

Ecuador:
Territorio Cofan Dureno



Ecuador: Territorio Cofan Dureno

Randall Borman, Corine Vriesendorp,
William S. Alverson, Debra K. Moskovits,
Douglas F. Stotz, y/and Álvaro del Campo,
editores/editors

OCTUBRE/OCTOBER 2007

Instituciones Participantes/Participating Institutions



The Field Museum



Fundación para la Sobrevivencia
del Pueblo Cofan



Museo Ecuatoriano de Ciencias Naturales

LOS INVENTARIOS BIOLÓGICOS RÁPIDOS SON PUBLICADOS POR/
RAPID BIOLOGICAL INVENTORIES REPORTS ARE PUBLISHED BY:

THE FIELD MUSEUM

Environmental and Conservation Programs
1400 South Lake Shore Drive
Chicago, Illinois 60605-2496, USA
T 312.665.7430, F 312.665.7433
www.fieldmuseum.org

Editores/Editors

Randall Borman, Corine Vriesendorp, William S. Alverson,
Debra K. Moskovits, Douglas F. Stotz, y/and Álvaro del Campo

Diseño/Design

Costello Communications, Chicago

Mapas/Maps

Dan Brinkmeier y/and Jon Markel

Traducciones/Translations

Amanda Zidek-Vanega, Emma Chica Umenda,
Álvaro del Campo, y/and Tyana Wachter

El Field Museum es una institución sin fines de lucro exenta de impuestos federales bajo la sección 501(c)(3) del Código Fiscal Interno./ The Field Museum is a non-profit organization exempt from federal income tax under section 501(c)(3) of the Internal Revenue Code.

ISBN NUMBER 978-0-914868-71-2

© 2007 por el Field Museum. Todos los derechos reservados./

© 2007 by The Field Museum. All rights reserved.

Cualquiera de las opiniones expresadas en los Informes de los Inventarios Biológicos Rápidos son expresamente las de los autores y no reflejan necesariamente las del Field Museum./Any opinions expressed in the Rapid Biological Inventories Reports are those of the authors and do not necessarily reflect those of The Field Museum.

Esta publicación ha sido financiada en parte por The Hamill Family Foundation, The John D. and Catherine T. MacArthur Foundation, PPD y ECOFONDO./This publication has been funded in part by the The Hamill Family Foundation, The John D. and Catherine T. MacArthur Foundation, PPD, and ECOFONDO.

Cita Sugerida/Suggested Citation

Borman, R., C. Vriesendorp, W. S. Alverson, D. K. Moskovits, D.F. Stotz, y/and Á. del Campo, eds. 2007. Ecuador: Territorio Cofan Dureno. Rapid Biological Inventories Report 19. The Field Museum, Chicago.

Créditos fotográficos/Photography credits

Carátula/Cover: Una protección formal del Territorio Dureno permitirá la conservación de la biodiversidad para las generaciones futuras. Foto de Á. del Campo./Formal protection of the Dureno Territory will conserve the region's biodiversity for future generations. Photo by Á. del Campo.

Carátula interior/Inner-cover: Los Cofan, de una manera muy activa, manejan y protegen sus territorios ancestrales, incluyendo el Territorio Dureno. Foto de Á. del Campo./The Cofan actively manage and protect their ancestral lands, including the Dureno Territory. Photo by Á. del Campo.

Láminas a color/Color plates: Figs. 1, 3C–E, 4F, 4G, 5E, 6C, 6D, 6G, 7A, 7B, 8A–C, 10A–D, A. del Campo; Figs. 4A–E, C. Carrera; Fig. 3F, R. Foster; Figs. 7E, 7F, D.Lane; Figs. 2A, 2B, 9C, NASA, J. Markel, y/and J. Costello; Figs. 5A–D, J. F. Rivadeneira; Figs. 7C, 7D, D. Stotz; Figs. 3A, 3B, C. Vriesendorp; Figs. 6A, 6B, 6E, 6F, M. Yáñez. Las figuras 9A y 9B han sido reimprimos de Sierra (2000), con el permiso de Elsevier Science./Figures 9A and 9B reprinted from Sierra (2000) with permission from Elsevier Science.



Impreso sobre papel reciclado/Printed on recycled paper

PARTICIPANTS

FIELD TEAM

Jaime Aguinda L. (*field logistics*)

Fundación para la Sobrevivencia del Pueblo Cofan
Federación Indígena de la Nacionalidad Cofan del Ecuador
Dureno, Ecuador

Roberto Aguinda L. (*field logistics*)

Fundación para la Sobrevivencia del Pueblo Cofan
Federación Indígena de la Nacionalidad Cofan del Ecuador
Quito and Dureno, Ecuador
robertotsampi@yahoo.com

Randall Borman A. (*large mammals*)

Fundación para la Sobrevivencia del Pueblo Cofan
Federación Indígena de la Nacionalidad Cofan del Ecuador
Quito and Dureno, Ecuador
randy@cofan.org

Daniel Brinkmeier (*communications*)

Environmental and Conservation Programs
The Field Museum, Chicago, IL, U.S.A.
dbrinkmeier@fieldmuseum.org

Carlos Carrera R. (*aquatic macroinvertebrates*)

Museo Ecuatoriano de Ciencias Naturales
Quito, Ecuador
carrera.carlos@gmail.com

Hugo Tito Chapal M. (*cooking*)

Comuna Cofan Dureno
Sucumbíos, Ecuador

Iván José Chapal M. (*aquatic macroinvertebrates*)

Comuna Cofan Dureno
Sucumbíos, Ecuador

Silvio Chapal M. (*large mammals*)

Comuna Cofan Dureno
Sucumbíos, Ecuador

Ángel Chimbo P. (*amphibians and reptiles*)

Comuna Cofan Dureno
Sucumbíos, Ecuador

John Criollo C. (*fishes*)

Comuna Cofan Dureno
Sucumbíos, Ecuador

Fausto Criollo M. (*field logistics*)

Fundación para la Sobrevivencia del Pueblo Cofan
Federación Indígena de la Nacionalidad Cofan del Ecuador
Dureno, Ecuador

Alfredo Nexer Criollo Q. (*large mammals*)

Comuna Cofan Dureno
Sucumbíos, Ecuador

Jose Criollo Q. (*field logistics*)

Comuna Cofan Dureno
Sucumbíos, Ecuador

Álvaro del Campo (*field logistics, photography*)

Environmental and Conservation Programs
The Field Museum, Chicago, IL, U.S.A.
adelcampo@fieldmuseum.org

Sebastián Descanse U. (*plants*)

Cofan Community of Chandia Na'e
Sucumbíos, Ecuador

Robin B. Foster (*plants*)

Environmental and Conservation Programs
The Field Museum, Chicago, IL, U.S.A.
rfoster@fieldmuseum.org

Mary Grefa M. (*aquatic macroinvertebrates*)

Comuna Cofan Dureno
Sucumbíos, Ecuador

Laura Cristina Lucitante C. (*plants*)

Cofan Community of Chandia Na'e
Sucumbíos, Ecuador

Célida Lucitante Q. (*cooking*)

Comuna Cofan Dureno
Sucumbíos, Ecuador

Nexar Manzasa C. (*field logistics*)

Fundación para la Supervivencia del Pueblo Cofan
Federación Indígena de la Nacionalidad Cofan del Ecuador
Dureno, Ecuador

Solaida Mendúa V. (*field logistics*)

Communal Park Guard-Fundación Supervivencia Cofan
Federación Indígena de la Nacionalidad Cofan del Ecuador
Dureno, Ecuador

Debra K. Moskovits (*coordination*)

Environmental and Conservation Programs
The Field Museum, Chicago, IL, U.S.A.
dmoskovits@fieldmuseum.org

Carlos Arturo Ortiz Q. (*plants*)

Comuna Cofan Dureno
Sucumbíos, Ecuador

Linda Ortiz Q. (*logistics*)

Fundación para la Supervivencia del Pueblo Cofan
Federación Indígena de la Nacionalidad Cofan del Ecuador
Dureno, Ecuador

Amelia Quenamá Q. (*natural history*)

Fundación para la Supervivencia del Pueblo Cofan
Federación Indígena de la Nacionalidad Cofan del Ecuador
Quito and Dureno, Ecuador

Héctor Quenamá Q. (*field logistics*)

Comuna Cofan Dureno
Sucumbíos, Ecuador

Zoila Quenamá M. (*field logistics*)

Fundación para la Supervivencia del Pueblo Cofan
Federación Indígena de la Nacionalidad Cofan del Ecuador
Dureno, Ecuador

Ejidio Quenamá V. (*plants*)

Comuna Cofan Dureno
Sucumbíos, Ecuador

Fredy Queta Q. (*birds*)

Comuna Cofan Dureno
Sucumbíos, Ecuador

Juan Francisco Rivadeneira R. (*fishes*)

Museo Ecuatoriano de Ciencias Naturales
Quito, Ecuador
jf.rivadeneira@mecn.gov.ec

Edgar René Ruiz P. (*fishes*)

Comuna Cofan Dureno
Sucumbíos, Ecuador

Douglas F. Stotz (*birds*)

Environmental and Conservation Programs
The Field Museum, Chicago, IL, U.S.A.
dstotz@fieldmuseum.org

Corine Vriesendorp (*plants*)

Environmental and Conservation Programs
The Field Museum, Chicago, IL, U.S.A.
cvariesendorp@fieldmuseum.org

Tyana Wachter (*international logistics*)

Environmental and Conservation Programs
The Field Museum, Chicago, IL, U.S.A.
twachter@fieldmuseum.org

Mario Yáñez-Muñoz (*amphibians and reptiles*)

Museo Ecuatoriano de Ciencias Naturales
Quito, Ecuador
m.yanez@mecn.gov.ec

Blanca Yumbo S. (*field logistics*)

Communal Park Guard-Fundación Sobrevivencia Cofan
Federación Indígena de la Nacionalidad Cofan del Ecuador
Quito and Dureno, Ecuador

COLLABORATORS

Cofan Community of Baboroé

Sucumbíos, Ecuador

Cofan Community of Chandia Na'e

Sucumbíos, Ecuador

Cofan Community of Dureno

Sucumbíos, Ecuador

Cofan Community of Pisorié Canque

Sucumbíos, Ecuador

Cofan Community of Totoa Nai'qui

Sucumbíos, Ecuador

**Federación Indígena de la Nacionalidad Cofan del Ecuador
(FEINCE)**

Lago Agrio, Ecuador

Herbario Nacional del Ecuador (QCNE)

Quito, Ecuador

Ministerio del Medio Ambiente

Quito, Ecuador

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. One division of the Museum—Environment, Culture, and Conservation (ECCo)—through its two departments, Environmental and Conservation Programs (ECP) and the Center for Cultural Understanding and Change (CCUC), is dedicated to translating science into action that creates and supports lasting conservation of biological and cultural diversity. ECCo works closely with local communities to ensure their involvement in conservation through their existing cultural values and organizational strengths. With losses of natural diversity accelerating worldwide, ECCo's mission is to direct the museum's resources—scientific expertise, worldwide collections, innovative education programs—to the immediate needs of conservation at local, national, and international levels.

The Field Museum
1400 S. Lake Shore Drive
Chicago, IL 60605-2496 U.S.A.
312.922.9410 tel
www.fieldmuseum.org

Fundación para la Sobrevivencia del Pueblo Cofan

The Fundación para la Sobrevivencia del Pueblo Cofan 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 biodiversity conservation and research, protecting and titling Cofan ancestral territories, developing economic and ecological alternatives, and education opportunities for young Cofan.

Fundación para la Sobrevivencia del Pueblo Cofan
Casilla 17-11-6089
Quito, Ecuador
593.22.470.946 tel/fax
www.cofan.org

Museo Ecuatoriano de Ciencias Naturales (MECN)

The Museo Ecuatoriano de Ciencias Naturales (MECN) is a public entity established on 18 August 1977 by government decree 1777-C, in Quito, as a technical, scientific, and public institution. The MECN represents the only state institution whose objectives are to inventory, classify, conserve, exhibit, and disseminate understanding of the country's biodiversity. The institution is obliged to offer 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, as well as contribute to implementing technical support for designing and establishing national protected areas.

Museo Ecuatoriano de Ciencias Naturales
Rumipamba 341 y Av. De los Shyris
Casilla Postal: 17-07-8976
Quito, Ecuador
593.2.2.449.825 tel/fax

ACKNOWLEDGMENTS

Our inventory of the rich forests of the Dureno Territory, straddling the Equator, was conceived by the Cofan. And the inventory would not have been successful without the deep knowledge, support, logistical talents, and superb field abilities of the Cofan. The Cofan were our teachers, collaborators, and counterparts. The teams for each organism group we inventoried had Cofan members and the mammal team was entirely Cofan. Sebastián Descanse and Cristina Lucitante played a central role in the botany team thanks to their previous ethnobotanical training and wonderful energy. Amelia Quenamá's remarkable skills as a naturalist led to important sightings in the herpetological, mammal, and bird inventories. And the fish team thanks Paul Meza Ramos, from the Museo Ecuatoriano de Ciencias Naturales, who facilitated bibliographic information for the fishes' report. For their help in identifying plant specimens, we thank M. Blanco (Aristolochiaceae). Carlos Carrera was extremely helpful in facilitating the drying of our plant specimens in the National Herbarium of Ecuador. In the Ministerio del Ambiente in Quito, we sincerely thank Dr. Fausto Gonzáles, Director General en Sucumbíos; Dr. Ulises Cápelo, Asesor Jurídico Regional; Fausto Quisanga, Líder de Biodiversidad Regional; and Dr. Wilson Rojas, Director Nacional de Biodiversidad.

For their tireless assistance in the field, we thank the superb Cofan team: Hugo Tito Chapal Mendúa, Iván José Chapal Mendúa, Silvio Filemón Chapal Mendúa, Ángel Chimbo Papa, John Humberto Criollo Chapal, Alfredo Nexer Criollo Quenamá, Fernando Criollo Queta, José Aroldo Criollo Queta, Sebastián Descanse Umenda, Mary Grefa Mendúa, José Serbio Hernández, Laura Cristina Lucitante Criollo, Célida Lucitante Quenamá, Nexar Manzasa Cumbe, Valerio Mendúa Lucitante, Carlos Arturo Ortiz Quintero, Héctor Quenamá Queta, Ejidio Quenamá Vaporín, Fredy Carlos Queta Quenamá, Edgar René Ruiz Peñafiel, and residents of the communities of Dureno, Baboroé, and Pisorié Canque, who warmly welcomed us to their threatened forests. We also thank Dureno forest guards Solaida Mendúa Vargas, Zoila Quenamá Mendúa, Blanca Yumbo Salazar, Jaime Aguinda Lucitante, and Fausto Criollo Mendúa, who were great help at our second and third campsite; their good sense of humor and enthusiasm were contagious. Nivaldo Yiyoguaje Quenamá and Linda Ortiz helped with logistics in Lago Agrio and Dureno.

Roberto Aguinda oversaw the logistical operations to set up the three field sites (Pisorié Setsa'cco, Baboroé and Totoa Nai'qui). With his wife Linda Ortiz, Roberto also facilitated pre-expedition meetings as well as the post-expedition presentation in Dureno.

While the team was in the field, Freddy Espinosa and his wife Maria Luisa López secured all coordination in Quito with the Museo Ecuatoriano de Ciencias Naturales, and kept communication going with Dureno, Lago Agrio, Quito, and Chicago. Sadie Siviter, Hugo Lucitante, Mateo Espinosa, Juan Carlos González, Carlos Menéndez, Víctor Andrango, and Lorena Sánchez also helped enormously arranging logistics from the Fundación Sobrevivencia Cofan office in Quito, pre-, during, and post-inventory.

Jonathan Markel prepared fabulous maps from the digital satellite image data, both for the logistical team and the inventory team. Dan Brinkmeier produced terrifically helpful maps for the presentations and report, and developed community outreach materials from our results. Elizabeth Joynes made available satellite images and maps and negotiated with ECOLEX and Jatun Sacha for permission to republish these images. We deeply thank all of them.

From Chicago, Tyana Wachter, as always, was instrumental in keeping operations running smoothly. Rob McMillan, Brandy Pawlak, and Tyana continue their magic problem-solving from our home base in Chicago. We sincerely thank Brandy and Tyana for their input in editing and proofreading several versions of the manuscript, Amanda Vanega and Tyana for quick translations into Spanish, and Emma Chica Umenda for the translations into Cofan. Jim Costello and his team, as always, did a wonderful job accommodating the special requests for this report.

Funding for this rapid inventory came from The Hamill Family Foundation, The John D. and Catherine T. MacArthur Foundation, PPD, ECOFONDO, and The Field Museum.

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

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.

RESULTS AT A GLANCE

Dates of fieldwork 23 May–1 June 2007

Region

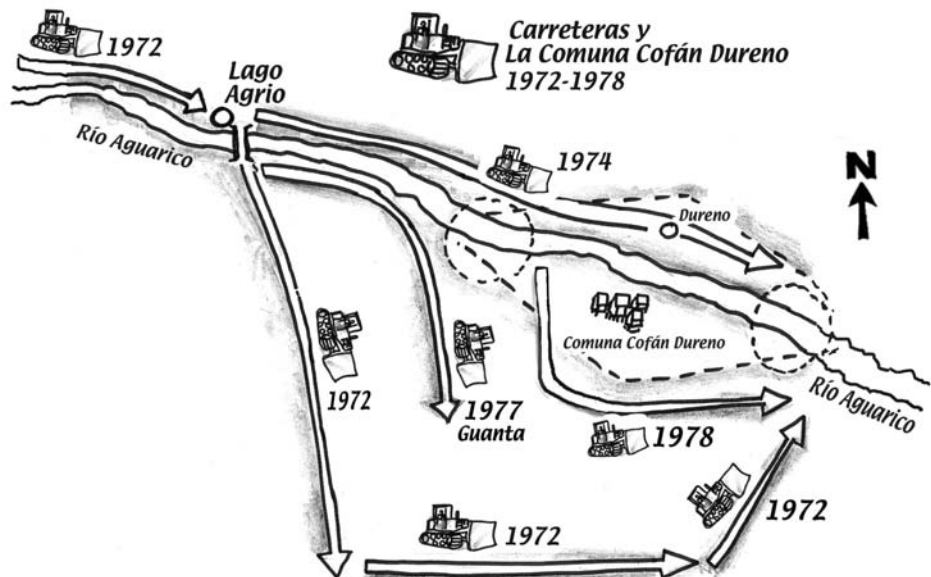
The Dureno Territory—part of the Cofan ancestral territories—lies in the extraordinarily species-rich, northwestern reaches of the Amazon basin, in the Sucumbíos Province of eastern Ecuador. The 9,469-hectare forest remnant on the southern banks of the Aguarico River, managed by the Cofan, has been surrounded by a grid of roads since the late 1970s (Fig. 15). By the mid-1990s the adjacent lowlands had been denuded, leaving the forest block isolated (Fig. 9). The streams that traverse the Territory all flow into the Pisorié River (Pisurí in Spanish), a southern tributary of the Aguarico River.

Inventory sites

We sampled three Amazonian lowland sites inside the Dureno Territory. The site names are, in Cofan:

- *Pisorié Setsa'cco* (“peninsula of the Pisorié River”), on a flat terrace 600 m west of the Aguarico River;
- *Baboroé* (named for the nearest Cofan settlement), on a terrace about 3 km south of the Aguarico River; and
- *Totoa Nai'qui* (the Cofan name for the Aguas Blancas River), 400 m east of the western boundary of the Dureno Territory.

Fig. 15



RESULTS AT A GLANCE

We explored 31 km of trails, sampling river floodplains, poorly drained bottomlands, and hills (ranging from 50 to 100 m high) as well as several bodies of water, including the Pisorié and its affluents: Totoa Nai'qui, Castillequi (known in Spanish as Castillo), a small stream known as the Guara, the Aguarico itself, and a small lagoon. We suspect that in the recent geological past the Coca River may have joined the Aguarico, drastically broadening the Aguarico floodplain to include much of the bottomlands of the Dureno Territory. In effect, the high hills of the Dureno Territory would have been islands in the temporarily broader, braided Aguarico floodplain.

Our Totoa Nai'qui site was within the 1,928-ha “Reserva Mundaé,” an area the Cofan made a no-hunting zone in 2005 to protect source populations of game for the rest of the Dureno Territory (Figs. 2B, 10). This was the only area we visited with substantial patches of giant bamboo, a habitat that has largely disappeared from the landscape around Lago Agrio.

Throughout the Territory, the forests we sampled varied from largely intact to heavily lumbered in the past. Water quality in the Territory varied, also: One river sampled—the Castillequi, very close to the border of the Dureno Territory—showed signs of recent pollution. Its headwaters, and headwaters of all rivers that cross the Dureno Territory are exposed to pollution, erosion, and oil spills outside the Territory, which greatly affect the quality of the water downstream.

Organisms surveyed

Vascular plants, aquatic macroinvertebrates, fishes, amphibians and reptiles, birds, and large mammals.

Highlights of results

The Dureno Territory is the largest remaining forest fragment in what was one of the richest natural areas in the world. Roads encircled the area in 1978, and by 1996, neighboring lands were largely deforested. Despite the isolation of the 9,469-ha area, we found substantially intact forests with high species richness for all groups that we sampled. Below we summarize our findings and highlight range extensions, species potentially new to science, and management priorities.

Table 1. Number of species we observed during the inventory and the number we estimate occur in the Dureno Territory.

Organismal group	Species observed	Species estimated
Vascular plants	ca. 800	2000
Aquatic macroinvertebrates	63	78
Fishes	54	80
Amphibians	48	62
Reptiles	31	54
Birds	283	400–420
Large mammals	26	39–40

<p>Vegetation</p>	<p>The Dureno Territory harbors a diverse mosaic of habitats, from river floodplains to poorly drained terraces, from low terraces to high hills (up to 100 m), and in the southern section (“Reserva Mundae”), a complex of vine tangles and giant bamboo. This extension of bamboo—a habitat that previously dominated large expanses now deforested—is one of the only surviving bamboo remnants in Ecuador. The habitat is protected only within the Reserva de Producción Faunística de Cuyabeno (Fig. 2A).</p>
<p>Vascular plants</p>	<p>We encountered a highly diverse flora, registering ca. 800 of 2,000 species we estimate for the Dureno Territory. These include 5–10 species potentially new to science, two in the genus <i>Aristolochia</i>. Among the most surprising finds is a major elevational-range extension for <i>Billia rosea</i> (Hippocastanaceae). We found this large-seeded species—known only from montane forests above 1,000 m—in the lowlands. The Dureno Territory harbors a natural pharmacy for the Cofan, with dozens of species used for their medicinal properties. The Cofan also have used the Territory for its timber resources for decades, especially for building canoes. The majority of the high-value timber species, including <i>Cedrela</i> sp., <i>Cedrelinga cateniformis</i>, <i>Cordia alliodora</i>, and <i>Brosimum utile</i>, already have been extirpated.</p>
<p>Aquatic macroinvertebrates</p>	<p>We registered 63 of the 78 species of aquatic macroinvertebrates that we estimate for the Dureno Territory, a relatively high number compared with other Amazon lowland sites in Ecuador. Snails (<i>Pomacea</i>), an important food resource for the Cofan, are abundant in many of the streams. We found indicators of high water quality in the entire Territory, and only the Castillequi River, at the edge of the Territory, shows signs of recent contamination upstream.</p>
<p>Fishes</p>	<p>We registered 54 of the 80 species we estimate for the Dureno Territory. Nine species are endemic. Characids are the dominant group, with 21 species making up 38% of the ichthyofauna. Two species of small catfishes are possibly new records for the Aguarico basin. We also found 14 species of fishes that may have ornamental value. The ichthyofauna of the Aguarico continues to be poorly known. We believe further studies will reveal that the basin includes at least 25% of all the species in Ecuador.</p>
<p>Amphibians and reptiles</p>	<p>We registered 79 species (48 amphibians and 31 reptiles), representing 68% of the species we estimate for the Dureno Territory (62 amphibians and 54 reptiles). The three sites shared only 28% of their species composition, most likely because of their differing topographic, floristic, and aquatic characteristics. Two frog species in the families Brachycephalidae and Centrolenidae may be new to science and we recorded a great species richness of geckos (five). The Territory is one of the last refuges for the highest concentration of amphibians reported for the planet; it includes half of the species known for the Aguarico basin.</p>

RESULTS AT A GLANCE

Birds

We found a species-rich forest avifauna (283 species), with most Amazonian bird families well represented. However, 40 species we expected do not seem to be present. Ten of these missing species are large birds that are no longer present, or have become very rare in the forest fragment, including game birds (*Crax salvini* and possibly others), large macaws, and large eagles. Another notable concentration of missing species is kingfishers. We had a single record of *Megaceryle torquata* on the Aguarico River and encountered no *Chloroceryle* (of four possible species) despite what appeared to be extensive, perfect habitat for these fish-eating birds along the Pisorié and Toota Nai'qui Rivers. The rest of the missing species are insectivorous birds concentrated in a few families, especially ovenbirds (only 2 of an expected 15 to 20 species registered), woodcreepers, woodpeckers, puffbirds, and jacamars. On the other hand, frugivorous species were well represented and abundant, from the smaller species, such as tanagers and manakins, to the larger cotingas, trogons, and toucans.

Large mammals

We registered 26 of the 39–40 species of large mammals known, from Cofan accounts, to exist in the Dureno Territory. Despite at least ten years of isolation, the Territory still supports a large group of white-lipped peccaries (*Tayassu pecari*), with some 150 individuals; large populations of collared peccaries (*Tayassu tayacu*); a high density of armadillos; and six species of monkeys. The two larger monkeys (red howler monkey, *Alouatta seniculus*, and white-fronted capuchin, *Cebus albifrons*) have small and vulnerable populations. In general, the Dureno Territory appears to have healthy populations of the smaller or fast-reproducing species. The two species that already have disappeared from the forest fragment are woolly monkey (*Lagothrix lagothricha poeppigii*; *cushava con'si* in Cofan, last seen in 1989) and giant otter (*Pteronura brasiliensis*; *sararo*, last seen in 1964). We did not see tapirs (*Tapirus terrestris*; *ccovi*) during the inventory, which the Cofan report as present but rare. With appropriate studies and effective management, the Dureno Territory should continue to provide a refuge for the mammals that still inhabit the forest fragment.

Why Dureno?

A 9,469-hectare block of forest near the oil town of Lago Agrio is one of the few remnants of the richest lowlands on the planet. Roads, colonization, and oil fields isolate this remnant from forests still standing in the Andean foothills to the west and in the Cuyabeno-Yasuní complex to the east (Fig. 2A). This forest stronghold, which once covered the entire region, is the Dureno Territory, one of the ancestral territories of the Cofan.

Early accounts of Dureno highlight the terrific abundance of game and birds important for ceremonial adornments. In the 1950s the Bormans—Bible translators living with the Cofan—still observed animals like the Wattled Guan (*Crax globulosa*) that have since disappeared from Ecuador and are now globally endangered.

Harsh changes arrived in the Cofan lands in the mid-1960s, when an oil consortium formed by Texaco and Gulf mobilized seismic teams and established exploratory wells throughout the region. By 1970, Lago Agrio had become an oil-boom town. From 1972 to 1974, roads sliced across the region and huge numbers of colonists, encouraged by government homestead policies, swarmed to stake out claims on the “empty lands” that were actually Cofan ancestral territories.

In reaction to these pressures, Cofan community members began to cut de facto boundary trails and, in 1978, received title to the Dureno Territory. Yet, in the same year, Texaco built a new road to the west that completely cut off the Dureno forest block (Fig. 15, p. 69), and even more colonists moved in quickly to establish land claims right up to the Cofan boundaries.

The Cofan continue to respond to ever-increasing conservation needs. Park guards (*guardabosques comunales*) and self-imposed hunting and fishing regulations have become core tools to achieve the Cofan vision of a rich forest that survives for the long term. Although they view wildlife largely in terms of food for their families, a deep awareness of the need to create safe areas for wildlife to reproduce has fueled the implementation of a zoning system that protects 1,928 ha of the Dureno Territory as a no-hunting site (Fig. 16, p. 75).

Dureno remains important in Cofan cultural and national identity. The Cofan’s successful conservation of their forests, despite relentless outside pressures, is clearly visible in satellite images (Figs. 2B, 9). Yet additional support from government and other institutions will be crucial for the Cofan to succeed in conserving as much as possible of what remains of one of the richest environments on Earth.

Conservation in Dureno

CURRENT STATUS

The Cofan received official title to the 9,469-ha Dureno Territory in 1978. Already in the mid-1960s the Cofan were developing ways to defend parts of their ancestral territory from the dramatic changes that were sweeping the region. The pressures on the Dureno Territory, now an isolated forest fragment, continue to increase. In 2005, the Cofan zoned their Territory, establishing a strict no-hunting zone—the 1,928-ha Reserva Mundaé (Fig. 16)—as a breeding haven and source for game species for the whole Territory. Although the Cofan have established a system of patrols and communal park guards, they do not yet enjoy official recognition from the national government for their role as protectors of this diverse section of Ecuador.

Fig. 16



CONSERVATION TARGETS

	<p>The following species, forest types, and ecosystems are of particular conservation concern in the Dureno Territory. Some are important because they are threatened or rare elsewhere in Ecuador or in Amazonia; others are unique to this area of Amazonia, key to ecosystem function, important to the Cofan, or important for effective long-term management.</p>
<p>Biological and geological communities</p>	<ul style="list-style-type: none"> ▪ One of the last remaining patches of rich-soil Amazonian forests near Lago Agrio; a natural pharmacy for the Cofan ▪ The lagoon in Pisorié Setsa'cco, a unique formation in the Dureno Territory ▪ Streams with rocky bottoms found only in the hills of Baboroé in the Dureno Territory ▪ Aquatic habitats, especially any stream with headwaters inside the Dureno Territory
<p>Vascular plants</p>	<ul style="list-style-type: none"> ▪ 5–10 plant species potentially new to science ▪ Dozens of plants of medicinal value to the Cofan
<p>Aquatic macroinvertebrates</p>	<ul style="list-style-type: none"> ▪ Substantial populations of snails (<i>Pomacea</i>), valued by the Cofan as a food resource
<p>fishes</p>	<ul style="list-style-type: none"> ▪ Important species in the Cofan diet and species of commercial value, e.g., large catfishes ▪ Ornamental species with potential market value
<p>Amphibians and reptiles</p>	<ul style="list-style-type: none"> ▪ Species restricted to the upper Amazon Basin in northern Ecuador and southern Colombia (<i>Cochranella resplendes</i>, <i>Hyloxalus sauli</i>, <i>Ameerega bilinguis</i>, <i>Enyalioides cofanarum</i>) ▪ Species susceptible to declines or poorly known species, including glass frogs (Centrolenidae) and poison dart frogs (Aromabatidae and Dendrobatidae)

<p>Amphibians and Reptiles (continued)</p>	<ul style="list-style-type: none"> ▪ Species that have apparently disappeared or are now very rare in the Santa Cecilia region (<i>Enyalioides cofanarum</i>, <i>Drepanoides anomalus</i>) ▪ Species consumed by the Cofan and of commercial use, for example tortoises (<i>Chelonoidis denticulata</i>) and caimans (<i>Caiman crocodilus</i>, <i>Paleosuchus trigonatus</i>)
<p>Birds</p>	<ul style="list-style-type: none"> ▪ Game birds that represent an important resource for the Cofan, including Cracidae, Tinamidae, and possibly Columbidae ▪ Large parrots that can play a role in dispersal of large fruits and whose feathers are prized by the Cofan ▪ Frugivores, especially larger species that could partially fill vacant dispersal niches previously filled by large mammals
<p>Large mammals</p>	<ul style="list-style-type: none"> ▪ Important game animals for the Cofan, including the collared peccary (<i>Tayassu tajacu</i>; in Cofan, <i>saquirá</i>) white-lipped peccary (<i>Tayassu pecari</i>; <i>munda</i>), red howler monkey (<i>Alouatta seniculus</i>; <i>a'cho</i>), and white-fronted capuchin monkey (<i>Cebus albifrons</i>; <i>ongu</i>) ▪ Giant armadillo (<i>Priodontes maximus</i>; <i>cantimba</i>), an endangered species, and one that may be a primary control agent for the leaf cutter ants (<i>Atta</i> spp.)

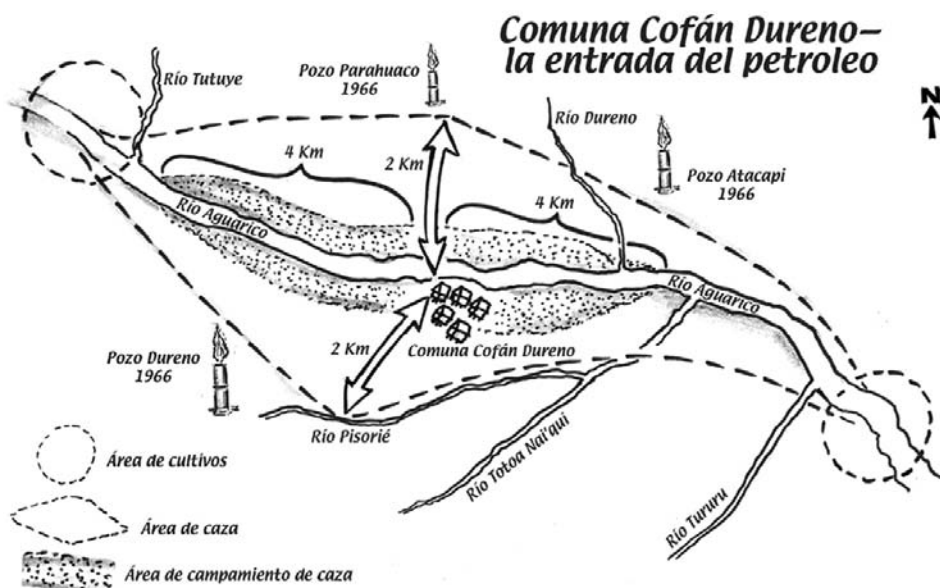
MAIN THREATS

The Cofan have been alone in fending off the pressures that have destroyed a large swath of eastern Ecuador, and which threaten more fragmentation of their ancestral lands. Ecuador's Ministry of Environment (Ministerio del Ambiente del Ecuador) has not yet officially recognized the importance of these lands for their biological and cultural richness.

Petroleum

The pressure from oil companies has been relentless in northeastern Ecuador since the mid-1960s (Fig. 17). The first massive impact to the forests was fragmentation, caused by new roads and subsequent colonization and deforestation. Petroleum impacts continue today in the form of repeated spills that go uncleaned and other pollution inherent in the oil industry. The petroleum industry continues to pressure the Dureno community to allow exploitation of "Campo Dureno," an identified oil reserve under the Dureno Territory. To exploit this reserve, Petroecuador wants to perforate at least four new wells and establish a transport infrastructure with pipelines, roads, and electrical systems. Such development would spell the death of the rich and fragile ecosystems in the Dureno Territory.

Fig. 17



New roads and unplanned colonization

Likely the most severe threat to the Dureno Territory after further oil exploitation is the construction of new roads that lead to disorganized colonization and further fragmentation and isolation.

Hunting and fishing by outsiders

Colonists surround the Dureno Territory to the west and south. With game disappearing from the denuded landscapes outside the Territory, the pressure of illegal hunting and fishing inside the Territory is steadily increasing. Much of this pressure comes from the illicit game markets in Lago Agrio. The Cofan community views this as one of the most immediate threats to their Territory.

Illegal logging

Old logging signs are evident through much of the Dureno Territory. Illegal logging by outsiders continues to pose a threat.

Excessive hunting and fishing

With the Dureno Territory now isolated from nearby forests, excessive hunting and fishing is likely to drive vulnerable species to local extinction.

Fishing with poison or explosives

A common practice in Amazonia, fishing with poison and explosives pollutes the waters and causes massive kills. Easy access to commercial poisons containing rotenone poses a serious threat.

RECOMMENDATIONS

Protection

- 01 **Secure formal recognition of the Dureno forest block from Ecuador's Ministry of Environment (Ministerio del Ambiente del Ecuador, or MAE)** because of the urgent need to protect its biological and cultural richness.
- 02 **Enter a formal agreement with MAE that grants official status and recognition for the Cofan communal forest guards and for protection and management measures already set in place by the Cofan.**
- 03 **Work with MAE, and the local police and justice system, to enforce existing environmental laws at a regional level—with fines and other sanctions—and use the Comuna Cofan Dureno as a test case.** For example, when a communal forest guard catches someone using poison for fishing, the MAE would proceed with the steps necessary to fine the person.
- 04 **Work with the national government to establish the Dureno Territory as permanently off-limits to petroleum exploitation,** in recognition of the importance of the Dureno Territory for culture and biodiversity, and in compensation to the Cofan for what they have suffered at the hands of the petroleum industry.
- 05 **Establish official meetings between the leadership of the Cofan and that of neighboring colonists (*cooperativas*)** to promote collaborations, recognize shared responsibilities, and reduce pressure from hunting, fishing, and other infractions by Territory neighbors.
- 06 **Create a buffer zone west and south of the Dureno Territory** through the purchase of colonist farms as available, to shield the Reserva Mundaie from outside pressures and edge effects.
- 07 **Reinforce the Cofan protection measures, increase the number of Cofan communal forest guards per rotating team, and link them into the successful communications system established for the official Cofan parkguards.**
- 08 **Reinforce effective protection of the Reserva Mundaie** to ensure its viability as a source of animals and plants for the rest of the Dureno Territory.
- 09 **Launch a communication and education campaign for neighboring colonists** about the dangers of pollution by herbicides, insecticides, and other poisons used for fishing.

Management of game species

Develop a management plan for hunting and fishing of vulnerable species, with seasonal or full restrictions as needed, together with the following elements:

- 01 **Institute yearly meetings in the Comuna Cofan to review status of**

conservation targets, especially for vulnerable species, and adjust management efforts as needed.

- 02 Continue to prohibit any commercial hunting within the Dureno Territory.
- 03 Continue to enforce the ban on outsiders hunting within the Dureno Territory.
- 04 Establish hunting guidelines for all large mammals (peccaries, primates, giant armadillo) and reevaluate hunting limits yearly, based on population sizes.
- 05 Restrict hunting of howler monkey (*Alouatta seniculus*) populations to allow their numbers to increase, taking into account their slow reproduction rate.
- 06 Manage the single remaining herd of white-lipped peccary (*Tayassu pecari*) to maximize use by the Cofan without endangering its long-term survival.
- 07 Manage the collared peccary (*Tayassu tajacu*) populations by maintaining a healthy breeding population in the Reserva Mundaie to replenish hunted areas.
- 08 Declare a complete ban on hunting of *Crax* (if they still exist), *Pipile*, and *Psophia* until their populations recover.
- 09 Limit hunting of *Penelope* and *Tinamus major* to allow numbers to increase until their populations become more robust.
- 10 Establish seasonal restriction on fish species, based on further research (below).
- 11 Monitor the take of larger fishes (e.g., catfishes and other staples of the Cofan) to avoid damaging populations through overfishing.

Monitoring and surveillance

- 01 Conduct yearly analyses of satellite imagery to detect large-scale changes in and around the Dureno Territory, and then mobilize appropriate action.
- 02 Survey densities of species important for the Cofan in the Dureno Territory (game animals, ceremonial or culturally important birds) to provide data for community management decisions, and review management decisions yearly. Focus initially on peccaries, primates, Cracidae, Tinamidae, and larger parrots, e.g., macaws, *Amazona*, *Pionus*.
- 03 Collect and analyze data on hunting pressure by Cofan on birds and mammals, and couple this information with the density data above to keep adjusting hunting regulations.

RECOMMENDATIONS

Monitoring and surveillance
(continued)

- 04 **Initiate a community program of water-monitoring using aquatic macroinvertebrates** to make decisions about sources of pollution and how to mitigate them. Train a few Cofan parkguards in the techniques for sampling waters for macroinvertebrates (Carrera and Fierro 2001b).

Additional inventories

- 01 **Establish a meteorological station to document precipitation and periods of drought** because the amount and timing of rain have a great impact on the composition of the forest.
- 02 **Capitalize on the opportunity to understand what is in the entire Territory by doing intensive inventories of most groups of organisms in different seasons of the year:** (a) Focus on the larger plant groups that explain most of the species richness there, e.g., Araceae, Fabaceae, Lauraceae, Rubiaceae, Sapotaceae; (b) Establish long-term sampling of water contaminant levels, examining seasonal patterns; and (c) Inventory fish species important in the Cofan diet and the ornamental species.

Research

- 01 **Assess the impact of isolation over time on key species.** Correspond with scientists working near Manaus on forest fragments to explore possibilities for comparative research and sharing of experience. Analyze genetic viability, carrying capacity of populations, and minimum area and population size requirements for species of importance to the Cofan and to the richness of the forest.
- 02 **Research the effects of water contamination in the benthic zones of rivers and streams due to the oil industry.** Scientists can work together with the Cofan to determine concentrations of heavy metals in the benthic fauna.
- 03 **Document the level of reproduction, regeneration, and patterns of growth of plant species of interest for the Cofan,** e.g., medicinal, food, timber.
- 04 **Investigate the dispersal of plants by birds and large mammals, focusing on species with large seeds,** such as palms, Sapotaceae, Lecythydaceae, Moraceae, *Inga*, *Parkia*. Compare these results with studies in non-fragmented areas and with a more complete set of seed-dispersers (e.g., those at Cuyabeno, Yasuní).
- 05 **Research the migration and reproduction patterns of fish species** to determine vulnerable stages that need to be managed; concentrate first on the species important in the Cofan diet.
- 06 **Study the ecology and feeding behavior of ornamental fishes,** to establish the feasibility of managing some species for commercial use.

- 07 **Investigate the foraging ecology of Crested Owl (*Lophostrix cristata*)** to understand its surprising abundance in the Reserva Mundaie in the Dureno Territory.
- 08 **Sample insects** to determine if unusually low insect abundance might account for low species-diversity of insectivorous birds or whether keystone insect species may have suffered local declines.

LONG-TERM BENEFITS OF CONSERVATION

- The Dureno Territory offers the last opportunity to protect some of the richest forests in the Amazon, in the legendary region near Santa Cecilia, where Andean foothills meet the lowlands
- The Cofan have created the opportunity for implementing management that protects the forest fragment while securing the Cofan long-term use of plants and animals important to their health and culture.
- The Dureno Territory may be the only sizeable chunk of isolated forest in Amazonia with historical and current data, offering the chance for scientists to study the impact of fragmentation on populations of animals and plants