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Geology and Terrestrial Flora and Fauna of Cayos Cochinos, Honduras*

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Abstract: We conducted brief (3-5 day), preliminary surveys of the geology and terrestrial flora and fauna of Cayos Cochinos, Honduras over a three month period (March-May) in 1995. Our descriptions focused on Cayo Cochino Pequeño which is a fully protected island in the Reserva Biológica Cayos Cochinos, a recently created Honduran national park. Bird and mammal surveys complemented previous studies of the avian, reptile and amphibian vertebrate faunas. The species composition and distribution of plants and insects are described for the first time. The checklist of (160) vascular plant species includes all the common forest plants and a characterization of the different vegetation types. Insect diversity was low on Cayos Cochinos and representatives of nine families were collected. Fifteen species of amphibians (n=2) and reptiles (n=13) have been previously reported on the islands. We noted 43 species of birds on the main islands and adjacent small cays. Two small colonies of Brown Pelicans on Cayo Cochino Pequeño represent the first breeding record for the species on the Caribbean coast of Honduras. A small group of Royal Terns breeding on Cayo Gallina, a sand cay close to Cayo Cochino Pequeño, provide the first confirmation that this species is nesting in Honduras. We collected eight species of mammals and observed two more, one of which is a certain record (*Agouti paca*), while the other (*Marmosa* sp.) requires verification. The six bat species recorded were common at the time of our survey, some with extremely high densities (capture rates) relative to mainland populations. Our report closes with management and research recommendations for Cayos Cochinos.

Key words: Protected area, fauna and flora inventory, neotropics, reptiles, birds, mammals, insects.

The Bay Islands and the nearby Cayos Cochinos (Hog Islands), off the Caribbean coast of Honduras, contain a flora and fauna that is relatively distinct from that found on the adjacent mainland (Monroe 1968, Wilson & Cruz 1993). To protect some of this natural richness, Honduras has recently created a national park, the Reserva Biologica Cayos Cochinos, and is currently in the process of developing management plans for both the terrestrial and marine regions encompassed by the reserve. Here we report the results of a brief terrestrial survey conducted during several one week visits to the islands in March-May, 1995.

The terrestrial portion of the reserve is composed of several small sand cays and two rock-based small islands, Cayo Cochino Pequeño (Little Hog Island) and Cayo Cochino Grande (Big Hog Island) separated by less than 3 km of open water. We use the name Cayos Cochinos to refer collectively to these two

islands and all nearby cays (Fig. 1). At 15°57'N, 86°30'W, the reserve is 20 km north of the Honduras Atlantic Coast and 30 km south of Roatan, the largest Bay Island.

Our terrestrial survey focused on Cayo Cochino Pequeño (CCP) which is fully protected and is the site of the research station (Fig. 1). It is now inhabited only by employees and visitors to the scientific research station. The island has an area of 65 ha and reaches an elevation of 140 m. It is roughly the shape of a boot facing west, with a narrow bootstrap at the north. The station and landing-strip are located at the heel of the boot. There is a principal north-south ridge, with the highest point just north of the island center, and several lesser ridges fanning out to the east and southwest. The slopes are steep but most of the ridgetops are gently rounded. There are three significant areas of stabilized beach. In spite of first appearances, the vegetation is surprisingly complex.

Cayo Cochino Grande (CCG) is the largest island of the Biological Reserve (Fig. 1). This island is 165 ha and reaches an elevation of ca. 142 m. Although we report observations made during one or two day visits to CCG, our survey of CCG was crude in comparison to that of CCP.

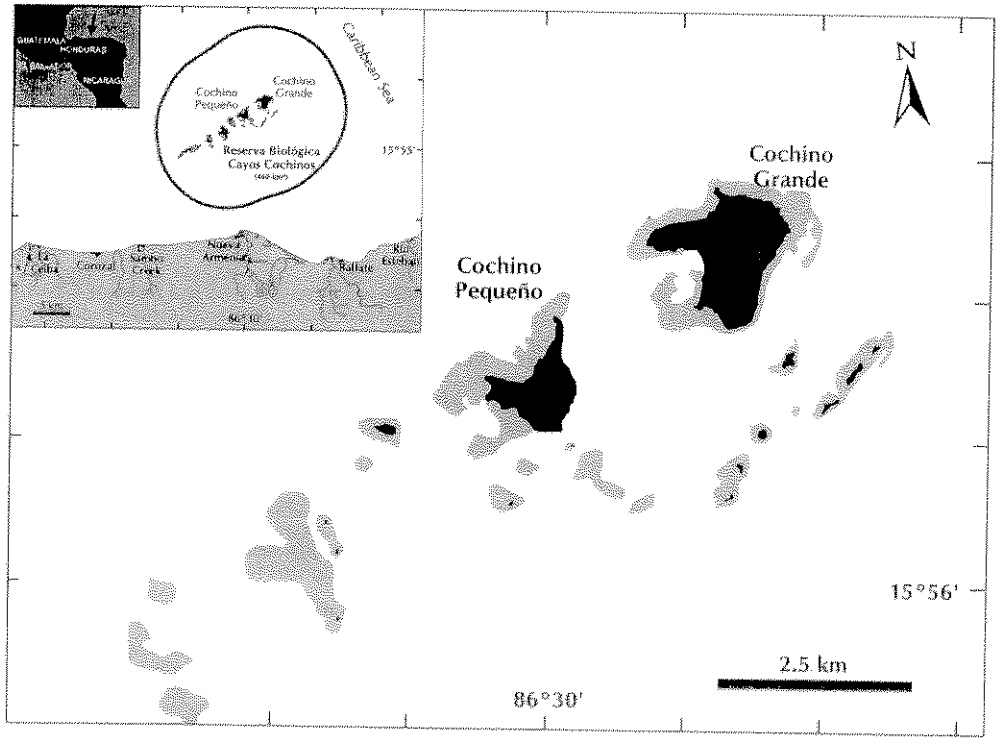

Fig. 1. Cayos Cochinos Biological Reserve, Honduras

Excepting ornithologists and herpetologists, the Bay Islands of Honduras, including Cayos Cochinos, have largely escaped the attention of terrestrial biologists. One hundred and thirty years ago the United States National Museum obtained a mouse opossum from Roatán (catalogued in 1865) later described as a new species, *Marmosa ruatanica* (Goldman 1911). A few years later, G. F. Gaumer collected five species of mammals on Roatán, and one on Bonacca (Thomas 1888); among them the agouti later described by Thomas as an endemic species, *Dasyprocta ruatanica* (Thomas 1901).

This seems to be the entire recorded history of mammalogy on these Islands. No earlier mammal collections have been reported for the Cayos Cochinos group of islands.

The larger Bay Islands have been surveyed by several ornithologists (Salvin 1888-1890, Bond 1936, Monroe 1968, Udvardy *et al.* 1973, Udvardy 1976, Howell & Webb 1992), but only Monroe (1968) has published a list of resident species for Cayos Cochinos. The herpetofauna of Cayos Cochinos has been recently surveyed by Wilson and Cruz (1993).

Geology of Cayos Cochinos
(Anthony Coates)

The Cayos Cochinos, like the larger Bay Islands, are underlain by rocks that have a long, complex, and intensely deformed history (Coates 1997, Donnelly 1992). Their geological origins seem to be related to that of the neighboring mainland, in particular to the Cordillera Nombre de Dios.

The rocks of Cayos Cochinos consist of metamorphic schists and amphibolites. They represent originally marine mud and silt that has been intensely compressed, heated and folded, such that new minerals have recrystallized from the original sedimentary deposits. In the Bay Islands these metamorphic rocks are also intruded by granite and serpentine. The growth of the new minerals has been in alignment with the later compressive forces of metamorphism, replacing the original sedimentary bedding, so that the schists are now highly laminated. Thin dikes have cut these schists, and both have been subsequently ptygmatically folded (*i.e.* extremely contorted).

To understand the origin of the Cayos Cochinos and Bay Island schists, a brief summary of the regional geology is necessary. The Bay Islands lie to the south of a major east-west Transform Fault which runs westward across Guatemala along the Motagua Valley. It separates the Maya Terrane (Peten, Belize, and the Yucatan and Chiapas) from the Chortis Terrane (Honduras, El Salvador and Nicaragua). Relative to the Maya Terrane to the north, the Chortis Terrane is moving eastward and may have moved as much as 1000 km. Both terranes are ancient continental crust and their basement rocks are as old as the Paleozoic (more than 300 Mya.) However, they were each formed far apart geographically and the Paleozoic geological history of each terrane is very different. By the end of the Cretaceous and the Early Tertiary (70-50 Mya), the Chortis block had migrated from the North and West to become "sutured" to the southern margin of the Maya Block. Starting in the Miocene, the two blocks began to move in opposite directions, shearing along the line of the transform fault, as the Caribbean Plate started to override the Atlantic Plate along the volcanic arc of the Lesser Antilles. The fault separating the Chortis and Maya terranes is also the boundary of the North American and Caribbean plates.

The most likely origin for the Cayos Cochinos schists is as an extension of the basement of the Chortis Terrane which is well exposed nearby on the mainland, in the Cordillera Nombre de Dios, where it also consists of metamorphic schists, and amphibolite with marble, intruded by serpentine and granite. Thus, the metamorphic rocks of Cayos Cochinos could be as old as Late Paleozoic. The sequence of events which formed them involves: first, the deposition of marine sediments in the Paleozoic (250 Mya); second, their conversion into metamorphic rocks when the Chortis and Maya Terranes were sutured in the Late Cretaceous-Early Tertiary (70-50 Mya), and, lastly, intense folding and shearing in the Miocene (about 25 Mya) when the Transform Fault became active along the northern margin of the Caribbean Plate.

The Cayos Cochinos and the Bay Islands are topographic high points sticking up from the ancient crystalline basement that underlies the coastal shelf. The islands cannot be more than a few thousand years old, the time since sea level rose to flood the coastal plain following melting of the ice caps. Reefs and their eroded calcareous sediments now mantle the shelf and most of its topographic highs, except in the major islands where examples of the basement schists are still exposed. Quartz boulders are common on the surface of the high islands, and it is likely that the soils are more acidic, with less cation-exchange-capacity, than is typical of most of Central America and Mexico, which are characterized by extensive volcanic and limestone regions.

MATERIALS AND METHODS

Vegetation and flora: The survey of plants was based on a four-day visit (7-11 May 1995) to CCP, during which it was possible to do: 1) a preliminary inventory of the flora (though the collections are mostly sterile); 2) a transect of 150 trees and shrubs in the most diverse and sheltered forest; and 3) a simple characterization of the different kinds of vegetation.

Insects: The survey of the insect fauna was based on four days of collecting on Cayos Cochinos Pequeño (5-9 May 1995), and one day (8 May 1995) on Cayos Cochinos Grande. Collections were made using standard entomological techniques, with well over 500 specimens obtained in 24 lots. One flight intercept trap (FIT) was placed in mixed *Quercus-Bursera* forest near the center of CCP, and another was placed in a *Quercus* forest along the main trail, approximately 1 km from the Biological Station. A double-sized Malaise trap (MT) was placed in mixed forest atop an east-west ridge at the western end of CCP. Black- and white-lights (BL) were used at the edge of the forest near the Station on two nights. Beating of vegetation (BV) and hand-net collecting (HC) were done on both islands, mainly along or near the trails or along the beach. Hand-net collecting focused on bees and wasps (Hymenoptera: Apoidea), and beetles (Coleoptera).

Birds: The ornithological survey was conducted on 5,6 and 7 (a.m.) and 9 (p.m.) May 1995 on CCP; 7 (p.m.) and 8 May on CCG and we explored several nearby cays on 9 (a.m.) May. We also visited the island of Utila, which is not part of the reserve, on 10 (p.m.) and 11 May. We surveyed birds visually and by voice, and focused on landbirds. We used mistnets for a total of 184 net-hours. Pectoral muscle biopsies and blood samples were collected from most of the mist-netted birds. Afterwards the birds were released. These samples are maintained in the STRI tissue collection. Species sequence and taxonomy are those of the American Ornithologists' Union (1983).

Mammals: The Cayos Cochinos were surveyed for mammals from 19 March to 1 April, 1995. We surveyed Roatán from 2-7 April. We trapped for small terrestrial mammals with Sherman, breakback, and Tomahawk traps for 648 trap/nights on CCP and 316 trap/nights on CCG. We set mist nets on 10 nights, 5 nights on each island. We spent one night walking to observe mammals. On Roatán we trapped with Sherman traps for 280 trap/nights, set nets on two nights and caught bats in a cave on one day.

RESULTS AND DISCUSSION

Vegetation and flora of Cayo Cochino Pequeño (Robin Foster)

The checklist of (160) vascular plant species includes, with certainty, all the common forest plants (Table 1). But with every foray into different parts of the island it will be possible to add more rare plants. The herbs on the beaches were not well collected, especially the grasses which were not in reproductive condition at this time. The wet season will probably reveal more ephemeral species and we estimate the total flora has close to 200 species.

Oak forest: Half of the island is covered with evergreen oak forest in which at least 90% of the canopy trees are *Quercus* cf. *oleoides*. This forest dominates all the high ridges and, excepting one embayment close to the station, the entire eastern flank of the island, which faces the strong dry-season winds from April through September. Oak is used in construction, but is considered a very hard and heavy wood, difficult to work. How much the larger *Quercus* trees on this island have been cut out is not clear. The trees appear to be very slow-growing and it is probable that the large trees are several hundred years old. Most of the large trees checked had hollow trunks. The canopy is mostly continuous, and in the few treefall gaps that can be found, *Bursera simarouba*, *Simarouba glauca*, *Byrsonima* and *Miconia* are the trees usually colonizing the small patches.

TABLE 1
List of vascular plant species found on Cayo Cochino Pequeño, Honduras.

Family Name	Genus/Species Name	Spanish Common Name	Plant type	Habitat type	Dispersal Mode[1]	Frequency[2]
Amaryllidaceae	*Crinum cf.*	Lirio	grass	beach	W	O
Anacardiaceae	*Mangifera indica**	Mango	tree			
	Spondias mombin		tree	lower slope	MLB	R
Annonaceae	*Annona glabra*	Anona	shrub/tree	beach	W	O
Apocynaceae	*Catharanthus roseus cf.**		grass/shrub			
Araliaceae	*Schefflera morototoni*		tree	slope	BSM	R
Arecaceae (Palmae)	*Bactris*	Biscoyol	shrub	lower slope	MLB	R
	*Cocos nucifera**		tree	beach	W	
	Thrinax radiata	Tique	shrub	beach/slope	BSM	F
	Acoeloraphe wrightii	Tique Cafe	shrub	slope		R
Asteraceae (Compositae)	*Ageratum cf.*		grass	beach	WD	F
	Mikania		vine/grass	beach	WD	O
	Vernonia	Añil	grass/shrub/vine	beach	WD	O
	Wedelia	Comida Cangrejo	grass	beach	W	A
	Asteraceae *#5*		grass/shrub	lower slope/rock outcrop	WD	O
	Asteraceae *#6*		grass	lower slope/rock outcrop	WD	F
	Asteraceae *#7*		grass	beach	WD	R
Bignoniaceae	Bignoniaceae*#1*		vine	upper slope	WD	R
	Bignoniaceae#		vine	slope	WD	A
Bombacaceae	*Pachira cf.*	Sapoton	tree	lower slope	W	R
Boraginaceae	*Cordia sebestena*		shrub/tree	beach	W	O
	Cordia #2	Sombre Ternero	tree	beach/lower slope	BSM	O
	Tournefortia		vine	lower slope	BSM	O
Brassicaceae (Cruciferae)	*Cakile lanceolata*		grass	beach	W	O
Bromeliaceae	*Tillandsia*	Piñuela	epiphyte	slope	WD	D
Burseraceae	*Bursera simaruba*	Palo Calato	tree	slope	BSM	D
Cactaceae	*Cactaceae#1*		grass	rock outcrop		R
Capparidaceae	*Capparis frondosa*	Hoja Ancha	shrub	lower slope	BSM	F
Caricaceae	*Carica papaya**	Papaya	shrub			
Celastraceae	*Maytenus cf.*		shrub/tree	slope		R
Chrysobalanaceae	*Chrysobalanus icaco*	Icaco	shrub	beach	W	O
	Hirtella racemtosa	Pasa	shrub/tree	slope	BB	F
	Licania hypoleuca		tree	slope	MLB	R
Clusiaceae (Guttiferae)	*Clusia*	Higuera Falsa/Matapalo	epiphyte/tree	slope/beach/rock outcrop	BSM	O
Combretaceae	*Conocarpus erectus*	Mangle Boton	tree	beach	W	F
	Laguncularia racemosa	Mangle Blanco	tree	beach	W	O
	Terminalia catappa	Almendra	tree	beach	W	O
Connaraceae	*Cnestidium rufescens*		vine	slope	BSM	O
	Connarus	Cansa Mulata	shrub/vine	slope	BSM	D

	Rourea				
Convolvulaceae	*Ipomoea pescaprae*	Cansa Mulata	shrub/vine	lower slope	BSM	F
Cyperaceae	*Cyperus#1*		grass/vine	beach	W	F
	Cyperus#2		grass	slope		R
			grass	lower slope/ beach		O
	Cyperaceae#3		grass	beach		O
	Cyperaceae#4	Navajuelo	grass	slope		D
Erythroxylaceae	*Erythroxylum*		shrub	lower slope	BSM	F
Euphorbiaceae	*Alchornea latifolia*		tree	upper slope	BSM	R
	Chamaesyce hirta		grass	beach		O
	Chamaesyce #2	Quita Mesquino	grass	beach		F
	Chamaesyce #3		grass	beach		O
	Croton#1		shrub/tree	slope/beach	EX	A
	Croton#2		grass	beach		R
	Euphorbia		grass	beach		F
	Phyllanthus	Pelotillas	grass	beach		R
	Euphorbiaceae#9	Yema de Huevo	tree	slope		O
Fabaceae-Caesalpinoid	*Delonix regia**		tree			
	Peltogyne	Paleto	tree	lower slope	W	R
	*Tamarindus indica**		tree			
Fabaceae-Papilionoid	*Andira inermis*	Almendro de Monte	tree	slope/beach	BB	A
	Canavalia	Frijol de Playa	vine	beach	W	A
	Crotalaria#1	Campanita	grass	beach		O
	Crotalaria#2		grass	beach		O
	Dalbergia#1		vine	beach	W	O
	Dalbergia#2	Bejuco Playa	vine	beach	W	A
	Desmodium		grass	beach		R
	*Gliricidia sepium**	Madreado	tree			
	Lonchocarpus cf.		vine	slope	WD	O
	Machaerium	Uña Guara	vine	upper slope	WD	O
	Sophora cf	Frijolillo	shrub/tree	beach		R
	Swartzia simplex	Hueso Cajuamo	shrub	lower slope	BSM	R
	Swartzia#2	Roble	tree	slope	BSM	O
Fabaceae-Mimosoid	*Calliandra*	Ocalito	shrub	slope	EX	D
	Entada monostachya cf		vine	lower slope	W	O
	Mimosa		grass	beach		O
	Pithecellobium#1	Ojo Negro	shrub/tree	lower slope	BSM	F
	Pithecellobium#2		tree	lower slope		R
Fagaceae	*Quercus oleoides cf*	Encino	tree	slope	MLB	D
	Quercus	Encino	tree	slope	MLB	R
Flacourtiaceae	*Casearia aculeata*	Escambron	tree/shrub	lower slope	BSM	A
	Casearia#2	Escambron Falso	shrub	upper slope	BSM	F
	Casearia#3	Cafecillo	shrub	lower slope	BSM	A
	Xylosma		shrub	lower slope	BSM	F
Hippocrateaceae	*Salacia cf*	Cama Cama	vine	slope	MLB	O
Hydrocharitaceae	*Thalassia testudinum*		grass	beach	W	A

Lamiaceae (Labiatae)	*Russelia cf.*		grass	beach		O
	Lamiaceae#2	Barriono	grass	beach		F
Lauraceae	*Cassytha filiformis*	Bejuco Redes	parasite/grass/vine	beach	BSM	F
	Lauraceae#2	Aguacatillo	tree	slope	BSM	R
	Lauraceae#3	Aguacatillo	tree	slope	BSM	O
Malpighiaceae	*Byrsonima crassifolia*	Nance	shrub/tree	lower slope/rock outcrop	BSM	O
	Byrsonima#2	Nance	tree/shrub	beach	BSM	A
	Byrsonima#3	Nance	tree	lower slope	BSM	R
	Hiraea reclinata		vine	lower slope/beach	WD	O
	Malpighiaceae#5		vine	lower slope/beach	WD	O
Malvaceae	*Hibiscus pernambucensis*		shrub/tree	beach	W	F
	Pavonia		grass	beach		O
	Sida	Malva	grass	beach		O
	Thespesia populnea		shrub/tree	beach	W	A
Melastomataceae	*Miconia#1*		shrub	beach	BSM	O
	Miconia#2		shrub/tree	upper slope	BSM	O
	Miconia#3		shrub	lower slope	BSM	R
	Mouriri myrtilloides	Machin Plomo	shrub	slope	BSM	F
Moraceae	*Artocarpus altilis**	Pan de Arbol	tree			
	Ficus	Mato Palo	epiphyte/tree	lower slope	BSM	O
Musaceae	*Musa*		grass	beach		R
Myrtaceae	*Calyptranthes*		shrub	lower slope/beach	BSM	F
	Eugenia#1		shrub	lower slope/beach	BSM	F
	Eugenia#2		shrub	upper slope	BSM	O
	Eugenia#3	Guayabillo	shrub	slope	BSM	F
	Myrcia cf.		shrub	lower slope	BSM	R
	*Psidium guajava**		shrub/tree	beach	BB	
Nyctaginaceae	*Boerhaavia*		grass	beach		O
	Neea		shrub	lower slope	BSM	O
Ochnaceae	*Ouratea*		shrub	slope	BSM	A
Olacaceae	*Ximenia cf.*		shrub	beach		R
Orchidaceae	*Schomburgkia cf.*	Orchidia Rosada	epiphyte	beach/slope	WD	A
	Orchidaceae#2		epiphyte	slope/rock outcrop	WD	R
Passifloraceae	*Passiflora auriculata cf*		vine	beach/lower slope	BB	O
	Passiflora#2		vine	beach	BB	R
Piperaceae	*Piper*		vine	beach/lower slope	BB	O
Poaceae (Gramineae)	*Andropogon*	Cola Venado	grass	beach/lower slope	WD	O
	Cenchrus		grass	beach		F
	Dactylis cf.		grass	beach	WD	O
	Lasiacis	Carisso	grass/vine	upper slope	WD	O
	Panicum	Pelo Indio	grass	beach	WD	O
	Panicum		grass	beach	WD	O
	Poaceae#7	Gramalote	grass	beach	WD	F

Polygonaceae	Poaceae#8	Grama	grass	beach	WD	O
	Coccoloba uvifera		tree/shrub	beach	W	A
	Coccoloba#2	Uva de Monte	tree/shrub	beach/slope	BSM	D
Portulacaceae	*Potulaca*	Carne de Perro	grass	beach		O
Proteaceae	*Roupala montana*	Carne Enfatada	tree	slope		O
Pteridophyta	*Acrostichum*		grass	beach	WD	O
	Lygodium		vine	slope	WD	R
	Polypodium	Cucaracha	vine/epiphyte	slope/rock outcrop	WD	R
Rhamnaceae	Rhamnaceae#1		tree/shrub	beach	BSM	O
Rhizophoraceae	*Cassipourea elliptica*	Cuero de Toro	shrub/tree	lower slope/beach	BSM	O
	Rhizophora mangle	Mangle Rojo	tree/shrub	beach	W	O
Rubiaceae	*Alibertia edulis*	Cacho de Venado	shrub/tree	slope/beach	BB	A
	Amaioua corymbosa		shrub/tree	slope	BSM	F
	Chiococca cf.		vine	beach/lower slope		R
	Hamelia patens		shrub/tree	beach	BSM	R
	Morinda citrifolia		shrub	beach	W	R
	Psychotria	Familia Cafe	shrub	lower slope	BSM	F
	Spermacoce		grass	beach	W	R
	Rubiaceae#8		shrub	lower slope	BSM	R
	Rubiaceae#9		shrub	slope	BSM	R
Rutaceae	*Citrus aurantium**		shrub			
	*Citrus#2**		shrub			
Sapindaceae	*Cupania*	Carbon	shrub/tree	slope	BSM	A
	Dodonaea viscosa		shrub	rock outcrop	WD	R
	Matayba	Botoncillo	tree	slope	BSM	O
	Paullinia cf.	Bejuco	vine	beach/lower slope	BSM	O
Sapotaceae	*Manilkara**	Nispero	tree			
	Pouteria#1	Naraco	tree/shrub	slope	MLB	F
	Pouteria#2	Lechoso	tree	slope	MLB	O
Scrophulariaceae	Scrophulariaceae#1	Carejo	grass	beach		O
Simaroubaceae	Simaroubaceae#1	Negrito	tree	slope/beach	BSM	F
Smilacaceae	*Smilax*		vine	slope	BSM	R
Tiliaceae	*Luehea speciosa cf.*	Calote	tree	upper slope	WD	R
Ulmaceae	*Trema micrantha cf.*		tree/shrub	beach	BSM	R
Verbenaceae	*Lantana camara*		shrub/grass	beach	BSM	O
	Lippia		grass	beach	W	F
	Stachytarpheta jamaicensis cf.		grass	beach		O

* Cultivated

[6] Dispersal Codes:

MLB = mammal and large bird dispersed
BB = bat and bird dispersed
BSM = bird and small mammal dispersed
EX = explosiveley dispersed
W = water dispersed
WD = wind dispersed

[7] Frequency Codes:

A = abundant
D = dominant
F = frequent
O = occasional
R = rare

The stature of the oak forests and the diversity of plant species in the understory varies dramatically. On one extreme are stunted wind-swept forests composed of nothing but *Quercus* with a 5-10m canopy and an empty understory. The understory is devoid of even juvenile oaks and only basal sprouts are encountered. It is not clear the oaks in wind-swept forest reach reproductive size. On the other extreme are semi-sheltered ridgetops with 35m tall *Quercus* mixed with a few other canopy species and a moderate diversity of understory shrubs, and herbs.

The range of differences observed in the oak forests of CCP seems best explained by differences in water availability in the dry season. Areas with deeper soil and less exposure to wind are the least likely to suffer major drought-stress and seem to be characterized by greater diversity and larger trees. It is also possible that the mainly tilted angle of the underlying rock strata determines the underground drainage and availability of water.

An alternative explanation is that the differences result from historical variation in burning. According to a second-hand source (J.F. Solis, pers. comm.), the last fire was about 30-40 years ago and continued to burn on the island for 9 months. Since the severity of burns is often related to water availability, and, in turn, affects the degree of soil erosion; it might be difficult to untangle the effects of fire from the effects of water stress. Many of the larger oaks show signs of fire damage, and many of the smaller ones seem to be stump-sprouts from larger trees, now dead.

The commonest shrubs in tall *Quercus* forest are all bird-dispersed: *Calliandra* (Fabaceae-Mimosoid), -with explosively-dispersed seed,- often in extensive shrubby stands; *Connarus* (Connaraceae) and frequently, *Alibertia edulis* (Rubiaceae), *Cupania* (Sapindaceae) and *Ouratea* (Ochnaceae). Scattered on the ground are clumps of a long-leaved Cyperaceae, usually the only herb in these forests.

Most of the oak trees have one or a few epiphytes of a large *Tillandsia* (Bromeliaceae) species on the trunk or upper branches, and in open areas, pseudobulb clusters of a large orchid (*Schomburgkia*?). The widespread *Tillandsia* has a large, skinny-branched, red inflorescence with white tubular flowers visited by hummingbirds. The phenology seems to be highly asynchronous, with inflorescences in all stages of development and senescence. This suggests that *Tillandsia* is a stable nectar source for much of the year. When growing near the ground, their inflorescences are subject to heavy attack by *"soldados"*, the large hermit-crabs seen even on the highest parts of the island.

Mature mixed forest: A tall mixed forest, 30-35m with relatively little oak, is found only on a few parts of CCP on the sheltered slopes and in hollows with deep soils on the lee side of the upper ridge and in the less accessible ravines on the southwest side of the island. The canopy is comprised mostly of evergreen species. We most commonly encountered two species of *Pouteria* (Sapotaceae), *Simarouba glauca* (Simaroubaceae), a *Swartzia* (Fabaceae-Faboid), and *Luehea* cf. *speciosa* (Tiliaceae). Common understory trees are *Roupala montana* (Proteaceae), *Alchornea latifolia* (Euphorbiaceae), *Mouriri myrtilloides* (Melastomataceae), *Cassipourea elliptica* (Rhizophoraceae), and *Amaioua corymbosa* (Rubiaceae). Common shrubs are *Hirtella racemosa* (Chrysobalanaceae), the same *Mouriri*, and *Alibertia edulis* (Rubiaceae). Conspicuous among the few lianas are a Hippocrateaceae with a large edible fruit, a *Machaerium* (Fabaceae-Papilionoid) and a Bignoniaceae.

The mixed forest appears to be at least 100 to 200 years old and could be much older. The fast-growing tree species are mostly the same ones that occur in the rare gaps in the oak forest. The deep soils and shelter from the wind apparently give the canopy species here a competitive advantage over the *Quercus*. Perhaps at one time, if there was less frequent burning and better soil development in what are now nearly pure *Quercus* forests, these species would have been more frequent on the east side of the island, especially on the lower slopes.

A transect sample of 150 trees and shrubs greater than 1cm diameter in the mixed forest revealed 30 species (Table 2). This represents a fairly high forest diversity for a small island, and is considerably higher that what was found in the *Quercus*-dominated forests. These are the most vulnerable forests to human clearing and, thus, the mixed forest remains intact only in the least accessible places on the island.

TABLE 2

Abundance of 30 species among 50 individuals in each of 3 diameter size classes (A,B,C) of trees and shrubs found in transects of mixed mature forest on Cayo Cochino Pequeño, Honduras.

Family Name	Genus/Species Name	A	B	C
Araliaceae	*Schefflera morototoni*	1		
Chrysobalanaceae	*Hirtella racemosa*			11
	Licania hypoleuca	1	1	
Euphorbiaceae	*Alchornea latifolia*		6	
	Drypetes cf.		1	
	sp#9	6	3	
Fabaceae-Papilionoid	*Swartzia sp#2*	6	1	
Fabaceae-Mimosid	*Calliandra*			4
	Pithecellobium			1
Fagaceae	*Quercus oleoides cf.*	7		
Flacourtiaceae	*Casearia*			1
Lauraceae	*Nectandra*			3
Malpighiaceae	*Byrsonima*	1		
Melastomataceae	*Mouriri myrtilloides*		6	9
	Miconia		1	1
Myrtaceae	*sp#1*		2	
	sp#2		1	2
Moraceae	*Ficus perforata cf.*	2		
Ochnaceae	*Ouratea*		1	
Polygonaceae	*Coccoloba*		1	
Proteaceae	*Roupala montana*	1	5	
Rhizophoraceae	*Cassipourea elliptica*		3	3
Rubiaceae	*Amaioua corymbosa*		3	2
Rubiaceae	*Alibertia edulis*			5
Sapindaceae	*Cupania*		3	1
Sapotaceae	*Pouteria sp#1*	8	8	6
	Pouteria sp#2	3	2	1
Simaroubaceae	*Simarouba glauca*	10	1	
Tiliaceae	*Luehea speciosa cf*	6	1	
TOTAL #SPECIES		12	19	14

A # of stems >30 cm. diam. at 1.3 m height (Area: 20 x 334 m = 6680 m^2)

B #of stems between 10 and 30 cm diam. at 1.3 m height (Area: 20 x 100 m = 2000 m^2)

C #of stems between 1 and 10 cm. diam. at 1.3 m height (Area:2 x 140 m = 280 m^2)

Mixed secondary forest: A young forest, mostly 10-30m tall, occupies a large section of the island on the northwest slope, from the edge of the ridge down to near the shore. Patches of this kind of forest are also found on the lower slopes near the shore on various parts of the island. The characteristic tree is *Bursera simarouba* (Burseraceae), which is deciduous (losing its leaves in April and May) but, during the dry period, continues to photosynthesize under its shiny red bark. Mixed with *Bursera*, and sometimes without it, are several other relatively fast-growing tree species, especially a *Byrsonima* (Malpighiaceae), a *Croton* (Euphorbiaceae), a *Coccoloba* (Polygonaceae), a *Miconia* (Melastomataceae) and small *Simarouba glauca*. In the understory there is considerable patchiness, but an abundance of several species of Myrtaceae, a *Casearia* and a *Xylosma* (Flacourtiaceae), an *Erythroxylum* (Erythroxylaceae), a *Pithecellobium* (Fabaceae-Mimosoid) and *Alibertia edulis* which, like *Simarouba*, seems to show up everywhere on the island. Frequent understory herbs are a *Lasiacis* (Poaceae) and a *Lygodium* (Pteridophyta). Throughout this young forest are occasional small individuals of species more conspicuous in the mature mixed forest.

Judging from the large size of the *Bursera*, we estimate these forest to be mostly 50-100 years old. They are generally growing on soils that are shallower than those of the mature mixed forests. It seems likely that parts of the island with mixed secondary forests were once like the mature mixed forests and were cleared and cultivated or otherwise severely disturbed. The subsequent degradation of the soils has allowed a regeneration of the forest that is different from the original, *e.g.* much more abundant in *Bursera*. This species is well-adapted to shallow soils subject to extreme drought and is frequently found colonizing the few gaps in the oak forest but only rarely in the mature mixed forest. Unlike *Quercus*, however, *Bursera* does not tolerate shade. A prediction for the future of this secondary forest is that, as it ages, it will gradually be invaded and taken over -in a couple-hundred years- by *Quercus*, though mixed with more tree species than the eastern slope.

Recent regeneration: A younger stage in the regeneration of mixed secondary forest is found mainly on two areas near the sttion:one on the lower slopes of the embayment east of the landing strip; and the other northwest of the station beyond the first ridge/slope. This dense scrubby vegetation, with gaps of herbaceous vegetation on the areas most devoid of soil, is only 3-10m tall, but has a plant composition already very similar to the older mixed secondary forest. Understory species of the mature mixed forest are common here and may be stump sprouts from the original vegetation. These plants are now growing in bright sun on impoverished soils and, perhaps for this reason, are usually sickly, with chlorotic leaves.

Regenerating areas were only briefly visited and different segments seemed to be of different ages. Most of these clearings were probably abandoned between 5 and 30 years ago. Elsewhere on CCP, many of the herbaceous species in regenerating areas are found only on rocky outcrops.

Back-beach forest: The flat back-beaches of all three major beaches on the island have probably been considerably disturbed. The large back-beach near the station and landing strip has been largely cleared or replaced with cultivated fruit trees. The other two back-beaches do not have cultivated plants but have suffered almost complete removal of the larger *Thrinax radiata* palms (J. F. Solis, pers. comm.) and only small palms remain. *Thrinax* is found scattered throughout the island but is very common only on the back beaches. There is also a high frequency of juvenile *Andira inermis* (Fabaceae-Papilionoid), a species of large tree that has been selectively removed for many years because it is much appreciated locally for lumber (J. F. Solis, pers. comm.). *Andira* may have been much more common throughout the mixed forest, though juveniles are more evident on the back-beach.

The rest of what remains of the stable beach forest is made up of scattered individuals representative of secondary and mature mixed forests, along with several pan-tropical species of beach trees. The forest trees here, at least in the sheltered areas, do not seem greatly affected by salt spray, and the alluvium from the slopes mixed with the sand seems to provide a productive soil for trees. The north beach on the island's narrow bootstrap is exposed to wind and waves blowing across it and the vegetation here consists mostly of shrubby, widespread beach species. We observed *Dalbergia* (Fabaceae-Faboid.), dense stands of the button mangrove,

Conocarpus erectus (Combretaceae), around the swampy areas and *Acrostichum aureum* (Pteridophyta), the mangrove fern.

Beach margin: The beach community has a typical, if disturbed, mix of the usual pantropical or widespread trees, vines, and herbs. Common trees are: *Cocos nucifera* (Arecaceae), *Coccoloba uvifera* (Polygonaceae), *Terminalia catappa* (Combretaceae), *Hibiscus pernambucensis* and *Thespesia populnea* (Malvaceae), and occasional *Dalbergia* and *Cordia sebestena* (Boraginaceae) and *Morinda citrifolia* (Rubiaceae). Common herbs include: the semi-succulent *Ipomoea pescaprae* (Convolulaceae), *Canavalia* (Fabaceae-Papilio-noid), *Wedelia* (Asteraceae), the spiny-fruited *Cenchrus* (Poaceae) and a small *Euphorbia* (Euphorbiaceae). On the beaches of the heel of the island are many more weedy herb species mixed in with the normal beach species.

Rock outcrop vegetation: Bare rock is exposed occasionally on a few cliffs and recently cleared areas, but most commonly above the shore-line. A few species seem specifically adapted to this habitat such as a *Polypodium* (Pteridophyta) and a small orchid. Others seem to take advantage of the reduced competition, such as a common Asteraceae, and epiphytes, such as the common *Tillandsia* and *Schomburgkia* and the large, succulent-leaved *Clusia* (Clusiaceae) which otherwise grows as hemi-epiphytic treelet from the tops of large trees. On the small rock hill at the tip of the bootstrap is a scattered population of a small, barrel cactus.

Biogeography: It would be premature to conclude much about the distribution of the forest species without complete identification, and without an inventory of the Bay Islands. The distribution of the flora of the Honduran mainland itself is poorly documented thus rendering weak arguments regarding the origin of the flora.

Not surprisingly, the plants so far identified to species level are mostly widespread species, many reaching as far south as Bolivia. The flora is clearly one adapted to strong seasonality (i.e. severe drought), and probably has little in common with the forest of the adjacent wet coast of mainland Central America. Much of the dry part of northern Mesoamerica, *e.g.* the Petén or Yucatán, is on more alkaline limestone soils rather than the apparently acidic soils of the Cochinos. Nevertheless, *Quercus oleifera* (if identified correctly) is characteristic of seasonal lowlands on more alkaline soils, such as near Flores in the Petén and as far south as Santa Rosa National Park of Guanacaste, Costa Rica.

Most of the woody plants of the forest are known to be bird-dispersed (see Table 1), as expected. But the explosive-dispersal of the dominant understory plant, *Calliandra*, presents a puzzle regarding its arrival on CCP, as do the large fruits of *Pouteria* and the liana in the Hippocrateaceae.

Rare species: Many species were seen only once or twice on the island, usually in small clumps. This is expected among the weedy plants on disturbed beach areas frequently subjected to species invading with the arrival of people and cargo (a process now greatly accelerated). The distribution of rare forest plants, however, is more perplexing. If competition from other species is low, as on most islands, why don't these species spread across appropriate island habitat?

A few examples of rare forest species follow: *Spondias mombin* (Anacardiaceae) and *Schefflera morototoni* (Araliaceae), both are widespread second-growth species elsewhere but they were seen only once on CCP; *Swartzia simplex* (Fabacea-Faboid.) and *Neea* (Nyctaginaceae), are common in the understory of seasonal forest on the mainland, but were observed in only one small clump. Finally, a second species of *Quercus* (often with serrate leaves that are whitish below) was seen only in small clumps in stunted forest at the northern and southern extremes of the main ridge.

Some likely explanations for the rarity of these taxa are: 1) the habitats are really not appropriate and the dominant species are better adapted; 2) they are recent invaders and have not yet expanded; 3) the taxa experience problems reproducing and will never expand without the arrival of more individuals of the same species or the appropriate pollinator; 4) they were more abundant or widespread but fire, clearing, or selective removal has reduced population size.

Colonization by plant species is more probable if invading species can establish without competition. Thus, one might predict increased

numbers of plant species on Cayo Cochino Grande than on the smaller CCP. This may be true because not only CCG is twice as large but because the frequency and extent of clearing by humans is greater on the bigger island. Data to test this hypothesis are not available.

Insects (Richard Leschen & William Wcislo)

Insect diversity was low on Cayos Cochinos. Insect fauna includes representatives of Collembola, Coleoptera, Hymenoptera, Diptera, Isoptera, Homoptera, Hemiptera, Orthoptera, and Lepidoptera. We focused on apoid aculeate Hymenoptera and Coleoptera.

The highest diversity of beetles were taken by flight intercept traps and from vegetation (Table 3). The most abundant beetles were lagriine Tenebrionidae, Anobiidae, eumolpine Chrysomelidae, and scymnine Coccinelidae. Beetle diversity was higher in the mixed forest than in the *Quercus*-dominated forest, presumably because the former had more niches for phytophagous species. A spotted *Ptinus* sp. (Anobiidae) was very abundant on leaf surfaces in the mixed forest, and *Neomida* sp. (Tenebrionidae) and *Byrrhodes* sp. (Anobiidae) were also abundant in two species of a polypore fungus (Basidiomycetes) growing on *Quercus* trees.

TABLE 3
Preliminary checklist of Coleoptera and apoid Hymenoptera on Cayo Cochino Pequeño (CCP) and Cayo Cochino Grande (CCG), Honduras.

Order/Family Name	Family/Genus Name	C C P	C C G[1]
Coleoptera			
Staphylinidae	Aleocharinae	X	X
	Belonuchus	X	
	Pselaphinae	X	
Elateridae	*Pyrophorus*	X	
	Elateridae	X	X
Bostrichoidea	*Ptinus*	X	
	Byrrhodes	X	
	Darcotominae	X	X
Coccinellidae	Scymnini	X	X
Corticariidae	Corticariinae	X	
Tenebrionoidea	*Ceracis* sp. 1	X	
	Ceracis sp. 2	X	
	Neomida sp. 1	X	
	Mordellidae	X	X
	Mordellidae	X	X
	Lagriinae	X	
	Phaleria sp. 1	X	
	Phaleria sp. 2	X	
Chrysomeloidea	*Euberia* sp. 1	X	
	Cerambycidae	X	X
	Lamiinae	X	
	Eumolpinae	X	

Curculionoidea	Anthribidae	X	
	Curculionidae	X	X
Hymenoptera			
Halictidae	*Dialictus* sp. 1	X	X
	Dialictus sp. 2	X	
Apidae	Centris	X	
	Trigonisca	X	
	Apis mellifera	X	X
Nyssonidae	*Stictia heros*	X	X

[1] We did not use a flight intercept trap nor a Malaise trap on Cayos Cochinos Grande. The absence of taxa on the larger island probably reflects sampling bias, and does not have biological significance.

Only 4 species of native bees, plus the domestic honey bee (*Apis mellifera*), were collected during our survey (Table 3). By comparison, on the larger island of Utila, at least 11 native bee species were observed in several hours on one day. One species of a very tiny stingless bee (*Trigonisca*, Meliponini) occurs on Cayos Cochinos, but these bees were not common. Honey bees were seen only in the beach area around the laboratory and residents' buildings. Two species of *Lasioglossum (Dialictus)* were collected in the open areas surrounding the airfield on CCP. Five individuals of these species were dissected. All had very worn wings, worn mandibles, and slender, undeveloped ovaries, suggesting that they were workers of a social species. Both *L. (Dialictus)* species are probably new, since they differ from descriptions of mainland species described by Cockerell (1949) and from individuals from an excellent collection of West Indian bees housed at Cornell University.

Solitary wasps that typically are abundant in xeric areas (*e.g.*, Sphecidae and Pompilidae) were also notably rare on Cayos Cochinos, yet again there were at least 8 species of sphecid wasps and at least 6 species of pompilid wasps on Utila. Three nests of a solitary wasp, *Stictia heros*, were excavated, and they did not differ noticeably from those described by Sheehan (1984) from Costa Rica. We saw no social wasps (Vespidae) on Cayos Cochinos, although we saw fragments of a nest (apparently *Polistes*) on one of the buildings.

The low diversity of insects on Cayos Cochinos is probably not entirely an artifact of the brief collecting. For example, more bee species were seen during a brief walk across the nearby island of Utila than during the entire stay at Cayos Cochinos. There are more than 200 species of bees known from mainland Honduras (Cockerell 1949). Flight intercept traps typically collect diverse beetle families in a short period of time (*e.g.*, Peck 1989), but they yielded only 15 families of Coleoptera from Cayos Cochinos. Likewise, Malaise traps frequently capture large numbers of Hymenoptera (*e.g.*, Noyes 1989), but we captured representatives from only 4 families (Formicidae, Ichneumonidae, Braconidae, and Chalcidae).

That the bee fauna of Cayos Cochinos was depauperate at this time of year was not surprising, because bee activity is synchronized with the blooming phenology of plants (*e.g.*, Heithaus 1979). Stingless bees are an important component of the mainland bee fauna, but are almost completely absent from Cayos Cochinos, as is true for the modern Caribbean fauna (Camargo *et al.* 1988), presumably because they are poor at crossing water gaps (*e.g.*, Kerr & Maule 1964).

The richness of an insect fauna often has a positive relationship with the diversity of the flora (*e.g.*, Strong *et al.* 1984). Thus, we do not expect Cayos Cochinos to have an especially diverse fauna when the islands are thoroughly collected. We spent a very brief time on the islands at the end of a long dry season when, based on other surveys (*e.g.*, Wolda & Wong 1988), insect diversity is expected to be lowest. Furthermore, the previous wet season was unusually dry (H. Guzman, pers. comm.), so diversity was probably lower than normal.

We used only a limited number of techniques, further biasing our sample, and we did not sample the canopy at all. Our preliminary survey is also hampered by the scarcity of qualified taxonomists and Honduran reference collections (see O'Brien & Ward 1987). We encourage interested taxonomists to obtain the unidentified material from the Snow Entomological Museum, University of Kansas (Coleoptera) or the Smithsonian Tropical Research Institute (other orders).

Herpetofauna (Gustavo Cruz D.)

Readers are directed to the recently published "Herpetofauna of the Cayos Cochinos, Honduras" (Wilson & Cruz 1993) for a description and discussion of the 15 species of amphibians (n=2) and reptiles (n=13) found on the islands. Table 4 in this publication provides a list of the Cayos Cochinos herpetofauna compiled from Wilson and Cruz (1993).

TABLE 4

Herpetofauna collected, observed, or reported on Cayo Cochino Pequeño (CCP) Cayo Cochino Grande (CCG) the Bay Islands (BI) and Nombre de Dios (ND) Honduras. Habitats listed for Cayos Cochinos only. Compiled from Wilson and Cruz (1993).

Name	C C P	C C G	BI	N D
Leptodactylus melanonotus		X[1C]	X[4]	X[4]
Smilisca baudinii	X[1H]		X[4]	X[4]
Kinosternon leucostomum		X[1C]		X[4]
Trachemys scripta		X[3C]	X[4]	X[2]
Anolis allisoni	X[1H/C]	X[1H/C]	X[4]	
Basiliscus vittatus		X[2H/M]	X[4]	X[4]
Cnemidophorus lemniscatus	X[3C]		X[4]	X[4]
Ctenosaura palearis	X[2H/R]	X[1H/R]		
Norops lemurinus	X[1H]	X[1H]	X[4]	X[4]
Phyllodactylus palmeus		X[1H/C]	X[4]	
Boa constrictor	X[4H]	X[3H]	X[4]	X[4]
Coniophanes imperialis	X[1H]			X[4]
Dryadophis melanolomus	X[1H/C]	X[1H/C]	X[4]	X[4]
Leptotyphlops goudotii		X[1H]	X[4]	X[4]
Oxybelis aeneus		X[1H]	X[4]	X[4]

[1] Collected
[2] Observed
[3] Collected and Observed
[4] Reported

[H] Hill Forest
[C] Coconut Grove
[M] Mangrove
[R] Rocky Promontory

Birds (Gilles Seutin, Sherry Thorn & Eldredge Bermingham)

We noted 34 species on Isla Cochino Pequeño, 24 on Isla Cochino Grande, and 23 on the adjacent small cays, for a total of 43 species (Table 5). Most observations were visual or acoustic, but we also captured with mist-nets 116 individuals representing 24 species. Below, we describe the various elements of the avifauna of the Cayos Cochinos separately. More detailed observations have been reported by Seutin *et al.* (in press), including a list and a discussion of the species we observed on Utila.

Resident seabirds: We recorded the breeding of two seabirds within the park limits. Two small colonies of Brown Pelicans were located on the north side of CCP, providing the first breeding record of that species on the Caribbean coast of Honduras. A small group of Royal Terns is breeding on Cayo Gallina, a sand cay close to CCP. This is the first confirmation that this species is nesting in Honduras. We noticed several hundred Magnificent Frigatebirds gathering at roosts in the late afternoons, but failed to record indications of breeding. We also observed probable Roseate Terns that breed outside the park limits on Sandy Cay near Utila (Udvardy *et al.* 1973).

Migrant seabirds and shorebirds: Several pelagic and coastal bird species frequent the Bay Islands without breeding there (Monroe 1968, Howell & Webb 1994). They are boobies, gulls, terns and jeagers. We only observed one of these species, the Laughing Gull, but others most certainly occur within the park limits at appropriate times of the year. We observed only three species of shorebirds (Table 5) but it is probable that more taxa frequent the archipelago at other times of the year. Still, we do not believe that large concentrations are ever present because of the absence of large mud flats.

TABLE 5

List of bird species observed in May 1995 on Cayo Cochino Pequeño (CCP), Cayo Cochino Grande (CCG), and small cayos around the Cayos Cochinos, Honduras.

English Name	Latin Name	CCP	CCG	Cayos
Brown Pelican	*Pelecanus occidentalis*	X	X	X
Magnificent Frigatebird	*Fregata magnificens*	X	X	X
Little Blue Heron	*Egretta caerulea*	X		
Green Heron	*Butorides virescens*		X	
Osprey	*Pandion haliaetus*	X		X
Chicken	*Gallus gallus*	X	X	X
Semipalmated Plover	*Charadrius semipalmatus*			X
Spotted Sandpiper	*Actitis macularia*	X	X	X
Ruddy Turnstone	*Arenaria interpres*			X
Laughing Gull	*Larus atricilla*			X
Royal Tern	*Sterna maxima*	X		X
Unidentified Tern (Roseate?)	*Sterna sp. (dougallii ?)*			X
* White-crowned Pigeon	*Columba leucocephala*	X	X	X
* Caribbean Dove	*Leptoptila jamaicensis*	X	X	
Ruddy Quail-Dove	*Geotrygon montana*	X		
* Green-breasted Mango	*Anthracothorax prevostii*	X	X	
* Fork-tailed Emerald	*Chlorostilbon caivinii*	X	X	X
Belted Kingfisher	*Ceryle alcyon*	X		
Woodpecker	*Picidae (Sphyrapicus varius ?)*	X	X	
Eastern Wood-Pewee	*Contopus virens*	X	X	X
Acadian Flycatcher	*Empidonax virescens*	X		
Great Crested Flycatcher	*Myiarchus crinitus*	X		
Barn Swallow	*Hirundo rustica*	X		
House Wren	*Troglodytes aedon*	X		
Gray-cheeked Thrush	*Catharus minimus*		X	
Swainson's Thrush	*Catharus ustulatus*	X	X	X
Gray Catbird	*Dumetella carolinensis*	X		
Philadelphia Vireo	*Vireo philadelphicus*	X	X	
Red-eyed Vireo	*Vireo olivaceus*	X	X	X
* Yucatan Vireo	*Vireo magister*	X	X	X
Tennessee Warbler	*Vermivora peregrina*	X	X	
Yellow Warbler	*Dendroica petechia*	X	X	X
Chestnut-sided Warbler	*Dendroica pensylvanica*	X	X	
Blackburnian Warbler	*Dendroica fusca*	X	X	
Bay-breasted Warbler	*Dendroica castanea*	X	X	X
Black-and-white Warbler	*Mniotilta varia*	X	X	
American Redstart	*Setophaga ruticilla*	X	X	X
Ovenbird	*Seiurus aurocapillus*	X	X	
Northern Waterthrush	*Seiurus noveboracensis*	X	X	X
Mourning Warbler	*Oporornis philadelphia*	X		
Dickcissel	*Spiza americana*			X
* Great-tailed Grackle	*Quiscalus mexicanus*	X	X	X
Baltimore Oriole	*Icterus galbula*			X

Herons: Several Little Blue Herons and one adult Green Heron were observed. We believe that both were migrants (see Seutin *et al.* in press). Other species may occur in migration and during the winter as they do on the Bay Islands.

Raptors: There are no known resident diurnal or nocturnal raptors on the Cayos Cochinos (Monroe 1968; this report). However, the area is used by Ospreys in winter and also probably by Merlins (*Falco columbarius*) and Peregrine Falcons (*Falco peregrinus*).

Resident landbirds: We observed good numbers of the six landbirds species that are definately known to breed on the islands (Monroe 1968; Table 5). The four most common taxa were, in decreasing order of abundance, the Yucatan Vireo, the Fork-tailed Emerald, the White-crowned Pigeon, and the Great-tailed Grackle. The pigeon was dominant in terms of biomass. We also noted these four taxa on one or more of the small, forested cays where the vireo and emerald probably breed.

The Green-breasted Mango was seen regularly only along the coastal strip of the two islands. We observed the Caribbean Dove on both islands, providing the first record for CCG. We estimated that the population of this species on CCP was about 25 pairs, similar to the number present in 1963 (Monroe 1968). The species was somewhat more abundant on Isla Cochino Grande that it probably only recently colonized. This, and recent observations from Roatán, a large island to the North, suggest that the Caribbean Dove is in a phase of geographic expansion in the archipelago.

None of the resident taxa were actively breeding while we visited the islands. However, several lines of evidence (*i.e.*, constant singing, frequent aggressive interactions, individuals with an enlarged cloacal protuberance or a limited brood patch) indicated that most vireos were starting their annual reproductive cycle.

Several species of landbirds that breed on the large Bay Islands have not been recorded on the Cayos Cochinos. Species for which an empty niche would seem available include a woodpecker (*Melanerpes* sp.), the Common Ground-Dove (*Columbina passerina*), the Brown-crested Flycatcher (*Myiarchus tyrannulus*), and the Yellow Warbler. Other taxa such as the House Wren might colonize the archipelago from the species-rich mainland. A male of that species had established a territory behind the field station on CCP, providing a first record for the Cayos Cochinos. It almost constantly sang and reacted very strongly to playbacks of its own vocalizations, but no mate was seen. Given the ecological amplitude of this wren and the availability of favored breeding habitat, we believe it might soon become established in the archipelago. On the other hand, a Ruddy Quail-Dove that we caught (a first record for either the Bay Islands or Cayos Cochinos) was probably a vagrant, and the species is not likely to ever become established in the archipelago.

Migratory landbirds: The Cayos Cochinos are frequented by large numbers of Neotropical migrants in transit; smaller numbers probably also winter. We estimated that during our visit the proportions of migrant and resident landbird individuals were roughly equal. The most abundant migrants were Red-eyed Vireos and several species of parulid warblers. Clearly, the list of species we recorded (Table 5) provides an incomplete picture of the diversity of migrants occurring in the area. An exhaustive inventory will require that the region be visited during other periods of the year.

Monroe (1968) listed the latest spring date on which many migrants have been reported in Honduras. Observations made during this survey contributed eleven new late records for the Republic that are presented in detail in Seutin *et al.* (in press)

Biogeographic considerations: As is typical on islands, the resident avifauna of the Cayos Cochinos has few species; only six landbird taxa have been recorded to breed (Monroe 1968).

The breeding avifauna of the Cayos Cochinos is a subset of that of the Bay Islands. In spite of their geographic proximity, these insular faunas are very distinct from the avifauna of the Caribbean lowlands of Honduras. Three resident landbirds of the Cayos Cochinos do not occur on the Honduran mainland, but only further to the northwest (*i.e.*, Belize and the Yucatan Peninsula): the White-crowned Pigeon,

Caribbean Dove, and Yucatan Vireo. A fourth species, the Fork-tailed Emerald, is geographically variable in Central America and the populations of the Bay Islands and the Cayos Cochinos are phenotypically more similar to those found in Belize and the Yucatan Peninsula than to Honduran mainland conspecifics (Monroe 1968, Howell & Webb 1994). Thus, only two Cayos Cochinos residents, the Green-breasted Mango and the Great-tailed Grackle, possibly have closer relatives on the adjacent mainland than further away.

Thus, the avifauna of the Cayos Cochinos and the Bay Islands is apparently more related to that of the Yucatan Peninsula and associated islands than it is to that of the nearby Honduras mainland. Two, non-mutually exclusive biogeographic scenarios might account for this hypothesis. First, most breeders might have colonized the archipelago by over-water dispersal after the islands were separated from the mainland by increasing sea levels in the late Pleistocene. Second, a number of taxa now restricted to the Yucatan Peninsula and the adjacent islands might have been more widespread in the Caribbean lowlands of northern Central America during the last glacial maximum. Some of those taxa could have been trapped in the late Pleistocene on the newly formed landbridge islands, where they survived until today while becoming extinct on the mainland.

Mammals (Louise Emmons & Byrdena Werfel)

On the Cayos Cochinos we collected eight species of mammals and observed two more (Table 6), one of which is a certain record (*Agouti paca*), while the other (*Marmosa* sp.) requires verification. In contrast to our results on Cayos Cochinos, our much smaller trapping effort on Roatán yielded 10 captures of native small mammals, including two rodent species and a mouse opossum.

TABLE 6

List of Mammals collected (or observed[1]) from the Bay Islands of Cayo Cochino Pequeño (CCP), Cayo Cochino Grande (CCG) and Roatan, Honduras.

Family Name	Genus /Species Name	C C P	C C G	Roatan
Marsupialia	*Marmosa robinsoni ruatanica*		X[1]	X[4]
Emballonuridae	*Saccopteryx bilineata*	X	X	X[3]
Emballonuridae	*Saccopteryx leptura*		X	
Phyllostomidae	*Artibeus jamaicensis*	X	X	X[3]
Phyllostomidae	*Artibeus phaeotis*		X	X
Phyllostomidae	*Glossophaga sorcina*	X	X	X[3]
Phyllostomidae	*Micronycteris schmidtorum*	X	X	
Molossidae	*Molossus molossus*			X[3]
Muridae	*Rattus rattus*		X	
Muridae	*Oryzomys couesi*			X
Muridae	*Sigmodon hispidus*			X[2,3]
Agoutidae	*Agouti paca*		X[1]	
Agoutidae	*Dasyprocta cf punctata*	X	X	

[1] Observed only
[2] From the offshore island of Bonacca
[3] O. Thomas 1988. Proc. Zool. Soc. 9:129
[4] E.A. Goldman 1911. Proc Biol. Soc. Wash. 14:237

Small terrestrial mammals: We had no success trapping any small terrestrial mamals on CCP and CCG. At nightfall swarms of giant cockroaches overran the traps and devoured the bait, which attracted several species of crabs. This interference makes us doubtful that the sampling for small non-flying mammals was adequate, especially since LE saw a probable mouse opossum near Plantation Beach on CCG at the end of the survey. Nonetheless,

longtime residents of Plantation Beach Resort were not aware of any native small terrestrial mammals on the islands. They stated that Asian black rats (*Rattus rattus*) were only introduced to the large island about eight years ago, when they arrived from Roatán inside a refrigerator. No rats had ever been seen prior to that incident but, unfortunately, they are now established around buildings on both sides of the CCG.

If native rats exist on CCP and CCG, populations were low during our survey. Some residents stated that CCP used to have a small rat but that none had been seen recently. At night the ground-level environment was overwhelmed by hermit and land-dwelling crabs which eat fruit, and by day, lizards. We suggest that these competitors and harsh island conditions make the islands unfavorable for rat species native to the rainforest on the adjacent mainland. In contrast, mouse opossums might do well on the islands, as these mammals are primarily insectivores that can hunt in vegetation above ground, outside the domain of crabs.

Large terrestrial mammals: The Cayos Cochinos have two large mammals, both rodents: agoutis (*Dasyprocta* cf *punctata*), and pacas (*Agouti paca*). Both Cayos support large populations of agoutis, probably near overpopulation on CCG. These animals feed mainly on the nuts of *Attaleya* palms, which grow in large monospecific stands on the ridgetops of CCG. There is local concern that agoutis are causing the rapid spread of *Attalea*, which shades out other tree species and may decrease the plant diversity of the island. This could be the case, because agoutis help propagate palms by burying their seeds. An interesting local rumour holds that agoutis only became numerous when permits were given to collect boas on the island for the pet trade, and 5,000 boas were taken within only two years. The agoutis on the Cayos may be of mixed origin: Tulio Muñoz, a lifetime resident of the Bay Islands, from Utila, told us that about 20 years ago fishermen brought agoutis from Utila and released them on the Cayos Cochinos to rebuild the game population. Possibly both agoutis and pacas were originally introduced to the islands by fishermen. We did not see pacas on CCP and, possibly, none occur there.

Bats: The most diverse sector of the island mammal fauna is its bat community. The six species we collected (Table 6) form a small ecological community. On CCP, the community consists of one insectivore that hunts insects aerially (*Saccopteryx bilineata*), one insectivore that gleans insects from substrates such as vegetation or possibly the ground (*Micronycteris schmidtorum*), one large frugivore (*Artibeus jamaicencis*) and one nectar-feeding bat (*Glossophaga soricina*). On CCG we observed two additional species: a smaller aerial insectivore (*Saccopteryx leptura*) and a smaller frugivore (*Artibeus phaeotis*). All of these bats were common at the time of our survey, some with extremely high densities (capture rates) relative to the populations normally encountered in mainland habitats.

The large Jamaican fruit bats had a phenomenally high population density at the time of our survey. This species seems to live chiefly along the littoral flats encircling the islands, where they were feeding intensively on fruits of "almendro" (*Terminalia*), an exotic tree, and other plants on the beach and forest edge. They did not seem to use the oak forest on the higher slopes of CCP. Competition for food was so intense among these bats that individuals emerged in broad daylight, at about 17:00, to vie for the fruits of *Cecropia* which had ripened during the day. The fruits were all eaten within a few minutes. Few or no bats were netted after 19:30. Apparently the bats had finished feeding shortly after dark. We have never seen this phenomenon on mainland sites, nor have we ever seen *Artibeus* active long before dark. This could be the basis for an interesting ecological research project as could the simplified community structure of bats on the Cayos Cochinos. Bats could be important dispersers of the native palms of the islands as well as pollinators and dispersers of other native species.

Taxa not observed: Our survey time was short, and we may not have discovered all the species. We were surprised, for example, by the absence of vespertillionid bats. We carefully observed the sky each nightfall for aerial insectivores and noticed only the emballonurids that we captured. Investigation of a report of bats under a house roof yielded only more *Saccopteryx bilineata*.

Limiting ecological factors: At the time of our visit the islands were experiencing one of the severest droughts in memory. CCP appeared to have virtually no free surface water available to animals, while on CCG only a few pools remained in some streambeds at the bottom of slopes. The mammal fauna of the Cayos Cochinos, especially the small island, but also much of the large island, seems limited to species that do not need to drink fresh water. Pacas may not occur on the small island for this reason and lack of water could also explain the absence of vespertilionid and molossid bats. The Cayos Cochinos are close enough to the mainland that some bats might migrate to them in wetter months.

Research and management suggestions

Plants: A survey of the flora and vegetation of CCG should be initiated. Each visiting class should map and measure one hectare (more in oak forest) of all stems 1cm diameter and up until the entire island is mapped, not as big a job as it sounds. Permanent plots should be established to study growth rates, recruitment and mortality as well as reproductive success and spread of rare species. The phenology of common species should be described. Survivorship of juveniles in different habitats could be compared and the physiology of species in and from different habitats should be studied, especially for their reaction to drought. The arrival and disappearance of herbaceous beach species should be monitored from year to year. Comparisons of pollinators, animal seed-dispersers, and genetic comparisons with mainland populations would be worthwhile.

Insects: An appropriate management plan for Cayos Cochinos minimally requires a brief survey of the insect fauna during the wet season, when diversity is expected to be greatest. If the level of diversity is manageable as expected, then a more extensive but preliminary year-round trapping program can be implemented using Malaise and flight-intercept traps and black-light traps. The collecting, preparation, and initial processing of this preliminary material could be done with Honduran students or assistants following modest training. It is especially important that the faunistic data be collected in an ecological context, including data on herbivory, pollination and host utilization. Finally, future studies of the insect fauna will be greatly facilitated by the establishment of a reference collection at the Station, or by supporting the continued development of the national collection (see O'Brien & Ward 1987).

Although the apparent low diversity of the insect fauna on Cayos Cochinos will probably not attract insect systematists, the islands offer an interesting opportunity for long-term monitoring of insect diversity and population dynamics, coupled with long-term monitoring of their ecological relationships (*e.g.*, plant-pollinator or host-parasite relationships). At most tropical sites, a year-round, long-term survey of seasonal abundance and diversity of the entire insect fauna is often impractical because the diversity is overwhelming. Consequently, surveys typically focus on a subset of the fauna and assume that these subsets are representative (*e.g.*, Erwin 1983). The Cayos Cochinos can provide a test case for assumptions made in other surveys. The faunal diversity is likely to be manageable, as are the ecological relationships of the insects. Furthermore, the pronounced seasonality at the Cayos Cochinos is likely to provide interesting comparisons to insect diversity and seasonality studies conducted at other tropical sites [*e.g.*, Proyecto ALAS at La Selva, Costa Rica (J. Longino & R. Colwell, pers. comm.), or the Environmental Studies Program on Barro Colorado Island, Panama (D. Windsor, pers. comm.)]. The added complication of comparing island with continental sites makes this latter aspect less attractive.

The Cayos Cochinos could also provide an interesting opportunity for the study of community-level effects of experimental removal or addition of dominant competitors. For example, feral honey bees (*Apis mellifera*) are present on the two large islands, but apparently are not abundant on the smaller cays. The effects of introduced honey bees on native bee communities range from negligible in central Panama (D.W. Roubik, submitted) to severe in southern Australia (M. Schwarz, in prep.). Such experiments first require a more thorough survey of the bee community.

Birds: Additional surveys are unlikely to add many new species to the list of resident birds of the Cayos Cochinos. However, our

knowledge of the birds that use the area in migration or as wintering ground is very limited. Future visitors to the islands that have a knowledge of birds could greatly contribute to our understanding of the avifauna of the park. A list of their observations should be solicited, and these lists should be reviewed and compiled by a competent ornithologist. This could lead to the production of a checklist of the birds of the archipelago that would simplify and standardize the reporting of observations. We suggest that the checklist be designed to elicit the reporting of breeding evidence.

The large numbers of Neotropical migrants that occur on the Cayos Cochinos for significant parts of the year may force the resident birds to change their pattern of habitat use and resource exploitation through the seasons. The great simplicity of the resident fauna might facilitate studies of resource utilization as a function of migrant and resident densities.

The resident avifauna is well suited for analyses of dispersal and recruitment in insular populations. Yucatan Vireos would be best suited for this because they are easy to catch for marking and to observe once released, and their nests are relatively easy to locate. A complete survey of the presence and abundance of this vireo in the cays during the breeding season should reveal whether vireos in the Cayos Cochinos are to be analyzed in a source-sink metapopulation context. Source-sink systems are presently the object of many studies in conservation biology.

The Caribbean Dove, which is unfortunately relatively difficult to catch, would also make a good subject for dispersal and recruitment studies. This species is especially interesting because its populations are small and the demography of small populations is poorly understood. Conservation biology would benefit from such an investigation. Any demographic study of a resident bird species should include monitoring of their parasites.

We do not believe that establishing a reference collection of bird skins on the island is a priority, especially considering the likely maintenance difficulties. However, it would be useful to preserve specimens found dead but in good condition. Alcohol preservation is probably the best option as the preparation of such specimens and the conservation of such collections are easy even for untrained personnel. Much data can be obtained from alcohol-preserved specimens, including information on diet, molt, and some diseases.

We recommend that the chickens present on Isla Cochino Pequeño be removed. Chickens often carry diseases, including avian pox, that can be transmitted to other birds. We suggest a less dramatic measure for Isla Cochino Grande to respect the habits of present inhabitants of the island. We recommend that residents be encouraged to keep their chickens and other introduced birds in enclosures. This could be promoted by providing residents with the supplies for building the enclosures. Regulations of the park should ban the voluntary introduction of exotic species, and residents should be made aware of this.

Mammals: The major management and conservation concern is the establishment of black rats on the islands. Possibly they have not yet reached CCP; if not, great effort should be directed at preventing their introduction. Rats introduced on islands typically spread rapidly and have a pronounced and negative impact on native rodents, birds, lizards, iguana eggs, sea turtle eggs and hatchlings and on the coconut industry.

If it is demonstrated that agoutis are responsible for the abnormal spread of *Attalea* palms, it will probably be easier to control the situation by culling palms than by cropping agoutis. If hunting were allowed, it would be unlikely to curb the population of agoutis, unless very intense. Large numbers of hunters with guns would threaten paca and dove populations and cause difficulties for conservation education. It would be much easier to tour the forests and cut the crowns off young *Attalea* in places where they appear to threaten native vegetation. With fewer palms, the agouti populations should diminish. An overpopulation of agoutis could also directly threaten the regeneration of native species, because these rodents also feed on the cotyledons of germinating plantlets.

We recommend that no domestic animals be allowed on the small island. The half-feral dogs should be removed or eliminated, as should the few feral goats. Dogs and cats have done great damage to island faunas worldwide. It may be difficult to rid CCG of pets, but there should at

least be a rule that cats, especially, must be neutered.

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RESUMEN

Realizamos un estudio preliminar de la flora y fauna terrestre de la Reserva Biológica de Cayos Cochinos, Honduras, por un período de tres meses en 1995. Nuestras descripciones enfatizan la isla de Cayo Cochino Pequeño la cual esta completamente protegida, de acuerdo a la ley de parques nacionales. Estudios de aves y mamíferos complementaron estudios previos sobre la fauna de vertebrado, en particular de aves, reptiles y anfibios. La composición y distribución de plantas e insectos se describen por primera vez. Finalizamos este trabajo con recomendaciones para el manejo e investigación de Cayos Cochinos.

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