

La Caza en Bosques Neotropicales

Repaso de los temas, identificación de lagunas, y desarrollo de estrategias.

A Caça em Florestas Neotropicais

Revisão dos temas, identificação de lacunas, e desenvolvimento de estratégias.

Hunting in Neotropical Forests

Review of the issues, identifying gaps, and developing strategies.



**WILDLIFE
CONSERVATION
SOCIETY**

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Amazon River, Peru

September 2002

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y desarrollo de estrategias

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Hunting in Neotropical Forests:

Review of the issues, identifying gaps,
and developing strategies

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CACERÍA EN SELVAS NEOTROPICALES

Revisión de temas, identificación de vacíos
de información y desarrollo de estrategias

A CAÇA EM FLORESTAS NEOTROPICAIS

Revisão das questões, identificação de lacunas e
elaboração de estratégias

HUNTING IN NEOTROPICAL FORESTS

Review of the issues, identifying gaps,
and developing strategies

HUNTING IN NEOTROPICAL FORESTS

**REVIEW OF THE ISSUES, IDENTIFYING GAPS,
AND DEVELOPING STRATEGIES**

**REPORT OF A WCS WORKSHOP
AMAZON RIVER, PERU
SEPTEMBER 2002**

WILDLIFE CONSERVATION SOCIETY

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Glossary

AIDECOS	Asociación Indígena de Desarrollo y Conservación del Samiria.
CABI	Capitanía del Alto y Bajo Izozog, or Izoceño Indigenous Organization.
CARE	Corporation for Assistance and Relief Everywhere.
CI	Conservation International.
CIBT	Centro de Investigación de los Bosques Tropicales, or Tropical Forest Research Center.
CIPTA	Consejo Indígena del Pueblo Tacana, or Indigenous Council of the Tacana People.
CONAP	Consejo Nacional de Áreas Protegidas, or Guatemalan National Parks Service.
DGB	Dirección General de Biodiversidad, or the Bolivian Biodiversity Directorate.
DICE	Durrell Institute of Conservation and Ecology and the University of Kent, Canterbury, UK.
FEPP	Fondo Ecuatoriano Populorum Progressio, or Ecuadorian Fund for Social Progress.
FMB	Fundación Moisés Bertoni, or Moisés Bertoni Foundation.
FOS	Foundations of Success.
IBAMA	Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis, or Brazilian Institute for the Environment and Renewable Natural Resources.
IDSMD	Instituto de Desenvolvimento Sustentável Mamirauá, or Mamirauá Sustainable Development Institute.
ILO	International Labour Organization of the United Nations.
INRA	Instituto Nacional de Reforma Agraria, or the National Institute for Agrarian Reform, the Bolivian agency responsible for land titling.

INRENA	Instituto Nacional de Recursos Naturales, or National Institute for Natural Resources.
IPAAM	Instituto de Proteção Ambiental do Amazonas, or Amazonas Environmental Protection Institute.
NGO	Non-government organization.
NTFP	Non-timber forest product.
NWTF	National Wild Turkey Federation.
OMYC	Organización Manejo y Conservación, Uaxactún, Petén, Guatemala, or Managment and Conservation Organization, Uaxactún, Petén, Guatemala.
SERNAP	Servicio Nacional de Áreas Protegidas, or the Bolivian National Parks Service.
TCO	Tierra Comunitaria de Origen, the term (as defined by ILO Convention 169) used in Bolivia to refer to Indigenous Territory.
TNC	The Nature Conservancy.
TRAFFIC	Trade Records Analysis of Flora and Fauna in Commerce.
UNAP	Universidad Nacional de la Amazonía Peruana, or National University of the Peruvian Amazon.
WCS	Wildlife Conservation Society.
WWF	World Wildlife Fund/World Wide Fund for Nature.

Preface

The Wildlife Conservation Society has been involved in hunting issues almost since its founding in 1897 as the New York Zoological Society. Its founder, William Hornaday, lobbied Congress to pass the Alaskan Game Act in 1902 which set hunting seasons and bag limits for the first time in Alaska, for a moratorium on seal hunting in 1914, and for the Migratory Bird Conservation Act in 1929 which set seasons and bag limits on hunting migratory birds. Since then, WCS's studies of hunting, and using the information to bring about controls and proper management, have grown vastly, and we now have at least 36 projects in 27 countries and four continents across the globe which are directly concerned with hunting in some way. These involve a wide range of activities, from research on hunting patterns and the impacts of different types and levels of hunting on wildlife populations, to producing more than 125 theoretical, management and popular publications on the issue since 1990, to working with governments, resource extraction companies and local communities in long-term programs to bring about effective controls and ensure that hunting is sustainable in core areas throughout the world.

WCS has been a leader in working on hunting issues in Latin America for more than ten years, with much of the early work being brought together in the seminal volume by John Robinson and Kent Redford in 1991. This and other publications around the same time set much of the global thinking on hunting issues in tropical forests throughout the world. Since then, our work in Latin America has expanded further in research, and in turning that research into action. WCS currently has projects concerned solely or partly with hunting management in seven countries in Latin America. Because of the local social and political conditions, these are mainly site based, and the mechanism for achieving conservation is largely, although not exclusively, by working with and through local communities.

We have clearly been leaders in hunting research in Latin America, and also in working with local communities there. But like the rest of the forested tropics, Latin America is changing rapidly, and pressures on land and resources are increasing every year. The unsustainably high wave of hunting which hit Asia first and is now peaking in Africa is likely to hit Latin America within the next five to ten years. This leads to the question: have our research and our relationships with local communities and other agencies in Latin America established systems and mechanisms which are robust enough to ensure that hunting for subsistence and trade is sustainable in the future? And can our network of projects be improved to increase their effectiveness in managing hunting sustainably throughout the continent in the future?

To address these questions, in September 2002, WCS held an internal workshop for its core staff working on hunting and wildlife trade issues in the field in Latin America. This report is on the workshop itself: its aims, core findings, and planned future directions. It is aimed primarily as an internal WCS working document, but because of the importance of the topic, it will also be distributed to key interested partners.

This is merely the first stage of a dynamic and ongoing process, and should be read in that context. Staff will write further reports individually and collectively in the future. We sincerely hope that the process started in this meeting will flourish, both within WCS and with all of our partners. This is crucial if the rich and diverse wildlife of Latin America is to continue to flourish in the wild, and is not all to be destined for the marketplace or kitchen.

The information contained in this report was gathered and written by all of the individual participants for the sites and countries in which they work, notably:

- Richard Bodmer
- Humberto Gómez
- Kim Hill
- Jeffrey Jorgenson
- Richard Margoluis
- Roan McNab
- Andrew Noss
- Michael Painter
- Pablo Puertas
- Damián Rumiz
- Pedro Santos
- David Wilkie

Each author has also continually contributed to the process of compiling the report. Neither the workshop itself, nor this report, could have been done without the sterling efforts of every participant. We thank them greatly for this, and look forward to working with them on developing the ideas and implementing the action plans contained herein. In addition, we would like to thank Helder Queiroz, João Valsecchi, and Leonardo Fleck for their input to the sections of this report on Mamirauá and Amanã.

We would also warmly like to thank Richard Bodmer and Pablo Puertas for giving us the use of their wonderful boat for the meeting, and for all of their immense efforts in ensuring that it kept running, on schedule, and that everything worked smoothly, so that we could have a meeting in a unique setting going along the upper Amazon amidst the sights and sounds of the rain forest, the river, its dolphins, macaws, howler monkeys, vast spectacles of water birds and other wonderful scenes. This could never have been done without you, and we hope that you have had some chance since then to catch up on sleep. Thanks also to Humberto Gómez and others in the WCS Bolivia Program for organizing the production of this report so efficiently.

Felicity Arengo and Elizabeth L. Bennett

REFERENCE

Robinson, J.G. and Redford, K.H. 1991. *Neotropical Wildlife Use and Conservation*. Chicago University Press, Chicago.

Objectives of the workshop

Across the tropical world, over-hunting of wildlife is having detrimental impacts on wildlife populations, causing dramatic declines and local extinctions of many species. Impacts on local human communities who depend on that wildlife for food, income and cultural well-being are also negative. Because of the importance of the issue, WCS has a broad portfolio of projects on hunting in tropical regions worldwide. We have made considerable progress in collecting data on the topic, and some projects are taking dramatic strides in reducing it to more sustainable levels at local sites or regions. The scale of the issue means that we need to step up these efforts dramatically if we are to save many species from local or even global extinction.

Latin America's position in this scenario is somewhat mixed. Human population pressure is lower than in the other rain forest continents, and large areas of forest still remain. The number of people per km² of remaining forest is 522 in South and South-east Asia, 99 in West and Central Africa, and 46 in Latin America. On the other hand, recent studies demonstrate that hunting of at least some species is unsustainable in much of Latin America, and that even relatively light hunting can reduce populations by 80% or more. Moreover, much of the recent thinking about sustainability of hunting in tropical forests, which has shaped the whole field, derives from work in Latin America. There is clearly an urgent need to review the exact threat posed by hunting in Latin America now, how much this is likely to become worse in the future as pressures inevitably increase, and how WCS can ensure that its field projects are taking action to reduce hunting where it is already unsustainable, and implement systems which will allow it to be contained as pressure increases. To this end, we organized a workshop, inviting WCS researchers and other staff who are currently involved in projects relating to hunting and wildlife trade in Latin America.

The objectives of the workshop were:

- to review the current status of hunting and hunting related issues in Latin America, focusing on the core sites where WCS is currently working;
- to exchange experiences and lessons learned between WCS projects;
- to determine major problems and issues, and review what is being done by WCS to address these;
- to determine how WCS can address gaps in knowledge and action more effectively, and identify clear actions and players to do so.

The workshop therefore aimed to result in:

- a WCS network of projects working on hunting issues in Latin America;
- a hunting management action plan for the WCS program in Latin America;
- a published report of the workshop;
- a program brochure;
- a subsequent press conference to be held in New York.

CHAPTER TWO

Participants

Maya Forest, Guatemala	Roan McNab
Yasuni, Ecuador	Jeffrey Jorgenson
Mamirauá/Amana, Brazil	Pedro Santos
Loreto, Peru	Richard Bodmer and Pablo Puertas
Chaco, Bolivia	Andrew Noss
Madidi, Bolivia	Humberto Gómez
Bolivia Santa Cruz program	Damian Rumiz
Mbaracayu, Paraguay	Kim Hill
WCS Peru-Bolivia subregional program	Michael Painter
WCS Living Landscapes Program	David Wilkie
WCS New York	Felicity Arengo and Elizabeth Bennett
Foundations of Success	Richard Margoluis

Organization of the workshop

The workshop lasted for five days. It was held on the WCS/DICE research boat operated by Richard Bodmer and his staff. We started at Iquitos and went upriver into the heart of the Pacaya-Samiria National Reserve and back. Hence, it included short breaks to visit the park, and one of the local communities involved in the conservation program there.

The meeting started with presentations giving overviews of the scale of hunting and wildlife trade and its impacts on wildlife: worldwide, within Latin America, and in the Loreto Department of Peru. Following this, each site-based participant provided an overview of current hunting and wildlife trade issues for the site in which he worked. This included the main issues, past research and its main findings, legal frameworks, major constraints, current WCS activities, and future plans.

Relevant information for each country was then summarized according to topic, specifically:

- research needs;
- education and awareness needs;
- legislative framework and possible needs; and
- capacity building needs at site level, and at other levels.

We then used this information to summarize what needed to be done both at site and regional levels, and drew the findings into one summary table of proposed actions (Section 5.8).

In addition, discussions were held on: research methods used in different projects, options for developing learning portfolios to derive "lessons learned" from WCS field projects, and possibilities for substituting wildlife with other forms of protein.

CHAPTER FOUR

Site summaries

Each site representative gave an overview of hunting issues for the site in which he works, as well as the country or regional context in which that site is based. See the above list for the speakers for each site.

4.1. MAYA BIOSPHERE RESERVE, GUATEMALA

- Sites in Mesoamerica with true wildlife management are very rare. None involves terrestrial wildlife, and none is community-based, with the possible exception of efforts to manage the ocellated turkey (*Meleagris ocellata*) in Uaxactún, Guatemala. Some of the best-known examples of wildlife ranching in the region (iguana and paca *Agouti paca*) have not proven viable.
- The Maya Biosphere Reserve (2.1 million ha) is Mesoamerica's largest protected area. Guatemala's lack of available land, however, makes all protected areas subject to increasing pressure as human populations increase. The threat of over-hunting in remaining forests is typically secondary to the threat of habitat conversion due to agricultural expansion, fire, and the opening of areas for road and petroleum development.
- In addition to other more immediate threats, hunting increasingly threatens wildlife in the Maya Biosphere Reserve, as the ability to control illicit extraction of all natural resources is inadequate.
- Gastronomic tourism is on the rise due to internationally supported development plans aimed to increase tourism in the area. Among the ten species of wildlife found in restaurants frequented by tourists, paca and white-tailed deer (*Odocoileus virginianus*) are the most commonly sold. Despite being illegal, restaurants list wild meat on their permanent menus, reflecting the inability of authorities to enforce the law.
- The law which regulates hunting dates from 1970 and is obsolete. An improved law was proposed in 1998, but after two of the three readings required, it stalled in the Guatemalan Congress. As a solution, the Guatemalan National Park Service (CONAP) produced a Decree as a temporary measure, but it was done without consultation with local communities, NGOs or most others affected by the legislation, and is inadequate.
- Since 1993, WCS has studied and promoted the sustainable use of wildlife in the forests of Uaxactún, Petén. Five years of data revealed that mammals comprised about 67% of the biomass harvested. The mammals most commonly hunted by villagers were paca, red brocket deer (*Mazama americana*), white-lipped peccary (*Tayassu pecari*) and white-tailed deer, and the most-frequently hunted birds were the great curassow (*Crax rubra*), crested guan (*Penelope purpurascens*) and ocellated turkey.
- Data have also been collected in Uaxactún on the abundance of hunted wildlife species around villages and in nearby source areas. Although the area affected by hunting in Uaxactún appears to be expanding, wildlife continues to be relatively abundant in the large source areas at least 10 km from villages.

- A WCS study of hunting by people extracting the non-timber forest products (NTFPs) "chicle" and "xate" showed that wildlife harvests were correlated with the presence of guns and dogs. Twenty-two wildlife species were hunted in a six month period, and harvesters earning lower wages were more likely to hunt animals encountered. Current levels of hunting across the Maya Biosphere Reserve are probably sustainable, but there is a limit to the number of impoverished harvesters who can collect NTFPs without depleting some wildlife species.
- WCS, the National Wild Turkey Federation (NWTF) and CONAP have developed a sport hunting and conservation program based on the ocellated turkey in the Uaxactún forest concession. This aims to replace the subsistence harvest of ocellated turkeys by villagers with a highly lucrative controlled sport-hunt for male ocellated turkeys. This increases income by 356 times per turkey harvested. Funds are managed by the village Hunters' Commission with WCS/NWTF oversight. They are used to strengthen other wildlife management initiatives and to pay into the Uaxactún concession rent. Proceeds also fund the monitoring of turkeys and four other species of game bird populations across the Uaxactún concession.
- Future plans for WCS in the region include: synthesizing the wildlife abundance and harvest data to evaluate the sustainability of hunting in Uaxactún; consolidating efforts to promote good wildlife management in the Uaxactún forest concession; continuing to monitor hunted wildlife species as a way to measure the effectiveness of other conservation measures; and expanding the ocellated turkey conservation and management project to other management units in the Maya Biosphere Reserve.

4.2. CHACO REGION, BOLIVIA

- Kaa-Iya National Park covers some 34,000 km², and is adjoined by an indigenous territory of a further 19,000 km². The area comprises dry forest, with only 500 to 800 mm annual rainfall which is highly seasonal. The indigenous territory is being titled to members of 23 Izocéño-Guarani communities, comprising a total of about 10,000 inhabitants. The Izocéño organization CABI administers the National Park, in conjunction with the national park service. CABI also administers the indigenous territory, setting management guidelines that will govern activities of third party cattle ranches and farms therein. Hunting is one of several subsistence, economic and cultural activities for Izocéños and other residents.
- Existing information produced with WCS support since 1991 includes: monitoring by Izocéño hunters of their hunting offtakes and locations; population densities and reproductive patterns of hunted species; surveys of wildlife prevalence in local diets; and the species, their numbers and prices involved in commercial hunting. Recommendations for management plans for hunted species are being developed, based on the data and on discussions with hunters and the wider communities.
- WCS helped to create the Kaa-Iya National Park in 1995, and to produce the park management plan in 2000. WCS's work also includes socio-economic research and training of students and Izocéño parabiologists. In addition, support is being provided for land titling, zoning, and the management plan for the indigenous territory.
- Within the 4,000 km² current hunting area used by the Izocéños, subsistence hunting is apparently sustainable for the grey brocket deer (*Mazama gouazoubira*), collared peccary (*Tayassu tajacu*), and four armadillo species. Hunting appears to be unsustainable for the tapir (*Tapirus terrestris*), white-lipped peccary and three-banded armadillo (*Tridactylus matucos*).

- Commercial hunting is illegal, but commercial parrot hunting provides subsistence level income for a small number of families. Other wildlife being sold are tegu lizard (*Tupinambis* sp.) skins and songbirds. The Government is promoting the commercial use of wildlife to make wildlife pay, and the Izoceños are interested particularly in parrots as the most valuable species, because of the importance of parrot hunting in the past. Based on hunter reports, WCS estimates that at least 20,000 birds a year were exported between 1980 and 1990, at which point commercial hunting was banned and the international market collapsed. WCS estimates that local hunters are currently harvesting approximately 3,000 turquoise-fronted parrots (*Amazona aestiva*) and 4,500 monk parakeets (*Myiopsitta monachus*) annually, mostly for the national pet trade. The practice is illegal, but the Government of Bolivia has no capacity to enforce the Bolivian or international laws (e.g., CITES), and bird hunting is an important income source for a few families. The parrot trade is very sensitive, and a pilot project would be problematic and uneconomic. Tegu and peccary skin harvests are more promising because the topic is less sensitive and the species better able to withstand hunting pressure. Even these are unlikely to be self-financing, however, if the costs of monitoring populations and implementing the program are considered.
- WCS has trained hunters and parabiologists to monitor wildlife populations and wildlife use, to conduct research, and to design, implement and administer species management plans. However, the Izoceño organization is unlikely to be able to fund the full costs of implementation and administration, and outside funds will be necessary.
- Izoceño communities and the authorities need to design, adopt, implement and administer a management plan for the indigenous territory. They should determine the importance of conservation and wildlife in this plan, explicitly defining the role of wildlife with respect to other elements and activities.
- Livestock raising is generally seen as compatible with wildlife management and hunting, and possibly even advantageous if it provides alternative sources of protein. However, wildlife is affected by disease interactions, competition, and habitat alteration, especially under the extensive ranging and minimalist livestock management practices prevalent in the area.

4.3. NORTH-WESTERN BOLIVIAN ANDES LANDSCAPE (MADIDI), BOLIVIA

- The north-western Bolivian Andes Landscape Conservation Area includes Madidi National Park and Natural Integrated Management Area, Apolobamba Natural Integrated Management Area and the Tacana Communal Land, and covers about 31,500 km². It is one of the most biodiverse terrestrial landscapes on Earth. It also has a high social diversity of indigenous groups, colonists and mestizos that leads to a wide range of natural resource use and a complexity of threats and issues. One such issue is hunting within the Tacana Indigenous Territory (*Tierra Comunitaria de Origen Tacana*, or TCO Tacana), a large area which, until recently, had no protection or management.
- WCS works on hunting issues with communities that invite us to provide technical support. The process uses a collaborative investigation approach, and depends completely on community decisions. Using this approach, we believe that the decision making process at a communal level is strengthened, the community feels ownership for the project, and decisions are taken on the basis of information collected. It is sometimes a slow process, however, and runs the risks of community lack of interest and fatigue.
- Hunting management is only possible if local communities have exclusive access to hunted lands, and if they can prevent unregulated access by third parties.

- Through participatory rural appraisals, the project has determined that more than 60 communities in the area, or more than 70% of the total, hunt. The highest impacts are in the Tacana Communal Land.
- Communities monitor their own hunting activities. Preliminary results in two Tacana communities show that frequently hunted species include tapir, red brocket deer, white-lipped and collared peccary, marsh deer (*Blastocerus dichotomus*), spider monkey (*Ateles* sp.), howler monkey (*Alouatta* sp.), capuchin monkey (*Cebus* sp.), squirrel monkey (*Saimiri* sp.), coati (*Nasua nasua*) and razor-billed curassow (*Mitu tuberosa*). Data on wildlife population densities have been collected for three sites where hunting is absent or low, but not yet for areas with significant hunting. No information is yet available on the productivity of hunted species; the Tacana TCO comprises different ecosystems including savannas and tropical forests, and productivity of some species is likely to be higher in the former than the latter. Hence, it is uncertain if the hunting is sustainable, but the picture will become clearer as more data are gathered.
- WCS and the Noel Kempf Mercado Museum are developing a national hunting database for all existing information on hunting in Bolivia including hunting pressure, economic importance, methods used, ethnic group, and community decisions taken after studies. A related national line transect database is also being compiled. It currently contains information on 26 sites, and provides information on the variation in abundance of hunted wildlife species across the country.
- WCS supports the Institute of Ecology to develop a wildlife management and conservation program, with the long-term goal of providing technical support in wildlife management to the Government through local universities. We also provide technical and financial support to Bolivian students and young professionals.
- The Madidi area is one of the most visited places in Bolivia. Tourism is the major economic activity in the Rurrenabaque/San Buenaventura region, and in 2001 tourism contributed about US\$20,000 to Madidi Protected Area through entrance fees. Many communities have recognized the importance of tourism, and the need to delineate boundaries between it and hunting. This will be a new area of work in future.
- The approach of working with the communities is slow, but it is hoped that it will result in their higher interest in managing hunting through controls, not just bans. In most cases, this requires an appreciation that managing hunting requires attaining sustainable use, not generating additional economic benefits.
- Another limitation is lack of control by the communities over outsiders hunting in managed areas, which can be addressed by ensuring secure land tenure. WCS has supported the local communities on this, and some advances have been made. More work is required because hunting is occurring in forestry concessions adjacent to the Tacana Communal Land.

4.4. BOLIVIAN LOWLANDS

- During the 20th century, Bolivia was not very successful in controlling the use of wildlife. Trade in pelts, feathers and other wildlife-related products was the basis of trade through much of the 19th century until the rubber boom, and it continued to be a major source of income for many people through much of the 20th century. A general ban on hunting enacted in 1990 was unrealistic and impossible to enforce. Recent policies focusing on sustainable development have resulted in the introduction of new laws and regulations on the environment, forestry and land rights,

creating the framework for a more sustainable use of biodiversity. Implementation and enforcement of the standards relating to wildlife are still deficient, however.

- A review of studies on hunting by indigenous groups, hunting by Brazil nut collectors and by loggers, and of commercial and sport hunting, shows that wildlife resources are often neglected, but are extremely important for the subsistence of local communities and as a subsidy for many economic activities in the forest.
- Urgent actions are needed to improve public policy, to initiate and to strengthen community-based wildlife management programs for both subsistence and commercial hunting, and to approach the still-deficient consideration of wildlife issues in forest management for timber and other products.

4.5. MAMIRAUÁ/AMANÃ, BRAZIL

- Amanã Sustainable Development Reserve (2,350,000 ha) is a mosaic of upland (*terra firme*) forests and seasonally flooded forests of *várzea* and *igapó*; Mamirauá Sustainable Development Reserve (1,124,000 ha) comprises entirely *várzea*.
- Human population densities are low, around 0.6 people/km² in the Focal Area of Mamirauá (260,000 km²) and in the Sustainable Use Zone of Amanã (640,000 km²), and even lower throughout most of the region, approaching zero in the remaining and largest portion of Amanã.
- Subsistence and commercial hunting by local people and outsiders occur in both the Mamirauá and Amanã Sustainable Development Reserves. Wildlife is sold in the main local towns and among local villagers, and animals are hunted mainly for food and for cash.
- One detailed study of hunting has been done in each of Mamirauá and Amanã, and a study monitoring wildlife use in six and four communities in Mamirauá and Amanã respectively has recently started. Results are discussed with the different stakeholders, and are then translated into management recommendations. This includes zoning of human activities, which is delicate due to legal restrictions. In Mamirauá, species hunted most often are turtles (*Podocnemis sextuberculata* and *P. unifilis*), followed by howler monkeys, cracids (Cracidae), and tortoises, although population densities do not vary much between more and less hunted sites. In the Amanã upland forests, most hunting occurs in the high-water season. Preliminary data indicate that ungulates are the main prey, especially the white-lipped peccary. Large caviomorph rodents (Caviomorpha) and several tinamou (Tinamidae) species are also hunted frequently. Subsistence hunting and fishing are inversely related, with more fishing and less hunting in the low-water season. Most game species are found close to communities. This and the connectivity of the reserves with other conservation units, notably the Jaú National Park, gives the overall impression of hunting sustainability.
- Several researchers have studied the biology and use of taxa that are scarce, threatened, or especially important to people, most notably river dolphins (Platanistidae), manatees (*Trichechus inunguis*), caimans and turtles.
- WCS has funded activities at Mamirauá and Amanã for more than ten years, including small grants for hunting studies. Currently, however, WCS is not funding hunting-related activities or monitoring.

- Hunting, including for subsistence, is currently illegal, although the wording of the law is somewhat ambiguous and enforcement by the Federal Government is poor.
- The core constraints on what can be done at the sites include strong traditions of hunting by urban communities, and considerable commercial hunting by local people and outsiders.
- The following research projects are needed in future: a study of the ecological determinants of herbivorous mammal densities in *várzea*, *igapó* and *terra firme* forests of Amanã; on wildlife densities in heavily hunted areas in Amanã; on the dynamics, scale and impacts of commercial hunting and hunting by outsiders in both reserves; and on the impacts of hunting on cracids and waterbirds. Overall monitoring of hunting patterns is also required for both reserves, as well as long-term monitoring of the abundances of the main game species.
- Additional steps needed to allow hunting at the site to be more sustainable in the future include: discussing hunting-related legislation and possible needs for change; improving awareness through environmental education in local communities and urban areas; improving law enforcement by the Government; improving surveillance and law enforcement by local communities; and improving coordination between both types of law enforcement personnel. Economic alternatives to commercial hunting should also be sought.

4.6. PACAYA-SAMIRIA NATIONAL RESERVE, PERU

- The Pacaya-Samiria National Reserve covers 2,150,770 ha of the province of Loreto. The reserve is dominated by whitewater flooded forests, or *várzea*. The reserve is made up of two major drainages: the Pacaya and the Samiria river basins, with the latter encompassing the larger section of the reserve.
- The mammals of the Samiria river live in an ecosystem that has large seasonal fluctuations between the flooded periods and dry periods, and these affect the ecology of the mammals. Arboreal species are less affected by the floods because they live above the water. In contrast, floods affect terrestrial mammals severely.
- Mammal populations in the Samiria River catchment are also influenced by hunting. Hunting by the local communities living in and around the reserve is a reality that must be accepted and managed appropriately. The people who hunt are generally poor rural people who need wild meat for subsistence or for financial income. Hence, the socio-economic importance of wildlife must be considered when developing management programs.
- Mammals can readily be over-hunted and become extinct. The reserve is zoned into fully protected core areas and buffer zones where people can hunt for subsistence. The fully protected areas are managed by park guards who maintain vigilance posts to keep local people out of the area. The buffer zones are intended to allow people access to natural resources, which they are meant to use sustainably.
- Hunting in the buffer zone is not sustainable; all of the ungulates and many of the primates are over-hunted in this area. Agouti and the white-faced capuchin (*Cebus albifrons*) are at the limit of sustainable levels of hunting, so given the possible error margin, hunting of these species could easily become unsustainable. The saki monkey (*Pithecia* sp.) is the only hunted species for which hunting is apparently sustainable in the buffer zone.

- By contrast, hunting in the use zone of the reserve is sustainable for almost all of the ungulates, rodents and primates analyzed. The only species that is obviously overhunted is the lowland tapir.
- Use of the protected zone of the reserve by hunters is negligible for almost all of the commonly hunted species, with the lowland tapir being the only over-hunted species. Less than 4% of the production of all other species is harvested, which is within sustainable levels.
- Since 1998, the reserve administration and NGOs have been working with local Cocama-Cocamilla people living in and around the reserve on community-based wildlife management actions. These have involved community hunting registers, and the initial stages of a community-based wildlife management plan. Village communities have been very positive about their involvement with community-based wildlife management, and have independently taken conservation actions to reduce hunting of vulnerable species.
- The local Cocama-Cocamilla villages are structured around indigenous organizations, which play a key role in implementing the community-based wildlife management actions. WCS is currently working with these organizations to develop the wildlife management plans further, and to help the communities to implement conservation actions.

4.7. RESERVA COMUNAL TAMSHIYACU-TAHUAYO, PERU

- The Reserva Comunal Tamshiyacu-Tahuayo (RCTT) covers 322,500 ha in the upland forests which divide the valley of the Amazon from the valley of the Yavarí. The RCTT is a Community Reserve, decreed regionally on June 19th 1991 (Resolución Ejecutiva Regional No. 080-91-CR-GRA-P). Community Reserves in Peru legally give the responsibility of managing resources to local communities. They are conservation areas, and communities are responsible for managing resources in a manner consistent with biodiversity conservation.
- The RCTT has a high diversity of fauna and flora. The diversity of mammals in the reserve is greater than in any other protected area in the Amazon, and possibly globally. For example, at least 14 species of primates are found in the RCTT, the greatest diversity of primates reported for any protected area in Peru. The red uakari (*Cacajao calvus*) is found in the reserve.
- The settlement zone of the RCTT is inhabited by both non-tribal people known in Loreto as "ribereños", and indigenous people of cocama-cocamilla, yagua, and mayoruna origin. Communities living in the settlement zone of the reserve are organized around political units, often with an elementary school and several health officials. Rules for land use and extraction of natural resources are determined by the consensus of inhabitants within each community.
- Environmental actions taken by the communities of the upper Tahuayo during the 1980s were the major factor influencing the legal creation of the RCTT. During the 1980s, people living closest to the proposed reserve discussed fair natural resource use. They began to take community initiatives to protect natural resources by setting community regulations amongst themselves.
- Decisions on resource use and management in the RCTT are voted upon democratically during community meetings. This allows communities to experiment with different types of management, and to find management systems which are compatible with their culture. Communities are not too large for effective communication, and can easily define their boundaries and membership.

- Wildlife management in the RCTT involves a combination of community-based and co-management strategies. The community-based side recognizes that communities are responsible for carrying out wildlife management. The co-management side involves stakeholders who have a meaningful interest in good management of the reserve, and includes local communities, government agencies, NGO extension workers, and researchers.
- Wildlife research and extension in the RCTT uses participatory methods that involve local people. Participatory wildlife research in the RCTT relies on researchers working with hunters to evaluate the impact of harvests, thereby building interest in community-based wildlife management.
- It was easy for communities to establish the following aspects of community-based co-management in the RCTT: (i) communities having an interest in managing their wildlife resources; (ii) communities registering the amount of hunting; and (iii) communities stopping people from outside the boundaries from hunting. Changing hunting from unsustainable to sustainable levels is more difficult for people to achieve because it often entails short-term economic costs.
- Over the four years from before management until after its establishment, harvests of artiodactyls showed a slight but not significant difference between 1991, 1994 and 1995. Similarly, harvests of large rodents and tapir showed no significant difference between 1991, 1994 and 1995. However, significantly less primates were hunted between 1991 and 1994, and again between 1994 and 1995.
- Lowland tapir are over-hunted, and harvests should be decreased. The initial period of community-based co-management did not result in a decrease in tapir harvests. One promising remedy is replenishment of hunted areas from unhunted ones. This source-sink strategy can be used by local communities to help guarantee the long-term use of wildlife. The unhunted areas would be a community-based fully protected area. If implemented throughout Amazonia, they could greatly enhance current conservation efforts.

4.8. MBARACAYU, PARAGUAY

- The 60,000 ha Mbaracayu Forest Reserve is the largest block of intact interior Atlantic rain forest in Paraguay. Ache Indians, who are the traditional inhabitants of the region, have permanent legal use rights within the reserve.
- It is important to determine whether Ache hunting patterns threaten wildlife populations and whether Ache hunting should be regulated in some way. Systematic data collection began in 1994 and continues to the present. Information collected can be used to tabulate annual harvest, and to estimate daily success rate and animal densities for all hunted species.
- Monitoring of harvest rates and animal densities was originally funded by TNC and WWF, it was picked up by WCS beginning in 1999 and continues to the present.
- The main core constraint is lack of educated human capital to conduct all aspects of wildlife management. Local people cannot develop or modify a research design, although they can implement it efficiently after sufficient training. They cannot make optimal equipment and supplies decisions, or purchase those necessary from foreign sources. They cannot analyze and interpret data because of lack of appropriate training in statistics and biology. They cannot complete some of the required logistical tasks associated with data collection, especially operation and maintenance of vehicles. In the current operation of the project, national level personnel are

responsible for data entry and accounting procedures. These tasks cannot yet be carried out by the local communities that wish to manage their wildlife resources.

- The main requirements for hunting to be sustainable hunting in Mbaracayu are: (i) enforcement of existing regulations against poaching. The native communities cannot achieve this. They do not have sufficient resources or influence with government officials, and racism against Indians tends to favor poachers when there is a conflict; (ii) education of community members concerning threatened species, biology of key species, and results from the monitoring of densities and harvest rates.
- Legislation requires a change to grant powers to park guards to detain illegal hunters within the reserve. A major thrust must be encouragement of local authorities to enforce existing legislation.

4.9. YASUNÍ REGION, ECUADOR

- The core issues relating to hunting at Yasuní are: the Huaorani and Kichwa hunt inside the national park and its legality is unclear; no community management plans exist; endangered woolly monkeys (*Lagothrix* sp.) are over-harvested; endangered live harpy eagles (*Harpia harpyja*) are kept as sources of feathers for Huaorani headbands; and petroleum company workers buy wild meat, and transport hunters and wildlife.
- Short-term studies on hunting at Yasuní have been conducted by the EcoCiencia Foundation and WCS. They have shown that modern hunting technology is widely used. Hunting is primarily for subsistence, and is generally unsustainable in the immediate vicinity of villages. Large bodied species have been widely depleted in the Kichwa/Mestizo areas of north-west Yasuní. Local markets at El Coca and Pompeya add somewhat to hunting by community members.
- WCS in Ecuador has not worked on hunting management in the past, although plans to do so are now being worked into the Yasuní Living Landscapes Program. Future plans include tentative plans to reinstitute hunting studies; a participatory action plan for Yasuní National Park and Yasuní Biosphere Reserve; and a potential WCS role in the development of community management plans. Other studies are being developed which will include the monitoring of hunting.
- One core constraint on what can be done at the site by working through local communities is that they are not well organized at the community or federation level, although the Kichwa/Mestizo are better organized than are the Huaorani. In addition, they are not well informed or concerned about wildlife ecology or conservation issues, and their behavior is highly unpredictable and potentially life-threatening. The logistical and psychological conditions are extremely difficult. Petroleum companies have an extremely strong influence, buying wild meat and hiring local workers often at highly inflated salaries; interference by timber and ecotourism companies is strong and they are often involved in illegal activities; and government development agencies exert strong pressure at the local level to produce crops.
- Current legislation permits subsistence hunting on community lands, although the legality of harvesting endangered species by indigenous groups on their own land is unclear. All commercial hunting is illegal throughout the country, but enforcement authorities generally ignore wildlife sales in markets and restaurants. Hunting by the police and military at rural posts is illegal, but is also generally ignored. A further enforcement problem is that park rangers are legally unable to carry firearms, seize illegal wildlife, or arrest violators; the police retain these powers. Knowledge

of wildlife regulations by police and military (the legal enforcement agencies) is poor, and corruption is prevalent amongst judges and enforcement officials.

- Kichwas and Mestizos generally have land tenure, but tenure by the Huaorani is not legally clear. All groups have legal rights to exclude outsiders from their lands, but enforcement is difficult at best.
- Steps needed to allow hunting at the site to be more sustainable in the future include: conducting research on hunting patterns, the role of markets and the biology and ecology of hunted species; ensuring Huaorani land tenure; improving Huaorani community organization and administration; instilling a conservation ethic; eliminating the role of petroleum company workers in hunting or transport of wild meat; and the development of alternative protein alternatives.

CHAPTER FIVE

Strategy

5.1. LONG-TERM GOALS

To ensure clear planning as the strategy to manage hunting in Latin America was developed, each program was asked to specify its overall long-term goal.

MAYA BIOSPHERE RESERVE, GUATEMALA: To conserve threatened species and their habitats across the eastern Maya Biosphere Landscape, by realizing the potential of sustainable use areas in balance with protected source areas.

CHACO AND MADIDI, BOLIVIA: To ensure conservation of biodiversity in protected areas and sustainable use in use areas, maintaining connections between, and the integrity of, both types of areas through management by local people and authorities.

MAMIRAUÁ/AMANÁ, BRAZIL: To achieve sustainable use and conservation of biodiversity, through continued and more effective participatory management between the Mamirauá Institute and local people.

LORETO, PERU: To have community-based wildlife use as a strategy for Amazon conservation. Community-based wildlife management areas would have both source and sink components. Source areas would be fully protected zones that are compatible with local people. The long-term benefits of sustainable use and the green leather peccary pelt trade are the major incentives.

MBARACAYU, PARAGUAY: To establish long-term resource use patterns that are sustainable, and which allow the recovery of Mbaracayu fauna to pre-1990 levels. This would be done through training Ache people to do all aspects of community management which do not require a Ph.D; greatly diminishing poaching by non-Ache hunters; generating some tourism income from Reserve area for local people; and linking Mbaracayu via corridors to other nearby forested areas.

YASUNÍ, ECUADOR: To ensure the conservation of biological diversity in the Yasuní region, using a species-based landscape approach.

5.2. RESEARCH NEEDS

One of the core aims of the workshop was to discuss how projects and programs should move further and more rapidly along the spectrum from research to effective management. Designing further research projects was not a major goal. Certain research is crucial, however, to allow management to be based on sound information, and to provide baseline data for future monitoring and adaptive management.

5.2.1. Regional level

- (1) Methods used by different projects vary and are not always comparable, both within WCS, and also between WCS projects and others.

WCS action required: Latin America Program to seek an opportunity to discuss research methods with field staff at greater length, to determine if indices or some other tool would improve options for data comparisons between projects.

- (2) Insufficient knowledge is available of the population dynamics and ranging behavior of key hunted species, especially the white-lipped peccary.

WCS action required: Latin America Program to conduct a priority-setting exercise for the white-lipped peccary. In Bolivia and Ecuador, this peccary has been identified as a landscape species, so this should be done in collaboration with the Living Landscapes Program.

- (3) Insufficient information is readily available on the market levels and dynamics of Latin American species in international trade.

WCS action required: WCS Hunting and Wildlife Trade Program to approach TRAFFIC to find out what information is available on trade in skins and live animals in Latin America, including for peccaries, parrots and crocodilians.

- (4) It is not known if the price of ammunition influences hunting in different areas.

WCS action required: All participants of this workshop to ascertain the price of ammunition in their areas. WCS Hunting and Wildlife Trade Program to coordinate, compile and disseminate information.

- (5) It is not known if the ready availability of affordable domestic meat supplies is correlated with a reduced demand for wild meat in markets. This information is important in determining how to reduce demand for wild meat.

WCS action required: All participants of this workshop to ascertain the prices of different domestic meats, fish and wild meat in their local markets. WCS Hunting and Wildlife Trade Program to coordinate and compile information, and Living Landscapes Program to analyze and disseminate it.

- (6) In Latin America, using commercial wildlife sales as a conservation tool is being promoted in some circles, yet it is not known if this can be done sustainably, and what the implications are for conserving traded and related species across their whole range.

WCS action required: WCS Hunting and Wildlife Trade Program to liaise with WCS field staff and other relevant expertise to assess under what exact conditions, if any, is commercial trade in wildlife from tropical forests a valid conservation strategy, and what controls need to be in place to ensure sustainable management of potentially traded species.

5.2.2. Site level

The person representing each site was asked to define one or more broad research needs, and specify actions needed to address them within the next three years.

MAYA FOREST, GUATEMALA: It is unclear how wildlife conservation can be ensured across the series of different management regimes in the Maya Biosphere Reserve.

WCS action required: WCS Maya Forest Program to: (1) monitor the abundance of hunted species as indicators of the effectiveness of conservation actions in the different management regimes, including evaluating the effectiveness of the ocellated turkey conservation and sport hunting project; (2) evaluate the sustainability of hunting in the Uaxactún catchment area; (3) study habitat use by the white-lipped peccary in the lowland eastern Maya forest landscape.

CHACO, BOLIVIA: (1) The inter-relationships between livestock rearing and wildlife conservation are unclear. (2) It is uncertain whether commercial trade in tegu lizard and peccary skins can be

managed sustainably, and provide sufficient benefits to local communities to enhance conservation at the site.

WCS action required: (1) WCS Chaco Program to: study hunting levels on cattle ranches; assess the impacts of ranching management issues (e.g., rotation, use of fire, provision of water) on wildlife populations; liaise with WCS Field Veterinary Program to assess health issues related to wildlife and livestock; liaise with WCS Hunting and Wildlife Trade Program to monitor pilot schemes for legal commercial trade in tegu lizard and peccary skins by local communities; (2) WCS Hunting and Wildlife Trade Program to examine the use of commercial wildlife trade as a valid conservation strategy (see above).

MADIDI, BOLIVIA: It is unclear whether hunting of different species in the Tacana region is sustainable, and we have little information about the hunting within Madidi protected area.

WCS action required: WCS Madidi Program to: (1) evaluate the population densities and productivity of hunted wildlife species in different ecosystems; (2) determine movements of wildlife between Madidi National Park and the Tacana TCO; (3) study the habitat use, ranging behavior and abundance of the white-lipped peccary across the landscape; (4) evaluate the extent of the hunting within Madidi and Apolobamba protected areas.

MAMIRAUÁ/AMANÁ, BRAZIL: (1) The population dynamics and the ecological correlates of hunted wildlife species within and between the different upland and seasonally flooded habitats are uncertain; (2) the dynamics, importance and sustainability of different types of wildlife extraction from Mamirauá/Amamá for sale in towns are unknown.

WCS action required: WCS Mamirauá/Amamá Program to: (1) study the population dynamics of hunted wildlife species and their ecological determinants in different habitats in Amamá; (2) initiate a study of cracid ecology in Mamirauá/Amamá; (3) study the contribution of Mamirauá and Amamá to wildlife sold in local towns; (4) study the contribution of commercial hunting to people's income in Amamá, and the relative merits of possible economic alternatives; (5) resume the program of monitoring populations of hunted wildlife species in Mamirauá and Amamá.

LORETO, PERU: A full understanding of how community-based wildlife management can lead to wildlife conservation has yet to be attained.

WCS action required: WCS/DICE Peru Program to: (1) conduct research on the potential of certification of peccary pelts in commercial trade; (2) investigate further the population biology of hunted species between flooded forests and *terra firme* forests, to understand sustainability more thoroughly at these sites; (3) investigate how communities can use catch per unit effort as a self-monitoring strategy.

MBARACAYU, PARAGUAY: It is not known why populations of several species are declining, including those which are not hunted by the Ache.

WCS action required: WCS/University of New Mexico Paraguay Program to: (1) develop a research design to determine what is happening to wildlife and habitats in the area, e.g., through interviews; (2) recruit local biologists to conduct intensive population studies; (3) collect systematic information on poaching.

YASUNÍ, ECUADOR: A full understanding of how community-based wildlife management can lead to wildlife conservation has yet to be attained.

WCS action required: WCS Yasuní Program to: (1) determine the impacts and relative importance of different conservation threats on wildlife; (2) conduct a study on the population dynamics of wildlife species in different ecosystems.

5.3. EDUCATION AND AWARENESS NEEDS

All of the site-based projects represented at the workshop operate mainly through local communities. In this context, "education" and "capacity building" are extremely similar. Hence, education and awareness needs considered here were specifically addressing regional needs. Site-based education program needs were amalgamated into the subsequent discussion on capacity building.

5.3.1. Regional level

- (1) Across the region, governments, development agencies and others are under the erroneous impression that captive breeding of wildlife will enhance both development and conservation. *WCS action required:* WCS Hunting and Wildlife Trade Program to liaise with WCS Living Landscapes Program and other expertise to write a WCS working paper. The aim is to inform decision makers of how captive raising of wildlife in tropical forests for food is not a "silver bullet" and is fraught with problems. It should also include information on the real value of replacing wild meat consumption with that of rearing domestic livestock.
- (2) Across the region, local people are often unaware of the boundaries of the lands under their jurisdiction, and their access rights to resources within those lands. *WCS action required:* WCS Latin America Program to conduct a program to inform local people of their jurisdiction, and their rights and responsibilities through national laws and international treaties to secure access to resources (e.g., ILO 169) within their territories. The capacity to do this should be transferred to all sites, except Chaco and Madidi where it is already underway.
- (3) Across the region, local communities are often unaware of the opportunities and potential sources of funding and technical assistance for self-help projects. *WCS action required:* WCS Latin America Program to liaise with WCS Development staff to compile a list of potential sources of funding and technical assistance for local communities.

5.4. LEGISLATIVE FRAMEWORK

No country discussed has perfect legislation to allow for ideal site-based programs to manage hunting and wildlife trade. Bearing this in mind, we reviewed whether current legislation in each country is adequate to allow for effective site-based wildlife management, or if it is a major factor limiting what can be done.

Overall, there was a feeling that reforming national level legislation may not be the most effective use of WCS's time and efforts, because jurisdictional overlaps between ministries might subvert new laws and regulations. In many cases, it is more important to facilitate the implementation of existing legislation. In some cases, however, relatively small changes in laws could considerably enhance wildlife conservation efforts in sites where we work.

5.4.1. Regional level

At present, no mechanism exists for providing timely support on policies in the wildlife, forestry, energy and hydrocarbon sectors, for regulations which are constitutional and can be enforceable at the site level. For example if we needed to put together a wildlife use program in the Chaco, how would our conservation concerns be translated into regulations that are constitutional and enforceable?

WCS action required: WCS Latin America Program to compile a list of experts in wildlife laws whose advice can be sought when needed.

5.4.2. National level

GUATEMALA: The law which regulates hunting dates from 1970 and is obsolete. An improved law was proposed in 1998, but after two of the three readings required, it stalled in the Guatemalan Congress. A more recent decree is inadequate.

WCS action required: WCS Maya Forest Program to host a participatory workshop with relevant actors to review the law and steps which are required to ensure that any necessary changes are legislated and implemented.

BOLIVIA: Current national laws are adequate to allow for effective site-based wildlife management.

WCS action required: WCS Bolivia Program to: (1) facilitate agreement negotiation by the relevant actors to implement existing legislation in a transparent way in areas where we work; (2) continue facilitating this process at sites to implement existing and new legislation; (3) continue to build good relations with the Government so that avenues exist to advise on any potential future legal and policy changes needed; (4) participate in the planned revision of the new wildlife law.

BRAZIL: The current law relating to subsistence hunting is somewhat ambiguous, and current laws are not implemented effectively.

WCS action required: WCS Brazil Program to: (1) host a participatory workshop with relevant actors to analyze the law and eventually propose its revision; (2) facilitate agreement negotiation by the relevant actors to implement existing legislation in an unambiguous and transparent way.

PERU: Community-based protected area legislation exists, but is not implemented.

WCS action required: WCS/DICE Peru Program to determine why the Peruvian Government is afraid to implement the community-based protected area legislation. Note: If the process that has begun is formalized, and experience integrated into proposals being presented to decision makers, it might be feasible to demonstrate that fears are unfounded.

PARAGUAY: At present, park guards do not have the legal authority to arrest offenders. Also, enforcement of existing laws at all levels is weak.

WCS action required: WCS/University of New Mexico Paraguay Program to: (1) support FMB in their efforts to get the law changed so that park guards are legally authorized to arrest; (2) liaise with WCS Latin America Program to arrange for letters to be sent periodically to capital city policy makers, informing them that local authorities are failing to enforce laws, with specific case examples. This should be done in collaboration with FMB.

ECUADOR: Existing laws are out-of-date, and implementation is inadequate. This is partly because of the complexities of the laws, and the different national and local government agencies involved in their implementation.

WCS action required: WCS Ecuador Program to: (1) liaise with the Government and other NGOs to publicize current legislation and explain to officials and the general public how to implement the laws; (2) prepare summaries of legislation on selected topics, and hold workshops to explain the laws and their implementation; (3) liaise with NGOs that specialize in legal matters to investigate options for consolidating and updating the current laws.

5.5. CAPACITY BUILDING AT LOCAL COMMUNITY LEVEL

MAYA BIOSPHERE RESERVE: Local regulations are not in place to allow for effective management, although mechanisms exist to allow for resolving conflicts within and between communities. Local capacity to deal with offenders from within the communities is low, but some capacity exists to enforce regulations against outsiders. The ability to monitor hunting patterns and wildlife populations is low for most of the communities of the Maya Biosphere Reserve, and higher in Uaxactún and Carmelita. Local formal education systems are inadequate to train young people in wildlife conservation issues.

WCS action required: WCS Maya Forest Program to: (1) conduct baseline research and use it to develop inexpensive and locally-intelligible local management systems; (2) strengthen local conflict resolution mechanisms. These work for non-wildlife resources, so this should be feasible; (3) promote locally-accepted wildlife uses and norms; (4) strengthen local capacity to monitor hunting patterns and wildlife populations; (5) liaise with other agencies (e.g., Peace Corps, Amigos de Uaxactún) to establish a general education system for young people in specific sites where WCS is committed long-term.

CHACO AND MADIDI, BOLIVIA: Some local regulations are in place to allow for effective management. Mechanisms exist for resolving conflicts within communities, although they are not specific to wildlife. Once the land titling process is complete, capacity to enforce regulations against outsiders will be high. Local capacity to monitor hunting patterns and wildlife densities is moderate in Chaco, lower in Madidi. The *Reforma Educativa* (Education Reform Law) provides good opportunities for environmental education by CABI and CIPTA in Chaco and Madidi respectively.

WCS action required: WCS Bolivia Program to: (1) continue to strengthen local community-based institutions at all sites where we work; (2) once land titling is complete, liaise with others to set legal precedents and apply them to specific cases; (3) support local communities in the development of local regulations regarding hunting in their territories; (4) continue to work with the Natural History Museum (for Chaco) and Institute of Ecology (for Madidi) to build up local educational programs and training programs for local parabiologists.

MAMIRAUÁ/AMANÁ, BRAZIL: Local regulations to allow for effective management exist for some fish species and caiman for most of the Focal Area of Mamirauá, and in this area they are effective. Effective management of other wildlife in the other areas requires that the work done in the Focal Area be extended. Mechanisms exist for resolving conflicts within and between communities, but are still somewhat weak. Capacity to control activities of outsiders is high in Mamirauá and low in Amaná. Local communities are expected to be able to monitor hunting patterns and wildlife populations, although up to now these tasks have been performed by technical-scientific personnel. Formal education programs were somewhat weak, but the Mamirauá Program has greatly improved them in most communities.

WCS action required: WCS Brazil Program to liaise with Mamirauá Institute staff to: (1) collect data on the social economy of the more remote areas of Mamirauá and Amaná, and strengthen the work of community organizations in those areas; (2) work within communities to strengthen people's trust in the decisions of community meetings, and to enhance the acceptance of communally-decided norms; (3) empower local law enforcement agents to enforce the laws, and promote greater coordination between those agents and the local communities; (4) provide training and funds to enable local communities to monitor hunting patterns and wildlife populations more effectively; (5) continue to extend environmental education programs to the smaller, less organized communities.

LORETO, PERU: Local regulations to allow for effective wildlife management have been developed for the community reserve at Tamshiyacu-Tahuayo, and are being developed for Pacaya-Samiria. Mechanisms to resolve conflicts are in place for both areas, although the potential for conflicts between communities in Tamshiyacu-Tahuayo still exists. Some flexibility of local regulations is part of the process, to allow for people suffering hardship or exceptional circumstances, and can be built into the management process. At Tamshiyacu-Tahuayo when problems with outsiders occur, communities work well with agricultural agencies to control them. At Pacaya-Samiria, communities work with park guards to control outsiders effectively. Local capacity to monitor hunting patterns at Tamshiyacu-Tahuayo is high through the use of game registers. It is somewhat less at Pacaya-Samiria, although should improve as the management plan develops. Formal educational systems are inadequate because the legal education system requires a certain minimum number of pupils before supplying teachers; this has led to recruiting immigrants to raise populations to the necessary levels.

WCS action required: WCS/DICE Peru Program to: (1) continue working with people and community-based wildlife management plans in both areas through extension activities; (2) at Tamshiyacu-Tahuayo, hold more inter-community workshops to resolve some conflicts on resource access; (3) at Tamshiyacu-Tahuayo, continue with extension activities and provide help in dealing with external offenders when needed; (4) at Tamshiyacu-Tahuayo, provide technical support for analyzing the information in game registers, and at Pacaya-Samiria, assist in developing management plans to enable the communities to monitor hunting patterns through game registers; (5) at Tamshiyacu-Tahuayo, WCS consider providing funding for teachers in the formal school system to eliminate the need for immigration; at Pacaya-Samiria, other NGOs are supporting an environmental education program, and no WCS action for this is needed.

MBARACAYU, PARAGUAY: A few informal agreements on resource use have been agreed by consensus, but no regulations exist. Political systems are weak, and no political organization exists for achieving enforceable consensus, which means that it is difficult to solve free-rider problems. Informal mechanisms are in place for resolving conflicts within communities, although they are weak between communities. Capacity to enforce regulations on outsiders is low because the Ache are reluctant to tackle armed poachers. Their capacity to monitor hunting patterns and wildlife populations is moderate, with some aspects of monitoring being good. The formal education process is poor, with no education past the third grade because the area is too rural and communities too small. Maths and science are too weak to allow people to understand even basic wildlife management concepts.

WCS action required: WCS/University of New Mexico Paraguay Program to: (1) organize a community resource use committee to generate effective mechanisms for allocating and managing resource use within communities; (2) assist communities to form inter-community organizations which have the authority to resolve conflicts; (3) protect the area against outside offenders, develop mechanisms to improve rapid communication between Ache parties in the Reserve and park authorities to inform the latter of encounters with offenders; (4) train communities to monitor hunting patterns and wildlife populations. This will achieve two-thirds of the capacity required. Outside technical support will continue to provide the final third, for data analysis, modification of research designs and interpretation; (5) seek volunteer teachers and relevant teaching materials. WCS Latin America Program to consult with WCS Education Department to determine what materials are available, and could be developed, in Spanish.

YASUNÍ, ECUADOR: Local regulations to allow for resource management are in place through the community management plan, although the wildlife component needs considerable improvement. No local mechanisms exist to resolve conflicts within or between communities; the local court system is supposed to do this, but is inefficient and unreliable. Local capacity to regulate internal and external offenders is low, as is the capacity to monitor hunting patterns

and wildlife populations. Formal education systems are also very weak and do not have courses in wildlife ecology or management.

WCS action required: WCS Yasuní Program to: (1) work with the communities to enhance the wildlife component of the community management plan, then to follow up with it and ensure strong quality control; (2) liaise with a local legal NGO to support the Government Justice Ministry to establish an office of mediator to resolve local resource conflicts; (3) enhance the ability of local communities to call on enforcement agencies whenever needed; (4) identify participating communities to monitor hunting patterns and wildlife populations, and work with those communities to develop technical skills and provide materials and supervision; (5) for the formal school system, provide more and better materials, increase contact between teachers and wildlife managers; contact Peter Feisinger for support in developing schoolyard ecology programs.

WCS Latin America Program to consult with WCS Education Department to determine what materials are available, and could be developed, in Spanish.

5.6. CAPACITY BUILDING AMONG OTHER RELEVANT AGENCIES

5.6.1. Regional level

Every two years, a conference is held in the region on Latin American wildlife management issues. This has been growing in size and professionalism in recent years, and is an important mechanism for enhancing overall capacity in the region for professional wildlife management. The next one is due to be held in one more year, yet it is not clear exactly who will organize it.

WCS action required: WCS Latin America Program to investigate if there is a problem, and if necessary to work with local agencies to ensure that the next meeting is held in late 2003/early 2004.

5.6.2. Site level

In each site, core management agencies are the local communities, or interest groups within those communities, or grassroots organizations formed by the local communities, in partnership with WCS and other agencies. The latter include governments, museums, universities, other NGOs, and grass roots organizations. If they are important in ensuring good wildlife management at a site, their capacity to fulfill that role was considered here. In addition, other agencies clearly have the major role to play in wildlife management outside the site, e.g., in managing wildlife trade in markets and internationally.

MAYA BIOSPHERE RESERVE: The Government and other NGOs have a major role to play in wildlife management. Their technical capacity is medium to high, depending on the institution, but their physical capacity is typically low. Government capacity to enforce wildlife trade laws across the country is also low.

WCS action required: (1) At site level, WCS Maya Forest Program to develop education programs, raise Government capacity to protect and monitor the use of wildlife, and fund the implementation of programs at least short-mid term; (2) at national level, WCS Maya Forest Program to educate government personnel on the importance of wildlife protection and sustainable use, and strengthen their capacity to protect and monitor wildlife.

CHACO AND MADIDI, BOLIVIA: Government agencies play a significant role at the two sites, specifically SERNAP, DGB, INRA, and the local municipalities. In addition, CARE, CI, the Museum and Instituto de Ecología are also involved. Government capacity for the site-based work is variable, and to enforce laws outside sites is low, largely because they do not consider wildlife trade to be a problem.

WCS action required: (1) At both sites, WCS Bolivia Program to work with indigenous organizations and the local population more generally to encourage responsible government agencies to enforce existing laws; (2) at national level, WCS Bolivia Program to: strengthen university programs in wildlife management to produce professionals capable of working with communities; support Reforma Educativa processes so that conservation is incorporated into the initiatives of CABI and CIPTA; and provide support at municipal level for environmental planning of their territory.

MAMIRAUÁ/AMANĀ, BRAZIL: IDSM is responsible for management at the sites. Institutes of higher education and research also act there. IBAMA and IPAAM are responsible for law enforcement. IBAMA's capacity is low, and although IDSM has a good relationship with them, they lack personnel, equipment and funds. The Mamirauá project has been supporting their operations, but this is not sustainable in the long-term. Government capacity to enforce laws in markets and restaurants is generally higher in the field, although they cannot address door-to-door sales.

WCS action required: WCS Brazil Program to provide long-term support to IBAMA at local level, or to support IPAAM establish an Amazonas State environmental rangers/guards unit.

LORETO, PERU: No other agencies are involved in managing Tamshiyacu-Tahuayo. At Pacaya-Samiria, the Government plays an important role through INRENA and the Department of Fisheries; their technical capacity is moderate, but physical capacity is low. Others working at Pacaya-Samiria are ProNaturaleza/TNC, WWF and UNAP. Outside the site, INRENA is strong in enforcing wildlife laws at airports, although such enforcement is low for restaurants, markets and for the pet and illegal pelt trade, as well as for commodities being transported by river. This is not currently of major concern because the scale of the trade is low and is apparently not a major threat at present.

WCS action required: None at site level; TNC has a role in working with government staff in Pacaya-Samiria. At national level, WCS/DICE Peru Program to build capacity to manage the peccary pelt trade sustainably.

MBARACAYU, PARAGUAY: FMB manages the Mbaracayu Reserve and has the final say in any management plan. Their physical capacity is good, and they have an endowment to ensure permanent funding. Their technical capacity is less good, in large part because well-qualified biologists move on to better jobs. Government capacity to enforce wildlife trading laws elsewhere in the country is unknown.

WCS action required: WCS/University of New Mexico Program to: (1) engage in training activities for FMB biologists; (2) train park guards.

YASUNÍ, ECUADOR: Other core agencies involved in management at the site are the Ministry of the Environment, Ministry of Energy and Mines which has total control over oil concessions inside the national park, FEPP and CIBT. In addition, the Catholic University of Ecuador and San Francisco University of Quito have field stations in or near the park. The physical and technical capacities of the Ministry of the Environment are low, and of the Ministry of Energy and Mines non-existent. FEPP and CIBT capacity is moderate, but their main focus is not wildlife management. Capacity to enforce laws in markets and restaurants is extremely low, due largely to a lack of political will.

WCS action required: WCS Yasuní Program to: (1) coordinate courses for local schools and park guards at the site; (2) coordinate with other NGOs to publish a document on the state of the environment in Ecuador, and distribute that to all relevant parties.

5.7. WORKING OUTSIDE OUR PROJECT AREAS

Although the core focus of most WCS projects in Latin America is the sites, conservation there sometimes cannot be done effectively without influencing the wider context in which they occur, for example, by influencing local, national or international policies, laws, treaties and agency capacities. Each project considered, therefore, whether WCS should also be working outside the site, with the aim of enhancing the ability to conserve wildlife at that site more effectively.

MAYA BIOSPHERE RESERVE, GUATEMALA:

Wider influence beyond the site is important to improve wildlife management in timber concessions, and to increase good management and support for it throughout the entire area.

WCS action required: WCS Maya Forest Program to: (1) work with CONAP to strengthen timber certification norms and verification, to improve wildlife management in timber concessions adjacent to Uaxactún; (2) work with OMYC to increase the patrols, presence and environmental education in Uaxactún, as well as Tikal National Park and Mirador-Rio Azul National Park, to strengthen protection in the biological corridors and parks. In future, this should be extended to include trans-border protection.

CHACO, BOLIVIA: Wider influence beyond the site is crucial to address issues such as land titling, gas pipelines, commercial use of wildlife, and trans-boundary management.

WCS action required: WCS Bolivia Program should continue to work with CABI to influence the Government and hydrocarbon companies.

MADIDI, BOLIVIA: Wider influence is important to address issues of land titling, municipal planning, and forestry certification. This includes the need to support the planning process at municipal level. At the same time, it is important to redress the balance that the main work in hunting in the Madidi Landscape is outside the core protected area.

WCS action required: WCS Bolivia Program to: (1) continue to support CIPTA to address forestry issues; (2) work with the Forestry Superintendent of the Certification Council on timber certification, to ensure that wildlife management is incorporated and verification processes are good; (3) continue with our support in the land use planning in TCOs at the landscape level; (4) extend hunting studies to include the core protected area.

MAMIRAUÁ/AMANÃ, BRAZIL: National legislation must be improved and ambiguities regarding hunting removed (see above). In addition, commercial hunting should be tackled in neighboring rural and urban areas to ensure that this is not a drain on wildlife from the reserves. Environmental education at school and at other fora, and the introduction of alternatives to hunting, are regarded as the best ways to achieve this purpose.

WCS action required: WCS Brazil Program to extend IDSM's environmental education programs beyond the town of Tefé.

LORETO, PERU: For the certification process of the peccary pelt trade to be established and turned into an effective conservation tool, other agencies must be involved within Peru, the region, and Europe where the pelts are turned into gloves and sold.

WCS action required: WCS/DICE Peru Program to collaborate with INRENA and CITES, to work with the local acopiadores and intermediaries, tanneries, the leather industry and European Union.

MBARACAYU, PARAGUAY: Increased technical, logistical and legal support of the local population living outside the Reserve is crucial in enhancing conservation. Effective conservation cannot be achieved without a much more effective system of prosecuting outside offenders once they have been apprehended.

WCS action required: WCS/University of New Mexico Paraguay Program to: (1) recruit a local person committed to conservation to hold community meetings and promote local radio broadcasts about wildlife and conservation issues; (2) lobby the prosecutor for environmental crimes to investigate and act against professional poachers.

YASUNÍ, ECUADOR: The timber and arapaima trades to Peru are threats which cannot be addressed solely at the site level. The process of decentralization is also problematic to the site, as is the generally low capacity of the National Parks Service.

WCS actions required: WCS Ecuador Program to: (1) conduct a study of the scale and *modus operandi* of the timber and arapaima fish trades; (2) conduct a needs assessment study of the National Parks Service, to assess how best to work with them to increase their capacity across the country.

5.8. SUMMARY OF ACTIONS NEEDED

The program designated for each action is in *italics*. HWT = Hunting and Wildlife Trade Program; LAP = Latin America Program; LLP = Living Landscapes Program; CP = relevant country or site program; UNM = University of New Mexico.

	RESEARCH	EDUCATION AND AWARENESS	LEGISLATION	CAPACITY BUILDING - LOCAL COMMUNITY LEVEL	CAPACITY BUILDING - OTHER RELEVANT AGENCIES
Regional	<p>1. Study population dynamics and ranging of key species, starting with a literature review of mammalian population dynamics. Focus on white-lipped peccary, LAP and LLP to conduct <i>priority setting exercise for white-lipped peccary</i>.</p> <p>2. Approach TRAFFIC to discuss trade levels and management of key species (peccaries, parrots, crocodilians) in Latin America, HWTP.</p> <p>3. Study how the price of ammunition influences hunting in different areas. All meeting participants, coordinated by HWTP and LLP.</p> <p>4. Study whether the presence and costs of local domestic meat markets are predictors of wild meat markets, by comparing prices of wild and domestic meat. All meeting participants, analyzed by and LLP.</p>	<p>1. Write and disseminate WCS working paper to inform decision makers that captive raising of wildlife in tropical forests for food is fraught with problems. LLP (through student) and HWTP.</p> <p>2. At each site (except Chaco where done), conduct program to inform local people of their rights and responsibilities for the land under their jurisdiction through national laws and international treaties (e.g., ILO 169). CPs.</p> <p>3. Find ways to help local communities take advantage of available opportunities for self-help projects. Compile list of potential funding sources and focus. LAP to coordinate with WCS Development office.</p>			<p>1. Ensure that the next conference on Latin American Wildlife Management takes place in late 2003/early 2004. WCS Latin America Program to work with local agencies to ensure that the next meeting is held.</p>

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	RESEARCH	EDUCATION AND AWARENESS	LEGISLATION	CAPACITY BUILDING - LOCAL COMMUNITY LEVEL	CAPACITY BUILDING - OTHER RELEVANT AGENCIES
Maya Forest, Guatemala	<p>1. Monitor abundance of hunted species as indicators of effectiveness of conservation interventions, including turkey project. CP (funding needed).</p> <p>2. Evaluate the sustainability of hunting in the Uxactun catchment area. CP (funding pending).</p> <p>3. Study habitat use and home range of the white-lipped peccary in the lowland eastern Maya forest landscape. CP (funding needed).</p>		<p>1. Host a participatory workshop with relevant actors to review the law. CP (funded).</p>	<p>1. Establish community regulatory systems, through baseline research followed by inexpensive and locally intelligible management systems. CP to find suitable person (funded).</p> <p>2. Strengthen mechanisms for resolving wildlife conflicts. CP to find suitable person (funded).</p> <p>3. Promote wildlife use norms, monitoring and regulatory framework to protect against internal and external offenders. CP (funded).</p> <p>4. To enhance local capacity to monitor wildlife: (i) conduct environmental education programs; (ii) train local people on monitoring techniques. CP to find suitable person (funded).</p> <p>5. Conduct environmental education for hunters involved in wildlife management. CP to find suitable person (funded). (NB same person could do 1-5).</p> <p>6. In partnership with others (e.g., Peace Corps, Amigos de Uxactun), establish general education system for youth in specific sites where WCS is committed long-term. CP (funding needed).</p>	<p>1. At site level: (i) develop education programs; (ii) raise capacity to protect and monitor the use of wildlife; (iii) fund the implementation of short-term programs. CP to seek support staff (funding needed).</p> <p>2. At national level: (i) educate government personnel on importance of wildlife protection and sustainable use; (ii) strengthen their capacity to protect and monitor wildlife. CP to seek support staff (funding needed).</p>

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	RESEARCH	EDUCATION AND AWARENESS	LEGISLATION	CAPACITY BUILDING – LOCAL COMMUNITY LEVEL	CAPACITY BUILDING – OTHER RELEVANT AGENCIES
Chaco, Bolivia	<p>1. Study livestock-wildlife relationships: (i) hunting on cattle ranches; (ii) health; (iii) habitat management for livestock that is compatible with wildlife. CP, with WCS Wildlife Health Program (ongoing, already funded).</p> <p>2. Determine best method to monitor catch/unit effort by local communities. CP (ongoing, already funded).</p> <p>3. Advise and monitor pilot commercial use programs of regulated and collared peccary skins by local communities. CP (ongoing, already funded).</p>		<p>1. Create space where relevant actors can negotiate agreements to implement existing legislation in a transparent way. CP (ongoing, funded).</p> <p>2. Continue advising government (through our partners) on natural resource management policies and laws. CP (ongoing, funded).</p>	<p>1. Continue strengthening local institutions to make specific systems for wildlife management, to increase capacity to protect against internal and external offenders. CP (ongoing, funded).</p> <p>2. Continue to support titling process to protect against external offenders. CP (ongoing, funded).</p> <p>3. In protected areas, continue park administration support. CP (ongoing, funded).</p> <p>4. To increase local capacity to monitor wildlife, formalize arrangements between Museum and TCO. CP (ongoing, funded).</p> <p>5. To improve formal education: (i) continue to build CABI initiatives; (ii) connect with Natural History Museum. CP (ongoing, funded).</p>	<p>1. At site level: (i) work with communities and general public to encourage responsible government agencies to enforce existing laws. CP (ongoing, funded).</p> <p>2. At national level: (i) strengthen university programs in wildlife management; (ii) support Reforma Educativa processes so that conservation is incorporated into initiatives of CABI; (iii) support municipalities in environmental planning of their territory. CP (ongoing, funded).</p>
Madidi, Bolivia	<p>1. Assess the sustainability of hunting in the Tacana region. CP (ongoing, funded).</p> <p>2. Evaluate productivity of hunted species in different ecosystems. CP (ongoing, funded).</p>		<p>1. Create space where relevant actors can negotiate agreements to implement existing legislation in a transparent way. CP (ongoing, funded).</p>	<p>1. Continue strengthening local institutions to make specific systems for wildlife management, to increase capacity to protect against internal and external offenders. CP (ongoing, funded).</p> <p>2. Continue park administration support. CP (ongoing, funded).</p>	As for Chaco.

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	RESEARCH	EDUCATION AND AWARENESS	LEGISLATION	CAPACITY BUILDING - LOCAL COMMUNITY LEVEL	CAPACITY BUILDING - OTHER RELEVANT AGENCIES
	<p>3. Determine wildlife movements between Madidi National Park and Tacana TCO. CP (ongoing; funded).</p> <p>4. Study habitat use, ranging behavior and density of white-lipped peccary. CP (ongoing; funded).</p>		<p>2. Continue advising government (through our partners) on natural resource management policies and laws. CP (ongoing; funded).</p>	<p>3. To increase local capacity to monitor wildlife, formalize arrangements between Institute of Ecology and TCO. CP (ongoing; funded).</p> <p>4. To improve formal education: (i) continue to build CIPTA initiatives; (ii) connect with Institute of Ecology. CP (ongoing; funded).</p>	
Mamirauá-Amanã	<p>1. Study population dynamics of hunted species and their ecological determinants in different habitats in Amanã. CP (partially funded).</p> <p>2. Conduct wildlife surveys in more heavily hunted areas in Amanã. CP (funding needed).</p> <p>3. Conduct studies of the ecology of crabs and other threatened or poorly known game species. CP (funding needed).</p> <p>4. Study the contribution of commercial hunting to people's income in Amanã, and the relative economic possible economic alternatives. CP to seek student and funding.</p>		<p>1. Create space where relevant actors can negotiate agreements to implement existing legislation in a transparent way. CP (ongoing; funded).</p> <p>2. Host participatory workshop with relevant actors to discuss and propose revision of the law. CP (funding needed).</p>	<p>1. To enhance community regulatory systems: (i) collect data on social economy of Amanã; (ii) strengthen work with community organizations in Amanã, and extend to Subsidiary Area of Mamirauá. CP (ongoing; partially funded).</p> <p>2. Trust of people in decisions of meetings must be strengthened to enhance internal compliance with regulations. CP working with local communities (ongoing; funded).</p> <p>3. Empower local law enforcement agents and/or promote greater coordination with government enforcement authorities to protect against external offenders. CP (ongoing; partially funded).</p> <p>4. Provide training, funds and materials to allow local community monitoring of wildlife. CP (funding needed).</p>	<p>1. At site level, long-term support to IBAMA and/or IPAAM guards. CP (ongoing; partially funded).</p> <p>2. At site level, extend environmental education project to neighboring rural and urban areas. CP (funding needed).</p>

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	RESEARCH	EDUCATION AND AWARENESS	LEGISLATION	CAPACITY BUILDING – LOCAL COMMUNITY LEVEL	CAPACITY BUILDING – OTHER RELEVANT AGENCIES
	<p>5. Resume monitoring program. CP (<i>funding needed</i>).</p> <p>6. Study the contribution of Amanã and Mamirauá to wildlife sold in local towns. CP <i>to seek student and funding</i>.</p>			<p>5. Extend environmental education project to smaller and less organized communities. CP (<i>funding needed</i>).</p>	
Loreto, Peru	<p>1. Study commercialization of peccary pelts for potential certification. WCS/DICE (<i>ongoing; funded</i>).</p> <p>2. Study population biology relationships between flooded forests and terra firme forests, to understand sustainability better. WCS/DICE (<i>ongoing; funded</i>).</p> <p>3. Study how communities can use catch/unit effort as a self-monitoring strategy. WCS/DICE (<i>ongoing/funded</i>).</p>		<p>1. Implement community-based protected area legislation; determine why the Peruvian government is afraid to implement the community-based protected area legislation. WCS/DICE (<i>funding needed</i>).</p>	<p>Community regulatory systems: Continue working with people and community-based wildlife management plans through extension activities. WCS (Ppuertas), DICE (H. Newing). ongoing (funded)</p> <p>Conflict resolution mechanisms: TT> hold more inter-community workshops to resolve some conflicts on resource access. SAU</p> <p>PS> No action needed.</p> <p>Protect against internal offenders: No action needed.</p> <p>Protect against external offenders: TT> Continue with extension activities, provide help when needed.</p> <p>PS> No action needed.</p> <p>Local capacity to monitor wildlife: TT> Game registers need technical support for information analysis. WCS (Ppuertas), ongoing (funded)</p> <p>PS> Assist AIDECOS in developing management plans. WCS (Ppuertas), PSNR staff.</p> <p>Formal education: TT> Legal education system requires minimum number of schoolchildren to have teachers. Communities are</p>	<p>1. At Tamshiyacu-Tahuayo, no WCS action needed.</p> <p>2. At Pacaya-Samiria, no WCS action needed with other partners. This is a role for TNC.</p> <p>3. At national level, capacity building with peccary pelt trade. WCS/DICE (<i>partial funding, funds pending</i>).</p>

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RESEARCH	EDUCATION AND AWARENESS	LEGISLATION	CAPACITY BUILDING - LOCAL COMMUNITY LEVEL	CAPACITY BUILDING - OTHER RELEVANT AGENCIES
Mbaracayu, Paraguay	<p>1. Study why populations of un hunted species are declining: develop research design to address this. WCS/UNM (partially funded).</p> <p>2. Recruit local biologists to conduct intensive population studies. WCS/UNM and local biologist (partially funded).</p> <p>3. Collect systematic information on poaching. WCS/UNM and local technician (funding needed).</p>	<p>1. Park guards should be authorized to arrest law breakers. WCS support FMB who is working on the issue (no further funding needed).</p> <p>2. Pressure local officials by international pressure, scrutiny, and shame to enforce laws. Write letters periodically to capital city policy makers telling them local authorities are failing to enforce laws. Bolivia regional coordinator to evaluate potential collaboration with FMB (no funding needed).</p>	<p>recruiting immigrants to raise population and qualify for teachers. WCS should provide funding for teachers to eliminate need for immigration. WCS (funding pending) PS> Other NGO activities support environmental education program. No WCS action needed.</p> <p>1. Organize community resource use committee, to establish systems for achieving enforceable consensus on hunting management systems. WCS/UNM (funding needed).</p> <p>2. Form inter-community organizations with the authority to resolve conflicts between Ache communities. WCS/UNM (funding needed).</p> <p>3. To protect against external offenders, improve rapid communication between Ache parties in Reserve and park authorities to inform of encounters with external offenders. WCS/UNM (funding needed).</p> <p>4. 2/3 of skills needed to monitor wildlife achieved through training. Outside technical support needed for other 1/3, for data analysis, modification of research design, interpretation. WCS/UNM (ongoing, funded).</p>	<p>1. At site level: (i) additional training of FMB biologists; (ii) training workshops with park guards. WCS/UNM (funding needed).</p> <p>2. Insufficient information is available to determine action at national level.</p>

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	RESEARCH	EDUCATION AND AWARENESS	LEGISLATION	CAPACITY BUILDING – LOCAL COMMUNITY LEVEL	CAPACITY BUILDING – OTHER RELEVANT AGENCIES
Yasuni, Ecuador	<p>1. Determine impacts and relative importance of conservation threats on wildlife. CP (ongoing, funded).</p> <p>2. Understand better population dynamics of wildlife species in different ecosystems. CP (ongoing, funded).</p>		<p>1. With Government and other NGOs, prepare summaries of legislation on selected topics; hold workshops for officials and the public to explain the laws and their implementation. CP (ongoing, funded).</p> <p>2. With NGOs that specialize in legal matters, propose options to update and consolidate current laws. CP (ongoing, funded).</p> <p>3. Summarize structure and function of local and national government agencies that influence environmental matters. CP (ongoing, funded).</p> <p>4. Pressure Ministry of the Environment to provide more inspectors, more efficient implementation of laws. CP with other NGOs (ongoing, funded).</p>	<p>5. Provide materials and seek volunteer teachers to support currently-poor formal education system. WCS/UNM to explore options for volunteer teachers; LAP to discuss with WCS Education staff availability of materials in Spanish.</p>	<p>1. At site level: (i) coordinate courses for local schools; (ii) provide courses for park guards. CP and NGO partners (partially funded).</p> <p>2. At national level, prepare publication on state of environment in Ecuador. CP coordinated with other NGOs (funding needed).</p>
			<p>1. Improve community management plan, and greatly enhance wildlife component. CP (funding needed).</p> <p>2. Support government justice ministry to establish office of mediator to resolve conflicts. CP and NGO with legal expertise (funding needed).</p> <p>3. Community-level institution building needed to protect against internal offenders. CP (funding pending).</p> <p>4. Enhance ability of local communities to call on enforcement agencies to deal with external offenders. CP and NGO collaborators (funding needed).</p> <p>5. Identify communities to monitor wildlife, develop their technical skills and materials. CP and collaborating communities (funding needed).</p> <p>6. Provide more and better materials for formal education systems, increase contact between educators and wildlife practitioners, develop schoolyard ecology program. CP to liaise with P. Feinsinger on schoolyard ecology; LAP to discuss with WCS Education staff availability of materials in Spanish.</p>		

Appendix

APPENDIX I: ASSESSMENT OF STRENGTHS AND WEAKNESSES IN LEGISLATION RELEVANT TO HUNTING MANAGEMENT

PA = Protected area

COUNTRY	DOES LEGISLATION NEED TO IMPROVED TO ALLOW US TO DO OUR JOB?	IS HUNTING LEGAL? INSIDE PAs?	ARE CERTAIN HUNTING TECHNOLOGIES CONTROLLED? INSIDE PAs?	IS SALE OF WILDLIFE LEGAL?	ARE THERE HUNTING SEASONS/BAG LIMITS?	ARE LAWS ENFORCED? INSIDE PAs?	ARE LAW ENFORCERS AWARE OF THE LAWS?
Bolivia	Yes. Certain laws already exist but institutional weaknesses work against application of the law. Reinforcing SERNAP or local institutions to enforce the laws will work. Negotiating inconsistencies between laws of different ministries would help.	Yes if it is subsistence hunting by people that live inside the PA. Hunting in PAs depends on the type or category of PA and zoning.	No. There are regulations for fishing but not for hunting.	No but the law is not enforced and wild meat can be found in markets and food places. Legal exceptions are for vicuna and spectacled caiman which can be commercially exploited with seasons and size limits.	Since 1990, there has been a total ban on hunting all wildlife except for vicuna and spectacled caiman, but it is not well enforced.	Yes but the degree to which they are enforced depends on the PA. Some are better than others; none are perfect.	Yes people are generally aware of the laws but are either afraid or do not have the political strength to enforce them.
Brazil	Yes in terms of regulation of subsistence hunting.	No, with a few exceptions. Subsistence hunting is banned but how the law is interpreted determines how law is applied. Commercial hunting is banned and sport hunting is allowed in one state.	Not applicable because hunting is banned.	No but still occurs.	No.	Yes but the extensive territory, small number of agents and budgetary restrictions greatly limit enforcement.	Yes generally but maybe not of some specific details.

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APPENDIX 1: ASSESSMENT OF STRENGTHS AND WEAKNESSES IN LEGISLATION RELEVANT TO HUNTING MANAGEMENT

(Continued)

PA = Protected area

COUNTRY	DOES LEGISLATION NEED TO IMPROVED TO ALLOW US TO DO OUR JOB?	IS HUNTING LEGAL? INSIDE PAs?	ARE CERTAIN HUNTING TECHNOLOGIES CONTROLLED? INSIDE PAs?	IS SALE OF WILDLIFE LEGAL?	ARE THERE HUNTING SEASONS/BAG LIMITS?	ARE LAWS ENFORCED? INSIDE PAs?	ARE LAW ENFORCERS AWARE OF THE LAWS?
Guatemala	Yes: wildlife laws are inadequate at the national level and need revision. Hunting seasons and bag limits in pending laws need improvement. In Maya Biosphere area, laws are good although hunting regulations need updating.	No; it is illegal in PAs but is legal with management in multiple-use areas.	By law yes but in practice rarely.	Yes for commercial purposes but it is not enforced in tourism restaurants. In villages in the Maya Biosphere Reserve, local sale of wild meat is tolerated, as is trading within the multiple use zone because they are considered to be for subsistence.	Yes but they date from the 1970s and are obsolete. Both hunting seasons and bag limits have been proposed under new legislation that is pending. Currently a CONAP decree is in force, but is generally ignored.	Very rarely.	Because of many changes in legislation, many CONAP people are not aware of the current legislation. SEPRONA (natural resource police) and POLITUR (tourism police) typically are unaware of the legislation.
Peru	Legislation does not need to be improved but it does need to be implemented. Community based protected area legislation exists at the regional level but is not implemented.	Yes in community based protected areas. Subsistence hunting is legal outside protected areas. There are also lists of legal and protected species.	Not rifles, only shotguns (linked to tetraotism)	Yes in cities of <3000 people. NB: Iquitos residents who have gardens on Iquitos-Nauta road buy dried meat when they visit gardens.	There used to be limits for subsistence hunting of peccaries, but it made no biological sense so it was revoked. No such regulations exist in national law but community reserves set internal limits. Sport hunting does have limits.	Prohibition of commercial pelt trade was enforced in Loreto – no other jaguar trade anymore. Authorities have tried to enforce laws on wild meat trade in large cities, but unlike pelt trade (which involved only a few big traders), wild meat trade is diffuse, so difficult to manage.	The police are not aware, or they are aware and abuse their authority by confiscating goods and reselling them.

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APPENDIX 1: ASSESSMENT OF STRENGTHS AND WEAKNESSES IN LEGISLATION RELEVANT TO HUNTING MANAGEMENT (Continued)
PA = Protected area

COUNTRY	DOES LEGISLATION NEED TO IMPROVED TO ALLOW US TO DO OUR JOB?	IS HUNTING LEGAL? INSIDE PAs?	ARE CERTAIN HUNTING TECHNOLOGIES CONTROLLED? INSIDE PAs?	IS SALE OF WILDLIFE LEGAL?	ARE THERE HUNTING SEASONS/BAG LIMITS?	ARE LAWS ENFORCED? INSIDE PAs?	ARE LAWS ENFORCED? AWARE OF THE LAWS?
Paraguay	Legislation for the area is sufficient. Park guards cannot arrest people and must patrol with police. Lack of legal authority of park guards to arrest people is a flaw.	Hunting is legal for the Ache in Mbaracuyu but not legal for anyone else in any other protected area. Hunting is legal on private lands.	Yes in Mbaracuyu. Ache must use traditional bows and arrows and cannot use firearms, dogs, or traps.	Tegu lizard skins can be sold, and permits may exist for selling wildlife as pets. Over 15 years ago when new laws were introduced, the skin trade crashed. Beef production is huge and meat is cheap so may determine why there is no wild meat market.	No except for Tegu, for which there is a size limit.	No, all laws can be subverted with connections and cash. With a few exceptions in the most visible parks, laws are only occasionally enforced. They generally are in Mbaracuyu and Chaco because of their high profile in the press.	Police are not aware of the laws. Local judges may also not be very informed about wildlife laws.
Ecuador	Legislation for the area is sufficient, but needs to be updated to include recent changes in government agency names and functions. It also needs to take into account the decentralization process. Park guards cannot arrest people and must patrol with police. Lack of legal authority of park guards to arrest people is a flaw.	No; hunting is not legal except for subsistence hunting by indigenous people.	No restrictions except for fishing regulations around the Galapagos.	Illegal but is generally ignored.	None.	In some places, forestry and fishing laws are enforced but wildlife laws are not. This is largely due to lack of political will.	In general there is much confusion over the laws.

APPENDIX 2. ACCELERATING LEARNING ACROSS PROJECTS: LEARNING PORTFOLIOS

by Richard Margoluis¹

Conservation takes place in complex systems. One approach to improving the chances that our conservation interventions will be successful within these complex systems is adaptive management, which incorporates research into conservation action. Specifically, this involves the integration of design, management, and monitoring systematically to test assumptions in order to be able to adapt and learn.

Adaptive management can be used at both project and program levels. At the project level, it involves working through the project cycle and using analysis from monitoring and evaluation to adapt and learn. At the program level, multiple projects can work together in a portfolio to test the conditions under which specific strategies work or do not work (Figure A2.1). A learning portfolio is a network of projects that use a common conservation action and work together to achieve three goals:

- to implement more effective conservation projects;
- to learn about the conditions under which this conservation action works, does not work, and why; and
- to improve the capacity of the members of the portfolio to do adaptive management.

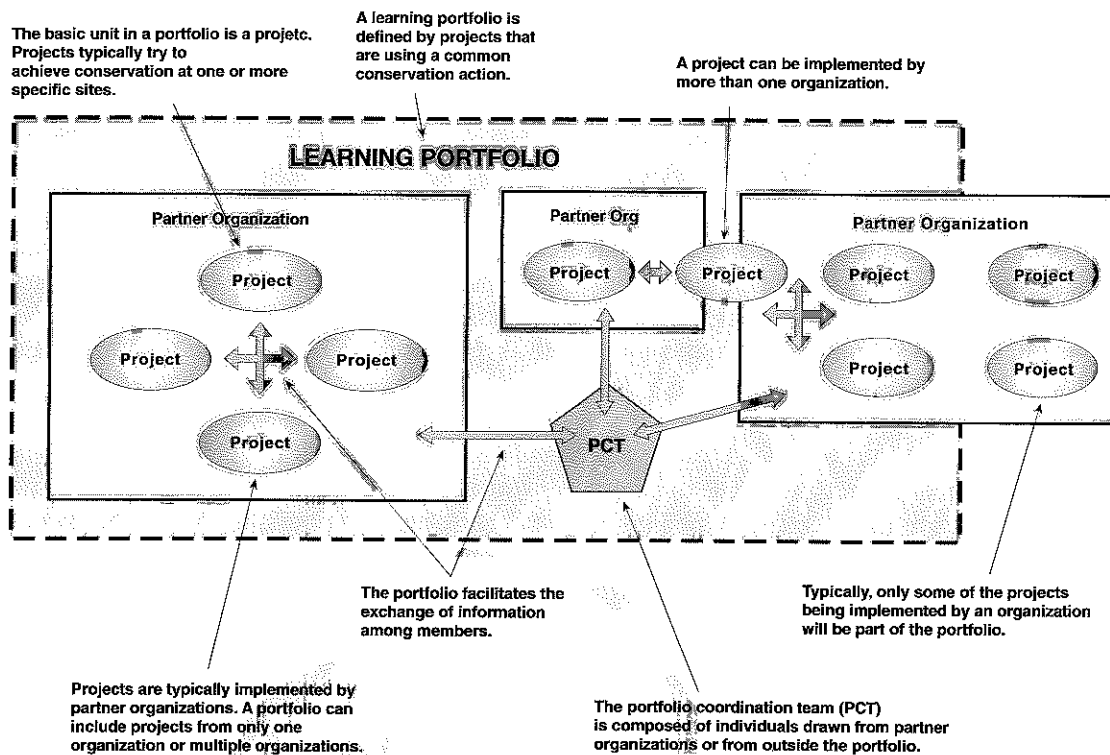
From an analytical perspective, projects in the portfolio that are not successful in implementing the strategy become as important as projects that are successful. By looking at both successes and failures across projects, we can learn about what works, what does not, and why.

Taking a portfolio approach to learning has a number of benefits including:

- it helps us *improve* the implementation of our projects;
- "failures" become *learning* opportunities;
- it promotes the development of *networks* of projects and cross-project learning;
- it provides a framework for *evaluation*; and
- it enables external partners to *add-value* by catalyzing and facilitating learning processes.

¹ Foundations of Success

Figure A 2.1.



APPENDIX 3. DISCUSSION TOPICS

APPENDIX 3.1. RESEARCH METHODS

1. Studying hunting: oftakes, and hunting pressure

Methods currently being used:

- **Maya Forest, Guatemala:** A paid assistant or student records hunting levels in the communities or castana/xate/chicle camp. Interviews are held to record hunting of rare and small animals. Skulls and crops of cracids are collected for compensation, but this might stimulate hunting even if the payment is minimal. A paid assistant or student records hunting levels in the communities or castana/xate/chicle camp.
- **Chaco and Madidi, Bolivia:** Communities record their own hunting patterns (species, weight, location, time, sex, reproductive condition), and monthly checks are made by WCS project staff. Limitations of this are that there are few or no records when hunts are unsuccessful because some hunters record these events and others do not, so it is not possible to analyze catch per unit effort. Further limitations are that not all hunters participate. Even though this is a data limitation, all community members are aware what is happening in the community related to the future management, and agree (at least for now) that key decisions will be made using the information gathered by the hunters.
- **Mamirauá/Amanã, Brazil:** In selected communities, questionnaires are administered by paid local assistants, one for each community monitored. Data collected include records of the composition of meals in terms of protein, wildlife hunted and traded, with fields for species, sex, size, weight, reproductive condition, location and habitat of harvest, resources used in the hunt, etc. Skulls are collected by paid assistants whenever possible. Participatory approaches, through meetings and semi-structured interviews with key hunters, together with harvest data, were used to assess hunting pressure around a large *terra firme* community.
- **Loreto, Peru:** Unpaid community representatives record information of all hunts, including unsuccessful ones (self-monitoring). Skulls of hunted animals are collected, and no compensation for this is paid. Informal interviews are conducted to determine which hunters are participating.
- **Mbaracayu, Paraguay:** A carefully-selected and paid community representative records all hunts by all hunters every day. Interviews are held to record animals hunted on hunting treks, which can last at least two weeks. Random spot-checks are conducted to ensure data accuracy.
- **Yasuní, Ecuador:** A paid assistant or student records hunting levels in the communities.

Discussion:

- Taking into account the total size and relative composition of the entire source and sink of the system is important. If the sink stays the same size and does not expand, sustainability is indicated.
- Another way to try to assess sustainability is to record catch per unit effort. This does not take account of any change in the system, however, e.g., differences in skill between individuals and communities, differences over space or time in technologies used, degree of access and use of transport. If conditions are relatively stable, this can be a very useful parameter.
- It is essential to cross-check hunting data using other methods: to evaluate wildlife populations as well as catch per unit effort. This can be done relatively easily using scats and tracks as indirect indices indicating changes in relative abundance.

2. Estimating populations of hunted wildlife species

Methods currently being used:

- Maya Forest, Guatemala: Cut line transects of 2 to 2.5 km length are walked at a standardized rate; DISTANCE is used to estimate densities if encounter rates are sufficient. This allows an assessment of changes over time. Paratechnicians and park service guards are trained to gather these data, and are paid \$10 per day and \$4 per transect respectively. Burrow checks with dogs to count fossorial animals were tried, but species identification is not possible. Camera trapping is used for large felids, and populations of parrots are estimated using point counts.
- Chaco, Bolivia: Here, line transects do not work, at least for the principal hunted species (ungulates and armadillos). Drive counts are much more effective for brocket deer, and community volunteers can be used in some cases. Populations of brocket deer, collared peccary, tapir, three-banded armadillos, tortoises and tegu lizards are assessed using telemetry. Direct counting of armadillos is impossible because of multiple species using the same burrows, and the difficulty in determining whether a burrow is occupied and by what species. Censuses with dogs were tried for armadillos, but it is difficult to estimate abundance from encounters. Parrot numbers are assessed using point counts (independent and simultaneous) and nest counts. Jaguar and ocelot densities are estimated using systematic camera trapping. Camera trapping may allow to estimate ungulate densities, extrapolating relative abundance from sites where density information is available from alternative methods (telemetry or drives). Track counts also provide information on relative abundance over time and across sites. Izozog parabiologists are trained to do many of the wildlife surveys, and are paid \$250/month. The goal of this is to develop local capacity to manage the TCO and National Park.
- Madidi, Bolivia: Cut line transects are walked using standardized methods; DISTANCE is used when encounter rates are sufficient, and when they are not, encounter rates are used. Local people have been trained to conduct the surveys, and they can now train others to do so. Jaguar are assessed using camera traps. To date, estimates have only been attained for sites with no or light hunting, not those with heavy hunting.
- Mamirauá/Amanã, Brazil: Permanent, cut line transects (Mamirauá: 4 km, Amanã: 8 km) are used to survey diurnal terrestrial birds and mammals in areas with different hunting pressures, to estimate abundance indexes and, when possible, densities. At Amanã, tracks of tapirs and white-lipped peccaries are also recorded. At Mamirauá, surveys span the entire annual cycle; at Amanã, they are restricted to the low-water season due to logistical limitations. Surveys are done by

professional biologists, with the aid of paid local assistants. Waterbird counts are done by observing all birds when travelling using speedboats at standardized speeds, and are also done by professional biologists; an attempt to repeat the same series of water bodies approximately every five years is being made.

- Loreto, Peru: Population estimates are made for macaws, large-bodied terrestrial animals and aquatic species. Open line transects (DISTANCE), fixed width transects and point sample methods are all used, with 20 to 40 students per year helping with the surveys. Local people do not do the surveys because it is very time consuming over and above their normal daily work, and is not congruent with participatory methods of management. Hence, the program either hires people to do the work, or uses students who understand the learning value and the necessity to gather reliable data for their theses.
- Mbaracayu, Paraguay: Diurnal transects are used to obtain data on absolute densities, and the data are analyzed using DISTANCE. Pre-cut trails are never used because repeat walks on the same cut transect do not produce independent samples. A team of six Ache conduct all of the surveys, with training spanning two years. These people are paid to do the transects, walking for ten days per month and at a cost of \$150/person/month. The detection function is unstable in DISTANCE, so the margin of error is considerable. Also DISTANCE does not allow for multivariate analysis or continuous variables such as time. Hence, most of the statistical analyses in this project are done using encounter rates.
- Yasuni, Ecuador: No wildlife population surveys are yet being conducted in the context of hunting studies. Biological monitoring in the context of conservation threats is being conducted at 10-12 sites; large aquatic and terrestrial species are counted along transects once a year; encounter rates are used.

3. Market surveys

- Maya Forest, Guatemala: Sales of wild meat we assessed in tourist restaurants, with wild meat sale questions being set within a broader tourist survey. All tourist restaurants in Peten were surveyed, and the results extrapolated to a larger area.
- Chaco, Bolivia: One study was conducted on sales of birds leaving the communities; this included intermediaries, but did not follow through to the ultimate destination of the birds. A market chain study is needed, including prices all along the chain.
- Madidi, Bolivia: No surveys have been done because the communities do not sell wildlife, including wild meat, on a large scale outside of the community.
- Mamirauá/Amanã, Brazil: Market surveys were done from 1994 to 1996, with a paid assistant in the fisheries program monitoring landings of fish in the two largest towns in the region. He also recorded wild meat that arrived with the fish, collecting data on the species, origin and price of the meat.
- Loreto, Peru: Meat market surveys in Iquitos are conducted every ten years; the next survey will be in 2006. Data are recorded on the local, regional, national and international trade in peccary pelts. A market survey was completed in 2002 for sales of large and small cats (jaguar, puma and ocelot), their parts, pelts, skulls and teeth. Macaws being sold in markets for the pet trade are also surveyed.

- Mbaracayu, Paraguay: No surveys have been done because there is no commercial sale of wild meat inside or outside the communities.
- Yasuní, Ecuador: Wild meat and live animals are available in local markets, and market surveys are being planned. Oil company employees buy wild meat, but the scale of such trade has not yet been quantified.

4. Discussion: Do we need to standardize methods between sites?

- For hunting surveys, differences in hunting techniques and conditions between sites make standardization of methods difficult. Catch per unit effort, for example, cannot be compared between sites and times unless hunting conditions are similar. Meeting participants felt that it would be beneficial to derive some standard parameters for all sites, even if different methods were used to obtain them. Further work is needed to ascertain how to do this.
- For line transect surveys, very different methods are being used by different projects. Mbaracayu in particular used different methods to those at other sites. Meeting participants did not feel it necessary to standardize methods between sites, largely because several studies had already been running for many years, and consistency of methods to allow trends to be assessed within sites over time was deemed to be more important than the ability to compare numbers between sites.

APPENDIX 3.2. DOMESTIC PROTEIN SUBSTITUTES AND THE INFLUENCE OF PRICES

Presentation: David Wilkie, WCS Living Landscapes Program

Economic theory suggests that providing consumers with access to acceptable and affordable substitutes may help to reduce unsustainable hunting and enhance wildlife conservation. Others believe that eating bushmeat is an immutable cultural tradition little influenced by income and prices. New research results suggest that consumption of wildmeat changes as its price increases in absolute terms and relative to the price of substitutes such as beef and chicken. In Gabon as you travel further from the capital city and deeper into the forest, transportation costs mean that the price of imported meat rises and the price of wild meat falls. Consumer choice reflects these relative price differences with wildmeat contributing to 6% of meals containing meat consumed by households in Libreville and 88% in isolated forest villages. Comparable results from rural communities in Honduras and Bolivia show that as the price of wildmeat rises consumption falls, and as the price of beef falls consumers switch away from eating wildmeat. In Bolivia a 10% decline in the price of beef was associated with a 74% decrease in consumption of wildmeat (Wilkie and Godoy, 2001).

Economic theory also suggests that as household income increases consumption of a commodity will rise if it is a necessity (i.e., has no substitutes), or is considered superior relative to substitutes. Consumption of an inferior good falls with rising income. Kuznets (1955) argued that consumption of many goods should exhibit an inverted U pattern with rising income. Consumption initially increases until income reaches a certain level at which point consumers switch to now affordable substitutes. Depending on a family's income, economic development could either drive their consumption of wildmeat up or down. The shape of the Kuznets' curve will determine the rate of change in consumption as incomes rise with economic development. New data show that the shape of the curve for a rural forest community in Bolivia is relatively flat and that wildmeat is a necessity ($E = 0.04$) for families with average incomes less than \$1041/year but becomes an inferior good ($E = -0.14$) when incomes rise above an average of \$4646.

These data suggest that wildmeat consumers are price sensitive and that when substitutes are available and affordable people will switch to eating something other than wildlife. The challenge therefore is to find ways to provide wildmeat consumers with access to substitutes. Ubiquitous trypanosomiasis and abundant and accessible wildlife have militated against the insipient development of livestock raising for food throughout the forests of Central Africa. In South America stocking rates are typically less than one cow for every five hectares of pasture, and in the case of family farms, labor constraints often militate against maintaining areas of pasture large enough to support an economically viable herd of cattle. And though chickens and goats can be found in most forest villages they are typically kept as savings or used as insurance when illness or disasters strike.

One approach to ameliorating the crisis associated with the unsustainable use of wildlife as food is to promote consumer access to substitute sources of protein. A number of projects have been started to domesticate and raise selected wildlife species (cane rats, duikers – forest antelope, bush pigs, etc.), under the assumption that families in the region like the taste of wildlife so much that only by raising and offering for sale captive bred wildlife will the need to hunt wild animals decline (Rahm, 1962; Tewe and Ajaji, 1982; Codjia and Heymans, 1990; Zongo, 1990). Unfortunately the logic behind captive breeding of wildlife species is flawed for several reasons, and thus is unlikely significantly to reduce the demand for wildlife or decrease the hunting of wild animals for food.

First, there is little if any evidence that families in the region would not shift their preferences from wildlife to other sources of protein if they were both available and cheaper. In fact, outside of urban

areas people appear to eat wildmeat because it is almost always the cheapest source of meat in markets (Barnett, 2000). Furthermore, preliminary evidence from Bolivia and Honduras shows that consumers are very price sensitive, and that as the price of wildlife substitutes drop, consumption of wildlife meat declines even more rapidly.

Second, captive breeding of wildlife makes little sense for low productivity species such as large antelope, primates, and most reptiles. Even production rates of cane rats (*Thryonomys swinderianus*), with a gestation of 5 months, and 6-13 months to reach an adult size of 4-5 kg (Houben, 1999), are considerably lower than for domestic pigs and chickens (Delfi Messinger, pers. com.). Raising mollusks and reptiles as a staple food is unlikely to be cost effective as they are slow to reach slaughter size and inefficient at transforming feed into meat. For example, a green iguana consumes as much food as a chicken but requires 3 years instead of 4 months to reach a slaughter weight of 3 kg (Werner, 1991). Similarly, Smythe (1991) calculated that captive raising of pacas, although feasible, was economically irrational as the meat would have to be sold for over \$20/kg to cover costs. Feer (1993) argues that in terms of meat productivity, pigs > zebu cattle > cane rat > duikers. Consequently, increasing the supply of meat through husbandry of truly domesticated livestock, such as pigs, goats, chickens and ducks, that have been selectively bred for over 5,000 years to convert feed into meat most efficiently, makes considerable more sense in productivity terms than attempting to raise wildlife in captivity – which is merely the first step in the long process of domestication. Lastly, the American Zoo and Aquarium Association has published numerous articles that convincingly shown how difficult and expensive it is to raise wild animals in captivity.

Small-livestock production (NRC, 1991; Branckaert, 1995; Hardouin, 1995) such as rabbit raising has been adopted by households in Cameroon in areas where wildlife are already scarce (HPI, 1996). Raising small domesticated animals such as rabbits and chickens is attractive in that methods of husbandry and veterinary care are well known. Small animal raising has been shown to be viable in peri-urban areas that are close to sources of demand, and where proximal wildlife species populations have already been depleted (Lamarque, 1995). That said, pig or rabbit rearing as an alternative to wildlife hunting is only likely to be successful, however, when the labor and capital costs of production are less than the costs of wildlife hunting and marketing (i.e., when game becomes too scarce to be worth searching for and transportation costs are not prohibitive). Of course, if domestic production of meat only becomes economically viable after wildlife has become so scarce as to be unprofitable to hunt, the strategy is clearly ineffective as a conservation measure. In some cases it may be necessary to subsidize the price of substitutes as a direct payment to communities who agree not to hunt particular species that are both at risk of extirpation and important sources of dietary protein.

Discussion

Under what circumstances does substitution work/not work?

- Substitution is an essential part of conservation, but in context together with other actions pursued simultaneously. For example, the zoning and management plan of Izocño TCO includes tourism, wildlife use, and agriculture. These reduce the need for seasonal migration by local residents.
- Taboos exist in a cultural context that makes changes for conservation purposes difficult. Many taboos that make economic sense are abandoned when economic situation change (e.g., new technology increases return rates of hunting taboo species).
- If people actually prefer wild meat they will NOT switch to substitutes.

- Meat provides not just protein but also fatty acids and other nutrients. Vegetable protein is not a substitute for wild meat. Chicken is not the same as wild game species. Pacas and peccaries are preferred species in most areas.
- Substitution is an option for urban populations, less so for rural populations. Livestock can be used as a substitute for wildlife meat and can benefit conservation. But if livestock is sold or used as a "savings account," there is no reason to reduce consumption of wildlife.
- Some communities rely on the sale of game meat for livelihoods (e.g., Uaxactun, Loreto) Economic alternatives must benefit those most directly involved in wildlife use, otherwise there is leakage from system. For example, if hunters are given alternative jobs, a void may be created that is filled by immigrants, so substitution may not reduce number of users. A serious social impact may also be generated by this situation.
- Captive raising of wild meat: domestic species have 10,000 years selective breeding that make raising of new wild species beginning now very unlikely to succeed, with the exception maybe of capybara, given its size, diet, and behavior. Universities and agencies continue to promote captive breeding of wild species for meat. WCS should research conditions under which captive breeding has been tried and disseminate results, mostly limitations, through a working paper.

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APPENDIX 4. EVALUATING THE SUSTAINABILITY OF HUNTING IN THE NEOTROPICS USING THE UNIFIED HARVEST MODEL

by Richard E. Bodmer²

Introduction

Hunting is an important activity for rural people throughout the neotropics (Robinson and Redford, 1991; Robinson and Bennett, 2000). Ensuring that this is sustainable is important for the long-term benefits which people derive from wildlife, and for the conservation of species and ecosystems (Bodmer *et al.*, 1997; Freese, 1997). During the past decade, numerous studies have looked at the sustainability of wildlife hunting in the neotropics using a variety of different models, including: (i) abundance, densities or standing biomass comparisons; (ii) stock-recruitment models; (iii) effort models; (iv) age structures; (v) harvest models; (vi) production models; and (vii) source-sink models.

Evaluating the sustainability of hunting is often done using these simple population models that can indicate whether species are over-hunted. The models are based on population parameters and hunting pressure. The confidence in deducing the sustainability of harvest is greatly enhanced by employing a combination of models that use independent variables. If the results of the different models point to the same conclusion, then the confidence of the conclusions is greatly augmented.

This short paper considers a model that evaluates the sustainability of hunting by combining several simple models into a single, unified model. The confidence of the analysis is enhanced because the unified model incorporates a variety of variables that in turn give greater certainty in the results.

The unified harvest model

The unified harvest model combines the stock-recruitment and harvest models into a unified model that evaluates both the sustainability of current hunting and the potential for long-term sustainable use. The unified harvest model uses a modified population growth curve, as with stock-recruitment curves (Figures 1a and 1b). The horizontal axis is the population size from extirpation (0) to carrying capacity (K), and the vertical axis as the sustainable limit of exploitation expressed as sustainable yield (SY). The SY mirrors the growth of the population dN/dt and has a maximum point of growth or a maximum sustainable yield (MSY). The major difference between the unified harvest model and the population growth curve model is that the vertical axis in the unified harvest model uses the percentage of production harvested as a measure of SY, rather than population growth. Thus, the harvest model can be used to evaluate the sustainability of offtake and the line (known as the SY line) shows the 20%, 40%, and 60% limits to the proportion of production that can be harvested. For example, a maximum of 40% of collared peccary production can be harvested sustainably according to the harvest model. Thus, the SY line in the unified harvest model is the 40% limit. If the harvest of collared peccary exceeds the 40% limit, it is deemed unsustainable. If, however, the harvest is lower than the 40% limit, the harvest appears to be sustainable. Thus, sustainable harvests can occur at

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any collared peccary population size, as long as the harvest is less than 40% of production. In the case of the lowland tapir the maximum level of harvest is 20% of production and in turn, the SY line represents the 20% limit for lowland tapir.

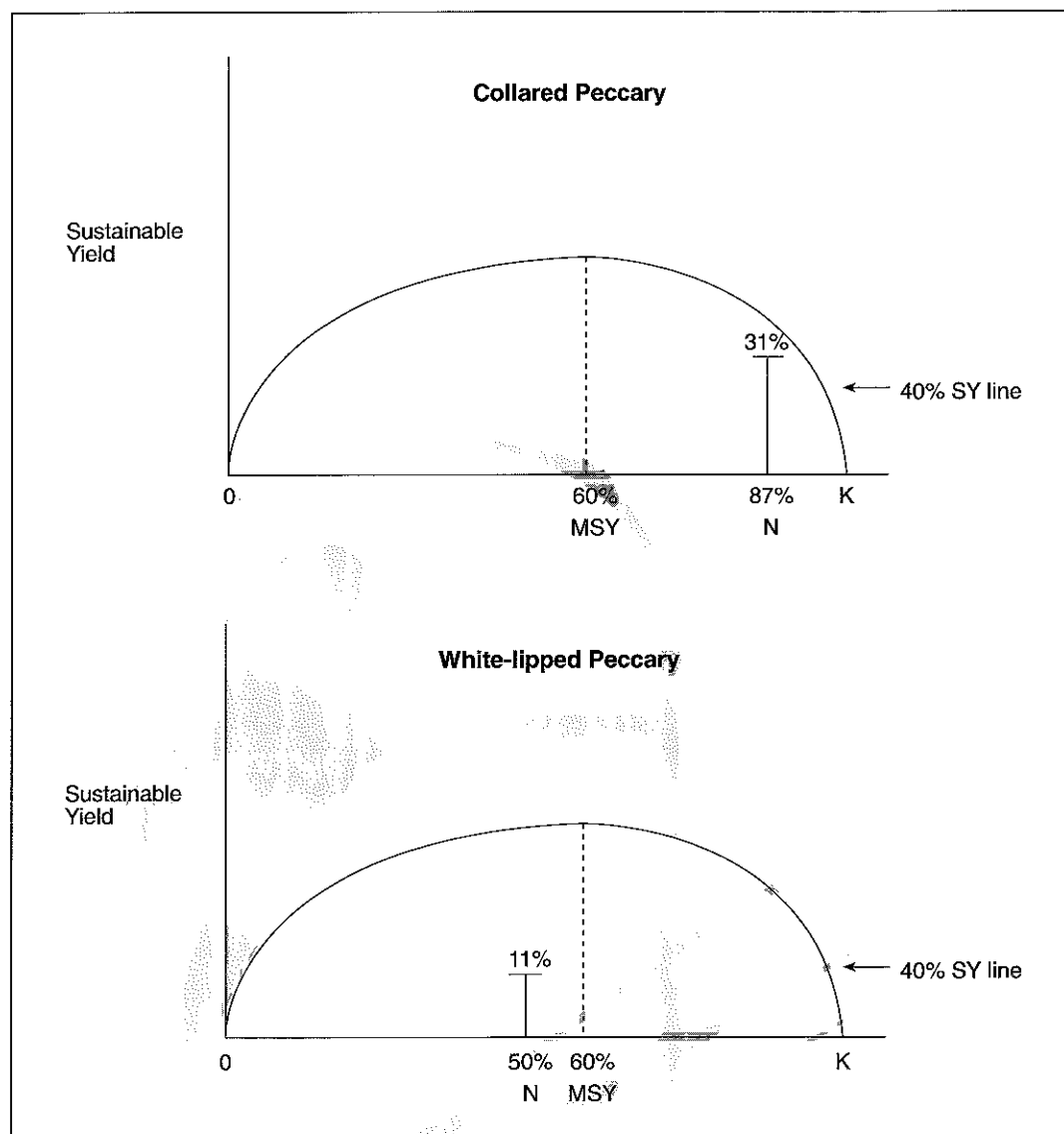


Figure 1a. Diagram of the unified harvest model. The height of the solid vertical line represents the percent of production harvested, whereas the position of the vertical line represents the proximity of the harvested population to K and MSY. The SY line is the estimated limit of sustainable harvests, which is 40% of production for peccaries.

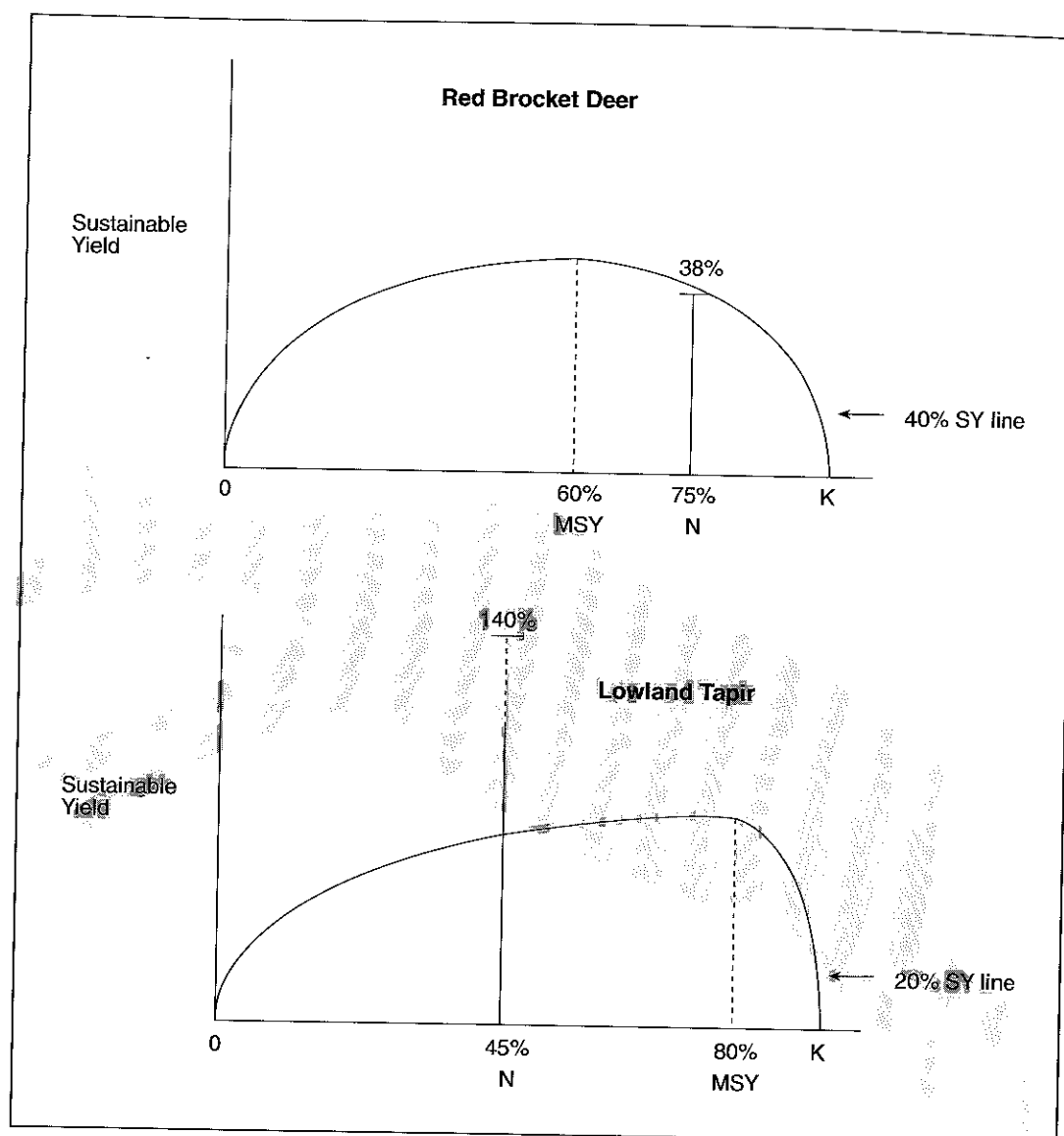


Figure 1b. Diagram of the unified harvest model. The height of the solid vertical line represents the percent of production harvested, whereas the position of the vertical line represents the proximity of the harvested population to K and MSY. The SY line is the estimated limit of sustainable harvests, which is 40% of production for deer and 20% of production for tapir.

The unified harvest model also analyses the riskiness of the harvests in terms of the potential for long-term sustainability by incorporating the stock-recruitment analysis. This is done by determining the proximity of the current harvest to carrying capacity (K) and to the maximum sustained yield (MSY) (McCullough 1987). A safe harvest is one that occurs to the right of the SY point. MSY is species-specific and is predicted to be at 50% for very short lived species, 60% for short lived species and 80% for long lived species. These differences are mainly due to variance in reproduction, and how this changes due to density-dependent interactions as populations approach K (Caughley, 1997). Very short lived species have the greatest variance in reproduction, and density dependent changes in reproduction show a normal distribution as their densities progress from low numbers to K. Short lived species show slightly skewed changes in their reproduction, with maximum production occurring at slightly greater

population levels, usually at 60% of K . Long lived species show little density dependent response to reproduction until their populations are quite large. Thus, the MSY is further to the right and is predicted to be at 80% of K .

The unified harvest model can be used to evaluate whether a harvest level is risky or safe, depending on the population size relative to the predicted MSY. For example, the collared peccary is predicted to have a MSY at 60% of K . If the base population size greater than 60%, the harvest is deemed to be sustainable in the long term, i.e., safe. If the base population is less than 60%, the long term sustainability of the harvest is deemed to be risky. The predicted MSY of lowland tapir would be at 80% of K , because they are a long lived species. Thus, lowland tapir harvests would be deemed safe only if the hunted population was above 80% of K .

The unified harvest model then combines the percentage of production of a harvested population with its position relative to MSY to give both a measure of the current sustainability and of the long term riskiness of the harvest. This can be very useful, since it can all be represented by a single line, which represents both the percent of production harvested in relation to the SY line and relative to the species MSY. For example, the model was used to evaluate the sustainability of ungulate hunting in the Tamshiyacu-Tahuayo Community Reserve (Figures 1a and 1b). For the collared peccary, 37% of production was harvested, which is below the 40% limit, and the harvested population was at 87% of K , well above the MSY at 60% of K . Thus, harvests of collared peccary appeared to be sustainable in the long term. For the case of the white-lipped peccary, 11% of production was harvested, which is well below the 40% limit. However, the harvested population was at 50% of K , which is below the predicted MSY of 60% K . Thus, harvests of white-lipped peccary appeared to be sustainable, but the population was potentially at risk in the long term. The case of the brocket deer was similar to that of the collared peccary. For the lowland tapir, 140% of production was harvested, which was well above the sustainable limit of 40%, and obviously not sustainable. Similarly, the tapir population was harvested at 45% of K which is well below the predicted MSY of 80% K . Thus, lowland tapir was both hunted at unsustainable levels and at risk in terms of long-term sustainability.

The unified harvest model is a practical way to evaluate the sustainability of hunting. The necessary information is hunting pressure, reproductive productivity, and density at hunted and unhunted sites. The density at hunted sites is used to calculate the species proximity to MSY, and is an important variable in estimating production. The density in unhunted sites is used to estimate K and, in turn, MSY. Data on reproduction (e.g., gross productivity) is used to calculate production, and harvest pressure is used to calculate the percentage of production harvested. Since the model combines both the stock-recruitment analysis and the harvest model, it carries with it the same concerns as these models. Sensitivity analysis can be incorporated into the model on both the SY and riskiness calculations.

The unified harvest model reflects the conservation requirements of species by setting the SY limits and MSY levels according to a species' vulnerability to over-hunting. In turn, this is correlated to life history characteristics including reproduction, longevity and generation time (Bodmer *et al.*, 1997). Species which are more vulnerable to over-hunting have higher bars in the unified harvest model, e.g., tapir for which the SY limit is set at 20% and the predicted MSY at 80%. In contrast, species that are less vulnerable to over-hunting have lower bars, e.g., collared peccary for which the SY limit is set at 40% and the predicted MSY at 60% (see Table 1).

Table 1
Limits to sustainable harvests.

Life history strategy	maximum % of production harvestable	Estimated MSY as a % of K
short-lived	60%	50%
medium-lived	40%	60%
long-lived	20%	80%

Discussion

The unified harvest model is a useful tool to evaluate whether hunting appears to be sustainable, but it is not sufficiently precise to determine exact hunting quotas. It can suggest whether current hunting pressures appear to be sustainable and can be maintained, and whether the hunting is unsustainable and hunting levels should be reduced. The model is not precise enough to be used to suggest increases in hunting, or to initiate hunting in unhunted areas. The information is not accurate enough and our understanding of the biology of tropical wildlife populations is not advanced enough to allow us to make such recommendations.

Hunting occurs throughout the neotropics, and we need to ensure that hunting levels are sustainable for the long-term conservation of species and the well being of rural hunters. The unified harvest model is a practical way to evaluate whether hunting is sustainable. Evaluating the sustainability of hunting is only the first step towards converting unsustainable hunting to more sustainable hunting. It is important to use the evaluation of sustainability as part of a process to manage hunting in a more sustainable manner.

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