(*for Color Plates, see pages 25–48*)

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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. One division of the Museum—Environment, Culture, and Conservation (ECCo)—is dedicated to translating science into action that creates and supports lasting conservation of biological and cultural diversity. ECCo works closely with local communities to ensure their involvement in conservation through their existing cultural values and organizational strengths. With losses of natural diversity accelerating worldwide, ECCo'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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### Instituto del Bien Común (IBC)

The Instituto del Bien Común 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. Among the projects led by IBC are Pro Pachitea, which focuses on local management of fish and aquatic ecosystems; the Indigenous Community Mapping project, which aims to defend indigenous territories; the ACRI project, which studies the communal use of natural resources; and the Large Landscapes Management Program, which aims to create a mosaic of sustainable use and protected areas in the Ampiyacu, Apayacu, Yaguas, and Putumayo watersheds. The proposed mosaic includes enlarged community lands, various regional conservation areas, and a national protected area.

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**Proyecto Especial Binacional Desarrollo Integral de la Cuenca del Río Putumayo (PEDICP)**

PEDICP is a decentralized agency of the Peruvian Ministry of Agriculture created in 1991 by the Peruvian-Colombian Amazonian Cooperation Treaty (TCA). The agency leads the Peruvian government's efforts to implement binational agreements since 1989 regarding the countries' shared border area of 160,500 km$^2$. PEDICP promotes the sustainable, integrated development of forests in the Putumayo, Napo, Amazon, and Yavarí watersheds through projects that support the responsible use of natural resources, protect the environment, and improve the quality of life of local residents. One of the agency's primary objectives is to encourage the peaceful, sustained development of towns in the Putumayo watershed—and especially indigenous communities there—by optimizing natural resource use and developing economic opportunities that are in harmony with Amazonian ecosystems.

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**Organización Regional de Pueblos Indígenas del Oriente**

The Organización Regional de Pueblos Indígenas del Oriente (ORPIO, previously ORAI) is registered in the Oficina Registral de Loreto in Iquitos. It includes 13 indigenous federations representing 16 ethnolinguistic indigenous groups along the Putumayo, Algodón, Ampiyacu, Amazon, Nanay, Tigre, Corrientes, Marañón, Samiria, Ucayali, Yavarí, and Tapiche rivers, all in the Peruvian department of Loreto.

ORPIO is a regional indigenous organization represented by an executive council of five elected members, each with a three-year term. As a regional organization, it makes regional-level decisions as determined by its statutes. ORPIO's mission is to work in support of indigenous rights, access to lands, and autonomous economic development based on the values and traditional knowledge of each indigenous community.

The organization facilitates communication in order to enable its members to make informed decisions. It encourages the participation of women in community organizations, and works to title indigenous lands. ORPIO works closely with the Peruvian government and other stakeholders interested in development and environmental protection in the department of Loreto.

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**Herbario Amazonense de la Universidad Nacional de la Amazonía Peruana**

Founded in 1972, the Herbario Amazonense (AMAZ) is an educational and research museum administered by the Universidad Nacional de la Amazonía Peruana (UNAP) in Iquitos, Peru. While the herbarium houses specimens from several countries, the bulk of collections showcase Peru's Amazonian flora, considered one of the most diverse on the planet. These collections serve as a valuable resource for understanding the classification, distribution, phenology, and habitat preferences of thousands of species of ferns, gymnosperms, and flowering plants. Since its establishment, students, teachers, and researchers from around the world have used the herbarium to study, identify, and teach about Amazonian plants, and in this way the Herbario Amazonense contributes to the conservation of the diverse Amazonian flora.

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**Museo de Historia Natural de la Universidad Nacional Mayor de San Marcos**

Founded in 1918, the Museo de Historia Natural 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 recorded more than 2,000 species during this rapid inventory, but it was done with so much support from so many different directions that it feels as though the number of people and institutions who helped us do it may be even higher.

We are especially grateful for and inspired by the work of the Special Binational Project for the Integrated Development of the Putumayo River Basin (PEDICP), a program of the Peruvian Ministry of Agriculture which has been working for 20 years to promote sustainable development and improve the quality of life along the country's remote borders with Colombia, Ecuador, and Brazil. PEDICP has long been a proponent of binational conservation areas both in the Yaguas-Cotuhé region and elsewhere on Peru's Amazonian borders, and we are honored to contribute to that long history. At PEDICP we especially appreciated the strong leadership and collaboration of Nilo Alcides Zumaeta Ramírez and Mauro Vásquez Ramírez. Luis Alberto Moya Ibáñez of PEDICP participated in the biological inventory both as a mammalogist and as an all-around expert on the Peru-Colombia border area, while Ricardo Pinedo Marín was part of the social inventory team. We also thank PEDICP for lending us their boats and excellent boat drivers Anselmo Sánchez and Saúl Cahuaza for the advance, social, and biological teams. PEDICP also presented the team with several books written by the program about the Putumayo and other watersheds in Loreto, which were a great help in writing this report.

Another essential partner in this inventory was the Peruvian non-governmental organization Instituto del Bien Común (IBC), which over the last ten years has worked tirelessly to give indigenous communities in the Napo-Amazonas-Putumayo region the tools to plan their long-term, shared future in the region. Our deepest thanks go to Richard Chase Smith, Margarita Benavides Matarazzo, Pedro Tipula Tipula, Maria Rosa Montes de Delgado, Karina Sifuentes Sotomayor, and Luis Murgía Flores. These inventories would not have been possible without the logistical support and constant help of the Iquitos IBC staff: Jomber Chota Inuma, Ana Rosita Saénz, Genoveva Freitas Gómez, Andrea Campos Chung, Freddy Ferreyra Vela, Jorge Gallardo Díaz, Rolando Gallardo Gonzáles, Billy Murayari Arévalo, and Francisco Nava Rodríguez. Melody Linares Pereira was a great help in packing food supplies for the team. We are especially grateful to all the IBC staff who work in the Bajo Putumayo region, including Ana Rosita Sáenz, Jackson Coquinche Butuna, Rolando Gallardo Gonzáles, Francisco Nava, and Luis Salas Martínez.

In addition to PEDICP, several other branches of the Peruvian government also helped make the inventory possible. Peru's National Protected Areas Service (SERNANP), which first established the Yaguas River valley as a national conservation priority in INRENA's 1993 master plan, followed the inventory's progress every step of the way and provided critical advice and information throughout. We are especially grateful to Luis Alfaro, Channy Barrios, and Jenny Fano. Julio Ocaña of Peru's Ministry of the Environment was also a key player in meetings to discuss conservation opportunities in the Yaguas-Cotuhé region. We also thank the Ministry of Foreign Affairs, which has been actively involved in the Putumayo region in recent years. We are especially thankful for our collaboration with Gladys M. García Paredes (in Lima) and Carlos Manuel Reus (in Iquitos).

Most of all, we owe an enormous thanks to the Peruvian National Police, whose efficiency and professionalism made traveling between our remote campsites—some of them nearly 400 km from Iquitos—safe and reliable. Not enough people are aware of the great service that Peru's police force and helicopter pilots have done for their country's astonishing biodiversity. We owe special thanks to General PNP Tomás Guibert Sagastegui and Coronel PNP Dario Hurtado Cárdenas. We also thank Comandante SPNP Gustavo Toro Ramírez, Mayor PNP Freddy Quiroz Guerrero, Mayor PNP Víctor Ascue Tello, Capitán PNP Freddy Chávez Díaz, Mayor Ma. PNP Luis Rubin Alva, Sob. PNP Gregorio Mantilla Cáceres, SOT1 PNP Segundo Sánchez Quispe, SOT3 PNP Elio Padilla Bernabé, and SOT1 PNP Jesús Loayza Borda. In Pucaurquillo we are deeply grateful to the Bora and Huitoto residents who supported us throughout the helicopter operations. We also thank Ángel Yaicate Murayari, René Vásquez Andrade, Santiago Arévalo Tamani, and Jorge Gallardo from IBC for their logistical support in that community, and Franco Quevare García and Catia Quevare García for their help with helicopter fuel.

We were honored to receive an invitation from the Federation of Indigenous Communities of the Lower Putumayo (FECOIBAP) to present the preliminary results of the biological and social teams at the federation's annual congress in Huapapa, and we are deeply appreciative of the warm welcome we received there. We could not have done this work without the support of the 13

native communities along the Bajo Putumayo River: Puerto Franco, Pesquería, Betania, Remanso, Corbata, Curinga, Puerto Nuevo, San Martín, Tres Esquinas, Huapapa, Primavera, Santa Rosa de Cauchillo, and El Álamo. Our special thanks go to the authorities and residents of Puerto Franco, Santa Rosa de Cauchillo, and Huapapa, for inviting us into their homes and sharing four days of their lives with our social team. We also appreciate all of ORPIO's crucial coordination during the inventories, and especially the support of Edwin Vásquez and Manuel Ramírez.

The social team would also like to thank the officers at the Peruvian National Police outposts in Bergheri and Curinga for overcoming several obstacles to get us to our sites. Deserving special thanks are SO1 PNP Gersy García Garcés and SO3 PNP Cesar Augusto García Fernández of the Bergheri outpost. We are also deeply grateful to Eber Mashacuri and Ludeño Gonzáles, our field guides in Puerto Franco; Marcos and Alvin Valles in Santa Rosa de Cauchillo; and Francisco Gaitán and Carlos Gonzáles in Huapapa. In the communities we are especially indebted to the families that welcomed us into their homes during the social team's inventory: Don Josué in Puerto Franco, the Gonzáles Prada family in Santa Rosa de Cauchillo, and the Gaitán Gonzáles and Gonzáles Zevallos families in Huapapa. We are sincerely grateful to Doña Ernestina Velásquez and Ludeño Gonzáles in Puerto Franco, Dennis Valles and Patricia Vargas in Santa Rosa de Cauchillo, and Irazema Zeballos and Esmith Gonzáles in Huapapa for their generosity in preparing and sharing delicious meals with the social team. We are also grateful to Ricardo Pinedo Marín of PEDICP, Ana Rosa Saénz of IBC, and to Manuel Rodríguez Santana, vice president of ORPIO, for joining the social team and sharing their knowledge and experience of the region.

Local residents built three remote campsites, more than 60 km of trails, and dozens of bridges to facilitate the biological team's work. Indeed, they probably did more work—and harder work—than anyone else involved in the inventory. They are: Joel Arévalo Velásquez, Pedro Arimuya, Abelino Dos Santos Ahuanari, Neyton Enocaisa Cachique, Rubén España Yurimachi, Rubén Espinoza Ahuanari, Ludeño Gonzáles Dahua, Segundo López Gonzáles, Sixto Hauxwell Mariño, Anderson Machoa Sandi, Leandrito Machoa Sandi, Ever Mashacuri Noteno, William Monihuari Mozombite, Rucel Noa Romañol, Josué Pacaya Hilorio, Néstor Pinedo Canayo, Wagner Pinedo, Luis Pucutuy Andoque, César Rodríguez Pinedo, Jorge Ruiz Cahuachi, Juan Sánchez Velásquez, Remberto Sosa Gutiérrez, Jorge Sosa Pérez, Rodolfo Sosa Pérez, Andrés Tananda Asipali, Lorenzo Torres Flores, Joyner Tuanama, Ney Tuanama, Aliardo Ushiñahua Gonzáles, Alvis Valles, Gerardo Valles Quiroz, Marcos Valles Souza, Jhonny Vargas Martínez, Felipe Vargas Saven, and Mariano Vega Torres. The work of these 'tigres' was expertly coordinated in remote wilderness by Álvaro del Campo, Guillermo Knell Alegría, Aldo Villanueva Zaravia, Italo Mesones Acuy, Julio Grández Ríos, and Gonzalo Bullard Gonzáles, and the result was a trio of comfortable, efficient, and pleasant campsites. Everyone's work was powered in the field by the miraculous culinary skills of Luz Angélica Lucano, Ernestina Velásquez Romaina, Magaly García, and Jessica Aruna Bico. We thank all of them deeply.

The geology team would like to thank Felix Rodríguez for measuring water sample conductivity, pH, and sediment concentrations in the laboratory.

The biological team offers a special salute to the Natural History Museum of the San Marcos Nacional University, which for years has offered a home away from home for rapid inventory scientists in Lima. Our botanical inventory could not have been done without the support of another Peruvian museum—the AMAZ herbarium at the Universidad Nacional de la Amazonía Peruana—as well as its director César Grández and curator Juan S. Ruiz. The botany team greatly appreciated the help of Josué Pacaya and Lorenzo Torres in the field, and the help of UNAP students Clara Sandoval, Danna Isabel Flores, Julio Grández, Marcos Ríos, Claire Tuesta and Edward Jimmy Alarcón in the herbarium. We thank Dairon Cárdenas of Colombia's Amazonian Institute for Scientific Research (SINCHI) for providing valuable information, publications, and unpublished data on Colombian plant communities near our study area. The following taxonomic specialists provided on-the-fly identifications of our specimens, and we salute their many other contributions to Amazonian plant science: Mac Alford (Univ. of Southern Mississippi), Bil Alverson (The Field Museum), Paul Berry (Univ. of Michigan), Julio Betancur (Universidad Nacional de Colombia), Michael Calonje (Montgomery Botanical Center), Laura Clavijo (Univ. of Alabama), Stefan Dressler (Senckenberg Research Institute), Hans-Joachim Esser (Botanische Staatssammlung Munich), Günter Gerlach (Munich Botanical Garden), Nancy Hensold (The Field Museum),

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The ichthyological team would like to thank Joel Arévalo Velásquez and Anderson Machoa Sandi for their valuable assistance collecting thousands of fish specimens in the field. The following taxonomic specialists helped confirm identifications: Carlos Donascimiento, Javier Alejandro Maldonado Ocampo, Oscar Akio Shibatta, Donald Thaphorn, and Giannina Trevejo. Linda Flores, manager of the Stingray Aquarium company in Iquitos, graciously provided information about the ornamental fish business.

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The mammalogy team would like to thank Pedro Vásquez of the Wildlife Conservation Society's Iquitos office and Rolando Aquino for providing books and bibliographic information on Amazonian mammals. Olga Montenegro would like to thank the National University of Colombia, and in particular the Natural Science Institute and the Wildlife Conservation and Management Group there for providing field equipment (especially camera traps and mistnets) used during the inventory.

Updates from the field were posted to the Scientist At Work blog on the *New York Times* website (*http://scientistatwork.blogs.nytimes.com*). This rewarding technological advance allowed us to share what we were finding (and seeing) with thousands of people who might never have known about the inventory otherwise. We would like to thank Jim Gorman and Thomas Lin of the *New York Times* for this wonderful opportunity. We appreciate all the readers who took the time to comment on our entries, especially the young readers who we really do hope will grow up to be tropical biologists. Álvaro del Campo, Zaleth Cordero, and Bob Stallard provided stunningly professional photos for the blog, while Jon Markel configured the tricky field modem on short notice.

The staff of the Hotel Marañón were a tremendous help throughout the expedition and the advance campaign. We thank Moisés Campos Collazos and Maritza Chavel Vigay of Telesistemas EIRL for their help maintaining radio contact between Iquitos and the field sites. Tyana Watcher and Álvaro del Campo showed extraordinary patience and dedication in helping transmit news from the team's families, through thunder and static, to our field camps. Also in Iquitos, Diego Lechuga Celis and the Vicariato Apostólico de Iquitos furnished us with an excellent workspace where we wrote the report and the auditorium where we presented our preliminary results. The Peruvian Center for Biodiversity and Conservation, a young conservation group, also provided us inspiring advice and valuable bibliographic information while in Iquitos.

In addition, CIMA staff in Lima helped enormously in obtaining the research permit on time. Jorge "Coqui" Aliaga, Lotty Castro, Yesenia Huamán, Alberto Asin, José Luis Martínez, Tatiana Pequeño, and Manuel Vásquez were extremely helpful as usual with administrative issues and accounting before, during, and after the inventory. We are deeply indebted to all of them.

As they have been many times before, Jim Costello and his team at Costello Communications in Chicago were extremely quick and efficient in converting our written and photographic work into an elegant printed volume. We appreciate their creativity, support, and patience during the intensive process of editing, re-editing, and re-re-editing the proofs. Any remaining errors are ours alone.

We also want to thank Jorge Ruiz Pinedo from Alas del Oriente in Iquitos for the outstanding reconnaissance overflight prior to the

inventory and for lending us his fuel cylinders for the helicopter. We are grateful, too, to Chu Serigrafía y Confecciones, the Hotel Señorial, and Francisco Grippa.

Jonathan Markel was a huge help to the expedition both before we entered the field and after we returned to Iquitos, preparing maps and providing geographical data under impossibly short deadlines. He was also a big help during the writing and presentation stages. Once again, Tyana Wachter played an irreplaceable role in the inventory, going above and beyond the call of duty every day to ensure that the inventory and everyone on it was in top shape, and solving problems in Chicago, Lima, Iquitos, and Pebas. Royal Taylor, Meganne Lube, Dawn Martin, and Sarah Santarelli were wonderful in solving problems from Chicago.

From start to finish, this inventory was funded through the generous support of the Gordon and Betty Moore Foundation, The Boeing Company, and The Field Museum.

The goal of rapid inventories—biological and social—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, natural resource use, 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 decisionmakers who set priorities and guide conservation action in the host country.

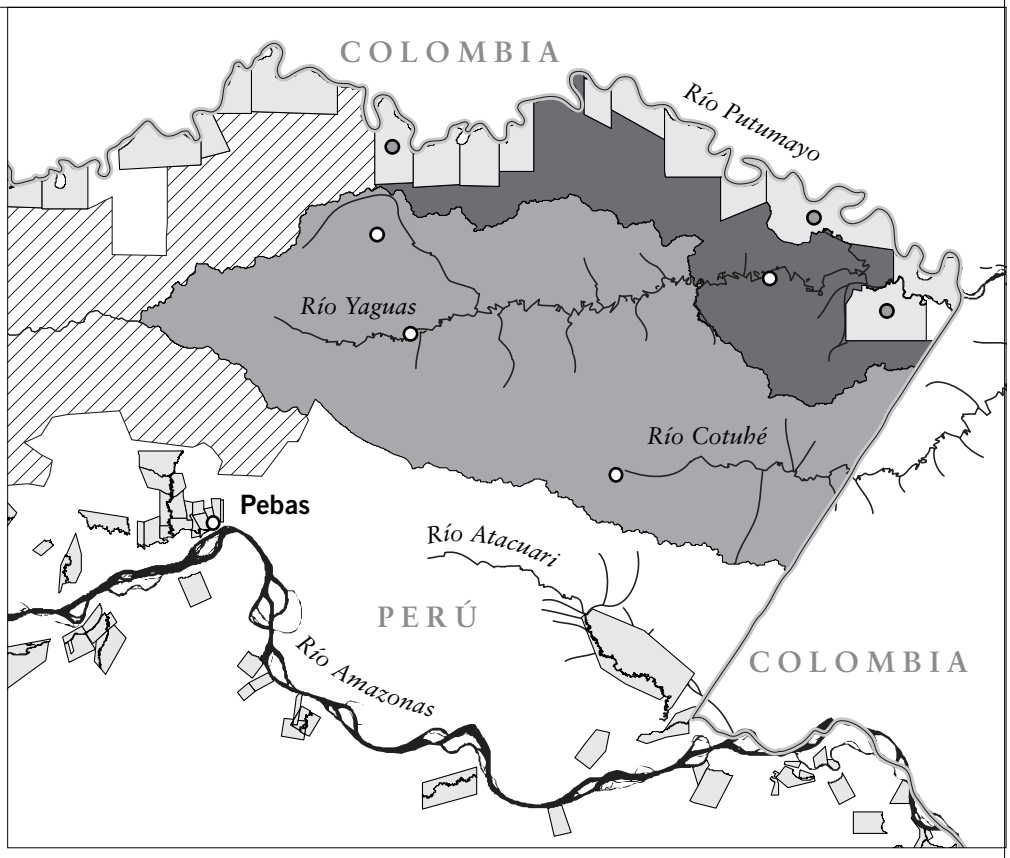
## REPORT AT A GLANCE

**Dates of field work**

14–31 October 2010*

*This report also includes data from a site visited in the Yaguas watershed during the Field Museum rapid inventory in August 2003 (see p. 196).


- Biological Site
- Social Site
- Proposed Yaguas-Cotuhé Area
- Proposed Yaguas-Putumayo Area
- Native Communities
- Other Areas




**Region**

We worked in the northeastern corner of Peru's Amazonian department of Loreto, in the remote watersheds of the Yaguas and Cotuhé rivers and in three indigenous communities along the lower Putumayo. Our goal was to describe human and biological communities in and around two proposed conservation areas: a 1.1 million-ha strictly protected area encompassing the entire Peruvian portion of the Cotuhé watershed and most of the Yaguas watershed, and a ~350,000-ha sustainable use area in the lower Yaguas and Putumayo watersheds, close to the communities.

**Inventory sites**

The biological team visited two sites in the Yaguas watershed—one in the headwaters and one close to its juncture with the Putumayo—and one site in the headwaters of the Cotuhé River. Complementing observations from these sites are data from an additional site in the Yaguas watershed, which the rapid inventory team visited in 2003.

## REPORT AT A GLANCE

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| | **Yaguas watershed:** | Choro, 15–20 October 2010<br>Yaguas, 3–9 August 2003<br>Cachimbo, 25–31 October 2010 |
| | **Cotuhé watershed:** | Alto Cotuhé, 20–25 October 2010 |
| | The social team worked in three communities: two on the banks of the Putumayo (Puerto Franco, 16–19 October, and Huapapa, 25–31 October) and one on the Yaguas (Santa Rosa de Cauchillo, 21–24 October). On 31 October both teams participated in the first annual congress of the Federation of Indigenous Communities of the Lower Putumayo (FECOIBAP) in Huapapa. | |
| **Biological and geological surveys** | Geology, hydrology, and soils; vegetation and plants; fishes; amphibians and reptiles; birds; medium to large mammals and bats | |
| **Social survey** | Social and cultural assets; history of the settlement process; demography, infrastructure, economics, and resource use and management practices | |
| **Principal biological results** | The rapid inventory confirmed that biological communities in these watersheds have an exceptional value for conservation at regional, national, and global scales. These two rivers appear to possess the most diverse fish communities in all of Peru. Likewise, the diversity of plants and other vertebrates places these forests among the most diverse on Earth. | |

| | Species recorded during the inventory | Species estimated for the region |
|---|---|---|
| Plants | >948 | 3,000–3,500 |
| Fishes | 337 | 550 |
| Amphibians | 75 | 110 |
| Reptiles | 53 | 100 |
| Birds | 393 | 500 |
| Mammals | 71 | 160 |

The Yaguas and Cotuhé watersheds harbor a bewildering variety of terrestrial and aquatic habitats, with the notable exception of white-sand forests. Two habitats are especially important for conservation: high, ancient, poor-soil terraces in the Yaguas headwaters, and diverse vegetation, including savannas and dwarf forests similar to *chamizales*, growing on peatlands. The region also maintains large populations of economically important timber, fish, and mammal species, and should serve as an effective source area for sustainable logging, fishing, and hunting in adjacent areas.

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| **Geology** | Interactions between elevation, soil fertility, and flooding produce an extraordinary patchwork of habitats underlying the biodiversity of the Yaguas and Cotuhé watersheds. The region was once a vast alluvial plain composed of two sedimentary deposits: the nutrient-rich, Miocene-age Pebas Formation below (six million years old), and nutrient-poor Plio-Pleistocene-age sediments above (two million years old). Over the last two million years, this ancient plain has been slightly elevated and heavily eroded, leading to the present-day landscape of low hills and valleys.<br><br>Because of this history, elevation in these watersheds is today strongly related to soil fertility and water chemistry. The highest elevations (~190 m) represent the old, highly-weathered remains of the Plio-Pleistocene plain and have the poorest soils. Intermediate elevations feature a mix of richer soils derived from the Pebas Formation (these often associated with mineral licks or *collpas*) and poorer soils on younger sediments, and streams there show the lowest conductivities of the region. At the lowest elevations (65 m) erosion has exposed more sediments of the Pebas Formation, producing richer streams and more fertile soils, but many of these soils have been buried beneath younger, less fertile alluvial sediments.<br><br>In the lower Yaguas watershed we discovered unusual, low-nutrient peat swamps with dwarf vegetation similar to that of *chamizal* forests located south of the Napo and Amazon rivers in Loreto. Tropical peatlands have only recently been reported for similar environments in the Amazonian basin. If these peats form rapidly, which appears to be the case, they could potentially be important sinks of atmospheric carbon and sources of methane. |
| **Vegetation** | The botanical team identified 11 forest types in the area: 1) forests on high, lower Pleistocene terraces; 2) forests on hills of relatively poor clay soils; 3) forests on hills of rich, Pebas Formation-derived soils; 4) forests on hills of nutrient-poor clay soils, dominated by the understory palm *Lepidocaryum tenue* (*irapay*); 5) stream and lakeside forests; 6) floodplain forests on flat terrain; 7) floodplain forests on uneven terrain; 8) floodplain forests in the headwaters; 9) mixed *Mauritia flexuosa* swamps associated with large rivers; 10) mixed *M. flexuosa* swamps in poorly drained upland areas; and 11) dwarf forests (*chamizales*) growing on tropical peats and not associated with white sands.<br><br>This long list of forest types reflects the region's highly heterogeneous soils, geology, and topography. Our most unexpected findings included: a) extensive upland forests growing on the ancient soils of lower Pleistocene (~2.4 million years old) terraces in the headwaters of the Yaguas River, with a flora that we did not see anywhere else in the region; b) upland forests on younger Pleistocene terraces (~120,000 years old) in the headwaters of the Cotuhé River, with a distinctive, poor-soil flora; and c) the dwarf forests growing on Holocene-age (4,000–5,000 years old) peat deposits in the |

| REPORT AT A GLANCE | |
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| | Yaguas River floodplain, with various plant species unique to this habitat but shared with white-sand *chamizal* forests south of the Napo and Amazon rivers. Our observations support the emerging consensus that the highest diversity of woody plants on the planet is located in a swath of forest stretching from the Ecuadorean Amazon in the west to Manaus in the east, and including the Yaguas and Cotuhé watersheds. |
| **Flora** | We collected 811 plant specimens representing >109 families and >948 species. Based on the region's high habitat diversity we estimate that it harbors 3,000–3,500 plant species, including much of the floristic diversity of the department of Loreto. Specialists have indicated ten species as probably new to science and seven species as new records for the Peruvian flora, and these numbers will likely increase with additional study. The region is rich in timber species and other useful plants. We did not find large populations of tropical cedar (*Cedrela odorata*), but on the old, poor-soil terraces we observed the important timber species *Cedrelinga cateniformis*. Forests throughout these watersheds are in good condition, especially in the headwaters, and they undoubtedly serve as an important source of seeds and fruits for the nearby human settlements on the Putumayo and Amazon rivers. |
| **Fishes** | The Cotuhé and Yaguas rivers may have the most diverse fish communities in all of Peru. In three weeks we recorded 337 species, of which 11 are potentially new to Peru and seven potentially new to science. We estimate that 550 fish species and up to 65% of Peru's freshwater fish fauna could inhabit these watersheds. This extraordinary diversity appears to be the result of the great variety of aquatic habitats and environmental gradients: water chemistry, altitude, and river size.<br><br>Species distributions track elevation, with fewer species in the headwaters and increasing numbers lower in the watersheds. We found some species typical of small streams (*Centromochlus, Ituglanis, Microrhamdia*) which may be restricted to such habitats, and other species typical of main river courses (*Pseudoplatystoma, Ageneiosus, Brachyplatystoma, Paratrygon*) and of large oxbow lakes (*Cichla, Astronotus, Osteoglossum*).<br><br>The preliminary list of fish species from these proposed protected areas includes at least 93 species that are economically important, either as food fish or as ornamentals. These include silver arawana (*Osteoglossum bicirrhosum*)—perhaps the most valuable ornamental species in Peru—*Brycon* spp., *Leporinus* spp., piranhas (*Serrasalmus* spp.) and migratory catfish like *Pseudoplatystoma punctifer* and *Brachyplatystoma vaillantii*. These catfish travel up Amazonian rivers in search of spawning sites, which we believe are frequent in the Cotuhé and Yaguas. Stingrays are very diverse in the area (we recorded five species) and include sought-after ornamental species of *Potamotrygon* as well as *Paratrygon aiereba,* the largest species in the family. |

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| **Amphibians and reptiles** | The herpetological inventory revealed 128 species: 75 amphibians and 53 reptiles. We expect that the region's total herpetofauna includes some 110 amphibian species and 100 reptiles. These are very high numbers, considering that our inventory coincided with a strong drought, and are likely the result of high habitat and microhabitat diversity in these watersheds. The species we recorded are typical of hilly Amazonian uplands and floodplains. Especially notable finds include two species that appear to be new to science (one *Osteocephalus* and one *Pristimantis*); range extensions for the frogs *Osteocephalus heyeri*, *Hypsiboas nympha*, and *Pristimantis padiali*, and the snake *Atractus gaigeae*; and the discovery of a fossorial species in the genus *Synapturanus*, associated with peatlands. Our list includes three species that are threatened both in Peru and globally: yellow-footed tortoise (*Chelonoidis denticulata*), black caiman (*Melanosuchus niger*), and smooth-fronted caiman (*Paleosuchus trigonatus*). Together with the *hualo* frog (*Leptodactylus pentadactylus*), these species are hunted for food or trade by local communities and are classified in CITES Appendices I and II. |
| **Birds** | We recorded 393 of the 500 bird species believed to occur in the region. The avifauna of these watersheds is typical of northwestern Amazonia and very similar to that observed in the Ampiyacu-Apayacu Regional Conservation Area (RCA) and the proposed Maijuna RCA. The Choro campsite had a typical uplands bird community. The Alto Cotuhé campsite had a slightly less diverse uplands avifauna than Choro, but more floodplain species. The Cachimbo campsite had few uplands species but a good suite of floodplain and aquatic birds.<br><br>As in the Maijuna region, the most important sightings were of a group that was restricted to poor-clay hills in all of our campsites: *Lophotriccus galeatus*, *Percnostola rufifrons* and *Herpsilochmus* sp. (this last species recently discovered along the Apayacu River and currently being described). These birds were most frequent in Choro, where poor-soil hills were more extensive, but even there they were less common than in the Maijuna region. At the Cachimbo campsite we also recorded the poor-soil specialists *Neopipo cinnamomea* and *Heterocercus aurantiivertex*. We observed the turnover of the two diurnal curassows present in Amazonian Peru: *Mitu salvini* was present at Choro, while *M. tuberosa* was present at Cachimbo and Alto Cotuhé. Conservation targets for birds include poor-soil species; healthy populations of game birds and macaws; eight species that are endemic to the northwestern Amazon; and 17 additional species that are only present in Peru north of the Amazon, six of which are only found east of the Napo River. |
| **Medium and large mammals** | We recorded 71 species of medium and large mammals during the rapid inventory. When small mammal species are included, these watersheds likely harbor approximately 160 different kinds of mammals.<br><br>Highlights of the inventory include 23 bat species, 12 primates, and 9 carnivores. We recorded the black-mantled tamarin (*Saguinus nigricollis*), a primate only found |

in Peru between the Napo, Amazon, and Putumayo rivers. Woolly monkey (*Lagothrix lagotricha*) densities were especially high in the headwaters of the Yaguas River. We found abundant tracks and signs of large cats (puma and jaguar), tapirs (*Tapirus terrestris*), white-lipped peccaries (*Tayassu pecari*) and collared peccaries (*Pecari tajacu*), and had direct observations of these last three and a puma. In the lower Yaguas watershed two river dolphins *(Inia geoffrensis* and *Sotalia fluviatilis*) were common, and we observed groups of up to nine *I. geoffrensis*.

At least seven of the species on the mammal list—mostly large primates, cats, cetaceans, and ungulates—are threatened at the Peruvian or global level. In the lower Yaguas some species were rarer (*Lagothrix lagotricha*) or more easily spooked (*Cebus apella* and *Pithecia monachus*) than at the upriver campsites, indicating that they have been hunted by nearby communities. We recommend managing the hunting of species that can be harvested sustainably (such as peccaries) and discouraging the hunting of large primates and tapirs in surrounding areas, in order to assure their long-term persistence and sustainable use.

**Human communities**

Peru's lower Putumayo watershed is home to 13 indigenous communities (ten with titled lands and three in the process of titling) and a total population of 1,100. Eleven of these communities are located on the southern banks of the Putumayo and two are at the juncture of the Yaguas and Putumayo. These towns, which are among the most remote in the Peruvian Amazon, are composed of a mix of ethnic groups including Huitoto, Bora, Quichua, Tikuna, Yagua, and non-indigenous immigrants.

The economy of this region has long been dominated by boom-and-bust cycles of natural resource extraction, beginning with the rubber boom (*Hevea brasiliensis*, *Couma macrocarpa*) a century ago. When the rubber trade collapsed, there followed successive booms in cat, peccary, and reptile pelts; rosewood (*Aniba rosaeodora*); latex (*Manilkara bidentata*); and coca. The most valuable natural resources at present are timber (especially tropical cedar, *Cedrela odorata*, and *Hymenaea* spp.) and fish (arapaima, *Arapaima gigas*, and silver arawana fry, *Osteoglossum bicirrhosum*).

These booms have historically been associated with patron-client relationships based on a debt-peonage system or "*habilito*," which have a history of negative impacts on local populations, including forced migrations, the loss of traditional territories, social inequality, and, more recently, conflicts between communities over access to natural resources. Likewise, these extractive economies have had a damaging effect on the region's natural resource stocks and their long-term sustainability. Today's economy has direct connections to international markets; timber is sold to Colombian brokers, while arawana fry are sold to intermediaries for the ornamental fish trade in Iquitos, from whence the fish are exported to Japan and China.

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| Human Communities (continued) | A subsistence economy is present in most communities, characterized by small-scale harvests of fish, timber, plant fibers, and game animals, as well as small-scale slash-and-burn agriculture. Most communities also participate in the extractive economy of timber and fish harvests, but at differing intensities.<br><br>The communities we visited showed a variety of assets, including a dynamic capacity for organizing and decision-making; strong networks of family support and reciprocity mechanisms; a rich knowledge of biology, including harvest methods for managing arawana and other aquatic resources; community initiatives to monitor and protect fishing sites; traditional ecological knowledge regarding the use of forest products (fruits, timber, and medicinal plants); and garden plots with a diverse range of crops. Together, these assets can provide the crucial knowledge and information needed to build a shared vision for managing and protecting the natural resources of the region over the long term. |
| **Principal assets for conservation** | 01 **A long-standing interest in conserving a network of watersheds in the Putumayo-Amazon interfluvium,** reflected in local communities' interest in preserving their forests, the area's inclusion as a conservation priority in Peru's 1993 and 2009 conservation priority planning, and PEDICP's repeated calls for a binational park in the region<br><br>02 **Local communities' talent for self-organization, especially communal initiatives to manage natural resources**<br><br>03 **The long-term presence in the region of the Instituto del Bien Común (IBC) and the Proyecto Especial Binacional Desarrollo Integral de la Cuenca del Río Putumayo (PEDICP),** and both organizations' experience in implementing initiatives to improve quality of life and the conservation of natural resources<br><br>04 **Existing initiatives in the Peruvian and Colombian governments aimed at making the two countries' laws in this border region more consistent and compatible** |
| **Principal conservation targets** | 01 **High habitat heterogeneity and rare geological and biological features,** including:<br>▪ High, ancient, early Pleistocene terraces in the Yaguas headwaters<br>▪ Peat swamps with unique dwarf forests (*chamizales*)<br>▪ Pebas Formation-derived mineral licks (*collpas*) scattered throughout the region<br><br>02 **A vast Amazonian watershed—the Yaguas—with intact ecosystems from its headwaters to its mouth,** including:<br>▪ Diverse forests in its headwaters<br>▪ Large oxbow lakes |

| RECOMMENDATIONS | |
|---|---|
| | ▪ Flooded habitats<br>▪ Underground tunnels and soil pipes<br>03 **Extraordinarily diverse plant and animal communities in good condition,** including:<br>▪ An intact flora and fauna that includes restricted-range species and species new to science<br>▪ Exceptionally diverse fish communities<br>▪ Healthy populations of nationally or globally threatened species<br>▪ Extensive populations of useful or commercially valuable species<br>▪ A source of plants and animals for neighboring human communities<br>04 **Culturally important areas, cemeteries, and other sacred sites**<br>05 **Diversified garden plots**<br>06 **Significant carbon stocks and sinks** |
| **Principal threats** | 01 **The perception of endlessly abundant natural resources** and a consequent lack of vision concerning their sustainable use over the long term<br>02 **The free and unregulated use of natural resources** in fishing, hunting, logging, and other extractive activities<br>03 **The region's location in a remote, sparsely populated border area** with a high tolerance for illegal activities |
| **Principal recommendations** | 01 **Establish a strictly protected conservation area that encompasses most of the Yaguas watershed and all of the Peruvian Cotuhé (Fig. 2A)** and includes representative samples of the principal natural habitats in the region. Our inventory results favor the establishment of a national-level strictly protected area.<br>02 **In the lower Yaguas watershed, adjacent to the proposed area of strict protection, establish a second conservation area—either regional or national in character—that encourages the sustainable use of natural resources,** especially by communities of the lower Putumayo (Fig. 2A).<br>03 **Manage both conservation areas under an integrated administration model and closely involve local communities in their management and protection.**<br>04 **Identify practical opportunities for cross-border cooperation between proposed areas in Peru and existing protected areas in Colombia, especially Amacayacu National Park.**<br>05 **Complete the legal land-titling of the landscape in the Yaguas, Cotuhé, and lower Putumayo watersheds.** |

# Why Yaguas-Cotuhé?

Dawn breaks fast over the Yaguas River valley of northern Amazonian Peru. Seconds after touching the thatch roofs of the native communities just outside the river's mouth, the first rays enter the broad valley and begin lighting up the lower stretches of its floodplain, which locals have used for centuries but no longer inhabit. Racing westward, the slanting morning light brightens the beaches and oxbow lakes of the lower Yaguas on its journey up the valley, waking up palm swamps and pink dolphins and the canopy of majestic upland forest before dawn finally breaks on the high, ancient terraces in the river's headwaters, more than 200 km to the west of its mouth.

Fully awake, the Yaguas is a sight to behold. The astonishing plant, animal, and landscape diversity of this little-explored valley make it an ideal showcase of Peru's megadiverse wilderness between the Napo, Amazon, and Putumayo rivers. In the Yaguas and neighboring Cotuhé watersheds, the aquatic communities alone are estimated to harbor some 65% of the continental fish species known to occur in Peru.

The Yaguas also represents an increasingly rare opportunity to preserve a vast, intact Amazonian watershed in its entirety. To complement a strictly protected core area in the upper and middle Yaguas, local communities are proposing an adjacent buffer area in its lower stretches where they can harvest timber, fish, and other resources under sustainable management plans. This watershed focus simplifies management and reduces costs, since the river is the only point of entry to the roadless interior.

Bordering the Yaguas valley to the south, the binational Rio Cotuhé watershed offers a parallel opportunity to solidify longstanding plans for a cross-border protected area in this corner of Peru and Colombia. Protecting the Peruvian Cotuhé, itself a biological gem with minimal impact, would link both valleys to Colombia's Amacayacu National Park, creating a spectacular corridor of megadiverse equatorial forest in the two countries.

# Why a New Protected Area in the Peruvian Amazon?

**Authors:** Nigel Pitman, Matt Finer, Clinton Jenkins, and Corine Vriesendorp

When we first asked this question in 2003, the answers were simple (Pitman et al. 2004). The proportion of Peru's Amazonian lowlands then inside conservation areas—14.9% of land below 500 m elevation—was well below the South American average, strictly protected areas were overwhelmingly concentrated in the south, and national parks covered less than one percent of the region's most diverse department, Loreto.

Eight years later, two of the three findings remain true. Current protected areas coverage in Amazonian Peru is higher than in 2003—21.2%—and now just above the South American mean (Fig. 13; Jenkins and Joppa 2009). But most of the new conservation land established over the last seven years is located in southern Peru, and the proportion of Loreto that enjoys strict protection remains exactly the same as in 2003: 0.4%. In other words, the protected areas of Amazonian Peru still do not contain an adequate representation of the region's world-record biological diversity.

One of the most encouraging developments in the region over the last seven years has been the spread of alternative conservation tools: conservation concessions, ecotourism concessions, municipal conservation areas, and regional conservation areas (Monteferri and Coll 2009), which together now cover 2.6% of Amazonian Peru. Especially promising is Loreto's Program for the Conservation, Management, and Sustainable Use of the Biological Diversity of Loreto (PROCREL), whose officially established regional conservation areas now protect 2.3% of that department (Fig. 13).

This good news is offset, however, by the accelerating threats facing the region. Rates of habitat destruction caused by gold mining, highway construction, hydrocarbon prospecting, and illegal logging are quantitatively higher now than they were in 2003 (Killeen 2007, Oliveira et al. 2007, Finer et al. 2008, Asner et al. 2010, Finer and Orta-Martínez 2010), and large-scale infrastructure projects appear likely to increase pressure on Peru's Amazonian forests in the short and medium term (Dourojeanni et al. 2009).

Parks alone will not solve these problems, but a strong, representative protected-areas network remains a crucial part of the solution. In addition to securing long-term protection for the astonishing plant and animal life in the Yaguas and Cotuhé river basins, establishing the two new proposed conservation areas described in this book will boost conservation coverage of Loreto's forests to 21.7%, and coverage of Peru's Amazonian lowlands to 23.7%.

# Conservation in Yaguas-Cotuhé

## CONSERVATION TARGETS

**Landscapes, Watersheds, Biological Communities, and Carbon Stocks**

- A continuous, trinational biological corridor that facilitates genetic flow among plant and animal populations across the Putumayo watershed, from the Amacayacu National Park (Colombia) in the east to the Zona Reservada Güeppí (Peru) and the Reserva de Producción Faunística Cuyabeno (Ecuador) in the west
- Highly variable geology resulting in a mosaic of rich and poor soils, and diverse water chemistry in streams and lakes
- A high diversity of habitats representative of the Amazon-lower Putumayo interfluvium and currently not strictly protected anywhere in Loreto
- The entire Yaguas watershed, with all the habitats typical of a major river in the Amazonian lowlands (headwaters, flooded forests, large oxbow lakes), including spawning sites for local and migratory fish species
- Intact forests in the headwaters of the Yaguas and Cotuhé rivers, which regulate hydrological cycles and minimize erosion
- High upland terraces in the headwaters of the Yaguas River—with ancient, fragile, and especially nutrient-poor soils—dating to the lower Pleistocene (~2 million years old)
- Creeks with pebbly, sandy beds, atypical substrates for the Peruvian lowlands so far from the Andes
- A potentially enormous stock of underground carbon in the peat deposits associated with swamp forests
- A vast above-ground carbon stock in trees and leaflitter, typical of an intact tropical forest

**Species new to science**

- Plants: 10 species in the genera *Aphelandra* (Acanthaceae), *Calathea* (Marantaceae), *Calyptranthes* (Myrtaceae), *Carpotroche* (Achariaceae), *Cyclanthus* (Cyclanthaceae), *Eugenia* (Myrtaceae), *Mayna* (Achariaceae), *Palmorchis* (Orchidaceae), and *Pausandra* (Euphorbiaceae)
- Fishes: seven species in the genera *Ituglanis*, *Centromochlus*, *Mastiglanis*, *Batrochoglanis*, *Ancistrus*, *Characidium*, and *Synbranchus*
- Amphibians: two species in the genera *Osteocephalus* and *Pristimantis*, found in the center of the proposed Yaguas-Cotuhé strictly protected area
- Birds: one species in the genus *Herpsilochmus*, discovered previously in adjacent areas (old terraces in the Maijuna region and on the Apayacu and Ampiyacu rivers) but not yet described

**Restricted-range species**

- Birds: four poor-soil specialist species on high terraces, eight species endemic to northwestern Amazonia, and 25 species that in Peru are only found north of the Amazon River
- Mammals: *Saguinus nigricollis* (black-mantled tamarin), a primate that in Peru is only found in the Napo-Amazon-Putumayo interfluvium and that does not occur in any strictly protected conservation area in Peru
- Seventeen species apparently new to science (see above), many of which likely have restricted geographic ranges

**New records for Peru**

- Plants: seven new records for the Peruvian flora, including herbs, palms, and canopy trees; this number will likely increase as collections are reviewed by more specialists
- Fishes: 11 species previously known from Brazil, Colombia, and Venezuela
- Reptiles: *Atractus gaigeae*, a snake previously only known from Ecuador

**Nationally or globally threatened species**

- Trees: Tropical cedar (*Cedrela odorata*, VU), *Manilkara bidentata* (VU), and *Couratari guianensis* (VU)
- Other plants: healthy populations of the ornamental cycads *Zamia ulei* and *Z.* aff. *hymenophyllidia* (Zamiaceae; CITES Appendix II)
- Fishes: *Paratrygon aiereba* and *Potamotrygon* spp., stingrays in the family Potamotrygonidae classified as threatened by the IUCN; arapaima (*Arapaima gigas*, CITES Appendix II)
- Reptiles: yellow-footed tortoise (*Chelonoidis denticulata*, VU) and black caiman (*Melanosuchus niger*, VU)
- Birds: Red-and-green Macaw (*Ara chloropterus*, VU), Scarlet Macaw (*Ara macao*, VU), and Salvin's Curassow (*Mitu salvini*, VU)
- Mammals: giant otter (*Pteronura brasiliensis*, EN), ocelot (*Leopardus pardalis*, VU), oncilla (*Leopardus tigrinus*, VU), giant armadillo (*Priodontes maximus*, VU), giant anteater (*Myrmecophaga tridactyla*, VU), woolly monkey (*Lagothrix lagotricha*, VU), tapir (*Tapirus terrestris*, VU), yellow-handed titi monkey (*Callicebus torquatus*, VU), and pink river dolphin (*Inia geoffrensis*, VU)

**Commercially important flora and fauna**

- Healthy populations of important timber species like *Cedrelinga cateniformis*, *Simarouba amara*, *Hura crepitans*, *Parkia nitida*, *Ceiba pentandra*, *Eschweilera* spp., *Hymenaea oblongifolia*, *Lacmellea peruviana*, *Manilkara bidentata,* and *Qualea* spp.
- Diminished populations of important timber species like tropical cedar (*Cedrela odorata*), which can be recovered with careful management
- Extensive populations of other useful plants, including *irapay* (*Lepidocaryum tenue*), *shapaja* (*Attalea insignis*), and *ungurahui* (*Oenocarpus bataua*), in the Yaguas and Cotuhé uplands

- Reptiles and amphibians hunted for food or trade by local communities, including white caiman (*Caiman crocodilus*), the *hualo* frog (*Leptodactylus pentadactylus*), yellow-footed tortoise (*Chelonoidis denticulata*), and smooth-fronted caiman (*Paleosuchus trigonatus*)
- Healthy populations of other game and fishery species, including at least 67 fish species that are valuable as food or ornamentals
- Healthy populations of ornamental fish species (with the exception of silver arawana, *Osteoglossum bicirrhosum*)

**Flora and vegetation**

- Intact and mostly undisturbed forests throughout the Yaguas and Cotuhé watersheds
- Hundreds of plant species that are characteristic of the Napo-Amazonas-Putumayo interfluvium and lack strict protection in Peru
- Distinctive plant communities on the high early Pleistocene terraces in the Yaguas headwaters
- Dwarf forests (*chamizales*) and a tremendous variety of other swamp vegetation growing on peat deposits in the Yaguas floodplain
- A characteristic riparian and lakeside flora associated with small rivers and oxbow lakes in the lower Yaguas River
- Rare, threatened, commercially valuable, and undescribed plant species (see above)

**Fishes**

- Two of the most commercially important fish species for residents of the lower Putumayo, both facing serious threats: silver arawana (*Osteoglossum bicirrhosum*, the leading ornamental fish species in Peru) and arapaima (*Arapaima gigas*, a valuable food fish)
- *Pseudoplatystoma punctifer* and *Brachyplatystoma vaillantii*, commercially valuable migratory catfish

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| | ▪ Small streams with a unique, specialized ichthyofauna (e.g., *Hemigrammus*, *Knodus*, *Rivulus*, and other ornamental fish species)<br>▪ Ornamental and potentially ornamental species in the genera *Gymnotus*, *Ancistrus*, *Apistogramma*, *Bujurquina*, and *Corydoras*<br>▪ Rare, threatened, and undescribed fish species (see above) |
| | **Amphibians and reptiles**<br>▪ A fossorial frog species in the genus *Synapturanus* associated with tropical peatlands<br>▪ A diverse community of snakes comprising mostly non-venomous species but killed by residents out of fear or misunderstanding<br>▪ Rare, threatened, commercially valuable and undescribed amphibian and reptile species (see above) |
| | **Birds**<br>▪ Large populations of game birds, especially Salvin's Curassow (*Mitu salvini*) and Razor-billed Curassow (*Mitu tuberosum*)<br>▪ Healthy populations of large macaws<br>▪ A small group of bird species restricted to poor-soil habitats<br>▪ Rare, threatened, and undescribed bird species (see above) |
| | **Medium and large mammals, and bats**<br>▪ Near-threatened species like white-lipped peccary (*Tayassu pecari*), jaguar (*Panthera onca*), and other cats whose populations are descreasing in portions of their ranges, like puma (*Puma concolor*) and ocelot (*Leopardus pardalis*)<br>▪ Game species with declining populations in various portions of their ranges (IUCN 2010), like red howler monkey (*Alouatta seniculus*), brown capuchin monkey (*Cebus apella*), and white-fronted capuchin monkey (*Cebus albifrons*), and species with a poorly known conservation status, like monk saki monkey (*Pithecia monachus*) |

- Diverse, complex bat communities that provide crucial environmental services like seed dispersal (frugivorous species) and insect control (insectivores) and thus help maintain forest structure and population equilibria
- Rare, threatened, and commercially valuable mammal species (see above)

**Cultural**

- Kinship and neighbor relationships that strengthen cultural roots and group identity, as well as social reciprocity, equality, and solidarity in communities
- Intergenerational transfer of traditional practices to manage and harvest natural resources
- Traditional management techniques compatible with conservation, such as diversified garden plots and the sequential re-use of secondary forests in slash-and-burn agriculture
- Long experience using forest plants for food, medicine, and building materials
- Deep knowledge of aquatic ecosystems (lakes, streams, and rivers) and resources

## THREATS

01 **The perception of endlessly abundant natural resources** and a consequent lack of vision regarding their sustainable use over the long term, which is associated with

- Unsustainable, market-driven harvests of some natural resources;
- Skepticism regarding management and/or conservation models that do not allow the free, unregulated use of resources;
- Misunderstanding and mistrust of conservation legislation and agencies

02 **The free and unregulated use of natural resources in fishing, hunting, logging, and other extractive activities**, which leads to

- Concentrated economic power in the hands of small influential groups (especially those with the greatest extraction capacity, e.g., *patrones*)
- Conflicts among communities
- A high tolerance for illegal activities

03 **The region's location in a remote, sparsely populated border area,** where

- Government institutions are weak or absent, especially those charged with natural resource mangement and the enforcement of environmental laws
- Peruvian and Colombian authorities apply different and sometimes conflicting laws, which generates confusion in the region and complicates enforcement
- Job opportunities are scarce and illegal activities such as drug traffic and natural resource smuggling are common
- Fuel and other goods are scarce and expensive

04 **A history of unsustainable hunting and logging in adjacent watersheds,** especially in the logging concessions in the Atacuari, Shishita, and Ampiyacu drainages to the south

05 **A long, ongoing history of migration and loss of cultural identity,** which results in

- Weak ties between recently arrived residents and the place they live
- A poorly understood sociocultural landscape in the region

06 **Possible future oil and gas concessions in the region, or the arrival of other large-scale infrastructure or extractive projects (e.g., highways, canals).** Neither petroleum nor gold are likely to occur in the region, given its geology, but unfounded rumors about their presence could potentially cause a large influx of small-scale miners and mercury pollution in the watershed

07 **Pending or overlapping land claims in some of the region,** including pending title petitions of some communities, the overlap of the historical "Predio Putumayo" with indigenous community lands and a large portion of the Yaguas watershed, and a conservation concession that includes most of the Cotuhé watershed, proposed here as a strictly protected area

08 **Debt-peonage systems related to the extractive economy,** which cause negative impacts on local populations. These include displacement, the loss of local ties, social inequity, and recent conflicts between communities over access to natural resources

ASSETS

**Cultural**

01 **A long-standing interest in conserving the Yaguas-Cotuhé region in a way that protects entire watersheds**

- Local community interest in preserving sacred forest sites (*sacha mama*)
- A priority conservation area in the Peruvian park service's 1993 and 2009 master plans
- A long-standing proposal for a cross-border protected area uniting Peru and Colombia (PEDICP/INADE)

02 **Local communities' talent for self-organization, especially communal initiatives to manage natural resources**

- Recent establishment of the Federation of Indigenous Communities of the Lower Putumayo (FECOIBAP)
- Various community initiatives to protect nearby oxbow lakes and other natural resources through fishermen's committees, fishery management plans for arapaima and silver arawana, and other measures

03 **Local knowledge of the forest and aquatic ecosystems, and the long historical use of various native species**

04 **Sustainable local agricultural practices**

**Biological**

05 **Intact and extremely diverse biological communities**

- One of the most diverse woody plant communities in the Amazon basin
- Probably the most diverse fish communities in all of Peru, with a total ichthyofauna estimated at more than 550 species
- Some of the most diverse amphibian and reptile faunas in the world
- A bird community of ~500 species, among the world's most diverse
- An intact mammal fauna, among the most diverse in Amazonia

**Regional**

06 **The current presence and long history in the region of the Instituto del Bien Común (IBC) and the Proyecto Especial Binacional Desarrollo Integral de la Cuenca del Río Putumayo (PEDICP),** and both organizations' experience in implementing initiatives to improve the quality of life and the conservation of natural resources. Possible bilateral alliances between Peruvian and Colombian institutions

07 **The current absence of oil and gas or mining concessions, and geological evidence indicating that oil and gold are unlikely to occur in the region**

08 **Existing initiatives in the Peruvian and Colombian governments aimed at making the two countries' laws in this border region more consistent and compatible**

- Working groups examining an extensive list of social, economic, and other topics of bilateral interest

09 **Borders of the proposed conservation areas that correspond to watersheds,** which will facilitate management

10 **Regional laws that protect headwaters areas (Ordenanza Regional 020-2009-GRL-CR)**

## RECOMMENDATIONS

**Protection and management**

01 **Establish a strictly protected area encompassing most of the Yaguas and Cotuhé watersheds (Fig. 2A)** and including representative samples of the principal natural habitats in the region. The results of our inventory support the establishment of a national-level strictly protected area, because the region

- Has been a high conservation priority for Peru since the 1990s, having been included as such in the Peruvian park service's 1993 and 2009 master plans, and was recommended even earlier for a cross-border protected area by PEDICP/INADE;
- Contains rare landscape features and diverse habitats, including high Pleistocene terraces and dwarf forests (*chamizales*) on extensive peatlands;
- Harbors exceptionally diverse fish communities, including at least seven species new to science;
- Protects extraordinarily diverse communities of plants, amphibians, reptiles, birds, and large mammals, including several species apparently endemic to this area of the Amazon;
- Is large enough to ensure the long-term survival of thousands of species characteristic of the Napo-Amazon-Putumayo interfluvium, which are not currently inside a strictly protected conservation area in Peru;
- Serves as a source of species for fishing, hunting, and logging in adjacent local communities and sustainable use areas (e.g., the Ampiyacu-Apayacu Regional Conservation Area);
- Has historically been considered a sacred site (*sacha mama*) by indigenous groups in nearby communities;
- Currently has no settled populations, uncontacted indigenous populations, mining or hydrocarbon concessions, or infrastructure projects;
- Contains neither petroleum nor gold, based on geological studies and maps of the region.

02 **Establish a second conservation area—either regional or national in character—that encourages the sustainable use of natural resources in the lower Yaguas watershed, adjacent to the proposed area of strict protection,** where communities of the lower Putumayo have a long history of natural resource use (Fig. 2A). The success of this area will largely depend on

- The active participation of nearby communities in its management (see below);
- Adaptive management plans to regulate natural resource extraction;
- A close collaboration between local communities and the protected area to restore the large oxbow lakes on the lower Yaguas, where some economically important fish species have been overexploited (e.g., silver arawana, arapaima); and

- Careful zoning that affords special protection to vulnerable habitats and species in the region (e.g., peat forests, primates, giant river otters).

03 **Manage both conservation areas under an integrated administration model and closely involve local communities in their management and protection,** via mechanisms including

- Training of local residents in natural resource management, replicating successful models in the lower Putumayo (e.g., the communities of Porvenir and Primavera) and elsewhere in Loreto (e.g., the Ampiyacu-Apayacu and Tamshiyacu-Tahuayo Regional Conservation Areas);
- Focusing management and enforcement efforts in strategic locations and entry points (e.g., the Santa Rosa de Cauchillo community at the mouth of the Yaguas River);
- Participatory mapping of natural resources (already carried out by IBC for community territories) and sociocultural mapping of neighboring communities, to help inform zoning and management decisions regarding the two proposed areas and to facilitate their implementation;
- Support from governmental and non-governmental organizations, and international cooperation agencies.

04 **Manage the two proposed conservation areas in partnership with adjacent protected areas to the west (the Ampiyacu-Apayacu Regional Conservation Area and the proposed Maijuna RCA),** thereby establishing and strengthening a large complex of protected forest in northern Loreto that is managed in collaboration with local indigenous communities (Fig. 2B).

05 **Identify practical opportunities for cross-border cooperation between the proposed conservation area in the Peruvian portion of the Cotuhé River and Amacayacu National Park in the Colombian portion.** This can be done in part through existing bilateral initiatives (e.g., the Colombia-Peru Plan for the Integrated Development of the Putumayo Watershed, the Bilateral Working Group, the countries' respective foreign ministries) with the goal of developing a shared vision of the region's protected areas and shared strategies to ensure their success.

06 **Complete the legal land titling of the landscape in the Yaguas, Cotuhé, and lower Putumayo watersheds,** with a special focus on

- Titling indigenous communities with pending claims;
- Resolving the overlap of the "Predio Putumayo" (a historical land claim dating to the rubber boom) with various indigenous communities and proposed conservation areas in the region;

| RECOMMENDATIONS | |
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| | ▪ Re-examining the conservation concession in the Cotuhé watershed, which overlaps with the proposed strictly protected conservation area.<br><br>07 **Empower local communities to serve as long-term conservation stewards of the area,** via strategies that include<br><br>▪ Strengthening existing organizations by clarifying their roles and potential regarding the conservation of natural resources and the improvement of communities' quality of life;<br><br>▪ Involving the indigenous federations of the area and especially FECOIBAP in opportunities for co-management of the proposed protected areas;<br><br>▪ Helping local residents construct a vision of sustainable, long-term resource use, based on the communities' social and cultural assets;<br><br>▪ Developing strategies with local residents and authorities to replace the extractive boom-and-bust cycle with stable economic opportunities;<br><br>▪ Creating new communication tools based on the participatory mapping exercise to express a long-term conservation vision, illustrate conservation concepts, and counter unwarranted rumors (e.g., the presence of gold deposits, the threats posed by giant otters to fisheries); and<br><br>▪ Designing educational materials for local students focused on specific topics in conservation and the sustainable management of natural resources, and encouraging adults and older residents to pass on their accumulated knowledge of the area to younger generations.<br><br>08 **Develop more efficient collaboration between the Peruvian armed forces stationed in this border region and the Peruvian authorities responsible for enforcing environmental laws,** based on successful experiences in Colombia and elsewhere.<br><br>09 **Enforce the existing prohibition of mining activity in the region.** |
| **Participatory monitoring and communications** | 01 **Involve local populations in the restoration and monitoring of the fauna in the large oxbow lakes of the lower Yaguas floodplain.**<br><br>02 **Involve local populations in the development and implementation of monitoring plans for vulnerable commercially valuable species** (e.g., tropical cedar, silver arawana), as well as for commonly used species (e.g., river turtles and other game animals).<br><br>03 **Involve local populations in the development and implementation of sustainable management plans for timber and fishery resources,** with the aim of ending illegal or unsustainable harvests. |

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| | 04 **Communicate at the local, regional, and national levels geological evidence indicating the absence of oil and gold in the region.** |
| **Research** | 01 **Mapping soils across the region** is a high priority because rich and poor soil heterogeneity is a strong driver of plant and animal distributions in the area.<br>02 **Study ombrotrophic swamps and other forests growing on peat deposits in greater detail** to better understand their origin, stability, and nutrient dynamics.<br>03 **Quantify the carbon stock and carbon accumulation rates in the peat deposits of the Yaguas watershed** and map the distribution of peat deposits in the region.<br>04 **Study the flora and fauna of the high, early Pleistocene terraces in the Yaguas headwaters in greater detail.**<br>05 **Carry out a social inventory of the town of Buenos Aires,** located where the Cotuhé River crosses the Peru-Colombia border. The survey should be carried out in partnership with Colombian researchers and indigenous organizations.<br>06 **Reconstruct the historical movements of the Yagua peoples and other indigenous groups known to have inhabited the region in the past** |