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Conserving Biological Diversity in the Tropics: The Role of Private Nature Reserves in Costa Rica

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Conservation efforts to preserve biological diversity are often focused on the establishment of protected areas such as national parks, wildlife refuges and forest reserves (McNeely *et al.* 1990, WRI, IUCN, UNEP 1992) under government control. Boza (1993) identified the need for innovative partnerships to ensure the maintenance of these areas in Costa Rica. Since ecotourism is viewed as a major benefit derived from the protection of these areas and a strong incentive to acquire new lands to complete the system (Boza 1993), a conservation link with the tourist industry would be attractive.

Numerous authors have examined the benefits and drawbacks to such a relationship (Boo 1990, Rovinski 1991, Giannecchini 1993, Burnie 1994). In the typical scenario, increasing levels of visitation by ecotourists to protected areas ideally generates revenue from entrance fees and services while contributing to local and national economies via employment, the development of infrastructure and exchange of foreign currency. However, the expansion of ecotourism also leads to problems associated with overcrowding, disturbance of wildlife (Damon and Vaughan, 1995) and the limited

carrying capacity of reserves to sustain ever higher levels of visitation.

This growth pattern has been dramatically demonstrated in Costa Rica where visitation to national parks is rising at 25-30% per annum (Bermudez and Mena 1992). The demand for ecotourism has also led to the rapid establishment of nature reserves on private land. Other reasons for the establishment of private reserves in Costa Rica include: the protection of biodiversity, cultural and economical reasons (Chaverri 1979, Fournier and Herrera de Fournier 1979, Gonzalez 1985, Fournier 1991, Fournier 1992).

Can private reserves complement government efforts to protect biological diversity? We examined this possibility by assessing (1) physical characteristics; (2) species occurrence, primarily of birds and mammals; and (3) threats to the ecological integrity of individual reserves.

We established a list of nature reserves by reviewing travel guides, advertisements in newspapers and promotional materials from travel agencies. Reserves were selected using

the following criteria: (1) private land ownership; (2) current business plan based on ecotourism; (3) site development financed without government or donor support; and (4) profit based operation. These criteria eliminated biological stations established by educational institutions and reserves created with the assistance of international fund-raising campaigns.

We visited each reserve and surveyed the site, frequently with biologists and guides who collected biological information. We obtained two types of species inventory data from these individuals: observational checklists of species occurrence often available to tourists, and personal records of wildlife sightings, particularly in relation to a predetermined list of 14 mammals. We determined reliability of this data by assessing qualifications and experience of observers and techniques for data collection and storage.

Interviews were conducted with the owner or manager of each reserve to determine site development, history, surrounding land use activities and community acceptance. Whenever possible, interviews were conducted in the field.

Locations of private reserves were plotted on topographic maps (1: 200,000). Distances were calculated to the nearest protected areas identified by Boza (1993).

We reviewed 41 potential reserves: 9 areas failed to meet our criteria and we were unable to obtain information from 6 other candidates. Our survey was extensive and included reserves throughout Costa Rica.

Physical Characteristics: The 26 reserves (Table 1) ranged in size from 20-1,492 ha and encompassed 10,124 ha. Average reserve size was 389 ha (S.D. = 471). Twenty reserves (77%) were less than 500 ha in size (Fig. 1).

Four reserves were adjacent to protected areas under the jurisdiction of the government of Costa Rica (Fig. 2). The average distance of the other 22 reserves to government-controlled areas was 12.4 km (S.D. = 11.1). The range of distances to nearest protected area was 0.5 - 33.2 km.

Biological Inventory: Species checklists were primarily available for birds (Fig. 3). Eight of the bird lists were simple checklists of presence only while the other 2 included both checklists and information on breeding status and seasonal patterns of abundance. Three additional lists were excluded from our analysis because they included species observed outside reserve boundaries.

The average number of birds/list was 200 (S.D. = 78) ranging from 86 to 333 species. A total of 645 different species of birds were identified at the 10 reserves, 74% of the Costa Rican avifauna (Stiles and Skutch 1989). Nearly all of the endangered avifauna in Costa Rica were found in private nature reserves: of the 27 species listed by Sanchez and Quesada (1989), 21 species (78%) were reported in our survey. All members of the Accipitridae and Falconidae are also considered endangered: 76% and 85% of the species in these families have been observed at private reserves. Except for the spotted-breasted oriole (*Icterus pectoralis*), species absent from reserves all require extensive wetland habitats that did not exist at private reserves.

Only 4 reserves (19%) had lists of mammals (Fig. 3). These lists included 47, 33, 26 and 19 species, respectively and were dominated by species of interest to tourists and reserve managers (e.g., non-primates, large carnivores, sloths). Non-human primates are endangered species in Costa Rica (Sanchez and Quesada 1989) and records were available from 20 additional reserves for these highly visible species.

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TABLE 1

Costa Rican Private Reserves Included in this Study

Reserve	Size (ha)	Year	Distance (km)	Holdridge Life Zone
Rara Avis	1300	1986	Adjacent	bmh-T
Sarapiquí Ecological	100	1991	4.1	bmh-P
Selva Verde	218	1985	7.1	bmh-P
El Gavilan	130	1988	6.5	bmh-T
Oro Verde	380	1990	4.1	bmh-T
Ecoadventure Lodge	538	1990	27.6	bmh-T
Arenal Observatory Lodge	386	1988	33.2	bmh-T
Villa Blanca Hotel	1380	1992	16.2	bmh-T
Los Innocentes	900	1989	Adjacent	bh-T
Curu	1492	1945	Adjacent	bh-T
Dundee Ranch Hotel	1300	1991	9.1	bh-T
Carara Ecological Hotel	141	1992	Adjacent	bh-T
Hacienda Baru	330	1988	30.8	bmh-T
Cabanas Escondidas	45	1991	31.3	bmh-T
El Salto Biological Reserve	26	1989	2.7	bmh-P
Marengo Reverse	500	1985	5.5	bmh-T
Campanario	113	1992	1.4	bmh-T
Corcovado Tent Camp	177	1991	0.5	bmh-T
Tiskita Lodge	170	1987	25.5	bh-T
Alberque de Montaña	200	1980	10.0	bp-MB
- Cabinas Chacon				
Finca de los Quetzales	53	1992	8.2	bp-M
Genesis II	43	1988	9.6	bp-MB
Rancho Naturalista	57	1987	20.9	bmh-P
Totuga Lodge	40	1987	1.6	bmh-T
Avarios Caribe	85	1990	11.4	bh-T
Chimuri	20	1988	5.5	bh-T

Key:

Size in hectares

Year initiated

Distance to nearest public protectec area

Holdridge Life Zone: bh-T= tropical wet forest, bmh-T= tropical very wet forest, bmh-P= premontane very wet forest, bp-MP= lower montane rain forest, bp-M= montane rain foest.

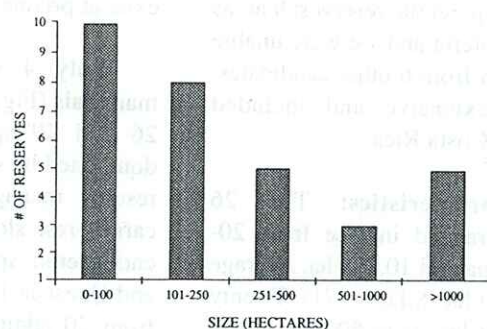


Fig. 1. Distribution of the distances of private nature reserves to the nearest protected area under the jurisdiction of the government of Costa Rica.

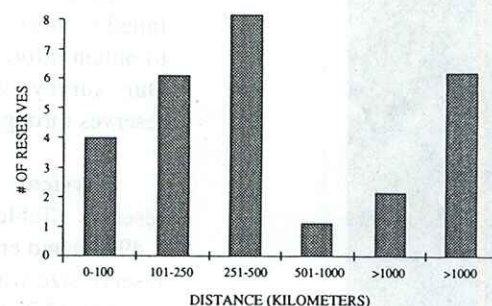


Fig. 2. Number of private nature reserves with formal lists or inventories of wildlife.

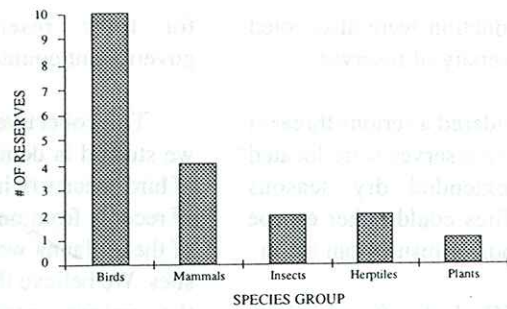


Fig. 3. Size distribution of the private nature reserves studied in Costa Rica.

With respect to non-human primates, the white-faced capuchin (*Cebus capucinus*) was the most common, found in 79% of reserves; while howler monkeys (*Alouatta palliata*) were also present at most reserves (75%). Spider monkeys (*Ateles geoffroyi*) were less common (13 reserves, 54% of sites). Squirrel monkeys (*Saimiri oerstedii*) were reported at only 4 sites (17%) but did occur at 67% of the reserves located within the known in-country range of the species.

Several other species were reported from 19 reserves. The jaguar (*Panthera onca*) and puma (*Felis concolor*) were only present at 6 (32%) and 3 (16%) reserves (N=19), respectively. In contrast, ocelot (*Felis pardalis*) and margay (*Felis wiedii*) were more common (14 and 13 reserves, 74% and 68% respectively). Jaguarundi (*Felis yagouaroundi*) were known from observations at 11 (58%) reserves. Since the little spotted cat or oncilla (*Felis tigrina*) was reported on one of 4 mammal lists, private nature reserves provided habitat for the 6 known felids in the country, all of which are endangered (Sanchez and Quesada 1989).

Two caviomorphs, the agouti (*Dasyprocta punctata*) and paca (*Agouti paca*) were present at nearly all 19 sites; agouti were recorded at 18 sites while 16 reserves reported the presence of paca. The collared peccary (*Tayassu tajacu*) was also present at 16

reserves (84%) while the white-lipped peccary (*Tayassu pecari*) was very uncommon (3/19, 16%). The latter species is endangered in Costa Rica (Sanchez and Quesada 1989) as is the tapir (*Tapirus bairdii*), a species present at 7 of 19 reserves (37%).

An additional 14 species of mammals are listed as endangered species in Costa Rica (Sanchez and Quesada 1989). Nine of these species including the giant anteater (*Myrmecophaga tridactyla*), collared anteater (*Tamandua mexicana*), silky anteater (*Cyclopes didactylus*), two-toed sloth (*Choleopus hoffmani*), three-toed sloth (*Bradypus variegatus*), Deppe's squirrel (*Sciurus deppei*), grison (*Galictis vittata*), southern river otter (*Lutra longicaudus*) and kinkajou (*Potos flavus*) were known to occur at private nature reserves.

Threats to Ecological Integrity: Illegal hunting of wildlife was the most common negative activity reported by reserve managers (Fig. 4). Poaching occurred at 20 reserves (77%) and was considered to be a potential threat at 3 of the other 6 sites. In most cases, paca was the primary species sought by hunters. Ocelot and deer were also hunted at individual reserves.

The extraction or removal of forest products was considered to be a threat at 14 reserves (54%). The cutting of "palmito" or heart of palm was reported as a common problem. The harvest of orchids and cutting of

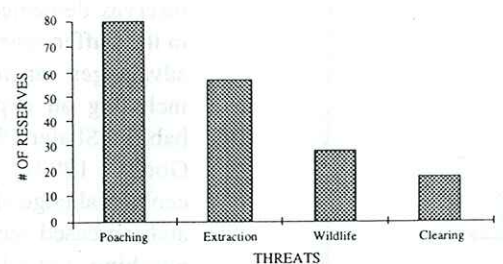


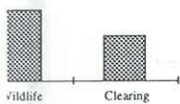
Fig. 4. The frequency of human-caused threats to ecological integrity as reported by reserve owners and managers.

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trees for charcoal production were also noted
as threats to the biodiversity of reserves.

Wildfire was considered a serious threat at
7 reserves (27%). These reserves were located
in regions where extended dry seasons
prevailed and where fires could either escape
from neighbouring lands or result from arson.

Four reserves (15%) had suffered habitat
loss or degradation due to illegal settlement by
squatters. Managers of reserves were generally
confident a combination of vigilance and
community involvement in business operations
would prevent or curtail such invasions.
Similar strategies were also viewed as a means
to reduce illegal hunting and extraction.

Analysis: Individual reserves contribute,
most obviously, to the protection of
biodiversity in Costa Rica by providing habitat
for endangered species. Some of these species
are not well protected in government reserves:
the squirrel monkey occurs at 4 private
reserves but is only present in 2 of the areas
identified by Boza (1993). Similarly, the
scarlet macaw (*Ara macao*) occurs at only 3
protected areas in Costa Rica (Vaughan *et al.*
1991), but inhabits 4 private reserves. By
protecting endangered species and other
species that exist as metapopulations (Wilson
1992), private reserves effectively expand the
conservation efforts of the government and
international organizations.

This effect is readily apparent when
reserves dedicated to ecotourism are located
in the buffer zones of protected areas. Several
advantages can result from this relationship,
including an expanded sphere of protected
habitat (Shafer 1990, Sayer 1991, Imback and
Godoy 1992), a reduction in negative
ecological edge effects (Saunders *et al.* 1991),
and increased security from disturbances like
poaching. Indeed we noted all human threats
to ecological integrity were offset by the
greater vigilance of staff at private reserves as
well as higher levels of community support

for these reserves compared to their
government counterparts.

The collective importance of the reserves
we studied is demonstrated by our assessment
of bird species richness. Despite the availability
of records from only 38% of the reserves, 74%
of the avifauna were reported to occur at these
sites. We believe this remarkable figure reflects
the unique ecological characteristics of
individual reserves and their country-wide
distribution. Furthermore, since riparian zones
and extensively forested areas exist within their
boundaries, we suspect many reserves serve as
biological corridors for migration and
dispersal. The resplendent quetzal
(*Pharomachrus mocinno*), great green macaw
(*Ara ambigua*) and three-wattled bellbird
(*Procnias tricarunculata*) are 3 species that
migrate along elevational gradients (Stiles and
Clark 1989, Stiles and Skutch 1989) and may
reside temporarily at private reserves.

Reserve size and degree of isolation from
other protected areas undoubtedly influenced
the species occurrence of mammals at
individual reserves. The general absence of
jaguar and puma supports the contention by
Terborgh (1992) that neotropical forest
fragments less than 1000 ha in size (85% of our
reserves) will ultimately lose resident
populations of these area-demanding species
(Emmons 1990). If the lack of these keystone
predators leads to a release of prey species that
function as seed predators to decrease the
diversity of forest vegetation (Terborgh 1992),
private reserves are potentially at risk. Only 1
reserve did not report the presence of agouti,
paca or peccary (76% had all 3 species, 90% a
combination of any 2 species) yet only 7
reserves had sightings of jaguar or puma.
Maintaining wide-ranging species at private
reserves will require the regional integration
and management of all types of protected areas.

Private reserves may be located in
ecoregions poorly represented in the
government system and in regions of the

country without existing reserves. We believe their inclusion into the existing network of traditional protected areas is overdue given the continual pressures of economic development in Costa Rica (Hunter 1994). The challenge will be for government managers to design plans that incorporate these areas into the gaps present in the current system (Chaverri 1979, Fournier and Herrera de Fournier 1979, Boza 1993). Land preservation generated by ecotourism can complement efforts by the government to safeguard biological diversity. However, in some cases, especially where reserves are local family-owned businesses, technical support and funding from international conservation organizations may be appropriate to ensure the long-term protection of the biodiversity represented by these often unique parcels of the tropical environment.

We thank the owners and managers of the nature reserves we visited for their hospitality and the many individuals who provided information and personal records on wildlife, especially Giovanni Bello Carranza and Jim Zook. Royal Jackson participated in many of the interviews and we appreciate his assistance. This project was completed while the senior author was on leave from Lethbridge Community College, Alberta, Canada.

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