

ENGLISH CONTENTS

(for Color Plates, see pages 19-34)

134	Participants	215	History of the Region and its Peoples
136	Institutional Profiles	215	Territorial History of the Matsés
139	Acknowledgments	218	Socio-cultural Assets of the Comunidad Nativa Matsés
141	Mission	229	Appendices
142	Report at a Glance	230	(1) Geology, Hydrology, Soils
147	Why Matsés?	250	(2) Plants
148	Why protect white-sand forests?	289	(3) Fishes
149	Overview of Results	296	(4) Amphibians and Reptiles
149	Landscape and Sites Visited	304	(5) Birds
149	Geology, Hydrology, Soils	322	(6) Mammals
150	Vegetation and Flora	328	(7) Matsés Demography
151	Fishes	329	Literature Cited
152	Amphibians and Reptiles	336	Previous Reports
152	Birds		
153	Mammals		
153	Human Communities		
154	Threats		
156	Conservation Targets		
159	Recommendations		
165	Technical Report		
165	Overview of Inventory Sites		
168	Landscape Processes: Geology, Hydrology, and Soils		
174	Flora and Vegetation		
184	Fishes		
191	Amphibians and Reptiles		
197	Birds		
205	Medium and Large Mammals		

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INSTITUTIONAL PROFILES

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. Environment, Culture, and Conservation (ECCo) is the division of the museum 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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Comunidad Nativa Matsés

The Comunidad Nativa (CN) Matsés is an indigenous territory legally registered in Loreto, and includes the majority of Matsés indigenous peoples in Peru. The Matsés territory was legally titled in 1993, and covers 452,735 ha in the Yaquerana district, Requena province, Loreto. The CN Matsés consists of 13 settlements, or *Anexos* situated along the banks of the Río Yaquerana, Río Gálvez, and the Quebrada Chobayacu. The Matsés, hunter-gatherers and farmers by tradition, are in the process of becoming more sedentary. Their organization is based on familial relationships and matrimonial alliances. The *Juntas de Administración* and the *Asamblea General de Delegados* govern formal institutional relationships between the *Anexos*, and the *Junta Directiva* legally represents the CN Matsés. The CN Matsés is autonomous and is not affiliated with any indigenous federation.

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Centro para el Desarrollo del Indígena Amazónico (CEDIA)

CEDIA is a non-governmental organization that has supported Amazonian indigenous peoples for more than 20 years, principally through land titling, seeking legal rights for indigenous groups, and community-based resource management. They have titled more than 350 indigenous communities, legally protecting almost four million ha for 11,500 indigenous families. With an integral vision of long-term territorial and resource management, CEDIA supports organizational strengthening of indigenous groups seeking to defend their territories and effectively manage their natural resources and biodiversity. They work with several indigenous groups including Machiguenga, Yine Yami, Ashaninka, Kakinte, Nanti, Nahua, Harakmbut, Urarina, Iquito, and Matsés in the Alto and Bajo Urubamba, Apurímac, Alto Madre de Dios, Chambira, Nanay, Gálvez and Yaquerana watersheds.

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Herbario Amazonense de la Universidad Nacional de la Amazonía Peruana

The Herbario Amazonense (AMAZ) is situated in Iquitos, Peru, and forms part of the Universidad Nacional de la Amazonía Peruana (UNAP). It was founded in 1972 as an educational and research institution focused on the flora of the Peruvian Amazon. It houses collections from several countries, but the bulk of the collections showcase representative specimens of the Amazonian flora of Peru, one of the most diverse floras on the planet. The collections serve as a valuable resource for understanding the classification, distribution, phenology, and habitat preferences of plants in the Pteridophyta, Gymnospermae, and Angiospermae. Local and international students, professors, and researchers use the collections to teach, study, identify, and research the flora. Through its research, education, and plant identification the Herbario Amazonense contributes to the conservation of the diverse Amazonian flora.

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INSTITUTIONAL PROFILES

Museo de Historia Natural de la 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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Centro de Conservación, Investigación y Manejo de Áreas Naturales (CIMA-Cordillera Azul)

CIMA-Cordillera Azul is a private, non-profit Peruvian organization that works on behalf of the conservation of biological diversity. Our 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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ACKNOWLEDGMENTS

The success of our rapid inventories depends largely—if not entirely—on an enormous network of collaborations on the ground: from the hospitality and ingenuity of local residents, to the excitement and collaborations of our scientist colleagues, to the invaluable support of large government agencies. This inventory was no exception. We sincerely thank each and every individual who helped make this work possible, although we are able to highlight only a small subset below.

We could not have surveyed the spectacular lowland forests surrounding the Comunidad Nativa Matsés without the integral involvement of our Matsés guides and counterparts. They participated in every aspect of the inventory: preparing camps and trails as part of the advance team; surveying plants, fishes, frogs, snakes, birds, and mammals as part of the biological team; identifying traditional assets as part of the social team. We cannot thank the Matsés leaders and our field companions enough for inviting us to inventory the forests neighboring their lands, welcoming us into their communities, and sharing their vision for the future with us.

Guillermo Knell once again handled the logistics masterfully, coordinating the advance preparations for the inventory and putting together a formidable, multi-talented team: José-Ignacio (Pepe) Rojas, Antonio Garate, and Dani Rivera. The advance team led the construction of heliports, campsites, and trails. In addition, Dani formed part of the herpetological team at Itia Tëbu, while Pepe contributed greatly to the bird inventory at Actiamë.

We received excellent support from every settlement within the Comunidad Nativa Matsés. In Choncó, Pepe Rojas was joined by Robinson Reyna from Jorge Chávez; Pepe Rodriguez, Antonio Reyna and Hernan Manuyana from Buen Perú; Pepe Vela, Benito Vela, and Andres Fasabi from San Jose de Añushi; and Jorge Waki, Samuel Coya, and Daniel Teka from San Juan. Dani Rivera and Antonio Garate established Itia Tëbu with Cesar Sanchez from Jorge Chavez; Eliseo Silvano and Oscar Lopez from Remoyacu; Mariano Manuyama, Ramon Jimenez, Glen Manuyama from Buen Perú, Noe Silvano from Paujíl; German Rodriguez and Gidebrando Tumi from San Mateo; and Juan Tumi from San Jose de Añushi. Guillermo Knell led the team at Actiamë that included Douglas Dunu and Daniel Nacua from Puerto Alegre; Mario Binches, Julio Tumi, and Leonardo Dunu from Buenas Lomas Nueva; Tomas Necca and Jaime Teca from Buenas Lomas

Antigua; Douglas Tumi and Luis Jimenez from Estirón; and Eliseo Tumi from Santa Rosa. Our cook, Eliza Vela Collantes, ensured that we were well fed.

Commander Dario Hurtado, of the Peruvian National Police Aviation Unit, once again brilliantly coordinated our impossibly complicated transportation logistics, inspiring calm even amidst the tensest moments through his unflinching leadership and rapid problem-solving capacity. We are grateful for the continued support and assistance from the Peruvian National Police and extend our special thanks to Captain Jhonny Aguirre and to Carlos Espinoza, of Requena. We also thank Carlos Gonzales and Copters-Peru for their support in the field.

The ornithologists thank Tom Schulenberg for his helpful review of the bird chapter and José (Pepe) Álvarez for his careful assessment of the *Hemitriccus* tape-recording from the white-sand forests. The ichthyological team thanks Hernan Ortega for providing valuable comments on the fish chapter, and the herpetologists thank Lily Rodriguez and Victor Morales for helping out with troublesome amphibian identifications.

The botanical team is deeply grateful to the Herbario Amazonense for providing space to dry and organize plant specimens. We extend a special thanks to the director, Meri Nancy Arevalo, who enabled and coordinated all of our work in the herbarium, and who also liberated one of us when the herbarium was unexpectedly locked during a city-wide strike in Iquitos. Several experts helped us to identify plant specimens and photographs; we thank W. Anderson, N. Hensold, M.L. Kawasaki, J. Kuijt, J. Kullunki, D. Neill, R. Ortiz-Gentry, C. Taylor, and A. Vicentini.

The social inventory team thanks Eddy Mejía, Patricio Zanabria, Manuel Vela Collantes, Ángel Uaquí Dunú Mayá, and Santos Chuncún Baí Bëso for sharing results from their preliminary fieldwork in the Blanco and Tapiche rivers. This information contributed greatly to the section on the History of the Region and its Peoples. Most importantly, we express deep gratitude to all residents of the Matsés settlements along the Río Yaquerana, Río Gálvez, and Quebrada Chobayacu, who received us in their homes, shared their friendship, and supported us in every way during our stay in the field.

The CEDIA offices in Lima and Iquitos supported us with many details; we especially thank Jorge Rivera for making

ACKNOWLEDGMENTS

invaluable maps and Ronald Rodriguez for coordinating the administrative and financial details of the inventory in Peru. We thank the Hotel Sadicita in Requena and the Hotel Doral Inn in Iquitos for tolerating the mud and occasional chaos.

As always, in Chicago we had the constant support of our winning team: Tyana Wachter and Rob McMillan. They helped out in every aspect, making sure that the inventory ran smoothly from the advance preparations to our time in the field to the writing, proofing, and dissemination of our reports. Dan Brinkmeier and Kevin Havener produced wonderful hand-drawn maps, and Sergio Rabiela provided invaluable technical assistance with satellite imagery. We were fortunate to work with a talented group of translators, proofreaders, and copyeditors, and extend our

sincere gratitude to Patricia Álvarez, Andrea Nogués, Roosevelt García, Guillermo Knell, Tatiana Pequeño, Laura Schreeg, Doug Stotz, and Tyana Wachter.

Jim Costello and his team at Costello Communications continue to give of themselves to make the design of each report convey the essence of the place. We thank them deeply.

We are extremely grateful to the administration at The Field Museum for its continued support and to the Gordon and Betty Moore Foundation for their grant supporting this inventory. Finally, we thank the Regional Government of Loreto and INRENA for continuing to invite us to participate in the conservation of Peru's exceptional wild lands.

MISSION

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

In 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 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 fieldwork

25 October–6 November 2004

Region

Loreto province, northeastern region of the Peruvian Amazon, in the interfluvium between the Blanco, Gálvez, and Yaquerana rivers. The area is bordered on the west by the headwaters of the Río Gálvez, a mere 3 km from the Río Blanco. In the south, the area borders the proposed Zona Reservada Sierra del Divisor; in the east, it borders the Comunidad Nativa Matsés, and to the north, the area is 150 km from the city of Iquitos (Figure 2). This vast extension of lowland forests harbors an exceptional variety of soils and forest types.

Sites surveyed

Three sites in the Amazonian lowlands that border the Comunidad Nativa Matsés: Choncó, in the middle part of the Río Gálvez basin; Itia Tëbu, in the headwaters of the Río Gálvez, close to the Río Blanco; and Actiamë, along the banks of the main channel of the Río Yaquerana (Figures 3A, E, I).

Organisms surveyed

Vascular plants, fishes, reptiles and amphibians, birds, and large mammals

Highlights of results

Our most surprising and spectacular result was finding a large archipelago of white-sand forests, known locally as *varillales*, in the headwaters of the Río Gálvez. These extensive patches of white-sand forest—unknown to scientists until this inventory—contain floral and faunal endemics and represent a rare habitat in Peru and the rest of the Amazon. Because of the great edaphic variation across the proposed Reserva Comunal Matsés, from the poor white-sand soils to extremely rich soils, the area harbors a near complete sample of the extraordinary diversity of plants and animals living in *terra firme* forests of the Peruvian Amazon.

Plants: The forests in the proposed Reserva Comunal Matsés are tremendously heterogeneous and diverse, and appear to shelter a higher diversity of plants than any other reserve in lowland Peru. The botanists registered ~1,500 species of plants in the field, and estimate a regional flora between 3,000–4,000 species. Of the more than 500 fertile species collected during the inventory, several of the locally common species are potentially new records for Peru and/or new to science. The forests here are notably intact.

Fishes: During two weeks of sampling the rivers, lagoons, and blackwater, clearwater, and whitewater streams of the area, the ichthyological team recorded 177 species of the more than 300 species they estimate for the region. Ten of these species are new records for Peru, and up to eight species could be new to science. Much of the fish diversity is concentrated in forest streams, with a great richness of ornamental species (cichlids, pencil fish). The larger rivers support healthy populations of species consumed by humans, including *paiche*, *tucunaré*, *doncella* and *arahuana*.

Highlights of results
(continued)

Reptiles and Amphibians: The herpetological team registered 74 species of amphibians and 35 species of reptiles (18 lizards, 13 snakes, 2 caimans, 2 turtles) during the inventory. Three of the amphibian species are potentially new to science, including one species that appears to be restricted to white-sand habitats (a *Dendrobates* with golden legs, Figure 6C). The herpetologists recorded a new genus for Peru, *Synapturanus* (Figure 7C), when they heard the call of this subterranean species coming from under the mud. The team estimates more than 200 species of amphibians and reptiles for the region, including 100-120 species of amphibians, 25 lizards, 4 caimans, 8 turtles, and 70 snakes.

Birds: In the 14 day-inventory, the ornithological team recorded 416 of the 550 species of birds they estimate to live in the region. Several of their records represent substantial range extensions, and four of the recorded species are locally distributed in Peru, with fewer than 10 previous records. The three inventory sites were markedly different in community composition (diversity and abundance of species) reflecting the habitat differences between sites. The team found two white-sand habitat specialists during the inventory, one of which may be new to science. With additional inventories, we would expect to find more habitat specialists in the vast white-sand archipelago in the Matsés region.

Mammals: Western Amazonia is one of the areas with highest mammal diversity in the world. The proposed Reserva Comunal Matsés is no exception, with 65 large mammal species estimated for the region, and 43 species recorded during the inventory. The area supports healthy populations of many species threatened at the global level, including a high density of large primates (woolly and spider monkeys, Figure 9A). Two rare and endangered monkey species, *Cacajao calvus* and *Callimico goeldii*, are known from this area, although they were not seen during the inventory. The mammal community within the Matsés region does not bear signs of hunting impacts and appears remarkably intact.

Human Communities

The Matsés people have lived in this region for generations, on both sides of the border between Peru and Brazil. In 1993 the Peruvian Matsés, with the assistance of CEDIA, obtained legal title to their lands, an area now known as the Comunidad Nativa Matsés (CNM: 452,735 ha). Some 1,700 Matsés people live within the CNM, dispersed among 13 human settlements, or *Anexos*, along the Quebrada Chobayacu, and the Yaquerana and Gálvez rivers.

Main threats

Timber extraction and related impacts (tractor trails [Figure 10D], access points for colonists), presents one of the most serious threats to the region. On the west side of the Río Blanco, an area slated for timber concessions overlaps with a large expanse of white-sand forest. These forests—with their extremely short and thin

REPORT AT A GLANCE

Main threats (continued)

trees—exhibit such low levels of productivity that generations of Matsés consider them unproductive both for hunting and for farming. The destruction observed in other white-sand forests (e.g., forests close to IQUITOS in the Nanay river basin) demonstrates clearly that not only would timber extraction in white-sand areas be unproductive and an economic loss, it would devastate the singular biological communities that live there.

Resource extraction is a threat to areas outside of the Río Blanco as well. Within the Río Gálvez watershed, the Matsés experience strong pressures from loggers and other commercial traders interested in harvesting the natural resources found within the Comunidad Nativa Matsés.

Antecedents and Current Status

For generations, the forests in and around the Comunidad Nativa Matsés have supported the traditional lifestyles of the Matsés people. Together with CEDIA, the Matsés have been proposing formal, legal protection for the proposed Reserva Comunal for 14 years. With the results of this inventory and the previous work of CEDIA in the region, the Comunidad Nativa Matsés proposes the protection of 391,592 ha to establish the Reserva Comunal Matsés in the diverse lowland forests bordering their titled lands. They also propose to extend their native community (CNM) farther south to include an additional 61,282 ha.

Principal protection and management recommendations

- 01 Establish the Reserva Comunal Matsés (391,592 ha, Figure 2, Map 1) to protect a nearly complete gradient of terra firme habitats that border the Comunidad Nativa Matsés.
- 02 Secure the highest level of protection for the extensive white-sand forests (Map 2) that offer minimal potential for resource use—commercial or subsistence—and are extremely fragile and harbor endemic species.
- 03 Provide adequate protection for the headwaters of the Gálvez and Yaquerana rivers, and their source areas of animal and plant populations that are important for the Matsés.
- 04 Ensure that the *Jefe*, the *Junta Directiva*, and the *Asociación de Jóvenes* of the Comunidad Nativa Matsés are an integral and central part of the administration of the proposed protected area, the Reserva Comunal Matsés.
- 05 With the Matsés community elaborate management plans for the use of natural resources within the Comunidad Nativa Matsés.

Map 1

Proposed areas bordering the
Comunidad Nativa Matsés



Map 2

White-sand forests in the region



REPORT AT A GLANCE

Long-term conservation benefits

The conservation area we are proposing for the Matsés region represents an **opportunity to protect the impressive array of habitats and microhabitats within the region**, which encompass a very high proportion of Loreto's world famous biodiversity. The forests within the proposed Reserva Comunal Matsés also harbor great cultural diversity, providing refuge for **the Matsés and the natural resource knowledge** they have accumulated over generations. The creation of this new conservation area will protect:

- 01 an area of high cultural and biological value
- 02 the extensive white-sand forests, rare and poorly understood habitats, with high plant and animal endemism
- 03 a nearly complete gradient of the principal terra firme habitats in Amazonia
- 04 the headwaters of the Gálvez and Yaquerana rivers
- 05 the important source areas of plants and animals for the Matsés
- 06 the commitment of the Matsés to manage their natural resources

Why Matsés?

At first glance, the Matsés region appears to be typical lowland Amazonian forest—wet, hyperdiverse, and teeming with wildlife. Hills, both gentle and more sloped, dominate the region, and rivers and streams course through its intact forests. From space, satellite images reveal a rich collage of green hues that reflect the underlying plant diversity, punctuated by the occasional deep purple of a swamp forest, or the harsh blue of a regenerating forest or clearing (Figure 2). But a closer look reveals broad swathes of forest on either side of the Río Blanco that reflect a shade of lilac; these unexpected hues were our first hint that the Matsés region is extraordinary.

The lilac areas were a mystery to us. In initial overflights we saw extensive populations of short *Mauritia* and *Euterpe* palms, leading us to speculate that our inventory in these areas would land us in an oddly stunted swamp forest. However, once on the ground we realized that these palms were not the *Mauritia flexuosa* or *Euterpe precatoria* palms typical of Amazonian swamp forests, but instead were their white-sand cousins, *Mauritia carana* (Figure 3G) and *Euterpe catinga* (Figure 4J). The lilac-colored areas represent an enormous complex of white-sand forests previously unvisited by scientists and larger than any of the known white-sand forests in Peru (Figure 12A).

The Matsés—the region’s long-term inhabitants—have a deep knowledge of the natural resources within their territories. They have known about these white-sand forests for ages and consider them to be fragile and sacred areas. Over generations, they learned that these areas are unproductive for agriculture because of their nutrient-poor soils and are unsuitable for hunting because of their scarce game species.

But it was not just the white-sand forests that impressed us during the inventory. In a single day, we could walk through floodplains, lush upland forests, wet bottomlands and swamps, all underlain by a vast patchwork of different soils. This wilderness shelters an almost complete representation of the forest and river types in lowland Amazonia. The habitat mosaic, with its soil fertility and hydrological gradients, is a crucial laboratory of evolution. Preserving the proposed Reserva Comunal Matsés and the adjacent white-sand forest, with deep involvement from the Matsés, will protect this rich and unusual natural tapestry for this and future generations.

Why protect white-sand forests?

Forests growing on white-sand soils are some of the least species diverse of all Amazonian forest communities. Typically, the trees are slender and short, and animals are scarce. Why should we work to conserve these odd, low-diversity communities?

Although white-sand forests are barely one-fifth as diverse as the richest Amazonian *terra firme* forests, the species that occur there are largely endemics. In the last ten years, biologists working in white-sand forests near Iquitos have discovered more than two dozen species new to science, including five birds, and numerous plants and insects. These species have not been registered outside of white-sand forests and many occur only in Peru.

White-sand forest communities are rare throughout the landscape. In the entire Amazon basin, they represent ~3% of lowland forests and these mostly occur within the Río Negro basin in Venezuela and Brazil. In Peru, white-sand habitats are even less common. There are eight known patches of white-sand forest in Peru, representing less than 1% of lowland Peruvian rainforest (Figure 12A). Currently, only one of these areas is protected, the Reserva Nacional Allpahuayo-Mishana (58,069 ha), and only some 20% of this reserve is white-sand forest.

The eight white-sand patches are isolated from one another and from similar habitats in Colombia, Venezuela, and Brazil. This scattered distribution likely reinforces not only the endemism but also the vulnerability of Peru's white-sand flora and fauna. For example, a new species of gnatcatcher (*Polyoptila clementsii*) was described in 2005. Fewer than 25 individuals are known in the world, and all occur in

two white-sand forest patches in and near the Reserva Nacional Allpahuayo-Mishana.

White-sand forests are extremely fragile. These soils have some of the lowest nutrient availabilities recorded anywhere. Mineral nutrients reside within living organisms, and roots and fungi quickly capture any decomposing nutrients. If the trees are cleared in a white-sand forest, nutrients leach rapidly through the sand, and the soil degrades. Using these forests for extractive or agricultural activity is counterproductive economically, because more resources are expended in clearing the forests than could ever be recuperated from agricultural or logging enterprises.

Because white-sand forests are rare, fragile habitats that shelter vulnerable and endemic species, the proposed Zona Reservada Los Varillales (195,365 ha; Figures 2, 12A) represents a terrifically important conservation opportunity. Along the Río Blanco there are scattered small human settlements; however, the great majority of the area is uninhabited and intact forest. In only three days at this site, scientists found species never previously recorded in Peru, and some new to science. This area represents the largest known white-sand forest in Peru. Since larger populations are more resistant to extinction, the Zona Reservada Los Varillales will safeguard rare and endemic species that otherwise will disappear forever.

Overview of Results

LANDSCAPE AND SITES VISITED

For two weeks in October-November 2005, the rapid biological inventory team surveyed *terra firme* forests, floodplains, swamps, streams, and lakes in the proposed Reserva Comunal (RC) Matsés (391,592 ha; Figure 2). We focused on three uninhabited sites to the north, west, and south of the native territories of the Matsés people, the Comunidad Nativa Matsés. Concurrently, the social team visited seven Matsés settlements, and met with Matsés leaders to identify local assets and initiatives that can play an important role in conserving their lands and those that border their community. Although this area of Peru is intimately known to the Matsés, nearly the entire region was unknown to biologists before our inventory.

Our closest point of comparison was a rapid inventory of four sites along the Río Yavarí (Pitman et al. 2003). Since the Matsés region forms part of the Yavarí basin, we suspected the two areas would be biologically very similar. However, on the contrary, results for all the organisms surveyed—plants, fishes, amphibians, reptiles, birds, and mammals—indicated that the Matsés region harbors many unique species. Moreover, several habitats surveyed in the Matsés region were not explored during the Yavarí expedition, nor are these habitats apparent on satellite images of the Yavarí region. Below we give a more detailed overview of our results, placing them in a regional and global context wherever possible, and highlighting the unique features of the Matsés landscape.

GEOLOGY, HYDROLOGY, SOILS

Several techniques were used to assess the geology, hydrology, and soils of the Matsés region, ranging from large-scale examinations of satellite images to smaller-scale measures of topographical features, soil profiles, and water properties. These preliminary measures reveal a landscape with great heterogeneity in soil fertility and soil composition within and among sites.

Two large geological features underlie this heterogeneous landscape: the Iquitos Arch and the Bata-Cruzeiro fault. The Iquitos Arch is an uplifted formation that runs more or less along an east-west axis and is bisected by the Bata-Cruzeiro

fault near the Río Blanco (Figure 2). Evidence of faulting in the Amazon basin is less obvious than in mountainous areas such as the Andes, but a careful look at the satellite image reveals numerous, almost linear, streams running perfectly parallel to the Río Blanco along the fault lines. In addition, the Río Blanco valley is the lowest point (<100 m above sea level) in the surrounding landscape, suggesting that this area dropped downward during the faulting process.

Across the region, typically only 100-120 m separates the lowest and the highest points on the landscape, and the highest point we surveyed was ~220 m above sea level. Topography ranges from the steeply incised hills at Actiamë, to the gentler and broader hills at Choncó, and the flat-topped summits at Itia Tëbu (Appendix 1F, Figure II).

Over distances as short as tens of kilometers, one can encounter an almost complete gradient of soil types and habitats of lowland Amazonia, from poor white sands to rich clays and the array of sand-clay mixtures in between these extremes. White sands are rare soil types within the Amazon, and their origins are unknown. They may represent old alluvial sands, or they could reflect the weathering of texturally complex sediments. Seen via satellite, these nutrient-poor white sands occur on either side of the Río Blanco, and represent the largest expanse of white-sand soils known in Peru.

Within the region, surficial soils vary on large and small scales. Soils in the north are principally from the Pevas Formation (remnants of a large lake system formed 18 million years ago), and southern soils are more likely to be fluvial sediments. Despite this general tendency, both of these types of soil deposits can occur anywhere in the region. Rivers and streams frequently change course, cutting new channels through older and often much finer materials, exposing new soil layers. This dynamism results in a patchwork of soils that varies laterally and vertically over scales as small as tens of centimeters.

Not only do rivers and streams actively shape the landscape by changing course, their water chemistry

provides information about the soil fertility and nutrient dynamics in the surrounding forests. We found that the inventory sites range from low conductivities in Itia Tëbu with rather low concentrations of dissolved materials and nutrients, to intermediate conductivities at Choncó, and higher conductivities at Actiamë with more solutes, and higher nutrient concentrations.

VEGETATION AND FLORA

Loreto is renowned as a center of tropical plant diversity, and the Matsés region appears to be one of the brightest hotspots. Our two weeks of collecting, photographing, and identifying plants in the field resulted in a preliminary list of ~1,500 plant species, a little less than half of the plant species we suspect occur within the region. Other rapid inventories in Loreto, including along the nearby Río Yavarí (Pitman et al. 2003), and farther north along the Ampiyacu, Apayacu, and Yaguas rivers (Vriesendorp et al. 2004) estimate a regional flora between 2,500-3,500 species. We believe that the proposed RC Matsés likely supports additional species associated with more specialized habitats (e.g., white-sand forests), and may harbor greater plant diversity than any existing protected area in lowland Peru.

Our three inventory sites covered almost the entire range of forested habitats of lowland Amazonia: swamp forests, floodplain forests, and terra firme forests on rich, intermediate and extremely poor soils. At any given site in the proposed RC Matsés, local plant species richness ranges from some of the richest in Amazonia (upland areas of intermediate to relatively-rich soil fertility) to some of the most depauperate (white-sand forest areas).

Because of their low diversity and relatively simple structure, the white-sand forests are the easiest to characterize floristically. At Itia Tëbu the white-sand forests are dominated by an emergent palm, *Mauritia carana*; a canopy tree in the Rubiaceae (*Platycarpum orinocense*, a tree collected only three times previously

in Peru); and four smaller trees—*Pachira brevipes* (Bombacaceae), *Euterpe catinga* (Arecaceae), *Protium heptaphyllum* subsp. *heptaphyllum* (Burseraceae) and *Byrsonima* cf. *laevigata* (Malpighiaceae). Before this inventory, *Mauritia carana* was thought to be an exceedingly rare palm, yet in the white-sand areas in the Matsés region the population numbers in the tens of thousands.

Upland forests in the Matsés region, similar to other lowland Amazonian forests, are overwhelmingly diverse. The scope of the plant diversity is so great that most species are rare. As an example, botanists surveyed plants over 10 cm in diameter in a 100-m survey at Actiamë, and recorded 47 species in 50 stems.

Focusing on a single family can make it easier to place this high diversity within a broader context. During the two-week inventory, we found 41 different species of Burseraceae trees in the three inventory sites, an unofficial record for this family in Peru. For comparison, it has taken more than four years to collect 40 species across a broad range of terra firme habitats in the Reserva Nacional Allpahuayo-Mishana.

Most of the plant specimens from our inventory remain unidentified; nevertheless, we estimate that a dozen or more of our 500 fertile specimens are likely to be new species.

FISHES

The ichthyological team surveyed a great variety of aquatic habitats, sampling 16 rivers and streams, two small pools alongside streams, two lagoons, one flooded forest known as a *bajjal*, and a *Mauritia* palm swamp known as an *aguajal*. Of these 24 sites, 15 were blackwater, five were clearwater, and four were whitewater environments.

These surveys revealed that the aquatic environments of the Matsés region support a highly diverse community of fishes. In 12 days of fieldwork, including interviews with Matsés fishermen, ichthyologists generated a preliminary list of 177 fish species that

represent 113 genera, 29 families, and 9 orders. Several habitats were not surveyed during this study, including large rivers such as the Gálvez, Blanco, and Yaquerana, and the numerous whitewater and blackwater lagoons seen during overflights of the area. With additional sampling of these habitats, the team estimates that ~350 fish species inhabit the Matsés region.

The region supports a great variety of clearwater, blackwater, and whitewater environments, and all support heterogeneous fish communities, some abundant in fish biomass (oxbow lakes and the main rivers), and others which are species-rich but only support moderate to low densities of fishes (clearwater and blackwater streams). Overall, the greatest fish diversity was found in headwaters of the Río Gálvez and in the streams that feed the Yaquerana, where we registered 125 species (70% of all fish species registered in the inventory).

At least five Characidae species represent new records for Peru. In addition, during the inventory of the Gálvez headwaters, ichthyologists registered *Ammocryptocharax* (Crenuchidae)—the first time this genus has been recorded in the country. One of the *Ammocryptocharax* species appears to be new to science, and in total, this inventory registered 8-10 potentially new species, including several in the genera *Pariolius*, *Tatia* and *Corydoras*.

Compared to other recently inventoried areas in Loreto, the proposed RC Matsés harbors one of the richest fish communities in forested aquatic environments in Peru, with 45-50% of the species unique to the Matsés region. Of the 177 species registered during the Matsés inventory, 89 (50%) were also present in Yavarí (Ortega et al. 2003a) and 98 (55%) were registered in the inventory of the Ampiyacu, Apayacu, and Yaguas rivers (Hidalgo and Olivera 2004). The Matsés region merits protection as a source of biologically, culturally, and economically important fish species, and as an important regional center of fish diversity.

AMPHIBIANS AND REPTILES

This inventory was conducted during October and November, some of the drier months of the year, and typically these drier conditions are less favorable for finding amphibians and reptiles. Nonetheless, herpetologists recorded a very diverse herpetofauna in the Matsés region including 74 species of amphibians and 35 species of reptiles represented by 18 lizards, 13 snakes, 2 turtles and 2 caimans. In only 12 days, the team registered more than 60% of the expected amphibian species known from the Iquitos area (~115 spp), and more than 50% of the lizard species of the Amazon basin.

Three species new to science were recorded during the inventory, including two, a *Bufo* in the *margaritifer* group (“pinocchio”) and a *Hyalinobatrachium* (Centrolenidae), already confirmed as species new to science during the rapid inventory of Río Yavarí (Rodríguez and Knell 2003). In the white-sand forests in Itia Tëbu the team found a rare poison dart frog, *Dendrobates* in the *quinquevittatus* group, with a black body, pale stripes descending below the mouth, and golden limbs. This species is almost certainly new to science, and appears to be restricted to white-sand habitats.

Herpetologists uncovered a rare fossorial frog, *Synapturanus rabus*, when they heard an individual calling under several centimeters of mud. This represents the first record of this genus in Peru, and represents a range expansion of at least 500 km for the species. Another rare and little known species was found when Matsés collaborators working with the advance trail-cutting team discovered the pitviper *Bothrops brazili*.

The Matsés were excited to find the arboreal frog *Phyllomedusa bicolor* at Actiamë, along the Río Yaquerana. Known to the Matsés as *kampô* or *dauqued*, this species is culturally important to numerous indigenous groups in the Amazon. Both men and women apply secretions from the frog’s dorsal glands to self-inflicted burns in their own skin, to give themselves strength and courage.

Other rapid inventories in the Yavarí (Rodríguez and Knell 2003) and Ampiyacu, Apayacu, Yaguas (AAY) watershed (Rodríguez and Knell 2004) provide a regional context for the herpetological diversity found during the Matsés inventory. Although we sampled at least five fewer days, we recorded nearly equivalent numbers of amphibians in Matsés (74 species) as in Yavarí (77), and more species than in AAY (64). In the Matsés region, we recorded 26 amphibian and 11 reptile species not found in AAY and 20 amphibian and 10 reptile species not recorded in Yavarí.

BIRDS

Ornithologists recorded 416 species of birds during the rapid inventory of the proposed Reserva Comunal Matsés, an unofficial record for rapid biological inventories in Loreto. With more complete surveys we estimate that ~550 species would be found in the region.

We spent three days exploring the white-sand forests in the Matsés region, documenting the low-density and low-diversity bird community typical of these habitats. During this time, we managed to tape-record a *Hemitriccus* tody-tyrant that differs from recordings of Zimmer’s Tody-Tyrant (*Hemitriccus minimus*), and may represent an undescribed species. Only one other white-sand habitat specialist was observed, Yellow-throated Flycatcher (*Conopias parva*), although more than 20 birds are known to associate with white-sand and other extremely poor soils. In the last decade, five bird species new to science have been discovered in white-sand habitats in Peru, typically after years of intensive surveys. Our findings underscore the importance of additional surveys in white-sand areas in the Matsés region, to search for habitat specialists and species potentially new to science.

Outside of the white-sand habitats, we encountered the high diversity characteristic of lowland Amazonian bird communities. For example, our four-day survey of one of the richer soil terra firme habitats registered 322 species. A handful of our observations

represent substantial range extensions, the most notable being a single Northern Waterthrush, *Seiurus novaboracensis*, seen along a stream at Actiamë. This North American migrant is known in Peru from only two records, one south of Lima on the Pacific slope, and the other at the Río Curaray (T. Schulenberg, pers. com.). Our survey during late October-early November represents the height of migration, and we registered 19 species of migrants from North America during the inventory, mainly land birds.

To understand the singularity of the Matsés avifauna, we compare our results to two other rapid inventories in Loreto. The Yavarí inventory (Lane et al. 2003) sampled four sites within the Yavarí drainage, downriver from the Matsés inventory. The Ampiyacu, Apayacu, and Yaguas inventory (Stotz and Pequeño 2004) sampled three sites north of the Río Amazonas, within the Amazonas and Putumayo drainages. Although many species are shared between these three inventories, at least a third of the avifauna is unique to each.

MAMMALS

Previous inventories in nearby areas, including the Reserva Comunal Tamshiyacu-Tahuayo and sites along the Gálvez and Yavarí rivers, indicate that 65 species of medium and large mammals likely occur in the proposed RC Matsés. During our two-week inventory, we registered 43 of these species and the Matsés recognize at least 60 as ones they encounter in their lands. The Matsés region is among a select group of Peruvian sites (e.g., Yavari; Ampiyacu, Apayacu, and Yaguas; Parque Nacional del Manu; Reserva Comunal Tamshiyacu-Tahuayo) that rank among the areas of highest mammal diversity in the world.

Large primates and ungulates, often favored by hunters, were remarkably abundant in the region (Figures 9A, B). Except for the area along the Río Blanco (Figures 8A, 10A), we found little or no evidence of hunting in our inventory sites. We did find fewer mammals in white-sand forests than elsewhere in the

region; however, this almost certainly reflects the reduced productivity of these habitats.

Several rarities were sighted during the inventory. We observed jaguars and their tracks (*Panthera onca*) on several occasions, and a bush dog (*Speothos venaticus*) was seen at Choncó. A female pink river dolphin (*Inia geoffrensis*) was observed nursing her young at the mouth of a small tributary to the Río Yaquerana.

Two rare species were notably absent during the inventory. We hoped to find two globally threatened monkeys, Goeldi's marmoset (*Callimico goeldii*) and the red uakari (*Cacajao calvus*). The Matsés recognize both species, although only a few have seen Goeldi's marmoset, a species that is rare across its range. Many recognized the red uakari, a species that typically is found in *Mauritia* palm swamps, and can range over 150 km² areas. Neither of these species is protected within the Peruvian park system (SINANPE).

HUMAN COMMUNITIES

The proposed Reserva Comunal Matsés is bordered along its eastern edge by the Comunidad Nativa (CN) Matsés, the largest titled indigenous land within Peru. Some 1,700 Matsés live within the 452,735 ha of the CN Matsés, distributed among 13 settlements known as *Anexos* (Appendix 7). The Matsés are an autonomous ethnic group that represent themselves, and are not affiliated with any indigenous federations. For the last 26 years, the anthropologist Luis Calixto has lived and worked with the Matsés, studying their social organization and participating in their daily lives. His work, along with technical assistance from the Centro para el Desarrollo del Indígena Amazónico (CEDIA) to the Matsés community beginning in 1991, provided the social context for this inventory.

In 1997, the Matsés people proposed a conservation area to the west, south, and north of their community, in lands where they have hunted and fished for generations. Their vision for this conservation

area is a Reserva Comunal within the Peruvian park system (SINANPE), a category that provides long-term protection and permits sustainable use of natural resources. Currently, the Matsés are the unofficial stewards of these lands. A Reserva Comunal would formally recognize the importance of their role and ensure more effective and long-term conservation of this area.

The Matsés are uniquely positioned to take on a greater and more official conservation role. Previous social research in the region and data from the asset mapping of the rapid social inventory demonstrate that the Matsés society is highly organized with explicit decision-making mechanisms within and among settlements. Traditional resource use and a strong sense of ethnic identity form the core of the Matsés community, and are reinforced in younger generations by bilingual schooling in Spanish and Matsés. A newly formed youth association, known as CANIABO (*caniabo* is youth in Matsés), provides leadership opportunities and training to younger Matsés. These organizational and cultural strengths, coupled with small-scale resource use and subsistence hunting, are strong indications that the Matsés would serve as responsible on-the-ground administrators of these lands.

In addition to the Comunidad Nativa Matsés, there are several other human settlements in the region. On the western side of the proposed protected area there are scattered communities along the Río Ucayali, as well as along its tributary, the Río Blanco. Requena, a small city along the Río Ucayali, is a three-day walk for the Matsés, and they sometimes trade, sell, and buy goods there. To the north of the CN Matsés, Colonia Angamos is the nearest and largest settlement, with an airstrip that receives flights to and from the city of Iquitos.

There are no known human settlements within the proposed Reserva Comunal. However, according to reports from the Matsés, uncontacted and/or voluntarily isolated Matsés people do inhabit those lands, as well as areas within the Comunidad Nativa.

THREATS

The gravest threats to the area are the timber concessions west of the Río Blanco, adjacent to the proposed RC Matsés. These concessions overlap directly with the largest patch of white-sand habitat in Peru, and represent an imminent threat to these fragile habitats. Plants grow exceedingly slowly in these nutrient-poor areas, resulting in trees that are stunted, slender, and decidedly unsuitable for timber. Only a specialized group of plants and animals can survive in these extreme soils. Not only would timber extraction in white-sand areas be unproductive, it would completely devastate the singular biological communities that live there.

Two additional activities are potential threats to the area: unmanaged hunting and illegal drug processing in temporary camps. Currently, both appear to have had minimal impacts in the region; however, if unchecked, each could produce more severe effects in the long-term. In much of Amazonia, hunting poses the greatest threat to animal communities, especially when hunting efforts are intense and large-scale. Illegal drug processing camps, because of their lawlessness, represent a danger both to human and biological communities.

Our inventory provides a preliminary assessment of these two threats, and their impacts. We found scattered evidence of past hunting (shotgun shells, a peccary skull in an old hunting camp), yet we also observed substantial and healthy populations of species typically favored by hunters (e.g., guans, curassows, agoutis, large monkeys). Near the Peru-Brazil border we found an abandoned drug processing camp, a small trail network, and a large oil drum. We suspect the abandoned airstrip on the Brazilian side of the river was part of the same operation. Although such temporary camps can have negative impacts on fauna, the abundant animal populations at this one suggest that drug runners at this camp may not have hunted game. However, the direct impact of this temporary camp on human populations, on either side of the Peru-Brazil border, remains unknown.

Our evidence of past hunting expeditions comes from Itia Tëbu near the Río Blanco, and the site abandoned by drug processors was found at Actiamë along the Río Yaquerana. Not surprisingly, both occur on major rivers. Because they provide access to otherwise remote areas, rivers represent the most vulnerable entry points for the region.

Given the timber interests, the potential for unregulated hunting, and the illegal drug processing camp, perhaps the most overarching threat for the biological and human communities of the area is the lack of formal protection. The proposed RC Matsés is one of the jewels of the Peruvian lowlands—encapsulating such a broad range of soil types that establishing a conservation area here would protect much of the floral and faunal diversity of the Peruvian Amazon. The headwater streams of the Yavarí, one of the principal tributaries of the Amazon, originate in this region, and the drainage network in the area harbors economically important fishes as well as new records, rare species, and species new to science. The Matsés region represents an enormous opportunity to protect a spectacular diversity of lowland terrestrial and aquatic habitats while they still remain intact.

CONSERVATION TARGETS

The following species, communities, and ecosystems are of particular concern in the region because they are (i) especially diverse or unique to this area; (ii) rare, threatened, vulnerable, or declining here and/or elsewhere in Peru or the Amazon; (iii) key to ecosystem function; or (iv) important to the local economy. Some of these conservation targets may meet more than one of the criteria above.

ORGANISM GROUP	CONSERVATION TARGETS
Biological Communities	<p>Major terra firme habitats in the Peruvian lowlands, from nutrient-rich clay soils to sandy loam hills with intermediate fertility to impoverished white-sand soils</p> <p>Extensive white-sand forests, a habitat representing less than 1% of the Peruvian Amazon (Figure 12A), with many endemic species</p> <p>Extremely acidic forest streams draining white-sand areas (Figure 3D)</p> <p>Swamp hummock complexes near the Río Gálvez headwaters</p> <p>Heterogeneous aquatic ecosystems found in the Río Gálvez headwaters and the Río Yaquerana watershed (including blackwater, clearwater, and whitewater)</p> <p>Headwaters of the Río Yaquerana and Río Gálvez rivers, critical to ensuring the integrity of the Yavarí watershed</p> <p>Upland forest communities, including flooded lowlands, palm swamps (<i>aguajales</i>) and white-sand forests with high amphibian and reptile diversity</p> <p>Intact and heterogeneous habitats that serve as a source of game species, especially in the headwaters of the Río Yaquerana and the Río Gálvez</p>
Vascular Plants	<p>Plants endemic to white-sand forests, including large populations of <i>Mauritia carana</i> (Arecaceae, Figure 3G), <i>Platycarpum orinocense</i> (Rubiaceae, Figures 4A, C), and <i>Byrsonima</i> cf. <i>laevigata</i> (Malpighiaceae)</p> <p>Populations of commercial timber species heavily exploited elsewhere in Loreto, including Spanish cedar (<i>Cedrela odorata</i>, Meliaceae), kapok or <i>Iupuna</i> (<i>Ceiba pentandra</i>, Bombacaceae) and <i>palisangre</i> (<i>Brosimum utile</i>, Moraceae)</p>
Fish	<p>Biologically, culturally, and economically important species in the region such as <i>Osteoglossum bicirrhosum</i> (<i>arahuana</i>), and <i>Cichla monoculus</i> (<i>tucunaré</i>)</p> <p>Large catfish such as <i>Pseudoplatystoma tigrinum</i> (<i>tigre zúngaro</i>), which are exploited intensely in other parts of Amazonia</p>

<p>Fish (continued)</p>	<p>Rare species and those with restricted distributions such as <i>Myoglanis koepckeii</i> (Figure 5F)</p> <p>Valuable ornamental species like <i>Paracheirodon innesi</i> (<i>tetra neón</i>), <i>Monocirrhus polyacanthus</i> (<i>pez hoja</i>), <i>Boehlkea fredcochui</i> (<i>tetra azul</i>)</p> <p>A diverse group of species in the <i>Apistogramma</i> genus (<i>bujurqui</i>), common in clearwater and blackwater within the heterogeneous forests in the Matsés region</p>
<p>Reptiles and Amphibians</p>	<p>Communities with many (up to 10) species of coexisting Dendrobatidae</p> <p>Amphibian species associated with white-sand forests and surrounding areas, such as the frogs <i>Osteocephalus planiceps</i> and a potentially new species of <i>Dendrobates</i> in the <i>quinquevittatus</i> group (Figure 6C)</p> <p>Populations of <i>Synapturanus</i> (Microhylidae, Figure 7C), a new genus for Peru</p> <p>Species with commercial value, such as turtles (<i>Podocnemis unifilis</i>, <i>Geochelone denticulata</i>) and caiman (<i>Caiman crocodilus</i>)</p>
<p>Birds</p>	<p>Birds of white-sand forest habitats, including potential habitat specialists and species new to science</p> <p>Diverse avifauna of terra firme forests</p> <p>Game birds threatened in other parts of their range, including Razor-billed Curassow (<i>Crax tuberosum</i>) and White-winged Trumpeter (<i>Psophia leucoptera</i>)</p>
<p>Mammals</p>	<p>An extremely diverse primate community (14 species) with abundant, large species such as <i>Lagothrix lagothricha</i>, <i>Ateles paniscus</i> (Figure 9A) and <i>Alouatta seniculus</i></p> <p>Populations of giant armadillo (<i>Priodontes maximus</i>), listed as endangered on the World Conservation Union's (the IUCN) Red List (2004)</p> <p>Habitat specialists such as <i>Callimico goeldii</i> and <i>Cacajao calvus</i>, both of which are listed as vulnerable on the IUCN's Red List (2004)</p> <p>Large mammals that have suffered local extinctions in parts of their range because of habitat loss or overhunting</p>
<p>Human Communities (Matsés)</p>	<p>High organizational capacity for managing a natural protected area</p> <p>Economic activities and production methods of a type and scale compatible with conservation (Figures 11F, I)</p>

CONSERVATION TARGETS

Human Communities (Matsés)
(continued)

In-depth cultural knowledge of the environment, including white-sand forests (*varillales*)

Commitment to conservation and to sustainable use of natural resources

RECOMMENDATIONS

Our shared long-term vision with the Matsés for their landscape is a mosaic of land-use areas that conserve the region's diverse and intact forests and the traditional practices and lifestyles of the Matsés communities living in them. Two priorities emerged from the integrated results of the rapid inventory and CEDIA's 14 years of work with the Comunidad Nativa Matsés: (1) conservation of the diverse landscape bordering the Matsés territories through the creation and consolidation of the Reserva Comunal Matsés and (2) conservation of the singular biology of white-sand forests through the creation of a dedicated protected area. Below we offer our recommendations for establishing these two protected areas—the Reserva Comunal Matsés and the Zona Reservada Los Varillales—including our suggestions for protection and management, zoning, future inventories, research, and monitoring and surveillance.

Protection and management

Reserva Comunal Matsés

- 01 **Establish the Reserva Comunal Matsés (391,592 ha) inside the boundaries outlined in Figure 2.** This area merits immediate protection based on its large and intact expanses of forests, its extraordinary biological richness, and its cultural importance for the Matsés. The area is directly adjacent to the proposed white-sand protected area (see White-sand Forests, below).
- 02 **Negotiate a process between the Junta Directiva Matsés and the Peruvian park service, INRENA, to ensure the integral involvement of the Matsés in the long-term conservation and administration of the Reserva Comunal Matsés.** There are compelling and practical reasons for the Reserva Comunal Matsés to be an indigenous-administered protected area. For 14 years the Matsés have worked with CEDIA to protect this area. They have an intimate knowledge of these forests, and are experienced in addressing invasion, encroachment, and resource extraction threats. Most importantly, the egalitarian decision-making process of the Matsés—which relies on building consensus—provides a strong foundation for administering and managing a protected area (see p. 218, Socio-cultural assets of the Comunidad Nativa Matsés).
- 03 **Involve members from all of the Matsés settlements, or *Anexos*, in the protection and management of the Matsés wilderness.** Work directly with Matsés officials (*Junta Directiva* and the *Juntas de Administración*) to promote local participation in protection efforts including:
 - **Involving members of local communities as park guards, managers, and educators.**
 - **Involving young Matsés in the conservation efforts, via the CANIABO Association** (*caniabo* means youth in Matsés).
 - **Managing harvest of game birds, mammals, and fish by members of the Matsés communities.** We recommend immediate participatory research

RECOMMENDATIONS

Protection and management
(continued)

(see Research 03, below) on the use of the landscape by native communities, their traditional management of game harvests, and the impact of hunting on more vulnerable species. We recommend implementing a management plan—designed by the community and based on the research results—to ensure sustainable hunting, including establishing strictly protected areas where hunting is prohibited to serve as source areas and sites for recovery of game populations.

- 04 Secure sustainable funding for the implementation of the Reserva Comunal.**
- 05 Provide technical and financial assistance** to the Comunidad Nativa Matsés and appropriate NGOs to improve the effectiveness and long-term viability of their efforts as they administer and protect the Reserva Comunal Matsés.
- 06 Map, mark, and make known the boundaries of the Matsés protected area.** Most vulnerable are the boundaries near the western and northern limits of the reserve, susceptible to incursions by people from farther upriver, along the Río Blanco, or Iquitos, and people from Angamos.
- 07 Train Matsés park guards.** Establish protocols with the Matsés, including routes for patrolling and procedures to stop illegal activities (e.g., logging).
- 08 Minimize impacts to headwaters within the region to protect the entire drainage network of the Yavarí and Yaquerana rivers.** Conserving the entire drainage, from the small forested streams of the headwaters, to the principal waterways like the Río Yavarí, is critical for protection of the watershed and of the communities of fishes, invertebrates, and vertebrates, as well as humans, who depend on the integrity of the watershed.
- 09 Expand the Comunidad Nativa Matsés to the south,** within the boundaries as outlined in Figure 2. The current southern boundary of the CN Matsés bisects a Matsés settlement (Buenas Lomas Antigua). The boundary should be expanded to the south to include the entire settlement, as well as the settlement at Puerto Alegre and the surrounding area. The extension is 61,282 ha.

White-sand Forests

- 01 Create the Zona Reservada Los Varillales (195,365 ha, Figure 2), to protect the biological uniqueness of the white-sand forests (*varillales*) on either side of the Río Blanco (see maps p. 145).** This area presents the largest expanse of white-sand forests in Peru. Logging and colonist incursions threaten this area; during the rapid inventory we observed several abandoned agricultural plots and a network of persistent and destructive trails cut by logging tractors. Timber is not

being extracted from the white-sand areas; these areas are razed for access to timber further inland. Our best estimates suggest that the white-sand vegetation destroyed by these tractor trails will take several hundred years, if not more, to recover. We recommend creating a Zona Reservada, and ultimately a Santuario Nacional (see below), to ensure immediate protection for the fragile white-sand forests.

02 Relocate logging concessions planned for the white-sand forests on the western side of the Río Blanco. White sands are the poorest soils in the Amazon basin and the trees they support are short and thin. These low-productivity areas are decidedly unsuitable for timber extraction, yet they are rich in endemic species and extremely valuable for conservation.

03 Determine the category and elaborate boundaries for the white-sand protected area. Our rapid inventory results support the strictest level of protection for this area, either as a national park or as a national sanctuary. We recommend joint discussions with the Regional Government of Loreto, INRENA, and Matsés officials to determine the final category. To elaborate the boundaries for the white-sand protected area, we recommend inviting experts in satellite imagery analysis to participate in the discussions: preliminary analyses by R. Stallard are a useful starting point (Figure 2, 12A).

04 Institute patrols for park guards to prevent logging, poaching, and other incursions.

Zoning

Engage the CN Matsés in participatory workshops to develop a zoning plan.

In conjunction with CEDIA, the Matsés have begun to develop maps of their current use of resources in the region. These should serve as a first step towards developing a zoning plan that protects the valuable biological communities in the area, and at the same time allows the Matsés to continue their traditional use of the forest, but under a plan for sustainable management.

Further inventory

01 Continue basic plant and animal inventories, focusing on other sites and other seasons, especially March-August. Priority aquatic areas for inventories include the Gálvez, Blanco, and Yaquerana rivers, and the unexplored lagoons, or *cochas*, observed during the overflights. The highest priority terrestrial habitats are the white-sand forests (see 02 below) and the forests along the blackwaters of the Río Gálvez and its tributaries.

02 Conduct long-term surveys of the white-sand forests in the Río Blanco area with biologists experienced in similar habitats in Amazonia. White-sand forests

RECOMMENDATIONS

Further Inventory
(continued)

harbor a great number of endemics and we suspect longer-term surveys will register additional rarely collected or new species, especially of plants and birds. Although we found only two birds specializing on white-sand habitats during this inventory, long-term inventories of smaller patches of white-sand forests near Iquitos (Reserva Nacional Allpahuayo-Mishana) have uncovered five species of birds new to science.

- 03 Confirm reports of two globally endangered primates in the region.** The red uakari monkey, *Cacajao calvus*, and Goeldi's marmoset, *Callimico goeldii*, have been reported in the region by the Matsés and others, but were not seen during our inventory. We recommend an expedition with the Matsés to confirm the presence of these monkeys, and to map their distribution within the area.

Research

- 01 Investigate the genetic structure and population connectivity of populations of white-sand specialists, compared to populations in other white-sand areas.** Species restricted to white-sand forests occupy a naturally patchy habitat. Understanding whether populations in one patch maintain gene flow with other patches will assist in understanding the evolution of these habitat specialists and in managing their populations.
- 02 Evaluate the ecological impact of subsistence hunting and gathering on biological communities in the region.** This research is the logical extension of the resource-use maps (see Zoning above), and should be directed towards preserving fauna and flora while maintaining the quality of life of subsistence hunter-gatherers and their families.
- 03 Evaluate the importance of habitat gradients in driving evolution.** The mosaic of habitats in the Matsés region constitutes a natural laboratory of evolution. These juxtaposed habitats represent an important resource for future investigations into the origin and maintenance of Amazonian plant diversity, as well as the diversity of insects, birds, and many other organisms.
- 04 Evaluate species range limits and biogeographic barriers in the region.** Although there are no obvious barriers to dispersal (e.g., broad rivers) east of the Río Ucayali, several bird species replace one another and/or species reach the edge of their range in this area. This includes 24 species of birds common in the Amazon and known from areas to the north, south, east, and west, but seemingly absent from the Yavari drainage (see p. 203, Birds). Understanding these distributions will help set boundaries for management areas, especially for forest-based species that may not be restricted to watersheds.

05 Measure the efficacy of boundary signs and patrols in reducing illegal incursions and encroachment into the newly protected areas of Reserva Comunal Matsés and the Santuario Nacional Los Varillales.

Monitoring/Surveillance

01 Track movements and demographics of Matsés settlements within the Comunidad Nativa Matsés (Figure 13, p. 217). Traditionally, Matsés settlements moved every 3-5 years. In the last 30 years the settlements have become more sedentary. Because the CN Matsés borders the reserve, the relocation or change in population size of Matsés settlements (*Anexos*) may influence the distribution of fauna and flora within the Reserva Comunal Matsés, and management plans should be revised accordingly.

02 Survey fish and game populations, including turtles and caimans. These data will be important for determining population baselines, setting conservation goals, and establishing zoning boundaries.

03 Design and conduct social research on the challenges and opportunities experienced by different stakeholders (indigenous communities and organizations, government agencies, relevant local/international NGOs) involved in the protection and management of the Reserva Comunal Matsés. As one of the few indigenous-administered protected area in Peru, the RC Matsés would serve as a model for other areas in Peru and Latin America. We recommend an evaluation of the workings of this process, with a goal of making policy recommendations to support the creation of political and legal frameworks capable of ensuring effective co-management of protected areas by indigenous peoples.

04 Develop a practical monitoring program that evaluates progress towards site-specific management goals. Combine results of research and inventories with the storehouse of Matsés traditional knowledge to establish baselines and targets for vulnerable species or populations.

05 Track threats to the area (including logging, colonization, and ephemeral drug processing stations). To identify and target the most vulnerable areas of the reserve, monitoring methods should include a combination of GIS, remote-sensing and traditional patrols of the area by Matsés, including Matsés park guards.