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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 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, and innovative education programs—to the immediate needs of conservation at local, national, and international levels.

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The Fundación para la Sobrevivencia del Pueblo Cofan (FSC) is a non-profit organization dedicated to conserving the indigenous culture of the Cofan and the Amazonian forests that sustain them. Together with its international counterpart, the Cofan Survival Fund, the foundation supports conservation and development programs in seven Cofan communities in eastern Ecuador. Their programs focus on research and the conservation of biodiversity, protecting and titling Cofan ancestral territories, developing economic and ecological alternatives, and education opportunities for young Cofan.

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FEINCE, the “Indigenous Federation of the Cofan Nation in Ecuador” is the political arm of the Ecuadorian Cofan, representing the five legalized communities in the country—Chandia Na’e, Dureno, Dovuno, Sinangoe, and Zábalo—at the national level. FEINCE works to defend the human rights of the Ecuadorian Cofan as a member of the larger umbrella groups that support indigenous groups in Ecuador: the Confederation of the Indigenous Nationalities of Ecuador (CONAIE) and the Confederation of the Indigenous Nationalities of the Ecuadorian Amazon (CONFENIAE). FEINCE is directed by a board of officers elected by the Cofan community every three years.

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The Ministerio del Ambiente del Ecuador (MAE) is the national environmental agency responsible for sustainable development and natural resource management. It is the highest authority for issuance and coordination of national policies, rules, and regulations, including basic guidelines for organizing and implementing environmental management. MAE develops environmental policies and coordinates strategies, projects, and programs for the protection of ecosystems and for sustainable use of natural resources. MAE sets regulations necessary for environmental quality associated with conservation-based development and the appropriate use of natural resources.

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The Museo Ecuatoriano de Ciencias Naturales (MECN) is a public entity established on 18 August 1977 by government decree 1777-C, in Quito, Ecuador, as a technical, scientific, and public institution. MECN is the only state institution whose objectives are to inventory, classify, conserve, exhibit, and disseminate understanding of the country's biodiversity. The institution offers assistance, cooperation, and guidance to scientific institutions, educational organizations, and state offices on issues related to conservation research, natural resource conservation, and Ecuador's biodiversity. It also provides technical support for designing and establishing national protected areas.

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The Herbario Nacional de Ecuador (QCNE) is a section of the Museo Ecuatoriano de Ciencias Naturales that carries out programs of inventory, research and conservation of the Ecuadorian flora and vegetation. It houses a collection of 160,000 plant specimens and a botanical library of 2,000 volumes. The Herbarium serves as the national center for information on the flora and vegetation of Ecuador, with broad public access, and is among the principal scientific and cultural institutions of the country. It constitutes a public service to scientists, natural resource managers, and students, and makes its voice heard in nationwide forums dealing with environmental and biodiversity issues. In the past two decades the Herbarium has provided training for hundreds of young Ecuadorian botanists, and carried out dozens of intensive botanical inventories throughout Ecuador.

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Instituto de Investigación de Recursos Biológicos Alexander von Humboldt (IAvH) is a private, civil, non-profit corporation linked to the Ministerio del Ambiente, Vivienda y Desarrollo Territorial in Colombia. It was created by law #99-1993, was constituted on 20 January 1995, and it is part of the Sistema Nacional Ambiental (SINA). IAvH is responsible for developing basic and applied research on genetic resources of Colombia's flora and fauna, and for conducting scientific inventories of biodiversity throughout the entire nation.

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The headquarters of the Gobierno Municipal del Cantón Sucumbíos (GMCS) are located in the community of La Bonita. GMCS was created by legislative decree on 31 October 1955, and published in the official registry #196 of 26 April 1957 (which regulates the juridical and institutional life of the municipality). The Cantón Sucumbíos is located in the northwestern corner of the Sucumbíos Province in northern Ecuador, on the border with Colombia. The *Cantón* (County) is the oldest in the province and was established in 1920.

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Corporación Grupo Randi Randi (CGRR) is a private, non-profit, Ecuadorian corporation. It was created in 2000 with a mission to encourage the conservation of natural resources, sustainable development, and social and gender equity. It promotes research and technical assistance to communities and organizations located in threatened ecosystems. The Group adopted the expression Randi Randi—“giving and giving” in the Kichwa language—because it expresses the sense of reciprocity that drives their work: they offer their knowledge, support, and experience knowing that it will be well received and returned in one form or another.

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The Jatun Sacha Foundation is a non-profit Ecuadorian organization that has been working since 1985 to conserve the country's biological diversity and promote the sustainable development of its peoples. The Foundation protects a variety of unique forest, aquatic, and paramo (high mountain grassland) ecosystems, all of which are under threat due to burning, deforestation, pollution, and other destructive activities. It has been a pioneer in the creation of private reserves as bases of operation to carry out various conservation activities, including research, ecosystem restoration, environmental education, and the development of sustainable alternatives for the communities in the local area. These reserves are found from sea level up to over 13,000 feet in altitude, and in environments as diverse as the Galapagos, the Amazon, dry-forest, and the high Andes.

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Nearly nine years ago, we singled out the Cabeceras Cofanes-Chingual as a significant conservation priority during one of our previous inventories in the northern Andes. The entire team is grateful for the opportunity to survey these rugged mountains and the communities that live nearby. Our effort builds on years of invaluable work in this area by conservation groups, the Cofan, and local authorities, and would not have been possible without the generous help of many collaborators and colleagues.

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Following the inventory, a working group was formed to pursue legal protected status for the area. We are incredibly grateful to this group of dedicated individuals, as their efforts led to the sectional resolution declaring the Área Ecológica de Conservación La Bonita-Cofanes-Chingual (AECBCC). At the time of the report, the proposal is still being evaluated at the national level. We would like to acknowledge the many people who have provided support to this process, among those Mayra Abad, Diego Aragón, Elizabeth Anderson, Wilson Arévalo, Paulina Arroyo, Margarita Benavides, Emerson Bravo, Diana Calero, Gerardo Canacúan, Tatiana Castillo, Byron Coronel, Gerardo Cuesta, Hugo Encalada, Mateo Espinosa, Segundo Fuentes, Chris James, Irene Lloré, Pedro Loyo, Manuel Mesías, Luis Naranjo, Luis Narváez, Angel Onofa, Patricia Pilco, Susan Poats, Ana Lucía Regalado, Guillermo Rodríguez, Orfa Rodríguez, Edgar Rosero, Esteban Salazar, Sadie Siviter, Luis Tatamues, and René Yandun.

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Jonathan Markel prepared excellent maps for the advance team, inventory team, and for the final report. In addition, he stepped in whenever necessary during the writing and presentation process, even serving soup to the participants. We are grateful to Dan Brinkmeier and Nathan Strait for producing great visual materials for the work in local communities by the social team.

As always, Tyana Wachter played a fundamental role, stepping in to solve problems whenever and wherever necessary in Chicago, Quito, Ibarra, Puerto Libre, and La Bonita. Rob McMillan and Dawn Martin worked their usual magic to solve problems from Chicago.

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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 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	Biological team: 15–31 October 2008 Social team: 8–30 October 2008
Region	Northern Ecuador, forested slopes covering elevations from 650–4,100 m on the eastern flank of the Andes. The Cabeceras Cofanes-Chingual spans Sucumbíos, Carchi and Imbabura provinces, sheltering the confluence of two major watersheds (Cofanes and Chingual), which drain into the Amazon basin, as well as the headwaters of a western-slope drainage (Chota), which flows to the Pacific Ocean.
Sites inventoried	<p>The biological team visited three sites:</p> <ul style="list-style-type: none">01 Laguna Negra, paramo at 3,400–4,100 m, 15–19 October 200802 Alto La Bonita, upper montane forest at 2,600–3,000 m, 23–26 October 200803 Río Verde, lower montane forest at 650–1,200 m, 26–31 October 2008 <p>Only the mammal and advance teams visited a fourth site, Ccuttopoé, which is unburned paramo at 3,350–3,900 m.</p> <p>The social team visited 22 communities. In the following nine focal communities they conducted intensive interviews, workshops, and informational meetings:</p> <ul style="list-style-type: none">01 La Barquilla, El Paraíso, and Rosa Florida—Parroquia (parish of) Rosa Florida, Cantón (county of) Sucumbíos, Provincia (province of) Sucumbíos02 La Bonita, La Sofía, and El Playón de San Francisco—Cantón Sucumbíos, Provincia Sucumbíos03 Mariscal Sucre—Cantón Huaca, Provincia Carchi04 Monte Olivo and Palmar Grande—Parroquia Monte Olivo, Cantón Bolívar, Provincia Carchi <p>In 13 additional communities, the team interviewed authorities and other key actors, conducted visual surveys of land use patterns, and briefly interviewed residents. These included Santa Barbara, Santa Rosa, Las Minas, and Cocha Seca (in Provincia Sucumbíos); and Huaca, Tulcán, San Gabriel, Miraflores, Raigrass, El Aguacate, Manzanal, Motilón, and Pueblo Nuevo (in Provincia Carchi).</p>
Biological focus	Geology, hydrology, soils, vascular plants, fishes, reptiles and amphibians, birds, and large mammals
Social focus	Social and cultural strengths, natural-resource use, community management practices, and archeology (historical human settlement in the region)

Principal biological results

Organism group	Laguna Negra 3,500–4,100 m	Alto La Bonita 2,600–3,000 m	Río Verde 650–1,200 m	Total registered 650–4,100 m	Total estimated 650–4,100 m
Vascular plants	~250	~300	~350	~850	3,000–4,000
Fishes	–*	1**	12	19*	25–30
Amphibians	6	10	22	36	72
Reptiles	2	1	3	6	38
Birds	74	111	214	364	650
Medium and large mammals	13***	15	29	40	50

* Ichthyologists did not sample Laguna Negra but instead visited an additional site, Bajo La Bonita, where they registered 11 species. They encountered an additional 12 species at lower elevations outside the proposed reserve, at sampling stations 017 and 018.

** *Oncorhynchus mykiss* (trout), a non-native, introduced species

***12 species were recorded at the other high-altitude site, Ccuttopoé.

Geology, hydrology, and soils: Fourteen million years and massive energy built the Andes from a seafloor into a towering, geologically complex, dynamic mountain range. Cabeceras Cofanes-Chingual is the result of this large-scale folding, faulting, and uplift; the rise and slow cooling of deep subsurface plumes of magma; and volcanic eruptions, deposition of magma and ash, and massive mud and rock slides. These geological processes continue today. The steep mountains rise from the floodplain of the Aguarico River, at an elevation of 650 m, to high-altitude lakes and paramo at more than 4,000 m. This dramatic rise occurs over a distance of 35 km and divides the Pacific and Amazon basins. During the last ice age (10,000 years ago), glaciers carved U-shaped valleys from the highest mountains. Powerful rivers continue to carve deeper into the lower valleys and deliver sediments and nutrients from the Andes to the Amazon River. Moisture-laden air masses from the Amazon Basin cool as they rise up the Andes, causing condensation and precipitation that maintain wet environments year-round at higher elevations. The paramos capture much of this moisture, channeling it to the rivers and streams that provide water to nearby human settlements and agricultural areas. The steep slopes that dominate the watersheds of Cabeceras Cofanes-Chingual are highly sensitive to erosion, induced by both natural and anthropogenic perturbations. A protected area in the region is essential to avoid deforestation and protect the water resources that arise in the paramo and Andean forests.

Vascular plants: The botanists encountered approximately 850 vascular plants during fieldwork—with essentially no overlap among the sites sampled—of which 569 have been identified to species, genus, or family. The rugged terrain and exceedingly wet conditions create dramatic small-scale differences in vegetation and plant composition. We estimate that the region harbors 3,000–4,000 plant species. Endemism is high and many species are restricted to the few remaining forests of northern Ecuador and southern Colombia. We found signs of logging, with *Polylepis* (Rosaceae) and *Podocarpus* (Podocarpaceae) extracted for local use and commercial markets. In contrast to heavily

Principal
biological results
(continued)

deforested Andean forests elsewhere, Cabeceras Cofanes-Chingual offers the rare opportunity to protect a diverse, intact gradient from rainforest to alpine grasslands.

Fishes: The ichthyologists registered 19 species in the three sites surveyed—Alto La Bonita, Bajo La Bonita, and Río Verde—one of them being the introduced trout (*Oncorhynchus mykiss*) in the higher elevations of the Cofanes-Chingual watershed, and the Sucio River. Of the species collected, four (in the genera *Characidium*, *Astroblepus*, *Hemibrycon*, and *Chaetostoma*) are likely new to science. The team registered an additional 13 species at lower elevations, to 480 m. We estimate 25–30 species in the 500–3,000 m altitudinal range of the region, a normal species-richness for this elevational gradient on the eastern slopes of the Andes. Typical of Andean foothill streams in Ecuador, Peru, and Colombia, the two most species-rich and abundant orders were Characiformes and Siluriformes, encompassing 55% and 36% of the species registered. Three families—Characidae (31%), Loricariidae (19%), and Astroblepidae (16%)—had the majority of species. Most abundant were the species of Astroblepidae and Loricariidae that show special adaptations to the rushing torrents of the Andean foothills, such as mouths modified with suction cups and interopercular teeth for clinging to rocks, and small or medium-sized bodies with reduced swimming bladders adapted for swimming along the bottom where currents are weaker.

Amphibians and reptiles: The herpetologists found 36 species of amphibians and 6 of reptiles (12 families, 19 genera) in 170 hours of effort. We estimate 72 amphibians and 38 reptiles for the region. With the exception of *Pristimantis chloronotus* frogs (found in two of the three sites), there was no overlap of species among the sites sampled, indicating three distinct herpetofaunas. The fauna at Laguna Negra, typical of paramo, had few species, most with localized, small ranges. Our methodology of searching in dead Espeletia and puya bromeliads confirmed the abundance of two frogs (*Osornophryne bufoniformis* and *Hypodactylus brunneus*) that are considered rare in the literature. Alto La Bonita's high-montane herpetofauna was dominated by *Pristimantis* frogs, including the first record of *P. colonensis* for Ecuador and a range extension for *P. ortizi*. *Osornophryne guacamayo*, a rare endemic, was abundant here; this would be a good site to learn about the species and what might protect it. The herpetofauna at Río Verde had Amazonian elements mixed with Andean foothill species. We recorded a latitudinal range extension for the frog *Cochranella puyoensis*—known previously only from the central portions of Ecuador's Oriente—and an altitudinal range extension for the frog *Rhinella dapsilis* (700–800 m), previously known only from Amazon lowlands below 300 m.

Birds: The ornithologists registered 364 species of birds during the inventory and estimate 500 for the three sites surveyed. Including the entire elevational range in the region—from 650 m to paramo—increases the estimate to 650 species. The forest avifauna is diverse, and we recorded relatively few species of other habitats. Aquatic

species were poorly represented; we observed a few species in rushing streams and occasional migrants at paramo lakes. The open paramo is species poor; most birds use the patches of isolated forest. The avifaunas were markedly distinct at each site surveyed, with essentially no overlap between Río Verde and the two high elevation sites, and only a quarter of the species in common between the paramo site at Laguna Negra and Alto La Bonita. Within each site, the avifauna varied greatly in association with changing elevation and topography. We registered one endangered species (Bicolored Antpitta), four vulnerable species (Wattled Guan, Military Macaw, Coppery-chested Jacamar, and Masked Mountain-Tanager), and nine near-threatened species; most species of conservation concern were at Río Verde. We recorded 14 range-restricted species: 9 are restricted to eastern Andean slopes, and 5 are in paramo. Although Ecuador is south of the main wintering grounds for migrants from North America, we found 17 species of migrants, including 4 (Swainson's Thrush, plus Blackburnian, Cerulean, and Canada warblers) that winter almost entirely in the humid Andes.

Medium and large mammals: The mammalogists used visual observations, scat, tracks, feeding evidence, smell, vocalizations, and interviews with local people to confirm the presence of 40 species (18 families, 8 orders) of the 50 species they estimate for the region. Our most important finding is intact populations of mountain tapir (*Tapirus pinchaque*) in two of our four sites (both above 3,000 m). Spectacled bear (*Tremarctos ornatus*) was present in healthy numbers at all four sites. Both species are considered vulnerable or endangered (UICN 2008), and threatened with extinction (CITES 2008), through most of their range. We observed abundant tracks and feeding sites of the little-known mountain paca (*Cuniculus [Agouti] taczanowski*), olive coatimundi (*Nasuella olivacea*), and an unidentified species of *Coendu* porcupine. At lower elevations around 1,500 m, populations of *Lagothrix lagothricha*, *Ateles belzebuth*, and *Alouatta seniculus* still exist. The protection of contiguous forests covering altitudinal ranges for each of these animals is critical for their conservation. Interviews with local people led us to one of the most interesting animals in the region: a giant pocket gopher (*Orthogeomys* sp.) that workers uncovered 4 m underground during excavations for the new road between La Bonita and La Sofia.

Principal social and archeological results

Past cultural landscape: The region has a rich and wide variety of archeological evidence that indicates it is an anthropogenic landscape formed during centuries, if not millennia. We found materials indicating the presence of early humans in two of the three areas sampled. In the lowlands of upper Amazonia (our Río Verde site) we found a small riverside occupation. In the Andean foothills we found a large settlement at the modern town of La Bonita, with evidence of a complex form of social organization, and transformation of the landscape through mound building and terracing. Although we found no evidence of human presence in the caves of Laguna Negra (in the paramo), these caves may have been occupied at the end of the Ice age.

Principal social and
archeological results
(continued)

Present-day cultural landscape: Cantón Sucumbíos (county of Sucumbíos), in Provincia Sucumbíos, was settled during waves of natural resource extraction, starting with rubber-tapping at the end of the nineteenth century. Population in the cantón was 2,868 in 2001. The entire county has electricity and piped water, all communities have elementary schools and distance-learning secondary schools, and La Bonita and El Playon have high schools. La Bonita and El Playon have health clinics; the other communities have medical and first-aid supplies and trained personnel. Economic activities include salaried jobs (especially for the municipality and other governmental work), farming and tending livestock, and logging. Communities along the “Interoceanic Highway” are intimately tied with the market economy—regional, national, and with Colombia—while more isolated La Sofía maintains a largely self-sufficient economy. The greatest assets in this cantón are (1) strong support for protection of forests and watersheds, (2) a dedicated search for alternatives to illegal logging, and (3) capacity to organize around public projects, such as the successful *juntas de agua potable* (management groups for potable water). Residents showed great interest in participating in emerging governmental programs for payment of ecological services, such as the Socio Bosque program of MAE (the environmental ministry). This interest in conservation stems from stricter regulations on illegal logging, fear of droughts, and the possibility of revenues through ecotourism or payment for ecological services. Another major asset in the region is that residents recognize that despite economic difficulties they have a good quality of life because their forests and waters are still healthy and their soils fertile. In February 2008 the municipal government created a protected area approved at the county level, the Reserva Municipal La Bonita (Figs. 2A, 2B, 10J, 12B). In addition, La Sofía is developing a strategic plan to protect its forests, reduce commercial mining activities, and maintain its communal identity and strong link with its environment.

In Provincia Carchi, the social inventory team focused on institutional players in cantones Huaca and Montúfar, which neighbor Cantón Sucumbíos. Carchi is more heavily populated than Sucumbíos. Today residents engage in farming (primarily potatoes) and dairy production. Illegal logging and charcoal production using forest trees still persist, with markets in Quito and Ibarra. Nonetheless, Huaca and Montúfar are developing conservation policies to protect the Andean highlands. Institutional assets in the region also include the Estación Biológica Guandera (part of the NGO Jatun Sacha) and the new extension of the Universidad Técnica del Norte, based in Huaca. Residents of Parroquia Monte Olivo (parish of Monte Olivo, including Palmar Grande, which we studied in more detail) are very enthusiastic for ecotourism and conservation of their forests and paramos. Monte Olivo was more successful than other towns we visited in forming cooperatives (*asociaciones*) for economic activities, especially women's cooperatives.

Principal threats

- 01 Mining
- 02 Logging
- 03 Deforestation and subsequent erosion, especially in headwater regions (with subsequent effects on human and wildlife populations that depend on streams for their water supply)
- 04 Expansion of the agricultural frontier
- 05 New roads and trails into intact habitat or sensitive archeological sites
- 06 Excessive burning of paramos
- 07 Introduction of non-native species (especially trout)
- 08 Water-use conflicts because of diversions for irrigation (Carchi)
- 09 For archeological sites, introduction of dairy cows (which disturb the soil) and raiding of valuable objects from ancient sites

Opportunities and targets for conservation

The rugged Cabeceras Cofanes-Chingual is one of the last remote, intact mountainous regions in Ecuador. Encompassing more than 100,000 ha of unbroken habitats, with altitudinal ranges from 650 meters at the mouth of the Chingual River to more than 4,100 meters on the meadows of the highest ridges, this mountainous landscape is the most important remaining refuge for endangered, range-restricted flora and fauna of the Ecuadorian Andes. Spectacular orchids, highly adapted fishes, brightly colored tanagers, and the mountain tapir are among the more conspicuous conservation targets at Cofanes-Chingual. So is the source of water that supplies the entire region. The invaluable, unbroken altitudinal gradient allows movement of plants and animals up and down the slopes and provides crucial buffer for global climate change.

Specific conservation targets appear in the chapter for each taxonomic group. Below we list the broader conservation targets in the region:

- 01 Ecosystem services of freshwater production in paramos, serving the entire region
- 02 A broad elevational gradient of intact forest, critical in allowing migration, especially in response to climate change
- 03 Diverse and endemic flora of the Northern Andes, a region largely deforested in other parts of Colombia and Ecuador
- 04 Highly endemic Andean and paramo fauna between 650 and 4,100 m
- 05 Distinct granite- and volcanic-rock-based, high-altitude glacial valleys and lakes

REPORT AT A GLANCE

Opportunities and targets for conservation (continued)

- 06 Hydrologic connectivity between rivers in both the Cofanes and Chingual watersheds
- 07 Aquatic ecosystems with little human impact (except introduction of trout)
- 08 Healthy populations of montane forest timber species (e.g., *Polylepis*, *Podocarpus*, *Humiriastrum*)
- 09 Diverse forest avifauna across an entire, montane elevational gradient
- 10 Endangered species that are common at the sites inventoried

Principal recommendations

These integrated recommendations use the strengths we encountered in the region to combat the threats that could fragment and destroy the remaining forest, an area vitally important for three provinces and globally valuable for its biodiversity:

- 01 **Grant formal conservation status for the continuous vegetation along the entire altitudinal range from lowland forest to Andean paramos.** This is a critical refuge for diverse habitats and water sources crucial for the region.
- 02 **Seize the opportunity to catalyze and implement a new conservation model—a municipal reserve.** The Reserva Municipal La Bonita should be supported by a Ministerial Decree from the national environmental authorities, and should integrally involve the local government and indigenous populations.
- 03 **Develop and implement participatory management plans for proposed and existing conservation areas:** Reserva Municipal La Bonita, Territorio Ancestral Cofan, and others.
- 04 **Form strategic alliances—among indigenous organizations, campesino associations, and municipalities—founded on a shared vision for protecting intact forests.** These alliances will become a local complement to the Ministerio del Ambiente.
- 05 **Reinforce and expand alliances among Carchi, Sucumbíos, and Imbabura provinces, strengthening existing links.** Evaluate the unique opportunities to conserve the globally important, intact forests and headwaters in Carchi and Imbabura, especially mechanisms that halt the advance of the agricultural frontier and join forces to protect water sources.
- 06 **Pursue binational collaborations for coordinated management of existing and potential conservation areas in Colombia.**

Current conservation status

Presentation of our preliminary results to the provincial governments and regional organizations generated a spirited discussion that resulted in a declaration—signed by all authorities present—to support the Reserva Municipal La Bonita and to create

similar reserves in the two neighboring provinces that still have a narrow band of forest shielding the headwaters of a third important river, the Chota (Figs. 2B, 12B).

Since the start of 2009, The Field Museum has facilitated several meetings in northern Ecuador with local government organizations, NGOs, and local scientists and residents. The goal of this Work Group (*Grupo de Trabajo*) is to secure immediate legal protection for the roughly 70,000 ha that we inventoried in October 2008, along an intact elevational gradient. Neighboring provinces (Carchi and Imbabura) have requested continued support from the Work Group to protect the two adjacent forest remnants, for an additional 18,450 hectares.

At the time of printing of this report, plans were moving forward for the official declaration of the Área Ecológica de Conservación La Bonita-Cofanes-Chingual (AECBCC) to protect the 70,000 hectares envisioned initially as a municipal reserve. The technical proposal for the area received initial approval by the Ministerio del Ambiente in July 2009. The Work Group continues to follow the declaration process closely, and will start developing a management plan for the AECBCC.

Why Cabeceras Cofanes-Chingual?

Following the tracks of a mountain tapir, one can descend from the surreal, windswept paramos* of Cabeceras Cofanes-Chingual through the precipitous slopes of cloud forests dripping with mist and orchids all the way down to tall Amazon forests in the lowlands. The conservation complex proposed in this report will protect the headwaters of two important rivers in the region, the Cofanes and Chingual, and will conserve water resources critical to human populations and to a rich assemblage of wild species. The complex will safeguard the forested slopes from 650 to 4,100 meters in elevation, one of the last intact altitudinal gradients remaining in Ecuador. Contiguous with Cofan ancestral lands and the Reserva Ecológica Cayambe-Coca, this new reserve will provide a key piece in the region's conservation puzzle, resulting in a corridor of more than 550,000 hectares of highly diverse forests.

The streams that drain the region are the sources of the Aguarico-Napo river system, one of the most important fluvial systems of western Amazonia. The Cofanes and Chingual rivers, which join to form the Aguarico, are some of the last unfragmented mountain rivers in Ecuador and provide crucial habitat for aquatic biota. Paramos and forests filter rainwater and modulate river flow in these headwaters, protecting critical sources of water for domestic and agricultural uses.

Habitat variation is striking and the distribution of species is narrow and markedly patchy: species on one ridge are often not on the next, nor are they found at lower or higher elevations. The intact vegetation of Cabeceras Cofanes-Chingual allows free movement of bears, tapirs, macaws, and other wide-ranging species up and down the mountains in search of food, mates, and nesting sites. The forested slopes buffer the effects of climate change because they allow species to migrate in response to hotter, wetter, or drier conditions.

Human history in the area spans thousands of years and has left a strong imprint on the environment. Accelerating deforestation and unsustainable mining and agricultural practices now endanger both wilderness and humans, and local residents are mobilizing to retain the forests that surround them. Three provinces—Sucumbíos, Carchi, and Imbabura—have joined forces to create a conservation complex that will ensure the long-term survival of this spectacular and diverse landscape.

* High-altitude grasslands.

Conservation in Cabeceras Cofanes-Chingual

CONSERVATION TARGETS

We envision Cabeceras Cofanes-Chingual as a conservation complex that protects diverse Andean forests for the long term and sustains the quality of life in neighboring towns and villages. Implementation of this vision will depend on a network of government and non-government organizations, public officials, scientists, local residents (including indigenous groups), and a strong scientific foundation. Below we highlight ecosystems, habitats, species, and human practices important for conservation of the area. Some of the conservation targets occur only in this region; others are rare, threatened, or vulnerable in other parts of the Amazon or Andes. Some are crucial for local residents; others play critical roles in ecosystem function; and still others are critical for the long-term health of the area.

Landscapes and ecosystem services

- A broad elevational gradient (650–4,100 m) of intact forest, critical in allowing migration in response to climate change
- High-altitude glacial valleys and lakes, including a rare glacially carved valley surrounded by solid granite walls
- Intact forests that provide natural protection from erosion in rugged mountain landscapes
- Forests that store globally important reserves of carbon
- High-gradient rivers and streams that ensure water supply for the entire region
- Hydrological connectivity between the headwaters and downstream areas throughout the Cofanes-Chingual basin, important for aquatic and human communities

Vascular plants

- A well-conserved sample of the diverse and endemic flora of the northern Andes, a region largely deforested in other parts of Ecuador and neighboring Colombia
- Healthy populations of timber species in upper and lower montane forests (e.g., *Polylepis*, *Podocarpus*, *Weinmannia*, *Humiriastrum*)

Conservation Targets (continued)

<p>Vascular Plants (continued)</p>	<ul style="list-style-type: none"> ▪ Tremendous diversity of orchids, including possibly some of the highest local richness of genera such as <i>Masdevallia</i>
<p>Fishes</p>	<ul style="list-style-type: none"> ▪ Highly endemic, poorly studied, Andean fish assemblages located between altitudes of 500 and 3,500 m ▪ Ecological integrity of aquatic communities, including fishes as a principal component
<p>Amphibians and reptiles</p>	<ul style="list-style-type: none"> ▪ Endemic species of the eastern foothills of northern Ecuador and southern Colombia classified as endangered, including <i>Cochranella puyoensis</i>, <i>Gastrotheca orophylax</i>, and <i>Hypodactylus brunneus</i> ▪ Amphibians whose reproductive strategies have been affected by climate change and epidemiologic factors in the Ecuadorian and Colombian Andes (<i>Hyloscirtus larinopygion</i>, <i>Cochranella puyoensis</i>, <i>Gastrotheca orophylax</i>) ▪ Species with restricted distributions associated with paramo microhabitats, which are threatened by excessive burning by humans (<i>Osornophryne bufoniformis</i>, <i>Hypodactylus brunneus</i>, <i>Riama simoterus</i>, and <i>Stenocercus angel</i>) ▪ Endemic species categorized as Data Deficient with restricted distributions in northern Ecuador and southern Colombia (<i>Pristimantis ortizi</i>, <i>P. delius</i>, and <i>P. colonensis</i>)
<p>Birds</p>	<ul style="list-style-type: none"> ▪ Endangered birds, including Bicolored Antpitta (<i>Grallaria rufocinerea</i>) ▪ Threatened birds, including Wattled Guan (<i>Aburria aburri</i>), Military Macaw (<i>Ara militaris</i>), Coppery-chested Jacamar (<i>Galbula pastazae</i>), and Masked Mountain-Tanager (<i>Buthraupis wetmorei</i>)

	<ul style="list-style-type: none"> ▪ Fourteen range-restricted species of Andean slopes and paramo ▪ Diverse forest avifauna across an entire montane elevational gradient
Mammals	<ul style="list-style-type: none"> ▪ Healthy populations of mountain tapir (<i>Tapirus pinchaque</i>) and Andean bear (<i>Tremarctos ornatus</i>) ▪ Abundant populations of <i>Nasuella olivacea</i>, <i>Agouti taczanowskii</i>, and other montane species ▪ Important predators, including puma (<i>Puma concolor</i>) and jaguar (<i>Panthera onca</i>) ▪ Intact populations of woolly monkey (<i>Lagothrix lagothricha</i>) and white-bellied spider monkey (<i>Ateles belzebuth</i>) at mid-level altitudes ▪ Intact altitudinal ranges for all these species, especially mountain tapir and Andean bear
Archeological and historical artifacts	<ul style="list-style-type: none"> ▪ A pre-Columbian settlement at La Bonita, made up of mounds and other modifications of the environment ▪ A pre-Columbian settlement at Río Verde, at the confluence of the Verde and Cofanes rivers ▪ Other archaeological artifacts and earthworks, an invaluable historical record of pre-Colombian settlements in the region, some of which are known to local residents
Human communities	<ul style="list-style-type: none"> ▪ Organic farms using traditional methods and crops and small-scale production (e.g., artisanal cheeses) ▪ Local ecological knowledge, including use of native medicinal plants ▪ Artisanal gold mining operations and technology, including apparently premodern sites that could become tourism opportunities

Conservation Targets (continued)

Human communities
(continued)

- Access roads for horseback or pedestrian travel, such as the road from La Bonita to La Sofía and the road to La Estación Biológica Guandera (as opposed to bigger thoroughfares that expose the area to colonization and large-scale extraction of natural resources)
- The “Eastern Road” (Camino del Oriente), a historical path linking Monte Olivo and La Sofía, which could complement community efforts in ecological and historical tourism

RECOMMENDATIONS

The rugged headwaters of the Cofanes, Chingual, and Chota rivers (including the latter's tributaries: Apaquí, Escudillas, and Sataqui) represent one of the last opportunities to conserve the distinct biological communities along an altitudinal gradient from 650–4,100 m. This mountainous area is the most important remaining block of forests providing refuge for unique and threatened species in the Andes, as well as essential water sources for human populations in Carchi, Imbabura, and Sucumbíos.

One portion of the forested block already is an established conservation area, Territorio Ancestral Cofan (30,700 ha). To the north is the proposed Reserva Municipal La Bonita* (70,000 ha; Figs. 2A, 2B), a conservation initiative originating within Provincia Sucumbíos. The western fringe indicated with a dotted line in Fig. 2B offers a unique opportunity to protect water sources and the few remaining forests and paramos in the provinces of Carchi and Imbabura.

Below we list our principal recommendations. These recommendations mobilize the strengths we encountered in the region to mitigate the threats that could fragment and destroy the remaining block of forest, an area vitally important for three provinces and globally valuable in its biodiversity.

Protection and management

- 01 **Grant formal conservation status to the entire altitudinal range, from lowland forest to Andean paramos, which harbors unique biological communities and water sources for the region.**
 - We recommend that the Instituto Nacional de Desarrollo Agrario (INDA, the national institute for agrarian development), conduct an evaluation to designate the area as appropriate for the conservation of natural resources. Steep cliffs, vertical slopes, and frequent landslides create highly unfavorable conditions for agriculture in the mountains.
 - Delimit specific conservation areas to protect the integrity of watersheds, (especially the headwaters) and a continuous range of intact habitats; coordinate the management of these areas as an integrated network.
 - Strengthen inter-institutional links among the Secretaría Nacional del Agua (SENAGUA, the national water authority), the Ministerio del Ambiente (MAE, the ministry of the environment), local governments, and community water organizations, among others.
 - Support and strengthen local conservation interests within the integrated network of protected areas (e.g., the Guandera Biological Station and a new conservation area in Monte Olivo, among others).
- 02 **Seize the opportunity to catalyze and implement a new conservation model— a municipal reserve (la Reserva Municipal La Bonita), with integral participation from parishes (*parroquias*) and indigenous populations, and the approval of the national environmental authorities with a Ministerial Decree.**

* The proposed municipal reserve is now being protected as the Área Ecológica de Conservación La Bonita-Cofanes-Chingual (AECBCC).

Protection and
management
(continued)

03 Develop and implement participatory management plans for proposed and existing conservation areas: Reserva Municipal La Bonita and the Territorio Ancestral Cofan, and others.

- Form a work group that includes the department of environment of the Sucumbíos municipal government (Departamento del Medio Ambiente del Gobierno Municipal Cantón Sucumbíos, GMCS), the mayor of GMCS, representatives of the parish (*parroquia*) boards of Rosa Florida and La Sofía, members of the Cofan Survival Fund (FSC), and the Cofan indigenous federation (Federación Indígena de la Nacionalidad Cofan del Ecuador, FEINCE), and other key actors.
- Together with local landholders, adjust the limits of the proposed La Bonita municipal reserve.
- Zone each conservation area, defining strict protection areas, areas of traditional use, and management areas.
- Identify critical access points for establishing control posts, using the La Bonita–La Sofía highway as a patrol route—with sentry huts at points of access to the highway—and halt land trafficking along the length of the road.
- Manage excessive burning in the paramos, hunting levels, and exotic species (e.g., trout, grasses, cattle).
- Restrict unsustainable fishing practices in the lowlands (e.g., use of dynamite and *barbasco* fish-poison)
- Implement initiatives (e.g., agroforestry) to reduce and ultimately eliminate timber extraction from conservation areas.
- Research alternatives to harmful agrochemicals and promote development of water treatment projects to preserve water quality.
- Implement a participatory *comité de gestión* (“management committee”) that involves residents living in and around the conservation areas in the development of management plans and the administration of the areas.
- Conduct an “environmental flows assessment” and use appropriate technologies to minimize the ecological impact of the proposed hydroelectric plant in La Sofía.
- Coordinate management among the neighboring conservation areas.
- Reinforce management plans with municipal ordinances.

04 Build strategic alliances—among indigenous organizations, *campesino* associations, and municipalities—founded on a shared vision for protecting intact forests. These alliances will provide a crucial local complement to the activities of the Ministerio del Medio Ambiente. Build on existing successful models, e.g., Cofan conservation management and park guard systems, and Reserva Ecológica El Ángel.

RECOMMENDATIONS

- 05 **Reinforce and expand alliances among Carchi, Sucumbíos, and Imbabura provinces, strengthening existing links.** Evaluate the unique opportunities to conserve globally important intact forests and headwaters in Carchi and Imbabura, especially mechanisms that halt the advance of the agricultural frontier; join forces to protect water sources.
- 06 **Develop financial mechanisms for the protected areas through the national and provincial governments.**
- 07 **Elaborate a strategic development plan for responsible land use, especially soil management, in the surrounding conservation areas and provide technical support for suitable aquaculture practices.**
 - Strengthen and improve existing programs, including the Centro de Investigación y Servicios Agrícolas para Sucumbíos (CISAS, the Sucumbíos agricultural research and services center) and municipal initiatives in Sucumbíos, Carchi, and Imbabura, improving follow-up with agriculturalists.
 - Pursue opportunities to collaborate with other private and public entities, e.g., the national agrofiseries research institute (Instituto Nacional Autónomo de Investigaciones Agropecuarias) and local extensions of various universities, including the Escuela Superior Politécnica Ecológica Amazónica (ESPEA) and the Universidad Técnica del Norte–Extensión Huaca.
- 08 **Consider economic alternatives that are ecologically compatible with the area, such as local handicrafts, and orchid and bromeliad cultivation, using successful models in Ecuador and other countries** (e.g., micropropagation of orchids).
- 09 **Carefully define possible financial mechanisms that could support environmental services, manage expectations, and base development of ecotourism on existing experiences** (e.g., the “Y” in the Laguna de Mache Chindul, and the Red Indígena de Comunidades del Alto Napo para la Convivencia Intercultural y el Ecoturismo [RICANCIE]).
- 10 **Expand successful training programs for teachers in environmental education, and distribute identification guides for native species and other materials to existing programs** (e.g., the “Green Notebook” (*Cuaderno Verde*) curriculum developed by the environmental education department in Sucumbíos.)
- 11 **Pursue binational collaborations with Colombia in contiguous conservation areas.**
- 12 **Conduct feasibility studies for an avoided-deforestation project in the Cofanes-Chingual region.**

Research

- 01 **Determine the distribution of the introduced rainbow trout** in the Cofanes-Chingual basin and evaluate its impacts on the aquatic ecosystem and native fish species.

REPORT AT A GLANCE

Research
(continued)

- 02 **Conduct cost-benefit studies of rainbow trout cultivation** to determine whether or not this “alternative economic development activity” is financially feasible.
- 03 **Study population dynamics and ecology of threatened species** (e.g., amphibians, macaws, mountain tapirs, spectacled bears), in particular, seasonal movements, home ranges, and key food and reproductive resources.

Additional inventories

- 01 **We recommend additional inventories targeting elevations we did not sample** (i.e., 1,100–2,500 m and 3,000–3,500 m) and focused on the isolated massif to the east of La Sofía, the upper Condué valley, the Ccuttopoé paramo, the upper Cofanes drainage, and the forested areas on the western flanks in Carchi province. For aquatic communities, we recommend additional inventories in the Cofanes and Chingual rivers and their main tributaries, beginning near La Sofía.
- 02 **Conduct inventories to understand the size and extent of the Bicolored Antpitta population.** Given the deforestation in Colombia, the populations in Cabeceras Cofanes-Chingual are likely among the largest within its range and critical for long-term conservation of this rare species.
- 03 **Inventory other paramo sites for Masked Mountain-Tanager**, which seems to be negatively impacted by burning of the paramo. Ccuttopoé is especially important because it lacks human-generated fires.
- 04 **Inventory appropriate habitat for locally distributed, near-threatened species**, including Black-thighed Puffleg, Coppery-chested Jacamar, and White-rimmed Brush-Finch.

Monitoring and surveillance

- 01 **Train a local corps of forest wardens, guides, and scientists to support the monitoring, surveillance, research, and inventory work for the complex of conservation areas in Cabeceras Cofanes-Chingual.**
- 02 **Monitor deforestation in the buffer zone**, to understand and eventually mitigate its causes.
- 03 **Monitor water quality, especially in the Chingual River**, which drains deforested lands to the north and east of its course, to create an early-alert mechanism to mitigate sources of pollution.