

CONSERVATION IN THE DEVELOPING WORLD: IDEAS ON HOW TO PROCEED

BERNARD PEYTON, Museum of Vertebrate Zoology, University of California, Life Science Building 1120, Berkeley, CA 94720

Abstract: Whereas many short-term goals to maintain bears and biodiversity target biological concerns and use preservationist strategies, long-term maintenance depends on improving human welfare and development. The focus of this paper is to provide ways to resolve conflicts between short- and long-term goals and to improve the delivery of inputs to human and wildlife targets in developing countries. The entire world community has a stake and responsibility in the outcome of bear conservation. The importance of bears to the progression from permanent agriculture to regional development, and to national, and international security is discussed.

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This paper offers solutions to the problems conservationists face in the developing world. Solutions have relevance when the problem has been appropriately identified. In the section titled "The Target of Conservation," I offer my view of the problem based on the 5 years of research I conducted on the spectacled bear (*Tremarctos ornatus*) in South America, my travels to national parks in Africa and Asia, and a review of the literature documenting the shift in international conservation policy from one of preserving beauty and national heritage to one of supporting sustained development (Int. Union for the Conserv. of Nat. and Nat. Resour. [IUCN] et al. 1980). The message from these sources of information is: problems are best solved under a pluralistic agenda, one that involves the collaboration of experts in the diverse fields of anthropology, sociology, economics, history, politics, ecology, and religion to name just a few disciplines. The recent attention to the contribution of diverse fields to conservation during the World Parks Congress held in Bali, Indonesia (1982), and recently in Caracas, Venezuela (1992), and documented in the World Conservation Strategy (IUCN et al. 1980) and its follow up document "Caring for the Earth, a Strategy for Sustainable Living" (IUCN et al. 1991) attests to this view. If the problem facing a bear species is only identified as being one of subsistence hunting, poaching, or the destruction of habitat by landless peasants, solutions tend to be restricted to better law enforcement that prevents these uses of wildlife. Such area protection most often results in limiting rural people's access to resources they depend on for survival (McNeely et al. 1990). These preservationist policies have little relevance in the developing world where nations are struggling to meet the welfare demands of an exploding and largely urban human population while trying to maintain political stability under strict austerity measures imposed by international lending institutions. In the introduction I explain why this is so. I provide specific solutions that have or would benefit bears from 3 different perspectives: legal, economic, and

biological. The goal of conservationists is to change behavior in the target audience to benefit both wildlife and humans. Conservation is thus more of a social and political endeavor than a biological one.

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INTRODUCTION

The hierarchy of problems (in descending order of importance) that contribute to the decline in bear populations are human population growth; the effect humans have on bear habitat (destruction, fragmentation, and alteration) and bear numbers (demographic effects); and last, reduced viability due to the loss of genes that results from the preceding effects. The more holistic the approach to bear conservation, the more humans must become the targets of conservation action, and the less the biological disciplines have to offer to the solution. The challenge facing the conservation community is to identify the key pressure points in the system that require action, and implement the appropriate measures given the capacity of the target audience to use and benefit from them. In the following sections I will present a sketch of the targets at the community, national, and international levels of social organization as they pertain to the conservation of the spectacled bear (*Tremarctos ornatus*). My purpose is to illustrate the complexity of human social structures that affect bears and other threatened taxa in the tropics.

The Biological Perspective

The major threat to spectacled bears is habitat destruction and fragmentation. Illegal hunting and commercial use of bear parts is of secondary importance, unlike the situation in Asia where these activities have as much if not more effect on bears than does habitat loss (Mills and Servheen 1991). Slash and burn agriculturalists are removing the best forest habitat for bears (1,000-2,500 m elevation) at a rate of approximately 40 m of elevation a year. These low montane forests provide a year-round supply of tree fruits and epiphytic bromeliads, the latter a preferred food when fruits are not ripe. Lack of soil nutrients and increased pests force the farmers to move up the slope every 3 years. Cattle graze both the abandoned fields below the ones currently in use and above the forest on paramo grasslands (3,000-4,000 m) where spectacled bears feed on terrestrial bromeliads (Peyton 1986). Because researchers have not found spectacled bears that are isolated in the bamboo and stunted forests between these 2 habitats, I suspect that bear survival in the Andes depends on access to these habitats. The replacement of the fruit trees with corn results in corn depredation by bears that are easily killed by hunters. The livestock affect the soil and thus prevent forest regeneration and promote flooding.

If the analysis of the problem stopped here and the conservation community had not advanced beyond the thinking of the Second World Conference on National Parks held in Wyoming in 1972, the appropriate target would have been the bear, and the prescribed solution in South America would have been to force the farmers to starve on some other mountain. The result by the beginning of the next century would be the eradication of bears in all but the 4 or 5 largest and least accessible national parks, perhaps La Macarena, Sanguay, and Manu among them. These islands would be embedded in a sea of human poverty whose waves would break over the shorelines daily for survival. In the Andes the "tragedy of the commons" is the wasting of watershed products once the vegetation is removed and trampled. Seen from this perspective, bear habitat conservation and human civilization go hand in paw. Worldwide slash and burn agriculturalists eliminate more forests than the total amount eradicated and disturbed by cattle ranching, commercial logging, and fuel gathering combined (McNeely et al. 1990).

Pluralistic Perspective

The enlightened conservationist must recognize that if people cause the problem, then they must be the target of conservation action. The driving forces of

change are social, economic, and political, and the solution must redress the inequities that forced them to hack their livelihood out of the forest. Cloud forest destruction is intimately tied to the failed agrarian reform measures the military governments of the 1960s in Latin America imposed on its poor. In the late 1950s and early 1960s, 2% of the human population in Peru controlled 78% of the land (Gradwohl and Greenberg 1988). Most of the remaining land holdings were too small to support the farmers. With hindsight we might say that the appropriate solution was to privatize farms, develop transportation, provide farm credits, and construct markets: painful solutions that the world is currently observing in what was the Soviet Union. Instead, the military governments built state-run cooperatives. With no incentives for the peasants to improve agricultural output, they migrated into urban centers where they believed educational opportunities and wages would be better. In 1963 the military government of Peru abdicated control to a popularly elected president, Fernando Belaunde Terry. He was faced with a rapidly growing urban population that severely strained the ability of the national budget to accommodate their welfare needs. During the period 1941 to 1981, Peru's urban population grew from 7 million inhabitants to just under 18 million (De Soto 1989). To relieve the congested cities and provide labor to extract resources from the Amazon basin, President Belaunde used foreign aid to build roads over the Andes to the jungle. Tropical countries like Peru that have poorly developed economies have no choice but to balance their budgets by mining their natural resources. Up until recently, this drain of resources from southern poor to northern rich nations has suited the foreign policies of the developed world, whose aid packages were designed to facilitate the flow. Contrary to expectations, the urban population continued to soar, but a smaller percentage of sierran inhabitants left their impoverished farms and dispersed toward the jungle. On the basis of hunter interviews in 52 separate regions in Peru, I estimated that spectacled bear populations were reduced to one-third of their former level 20 years after the roads were built (Peyton 1981). The other bear species that is most likely to be affected by resettlement programs is the sun bear (*Helarctos malayanus*). The World Bank-sponsored transmigration project in Indonesia to voluntarily relocate people from the crowded inner islands of Sumatra and Java to the less populated outer islands of Kalimantan, Sulawesi, and Irian Jaya is the largest such program in the world. It has already moved 3.5 million people. Resettlement projects in Indonesia have resulted in the loss of 48

million ha of forest (Gradwohl and Greenberg 1988). The Federal Land Development Authority in Malaysia by 1984 had moved approximately 500,000 landless people, which resulted in the loss of 6,000 km² of closed canopy forest in the range of the sun bear (Collins et al. 1991). In my experience the single most damaging effect on wildlife populations in the tropics during the last century has been improved human access.

If the analysis stopped here, the major issue would be to relieve the pressure on the habitat. The targeted population would be the communities of landless farmers, and the solution would be to provide permanent agriculture. However, permanent agriculture depends on either a central authority that prevents personal excess, such as existed in the time of the Inca, and today in China and Cuba; or private property laws that are enforceable. Peru has neither. This is why no farmer wants to invest in anything permanent. The state or a wealthy neighbor could take it away. In his landmark study of the nature of informal economies in Latin America, Hernando de Soto (1989) revealed that the executive branch of Peru's government maintained a mercantile economy by passing 99% of the laws without parliamentary consultation, an average of 17,000 new laws annually. While these laws continue to prevent citizens from accumulating capital, citizens gather in informal institutions to meet their needs. Between 1960 and 1984 black marketeers managed to spend 47 times what the state spent on housing. They have constructed 83% of the markets, and operate 95% of the public transportation, all illegally (De Soto 1989). Instead of liberating capital, the legal tangle has buried it underground. It is little wonder countries like Peru have a hard time competing in international markets when it takes more than 280 days to start a small business there and costs a small industrial firm more than 300% of its after-tax profits to comply with government laws (De Soto 1989). It is generally recognized that countries that have the most damaged ecosystems are the ones that have poor property rights (McNeely et al. 1990).

If our analysis stopped here we would additionally identify the need to pressure legislators to reform judicial systems and government policy. But this is only half the picture. The other half is the self-interest of the developed nations to maintain their access to natural resources. This they have done by creating a mercantile relationship with the resource-based economies of the world through the control of capital markets, high tariffs on third world exports of manufactured goods, and self-serving lending policies. Most

foreign aid is bilateral (65%) and is given in the form of technical assistance and credits to purchase goods to promote the economic and security interests of donor nations (Williams 1991). By any other name it is a subsidy in the donor countries.

Up until 1985, 80.7% of the world's foreign aid bought machinery and consultants of developed countries or OPEC nations (Pearl 1989). Two years later three-quarters of the total foreign aid of the United States was budgeted for military assistance, and the next 2 largest donors, Japan and Germany, earmarked their aid to increase their access to foreign markets (Wolf 1987). The majority of the concessionary aid (55%) (Williams 1991) went to the countries with the most natural resources, a harvestable collateral.

To elucidate what effect aid might have on third-world economies I repeated an analysis done by Ayres (1989) wherein he found a positive correlation between the amount of external debt of selected third-world countries and their annual amount of deforestation. For 16 tropical nations with bears and 45 tropical nations without bears I found similar results ($r = 0.5173$, $P = 0.04$; $r = 0.9437$, $P \leq 0.001$). These correlations do not prove that tropical nations are paying off their debt by harvesting their forests, because deforestation rates for all tropical forests analyzed ($n = 61$) are also positively correlated with the size of the country ($r = 0.9079$, $P \leq 0.001$), the amount of wilderness and forest remaining ($r = 0.6334$ and 0.9433 , $P \leq 0.001$), and the human population size ($r = 0.29$, $P = 0.02$). A more telling statistic for the 16 countries with bears is the correlation between the percentage of the total closed forest area lost each year and the external debt expressed as a percentage of a country's annual exports ($r = 0.8012$, $P \leq 0.001$), or its gross national product ($r = 0.6851$, $P = 0.005$), 2 measures of the ability of a country to pay its foreign debt. Using percents as variables helps eliminate the biases size of closed forest and debt have on deforestation. When the effects of size of the country and human population on the dependent variable are controlled in the preceding analysis the correlations between variables is stronger (partial correlation, $r = 0.8666$, $P \leq 0.001$; $r = 0.7083$, $P = 0.007$). More analysis will be needed to confirm the relationship between deforestation and foreign debt. Targets for conservation action exist at all levels of human social organization.

Finally the megaproblem that underlies the disproportionate distribution of resources and access to them is human population growth. The tropical nations have 75% of the world's population but only 15% of the wealth (McNeely et al. 1990). By 2025 the world's

population is expected to exceed 8,400 million people, 84% of whom will be living in developing countries. Nowhere is the prognosis of human population growth more dangerous to bear species than in Asia. In 2025 Asia's projected population ($n = 4,928$ million) is expected to be nearly equal to the world population of 1988 ($n = 5,112$ million). At this time 1 in every 4 people will reside in the Indian subcontinent (Williams 1991).

Sloth bears (*Melursus ursinus*) are vulnerable because their range on foothills south of the Himalayas is more desirable to agriculturalists than land at higher elevations. The known populations in India are small (35-225 bears) and insular (Servheen 1989). Asiatic black bears (*Ursus thibetanus*) likewise will be hurt as Himalayan watersheds are destroyed by villagers meeting their fuelwood requirements. The wide geographic range of the Asiatic black bear speaks well for its survival but its preferred status among Asians for its medicinal properties, and the extensive trade in bear parts (Servheen 1989, Mills and Servheen 1991) will cause its extinction in the wild if conservationists adopt a policy of benign neglect. The large forests of Malaysia and Indonesia offer the sun bear its best chance of survival provided laws are drafted and enforced for their protection over the short term. Indonesia not only contains the majority of the Asian tropical forests (113,895 thousand ha, 37.3% of the total) (McNeely et al. 1990), but also has the second highest deforestation rate in the world and the fifth largest human population (Servheen 1989), which will double in the next 35 years (Williams 1991, Hammond 1990). At the current rate of deforestation, there will be no forests left in Malaysia and Indonesia by the end of the next century (table 19.1 in Hammond 1990). Giant panda (*Ailuropoda melanoleuca*) populations exist in 12 reserves on 6 mountain blocks in China. There is considerable habitat fragmentation within forest blocks. During the last 17 years George Schaller (Wildlife Conservation Society, New York, N. Y., pers. commun., 1992) estimated that giant pandas lost 40% of their range to human encroachment. Threats include the loss of lower elevation range, clearcutting that destroys bamboo (the panda's principle food), poaching for pelts despite stiff penalties including death, and the removal of bears from the wild to zoos where reproduction is poor and not encouraged (Donald Reid, University of British Columbia, Vancouver, and George Schaller, pers. commun. 1992). Survival of the giant panda will require the most intensive efforts to improve habitat quality and reduce human interference.

SOLUTIONS

The key to lowering the world's population growth is to increase the distribution of income to the world's lowest income earners. Studies in South Korea, China, India, and Puerto Rico all indicate a substantial drop in fertility with very minor increases in income. In India the distribution of land, the main source of power in a community, has the most influence on fertility. The more land, the lower the birth rate. In the Andes, children are considered assets by parents. Peasant farmers want large families to protect their fields from being stolen, to have a diversity of talent to draw from in the family unit, and to provide for their old-age needs. A slight increase in employment and thus living standard results in families accumulating capital. Birth rates start to decline once families perceive that they can provide for themselves without accumulating children. Excess capital they spend on education and welfare for their families (Repetto 1979). The higher the education level, particularly for females, the lower the birth rate. For 75 countries with tropical forests in 1989 the number of children per 1,000 individuals was positively correlated with the percent of females who were illiterate ($r = 0.7018$, $P < 0.001$), and negatively correlated with the proportion of the population that was urban ($r = -0.3832$, $P = 0.001$), the per capita gross national product ($r = -0.5152$, $P < 0.001$), and the proportion of the national budget spent on health ($r = -0.2346$, $P = 0.112$) and welfare ($r = -0.4883$, $P = 0.001$). Education opportunities increase in urban environments as do the delivery of health and welfare benefits. Repetto (1979) found that a rise in income had little to no effect on birth rates for wealthy nations. The implication of this is staggering in light of the fact that 85% of the births occur in developing nations. A slight redistribution of capital from the wealthy nations to the poorest people of the developing nations would have a profound future effect on world population growth and its natural resource base. For these reasons I argue that the highest priority of conservation efforts is to provide jobs to those who live with nature, not just capital. In the following sections I discuss 3 approaches that directly or indirectly benefit bears and people.

Legal and Policy Approaches

The most cost-effective way a person can influence birth rates in developing nations is by influencing law and policy. On the international level helpful policies are those that reduce market interference and increase flow of resources to developing countries. These would

include policies that liberalized trade, removed tariffs on imports from third world nations, and removed subsidies on the agricultural products of developed nations. Acceptance of these conditions by wealthy countries should be conditional on better distribution of capital assets in the developing countries. Trade barriers and international debt combined cost third-world nations nearly 3 times what they receive in development assistance (Durning 1989).

Incentives and pressure should be exerted on non-signatory nations to ratify the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES, Washington 1973) and the Convention Concerning the Protection of the World Cultural and Natural Heritage (Paris 1972). If voluntary compliance was not forthcoming from a country, tariffs could be raised on its export products and foreign aid could be withheld. Incentives could include relaxed tariffs or increased foreign aid tied to compliance.

Ratification of CITES is one of the first steps toward controlling trade in animal products. Another step is to standardize environmental laws throughout the world and incorporate the standards in the General Agreement on Tariffs and Trade (GATT). At the moment the United States does not bar imports on products that are produced in an environmentally unsafe manner and GATT rules do not apply to United States domestic policy (Wall Street Journal, 12 Feb 1992). World lending institutions need to adopt policies such as the Wildlands Policy of the World Bank (1986) to prevent implementation of projects that indiscriminately destroy natural resources, particularly projects that resettle large numbers of people into ecologically fragile areas they are not familiar with. To benefit bears one target should be the Asian Development Bank, which follows the policies of Japan, its biggest contributor.

At the national level developing countries should tie authorizations of multinational corporations to operate with significant improvements in the host country in the areas of providing jobs, improving technical ability, increasing the manufacturing base, and compliance with environmental standards (Pearl 1989). If not, developing nations will be forever trapped in mining their natural resources. To the extent that these measures can be standardized over large regions they will prevent multinational corporations from being able to play countries off each other.

Conservationists have an obligation to educate legislators about the link between environmental degradation and world security. Tactics of change include short-term measures to broaden the military's role in environmental issues and long-term prospects of

transferring significant funds and human resources from defense to other needs. The United States, which spent 24.6% of its budget on the military in 1989 and only 1.8% on education (Hammond 1990), should take the lead. A mere transfer of 0.1% of the world's annual military expenditure would fund a 5-year action plan to save the world's tropical forests (Renner 1989). Reallocated funds from military budgets could be used to establish parks along contentious border areas. As of 1989 there were 68 border parks involving 66 countries (Renner 1989). Candidates in the Andes for border parks include borders between Colombia, Ecuador, and Peru, and Venezuela and Brazil. In tropical environments, defense departments can provide scientists with travel to remote areas, technical support, maps that are unobtainable by the general public, and remote sensing devices. Field biologists can provide the military with knowledge of environmental and social issues and survival training in remote areas.

At the regional level, laws and policies should emphasize ecosystem conservation in addition to species concerns. Riparian areas are of critical importance to bears and the vast majority of species throughout the world. We need national and regional legislation protecting wetlands and riparian areas as threatened ecosystems. These measures should be carried out by an institution at the cabinet level, such as a National Institute of the Environment.

Economic Approaches

Consumptive Use.—To save species in the tropics it is essential that they have utilitarian value to create incentives to not destroy them (Freese and Saavedra 1991). In other words we must "use it or lose it." Because parks are too small for bears, these values must exist for bears outside protected areas. The extremely high value placed on the trade of both live bears and their parts in Asia presents a conundrum for conservationists. The adoption of international laws protecting the trade of endangered species, strict enforcement, and education to change Asian values toward wildlife are vital (Mills and Servheen 1991), but may occur too late for bears in much of Asia. On the other hand the advocacy of consumptive use for bears is inappropriate under the prevailing methods of evaluating commodities. Conventional income accounting does not recognize the depletion of natural resource inventories.

Thus the economy of Indonesia was evaluated as increasing 6-7% annually while the reality was closer to 3%. The difference is the value of the declining assets such as timber, petroleum, and soil (Repetto et al.

1989, Warford 1987). In Asia, evaluating the depleted asset as capital would cause bears to be harvested to extinction. To the local beneficiary the low growth rate of bears tends to discount future benefits below the perceived present value. If the bear gets away, somebody else will use it. This is perceived as a missed opportunity cost (Clark 1976) which further depresses future benefits.

The choice of the conservationist here is to know whether to go with the prevailing short-sighted utilitarian ethic, against it, or both. I suggest exploring both. Export bans by themselves do little to promote sustained wildlife use because they don't consider wildlife can be managed as a renewable resource. When bans are in effect, trade goes underground, prices and incentives synergistically escalate, and traders are not surprisingly reluctant to inform the government of their activities. Thus there is little public knowledge of the extent of illegal trade (Thomsen and Brautigam 1991). To make sustained management work, incentives must be created that will promote voluntary compliance with limits on harvest and promote cooperation among trappers, traders, and government agencies.

A model program to protect parrots in Suriname provides a way to proceed. Here the government agency responsible for enforcing wildlife laws (Natural Protection Division of the Suriname Forest Service) teamed up with a nongovernment organization that promoted scientific research and tourism (Stichting Natuurbehoud Suriname). They developed a sustained-use strategy of exporting parrots that caused agricultural damage, thereby earning a modest amount of foreign exchange. After reviewing the data on species distributions and abundance, they established quotas that would be adjusted annually. People who wanted to export were required to join an association of animal exporters and keep a logbook on the trapping activities and on the number of birds in holding facilities. Authorizations for the association can be withdrawn by the government if inspections revealed noncompliance by only 1 person in the association. Thus there was incentive for association members to police themselves. It is important in any development scheme for the target audience to share some of the risks to create incentive. The exporter received through the Central Bank at least a minimum payment set for each species in local currency. To receive it, the exporter had to comply with reporting regulations and the importer had to pay the Central Bank in United States dollars. One year after the system went into effect, Suriname earned 240,000 dollars (U.S.) in foreign exchange, and illegal trapping and trade had been reduced (Thomsen and

Brautigam 1991).

Tropical bears could be managed under this scheme if the local communities were able to profit sufficiently. First, all countries that have not become signatory parties to CITES should be tempted to do so. In addition, all countries in southeast Asia should sign a convention that establishes region-wide regulations on the trade of animal products. Biologists must come up with census methods that can be carried out by local people, economists must come up with a net production evaluation of bears that does not ignore depletion in assets (Saether and Jonsson 1991), and educators must provide the public with additional values to counterbalance the practice of discounting an asset's future worth. The important message I present is not what to do, but not to throw the problem out before approaching it from a multidisciplinary perspective. To admit that a species has economic value in sustained yield is not the same as saying it has less of other values. The best strategy for preserving tropical bear species is to present the problem in the context of the values and beliefs that currently exist in the target human population.

The indirect consumptive measures that have been successful for protecting bears link community development with conservation. An approach with growing popularity is the creation of a wilderness core area surrounded by buffer zones where forestry extraction, alternative farming, and human habitation are permitted (Grumbine 1990). This is the concept behind UNESCO's Man and the Biosphere program. The La Planada Reserve in Colombia was set up in this fashion to experiment with alternative forms of agriculture such as palm utilization to benefit the Awa Indians. The result has been to reduce agricultural expansion into bear habitat while increasing agricultural output (Orejuela 1989).

These kinds of projects offer the greatest opportunity for conservationists to tuck their concerns under the umbrella of a large budgeted project. During the late 1970s USAID sponsored a road-building project into the Palcazu Valley of central Peru as part of a resettlement effort to relocate Amuesha indians to areas where they could receive land titles. A committee of concerned professionals in what became known as the Pichis-Palcazu Special Project objected to plans to move thousands of people into an area with 45 degree slopes and 7 m of annual precipitation. They oversaw the establishment of the National Park of Yanachaga, which protected the core watershed. This park has spectacled bears. The Amueshas were employed in the buffer zones harvesting timber in strips 20-50 m wide and

under a 30-40 year rotation. Draft animals removed the larger timber. Smaller trees and vegetation on the edge of the strips provided seeds for recolonization. Nutrients in the form of small branches were left to recycle and, unlike slash and burn agriculture, there was no burning. This is a project that uses a resource in a sustained way for local benefit. The estimated profit per ha with this long rotation could reach \$3,500 U.S., which is \$500 less than an estimate provided for timber harvest in the Amazon basin (Gradwohl and Greenberg 1988, Ayres 1989). Development agencies and nongovernment organizations (NGO) should lower their guards and learn how to exploit each other for mutual benefit.

Preserving diversity in tropical bear-inhabited areas has its most immediate application in agriculture and pharmaceuticals. Areas where there are spectacled bears have provided human society with the potato, tomato, and cinchona bark, the source of quinine that combats the disease that has killed more people than any other: malaria (King 1992). Wild relatives of the potato and tomato are eaten by spectacled bears and could be important sources to confer disease resistance to these world staples.

Nonnative species comprise more than 98% of the agricultural produce in the United States (Wood 1988). Half the world's daily calories come from maize and potatoes, both new-world crops. By weight, one-third of the world's top crops originated in the Americas. Before the Spaniards found the potato in 1535 in Peru, the local farmers cultivated more than 3,000 varieties. The importance of this diversity was not lost on the 1 million Irish who died and the 1.5 million who emigrated in 1845 after the potato crop failed due in part to limited genetic diversity (King 1992). Laws and contracts will be necessary to obligate the pharmaceutical companies to pay a percentage of their profits and provide jobs to the local communities from which the wild progenitors were extracted.

Nonconsumptive Use.—The most valuable measure that protects bear habitat is the maintenance of watersheds. The Himalayas and the Andes are the 2 areas of the world with bears where watershed conservation has the most relevance. Annual costs of damage from flooding in India has been estimated to be \$250 million (U.S.), not counting the suffering of millions affected by loss of life and property (Spears 1982). Population pressure pushes disadvantaged people into mountainous regions where nutrient-poor soils are particularly vulnerable to erosion after forest removal.

How to give the local farmer the maximum

agricultural yield while maintaining soils is as much a challenge for sociologists as it is for hydrologists. With so little room in their economies for failure, peasants opt for secure measures, even if they result in low yield. Livestock grazing in the cloud forest of the Andes is such a measure. Cattle are capital on hooves to the landless Andean peasants. During the short term, peasants receive benefit from trading cattle for food when their crops fail. At some point the increase in beef does not offset the degradation of the soil, and the farmer is worse off. On the steep slopes between the Forest Reserve of Antisana and the National Park of Cayambe Coca, a Peace Corp-sponsored project was underway in 1985 to increase forage by planting nitrogen-fixing trees in small pastures. Measures such as these take the pressure off the steep slopes where overgrazing can do the most harm.

Ecotourism is one of the fastest growing industries in the world, but it is insufficiently exploited to benefit tropical bears. The United States sends approximately 5 million ecotourists annually to foreign wild areas, where they spend \$2,000-3,000 (U.S.) apiece. In Nepal and Ecuador, 2 countries with bears, ecotourism is the major vehicle for earning foreign exchange. Tropical bears are secretive and live in areas of poor access and visibility, conditions that do not favor tourism. However, crop-pest bears in South America can earn tourist revenue. Spectacled bears raid cornfields, starting 3 weeks before harvest in the lower elevations of the valley. By the time the corn is ripe in the upper elevations of the valley (2,500 m), the fields lower down have been harvested. The drop in food availability concentrates the bears in the few fields at the upper end of the valley where as many as 9 bears can be seen simultaneously. The predictability of the bears being there offers the best opportunity I know of to see spectacled bears. Local farmers would need to be compensated for their crop losses and time spent shooing bears out of the fields when there were no tourists. Candidate sites for bear viewing include Cayambe Coca National Park in Ecuador, and the Historical Sanctuary of Machu Picchu, Peru. The goal is to solve people and wildlife problems at the same time.

The approach of solving several problems simultaneously occurred to Dr. Thomas E. Lovejoy when in 1984 he proposed exchanging international debt for the options to do conservation work. Known as "debt swapping," the vehicle allows NGOs to buy debt at a discount on the financial market. A host country bank redeems the discounted debt in local currency to be used for conservation measures. The downside of

debt swapping is that it can increase inflation in the host country. Fundacion Natura, a conservation-oriented NGO in Ecuador, managed to keep inflation down by arranging to receive local currency from the Central Bank in small amounts over time with which it funded national parks. The greater the amount of debt and inability to pay it, the more discounted its value can be. Potential targets include countries with bears whose international debt exceeds 25% of the value of their exports (Mexico, Venezuela, Ecuador, Bolivia, India, Indonesia, Myanmar, and Turkey).

Biological Approaches

The most promising biological argument for the survival of tropical bears is their flagship status to represent many of the most biodiverse areas of the world. Tropical forests occupy only 7% of earth's surface and contain half the estimated species (Wilson 1988). I learned how much spectacled bears overlap with this diversity when I was invited in 1985 to participate with 2 dozen specialists of neotropical flora and fauna in a workshop sponsored by the World Wildlife Fund (WWF). The agenda was to determine the protected and nonprotected Andean areas WWF should focus on to maintain biodiversity. The participants discovered that their different perspectives resulted in the same choices. Of the 16 protected areas chosen, spectacled bears existed in 12 of them (Saavedra 1986). From a bioregional perspective, 5 of the 10 world "hotspots" for biodiversity chosen by Norman Myers (western Ecuador, Colombian Choco, eastern Himalayas, peninsular Malaysia, northern Borneo; McNeely et al. 1990) are populated by bears. Finally, Russell Mittermeier's (1988) choice of the 12 countries with the highest vertebrate and plant diversity include 8 countries with bears (Colombia, Ecuador, Mexico, Peru, China, India, Indonesia, and Malaysia). One of these, Colombia, with only 0.77% of the world's land surface has 10% of the world's species of terrestrial plants and animals including 20% of the world's birds (1,721 spp.). The country also has half of the parks that contain spectacled bears. Bears represent the world's biodiversity, but they have yet to reach their potential to advertise the urgent need to maintain these resources. Research to document the biodiversity in all bear-inhabited areas of the world should have high priority. Less diverse temperate and holarctic areas where 3 bear species reside should receive at least a third of the overall budget because diversity is most important and useful to those who live with it, and no area on earth is less important in this regard.

Specialist groups such as those of the Survival Service Commission (SSC/IUCN) should be organized to cover regions. Candidate regions include lowland Asian tropical forests and Andean cloud forests. These groups would draft biodiversity action plans for their areas along the lines of what has been prepared in Madagascar and Venezuela. These groups should then consult with groups representing the political, economic, and social concerns of the region to draft regional action plans that incorporate the ecological contribution.

How large should a wilderness area be to maintain a viable population of a tropical bear? After over 25 years of intensive research, biologists still disagree or do not know how many grizzly bears (*Ursus arctos horribilis*) there are in the Yellowstone ecosystem of Montana and Wyoming or whether that population will survive the next few hundred years (Salwasser et al. 1987). Obtaining a population estimate for a tropical bear species is an order of magnitude more difficult. Every aspect of field research in tropical bear areas is mired by limited access and the increased complexity of the habitat. The most effective way to get around these difficulties is to base management on the trend of the population rather than a count. For instance a first approximation of the minimum area needed to sustain a spectacled bear population can be made by noting that only those parks with over 120,000 ha that includes at least 1,000 m of elevation have spectacled bear populations that are judged to be stable or increasing (Peyton 1989). Examination of jaw bones placed in crude age classes from several time periods allowed Dale McCullough (1974) to estimate the trend of an Asiatic black bear population in Taiwan. Population trend data is relatively inexpensive to get, and can employ local people trained by sociologists and biologists (see Herrera et al. 1994, for an example). In recognition of the lack of population information, land managers have increased the odds of bear survival by drafting legislation to preserve corridors between habitat patches. In Latin America this has been done most successfully in Venezuela. Fifteen percent of Venezuela's land area has been designated as National Parks (Yerena 1994).

The most recent method that relies on accurate count data is known as a minimum population viability analysis (MVP). The latter method is popular among members of the American Association of Zoological Parks and Aquaria, the International Union of Directors of Zoological Parks, and the Captive Breeders Specialist Group (SSC/IUCN). The technique involves gathering all the known demographic, reproductive,

genetic, and environmental data from wild populations, building a model, and estimating the probability of the simulated population surviving for 100-200 years (Foose 1990). Minimum population viability analysis is supported by the idea that many species will not survive in the future except in captive or semi-wild situations (Conway 1988). The analysis is well suited for these purposes because it is comprehensive of the major causes of extinction of insular populations (Gilpin and Soule 1986). Proponents and antagonists point out the following challenges of the method: estimating the size and structure of viable populations (Woodruff 1989); how to interpret variation (at what point is inbreeding or outbreeding deleterious); clarifying the relationship between genetic variation, individual fitness, and population viability; and quantifying endangerment and risk with respect to specific time spans.

Critics of the method's application note that the definition of a viable population is nonquantifiable (Wilcove 1989); there is a tendency to substitute parameters from closely related populations or theory for solid information (Grumbine 1990), the results are subject to interpretations (Mace and Ballou 1990, Allendorf and Leary 1986); most animals are not suited for captive management (Terbourgh et al. 1986); the effort will not preserve the organization of nature, just its fragments (Whitmore 1980); preserving genes should be considered a last ditch effort; and the increased attention to the analysis will take away valuable resources which should be spent in preserving animals in situ. Russell Lande (1988) claims extinction is fundamentally a demographic event. If a population goes extinct for demographic reasons, then it does matter what the genetic effects are (Russell Lande, University of Oregon, Eugene, pers. commun.). Along the same reasoning, if the habitat is not protected there will be nothing to put animals back into. Advocates of the analysis technique are well aware of these problems. In my opinion MVP analysis should be done well before a species is endangered to track a population's viability over time. If the time comes when such information is useful, it will be available. There will be competition for funds over the short term between in situ and ex situ advocates. The attractiveness of having a genetic anchor to windward is offset by its cost. The entire annual budget of Serengeti National Park is \$500,000, a sum that would cover the annual care of only 5 primate species in North American Zoos (Western 1987). The funds needed to sustain tropical bears in the wild must come from substantial sources such as development banks, aid agencies, and

multinational corporations. Over the long term the resources themselves must finance bear care.

Maintaining the highest levels of heterozygosity in target wild populations may involve selective breeding of individuals in captivity and their reintroduction into the wild. Notwithstanding the pre-and post-release logistics, weaning captive animals of their dependency on humans, and restoring knowledge in released animals that would have been communicated in the wild (Conway 1989), the real hurdle of ex situ management is its limited ability to benefit local people who live with bears. The sophistication of the facilities and expertise and pressure to act quickly on behalf of endangered species make these efforts extremely "top down" in management style. The lack of education by rural poor who live with bears and their lack of facilities make it difficult but not impossible for them to be included as "animal rescue" beneficiaries. In general the larger the bear population and area it inhabits, the less ex situ management or biology enters into the solution of its survival. Minimum population viability analysis is not the most important management tool for spectacled bears that inhabit the entire eastern slope of the Oriental Andes from southern Colombia to Santa Cruz, Bolivia. Nor is it easily applied to species we know next to nothing about, such as the sun bear. Its best use is to manage insular populations we know a lot about. Among these are captive populations worldwide and insular brown bear populations in Europe (*Ursus arctos*) and North America. Selecting which species, what areas, and when to commit the resources is an art.

Advocates of in situ management must recognize an increasingly large number of species may need ex situ management to survive. They should recognize that national parks and reserves will not provide long-term survival for many wild species they contain (Lovejoy et al. 1986, Wolf 1987, Shaw 1991). In addition to being large, areas for bears ideally should have an elevational component as a hedge against local and global climate shifts, have prospects to integrate nonreserve land into the management plans (Wilcove 1989), and be in a condition to maintain species 10-15 years in the future when management goals are attained. Finally, target areas should be politically stable. Human deprivation and the degradation of the environment are a threat to national and world security. The bulk of the insurrections throughout Latin America during the 1960s and 1970s were located in rural areas with threats to native land security. The collapse of agrarian structures that maintained acceptable terms of trade to farmers in Peru in 1963, 1965, and in the late 1970s

was one factor that accounted for the popularity of the Sendero Luminoso movement in the 1980s. Popular support for the guerilla movement FARC in Colombia came on the heels of the spread of coffee that displaced peasants south and west from the 2 Santander provinces. The effect has been a severe decline in spectacled bear populations in the Central Andean Range. Guerrillas in Venezuela in the 1960s had their strongest support in coffee districts where the percentage of sharecroppers and squatters was triple the national average (Wickham-Crowley 1992). In 1971 I travelled to India from Sri Lanka on a boat with approximately 500 Tamil tea workers that had been thrown out of their country after 4 generations of occupancy. Tamil insurrections have increased since that time.

The strain guerrilla movements put on national budgets combined with the loss of earnings from industries such as tourism results in increased government neglect of welfare issues. The effects insurrections have on local conservation institutions include the loss of support from foreign NGOs and the cut-off of information from guerrilla affected areas. We still do not know the status of spectacled bears in the Cordillera Perija of Venezuela, most of central Colombia, most of Bolivia, and now southern Peru due to political instability. My former study area in the Quillabamba Valley northeast of Machu Picchu, Peru, has until very recently been occupied by the Sendero Luminoso terrorists. This area along with the Huallaga Valley in Central Peru are major coca growing areas. Sendero Luminoso, Farc, and M-19 guerrillas provide protection for the drug traffickers in return for financial support. Poaching in Peru of spectacled bears is on the increase, not by terrorists, but by the police sent to combat them (Renato Marin Laurel, bear hunter and taxidermist, Cuzco). In Africa, elephants increased 2.5% annually under stable governments and declined 16% under unstable governments (Western 1989). Insurgent forces are fighting government troops in 18 of the 45 countries with bears (Dunnigan and Bay 1991).

Implementation of Solutions

Plans and their implementation must fit the ecological, social, political, and economic traits that characterize the target areas where bears live. In general the goal should be to reduce the negative impact people have on bears and their habitat. The complexity of the issues is best addressed in a multidisciplinary fashion. The most important element to include from the very beginning are the people who live with bears.

Every opportunity to make them the beneficiaries of project products should be explored. This section contains some practical advice on how this can be achieved.

The art of program implementation is one that balances the efficiency of "top-down" authority with the "bottom-up" capacity building measures in the target group. There is both a behavior-changing and a physical-resource aspect of most projects. The behavioral side is by far the most important. My advice is for planners to spend considerable time in the target area absorbing the informal and formal ways people conduct their affairs before devising strategies. Project goals should be built on these existing patterns of behavior (Honadle and Vansant 1985). Due to the long history of abuse by authorities, rural peasants should not be expected to embrace project goals until the benefits of the new behavior can be demonstrated to them. The best way to start this process is to include them in all aspects of the project from inception. Make it a priority that the beneficiaries share planning and decision making. Continuity of program execution is achieved by having planners become the program executioners. Greater emphasis should be placed on the learning process and not on achieving goals within a fixed time frame. The goal that needs to be demonstrated above all others is self capacity. The intention right from the start should be for the beneficiaries to take charge of the project. The art here is to balance incentives with obligations. There is every reason why local people should become park rangers, tourist guides, field researchers, and business owners. Not only are they adapted and knowledgeable of the local conditions, but they would have the trust of others in the community. The incentive that has the most effect in community development is one that enables communities to have control over their resources. To develop sufficient responsibility to control resources, the beneficiaries should share some of the risks. Risks that would benefit bears include removing cattle from tropical montane forests and planting alternative crops. Above all, the behavioral and resource aspects I mention in the next paragraph should not isolate people from resources without compensating benefits returned to them. In general it is better to try to find ways people can live compatibly with nature without moving them. Their presence is the best defense against people moving in who do not have their best interests or those of the wildlife in mind.

On the resource aspects of capacity building, every effort should be directed to shorten the distance (Durning 1989) and maximize the flow of aid from the

donor to beneficiaries. An effective way to do this is to support local conservation NGOs that have good working relationships with government authorities. This way aid is shielded from bureaucratic ineptitude. Aid should also be shielded from the donor's political and economic interests. Whenever possible house project goals in existing institutions that have a clear mandate and autonomy, rather than bypassing them or creating new institutions. If the goal is to involve local people then project implementors should stay away from capital-intensive measures and employ technology within the capacity of the target group to use it (Honadle and Vansant 1985). Greater emphasis should be placed on maximum involvement of human resources than on efficient use.

Once the top-down measures have built the capacity for change, implementation should focus on bottom-up measures. It is a creative process whereby people who have gained self-respect form institutions to meet their needs (Honadle and Vansant 1985). The primary reason projects fail is the lack of attention to these development issues. Projects that "save the bear" and last a year or two are not development oriented. The real contribution of a project occurs after it has ended, when the development process has been institutionalized. The most underfunded aspect of a project is usually monitoring and evaluating its performance, particularly many years after the top-down efforts have stopped. Local people as well as independent outside groups should be hired for this purpose. During all phases of the project it is important to exchange information in both formal and informal settings. Finally, the results should be published in sources that are readily obtainable and written in the language(s) of the people who would most benefit from the information.

SUMMARY

The trickle-down theory that has guided economic policy of conservation institutions has largely benefited the targets above the community level. To solve the problems of world human population growth, conservation biologists must make it a priority to affect a more equitable distribution of income to the world's poor. The target that should receive the bulk of the benefits are the people who live with wildlife. At the community level, jobs could be created through development of consumptive and nonconsumptive uses of natural resources that also benefit wildlife. Support for these measures at the national and international levels includes regulation of trade, shifts in policy of

lending institutions and the conduct of multinational corporations, land reform, and the privatization of property. The strategy that has the most effect over the short term is to find creative ways to redistribute the existing capital rather than creating new sources of wealth. Deciding where to act and how to build the capacity for self help in the target audience should be approached in a multidisciplinary forum. The contribution of biologists is to ensure that the areas and methods chosen for conservation are those that maximally maintain future use options. Criteria include maintaining biodiversity and preservation of ecosystem function such as watersheds. Although bears represent but a small fraction of the mammalian fauna on earth, they nonetheless represent a large part of the world's biodiversity. Their continued presence in watersheds is one of the best indicators of the health of the planet.

From the above it is evident that conservation is a multidisciplinary endeavor. Those who are going to make it work are those who can make the connections between its many disciplines. This involves analyzing both qualitative and quantitative data. Management decisions have to be made on precious little of both data types. Plans and policies must be implemented with a careful balance between the efficiency of centralized authority and the sustaining measures of capacity building. Changing behavior in the target population, be they farmers or nations, is a matter of balancing incentives and restrictions. Conservation is thus less a biological activity than a social and political activity. At its best it is grounded in feeling.

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