage are frequently non-existent, turning community sentiment against the government and conservation policies. This is especially true if the community derives no direct benefit from those policies, such as a proportion of the fees paid by tourists and professional hunters or of fines levied on poachers.

Open access property

In open access resources the rights to the resource are undefined and its use unregulated, and no limits or restrictions are placed on who uses the resource units. This situation is in theory rare, as resource use is normally governed by common or state property rules and regulations at the local level. It is usually the breakdown of common property systems that engenders open access sys-

tems, eliminating regulation of individual use of wildlife and sanctions against overuse. This breakdown is frequently initiated by governments establishing new rules which they are unable to enforce but that negate the old rules at the same time. Such breakdowns can seriously threaten resource sustainability, including wildlife survival. In many cases where market hunting is taking place, wild animals have become an open access resource (Wilkie *et al.*, 1992).

Private ownership of wildlife

Private ownership of free-ranging wildlife in the tropics is extremely uncommon. In many cases, the state government retains actual ownership of the national wildlife resources regardless of other property regimes that might be in effect. In some cultures, wild animals are seen as free goods from nature, but generally they are viewed as a resource that is not subject to ownership. There are two kinds of exception to this general rule. First, an individual might capture an animal. In this case, the animal is often treated as if it were domestic stock, raised as a pet or for future slaughter. Second, ownership of an individual wild animal, in most indigenous societies, is generally established once it is hunted and killed. A common responsibility of this form of "ownership" is to oversee the distribution of meat, an activity that follows strict social guidelines.

In one variation, ownership of a hunted animal among the Aka of the Central African Republic accrues to the owner of the weapon that killed it. Parts are distributed to other hunters according to their role in the hunt and according to weapons used in the kill. Each hunter then distributes the meat among his family members according to a well-defined system (Bahuchet, 1990). In another variation, hunters may be restricted from consuming their own kill but receive meat from others. This taboo, extended to many game species for hunters and their family members, is applied by the Ache in Paraguay (Hill and Hawkes, 1983).

Governments may sanction similar "ownership rights upon death" in the form of hunting licenses. Individual animals are not indicated, but the number of animals that may be taken is usually specified. Under regulated conditions, governments may grant large-scale use rights to an individual or group.

In some countries, wildlife on private land may be considered the property of the landowner. For example, wild species may be fenced and held captive for use, as in the case of antelope maintained on game farms in South Africa and Zimbabwe. Such ownership resembles that of domestic stock. Under other circumstances, free-ranging animals may be taken while on private property. Wild caiman, for example, are harvested from cattle ranches in Venezuela. This represents a seasonal and transitory "ownership" as the animals are not confined.

Issues are not as clear-cut when defining wildlife ownership on communally held lands. People in pastoral societies using communal grazing lands easily identify their personal domestic stock. But wildlife presents very different problems. Individual animals are not recognized and personal ownership of free-ranging wildlife is usually an alien concept.

The hazards of privatization

The relationship between private property and resource management is a subject of great controversy. All property that is not 'open access'has either been controlled by the state or "privatized"

by individuals, families or groups. The controversy focuses on individual vs group ownership. For forests and pasture the debate is even more intense as these resources need to be managed in large units to obtain the habitat and other environmental benefits. Neoclassical economists argue that common property degradation can be avoided by individual-level privatization and blame resource depletion on the lack of individual control. However, individual or family-level privatization can produce very negative effects. Large landholdings may be shifted from common use into the hands of a few, creating a system of unequal distribution of wealth. Degradation of the reduced resources available to those excluded by the privatization may be further accelerated. Increased predatory exploitation is sometimes the result of private property resource use. "Rational use," in the economic definition, may dictate rapid and destructive exploitation for maximum short-term profits, if quick turnover and reinvestment are the goals. This has proven to be especially true for small individualized patches of forest and the wildlife dependent on them.

Governments may regard land without formal private ownership title as neither owned nor managed. One consequence of this has been that, in recent decades, extensive areas of untitled land in some countries in the tropics have been deeded in colonization or resettlement programmes to the landless poor. Requirements for establishing ownership may include activities such as felling the forest. In this manner, many resources that were once collectively managed have been degraded, including wildlife.

Community forestry activities should help buttress common property management by lending institutional support. Before any intervention, local communities and project planners need to consider how a new system can care for the whole group and avoid leaving the local community out of the benefits from the initiative. This applies as much to wildlife use as it does to other forms of natural resource management.

Assessing the alternatives for incorporating wild animal species into community forestry activities

There has been much discussion concerning which method of interaction with wild fauna is best suited for incorporation into community forestry and other types of development projects. This chapter examines the variety of ways in which humans can utilize wild animal resources. Appropriate nomenclature is defined and a set of decision criteria is provided together with an example of a possible activity prototype, to assist field officers in their efforts to construct activities that will incorporate wild animal species.

Classification of nomenclature

Humans interact with wild animal resources in a variety of ways. At one end of the continuum is the hunting of wild animals and at the other end there is harvesting of confined, domesticated species. In between these two extremes, a variety of terminology is used to explain the different approaches. Terms frequently used are "farming" and "ranching," variously modified by the terms "semi-intensive," "extensive" and many others. It is important to review some of this terminology to help avoid confusion.

One of the more useful classification systems is that proposed by Hudson (1989). Based on an analysis of the ways in which humans utilize ungulates, Hudson has proposed four different categories. The four types are described below.

Hunting: the harvest of essentially wild populations for subsistence, commercial or recreational purposes. In a hunting system, proper management involves correctly estimating maximum sustained yield.

Herding: systems in which animal distributions are critically controlled by behavioural modifications, such as luring, habituation, taming, etc. Reindeer are managed in this way.

The next two types are both systems in which animal movement is restricted by physical barriers. Containment systems occur along a gradient from extensive to intensive husbandry, with ranching at one end of the continuum and farming at the other.

Ranching: management of populations that are fenced but otherwise managed as wild animals. Unlike the hunting systems, the individual animals are operationally owned by the enterprise and

are isolated by fencing from wild animals. Usually an assemblage of wild species is managed on natural vegetation, and they are harvested in the field. This system is most developed in southern Africa (Skinner, 1989).

Farming: a variety of intensive husbandry options for wild species on fenced properties, which can involve supplementary feeding, controlled burning and veterinary treatment. Farming can be further described according to the intensity of human involvement in species management.

1) Semi-intensive system: similar to ranching - animals live in large fenced areas of natural habitat with access to a permanent source of water. The fence restricts movements of the animals, excludes terrestrial predators, large herbivores and poachers, and facilitates the capture of animals.
2) Intensive system: animals are closely confined in corrals similar to pig breeding operations, and they are provided with forage, a pool and some shade.

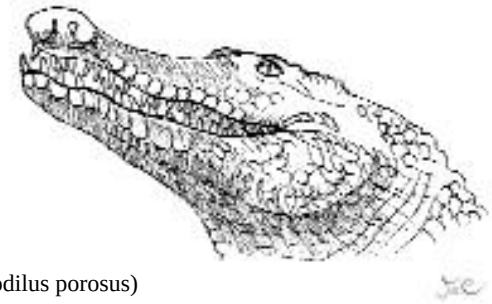
The most intensive type of farming system is "confinement rearing" as practised in zoos, but it is rather uncommon unless for highly valued products such as musk and velvet antlers (Hudson, 1989). In this system, wild animals are managed, handled and slaughtered in similar ways to domesticated livestock (Drew, 1989).

There can be some overlap of management procedures, using both hunting and captive rearing to procure a sustainable harvest. Good examples of this flexible management are the green iguana and crocodiles.

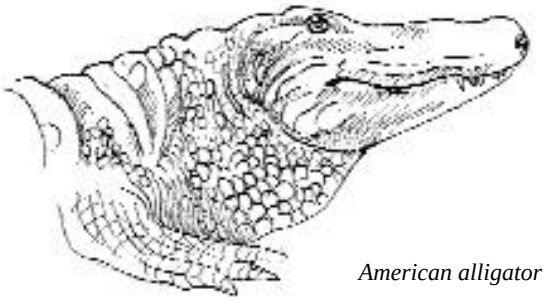
The green iguana (*Iguana iguana*) is a popular game animal in Central America and has become very rare over much of its range. In a project described by Werner (1991), eggs from wild females are "hunted" or collected from the wild and incubated in captivity. The young are raised in captivity until they have grown large enough to avoid many of the dangers that face young wild iguanas, whereupon they are released to continue growing in the wild for subsequent human harvest. With egg-laying animals it is possible to secure eggs from the wild without directly affecting the ability of reproductive females to give birth to future clutches.

In the case of crocodilians (caiman, alligators, gharials and crocodiles) farming has been confined mainly to large-scale private operations. However, there have been experiments in New Guinea to develop community projects that could be extended to other parts of the world. In a combination of hunting and ranching, the young crocodiles are taken from the wild populations and reared in captivity to slaughtering size. The aim is to ensure a sustainable-yield harvest, in contrast to the direct hunting and harvest of commercially sized animals from the wild. Farming crocodiles, on the other hand, involves the captive propagation and rearing of animals: a breeding population must be maintained in captivity, unlike ranching the where the breeding population is wild.

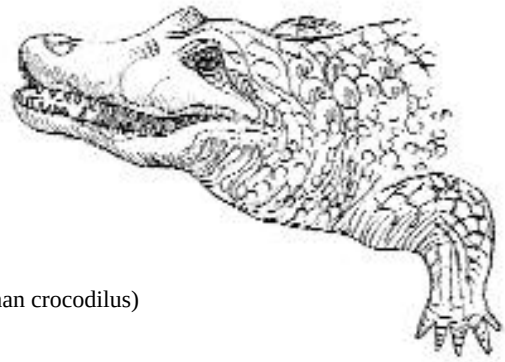
Domestication is another term that needs to be clarified. Hudson (1989) has argued that the term "domestication" should be reserved for the process that results in genetic adaptation of animals currently controlled by man and that there must be detectable differences between domestic species and their wild progenitors. By this definition, a species is not domesticated simply by being raised like conventional farm animals, even though the process may eventually lead to domestication. In Hudson's words, domestic animals are husbanded rather than hunted, produced rather than procured.



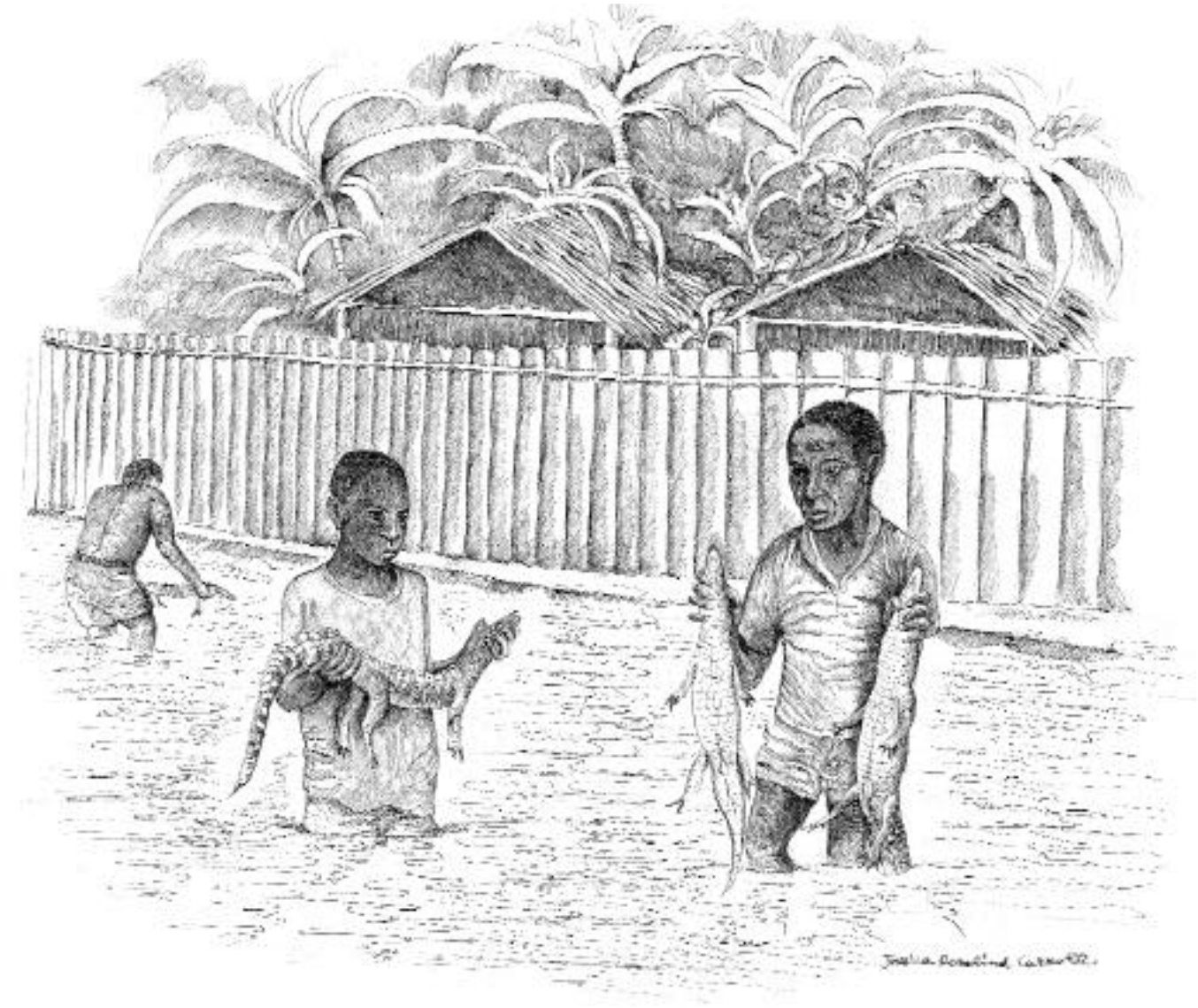
Saltwater crocodile (Crocodilus porosus)



American alligator (Alligator mississippiensis)



Spectacled caiman (Caiman crocodilus)



Crocodile farming in Papua New Guinea. Young crocodiles taken from the wild are raised in special enclosures in villages. When they reach a certain size, the crocodiles are sold to local ranches, where they are reared to slaughtering size.

Eltringham (1984) adds to this by noting that farmed or ranched species are no longer truly wild and represent an intermediate step on the way to domestication. This author states that "no animal should be considered domesticated unless it breeds readily in captivity and its owner has some control over its reproduction. It is necessary to distinguish between domestic animals and those that are merely tame, for the fact that a wild animal can be tamed is no guarantee that it will make a suitable domestic animal."

Other relevant terms include *culling*, defined as the reduction of a wild population perceived to be overabundant, and *cropping*, which refers to the removal of wild animals for economic reasons.

Soft management

Increasingly, researchers are beginning to realize that the distinction between wild and domestic species (of animals or plants) is not as clear-cut as once thought. Humans have been manipulating wild species for millennia and careful research has shown many cases in which indigenous

people engage in "partial domestication," which could also be referred to as "soft management." Most of the literature documenting this type of practice is concerned with plants. Alcorn (1981) points out that "agriculture is only one type of plant management, and domestication is only one of the processes to which people submit plants." Soft management practices for plants include slashing, neglecting, sparing, protecting, transplanting or planting. The result of these activities is such that what may appear to be undisturbed forest to the uninitiated observer, can in fact be a vegetation formation in which species composition and distribution are largely a product of human action. Balée (1989) refers to these types of plant communities as "cultural artifacts."

It is becoming increasingly clear that animal communities have also been affected by humans in ways that have not traditionally been thought of as management. Though such practices are often even less clear-cut than in the case of plants, they are evident throughout the world. Perhaps the most obvious method is the use of fire to increase hunting success by either making hunting easier through clearing, attracting game animals to the areas of regrowth, or increasing the carrying capacity of the environment for certain game species. Deliberate burning practices of this type have been documented in Australia, New Guinea, southern Africa and Central and South America.

There are many other examples of soft management of wild animal species. The indigenous peoples of the Amazon refrain from cutting wild fruit-bearing trees in gardens in order to increase populations of game animals. Farmers have been known to deliberately plant more crops than are needed in order to provide food for game animals. Other soft management practices include rotation of hunting zones, restraint from killing females, taboos and seasonal movements by hunters. In Zambia, farmers have been known to plant trees around their houses because they seasonally host a highly appreciated caterpillar.

It should be noted here that since cause and effect for many of these practices have not been quantified, it may turn out that some of the techniques simply make animals easier to kill, rather than actually influencing breeding patterns or increasing production rates.

A case study of contemporary soft management: satellite camps and the Yuquí of Amazonian Bolivia

The traditional practice of leaving fruiting trees in gardens in order to attract game animals was used by Redford and others together with the Yuquí as a basis for the development of an agroforestry project that incorporated wild animals (see Redford *et al.*, 1992). In the case of the Yuquí, the major factor responsible for decreases in game yields appeared to have been a recent unwillingness on the part of hunters and their families to hunt in areas away from the settlement. The result of this unwillingness was a dramatic decrease in hunting success in an area within about a 10 km radius of the settlement. The objective of the project was to help the Yuquí find a better way to "manage the forest" in order to increase the harvest of game animals and, secondarily, of fruit from wild trees.

The forest management strategy proposed the creation of satellite encampments to be scattered throughout the Yuquí territory. Camps were designed to attract game by planting fruit-trees, while at the same time providing agreeable camping spots for the hunters and their families. The satellite camps or villages were based on agroforestry plantings and incorporated wild and do-

mestic fruit-trees. These trees provided fruit directly to the Yuquí and also served to attract and increase the population of important game species, many of which are fruit-eating.

Selection of fruit-tree species for planting in the satellite camps was based on: 1) the food habits of game species; and 2) the species of wild fruits used directly by forest-dwelling humans. Camp sites were identified based on several practical considerations, including spacing between camps and finding locations that were both strategic and agreeable.

Several factors may affect the viability of this type of management system. A system of satellite camps can only be applied in areas of low human population density with large tracts of relatively undisturbed habitat. The satellite camps must be located a certain minimum distance apart. Around each camp there will be an area (approximately 5-10 km radius from the camp) that receives heavy hunting pressure, due to the fact that a person can hunt in this area in the day and return to the camp to sleep. Within a short period of time, this area can be expected to have a lower density of animals than the surrounding forest and to serve as a "sink" into which animals from less hunted areas will move. If the camps are placed too close together, the agroforestry-game systems will attract game animals from only a small "catchment basin" or several overlapping basins; this could cause overharvesting and the eventual extinction of the game population. However, if the "catchment basins" were relatively large, non-overlapping and not heavily disturbed, then a viable breeding population of game could more easily be maintained and the system could be sustainable.

Soft management options

There are many species, including insects in Mexico, turtles in Brazil, snakes in Southeast Asia and forest duikers in Africa, that community forestry projects could consider managing for food production.

Subsistence food production

In the last two decades there has been a great deal of interest in developing ways of increasing human consumption of large rodents like capybara, giant rats and grasscutter rats. A recent publication entitled "Microlivestock" (National Research Council, 1991) devotes a large section to rodents such as the agouti, coypu, guinea pig, paca and several others. However, in this publication as well as many others (cf. Mendes, 1987), the emphasis is on captive rearing, and even domestication, of these wild species. There has been little discussion of management of animal populations in the wild, perhaps because many of these species can become pests and compete with farmers for crops. However, there do seem to be exciting possibilities for developing soft management programmes for large rodents in several parts of the tropics.

An example this type of management can be found in a study of the Runa of the Ecuadorian Amazon, who hunt in the forest and in fallow and active gardens (Irvine, 1987). Though the majority of animals are killed in the forest, fallows are important hunting locations for small (1 kg) rodents like agoutis (*Dasyprocta*). The Runa plant *Bactris* palms in their fallows and actively hunt these fallows for *Dasyprocta* and *Myoprocta*, which are attracted to the palms. In fact, this study found that 72 out of 126 game captures recorded at fruiting trees were at *Bactris* palms.

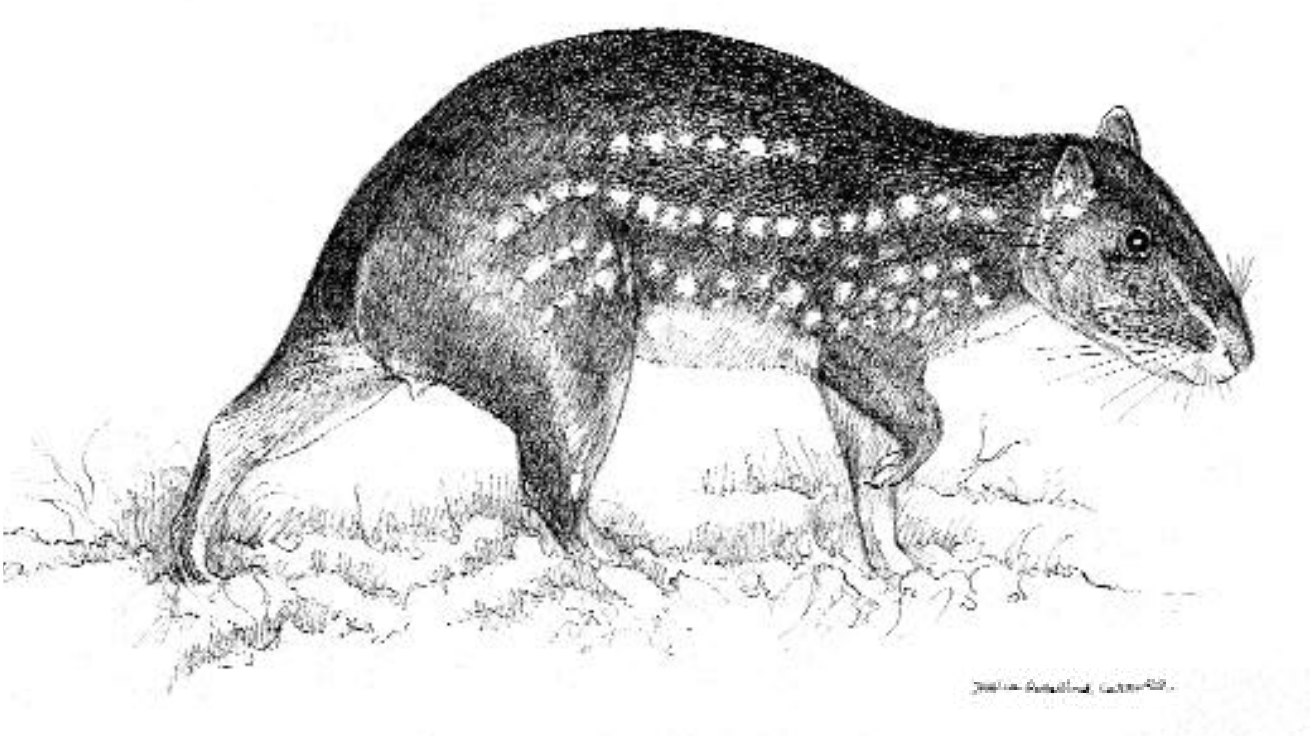
Non-subsistence use of game meat

Up to this point, no distinction has been made between different types of game meat. There are, however, different reasons why people purchase and consume meat from wild animals. At one

extreme are people who either have no other source of animal protein or cannot afford alternate sources. For these people, wild animals from insects to antelope provide an irreplaceable dietary product. At the other extreme are people who consume meat from wild species as a luxury or out of preference. These people are prepared to pay a much higher price for wild meat than for domestic meat or other sources of animal protein such as fish.

When contemplating the integration of wild animal species into community forestry activities, it is important to distinguish which of these two consumer groups is to be targeted. It may be that the economic and opportunity costs of production of wild animals species will only be recuperated if production is oriented towards game meat as a luxury food.

Paca production is an example where this type of cost-effectiveness assessment can be usefully applied. The paca (*Agouti paca*) is a large rodent that reaches up to 10 kg and is ranked as the most preferred game meat in many parts of tropical South and Central America. There have been several projects attempting to domesticate this species, the most successful of which is under way in Panama. However, the slow reproductive rate of the paca and its non-social nature have



The paca (Agouti paca) *is a large rodent, ranked as the most preferred game meat in many parts of tropical South and Central America.*

made domestication difficult. Under very careful and intensive experimental conditions, Smythe (1991) was able to calculate that the cost of production was US$ 4.91/kg for the live animal or US$ 6.44/kg for the meat - what the author of the study refers to as "still very expensive meat." With its consumer popularity as a luxury meat, however, these costs of production for paca meat are reasonable. If viewed as a source of meat for subsistence, on the other hand, the costs are much too high.

Another group of species that might lend itself to production for the luxury market under community forestry projects is that of fruit bats. These species, particularly relished by the peoples of Southeast Asia and the islands of the Pacific, are generally a luxury food, served at ceremonies and in restaurants. By developing management plans for fruit bat populations, local people could garner not only the direct financial benefits from their sale but also the indirect ecological and economic benefits brought by these bats: at least 163 plant species are known to rely to some degree on bats for pollination or seed dispersal, and it has been calculated that these 163 plants produce at least 443 products useful to humans. However, as with most species, there are also costs to farmers in fostering fruit bat populations, and these costs would only be outweighed by sale of bats as a luxury food (Mickleburgh *et al.*, 1992).

Production of game meat for subsistence use and luxury markets through soft management underscores one of the important contributions wildlife can make towards improving human well-being. However, the large animals most often associated with meat production require substantial forest or woodland to support them. Many of the places where community forestry activities are undertaken have only small pockets of forest or woodland remaining, and even those are usually degraded. In these situations, there is a need to incorporate small-sized wildlife, which is often highly productive. Hence it is important to stress the potential of very small species, meaning those of less than 1 kg in weight. There are not many examples to illustrate the rich potential contribution of very small animals, but a few do exist concerning insects.

The commercial production of insects for food

In Southeast Asia, attempts have been made to breed caterpillars of the tropical butterfly *Papilio polytes* for food. These caterpillars grow to harvestable size in 17 days and have a quicker food conversion rate than any other popular animal used for food production. Another example comes from southern Africa, where caterpillars of the mopanie moth (*Conimbrasia belina*) are being raised for food. Annual sales through cooperative markets now amount to over 1.5 million kg of dried caterpillars. Even a caterpillar cannery has recently been established (Lindberg, 1989). Projects under way in Nepal, Mexico and Thailand are exploring ways in which insects may be raised or mass-harvested for local consumption as well as marketing (DeFoliart, 1989).

Though not frequently thought of in this context, there are also many examples of soft management techniques being applied to insects in the wild. In many parts of the tropics, the larvae of large beetles are much appreciated for their high fat content. In order to facilitate the collection of these larvae, suitable locations for oviposition are prepared, left for the females to locate and subsequently visited for the collection of larvae. In a slight variation to this theme, the National Research Council documents how bird-wing butterflies, much sought after by collectors, can be managed. Farmers grow plants suitable for oviposition and collect caterpillars for rearing in captivity. Adult butterflies are obtained immediately after eclosion, at the best moment for sale.

Other projects that may be promising include the development of management procedures for large snails. In addition to insects, other kinds of very small animals may be managed in the wild, as in the case of management of frogs and fish in rice paddies and irrigation canals.

Non-food economic products of wild animals

Although much of the focus of this study has been directed towards the use of wildlife for food, it may be that in certain circumstances this would not be the most advantageous use to which communities could put wildlife.

The pet market

Soft management of wild animals can be directed at uses other than food. For example, even though parrots are frequently eaten for food, they are much more valuable as pets. Parrot nestlings are preferable to adults for harvesting because they make better pets, their harvest has a relatively low impact on wild populations, and they can be harvested in greater numbers. Beissinger and Bucher (1992) discuss ways in which the habitat can be modified to increase the harvest of parrots, including adding nest sites (especially in the form of nest boxes), increasing food supply, protecting nests from predators and deliberate multiple-clutching of wild pairs. They report on work in Venezuela that indicates that management procedures such as these result in increased production by green-rumped parrotlets.

Wild animals and tourism

Wild animals may assume more value to local communities through tourism. Tourists are clearly willing to pay to see animals. Western and Henry (1979) calculate that every male lion living free in the national parks of Kenya currently is worth US$ 2 to 3 million in its lifetime as a tourist attraction. In Amazonian Peru, Munn (1992) concludes that an adult macaw might be worth US$ 22 000 to US$ 165 000 in its lifetime through what tourists will pay to see it in the wild.

There is increasing recognition that for local communities to support rather than resist this type of economic activity, local people must benefit from this "ecotourism." Several approaches have been tried to accomplish this, such as Kenya's decision to charge each visitor staying overnight in a game lodge an extra fee that is then allocated to local communities (Olindo, 1991), and the development of private reserves for ecotourism destinations in Costa Rica (Rovinski, 1991). Local people themselves are finding other creative ways of capturing some of the benefits from ecotourism. Horowitz (1990) describes how 70 landowners in Belize helped develop a management plan for the black howler monkey (*Alouatta pigra*), which is sought after by ecotourists. The Kuna of Panama have set up a reserve that was designed for ecotourism and is to be integrated with "ethnic tourism" (Chapin, 1990).

Wild animals and other luxury products

In many cases, meat may be far from the most remunerative product that a community can obtain from a wild species. The comparative advantage of wild species may lie in the luxury products that can be made from them, such as pictures, fans and musical instruments made from feathers, wings, teeth, bones, elytra, shells and other parts of animal bodies (Dourojeanni, 1985). There is a large international market for what might be termed "display fauna" - animals or their parts that are used to produce luxury goods for display. These might include pictures made from butterfly wings or bird feathers, pinned insects, poison-arrow frogs, aquarium fish and even parrots such as those mentioned above (Redford and Robinson, 1991).

The musk deer (Moschus spp.) *has traditionally been killed to extract the musk it produces in a gland under its abdomen. Musk is one of the most valuable animal products in the world and experiments with sustainable harvesting are now under way with communities in China.*

For some products, there are already well-developed national and international markets, such as for aquarium fish, in which local communities could participate in ways similar to brazil-nut collectors from the Amazon (Clay, 1992). Of particular interest are butterflies, which are sold either as whole specimens, or whose wings are used to make "paintings." It has been estimated that in Brazil perhaps as many as 50 million butterflies are harvested annually for the tourist market (Oldfield, 1984). There is an increasing trend to establish butterfly "farms," designed to produce animals for the display trade, wings for processing or pupae to be sold to butterfly "gardens," a form of live butterfly zoos gaining in popularity in many western countries.

One of the most valuable animal products in the world is musk, the secretion of the preputial gland of male musk deer (*Moschus* spp.). Traditionally, the animals have been killed to extract the musk, but one of the species, *M. berezovskii*, which ranges into southern China and northern Vietnam, is the subject of experiments with communities in China raising captive deer for musk production. Green (1987) has suggested that communities could develop management procedures that would allow the repeated capture of free-ranging deer and the sustainable harvesting of musk. There are apparently already similar proposals to farm civets for their musk in Ethiopia (Anon., 1993).

Wild animals and medicine

The trade in wild animal products for medicinal or magical purposes is ancient and widespread. For example, rhino horn and other rhino products have been traded between East Africa and Asia for at least 2 000 years. Markets throughout the tropics are full of animal products for these purposes, including skins, teeth, bones, bezoar stones, fats and live animals.

In many cases, such as with rhinos, the trade in animal products has endangered the species involved. Such trade is not to be encouraged. However, there should be no reason to prevent local people from developing management plans for other animal species with medicinal values as well as for those with value as food. Such a proposal has been made for southern Africa, where there is an extensive demand by practitioners of traditional medicine for striped weasels (*Poecilogale albinucha*). Farmers in Kwa Zulu and other areas are being encouraged to consider farming striped weasels using techniques developed for mink farming in Europe (Anon., 1993).

Wild animals as sources of genetic improvement

All domestic animals have wild progenitors and there have been suggestions that great advances in the productivity of domestic species may be achieved by cross-breeding with related wild species. This suggestion has its origins in the management behaviour of traditional peoples. For example, in New Guinea some groups release domesticated sows into the forest to be inseminated by feral or wild pigs, while in Southeast Asia some people tether domestic cows near artificially stocked salt-licks in the forest so that the cows will be inseminated by wild guar bulls. This type of management is similar to that of some traditional farmers who allow wild relatives of crop plants to grow near their fields, thus allowing transfer of g
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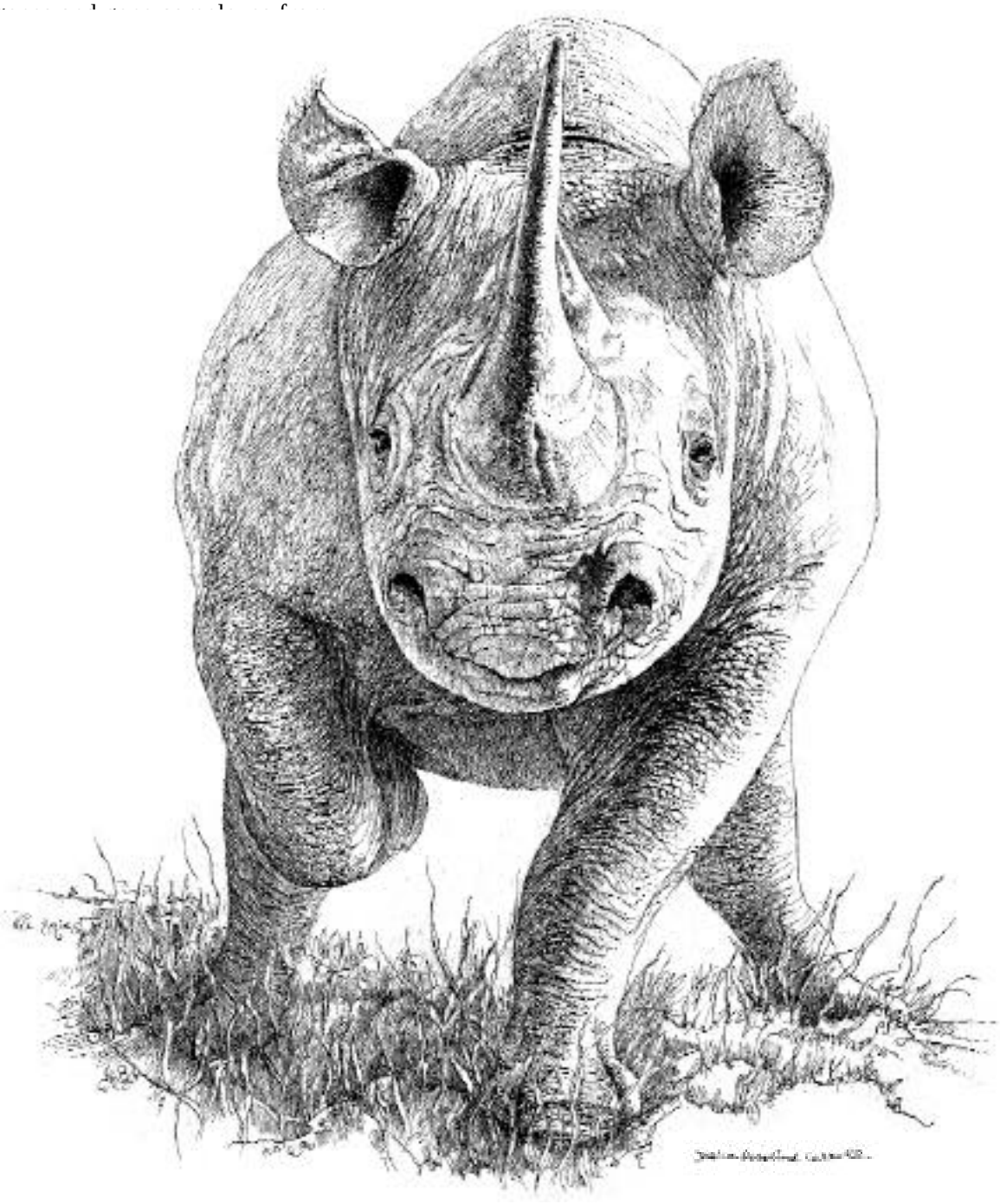


The ancient trade in rhino horn has left the rhinoceros an endangered species.

Negative consequences of integrating wild animals into community forestry activities

As many of the agricultural crops planted by farmers are also appreciated by wild animals, there are occasions when wild animal species compete with humans for food. When an animal species causes major damage to crops, it is called a pest. Pests may be nematodes, grasshoppers, leafcutter ants, mice, various types of birds, pigs, elephants, monkeys, etc.

For example, in parts of Venezuela whistling ducks are major predators of rice (Dallmeier, 1991). Crop depredation by elephants occurs to a varying extent throughout their present range in Africa and Asia, wherever cultivation neighbours an elephant habitat (Sukumar, 1989). In many parts of the Asian and African tropics, fruit bats can cause major damage to commercially grown fruit, particularly when the supply of wild fruits has been reduced through forest loss (Mickleburgh *et al.*, 1992).

In short, in virtually all settings in which humans plant crops close to wild animal habitats, there will be at least one species that is a pest. When communities are interested in integrating wild species into community forestry activities, this competition must be recognized. Some species of animals that would otherwise make excellent candidates for soft management practices or confinement, may have to be excluded because of the potential damage that might result from increasing their populations. This is particularly true of small animals with the ability to rapidly increase their populations or for large animals such as elephants, which are capable of extensive destruction.

Some professionals have also expressed concern about the relationship between captive-bred and wild stocks of the same species. If captive breeding becomes economically viable and international regulations are modified to allow legal trade in animal products from these breeding operations, then a negative effect can be expected on wild populations of the same species. First, it will be difficult to distinguish between wild and captive animals, resulting in the harvest of wild specimens to be sold as captive-reared. Second, without a direct economic link between harvest rates and the sustainable replacement of the wild population, as is required in a hunting or ranching situation, the importance of conserving wild populations and their habitats would become less urgent (Thorbjarnarson, 1991).

Another common practice that leads to problems is the introduction of exotic wild animal species into new environments. It is important to assess whether incorporation of exotic species into community forestry activities will have negative biological side-effects. Virtually without exception, the introduction of exotic wild animal species into new areas has had major negative repercussions on local ecosystems as well as on humans. There have been countless failures, which are hardly counterbalanced by the very few successes. For this and other factors (such as disease transmission from wild to domestic species), it is better to work with wildlife that originates from in and around the local area.

There may also be gender-specific considerations in assigning “pest” status to a wild animal species. In areas where women are in charge of gardens, for example, a species of animal that men would like to manage for hunting could reproduce to levels where its depredation of gardens would significantly decrease production, thus negatively affecting women’s productive activities.

Decision criteria

The purpose of this chapter has been to discuss different ways in which people can manage, harvest and use wild animal species. Some situations indicate that wild harvest from the forest can be supplemented by implementing soft management practices; others indicate that some form of confinement or even domestication would be appropriate.

To harvest species from the wild, without undergoing the process of domestication, several factors need to be considered.

1) Is the nature of the human socio-economic situation such that animals and/or the habitat containing those animals can be owned or controlled?

If not, then strict hunting with sustainable culling is probably one of the few feasible management options. If ownership or control is possible, then management with future benefits accruing to managers is possible. Ownership may allow for ranching or farming activities and the application of more intensive husbandry techniques.

2) Will the incorporation of wild species into a project have negative side-effects on community or household harmony?

For example: will the benefits of the project be shared equitably amongst the relevant gender groups of the target human population? Will the animals cause damage to other, more valuable sources of income, such as crops? Will the project interfere with socially-determined food-sharing patterns?

3) Does the biology of the species in question lend itself to any type of rearing in confinement?

If not, and if the species does not lay eggs, then wild harvesting is the only option, though once the eggs are laid (reptiles, insects, birds) it may be possible to develop a system in which reproductive females are left wild and eggs/young are captive-reared.

Before considering the possibility of domesticating a wild species, however, it is appropriate for planners to ask themselves some of the following questions.

1) Is a wild species appropriate, or should efforts be concentrated on already domesticated species?

For example, there has been discussion of domesticating cracid species such as guans and curassows. However, the average cracid lays less than two eggs a year (Silva and Strahl, 1991) as compared with a chicken, which can lay more than 100 eggs (National Research Council, 1991; Emmons, 1987).

2) Will encouraging use of a wild species in a community forestry project encourage management of wild populations of that species, or will it lead to overexploitation?

Negative effects that market valuation has had on populations of some target species have been well documented, especially in Africa. This is not always the case, however, and Adams and

McShane (1992) make the following suggestion: "The current bushmeat trade in Africa may provide a better model for agricultural policy than the other way around, thus turning the usual development strategy on its head."

3) Does the animal species being considered produce a product that can compete with similar products on the market?

If not, then the costs of domestication or confinement rearing will probably make the product non-competitive. As Eltringham (1984) has pointed out: "Two principles emerge particularly from the 'domestication' of African ungulates. One is that the apparent superiority of wild animals over domesticates becomes lost or reduced under conditions of captivity. The other is that the present domesticated animals are very suitable for the roles they have to perform."

Thus, for animal species to be considered as suitable candidates for domestication, several prerequisites are essential:

1) they must have something to offer, whether it be the performance of work, meat or other edible products, hair, hide or a combination of these;
2) they must be amenable to some degree of human handling, even if only when young;
3) the young must exhibit fast growth rate;
4) females must have a high reproductive output in terms of live weight of young produced per year;
5) the species must exhibit social behaviour that permits it to be grouped in a minimal space for feeding and handling; and
6) the species must be able to reproduce on an diet that is relatively inexpensive (Smythe, 1991; Emmons, 1987).

Only after considering the above issues should a community forestry project or other activity contemplate integrating wild species into its design.

Regional examples of wildlife use and management by local communities

The previous chapters have discussed the important role of wild animal species in the lives of rural people. Whether directly, as a source of food and other products and as socio-cultural symbols, or indirectly, as contributors to the maintenance of a healthy biosphere, wild animals remain essential components of subsistence and non-subsistence economies in many parts of the world. While countless detailed examples of wildlife *use* can be found, descriptions of community *management* of wildlife resources are rather scarce. In this chapter, an attempt has been made to gather together a selection of these descriptions. Thus the chapter provides examples to open discussion aimed at better understanding possible ways in which wild animal management can provide the products and services needed both by human communities and by the ecosystem. These are only *examples* of some existing systems; they are not to be taken as models to be copied, but rather as a source of ideas from which to begin to develop new activities with local communities.

The chapter explores some traditional and some more recently evolved practices adopted by local peoples to manage wildlife resources. Wherever possible, examples from private enterprise have been included where they could be adapted for use in community forestry activities. The examples discussed here are drawn from the spectrum of tropical ecosystems of Africa, Latin America, and Asia and the Pacific region. They are meant to be illustrative of the diversity of possible management systems rather than an exhaustive compilation.

The success of any management system will depend on such factors as local history, local technologies, resource use organization and regulation, and local food security strategies. Also basic to planning an activity are national policies, infrastructure, legal structures and the physical characteristics of the area, as well as recent trends that could indicate future change. Therefore, all of the examples in this chapter are site-specific and not necessarily replicable in different locations, but they are useful in understanding the practical application of many of the concepts discussed in earlier chapters.

AFRICA

Africa has great geographic and biological diversity. Tropical and subtropical forests, mangroves, coastal forests, semi-arid scrub forests, savannas and deserts are part of the spectrum of ecosystems found on this large continent. African nations contain large rural populations that depend on the natural resource base for their livelihood. Depletion or destruction of these resources is of great concern.

Two of the most important changes with long-term effects on wildlife are accelerated deforestation, with the resultant loss of habitat, and market hunting, which was discussed in the previous chapters. The causes of deforestation are many, but they frequently involve logging, fuelwood collection by growing urban populations, expanded agricultural programmes and infrastructure development such as road construction. Most development activities proceed with little regard for the effects of wildlife loss on the people. Other forces may also result in deforestation. In Zambia, for example, where certain caterpillars are highly regarded as a food source, traditional management involves careful pruning to increase leaf area for caterpillar feed. Recent commercialization of caterpillars, however, has led to increased collection in the Miombo woodlands, using the destructive collection method of felling trees. Deforestation of over 31 000 ha has resulted from this practice (Pullan, 1981).

Commercial logging also has an important secondary effect on wildlife populations aside from the destruction of habitat. Even in "low-impact" selective logging operations, dramatically increased hunting by formerly subsistence hunters, due to increased access and marketing opportunities, may severely deplete wildlife. Wilkie *et al.* (1992) describe extensive hunting along roads in a Congo logging concession. Even though the actual timber extraction in this case caused little habitat disturbance, kills by subsistence-turned-market hunters have increased dramatically due to the easy access. Concession employees purchase bushmeat from the local hunters for resale elsewhere, and company vehicles provide easy transport.

Wildlife management for ecotourism in Tanzania

Ecotourism is an important national industry in Tanzania. The majority of foreign travellers come to see wildlife, and more than 80 percent of them visit the northern conservation areas. Although the industry is relatively underdeveloped, especially when compared to neighbouring Kenya, it generates a large amount of foreign exchange. Earnings from approximately 103 000 tourists for 1986 were estimated at US$ 27 million (Attwell, 1992). This is a very productive form of land use in terms of income generation and employment, especially in marginal agricultural and grazing areas.

The Masai ecosystem is a good example. Located in northeastern Tanzania, it contains a variety of habitats but is comprised mostly of arid lowlands with abundant wildlife populations. Very little of this land is suited for agriculture, and environmental degradation would result from farming these arid areas. Traditional pastoral practices of the Masai residents do not appear to conflict with wildlife conservation.

The Masai ecosystem contains two national parks, which attract visitors and provide income from accommodations and ancillary services. Game Controlled Areas (GCAs) lying outside the national parks are multipurpose areas for grazing, cultivation, wood cutting and hunting. Safari hunters, using wildlife in the GCAs, also provide local employment and contribute significant sums of foreign currency. The national government has developed a new policy that will replace the Game Controlled Areas with Wildlife Management Areas (WMAs). The Wildlife Management Areas are designed for licensing wildlife utilization to communities and private individuals, with strict regulation of agriculture and livestock development (Attwell, 1992).

The new regulations are designed for community involvement in planning the future of their resources. Integrating community forestry activities into the current focus on wildlife utilization could combine forest and tree resource management with wildlife management for ecotourism. This would help protect the valuable watersheds in this arid ecosystem, many of which are presently deteriorating (Prins, 1987).

Another interesting initiative is the Tanzania Wildlife Corporation (TAWICO), a state-run wildlife management enterprise that was established by the government in 1974 and entrusted with the commercial utilization of wildlife. The enterprise began with sport hunting, game cropping, processing of game trophies, photographic safaris and the capture of live mammals and birds. Initially, TAWICO tried unsuccessfully to provide all the sport hunting services by itself. Shortly thereafter, experienced safari companies were incorporated to accommodate the large numbers of potential clients (Ndolanga, 1988). Sport hunting has proved financially successful and brings in valuable foreign exchange. Revenues totalling over US$ 2.2 million were collected by 27 private companies for 1990 (Attwell, 1992). While the amounts charged for hunting may appear considerable at first glance, they are low when all factors and costs of conservation are considered (Ndolanga, 1988).

Typically, private companies are foreign-owned, and local communities generally see little employment or other benefits. The nature of the hunting and the remote locations mean that much of the meat is wasted. In contrast to this, game cropping operations by TAWICO are more beneficial at the local level. From 1985 to 1989, 6 007 zebra and 4 256 wildebeest were culled, as well as numerous other animals (Attwell, 1992). Due to lack of refrigeration facilities, most of the meat is dried to produce biltong. The economical provision of meat is considered a vital service to the rural inhabitants and the costs are subsidized to keep the prices low. The skins are taken to the TAWICO taxidermy factory for processing and sale at a profit. These and other wildlife products are distributed for both local sale and, with the proper international trade permits, to international markets.

The operations of TAWICO play an important role in the national economy, and its role is expanding. Ecotourism, based on viewing or hunting wildlife, is a very fast-growing industry in Tanzania. Approximately 280 000 tourists visited Tanzania in 1990, representing a 300 percent increase over 1985 (Attwell, 1992). Greater involvement at the community level through community forestry activities will reinforce the conservation values concerning wildlife and other resources among the rural inhabitants.

Fire management for protein and silk production in Madagascar

Human populations have wrought great changes in the natural landscape in savanna Madagascar. Human-initiated fire has produced areas of savanna woodland where tropical highland forests

once existed. These grasslands are dominated by the fire-resistant tree tapia (*Uapaca bojeri*). This tree is used for its edible fruits, fuelwood and medicinal bark. It also serves as a host plant for a variety of valuable insects.

The native silkworm (*Borocera madagascariensis*) feeds on the tapia leaves and the silk is used for weaving an assortment of traditional cloths. Various interventions are sometimes performed to increase cocoon production, including predator control and restocking of areas depleted of silkworms. Harvest of cocoons occurs up to three times a year, and some are set aside for reproduction. This industry has been seriously affected by the substitution of cheaper cotton cloth.

Lepidopteran insects are also collected from tapia trees for food. Both chrysalids and caterpillars of a variety of species are eaten. These are collected for family use or sold at markets. Consumption was previously higher, but European missionaries and administrators have discouraged their consumption.

Another lepidopteran product from tapia is a large moth, *Argema mittrei*. The adult male is prized by collectors as one of the world's largest moths and may develop a wingspan of 18 cm. As it may be damaged by netting, captive rearing is preferred. The *Argema* egg cases are very distinct and tapia trees, among others, are carefully searched for them.

The tapia woodland ecosystem is a product of human activities, but these activities can also destroy it. Fire and fuelwood collection are seen as the biggest threats (Gade, 1985). Community resource management activities need to be developed to protect and rehabilitate these forests, providing silk, food, fuelwood and valuable insects for the international collectors'market.

Community game management in Botswana

A game harvesting programme to benefit the rural poor was begun in 1987 in Kedia, in the western Central District. It is comprised of two major elements: game management for subsistence hunting and the storage, processing and marketing of wildlife products. The Department of Wildlife and National Parks establishes quotas for the various species and issues a special permit to the community. The government has provided firearms and two vehicles to be used by certain people who are designated as project hunters. Meat from the culled wildlife is provided at low cost to the community. The community has now developed a conservation ethic towards game protection, as shown by an increase in local wildlife populations and decrease in poaching (Ajayi, 1990).

The sale of wildlife products has been very successful. Trophies and processed skins are sold to the Botswana Game Industries (BGI) with 70 percent of the earnings returning to the community and the remainder financing management costs and vehicle maintenance. A village tannery produces hides from wild and domestic animals for sale to BGI or for use in local handicrafts. It is manned by trained villagers and uses materials largely of local origin. A building in Kedia was constructed for storing skins (Hitchcock, 1989).

Local participation in utilization and administration of wildlife is an important element in the project and expanded employment has been a valuable result. Future research must focus on sustainability and distribution of benefits. The programme evolution could be of service as a model for solutions in other locations.

Sustained-yield wildlife management in Zambia

Zambian Game Management Areas (GMAs) today cover about 24 percent of the national territory. They were created to incorporate wildlife utilization by the local occupants, although use of these areas has been dominated by sport hunters and foreign ecotourists. In response to the needs of rural residents who felt excluded from the benefits of wildlife use, an experimental GMA system was recently developed in eastern Zambia.

The Lupande Game Management Area, consisting of five chiefdoms, was chosen for a new management approach to achieve local involvement (Lewis *et al.*, 1987). Input from village leaders was included in wildlife management planning, and priorities incorporated community needs. Local residents were trained by the National Park Service (NPS) for year-round employment, and revenues generated within the GMAwere retained for management and community benefit.

Two main activities were used for generating revenue: wildlife safari hunting and sustained-yield harvesting of wildlife. Private safari companies entered an auction for exclusive sport hunting rights. The contract terms set hunting quotas and guarantees for employment of local people. Their activities are monitored jointly by the local communities and the NPS. Revenue is shared among the safari operators and pays for management costs, tourism promotion and development benefiting residents of the GMA.

Sustained-yield wildlife harvesting began with hippos. Revenues from the hippo culling came from meat, hides and teeth. The profits were then divided among the communities after financing the management costs. About 40 hippos were harvested annually using labour-intensive methods. This maximized local employment and reduced start-up costs and overheads (Lewis *et al.*, 1987). The harvest project was then expanded to include other species (Attwell, 1992).

The project has succeeded in addressing problems in previous management programmes. The communities involved receive direct monetary benefits in the form of employment and revenues from the Game Management Areas' utilization programme. Earnings from safari operations and harvesting are well accounted for and the proper community disbursements are made following local decisions (Lungu, 1990).

A shift in attitudes of the local people towards conservation of their wildlife resources was seen. Before the programme, very negative feelings were expressed toward the NPS. With increased community involvement and the employment of local people by NPS as Village Scouts, the trend was reversed. This resulted in much greater efficiency of anti-poaching enforcement. The area borders a national park that also benefits from the increased protection. These positive results show how the inclusion of local people can bring about dramatic changes for conservation (Mwenya and Lewis, 1990).

Local benefits from wildlife use in Zimbabwe

In an effort to develop effective sustainable use programmes for wildlife, the government of Zimbabwe has begun to include local communities directly in programme planning and in distribution of benefits and revenues. This community-based wildlife management programme, known as CAMPFIRE (Communal Areas Management Programme for Indigenous Resources), shows great promise. The varied benefits provide profits at three levels: to the villagers, who receive cash, meat and/or employment; to the community, which receives revenues and development; and to the nation, which benefits from increased tourism and rural productivity (Pangeti, 1990). The programme has been able to achieve community responsibility for conservation.

The national government contributes financial and technical assistance, with labour and local building materials furnished by the community. Under the current system, profits that are returned to the villages may be used for communal projects or disbursed directly to citizens. With the increased involvement in planning, management and benefits of their wildlife, the communities are given incentives for conservation (Jansen, 1990).

The programme began initially with safari hunting, which continues to be the major source of revenue. This had several advantages: communal areas are often far from the main tourist routes, little infrastructure is required, and operations are quickly initiated with little overhead and large financial rewards. Quotas were set conservatively to maintain trophy quality, and because the offtake is low, there is little effect on wildlife populations. Finally, meat is usually distributed locally as safari hunters want little. Provisions were also established to provide for poaching control, game cropping, removal of problem animals and compensation for losses to livestock or crop damage.

The programme is new and developments are progressing in many communities. CAMPFIRE began in 1989 with only two districts, and now 12 have been granted management authority and have functioning projects. All but one have opted for granting sport hunting concessions to private safari concerns (Attwell, 1992). Sizable earnings have been realized resulting in general local support. Game cropping schemes have popular support but are not yet large scale.

Non-consumptive wildlife use in Kenya

Kenya has experienced severe changes in wildlife use from consumptive excesses to strict conservation. The colonial hunting laws excluded local people, favouring wildlife use by wealthy residents and foreign visitors. After Kenya enacted a total hunting ban in 1977, the government sought to accommodate the existing safari hunting companies and the thousands of workers that faced unemployment. The public and private sectors joined to produce the most thoroughly developed tourism industry in Africa today. Gross income in 1985 exceeded US$ 350 million.

Wildlife use in Kenya is largely through non-consumptive tourism. This is a tremendous source of national income and employment. Although most of the game viewing takes place within the many national parks, much of the surrounding land is important to both the wildlife and the tourism industry. The government has encouraged lodge construction on land outside the protected areas. These may be private or communal lands, and many function as important wildlife dispersal and migration areas. These areas are becoming important as game viewing areas as well, which helps disperse tourist pressure away from the parks. As income is distributed to local communities, the people have become protective of their wildlife resources and poaching has been reduced. The outcome of this economic sharing system has been to develop a more positive attitude towards wildlife conservation (Olindo, 1987).

Traditional wildlife management in Nigeria

Nigeria's stated goals for the management of wildlife are: preservation of national heritage, game meat production and tourism. However, it lacks the legal and institutional structure to achieve these goals (Anadu, 1987). No comprehensive national wildlife law exists for management, only an outdated list of prohibited species, with most details left to the individual states. Even though forest and wildlife reserves have been declared, they exist without monitoring or enforcement (Osemeobo, 1988).

Forest resources have historically provided food, shelter, medicines and other life-sustaining materials. In traditional Nigerian cultures use of these resources is based on common property regimes (Osemeobo, 1991). Community members are bound by social obligations that govern the use of resources. Generally, live wild animals are owned communally and open to all for hunting. Personal ownership of a particular animal is established upon killing according to established rules of hunting.

Wildlife conservation in the past has been achieved through certain social restrictions, but these are now breaking down. While open access exists for most of the surrounding environments, strict regulation or prohibition of hunting and fishing is now enforced only in designated ceremonial forests and rivers. Animals and other forest resources in these shrine forests are regarded as sacred. Some areas remain open to hunting only once a year. Some further restrictions exist on consumption of various species, such as crocodiles, pythons, antelopes, monkeys and pigs, through taboos which may be based on gender or age (Osemeobo, 1991).

There are numerous conservation benefits for wildlife under this system, but these practices are breaking down. Incentives from wildlife trade and changes in land tenure undermine the traditional systems. It is possible that the current trends toward habitat degradation and deforestation could be slowed by supporting some of the social norms that foster value and respect for the forest and its products.

Sericulture presents an example of this type of degradation of traditional resource management. Unlike traditional sericulture in Asia, which utilizes the species *Bombyx mori* (which feeds only on the mulberry tree), in Nigeria most silk is produced using various species of *Anaphe* (Family Notodontidae). These species generally produce communal nests consisting of multiple cocoons and feed on a variety of tree species. Production has relied on wild silk, and the industry has only attempted one farm operation in 1942. The silk is woven into 10 cm wide strips and then fashioned into garments.

Overcollection of cocoons and deforestation have been blamed for a crisis in the non-mulberry silk industry. The larvae are eaten and have high contents of both protein and fat. The principal host trees for the *Anaphe venata* silkworm, *Triplochiton* spp., accounted for more Nigerian timber exports than all other species combined. No large-scale reforestation projects exist for this species as yet.

Native silkworms have not been domesticated and their life histories have not been well described. Ashiru (1989) proposes that mulberry cultivation and *Bombyx* silkworm production is a viable alternative for Nigerian farmers, especially suited for agroforestry. Many possibilities are available for community forestry activities incorporating sericulture, including reforestation programmes for *Anaphe venata*.

Traditional hunting rights in the Central African Republic

Here wildlife plays a significant role in the all citizens' nutrition, supplying an estimated 30-40 percent of meat consumed. For certain pygmy groups, wildlife provides most of the protein, talismans, medicines, ornaments and other uses of cultural importance. Hunting pressure can be intense; an estimated 52 000 duikers are taken annually by about 20 hunter groups (Doungoube, 1990).

In response to national depletion of forest cover and wildlife populations, the Dzanga-Shanga Dense Forest Reserve was established in conjunction with a national park. The park was created as a non-hunting "animal reservoir", with communal hunting rights granted in the adjacent reserve. Forty percent of the national park entrance fees goes to Bayanga, the nearby community. These actions produced wide support from the local people. Safari hunting is also permitted and the local people are engaged as guides. Community members also comprise the efficient anti-poaching units. Future objectives include increasing tourism and improving standards of living through rural development.

The battle against the tsetse fly

Many African countries, supported by international development institutions, are carrying out programmes for eradicating the tsetse fly (*Glossina* spp). This insect vector transmits protozoan parasites, which cause trypanosomiasis (sleeping sickness) in man and in cattle. Its presence limits human activities throughout many parts of tropical Africa and, in some areas, has protected wildlife populations from the disturbance of human activities. Eradication of tsetse flies will open some marginal lands now excluded from human habitation. In some instances, this may lead to deforestation and soil erosion through destructive agriculture and overuse by livestock (Matthiessen and Douthwaite, 1985).

Many African governments have policies for increasing beef production for domestic use and as a means of generating foreign exchange. The programmes are often implemented at the expense of native wildlife populations and may include costly habitat modifications, such as brush clearing, associated with tsetse fly eradication. Some programmes rely on extensive spraying of persistent insecticides that have negative effects on a variety of wildlife species (Ormerod and Rickman, 1988).

Areas opened to expanded settlement are sometimes already inhabited by local people with no tradition of stock-keeping who rely on wild sources for their protein. Domestic stock may not integrate well into their traditional farming systems. These bush-dependent people should be considered when planning cattle expansion and use of native wildlife. Mixed systems may be more productive options. Careful land use planning needs to be an integral part of any tsetse fly eradication programme (Matthiessen and Douthwaite, 1985).

Community involvement in wildlife management

As seen in many of the examples above, Africa is taking a leading role on the path toward community involvement in wildlife management. Many governments have seen the utility of including rural inhabitants in the decision-making process. The transfer of responsibility for the conservation of wildlife to the people who directly receive the benefits has yielded positive results. The resource is often fiercely protected by those who profit from its use and the benefits often offset the incentives for alternative land uses.

LATIN AMERICA

Like Africa, Latin America has great geographic and biological diversity. All the ecosystems found in Africa can also be found in this region, which, in addition, has large areas of high mountains with their own ecologies. Here too, the need to better manage the local wild plant and animal population is both urgent and vital.

Changing land rights

In recent decades, land tenure systems have undergone great changes in tropical Latin America. Great expanses of lowland forest in the Amazon basin, used by indigenous groups long before European exploration, have recently been subjected to colonization and deforestation by immigrants. Frequently, these new arrivals have no knowledge of or respect for the traditional land use systems. Sound management practices are often discarded and replaced with less appropriate technologies. As a consequence, wildlife populations have greatly diminished in these areas. In many countries, government subsidies promoting cattle production and intensive agriculture have accelerated the process and concentrated large pieces of land into the hands of relatively few people.

Many conflicts over property rights have arisen between the settlers and the indigenous groups. Recently, however, after a period of organization and international support, indigenous groups have begun to have their rights recognized. Several governments throughout Latin America have begun to grant title with resource use rights to many of these groups.

The changes in land rights have coincided with an evolution of conservation policies in the region. Beginning in the late 1960s, and derived from strong preservationist attitudes, policies were formed in reaction to the excesses of wildlife exploitation of previous decades. Now, in response to the needs and realities of local people, there has been a shift toward a more practical focus on sustainable use. For this reason, there is great interest in a variety of soft management systems.

Increased market involvement

The growing dependence of rural inhabitants on manufactured items has led to a rapid increase in market participation, which in turn has also brought changes that severely affect wildlife populations. The need for cash items for barter has dramatically changed many activities in local societies. Meat, once shared in the community, is now often hunted in increased quantities for trade in goods not provided by the environment. Local traditional items, such as parrot feather headbands, are sold to visiting tourists for large sums, encouraging increased extraction. Agricultural practices are shifting from subsistence for the community to cash crops for sale.

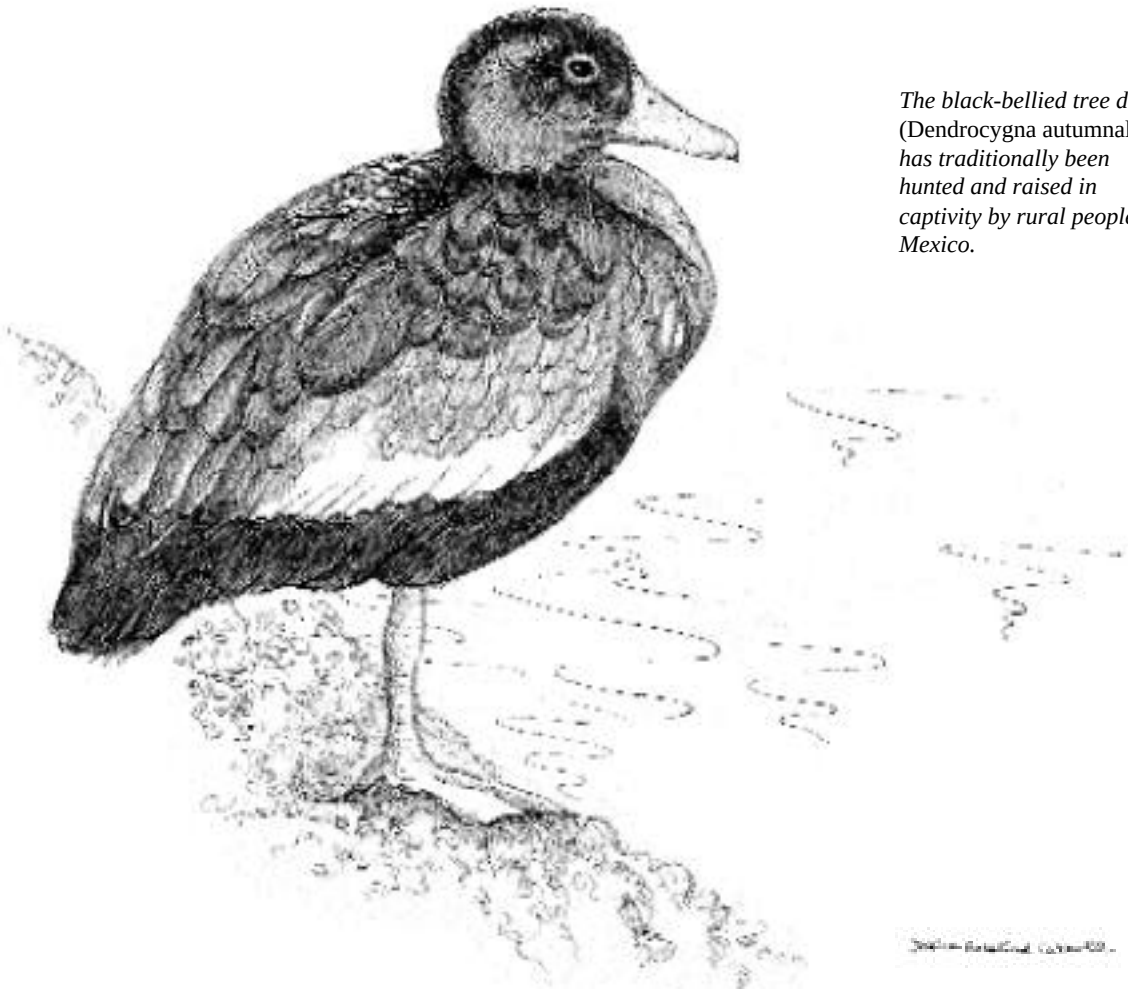
Accompanying these shifts in activities is the increased availability of new technology. Modern tools often multiply by many times the impact one individual can have on the environment. Probably the most important development in terms of direct wildlife reduction, is the use of firearms. It has been shown that indigenous people usually increase their meat consumption,

rather than decreasing time spent hunting, when given access to firearms. Outboard motors have greatly increased the impact range of individuals on fauna populating the river systems. The list of new tools is long, but all share a common trait: they require market involvement for acquisition and maintenance.

Adjustments need to be made that thoughtfully integrate wildlife conservation with sustainable wildlife use. The following projects are illustrative of some of the possible ways this aim can be achieved.

Duck harvesting in Mexico

The black-bellied tree duck (*Dendrocygna autumnalis*) has traditionally been hunted and raised in captivity by rural people in Mexico. People harvest the eggs from wild nests, then hatch them using domestic fowl such as chickens, ducks or turkeys. The tree ducks are then raised on the farm along with the domestic fowl. They are consumed periodically throughout the year and few remain by the next nesting season. The local people justify the egg collection claiming that the species will not breed on farms and that wild caught hatchlings die from unknown causes. A recent study, however, revealed that the local farmers lacked the necessary management skills (Feekes, 1991).



The black-bellied tree duck (Dendrocygna autumnalis) *has traditionally been hunted and raised in captivity by rural people in Mexico.*

AKayapó woman and her child gather honey. The Kayapó eat large quantities of honey, often consuming it along with pollen, larvae and pupae, which increase its nutritional value.

The study undertook to develop a sustainable management programme. A nest box using palm trunk sections was designed that achieved great nesting success and subsequent egg production. A risk emerged, however, that increased harvest potential through use of the nest boxes, instead of the traditional harvest methods, could lead to tree duck decline if harvest levels are not controlled. The introduction of the new technology must be accompanied by ecological education. Some possibilities that were proposed were to use nest boxes for protective breeding areas to increase wild stocks, or to use them in a variation on the traditional method by releasing ducks reared by domestic "mothers."

Invertebrate use by the Kayapó in Brazil

The Kayapó of Brazil have intimate knowledge of bees and recognize 56 species of stingless bees. They regard honey very highly and eat large quantities when possible. It is often consumed along with pollen, larvae and pupae, which increase the nutritional value. Beeswax also has great spiritual and practical value in the manufacture of various artifacts.

Bees are classified by nest structure and location, as well as use, aggressiveness and other traits. These characteristics determine the manner and purpose of harvest. Part of the brood comb is always left, along with some honey, to assure future propagation. Some species are also estab-

lished near agricultural fields, although the Kayapó apparently have no understanding of pollination (Posey, 1983).

Another interesting non-food use of invertebrates by the Kayapó has been reported (Overal and Posey, 1990). Two species of the ant genus *Azteca* are employed to help protect fields, gardens and fruit-trees from attack by leafcutter ants (*Atta* spp.). Leafcutters can be exceedingly destructive to food plants and do much damage in an overnight infestation. Active nests of the arboreal *Azteca* are located, then nest fragments are transported and placed in strategic positions by the Kayapó men. These ants repel the entrance of *Atta* into surrounding locations. Observations show that less leaf damage from *Atta* occurs in these protected areas compared to unprotected gardens.

The examples above illustrate only a few of the several uses of invertebrates by the Kayapó. For many indigenous groups, invertebrate use is very important but has been largely overlooked.

Wild harvest of caiman in Venezuela

During this century, many wildlife species in Venezuela have been reduced through the effects of commercialization and development. In reaction to this, the Venezuelan government imposed a 10-year moratorium on hunting beginning in 1972. The common caiman (*Caiman crocodilus*) previously exploited at low levels, recuperated quickly and soon became abundant in some areas. Aprogramme to allow for a controlled harvest was devised and began on a limited scale in 1982.

Much of the most suitable habitat, and hence the best caiman populations, is found on the large cattle ranches of the central plains. A key feature of the programme was to award control of these caiman to the ranch owners. The caiman then were included as another component of the ranch stock and would be guarded as such. This is a practical method for protection of a resource that is impossible for the government alone to control against poachers (Thorbjarnarson, 1991).

The scheme is managed according to an annual survey of the ranches that wish to apply for permits. Official hide tags are then allotted according to a fixed percentage of the population found. This affords the flexibility to make yearly quota adjustments as populations fluctuate. Wild harvest provides the only practical system for utilizing caiman, whose skins are valued for sale. Meat, which is salted and dried, provides additional income. It is used to prepare traditional foods during religious festivities.

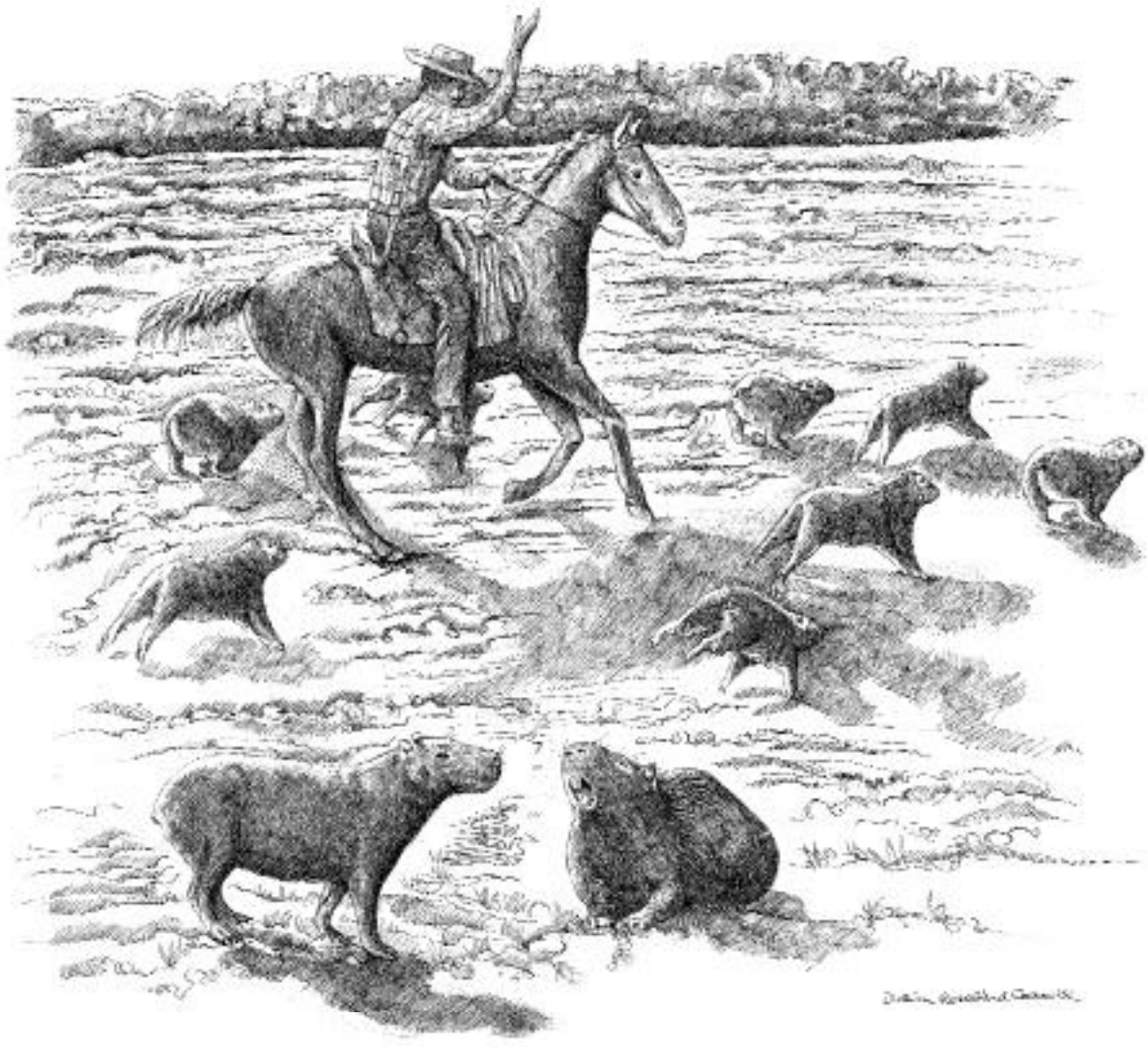
The programme has additional economic value beyond revenues derived from meat and skins. People are employed for the harvest, and because hides must be partially tanned within Venezuela, tanneries provide employment as well. Some finished products are manufactured by local industries, but currently most hides are exported. The programme is supported by a small hide tax collected by the government. Although this system has been developed using private landholders, it could be adapted to a community that owns or holds use rights to property with suitable caiman habitat.

Capybara use in Venezuela

Capybara (*Hydrochaeris hydrochaeris*) is the world's largest rodent. It is found from eastern Panama to northern Argentina. Currently, only ranches are licensed for harvesting the animals for their valuable skins and meat. The meat, as with caiman, is salted and dried for use in traditional meals. The fat is also used in folk remedies (Ojasti, 1991).

Permits to harvest are granted following annual population surveys. This rodent may produce litters twice a year, with three to five young. The species thrives on natural pastures and therefore does well on cattle ranches. Exploitation of capybara produced significant additional income for the few ranches that made the effort to harvest. In Venezuela, on open savanna areas, capybara are generally herded by horsemen to a central area for culling.

Management and harvest of the capybara could be readily incorporated into a community-based land use system. Many factors make capybara more desirable than cattle for local use and consumption, including their suitability to the local environment and efficient use of native plant resources. They also convert feed into meat more efficiently than cattle, support higher harvest



Capybara (Hydrochaeris hydrochaeris) *is the world's largest rodent, found from eastern Panama to Argentina. Many factors make them more desirable than cattle for local use and consumption. In Venezuela, they are ranched on open savannah areas, where they are generally herded by horsemen to open areas for culling.*

rates and require lower overhead maintenance costs. Market value is good, though it varies according to the location and availability of infrastructure.

Management of tegu lizards in Argentina

Exploitation of tegu lizards (*Tupinambis* spp.) is an important industry for Argentina. Over 1.2 million hides have been exported annually for over a decade. The United States imported tegu hides and products worth US$ 24 million in 1985 and is Argentina's principal market (Fitzgerald, 1989). Tegu hunting supplies a significant portion of the annual income for thousands of rural Argentines in the northern areas. Many people eat tegu meat, and medicinal use of the fat is important and widespread (Fitzgerald *et al.*, 1991).

Hunters may be classified into two general groups: the occasional hunters, who catch tegus opportunistically when not engaged in their main employment, and the professionals, who invest concentrated effort in hunting with trained dogs. No size regulations are in effect but larger skins command superior prices, which effectively discourages the taking of young animals.

Only four northern provinces have historically set quotas for tegu harvests, though not based on biological data. Skins from other provinces, as well as from Bolivia and Paraguay, have clandestinely entered the trade. A new system involves 10 provinces and tax incentives to encourage local tanning and processing. International regulations are in place to control cross-border transfers. The system is currently evolving as previously unknown biological information is discovered. The fact that the species has sustained high harvest levels with little manipulation provides a positive outlook for future management.

Sustainable harvest of the guanaco

The guanaco (*Lama guanicoe*) is one of the few wild ruminants in Latin America that is suitable for managed harvest. Harvest of newborn guanacos in Argentina is an important local industry. In 1979, over 86 000 skins were legally exported, valued at US$ 3.6 million. Yet this harvest is not founded on detailed biological studies. Current work in Chile is aimed at providing the biological data necessary to develop a sound management plan. Products that can be taken are meat, wool and skins (Franklin and Fritz, 1991).

Previously, herds numbering thousands were found throughout its range. Herds have been severely reduced and the species is absent in much of the former range. It was suspected of competition with cattle and sheep, and eliminated from much of the land used for grazing. Today, herds are recovering and research has been undertaken to develop sustained-yield harvest models. Because the males are polygynous, and form large groups, harvest of males only is possible without jeopardizing the reproductive potential of the population. The conclusion of the biological research is that free-roaming guanacos present real possibilities for a sustained-yield harvest programme that could yield benefits to local communities (Bonacic and Bas, 1992).

Invertebrate food in Amazonia

Arthropods form a significant part of the diet of many indigenous groups in Amazonia. These may be taken in an opportunistic fashion when encountered during other activities and may be eaten immediately. Certain social insects may be collected in large amounts for consumption at a later time or further preparation, as with the highly seasonal emergence of winged termite alates and locust swarms.

Certain groups have developed managed harvest techniques, the similarity of which indicates possible cross-cultural transfer of technology. Dufour (1983) reported that the Tatuyo of south-eastern Colombia cut particular palms in anticipation of future insect harvest. These felled palms attract beetles that lay eggs there. Later, high-energy palm grubs (*Rhynchophorus* spp. larvae) can be collected. The same "farming" strategy by the Barí of western Venezuela was also noted by Beckerman (1977) for *R. palmarum* using *Jessenia* palms.

A similar method of felling palms is employed by the Guayaki of eastern Paraguay. Trees are notched to provide more breeding sites for the *Passalidae* beetle larvae (Ratcliffe, 1990). The Nambiquara of western Brazil harvest grubs from species of *Cerambycidae* and *Caricaceae* in a similar manner (Setz, 1991). The Yanomamo of Venezuela and Brazil first harvest the edible heart of palm when felling the tree, and several months later the decaying trunk may yield nearly 1 kg of grubs (Chagnon, 1968).

Food production using palm grubs could easily be integrated into community forestry activities. The larvae are already well accepted in many cultures throughout the tropics and need no introduction. A systematic programme of palm trunk preparation could maintain substantial larvae production over time.

Additional benefits could be obtained when using grub production as part of an integrated pest management system. The various species of larvae used as food are also responsible for great losses to oil and coconut palm plantations worldwide. Limited research has shown that felled logs, using plantation waste materials, can be used to lure beetles away from the productive trees. The new world palm weevil (*Rynchophorus palmarum*) against which chemical insecticides have proven ineffective, also carries a nematode that causes red-ring disease. Bait logs as described above can be used not only to reduce infestation but also to increase larvae production (DeFoliart, 1990).

Swidden agriculture for game management

Swidden agriculture is a common form of food production in the tropics. The use of these plots to attract game for hunting has been well documented. The variety of planted crops plus the successional forest vegetation are very attractive to favoured game species such as rodents, peccary and deer (Dufour, 1990). Certain groups, such as the Lacandon Maya of Mexico, plan for losses and plant additional amounts to lure and encourage game species (Nations and Nigh, 1980).

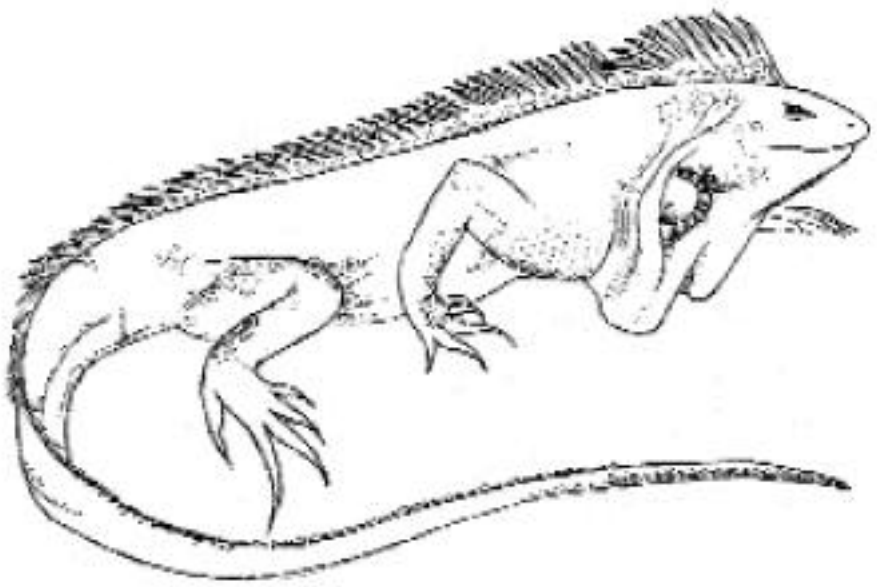
The use of agricultural plantings to attract game is a widely dispersed and very old practice. Even in prehistoric times, wildlife appears to have been purposely attracted to agricultural fields. In the southwestern United States, the ancient remains of a variety of wildlife species have been found outside of their normal habitats. Emslie (1981) has speculated that Pueblo groups created the necessary habitats through their agriculture and made range extensions possible for these species. Archaeological analysis of prehistoric kitchen remains from coastal societies in Panama shows a high incidence of certain forest-edge mammal species that also readily enter clearings such as agricultural fields. Deep forest species common to the area are absent or poorly represented in the remains, which suggests they were not pursued (Linares, 1976). "Garden hunting" (hunting of animals in cultivated fields) is a common and important practice among the present-day Cuna and Guaymí of Panama.

Descriptions of swidden agriculture sometimes refer to the "abandonment" of the field after a few short years of use. While the production of primary staple crops is discontinued, these fields are far from abandoned. Long-term planning is incorporated in the initial planting of the fields. Many species of fruit-trees are planted which do not bear fruit for some years. These trees not only produce food for human consumption but are also included to attract game animals. Ethnobotanists have recorded a wide variety of uses for the many species planted by indigenous groups. Numerous plants interspersed in these garden plots are used solely as game attractants. The Kayapó of Brazil widely distribute their gardens, thus affecting game over large areas. For this reason Posey (1982; 1984) has characterized the swiddens as "game farm orchards" and has asserted that these activities have increased the amount of game available.

Green iguana management in Panama

The green iguana (*Iguana iguana*) is highly regarded as a source of meat and eggs throughout most of its range, which stretches from Mexico to Paraguay. Land use patterns such as cattle pasture development and swidden agriculture in Panama have severely reduced forest habitat, a requirement for the herbivorous iguanas. Populations of other forest species that are hunted for food have likewise suffered in the process. An innovative project has been devised in Panama for community development that combines reforestation with increased wildlife production.

The Iguana Management Project in Panama has assessed the biological, social and economic feasibility of various models to achieve the goal of sustainable production. Collecting eggs from wild nests is difficult and unreliable. A sustainable plan requires reliable egg production, so



The green iguana (Iguana iguana), *is highly regarded as a source of meat and eggs. It is the subject of a management project in Panama, which aims to achieve sustainable production of the reptile.*

captive reproduction was seen as the best solution. After numerous trials, a satisfactory plan for maximizing reproductive output was achieved, one that combines cage design, stocking rates and ratios, diet, incubation conditions and other factors (Werner, 1991). Captive egg output and hatching success can be much higher than under natural conditions.

Mortality of wild hatchlings in their first year is dependent on a variety of factors but has been estimated as high as 95 percent in some circumstances. This can be reduced substantially by raising the captive born hatchlings to a size where predation is reduced. Iguanas also show site affinity so they usually remain in the area of release. Densities can be increased by adding supplemental feeding stations.

The success of a release programme is largely dependent on available habitat. Planting native multipurpose trees can be of particular benefit. These trees, in addition to providing suitable habitat for the iguanas, can be useful for fuelwood, fruits and lumber, as well as improving water and soil conservation. Habitat management could also provide shelter for a variety of other animals beside the iguanas.

Community conservation in Belize

A conservation programme coordinating voluntary involvement of private landholders was initiated in Belize in 1985. The programme has four main goals: conservation, education, research and tourism. The success of the project is dependent on community members as custodians of the land.

Biologists initially met with landholders individually to assess their property. The project was presented to community members and received widespread support. Under the programme, a management plan is developed that provides for personal agricultural needs and for the project's conservation goals. A voluntary pledge is then signed to uphold the established plan. The property is visited annually for review and to check compliance. Until now, about 90 percent of the community members have abided by their pledges and are proud to be involved (Horwich and Lyon, 1990). Key elements include conserving forest strips, aerial pathways and important native food trees. Success has been shown, among others, by a large increase in the monkey population.

The project began with 11 members and now boasts over 100 landowners. A small museum has been built and serves for conservation instruction for the schools and for the community. A4.8 km interpretive trail has also been constructed, with information signs and an accompanying guidebook. Research has begun on the local wildlife, with complimentary studies on integrating farming practices with the conservation goals of sustainable management. Future goals are for reintroduction of important plant and animal species that have been eradicated through overuse.

Wildlife conservation has enhanced the area's ability to attract ecotourists. The community had previously expressed interest in increasing tourism in the area and this was aided by recent road improvements. Benefits to the local community have been significant in terms of income and employment. A simple shelter was originally constructed for tourists, but they are now staying with villagers in a "bed and breakfast" style of accommodation.

SOUTHEAST ASIA AND THE PACIFIC REGION

This vast geographical area is marked by great geological and biological diversity. Asia is also one of the world's most populated regions and includes some of the world's poorest countries, whose inhabitants are particularly dependant on natural resources for their livelihoods. Various forms of community resource management are being implemented in this region.

Wildlife resources and insect farms in Papua New Guinea

As in many other regions, wildlife plays a significant role in the lives of rural Papua New Guineans. Surveys conducted in the deltaic mangrove swamps and rain forest communities of the Wabo area along the Purari river showed that local people used 15 of the approximately 50 species of mammals found in the area, 37 of the 250 species of birds and all of the 12 species of reptiles (Liem, 1983). Liem suggests that the best approach for management of wildlife and their habitats in Papua New Guinea is to set up wildlife management areas in which the legal traditional owners of the land and wildlife devise their own management rules and enforce them themselves. This management strategy would allow traditional landowners to harvest wildlife from their land but would prohibit others from hunting there, thus alleviating outside hunting pressure.

Papua New Guinea has long been noted for its spectacular butterflies and other insects. Legislation in 1974 reserved the lucrative trade for nationals, and the Division of Wildlife initiated the Insect Farming, Trading and Conservation Project. Over 500 producers are currently involved and receive substantial income for their efforts. A non-profit government agency is responsible for international marketing and sales, and gives technical support (Hutton, 1985).

Insect farms are inexpensive to begin, requiring only about US$ 10 for supplies. They are often located on community land, in abandoned gardens or in areas not suited for agriculture. Certain plants are cultivated to attract the butterflies, moths, beetles and other insects from surrounding areas. If the site has been severely damaged by logging or natural disasters, reintroduction of insect species is easy and usually permanent.

Most farmers use a simple "bush house" made of local materials to guard developing pupae. The pupae are removed from the food plants then hung in rows. The house is lined with wire mesh to keep out rats, birds and other pests. After hatching, the insects are killed and preserved in simple solar driers made with plastic sheeting. Specimens are sent to the marketing agency in reusable cardboard shipping boxes, and a full box earns the farmer an average of US$ 50.

The project has many elements that encourage success. Start-up and maintenance costs are very low and the insects are generally common and easily attracted. Techniques are quickly mastered and daily time requirements are minimal. The low weight and volume, but high value, make it a perfect rural product in Papua New Guinea, which relies heavily on air transport. Earnings can be significant and some farmers make as much as US$ 1 200 a year (Fitzgerald, 1989).

Maring hunters in the highland forests of Papua New Guinea

The Maring people of the central highlands are a hunter-gatherer group who exploit the primary and secondary forest for a wide variety of forest resources. In addition to cultivating forest gar-

dens, they also maintain a small number of pigs for ritual occasions. However, wild game is the main source of protein among the Maring (Healey, 1990). The Maring people also extract several floral and faunal products from the forest to be exchanged and traded with other groups. Products such as marsupial pelts, bows and arrows, tree oil, net bags and particularly bird plumes are highly valued and are traded in many parts of the highlands.

The Maring economic and social systems are intimately tied with wild forest resources. Wild birds, in particular, are the basis of production for the plume trade. Healey (1990) notes that the Maring hunters are aware of the ecological consequences of their exploitation. They realize that decreased numbers of valuable birds may constrain their capacity as hunters. To maintain their position in the network of trade as important producers of desirable goods, they must not overexploit the resource. Thus, the exploitation of natural resources among the Maring hunters is mediated by cultural and social organization of hunting, and hunters can articulate strategies that reduce impact while maintaining yield.

Mangroves and shrimp in Vietnam

The Vietnamese government is anxious to "refoliate" the country (after the extensive defoliation used as a war tactic in the 1960s and 1970s) and is in the process of developing a variety of new forestry initiatives. Agroforestry and community forestry projects that combine row crops with trees are an important part of the government programme (Pardo, 1990). One such initiative is in the extensive coastal mangrove forests at the southernmost tip of Vietnam, which presents a special challenge and opportunity because large tracts of mangroves are being cleared to establish shrimp ponds.

The provincial planners of the Forestry Department, with help of the FAO, have developed an innovative model that includes both the shrimp production and the mangrove forests on which the shrimp depend. Under the Forestry Department's model, families are given 10 hectares of land: 2 ha for the development of shrimp ponds and the rest to be retained as mangroves. The families can thus benefit from selling the shrimp as well as obtaining fuelwood, charcoal, building materials and other products from the forest (Pardo, 1990).

Wildlife use and management in the semi-arid scrub forests of western India

Malhotra and Gadgil (1988) describe the modes of subsistence of three non-pastoral nomadic groups in the semi-arid regions of the western Indian state of Maharashtra. The modes of subsistence of these groups and those of the sedentary population in the region represent ecological strategies designed to deal with scarcity and uncertainty of food supply. The strategies are cultural adaptations to reduce competition between groups and are excellent examples of resource use and management.

The hunting practices of the three nomadic groups, which depend on wild game for protein, exemplify these strategies. The Nandiwallahs, Vaidus and Phasepardhis hunt wild animals in the thin scrub forests and semi-arid savannas of the region. The Phasepardhis were traditionally entirely dependent on hunting and gathering, and they specialized in snaring animals such as blackbucks, partridges, quails and pea-fowl. The Nandiwallahs use dogs to hunt species such as hyenas, leopards, wild pigs, hares and porcupines. The Vaidus also use dogs to hunt but specialize in catching smaller prey such as mongoose, squirrels and smaller cats, as well as some aquatic animals such as crabs, turtles and crocodiles.

Thus, the different hunting practices of the three groups give an idea of the resource partitioning and avoidance of niche overlap by these groups. This example of resource partitioning can be useful in developing models for other community resource management systems.

Wildlife management in Bhutan

In this mountainous country, increasing deterioration of grazing lands and destruction of wildlife habitat is leading to increasing competition for forage resources between wild ungulates and livestock (Wollenhaupt, 1989). In northern Bhutan, local people are burning more land to enlarge grazing lands to accommodate their steadily rising livestock populations. However, this strategy also leads to an increase in the number of blue sheep, one of the wild ungulate species found in the region.

One management option could be to manage the wild blue sheep populations for hunting on the common grazing land. This management alternative would help the local people to obtain economic benefits from hunting the blue sheep, which is not a threatened species. In addition, selective hunting would also decrease grazing pressure on the land and therefore the need to clear more forests. The details of this management option would depend on the traditional modes of utilization and management by local Bhutanese herders. However, integrating livestock and wild ungulates is a prospect that is well worth exploring in this context.

Animal farming for traditional medicine in Southeast Asia

Animal products are an essential component of Chinese medicine. Deer antlers, antler velvet, animal bones, reproductive parts, insects and rhino horn are among the important components in a Chinese pharmacy. Deer are farmed in varying degrees in several parts of Asia to supply the traditional medicine industry (Drew, Bai and Fadeev, 1989). In China, Korea and Russia, small herds of deer are managed intensively for velvet antler production. Some live animals are also sold.

Current deer management practices in Asia are mainly based on intensive feedlot farming, but small herds of free-ranging deer can be raised by herders on tropical and subtropical pastures. This could serve as a viable activity in community forestry activities in this region.

Silkworms in India

Silk production is an important industry in China and India. In both countries, forest and hill peoples have been gathering raw silk in the wild for centuries. In India, this raw material comes from the tasar silkworms that feed on a variety of trees that grow wild in tropical, subtropical and temperate zones (Jolly, Sen and Das, 1976).

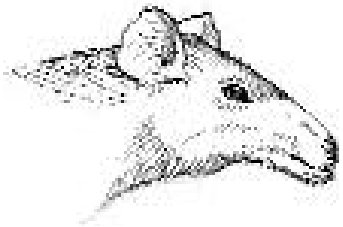
Tasar silk is secreted by several species of the genus *Antheraea* (Saturniidae). The worm feeds on a variety of trees commonly found in subtropical forest tracts, such as asan (*Terminalia tomentosa*), arjun (*T. arjuna*) and sal (*Shorea robusta*). In the temperate forests, the worm feeds on several commonly found oak species.

Integrating silkworm species into community forestry activities in the silk production zones of India would be profitable for local forest users, who would benefit from the economic returns of silk production as well as from the diverse benefits of the standing forests.

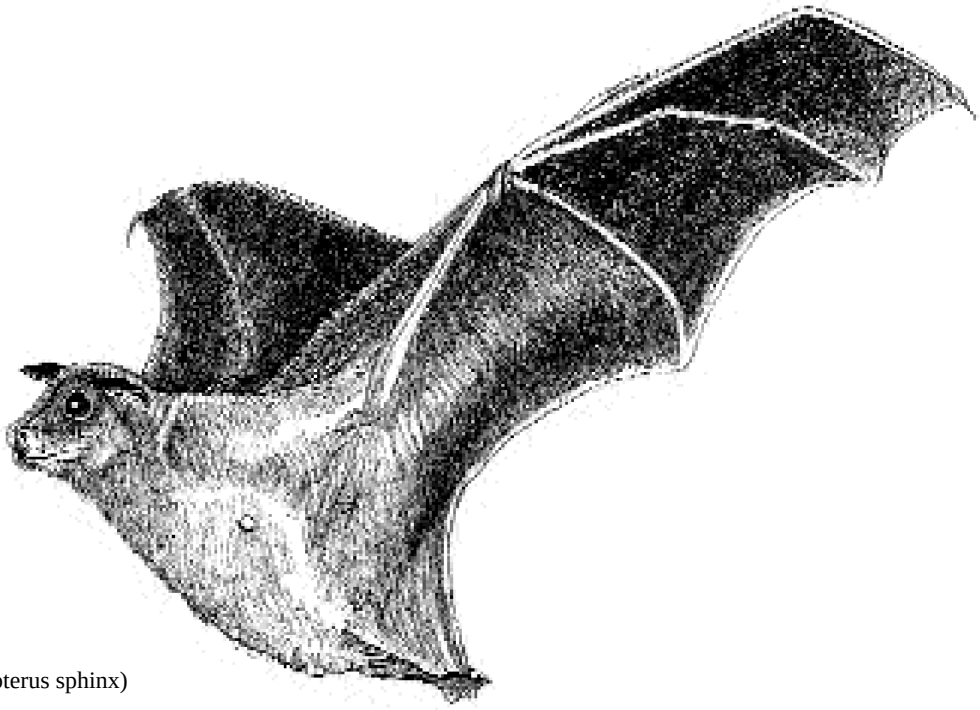
Hunting, farming and interethnic relations in the Philippines

The Palanan Bay area of northeastern Luzon province in the Philippines is characterized by steep river valleys and a narrow coastal plain. The majority of the area is covered in dipterocarp forest.

Gould's fruit bat (Pteropus gouldii)



Long-tongued fruit bat (Macroglossus minimum)



Dog-faced fruit bat (Cynopterus sphinx)

The predominant human settlers in this region are the Palanans, who farm in the river valleys, and the Agta, who are a hunting and fishing people living on the periphery of the Palanan settlements. Agta hunters provide fish and game to the Palanan in exchange for domestically produced carbohydrate foods such as corn and tubers. Both populations depend largely on wild game for protein (Peterson, 1981).

Ecologists have noted the importance of "ecotones," or areas on the edges between fields and forests, in supporting higher densities of some species of animals. Wild pigs and deer can take advantage of the patchwork effects of the forest-field mosaic and are ideal candidates for hunting. The Agta camp near farms to take advantage of the major game animals that are attracted to the forest-field edges created when the farmers open new areas for cultivation. The Palanan-Agta interdependence is an interesting example of human ecology and wildlife management that could have applications in other contexts of forest/farm interaction.

Changing resource use in Asia and the Pacific

Traditional modes of subsistence and resource use and management in this region are undergoing extensive changes. As expanding and evolving agricultural practices, guns and other modernizing forces lead to the destruction of habitats and depletion of wildlife, subsistence hunters and marginal farmers have to find new strategies to deal with the new situations. For instance, the hunting practices of the non-pastoralist nomads discussed by Malhotra and Gadgil (1984) have changed considerably. The three nomad groups traditionally observed a number of cultural taboos, such as not hunting animals during the breeding season, releasing young animals and not hunting at least one day in a week as well as refraining on religious days. However, these controls are rapidly breaking down as wildlife numbers decline and the animals become the target of wildlife conservation enforcement agencies.

In other areas traditional subsistence use is being replaced by hunting for markets. To satisfy the often high demands for wildlife and its products, traditional low-intensity techniques of hunting and resource management are replaced by more intensive technologies.

The devastation of wildlife on the island of Guam is illustrative of the effects of overexploitation and habitat destruction for commercialization (Savidge, 1984). The Chamorros, the earliest known human inhabitants of Guam, subsisted on agriculture, fishing, hunting and gathering, using relatively unsophisticated technology. Introduction of exotic species and intensive exploitation of the native fauna followed colonization. In present times, many native species of plants and animals are already extinct on the island or are threatened with extinction. For example, habitat loss and overhunting have severely depleted several species of fruit bats. These animals are a popular food item in Guam and fetch as much as US$ 20 each. Gathering in large roosts, the fruit bats are an easy prey for the hunters who now use guns rather than the traditional nets (Savidge, 1984). The birds and the marine resources on Guam and on other Micronesian islands face similar fates.

Habitat degradation can be avoided through managed land use. While land use decisions can be reversed in the future to favour wildlife, many effects of present policies cannot be. Once severely degraded, most environments cannot easily be restored to their previous potential for wildlife or biological productivity.

Summary and Conclusions

Animals are everywhere, and everywhere they are valued by humans for a wide variety of reasons. Though usually valued positively, some animals have negative values, such as the locust swarms of Africa and Asia. Sometimes the value placed on a certain animal species varies according to context, as in the case of the highly valued elephants of East Africa which become dangerous threats when crop raiding.

Animals are most frequently valued by humans for their meat. Caldecott (1988) reminds us: "Where game stocks remain adequate, monetary poverty need not be associated with dietary poverty." In addition to meat, since earliest times animals have been providing humans with other products vital for subsistence, such as clothing, tools, medicine and material for handicrafts and art. Many of these animal products have also acquired commercial value in local, national, and international markets. Game meat, including insects, is sold in many local markets. Hides and skins have had significant international markets. And some animal products, like elephant ivory, musk from musk deer and rhino horn, have been so valuable that their quest has shaped human history.

Wild animal species have other values that are non-consumptive in nature. These include religious and spiritual values, values due to the willingness of tourists to pay to see them, biotic function values and what can be termed "emergent ecological values."

The goal of community forestry

Community forestry aims to assist local people to improve their livelihoods by successfully managing their natural resources, particularly trees and forests, through forestry and forestry-related projects. Wildlife plays an important role in the lives of many of the people targeted by these projects. Wild animals fulfil this role only if their populations are conserved. Often, the conservation of wildlife can be enhanced if the utilization of the animals by humans is recognized and integrated into management systems. Many wildlife conservation projects, particularly those in Africa, contain elements of both preservation and utilization. This combining of objectives is due to the fact that most wildlife conservationists have come to recognize the legitimate rights of rural populations to use their natural resources and the fact that any conservation scheme must have the support of local people to survive.

All around the world, changing human behaviour, changing management patterns, habitat modification and resource depletion have often resulted in the destruction of the wildlife resource and the consequent diminishment of an important part of the subsistence and economic base of local communities. A positive step forward can be achieved by including wildlife in community forestry projects that are designed to buffer some of the detrimental effects of the changing trends. The principle of responsible stewardship of the natural world is an important element in the examples of wildlife use and management cited throughout the text. Such a principle can provide important guidelines to develop local community forestry activities that can integrate wild animal species within them.

Where communities cannot afford to preserve their wildlife for their intrinsic ecological functions alone, the successful incorporation of wildlife into productive local enterprises may accordingly help achieve conservation goals with little need to modify land use patterns. At one extreme, in regions where the landscape is heavily settled, smaller species of animals may be managed for human use in sacred groves, along riverine forests and in small woodlots. In such places, beetle larvae, butterflies, large lizards and rodents can be managed for food and commercial sale. In regions where extensive selective logging has taken place, but reasonably large patches of forested land remain, management efforts could focus on deer or small antelope, large rodents, large insects, tortoises and butterflies. At the other extreme, where local people have rights to very large areas of relatively intact forest, management could focus on all of the above-mentioned species plus large animals of interest to tourists such as okapi, large macaws or jaguars.

Finally, the terms in which a project's success will be measured must be made clear from the outset. The aim of all community forestry projects is twofold: first, to enrich and improve the well-being of human communities, and second, to help preserve the world's biological diversity. As can be seen from the numerous examples in Chapter 5, when local inhabitants are included in the decision-making process and given the responsibility for and the benefits from the sustainable management of local wildlife, projects are more likely to be assured of success and the resource is more likely to be protected.

Glossary

abiotic	non-living
bezoar stones	hard lumps formed in the stomach or gastric system, typically in ungulates
biotic	living
catchment basin	a natural drainage basin which channels rainfall into a single outflow; used also to refer to an area from which game animals are harvested
culling	killing a select number of organisms, usually for management purposes
entomology	the study of insects
ethnobotanists	scientists studying the use of plants by humans
fallow	a previously cultivated area which is left uncultivated so as to increase future agricultural productivity
game	animals which are hunted by humans
herbivory	the consumption of photosynthetic material (usually leaves) by animals
herpetofaunas	the reptiles and amphibians found in a given region
heterothermia	cold-blooded
homeothermia	warm-blooded
invertebrates	animals without backbones (such as insects)
kwashiorkor	a severe form of malnutrition due to insufficient protein consumption, most commonly found in children
market hunting	hunting for sale in markets
nagana	(in cattle) tsetse disease
neonate	a new-born animal
neotropics	the tropical regions of the western hemisphere
phylogenetic	related to phylogeny; the evolutionary relationships between groups
savanna	open, grass-dominated ecosystems
source faunas	the entire animal life of a given region available for use by humans
sustained yield	the condition of being able to harvest at a given rate over a sustained period of time
swidden agriculture	shifting cultivation
ungulates	hoofed animals
vertebrates	animals with backbones (such as mammals, fish, birds, etc.)

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