Technical Report

OVERVIEW OF INVENTORY SITES

This inventory took place in the Área de Inmovilización Federico Román, and in forests immediately to the south. The Área is in southwestern Amazonia.

The Área de Inmovilización is approximately 74,335 ha (287 square miles) in size, and comprises the northeastern corner of Bolivia. Bounded by the large Madera River* to the east and the small Abuna River* to the north (each forming a political border with Brazil), the Área de Inmovilización is distinct in the satellite image (Figure 2): its dark bluish-green color in this image is due to impeded drainage, presumably because of a shallow, underlying rock layer associated with the Brazilian Shield, in contrast to better-drained areas to the south and west. Equally striking on this satellite image is the irregular fringe of pale blue surrounding the Área de Inmovilización, representing deforested areas along the Brazilian side of the border.

Upland forests on well-drained soils surround the Área de Inmovilización Federico Román to the south and west. These forests appear with a rusty orange color in the satellite image (Figure 2) and are continuous with similar forests southwestward, north of the Madre de Dios River. We inventoried this forest type at our first camp, south of Nueva Esperanza.

A third forest type covers the region west of the Área de Inmovilización, west of the Negro River. Forests in this region appear as a mix of green and tan colors on the satellite image (Figure 2), with less orange than the adjacent upland forests. We did not visit these forests on the ground, but overflights showed them to be lower in stature and with more vines than the adjacent upland forests.

The inventory area has few roads, these mostly dirt and in poor condition, and few or no permanent settlements in the interior. Most human travel is by boat along the rivers.

The 2002 biological inventory team used three camps, all except the first along the Madera River.

* In Brazil, these are known as the Rio Madeira and Rio Abunã. We use the Spanish spelling for these river names throughout this report.

Caimán Camp and vicinity
(Federico Román Camp One)
(10°13.57-13.60'S, 65°22.57-22.62'W at camp, based on two GPS units)
We established camp along an old logging road approximately 15 km south of Nueva Esperanza at the crossing of a small stream. The little-used road connects Nueva Esperanza (at 10°03.40'S, 65°19.99'W) with Arca de Israel, to the southeast, as well as points south and west, and provides access to several old roads and trails. The surrounding forest, logged about 30 years ago, is now little disturbed. From 13–17 July, 2002, we inventoried forest trails and roadsides surrounding the camp, several kilometers to the west-southwest (where a small amount of active logging was taking place), several kilometers to the southeast (to the margin of Arca de Israel), and north approximately 5 kilometers to a separate set of forest trails.

Trails North of Caimán Camp – We cut and inventoried several km of trails west of the main road to Nueva Esperanza in a rectangular pattern, ending at 10°09.73'S, 65°22.83'W (to the northwest) and 10°09.79'S, 65°21.56'W (to the southeast). These trails traverse hilly second-growth forest, also logged about 30 years ago and similar to the forest around the Caimán Camp. We also made observations in transit, by truck, between these northern trails and Nueva Esperanza.

Piedritas Camp and vicinity
(Federico Román Camp Two)
(Approx. 09°57.22'S, 65°20.23'W, based on 1:50,000 map: Telmo, 6564 III, 1985)
The camp sat on the high west bank of the Madera River, ca. 1 km south of Cachuela Las Piedritas (a large rapids) and immediately south of an abandoned military post and a large rock outcrop at the river's edge. From camp, an old trail ran west through forest to the bank of a small stream at 09°57.50'S, 65°20.50'W. At that point, a newly cut trail system ran 7.2 km north to 09°54.02'S, 65°21.71'W, with alternating side trails to the southwest (5 km, to 09°59.25'S, 65°23.23'W), northeast (4 km, to 9°55.47'S, 65°20.18'W) and west (4.6 km, to 09°56.97'S, 65°24.17'W). The central trail and northeast trails ran through well-drained terra-firme forest logged approximately 30 years ago, but now undisturbed. The northern, western and southwestern trails first ran through similar upland forest but then descended slightly into poorly drained, low sartenejal forest. We inventoried these sites from 17–20 July, 2002.

Manoa Camp and vicinity
(Federico Román Camp Three)
(09°41.11-41.19'S, 65°24.07-24.12'W at camp, based on two GPS units)
We also reached this camp by boat on the Madera River; it was located ca. 3 km northwest of the current military camp at Manoa. Like the previous, this camp was located on the high west bank of the Madera River, with a main trail running west through various forest habitats to a junction at 09°41.67'S, 65°25.30'W. From this junction, the following three trails diverged. We walked these trails from 21–25 July, 2002.

North Manoa Trail – This trail ran for several kilometers from the junction through swamp forest, forest transitional to sartenejal, and forest on better-drained soils to approximately 09°41.05'S, 65°26.07'W at the point of the peninsula where the Abuna and Madera Rivers converge and flow north towards the Amazon.

West Manoa Trail – After leaving the junction, this trail ran west for several kilometers toward the Abuna River, through open forest covered with *Scleria*, through forest on better-drained soils, through forest transitional to sartenejal (with pronounced channels and associated raised areas), and then into better-drained forest on what appear to be very acid, sterile soils at the east bank of the Abuna River. It ended at 09°41.94'S, 65°26.86'W.

South Trail – From the junction, this trail ran for a couple of kilometers through terra-firme forest to 09°43.00'S, 65°23.93'W.

Overflights

In March, 2002, and again on 24–25 July, 2002, we spent ca. 6 hours flying over all of the Área de Inmovilización Federico Román and adjacent forests as far south as Arca de Israel and beyond (Figure 2).

FLORA AND VEGETATION

Participants/Authors: William S. Alverson, Robin B. Foster, Janira Urrelo, Julio Rojas, Daniel Ayaviri, and Antonio Sota

Conservation Targets: High and low sartenejal forests and other low forests and open vegetation; large blocks of terra-firme forest logged three decades ago but in good condition; plant species uncommon in Bolivia or Pando, important to wildlife, or commercially valuable.

METHODS

The team had 12 days to assess the vegetation in and immediately south of the Área de Inmovilización Federico Román. The three camps were evenly spread across the eastern side of the Área de Inmovilización, which we could access by boat on the Madera River. The southernmost camp ("Caimán") was established outside of the Área de Inmovilización at the edge of two forestry concessions (San Joaquín and Los Indios), from which we could assess the well-drained, old secondary forests that border the Área to the south. Using satellite imagery as a guide, the northern two camps and trail systems (Piedritas and Manoa) were established to provide access to the complex of poorly drained vegetation types that characterize the interior of the Área de Inmovilización (Figure 3).

We did not gather quantitative data with transects. Instead, we kept running lists of species identified in the field and recorded qualitative information about their abundance and presence in various habitats. We took several hundred photographs as documentation of species presence and as a tool for later identification of unrecognized species; once processed and digitized, a representative subset of these photographs will be available at *www.fmnh.org/rbi*. We also made 328 plant collections in a number series under J. Urrelo et al. All specimens were field-treated with alcohol, dried at the university in Cobija, and will be deposited in herbaria at the Universidad Amazónica de Pando, Cobija (UAP), the Herbario Nacional, La Paz (LPB), and the Field Museum (F).

FLORISTIC RICHNESS, COMPOSITION AND DOMINANCE

Our preliminary list of vascular plants (in Appendix 1) lists 821 species within the area in and around the Área de Inmovilización Federico Román. Based on the variation within habitat types that we were able to explore on the ground, and on the presence of several habitat types that we did not visit, we estimate a total vascular plant flora of around 1200 species.

VEGETATION TYPES

Non-inundated soils

- Terra-firme forests on well-drained soils, logged about 30 years ago
- Recently disturbed forest and roadsides
- Dry lajas with shallow soils over rock

Vegetation on seasonally or permanently inundated soils

- Open riverbanks along the Madera River
- Seasonally inundated stream channels
- *Symphonia* swamps
- *Scleria* forest
- High sartenejal forest
- Low sartenejal forest
- Wet lajas or open pampas

LOGGED FORESTS ON WELL-DRAINED SOILS

This forest type was most common to the south and west of Nueva Esperanza, where it was present in large, contiguous blocks. There, the hilly terra-firme forests had sandy-clayey, well-drained soils except for small ribbons of habitat along streams and valley bottoms. Within the Área de Inmovilización itself, this forest type was common but typically occurred in smaller, irregular blocks and strips interspersed with wetter habitats such as the sartenejales.

These forests were selectively logged approximately 30 years ago. The tall canopy is discontinuous and consists of large individuals that were not removed during this episode of logging. Most notable were a very large number of Brazil nuts (*Bertholletia*) to 40 m or more tall. Also common as emergents were other species of Lecythidaceae (*Couroupita, Couratari*), Moraceae (e.g., *Ficus schultesii*, *F. nymphaeifolia*), and Fabaceae, especially *Peltogyne, Hymenaea*, *Dipteryx*, two species of *Enterolobium*, and *Tachigali* spp. These remnant emergent species were not commercially viable at the time of the last timber harvest, though some commercial species are still present in small quantities: *Amburana cearensis* ("roble") and *Cedrelinga catenaeformis* ("tornillo," both Fabaceae), as well as scattered, untapped *Hevea* (Euphorbiaceae). Below this discontinuous supercanopy, there was a relatively continuous subcanopy, at 15–25 m, in which *Tetragastris* (Burseraceae), *Oxandra xylopioides* (Annonaceae), *Pourouma minor* (Cecropiaceae), *Naucleopsis* spp. (*N. ulei* and a bullate-leaved sp.) and *Pseudolmedia laevis* (Moraceae), *Inga* and *Tachigali* spp., (Fabaceae) *Metrodorea flavida* (Rutaceae), *Astrocaryum gynecantha* (Arecaceae), *Schefflera morototoni* (Araliaceae), patchy *Rinorea* (Violaceae), and several other palms, Rubiaceae, and Melastomataceae were common. There were no large areas dominated by bamboos.

In each site, we found a few species not seen in terra-firme forests at the other sites, e.g., two species of *Diospyros* (Ebenaceae), *Brosimum potabile* (Moraceae), *Chaunochiton* (Olacaceae), at Manoa; but the same common species were found in the terra-firme forests at each of the three inventory sites.

Although we visited during the dry season, the moderate coverage of tree limbs and boles by mosses and other epiphytes indicates that this is a moist forest, more so than the forests of similar structure and composition that we inventoried recently in the Área de Inmovilización Madre de Dios (Alverson et al., in press).

The majority of the habitat surrounding the Caimán Camp and trails comprised this type of terra-firme forest, though there was a relatively small amount of more recently disturbed habitat, described next.

RECENTLY DISTURBED FOREST AND ROADSIDES

Recent human disturbance is most notable in and around Nueva Esperanza and Arca de Israel (Figure 2), but small, old clearings are scattered elsewhere, mostly along the Madera River, such as the old military camp at Piedritas, the active military camp at Manoa, and various other small chacras and human incursions. A few of these openings are abandoned or lightly used Brazil-nut harvester camps surrounding the Caimán camp. Remnant cultivated plantings persist in some of the clearings, especially at the old military post at Piedritas.

The roadways and trails connecting Nueva Esperanza, Arca de Israel, and more actively used logging roads to the south in the Los Indios Concession had a thin (5–15 m) margin of second growth, commonly including lianas, shrubs or small trees of *Piptadenia* (Fabaceae), *Solanum* spp., *Cecropia* (Cecropiaceae), *Casearia* (Flacourtiaceae), *Sapium* (Euphorbiaceae), and a *Duguetia* (Annonaceae) with astoundingly long horizontal branches. The vine, *Passiflora coccinea* was an ubiquitous colonizer on the bare soil of roadsides and banks.

DRY LAJAS

We saw two examples of dry lajas—areas with very shallow soils over rock—during the overflights. The first was on an outcrop directly north of Arca de Israel and the second was southwest of the Manoa camp. This habitat was distinct from the air because all its trees were leafless and at first appeared to be dead. We were not able to visit these habitats on the ground.

We also flew over another odd habitat to the west of Manoa that appeared to be dominated by a few species of trees with their crowns very densely packed. We were not able to identify these species from the air, nor were we able to determine if their local dominance was due to the presence of a special soil- or rock-outcrop.

OPEN RIVERBANKS OF THE MADERA RIVER

This large river, running north to join the Amazon, passes over several large, rocky rapids between Arca de Israel and its junction with the Abuna River. The river has numerous islands and open sandbars, and its banks vary from open sand and mud flats to steep banks over 10 m tall, sometimes of solid rock.

Stabilized sandy and muddy beaches were covered with successional growth typical of this part of the Amazon basin, with *Gynerium sagittatum*, *Cecropia membranacea*, *Mimosa pigra*, and in some cases *Salix humboldtiana*. On higher banks, *Muntingia calabura*, *Ceiba pentandra*, *Ficus insipida*, and a species of *Guadua* were common and conspicuous.

SEASONALLY FLOODED STREAM CHANNELS

The water level of the Madera River and at least the adjacent portions of its tributaries varies greatly on a seasonal basis, as evidenced by flood marks on trunks. At the Piedritas and Manoa inventory sites, streams (arroyos) feeding the Madera were cutting through thick mud and sand deposits left by recent high water in the river. Even a kilometer or more upstream from the mouths of these streams, flood marks on trees were often 2 m or more in height.

This seasonal buildup of water (including back-flow from the main river) creates a characteristic habitat along the lower parts of these streams that was detectable at Piedritas and very distinct at the Manoa inventory site. This habitat type has a very open understory, more vines, and a slightly lower canopy than the surrounding terra-firme forest.

The Manoa site was dominated by a *Lueheopsis* species (Tiliaceae), with very dark green foliage easily visible even in the overflights. A *Guarea* (Meliaceae), a *Virola* (Myristicaceae), a *Zygia* and a *Peltogyne* (Fabaceae), a *Calyptranthes* (Myrtaceae), a *Mouriri* (Melastomataceae), a *Manilkara* (Sapotaceae), and *Licania* cf. *hypoleuca* (Chrysobalanaceae) were all common.

SYMPHONIA SWAMPS

This habitat, at the Manoa site, is also flooded yearly by whitewater backflow from the Madera River. It is characterized by the dominance of the stilt-rooted *Symphonia globulifera* (Clusiaceae) in flat, mucky, poorly drained areas. *Lueheopsis* (Tiliaceae), a rusty-leaved *Ocotea* (Lauraceae), a *Tachigali*, and another, unknown genus of Fabaceae (with trapezoidal leaflets) also were common here.

SCLERIA FOREST

The satellite images show this odd habitat as bands of green interspersed with the blues of the sartenejales and the rusty oranges of the upland (terra-firme) forest in the northernmost portion of the Área de Inmovilización Federico Román (Figures 2 and 3). The habitat is very difficult to enter on the ground because a prominent element of the vegetation is a dense tangle of viney *Scleria* (Cyperaceae), with razor-sharp leaf margins that shred clothes and skin. For this reason, presumably, there are still remnants of this type of habitat on the Brazilian (northern) side of the Abuna River, amidst open pastures and fields where other native vegetation has been devastated.

The *Scleria* forest has scattered trees to 15–20 m tall, though most are less than 10 m. As in the adjacent wet areas, discussed above, *Lueheopsis* is probably the most common tree present. Several Fabaceae are also very common—a *Peltogyne* sp., a finely pinnate species with rectangular leaflets, and a finely bipinnate species—as were a brown-fuzzy *Ocotea* (Lauraceae), a *Garcinia* (Clusiaceae), a *Vochysia lomatophylla*, and a glabrous *Tachigali* (Fabaceae). Several of the most common woody species here had dark brown or black bark, often highly textured or roughened.

Several aspects of the *Scleria* forest were reminiscent of old, revegetated pampas (pampas arboladas) recently visited in central Pando by the rapid inventory team (Alverson et al., in press). The habitat was in a flat area with poor, clayey soil that

probably floods seasonally. Taller trees were scattered and the leaf litter was often 10 cm deep and very spongy, as if leaf decay proceeds slowly. Finally, we observed evidence of past fire in the form of a few charred stumps and buried charcoal. Probably due to the dense blanket of *Scleria*, this forest differed from the pampas arboladas by its very empty understory (though low vines of a *Plukenetia* species were common).

In sum, the *Scleria* forest, like the pampas, appears to result from a combination of poor soil and episodic disturbance, either from non-human or human sources. It may represent a variant of the sartenejal forests that differs because of its fire history, though the microtopography also differs, as discussed below.

HIGH AND LOW SARTENEJAL FOREST

North and west of Nueva Esperanza there is a dramatic change in forest habitats, compared to the relatively well-drained Bolivian forests to the west and south. The well-drained, terra-firme forest habitat is still present but not in large, unbroken blocks; rather, it is confined to narrow, irregular strips on perhaps a third of the landscape. These peninsulas of terra-firme appear on the satellite image as a confetti of orange and green colors with a distinctively coarse grain (Figure 3). In between these irregular peninsulas of terra-firme forest lie more extensive sartenejal forests that have a finer grain; they appear as paler orange areas (high sartenejal) and turquoise-blue areas (low sartenejal), on the satellite images.

The sartenejal forest habitat occupies much of the center of the Área de Inmovilización Federico Román. The soils are poor and poorly drained. The canopy is conspicuously lower than the surrounding terra-firme forest, from 5–20 meters in height. The litter mat is thick and spongy, and the surface of the ground is patterned with a maze of raised bumps (monticulos) or ridges from one to a few meters across, separated by rounded depressions or low channels appearing as seasonal waterways. The general northwest-southeast patterning of this type of habitat suggests association with ancient river flood plains.

High sartenejal forest is transitional in height (generally to 15 m) and composition: some species from both the terra-firme forest and the low sartenejal occur here. During the overflight, one of us (Foster) realized that we could distinguish the boundary between low and high sartenejal forest (as seen on the satellite image) because the palm *Oenocarpus bataua* drops out in the low sartenejal. A few species seemed to prefer the boundary between the sartenjal and terra-firme habitats, e.g., a *Duguetia* species (Annonaceae), and an odd *Psychotria* (Rubiaceae), both collected with flowers and fruits. *Attalea speciosa* (Arecaceae) and *Phenakospermum* (Musaceae) were conspicuous in the high sartenejal. Other species found here but not in the surrounding terra-firme habitats included a *Xylopia* (Annonaceae) and *Qualea wittrockii* (Vochysiaceae).

Low sartenejal is brushy in appearance and short in stature (to 10 m). The spiny palm *Mauritiella armata*, a *Tachigali* (Fabaceae), *Qualea wittrockii* and *Q. albiflora* were taller elements here. The ground surface is a very spongy mass of leaves and roots. Common understory plants included the fern *Trichomanes*, *Coccocypselum* (a variegated, herbaceous Rubiaceae), *Selaginella*, and a non-viney *Ischnosiphon* (Marantaceae). The midlayer included many individuals of *Mouriri* and other species of Melastomataceae (*Henriettella*, *Loreya*) that were common here but not in the terra-firme forest (also the palm *Bactris hirta* and *Moutabea*, a viney Polygalaceae).

WET LAJAS (OR OPEN PAMPAS)

We were not able to visit these habitats on the ground but saw them during the overflights. They are visible on the satellite images adjacent to an oxbow in the Abuna River, west-southwest of the Manoa military post, as a cluster of pale blue dots (Figure 3). These are open areas, with few or no scattered trees and shrubs, filled with herbaceous vegetation and often standing water. They are probably generated by clayey, poorly drained soil or a superficial rock layer. They adjoin the *Scleria* forest habitats to the northeast, and probably reflect even more severe edaphic conditions there.

SIGNIFICANT RECORDS

We have not yet been able to compare the specimens collected during the inventory with other herbarium material. Our preliminary assessment is that we observed several species that have not previously been registered in Pando or Bolivia, or which have been collected few times in Bolivia. Most of the new and odd records come from the sartenejal forests but a few were in upland habitats.

At Campamento Caimán, these include a *Spathelia* (Rutaceae), a more or less unbranched treelet that flowers once after 8–10 years and then dies (Figure 5B). This is likely a new species for Bolivia.

In the terra-firme forest at the Manoa site, we encountered a large tree (ca. 45 m tall, 1.6 m diameter at chest height) of *Brosimum potabile* (Moraceae) which, to our knowledge, has not previously been registered in Bolivia.

In the sartenejal forest at the Manoa site we collected a once-pinnate, dwarf *Jacaranda* sp. (Bignoniaceae), which may be new for Bolivia or Pando but needs to be confirmed. Also in the sartenejales, we collected a *Tococa* sp. and a *Salpinga* sp. (both Melastomataceae) that appear to be new for Pando, if not Bolivia.

Parkia ignaefolia (Fabaceae) may be also be a new record for Bolivia, but this needs confirmation. It was found in the sartenejal forest at the Piedritas site. At least one of the *Peltogyne* species we observed (also Fabaceae) and *Syngonanthus longipes* (Eriocaulaceae) were new to Bolivia.

Pseudima frutescens (Sapindaceae) occurred in terra-firme forest at the Caimán site and has been collected only a few times in Pando. *Chaunochiton* (Olacaceae), with strange, large fruits, was collected in terra-firme forest at the Manoa site and has only been documented once or a few times before in Pando.

Two Lecythidaceae, a delicate, sparsely branched, shrubby *Gustavia*, and a large arboreal *Couratari* with very tiny, slender fruits need to be checked. They were common and striking in seasonally innundated habitats but we did not recognize either species.

To our knowledge, none of these species is endemic to the Área de Inmovilización Federico Román, nor is any likely to be. Those constituting new records for Bolivia are species that occur elsewhere to the north and east, with additional novelties for Pando coming from the south. Because of its position in the extreme northeastern corner of Bolivia, the Área de Inmovilización Federico Román does protect species and habitats that are found nowhere else in Pando or Bolivia. Furthermore, the Área de Inmovilización serves as an important refuge for many species and habitats of southwestern Amazonia which have been lost, or are currently being destroyed to the north and east in Brazil.

PLANTS IMPORTANT TO WILDLIFE

Many of the dominant species in terra-firme forests of the Área de Inmovilización provide food for birds and mammals, e.g., trees in the families Fabaceae, Moraceae, Lecythidaceae, Arecaceae, Myristicaceae, and Rubiaceae. In the low sartenejal and other poorly drained habitats, the volume of fruits and seeds produced appears to be much less.

INFERRED HISTORY OF HUMAN USE

The Área de Inmovilización Federico Román sits at the junction of the Abuna and Madera Rivers just downstream from several major rapids that impede navigation. This area may have functioned as a crossroads in the last two centuries but we did not see signs of old, large-scale habitat manipulation. The major change reportedly occurred about 30 years ago, when logging roads were built and most of the terra-firme habitats were selectively logged for the most valuable timber, e.g., *Swietenia macrophylla* and *Cedrela odorata* (Meliaceae), *Amburana cearense* and *Cedrelinga* sp. (Fabaceae). This seems to have been a short-lived disturbance and the forests in this region have not been greatly disturbed since that time. Juveniles of all of these commercial species are still present in the forest, which bodes well for the future, especially if these species become protected from

overharvesting. We did observe recent timber harvest in the southwest corner of the Caimán site, in the Los Indios forestry concession, but that was not yet extensive within the inventory area.

There has been no major immigration of people along the logging roads into the heart of the Área de Inmovilización Federico Román. However, gold mining in the river and on land has been a major pursuit in the last couple of decades (see Human Communities). The main impact of the gold mining is local, as seen in the abandoned pits to the west of Nueva Esperanza (Figure 7A). Supplemental hunting along the Madera River has resulted in a small to moderate number of trails that penetrate the forest but the overall effect of these, and the few remote chacras we saw during the overflights, is not great at present. Some of the trails appear to be used to extract wood and possibly other materials to the Brazilian side of the river or to the gold dredges (dragas) currently moored in the Madera.

Brazil nuts were long harvested in the area, until local prices dropped to a level that discouraged this practice. At present, except close to the human settlements, virtually no Brazil nuts are harvested, even though large Brazil-nut trees (*Bertholletia excelsa*) are a common and conspicuous element in the terra-firme forest. Rubber trees (*Hevea guianensis*) in the area are often large but less common, and none showed scars from recent tapping.

THREATS AND RECOMMENDATIONS

Habitat destruction through widespread timber harvest, conversion to cattle pastures, or creation of cultivated fields is the primary threat. However, the soils of most of the Área de Inmovilización are sufficiently poor that neither agriculture nor ranching would be successful for more than a couple of years. For this reason, the devastation caused by habitat destruction would greatly outweigh any short-term benefits to humans. Instead, we recommend the following alternatives:

1) In the terra-firme habitats south (and west) of the Área de Inmovilización, work with local communities and the owners of the logging concessions to establish ecologically sensible forest-management plans that avoid uncontrolled colonization and over-exploitation and depletion of these forests.

2) Designate the current Área de Inmovilización Federico Román, and additional area in adjacent terra-firme forests, as a National Wilderness Reserve (Reserva Nacional de Vida Silvestre). This area is large enough to function as a core reserve for many plants and animals that are found nowhere else in Bolivia and are being rapidly decimated in adjacent Brazil.

3) Establish cooperative agreements with the Bolivian military to help them carry out more effective patrols against unlawful incursions into the Área de Inmovilización Federico Román by game, gold, and timber poachers gaining access by the Abuna and Madera Rivers. Staff at the military posts could gain resources for their work and could receive training in conservation enforcement, thus providing action and information in support of conservation goals.

4) Explore the possibility of conservation tax credits or other benefits at the government level for the local Municipios. Approximately 20% of the Municipio de Nueva Esperanza now comprises the Área de Inmovilización. If a National Wilderness Reserve is declared that encompasses the Área de Inmovilización plus additional lands to the south and west, 40–50% of this Municipio could be land primarily dedicated to the conservation of native flora and fauna. For example, there may be ways of encouraging economic incentives for the sustainable harvest of Brazil nuts in this region, which are common but now essentially unutilized because of market prices.

5) Carry out further on-the-ground inventories in cooperation with BOLFOR, UAP, and the Bolivian national museums, targeting habitats in the Área de Inmovilización Federico Román not sufficiently explored during this short inventory, e.g., dry and wet lajas, habitat dominated by one or a few tree species with densely packed crowns (the "zona naranja"), and additional variants of sartenejal forest. These studies should also strive to understand the role of fire and

soil in generating the *Scleria* forest, laja habitats, and sartenejales, in comparison to the ecological factors that engender open and revegetated pampas further to the south and west.

AMPHIBIANS AND REPTILES

Participants/Authors: John E. Cadle, Lucindo Gonzáles, and Marcelo Guerrero

Conservation Targets: Southwestern terrestrial Amazonian herpetofauna, crocodilians, and river turtles.

METHODS

We sampled three sites within Federico Román province: Caimán (13–16 July 2002), Piedritas (17–20 July 2002), and Manoa (21–24 July 2002). Coordinates and general descriptions of these sites are given in the Overview of Inventory Sites section of this report.

We used transect sampling and random encounter survey methods to inventory amphibians and reptiles. We attempted to obtain voucher specimens for all species encountered except for crocodilians, which we photographed. However, we recorded some species only as sight records or (for frogs) calls heard; these are indicated in the list of species (Appendix 2). We walked trails during both day and night surveys. In addition, we focused on specific kinds of microhabitats—such as ponds, streams, and rivers—that might be used by amphibians and reptiles. Voucher specimens are deposited in the Museo de Historia Natural "Pedro Villalobos" (CIPA, Cobija), Universidad Nacional de Pando (Cobija), and the Museo de Historia Natural "Noel Kempf Mercado" (Santa Cruz); representative samples will ultimately be deposited in The Field Museum (Chicago).

Our survey methods did not yield results interpretable as quantitative measures of species' relative abundances. Because we were conducting the survey during the dry season, the most unfavorable period for activity of most amphibians and reptiles in the region, our survey did not detect certain species that we are reasonably sure are common to abundant elements of the fauna surveyed. In addition, for most tropical rainforest herpetofaunas, repeated measurements of relative abundances at the same site over long periods of time are required to obtain relative abundances with any confidence because of the strong dependence of activity of amphibians and reptiles on microclimatic variables at small spatial and temporal scales.

RESULTS OF THE HERPETOFAUNAL SURVEY

We recorded 44 species of reptiles (19 snakes, 20 lizards, 3 crocodilians, 2 turtles) and 39 species of amphibians (all frogs) from the three Federico Román sites (Appendix 2; see also Systematic Comments, below). Once systematic problems and tentative identifications are resolved, these totals may be modified slightly. We suspect that all species we detected are found in appropriate microhabitats throughout the region; moreover, since we were sampling during the dry season, encountering a particular species at a particular site was very opportunistic. Therefore, we do not think it is fruitful to evaluate or compare each sampled site separately. Despite differing species compositions in the sample from each site, we found comparable total numbers of snakes, lizards, and frogs at all three sites: Caimán (10 snakes, 10 lizards, 23 frogs), Piedritas (9, 9, and 25 species, respectively), and Manoa (10, 12, and 20 species, respectively). The differences between the forestry concession site (Caimán) and the two Área de Inmovilizacíon sites (Piedritas and Manoa) probably reflect only the nature of the sampling methods, the brief sampling periods, and the dampening effect of the dry season on activity of amphibians and reptiles in general. We consider the entire sample as representative of the herpetofauna at all three sites subject to minor differences based on microhabitat availability (see discussion of plant communities).

Based on more thoroughly inventoried sites in southwestern Amazonia, we suspect that the total herpetofauna for Federico Román would total 140–160 species (approximately 80 species of reptiles and 60–80 species of amphibians). Our inventory probably sampled about half of the frog species and

about the same proportion of reptile species that might be expected for the three sites.

Virtually all of the species we recorded are common elements of herpetofaunas in southwestern Amazonia, and have been recorded at other well-inventoried sites in southeastern Peru (Manu National Park, Tambopata Reserve, Cuzco Amazónico, Pampas del Heath; Rodríguez and Cadle 1990, Morales and McDiarmid 1996, Duellman and Salas 1991, Cadle et al. 2002, and R. McDiarmid, pers. comm.) or northern Bolivia (Reserva Nacional Manuripi; L. Gonzáles, unpublished data). Many are widespread Amazonian species and are found, for example, in the region of Iquitos, Peru (Dixon and Soini 1986, Rodríguez and Duellman 1994); Santa Cecilia, Ecuador (Duellman 1978); or Manaus, Brazil (Zimmerman and Rodrigues 1990). No species of amphibian or reptile we observed are local or regional endemics. The fauna is characteristic of other areas of northern Bolivia and southeastern Peru (Cadle and Reichle 2000).

Despite the primarily Amazonian affinities of the Federico Román herpetofauna, a few species are more generally associated with more open formations to the south. These include *Leptodactylus labyrinthicus* (Leptodactylidae) and, pending resolution of taxonomic difficulties, possibly *Bufo granulosus* (Bufonidae) and *Leptodactylus chaquensis/macrosternum*. *Bufo granulosus*, although widespread in South America, is a complex of species, some forms of which are characteristic of open formations in eastern Bolivia. *Leptodactylus chaquensis* and *L. macrosternum* (see Systematic Comments below) are sibling species and indicative of a pattern observed in some western Amazonian species north of the Beni River: they have close relatives in drier, more open formations of southern Bolivia, Argentina, Paraguay, and/or southwestern Brazil (Cadle 2001). The record of *Leptodactylus labyrinthicus* is near the northern limit of the species in Bolivia, although it has been reported from the Parque Nacional Madidi (Pérez et al. 2002).

Our collections include several new country records for Bolivia, although these species were expected on the basis of other distributional records nearby in Brazil or Peru: *Dendrobates quinquevittatus* (Dendrobatidae; see Caldwell and Myers 1990), *Anolis* cf. *transversalis* (Iguanidae, tentative identification), and *Uranoscodon superciliosus* (Iguanidae; see Avila-Pires 1995 for summaries of lizard distributions).

As would be expected for dry season sampling of a tropical herpetofauna, the seasonal effect was most notable on the frogs detected in our inventory. Frog activity was very low, as evidenced by few species calling and few individuals of each species active. We found evidence of only two species of frogs actually reproducing during our sample period: nests of *Hyla boans* were common along streams at the Caimán site and tadpoles tentatively identified as this species were collected; the other species breeding during the sample period is probably a species of *Colostethus*, again tentatively identified by tadpole samples. We heard a few other species calling on several to many occasions (e.g., *Bufo granulosus*, *B. marinus*, *Hyla lanciformis*, *Leptodactylus fuscus*), but we saw neither eggs nor tadpoles of these species.

SYSTEMATIC COMMENTS

Unresolved problems with the systematics of certain groups represented in our inventory preclude precise identifications of some voucher specimens at the present time, and additional study is necessary for some others. These comments will help researchers (who may wish to use our preliminary report in faunal, distributional, or systematic work) gauge the uncertainty inherent in rapid surveys of herpetofauna in areas such as Federico Román. We stress that this report, written before adequate study of the collections, should not be taken at face value particularly with respect to the identity of the more difficult groups in the inventory. The following comments call attention to the availability of specimens that might help resolve distributional or taxonomic issues.

Bufonidae: Our sample contains two species of the *Bufo margaritifer* complex, which is widely recognized to contain many poorly differentiated

species, some of which are as yet undescribed (Hoogmoed 1990).Without more detailed study we hesitate to assign names to specimens in our sample. Two species of the complex have been reported previously from Pando (Köhler and Lötters 1999).

Dendrobatidae: Our collection of two specimens of *Dendrobates quinquevittatus* represent the first record of this species from Bolivia. Our specimens conform to the strict concept of that species discussed and illustrated by Caldwell and Myers (1990: figure 7).

We recorded two species of *Colostethus, C.* cf. *trilineatus* and an unidentified species, from Federico Román. As Köhler and Lötters (1999) indicated, the identity of species of *Colostethus* in Bolivia is uncertain. Specimens from southeastern Peru and northern Bolivia have been referred to as *C. marchesianus* (e.g., Duellman and Salas 1991, Pérez et al. 2002). That is doubtful based on new descriptions of specimens from the type locality (Caldwell et al. 2002) and the population studied by Duellman and Salas (1991) was subsequently referred to *C. trilineatus* (De la Riva et al. 1996). Pending much needed comprehensive study of *Colostethus* in western Amazonia (Caldwell et al. 2002), we tentatively assign *marchesianus*-like specimens from Federico Román to *C. trilineatus* following Köhler and Lötters (1999). Our unidentified species is very similar to *C. trilineatus*, has a deep yellow venter, and apparently corresponds to *Colostethus* species A of Köhler and Lötters (1999).

Our assignment of the names *Epipedobates pictus* and *E. femoralis* to specimens is only provisional. These two species are easily confused (Rodriguez and Duellman 1994). Additionally, the *Epipedobates pictus* complex is an array of confusing sibling species, at least three of which occur in northern Bolivia and/or adjacent regions of Brazil (*E. pictus*, *E. hahneli*, *E. braccatus*). Furthermore, "*Epipedobates pictus*" and "*E. hahneli*," each include two or more distinct species (Caldwell and Myers 1990, Köhler and Lötters 1999). The confusion of species in this complex in southwestern Amazonia was discussed by De la Riva et al. (1996) and Köhler and Lötters (1999).

Hylidae: One species of *Osteocephalus* that we collected is an undescribed species known from northern Bolivia and southern Peru.

Leptodactylidae: *Leptodactylus chaquensis* and *L. macrosternum* are sibling species that can only be distinguished by call characteristics (De la Riva et al. 2000). Their precise distributions are unclear, but they overlap in eastern Bolivia. We obtained a single specimen and are uncertain at this time which name applies to it.

Microhylidae: Our sample includes three specimens of *Chiasmocleis* that can be distinguished by superficial aspects of coloration, but two are represented only by juveniles. One to three species may be represented by the specimens.

Iguanidae: We collected one female specimen of a large *Anolis* that we refer to *A. transversalis*. We believe this would be the first record from Bolivia if our identification is correct (cf. the distribution summarized by Avila-Pires, 1995). We have not yet verified that the scutellational features of our specimen conforms to *A. transversalis*. In life the ground colors varied from bright metallic green to brown, but the middorsal area was sky blue. The dorsum was marked with diagonal rows of dark brown spots. The head was mainly green with small brown spots. The venter was pale green. The large dewlap was deep yellow, almost ochre, with metallic green scales forming diagonal stripes. *Uranoscodon superciliosus* is represented by a single specimen in our collection, but we observed several others at the same locality. This represents the first record for Pando (Avila-Pires 1995, Dirksen and De la Riva 1999).

Scincidae: At least three species of *Mabuya* (*M. bistriata*, *M. nigropunctata*, and *M. nigropalmata*) are known from the general region of Pando. We do not assign names pending more detailed study of the specimens. The systematic confusion of Amazonian species of *Mabuya* was discussed by Avila-Pires (1995).

THREATS AND RECOMMENDATIONS

All of the species in our sample are expected for this region. None are known to be regionally endemic or

keystone species, and most are widely distributed in Amazonia. No single species in our sample is particularly noteworthy in terms of conservation priority, but the region probably harbors an intact terrestrial herpetofauna despite previous logging in the area (river turtles and crocodilians need additional study). Maintaining the present herpetofaunal community intact, rather than focusing on individual species, should be a focus of conservation efforts.

The most general threats to maintenance of this intact herpetofaunal assemblage are forest disturbance and clearing, though we cannot specify or quantify these effects in detail. Opening of the forest through logging or clearing has diverse effects, creating more habitat for "open formation" species and consequently decreasing habitat for closed forest species. The most damaging influence of forest disturbance insofar as the herpetofauna is concerned is a general drying of forest microhabitats (e.g., leaf litter) that are very important for many species of amphibians and reptiles. Any management of these forests should strive to maintain moisture, light, and temperature regimes of the understory, leaf litter, and ground surface essentially intact.

A potential focus of conservation might be species of crocodilians or turtles in the region. We detected few species and few individuals of them along the main course of the Madera River. We saw no *Caimán niger*, which would be of interest if there are still population remnants left. Local informants claim that the Madera River houses a population of *Podocnemis expansa*, a large river turtle that is extremely endangered in most of Amazonia where it still occurs. We cannot substantiate whether the turtle still exists in this part of the Madera River, but this would be a species for conservation efforts if such a population exists.

As indicated by Cadle and Reichle (2000) and Cadle (2001), the portion of Bolivia north and west of the Beni River (Pando and portions of La Paz departments) harbors a herpetofauna very similar to others in southwestern or western Amazonia. The sites within Federico Román we sampled fit easily within this pattern. This specific region is probably not of particular import herpetologically except as a relatively intact assemblage representative of this herpetofauna.

There is a need for longterm surveys of herpetofauna in most of Amazonia. Despite the fact that several sites have been surveyed within southwestern Amazonia, the microgeographic scale of the distribution of some species means that we can still learn much from continued surveys in new regions. Obviously, for amphibians and reptiles, these should be conducted during the seasons most favorable for activity (i.e., rainy season).

There is also a need to understand the effects of disturbance on particular species of amphibians and reptiles. The only place within Amazonia where this has been studied is the vicinity of Manaus in Amazonian Brazil (Zimmerman and Rodrigues 1990). These studies should be replicated, especially with the different forest types that are present in southwestern Amazonia compared to those in central Amazonia. Because some of the history of disturbance of the forests within Pando can be recovered from historical documents, Pando offers an excellent opportunity to evaluate these effects on individual species of amphibians and reptiles.

BIRDS

Participants/Authors: Douglas F. Stotz, Brian O'Shea, Romer Miserendino, Johnny Condori, and Debra Moskovits

Conservation Targets: Large game birds, especially populations of tinamous, cracids, and trumpeters; parrots; terra-firme forest birds; birds of seasonally-flooded forests; endemic birds of southwestern Amazonia.

METHODS

We walked roads and trails to locate and identify birds, usually walking alone, or occasionally in pairs. We left camps from one to three hours before sunrise, remained in the field typically until late morning or early afternoon, and returned to the field for a period from mid-afternoon until sunset to two hours after sunset.

We made efforts to survey all habitats at each of the camps, and to have at least one observer in each of the well-defined habitats at dawn for at least one day. All field observers carried binoculars, and O'Shea carried a cassette recorder with a directional microphone to make sound recordings. The sound recordings will be deposited at the Library of Natural Sounds, Cornell Laboratory of Ornithology.

Stotz and O'Shea did a series of unlimited distance point counts at each of the camps. Each point count lasted 15 minutes. We began points 15–30 minutes before sunrise, and did eight points 150 meters apart along pre-existing trails and roads in one morning. We concentrated in taller, terra-firme forest and had a total of 32 points at Caimán, eight at Piedritas, and 24 at Manoa. In addition, O'Shea and Stotz recorded the numbers of individuals of all bird species observed to aid in assessing relative abundance.

RESULTS

The bird team recorded a total of 412 species during 12 days at three camps. The short periods spent at each camp contributed to the large number of species that were recorded at only a single camp. However, there were also strong avifaunal differences between camps, especially between Caimán, in hilly terra-firme forest, and the other two camps farther north, which had flatter topography, more riverine influenced habitat, and less rich terra-firme forest. We recorded 300 species at Caimán (plus 19 additional species around the village of Nueva Esperanza), 284 at Piedritas (plus seven on river trips to and from the site) and 299 at Manoa. In 1992, Ted Parker surveyed birds for seven days at two camps farther west in Federico Román (Sites 3 [Río Negro] and 4 [Fortaleza], in Appendix 6 of Parker and Hoke 2002). He observed 276 species. His list of species at these camps suggests that the avifauna at these sites is similar to the avifauna we encountered in the terra-firme forests at Piedritas and Manoa. Parker recorded 16 species that we did not find (his Table B1).

Northeastern Pando, biogeographically, can be viewed as the easternmost extent of southwestern Amazonia. In general, we found the southwesternmost species in complexes with allospecies replacements across Amazonia. However, there are signs that the region we surveyed has some mixing of avifaunal elements. We (and/or Parker) encountered 13 species (see Appendix 3) that otherwise in southwestern Amazonia are known only from east of the Madera River. Also the diversity of southwestern Amazonian endemics is much lower than that found farther west in Amazonia. We found only seven of the 26 southwestern Amazonian endemics listed by Parker et al. (1996). In comparison, Schulenberg et al. (2000) recorded 13 such species in western Pando, despite recording nearly one hundred fewer species overall.

The avifauna in Federico Román is surprisingly different from other parts of Pando. Schulenberg et al. (2000) recorded over 60 species that we did not encounter in a similar inventory, while we observed about 160 species that he did not encounter. Comparisons of these relatively brief surveys may overstate the differences among sites with many rare species being observed at only one site that with more intensive surveys would be found at both sites. However, at Federico Román we also observed 72 species that have not been recorded in on-going surveys at the Reserva Nacional de Vida Silvestre Amazónica Manuripi, where more than 500 species of birds have been recorded (Miserendino, unpubl.) While some of these species eventually will be found in the Manuripi reserve, a difference of this magnitude in such nearby Amazonian sites is striking.

One of the most salient aspects of our avifaunal surveys was finding at all three sites large populations of game birds. Trumpeters (*Psophia leucoptera*) and currasows (*Mitu tuberosa*), as well as other large, hunted birds were encountered regularly at both Caimán and Piedritas and seemed rather tame. As these species usually are depleted locally or become very skittish when hunted, this indicates that there is very little current hunting pressure in this region, despite a significant human population on the Brazilian side of the river and two Bolivian villages not very distant

from Caimán. Maintainence of large populations of these species in the new wilderness reserve is an attainable conservation goal. It would also be instructive to understand why the hunting pressure is so low, despite the presence of large human populations in the region.

The three camps surveyed showed distinct differences in their avifauna. Caimán stood out especially as different from the other two. Caimán had a more diverse and abundant terra-firme forest avifauna. In point counts at Caimán, we found 152 species, versus a total of only 128 at the other two camps. Additionally, about 20% more birds were recorded per point at Caimán, indicating a higher density of birds. Caimán has an essentially typical avifauna, in comparison to other intact terra-firme sites in Amazonia. Piedritas and Manoa, on the other hand, are below average in terms of their typical forest avifauna. The avian diversity of these latter two camps is nonetheless reasonably high, reflecting the contribution of river-associated habitats and a high level of diversity in forest structure at these two camps.

During our surveys, we found four species previously unrecorded from Bolivia and 16 additional species that were unrecorded from Pando (Appendix 3). Most of these birds are not unexpected as they have been recorded in nearby parts of Brazil or Beni, but they indicate that Pando remains underexplored for birds. Of the four species new to Bolivia, *Amazona festiva* is regular along the Madera River farther north in Brazil, and *Brotogeris chrysopterus* and *Bucco capensis* are known from several sites in adjacent Rondônia. *Conopias parva* was more of a surprise: its published range extends only to near the south bank of the Amazon. However, it apparently occurs at least locally through much of southern Amazonian Brazil (M. Cohn-Haft, pers. comm.).

Caimán

Although vegetation here was dominated by hilly terra-firme forest that had been lightly logged, and most of our access was via dirt roads that had a narrow strip of second growth at their edge, we recorded a very diverse terra-firme forest bird community at Caimán. We recorded 46 species of birds only at this site. However, this greatly understates the differences between Caimán and the other two sites. Many species of forest birds were far more abundant at Caimán than at the other two camps.

The most notable aspect of the avifauna at Caimán was undoubtedly the mixed-species flocks of both understory and canopy. We encountered these flocks regularly and the number of species in the flocks was high, especially in the canopy flocks. In much of Amazonian Bolivia (e.g. northeastern Santa Cruz), these mixed-species flocks are somewhat local, especially in the understory, and not as diverse as such flocks farther north in Amazonia. At Caimán, the understory flocks were typically less diverse than one might find in a more central Amazonian site, but we found all understory flock species expected in the area.

One unusual find at Caimán was reasonably good numbers of *Notharchus ordi*. We observed at least five different individuals, including one pair. This species is typically rare and although widespread across Amazonia, seems to be patchily distributed. Previously, it was known in Bolivia only from two birds collected near Cobija (Parker and Remsen 1987).

Piedritas

The forest here was extremely variable in its structure. Most of the area was terra-firme forest with a high density of palms, but there were extensive sartenejales and a moderately extensive area of flooded forest associated with a large arroyo.

The terra-firme forest avifauna was more depauperate than at Caimán, with low densities of many common species. Noticeable in their rarity were mixed-species flock species and territorial understory antbirds. Compared to Caimán, Piedritas had much lower levels of bird activity in the terra-firme forest. However, additional habitats, especially low sartenejales (seasonally flooded forests along a stream about 1 km west of the camp) and habitats along the Madera River resulted in nearly as many species being recorded here as at Caimán.

Although the seasonally flooded forest was relatively small in area, the diversity of species restricted to this habitat was surprisingly high. Of the greatest interest among these species were *Myrmotherula assimilis*, an antwren that is usually restricted to river islands, and *Zebrilus undulatus*, a rare, but in Amazonia widespread heron, previously unrecorded in Pando. The sartenejales were very low in diversity and numbers of birds. Only manakins (Pipridae) seemed to be relatively common. However, several species associated with savannas or white-sand scrubs in Amazonia were recorded in these habitats, including *Galbula leucogaster*, *Xenopipo atronitens*, and *Hemitriccus striaticollis*. *Cnemotriccus fuscatus*, although also found in second growth and thickets near the arroyo, was common and perhaps the most characteristic species in this habitat type.

Piedritas and Manoa shared 42 species that we did not record at Caimán. Most of these represent second-growth species, such as *Taraba major*, *Myiarchus ferox*, and *Chelidoptera tenebrosa*, or species associated with riverine habitats such as shorebirds, terns, kingfishers, and swallows. The forest-dwelling species were almost entirely associated with seasonally inundated forests or with the low-stature forests that were absent at Caimán. Although Piedritas and Manoa had more second-growth species than did Caimán, this portion of the avifauna was not very common or diverse. Several typically common species of these habitats were unrecorded at any site including *Tyrannus melancholicus*, *Myiozetetes similis*, and *Saltator coerulescens*.

Manoa

Like Piedritas, the density and diversity of birds in the terra-firme forest at this site was substantially lower than that found at Caimán. However, this effect was less severe than at Piedritas. The richest area at Manoa was the high-ground forest on the bluffs overlooking the Madera and Abuna Rivers. Densities of birds fell off as one moved inland in the high-ground forest.

In a number of areas there were woodlands of lower stature, usually covered with a viney razor-sedge (*Scleria*, Cyperaceae). These *Scleria* forests were probably seasonally inundated. Although distinct botanically from the sartenejales at Piedritas, these forests had many of the same bird species. Additionally, a few of the species restricted to the seasonally flooded forests at Piedritas (e.g. *Thamnophilus amazonicus*, *Neopelma sulphureiventer*) were in the *Scleria* forest. At the edge of one of these low-stature woodlands, Stotz observed and heard sing a *Herpsilochmus* belonging to the *atricapillus* complex. True *atricapillus* occurs in the deciduous forests of eastern and central Bolivia, but the bird seen at Manoa probably belongs to a currently undescribed species that is known from Amazonian Brazil west of the Madera River (M. Cohn-Haft pers. comm.). In the absence of any documentation, the assignment to this undescribed form must remain tentative. Obtaining a tape-recording of this species from Federico Román would contribute to our understanding of this complicated group of species.

THREATS AND PRELIMINARY RECOMMENDATIONS

The main threat to this area's avifauna is forest destruction. Much of the forests in Brazil just across the Madera River from this area have been destroyed for agricultural development. In this part of Pando, human populations are low, but expansion of the small communities at Nueva Esperanza and Arca de Israel could threaten the area's forests. The terra-firme forest around our Campamento Caimán has been lightly logged and is in a logging concession. The area around Manoa and Piedritas, although lightly logged about 30 years ago, is now not disturbed by logging. Some collection of Brazil nuts was occurring, but there was no organized system of collection in the region (see comments on this issue on page 78).

Large populations of relatively tame gamebirds and monkeys suggest that hunting pressure has been limited or non-existent to this point. However, the high human population density on the Brazilian side of the Madera and Abuna Rivers means that hunting is a concern; already fishermen regularly use the Bolivian shore to tie up their boats.

This area at the northern tip of Bolivia in northeastern Pando contains a rich Amazonian avifauna. The over 400 species we recorded in less than three weeks marks it as one of the most diverse sites in Bolivia. It especially stands out as an important site for a protected area because of the extensive deforestation that has occurred and is continuing immediately across the boundary rivers in Brazil. The small human populations on the Bolivian side means that a conflict between development and conservation is not inevitable here.

We recommend creation of a large protected area that includes the distinctive, hilly terra-firme forests around Caimán, as well as the diverse forest habitats found in the Área de Inmovilización to the north. The forests near Caimán were clearly the richest for birds, with greater diversity of species and population density. At the same time, that area lacked the habitat diversity that we found at Piedritas and Manoa. To protect the impressive avian diversity will require conservation of the contiguous habitat types in and south of the Área de Inmovilización. The opportunity for conservation is huge.

LARGE MAMMALS

Participants/Authors: Sandra Suárez, Gonzalo Calderón, and Verónica Chávez

Conservation Targets: Bolivian red howler monkeys (*Alouatta sara*, "manechi"); Black-faced black spider monkeys (*Ateles chamek*, "marimono"); primates in general because of their high species richness and high population densities; pink river dolphins (*Inia boliviensis*, "bufeo" or "boto"); and commonly hunted large mammals such as white-lipped peccaries (*Tayassu pecari*, "tropero") and tapirs (*Tapirus terrestris*, "anta").

METHODS

We inventoried nocturnal and diurnal large mammals using a combination of methods, including visual sightings and other secondary clues such as distinctive odors, tracks, vocalizations, nests or dens, and other traits left behind by animals such as chew marks, holes, urine, and feces. These data were collected by walking transects and roads between 6:30 AM and 6:30 PM for diurnal mammals and from 6:30 PM to 6:30 AM for nocturnal mammals. Three mammalogists logged a total of 303.75 observer hours over 10 days. Broken down by site, this includes 107 hours at Caimán (four days), 92 hours at Las Piedritas (three days), and 104.75 hours at Manoa (three days). While we included records from other biologists, their observer hours were not calculated.

In addition to this simple survey method, we also created "track scrapes" along one transect at the Piedritas site by clearing all the leaf and other organic debris from an area along the transect and sifting approximately 1 cm of dirt over the clearing using 2 mm plastic mesh. We made a total of 10 track scrapes approximately 50 m apart, each measuring approximately 1 m long by 0.5 m wide. These pits were re-visited twice on consecutive days to check for animal tracks. Unfortunately, this method did not prove to be very effective; almost no tracks were seen in the track scrapes. Instead, most animal tracks recorded were along stream edges, along the road, and in mud wallows.

We counted groups or solitary animals as one registry and took care not to count the same group or animal seen by several observers more than once. Where tracks were concerned, we counted one record per site, wallow, stream edge, or mud pit along a road. Whether one animal/group or several animals/groups left tracks in an area, we counted this as one record, as there was no way to distinguish between the tracks of one animal or another, nor the age of the tracks. Therefore, our recordings are underestimates.

We also inventoried some small mammals by placing 15 snap-traps on the ground every 15 m, and five snap-traps 1–2 m above the ground in small trees, for a total of eight days (three days at Caimán, three days at Piedritas, and two days at Manoa). The traps were baited with squash (Cucurbitceae) flavored with vanilla extract and were checked every 24 hours for specimens, which were preserved by injecting their

abdomens with a 10% formalin solution and then submerging them in 70% ethanol. Only three small mammals were trapped, and we manually captured the other two.

We estimated abundance per taxon based on the number of registries during the inventory. The five categories for abundance were as follows, in descending order: abundant, more common, common, less common, and rare. Animals that were not recorded were listed as "expected." These categories are broad and take into consideration the expected abundance for the animal in question and whether the records are based on actual sightings or secondary evidence.

- **"Abundant"** describes species that are commonly seen, or where secondary evidence, such as tracks, is very common.
- **"More common"** describes species that are sometimes seen, or whose secondary evidence is common.
- **"Common"** refers to animals that are not difficult to see, or whose secondary evidence is normally present in an area, but not as widespread as "more common" species.
- **"Less common"** is a category including species that are not normally seen, but are registered more than once.
- **"Rare"** is used for species that are almost never seen.

Some species were registered a different number of times, but were placed in the same abundance category. This is due to the expected abundance for that particular species in the areas sampled. For example, pink river dolphins (*Inia boliviensis*) are not present in most regions of Pando, but where they occur, they are common. We registered dolphins only four times at a single site, but gave them an estimated abundance as "common"; they are considered "regionally" common, and during our inventory were spotted on many of the few occasions that it was possible. On the other hand, night monkeys (*Aotus nigriceps,* Figure 6D) were recorded seven times, three of these records were actual sightings, and they were listed as "common" as well.

Nomenclature for all large mammals except primates follows Emmons (1997). Primate nomenclature follows Rowe (1996).

RESULTS

We registered a total of 44 species in the entire inventoried area, 39 of which were large mammals representing 80% of the expected 51 large mammal species for the area. Our list of expected species was based on what occurs in other areas in Pando and on distribution maps (Rowe 1996, Emmons 1997).

The area overall showed a very high diversity and density of large mammals, with 10 species of primates. Although populations of large, commonly hunted mammals were perceived to be healthy throughout the region, we found differences in species abundance in the three different sites, undoubtedly due to differing degrees of human intervention.

Caimán

Caimán was the site most populated by humans, with two communities and a military post nearby. Additionally, on the Brazilian side of the Madera River is the small town of Araras and a highly transited thruway. The inventory area also includes an active logging concession with logging roads. The effects of this human activity were apparent in the density and species we recorded at Caimán. Although large mammal density was high, there were several differences when compared to the other two inventory sites (Piedritas and Manoa). Tapirs (*Tapirus terrestris,* Figure 6E), for example, were far more common in the other two sites. This may be due to more hunting in Caimán, but it may also be, in part, due to the location of our trail systems, which were generally roads and trails fairly close to human settlements. It is less likely that tapirs would travel in these areas.

The density of primates was also different at Caimán, with the most abundant species being the tamarin groups (*Saguinus fuscicollis* and *S. labiatus*)

and brown capuchin monkeys (*Cebus apella*). These species fare well in disturbed forests and near human settlements. Although capuchin monkeys are commonly hunted, the community of Arca de Israel claims that they do not hunt for religious reasons. The local population of capuchin monkeys was healthy and they were not shy of people. Similar behavior in the tamarin groups leads us to conclude that the hunting of primates in the area is minimal, making it a good place for primate research. The low densities of other primate species such as monk saki monkeys (*Pithecia irrorata*) and white-fronted capuchins (*Cebus albifrons*), and the lack of some species such as howler monkeys (*Alouatta sara*) and spider monkeys (*Ateles chamek*), are probably due to logging activity. These animals tend to be shy of noise and people.

Similarly, the cat population (Felidae) was a bit smaller than at the other two sites, with almost all records from tracks. This is likely a result of logging and human activity.

There was a high density of tyras (*Eira barbara*) at Caimán compared to no records at the other two sites. While we suspect that tyras are present at the other sites, their high density at Caimán demonstrates their ability to live in disturbed habitats and near human populations (Emmons, 1997).

Of particular interest for this site was the possible discovery of a new species of agouti (*Dasyprocta* sp.) for Bolivia, or perhaps to science. Several researchers spotted a very dark or black species of agouti on different occasions. A clear identification was not possible, making further investigation and sampling of a specimen necessary in order to identify the species. It may be the black agouti (*Dasyprocta fuliginosa*), which is found further north in parts of Brazil, Ecuador, Peru, Colombia, and Venezuela, and whose southern range extension comes close to Pando. This would mean a considerable extension of its range to the south. It is also possible that this is a new species.

The long-furred woolly mouse opossum (*Micoureus demerarae*) was another new mammal registry for Pando.

Piedritas

Piedritas seemed to us to be the least disturbed of the three sites, with no human populations nearby, and only a highway near the river on the Brazilian side. Based on the high density and diversity of large mammals at this site, it was clear that hunting pressure is minimal. Commonly hunted species, which are usually the first to disappear under hunting pressure, were registered in the area. For example, white-lipped peccaries (*Tayassu pecari*) and howler monkeys (*Alouatta sara*) were recorded and very healthy populations of commonly hunted mammals such as tapirs (*Tapirus terrestris,* Figure 6E) and deer (*Mazama* sp.) were apparent. Other commonly hunted species, such as agoutis (*Dasyprocta variegata*), pacas (*Agouti paca*), and collared peccaries (*Tayassu tajacu*), were also very abundant.

Of the 10 species of primates we registered for Federico Román, nine were recorded at Piedritas. The only exception, the spider monkey (*Ateles chamek*), is normally very difficult to see in Pando, and most likely does exist at the inventory site. The primate densities at Piedritas were high, and the diversity of species was splendid, higher than at the other sites.

Of particular interest at Piedritas was a new squirrel (*Sciurus* sp.) for Bolivia or perhaps a new species for science. Several researchers observed a large, dark red squirrel with a dark chestnut-brown tail-base and white belly. No such species is registered for the area, and it may be the Junín red squirrel (*Sciurus pyrrhinus*), which is known from a small area in Central Peruvian montane forest. This may be an extension of its range, as well as its habitat. Further research and a specimen will be necessary to determine the species.

Manoa

The final inventory site, Manoa, was similar to Piedritas in large mammal diversity and density, despite the presence of considerable human activity on the Brazilian side of the Madera River. The town of Abunã in Brazil's state of Rondônia is just over the river. A major road passes through the town and includes a

river crossing at the mouth of the Abuna River. The traffic from the highway, as well as the noise from the barges at the river crossing are heard clearly from within the forest on the Bolivian side. This may explain the drop in records of certain species in comparison to the previous two sites, particularly for Felids, where we had only one record (*Leopardus pardalis*). Nevertheless, populations of commonly hunted species, such as tapirs (*Tapirus terrestris*), were healthy. Even some of the rarer and difficult-to-see species that are commonly the first to disappear under hunting pressure, e.g., howler monkeys (*Alouatta sara*) and spider monkeys (*Ateles chamek*), were spotted. (Spider monkeys and coatis [*Nasua nasua*], were not seen at the other two sites, although they surely are present.) These are good indications that hunting pressure in the area is minimal.

The pink river dolphin (*Inia boliviensis*) was also only seen at this inventory site. It may not exist further up the Madera River. Some scientists consider the species in this region to be a separate species from the more common Brazilian form (*Inia geoffrensis*). The dolphins in the upper Madera River are an isolated population, and if considered a separate species, would be endemic to the region (Emmons 1997).

Of the 10 species of Primates expected for the area, eight were registered. Surprisingly, throughout the entire inventory of Federico Román, we never spotted the titi monkey (*Callicebus* sp.). We heard it once at Piedritas, and once at Manoa, but on the Brazilian side of the Abuna River (not registered for this RBI). Titis are common in most of Pando, and are usually not difficult to detect. Yet, we heard almost no vocalizations from this species, which may mean that it is rare in the region. This genus is under taxonomic revision (van Roosmalen 2002), and it is not clear which taxon exists in Pando, or if several taxa exist. It will be interesting to get clear records or specimens from the entire department, including Federico Román.

THREATS

At the moment, the clearest threat to the large mammals in Federico Román is hunting. There is pressure from the Brazilian side of the border, from which hunters cross over into Bolivia. At Manoa, we heard rifle shots across the Abuna River in a small fringe of forest that remains there. Fishing by Brazilians is frequent as well. People who knew of our presence in the area were eager to use our trails to hunt as soon as we left. In Caimán, hunting is also a threat to the local mammal population, but in this case not only from the Brazilians, but also from the local communities.

Habitat destruction in Federico Román is minimal when compared to other parts of Pando. Only at Caimán did logging activities, and to some extent the local communities, pose a threat to the mammals. For example, the large communal clearings made in Arca de Israel for subsistence agriculture are probably more threatening to some species than typical small clearings made by most communities in Pando. Also of concern are the active sawmills nearby in Brazil, which may extract wood from Bolivia.

Noise pollution from the thruway in Rondônia may negatively affect some species in Federico Román, particularly cats, causing them to move farther from the border. This is most severe in Manoa, but is most likely not a serious threat to the population.

Brazilian gold miners, still active along the Abuna and Madera Rivers, also pose a threat. The use of mercury for the extraction of gold is a serious danger to aquatic life, and in the case of mammals, to the population of dolphins. Similarly, the debris left behind from the gold rush in the 1980s—hundreds of rusting "dragas" (dredges) along both rivers—is oxidizing into the water and is an eyesore.

RECOMMENDATIONS

First and foremost, we recommend that the Área de Inmovilización Federico Román be designated a wilderness preserve, including the current logging concessions to the south. It is an area of very high

mammal density and diversity, it is rich in primates, and has some species possibly new for Bolivia or for science. The area is characterized by nearly uninhabited, well-maintained forests, and represents the western extension of the Brazilian Shield, conserving some species that are disappearing just over the border, in Brazil.

Most threats to the area, such as hunting, are due to human activity that infiltrates from Brazil. We recommend that these hazards be controlled legally by giving the area conservation status, with international agreements regarding common waterways. On a similar note, noise pollution could be considerably reduced by imposing a strict speed limit and perhaps by constructing a bridge at the current barge crossing. Obviously, such activities would have to involve Brazilian cooperation and organizations. It may even be possible to protect the small fringe of forest that remains in Brazil to the north of the Abuna River as a buffer zone. Such international projects can be very encouraging for the creation of cooperative efforts for conservation, and can help avoid international conflicts.

Lastly, we recommend that further research be carried out in the area. Small mammals should be inventoried. Also, these forests would be excellent for behavioral studies of primates and almost all other local mammals, as most mammals were not shy of people. The area would also be useful for comparative research regarding the effects of human population on local wildlife. Finally, there is great interest in determining the species of several mammals in the area, such as: howler monkeys (*Alouatta sara* or *A. seniculus*), titi monkeys (*Callicebus* sp.), squirrels (*Sciurus* sp.), agoutis (*Dasyprocta* sp.), and pink river dolphins (*Inia boliviensis* or *I. geoffrensis*). Many of these taxonomic issues should be addressed locally as well as departmentally.

HUMAN COMMUNITIES

Participants/Authors: Alaka Wali and Monica Herbas

Conservation targets: Low-impact use of non-timber forest products, such as Brazil nuts, palm fruits, medicinal herbs; diversified-crop gardens; small livestock management.

METHODOLOGY

From 21-25 July, 2002, we used participant-observation techniques, semi-structured and structured interviews, and town meetings for our social assessment.

HISTORY

The recent history of settlement in the region began in the late 1970s with the discovery of gold by Brazilians, who quickly recruited Bolivians to work with them to stake claim to the gold. By 1982, Bolivian gold miners established a mining cooperative and in 1983, the Bolivian Government established a small naval port and army base on the Madera River. The peak of gold mining activity was in the mid 1980s, at which time, according to accounts by local inhabitants, there were literally thousands of small dredging machines in the river and nearby areas. Mercury was used to process the gold and residents spoke of contamination. The human population of the region at the time was estimated to be in the thousands. According to Bolivians who participated in the gold rush, there were high incidences of violence and crime associated with the gold mining, although mostly on the Brazilian side of the river. Between 1983–1992, the Bolivian mining cooperative (which by then went by the name of Nueva Esperanza) engaged in a running battle with the mining company EMICOBOL, which also was trying to stake a claim to a large area within the region. Those who participated in the effort to retain the cooperative's land developed organizing strategies, learned how to use the law and stake a claim to their land and economic rights. Eventually, they were able to establish the town of Nueva Esperanza, which gained its legal status (*personería jurídica*), in 1991, and in 1996, after several years of effort, they succeeded in making Nueva Esperanza the provincial capital.

By the early 1990s, however, the gold rush was reaching its end. Many people started leaving the region, and the population declined. However, there has been a steady trickle of people arriving since the early 1990s, and these new migrants today form the core of the population in the region. With the passage of the new forestry law in 1996, forestry concessions were granted and a logging camp, Los Indios, was established. The biggest new migration occurred only about two years ago, in 2000, when a religious commune migrated en masse and established the community of Arca de Israel, up river from Nuevas Esperanza on the banks of the Madera River (Figures 2D, 7C). The commune is part of an international religious group, "*La Asociacion Evangelica de la Misión Nuevo Pacto Universal*," which has its origins in Peru and is probably millenarian in outlook. By 2002, two other communities were formed in the region—La Gran Cruz (which in part includes members of the same religious commune) and Puerto Consuelo—both of which are still attempting to obtain legal standing.

DEMOGRAPHY

Our report focuses on the two Bolivian communities we visited, Nueva Esperanza and Arca de Israel. Both communities are composed of migrants, the bulk of whom have arrived in the region after 1990. According to data supplied by officials at Nueva Esperanza, the entire municipal population is over 500 people, with about 136 in Nueva Esperanza and about 415 in Arca de Israel. The settlement pattern in both cases is that of a concentrated village, with houses arranged in linear form along "streets." Nueva Esperanza has a plaza where the offices of the Provincial and Municipal government are located. The dominant construction in Arca de Israel is a large church or temple where the community gathers for religious worship. As far as we can discern, the households are composed of nuclear families in both cases.

There are several key differences between the two villages. Nueva Esperanza's inhabitants seem to come largely from the Department of Beni, which like Pando, is ecologically part of the lowland tropics. Residents told us they had come to the region in search of gold and elected to remain even when they did not find it. On the other hand, Arca de Israel's inhabitants are almost all from the highland areas of Potosí, Chayanta-Norte, Cochabamba and Oruro. According to their accounts, they were living in a situation of poverty and constant land conflicts as a result of land fragmentation, erosion and tenure problems. For them, Federico Román is a haven and they perceive it as an opportunity to expand into the ample terrain that they see around them. According to the nurse at the clinic in Nueva Esperanza, the residents of Arca de Israel are not really interested in practicing birth control. Arca de Israel residents also informed us that they intend to bring additional family members and religious compatriots to the region as soon as it is economically feasible. Already, some members of the commune have established a second foothold in the region in the vicinity of the settlement of La Gran Cruz. A third settlement is also being formed.

ECONOMY

In both communities, a subsistence-oriented lifestyle predominates with a heavy dependence on slash and burn horticulture. The major crops are yucca and rice. People also cultivate various fruit trees, and plantains and bananas. The principal difference between the two communities is that whereas people in Nueva Esperanza use small-scale plots (each family cultivating for themselves), people in Arca de Israel clear large (50 hectares or more) plots for a communal planting. Thus, instead of each household working on their own, in Arca de Israel the work is allocated to "work groups" composed of 20 individuals. Each group has a leader and the community decides collectively which group will do what work on any given day. All resources are then redistributed equally among the commune members (although it may be that families with more children get more food, etc.).

The degree to which people hunt and fish in these two communities is not clear. According to Arca de Israel residents, they do not hunt at all, relying instead on livestock (pigs, chickens, sheep) for meat. Nueva Esperanza residents also seem to rely more on livestock (pigs, cattle, chicken) for meat although they may hunt occasionally. People do fish for subsistence purposes.

The principal source of cash in Nueva Esperanza is employment in the municipal and provincial government and work on government-funded projects for infrastructural improvements in the community (such as the Plan Nacional de Empleo and the Programa Integral de Empleo). Additional income is derived from the sale of horticultural produce (e.g., rice), sale of cattle (although it appears that only one or two families own cattle), and the sale of Brazil nuts when in season. People in Nueva Esperanza continue to mine for gold on a small scale.

In Arca de Israel, the principal source of cash income is the sale of rice. Interestingly, women here continue to weave textiles traditionally found in their highland homelands. However, they have not commercialized the textiles as of yet. Both communities have strong commercial links to the Brazilian communities on the other side of the Madera River. Many people in Nueva Esperanza appear to sell their products (rice, cattle) directly to merchants in Araras (for example, while we were there, a man slaughtered and sold a cow to one of the big store owners in Araras). People in both communities ferry their products across the river and then transport it by road in Brazil to Guajará-Mirim, crossing back there to the Bolivian city of Guayaramerín. Here, there are also many links to merchants (as well as familial ties for the people in Nueva Esperanza).

Aside from horticulture, the only other economic activities are also very small scale—a rice-processing mill in Nueva Esperanza, a Brazil-nut processing plant (which is not functioning, however, because of lack of funding to buy necessary parts), and a newly started small-scale brick making enterprise—all in Nueva Esperanza.

In sum, economic activities in the two communities are entirely within a regional context and do not link these communities to larger national or international markets. The sole exception is the lumbering activity occurring in the forestry concessions (but no one from either community, it appears, works at the lumber camp).

SOCIAL ORGANIZATION: INFRASTRUCTURE AND INSTITUTIONS

The two communities differ in their mode of social organization. Nueva Esperanza is organized around its political and civil institutions, in addition to the social forms dictated by kinship and household networks. Arca de Israel, on the other hand, is organized through the religious structure, although a parallel governing structure dictated by the norms governing *personería jurídica* also is in place. It appears that in Arca de Israel, even household formation and kinship ties are subsumed under the religious norms of the commune.

Nueva Esperanza is the municipal and provincial seat, and these institutions (the alcaldía, the *subprefectura*, the office of the *corregidor*) are the principal vehicles through which the community sets laws and norms for governance. There are other governmental institutions as well, such as the Naval Base, the health clinic, and the school (which goes to intermediate level.). Arca de Israel only has a school and a small health post. Additionally, people in Nueva Esperanza pertain to political parties (which during our visit was particularly salient because of the recent elections), and these sometimes seem to define alliances or lines of schism. Interestingly, Arca de Israel decided collectively to join a single party and voted uniformly for one candidate for President. Indeed, the religious group, as a whole at the national level, voted en masse. Their reasoning was that this will give them a measure of political power. Residents informed us that a sign was given to their religious leader that the candidate of the Movimiento Nacional Revolucionario (MNR) party would win the election, and this was the party they all voted for. (This candidate did, in fact, win.)

Residents openly discussed the close links of Arca de Israel with the national religious organization and the mandate of that organization to expand.

While all of these national and departmental institutions are present locally, the relationships between the national and departmental governments and the local communities (especially Nueva Esperanza) have been conflictive. There is a perception that these institutions neglect and abandon the province of Frederico Román because of its remoteness. For example, people expressed great dissatisfaction with the establishment of the logging concessions under the new forestry law, because in effect the three concessions cover more than half of the land that pertains to the province and include the area around the municipal seat.

Civil institutions or organizations in Nueva Esperanza include: two places of worship (one Catholic church and one Evangelical church); a Club de Madres (Mother's organization common throughout Bolivia); a sports club (men play soccer frequently in the afternoons and play in tournaments against teams from neighboring towns in Brazil); an Organizacion Territorial de Base, which includes the Comité de Vigilancia, and monitors local governmental actions. Most recently, residents of Nueva Esperanza have taken advantage of the new forestry law to form the Asociación Social del Lugar (ASL), which is a type of cooperative designed to give communities a chance to develop both logging and extractive activities within local forests. The ASL, like lumber companies, can submit a forestry management plan to the Superintendencia Forestal and then engage in these activities with the intent to generate employment and income. In Arca de Israel, the church is the major civil institution.

Leadership of the communities seems to stem principally from the civil institutions or the governmental organizations. In Nueva Esperanza, there have been leadership changes over the years, but there are a recognized group of senior men who exert influence over community decisions. Women, however, are also active in civic and political institutions and freely articulate their opinions. Women are key actors, it appears, in the ASL. In Arca de Israel, leadership stems from the church, which is closely integrated with the governing and political structures.

Both communities are linked to regional and national urban centers principally through radio telephones. The roads in the region are of poor quality and most rely on the Brazilian road and transportation system to go anywhere. A few people in Nueva Esperanza own vehicles (motorcycles, motor boats), and the community of Arca de Israel owns a truck and several motor boats.

DISCUSSION AND ANALYSIS

It is clear that the communities of the region present substantive opportunities for effective collaboration on the conservation and long term stewardship of the proposed wildlife refuge, but also present obstacles. The greatest advantage in both communities is their professed desire to participate in conservation and to manage the lands that pertain to them in a manner compatible with long-term stewardship of the land. In all cases, people expressed a great interest in learning more about the biological diversity of the region. The existence of the ASL in Nueva Esperanza is a hopeful sign of a potential partner for conservation work. In general, it seems as if the community of Nueva Esperanza is moving toward a more active, organized mode of resource management and community decision-making. Having transformed the mining cooperative into a real settlement and having obtained the status of provincial capital, residents are committed to maintaining their foothold in the region. In Arca de Israel, the strong communal organization should also facilitate good partnership.

In both communities there is a strong desire to achieve a better quality of life (although the exact indices of what this entails need to be investigated more thoroughly), and toward this end, both communities are embarking on various strategies to

augment income, find productive economic alternatives (particularly to gold mining), and establish good rules of governance and decision-making processes for their respective settlements. Both communities have very specific plans for the near future. People in Nueva Esperanza, through the ASL, intend to consult with forestry experts to develop their management plan and to re-vitalize the Brazil-nut processing plant, as well as find other non-timber uses for the forest and begin small-scale extractive activities. In Arca de Israel, it appears that the main economic vehicle will remain intensive rice production for the near future.

The principal obstacles to developing good partnerships based on conservation action revolve around: (1) the lack of local capacity to access technical knowledge for sound resource management; (2) the lack of knowledge about the sustainable use of the ecosystem (especially the residents of Arca de Israel who are from the highlands and seem to have virtually no knowledge of the lowland tropical environment—less so for those in Nueva Esperanza who are largely from the Beni); and, most significantly, (3) distrust of external governmental (and possibly non-governmental) agencies or institutions.

A major threat to the anticipated conservation efforts potentially are the intention of the residents of Arca de Israel to expand (i.e., to colonize more land along the Madera River), through promotion of expanded migration to the region by families and friends still in the highlands. Another threat stems from potential logging activity in the region, which, if it does not strictly follow the Forestry Law, has not only the potential of degrading the ecosystem but also of establishing precedents for intensive resource exploitation that residents in the region will be hard put not to follow. A final threat is the persistence of gold mining activity in the region and the continued desire on the part of some residents to "strike it rich" through discovery of yet another vein of gold.

Potential targets for conservation that involve human interaction with the natural landscape include:

1) Brazil-nut extraction activities, which if managed properly could be a source of income that remains a low-impact use of the natural resources;
2) Maintenance of small-scale horticultural gardens for subsistence (such as those in Nueva Esperanza)—plots of between 1–3 hectares that contain diversified crops, and are left for long periods of fallow after initial use;
3) Extraction of non-timber forest products such as the fruit of the asaí palm (*Euterpe*), other palm fruits, and medicinal herbs;
4) Better managed care of small livestock (chickens, goats, sheep) for consumption;
5) Fishing for subsistence purposes.

In Nueva Esperanza, the following social characteristics are potential assets or strengths that can become the building blocks for a strong participatory or collaborative development of stewardship of the protected areas and the areas of the buffer zones in which the communities are located:

1) Existence of the Asociación Social del Lugar (ASL) which can be the main partner at the local level to develop resource management plans, and to find people willing to work in inventory, monitoring or other conservation related actions;
2) Existence of effective community leadership as manifest in the local organizations (OTB and Comite de Vigilancia) and those in municipal government (i.e., the *Consejales*);
3) Active participation of women in the decision-making structures at both the household and community levels;
4) Interest of the schoolteachers and of various parents of school-age children in access to more materials and curriculum related to environmental education;

5) Avid interest of community members in the scientific work of the rapid biological inventory and their desire to be informed of the results.

In Arca de Israel, we found the following social characteristics to be assets:

1) A communal lifestyle with respect to the division of labor and resources, which is an indicator of a high degree of social organization;
2) The community is newly established and its members appear to be open to ways to use the land in a manner compatible with conservation;
3) Lack of any desire to engage in gold mining;
4) Existence of handcrafts (weaving technologies, for example, which continue traditions from the highland areas) that can be a source of small-scale income, but also act to preserve community identity and distinction as well as acting as a manifestation of people's creativity.

Our recommendations for follow-up work with the communities include the following:

1) Discuss results of the rapid biological inventory with both communities immediately, perhaps through assemblies or town meetings and invite commentary on the forms of participation for the processes involved in granting permanent protected area status and implementing a conservation design process;
2) Insure that the land-titling process now under way with INRA (Instituto Nacional de Reforma Agraria) guarantees a measure of security and stability to local populations while not leaving the door open to uncontrolled or rapid colonization through increased migration;
3) Quickly provide technical advice to the ASL in Nueva Esperanza and the communal leaders in Arca de Israel on development of land use strategies and plans that are oriented toward low-impact use;
4) Conduct more intensive participatory asset mapping to elicit community strategies, visions, and capacities for sustainable but high-grade quality of life.

ADDENDUM—The Community of Araras (Brazil)

While we did not conduct extensive interviews and observations in Araras (Rondônia), we did attempt to understand the relationships of its residents to the Área de Inmovilización and its environs on the other side of the Madera River. It is interesting to note that no one in Araras seems to own a boat or motor to cross the river, so that visits to the Bolivian side are not a regular part of the life of the residents here. However, there are close ties of commerce and in some instance friendship as well as indications of resource sharing between Araras residents and those in Nueva Esperanza.
Like their Bolivian counterparts, the bulk of residents in Araras seem to have been attracted to the region during the gold rush. Many come from other parts of the Brazilian Amazon. Currently, the major occupations are gold mining (small scale), commerce (there are stores, restaurants, a gas station, a mechanic shop, and other small businesses), and day labor on neighboring cattle ranches. There is a school, but the health clinic was recently closed and people must go to the next town on the road to get medical attention. There are four churches (one Catholic, three Evangelical).

We recommend further studies of economic activities in Araras and adjacent communities to verify the extent of their involvement in Bolivia. Programs of environmental education may be an effective way to reach people here towards participation in the stewardship of the buffer zone around the protected area.