rapid biological inventories 12

Perú: Ampiyacu, Apayacu, Yaguas, Medio Putumayo

Nigel Pitman, Richard Chase Smith, Corine Vriesendorp, Debra Moskovits, Renzo Piana, Guillermo Knell y/and Tyana Wachter, editores/editors

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The Field Museum

Comunidades Nativas de los ríos Ampiyacu, Apayacu y Medio Putumayo/Indigenous Communities of the Ampiyacu, Apayacu and Medio Putumayo rivers

ORAI FEPYROA FECONA FECONAFROPU

Instituto del Bien Común

Servicio Holandés de Cooperación al Desarrollo/ SNV Netherlands Development Organization

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The Field Museum

The Field Museum is a collections-based research and educational institution devoted to natural and cultural diversity. Combining the fields of Anthropology, Botany, Geology, Zoology, and Conservation Biology, museum scientists research issues in evolution, environmental biology, and cultural anthropology. Environmental and Conservation Programs (ECP) is the branch of the museum dedicated to translating science into action that creates and supports lasting conservation. Another branch, the Center for Cultural Understanding and Change, works closely with ECP to ensure that local communities are involved in conservation in positive ways that build on their existing strengths. With losses of natural diversity accelerating worldwide, ECP's mission is to direct the museum's resources—scientific expertise, worldwide collections, innovative education programs—to the immediate needs of conservation at local, national, and international levels.

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Native communities of the Ampiyacu, Apayacu and Medio Putumayo rivers

Twenty-eight indigenous communities live along the northern and southern borders of the proposed Zona Reservada. These communities belong to the Yagua, Huitoto, Bora, Quichua, Cocama, Ocaina, Mayjuna, Resígaro and Ticuna peoples. Most of these cultures have lived in the region for generations; others arrived in the nineteenth century as slaves for the rubber industry. In the 1980s and 1990s, the communities established three indigenous federations to defend their rights and territory. The Federación de Comunidades Nativas del Ampiyacu (FECONA) represents several communities on the Ampiyacu River. The Federación de Pueblos Yagua de Orosa y Apayacu (FEPYROA) represents several communities on the Apayacu, Napo and Orosa rivers. The Federación de Comunidades Nativas Fronterizas del Putumayo (FECONAFROPU) represents several communities on the Putumayo and Algodón rivers. All three federations belong to the regional indigenous organization ORAI: the Organización Regional AIDESEP Iquitos.

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Instituto del Bien Común

The Instituto del Bien Común (IBC) is a Peruvian non-profit organization devoted to promoting the best use of shared resources. Sharing resources is the key to our common well-being today and in the future, as a people and as a country; to the well-being of the large number of Peruvians who live in rural areas, in forests, and on the coasts; to the long-term health of the natural resources that sustain us; and to the sustainability and quality of urban life at all social levels. IBC is currently working on three projects: the Pro Pachitea project, which focuses on local management of fish and aquatic ecosystems; the Indigenous Community Mapping project, which aims to defend indigenous territories; and a project with the communities and organizations of the Ampiyacu, Apayacu and Putumayo rivers to promote the sustainable management of the forests that border indigenous territories in the region, through the creation of a Reserved Zone and the future designation of several communal reserves. The IBC recently completed the ACRI project, a study of how communities manage natural resources, and distributed the results in a number of publications.

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SNV Netherlands Development Organization (SNV-Perú)

SNV is a Dutch organization dedicated to aiding development, improving governance, and reducing poverty in developing nations. Through SNV, international experts share knowledge, experience and abilities with local institutions dedicated to development in 28 countries in Asia, Africa, Europe and Latin America. SNV has worked for 36 years in Peru, concentrating on economic development, local governance, and the use and management of natural resources, while promoting equality in gender, culture, and environment. To encourage long-term, sustainable results, SNV works to improve the performance and increase the influence of local development organizations. This strategy seeks to facilitate change in organizations and in countries, reduce the imbalance of power, and provide structural solutions that reduce poverty.

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Centro de Conservación, Investigación y Manejo de Áreas Naturales (CIMA-Cordillera Azul)

CIMA-Cordillera Azul is a private, non-profit Peruvian organization that works to conserve biological diversity. CIMA's work includes directing and monitoring the management of protected areas, promoting economic alternatives that are compatible with biodiversity protection, carrying out and communicating the results of scientific and social research, building the strategic alliances and capacity necessary for private and local participation in the management of protected areas, and assuring the long-term funding of areas under direct management.

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Museum of Natural History of the Universidad Nacional Mayor de San Marcos

Founded in 1918, the Museum of Natural History is the principal source of information on the Peruvian flora and fauna. Its permanent exhibits are visited each year by 50,000 students, while its scientific collections—housing a million and a half plant, bird, mammal, fish, amphibian, reptile, fossil, and mineral specimens—are an invaluable resource for hundreds of Peruvian and foreign researchers. The museum's mission is to be a center of conservation, education and research on Peru's biodiversity, highlighting the fact that Peru is one of the most biologically diverse countries on the planet, and that its economic progress depends on the conservation and sustainable use of its natural riches. The museum is part of the Universidad Nacional Mayor de San Marcos, founded in 1551.

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We are deeply grateful to the indigenous communities of the Ampiyacu, Apayacu, Yaguas, and Medio Putumayo region, and to the coordination and facilitation of the indigenous communities and the federations that represent them, who invited us to carry out this inventory of their forests. Without the generous and constant support of the indigenous communities throughout our work together—from the first meetings and overflights, to the construction of the remote campsites, to the field inventories themselves—this project would still be on the drawing board. We are especially grateful to the leaders of the indigenous federations, especially Benjamín Rodríguez Grandes of ORAI, Hernán Lopez of FECONA, Manuel Ramírez of FEPYROA, and Germán Boraño of FECONAFROPU, for whom this inventory represents one small step in a long and ongoing struggle.

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At the remote field sites that the biological team visited, advance teams established campsites under very difficult conditions. We owe immeasurable thanks to Alvaro del Campo, who coordinated and oversaw all of the activities, and whose extraordinary capacity for problem-solving got us through each road-block. Once again, Dario Hurtado provided miraculous coordination for air transport between rustic unmarked heliports, ferrying impossible amounts of cargo and personnel (even dugout canoes) with helicopters from Copters Perú and the Policía Nacional del Perú. For their help in the overflights preceding the inventory, we thank Richard Alex Bracy of North American Float Planes in Iquitos, and the Fuerza Aerea Peruana.

Local communities did nearly all of the advance work. Asterisks mark members of the advance teams who did an extra service, remaining at the camp to help the biological team throughout the inventory. The Yaguas camp was built by Walter Vega Quevare*, Melitón "Coronel" Díaz Vega*, Robinson Rivera Flores, Rigoberto Salas Peña, Haaker Mosquera Merino*, and William Mosquer Merino of the Pucaurquillo community; Andrés Flores Tello, Cleber Panduro Ruiz, Elber Manuel Ruiz Sánchez, and Linder Flores Arikari* of the Brillo Nuevo community, and Pedro Gonzales Guevara of Pebas, with the coordination of Alvaro del Campo. Denis Mosquera Merino in Pucaurquillo was an additional help to the Yaguas team during the construction of the campsite.

The Maronal camp was built by Hernán López Rodríguez*, Alfredo Meléndez López*, Aurelio Campos Chacayset*, Teobaldo Vásquez Pinedo, Carlos Vásquez Pinedo, Henderson Ruiz Imunda, Robert Panduro Mibeco, Victor Ruiz Rodríguez, Jabán Nepire López, and Isaac Nepire Ejten, all of Brillo Nuevo; Benavides Trigoso Peña, Jhonny Díaz Prado, Mauricio Rubio Ruiz, Pedro Mosquera Roque, and Guillermo Collantes Lligio* of Pucaurquillo; and Juan Carlos Silva Peña, Abelardo Cachique, Gregorio Tello Arirama of Ancon Colonia, with the coordination of Guillermo Knell.

The Apayacu camp was built by Atilio Ruiz Barbosa*, Purificación Ruiz C.*, José Murayari C.*, Lindenber Gadea F.*, Manuel Ramírez López*, Emilio Ortiz S., Amancio Ruiz Barbosa, Orbe Noroña, Melchor Greffa F., Abraham Jaramillo C., and Reynaldo Greffa F., with the coordination of Aldo Villanueva.

At all three campsites, Eli Soria Vega and Hortensia Arirama Vega kept the team well-fed from their fabulous field kitchen, while Alvaro del Campo, backed up by Jennifer Eagleton and Rob McMillan in Chicago, ensured the complicated logistics went off without a hitch.

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The goal of rapid biological and social inventories is to catalyze effective action for conservation in threatened regions of high biological diversity and uniqueness.

Approach

During rapid biological inventories, scientific teams focus primarily on groups of organisms that indicate habitat type and condition and that can be surveyed quickly and accurately. These inventories do not attempt to produce an exhaustive list of species or higher taxa. Rather, the rapid surveys 1) identify the important biological communities in the site or region of interest, and 2) determine whether these communities are of outstanding quality and significance in a regional or global context.

During social asset inventories, scientists and local communities collaborate to identify patterns of social organization and opportunities for capacity building. The teams use participant observation and semi-structured interviews to evaluate quickly the assets of these communities that can serve as points of engagement for long-term participation in conservation.

In-country scientists are central to the field teams. The experience of local experts is crucial for understanding areas with little or no history of scientific exploration. After the inventories, protection of natural communities and engagement of social networks rely on initiatives from host-country scientists and conservationists.

Once these rapid inventories have been completed (typically within a month), the teams relay the survey information to local and international decision-makers who set priorities and guide conservation action in the host country.

REPORT AT A GLANCE	
Dates of field work	3-21 August 2003
Region	Lowland forests of northeastern Peru, in the broad interfluvium between the Amazon and Putumayo rivers, three degrees south of the equator. The region's indigenous communities, with the results from the inventory, propose formal protection for a 1.9 million-ha wilderness bordering their lands. The area's southern reaches are less than 50 km from the city of Iquitos, but its northern reaches, along the Colombian border, are some of the most inaccessible areas in Peru.
Sites surveyed	Three sites at the heart of the proposed reserve: the upper headwaters of the Yaguas River, the upper headwaters of the Ampiyacu River, and the upper headwaters of the Apayacu River. The Yaguas is an immense, essentially uninhabited river valley with settlements only at its mouth (Figure 2). The site we visited was old-growth floodplain forest. The other two sites are dominated by upland forest on low hills, mostly under 200 m elevation and drained by small headwater streams lined by swamp forest. The proposed Reserved Zone also includes a 100-km stretch of the blackwater Algodón River, a biologically distinct ecosystem that we surveyed from the air but did not visit.
Organisms surveyed	Vascular plants, fishes, reptiles and amphibians, birds, large mammals, and bats.
Highlights of results	Biological communities in the proposed Reserved Zone are among the planet's most diverse, harboring as many as 1,500 vertebrate and 3,500 plant species. Plant and animal diversity were astonishing at all three sites we visited, but the vast, undisturbed, and inaccessible Yaguas valley had the highest conservation value. **Plants:** Upland plant diversity, on low, acidic hills of intermediate fertility, is astronomical. As in Yavarí, south of the Amazon River (Pitman et al. 2003), the team registered more than 1,500 plant species in the field, of an estimated regional diversity of 2,500-3,500 species. Small-scale diversity of woody plants here may be the highest on the planet; one of our 100-stem inventories contained 88 different species. Forests here are floristically similar to those around Yavarí and Iquitos, but lack white-sand soils. However, many common plant species, like the tree *Clathrotropis macrocarpa* (Fabaceae), are typically Colombian taxa that only reach these northernmost forests of Peru and were not in Yavarí, to the south. **Fishes:** In black- and whitewater streams, rivers, and lakes at the three sites we registered 207 fish species. We expect that the total ichthyofauna of the proposed reserve exceeds 450 species—more than 60% of all fish species in the Peruvian Amazon. Fifteen species we collected are new to Peru and five are new to science,

including an electric fish in the genus *Gymnotus*. The never-before-studied Yaguas River was the most diverse site we sampled; half of the species recorded there were not seen anywhere else during the inventory. Overall, roughly half of the species that we found in this northern region did not occur to the south, in the region we sampled the Yavarí River.

Reptiles and amphibians: The Iquitos area is a global epicenter of herpetological diversity, and more than 300 species of reptiles and amphibians are expected to occur in the proposed Reserved Zone. We registered 64 out of an estimated 115 species of amphibians, including a salamander and an unfamiliar caecilian, and 40 out of an estimated 194 species of reptiles, including 15 snakes, 19 lizards, three caimans, and three turtles.

Birds: The ornithological team registered 362 bird species during the inventory, of an estimated regional avifauna of 490 to 540 species. Five of the species we recorded are restricted to the northwestern Amazon, and an additional 18 only occur north of the Amazon River. Among the species expected along the Putumayo River is the Critically Endangered gamebird *Crax globulosa*.

Mammals: Mammal communities are untouched by human influence on the Yaguas River, where the team found what may be the highest density of lowland tapirs ever recorded—11 sightings in less than two weeks—and recorded groups of white-lipped peccaries (*Tayassu pecari*) with 500 individuals. The other two sites show the effects of occasional hunting by local communities, but will sustain a very diverse wildlife under improved management. We estimate a regional mammal fauna of at least 119 species, including the rare canid *Atelocynus microtis*. In Peru, the primate *Saguinus nigricollis* is restricted to this Putumayo-Amazonas interfluvium, and is not currently protected within Peru's parks system.

Human communities

The proposed Reserved Zone is bordered to the north and south by the 26 indigenous communities who have led the initiative to establish it. These include Huitoto, Bora, Yagua, Ocaina, Quichua, Cocama, and Mayjuna communities; two additional communities, Ticuna and Yagua, are at the mouth of the Yaguas. These communities have a total population of roughly 3,000 people and titled lands totaling >110,000 ha. The indigenous federations that represent the communities have built partnerships with the SNV Netherlands Development Organization, the Instituto del Bien Común, The Field Museum, CEDIA, and other organizations to produce detailed maps of indigenous resource use in the area and to push for the protection of their traditional lands.

REPORT AT A GLANCE

Main threats

Most of the proposed Reserved Zone is relatively untouched at present, but forests along all the main rivers except the Yaguas are visited frequently by local hunters, fishermen, and small-scale loggers. No proposed forestry concessions overlap with the proposed conservation land. In 1999, the government of Loreto considered a Korean proposal to build a huge industrial complex for forest and mineral products in the area. In the north, chronic instability, drug transport, and isolation are long-term problems in remote communities along the Colombian border.

Current status

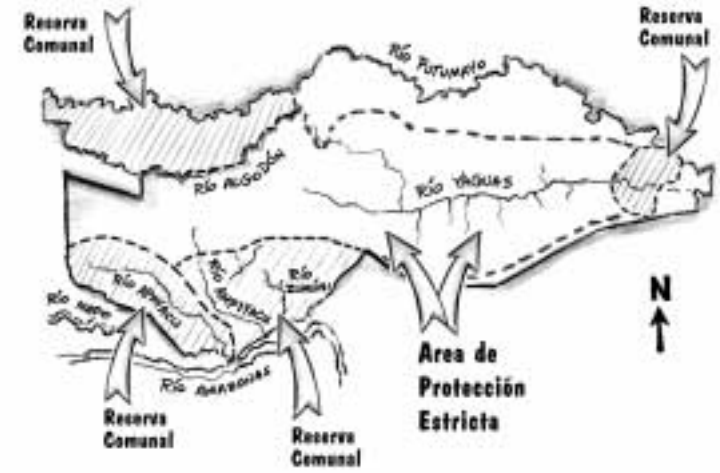
The indigenous communities' 2001 proposal to establish a Communal Reserve in a 1.1 million-ha expanse of their traditional territory could not be approved by Peru's protected areas service (INRENA), for whom protecting this megadiverse area of Peru has long been a priority, without additional biological information. Based on the results of the recent rapid biological inventory, the proposal has been modified to incorporate the entire watershed of the Yaguas River, rather than just its headwaters, thereby increasing the proposed Reserved Zone to 1.9 million ha. The proposed conservation complex includes Communal Reserves and a National Park (see below). The new proposal has been viewed favorably by INRENA.

Principal recommendations for protection and management

01 *Establish a core area of strict protection:* **Yaguas National Park**. The National Park will protect intact forests with the highest conservation value on the landscape—the headwaters of the Apayacu and Ampiyacu rivers, a stretch of blackwater habitats along the Algodón River, and the uninhabited portion of the Yaguas River.

02 *Establish four communal reserves* for managed use by the resident native communities (see map below and Figure 3).

03 *Readjust the boundaries of native communities* to reflect current use.



REPORT AT A GLANCE

Long-term conservation benefits

01 *A new conservation area of global importance,* protecting the world's most diverse forests north of the Amazon River.

02 *Permanent preservation of a source area* for commercially important fish and large mammal populations vital to the economy of Loreto.

03 *Watershed protection* for five major rivers in Loreto.

04 *Participation of local indigenous populations in the management of the region's natural resources,* as stakeholders in and beneficiaries of the long-term protection and sustainable use of the greater Ampiyacu valley.

Why Ampiyacu, Apayacu, Yaguas, and Medio Putumayo?

And why such a complicated name? Bounded to the north and south by three major rivers—the Napo, the Putumayo, and the Amazon itself—and drained by five tributaries—the Apayacu, Ampiyacu, Yaguasyacu, Algodón and Yaguas—this sprawling lowland wilderness in northeastern Peru eludes a straightforward label. Even the nine different indigenous groups who have lived in these forests for generations have no easy answer. What they do agree on—and what underlies their proposal to create a new conservation area here for Peru—are the sacred places, called *sachamamas*, at the remote heart of this landscape: the poorly explored forests considered by tradition to be a sanctuary for fauna and flora, watched over by mythical forest spirits.

For three weeks in August 2003, our biological and social teams explored these forests with indigenous colleagues from nearby communities. A tapestry of low hills stretching to the horizon in every direction, criss-crossed by creeks and dotted with palm swamps, this landscape is home to one of the richest biological communities on Earth, harboring probably 1,500 vertebrate species alone, many of which occur only north of the Amazon River. Mammal surveys recorded the highest density of lowland tapirs anywhere on Earth; ichthyologists estimate that 40% of Peru's freshwater fish live in the area; more than 500 bird species are expected; and more species of trees grow in a football-field-sized patch of forest here than are native to all of North America.

If biologists and locals agree on the sacredness of this area's core forest, we also agree on the need to use forest products in the surrounding forests, closer to the communities, in a way that will benefit people and wildlife in the long term. To that end, the communities have already completed a meticulous map of their resource use in the region. The next step is to design a mosaic of land uses in which "sacred," strictly protected forests coexist peacefully with forests that are managed sustainably by and for the people who live here.

Why a New Protected Area in Amazonian Peru?

Peru's Amazonian lowlands, an expanse of tropical forest the size of Madagascar, are already home to 16 protected areas. The best known of these—Manu National Park, Cordillera Azul National Park, and the Pacaya-Samiria National Reserve—protect vast tracts of land. Why establish more?

The answer is that existing reserves do not cover an adequate representation of the biological diversity in the region. In fact, only a small expanse of lowland Amazonia is currently in protected areas in Peru. As of January 2004, protected areas accounted for 14.9% of Amazonian Peru below 500 m elevation (Figure 11). This coverage is significantly below the South American average (22%), as well as several other Latin American countries, from Venezuela (47%) and Brazil (18%) to the Dominican Republic (32%). Even more worrisome, the proportion of lowland forest that is strictly protected from resource extraction—that is in parks managed as wilderness—is only 2.9%. Manu and Cordillera Azul national parks are indeed immense, but because they are on the Andean slopes, they protect more montane than lowland forests.

Conservation coverage is weakest in the department of Loreto, where the forests described in this book are located. Loreto is the size of Germany, mostly roadless, and probably Peru's most diverse department, but only 0.4% of it is currently in strictly protected parks. An additional 8.6% is in other conservation categories, but most of this corresponds to Pacaya-Samiria, a sprawling wetland which protects none of the terra firme forest that dominates the department. There is only one protected area in the megadiverse uplands north of the Napo and Amazon rivers across their 700-km traverse from Ecuador to Brazil, and it is relatively small by Amazonian standards (the 620,000-ha Zona Reservada Güeppí).

The proposed Reserved Zone in the Ampiyacu, Apayacu, Yaguas, and Medio Putumayo region is designed to fill this gap, protecting the plants and animals that exist only north of the Amazon River. Establishment of the Reserved Zone will boost conservation coverage of Loreto's lowland forests to 14.2%, and coverage of Peru's Amazonian lowlands to 18.2%.

Overview of Results

LANDSCAPE AND SITES VISITED

For three weeks in August 2003, the rapid biological inventory team surveyed upland and floodplain forests, lakes, rivers, and swamps at the heart of the currently proposed 1.9 million-ha Reserved Zone (Figure 2). We focused on three remote sites in the headwaters of the Yaguas, Ampiyacu and Apayacu rivers, a region previously unvisited by biologists. At the same time, the social team was visiting 18 indigenous communities bordering the proposed Reserved Zone and discussing local initiatives to establish a new conservation landscape.

Although northern Peru is famous for extreme environmental patchiness—epitomized by the white sand islands around Iquitos—the landscape of the proposed Reserved Zone, bounded by the Putumayo River to the north and the Amazon and Napo rivers to the south, is relatively homogeneous in soils, geology and climate. Seen from above, in satellite images and overflights, endless low hills stretch west, east, and north into Colombia, dotted with thousands of tiny palm swamps. We found no obvious environmental gradients in the areas we visited, and no white sand soils, though the contrast between the classic blackwater river that drains the northern portion of the area (the Algodón) and the primarily whitewater rivers that drain the central and southern portions hints at some important large-scale soil differences.

The warm, wet, and humid climate here and across most of Loreto is technically aseasonal, in that no month sees less than 100 mm of rain. Annual rainfall is 3 m, typically peaking in March and November and lowest in June and February. This relatively predictable picture is punctuated occasionally by short and catastrophically violent windstorms, which can topple thousands of trees in a matter of minutes.

VEGETATION AND FLORA

Because of their proximity to Iquitos, forests along the southern border of the proposed Reserved Zone—especially near Pebas and the Sucusari River—have been relatively well studied by botanists. By contrast, forests in the central and

northern forests were a mystery until this inventory. Despite our best efforts in the field, including 1,350 collections, 1,900 photographs, and nearly 3,000 plants inventoried in quantitative surveys, the fantastic diversity of these plant communities and the brevity of our inventory mean that perhaps half of the regional flora has yet to be documented by botanists.

Based on our results, and more complete inventories of areas closer to Iquitos, we estimate that between 2,500 and 3,500 plant species grow in these forests. The majority of these are woody taxa—mostly trees, shrubs, and lianas—with a smaller component of understory herbs and epiphytes. At small scales, the species richness of these woody plant communities is perhaps the highest on Earth. One sample of 100 trees and shrubs in a small patch of understory contained 88 different species, the most "common" of which was represented by just three plants. Our three 1-ha transects of large trees contained an *average* of 299 species—70% more than in comparable surveys in Manu National Park.

Only a handful of the plants we collected during the inventory have been studied by taxonomic specialists, but this has already turned up taxa that are new to science or to Peru. One apparently undescribed species is an understory herb in the monotypic genus *Cyclanthus* (Figure 5F); another is a tree in the Clusiaceae (Figure 5E). Our collection of the understory herb *Monophyllanthe araracuarensis* (Marantaceae, Figure 5H) is only the second; the first is from the Caquetá River basin in Colombia.

Several other species that we collected are well-known elements of Colombian forests on the other side of the Putumayo, but these are balanced by a large number of species that are widely distributed throughout Loreto. The best example of the former is the tree *Clathrotropis macrocarpa* (Fabaceae), dominant in several Peruvian and Colombian forests to the north of the Amazon and Napo, but only known from scattered collections to the south. Most of the other dominant tree species in the uplands here are common across much of the Iquitos region, like *Oenocarpus bataua* (Arecaceae), *Senefeldera inclinata* (Euphorbiaceae), *Eschweilera coriacea* (Lecythidaceae), *Virola pavonis* (Myristicaceae), *Hevea guianensis* (Euphorbiaceae), *Protium amazonicum* (Burseraceae) and various species in the genus *Iryanthera* (Myristicaceae).

Swamp forests are common on the landscape, but not in the typical fashion. Rather than dominating large blocks of land, swamps here are scattered in tiny pockets along the streams that drain the low hills. Most of these swamp forests are dominated by the distinctive palm *Mauritia flexuosa* and look similar on satellite images and overflights, but can be compositionally dissimilar in the extreme on the ground.

FISHES

The ichthyological team studied fish communities at 32 standardized sampling stations spanning the range of aquatic habitats at our sites. Covering more than a hectare in extent, these stations included the 40-m wide main channels of the Yaguas and Apayacu rivers, upland streams narrow enough to step across, oxbow lakes, palm swamps and occasionally flooded low-lying areas, in whitewater, blackwater, and clearwater habitats. Because our inventory took place in a dry period, river levels were relatively low and there were few inundated floodplains to sample. We were also unable to sample the Algodón River, a large, blackwater tributary of the Putumayo that remains a very high priority for fish surveys.

The 5,000 fish specimens we collected during the inventory have been sorted to 207 species in 33 families and 11 orders. As expected in upper Amazonian fish communities, two orders—Characiformes and Siluriformes—dominate community structure, accounting for 84% of the species we recorded. Additional species registered by the social team in interviews with local communities and species recorded by previous expeditions to the lower Apayacu bring the total for the Ampiyacu, Apayacu, Yaguas, and Medio Putumayo (AAYMP) region to 289. We estimate that with additional inventories, the region may have as many as 450 fish species, or a full 60% of the ichthyofauna of Amazonian Peru.

Fish diversity of the region seems especially high because the ichthyofauna is a mix of taxa shared with southern-bank tributaries of the Amazon, like the Yavarí River, and taxa shared with the Putumayo basin. As a result, roughly half of the fish community of the AAYMP would remain unprotected if the proposed Yavarí Reserved Zone were declared, highlighting the importance of protecting both regions.

We collected at least one species that is a new record for Peru—*Moenkhausia hemigrammoides*—as well as 15 others that may also prove to be new for Peru. Five species are potentially new to science, including electric fish in the genus *Gymnotus* (Figure 6E) and pimelodid catfish in the genus *Cetopsorhamdia.*

The vast majority of the species we recorded are smaller than 10 cm long as adults, and many of them are economically valuable as ornamental fish. Among the larger, commercially important fish we found *Arapaima gigas* (*paiche*), *Osteoglossum bicirrhosum* (*arahuana,* Figure 6B) and *Cichla monoculus* (*tucunaré*); there are also reports of *Colossoma macropomum* (*gamitana*), *Piaractus brachypomus* (*paco*), *Pseudoplatystoma fasciatum* (*doncella*) and *Brachyplatystoma filamentosum* (*saltón*). Local communities reported that many of these important food species are periodically overfished by freezer boats that occasionally work the rivers in the region.

AMPHIBIANS AND REPTILES

Forests around Iquitos are a global epicenter of herpetological diversity and home to 115 amphibian and 194 reptile species. The herpetological team spent two weeks seeking out amphibians and reptiles in a variety of habitats and microhabitats at the three sites, identifying others by their song, and collecting 66 specimens for the UNMSM Natural History Museum in Lima.

The preliminary list from the inventory includes 64 amphibian and 40 reptile species. Diversity was especially high in the genera *Osteocephalus* (eight species) and *Eleutherodactylus* (13). The number of *Osteocephalus* species is the highest ever recorded for a single area. We did not record several frog species known to occur in flooded forests on the lower Ampiyacu and Apayacu, which indicates high levels of habitat-related beta diversity exist in the proposed Reserved Zone.

Two of the amphibians registered appear to be undescribed species, including one of the eight *Osteocephalus* species (Figure 7F) and a caecilian in the genus *Oscaecilia* (Figure 7D), discovered eating earthworms during a middle-of-the-night downpour in our Yaguas camp. Our records of *Osteocephalus mutabor* and *Lepidoblepharis hoogmoedi* represent significant range extensions for these species, and our collection of the false coral snake *Rhinobotrium lentiginosum* (Figure 7C) is apparently only the third for Peru.

BIRDS

Several sites on the northern banks of the Napo and Amazon rivers, including Sucusari and Pebas, have been well surveyed for birds. By contrast, the middle Putumayo, Algodón, Yaguas, and the vast majority of the terra firme forests in the AAYMP region have not, to our knowledge, been studied by ornithologists. The three sites we visited provided a good look at the most diverse bird habitat in the AAYMP region—upland forest—but we missed a number of blackwater birds, large river island birds, and open-habitat birds that almost certainly occur on the Algodón or Putumayo.

In eighteen days of field work we registered 362 bird species. Based on bird lists from nearby sites, we estimate a regional avifauna for the proposed AAYMP Reserved Zone at nearly 500 species. Most of the ~140 species we expect but did not record are either very rare, and would require longer-term sampling to discover, or specialize on riparian habitats that were not common at the sites we visited. An additional 40 species would be expected if the proposed Reserved Zone were extended to include large river habitats along the Putumayo or lower Algodón.

Most of the birds we recorded are widespread species, but five are endemic to northwestern Amazonia: Fiery Topaz (*Topaza pyra,* Figure 8E), Salvin's Curassow (*Crax salvini*), Dugand's Antwren (*Herpsilochmus dugandi*), Ochre-striped Antpitta (*Grallaria dignissima,* Figure 8D), and Red-billed Ground-cuckoo (*Neomorphus pucheranii*). Another 18 species are present in Peru only north of the Amazon, and these are currently unprotected by Peru's parks system, including the proposed Yavarí Reserved Zone. Seven of the species we recorded, including the nationally endangered Harpy Eagle (*Harpia harpyja*), are on Peru's endangered species list. We did not encounter the Wattled Curassow (*Crax globulosa*), a critically endangered species at the global level, but it may occur on the floodplains or islands of the Putumayo.

Bird communities in the AAYMP region appear largely intact, and game birds (guans, curassows, trumpeters and tinamous) were common at all three sites we visited. Hunting pressure was especially low in the Yaguas River site, where we observed pairs of Salvin's Curassow (*Crax salvini*) daily. Without protection and management, this is unlikely to remain the case, especially along the rivers that provide easy access to hunters and logging parties. One solution is to establish a network of protected areas, where hunting-free source areas can replenish game bird populations in adjacent sink areas where hunting is managed. Wherever they are located, these source and sink areas will represent the first large conservation area in Loreto that protects upland bird communities. To the extent that the areas can also include significant stretches of large river habitat, the proportion of Loreto's megadiverse avifauna under protection will rise.

MAMMALS

The mammal communities of the forests between the Napo, Amazon, and Putumayo are poorly studied, and range maps of several species in the scientific literature show question marks for this area. Our inventory focused on large mammals, and was complemented by several nights trapping bats with mist nets. We recorded 39 non-volant mammal species and 21 bat species, for a total that is roughly half of the 119 mammal species expected to occur in the proposed Reserved Zone. This expected diversity represents more than a quarter of all mammals known from Peru.

Ten of the 13 expected primate species were recorded during the inventory. Of special interest are two tamarin species in the genus *Saguinus. S. nigricollis* is perhaps the most range-restricted mammal registered in the inventory, with a distribution that extends narrowly to neighboring areas in Ecuador, Colombia and Brazil, and is not currently protected by any Peruvian park. Before our inventory, its congener *S. fuscicollis* was not confirmed to occur between the Amazon and the Putumayo, and our observations fill a large gap in its distribution, linking Peruvian populations south of the Amazon to Colombian populations north of the Putumayo. Interestingly, *S. fuscicollis* was much less abundant here than in other known populations, and significantly outnumbered by *S. nigricollis.*

Populations of large primates were smaller than expected, even in the unhunted Yaguas site, and may reflect persistent impacts of historical depletion. By contrast, ungulate populations were large and healthy, overwhelmingly so for some key species. At Yaguas we documented what is likely the highest density of lowland tapir (*Tapirus terrestris*) ever seen anywhere, with more than 11 direct observations in a two-week period. At this same site we encountered groups of white-lipped peccaries (*Tayassu pecari*) estimated to number some 500 individual animals. During the inventory we also recorded a large number of Amazonia's rarest or most threatened mammal species, such as the giant armadillo (*Priodontes maximus*), the short-eared dog (*Atelocynus microtis*), the giant anteater (*Myrmecophaga tridactyla*), and the jaguar (*Panthera onca*).

Our limited bat sampling resulted in a preliminary list of 21 species, representing approximately a third of the expected bat fauna in the region. Notable records include an unidentified specimen in the genus *Myotis,* which may be new to science, and a large

Sturnira that matches the poorly known *S. aratathomasi,* a species thought to be largely montane. *S. aratathomasi* and *Artibeus obscurus* are both considered near threatened at the global level.

The Yaguas River valley site was the best preserved of the three we visited, and merits strict protection as a source area for animals hunted in the surrounding communities to the north and south. Impacts were obvious at the other two sites, which are visited occasionally by hunting parties from communities lower on the Apayacu and Ampiyacu. At both Maronal and Apayacu, mammal communities were less diverse and less abundant, and animals were much more wary around humans. A mosaic of strictly protected and managed-use areas in the AAYMP region will provide a perfect opportunity to implement game management programs in the major watersheds in cooperation with local residents.

HUMAN COMMUNITIES

Because the original proposal for a conservation area in the AAYMP region originated in the indigenous communities that live along its borders, the social context of the proposed Reserved Zone was well known at the time of the biological inventory. Twenty-six indigenous communities occur to the north and south of the proposed area, mostly along the Apayacu, Ampiyacu, and Putumayo rivers, with one community on the Algodón and two at the mouth of the Yaguas. These communities are home to some 3,000 people in nine different ethnic groups—Huitoto, Bora, Yagua, Ocaina, Cocama, Quichua, Mayjuna, Resígaro and Ticuna—and are represented by three indigenous federations that represent communities in the Apayacu watershed, the Ampiyacu watershed, and the Putumayo watershed respectively.

The social team visited 18 of these communities in August 2003 to discuss conservation opportunities with local residents and to identify local practices, strengths, and relationships relevant to conservation efforts in the region. Two day-long workshops in the Apayacu and Putumayo regions brought local residents and leaders together in discussions about threats to the social and environmental well-being of the communities, solutions to those threats, various options for conservation areas under Peruvian law, and the status of the proposal for a Communal Reserve submitted to INRENA in 2001. Shorter visits, interviews, and discussion groups in individual communities opened a window on local concerns, aspirations, and daily life in the communities, and provided a forum for ideas and complaints regarding new proposed conservation areas.

THREATS

The AAYMP region is large and politically heterogeneous, and different threats affect different areas. To the north, the principal threat is chronic political instability along the Colombian border. Intimidation by Colombian guerrillas and loggers is commonplace on the Peruvian side of the border, and in the absence of a strong government presence much of the region remains largely lawless. Unless special attention and resources are directed to communities along the Putumayo, a new conservation area in the AAYMP will risk having a porous and problematic northern border.

To the south, the most serious concern is unregulated resource extraction along the Ampiyacu and Apayacu rivers, which are logging, hunting, and fishing grounds for the nearby markets in Iquitos. Local communities complain that the forests and lakes outside of their territories—and sometimes inside them—are frequently targeted by logging and hunting parties from outside the region, who extract resources with no management plan or long-term vision. A large Korean company recently proposed to build an industrial complex in the region; the proposal was not approved but remains an attractive option for some government authorities and could revive. Local communities themselves use large areas of the forest outside their legal territories to hunt, fish, and log, and this informal, unregulated resource extraction is also a potential threat to the core areas in the long-term.

Throughout these forests, the marginalization of indigenous communities represents a persistent low-level threat. The lack of basic government services has resulted in a slow depopulation of many communities, the consequent erosion of traditional power structures, and a profound distrust of government agencies and officials. There is also a divide between indigenous communities and the mostly non-indigenous district-level authorities, and contrasting long-term visions for the landscape.

CONSERVATION TARGETS

In any landscape, certain species, forest types, and ecosystems have special conservation value. The following table highlights species, forest types, and ecosystems in and around the proposed Ampiyacu, Apayacu, Yaguas, and Medio Putumayo Reserved Zone that are of special importance to conservation. Some are important because they are threatened or rare elsewhere in Peru or in Amazonia; others are unique to this area of Amazonia, key to ecosystem function, important to the local economy, or important for effective long-term management.

ORGANISM GROUP	CONSERVATION TARGETS
Biological Communities	Near-entire watersheds of three large rivers—the whitewater Ampiyacu, Apayacu, and Yaguas—and much of a fourth—the blackwater Algodón. Large tracts of Loreto's most representative forest type, poorly protected elsewhere in the department: intact, megadiverse upland forest. A diversity of aquatic habitats and microhabitats in the Putumayo and Amazon drainages.
Vascular Plants	Extraordinarily diverse plant communities growing on terra firme hills and terraces. Threatened populations of commercial timber species (especially *Cedrelinga cateniformis* (Figure 5A), *Cedrela* spp., and *Calophyllum brasiliensis*). Readily accessible floodplain and inundated forests. Blackwater riparian communities not protected elsewhere in Loreto.
Fishes	One of the most diverse freshwater ichthyofaunas of Peru. Populations of commercially valuable migratory fish species, including *doncella* (*Pseudoplatystoma fasciatum*). A great variety of small ornamental species, including *pez hoja* (*Monocirrhus polyacanthus*, Figure 6C) and other species likely new to science.
Reptiles and Amphibians	Intact and diverse herpetofaunal communities in a mosaic of forest types. Recovering populations of commercially hunted species, like caimans and tortoises. Restricted-range species.
Birds	Five species endemic to northwestern Amazonia and 18 others known in Peru only north of the Amazon. Game species, including Nocturnal Curassow (*Nothocrax urumutum*) and Pale-winged Trumpeter (*Psophia crepitans*). Large hawks, including Harpy Eagle (*Harpia harpyja*).

CONSERVATION TARGETS	
Mammals	Hyperdiverse and intact communities of non-volant mammals and bats, best represented in the Yaguas River valley. The highest population density ever recorded for the lowland tapir, *Tapirus terrestris.* *Saguinus nigricollis,* a restricted-range primate, and intact populations of several other primate species under hunting pressure elsewhere in Amazonia. The endangered giant armadillo, *Priodontes maximus,* and at least three other globally threatened species.
Human Communities	Sacred places set aside by local indigenous communities as refuges for flora and fauna. Reforestation with economically valuable hardwood and fruit trees. A large-scale map of hunting, logging, and other extractive activities by indigenous communities.

The conservation landscape we propose for the Ampiyacu, Apayacu, Yaguas, and Medio Putumayo region will provide **long-term protection for areas as rich in cultural as in biological diversity.** Our vision is an integrated system of land use areas that simultaneously provides (i) a refuge for biodiversity, including the **hundreds of unprotected species occurring only in forests north of the Amazon River,** and (ii) a strong framework for conservation stewardship, with **local indigenous communities actively participating in the management and protection of natural resources** in their forest homes.

A new reserve in the region will secure a *better economic, environmental, and cultural future* for Peruvians in Loreto and the rest of the country by:

01 **protecting vast tracts of high diversity terra-firme forests** absent from other reserves in Peru,

02 **preserving traditional ways of life** for the nine indigenous groups living in the area—a central component of Peru's rich cultural heritage,

03 **creating economic opportunities** for indigenous and *ribereño* communities—and by extension, the nearby markets in Pebas and Iquitos,

04 **safeguarding the headwaters** of five principal rivers in the region of Loreto—a proactive measure to ensure uncontaminated water for future generations,

05 **establishing source areas of game** to replenish animal populations depleted by unmanaged hunting—including tapirs, peccaries, and large primates.

RECOMMENDATIONS

Our long-term vision for the Ampiyacu, Apayacu, Yaguas, and Medio Putumayo landscape is an integrated system of land use areas that simultaneously protect the region's diverse forests, and the traditional practices and lifestyles of the local communities living in them. This vision is the product of collaborations over five years with resident native communities, and this rapid inventory. We offer preliminary recommendations for the Ampiyacu, Apayacu, Yaguas, and Medio Putumayo region below, including specific notes on protection and management, inventories, sustainable resource use, research, and monitoring.

Protection and management

01 **Establish the proposed *Ampiyacu, Apayacu, Yaguas, Medio Putumayo Reserved Zone* inside the boundaries outlined in Figure 2.** Reserved Zone status will ensure immediate protection while studies determine the most appropriate set of final categories for the areas within the set boundaries.

02 **Create within the Reserved Zone a mosaic of protected and use areas,** based on the results of the rapid biological inventory, the use map of local communities, and the keen interest of local communities in continuing to use and manage natural resources in the area. From the results of the rapid inventories and discussions with indigenous residents, we recommend the following matrix of protected and non-protected areas:

A. **A core area of strict protection— *Yaguas National Park*—** that includes the headwaters of the Apayacu and Ampiyacu rivers, a stretch of blackwater habitats along the southern banks of the Algodón River, and a large portion of the Yaguas watershed. These intact forests have the highest conservation value in the landscape.

A national park will protect important breeding areas for economically valuable plants, fishes, birds, and mammals, and a large tract of Loreto's dominant forest type (upland forest) with its magnificent array of plant and animal species. Protection of that rich biodiversity will come at a relatively low cost to the department: the proposed core area covers just ~2% of Loreto (and just 1.5% of Peru's Amazonian lowlands), but will provide long-term protection for >3,000 plant and ~1,500 vertebrate species, many of them protected nowhere else in Peru.

A new national park here will increase the proportion of Loreto's megadiverse lowland forests that currently enjoy strict protection from an inadequate 0.4% to just below 3%.

RECOMMENDATIONS

Protection and management (continued)

B. **Four Communal Reserves for managed use by the resident native communities,** as listed below. These Communal Reserves will be the first protected areas of this kind in Loreto (the Tamshiyacu-Tahuayo Communal Reserve is not yet part of Peru's national protected areas system). Given their proximity to Iquitos, these protected areas will attract significant conservation and development investments to Loreto, and are sure to be an energetic foundation for sustainable use programs that benefit both human communities and wildlife.

   i. **Apayacu Communal Reserve in the southwestern portion of the proposed Reserved Zone,** including the middle and lower watershed of the Apayacu River and adjacent areas in the Napo watershed (see Figure 3), and managed jointly by INRENA, local indigenous communities, and FEPYROA.

   ii. **Ampiyacu Communal Reserve in the southeastern portion of the proposed Reserved Zone,** including the middle and lower watershed of the Ampiyacu River and adjacent areas in the Napo watershed (see Figure 3), and managed jointly by INRENA, local indigenous communities, and FECONA.

   iii. **Algodón-Medio Putumayo Communal Reserve in the northwestern portion of the proposed Reserved Zone,** (see Figure 3), managed jointly by INRENA, local indigenous communities, and FECONAFROPU.

   iv. **Yaguas Communal Reserve in the lower part of the Yaguas basin, contiguous to the native communities located at its mouth** (see Figure 3), and managed jointly by INRENA, local indigenous communities, and FECONAFROPU.

C. **Re-adjusted boundaries of native community properties through development of detailed land-use and land-ownership (cadastral) maps.** In some cases, territories established years ago are no longer adequate to support the basic needs of their residents, and should be enlarged to accommodate current needs.

RECOMMENDATIONS

Protection and management (continued)

03 **Strengthen local government and community institutions to buffer the proposed Reserved Zone and to improve quality of life of local residents.**

A. **In the northern portion of the Reserved Zone, promote binational action for conservation along the Peru-Colombia border.** Work with Peruvian and Colombian authorities, interested communities, and nongovernmental organizations—especially PEDICP, the Special Project for Development for the Putumayo Basin—to bring new resources and attention to this neglected region. Implement special measures to buffer the Algodón-Medio Putumayo Communal Reserve, and the indigenous communities that will manage it, from a continued influx of immigrants and from incursions by Colombian loggers and hunters.

B. **In the southern portion of the Reserved Zone, work with and strengthen local and regional institutions,** to explore alternatives for controlling and managing the logging activities in the Ampiyacu and Apayacu basins.

04 **Ensure participation of local indigenous and *ribereño* populations in the management of the region's natural resources,** as stakeholders in and beneficiaries of the long-term protection and sustainable use of biodiversity in the AAYMP region. Promote regular dialogue and build a working relationship among INRENA, local indigenous federations, and local authorities in the district capitals of the region (Pebas, San Antonio de Estrecho, and San Francisco de Orellana) and the Regional Government. Ensure that management of the proposed Communal Reserves remains in the hands of the communities that have used these forests for generations, and guarantee participation of local communities in the management of the strictly protected core area. Provide local residents with strong programs and educational materials, hire most park guards from nearby towns, establish park guard stations and regular patrols, and post signs at key entry points along the borders.

05 **Secure sustainable funding** that will provide the technical and financial assistance requested by local communities to improve the effectiveness and long-term viability of their management and protection. This should include scholarships for the leaders of indigenous communities and federations, scholarships for young indigenous students and biologists of the region, and improved primary education in the communities, to ensure a pool of experienced, talented, and well-trained residents to help monitor and manage the proposed protected areas.

RECOMMENDATIONS

Further inventory

01 **Continue basic plant and animal inventories in the large sections of the proposed Reserved Zone that the rapid biological inventory team did not visit.** Especially high priorities include:

A. *The middle and lower Yaguas River valley.* Our survey was the first visit of biologists to this extensive, uninhabited river basin. Additional information on plant and animal communities in its lower stretches is necessary for zoning the strictly-protected area proposed for these forests. Biological inventory of the Yaguas could be profitably combined with an inventory of Colombian forests near the mouth of the Yaguas and linking the proposed national park to Colombia's Amacayacu National Park (see below).

B. *Blackwater habitats along the Algodón River.* These are likely to include significant numbers of plant and animal taxa that are not present anywhere else in the proposed Reserved Zone and deserve special attention in research and management.

C. *Patches of terraced upland forest scattered throughout the proposed Reserved Zone.* These may contain some plants and animals that do not occur in the more common hilly upland forest. Exploring these terraces is easiest from the Sabalillo research station on the lower Apayacu (see below).

D. *Large river islands at the mouth of the Algodón and along the Putumayo.* These are not currently inside the limits of the proposed Reserved Zone, because they are believed to be significantly disturbed by hunting and settlement. However, intact habitat of this kind has high conservation value and could potentially be included in the protected areas proposed for the region. These islands are one of the preferred habitats of the threatened game bird *Crax globulosa*.

02 **Conduct fish inventories in the main courses and lateral habitats of the Algodón and Yaguas Rivers,** which have never been visited by ichthyologists.

03 **Conduct binational inventories in association with Colombian researchers** to the east of the proposed Reserved Zone, in the area between the proposed Yaguas National Park and the Colombian Amacayacu National Park, to investigate opportunities for cross-border conservation and joint patrolling and management of these remote areas.

RECOMMENDATIONS

Further Inventory (continued)	04 **Confirm the presence or absence of potentially occurring species of special conservation interest,** such as the threatened game bird *Crax globulosa,* the rare and endemic trees *Licania vasquezii* and *L. klugii,* the threatened giant river otter *Pteronura brasiliensis,* and the range-restricted frogs *Eleutherodactylus aaptus* and *E. lythrodes.*
Research	01 **Compile existing data and publications from the long list of inventories and research projects carried out along the southern and northern borders of the proposed Reserved Zone,** which date back more than a century. These include detailed studies at Pebas, at the ACEER research station and elsewhere on the Sucusari River, at the Sabalillo research station, as well as data from the Alpha Helix expedition, Peruvian and Colombian expeditions to the Putumayo River, and other less-known projects. 02 **Promote the Sabalillo research station on the lower Apayacu as a center for research and training** in the region. The station has a good inventory program underway, strong links to local universities and communities, and shares research results from the station on an excellent website (www.projectamazonas.com).
Sustainable Use of Local Resources	01 **Build on the region's strong history of studies on local resource use and management to develop viable extractive alternatives to timber** that provide real economic benefits for indigenous communities. Biological and socioeconomic studies of forest products are needed because extraction of forest products from communal reserves will require that communities submit detailed management plans to INRENA. 02 **Provide scholarships to train young indigenous students** in social and biological aspects of conservation and management of natural resources. 03 **Explore the technical and legal possibilities for creating areas outside of the Communal Reserves for commercial logging by the local communities and under management plans.** Build on existing programs in local communities that reforest degraded areas with economically valuable tree species to identify areas in need of reforestation and new tree species of interest, and to build new nurseries in each of the major watersheds. 04 **Implement community-based recovery programs for species impacted by historical overhunting,** like black caimans (*Melanosuchus niger*), river tortoises (*Podocnemis* spp.), and large primates.

RECOMMENDATIONS

Sustainable Use of Local Resources (continued)	05 **Provide indigenous people with assistance and training in the design and implementation of management plans for natural resources located within their communities and the Communal Reserves.** The use of economically important natural resources (fish, wildlife, non-timber forest products, etc.) should be evaluated and management plans designed in order to encourage the sustainability of these extractive activities.
Monitoring	01 **Implement community-run programs in each major watershed to monitor the status of key threats, populations, species, and habitats over the long term.** Relevant examples include monitoring populations of black caiman *(Melanosuchus niger),* river turtles *(Podocnemis* spp.), and large primates impacted by historical hunting, and documenting incursions of hunters, fishermen and loggers. 02 **Implement community-based programs that monitor the hunting and fishing effort and harvest of local communities in the region over the long term** to ensure that current uses of wildlife meat and fish are sustainable and to modify management, as needed, to maintain their sustainability. 03 **Monitor basic economic activity of communities in the vicinity of the proposed Reserved Zone,** including data on the prevalent sources of income for men and women, per capita income, and rates of underemployment. 04 **As nearby Iquitos continues to grow, monitor deforestation rates, population growth rates, and quality of life in and around communities** in the vicinity of the proposed Reserved Zone.

Technical Report

OVERVIEW OF INVENTORY SITES

The proposed Ampiyacu, Apayacu, Yaguas and Medio Putumayo (AAYMP) Reserved Zone is a 1.9 million-ha wilderness area in the lowland forests of northern Amazonian Peru, its southern limit just 60 km north of the city of Iquitos. The area is bordered to the north and south by the Putumayo, Napo and Amazon rivers, and drained by four large tributaries: the Algodón, Yaguas, Ampiyacu and Apayacu.

The AAYMP's landscape is typical of the lowland Amazon basin, with hundreds of low, rolling hills underlain by thick slabs of sedimentary deposits. Instead of imposing landmarks like mountains, waterfalls, or lakes, the primary landscape features are streams, small swamps, and saltlicks. Climate, too, is relatively predictable: warm, wet, and aseasonal.

The banks of the Putumayo, Napo and Amazon are lined by small towns and indigenous communities, as are the lower stretches of the Apayacu and Ampiyacu, and the upper stretches of the Algodón. Apart from two communities at its junction with the Putumayo, the entire watershed of the Yaguas River is uninhabited.

During the rapid biological and social inventory of the proposed reserve in August 2003, the social team surveyed communities along the major rivers in the north and south, while the biological team focused on three sites at the uninhabited heart of the area. In this section we give a brief description of the sites visited by both teams. The following chapters provide detailed descriptions of the flora, fauna, and human communities at each site.

SITES VISITED BY THE BIOLOGICAL TEAM

Prior to the field work, we scanned satellite images for sites that offered a good selection of the principal terrestrial and aquatic habitats in the region. At each of the three sites we selected, an advance field team hiked in to establish a campsite, ~25 km of temporary trails, and a small landing pad. The remainder of the team and equipment traveled between sites by helicopter.

Yaguas campsite
(2°51'53.5"S 71°24'54.1"W, ~120-150 m elev.)

This was the first site we visited, and the only one we inventoried in the Putumayo watershed. Our camp was located in the upper reaches of the Yaguas River, some five days' canoe travel upriver from its junction with the Putumayo and several days' travel from the nearest town. None of the local guides who worked with us in the field had ever been in this area, and no uses were reported for it in a recent map of local communities' land use (see "Protecting the Headwaters: An Indigenous Peoples' Initiative for Biodiversity Conservation" and Figure 3). During the rubber boom, early in the twentieth century, the Yaguas was an important collection center for natural rubber harvested in the surrounding forests (M. Pariona, pers. comm.), but the entire watershed is now essentially uninhabited and its forests undisturbed. The only sign of human presence we encountered were two large trees on the Yaguas floodplain that had been felled and partially sawn into planks at least a decade earlier. From the air, uninhabited forest extended unbroken to the horizon in every direction.

For six days we explored the forests around our campsite on a low bluff overlooking the Yaguas. To the north and west of camp, majestic old-growth forest covered the broad floodplain. To the east, an abandoned river channel mostly filled in with low vegetation held a tiny blackwater lake, apparently fed by rainwater. This lake, too small to appear in topographic maps of the area, was remarkable in that its border was only 10 m from the river's edge but its water level nearly 10 m above that of the Yaguas.

The channel of the Yaguas is roughly 40 m wide here (during our visit the river was low and only ~15 m wide), but its floodplain is quite broad. From our campsite it was a 1.5-km walk inland, through forests that flood when the river rises—a complex of low levees, abandoned river channels, swampy low areas and *aguajales*—to the first hills of the uplands. Most of the forest we studied at this site was influenced by the river in one way or another, as the trail network explored different floodplain habitats: the steep banks of the Yaguas, a *Mauritia* palm swamp, an island in the middle of the river, and the blackwater lake.

As at the other two sites we visited, the uplands here were composed of low, gently rolling hills under 200 m elevation. (The highest point within the proposed Reserved Zone is 233 m.) The first hills above the floodplain at this site may have been old river terraces; they were only 10-20 m higher than the floodplain and their soils 60% silt. Less than a kilometer farther inland, higher hills rose up much more steeply, approximating the sort of terrain that was common at the second and third sites.

Maronal campsite
(2°57'56.3"S 72°07'40.3"W, ~160-180 m elev.)

The second site was roughly 80 km west-southwest of the first, in hilly upland forest in the upper reaches of the Ampiyacu River basin. Our camp was just a few kilometers from the dividing line between the Ampiyacu and Algodón watersheds, and the only nearby bodies of water were tiny streams draining the surrounding hills. The closest river, a 10-m wide tributary of the Ampiyacu known as the Supay, was 3 km to the west of camp.

For six days we explored these hills along 30 km of trails. Here too the hills were mostly low and gentle, but elevations were 30-40 m higher than at the first site; this was the high terra firme that we were not able to explore completely at the first campsite. As at the first site, upland soils here were characteristically acidic, low in most nutrients, and mostly a mix of silt and sand.

While there were only narrow strips of floodplain near the camp, much of the low-lying land between hills in the vicinity is poorly drained and holds small patches of swamp forest. From the air (as well as on the satellite image), one surveys a great expanse of upland forest speckled with hundreds of tiny stands of palm-dominated swamps.

Although this campsite was also far from human communities, both recent and historical human impacts were more obvious here than on the Yaguas. One reason was that our campsite was located on an old trail that links the Amazon and Algodón rivers,

running from the communities on the lower Ampiyacu in the south to the Quebrada Raya on the Algodón in the north. (A parallel trail runs from Pebas to the mouth of the Algodón; see map in Figure 3.) The trail is used infrequently today, and much of it is overgrown, but it was formerly an important route for goods and travel. Our guides told us that until some 40 years ago, a family lived at the halfway point of this trail, not far from our campsite, harvesting rubber, collecting animal skins, and trading with passing travelers. Apart from an abundance of old trails and a few old marked trees, we found few lasting impacts related with this old homestead and the trail.

By contrast, recent impacts of logging teams working along the Supay, west of our camp, were very apparent. Just a few months before our visit, logging teams had harvested several large trees, leaving behind a rustic camp, large clearings, skidder trails, and a 1-km trail along which timber was rolled or carried to the Supay, to be floated down the Ampiyacu. According to our guides, the species of interest were *lupuna* (*Ceiba pentandra*), *cumala* (*Virola* spp.), and *marupá* (*Simarouba amara*). Apart from logging activity, indigenous land-use maps for the area show this to be an occasional hunting ground (see "Protecting the Headwaters: An Indigenous Peoples' Initiative for Biodiversity Conservation" and Figure 3). Large animals were not as abundant at this site as at Yaguas (see "Mammals").

A couple of kilometers to the north of camp was a large patch of naturally disturbed forest (known in this part of Peru as *purma*), which stands out clearly on satellite images of the area as a yellow patch in a sea of green. This landscape feature is the result of a violent downdraft which flattened several dozen hectares of forest during a 1986 windstorm. The clearing has now been naturally reforested by fast-growing pioneer trees in the family Cecropiaceae. The giant herb *Phenakospermum guyannense* (Strelitziaceae) dominates the midstory in large patches, shading a meager understory vegetation. Windstorm-damaged patches like these are an occasional feature of forests across the Amazon lowlands, and their origins and dynamics are not well understood.

Apayacu campsite
(3°07'00"S 72°42'45"W, ~120-150 m elev.)

Our third inventory site was on the upper Apayacu River, in the southwestern corner of the proposed Reserved Zone and just ~35 km north of the confluence of the Napo and Amazon rivers. This site was 67 km west-southwest of the second site and 147 km west-southwest of the first site (Figure 2).

We set up camp on a bluff above the river, with its narrow floodplain to one side and a complex of low hills to the other. Part of the 25-km trail system traced the river's course, while other sections explored the hills and the nearby Huayra stream, and circled a large, stream-fed swamp surrounded by upland forest. Here too the hills were relatively gentle and interspersed with patches of swampy lowlands, and very similar in soils, topography, elevation, and vegetation to the hilly sections of the previous sites. The floodplain of the Apayacu was much narrower than that of the Yaguas, however, often extending just a few meters from the river's edge (see "Flora and Vegetation").

This was the least remote of the three sites we visited, only ~20 km upriver from the Yagua community of Cuzco. Large animals were relatively scarce here, in part because of regular hunting along the river (see Figure 3), and in part because a hunting camp had operated in the vicinity of our campsite the year before, according to our guides. While we were at this camp, a fishing and hunting party from the communities downriver passed by on their way up the Apayacu. Logging impacts were also apparent at this site, especially upriver from camp along the Apayacu.

COMMUNITIES VISITED BY THE SOCIAL TEAM

While the biological team was in the field, the social team surveyed 18 of the 26 native communities to the north and south of the proposed Reserved Zone.

To the north, along the Algodón and Putumayo rivers, we worked in seven communities belonging to the Yagua, Huitoto, Bora, Ocaina, Mayhuna and Quichua indigenous groups. These communities form part of the FECONAFROPU indigenous federation

(Federación de Comunidades Nativas Fronterizas del Putumayo).

To the southwest, along the Apayacu River, we visited four communities belonging to the Yagua and Cocama indigenous groups and forming part of the FEPYROA indigenous federation (Federación de Pueblos Yaguas de los Ríos Orosa y Apayacu). To the southeast, along the Ampiyacu River, we worked in seven communities belonging to the Bora, Huitoto, Ocaina and Yagua indigenous groups, and including a few Resígaro families. These communities form part of the FECONA indigenous federation (Federación de Comunidades Nativas del Ampiyacu). We discuss all of these communities, as well as the others in the region that the social group did not visit, in more detail in "Human Communities." Summary information on communities in the vicinity of the proposed Reserved Zone is given in Appendix 7.

In addition to the community surveys, the social team also carried out semi-structured interviews with government authorities, including mayors and INRENA representatives, in Pebas (on the Ampiyacu) and San Antonio de Estrecho (on the Putumayo).

FLORA AND VEGETATION

Authors/Participants: Corine Vriesendorp, Nigel Pitman, Robin Foster, Italo Mesones, and Marcos Ríos

Conservation targets: Extraordinarily diverse plant communities growing on terra firme hills and terraces; threatened populations of commercial timber species (especially *Cedrelinga cateniformis, Cedrela* spp., and *Calophyllum brasiliensis)*; readily accessible floodplain and inundated forests; blackwater riparian communities not protected elsewhere in Loreto

INTRODUCTION

Forests in the southern reaches of the proposed Reserved Zone—a four-hour boat ride from Iquitos—are fairly well known to botanists. Starting in the 1970s, several botanists collected along the banks of the Ampiyacu River and its tributary, the Yaguasyacu (A. Gentry, J. Revilla, and the Alpha Helix Expedition: T. Plowman, R. Schultes, and O. Tovar). More recent studies in these southern reaches include a large-scale quantitative inventory of woody plants (Duivenvoorden et al. 2001, Grández et al. 2001), a detailed mapping of palm distributions (Vormisto 2000), and a large-scale survey of ferns and melastomes (Tuomisto et al. 2003). Two years ago, a permanent base for biological studies, the Sabalillo Research Station, was established along the Apayacu by Proyecto Amazonas (2003); researchers are building a list of flora in the vicinity of the station (D. Graham, pers. comm.).

At the northern end of the proposed Reserved Zone—in the watershed of the Putumayo River—the forests are well known to the indigenous populations (see "Human Communities") but still relatively unknown to scientists. To our knowledge, neither the Algodón watershed nor the vast majority of the Yaguas watershed have ever been explored by botanists.

METHODS

During our three weeks in the field, the botanical team fanned out across each site, with the goal of characterizing the vegetation and generating a preliminary list of the flora. We catalogued plants of all life forms, from herbs and epiphytes to canopy emergents, using a combination of fertile collections, quantitative surveys along transects, and field observations. Altogether we collected around 1,350 plant specimens, now deposited in the Iquitos herbarium (AMAZ), the Museum of Natural History in Lima (USM), and the Field Museum (F). R. Foster and C. Vriesendorp took nearly 1,900 photographs for a preliminary plant guide to the region. With the help of the native indigenous groups, the preliminary plant guide will eventually include common names in local languages.

At each site, N. Pitman, I. Mesones, and M. Ríos inventoried all trees ≥10 cm diameter at breast height in a transect measuring 1-ha (5 m x 2 km), for a total of 1,955 adult trees. C. Vriesendorp, I. Mesones, and M. Ríos carried out quantitative inventories of 800 understory plants, and I. Mesones inventoried

Burseraceae and palms. R. Foster made detailed observations on all aspects of these plant communities, in addition to spearheading the group's effort to generate a preliminary species list.

VEGETATION OVERVIEW

At the largest spatial scales—seen on satellite images or in overflights—vegetation in the AAYMP region has a more or less uniform appearance, due to the immense stretches of upland forest on low, rolling hills, which extend to the east, west, and north into Colombia. These hilly upland forests appear to account for at least 70% of the landscape. Within this matrix, large patches of a second kind of upland forest are discernible on satellite images, accounting for maybe 10% of the landscape and showing up in Landsat images (bands 5, 4, and 3) as dark patches with flatter, terraced topography. This forest type is scattered irregularly through the AAYMP region, but appears most frequent between the Apayacu, Napo and Amazon in the south, and between the Algodón and Putumayo in the north.

Flooded forests and swamps complete the landscape, but not in the typical fashion. The only large blocks of swamp or flooded forest inside the proposed Reserved Zone are in the floodplains of the Algodón River. Elsewhere, tiny stands of swamp and flooded forest dot the hilly and terraced upland forests. Both from the air and on the ground, the impression is of low terra firme hills encircled by narrow strips of flooded forest or swamp. At all three of our campsites, getting from one hilltop to another often involved slogging through the narrow swamp that separated them.

The structure of these forests, both upland and flooded, is typical of lowland Amazonia. Upland forests have a closed canopy at 25 or 30 m height, with scattered emergents towering 15 or 20 m higher than the canopy, and an understory that may be dense with shrubs, treelets, and herbs; dominated by a single palm or fern species; or deep in shade and relatively open. All forest types here are dappled with occasional treefall gaps. But in contrast to other sites in Loreto—like Yavarí—clearings associated with the ant-inhabited treelet *Duroia hirsuta,* locally known as *supay chacras,* are practically absent (Pitman et al. 2003).

Compositionally, the AAYMP region reflects an intersection of several regional floras, but floristic work is still too rudimentary to make more than casual observations. We recorded some species that are common farther north in Colombia but relatively rare elsewhere in Loreto (*Clathrotropis macrocarpa,* Fabaceae); other species more typical of forests in Allpahuayo-Mishana (*Parkia igneiflora,* Fabaceae); and several species that we had never seen before and that are not represented in the Iquitos herbarium. Although many of the species we registered are widespread across Loreto and western Amazonia, one of the most common tree species found along the floodplain in the lower reaches of the Ampiyacu, *Didymocistus chrysadenius* (Euphorbiaceae), was absent from our sites closer to the headwaters (Grández et al. 2001).

FLORISTIC RICHNESS

Based on our field observations and collections at the three inventory sites, we generated a preliminary species list of ~1,500 species for the AAYMP region (Appendix 1). With the additional species registered on the Ampiyacu and Yaguasyacu by Grández et al. (2001), and using botanical work in areas surrounding Iquitos as a benchmark (Vásquez-Martínez 1997), we estimate a total flora for the proposed reserve of 2,500-3,500 species.

Small-scale species richness of woody plants here is perhaps the highest on Earth. Certainly it is hard to imagine a more diverse treelet inventory than the one we carried out in terra firme at Apayacu: 88 different species in 100 plants, with the most "common" species represented only three times. All three inventories of adult trees revealed similarly astonishing levels of diversity, containing an *average* of 299 species/ha. There too, most trees were extremely rare; half of the species we recorded are represented in the dataset by a single tree! Together, these inventories substantiate recent reports that these forests—and their neighbors just south of the equator in western Amazonia—are the world's richest in tree diversity (ter Steege et al. 2003).

Certain genera and families were extraordinarily species rich, while others were surprisingly species poor, compared to other sites in Amazonia. Across all three sites, diversity in the genus *Mabea* (Euphorbiaceae) was higher than at any other site we know, with at least six different species commonly found in the over- and understory, and one of these growing as a liana. Palms (Arecaceae) were especially diverse and abundant throughout the region, with 50 species recorded overall. Although not among the most diverse tree families overall, we found substantially more Clusiaceae in these forests (17 spp. in the tree plots alone) than at other known sites in Amazonia.

In the overstory, the most diverse families sampled in three 1-ha tree transects on terra firme were Fabaceae *sensu lato* (86 spp.), Lauraceae (45 spp.), and Chrysobalanaceae (38 spp.). *Licania* was the most diverse genus overall, followed by *Eschweilera* (Lecythidaceae), *Pouteria* (Sapotaceae), *Inga* (Fabaceae), *Tachigali* (Fabaceae) and two genera of Myristicaceae, *Virola* and *Iryanthera.*

Herb diversity was highest within the Marantaceae family, and *Ischnosiphon* and *Monotagma* spp. were a common feature in all of the sites, often dominating small patches of forest. A high diversity and abundance of *Paullinia* and *Machaerium* lianas offset the surprising dearth of Bignoniaceae. Compared to other sites in Amazonia, epiphytes, especially Araceae (*Philodendron, Anthurium, Rhodospatha, Heteropsis*) and fern trunk climbers (*Lygodium* spp. and *Microgramma* spp.) were abundant, although not overwhelmingly diverse.

Ficus (Moraceae), *Heliconia* (Heliconiaceae) and *Psychotria* (Rubiaceae) were noticeably underrepresented at all three of our inventory sites. In some forests, these three genera are disproportionately species-rich compared to the rest of the community, and typically their fruits and flowers support the vertebrate community during times of food scarcity. Trees in the family Sapindaceae were also poorly represented at all three sites, although we expect to find them on richer soils in the region.

HABITAT TYPES AND VEGETATION

As is typical of lowland Amazonia, small-scale variation in soil types combined with remarkably high diversity makes defining communities and habitat types a challenge. During our rapid inventory, as a rough approximation, we used drainage and gross features of the landscape to classify several broad habitat types. Many of these occurred at all sites, although a couple of habitats occurred only at a single site. We discuss the composition and structure of each habitat, following a gradient from wetter habitats towards terra firme, highlighting site-to-site variation where important.

Riverside flora (Yaguas and Apayacu)

Plant communities along riversides are perhaps the most easily defined and recognizable elements in the Amazonian landscape, as active meanders generate obvious successional sequences along banks. By Amazonian standards, the rivers in the proposed Reserved Zone are atypical, at least in our inventory sites close to the Yaguas and Apayacu headwaters. Beaches and exposed mudbanks were uncommon at both sites, with little evidence of the gradual erosion, flood dynamics, or active meanders typical of other Amazonian rivers (e.g., the Madre de Dios). Banks along the Ampiyacu and Yaguas do not appear to erode gently; instead, soil falls off in large sheets, creating steep walled causeways akin to miniature canyons. Despite the "boxy" nature of the waterways, several species could be found reliably along the mudbanks and riverside of both the Yaguas and the Apayacu.

Mudbanks often supported two or three species, dominated by a *Piper* (Piperaceae) shrub and a sedge (Cyperaceae). Oddly, no grass species were found growing here, and two infrequent sedge species were the only other species sometimes present in these exposed, highly disturbed areas.

Along the riverside, a predictable flora of water-tolerant and pioneer species occurred in several successional stages, starting with *Tabernaemontana siphilitica* (Apocynaceae) and *Annona hypoglauca* (Annonaceae) closest to the water. Behind these short-

statured plants, *Triplaris* sp. (Polygonaceae) and *Cecropia latiloba* (Cecropiaceae) grew in dense aggregations, and *Calliandra* sp. (Fabaceae), at least three different species of *Inga* (Fabaceae), and a *Neea* sp. (Nyctaginaceae) dominated the stretch of riverside vegetation farthest inland. Patches of *Heliconia juruana* (Heliconiaceae), one of the few heliconias encountered during our inventory, were present throughout the understory.

Streamsides

Streams at all three sites also displayed very steep walls, suggesting a similar pattern of erosion may occur along these smaller waterways. We found many species typical of gaps (*Hyeronima, Croton;* Euphorbiaceae) in the high light environments along the streambeds. In areas of stream overflow, the ground cover was often a single species of filmy fern (Hymenophyllaceae). In the overstory along stream banks we often encountered *Sterculia* trees (Sterculiaceae), their enormous fruits bobbing slowly downstream, or more dangerously, crashing loudly downward through the vegetation and plunging into the water. Alongside *Sterculia,* the palm *Euterpe precatoria,* the tree *Tovomita stylosa* (Clusiaceae) and a *Zygia* (Fabaceae) shrub were common.

Aguajales

As elsewhere in Loreto, the AAYMP region showcases an immense variety of swamp forests. These are often lumped under the term *aguajal,* due to the frequent dominance of the palm *Mauritia flexuosa,* known locally as *aguaje* (Kalliola et al. 1998). Nevertheless, the floristic composition of *aguajales* varies from huge pure stands of *Mauritia* to small patches containing a mixture of *Mauritia* and other trees. Two swamps dominated by *Mauritia* may be totally different in the rest of their flora.

For example, a large inundated area at the Yaguas site—easily visible on the satellite image and presumably river fed—occurred close to the main course of the Yaguas. Here other palm species, including *Astrocaryum murumuru* var. *murumuru, Oenocarpus bataua,* and *Socratea exorrhiza,* were just as abundant as *Mauritia,* and the understory was varied. At the Maronal site, two swamps—small in size and invisible on the satellite image—occurred in areas flooded by streams. A thin strip of *Mauritia* filled in the central, wettest area, which was surrounded by a diverse assemblage of overstory trees and shrubs more typical of terra firme. In Apayacu, a medium-sized swamp forest at least 2 km in circumference grew in an inland basin, fed by small streams and rainwater. Here *Caraipa* (Clusiaceae) dominated the understory, and *Mauritia* was much more abundant than at the other two sites. It stands to reason that several other, floristically different *aguajales* grow in the AAYMP region; in overflights we observed large tracts of swamp forest with near-complete *Mauritia* dominance and stretches of open water. Similarly, it seems likely that the *aguajales* in this region of Loreto have substantially different flora and fauna from those that dominate large stretches of the department to the southwest, around the mouth of the Pastaza River. The blanket term *aguajal* oversimplifies the biology and dynamics of these floristically heterogeneous forests.

Floodplain forests (Yaguas and Apayacu)

Floodplain forests at the two riverine sites, Yaguas and Apayacu, are markedly different from one another. At the Yaguas site, we found a well-defined floodplain with levees, occasionally inundated areas, and near-continuously inundated areas. Along the Apayacu, the floodplain area was neither vast nor predictable; small patches of inundated forests merged seamlessly into different communities on higher ground.

On the extensive Yaguas floodplain, we typically encountered trees of *Tachigali* (Fabaceae), *Astrocaryum murumuru* var. *murumuru* (Arecaceae), *Eschweilera gigantea* (Lecythidaceae), *Ceiba pentandra* (Bombacaceae), and the beautiful orange buttresses of *Sloanea guianensis* (Elaeocarpaceae). The palm *Manicaria saccifera,* almost always occurring in clumps of two stems, was abundant in occasionally inundated areas. Typical understory species included *Oxandra xylopioides* (Annonaceae), *Rinorea lindeniana* (Violaceae), both *Protium nodulosum* and *trifoliolatum* (Burseraceae), along with two abundant species of *Sorocea* (Moraceae), both fruiting and flowering during

the inventory. A small understory palm, *Hyospathe elegans* (Arecaceae), occurred in dominant patches across kilometers of the floodplain in Yaguas, in addition to prevailing in stream overflow areas in Maronal.

Terra firme hills

At all three sites the dominant vegetation type is upland forest on gently rolling hills (see above). Our 1-ha transects sampling adult trees suggest that the species composition and diversity of this forest type are quite similar at the three sites we visited, even though the farthest sites are >140 km apart. On average, 39% of the species in a transect are shared with any other transect, and 55% of trees belong to shared species. Based on these numbers, our working hypothesis is that tree community composition is relatively predictable over a large proportion of the AAYMP region. In other words, the common species shared by our transects probably dominate forests in most of the AAYMP.

Ironically, these tree communities are so diverse that almost no species are common in an absolute sense. The canopy palm *Oenocarpus bataua* (Figure 5G) was the most common tree across our inventory, but accounted for a mere 3.6% of all trees Other species that were "common" in the transects include two explosively dehiscent species, *Senefeldera inclinata* (Euphorbiaceae) and *Rinorea racemosa* (Violaceae), and several animal dispersed species: *Eschweilera coriacea* (Lecythidaceae), *Virola pavonis* (Myristicaceae), *Mabea* cf. *angularis* (Euphorbiaceae), *Iriartea deltoidea* (Arecaceae), *Protium amazonicum* (Burseraceae), and *Hevea* cf. *guianensis* (Euphorbiaceae); most of these are also common in many other sites in northern Loreto. This list of dominants is a curious mix of taxa that prefer richer soils, like *Iriartea*; taxa typical of poorer soils, like *Senefeldera* and *Hevea;* and taxa that are broad generalists, like *E. coriacea.* This compositional mix extends to rarer species as well, perhaps reflecting the fact that upland soils at these sites are intermediate between sand and clay, composed of ca. 50% silt.

Tree diversity in these forests is formidable. Our transects contained an average 299 species/ha—more tree species in a single hectare than are native to the United States. Even the lowest-diversity transect (at Yaguas, where we registered 283 species) ranks among the top ten most diverse hectares in the world. The variation in diversity between our sites vanishes when the datasets are standardized by the number of trees, suggesting that diversity is predictably high across immense stretches of upland forest here.

Quantitative inventories of understory stems revealed a similar pattern of extremely high diversity, with a handful of species shared among transects. Species common as trees were also common in the understory, including *Senefeldera inclinata, Clathrotropis macrocarpa, Virola pavonis, Mabea* cf. *angularis* and *Rinorea racemosa.* On sandier hills, *Neoptychocarpus killipii, Lepidocaryum tenue,* and *Geonoma maxima* were quite common, although often in patches, co-occurring with *Pausandra trianae,* an explosively dehiscent treelet.

A single Marantaceae species, *Monophyllanthe araracuarensis,* covered several square kilometers of terra firme at Maronal and Apayacu, carpeting more than a dozen small hills, before suddenly disappearing. Other Marantaceae genera (*Monotagma, Calathea, Ischnosiphon*) and a fern (*Adiantum* sp.) formed more modest patches in all three sites. Their patchy distributions suggest these lifeforms may respond to imperceptible small-scale soil or drainage differences, perhaps much more so than larger plants such as trees.

UNIQUE HABITATS AND UNDERSTUDIED HABITATS

Oxbow lake vegetation and large-scale *purma*

Two habitats—vegetation bordering an oxbow lake and even-aged secondary forest (*purma*)—we encountered at one inventory site only (Yaguas and Maronal respectively). However, from the satellite image it is clear that both of these habitats are found in other areas of the proposed Reserved Zone.

At the Yaguas site, a small oxbow lake, roughly 500 m in circumference and therefore invisible on the satellite image, sits 10 m from the main course of the

Yaguas River. Tree species typical of blackwater lakes grow in the shallow water along the lake edge, including dense aggregations of *Bactris riparia* (Arecaceae), and several individuals of *Macrolobium acaciifolium* (Fabaceae). *Croton* and *Hyeronima* (Euphorbiaceae) species colonized the drier high light areas, overtopping large patches of the herb *Crinum erubescens* (Amaryllidaceae).

Across the AAYMP region, as in other lowland Amazonian sites, areas of even-aged secondary forest, or *purma,* jump out as bright smears on the satellite image (Figure 2). These *purmas* occur when a dramatic sequence of unpredictable atmospheric events, or downbursts, pushes air downward with enough force to flatten patches of forest (Nelson et al. 1994). In 1985-86, travelers on the trail between the Ampiyacu and Algodón rivers near our Maronal camp noticed several small *purmas* in the area, along with one stretch so extensive that it obliterated any traces of the trail for kilometers. Seventeen years later, we found these areas overgrown with even-aged secondary forest dominated by a *Cecropia sciadophylla* (Cecropiaceae) overstory, and a *Phenakospermum guyannense* (Strelitziaceae) understory.

Unsampled habitats

Although our inventory covered a diverse range of habitats, we missed two obvious landscape features: upland terraces (see above), and the Algodón, a blackwater river dominating the northern reaches of the proposed reserve. Both of these merit in-depth inventory and protection. From the overflights, we know that large stretches of forest along the Algodón are dominated by the clonal palm *Astrocaryum jauari* and the tree *Macrolobium acaciifolium* (Fabaceae), suggesting a classic blackwater habitat with a markedly different floristic composition from the sites we visited—a distinctive habitat with high conservation value. The floristic composition of the upland terraces, and their similarity to the adjacent terra firme hills, is harder to predict. Several of these terraces occur close to the communities of Cuzco and Sabalillo along the Apayacu, so gathering information about their conservation value could be relatively straightforward.

NEW SPECIES, RARITIES, AND RANGE EXTENSIONS

Although most of the plant species we collected during the inventory are still unidentified, some have already been confirmed as new species, or significant range extensions for described species. It is difficult to confirm new tropical species quickly, because typically more than ten years pass before an unknown tropical plant collection is described as new to science. We suspect that 10-15 specimens collected during the inventory are likely new species, but can only confirm one: a new species for the monotypic genus *Cyclanthus* (Cyclanthaceae). The only described species in the genus, the well-known and broadly distributed understory herb *C. bipartitus,* has smooth bifid leaves with a broad bract cupping the spadix. The new species has a simple leaf with raised veins, and a slender spathe—twice as long as that of *C. bipartitus*—framing the spadix (Figure 5F).

Another herb, unknown to all of us, is also potentially a new species. We found this species of *Rapatea* (Rapateaceae) in the understory at several sites. Despite the distinctive appearance of its crinkled, accordion-like leaves, we have yet to find this species in herbarium collections. Additionally, we collected an unknown species of Clusiaceae with a softball-sized fruit (Figure 5E). This tree has been identified as belonging to *Lorostemon* (B. Hammel and P. Stevens, pers. comm.). This genus apparently has not been recorded previously in Peru, and the specimen may represent a new species.

Several species on our list represent range extensions for poorly known species, and at least one is not listed in the *Catalogue of the Flowering Plants and Gymnosperms of Peru* (Brako and Zarucchi 1993). Our record of *Monophyllanthe araracuarensis* (Marantaceae) is only the second for this species, and the first for Peru (Figure 5H). The only previous record of *M. araracuarensis* is the type collection from a population near the Caquetá River in Colombia.

Along the Yaguas River, we found another poorly known species, the palm *Manicaria saccifera,*

growing in clumps of two individuals. Although it was common in the Yaguas floodplain, this population represents only the third record for this species in Peru. The current distribution for this species indicates a disjunction, with collections from Central America to the Chocó, and then no further records from Colombia until reaching the Guiana Shield. Our small patch of *M. saccifera* in northern Peru represents one of the southernmost parts of its distribution.

THREATS, OPPORTUNITIES, AND RECOMMENDATIONS

On a regional scale, the AAYMP area represents a tremendous opportunity to protect a vast expanse of terra firme—the dominant habitat here and throughout the Peruvian Amazon. Currently, not a single reserve in Loreto protects significant tracts of upland forest. Indeed, existing protected areas in Loreto protect several habitats that are not present in the AAYMP, such as the vast inundated forests of Pacaya-Samiria and the white sand hills of Allpahuayo-Mishana.

Despite their promise, we noted several threats to forests in the area. Our sites were located near the center of the proposed Reserved Zone, nearly equidistant from the population centers along the Ampiyacu and Apayacu to the south, and the Algodón to the north. However, even in these remote sites, we found fading scars on tapped rubber trees, stumps of felled timber trees, and the remains of temporary hunting camps.

We also found evidence of timber extraction at all three sites. The greatest destruction was at Maronal, where we found the remains of six felled trees, five of which were skidded to a stream and presumably floated downriver. The sixth was an enormous *lupuna* (*Ceiba pentandra*) with more than 22 m of valuable bole left to rot in the forest. Even though all felled trees were growing close to rivers, loggers had cleared substantial areas of forest (~10 m x 50 m) to drag the cut wood to the water. In seedling surveys of these clearings, we found only two seedlings of commercially valuable species, with the rest of the regrowth (more than 1,000 individuals) dominated by fast-growing weedy species.

Populations of the most valuable timber trees in Loreto seem naturally rare in these forests (*Cedrela* spp., *Cedrelinga cateniformis,* and *Swietenia macrophylla*). Nevertheless, roughly 30% of the trees in our upland tree transects belong to other genera that have some commercial value as sawnwood in Loreto (fide Dolanc et al. 2003). Without a small number of valuable species that can help focus management, designing and carrying out non-destructive and sustainable logging practices will be a challenge in these forests.

If areas adjacent to the proposed reserve are to be logged, we recommend active management based on informed cutting limits—specifically, prohibiting the logging of pre-reproductive individuals. Species of *cedro* (*Cedrela* spp.), *tornillo* (*Cedrelinga cateniformis*, Figures 5A, B), and *lupuna* (*Ceiba pentandra*) often do not reproduce until their diameters are greater than 80 cm (C. Vriesendorp, pers. obs.; Gullison et al. 1996).

Furthermore, few of these timber species regenerate without active reforestation, involving planting seedlings and subsequently clearing lianas and herbs from these juveniles as they grow. Several indigenous communities, including Brillo Nuevo and Pucaurquillo, are already reforesting close to populated centers, potentially alleviating pressures on timber species in the long term (M. Pariona, pers. comm.; see "Human Communities").

FISHES

Authors/Participants: Max H. Hidalgo and Robinson Olivera

Conservation targets: Diverse fish communities in rivers, lakes, and streams, and in smaller aquatic habitats of the forest interior; entire watersheds of three large rivers (the Apayacu, Yaguas and Ampiyacu); commercially and evolutionarily important species, including *Arapaima gigas* (*paiche*) and *Osteoglossum bicirrhosum* (*arahuana*); commercially important migratory species, like *Zungaro zungaro* (*zungaro*) and *Pseudoplatystoma fasciatum* (*doncella*), which are fished intensively elsewhere in Amazonia; numerous ornamental species, like *Monocirrhus polyacanthus* (*pez hoja*) and *Boehlkea fredcochui* (*tetra azul*), some of them potentially new to science; rare species like *Thalassophryne amazonica* (*pejesapo*)

INTRODUCTION

The Amazon lowlands, the largest natural region of Peru, are drained by an immense aquatic network of countless lotic (rivers, streams, and creeks) and lentic (lakes, or *cochas*) habitats. Because these aquatic habitats are divided into basins and sub-basins, and interact with vegetation to create a large number of habitats and micro-habitats for fish, diversification has been impressive. Roughly 750 fish species have been recorded for the region, which accounts for 87% of the freshwater ichthyofauna of Peru (Chang and Ortega 1995). Peru's continental ichthyofauna is expected to exceed 1,100 species once the many poorly explored headwater regions and minor basins—like the Apayacu, Yaguas, and Ampiyacu rivers—have been studied (Ortega and Vari 1986).

This inventory focused on fish communities in the headwaters of these three rivers. At a larger scale, these rivers correspond to two major watersheds: that of the Putumayo River (Yaguas) and that of the Amazon itself (Ampiyacu and Apayacu). Our principal goals were to collect basic information on the fish of a poorly explored site (taxonomic composition, structure and distribution), observe and document the conservation status of aquatic habitats in the region, and make scientific collections from an area that is of interest to conservation.

Information regarding previous inventories in this region is scant. Historically, the Ampiyacu River has played an important role in South American ichthyology, because Cope's research in the 19th century led to the description of several new species collected in Pebas (Cope 1872, 1878). We were also fortunate to have species lists from recent inventories by Graham (2002) and Schleser (2000) in some tributaries of the Apayacu River. And because inventories similar to this one have recently been carried out in the Yavarí (Ortega et al. 2003a) and Putumayo Rivers (Ortega and Mojica 2002), we were able to make some basic comparisons of the ichthyofaunas of these regions of Loreto.

METHODS

In each of the three campsites we inventoried fish communities for five days, with the help of a local guide. We established between nine and twelve sampling stations at each campsite, for a total of 32 (Appendix 2). At each station we recorded GPS coordinates, noted basic habitat characteristics, and collected fish. At all three campsites, access to the habitats we sampled was primarily by trail, but in Apayacu we used a *peque-peque* boat.

Selection of the sampling stations

We selected the sampling stations based on habitat type, quality, size, and accessibility, as well as other logistical considerations. The stations cover a broad spectrum of aquatic habitats, including primary tributaries (rivers and streams), lentic habitats (lakes and temporary pools in the forest interior, sometimes called *tahuampas* locally), and aquatic habitats in uplands and low-lying areas, principally *Mauritia* palm swamps. Of the 32 stations evaluated, 27 were lotic habitats (rivers and streams) and five lentic (three *tipishcas*, or oxbow lakes still connected to the main river, one temporary pool in the forest at the Yaguas site, and one oxbow lake). Thirteen stations were whitewater, 11 clearwater, and eight blackwater.

In the large rivers we were able to establish several different sampling stations, but in streams we established just one. We sampled nine stations in the

Yaguas and Apayacu rivers, four of them in *tipishcas* and five on the banks of the main river.

Given the time of year and the field conditions, we were not able to sample inundated floodplain forest. This is a very important habitat for the reproduction of commercially important species, particularly some large catfish like *doncellas* and various species of Characidae, Curimatidae, *bocachicos* and *lisas*. Lentic habitats (lakes) were also undersampled. We did not visit the Algodón River basin, which remains a blank spot on the map for ichthyology and deserves significant attention.

Fish collections and analysis

We collected fish with nets measuring 5 x 1.8 m and 4 x 1.2 m, with netting of 5 and 2 mm respectively, sweeping the nets along the banks. At each station we repeated the sweeps until we obtained a representative sample (until all microhabitats had been sampled and the collected species began to repeat themselves). We made occasional use of hook and line to record large food species. We also made diurnal and nocturnal observations of the clear- and blackwater sites, to identify species that could not be captured.

We fixed collections immediately in a 10% formol solution, leaving them in solution for a minimum of 24 hours. We then transferred them to 70% ethyl alcohol. We made preliminary identifications in the field using standard keys (Eigenmann and Allen 1942, Géry 1977) and our experience from other fish inventories in Amazonian Peru, especially on the Yavarí River (Ortega et al. 2003a).

Because New World freshwater fishes (especially Amazonian fishes) are still poorly studied, phylogenetic relationships of many groups remain unresolved, and classifications are often tenuous, preventing the accurate identification of several groups. During the rapid inventory it was possible to identify a good proportion of the material to species; the remainder we identified to genus, subfamily, or family, and sorted to morphospecies, as is standard in such inventories (e.g., Chernoff 1997). More precise identifications will be made in the Ichthyological Department of the UNMSM Natural History Museum, and in consultation with specialists in other institutions. We deposited all collections at the UNMSM Natural History Museum in Lima.

DESCRIPTION OF STUDY SITES

Yaguas

Here we established nine stations, including the 40 m wide Yaguas River, a blackwater lake, a large whitewater stream, and a variety of aquatic habitats in the forest interior. These included small blackwater creeks and temporary pools connected to the river at floodlevel. The Yaguas River is a tributary of the Putumayo, with whitewater that is a creamy brown color, poorly transparent, rich in nutrients and suspended sediments, and with a soft, sand and silt bed. Few banks are exposed, and the beaches we found were steeply angled (45-60°). The main channel appeared to be at an intermediate stage between high- and low-water, and had an average depth of 5 m. Following a light rain of a few hours, the water level rose a few meters.

Maronal

At this site we were deep in upland forest, and all 11 stations sampled were forest creeks under a closed canopy. The majority of these habitats had clear water that was slightly greenish and totally transparent, with few suspended sediments, intermediate pH, and variable levels of nutrients, although a few tended towards blackwater. Three additional stations were blackwater and two others whitewater. The main stream in the vicinity of this campsite, collector of most of the small upland creeks here, is the Supay. Roughly 15 m across, the Supay is a lotic, blackwater tributary of another stream that empties into the Ampiyacu River.

The other streams studied at this campsite were smaller than 5 m across, with very narrow banks and soft bottoms composed mostly of organic matter: leaf litter, and many submerged trunks and roots. Several had deep holes and underwater tunnels, which provided a large number of microhabitats for fish. These streams are strictly rainfed, and their water level rises and falls quickly following even moderate rains. Some of the

sampling stations established at this site were small, apparently seasonal pools (some no larger than 1 m^2) in low-lying areas, especially in *Mauritia* palm swamps.

Apayacu

At this third campsite, the main habitat we studied was the Apayacu River. The Apayacu is similar to the Yaguas but slightly narrower (<40 m across). It is a whitewater river lined by steep, narrow banks, and with a bottom of sand and organic matter. Here we were able to explore more of the river's large tributaries than in Yaguas, because we had a motorboat. The largest tributaries were deep and very similar to the main river in their steep banks, which made sampling a challenge. The type of water in these habitats varied from clearwater to whitewater to black. We sampled ten lotic habitats and two lentic ones.

RESULTS

Species diversity and community structure

We collected some 5,000 fish specimens during the rapid inventory, resulting in a preliminary list of 207 species, 111 genera, 33 families, and 11 orders (see Appendix 3). Adding other food fish registered by the social team in the indigenous communities they visited (Figure 6H) brings the number of species recorded during the inventory to 219. Including results from previous inventories by Graham (2002) and Schleser (2000) brings the number of species known from the AAYMP region to 289. Of these, 56% have been identified to species, while the remainder require more study (40%) or are potentially new to science (~5%).

More than 75% of the species we registered are smaller than 10 cm long as adults. The most abundant of these are species of the family Characidae (~40% of the individuals) with value as ornamentals. Among the larger, commercially important fish we found *Arapaima gigas* (*paiche*), *Osteoglossum bicirrhosum* (*arahuana*, Figure 6B) and *Cichla monoculus* (*tucunaré*); there are also reports of *Colossoma macropomum* (*gamitana*), *Piaractus brachypomus* (*paco*), *Pseudoplatystoma fasciatum* (*doncella*), and *Brachyplatystoma filamentosum* (*saltón*).

Sixty-two percent of the species we registered belong to ten families in the order Characiformes (129 species), and 80% of these belong to the family Characidae (103). The second most diverse order was Siluriformes, with 22% of the total species diversity (46 species). Of the nine families in the Siluriformes, Loricariidae was the most diverse, with 17 species—8% of the ichthyofauna and 37% of the catfish we recorded in the inventory. The other nine orders and 31 families represent only 15% of all species. This overwhelming dominance in diversity of Ostariophysi species (Characiformes, Siluriformes, and Gymnotiformes) is typical of many other watersheds in the Peruvian Amazon (Chang 1998, de Rham et al. 2000, Ortega et al. 2001, 2003a, 2003b).

Diversity by site and by habitat

Of the three campsites we visited in the inventory, Yaguas had the most species (131). Maronal had 79 and Apayacu 112 species. In Yaguas we also found the most diverse sampling stations of the inventory, mostly in the Yaguas River. In one station in the main channel we recorded 43 species and in another, a *tipishca*, we recorded 39 species.

Whitewater habitats were the most diverse in fishes, especially the main channels and *tipishcas* of the Yaguas and Apayacu rivers. Next highest in diversity were blackwater habitats. In Yaguas we found a blackwater stream with 35 species (the second highest diversity at the site). The only lake we studied had 32 species.

In Maronal, blackwater habitats were the most diverse, with a mean of 21 species and a maximum of 30 per station. Clearwater habitats averaged 20 species. In Apayacu, the different types of water had very similar diversities; clearwater (the most common), whitewater and blackwater all had very diverse stations (up to 35 or 36 species).

Because of the season, we did not find areas of flooded forest as large as those encountered on the Yavarí River by Ortega et al. (2003a). As a result, in Yaguas and Apayacu lotic habitats were the most diverse and few lateral habitats were available to study. In Maronal, the stream network we studied corresponded

to the microbasin of the Supay Stream and was not affected by flooding on the Ampiyacu River. Water level of these small streams is very much influenced by rainfall, allowing them to flood lateral habitats in upland forest and providing new microhabitats for fish. This may explain the high number of species found for the site (79).

Compositional similarity among campsites

Only 15% of the species recorded in the inventory (31 species) were found at all three sites. Fifty-nine percent (123 species) were found at only one site (50, 25, and 24% of the species found at Yaguas, Maronal and Apayacu, respectively). The two sites in the Amazon watershed (Maronal and Apayacu) were more similar to each other than to the site in the Putumayo watershed (Yaguas). Yaguas and Maronal shared 25% of their species; Yaguas and Apayacu 29%; and Maronal and Apayacu 35%. When Maronal and Apayacu are lumped and compared to Yaguas—to compare the Amazon and Putumayo basins—the similarity is 32%.

Interesting records

Moenkhausia hemigrammoides is confirmed as a new record for Peru, and some 15 other species, mostly in the genera *Hemigrammus, Hyphessobrycon, Moenkhausia* and *Jupiaba,* are possibly new as well. Some of these were also registered in the recent inventory of the Yavarí River (Ortega et al. 2003a).

Perhaps five species are new to science. These include electric fish in the genus *Gymnotus* (Figure 6E), pimelodid catfish like *Cetopsorhamdia,* and a few characids.

We found a variety of species that are valuable as ornamentals and that are restricted to a few watersheds in Loreto, like *Boehlkea fredcochui* (*tetra azul*) and *Monocirrhus polyacanthus* (*pez hoja*, Figure 6C). Another interesting record is *Thalassophryne amazonica* (*pejesapo*), a rare species that is poorly represented in the collections at the UNMSM Natural History Museum in Lima.

In the creeks at Maronal we found several small individuals of fish that grow to be very large. One example is a catfish found in a creek not more than 5 m across, inside a submerged palm trunk, which was first identified as the large game fish *zungaro* (*Zungaro zungaro*). More recent work suggests it may instead be a new species for Peru in the genus *Pseudopimelodus.*

DISCUSSION

Regional diversity

The Ampiyacu, Apayacu, Yaguas, and Medio Putumayo (AAYMP) region has one of the most diverse fish communities of the Peruvian Amazon. Comparable inventories elsewhere have registered 310 species in the Putumayo basin (Ortega and Mojica 2002), 240 species in the Yavarí basin (Ortega et al. 2003a), 232 species in the Tambopata-Candamo basin (Chang 1998), 210 species in the Manu basin (Ortega 1996), ~200 species in the Pachitea basin (Ortega et al. 2003b), 156 species in the lower Urubamba basin (Ortega et al. 2001), 105 species in the Heath basin (Ortega and Chang 1992), and 93 species in Cordillera Azul (de Rham et al. 2000). Our conservative estimate for the ichthyofauna of the AAYMP region is between 400 and 450 species.

We made some basic comparisons of diversity and composition between the AAYMP region and the closest inventories, those in the Yavarí and Putumayo. The AAYMP inventory recorded fewer species than the Yavarí inventory (207 vs. 240 species, respectively). In both areas, the Characiformes and Siluriformes dominate community structure, with more than 80% of species. The compositional similarity between the two regions is roughly 50%.

By contrast, the AAYMP region shares only 35% of its species with the list of 310 species reported for the Putumayo basin (Ortega and Mojica 2002). These results are very interesting, because there are at least two reasons to expect a greater similarity between the AAYMP region and Putumayo than between the AAYMP region and Yavarí. First, the Yaguas River was the most diverse site in the AAYMP inventory, and it is a tributary of the Putumayo. Second, both the AAYMP and the Putumayo are north of the main Amazon, while the Yavarí River is south of it.

Although ours is just a preliminary inventory, the available information suggests that the relatively short distance between the mouths of the Ampiyacu, Apayacu, and Yavarí (~300 km) allows a greater interchange of fish species between these rivers than between the first two and the much more distant Putumayo. This may be especially important for some small species in the Characiformes and Siluriformes (the dominant taxa), which might find the broad Amazon a geographic barrier for large-scale migration between other aquatic habitats.

The lower similarity between the Putumayo basin and the AAYMP region may also be due to the addition of taxa in the Putumayo that are typical of its northern (Colombian) tributaries and not present in Peru. Indeed, some 30 new fish species for Peru were discovered during the recent inventory of the Putumayo (H. Ortega, pers. comm.).

More rigorous explanations for these patterns will require additional research in systematics, community ecology, species distributions, and biogeography, as well as year-round exploration of the poorly known basins in this region. The region spanning the Ampiyacu, Apayacu, Yaguas, Medio Putumayo, and Yavarí river basins may have the highest diversity of freshwater fish in Peru. At a larger scale, the Loreto region probably has the highest diversity of freshwater fish in Peru, because of the large number of important tributaries and vast extensions of flooded forest there (Chernoff et al. in press, Ortega et al. 2003a, de Rham et al. 2001, Hidalgo 2003).

Conservation importance

Apart from its remarkable diversity of fish, the AAYMP region includes an impressive variety of well-preserved aquatic habitats, especially in the headwaters, that deserve protection. The proposed conservation area includes several aquatic habitats that play key roles in the dynamics of fish communities, and in the migration, reproduction, and feeding of numerous economically and ecologically important species.

Present and potential threats to the region include unmanaged logging, which intensifies soil erosion, impoverishing aquatic habitats and microhabitats for fish. Overfishing of food and ornamental fishes by commercial fishermen, without regard for minimum sizes, net sizes, or harvest limits, is also a threat to commercially important species. The continuous use of toxic substances to catch fish, particularly *barbasco* and *huaca*, has negative effects in aquatic habitats in the short and long term.

Establishing integrated management of these basins is a high priority, and will be especially effective if the proposed conservation area includes entire watersheds. For this reason, we recommend that any protected area established in the area include the complete watersheds of the Yaguas and Algodón rivers.

AMPHIBIANS AND REPTILES

Authors/Participants: Lily O. Rodríguez and Guillermo Knell

Conservation targets: Intact herpetological communities in upland forests; species traditionally hunted for food (like *Leptodactylus pentadactylus,* large frogs in the genus *Osteocephalus*, and caimans) or for commerce (like land tortoises, black and white caimans, and the aquatic turtles *Chelus fimbriatus,* and *Podocnemis sextuberculata*; restricted-range species

INTRODUCTION

There have been several herpetological studies of the region between the Putumayo, Napo and Amazon rivers over the last 25 years, but this inventory is the first to work in the heart of the region, and the first to study reptiles and amphibians of the Yaguas River valley. Much of the previous work in the surroundings of the proposed Reserved Zone, on the lower Ampiyacu River (Lynch and Lescure 1980, Lescure and Gasc 1986) and in forests along the Napo River (Rodríguez and Duellman 1994), focused on floodplain or *várzea* habitats. Additional research between 1995 and 2002 at the Sabalillo biological station on the lower Apayacu River has also provided a great deal of herpetological information (D. Graham, D. Roberts, R. Bartlett, R. Hartdegen, C. Yánez Miranda, pers. comm.).

Our inventory focused on the amphibians and reptiles of upland forests. The distinction is important, especially in the Ampiyacu and Apayacu watersheds, where the herpetofauna we found in the headwaters shows some marked differences from the herpetofauna known from the floodplain forest on the lower stretches of these rivers. For example, the largest and most common frog in Amazonia (*Bufo marinus*) occurs in the lower watershed but was not spotted in the headwaters.

METHODS

We spent 16 days and a total of 140 sampling hours in the three sites visited by the inventory team. G. Knell carried out most of the field work, working at all three sites during the inventory, making observations on the herpetofauna at the second site during its construction the week before the inventory, and collecting information on commercially important species in the communities of Cuzco and Sabalillo, on the lower Apayacu. L. Rodríguez only sampled the third site. During the inventory, other members of the team contributed additional collections and observations.

In the field, we relied on opportunistic observations and collections. We walked trails, riverbanks and streambanks during the day and at night, collecting or field-identifying animals by direct observation or songs. Among the microhabitats we paid special attention to were occasional pools in low-lying areas of the floodplain forest, clearings and tree-fall gaps (including the heliports), leaf litter, the bases of buttressed trees, and the branches and bracts of dead palms.

Field-identified species were photographed and released. We collected hard-to-identify species for further study by taxonomic specialists. The collection of 66 animals will be deposited in the Natural History Museum in Lima.

RESULTS

Diversity

We registered 64 amphibian and 40 reptile species during the inventory (Appendix 4). This is more than half of the 115 amphibian species known from Iquitos (Rodríguez and Duellman 1994). Because of their more secretive habits, we registered only 21% of the 194 reptile species of the Iquitos region (Lamar 1998); this is a reasonable proportion for a rapid inventory and indicates a healthy reptile community. That more than half of the Iquitos region's megadiverse amphibian fauna can be registered in the AAYMP region in just 16 days is an indication of the very high conservation value of these forests for herpetofauna.

Among the amphibians, we found especially remarkable diversity in the genera *Osteocephalus* (eight species) and *Eleutherodactylus* (13). The diversity of *Osteocephalus* is the highest ever recorded for a single region, and confirms earlier suggestions about the conservation importance of this region (Rodríguez 1996, Figure 7F).

Despite the impressive diversity in some groups, we did not find a number of frog species that are typical of floodplain or swamp habitats. Small frogs in the genus *Scinax* and *Hyla* were notably absent; these have explosive reproduction and are generally abundant in puddles and ephemeral pools. The low diversity of these genera is an important contrast with anuran communities in the Yavarí River valley (Rodríguez and Knell 2003), the Putumayo region, and the lower Ampiyacu basin. The range-restricted species *Eleutherodactylus aaptus* and *E. lythrodes* were not recorded either, which suggests that they may be restricted to floodplain forests in these watersheds and are rare or absent in the uplands.

New species and other notable records

At least two of the 64 amphibian species we recorded are likely new to science. Among the eight sympatric species of *Osteocephalus* we collected a medium-sized frog that appears to be new (Figure 7F). We also found what a taxonomic specialist believes to be an undescribed species of *Oscaecilia* (M. Wake, pers. comm.), a rare

genus of caecilian or blind snake with only two species known from Peru (Figure 7D). Caecilians are legless, fossorial amphibians whose biology and geographic distribution are poorly known; in Peru only 15 species have been recorded.

Among the dendrobatids, we identified three species of *Colostethus*. The first, *C. trilineatus*, we collected only in the Yaguas camp; the other two, including a taxon similar to *C. trilineatus* but larger and with a yellow throat, were collected at Maronal. We did not find *C. melanolaemus*, described recently from the ACEER biological station, a locality along the Napo (some 30 km south of our Apayacu camp), and also recorded on the Yavarí; perhaps it is a floodplain species not present in the uplands.

Two records represent significant range extensions. *Osteocephalus mutabor*, known from the Pastaza River, has been recorded very close to the Ecuadorean border on the Napo River (Duellman and Mendelson 1995). *Lepidoblepharis hoogmoedi* is a lizard known from Tabatinga in Brazil, near the confluence of the Putumayo and Amazon rivers. These records suggest a common origin of the herpetofauna found throughout the headwaters of the Pastaza, Napo, and Putumayo rivers, in a region that stretches from the Andean foothills in Ecuador to the Ampiyacu and Yaguas in Peru.

Among the reptiles we found the rare false coral snake *Rhinobotrium lentiginosum* (Figure 7C), which has been registered very sparsely in Peru. Our collection may be just the third on record. *Atractus* cf. *snethgeleae* and the two species of *Micrurus* are also rare records, generally from *várzea* forests.

Highlights of the sites surveyed

Yaguas

At this site we found the largest number of reptiles and common floodplain species. The most common species in our first camp were toads in the *Bufo typhonius* complex. Most of the individuals recorded were juveniles and belonged to the morphospecies *B. typhonius* sp. 1. The dendrobatid *Colostethus trilineatus* was very abundant and active both in the morning and in the afternoon, and the leptodactylid *Eleutherodactylus altamazonicus* was spotted several times on nocturnal walks close to camp. Common species close to streams and seasonal pools included *Leptodactylus petersi* and *L. pentadactylus*, and hylids like *Hyla calcarata*.

The most interesting record at this camp was the new caecilian in the genus *Oscaecilia* (Figure 7D), discovered one night feeding on worms in the middle of a rainstorm. We also found two individuals of the colubrid snake *Xenopholis scalaris* close to a palm swamp, two species of *Micrurus*, and five species of *Anolis*.

Maronal

This was the inventory's most interesting site, given the number of rare upland taxa we found. Among the most interesting records are *Hyla albopunctulata* and the new species of *Osteocephalus (*Figure 7F), which was found in a small depression in the forest. The most common species were two toads in the *Bufo typhonius* complex, sp. 1 and sp. 2, which were observed both day and night sleeping on plants about a meter above the ground. Several dendrobatids were common, including *Epipedobates femoralis, E. hahneli, Dendrobates amazonicus, D. tinctorius igneus*, and an unidentified *Colostethus*. *Osteocephalus deridens* was common in low-lying areas, where it sang from bromeliads more than 2 m above the ground. *Hyla marmorata* and *H. geographica* were also sighted here several times. In hillier areas, *Osteocephalus taurinus* and *O. buckleyi* were among the most common species. We also found *Phyllomedusa atelopoides*, the only terrestrial species in the genus.

Anolis nitens scypheus was sighted commonly in the leaf-litter during our walks. This lizard has one of the largest body sizes and one of the smallest geographic ranges of its group.

Apayacu

The biggest surprise here was the absence of *Bufo marinus*, even though our camp was on the banks of the Apayacu River. Arboreal frogs in the genus *Osteocephalus*, like *O. planiceps, O.* cf. *yasuni*, and *O. cabrerai*, were the most common species here. *Hyla geographica* was very common close to creeks and streams, while along the river bank and in forest

pools it was common to find *Hyla boans, Leptodactylus petersi, L. pentadactylus,* and *Physalaemus petersi.*

In a 500-m stretch of the river one night we observed nine dwarf caimans (*Paleosuchus trigonatus,* Figure 7A). The boa *Corallus hortulanus* (Figure 7B) was sighted here on two occasions, also close to the river.

RECOMMENDATIONS

Protecting the sites we visited will ensure the long-term conservation of an intact upland herpetofauna in a global epicenter of amphibian and reptile diversity. The most important current threat is deforestation. Because the three sites we visited were primarily upland forest, where several commercially important timber species grow, future management plans for timber extraction in the region should focus on maintaining conditions for the herpetological community, like soil and leaf litter moisture, and light and temperature levels at the soil surface.

Apart from continuing with the inventory of the regional herpetofauna, we recommend studies that focus on arboreal groups and species apparently restricted to upland forests. We also recommend surveys during the dry season to determine the use and impact of local communities on populations of the threatened aquatic turtles *Podocnemis expansa, P. unifilis, P. sextuberculata* and *Chelus fimbriatus.* Equally important is documenting the conservation status of large caiman populations, especially the black caiman (*Melanosuchus niger*). If any of these populations show evidence of overhunting, local communities should implement recovery plans to complement the establishment of new protected areas.

BIRDS

Authors/Participants: Douglas F. Stotz and Tatiana Pequeño

Conservation targets: Five species endemic to northwestern Amazonia: Fiery Topaz *(Topaza pyra),* Salvin's Curassow *(Crax salvini),* Dugand's Antwren *(Herpsilochmus dugandi),* Ochre-striped Antpitta *(Grallaria dignissima),* and Red-billed Ground-cuckoo *(Neomorphus pucheranii),* and 18 others known in Peru only north of the Amazon; diverse terra firme forest community; game birds, expecially the Nocturnal Curassow *(Nothocrax urumutum),* Salvin's Curassow *(Crax salvini),* Pale-winged Trumpeter *(Psophia crepitans);* large hawks, including Harpy Eagle *(Harpia harpyja)* and hawk-eagles *(Spizaetus* spp.)

INTRODUCTION

Peru's northern Amazonian lowlands remain undersurveyed for birds, even in areas close to the city of Iquitos. North of the Amazon and east of the Napo, relatively few sites have been well surveyed, and all of these are fairly close to these major rivers.

The town of Pebas at the mouth of the Ampiyacu River was a well-known collecting locality in the 1800s. Important collections there included those of Castelnau and Deville, Barlett, and Hauxwell. Apayacu, near the mouth of the Apayacu River, has been visited by a variety of ornithologists during the last century. The largest collection from this site was by the Olallas, who were in the region from December 1926 to February 1927 (T. Schulenberg, pers. comm.).

Teams of ornithologists from Louisiana State University worked in the region during the early 1980s. They visited three localities north of the Amazon and east of the Napo, including the lower Sucusari River, an east-bank tributary of the Napo; the Quebrada Oran, a north-bank tributary of the Amazon east of the Napo; and the Yanayacu River, another east-bank tributary of the Napo. Capparella (1987) lists the species collected at these sites. Cardiff (1985) reported significant records from the Sucusari (and another locality on the right bank of the Napo), including three species new for Peru. The Sucusari was worked subsequently much more thoroughly by Ted Parker. T. Schulenberg has created an unpublished database

with records from these five localities, which we used for comparison with our findings.

METHODS

Our protocol consisted of walking trails, looking and listening for birds. Observers departed camp between one hour before and shortly after first light. We were typically in the field until mid-afternoon, returning to camp for lunch, after which we returned to the field until sunset. Observers occasionally remained in the field through the day, and sometimes returned to camp well after dark. We attempted to walk separate trails each day to maximize coverage of all habitats in the area. At Yaguas, we did not visit more distant parts of the trail system, more than 5 km from camp. Similarly, at Maronal, trails to the *purma* and the Quebrada Supay were undersurveyed.

We took point-count censuses of birds at each of the three camps. In these censuses, we recorded all birds seen or heard during fifteen minutes at eight consecutive points along a trail, 150 m apart. We initiated point counts shortly after first light, and typically finished by 8:30 AM, within three hours of local sunrise. All birds detected were noted, regardless of their distance from the survey point. We concentrated these surveys in forest habitats, but we attempted to locate different series of point counts in the different types of forest found at each camp. We obtained 32 point counts at the Maronal and Apayacu camps, and 24 at Yaguas.

Both observers carried a tape recorder and microphone on most days to record bird sounds, to document species occurrences, and for playback to confirm identifications. We kept daily records of the number of each species observed. In addition, we compiled a daily list of species encountered during a round-table meeting of all observers each evening. This information, along with point count data, was used to estimate relative abundances of species at each camp. Observations from others in the inventory team, especially D. Moskovits, supplemented our records.

RESULTS

Diversity

We found 362 species of birds during the rapid inventory (Appendix 5). The vast majority of these (more than 300) are forest species. Terra firme forest had the most diverse avifauna, with 216 species; an additional 23 species were along streams in upland forest. The other forest species were only in low-lying forests along the rivers, or in palm swamps. At Yaguas we found 272 species, at Maronal 241, and at Apayacu 301.

The five localities discussed in the introduction of this chapter have a combined species list of 515 species. We found 16 species that had not been recorded at those sites. Because they are all on or near large rivers, those sites include a number of habitats that were not present in our survey. We estimate that about 490 species will be found in the region with more complete surveys, including larger stretches of riverine habitat. Most of these additional species are either uncommon or are associated with riverine habitats that were poorly represented at the sites we visited. Only about 20 of the additional species expected are true forest species. An additional 40 species could be expected within the proposed Reserved Zone, if the area surveyed were expanded to include areas along much larger rivers (the Putumayo, or perhaps the lower Algodón), river islands such as exist on the Putumayo, or areas of extensive *várzea* forest.

Species composition, distributions, and conservation status

The avifauna of the AAYMP region is typically Amazonian, and most species are widespread. The northwestern corner of Amazonia has been identified as an area of endemism (Napo Center, Cracraft 1985), extending south to the Amazon River and north and east to the Vaupes River. We found five species that are restricted to this area: Fiery Topaz (*Topaza pyra,* Figure 8E), Salvin's Curassow (*Crax salvini*), Red-billed Ground-Cuckoo (*Neomorphus pucherani*), Dugand's Antwren (*Herpsilochmus dugandi*), and Ochre-striped Antpitta (*Grallaria dignissima,* Figure 8F). The ranges

of an additional 11 species that we found are restricted to north of the Amazon, and seven other species occur in Peru only north of the Amazon, but cross the Amazon farther east in Brazil. All of these species use forest habitats.

We found no species considered to be globally threatened by the IUCN (Birdlife International 2000). Only one of the species we observed, the widespread but always rare Harpy Eagle (*Harpyja harpia*), is treated as near-threatened by IUCN. In general, the large ranges of Amazonian birds, plus the existence of extensive forest, means that Amazonian birds are not at immediate risk of extinction. One species that occurs in the region but that we did not register during the inventory, the Wattled Curassow (*Crax globulosa*), is critically endangered. It could occur on river islands and in extensive areas of *várzea* in or near the proposed Reserved Zone. Historically, it was collected near Pebas.

Several of the birds we encountered are on Peru's threatened species list. Harpy Eagle (*Harpia harpyja*) is considered endangered, while King Vulture (*Sarcoramphus papa*), Blue-and-yellow Macaw (*Ara ararauna*), Scarlet Macaw (*Ara macao*), Red-and-green Macaw (*Ara chloroptera*), Chestnut-fronted Macaw (*Ara severa*), and Red-bellied Macaw (*Ara manilata*) are considered vulnerable. Salvin's Curassow (*Crax salvini*), Maroon-tailed Parakeet (*Pyrrhura melanura*), Blue-headed Parrot (*Pionus menstruus*), Yellow-crowned Parrot (*Amazona ochrocephala*) and Mealy Parrot (*Amazona farinosa*) are listed with an indeterminate status. None of these species appears to be under any serious threat.

Notable records

Although this part of the Peruvian Amazon has been poorly surveyed for birds, we did not encounter any species that were completely unexpected. We did find a few species that are very poorly known in Peru. Most notable are three species that Álvarez and Whitney (2003) treated as specialists on nutrient-poor soils: *Nyctibius bracteatus, Lophotriccus galeatus,* and *Conopias parva.* As noted by the botanical team, the area surveyed is intermediate in nutrient level. This region appears to have no white-sand soils, and the streams are not classic blackwater streams. The tie between these species and very nutrient-poor soils appears tenuous. We found none of the classic white-sand specialists discussed by Álvarez and Whitney (2003), which include four species newly described to science, and seven other species not previously reported from Peru. Other poorly known species that we found include Fiery Topaz (*Topaza pyra,* Figure 8E), Sapphire-rumped Parrotlet (*Touit purpurata*), and Collared Gnatwren (*Microbates collaris,* Figure 8B).

DISCUSSION

Habitats and avifaunas at surveyed sites

At all three sites, the dominant habitat was terra firme forest on poor clay soils, with low-lying, poorly drained areas and a number of small forest streams scattered throughout. At Maronal and Apayacu, we surveyed moderately hilly terra firme forest extensively. This habitat was not found close to camp at Yaguas and received less attention from us there. At Yaguas, the upland forests we surveyed were mainly on old floodplain terraces above the annual flood level. The Yaguas and Apayacu camps lay alongside whitewater rivers sufficiently broad to open up the canopy. The Yaguas River creates a narrow floodplain forest while the upper Apayacu does not. At Maronal, none of the streams were more than a couple of meters wide, and did not open up the canopy. A small oxbow lake at Yaguas and small *aguajales* (palm swamps) at Yaguas and Apayacu provided additional habitats at these camps that were absent at Maronal.

Yaguas

The river and nearby oxbow lake at Yaguas provided the most distinctive element of the avifauna at this site. However, bird communities in these habitats were depauperate by Amazonian standards, even recognizing the small extent of available habitat. There were very few water birds. The only heron seen during the inventory was Rufescent Tiger-heron (*Tigrisoma lineatum*); two other species were recorded the week before the inventory, while the camp was being

constructed. Three species of kingfishers, Green Ibis (*Mesembinibis cayennensis*), Sungrebe (*Heliornis fulica*), Hoatzin (*Opisthocomus hoazin*), and Gray-necked Wood-Rail (*Aramides cajanea*) were the only other waterbirds recorded here. Diversity of other typical riverside birds was also low. Among the species absent were Ladder-tailed Nightjar (*Hydropsalis climacocerca*), Gray-crowned Flycatcher (*Myiozetetes granadensis*), several species of swallows, Blue-gray Tanager (*Thraupis episcopus*), Yellow-browed Sparrow (*Ammodramus aurifrons*), and seedeaters (*Sporophila* sp.). Point counts in the riverine forest were the least diverse, although the numbers of individuals per point was comparable to other sites.

Maronal

The avifauna at Maronal was essentially a terra firme forest community. Small forest streams added to the diversity but were too small to introduce a significant riverine species component. A few species usually associated with river edges or human perturbation, such as Yellow-tufted Woodpecker (*Melanerpes cruentatus*) and Rufous-throated Woodcreeper (*Dendrexetastes rufigula*), occurred here in the abundant treefalls, especially on the ridgetops. Along the forest streams we found a few species that typically occupy transitional, but not terra firme forests, like Plumbeous Antbird (*Myrmeciza hyperythra*) and Wire-tailed Manakin (*Pipra filicauda*). We also found Long-billed Woodcreeper (*Nasica longirostris*), a typical riverside bird, to be common here, even occurring in the ridgetop forests. Its abundance was surprising, as we had anticipated that it would be absent from the site.

We observed a single Harpy Eagle (*Harpia harpyja*) in flight by the heliport, our only record at any of the three camps. Given the wide extent of intact forest and good populations of arboreal mammals, it seems likely that the large eagles are more widespread in the region than our single observation might suggest. Variegated Antpitta (*Grallaria varia,* Figure 8C), previously known in Peru only from the Sucusari River, was present at Maronal, and we found a nest (Figure 8D, see below).

Another interesting find at Maronal was the overlap of two species of *Malacoptila.* We found White-chested Puffbird (*Malacoptila fusca*) regularly, and recorded Rufous-necked Puffbird (*Malacoptila rufa*) on one occasion. For the most part several species of *Malacoptila* replace one another parapatrically in western Amazonia and along the slopes of the Andes. However, this species pair was also found together along the Yanayacu River by an LSU expedition in 1983, and they have been found together at other sites, like the Morona and the mouth of the Curaray rivers (T. S. Schulenberg, pers. comm.). These two species appear to be broadly sympatric across much of northern Peru. The details of their interactions remain to be discovered.

Another species pair with an intricate distribution pattern in the region are two species of *Terenura* antwrens. At Maronal, we observed and tape-recorded Ash-winged Antwren (*Terenura spodioptila*), a species poorly known in Peru. It has been collected at Güeppí, and Ted Parker observed it at the Sucusari River. However, the more southerly Chestnut-shouldered Antwren (*Terenura humeralis*) has been recorded at several sites north of the Amazon and east of the Napo River.

Apayacu

The Apayacu site bordered the Apayacu River, but as in Yaguas, the complement of riverine birds was small. If anything, the riparian avifauna at this site was less diverse than at Yaguas, lacking such birds as Undulated Tinamou (*Crypturellus undulatus*), Hoatzin (*Opisthocomus hoazin*) and Lesser Kiskadee (*Pitangus lictor*). Along much of the river, the forest was typical terra firme with typical terra firme birds. The terra firme forest bird community was better represented here than at Yaguas, but not as complete as at Maronal. A small *aguajal* here provided sightings of Point-tailed Palmcreeper (*Berlepschia rikeri*), still known from only a handful of localities in Peru, and Sulphury Flycatcher (*Tyrannopsis sulphurea*), two species typically found in association with *Mauritia* palms.

The most notable species we found at Apayacu were Rufous Potoo (*Nyctibius bracteatus*) and Helmeted Pygmy-Tyrant (*Lophotriccus galeatus*). Álvarez and Whitney (2003) mention three specimen records in Peru for the *Nyctibius* in addition to three of their own

records from west of Iquitos. One of these specimens comes from near the mouth of the Apayacu River; we tape-recorded a bird immediately behind the Apayacu camp early on the morning of 15 August. *Nyctibius bracteatus* remains poorly known, although records have multiplied dramatically since its voice was confirmed near Manaus in the early 1990s.

The pygmy-tyrant was fairly common at Apayacu, and we tape-recorded three individuals. Álvarez and Whitney (2003) suggest that this species, by occupying nutrient-poor areas, is able to occur in sympatry with its widespread congener, Double-banded Pygmy-Tyrant (*Lophotriccus vitiosus*). Although we first found this species within the *aguajal* at Apayacu, it also occurred regularly within the terra firme forest. We never recorded the two species within hearing distance of each other, but it did not appear that *L. galeatus* was restricted to particularly unusual microhabitats at this camp. Similarly, in central Brazil near Manaus, this species occurs together with *L. vitiosus* at some forest sites (Willis 1977).

Comparisons among sites

Of the 362 species we registered, 169 were present at all three camps. Yaguas and Apayacu had 227 species in common; Maronal and Apayacu had 204 in common; and Yaguas and Maronal had the fewest species in common: 183. We found 39 species only at Apayacu, 27 only at Yaguas and 16 only at Maronal. Longer surveys might reduce the observed differences among camps. However, there were striking differences, not just in species presence and absence, but also in abundance. For example, some of the most common understory antbirds at Maronal, such as Plain-throated Antwren (*Myrmotherula hauxwelli*), Sooty Antbird (*Myrmeciza fortis*), Spot-backed Antbird (*Hylophylax naevia*), and Rufous-capped Antthrush (*Formicarius colma*), were less common at Apayacu, and uncommon or rare at Yaguas. Yaguas also lacked several species of ground-walking antbirds that were at least moderately common at the other two sites: Black-faced Antthrush (*Formicarius analis*), Striated Antthrush (*Chamaeza nobilis*), Variegated Antpitta (*Grallaria varia*), and Chestnut-belted Gnateater (*Conopophaga aurita*). On the other hand, Ruddy Pigeon (*Columba subvinacea*) was more common than Plumbeous Pigeon (*Columba plumbea*) at Yaguas; at Maronal, where *Columba plumbea* was common, we recorded *C. subvinacea* only once; and at Apayacu, *C. subvinacea* was not as rare, but it was much less common than *C. plumbea.*

Some of the species absent at Maronal are a reflection of the lack of riverine habitats at the site. Among the more common species of riverine forests at the other two camps that were absent at Maronal are Pauraque (*Nyctidromus albicollis*), Fork-tailed Palm-Swift (*Tachornis squamata*), Blue-crowned Motmot (*Momotus momota*), Black-fronted Nunbird (*Monasa nigrifrons*), Striped Woodcreeper (*Xiphorhynchus obsoletus*), Streaked Antwren (*Myrmotherula surinamensis*), Drab Water-Tyrant (*Ochthornis littoralis*), Greater Manakin (*Schiffornis major*), several swallows, and Silver-beaked and Masked Crimson Tanager (*Ramphocelus carbo* and *R. nigrogularis*).

Less easily explained are species like Citron-bellied Attila (*Attila citriniventris*) and White-crowned Manakin (*Dixiphia pipra*), which were fairly common in terra firme at Yaguas and Apayacu, but not found in that habitat at Maronal. The *Attila* situation was especially complicated. At Yaguas we found *Attila spadiceus* in the riverine forest and *A. citriniventris* in the rest of the forest. At Apayacu, *A. citriniventris* likewise occurred fairly commonly in the terra firme forest, but *A. spadiceus* was less tied to the riverine forests, occurring uncommonly throughout the forest. At Maronal, where one might expect the terra firme species *A. citriniventris,* we had only *A. spadiceus.*

One feature shared by all three sites was the lack of any significant human disturbance (see "Sites Visited by the Biological Team"). As a result, a number of open-habitat species typically found in most Amazonian sites were absent at all three sites. Many of the species that occupy human-created disturbance in Amazonia also occupy the open areas along rivers (e.g., *Tyrannus melanocholicus, Ramphocelus carbo*). Some of these species were present at Yaguas and Apayacu. Because of

its lack of a river as well as human perturbation, the avifauna at Maronal stands out in its total lack of this ubiquitous element of the Amazonia avifauna. Of the 166 species listed by Stotz et al. (1996) as typical of disturbed habitats, we found only four (*Piaya cayana, Glaucidium brasilianum, Chaetura brachyura,* and *Dacnis cayana*) at Maronal. Twenty-one additional species were recorded at the other camps. Even this number is small compared to most Amazonian sites. For example, on the Yavarí inventory, where the habitat was relatively undisturbed, Lane et al. (2003) recorded 37 of these species.

Comparison with Yavarí inventory

The Yavarí rapid inventory in April 2003 recorded 400 species of birds (Lane et al. 2003), while we recorded 362 in the AAYMP rapid inventory. This slight difference in species richness masks a marked difference in the species composition of these two regions. The Yavarí inventory recorded 122 species that we did not encounter in the AAYMP inventory. Most of these species (51) are associated with riverine and other aquatic habitats that were rare at the sites we visited in the AAYMP region. Twenty additional species recorded in Yavarí but not in the AAYMP only occur as migrants in the region, and 18 represent species that are replaced by closely related species in the AAYMP region (Table 1). Five others are birds whose ranges do not extend as far northwest as the AAYMP (but which do not have an obvious replacement species there), and seven use second-growth habitats that were essentially non-existent at the sites we visited during the AAYMP inventory. The absence of the remaining 21 species from the AAYMP inventory shows no obvious geographic or ecological reason and may reflect a sampling artifact.

In contrast, 57 of the 83 species found on the AAYMP inventory but not at Yavarí are terra firme forest species. Although some of these terra firme species may be in the Yavarí region, the numbers suggest marked differences in the forest avifaunas of the two regions.

Table 1. Bird species replacing each other between the AAYMP region and the Yavarí River valley (Lane et al. 2003).

Genus	AAYMP	Yavarí
Crax	*salvini*	*tuberosum*
Odontophorus	*gujanensis*	*stellatus*
Psophia	*crepitans*	*leucoptera*
Pyrrhura	*melanura*	*picta roseifrons*
Pionites	*melanocephala*	*leucogaster*
Galbula	*albirostris*	*cyanicollis*
Malacoptila	*fusca*	*semicincta*
Thamnomanes	*ardesiacus*	*saturninus*
Thamnomanes	*caesius*	*schistogynus*
Terenura	*spodioptila*	*humeralis*
Gymnopithys	*leucaspis*	*salvini*
Grallaria	*dignissima*	*eludens*
Conopophaga	*aurita*	*peruviana*
Pipra	*erythrocephala*	*rubrocapilla*
Thryothorus	*coraya*	*genibarbis*
Tachyphonus	*cristatus*	*rufiventer*
Lanio	*fulvus*	*versicolor*
Icterus	*chrysocephalus*	*cayanensis*

Reproduction

Many insectivorous passerines had older juveniles accompanying them. This, together with generally low levels of singing, suggests that for the most part the main breeding season had ended fairly recently. There were a few younger chicks as well; for example, a Marbled Wood-Quail (*Odontophorus gujanensis*) was accompanied by two downy chicks at Maronal. However, we found a few birds actively nesting. We found a nest of *Grallaria varia* with two eggs just outside our camp at Maronal on 10 August (Figure 8D). This is one of the few nests of this species that have been found and the first found in Peru. A female Reddish Hermit (*Phaethornis ruber*) had nearly completed building a nest on the underside of a *Geonoma* palm leaf, and a pair of Paradise Jacamars (*Galbula dea*) was excavating a hole in an arboreal termite nest at Maronal. A pair of Mouse-colored Antshrikes (*Thamnophilus murinus*) had almost finished building a nest at Yaguas. A few other species were seen carrying nesting material, including Moustached Antwren (*Myrmotherula ignota*) and Gray-crowned Flycatcher (*Tolmomyias poliocephalus*) in Yaguas, and Screaming Piha (*Lipaugus vociferans*) at Maronal. We were not specifically looking for breeding evidence and, these data may significantly understate the level of nesting occurring.

Migration

There was little evidence that migrants were present at the time of our survey. Only a few austral migrants were recorded, including Vermilion Flycatcher (*Pyrocephalus rubinus*) and Crowned Slaty-Flycatcher (*Empidonomus aurantioatrocristatus*). A single Piratic Flycatcher (*Legatus leucophaius*) at Yaguas probably represents a migrant from the south as well. We saw a migrant Streaked Flycatcher (*Myiodynastes maculatus* subspecies *solitarius*) at Maronal, while at Yaguas the sole record was an individual of the resident population (nominate *maculatus*). Boreal migrants were essentially absent. The ichthyologists saw an unidentified shorebird (probably Spotted Sandpiper, *Actitis macularia,* or Solitary Sandpiper, *Tringa solitaria*) along the river at Apayacu. The most interesting migrant we sighted was an unidentified *Catharus* thrush (probably Gray-cheeked, *C. minimus*) that Pequeño saw in the forest at Apayacu on 18 August. This is extremely early for any of this genera to have reached South America. They typically arrive in numbers toward the end of September, and the earliest records for the genus in South America of which we are aware are 4 September in Colombia for Veery (*Catharus fuscescens*; Dugand 1947), and 25 September, also in Colombia, for Swainson's Thrush (*Catharus ustulatus*; Paynter 1995).

While the small number of migrants we observed is largely a function of season, the lack of extensive open habitats and broad rivers also plays a role. Immediately following the inventory, in five days of casual observation along the Amazon river in Iquitos, we observed seven species of austral migrants, and six species of boreal migrants.

Abundance patterns

While all camps showed relatively typical forest avifaunas, there were notable differences among the camps in the abundance of some groups; other groups were notable for being consistently rare or abundant. We found game birds (guans, curassows, trumpeters, and tinamous) common at all three camps, but especially so at Yaguas, where we observed Salvin's Curassow (*Crax salvini*) daily in pairs along the river. Despite the relative abundance of cracids, Speckled Chachalaca (*Ortalis guttata*) was absent from any of the survey sites—another example of the poor diversity of riverine and second-growth species. We found parrots in good but not particularly notable numbers at all of the camps. Among the macaws, only Blue-and-yellow (*Ara ararauna*) and Red-bellied (*Ara manilata*) were particularly common. Both species use *Mauritia* palms regularly, and these palms were abundant in the region. Blue-headed Parrots (*Pionus menstruus*) and *Amazona* parrots seemed low in numbers. Orange-cheeked (*Pionopsitta barrabandi*) and Black-headed Parrots (*Pionites melanocephala*) greatly outnumbered *Pionus* and *Amazona* at all camps. Among the smaller parrots, only Maroon-tailed Parakeet (*Pyrrhura melanura*) was very common.

Antbirds that follow army-ant swarms, especially Sooty Antbird (*Myrmeciza fortis*), White-plumed Antbird (*Pithys albifrons,* Figure 8A), Bicolored Antbird (*Gymnopithys leucaspis*), and Hairy-crested Antbird (*Rhegmatorhina melanosticta*), were well represented at all camps, and unusually common at Maronal. We regularly encountered both *Eciton burchellii* and *Labidus praedator* swarms at all of the camps. Strangely, woodcreepers that follow ants were rare at all camps.

We focused considerable attention on mixed-species flocks. The understory flocks led by *Thamnomanes* antshrikes were very common. However, flock diversity tended to be low. In much of Amazonia, four species of *Myrmotherula* antwrens typically co-occur in understory flocks (*M. menetriesii, axillaris, longipennis* and one species of dead-leaf specialist). At all three camps, only Gray Antwren (*M. menetriesii*) and White-flanked Antwren (*M. axillaris*) occurred in most flocks. Long-winged Antwren (*M. longipennis*) was uncommon to rare at Yaguas and Maronal, and unrecorded at Apayacu. While we found three species of dead-leaf specialist *Myrmotherula* (Stipple-throated Antwren, *M. haematonota;* Ornata Antwren, *M. ornata*; and Rufous-tailed Antwren, *M. erythrura*), all were rare and seldom seen in mixed-species flocks. Other groups, such as woodcreepers, furnariids, and flycatchers were similarly found in low diversity in most understory flocks.

Canopy flocks were even more uncharacteristic of other sites in Amazonia. While we recorded nearly all the expected canopy flocking species, we rarely found independent canopy flocks. Typically common canopy flock species, such as Dusky-capped Greenlet (*Hylophilus hypoxanthus*), Forest Elaenia (*Myiopagis gaimardi*), Fulvous Shrike-Tanager (*Lanio fulvus*), and Chestnut-winged Hookbill (*Ancistrops strigulatus*) were usually found either alone in the canopy or accompanying understory flocks. Contributing to the general paucity of canopy flocks was the relative rarity of many of the frugivorous and nectivorous tanagers (*Tangara, Cyanerpes, Dacnis, Hemithraupis flavicollis,* etc.).

Use of *Symphonia globulifera*

In general, understory hummingbirds (mainly hermits, *Phaethornis* sp. and Fork-tailed Wood-Nymph, *Thalurania furcata*) were present in good numbers, although the complete lack of Straight-billed Hermit (*Phaethornis bourcieri*) was somewhat unexpected. Nearly all of the canopy hummingbirds we recorded, except for Black-eared Fairy (*Heliothryx aurita*), were birds foraging at the flowers of the canopy tree *Symphonia globulifera* (Clusiaceae). We found these trees scattered through the forest at each of the camps, mostly in low-lying areas with standing water, typically attracting several species of hummingbirds as well as various species of tanagers, especially the more nectivorous genera: *Chlorophanes, Cyanerpes* and *Dacnis*. In addition, we saw Black-headed Parrot (*Pionites melanocephala*) and Maroon-tailed Pakakeet (*Pyrrhura melanura*) eating *Symphonia* flowers. In Table 2, we provide a list of all the bird species seen using *Symphonia* flowers during the inventory.

The most significant species we saw at the *Symphonia* flowers was the hummingbird Fiery Topaz (*Topaza pyra,* Figure 8). We saw (and tape-recorded) males behaving territorially in *Symphonia* trees at Yaguas and at Apayacu. This species is poorly known throughout its range. Our records fall into a gap in the known range between eastern Ecuador and adjacent Amazonian Peru and southeastern Colombia, along the Vaupes River. The Ecuadorian birds have recently been described as a subspecies distinct from the nominate form in eastern Colombia, southern Venezuela, and northwestern Brazil (Hu et al. 2000). In the absence of specimens, the subspecific identity of the birds we saw remains in doubt.

Table 2. Birds observed foraging in flowering *Symphonia globulifera* trees in the rapid inventory. Letters in the third column refer to the three sites visited: Yaguas, Maronal and Apayacu.

Common Name	Scientific Name	Observed at
Maroon-tailed Parakeet	*Pyrrhura melanura*	M
Black-headed Parrot	*Pionites melanocephala*	Y
Gray-breasted Sabrewing	*Campylopterus largipennis*	Y,A
Black-throated Brilliant	*Heliodoxa schreibersii*	Y,A
Fiery Topaz	*Topaza pyra*	Y,A
White-necked Jacobin	*Florisuga mellivora*	Y,A
Fork-tailed Woodnymph	*Thalurania furcata*	Y,M,A
Rufous-throated Sapphire	*Hylocharis sapphirina*	A
Purple Honeycreeper	*Cyanerpes caeruleus*	Y,M,A
Short-billed Honeycreeper	*Cyanerpes nitidus*	M,A
Green Honeycreeper	*Chlorophanes spiza*	Y,M,A
Paradise Tanager	*Tangara chilensis*	Y
Green-and-gold Tanager	*Tangara schrankii*	Y
Yellow-bellied Tanager	*Tangara xanthogastra*	Y
Opal-rumped Tanager	*Tangara velia*	A
Opal-crowned Tanager	*Tangara callophrys*	Y

THREATS, OPPORTUNITIES AND RECOMMENDATIONS

Principal threats

The principal threat for birds in the AAYMP region is habitat destruction, especially deforestation, given the largely forest-based avifauna of the region. With the high densities of game birds and the presence of some of the species most sensitive to hunting (curassows and trumpeters), the introduction of significant hunting into the region would have noticeable impacts on the populations of these species. Continued subsistence-level hunting in the lands used by the native communities should not impact the populations of these birds negatively in the area we surveyed. We expect that the greatest potential for negative impacts would be along the river courses that provide relatively easy access to parts of the region. The fact that Salvin's Curassow (*Crax salvini*) appears to concentrate in the riverine forests may put this species especially at risk from hunting.

Opportunities for conservation

There is little protected area north of the Amazon River in Peru. Given the significant biogeographic turnover in crossing the Amazon, the AAYMP area provides an important opportunity to protect this rich, different avifauna. As the area surveyed is largely terra firme forest on clay soils that is almost completely undisturbed, it also provides a tremendous opportunity to protect a significant expanse with the most diverse bird community. Currently, none of the protected areas in northern Peru cover a significant extent of terra firme forest on either side of the Amazon.

The region can also act as a resource bank (source populations of hunted species) for native communities in surrounding areas. A protected area within the region will be crucial to provide resident native communities with long-term continuity of their traditional lifestyles.

Recommendations

Protection and management

Some large river islands and large oxbow lakes within the proposed Reserved Zone should receive strict protection or at least protection from deforestation. Although extending the area receiving strict protection to include all or nearly all of the Yaguas drainage improves the representation of riverine habitats, Yaguas is a small river that appears to lack key habitats associated with larger rivers. The Putumayo has many large oxbows and islands visible on satellite images. The Algodón River has some oxbows, but appears to lack islands. These two drainages seem to have the best potential for finding high-quality examples of aquatic habitats that otherwise would be lacking in the area slated for strict protection.

Rivers provide both access and resources in the less used part of the region. Recognizing this reality, we might consider continued use of these areas by the communities along the Apayacu and Ampiyacu drainages and perhaps southern tributaries of the Algodón, even as the surrounding areas are strictly protected. This might be granted in exchange for stricter protection for some important sites in the lower drainages that contain habitats not otherwise represented in the headwaters of these rivers. The difficulty would lie in enforcement of protection, and success would rest on thorough participation of the local communities in stewardship of the region.

Additional inventories

The Putumayo River needs to be surveyed for its biological resources as soon as possible. This large river is almost completely unknown on both the Peruvian and Colombian sides, but has a distinctive set of habitats associated with it. The area along and near the Putumayo has large oxbows and the river itself has large islands; these islands in other drainages have proven to have a distinct, specialized, restricted-range avifauna. The oxbow lakes and islands should be inventoried and examples of each that are of high quality should receive strict protection. In surveying the

Putumayo River, the possibility that populations of the endangered Wattled Curassow (*Crax globulosa*) exist on islands in the river should be evaluated carefully.

We also recommend surveys of any large oxbow lakes in the area. In the area we surveyed and in the headwaters region generally, there are no large oxbows. They do exist elsewhere in the proposed area of the Reserved Zone, and have the potential to contribute a significant number of additional bird species not represented in the uplands or along the small rivers that would be protected in the headwater region.

In our surveys, we did not encounter any sandy-soil areas. Such areas may not exist within the area of the proposed Reserved Zone. However, if there are areas of sandy soil, especially white sand with *varillal* (typical white-sand vegetation), these should be surveyed. Such areas have significant endemic biodiversity elsewhere in northern Peru (see Álvarez and Whitney 2003).

Research

There was substantial variation among sites in diversity and abundance of terra firme forest understory bird communities. Research on the nature and causes of this variation would help us identify areas of terra firme forest most effective in preserving good examples of terra-firme communities.

We also recommend studies on the population dynamics of Amazonian game birds under various levels of hunting. This region would be a good place for such a study, given the presence of local populations with variable degrees of access to the headwaters region.

MAMMALS

Authors/Participants: Olga Montenegro and Mario Escobedo

Conservation targets: *Saguinus nigricollis,* a range-restricted primate; the giant armadillo *Priodontes maximus,* considered Endangered by the IUCN; large primates threatened by hunting across much of their geographic range, especially *Alouatta seniculus, Cebus albifrons, Lagothrix lagothricha, Callicebus torquatus* and *Pithecia monachus*; carnivores, especially in the families Canidae (*Atelocynus microtis*), Felidae (*Leopardus pardalis, Panthera onca*) and Mustelidae (*Lontra longicaudis*); *Tapirus terrestris*, the largest terrestrial mammal in Amazonia, considered Vulnerable by the IUCN; *Artibeus obscurus* and *Sturnira aratathomasi*, two frugivorous bats important as seed dispersers and considered Near Threatened by the IUCN

INTRODUCTION

Little is known about the mammal fauna of the Amazon-Napo-Putumayo interfluvium. Apart from a few primate studies in the Napo watershed (Aquino and Encarnación 1994, Heymann et al. 2002), the mammal literature for this area of the Peruvian Amazon is nearly nonexistent. Some limited work has been carried out in the region, but there are no published species lists for mammals. For example, the Sabalillo research station on the Apayacu River provides only a list of species potentially present in the area (Project Amazonas 2003).

The scarcity of mammal inventories in the region means that distributional limits of some species are still poorly known north of the Amazon River. For example, the distribution maps of primates like *Callimico goeldii, Saguinus fuscicollis* and *Saguinus tripartitus* given by Aquino and Encarnación (1994) and Rylands et al. (1993) mark the Amazon-Napo-Putumayo interfluvium as a question mark.

In this chapter we present results of the rapid mammal inventory of the Ampiyacu, Apayacu, Yaguas, and Medio Putumayo (AAYMP) region in two parts: non-volant mammals (terrestrial, arboreal, and aquatic) and bats. We compare mammal abundance and diversity at our three inventory sites, highlight notable records, and emphasize important conservation targets.

METHODS

Non-volant mammals

We concentrated our efforts on large mammals, as we did not have enough time to sample small terrestrial mammals adequately. We used a combination of direct observation and indirect evidence, such as tracks and other signs of mammal activity (feeding remains, dens, scrapes on trees), to sample along trails varying in length from 2 to 14.4 km. These trails crossed through the majority of habitats at each site.

We conducted both diurnal and nocturnal surveys, generally accompanied by a guide from the local communities. Our diurnal surveys typically began between 6 and 7 AM, and extended until 5 or 6 PM. We walked slowly along the trails (at ~1 km/hour), scanning the vegetation from the canopy down to the ground and recording the presence of terrestrial and arboreal mammals. On some occasions we followed animals to confirm their identity and estimate group size. We also listened for vocalizations and other non-visual clues indicating the presence of mammals. For each observation, we noted the species, time of day, number of individuals, perpendicular distance to the trail, and for individuals sighted in trees, their height above the ground.

Other researchers in the inventory team, especially D. Moskovits, C. Vriesendorp, T. Pequeño, D. Stotz, G. Knell, A. del Campo, I. Mesones, and M. Ríos, as well as our guides from the local communities, also contributed mammal observations to the list.

To compare mammal abundances among the three inventory sites, we estimated relative abundance of signs or tracks of terrestrial mammals per kilometer. For each trail, we recorded the presence of tracks only once. For primates with sufficient observations we estimated the encounter rate per kilometer using the total distance surveyed at each site. We did not estimate abundance for species recorded only a few times.

Bats

To capture bats we used mist nets of different lengths (6.9 x 2.6 m, 12 x 2.9 m). We sampled bats in terra firme forest, *Mauritia flexuosa* swamps (*aguajales*), and seasonally flooded forests, and in microhabitats including streams, treefall gaps, and fruiting trees. Before opening the nets at each site, we noted the habitat type, predominant vegetation, and current weather conditions. To capture bats in the subcanopy we used a pulley system to raise mist nets up to 15 m above the ground. We searched for bat roosts during the day, and installed nets at these sites when possible.

We typically opened the mist nets between 5:30 and 9 PM, noting the time the nets were opened and the time each individual bat was captured. We checked the nets constantly, and transferred captured bats in cloth bags to the campsite for identification. We identified bats using the keys in Pacheco and Solari (1997) and Tirira (1999). Once identified, the animals were released.

We calculated capture effort and success for each site with the number of nights, hours, and nets worked. We express capture effort in number of net-hours, calculated as the product of the number of nights, hours, and nets used at each site (Montenegro and Romero 1999).

RESULTS

We recorded 39 non-volant mammal species and 21 bat species, for a total of 60 species (see complete list in Appendix 6). Based on distribution maps for Peruvian mammals, we estimate at least 119 species for the region.

Non-volant mammals

Species recorded

The non-volant mammals registered in the inventory span ten orders, 19 families, 36 genera, and 39 species. In addition to the species listed in Appendix 6, we have indirect evidence of two other species, although we could not confirm their presence. In Yaguas we heard vocalizations of a nocturnal monkey which we suspect may be *Aotus vociferans*, based on the geographic distribution of this species. In addition, communities along the Apayacu River reported the recent capture of a manatee (*Trichechus inunguis*) in the lower part of the river, which they say is an infrequent occurrence. We did not include the manatee in our inventory list,

but highlight it here as an important point for the distribution and conservation of this vulnerable species.

There are 460 species of mammals reported for Peru (Pacheco et al. 1995) and 119 of these (25.8%) are likely found in the proposed Reserved Zone. Of these, 72 are non-volant, indicating that the 39 non-volant mammals we observed represent 54.2% of the mammals potentially present in this region of Peru. The 33 expected species that we did not record during the inventory are mostly small mammals, like rodents and marsupials, which are difficult to detect without a longer-term trapping effort. For medium and large mammals, almost all groups were well represented in our inventory. We observed ten of the 13 primate species expected, three of the four armadillos, and all four even-toed ungulates (Artiodactyla). Carnivores were the exception, as we recorded only seven of the 15 expected species. Nonetheless, the inventory registered a majority of the medium and large mammals predicted to occur within the proposed Reserved Zone.

Interesting records

Of all the species we observed, *Saguinus nigricollis* has the most restricted geographic distribution. In Peru, this small primate occurs only in the Putumayo-Amazon interfluvium (Aquino and Encarnación 1994). Its distribution is similarly narrow outside of Peru, including only neighboring areas in Ecuador, Colombia, and Brazil (Eisenberg and Redford 1999). Aquino and Encarnación (1994) distinguish two subspecies, *S. n. nigricollis* and *S. n. graellsi*. The former is more common, and, based on its reported geographic distribution, is the one we recorded in the proposed Reserved Zone.

We also observed *Saguinus fuscicollis*, a species previously unconfirmed in the area, according to Aquino and Encarnación (1994). This species occurs in Peru south of the Napo and Amazon rivers, and in Colombia north of the Putumayo River, where it has been reported from La Paya National Park (Polanco et al. 1999), but its distribution in the Napo-Amazon-Putumayo interfluvium remained a question mark. Interestingly, *S. fuscicollis* is much more abundant elsewhere in its range than it is here, where we found it significantly outnumbered by *S. nigricollis*.

Among the larger primates, we expected to encounter *Ateles belzebuth*, at least at the more remote and less impacted Yaguas site. However, we found no evidence of the species at any of the sites, suggesting that strong hunting pressure in the past may have caused local extinctions, or population declines, as reported by Aquino and Encarnación (1994) for other areas in Loreto.

We also documented a surprisingly low density of *Alouatta seniculus*, a widely distributed large primate that is generally abundant in forests with low hunting pressure. In the proposed Reserved Zone, we registered this species only infrequently, and mostly via vocalizations. Our only direct observation was at the Yaguas site, where we expected to find larger populations. It is possible that the two largest primates (*Ateles belzebuth* and *Alouatta seniculus*) suffered substantial hunting pressure in this area in the past.

In contrast to the surprising scarcity of large primates, we found substantial ungulate populations in the area, particularly near the Yaguas River (see below). This is especially noteworthy for tapirs (*Tapirus terrestris*), given their typically low population densities and propensity to disappear quickly from heavily hunted areas. The density of tapirs in the Yaguas site is probably the highest ever recorded anywhere. Tracks were very common, and our team made 11 direct observations in just two weeks. These direct observations include those of the inventory team and those of the team who built the campsite the week before our visit. We observed tapirs during the day and at night, on the trails, in the Yaguas River, and at a natural clay lick on its banks. At Yaguas we also encountered large groups (~ 500 individuals) of white-lipped peccaries (*Tayassu pecari*).

Species of special interest to conservation

In addition to the giant armadillo (*Priodontes maximus*) considered Endangered (EN) under IUCN criteria (IUCN 2002) several of the species observed during the rapid inventory are globally important conservation targets.

Saguinus nigricollis is not currently present in any Peruvian protected area, underscoring the need to establish a reserve between the Napo and Putumayo rivers (Aquino and Encarnación 1994). Apart from the species' precarious conservation status, its biology and ecology remain almost entirely unknown (Eisenberg and Redford 1999).

Large primates, including *Alouatta seniculus* and *Lagothrix lagothricha*, are hunted for food across the Peruvian Amazon, both for subsistence and commercially. Although not listed by the IUCN (2002), *Lagothrix lagothricha* is listed as a threatened mammal of Peru (Pacheco 2002). Both INRENA (until 1999) and Pacheco (2002) consider *L. lagothricha* an endangered species. Both *Lagothrix lagothricha* and *Alouatta seniculus* are considered Vulnerable in the most recent classification by INRENA (1999). The subspecies of woolly monkey present in the proposed Reserved Zone is *L. l. lagothricha*, distributed along the northern margin of the Napo River and not safeguarded in any of Peru's protected areas (Pacheco 2002).

Large carnivores typically have low population densities and, in some species, have been subjected to intense hunting pressure. This is the case for both jaguars (*Panthera onca*) and river otters (*Lontra longicaudis*), which are globally listed by the IUCN as Near Threatened (NT) and Vulnerable (VU) respectively. The river otter is considered in danger of extinction in Peru, and its current fragmented distribution reflects extensive hunting during 1960-66 (Pulido 1991, Pacheco 2002).

Tapirs (*Tapirus terrestris*) are more vulnerable to overhunting than are smaller species primarily because of their low reproductive rates, long intervals between generations, and longevity (Bodmer et al. 1997). Even under moderate hunting pressure, tapir populations can decline rapidly (Bodmer et al. 1993).

Comparison among inventory sites

We found the greatest number of non-volant mammals in the headwaters of the Yaguas River (30 species), followed by Maronal (28) and the headwaters of the Apayacu (26).

Relative abundances differed among sites for the majority of mammals. For the bulk of the terrestrial mammals and three primates, the greatest relative abundances were recorded at Yaguas (Table 3), including an unusually high abundance of tapirs (*Tapirus terrestris*). White-lipped peccaries were abundant in Yaguas as well, as evidenced by widespread tracks, and a group of approximately 450-500 individuals observed near a *Mauritia* swamp. Brocket deer (*Mazama* spp.), pacas (*Agouti paca*), woolly monkeys (*Lagothrix lagothricha*), squirrel monkeys (*Saimiri sciureus*), and tamarins (*Saguinus nigricollis*) were also more abundant at Yaguas than at the other sites. Yaguas was the only site where we saw tracks of giant anteaters (*Myrmecophaga tridactyla*) and coatimundis (*Nasua nasua*). Of the three inventory sites, Yaguas appears to be the best conserved.

Many of the species seen at the Yaguas site were also seen at Maronal, but often at slightly lower relative abundances. An exception was the greater evidence of jaguar (*Panthera onca*) at Maronal, including fresh tracks on several trails. Another typically rare species, the short-eared dog (*Atelocynus microtis*) was also recorded at Maronal. We found tracks, and one member of the team (D. Moskovits) saw an individual during the inventory. Members of the Bora community also saw an individual on two occasions at Maronal while opening the trails prior to the inventory.

The Apayacu site had not only the fewest mammal species, but also the lowest relative abundances for the majority of recorded mammals. The two armadillo species—the common *Dasypus novemcinctus*, and the giant armadillo *Priodontes maximus*—were an exception; their dens were similarly abundant at all three sites (Table 3).

Both in Maronal and Apayacu we found evidence of previous hunting, including old hunting camps and mammal skulls. In Maronal we found white-lipped peccary (*Tayassu pecari*) and paca (*Agouti paca*) skulls along the banks of the Supay Stream. In Apayacu we found woolly monkey (*Lagothrix lagothricha*) skulls. There is clearly greater pressure on

mammal communities along the Apayacu than at the other sites, as hunters from the communities downriver often hunt and fish in the area. Not only did the site exhibit lower abundances of mammals, but the mammals in Apayacu appeared more furtive and skittish than those at the other sites.

Table 3. Relative abundances of mammal tracks and sightings at the three study sites.

Species	**Local name**	**Relative abundance of tracks** (Number of tracks/km)		
		Yaguas	Maronal	Apayacu
Agouti paca	paca	0.522	0.235	0.156
Atelocynus microtis	short-eared dog		0.034	
Cabassous unicinctus	southern naked-tailed armadillo	0.080	0.101	
Dasyprocta fuliginosa	black agouti	0.040	0.067	0.117
Dasypus novemcinctus	nine-banded armadillo	0.843	1.006	0.938
Eira barbara	tayra	0.040	0.034	
Leopardus pardalis	ocelot	0.201		
Lontra longicaudis	southern river otter	0.067	0.078	
Mazama americana	red brocket deer	0.723	0.436	0.078
Mazama gouazoubira	grey brocket deer	0.161	0.034	
Myoprocta pratti	green agouchy	0.040	0.067	0.039
Myrmecophaga tridactyla	giant anteater	0.161		
Nasua nasua	South American coati	0.040		
Panthera onca	jaguar	0.080	0.101	
Pecari tajacu	collared peccary	1.566	0.268	0.156
Priodontes maximus	giant armadillo	0.361	0.302	0.313
Tapirus terrestris	lowland tapir	2.530	0.704	0.469
Tayassu pecari	white-lipped peccary	0.281	0.034	
Species	**Local name**	**Frequency of sightings** (Number of sightings/km)		
		Yaguas	Maronal	Apayacu
Cebus albifrons	white-fronted capuchin monkey	0.110	0.131	0.035
Lagothrix lagothricha	common woolly monkey	0.164	0.098	0.035
Pithecia monachus	monk saki monkey	0.055	0.098	0.070
Saguinus nigricollis	black-mantle tamarin	0.411	0.262	0.210
Saimiri sciureus	squirrel monkey	0.137	0.066	0.035

Bats

Species recorded

We captured 50 bats belonging to four families, five subfamilies, 11 genera, and 21 species (Appendix 6). Our list includes species captured nocturnally and diurnally, and species observed during the day but not captured, such as *Rhynchonycteris naso*, seen along the banks of the Yaguas and the Apayacu, roosting in branches of fallen trees. Bat species encountered during this inventory represent 13.8% of the 152 bat species reported for Peru (Pacheco et al. 1995).

Interesting records

During the rapid inventory we captured a small bat in the family Vespertilionidae and the genus *Myotis*, which does not resemble any of the known species within this genus, and could be a new species. A detailed revision of the captured individual and comparison with museum collections is necessary to confirm this as a new species.

We captured a large *Sturnira* with characteristics that match those of *Sturnira aratathomasi*, a species previously reported only from sites at higher altitudes. *S. aratathomasi* is a poorly known species, and there are few museum collections. It is known from Andean sites in Colombia (Peterson and Tamsitt 1968, Alberico et al. 2000) and Venezuela (Soriano and Molinari 1984), and collections exist from an unknown location in Ecuador (Soriano and Molinari 1987). The first report of this species from Peru is from the highlands of the department of Amazonas (McCarthy et al. 1991). It may be that this species has a broad distribution, and is not solely restricted to higher elevations. Unfortunately, we did not collect this specimen; we recommend that more exhaustive inventories be conducted in the region to confirm the presence of this species in lowland Peruvian forests.

Habitat preferences

A few species were encountered solely in a single habitat, such as *Phyllostomus elongatus*, captured solely in mature, closed-canopy forest; *Mesophylla macconnelli*, restricted to low-lying areas in the forest, such as abandoned stream beds; and *Trachops cirrhosus*, a species that feeds on frogs and prefers puddles, streams, and oxbow lakes.

We also recorded habitat generalists, such as *Carollia perspicillata* and *C. castanea*, which were captured in a variety of habitat types.

Along the Apayacu River we encountered *Tonatia silvicola* and *Phyllostomus hastatus* roosting together in a hollow termite nest less than 5 m off the ground, indicating that these species share roosting site and use shelters much closer to the ground than expected for such large species. Six of the nine species captured along the Apayacu River were feeding on fruits of a nearby *Ficus glabra* approximately 30 m tall. This observation highlights the importance of figs as a keystone frugivore resource, potentially sustaining various species during periods of scarcity like the one we observed during the inventory.

Species of special interest to conservation

Two of the bat species captured, *Artibeus obscurus* and *Sturnira aratathomasi*, are considered near threatened (LR/NT), according to the IUCN classification for Peru (Hutson et al. 2001). The classification of these two species reflects the poor understanding of their distribution within Peru, their unknown conservation status, and for *Sturnira aratathomasi*, the limited collections in museums and field inventories.

Site comparisons

At Yaguas our capture effort of 51.2 net-hours resulted in 21 bats in nine species. At Maronal, rain reduced our capture effort to 20.7 net-hours, and we captured ten bats in seven species. At Apayacu our 22.4 net-hours resulted in 20 bats in ten species.

We had the greatest capture success at the Apayacu site, with 0.83 individuals per net-hour, in contrast to the Maronal and Yaguas sites, with 0.48 and 0.41 individuals per net-hour respectively. Our greater capture success in Apayacu does not necessarily reflect a greater abundance of bats in this area; it is more likely due to one highly successful trapping location 15 m above the ground, close to a fruiting tree.

DISCUSSION

Non-volant mammals

Similarities and differences with other sites in the Peruvian Amazon

The diversity of non-volant mammals species is fairly typical for rapid inventories in the northern Peruvian Amazon. During the rapid inventory along the Yavarí River, 39 species of non-volant mammals were observed directly or indirectly, exactly the same as our inventory (Salovaara et al. 2003). The Yavarí inventory includes species encountered during other studies in additional sites, resulting in a longer list for the area.

The Yavarí and AAYMP inventories share 68.8% of their non-volant mammal species. Most of the species that are not shared are range-restricted primates. For example, *Saguinus nigricollis* and *Callicebus torquatus* are present in the headwaters of the Yaguas, Ampiyacu, and Apayacu, while *Cacajao calvus, Ateles paniscus, Saguinus mystax,* and *Aotus nancymae* are present along the Yavarí. These differences emphasize the importance of conserving both of these areas, because they protect different species assemblages.

The three areas sampled during this inventory share several species with neighboring areas in Colombia. *Saguinus nigricollis, Callicebus torquatus* and *Bassaricyon gabbii* are present to the east of the Yaguas River, in Amacayacu National Park in the Colombian Amazon (Bedoya 1999). Similarly, *Saguinus fuscicollis* and the majority of the other mammal species encountered during the inventory have also been recorded on the other side of the Putumayo, in Colombia's La Paya National Park (Polanco et al. 1999).

Similarities and differences among inventory sites

Although the three sites we inventoried shared close to 90% of their species, there were substantial differences in relative abundances. The abundant populations of game species at the Yaguas site almost certainly reflect the current absence of hunting and the undisturbed habitats at this site. *Mauritia* palm swamps, or *aguajales*, are particularly important to sustaining ungulate (tapirs, peccaries, deer) and large rodent populations (pacas and agoutis), as *Mauritia* fruits constitute such a large component of their diet. *Aguajales* were present at all three sites, but local peoples harvest the *aguaje* fruits during the fruiting period in the Maronal and Apayacu sites. In the more remote Yaguas site, human harvests of *aguaje* fruit are infrequent or non-existent, given that few people visit the area.

Another important habitat feature for ungulates, large rodents, and some primates are clay licks, or *colpas* (Montenegro 1998). In Yaguas we found several clay licks and saw a tapir visiting one of them. If clay licks exist in Maronal and Apayacu, they are likely hunted, as hunters tend to search for *colpas* (Puertas 1999). The lack of human interference with clay licks in the Yaguas area probably also contributes to the greater relative abundances of ungulates in the area.

In terms of conservation status, the Yaguas site appears much better preserved than the other two sites. Maronal is still relatively well conserved, and still has rare mammal species like jaguar and short-eared dog, but it suffers from past and ongoing human impacts, especially small-scale timber extraction. Apayacu shows clear impacts of hunting and resource extraction, especially in populations of medium and large mammals.

The most important conservation areas for mammals are the headwaters of the Yaguas River and Maronal. The less impacted Yaguas site is especially important for its unusually high abundance of tapirs and other ungulates and primates.

Bats

Similarities and differences with other Amazonian sites

With the possible exception of one unknown *Myotis* species which may be confirmed as a new species, all bat species registered during the inventory were previously known from Peru. As is typical of the Neotropics, Phyllostomatidae (leaf-nosed bats) dominate the list, accounting for 85% of captured species. Leaf-nosed bats play an important role structuring tropical forests through seed dispersal, and in some areas they disperse seeds of up to 24% of forest species (Humphrey and Bonaccorso 1979).

Bat habitat in the three sites is similar, both in the AAYMP region and in the recently surveyed

proposed Reserved Zone in the Yavarí River valley (Escobedo 2003). We encountered similar species richness at both sites, with 21 species in the AAYMP region, and 20 species in Yavarí. As expected in these preliminary inventories, we captured some species in the AAYMP region that were not encountered in Yavarí, and vice-versa. Polanco et al. (1999) report five families, five subfamilies, and 29 species—comparable numbers to our inventory—for the La Paya National Park in Colombia, to the north of the Putumayo River.

THREATS, OPPORTUNITIES, RECOMMENDATIONS

The principal threats to mammals in the areas we visited are excessive, unmanaged hunting (Figure 10B) and large-scale timber extraction. Hunting is now a minimal threat to mammals in the Yaguas area, but if not formally protected the area could experience more intense hunting pressure when other areas are depleted of mammals. Because people are absent from the Yaguas River with the exception of a community at its mouth, there is an enormous opportunity to preserve this important area without altering the current use of natural resources by communities in the region.

Areas with minimal human impacts, like the Yaguas headwaters, can serve as source populations to repopulate depleted mammal communities in adjacent, intensively hunted areas. The local initiative for protecting and conserving the AAYMP region represents a fantastic opportunity to establish wildlife management and sustainable hunting programs, which can lead to the recuperation of mammal populations in more heavily hunted areas (Figure 10A).

HUMAN COMMUNITIES

Authors: Hilary del Campo, Mario Pariona and Renzo Piana (in alphabetical order)

Conservation targets: Areas of forest considered sacred by indigenous communities, respected as sanctuaries for plants and animals; use of palms and other forest products for house construction, roofing, and handicrafts; use of fish stocks for food and commerce of ornamental fishes; reforestation with native timber species; soil-enrichment by rotation of crops; reforestation of secondary forest with native fruit trees

INTRODUCTION

This chapter presents results from field work carried out by the authors in August 2003 in 18 indigenous communities and towns involved in the proposal to create a Reserved Zone in the Apayacu, Ampiyacu, Algodón, Yaguas, and middle Putumayo river valleys.

Our goals in the field were several. We presented workshops with the goals of informing participants of the different categories of protected areas in Peru's park system, and giving voice to questions, worries, and ideas of community members with respect to the current proposal. We also documented the ways that local communities are currently managing and protecting their natural resources on their own, independent of the Peruvian government, and the factors these communities view as threats to their social, economic and environmental well-being. Based on these observations, we present recommendations for the zoning, categorization, planning, and management of the protected areas proposed for the region.

The consensus among the local communities is to create a mosaic of protected areas, in which reserves managed for the sustainable use of resources (e.g., several Communal Reserves) buffer a strictly protected region (e.g., a National Park). This mosaic represents a great opportunity for both human and non-human communities in the region, since the interest of the local indigenous population in a sustainable future for the area could translate into a long-term support for a conservation landscape.

METHODS

We conducted field work 3-21 August 2003 in 18 communities belonging to three indigenous federations: the Federation of the Yaguas Peoples on the Orosa and Apayacu Rivers (FEPYROA), the Federation of the Native Communities of the Ampiyacu River (FECONA) and the Federation of the Native Communities of the Putumayo River Border (FECONAFROPU).

To the north, along the Algodón and Putumayo rivers, we worked in seven communities belonging to the Yagua, Huitoto, Bora, Ocaina, Mayhuna and Quichua indigenous groups and the FECONAFROPU federation (see Figure 2).

To the southwest, along the Apayacu River, we visited four communities belonging to the Yagua and Cocama indigenous groups and forming part of the FEPYROA federation. To the southeast, along the Ampiyacu River, we worked in seven communities belonging to the Bora, Huitoto, Ocaina and Yagua indigenous groups, and including a few Resígaro families, and forming part of the FECONA federation (see Figure 2). Population size, territory size, and other summary information on communities in the vicinity of the proposed Reserved Zone are presented in Appendix 7.

In each of these communities, we made systematic observations and accompanied locals in communal activities to understand better the social landscape, the use of natural resources, and the local economic activities. We visited crop gardens and took part in the harvest of various products. These activities opened a window on daily routines and practices supportive of the conservation and management of a protected area.

We conducted two day-long workshops. The first, focused on communities of the FEPYROA federation (the Apayacu basin), took place on 5 August in the indigenous community of Yanayacu with 43 people in attendance. The second, focused on communities of the FECONAFROPU federation in the middle Putumayo, took place in San Antonio de Estrecho on 12 August with 59 people in attendance. Because the original proposal for the creation of a Reserva Comunal largely originated from FECONA, and that federation's leaders and members were well-informed about the proposal to create a Reserved Zone, we did not conduct a workshop in the Ampiyacu basin. Instead, we carried out other activities with community members and leaders.

We designed the workshops specifically to discuss the advantages and disadvantages of the possible creation of a Reserved Zone in the region, and to explain INRENA's reaction to the first proposal to create a Reserva Comunal (ORAI et al. 2001). Before and after the workshops, we continued these conversations at a community level via interviews with focal groups and via informal conversations with community members, traditional leaders, and community leaders.

We also carried out semi-structured interviews with local authorities—like mayors and INRENA officials—in the towns of Pebas and Estrecho, and with locals and leaders of the indigenous federations and of the regional indigenous organization ORAI (Organización Regional AIDESEP Iquitos).

Throughout our time in the field, we tried to keep a balance between male and female informants, although this was more difficult in the focal groups and workshops, where the majority of leaders were men. Other participative activities were mostly led by women.

RESULTS AND DISCUSSION

Local practices beneficial for conservation

Sacred places

Local indigenous groups recognize certain sacred or mythic places, locally known as *sachamamas*, as sanctuaries where plants and animals reproduce. Local inhabitants treat these places with great respect and generally keep them off-limits, because they are believed to have magic powers and to be protected by the fathers and mothers of the forest and its animals. Locals tell many stories about the *sachamamas*. Often these stories tell of hunters or travelers who have heard strange noises, felt the ground and forest tremble, experienced peculiar weather, gotten lost, or otherwise experienced the powers of the spirits who protect these places. The map in Figure 3 shows the location of *sachamamas* in the region (ORAI et al. 2001).

The existence of these sacred places reflects cultural values that are interwoven with nature and that prevent the abuse of natural resources. These beliefs establish a solid foundation of respect for the regulations involved in the creation and management of a protected area. Building on these beliefs, myths, and local traditions linked to the management of natural resources will help establish the fair and participative local conservation practices crucial for the well-being of a future protected area.

Management of chambira and irapay

Chambira (*Astrocaryum chambira*) is a large palm whose young leaves are the source of fibers used for various woven handicrafts (hammocks, bags, others). In some communities in the Ampiyacu basin, inhabitants manage the species (mostly in secondary forest) by harvesting only the terminal portion of the palm frond. Locals also transplant seedlings found in the forest to their crop gardens, for harvesting when they reach maturity. These traditional practices permit the conservation and sustainable use of a plant resource that is economically important for local communities (but see Smith and Wray 1996).

Irapay (*Lepidocaryum tenue*) is a small palm whose leaves are used to build roofs in indigenous communities. The leaves are valuable locally and regionally and the roof panels (*crisnejas*) are sold in Iquitos and Pebas. Communities on the Ampiyacu and Yaguasyacu rivers harvest the leaves in a way that permits quick regrowth of the harvested plants. This practice reflects an ancestral knowledge of the resource, and maintains both natural *irapay* populations and their revenue.

Local fishing practices

Fisheries in the three watersheds we studied are of great importance for the health and diet of the indigenous and *ribereño* populations in the region. Communities have organized themselves to prevent freezer-boats from fishing the lakes and rivers in their territories. The goal is to prevent the large-scale extraction of commercially important fish, like *paiche* (*Arapaima gigas*), *arahuana* (*Osteoglossum bicirrhosum*, Figure 6B), *boquichico* (*Prochilodus nigricans*), *gamitana* (*Colossoma macropomun*), *palometa* (*Mylossoma duriventris*), *sábalo* (*Brycon* spp.) and large catfish (Pimelodidae). In this way, locals manage their fisheries for food and commerce. However, the Regional Coordinator of Production (formerly DIREPE) still grants outside fishermen permits to fish in indigenous territories, since by law bodies of water inside communities are open resources, and this causes conflicts.

Reforestation and soil restoration

Communities in the Ampiyacu basin are actively reforesting with economically valuable timber species (principally tropical cedar, *Cedrela* spp.) both by managing natural regeneration under seed trees and by taking advantage of the seedlings produced by INRENA's greenhouse in Pebas. These experiences represent a foundation that future reforestation programs can build on, for the well-being of the forest and local inhabitants.

In the communities of the Ampiyacu, Apayacu, and Putumayo, locals plant native fruit trees like *Inga* (locally known as *shimbillo* or *guava*) and other trees (*caimito, uvilla, pijuayo, umarí*, etc.) to enrich soils in their crop gardens. *Inga* trees produce edible fruits and firewood, as well as fixing nitrogen, while the other species produce edible, commercially valuable fruits. Non-native fruit trees are also planted in crop gardens and secondary forest. These practices demonstrate an interest in maintaining crop diversity and in using soil, plant, and animal resources in a sustainable way.

Results of the workshops

The workshops were participative and interactive. They opened with a review of the territory used by native communities between the Putumayo, Ampiyacu and Apayacu rivers (see "Protecting the Headwaters: An Indigenous Peoples' Initiative for Biodiversity Conservation" and Figure 3; ORAI et al. 2001), to orient participants in the landscape of the proposed Reserved Zone. Next, we described the various categories of protected areas in Peru's park system, the

role INRENA plays in managing them, and various legal aspects of protected areas. We paid special attention to the distinctions between different categories of protected areas, regarding the extent to which it was possible to use natural resources inside each category, and spent the most time discussing the category of Communal Reserve.

In discussing threats to the area, participants described the various challenges to their well-being which could affect their participation in the management of the Reserved Zone and the eventual creation of one or more Communal Reserves. Next, participants proposed actions they could take against these threats. This part of the workshop was directed in such a way that it evolved into a discussion of the proposed creation of the Reserved Zone and local capacity for managing it.

Next we explained INRENA's reaction to the original proposal of ORAI et al. (2001). We noted INRENA's continued interest in preserving the area, which it considers a high priority for conservation and for the surrounding communities' use. We also explained the role of the Field Museum and the rapid biological inventory, describing each step of the field work and the presentation of the results. We listed the steps that remained to complete a technical proposal (*expediente técnico*) that includes more extensive biological and social information than the previous proposal. Finally, we discussed the process of land-use zoning and the possibility of meeting again in the future with native communities.

In the Yanayacu workshop, Miguel Manihuari, vice president of ORAI, described the support that the regional indigenous organization provides native communities at the regional level, as well as the work done by its national (AIDESEP) and international (COICA) counterparts. Benjamín Rodríguez Grandes, president of ORAI, gave a similar presentation at the San Antonio de Estrecho workshop.

The data gathered during the workshop indicate that the federations and communities share, for the most part, a common vision of the future. Following the mapping exercise and the discussion of INRENA's reaction to the 2001 proposal (ORAI et al. 2001), the participants expressed a shared interest in managing a mosaic of protected areas that would complement areas of sustainable use with areas of stricter protection. Both in the workshops and in the visits to the communities, people suggested that the communal reserves could be managed by the individual federations, while the strictly protected area would benefit all of the surrounding communities. During the workshops, we noticed several conversations among the participants in which they noted that a strictly protected area would serve as a source area for animal reproduction and seed production for the communal reserves and indigenous communities.

The three federations affirm that their working relationship is strong, that they share a common vision for the future, and that they remain committed to working with the Peruvian government to improve the use, management and conservation of resources in these basins.

Threats

The communities of all three federations face many of the same threats, and share the same concerns about the problems that could result if a Reserved Zone is not declared. These threats include the incursion of outsiders to hunt, fish, or extract resources in indigenous territories; the erosion of indigenous culture; the lack of economic opportunities; the scarcity of fish and game; and the lack of social justice. Members of the FECONAFROPU federation complained about the lack of basic health and educational services in their communities, and discrimination against indigenous communities by government authorities, especially the *municipalidad*, military authorities, and INRENA.

Extraction of resources by outsiders

In both workshops and in the visits to the communities, locals agreed that a central threat to their well-being are incursions by outsiders into their communal territory, into adjacent areas, and into nearby open-access areas. In general, these are fishermen, loggers, and hunters from towns near Iquitos (in the southern communities) or Colombia (in the northern communities), who use freezer-boats to extract large quantities of fish, or who extract timber in cooperation with communities via a patronage

system. Community members explained that incursions into neighboring areas are just as big a threat as incursions into titled community lands, because the space communities use to hunt, fish, extract other natural resources, protected sacred lands, and strengthen ties between families and communities is much larger than their titled lands.

Timber extraction

Logging by outsiders is considered a critical threat, because small-scale logging is one of the most important sources of income for the area's indigenous communities. Under current laws, commercial logging is prohibited in the region. Unfortunately, government authorities do not distinguish between the limited amount of wood that a community member extracts for subsistence use and the dozens of trunks that outsiders extract. This has a variety of effects. On the one hand, community members are forced to work illegally, because they have no other valuable resources to sell to pay for healthcare and education. On the other hand, recognizing their inability to extract timber from their community territories, local leaders arrange deals with *patrones* and *habilitadores*, who then take responsibility for selling the wood. Most of the time, a community benefits little from these deals. In forests along the Putumayo River, illegal logging is carried out by Colombian loggers who falsify logging permits, transport the wood secretly to the Colombian side of the Putumayo, and threaten community members who complain to the authorities about their activities.

Logging concessions are considered an obstacle by the indigenous population, because they impede their access to forest resources, break family links between indigenous groups, and alter and destroy sacred or mythic places. Until very recently, a large part of the proposed Reserved Zone was classified by the Peruvian government as working forest and was to be publicly auctioned as part of the new forestry regulations. Unfortunately, this process is very complicated for indigenous communities, who rarely bid for concessions because they lack the technical assistance and money required to participate in the auctions. Without outside assistance, native communities are unlikely to be granted the commercial extraction rights to forestry concessions. Owing to the complexity of the paperwork, forestry concessions are generally awarded to outside loggers. Concession owners acquire the exclusive rights to extract timber from the area and will prohibit access to the land by others. If this process continues, communities will be shut off from the areas where they currently extract resources for subsistence.

Chronic instability on the Colombian border

The political violence that plagues the Putumayo basin prompts migration of outsiders and affects the daily life of local communities. The activities of the Colombian guerrilla group FARC (the Colombian Revolutionary Army) inside Colombia send waves of displaced people across the Putumayo to Peruvian territory, where they settle temporarily in lands that belong to indigenous communities of the FECONAFROPU federation. Community members state that the constant influx of migrants and migrant presence in their communities constitute threats to their daily life and traditions, since migrants do not often join in community life and bring with them customs that affect everyone, like alcohol abuse, overfishing, and overhunting.

Limited government services

Communities state that the local governments do not take indigenous organizations into account in their development plans. Government authorities, whether at the national or municipal level, and in a variety of different offices, are perceived to consider native communities and their organizations incapable of managing their lands and the use of natural resources on their own. Communities complain that government officials often make decisions about the administration of their territories without consulting indigenous organizations. This causes problems, because the government's point of view regarding territory and resource use does not always agree with the indigenous point of view.

For example, government officials are not aware that the establishment of forestry concessions in the Ampiyacu, Apayacu and Algodón would restrict the access of indigenous communities to resources

and lands they have used for decades. Indigenous communities are fiercely opposed to concessions, and have instead proposed establishing one or more Communal Reserves. However, the municipal authorities in Pebas district argue that the creation of a Reserved Zone for the indigenous population of the district (approximately 1,500 people) would reduce their authority regarding land use and put an end to all possibilities for development.

The one exception to these conflicts occurs in the political campaign season, when communal organizations, which control a large number of votes, are courted by candidates to local and national office, and promises of infrastructure, gifts, and parties are widespread. When the elections are finished, however, indigenous communities are once again marginalized.

Large-scale migration in response to inequalities in educational and healthcare opportunities

Many of the communities we visited had little infrastructure for education and healthcare. Clinics without medicine were common as were schools without teachers, because the number of students is often too low for the Ministry of Education to justify sending a teacher. Many community members with small children are forced to abandon their communities during the school year (nine months of the year) so that their children can attend school in a larger community. A similar phenomenon is seen in older people, who leave their communities and move to larger towns in search of medical services provided by the government. In the long term, this migration leads to the depopulation of entire communities. Young people who grow up in the city have no interest in returning to their villages, and older people no longer keep the communities' traditions and cannot pass them down to the next generations.

RECOMMENDATIONS

Protection and management

- **Strengthen the federations institutionally and provide training to leaders of indigenous organizations.**

  One problem is that the term for leaders is short; new leaders are typically elected every two years. (In practice, terms are often shorter, because leaders who do a poor job are quickly replaced, and political rivalries within the organizations are commonplace.) Training leaders is part of the solution, since better-prepared leaders will remain in office long enough to implement projects and put their training into practice. Communities must also be educated about the importance of electing well-trained leaders, and reworking community rules and federation statutes so that they encourage longer working terms for elected leaders.

- **Develop alternatives that provide economic benefits for indigenous communities that extract forest products.**

  The Peruvian government requires that indigenous communities file management plans before they can legally sell natural resources. Similarly, logging permits are required before communities can cut trees for subsistence (i.e., house-building) inside or outside their territories. Although these requirements are part of a broader government effort to promote the sustainable use of natural resources, their effect among indigenous communities is precisely the opposite. Indigenous communities possess the technical skills but lack the economic resources to present a natural resource management plan, which is a long, costly and complicated process. As a result, communities make agreements with outside loggers to extract forest products in exchange for a small profit. It is important that the government recognize that indigenous communities are allies of their efforts to protect and manage natural resources, and simplify the application process for those indigenous communities interested in implementing management plans.

- **Enlarge the communal territories of communities that request it within the Reserved Zone, to improve local living conditions and create a buffer zone for the conservation area.**

  Many of the communities we visited, especially those in the Ampiyacu watershed, have very small legal territories and growing populations, which will soon limit their access to natural resources. These communities have proposed that once the Reserved Zone is created and is being zoned, communities that urgently need more territory be granted it. If expanding current territories is not an option, new territories or annexes should be considered. This will help reduce the communities' impact on the resources inside the future protected areas and will strengthen their buffer zones.

- **Establish zones for hunting, fishing, and gathering forest products.**

  Zoning of future protected areas should take into consideration local communities' use of resources outside of their communal territories (see Figure 3; ORAI et al. 2001). We recommend that during the zoning process, one or more Communal Reserves are considered, so that communities can continue to use the places they use at present to extract forest products, especially non-timber forest products.

Research

- **Undertake biological and socioeconomic studies of the use of forest products.**

  It is important to identify the natural resources that can be harvested profitably and sustainably by local communities, since their extraction of these resources from Communal Reserves will require management plans approved by government agencies. Management plans should take advantage of local practices that communities have developed from long experience. Local residents, and especially indigenous residents, have developed techniques to manage natural resources based on the biology of the target species and these techniques are generally well known in the local population.

History of the Area and Previous Work in the Region

PROTECTING THE HEADWATERS: AN INDIGENOUS PEOPLES' INITIATIVE FOR BIODIVERSITY CONSERVATION

Authors: Richard Chase Smith, Margarita Benavides and Mario Pariona

INTRODUCTION

In May 2001, 26 native communities represented by one regional and three local community associations presented a petition to the Peruvian Natural Resources Institute (INRENA) to create a Communal Reserve in an area of the department of Loreto considered to be part of their traditional territory (ORAI et al. 2001). The 1.11 million-ha area lies between the Apayacu and Ampiyacu rivers to the south and the Algodón and Putumayo rivers to the north (see Figure 2).

In this chapter, we take a look at the actors and processes that led up to this petition. In the first section, we offer some quantitative data on the communities and their associations. In the second section, we look at the economic history of the area and the conditions that gave rise to their concern for conserving their territory and the biodiversity it contains. In the third section, we describe the participatory research and mapping process that the Instituto del Bien Común carried out with the community associations to document the area that the indigenous population uses for extractive activities beyond their titled lands. In the final section, we describe the recent actions taken by the community associations to protect the headwaters of their rivers.

THE COMMUNITIES AND PEOPLES IN BRIEF

Along the Ampiyacu River, a small tributary of the Amazon near the Peru-Brazil border, there are 14 communities of the Huitoto, Bora, Yagua, and Ocaina peoples. They are all members of the Federation of Native Communities of the Ampiyacu (FECONA), created in the early 1980s. As of 1997, there were 356 families living in these communities, with a total population of 1,708. The 14 communities have a total of 40,151.5 ha demarcated for their use, of which 28,722 ha or 72% is legally titled. This gives an average area of 23.5 ha/person demarcated for their legal use in both subsistence and commercial activities.

Along the Apayacu River, also a small tributary of the Amazon located just upriver from the mouth of the Ampiyacu, there are three communities of the Yagua people. They are members of the Federation of Yagua People of the Oroza and Apayacu Rivers (FEPYROA). As of 1998, these three communities consisted of 76 families and 373 persons. They have a total of 13,281.5 ha demarcated for their use, of which 11,211.60 ha or 84% is legally titled. This gives an average area of 35.6 ha/person demarcated for their legal use.

To the north, along the Putumayo River, which forms the border between Peru and Colombia, there are eight communities made up of Huitoto, Bora, Quichua, Yagua, Cocama, and Ocaina peoples. In the headwaters of the Algodón River, a tributary of the Putumayo River, there is a single Mayjuna community, and at the juncture of the Yaguas and Putumayo rivers there are two communities of Yagua and Ticuna peoples. They are members of the Federation of Frontier Communities of the Putumayo (FECONAFROPU). As of 1998, there were 131 families in these 11 communities with a total population of 764 persons. They have a total of 116,499 ha demarcated for their use, of which 71,660 ha or 61.5% is legally titled. This gives an average area of 152.50 ha/person demarcated for their legal use.

AN ECONOMIC HISTORY OF THE AREA

The recent history of the indigenous peoples in all of these communities is similar. The entire region was heavily affected by the extraction of rubber, especially during the peak years of the boom era (1890-1915), and our area of interest lay within the enormous Putumayo estates of the infamous Julio C. Arana and his Amazon Rubber Company. Hardenburg's (1912) account of the extreme cruelties and exploitation of the native peoples and the confirmation by the British Casement Commission gave public exposure to this situation. Virtually all of the native peoples had been locked into supplying raw rubber to Arana's company through the system of debt peonage linked to company stores.

The collapse of both the rubber boom and the Amazon Rubber Company were important factors that brought about a border war between Peru and Colombia during the end of the 1920s and beginning of the 1930s. In 1937, in an attempt to escape from the conflict, a Peruvian *patrón*, a former boss for the Amazon Rubber Company, moved a large group of "his" Huitoto, Bora and Ocaina Indian workers out of the Caquetá River of Colombia and into the Ampiyacu basin. For the next two decades they gathered forest products—rubber, animal skins, rosewood, resins and others—for their *patrón*, paying off the perpetual debt which they accrued at the company store. When their *patrón* abandoned the area in 1958 because of the diminished world demand for Amazonian products, the Indians had ambivalent feelings about his departure; they gained their freedom from a system of debt peonage, but they lost what they now remember as a secure source of market goods.

For the next 25 years, they tried many different activities to regain access to those coveted goods. They exchanged the traditional forest products at a great disadvantage with the river traders who began entering the Ampiyacu basin after the *patrón* had left. During the 1970s, they attempted to raise cattle, imitating a small ranch established by an American missionary on a tributary of the Ampiyacu.

During the mid-1980s, they experienced an economic boom. They sold coca leaf to the Colombian cartel for several years until the police pushed the cartel further south into Peru. A growing tourist trade was brought into the lower villages several times a week by a tour operator to buy handicrafts and to pay for the privilege of seeing traditional dancing. A crafts marketing project, promoted by a Lima-based outlet and implemented by FECONA, encouraged the production and sale of hammocks and shoulder bags made from the fibers of the *chambira* palm. However, a 1992 evaluation of this project concluded that: "The project should not be reactivated because the raw material (*chambira*) is being used up without any thought as to its conservation. There is no attempt to manage this species so that [its reproduction] keeps up with the level of exploitation; for that reason it tends to disappear" (Smith and Wray 1996).

In the second half of that decade, the Peruvian government established a branch of the Agrarian Bank in nearby Pebas to encourage the production of jute for a government-owned sack factory on the coast. The Agrarian Bank gave out credit to plant jute and bought up all the production at subsidized prices. The acreage planted in jute along the Ampiyacu, as indeed along other Amazonian tributaries, increased dramatically between 1985 and 1990.

The austerity measures introduced by the Fujimori government in 1990 led to the closing of both the sack factory and the Agrarian Bank. An entire crop of jute rotted. At the same time, the cholera epidemic and the increase of subversive activities reduced the flow of tourists to a trickle; unsold handicrafts piled up in the village. It was economic hard times again.

Two trends marked the local economy during the 1990s. On the one hand, the only regional market that had expanded was that for game meat. With the other alternatives gone, the men rushed to the forest to hunt whatever animal they could find; the choicest meat was sold to intermediaries for the regional market. The high price paid made the effort worthwhile, but the game disappeared quickly. Pushed to recognize what was happening, many of the community members of the Ampiyacu admitted that they were over-hunting game stock in their area, violating their own traditional norms against taking more than they need for subsistence. And yet, fully aware of the consequences of their own actions, they continued to both lament the disappearance of wildlife species and hunt them to extinction.

On the other hand, the over-exploitation of forest resources around Iquitos forced many extractors to look for more isolated areas where fish, timber and palm hearts, among other products, were still abundant. There was a marked increase during the decade in the number of individuals and companies who illegally extracted these resources from the forests and waters of the Ampiyacu and Apayacu basins. With the new Forestry Law passed in 2001, the regional timber industry increased its efforts to fell and remove valuable timber species in this region before the old concessions were annulled and the new requirements for forest management plans were put in place. The community associations have not been very effective in controlling these illegal activities.

The 1992 study of the indigenous Amazonian economy showed that the increased desire for market goods coupled with the market's fluctuating demand for certain Amazonian products produced a series of profound changes in indigenous Amazonian societies (Smith and Wray 1996). Several of these changes, e.g., the increased rate of extraction and production for the market and the combination of reduced mobility and larger, more permanent settlements, have put enormous pressure on the natural resource base of most indigenous Amazonian communities. The case of the *chambira* palm, wild game animals, and today, valuable timber species, demonstrate clearly the urgency of implementing new models of production, extraction and conservation in the Amazon. Developing an economy which is both cash producing and ecologically viable is one of the greatest challenges now facing both the local indigenous Amazonian communities and the global market economy.

PROTECTING THE HEADWATERS THROUGH RESOURCE-USE MAPPING

The communities of the Ampiyacu were among the first in Loreto to receive land titles after the 1974 Native Communities Law. However, the average size of the parcels titled was quite small and clearly covered only a small portion of the forest and river areas used by the local population for subsistence and market activities. Community members expressed on many occasions their urgent interest to protect the natural resources in a larger area around their communities from outside poachers. Although their community association, FECONA, had, with some early success, established control over the river access to their territory, there existed many other points of clandestine entry through the forest that were being used to extract resources.

The situation became desperate in 1999 for two reasons. As a result of the peace accord signed between Peru and Ecuador, the Peruvian government

ceded property rights to the Ecuadorian government for a parcel of land near the mouth of the Ampiyacu River, as a center for Ecuadorian commercial activities on the Amazon River. At the same time, information leaked out to community leaders that a Korean company had presented a formal request to the Peruvian government for a 250,000-ha concession for developing an industrial complex based on forest and possibly mineral products. The requested concession was located in a heavily forested region between the Ampiyacu and Putumayo Rivers, precisely in the area used by the indigenous populations of both rivers.

The Instituto del Bien Común (IBC) proposed working with the three community associations of this area and with ORAI (Regional Organization of AIDESEP in Iquitos) to protect the natural resources and the biodiversity in the headwaters of the Ampiyacu, Apayacu and Algodón Rivers from encroachment. After discussion of the proposal in community assemblies, an agreement was signed among IBC, ORAI, and the three indigenous organizations (FECONA, FEPYROA and FECONAFROPU) to carry out the work.

The strategy for protecting the headwaters was to work with INRENA and with community participation to create a Communal Reserve in that area. Given the Peruvian government's reluctance to title large indigenous territories, the Communal Reserve offers the only other alternative to the native communities to protect the areas they rely on beyond their community boundaries. More than a decade and a half after establishing the legal concept in the 1978 Forestry Law, the Communal Reserve was incorporated into the national park system (SINANPE) under the administration of the Ministry of Agriculture (INRENA). This change offered stronger protection for the communal reserves and their resources, but it weakened indigenous control over the same.

The IBC mapping team proposed a joint effort to establish in a rigorous way how much land area the communities were actually using so that their proposal for a Communal Reserve would accurately reflect actual resource use patterns. First, community boundaries would be georeferenced and plotted onto an officially recognized digital base map; and second, points where specific resources were extracted would be geo-referenced and plotted over the base map. The methodology for carrying out both steps was developed at IBC, based on fieldwork in other areas of the Peruvian Amazon, plus exchange with other community mapping efforts around the world (Brown et al. 1995, Chapin and Threlkeld 2001, Eghenter 2000, Poole 1998, Saragoussi et al. 1999).

Prior to fieldwork for the resource use mapping, the IBC mapping team generated a georeferenced base map of the entire region that included the community boundaries and other geographical features. A satellite image of the same area and at the same scale was printed with a transparent overlay as an aid in identifying features not on the base map and in orienting community members. The mapping team then worked with leaders from the three associations and the 26 communities during two periods of fieldwork. During the first period of eight weeks, the team worked with members of each community to identify the areas where they fish, hunt and gather a variety of forest resources. Natural resources important for both subsistence and market use were taken into consideration. Points of cultural significance were also marked. In many cases small streams and other features not found on the base map were added. All of this information was discussed and agreed upon by the participating community members. A different overlay was used in each community, resulting at the end of this period of fieldwork in 26 individual community resource use maps.

Back in the laboratory, GIS specialists used a digitizing table to register the information from the community maps into the GIS system and to build a composite map combining all the resource use sites from the 26 community maps. Not surprisingly, there was an enormous amount of overlap, demonstrating that different communities used large areas in common without apparent discrimination or conflict.

This draft composite map was then taken back to the communities for verification. This was carried out in two ways. The team revisited some of the communities asking the leaders and members to verify the points of

resource use, cultural significance and new geographical features now on the printed composite map. The mapping team then trained three leaders from the Ampiyacu communities to use hand-held GPS units. This group spent three weeks traveling into the headwaters of the Yaguasyacu River to record coordinates for actual hunting and gathering sites found there; a second group carried out the same ground-truthing process in the headwaters of the Apayacu River. The importance of this sort of ground-truthing is demonstrated by a recent study which found an average 11.70% error in a sample of 144 GPS points verifying the participatory resource use mapping methodology for 15 domestic units in Brazil's Jau National Park (Pedreira Pereira de Sá 2000).

A corrected composite map was then generated and used, along with the satellite image, to define the boundaries for the proposed Communal Reserve in such a way that all the areas used by the communities would be included. In most cases, either the watershed divide or a river was proposed as a boundary for the Communal Reserve; the total area included within this proposed reserve is 1,111,000 ha.

Indigenous leaders of ORAI and the three indigenous associations reviewed the final map and the proposal. The initiative of the creation of the Communal Reserve was also presented and discussed with the municipalities of Pebas and Estrecho and the local offices of the Ministry of Agriculture.

PROPOSAL FOR PROTECTING THE HEADWATERS

Based on the results of the 2003 rapid biological inventory presented in this publication, the community associations have updated their proposal. They are now requesting the creation of a 1.89 million-ha Reserved Zone covering the upper watersheds of the Apayacu, Ampiyacu, and Algodón rivers, plus the entire watershed of the Yaguas River. A Reserved Zone is a transitional status that protects an area while further studies are carried out as the basis for establishing the definitive status for the protected areas to be created. The communities are discussing a proposal to create a mosaic of three different kinds of land use categories: strictly protected areas, areas for managed use, and areas for expanding community-held lands. The proposed Reserved Zone shares borders with 28 native communities and has another ten native communities in its area of influence. This proposal is among a growing number of natural protected areas proposed by indigenous peoples in the Peruvian Amazon.

THE SOCIAL LANDSCAPE: ORGANIZATIONS AND INSTITUTIONS IN THE VICINITY OF THE PROPOSED RESERVED ZONE

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INTRODUCTION

The proposed Reserved Zone in the Ampiyacu, Apayacu, Yaguas and Medio Putumayo watersheds is an epicenter of biological, cultural, and ethnic diversity. These three factors have been interrelated for centuries, because indigenous populations have long used the natural resources in these forests, rivers and lakes for food, medicine, construction, and a host of other activities. Today, indigenous communities' growing need for market goods and the growing market for forest products have spurred non-traditional commercial uses, like selling wildlife meat, fish, wood, and handicrafts to towns and cities in the region (Chirif et al. 1991).

Several studies of the socioeconomic, anthropological and biological aspects of the region have been published (see Benavides et al. 1993, 1996; Denevan et al. 1986, Smith 1996, ORAI et al. 2001, IBC 2003). However, there is still very little information on the working mechanisms of the social organizations within indigenous communities and the federations that represent them. This makes it difficult to build good working alliances between the state, non-governmental organizations, and the indigenous communities that can support the proposed Reserved Zone and work together towards social development and a sustainable economy in the region.

In this chapter we briefly describe the several institutions and social organizations that exist in the neighborhood of the proposed Reserved Zone, with which local residents organize their daily life and manage their territories. We also explain the roles, activities, and responsibilities of councils and traditional leaders, both according to ancestral norms and by law. Throughout, we focus on organizational strengths and potential that can help in the establishment and management of a new protected area in the region.

STUDY AREA

The proposed Reserved Zone includes three districts of the department of Loreto: Pebas, Amazonas and Putumayo. These are administrated from the town of Pebas, at the mouth of the Ampiyacu River; the town of San Francisco de Orellana, at the mouth of the Napo River; and the town of San Antonio de Estrecho, on the southern bank of the Putumayo River, respectively. The three districts are home to roughly 34,000 people and have a population density of 0.57 people/km^2 (Bardales 1999). Amazonas is the largest district, with a population of 13,358. The three towns are governed by democratically elected mayors and their *regidores*.

There are also several smaller towns and communities settled by non-indigenous, or *ribereño*, villagers. These villages, which were generally established by *patrones* or colonists, are today governed by the Lieutenant Governor (Teniente Gobernador) and the Municipal Agent (Agente Municipal).

In addition to these towns, there are 28 indigenous communities surrounding the proposed Reserved Zone, mostly along the banks of the major rivers. The 14 communities on the Ampiyacu and Yaguasyacu rivers are inhabited by a mix of ethnic groups, including Huitoto, Bora, Ocaina and Yagua peoples. The three communities on the Apayacu River have traditionally been Yagua villages, but one of them (Cuzco) is now governed by Cocama families and *ribereños*. In the Medio Putumayo, the communities belong to the Huitoto, Ocaina, Yagua and Quichua ethnic groups. On the southern bank of the Algodón River, the community of San Pablo de Totolla is inhabited by the Mayjuna people. Finally, the three indigenous communities at the mouth of the Yaguas River are mostly populated by Yagua families (see Appendix 7).

SOCIAL ORGANIZATION

Indigenous federations

Native communities in the region began organizing into indigenous federations in the 1980s, prompted by the search for social equality and the need to solve territorial problems, like the lack of land, the lack of land titles, and incursions by outside hunters and fishermen. Indigenous federations represent an organizational base for the management of the proposed Reserved Zone, since their mandate is to defend traditional rights, promote local development through the use and conservation of natural resources, and raise funds to improve the quality of life in the communities they represent. Three indigenous communities are active in the region:

FECONA, the Federation of Native Communities on the Ampiyacu

This federation, founded in 1988, is based in the Bora community of Pucaurquillo, on the eastern bank of the Ampiyacu River, close to the town of Pebas. FECONA represents 13 indigenous communities in the Ampiyacu watershed, many of them bordering the proposed Reserved Zone. The federation is headed by six leaders who serve two-year terms. FECONA has a radio which it uses to maintain communication between its communities.

FEPYROA, the Federation of Yagua Communities on the Orosa and Apayacu

This federation was founded in 1996 and is based in the community of Comandancia, on the eastern bank of the Orosa River. FEPYROA represents 17 communities on the banks of the Orosa, Apayacu and lower Napo. Only the communities on the Apayacu border the proposed Reserved Zone. This federation is also directed by six leaders who serve for two years, and has a radio in the town of Apayacu.

FECONAFROPU, the Federation of Borderland Native Communities on the Putumayo River

This federation was founded in 1996 and is based in the town of San Antonio de Estrecho, on the southern banks of the Putumayo River. FECONAFROPU represents 44 communities along the Putumayo and one on the Algodón. Only the communities on the middle Putumayo, as well as two communities at the mouth of the Yaguas River and the community of San Pablo de Totolla border the proposed Reserved Zone. This federation is also headed by six leaders with two-year terms.

Although these indigenous communities have strong local roots, they also rely on an international community that supports indigenous groups, indigenous rights, and indigenous participation in civil society. The indigenous federations are affiliated with the regional organization ORAI, which in turn is affiliated with the national organization AIDESEP and the international organization COICA. They have also formed alliances with international groups like the Amazon Alliance.

Indigenous federations have overcome some initial difficulties related to the management of funds for development projects. These projects, which for the most part did not originate in the communities themselves but were designed to address supposed needs of the communities, were unsuccessful because they were incompatible with indigenous culture. In this early period the federations also failed to cultivate strong relationships and effective dialogue with the national government.

Despite these challenges, the federations are beginning to operate more efficiently, and continue to defend indigenous territorial rights and indigenous access to natural resources through a balanced, autonomous process. FECONA worked with INRENA and the Ministry of Production to monitor the extraction of forest products from the Ampiyacu watershed. This alliance allowed the federation to monitor more strictly the volume of products requested from the communities, promote the responsible use of extractive areas, and facilitated the distribution of payments from the sale of products. It also provided the federation with some funds for day-to-day operations.

Community organization

History and legal framework

The first indigenous communities were officially recognized and titled by the Peruvian government in the Ampiyacu watershed in 1975, thanks to the initiative of SINAMOS and, later, to the work of AIDESEP Nacional, with funding from international financial institutions (Chirif et al. 1991).

The legal framework of the indigenous communities consists of three laws: the Political Constitution of the State, the Civil Code, and the Law of Indigenous Communities and Agrarian Development in the Lowland and Andean Forest (Law No. 22175; CEDIA 1996). Indigenous communities are recognized as legal entities in the public interest, composed of nuclear or dispersed families that are settled within a defined area. They are held together by cultural elements such as language, family relationships, and the shared use of natural resources. The law grants indigenous communities autonomy in their internal organization, administrative and economic management, and the use of their lands and natural resources (CEDIA 1995a, 1995b, 1995c).

All indigenous communities are governed by an Asamblea Comunal and a Junta Directiva. The Asamblea Comunal is a body that ensures community-wide participation in community decisions, and is composed of all the community members listed in the Padrón de Comuneros (CEDIA 1996). The Asamblea is the chief governing body and maximum authority in the indigenous community, and its decisions are binding. The Junta Directiva is a smaller group of community members elected by the Asamblea General to represent its interests. It consists of a chief, a second-in-command, a secretary, a treasurer, and one or two *Vocales*, and is responsible for leading the community and its administration (CEDIA 1996).

There are formal and informal organizations and leadership positions in native communities. The formal organizations operate by law and with the sanction of the state to promote development, and were

created by the communities to interact with other institutions. The informal organizations are created to satisfy family needs, to regulate the use of natural resources, and to organize community activities. Frequently, the informal organizations help focus the formal organizations, and both are important in the daily life of communities. Unlike formal organizations, informal organizations are based on social ties like family alliances and informal support groups.

Below we describe social strengths and organizational mechanisms, formal and informal, that are important allies for future work.

Formal organizations

The principal leadership positions in communities are those of community chief or president, Teniente Gobernador and Agente Municipal. School teachers, health workers, and the presidents of clubs like the Comité de Vaso de Leche, the Asociación de Padres de Familia, the Club de Madres, and the Comités de Pescadores Artesanales (see below) also participate in community decision-making.

The community president is the leader of the Junta Directiva of the community and the top leadership position, responsible for directing the community government. The Teniente Gobernador has the authority to implement community laws and decisions and to ensure that they are respected, and is responsible for keeping the peace (CEDIA 1999). The post of Teniente Gobernador, which is filled by election or appointment by the district governor, existed long before the formal creation of indigenous communities. The Agente Municipal is appointed by the Alcalde Distrital and carries out activities charged by the Municipal Council, such as supervising the civil register, improving community infrastructure, and maintaining public services like roads, radios, and sporting grounds. The Agente Municipal tends to complement the work of the Teniente Gobernador.

In our community work we have identified the following formal organizations within the jurisdiction of these leaders which could be involved in the management of natural resources, and whose participation in a future protected area is recommended.

"*Glass of Milk" Committee (Comité de Vaso de Leche)*
The municipality grants this committee, led by community women, the task of distributing food from the National Program of Food Support (PRONAA) to the communities. The committee distributes breakfast to poor children and schoolchildren. These committees are very efficient and highlight the organizational capacity of women in the communities.

Parents' Association (Asociación de Padres de Familia)
This association ensures that the community schools are well run and gives teachers the assistance they need to do a good job. This organization, recognized by the Ministry of Education, is created whenever a school is built. Parents of children who attend the school elect a council overseen by a parent. Teachers often also play an important role in the association by helping community members with decision-making and supporting educational needs and requests of the community. The association is an important base for educational activities in the community, including environmental education in schools.

Fishermen's Committees (Comités de Pescadores Artesanales)
These committees are promoted by the Ministry of Production through the Dirección Regional de la Producción, with the goal of organizing and promoting small-scale fisheries in rural areas. These committees exist in the towns of Apayacu, Pebas, and San Antonio de Estrecho and receive financial support from the Special Development Project for the Putumayo Basin (PEDICP). With more training in sustainability and conservation, they could potentially play an important role in the management of lakes and rivers in the proposed Reserved Zone.

Promotores de Salud
Community health workers are generally employed by the Ministry of Health to operate clinics and provide medical services. That most of the indigenous and *ribereño*

population uses medicinal plants and the help of shamans or *curanderos* highlights the importance of traditional knowledge in complementing Western medicine.

Informal organizations

New projects and development initiatives in indigenous communities tend to spark energetic activity in a variety of informal organizations that are poorly known outside the communities. Often these unexpected sources of energy and ideas contribute the most to projects. These informal organizations and leaders are respected by the community, well-attended, and involve community members of all ages and both sexes. Involving them in projects related to the conservation and management of natural resources requires learning what they are and how they operate. Among the most important are:

Traditional leaders (curacas)

The *curaca* is a traditional leader in a family group or clan, generally for life. In the case of the Ampiyacu watershed, these leaders are losing their authority, and naming them is no longer a tradition. They still play important roles, however, and their decisions are considered very important. The *curacas* are also important in that they often sustain a more traditional, indigenous perspective on the importance of nature and man's relationship with the environment. In more traditional communities, the *curaca* is an important reservoir and teacher of traditional knowledge.

Public work groups (mañaneo)

These generally come together to carry out a specific job, like a cleanup of the town center or the harvest of a certain product for the common good. Work generally begins in the morning and lasts for up to four hours. *Mañaneos* are very common in indigenous communities and involve both men and women.

Family work groups (minga)

These are generally groups of friends or family members that come together to help a specific family. They are frequent in communities, and can involve planting or harvests in garden plots or house-building. Generally the work lasts a day and concludes with a party, food and drink. In the indigenous communities of the Ampiyacu watershed, women organize *mingas* to make handicrafts. The *minga* is a classic example of the organizational capacity of communities; communal work that is based on social networks for the well-being of the entire community and that strengthens ties between families and neighbors.

Communal crop garden work groups

The Agente Municipal and the president of the community organize the entire community to work in these groups. The aim is to pay community debts or to buy something that will benefit the entire community. These groups clear and plant garden plots with crops that are valuable on the regional market, like plantains, corn, or rice, and sometimes cut timber. In some cases, groups are gender-specific, as in the community of Yaguasyacu, on the Apayacu River, where the women maintain a communal garden plot whose produce is shared among families. These work groups represent important partners in the region, especially for projects to develop alternative economic activities in line with the regulations of the proposed Reserve Zone, to reforest degraded lands, and to mange timber.

Logging groups.

Consisting of at least ten people, these groups live in the woods for two or three months at a time, cutting timber together. The sale of and profits from the extracted wood are not managed communally, but individually. The long experience these groups have in cutting timber results in lower environmental impacts. Even so, this sort of logging can be improved and better managed in the management plans of a future Reserved Zone.

Hunting groups

These usually consist of three or four men who hunt in the woods for two or three weeks. Here, too, the wildlife meat is sold on an individual basis. The hunters have a lot of practical knowledge about animal ecology and techniques for capturing animals, which are useful tools for wildlife management and conservation.

Although women do not hunt themselves, they prepare and cook the meat. As a result, they know a great deal about how many animals are hunted and they help decide which species should be hunted for food.

Committee to organize traditional parties

This committee is headed by the *curaca*. A community that is invited to one of these parties by another community takes the invitation very seriously, and the entire community—men, women and children—takes part. An important part of these events is the exchange of wild fruits, wildlife meat, fish, and the finest crops of the harvest. This strengthens friendships, refocuses the communities' dependence on the forest, bolsters cultural traditions, and cements alliances between *curacas*.

Committee for rural electrification

This committee in Pucaurquillo successfully monitors and maintains the town's generator and manages the fee collection for energy use. The importance of this committee is largely in the mechanisms it has established to manage the money it collects, with the goal of guaranteeing the community a constant supply of electricity.

Handicrafts committee

This committee was born from the Handicrafts Project, financed by Oxfam America (Benavides et al. 1993). In Pucaurquillo, members of this committee sell their handicrafts in Iquitos and occasionally take part in handicraft fairs in Lima. Roughly 90% of the work is done by women, who also lead the committee. This committee represents an important contact for planning economic activities compatible with the proposed Reserved Zone.

Traditional dances committee

This committee was born from the desire to provide better, more organized traditional dances for the tourists who visit the community of Pucaurquillo. The committee also coordinates traditional dances in other cities and negotiates fair deals with the tourist operators they work with (Benavides et al. 1993).

Other informal organizations

In indigenous populations some social structures that have operated for generations still persist, sometimes almost imperceptibly, and these deserve special attention. In many indigenous communities, family clans and their leaders control certain territories; a community may be governed by two or more clans. In these cases, a clan's territory is effectively its property, with roughly defined property lines, and its natural resources are managed exclusively by the clan. When natural resources are harvested to sell, the head of the clan oversees the harvest and arranges for its sale, and the profits are distributed among the clan, not among the community.

Government institutions with ties to indigenous communities

Government institutions are charged with the mission of encouraging the development of communities and villages, and an alliance between the state and the communities is important for the proposed Reserved Zone. At this scale, the state institutions of interest are the municipalities, since they are the highest-ranking local government. Community members have many skills to offer the districts in which they reside. To compensate for the limited assistance they generally receive, indigenous communities have built special relationships with the municipal districts, the regional government, ministerial offices, and development projects like FONCODES and PRONAA. Thanks to this organization, and after patient and complicated negotiations on the part of their representatives, some indigenous communities have received some basic services like the construction of schools, health clinics, bridges, sidewalks, radio services, generators, and crop depots.

District municipalities

In the proposed Reserved Zone, three municipal offices represent the communities and the civil population in general: the office of the district of Pebas, the office of the district of Las Amazonas, and the office of the district of Putumayo.

The Pebas municipal office is located in the town of Pebas and has a branch in Iquitos. By the initiative of the municipality, there is a tenuous working relationship with the indigenous communities of the Ampiyacu River, despite the presence of a Regidora Indígena (a Huitoto from Pucaurquillo). The indigenous communities have requested more contact with and resources from the municipality. They remember fondly that in 2003 the municipality granted the local indigenous federation (FECONA) some small funds to organize an indigenous conference.

The municipal office of the Las Amazonas district is located in the town of San Francisco de Orellana and also has a branch in Iquitos. In order to raise funds for the communities, the municipality has been buying material from sawmills (posts for electrical lines, wood to build bridges) for local works.

The municipal office of the Putumayo district is located in San Antonio del Estrecho and has a branch office in Iquitos. Thanks to work by FECONAFROPU and the leaders of the indigenous communities, the municipality has installed radio communication in some communities. Municipal funds have also built schools and brought electricity to some communities.

Other government institutions

Apart from the district municipalities, indigenous communities maintain links with other government institutions, like the National Institute of Natural Resources (INRENA), the Ecological Police, and the National Institute of Development (INADE). INRENA manages and protects Peru's parks and natural resources, and belongs to the Ministry of Agriculture. It has two offices in the region—one in Pebas and the other in San Antonio de Estrecho—and operates a small post in the village of Alamo on the Putumayo River.

The Ecological Police is an institution of the Ministry of the Interior whose mission is to enforce environmental laws. Because its only office is in Iquitos, the regular police in the rural police stations take on the Ecological Police's job.

The Special Project for the Development of the Putumayo Watershed (PEDICP), which is part of INADE, has ties with the indigenous communities in the region through its office in Iquitos. PEDICP is based in San Antonio de Estrecho, where it promotes agricultural, livestock, and forestry programs and provides social aid in the Putumayo watershed. The project also provides technical assistance to forestry management in the indigenous community of Santa Mercedes.

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