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Conservation and Indigenous Human Land Use in the Río Plátano Watershed, Northeast Honduras

Jeffery W. Froehlich

Karl H. Schwerin

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CONSERVATION AND INDIGENOUS HUMAN LAND USE IN THE RÍO PLÁTANO WATERSHED, NORTHEAST HONDURAS

Edited by

Jeffery W. Froehlich and Karl H. Schwerin

THE UNIVERSITY OF NEW MEXICO

ALBUQUERQUE, NEW MEXICO 87131

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CONSERVATION AND INDIGENOUS HUMAN LAND USE

IN THE

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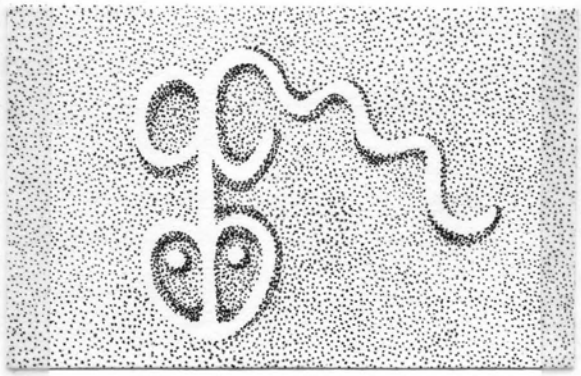
Department of Anthropology
University of New Mexico



Frontispiece Note: This design and the one above are artistic renditions of two petroglyphs (*piedras pintadas*) which occur on islands in the section of the Río Plátano shown in Fig. III-1. They demonstrate a prehistoric occupation and/or utilization of the Río Plátano watershed which is beyond the memories or myths of the present inhabitants of the area. Though some of the carvings represent human faces or masks, and one is suggestive of a map, the two shown here have no clear meaning. Perhaps the one above is a lizard or a metamorphosing frog; in either case, it provides a symbol for continuing conservation efforts in the Río Plátano Biosphere Reserve.

Final report submitted to the Animal Research and Conservation Center of the New York Zoological Society in compliance with a contract agreement by the University of New Mexico for project titled: "Ecological Survey and Management of a Rain Forest Park in Honduras."

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Jeffery W. Froehlich and Karl H. Schwerin

BACKGROUND TO THE PROBLEM

In terms of volume and potential impact, the most serious conservation problem in the world today is the destruction of lowland tropical forests and the extinction of their fauna. Since 1950, according to the Food and Agriculture Organization, half of the world's forests have vanished (Cultural Survival, Inc., 1982). The conversion rate of these forests is currently so great that a recent National Research Council (1980a) panel has predicted that their existence as a natural ecosystem will cease by the year 2000, except perhaps in two areas – Western Amazonia and Central Africa.

The prospects for the forest fauna and flora are equally grim. At present, only about one-sixth of an estimated 3 million tropical species of plants and animals are even named, let alone scientifically studied (National Research Council, 1980b). Potentiating this lack of knowledge, the rate of extinction is expected to reach one per hour by the year 2000 (Myers, 1979), with an estimated one million species disappearing in the next 20 years (Norman, 1981).

In addition to a loss of knowledge for its own sake or from an aesthetic appreciation of nature, we may also be losing genetic variability of potential economic or medicinal value to humanity (e.g. Feldman and Sears, 1981). With so few of these organisms even catalogued, we may never know what has been lost. Moreover, the inevitable loss of genetic diversity in the organisms which are conserved may limit future developments of our food base. Recently, for example, a rare virus-resistent, perennial variety of corn was identified in a small area of Mexico, offering the hope of selective breeding, or perhaps even gene transfers to improve cultivated corn (Vietmeyer, 1979), but only if this kind of genetic diversity is maintained. Ironically, a lip service statement given by a top representative of the Reagan Administration is also a most eloquent summary of the problem; James Buckley said, "The process is tantamount to book burning; but it is even worse in that it involves books yet to be deciphered and read" (Norman,

1981: 1105).

Nowhere is the problem of forest destruction and faunal extinction more pressing than in Central America, where 66% of the tropical forests have already been lost (Cultural Survival, Inc., 1982). One of the principal causes for this prodigious rate of forest destruction is the World Bank sponsored development of livestock production. In Honduras, for example, where the current rate of forest loss is 700 km^2 per year and only 20,000 km^2 remain, beef production increased by 300% from 1965 to 1975, while consumption in the region declined by 17% (Nations and Komer, 1982). Much of this "surplus" beef comes to the United States for inclusion in fast-food hamburgers; even the American house cat eats more beef than the average Central American (Nations and Komer, 1982)! Ironically, while World Bank and United States' development policies in Central America are sometimes justified as food production for a hungry world, the yearly yield of 10 kg of beef per hectare is probably one of the most inefficient uses of the thin, nutrient-poor soils of former tropical forests. In Chiapas, for example, the Lacandones produce about 6,000 kg of maize and an equal quantity of root crops per hectare per year for 5 to 7 years, after which the land is recycled for about a decade (Nations and Komer, 1982).

One important step toward the preservation of the few remaining forests in Central America is the education of the American public. As stated by Nations and Komer (1982: 12), "Americans must become aware that when they bite into a fast-food hamburger or feed their dog, in effect they are consuming toucans, tapirs, indigenous peoples, and tropical forests." Of more immediate importance, the aforementioned National Research Council (1980b) panel has recommended a number of biological research priorities in the tropics. These include special inventories, baseline ecological studies, continuous ecological monitoring, and the study of indigenous human land use. Rarely are the local people consulted, let alone is their intimate and successfully adapted knowledge of local resource management heeded (Cultural Survival, Inc., 1982). In order to pursue these studies and to allay the potential ecological disasters alluded to earlier, the obvious first step is to set aside as much land as possible as forest preserves (National

Research Council, 1980b). The minimum size for such reserves to preserve natural conditions is thought to be about 100,000 hectares (Cultural Survival, Inc., 1982).

THE MAN AND THE BIOSPHERE PROGRAM

Since 1970, the Man and the Biosphere (MAB) Program of UNESCO has been striving toward these goals, particularly as they relate to the preservation of indigenous human cultures in the context of natural reserves, where their intimate knowledge of the ecosystem can be used in the development of effective management plans (Glick, 1980). Working within a framework of cooperation between the natural and social sciences, the MAB program has proposed an international network of "biosphere reserves," representing the world's major biomes and unique species resources. The multiple purposes for such reserves include conservation of genetic resources, baseline ecological studies, and the training of the local populace in the necessity and methods of conservation. The problems of reserve management are many-faceted and require detailed data, including the functioning cultural ecology of the indigenous people, long-term monitoring of critical species to detect declines and losses in forest fragments, and the regulation of those remaining species within the framework of population biology studies in a depleted ecosystem (National Research Council, 1980b). Obviously, species loss will be indirectly proportional to the size of the reserve (Lovejoy, 1979) and directly affected by human population growth and hunting pressure. Reciprocally, the conservation of some endangered species (e.g. primates) may also require their reintroduction, but this solution could only be based on extensive knowledge of the local ecosystem and the cooperation of the local human population.

With regard to both the MAB criteria of representativeness and uniqueness, the Central American tropics are essential for inclusion in this reserve network. Representing a unique, zoological exchange (Simpson, 1980) between two colliding continents, the former peninsula below Mexico has few large natural areas of tropical forest left, yet the evolutionary understanding of the entire neotropics pivots on this faunal exchange (Marshall, et al., 1982). Moreover, population growth in Central America is prodigious, making it essential to include the human

element in any forest conservation plan. The present 35 million horticulturalists in Central America are expected to increase to 57 million by the end of the century. The impact of this demographic expansion will be especially great in areas now covered by tropical forests, because only 7% of the population own 93% of the presently arable land (Nations and Komer, 1982). Except for an enlightened conservation program and system of national parks in Costa Rica (Cahn and Cahn, 1979) and the newly established Darien National Park in Panamá (Nations and Komer, 1982), Central America has lagged behind in the designation of areas for the protection of indigenous people and the conservation of the natural resources within which they live.

THE RÍO PLÁTANO RESERVE

In Honduras during the past two decades a number of conservation laws and decrees have been promulgated, dealing with everything from wildland management to the naming of archaeological preserves. Unfortunately, few of these have been supported by the necessary budgetary appropriations or implementation. Nonetheless, such legislation does indicate that some enlightened Hondurans have a growing awareness of the importance of environmental concerns (Glick, 1980).

In 1977 a major effort was made by the Dirección General de Recursos Naturales Renovables (RENARE) to organize a system of wildlands for the country. Eighteen potential areas were identified, and funding was sought to support their evaluation, and, where it was shown to be appropriate, to establish national parks. By 1980 only six of these areas had been officially visited (Glick, 1980).

The work of RENARE has, however, been closely coordinated with that of the Wildland Management Unit of the Centro Agronómico Tropical de Investigación y Enseñanze (CATIE), an internationally funded, conservation-oriented consulting group in Costa Rica, which assists wildland planning and management efforts throughout Central America. CATIE has given emphasis to the protection of large representative samples of the major ecosystems in the region, particularly the tropical rain forests, because of their ecological diversity and the rapid rate at

which they are being destroyed. Since the Northeast Honduran Mosquitia is almost entirely covered by tropical rain forest, it was obvious to look to this region for an area that merits protection (Glick, 1980).

Although other potential areas exist within the Mosquitia, the Río Plátano watershed was particularly attractive. In the first place it lies within the limits of an area which had been set aside by presidential decree in 1969 as a Parque Arqueológico Nacional, a reserve zone within which all archaeological research and excavation would be legally controlled (Gilbert and Glick, 1978). Not only did the region already enjoy a certain measure of official protection, it was also considered extremely diverse ecologically. The known fauna included several endangered or threatened species. Due to the extreme ruggedness of the terrain and the frequently unnavigable river, it was believed the area had had only minimal impact from the traditional Miskito or other native populations, while practically no modern influences had penetrated the area. Finally, the Río Plátano drainage contained some quite spectacular scenery.

Because the upper course of the Plátano is isolated and virtually untouched, it seemed ideal for a Biosphere Reserve designed to preserve genetic diversity in a representative tropical rain forest. At the same time, on the lower course of the river and along the coastline in both directions from its mouth there is significant indigenous human settlement and exploitation of the adjacent forest, streams, lakes, and ocean. Areas adjacent to the Plátano drainage seemed appropriate as a buffer to protect both the human and natural resources. The area thus contained within it the whole range of zones which the MAB Program deems ideal for a Biosphere Reserve: (1) a Core Zone which could be managed so as to allow only minimal human disturbance, surrounded by (2) a Buffer Zone where human activity would be limited to managed exploitation (such as research, tourism, and education) and the pursuit of regulated *traditional* activities such as hunting, fishing, or lumbering, while agriculture or settlement would be prohibited, and (3) a Cultural Zone which could be managed so as to protect the traditional cultures from rapid change or disintegration. At the same time, establishment of a Reserve would make it possible to study these cultures so as to determine which of their exploitative practices are in harmony

with the environment, and to regulate those which are not (Gilbert and Glick, 1978). Small areas could also be set aside within the other three zones as Special Use Zones for the location of administrative centers, guard stations, or research facilities.

In 1977-78, a few brief visits to the Río Plátano region were made by RENARE personnel and U.S. Peace Corps volunteers. Because of time and monetary limitations, these initial surveys totaled only about 6 weeks of research by teams of 6 to 9 (Glick, 1980). On the basis of these investigations and data extrapolated from elsewhere in Honduras, a preliminary natural and cultural resource inventory was compiled (Cruz et al., 1978), and planning documents were drawn up for developing a biosphere reserve (Gilbert and Glick, 1978; RENARE, n.d.). A decree to formally establish the Reserve was drafted, but was not signed into law until December 1980. In the meantime, however, RENARE moved ahead and undertook the initial steps necessary to establish its presence in the Reserve and to initiate local administration. A Miskito schoolteacher was named resident director, and three inhabitants were hired as forest guards after being selected by the local people. Using a small grant from the World Wildlife Fund to CATIE, a structure was erected in the vicinity of the Plátano's mouth (Kuri) to serve as guest house, administrative office, and research center. Work was also begun on a second house upstream near the village of Las Marías. Thus, even before the presidential decree was signed, RENARE had begun to implement its plan for protecting this area from future development or depredation.

PHYSICAL CHARACTERISTICS AND HUMAN OCCUPATION

The Río Plátano Biosphere Reserve encompasses about 400,000 hectares (1600 mi.^{2}) in a sparsely populated area along the western edge of the Mosquitia Region of Northeast Honduras (see figure I-1). The Reserve is bounded by the Río Paulaya on the west, the Río Wampu on the south, the Río Sicre on the east, and the Caribbean Sea on the north. Within a large outer buffer, a core area has been designated, which comprises virtually the entire drainage basin of the Río Plátano, an area of more than 130,000 ha. The vast majority of both the Core Zone and the sur-

rounding Buffer Zone are mountainous. Much of it is sufficiently rugged that away from the rivers it is rarely, if ever, penetrated by humans. The mountain ridge along the western side is marked by several spectacular peaks which project from the surrounding terrain. Above Las Marías the Río Plátano is marked by a number of rapids which become increasingly difficult to negotiate. After every storm, and throughout the wet season, they are not navigable by even the most experienced native. Almost the whole of the core and buffer areas are covered with dense rain forests.

Except for farming settlements along the courses of the Río Paulaya, the Río Wampu, and the lower 10 km of the Río Plátano below the first rapids, there is no permanent human habitation anywhere within this forested area today. There are, however, reports of several archaeological sites in the upper Río Plátano basin, petroglyphic signs of former occupants on rocks above the first rapids, and historical accounts of settlements existing further upstream than they do now. Apparently the general tendency over the past one or two centuries has been for the population to move gradually downstream, out of the more mountainous regions and onto the coastal plain. We might guess that in the past, warfare and raiding on the part of coastal populations (Miskito? , English?) forced their adversaries (e.g. Paya) to seek refuge in the mountians. Today, when this sort of hostility no longer exists, the mountain dwellers have been able to move downstream to farm the more level areas on the coastal plain. Today the upper course of the Río Plátano is traversed only by gold panners in search of placer deposits, and fishermen seeking the greatly prized *cuyamel* which frequent the upstream rapids. An occasional hunter may penetrate the forest in search of game, but never as far as the mountain ridges.

The lower course of the Río Plátano, an area of approximately 300 km^2 designated as the Cultural Zone, may be considered to begin at Las Marías. From here the river traverses the broad coastal plain between the mountains and the sea. The first 20 km or so below Las Marías run through rain forests along the western edge of the plain, with a narrow band from 500 to 1000 m on each side of the river subject to periodic inundation. Six to seven percent of human population within the Reserve occupies this narrow band. At Guapinyari (La María) the

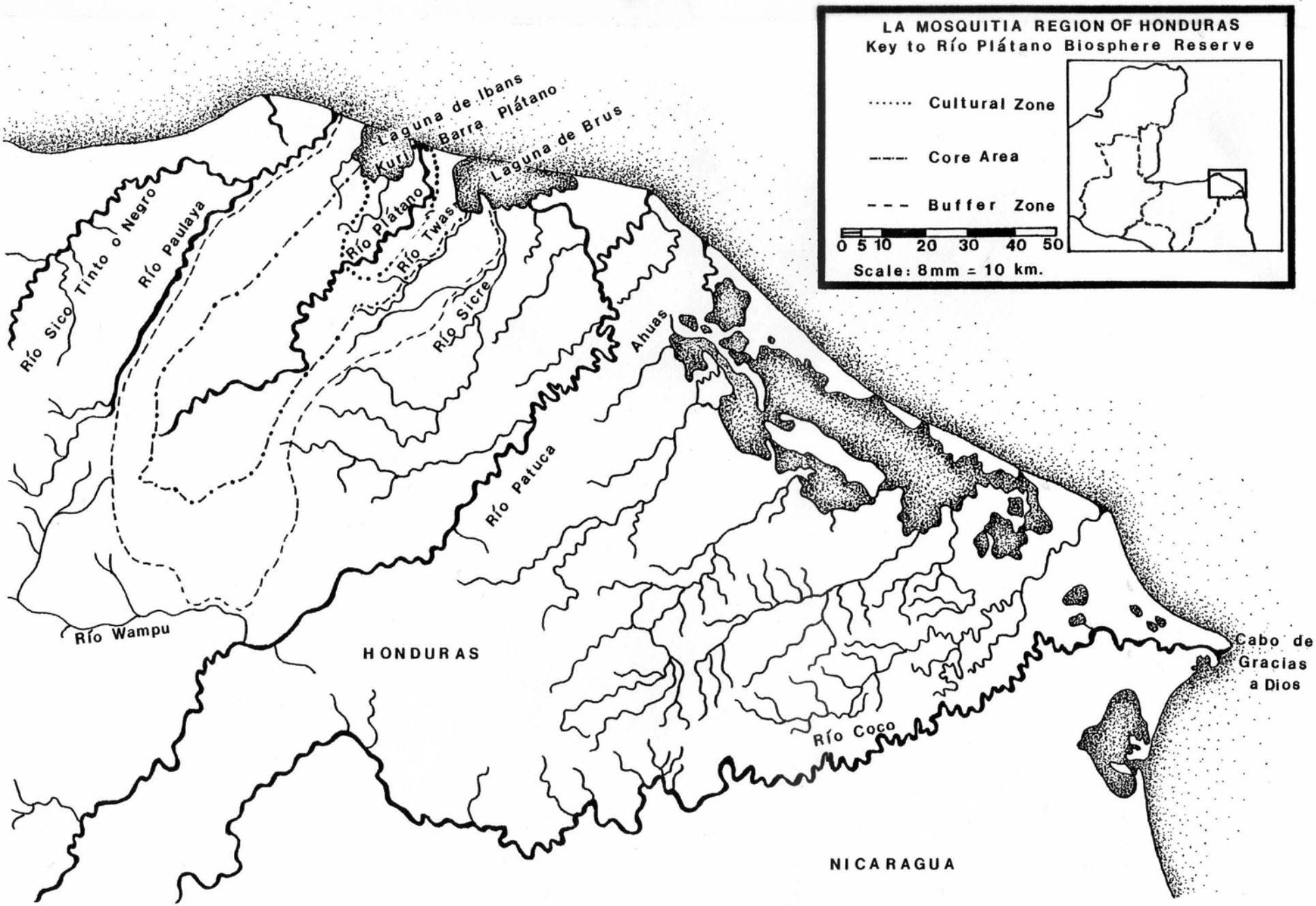


Fig. I-1. The Mosquito Coast of Honduras with outlines of the three zones in the Río Plátano Reserve.

periodically flooded area expands markedly and within three to five kilometers the terrain becomes swampy. Most of the final 25 km of the river flows through this swampy area, which extends all the way to the shores of Brus Laguna. The swampy zone is covered by a much more open forest, dominated by palms and pine trees, and interspersed with open expanses of grass. There appears to be little or no human habitation here, except along the course of the river itself. Cattle are, however, allowed to roam freely thoughout this area.

The area bordering the river is lined by hardwood gallery forests, which thrive on the high natural levees between the river and the backwater swamps. This is the zone which is most attractive to local agriculturists. Not only is it accessible from the river, but the soils are fertile, and the structure of the natural levees makes it less subject to flooding than the lower terrain further away from the river.

Although the Río Plátano and its tributaries are the principal drainage within the Reserve, several other streams also drain parts of the area. The Río Sicre marks the eastern boundary of the Reserve. The Río Twas drains an area between the two larger rivers. Both the Twas and the Sicre empty into the Brus Laguna. West of the Plátano the relatively small savanna plain south of Laguna Ibans is drained by the Crique Guapinijari. The Río Paulaya, which marks the western edge of the Reserve, is essentially beyond our area of concern.

The two large lagoons in the immediate environs are also significant features of the landscape. The western third of the brackish Brus Laguna (120 km^2) is included within the Buffer Zone portion of the Reserve, while Laguna Ibans, a large shallow freshwater lake (63 km^2), is wholly within the Cultural Zone. Mangroves are found extensively around the borders of both lagoons. Although these are both sizable bodies of water, their direct economic role in the life of the local people appears to be minimal. They are more important in facilitating transportation than in providing food resources or raw materials. Reputedly, they are inhabited by manatees, which were hunted in the past.

The coastal portion of the Reserve extends from the mouth of Brus Laguna, past the mouth of the Río Plátano, to the mouth of the Río Sico Tinto o Negro (of which the Río

Paulaya is a major affluent). Most of this consists of a narrow sandy beach, rising as much as 10 m above the sea in some places. Much of this beach front strip is or recently has been under cultivation, but some is covered by low forest (10 to 15 m tall), or groves of Caribbean pine or tique palm. At the edge of the beach the dominant tree is the sea grape (some venerable specimens may reach 10 m in height). At the mouth of the Río Plátano the high ground may extend as much as 50 m inland. Twenty-seven percent of the population lives in the zone between the mouth of the Plátano (Barra Plátano) and Kuri. Between Kuri and Payabila (a distance of 4 km) there is a stretch of dry savanna extending inland for 2.5 km. Payabila is located at the northeastern corner of Laguna Ibans. The area south of the lake is interspersed with savanna and swampland.

Laguna Ibans is separated from the Caribbean by a long, narrow spit of land that extends 17 km from Payabila to the mouth of the Río Sico. It ranges in width from 100 m at Cocobila to 700 m between Ibans and Plaplaya. Surprisingly, two-thirds of the local population lives along this narrow bar between Payabila and Plaplaya. Thus, the bulk of the indigenous people live on or near the coast; they are not involved with the exploitation of resources in the interior mountains of the Reserve.

BACKGROUND TO THE 1981 UNIVERSITY OF NEW MEXICO SURVEY

During the summer of 1980, a native Honduran graduate student from the Department of Anthropology at the University of New Mexico (UNM) visited Honduras with pilot research support from the Tinker Foundation. Working under the supervision of Associate Professor J. Froehlich, the graduate student was motivated to encourage primate conservation in his native land and to identify undisturbed areas where howler monkeys (*Alouatta*) and spider monkeys (*Ateles*) were still sympatric, for possible future studies of behavioral ecology and competitive exclusion. During his visit he learned of the establishment of the Río Plátano Reserve. After a brief reconnaissance of the Reserve in which he ascertained its potential for research, he elicited the cooperation of RENARE for a possible UNM survey project. He also learned that RENARE

was especially concerned with scientific documentation and conservation publicity for the Reserve, in order to attract international attention and support.

With the attention of the UNM Anthropology Department attracted to the Honduran Reserve, a collaborative research protocol was developed in the fall of 1980. The primary objective of this proposal was to document floral diversity in the Reserve and the associated variation in mammalian fauna, particularly as the latter was influenced by human predation. At this stage of the research, censusing of monkey populations for future research was of secondary, though not trivial, concern.

Since the Reserve contained a significant indigenous human population with a long history of local resource exploitation, it closely conformed to the guidelines of the MAB program. In an underdeveloped geographical region noted for its land tenure problems, the Honduran Río Plátano Reserve provides a test case for the ideal of conservation management within the context of controlled and protected indigenous land use. Obviously such management requires a detailed knowledge of indigenous cultural ecology (Cultural Survival, Inc., 1982). Reciprocally, the success of the Reserve requires the cooperation and sympathetic support of the local people, once they are informed of broad conservation issues. Thus, it was considered essential to complement the preliminary faunal survey work with an assessment of the cultural utilization of forest resources by the local population. With a broad background of studying similar problems in South America, Professor K. Schwerin was recruited to begin comparative studies and to provide the baseline data for informed management decisions.

With moderate support from the New York Zoological Society, the ultimate objective of this preliminary UNM survey of the Reserve was to make recommendations regarding its management and future conservation support. Thus, the details of the research design followed these guidelines. Students and a postgraduate voluntary botanist carried on the research when the principal investigators had to return to teaching duties. This maximized the data collection, albeit the limited amount of logistical support curtailed the faunal and floral surveys to all but the periphery of the virtually inaccessible Core Zone. River travel into the interior mountains was

hazardous and costly, since it could only be managed during dry weather by hired boatmen. Nevertheless, the peripheral area near the boundary of the Cultural Zone is also the region of greatest human impact; thus, the results of intensive survey work in our two study areas relate directly to the degree of human resource exploitation.

Similarly, the cultural survey was carried on with the objective of ascertaining the ethnographic side of resource utilization. Data collection during the brief intersession by the principal ethnographic investigator was extended only slightly by an anthropologist in Honduras, Fernando Cruz. Nevertheless, there was time to achieve an impressionistic foundation for later studies and to entertain a secondary consideration; namely to what extent will the "protection" provided by the biosphere structure of the Reserve prevent the local population from natural progress? In the final analysis, the overriding issue of this investigation and of the results reported here is the reconciliation of the competing interests between indigenous human development and the international concern for conservation of natural resources, especially the large, endangered mammals.

II. A CULTURAL SURVEY OF THE RÍO PLÁTANO RESERVE

Karl H. Schwerin and Fernando Cruz

INTRODUCTION AND HISTORICAL BACKGROUND

The Mosquito Coast extends from the mouth of the Río San Juan, which marks the border between Costa Rica and Nicaragua, northward along the Caribbean coast of Nicaragua to Cabo Gracias a Dios, a distance of nearly 500 km. From there it angles northwestward and then more or less due west as far as Cabo Honduras near the city of Trujillo, an additional distance of 350 km (Conzemius, 1932:1). In Honduras this region is referred to as "La Mosquitia." The territory also includes the adjacent low-lying coastal plain, which in the vicinity of the Río Coco extends upriver as much as 500 km.

Several distinct ethnic groups occupy this region, but the predominant population is Miskito. While there are no reliable figures on the numbers of Amerindians in Honduras, we would guess that there may be 10,000 or more Miskitos. The best available evidence suggests that the Miskito did not exist as a distinct population at the time of European contact. Rather, they represent an emergent culture which developed as an adaptation to contacts with the English buccaneers who frequented this coast. The buccaneers took native women as concubines and sometimes even as wives. Native men frequently accompanied them to sea, sometimes for long periods, to assist in provisioning the pirates. Shipwrecked and escaped Negro slaves also took refuge on the coast. The Miskito have never had any reservations about marriage with outsiders, and as a result the population is very mixed genetically, with some Caucasian and a strong admixture of Negroid traits. On the whole the Miskito are much darker than the average Amerindian, and they not infrequently exhibit various Negroid phenotypic traits.

The outside (or European) contacts also provided many desirable trade goods, but among the most valued were firearms. The possession of firearms enabled the Miskito to raid their neighbors, some of whom they captured and sold as slaves. Gradually the other tribes withdrew into the interior, in order to protect themselves from Miskito raids. Meanwhile, the Miskito

spread up and down the coast from the vicinity of Cabo Gracias a Dios until they reached from Cabo Camarón in Honduras to the Río Escondido in southern Nicaragua. Although they tended to prefer coastal settlements, they also expanded far into the interior, following the course of the Río Coco (Helms, 1971:18-19.).

Early Miskito seem to have lived in small scattered family groupings. They subsisted as much by fishing and hunting as by agriculture. Associated with these patterns was a relative degree of residential mobility. This undoubtedly facilitated the ease with which they took up trade and travel with the English. As they expanded, they borrowed freely in a cultural sense. Not only did they acquire trade goods, but the Miskito language is marked by extensive borrowing of English terms. Other words and ideas were acquired from their Indian neighbors or adopted from immigrant Negroes. Yet their own identity remained strong. Because the Miskito are matrilocal, the resident core of related women served as a focus for group stability and a context for traditional socialization of the young. In this way Miskito culture and values have been maintained as a dominant force in their society, even in the face of massive external influences (Helms, 1971:24-25).

Although the Spanish claimed sovereignty over the Mosquito Coast, they never discovered gold or other desirable resources there; and since some natives were hostile to them, they never exercised effective control. Thus, when English buccaneers arrived in the latter part of the 17th century, they found a political vacuum. The many lagoons and tortuous channels which stretch along this coast offered a haven from which to prey on Spanish shipping. In return for a safe refuge, the English offered the natives a variety of attractive trade goods, such as cloth, beads, machetes, rum, guns, and ammunition. Eager to obtain trade goods, the Miskito began to raid their neighbors in quest of loot and slaves, which could be exchanged with the pirates. In time it was found that the English were interested in several local products such as dyewoods, tortoise shell, sarsaparilla, cacao, pelts, and rubber, which the Miskito were able to supply. They rather quickly became dependent on this trade for their basic economic needs (Helms, 1971:21). In order to protect their interests, the English established a protectorate over the coast, which was

maintained until pressure from the United States in 1860 forced them to abandon all claims in favor of Honduras or Nicaragua.

At this time there was an important change in the nature of coastal exploitation. Trade or barter by individuals was replaced by large investments of foreign capital in an attempt to exploit single large resources intensively. The local population continued their accustomed dependence on trade and imported goods, but now they were often forced to sell their labor as part of a labor gang, rather than selling local products which had been collected individually. Since about 1860 the Mosquito Coast has been characterized by a series of boom-and-bust cycles in which one product has been replaced by another. Helms (1971:27-29) documents the succession of rubber, mahogany, gold and silver, bananas, and pine up to 1960. These have been followed since 1960 with turtling (to produce green turtle soup) in Nicaragua (Cattle, 1977), and diving for lobster in Honduras.

One other important influence among the Miskito has been the Moravian Church. Moravian missionaries from Germany first arrived in Bluefields, Nicaragua, in 1849. They seem to have been enthusiastically accepted by the Miskito, for Moravian congregations are found throughout the Nicaraguan Mosquito Coast. The Moravians are to be noted for their training of native personnel to assume major religious functions; many Miskito congregations are served by native lay pastors.

In Honduras, however, Moravian activity was not begun until 1930. Once again, their impact spread far and wide (Marx, 1980). A well-equipped hospital is located in Ahuás. Two light planes are maintained there for purposes of transporting the ill from any part of the Mosquitia for treatment, and there is radio contact with most communities that have a minister or pastor. At the present time there are ten ordained Miskito ministers and 22 native lay pastors. In 1980 the Moravian congregations of the Mosquitia established a school in the town of Brus Laguna to train Miskito pastors. At the present time, however, contact with the Moravians in Nicaragua appears to be minimal.

Residents of the Mosquito Coast generally distinguish three groupings of Miskito: those

who live along the Nicaraguan coast (cf. Nietschmann, 1973; Cattle, 1977), those who live along the Río Coco (cf. Helms, 1971), and those who live along the Honduran coast. It is with the latter, or Honduran Miskito, that we are concerned here.

Although the Honduran Mosquitia is primarily occupied by Miskito, several other ethnic groups are also found. A small community of Sumo Indians is reputedly located on the Río Patuca. An even smaller settlement of Paya mixed with Miskito is found in Las Marías on the Río Plátano. Several sizable communities of Garífuna (Black Caribs) are located along the western coast of the Mosquitia (the easternmost of these, Plaplaya, is located just within the bounds of the Río Plátano Reserve). Finally, a few Ladinos from the highlands are also scattered throughout the region. Most are government officials, or members of the Armed Forces, a few are merchants or boat owners, and some are small farmers or cattlemen who have recently entered the region in search of new economic opportunities.

SURVEY METHODS

The cultural survey was designed to begin assessing the environmental impact of the human population living within the Reserve. This was to be achieved through the use of interviews, participant observation, surveys of garden plots, and quantification of resources taken from the Reserve. It was projected to include a Honduran anthropologist who would work on the initial survey and be able to continue the work after the principal investigator (K.H.S.) left. For this purpose, the collaboration of Lic. Fernando Cruz of the Instituto Hondureño de Antropología e Historia (IHAH) was obtained. Because of teaching duties and other conflicts, field work was limited to the month of January, 1981. Consequently, we were only able to achieve a very good overview of the distribution of the population within the Reserve, and a qualitative picture of their use of local resources. We were, however, unable to obtain the quantitative data that was desired.

HUMAN DEMOGRAPHY AND DISTRIBUTION

In 1980 RENARE (n.d.) reported a population of 2655 within the boundaries of the

Reserve. The vast majority of these are Miskito (1824) or have at least one Miskito parent or two Miskito grandparents (218), for a total of 77%[1]. Miskito are dominant in almost all the coastal settlements except Plaplaya (mostly Garífuna) and Payabila (see Table II-1). At Las Marías the population (74 total) is almost evenly divided between Miskito (21), Paya (30), and other (23), with the Paya having a slight edge (but still comprising only 2% of the Reserve's total population).

Table II-1. Population distribution of people living in the Río Plátano Reserve (after RENARE n.d.).

Location/Ethnic Group	Miskito	Miskito-Paya	Paya	Garífuna	"English"	Sambo	Ladino	TOTALS
Baltiltuk/Búlebar Las Marías	74	11	54		3		2	144
Envidil/Guapinyari	4						18	22
Barra Plátano	343						61	404
Kuri/Tasbapauni/ Utla Almuk	292	6				15	5	318
Payabila	23				6			29
Belén	114						5	119
Cocobila	422			3			20	445
Ibans	644			1	1		32	678
Plaplaya	109		1	333			53	496
TOTALS	2025	17	55	337	10	15	196	2655

The most interior settlements in the Reserve, Baltiltuk, Las Marías, and Búlebar, are all located on the Río Plátano within three km of one another, near the point where the coastal plain gives way to the mountains (Figure II-1). RENARE (n.d.) gives a population for these settlements of 144 (5% of Reserve total), of which 74 are Miskito, 54 are Paya, 11 are Miskito-Paya, and 5 are other (Glick [1980:61], however, reports only 17 pure Paya Indians, "almost all of advanced age" and rapidly being assimilated by the dominant Miskito culture.) Physically, the Paya are more characteristically "Indian" in their features. They tend to be shorter than the

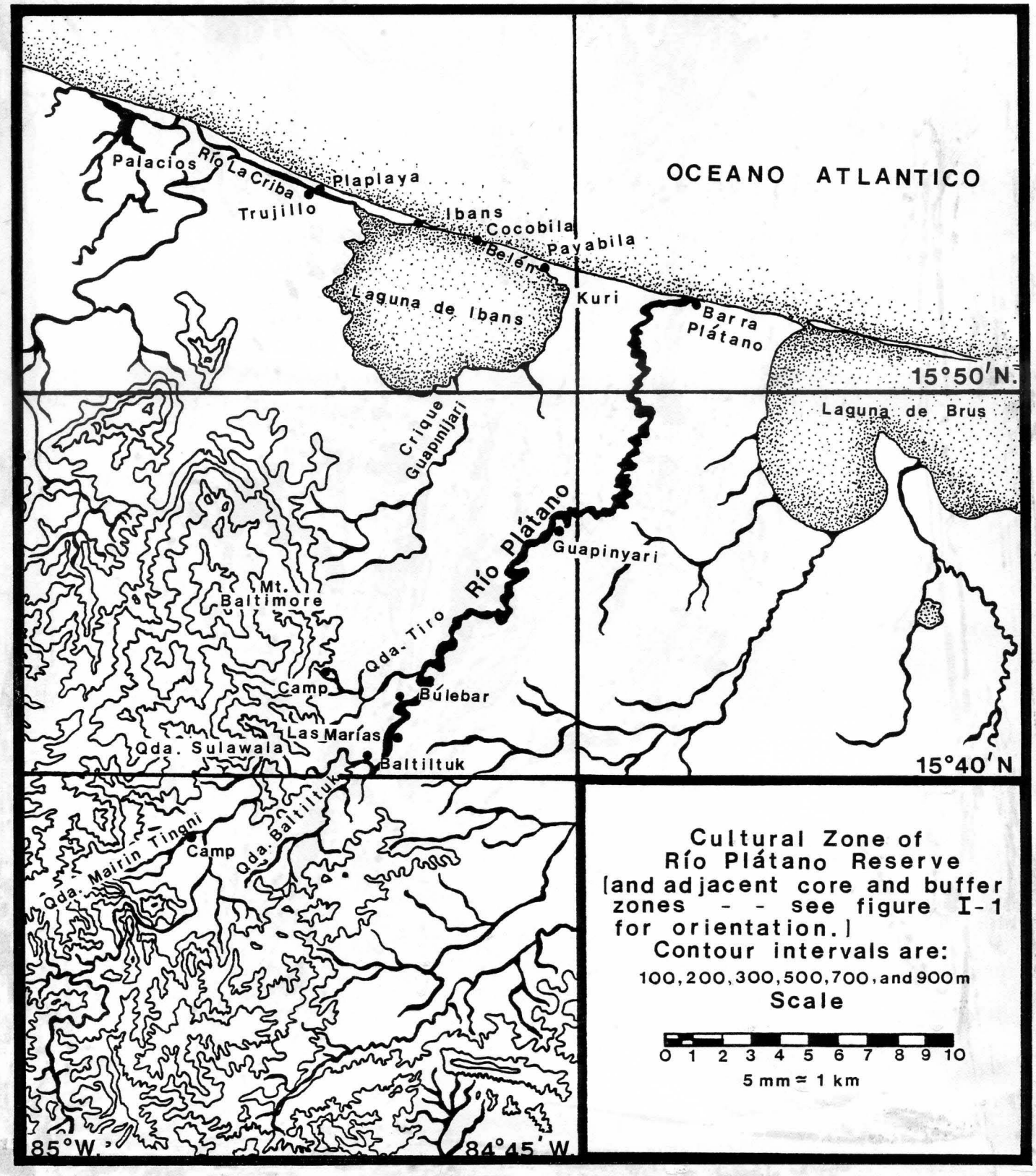


Fig. II-1. The Cultural Zone of the Río Plátano Biosphere Reserve with the place names and landmarks mentioned in the text.

Miskito and they would fit easily within Indian populations of Amazonia. The Miskito are much more difficult to characterize, for in general they exhibit characteristics of both Indian and Negroid types, while particuilar individuals may also bear traits which might be identified as coming from one or another European stock.

Further downstream Guapinyari and Envidil are reported with 22 inhabitants (less than 1% of the Reserve population), 18 of which are Ladino and only 4 Miskito. In sum, only 6% of the Reserve population lives along the river in the interior of the Reserve.

At the mouth of the river, Barra Plátano has a population of 404 (RENARE, n.d.). This is perhaps the most mixed group within the Reserve – 343 are listed as Miskito and 61 as Ladino. A range of individual characteristics was personally observed in that community, from the dominant mean associated with the Miskito, to pale skin and light brown straight hair on one end of the spectrum and very dark skin, black tightly curled hair and other Negroid characteristics on the other. It would appear that there has been and continues to be a great deal of racial and ethnic mixture going on in Barra Plátano, which by itself would be an extremely informative topic for detailed genetic investigation.

West of Barra Plátano the settlements of Tasbapauni, Utla-Almuk and Kuri contain a population of 318 (12%). With the exception of 15 Sambos (mixed Black and Indian) and 6 mixed Payas, almost all the rest are Miskito. Some of the Sambos have Miskito mates and thus some of the children are rather darker than the mean among Miskito. Twenty-seven percent of the population is located from Barra Plátano to Kuri, the remaining 67% lives from Payabila to Plaplaya.

Payabila has only 29 inhabitants, of which 19 are "English," i.e. English-speaking Blacks from the Bay Islands. Some of these have Miskito spouses. Belén has a population of 119, predominantly Miskito. Just west of Belén is the larger community of Cocobila with 445 inhabitants, also predominantly Miskito. Ibans, with 678 people, is the urban center of the Reserve, and again it is a mostly Miskito community, with 20 resident Ladinos. The westernmost town of the Reserve is Plaplaya, and here we encounter a radical ethnic shift. Only 109 of the 496 inhabitants are Miskito, and 53 are Ladino. The remainder are Garífuna or Black Caribs (13% of the

Reserve population). The Garífuna are descendants of escaped slaves who sought refuge among the Island Carib of the Lesser Antilles. They learned the Carib language and created a distinctive syncretism combining African and Carib cultures. The British removed them to Roatan Island, and from there they have spread along the Caribbean coasts of Belize, Guatemala and Honduras. Plaplaya appears to be the easternmost settlement of these Black Caribs, and thus marks the point of contact between these two expansive and culturally vital ethnic groups – the Garífuna and the Miskito.

COMMUNICATION AND SERVICES

No roads exist in the Río Plátano region, nor do any even approach the area. The usual mode of access is by small boats (*goletas*) which travel irregularly between La Ceiba and Brus Laguna, disembarking passengers and supplies along the coast. There are at least two or three boat owners in Ibans, Plaplaya and Trujillo (on the south side of Río la Criba across from Plaplaya, but outside the Reserve). Such travel is slow, unreliable, and dependent on good weather.

There is weekly air service by DC-3 with LANSA airlines from La Ceiba to Brus Laguna and Ahuas. From Brus Laguna it is possible to contract a small boat or *tuctuc* ("putput" – a large dugout canoe equipped with an inboard motor and a rudder) to carry one across the lagoon to Barra Plátano. In conjunction with the LANSA DC-3 flight, a small plane flies from Palacios, at the western edge of the Reserve, to Brus Laguna before returning to Palacios and La Ceiba. It can carry three passengers on each leg of the flight. LANSA agents in Brus Laguna and Palacios are in radio contact with the company office in La Ceiba. From Palacios it is again possible to contract a *tuctuc* to carry one as far as Payabila.

Belén has a landing strip adequate for small planes. There is also a very short landing strip at Las Marías. These are used principally by Moravian missionary pilots based in Ahuás. They make unscheduled but continual flights throughout the Mosquitia. There are no clinics, dispensaries or other modern health services within the Plátano Reserve, but the missionary planes are

on constant call to fly the sick out to the excellent hospital maintained by the Moravians in Ahuás. Their planes, which hold five passengers, are utilized principally for medical assistance and church business, but it is possible for others to obtain passage on a space available basis. There appears to be an average of about one flight per week to most of the settlements with landing strips.

In conjunction with this air service (Alas de Socorro), the Moravian Church maintains a radio network in the Mosquitia. There are 12 to 15 battery-operated radios in this network, distributed throughout the region; most are operated by the local lay pastors. In spite of the extent of this network, it is reported that there is no direct radio communication with the Moravians in Nicaragua. Local transmitters are generally on the air from 6:15 to 8:00 a.m. and again from 1:30 to 4:00 p.m. The central transmitter is at Ahuás, and this broadcasts daily from 8:00 a.m. to 12:00 p.m. The principal function of this radio network is to make up flight plans for the movement of people among the various stations and especially to and from Ahuás. Other messages are, however, transmitted through the system, such as information on legal papers, health matters, the secondary school at Brus Laguna and the students attending it, personal requests, police messages, and requests for specific items. There is a charge of L. 0.10 for each message sent. Users are allowed to broadcast only in Spanish and English. The government is said to prohibit communication in Miskito on this network.

The Moravian lay pastor in Las Marías, where malaria is an endemic problem, operates one of these two-way radios. Since the minister in Cocobila, Rev. Walter Navarro Allen, serves as administrator for the Moravian Church in Honduras, he operates another of the principal centers of radio communication for the Moravian network.

Travel within the Reserve is almost wholly by one or another form of dugout. The larger *tuctucs* are used on the lagoons and for deep water along the lower stretches of the Río Plátano. The smaller dugout *cayucos* are also used on the lower stretches of the river, as well as in crossing the surf to communicate with boats lying offshore and to carry passengers and freight. These are generally paddled by hand, although they are sometimes fitted with an outboard motor. The

local director of the Reserve has two flat-bottom aluminum boats which are used on the river. Special flat-bottomed dugouts called *pipantes* are used for traveling further upstream, through the rapids. They are designed for poling, although they may also be paddled. Along the beach there is constant foot travel among the various settlements. A trail also connects Las Marías and Payabila, but it is said to be used mostly for driving cattle to the coast during the dry season.

Religion is an important factor in the life of many Miskito and a church is maintained in most of the larger settlements. Rev. Allen is an ordained minister and he is also responsible for the Moravian congregation in Cocobila, which numbers 218 adult members and 143 baptised children. Another church in Ibans is served by a student pastor, and there are additional churches in Barra Plátano and Las Marías with lay pastors in attendance. One of us (F.C.) found that approximately 40 people regularly attend church in Las Marías. Whereas the Miskito are predominantly Moravian, or else not affiliated with any particular church, the Garífuna of Plaplaya are predominantly Roman Catholic. There is a Catholic church in that community, but there is no information on whether it is attended by a priest. Rev. Allen reports that recently members of the Baha'i sect attempted to proselytize in Cocobila, but there is no continuing Baha'i presence.

Public schooling is available in most of the larger settlements. There are schools in Plaplaya, Ibans, Cocobila, Belén, Utla-Almuk, Barra Plátano and Las Marías. The school in Las Marías offers only the first three grades. The others all offer the full six grades (RENARE, n.d.).

As indicated above, there are no modern health facilities within the Reserve. However, wells have been sunk in some settlements to provide a source of uncontaminated water. Such wells, provided with a hand pump, were observed in Barra Plátano and Kuri.

ECONOMIC ACTIVITIES – HORTICULTURE

Even though people living within the Reserve engage in a variety of economic activities, agriculture remains the basis of their subsistence (although it is not necessarily the most lucrative). In our brief survey we identified 38 distinct species of cultivated plants (Table II-2). Some,

such as manzana rosa (*Eugenia jambos*), toronja or grapefruit (*Citrus paradisi*), cereza (*Eugenia uniflora*), manzana (unidentified), and floripondio (*Datura aborescens*) seem to be grown primarily as novelties. Others, such as orange (*Citrus aurantium*), limón (*Citrus aurantifolia*), ciruela (*Spondias purpurea*), almendra (*Terminalia catappa*), mango (*Mangifera indica*), avocado (*Persea americana*), pineapple (*Ananas comosus*), cashew (*Anacardium occidentale*), papaya (*Carica papaya*), guava (*Psidium guajava*), sapote (*Pouteria* sp?), are grown for their seasonal fruits. The principal staple crops within the Reserve are manioc (*Manihot utilissima*), malanga (*Xanthosoma* spp.), bananas (*Musa* spp.), rice (*Oryza sativa*), maize (*Zea mays*), and beans (*Phaseolus vulgaris*). Their relative importance seems to be more or less in the order listed. We recorded nine different varieties of manioc and nine varieties of bananas which are grown locally, as well as four varieties of rice and three varieties of malanga. These are supplemented with breadfruit (*Artocarpus communis*), coconut (*Cocos nucifera*), and pejibaye palm (*Guilielma gasipaes*) in the vicinity of Las Marías.

Fields are cleared toward the end of the wet season or beginning of the dry season, December to March. Along the coast a manzana (100 yards x 100 yards) of forest 40 feet high will take about five person-days to clear, using machetes and axes. We have no comparative data on the labor involved in clearing more mature secondary forest upriver, but we would guess that it would be comparable or perhaps require a slightly greater investment of labor. Wage labor in the fields is paid L. 4.00 (L. 2.00 = $1.00 U.S.) per day, without meals. (The presence of outside scientists is starting to inflate this to L. 6.00.) The slash is left to dry for about three weeks. It is burned in one day and the crops are planted the next. It is said that if the burned field is left too long without planting, the crops will not grow well and the effort will be lost.

Beans and maize are planted in January, the beans are harvested in March and April, and the maize in May. Maize may again be planted in April or May and harvested in September or October. However, judging by the fact that numerous people were drying and winnowing rice during the time that we were in the Reserve in January, it seems probable that rice may be planted as late as July. Rice and maize do not require much care and are thus extensively

Table II-2. Plants cultivated in the Río Plátano Reserve.[2]

Honduran Name	English Name	Scientific Name
aguacate	avocado	*Persea americana*
algodón	cotton	*Gossypium* sp.
almendra	tropical almond	*Terminalia catappa*
arroz	rice	*Oryza sativa*
café	coffee	*Coffea arabica*
camote	sweet potato	*Ipomoea batatas*
caña (de azúcar)	sugar cane	*Saccharum officinarum*
cereza	Surinam cherry	*Eugenia uniflora*
chile	chile peppers	*Capsicum* spp.
ciruela	------	*Spondius purpurea*
coco	coconut	*Cocos nucifera*
floripondio	Gabriel's trumpet	*Datura arborescens*
frijol	beans	*Phaseolus vulgaris*
guanábana	guanabana	*Annona muricata*
guayaba	guava	*Psidium guajava*
guineo	banana	*Musa* spp.
jícaro	calabash	*Crescentia cujete*
limón	lime	*Citrus aurantifolia*
maïs	corn	*Zea mays*
malanga	yautia, malanga	*Xanthosoma* spp.
mango	mango	*Mangifera indica*
manzana	------	?
manzana rosa	rose apple	*Eugenia jambos*
marañón	cashew	*Anacardium occidentale*
mazapán	breadfruit	*Artocarpus communis*
naranja	orange	*Citrus aurantium*
nopal	prickly pear	*Opuntia* sp. or *Nopalea* sp.
palma africana	African oil palm	*Elaeis guineensis*
papaya	papaya	*Carica papaya*
pejibaye	peach palm	*Guilielma gasipaes*
piña	pineapple	*Ananas comosus*
plátano	plantain	*Musa* spp.
sapote mamey	------	? *Pouteria* sp
té limón	lemon grass	*Andropogon citratum*
toronja	grapefruit	*Citrus paradisi*
uraco sapote	------	? *Pouteria* sp.
yuca	manioc	*Manihot utilissima*
?	castor bean	*Ricinus communis*

planted. Beans, however, are tricky and have to be more carefully tended.

While manioc and bananas may be planted almost any time of the year, local farmers maintain that they do best if planted during the dry season – January through May. They do not produce as well if planted during the wet season, and bananas may even die if planted during stormy weather. Manioc needs to be weeded twice during the year. After a year's growth, one plant may produce ten pounds of tubers. Sweet potatoes (*Ipomoea batatas*), which also take a year to mature, are much less productive.

We were told by one farmer that he was cultivating 2½ *manzanas* (2.1 ha) of manioc and one *manzana* (.84 ha) of malanga, which he supplemented with eggs, poultry, and livestock. Another farmer reported that each year he plants 2 *tareas* of manioc (.4 ha), one *manzana* of bananas, one *tarea* (.2 ha) of beans, one *manzana* of rice, and needs to produce 25 *cargas* (2275 kg) of maize in order to feed his family. On the basis of these very limited data, it would appear that the average family needs about 3 *manzanas* (2.5 ha) per year to provide for its basic subsistence. This suggests that somewhere between 1500-1600 *manzanas* (1250-1350 ha) need to be under cultivation each year to provide for the residents of the Reserve. However, due to other sources of income (see below), it seems likely that less than this is actually cleared and planted. Even so, there is undoubtedly more than sufficient land, that is suitable for agriculture and easily accessible within or adjacent to the Cultural Zone, to provide adequately for the needs of the present population. Furthermore, not all of those who live within the Reserve and engage in agriculture are dependent on Reserve lands for purposes of farming – many, for example, have fields along the Río Sico.

Close to Barra Plátano there is no really good agricultural land; most lies some distance upriver. Fields are cleared and planted along both sides of the river to such an extent that almost all the vegetation visible from the river between Barra Plátano and Las Marías is clearly secondary growth. In fact, the Río Plátano derives its name from the abundance of bananas growing in both cultivated and abandoned fields all along its length. A few families live in permanent habitations scattered along the river, while others reside there only seasonally.

In January and February, those who have fields along the river take the whole family upstream and spend anywhere from a few days to several weeks in clearing and planting. They do not come back downstream unless they need something from Barra Plátano. Families from that settlement seem to cultivate at least halfway upstream toward Las Marías. At about the midway point there is a small permanent settlement (Guapinyari) with three or four houses. People from Las Marías come downstream to farm along the margins of the river. They also travel upstream as far as the mouth of Quebrada Sulawala (about 7 km or 2-3 hours by dugout),

and there is heavy utilization of the area along Quebrada Baltiltuk where people have planted fields at least 5 km upstream. Another attraction of the latter creek is that there is considerable game in the area which it drains.

Because the soil along the course of the river is recently deposited alluvium, it is generally soft, easy to work and very fertile. Although fields may be damaged by periodic flooding, this same process serves to renew the fertility of the soil. Thus river banks and flood plains are extremely attractive to agriculturists all over the world. As Denevan and Schwerin (1978) have shown in Venezuela, this type of farming can be extremely productive. River bank fields can be maintained under nearly permanent cultivation; under certain circumstances rather sophisticated techniques of cultivation and water management have been evolved. Unfortunately, we have no information on how long fields are cultivated in the Reserve.

There was no opportunity to examine first-hand any of the fields located along the course of the Plátano River, but it was reported that they extend back from either bank of the river no more than 500 m. Thus, there is a narrow strip of agricultural land parallelling the river. The actual length of the river between Barra Plátano and Las Marías is close to 50 km, but because the course is sinuous (with the internal diameter of many of the curves less than 1 km) and not all areas are suitable for agriculture, we might consider that only 30 km is available for cultivation, thus a reasonable estimate is 30 km^2 along the Río Plátano and another 5 km^2 along Baltiltuk Creek. This is 3500 ha or nearly 3 times as much land as was calculated above for the support of the whole Reserve population. Even with periodic abandonment of fields and reclearing of secondary forest, there appears to be sufficient cropland to support the current and anticipated populations without impacting the Core Zone of the Reserve.

Although there are few or no fields at Barra Plátano (except for small house gardens adjacent to the dwellings), there are suitable, if limited, areas for fields along the inland side of the sand bar which stretches from the mouth of the Plátano to the mouth of the Río Sico. There are a number of fields in the vicinity of Kuri, but the most intensive area of cultivation is at Cocobila where we measured, by pacing, roughly 3 *manzanas* (2.5 ha) under cultivation. Simi-

lar fields are also planted at Belén and Ibans, and it seems probable that they exist at Plaplaya as well.

The inhabitants of Payabila evidence an unusual interest in agriculture and a spirit of curiosity and experimentation which is noteworthy. We identified a total of 15 cultivated species in that settlement, which is remarkable considering there are only about five houses. It is second only to Belén in number of species observed. Furthermore, five of these species were not observed anywhere else within the Reserve, and two more were identified in only one other locale. However, there are no large fields at Payabila, most of the staple crops such as manioc, malanga, and bananas are planted in fields located across Laguna Ibans. The same is true of Belén and Cocobila, where fields planted behind the beach ridge near the habitations are primarily for convenience and remain secondary to those planted across the lagoon. Although we were unable to determine precise locations, it seems probable that most or all of these are nonetheless within the designated Cultural Zone. There is no evidence, however, that any of the inhabitants from Payabila westward utilize the banks of the Río Plátano for agriculture.

For agricultural purposes the people at Ibans appear to be oriented outside of the Reserve. They travel to the Río Sico, a distance of four hours or more by motorboat, in order to clear and plant their fields. They may remain several weeks at a time at the fields, and frequently one or more persons is left there as a permanent caretaker. It is our guess that people from Plaplaya also utilize the Río Sico for their staple crops, rather than locations within the Reserve.

HUSBANDRY

Locations on the Río Sico are also attractive because cattle and pigs can be cared for there without bothering one's neighbors. In all the settlements along the coastal portion of the Reserve, people seem to have voluntarily abandoned the raising of pigs because of the depredations which they cause to fields and gardens. Only in the vicinity of Las Marías are the fields sufficiently isolated from the settlement that people are able to keep pigs without difficulties. Probably this also explains why it is the only settlement where goats were observed. Pigs from

Las Marías may be butchered and sold in Barra Plátano at L. 1.20 per pound, bringing the owner a total return of L. 80-100.

Cattle are more common, although we have no good impression as to what proportion of the inhabitants actually own cattle. However, residents in Ibans, Cocobila, Payabila, Kuri, and Las Marías all reported owning cattle. Herds seem to range from 14 to 60 head; one young man in his early twenties owns five head, intermixed with his father's herd. The livestock census of 1974 reported 4,238 cattle for the region (Cruz et al., 1978:43).[2] Cows are worth L. 300-400 per head. At least two individuals with large herds also own a few horses. People from Ibans keep their cattle on the Río Sico. Most of the cattle from Cocobila and Payabila are run in the savannas south of Laguna Ibans. Cattle owners at Kuri run their cattle in the savannas near the lower end of the Río Plátano, while those at Las Marías allow their herds to wander through the forests in the vicinity of their homes. In this locale, cattle cannot be allowed to range too far from the centers of habitation, lest they be attacked by jaguars (as occasionally happens anyway, even near Kuri).

Muscovy ducks (*Cairina moschata*) were observed at Las Marías and guinea hens (*Numida meleagris*) in Cocobila. However, chickens (*Gallus domesticus*) are the only poultry which seems important. They are kept in several settlements. The eggs are eaten by the owners, or sold for 20 centavos apiece. Chickens are sold infrequently, but may bring L. 6.00 each.

HUNTING AND FISHING

Because of the short period of time in the Reserve, we were unable to get a very satisfactory impression of hunting activities. It would appear, however, that hunting is a continual pursuit. It is reported that men rarely travel upstream or go to their fields without a gun in hand. A man may travel for one to four days away from home in search of game. Our impression is that at the present time these hunters are only moderately successful. It is also more difficult to hunt during the dry season because it is harder to follow the spoor. Yet, in general it appears that hunting pressure has been intense. There is little game in the vicinity of habitation,

and it appears to remain scarce even at considerable distances from permanent settlement. The upper drainage of Baltiltuk Creek is said presently to be a good hunting area, especially for white-lipped peccary (*Tayassu tajacu*). But spider monkeys (*Ateles geoffroyi*) and deer (*Odocoileus virginianus*) are rare in all the more accessible areas. The predatory cats are also uncommon, but when they intrude they are sometimes shot in defense or for their pelts; the latter is true also for the otter (*Lutra annectens*). Pelts of these species can be sold in Brus Laguna.

The most common game appears to be white-lipped peccary, but even these seem to be taken infrequently. Almost every portion of the peccary, which may weigh 36-41 kg, is used in some way. Curiously, the tapir (*Tapirus bairdii*) is also relatively common, to judge by the frequency of its spoor. However, it is most active at night and is thus rarely seen or killed. There are also manati (*Trichechus manatus*) in Laguna Ibans. Formerly they were hunted by the local inhabitants, but this species has been protected since 1979 and it is said that they are no longer pursued. It would not be surprising, however, if one is occasionally taken illegally.[3]

In contrast to the paucity of mammalian fauna, birds are abundant in and near the Cultural Zone of the Reserve. Some of these, such as the pajuil (*Penelope purpurascens*) and chachalaca (*Ortalis garrula*) are certainly hunted, but we have no data on the intensity with which they are pursued. Marcus (1981) includes these two species along with the macaw (*Ara ambigua*) and the dove (*Leptotila verreauxi*) as the most important of the 16 bird species that are hunted within the Reserve. There is also an abundance of reptiles, but only the turtles (tortuga pintada, *Rhinoclemmys funerea*, and tortuga negra, sp. unidentified) and iguanas (*Iguana iguana*) are regularly hunted. One species of turtle is said to inhabit both the lagoons and the river, but there is a second species which occurs exclusively in the river. Iguanas are taken almost anytime they are encountered. We have no information on whether caiman (*Caiman crocodilus*) are regularly pursued.

There is also a good deal of fishing in the rivers and lagoons for species such as machaca (*Cichlasoma maculicauda*), mojarra (*Cichlasoma guttulatum*) and various *bagres* (catfish). As salinity levels vary, ocean species may enter the lagoons and the lower courses of the rivers,

making it possible to catch róbalo (snook, *Centropomus* spp.) and even sábalo (tarpon, *Megalops atlanticus*). Although hook and line or nets are commonly used, and spears or harpoons are employed for larger species, spearguns have recently become popular. There is some indication that spearguns, used in conjunction with face mask and flippers, have greatly enhanced the efficiency with which fish are taken, causing a decrease in their abundance. Local people complain that the fishing is not as good now as it was ten or fifteen years ago.

The most highly prized fish is the *cuyamel* (*Joturas pichardi*) which is abundant on the upper course of the Río Plátano in the stretches marked by rapids. The inhabitants of Las Marías make annual expeditions upstream for the express purpose of fishing for *cuyamel.* Large numbers are taken and dried for use in the village. Cruz, et al. (1978:52) also report their sale at L. 1.502.00 per fish to merchants from La Ceiba, but there are no data available on the frequency or magnitude of this commerce. Again, intensive spear fishing, with goggles and flippers, is said to have drastically affected the abundance of this species.

In contrast to the exploitation of the river and lagoons, there appears to be little or no fishing in the sea. This is in spite of the former existence of a sport fishing camp near Barra Plátano and the fact that numerous young men from the area are employed in commercial lobster fishing off the coast.

HOUSING AND BUILDING MATERIALS

Although there appears to be little gathering of edible foods from the wild vegetation, a variety of arboreal species is utilized for construction materials and other purposes. A very durable house siding which will last 20 to 25 years is made by overlapping split stems of the yagua palm (*Paurotris* sp., or possibly *Scheelia* sp.?). This species grows in standing water or at least in areas that are seasonally flooded. The wood is so valued that trees are generally cut down whenever they are encountered. When yagua is unavailable, the stems of tique (*Geonoma* sp.) may be substituted. This is a small palm, 1.5 -5 m tall, which grows in clumps on the savanna. The stems, which are much less durable than yagua, are also used for fencing. Tarro, a

bamboo, is another material used as house siding. The siding may be left as is, but is sometimes painted a bright color. Tique leaves are widely used for roof thatch, and are lashed into place individually. Leaves of the suita palm (*Calyptrogyne sarapiquensis*) are preferred over tique for thatch. They are lashed together on a pole 1-2 m long; the poles are then lashed into place on the roof. The suita is a common element of the rain forest around Las Marías. Occasionally a newer house is roofed with corrugated sheets of zinc. Miskito houses are typically raised off the ground about 1.5 m. House pilings are made from Santa María (*Calophyllum brasiliense*), cedro (*Carapa guianensis*), San Juan (*Tabebuia rosea*) or guanacaste (*Enterolobium* sp.). Curiously, there does not seem to be much use of the Caribbean pine (*Pinus caribaea*), which is abundant throughout the region, except for torches and fire starters.

Trees with desirable wood are cut down in the forest and floated downriver to the settlements. Planks for construction are laboriously sawed from these logs by hand. We would guess that these offer a minor source of income. There is also some evidence for part-time carpenters who work at building houses. They can earn about L. 5.00 per day whenever their services are needed.

Miskito houses generally consist of two structures. The larger building, with one or two rooms, may be 6-7.5 m long and 4.5-5.5 m wide. It serves for daily activities, sleeping, storage, and visiting. Families which are better off may furnish these rooms with a table and chairs. Poorer families may only have benches. A smaller structure adjacent to this serves as kitchen and dining room. An adobe stove, constructed either on the floor or raised on a waist-high counter, is used for cooking. These are invariably plastered with an attractive white mud. Most kitchen utensils today are enamel, aluminum, plastic, or glass. No pottery was observed, and even calabashes (*Crescentia cujete*), which were observed growing in nearly every settlement, are rarely utilized any longer. Some women also own a sewing machine.

Santa María, cedro, San Juan, and guanacaste are also used in the manufacture of dugout canoes, as well as laurel (*Cordia alliodora*), caoba (mahogany, *Swietenia macrophylla*), cedro real (*Cedrela odorata*), and ceiba (*Ceiba pentandra*). Sometimes these are cut from the forest,

but often people just select a drift log from the river or beach. The rough shape is cut out with an axe, and then the canoe is finished with a curved adze. The wood is hardened and infestations of termites and other insects are killed by igniting a quick, hot fire of leaves inside the canoe. When it is very hot, the leaves are dumped out and the canoe is filled with water. Most families maintain at least one large canoe for long distance travel or carrying large loads, and one or more small canoes for local transportation. Small canoes used to sell for around L. 70, but recently the price has risen to L. 110. Larger dugouts may cost as much as L. 800, although one informant reported purchasing one, third-hand, for L. 300. While coastal craftsmen are skilled at making *cayucos* and *tuctucs*, there is general consensus that the best *pipantes* (flat-bottomed dugouts used for poling up rapids) are constructed by inhabitants of Las Marías.

OUTSIDE INCOME

Aside from house construction and the building of dugouts, no other local crafts were observed in the Reserve. (Bark cloth used to be made in Las Marías and is still preferred as a sleeping blanket, but today is obtainable only from communities on the Río Patuca.) The inhabitants of Las Marías engage in sporadic panning for gold along streams which lie upriver from the settlement. This does not appear to represent a major source of income, however. Conflicts occasionally erupt between the local inhabitants and outsiders who come in seeking gold. One gold miner was reported to be threatening with a pistol anyone who sought to travel past his camp.

The most lucrative activity in the region is diving for lobster. Large fishing boats come in from the Bay Islands and cruise the coast recruiting divers. According to Sixto George Weilang, local supervisor of the Reserve, the first lobster boats appeared in 1963. There were only about three divers in the whole Río Plátano area at that time, but many quickly took up the work. By 1966 there were 16, in 1967 there were 20, and by 1968 there were 40 divers. Today there are some 50 divers in Barra Plátano alone. While young men from the other coastal settlements have also taken up diving, they are much fewer in number.

Young men go out in pairs to sign on, each pair taking their own *cayuco* with them. One member of the team does the diving while the other serves as *ayudante* or assistant, paddling the *cayuco*, managing the gear, and unloading the lobster. They go out for 15 to 20 days, sometimes even a month. At first the boats only exploited the shallower lobster beds near the shore, and this was accomplished without scuba gear. These beds were rather quickly fished out, however, and they had to move into progressively deeper water. Today all divers use a mask and oxygen tanks and go down to a depth of 10 or 12 fathoms. They use a hook to pull the lobster from under the rocks and then kill it. Only the tails are preserved. Divers are paid L. 3.20 per pound, and can earn L. 800-900 per trip. Sometimes their earnings top L. 1000; sometimes they are as little as L. 400. The boat owners, however, sell the lobster to the packing companies on the Bay Islands for L. 12.00 per pound.

The best divers are 20-23 years old, although some boys start diving as early as the age of 12. This activity is not without danger. Local people complain about frequent injuries suffered by divers. A Peace Corps volunteer, who had accompanied the divers on one of their trips, reported that they receive little or no formal training and that they tend to surface too rapidly for the periods of time spent under water. Common complaints include pains in the joints, headaches, etc. One young man is said to have lost his eyesight.

More insidious, but perhaps with far greater repercussions in the long run, is the impact resulting from large sums of money made over a short period of time. Sometimes the boys receive a *pisto* or advance on their wages before going out to sea. At the end of the 2-4 week tour they are paid and returned home. Deductions are made for food, advances, and any damage to equipment. They are then given a check for the rest of their wages.

One problem is that there are no banking institutions anywhere near the Río Plátano; the nearest bank is in Puerto Lempira. There are, however, several cantinas or bars in Barra Plátano which will cash these checks, but only if the boys will first buy a liter of *aguardiente*. Local people complain that once they have had a liter of liquor they keep on drinking until the money has all been spent. There are six cantinas in Barra Plátano, two owned by local people, four by

Ladinos who have come from outside. Most observers are critical of the dissipation and alcoholism that have appeared here in the wake of the lobster industry. Since a liter costs L. 10-20, it is difficult to believe that the whole of a young man's wages is expended on alcohol. Undoubtedly some portion of it goes for clothing, transistor radios, or even one's family.

With all this ready cash, what *has* happened is a decline in subsistence farming, and a growing dependence on purchased foodstuffs. In addition to the cantinas, there are at least two relatively well-stocked stores in Barra Plátano. This is a pattern which strongly parallels the situation that developed among the Nicaraguan Miskito, where cash from the sale of green turtles to the soup canneries was utilized for the purchase of foodstuffs (Cattle, 1977). One would expect that the decline of nutritional status, which occurred in Nicaragua when purchased foods replaced those obtained locally, is being repeated here. In visiting Barra Plátano, one is impressed with the number of relatively well-dressed young men who are just standing around or wandering about. Older inhabitants complain that through the influence of the lobster boats young people want to earn a lot of money quickly. "They're not interested in L. 17-18 a day" (excessively high as a daily wage, to judge from other figures that were quoted to us). Nor do they have any idea of how to farm. "After two hours of poling a boat they are exhausted. They can't even carry 30 or 40 pounds as much as a half mile."

These criticisms are undoubtedly exaggerated, but it seems clear that many young men see little reason to engage in hard farm labor when large sums of cash are readily obtained through diving. Furthermore, young men with ready cash are no doubt more attractive to the young women than is a solid farmer who can offer only steady labor in the planting, harvest, transport and preparation of the crops produced in his field. We are likewise dubious about the extent of alcoholism which actually exists here. It is clear that there is excessive drinking when the divers arrive with their paychecks. Undoubtedly this represents a conspicuous display of their newly acquired wealth and a desire to impress their peers and neighbors. The degree to which this has resulted in addictive dependence, however, is quite uncertain.

There are several other major sources of income for inhabitants of the Reserve, which

taken all together may involve nearly two dozen families. These relate to commerce and professional employment. To begin with, there are the stores and bars. The bars deal primarily in beer and *aguardiente*, and are generally provided with a jukebox or record player for entertainment and dancing. They may, however, carry a small inventory of utilitarian items. At least some of the bars own a generator and are thus able to power a refrigerator and/or freezer, as well as provide their own electric lights at night. The bars are said to be very lucrative operations. There are six bars in Barra Plátano and at least two more in Belén-Cocobila.

Although we lack firm data on business investment and income, the stores give the impression of being equally profitable. The stores – two in Barra Plátano, and one in Ibans – were observed to be well-stocked and had a steady business. They were provided with kerosene refrigerators, the owners were well-dressed, and some had obvious amenities such as a gas range. Even people from Las Marías come to Barra Plátano to buy basic items such as salt, sugar, coffee and flour, as well as cigarettes, matches, flashlight batteries, and even clothing.

In Ibans a couple of well-to-do entrepreneurs have combined their resources to make an entry into the lobster fishing business. They had brought in a boat builder from the Bay Islands and at the time of our visit they had completed the hull of a good-sized lobster boat. It still remained to be fitted with a superstructure and an engine. In the meantime, however, they had bought an old dilapidated boat which they were refurbishing. In pursuing this work they had an extensive array of power tools which were operated off their own generator. At least one of the partners had begun as a school teacher, but had found greater rewards in pursuing these entrepreneurial activities.[4]

The position of school teacher appears to provide an ideal springboard for entering other financially rewarding occupations. In addition to the entrepreneur just cited, another former school teacher owns one of the most successful bars in Barra Plátano. Sixto George Weilang, the very competent local supervisor of the Reserve, continues in his role as teacher in one of the local schools. There are other teachers in Barra Plátano, Las Marías, Belén, Cocobila, Ibans, and Plaplaya. The evidence suggests that teachers earn somewhat more than the local average family

income.

The other local professional is the Moravian lay pastor. There are three of these within the Reserve, in Las Marías, Barra Plátano, and Ibans. It would appear that the income for lay pastors is about equivalent to that of the local average. In addition, however, there is the ordained minister Rev. Walter Navarro Allen who resides in Cocobila. He is also the administrator for the whole Moravian Church in Honduras. As such he carries on an active communication throughout the Mosquitia by radio, airplane, and correspondence. By virtue of his position and his responsibilities, his income is probably comparable to that of the local storeowners.

Finally, there are the employees of the Reserve. In addition to the local director, there were at the beginning of 1981, three forest guards who were performing a variety of duties during the initial phase of getting the Reserve operation off the ground. Their salaries are modest, and the Director frequently found himself in the position of having to pay out of his own pocket for supplies or services essential to maintenance of the Reserve operation and the responsibilities that entailed. Nonetheless, it may be expected that once the initial problems of getting the Reserve administration operational are solved, additional personnel are added to the Reserve staff, and the number of visitors to the Reserve increases, employment with the Reserve will also come to play a larger role in the local economy.

SOCIAL AND POLITICAL ORGANIZATION

Our visit was too short to ascertain very much about the subject of local social and political organization. It appears that the practice of matrilocal residence, prevalent among the Nicaraguan Miskito, also applies here. We did not collect any other information about family organization, although there are hints of the existence of some sort of extended family grouping.

Lay pastors seem to enjoy a certain respect and occupy a position of leadership at least within their congregations. We did not determine whether this extends to non-church members of the community. One might expect that an ordained minister would occupy a higher status

than the lay preacher, but there is no way of confirming this within the Reserve. The one ordained minister is clearly exceptional in that he heads the Moravian Church for the whole country.

In general, teachers appear to occupy a higher status and enjoy greater respect and influence than pastors. Even after leaving the profession, former teachers continue to be addressed as *Profesor.* They are invariably named as people of influence and knowledge within a given community, and they seem in fact to occupy a position of leadership. One or two influential individuals were also described to us as *politicos* or politicians who serve as local representatives for national political parties. From the limited data that we acquired, all or almost all of these leaders appear to function on an informal basis. No information was collected concerning formal political offices, or whether such positions even exist. There are one or two soldiers or national guardsmen posted to Cocobila to help in keeping the peace, but there was no indication of local judges or administrators. Clearly this whole area of social and political organization requires much more extensive investigation in order to clarify the general outlines, and intensive research to understand the functional details of these institutions.

No information was collected on the survival of aboriginal religious practices. The role of the Moravian Church in both religion and health care has been thoroughly discussed above. The church also serves to promote regional integration both through a common religious identification and also through periodic visits by delegations from one or more local Moravian churches to the congregations of other churches in the region. Within the Reserve, one old Paya man still practices the traditional herbal medicine.

UTILIZATION OF THE RESERVE AREA AND ITS RESOURCES

The area of most intensive human utilization of the Reserve area is along the littoral, a narrow band of beach and coastline stretching from the mouth of the Río Sico (at Plaplaya) to the mouth of the Río Plátano (at Barra Plátano). This is the area of densest human occupation (2489 inhabitants, or 93.7%). With the exception of some possibly natural savanna regions

around Payabila, this strip has been utilized for timber, thatch, or cut down to make way for houses and fields.

Five hundred meters or so back from the ocean, one encounters either Laguna Ibans or the broad expanse of savanna and swampland that extends back 7 to 10 km. Around the shore of Laguna Ibans some of this is utilized for agriculture. Occasionally timber is cut here – when particularly desirable species are encountered. But the most extensive use of the swamp-savanna zone is for cattle grazing. The number of cattle currently using the zone does not seem to be excessive, although there can be no doubt that their presence will have disturbed, to a certain extent, the natural conditions of the vegetation. Other uses of the savanna zone appear to be limited. One has the impression that the swamp-savanna zone is presently subject to the least pressure of any that is regularly utilized by the human population.

On the other hand, the lower course of the Río Plátano, between Barra Plátano, on the one hand, and Quebrada Sulawala and Baltiltuk Creek on the other, is utilized nearly as intensively as the littoral zone. It is not an area of dense habitation, but instead this area bordering the river is heavily exploited for agriculture. The banks of the river are so heavily disturbed that it is almost totally characterized by secondary growth, and the dominant genera which characterize the course of the river are *Heliconia* (platanillo) and *Musa* (bananas). It does not seem likely that the intensity of exploitation in this zone will decrease, for the appearance of alternative sources of income in the Mosquitia region will be balanced with a continuing growth of population. It is even possible that this zone could be more intensively utilized by extending the length of time each field is cultivated. Whether local soil fertility, damage by flooding, etc. would permit this, will have to be determined by more detailed research into local agricultural practices.

The river and the lagoons are heavily exploited for fish and game, and it is likely that the current level of exploitation is at or beyond the productive capacity of these aquatic systems. Certainly one does not have an impression of a great abundance of fish or aquatic game. Only the isolation of parts of the upper Río Plátano drainage may aid in maintaining an adequate

population of some of these species, such as the *cuyamel.* Although hunting is a continual pursuit of the local population, it seems to be only moderately successful. The mammalian survey team found that most species continued to be scarce as much as a day's travel or more away from Las Marías. This evidence suggests that hunting pressure is considerable and that it represents a constant drain on the edible species. It may well be that the more accessible areas of the Reserve are already being over-hunted.

Accessible areas are also being exploited for timber – primarily for local construction of houses and canoes. Some of this undoubtedly becomes available when fields are cleared for agriculture, and canoes are sometimes manufactured from drift logs. To date there appears to be no commercial exploitation of the timber. Local utilization does not seem to be excessive, and the pressure on timber resources is probably minimal. Undoubtedly, there is greater destruction of forest and timber through agricultural acitivity than directly through felling for the wood itself.

The vast interior of the Core Zone (away from the rivers) is relatively inaccessible and rarely penetrated, even by native inhabitants. Although precise data are still lacking on the natural resources to be found there, the evidence suggests that at the present time it is not under serious exploitative pressure.

FUTURE PROSPECTS

There are two major prospects for change within the Reserve during the forseeable future. The first has to do with the impact of income injected from outside sources. The second relates to the impact of the Reserve itself.

At the present time lobster diving is the principal source of outside income and it represents a considerable cash input into the local economy. There are several factors which could significantly increase this source of income. More young men may be attracted to this employment. Local entrepreneurs are already bidding to participate in the lobster fishing. The fishing in general could intensify, or the wages paid for lobster could increase. We have already indicated how disruptive these large sums of cash have been for local society. Further increases of cash

hardly seem likely to improve matters. On the other hand, there are indications that the lobster industry merely represents the latest in a long series of boom-and-bust cycles along the Mosquito Coast (see above).

The situation is very similar to that reported by Cattle (1977) among the Nicaraguan Miskito who were fishing commercially for green turtle. At the time of her research in the early 1970's, green turtle were already becoming scarce (and at the present time they are on the endangered species list). Unfortunately, the Nicaraguan Miskito were neglecting subsistence agriculture and had already become extremely dependent on the cash economy. The collapse of commercial turtle fishing must have had serious repercussions throughout the region.

In Honduras there are indications that lobster fishing could follow a similar pattern. The lobster had already been fished-out of the shallower inshore waters before the industry reached its present level of intensity. It is possible that the present level of exploitation will soon deplete the remaining lobster beds. What would happen to the local economy should the lobster industry collapse? The results could range from disruptive to disastrous, according to the degree of dependence developed within the local economy.

There are other possibilities for local economic development. The Honduran Forestry Development Corporation (COHDEFOR) has been eyeing the region for possible exploitation of timber resources. Such a project would undoubtedly concentrate on the stands of Caribbean pine, though there are certainly other potentially exploitable species within the area. There are also possibilities for intensification of cattle grazing, particularly on the extensive savannas and swamplands inland from the coast and south of both lagoons. A more ambitious plan could conceivably emulate the Brazilian pattern by seeking to expand available pasture by cutting down expanses of forest. Either of these possibilities would, however, require an investment in necessary infrastructure, such as port facilities, roads, machinery and equipment, lumber mills or slaughter houses. Since the Reserve itself has already been set aside as a protected area, it is unlikely that such development schemes could be established within its bounds (unless there were a radical political shift within the country.)

Although a limited amount of timber exploitation may be allowed within the Buffer Zone, it seems most likely that modern lumbering or cattle grazing activities would be centered in Brus Laguna (or less likely, around Palacios). Their impact upon the Reserve then would be secondary, attracting labor from the Reserve settlements and providing yet another source of outside cash income for Reserve families. Conceivably some direct impact might also be felt, particularly if large numbers of cattle were to intrude within the Reserve, or if lumbering on the margins of the protected area were to affect watersheds and drainage of boundary rivers like the Twas and the Río Sico.

The very presence of the Reserve will have an increasing impact on the local people, although they themselves are hardly yet aware of the plans for it or how it is likely to affect them. In spite of the fact that meetings were held to inform the inhabitants about the Reserve, most people remain grossly uninformed. There is some idea that jobs will become available to maintain the Reserve stations and cater to the needs of visitors. (Inflation of local wages is already occurring.) There is a vague conception that increased numbers of visitors will bring additional money into the area. Certainly an influx of scientists and scientific tourists, as well as bureaucrats and administrators from the cities, is bound to have some impact on the local culture – at the very least it will produce a more sophisticated population. But we doubt that this, in itself, will produce any fundamental economic or social changes. Individual visits will be short term, and, by and large, isolated from and uninterested in the mass of local population. Finally, there is little evidence that people are prepared to accept the restrictions implied by Reserve status.

In Tegucigalpa we were told that the existence of the Reserve would allow local people "to maintain their traditional way of life, without pressure from outside influences, or being forced to change." Philosophically this may be an attractive ideal, but practically we found little evidence that this is a value held by residents of the Reserve. They appear to desire all the "good things" that modern life has to offer – more material goods, higher incomes, better schools and health care, improved housing, better communication and transportation, etc. The quickest way

to achieve these things would be to "develop" the area, exploit its natural wealth, and materially improve individual incomes and standards of living. In the long term, of course, these very gains could be just as readily lost through destruction of the resources that made this kind of "development" possible. Unless there is very careful and enlightened administration of the Reserve, with close attention paid to the desires and needs of the resident population, we think it quite likely that within the next few years a serious confrontation will develop between local inhabitants and Reserve administrators. Nor does this take into account increasing pressures along the southern and western boundaries, where colonists are likely to invade the forest from Olancho Province and from the Río Sico, respectively.

In sum, the questions and potential problems raised by this preliminary cultural survey of the Río Plátano Reserve point to the need for further, intensive social research in the area. Since regulation of some current resource exploitation practices is indicated, management of the Reserve can only succeed if the concerns of the local people are considered. Moreover, there appears to be a potential confrontation brewing between the ideal of protecting cultural and natural resources and the wishes of the indigenous population. Carefully controlled development by the people and compensation for their sacrifices to conservation may avert this crisis.

III. MAMMALIAN AND FLORAL SURVEY: INITIAL DOCUMENTATION OF RÍO PLÁTANO RESERVE

Jeffery W. Froehlich, Lee Benshoof,
Janice Saunders, and Thomas R. Logan

A. INTRODUCTION

Within necessary temporal and financial limitations, confounded by unseasonable weather and logistical obstacles, our primary objective was the documentation of biological resources within the Core Zone of the Reserve. A supplementary objective was a comparison of flora and mammalian fauna in two or more concentrated study areas, with the differences being related to the impact of hunting and other factors on these resources.

Thus we focused our efforts within and surrounding two study sites on tributaries of the Río Plátano, inside, but close to the tentatively defined boundaries of the protected Core Zone of the Reserve. The first of these was located on the Quebrada Mairin Tingni, approximately 12 km up the Río Plátano from the boundary of the Core Zone, which is near Las Marías (see Figure III-1). From our *champa* or campsite and the surrounding square kilometer study area (Section 22 E. by 29 N.)[1] on a large, moderately level flood plain, we explored by stream bed, river, and trail in all directions but east, including the top of Cerro Il Bila, its adjacent western ridge, and for 3 km into the headwaters of Quebrada Il Bila. A range of elevations from 40 to 300 m was encompassed within this survey area.

The second study site was selected because it was easily accessible by foot, while unseasonable wet weather rendered the Río Plátano periodically unnavigable and money for boatmen was running low. This site was located approximately 4 km NW from Búlebar (Section 28 E. by 38 N.), on a northern tributary of Quebrada Tiro (see Figure III-2). From it a trail was tediously cut for nearly 6 km WNW to the crests of two southern ridges as well as a view of Mt. Baltimore. Elevations of 60 to 820 m were included within the Tiro Study Area and along the adjacent mountain trail, allowing a range of extensive botanical observations (see below).

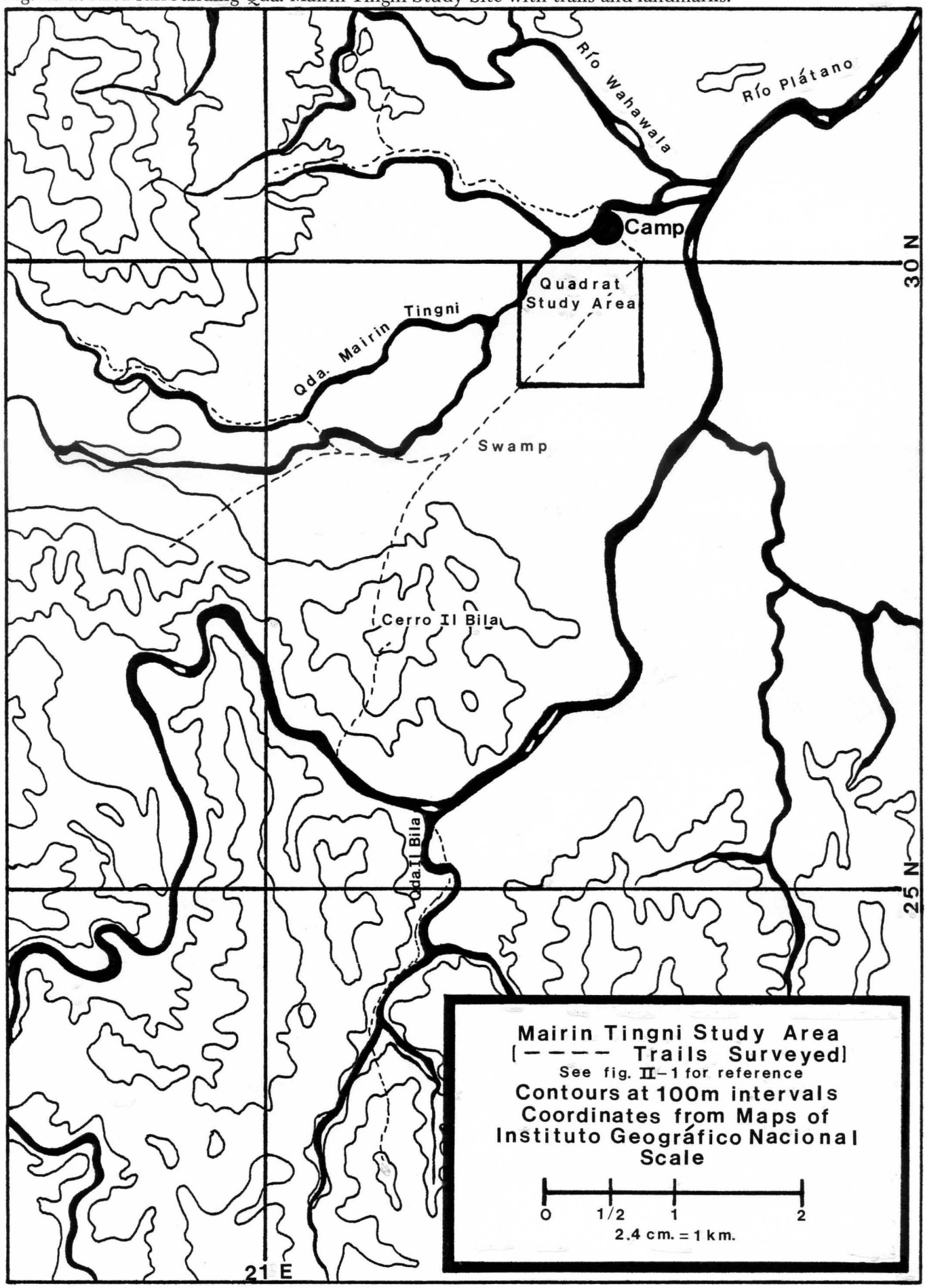
At the first study site, only casual observations were made of the flora, however, because weather prevented a planned return trip in April with the botanist (J.S.). In general the area surrounding the Mairin Tingni Site was characterized by extremely disturbed, thick undergrowth, a paucity of large trees, and a profusion of intertwined vines. Travel anywhere, except in the constantly flowing stream channels and on the leeward slopes of mountains, proved laborious and slow. For example, it took two men a full day to cut a 500 m trail, after which, visibility was never greater than 10 m on either side and frequently less than 5 m. There were also large areas of marsh or otherwise damp soil on the flood plain, suggesting poor drainage. The short, moisture-loving suita palm (*Caluptrogyne sarapiquensis*) abounded everywhere. Even on the mountain slopes, the forest had an extremely disturbed, dense appearance, with large stands of *Bambusa* sp. on the well-drained ridge tops.

Among the common large trees noted on the plain, near the water courses, were *Calophyllum* cf. *chiapense, Cedrela odorata, Ceiba pentandra, Ficus* spp., *Luehea seemanii*, and *Virola* sp. On the mountain slopes and ridges, we typically encountered *Didymopanax morotoni, Ficus insipida, Quararibea* sp., and *Spondius mombin.* As discussed later, many of these large trees showed signs of wind damage, with some dead trunks laden by 30 m growths of convoluted morning glories (*Merremia* spp.).

By contrast, the flora of the Tiro Study Site, described more fully below, can be characterized by better drainage and less disturbance. The thick undergrowth was restricted to the steeper hillsides, while there were large expanses of open forest with numerous large trees. Most of the ravines were only seasonal watersheds and the sandy clay soil was rocky rather than comprised of uniform clayey muds as it was along the Mairin Tingni.

As a way of documenting these differences between the two sites, the trails were paced in each and subjectively characterized as excellent, "cathedral" forest, good, fair, or poor. On the Tiro to Baltimore trail, more than 12% was excellent, 66% was fair to good, and 21% was rated as poor. At the Mairin Tingni Site, however, none was excellent and over 35% was poor. Since the Baltimore Trail traversed the steep, wind-exposed ridges, the contrast reflected in these

Fig. III-1. Area surrounding Qda. Mairin Tingni Study Site with trails and landmarks.



figures was even greater in other, less disturbed parts of the Tiro Site.

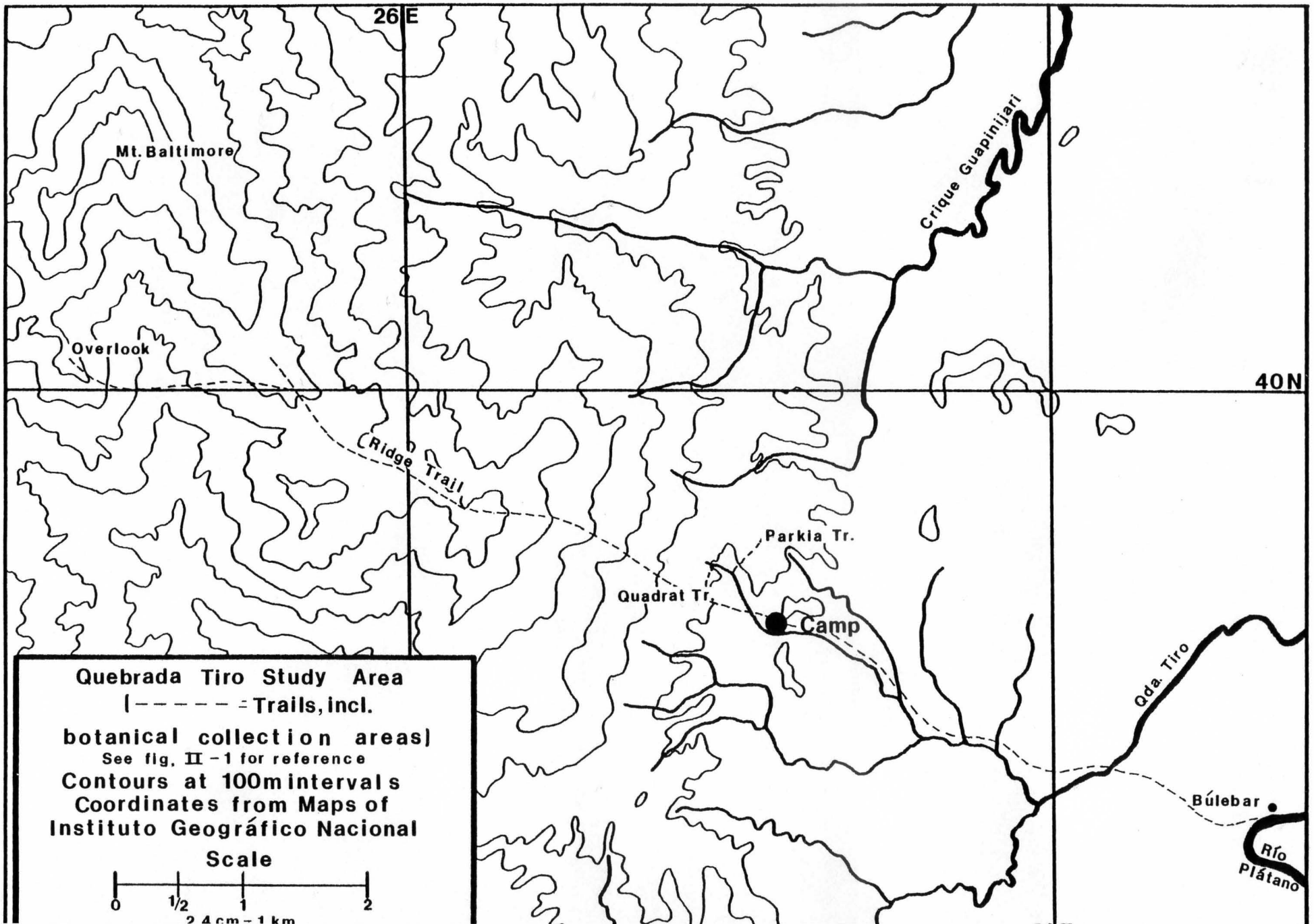
The weather we recorded during February on the Mairin Tingni and in March and April at the Tiro Site was unseasonably wet (see Table III-1). Extrapolating from the first 15 days of February and the estimated 75 mm which fell during the trip down river on 16 February, we obtained a monthly estimate of 646 mm. Such an extreme amount seems justified by the fact that storm clouds continued to form over the mountains throughout the remainder of the month. This rainfall is far above the 146 mm February mean for Tela, on the north coast of Honduras (Portig, 1976), and it exceeds the recorded 180 mm maximum at Sico, approximately 25 km north of the study area. (Cruz et al., 1978).

Moreover, the temperature was unexpectedly low at times; one night it reached a chilly 13° C. Apparently the expedition experienced a "norte," when a cold air mass meets warm, tropical air and long-lasting, non-electrical rains result, a phenomenon characteristic of the Honduran north coast (Portig, 1976).

Table III-1. Rainfall records at two field camps in the Río Plátano Reserve from late January to early April, 1981.

Mairin Tingni Study Site		Quebrada Tiro Study Site	
Date	Rainfall (mm)	Date	Rainfall (mm)
25 January	0	14 March	0
26 January	0	15 March	tr.
27 January	0	16 March	0
28 January	0	17 March	tr.
29 January	0	18 March	tr.
30 January	0	19 March	3
31 January	tr.	20 March	0
1 February	0	21 March	0
2 February	tr.	22 March	0
3 February	2	23 March	5
4 February	118	24 March	6
5 February	64	25 March	0
6 February	20	26 March	tr.
7 February	0	27 March	0
8 February	0	28 March	13
9 February	0	29 March	25
10 February	4	30 March	0
11 February	1	31 March	3
12 February	55	1 April	5
13 February	26	2 April	25
14 February	2	3 April	15
15 February	2	4 April	tr.
		5 April	tr.
		6 April	0
		7 April	17
		8 April	0
		9 April	0
		10 April	10

Fig. III-2. Area surrounding Quebrada Tiro Study Site with trails and landmarks, including botanical sampling areas.



There was a large effect of this "dry season" weather on the actual field work accomplished. At the Mairin Tingni Site, only 86 person-days were actually devoted to data collection, while the Tiro Site received only 52 person-days of attention. Compounded by the logistical difficulties of river travel during intermittent heavy rains, our work output was low but probably not atypical for the dry season in the Río Plátano Reserve. In any case, no more than a 50% productivity rate should be anticipated for future research in the Reserve.

B. BOTANICAL PATTERNING AT QUEBRADA TIRO

OBJECTIVES AND METHODS

As noted, it was only possible to conduct detailed botanical census work at the Quebrada Tiro Study Site. Plans to return to the first study site were thwarted by unseasonable rain and the unnavigability of the Plátano. Along the Tiro and in the neighboring mountains, the objectives of the botanical collection and documentation were threefold. Our primary purpose was to initiate a comprehensive list of the flora which was representative of the undisturbed parts of the Reserve's Core Zone. Most previous botanical work in the Reserve had been at lower elevations, nearer to the Río Plátano or in the coastal savannah.

For the secondary objective of comparing different ecological plant communities, and ultimately studying associated variations in the fauna, our systematic work was subdivided into five ecological zones. Immediately around camp, we studied the bank of the Tiro (ca. 70 m elevation), a steep southwest slope (ca. 100 to 160 m), and a more gentle, east-facing ridge (120 to 200 m). From the latter, a trail extended northwest along the ridge to an elevation of 800 m and was botanically sampled from 450 to 700 m. These four sampling areas were selected because of different topographic orientations and their apparently distinctive species compositions. Lastly, intermittant floral samples were taken along the 4 km trail leading back to Búlebar and in disturbed areas adjacent to the Río Plátano. As a tertiary objective, we also tagged approximately forty trees in each of the first three collecting areas, for the benefit of subse-

quent researchers.

Within these three primary collecting areas, crude transects were established, along which the trees were mapped, tagged, and measured. Because of the preliminary nature of this botanical survey, trees were selected for tagging by a subjective assessment of their representativeness, as well as their fertile condition and ease of identification. Although some sterile specimens were collected from larger trees, it proved difficult to identify some of these from keys based on fertile characters or in later work in the herbaria in Tegucigalpa and at the Missouri Botanical Garden. As a result, the present species list must be viewed only as a beginning of botanical knowledge in the area.

The collection of voucher specimens was very slow, as the trees had to be scaled by a local climber with irons and ropes. Alternatively, fallen fruit or the leaves of saplings of the same species could sometimes be located near the ground. Plant specimens were dried in a plant press over a clay oven constructed at the campsite. The trees were tagged and numbered with survey flagging and aluminum roofing nails. As often as possible, a local guide was asked the vernacular name of the tree and other information regarding its use by animals and people. In addition to the documented, tagged collection, numerous other voucher specimens were obtained in all five collecting areas for later identification. All voucher specimens were ultimately deposited with the New York Botanical Garden, for greatest accessibility by subsequent researchers. Finally, we made records of trees not collected, but recognized from work in the other sampling areas or in previous studies elsewhere in Honduras.

RESULTS AND DISCUSSION

Altogether about 300 plants were identified and 206 voucher specimens were collected. This sample represents approximately 75% of the floral diversity in the limited areas visited by the botanist (J.S.). In general, the assessment of the forest adjacent to the camp at the Quebrada Tiro Site is one of a primary virgin rain forest, undisturbed by human intervention and with no evidence of invading, exotic species. Since our species list[2] differs from that established in previous surveys of the Reserve (Cruz, et al. 1978: 102-107), this preliminary systematic floral

Table III-2. Trees censused and marked in the Quebrada Tiro Study Area. See the maps in Figs. III-3, III-4, and III-5 for the approximate locations of these specimens.

Number	Taxon	Estimated Height (ft.)	Girth (mm)
1	*Guarea* sp. (sapling)	15	355
1A	*Siparuna nicaraguensis*	10	10
2	*Psychotria* sp.	13	70
3	*Myriocarpa longipes*	15	70
5	*Coccoloba tuerckheimii*	20	260
6	*Pouteria* sp.	80	590
7	*Terminalia* sp.	70	1020
8	*Vatairea* sp.	---	---
9	*Cespedesia macrophylla*	50	---
10	*Pleuranthodendron mexicanum*	60	1370
11	*Swietenia humilis*	80	4400
12	*Dialium guianense*	---	---
14	*Desmopsis panamensis*	7	67
15	*Pausandra triane*	15	192
16	*Ocotea* sp.	50	1000
17	*Apeiba membranacea*	45	1197
17A	*Hirtella paniculata*	---	379
18	*Pouteria izabalensis*	40	830
19	*Erythrochiton incomparabilis*	12	120
20	*Rheedia intermedia*	45	645
21	*Brosimum alicastrum*	80	---
22	*Carpotroche platyptera* (small tree)	---	---
23	*Sloanea* sp. (seedling)	10	90
24	*Miconia* sp.	30	240
25	*Pterocarpus officianalis*	90	---
26	*Pourouma aspera*	10	65
27	*Guarea* sp.	12	85
28	*Cephaelis elata*	10	120
29	*Tapirira guianensis*	20	85
30	*Sloanea meianthera*	100	---
31	*Acalypha diversifolia*	10	100
32	*Tabernaemontana* sp.	35	390
34	*Trichospermum caribeum*	60	1255
35	*Symphonia globulifera*	80	2540
40	*Tetragastris panamensis*	60	485
41	*Guatteria amplifolia*	15	150
42	*Eugenia* sp.	---	---
43	*Protium* sp. (chopped down)	60	256
44	*Virola sebifera*	---	---
45	*Sloanea zuliaensis*	40	700
46	*Calophyllum brasiliense*	120	4000
48	*Casearia sylvestris*	9	25
49	*Pithecolobium arboreum*	120	1475
50	*Inga* sp. (sapling)	5	5
52	*Parkia pendula*	140	3200
53	*Symphonia globulifera*	90	2130
54	*Calophyllum brasiliense*	15	55
56	*Mollinedia puae*	10	70
57	*Pachira aquatica*	25	245

Number	Taxon	Estimated Height (ft.)	Girth (mm)
58	*Sloanea* sp.	100	3000
60	*Casearia arborea*	---	645
61	*Coussapoa* sp.	20	330
62	*Cynometra* n. sp.	60	1700
63	*Bursera simaruba*	50	930
64	*Hirtella racemosa*	7	45
65	*Inga* sp. (pubescent)	6	35
66	*Sloanea zuliaensis*	35	ca. 700
67	*Protium* sp.	11	82
68	*Eugenia* sp.	10	10
69	*Bursera simaruba*	60	1555
70	*Eugenia* sp.	25	234
71	*Hirtella triandra*	45	710
72	*Malmea depressa*	30	520
74	*Miconia* sp.	80	1720
75	*Pachira aquatica*	70	1375
76	*Sloanea* cf. *meianthera*	90	1000
77	*Miconia* sp. (copper leaf)	30	240
78	*Pouteria campechiana*	60	1105
82	*Aphelandra deppeana*	10	---
83	*Quararibea* sp.	8	40
84	*Dendropanax arboreus*	30	315
85	*Chamaedora ernsti-angusti*	---	---
87	*Lunania parviflora*	50	---
88	*Pourouma aspera*	16	25
89	*Clusia* sp. (epiphyte)	---	---
90	*Genipa americana*	35	760
91	*Quararibea* sp.	40	950
93	*Ficus insipida*	50	2000
94	*Hieronyma alchorneoides*	60	3080
95	*Virola* sp.	45	480
96	*Hieronyma alchorneoides*	60	1480
98	*Ormosia coccinea* (sapling)	15	230
99	*Cassipourea guianensis*	35	620
100	*Eugenia* sp.	20	340
101	*Tapirira guianensis*	---	1565
102	*Sorocea* sp.? (sapling)	15	15
103	*Rheedia intermedia*	25	260
104	*Swartzia simplex*	20	360
105	*Cordia bicolor*	70	1220
106	*Genipa americana*	60	650
107	*Pouteria* sp.	45	790
108	*Pachira aquatica*	80	1390
110	*Brosimum alicastrum*	100	4200
111	*Dendropanax arboreus*	50	1070
112	*Bauhinia* sp.	---	200
113	*Pseudolmedia oxyphyllaria*	15	160
114	*Sloanea* sp.	120	---
117	*Ficus insipida*	---	---
118	*Pseudolmedia oxyphyllaria*	---	---

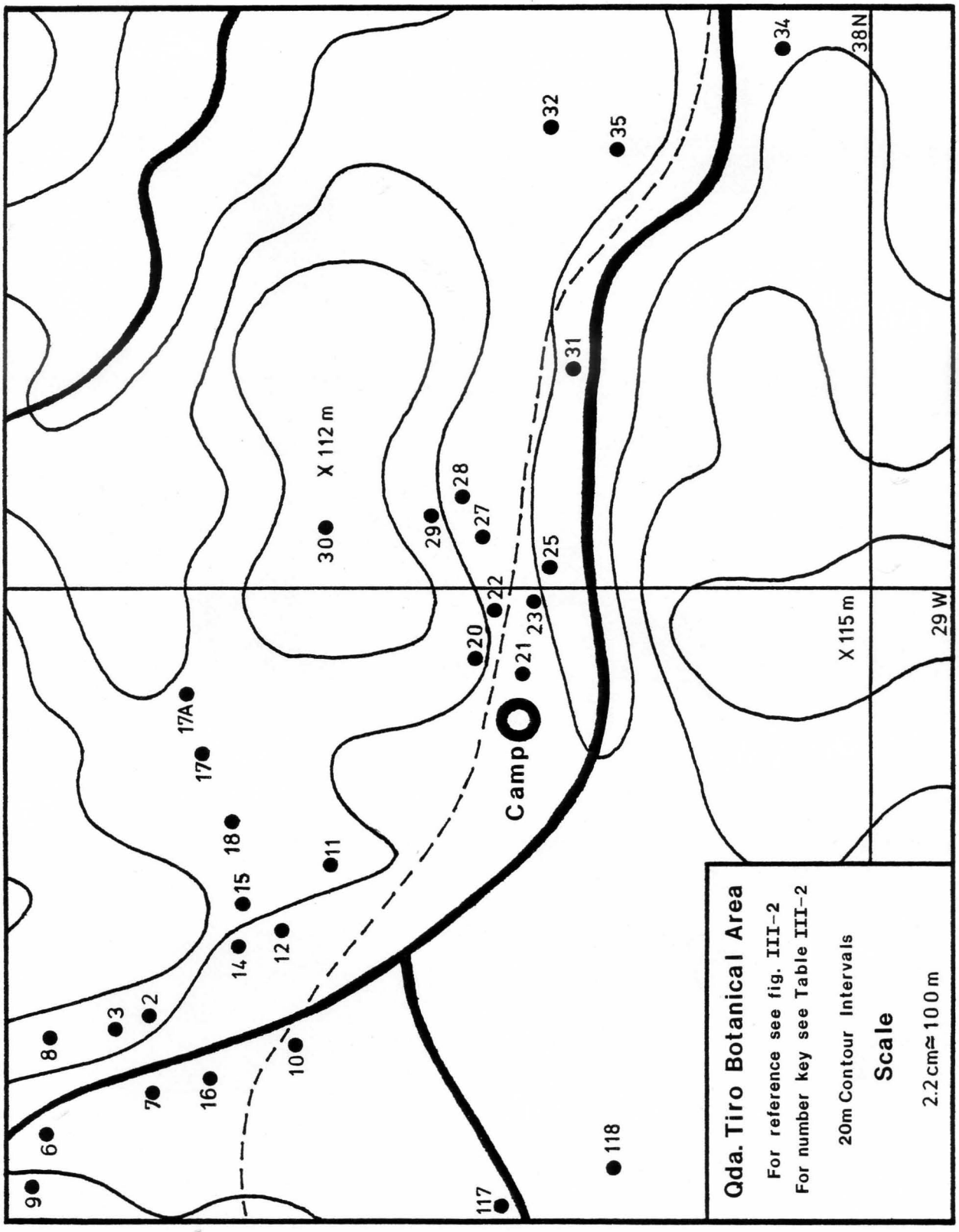
list indicates that much more collecting needs to be undertaken in the more inaccessible regions of the Reserve before its virgin, climax rain forest is fully understood.

Table III-2 lists the representative, tagged specimens in each of the three primary collecting areas near the campsite, together with their chest-height circumferences and estimated heights. Most of the identified trees in the area along the banks of the Tiro (Nos. 1-35; 117-118 in Table III-2) are at elevations approximating 70 m, within a short distance of the campsite (see Figure III-3). The exceptions were specimens tagged on the lower, south-facing slopes above the camp. In general, the conditions around the creek were rather homogeneous, with a larger proportion of shrubs and herbs dependent upon greater sunlight and moisture than elsewhere. Tiro Creek itself was rather rocky and shallow, not filling its bed during the month of March. Because of the homogeneous nature of this collecting area, the sampling was more diluted over a broader area than in the other two primary ecological zones.

The second primary collecting area, known as *Parkia* Trail, began about 400 m above camp, on the east bank of the creek (see Figure III-4 and Nos. 40-85 in Table III-2). It leads northeast up the slope to an elevation of 170 m, with the first trees sampled about 25 m from the creek, at an elevation of about 100 m. For the first one-third of the slope, one finds trees typical of the lower Tiro Creek sample, such as *Apeiba, Ficus, Sloanea,* and *Terminalia. Carpetroche platyptera* and *Pausandra trianae* were common small trees. *Tetragastris* fruits were frequently found partially eaten on the ground.

After the halfway point, there is a noticeable change in floral species. Northward along the slope, there is almost a grove of *Parkia pendula*. With their small bipinnate leaves and fruit suspended below the canopy on large, branching peduncles, this is a noteworthy and unusual aggregation. Since *Parkia* has only been collected north of South America once before (in Mexico), this discovery makes this study area highly significant, especially since *Parkia* sp. are usually bat pollinated. Moreover, similar clumped dispersion patterns in tropical forests have recently been discussed in terms of the foraging and roosting behaviors of frugivorous bats (Fleming and Heithaus, 1981).

Fig. III-3. Botanical census area surrounding campsite on the banks of the Qda. Tiro.Trail shown as a dotted line.



Another peculiarity of the flora on this hill was the presence of *Pachira aquatica*, normally a species found near rivers and mangrove swamps, where the seeds are water-dispersed. Three specimens were found on the hill, at elevations of 120 to 160 m. If this is indeed the same species, its presence suggests that wet conditions are typical here, and that another mechanism of seed dispersal, by birds or rodents, is operating.

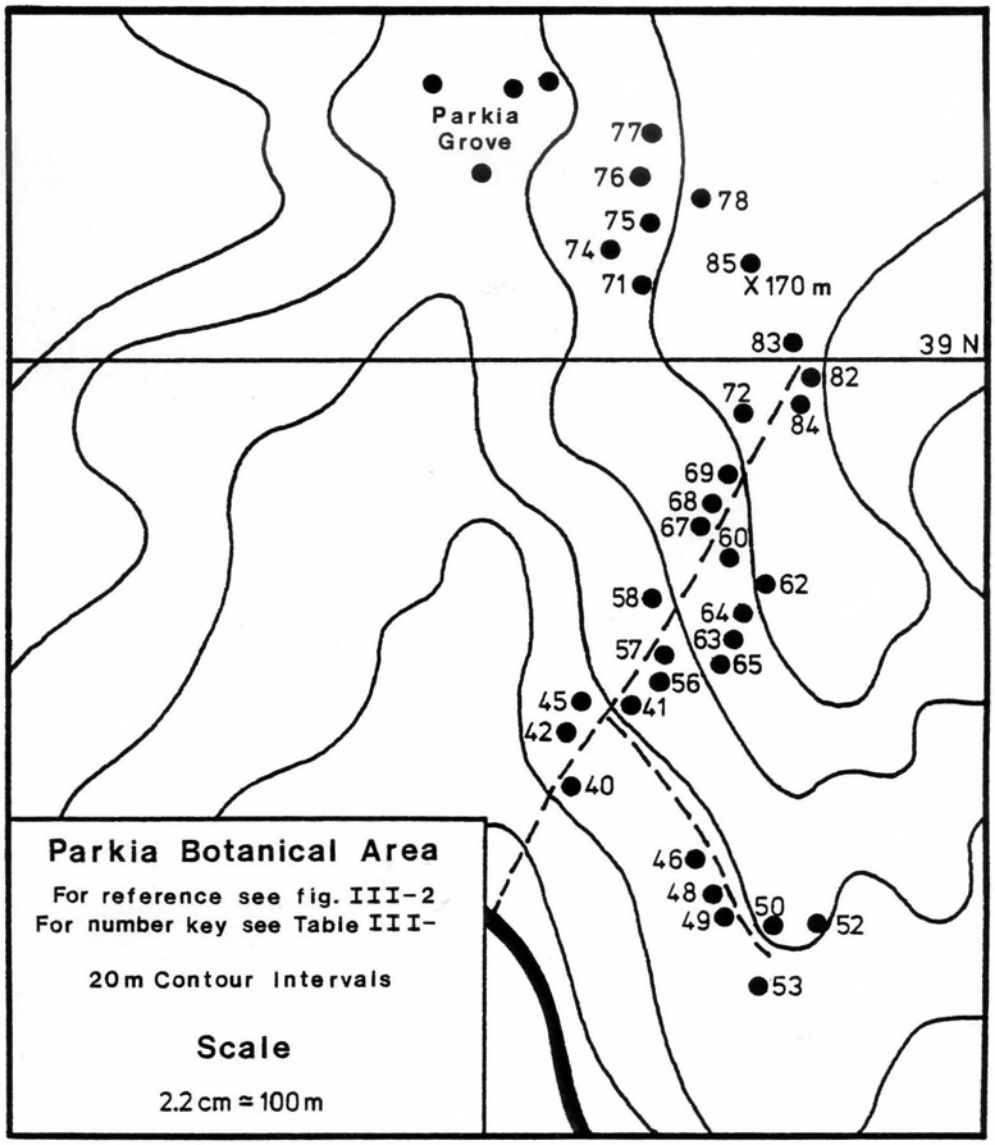
A third distinctive element on this hill was an indeterminate species of *Sloanea*. A large tree with a buttressed trunk, it also appeared, through binoculars, to be abundant on the next ridge to the north. It has a four-part pubescent capsule, unlike any found in the herbaria; the specimen has been sent to a specialist for further indentification.

Finally, the summit of the hill was rather open and dry, with the undergrowth comprised of an epiphytic palm and a fern. More shrubs were also found. These, such as *Aphelandra*, are usually more typical of dry, better lit locations. The *Parkia* trees also seemed to favor drier conditions, which makes the presence of *Pachira aquatica* all the more perplexing. Altogether, the *Parkia* Trail study area was an impressive floral array, worthy of further investigation.

With an orientation in the opposite direction and a gentler slope, the third primary collecting area, known as the Quadrat Trail, provided some interesting contrasts. The trail began just west of camp, across the creek (see Figure III-5). Tagging (Nos. 87-114 in Table III-2) and collecting was commenced on top of the hill, at elevations of 120 to 200 m. Most of the trees in a small area of 200 meters square are included, except for a few where specimens could not be obtained. The area appears quite different from the *Parkia* Trail sample, but it is difficult to describe precisely how. The forest seemed denser, but insufficient time was spent to document this. The understorey trees were commonly *Desmopsis, Quararibea, Rheedia,* and *Swartzia.* The canopy included *Brosimum, Ficus, Hieronyma* and another large specimen of *Pachira aquatica.*

Above the main sampling area, *Pseudolmedia oxyphyllaria* was abundant, with fruits scattered on the ground after *Cebus* and birds were observed feeding. At higher elevations (250 m) on the ridge, *Schizolobium parahybum* was found, with its large, single-seeded pods. Here, also, sapote trees (*Pouteria* sp.) were abundant, although one or two were found at lower elevations.

Fig. III-4. *Parkia* Trail botanical census area, approximately 400 m above camp in Fig. III-3 along bank of Qda. Tiro.



This was also a favored food of the capuchin monkeys.

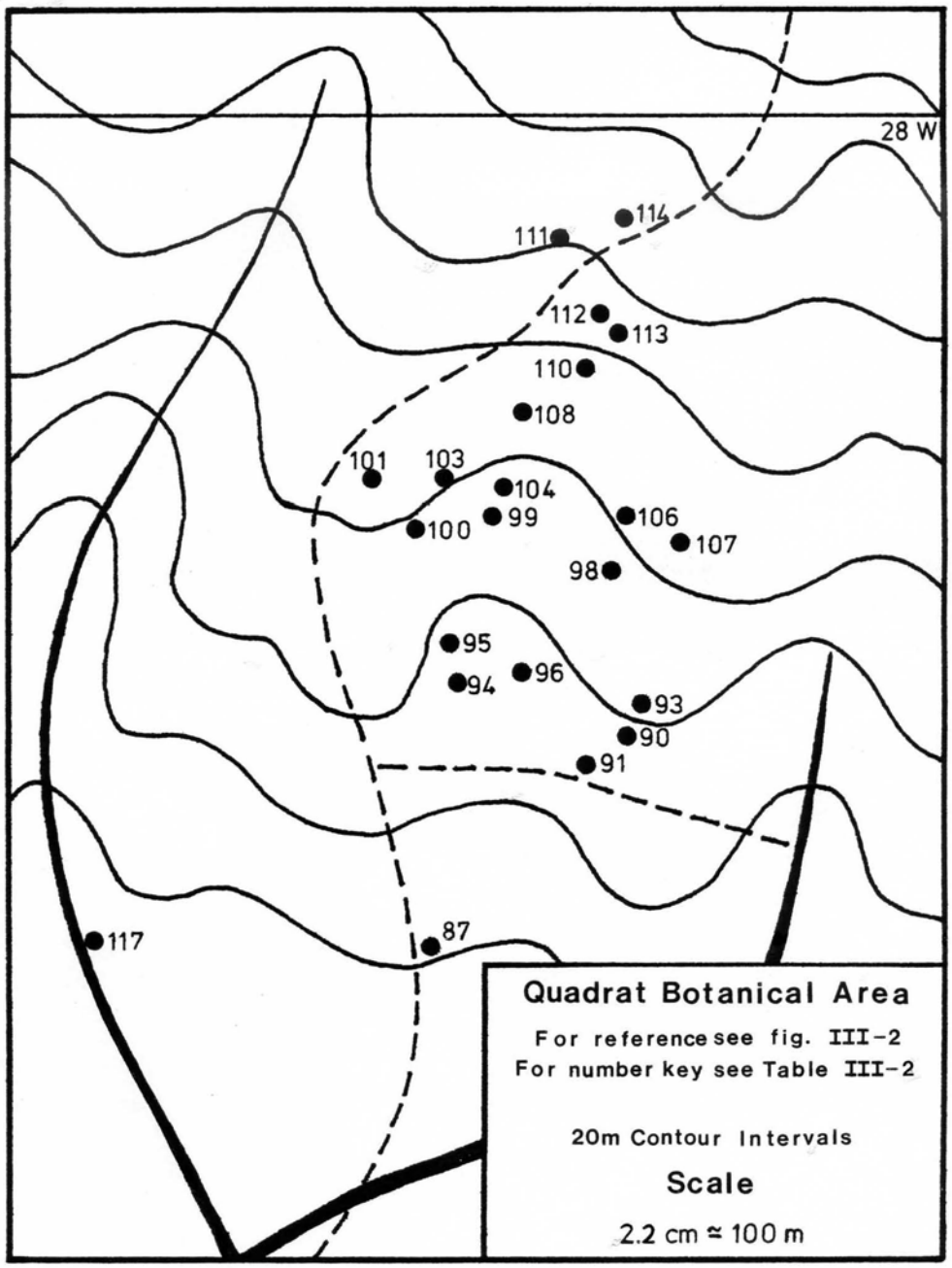
Beyond the Quadrat Trail, a one-day collecting and observing trip was made northwest along the ridge to high points overlooking the slopes of Mt. Baltimore. Initially, the flora on the ridge trail was similar to that of higher (250 m) elevations in the quadrat study area. At 450 m, however, typical species included *Ardisia tigrina, Rheedia intermedia, Smilax subpubescens,* and *Ternstroemia tepezapote.* Only *Rheedia* had been encountered at lower elevations. The rare grass *Pharus cornutus* was also seen.

At 600 m, the vegetation was markedly different, with species such as *Lobelia tatae* and *Satyria warscewiczii* being characteristic. The forest was open, with a sparse understorey and a three-to-five inch leaf litter. Palms, such as *Welfia,* were common. Large, unknown trees, different from lower elevations, populated the slopes. As the elevation increased and became more steep and rocky, the canopy height was much lower, with flowering shrubs and ericaceous shrubs becoming more common. Sedges and ferns were also encountered.

Finally, the top of the ridge was a convoluted mass of shrubs, their crowns closely entwined. The most characteristic species were *Clusia salvinii* and *Magnolia sororum.* Others included *Lacistemma aggregata* and *Psychotria elata.* The vegetation above the 600 m level seemed to have reduced, sclerophyllous leaves, presumably due to dessication from exposure and shallow soil depth. Although only a day was spent by the botanist at these elevations, without much relevant previous experience, the impression was one of great potential for studies of diverse floral communities and unusual range extensions. Also, from the vantage of some places on these high ridges, future tree census and species distribution studies could be conducted with color and infrared photographs taken over a period of time.

In a preliminary botanical survey, limited in area and time, it is noteworthy that out of the approximately 200 taxa collected and provisionally identified, over 6% are new to the flora of Honduras. These significant range extensions include the four genera *Paradrymonia, Parkia, Piptadenia,* and *Tapirira* and nine new species, comprised of *Ficus nymphaefolia, F. obtusifolia, Urera laciniata, Hernandia didymantha, Hirtella paniculata, Cynometra* n. sp.? , *Lunania parvi-*

Fig. III-5. Quadrat Trail botanical census area, just west of camp and Qda. Tiro shown in Fig. III-3.



flora, Bellucia axianthera, and *Genipa americana.* The floral composition of the Honduran Mosquitia is thus new to science and greatly deserving of total preservation, at least until it can be thoroughly documented.

C. COMPARATIVE MAMMALIAN ECOLOGY

OBJECTIVES AND METHODS

In the draft management plan for the Río Plátano Reserve, it is admitted that the knowledge of faunal diversity and distribution in the region is low, with no previous scientific studies nor collections (RENARE, n.d.). To a greater or lesser extent, therefore, it was obvious that most collecting conducted in the Plátano watershed would be a scientific range extension for the animal in question, at least within Honduras. Nevertheless, the same management plan also asserts that the population of mammals in the area is abundant and consists of a great diversity of species (RENARE, n.d.). The transparent uncertainty implicit in contradictory statements such as these underscored the need for systematic studies of mammals in the Reserve for future planning and fund raising.

Some of the mammalian taxa listed as present in the Reserve in previous reports (Cruz, et al., 1978), in fact, were not actually observed, but surmised from distributions elsewhere in Honduras or Central America. Moreover, the documentation of smaller mammals, such as rodents and bats, was almost totally lacking. Thus, the primary purpose of the mammalian survey was to substantiate and enlarge the systematic list of mammals by direct or indirect observations and by trapping.

A secondary objective, which had to be greatly curtailed by insurmountable logistical difficulties, illness, and limited time, was to document differences in faunal distributions and relate these to differences in habitat and human intervention. For this purpose, particular attention was paid to the systematic trapping and collecting of small rodents, bats, and marsupials, many of which could not be identified otherwise. These voucher collections were

taken to the Museum of Southwestern Biology at the University of New Mexico for detailed study and publication; half will be returned to Honduras at a later time.

Finally, because it was anticipated that some of the distributional patterns of large mammals would be the result of previous hunting, these animals were especially investigated at the two primary study sites in the Mairin Tingni and Tiro watersheds. Local informants, including the park guard assigned briefly to us as a guide, were asked about the "game" in the two areas and the history of its exploitation.

RESULTS

In Table III-3, we present a systematic list of the mammalian fauna which was actually documented. In this effort, we were greatly helped by the extensive unpublished observations of M. Marcus, an ornithologist and Peace Corps volunteer who had spent several months in the Reserve, prior to joining our expedition at the Mairin Tingni Study Site. By trapping and mist-netting, we have moderately expanded the previous published lists. We have also eliminated, at least for the time being, some of the suspected mammals which have yet to be documented.

As with the botanical survey and recent work in ornithology (Marcus, 1981), the mammalian capture effort has resulted in several documented range extensions. Since no previous collecting had occurred in eastern Honduras, all of the capture data is essentially a range extension to the east. More noteworthy, however, four new mammalian species have been concretely documented for the fauna of Honduras. These range extensions are *Philander opossum, Oryzomys bombycinus, Tylomys nudicaudus,* and *Ectophylla alba.* The latter, the misnamed Honduran white bat, is an ironic range extension, because the type collecting locality in Nicarragua was originally thought to be in Honduras. *Philander opossum* represents a range extension into Honduras, because although it has been stated that the four-eyed oppossum's range included Honduras (Goodwin, 1942; Idiaquez, 1978:22), we are not aware of any previous documented specimens of this taxon from that country. Since some of the above range extensions represent the most northern known locality, the Río Plátano Reserve is an

Table III-3. Systematic list of the mammals observed and/or otherwise documented[I] in the Río Plátano Biosphere Reserve during 1980-81.

SCIENTIFIC NAME	LOCAL VERNACULAR	ENGLISH NAME
Marsupialia		
Caluromys derbianus	Guazalo peludo	Wooly opossum
Didelphis marsupialis	Guazalo común	Southern opossum
Philander opossum	Guazalo de cuatro ojos	Grey four-eyed opossum
Chiroptera		
Artibeus jamaicensis	---	Jamaican fruit bat
Artibeus lituratus	---	Big fruit bat
Artibeus toltecus	---	Lowland fruit bat
Artibeus watsoni	---	Thomas' fruit bat
Carolia brevicauda	---	Silky short-tailed bat
Carollia castanea	---	Allen's short-tailed bat
Ectophylla alba	---	Honduran white bat
Glossophaga commissarisi	---	Commissaris' long-tongued bat
Glossophaga soricina	---	Pallas' long-tongued bat
Rhynchonycteris naso	---	Brazilian long-nosed bat
Primates		
Cebus capucinus	Mono cara blanca	White-faced monkey
Aloutta palliata	Mono alluador	Mantled howler monkey
Ateles geoffroyi	Mono araña	Black-handed spider monkey
Carnivora		
Eira barbara	Tayra	Tayra
Felis concolor	Puma	Cougar
Felis onca	Tigre	Jaguar
Felis pardalis	Ocelote	Ocelot
Felis weidii	Tigrillo	Margay
Felis yagouaroundi	Jagarundi	Jagarundi
Galictis allamandi	Hurón	Grison
Lutra annectens	Nutria	Southern river otter
Nasua narica	Pizote	Coati mundi
Potos flavus	Mico de noche	Kinkajou
Urocyon cinereoargenteus	Gato de monte	Gray fox
Sirenia		
Trichechus manatus	Manati	Manatee
Perissodactyla		
Tapirus bairdii	Danto	Tapir
Artiodactyla		
Mazama americana	Antílope	Red brocket deer
Odocoileus virginianus	Venado cola blanca	White-tailed deer
Tayassu pecari	Jaguilla	White-lipped peccary
Tayassu tajacu	Chancho de monte	Collared peccary
Edentata		
Cyclopes didactylus	Hormiguero	Silky two-toed anteater
Dasypus novemcinctus	Gusuco	Nine-banded armadillo
Myrmecophaga tridactyla	Oso caballero	Giant anteater
Tamandua mexicana	Tamandua	Tamandua
Rodentia		
Cuniculus paca	Tepescuinte	Paca
Dasyprocta punctata	Guatuza	Agouti
Heteromys desmarestianus	—	Desmarest's spiney pocket mouse
Hoplomys gymnurus	---	Armored rat
Nyctomys sumichrasti	---	Sumichrast's vesper rat
Oryzomys bombycinus alleni	---	Long-whiskered rice rat
Oryzomys caliginosus	---	Dusky rice rat
Proechimys semispinosus	---	Tomes' spiney rat
Sciurus deppei	Ardilla de Deppe	Deppe's squirrel
Sciurus variegatoides	Ardilla jaspeada	Variegated squirrel
Tylomys nudicaudus	---	Peters' climbing rat

[I] For further discussion of captured rodent and bat faunas see Benshoof, Yates, and Froehlich (in prep.).

important area for the study of inter-American faunal exchange (c.f. Simpson, 1980; Marshall, et al., 1982).

As any conservationist reviewing the faunal list in Table III-3 will also note, there are several endangered or threatened species present in the Reserve. Our impression is that some of these, such as *Tapirus bairdii* and *Felis onca,* are moderately abundant, while others like *Ateles geoffroyi* are relatively rare, in need of rigid hunting regulations. The day before we arrived in Las Marías, for example, three spider monkeys were brought back by hunters from the upriver, protected zone of the Reserve.

Other, more commonplace mammals were also impressionistically rare in all of our observations. The infrequency of *Cuniculus paca* and *Dasyprocta punctata* may also be due to hunting pressure, but the absolute paucity of both *Sciurus* species demands some other explanation. As discussed later, we believe that a high frequency of severe weather in the region has truncated some frugivorous mammal populations by causing periodic bottlenecks in the food supply.

From a comparison of the occurrence and relative abundances of mammals in our two study areas, we can partially distinguish the relative influences of these two factors – hunting and weather – on limiting the population densities of different animals. Table III-4 shows the faunal lists and frequency of observations for the two study sites where trapping was conducted. In some cases the frequency data are precise, based on number of captures for a specified number of trap-nights. For other taxa, estimation was necessary or the abundance of the animal was unknown. In the cases of relatively few observations, the apparent absence of the animal at the other study site may be questionable. Nevertheless, a comparison of the two localities does reveal an interpretable pattern.

Observations at the Mairin Tingni study site were based on 86 person-days. Some of these, however, were spent noisily cutting trails through thick underbrush; obviously no mammals were observed on these days. In addition to direct or indirect (tracks, trails or feces) observations of animals, a total of 60 specimens were collected at the Mairin Tingni Site. Thirty-

six Tomahawk Livetraps were used for a total of 448 trap-nights, while 90 Sherman Traps accounted for another 1500 trap-nights. Finally, mist nets were set out for 31 nights.

Table III-4. Comparative mammalian census data[I] for the two study sites in the Río Plátano Reserve, arranged by principal expected diet.

Quebrada Mairin Tingni		Quebrada Tiro	
Taxon	**Number**	**Taxon**	**Number**
OMNIVORES			
Cuniculus paca	1 sighting		
Dasyprocta punctata	2 sightings		
Didelphis marsupialis	3 captures		
Nasua narica	2 sightings	*Nasua narica*	Group of 15
Philander opossum	3 captures		
HERBIVORES			
Heteromys desmarestianus	4 captures	*Heteromys desmarestianus*	1 capture
Hoplomys gymnurus	2 captures	*Hoplomys gymnurus*	2 captures
Nyctomys sumichrasti	3 captures		
Oryzomys bombycinus	8 captures		
Oryzomys caliginosus	2 captures		
Proechimys semispinosus	10 captures		
Tapirus bairdii	1 shot (many tracks)		
Tayassu pecari	4 groups	*Tayassu pecari*	1 sighting
		Tylomys nudicaudus	1 capture
FRUGIVORES			
Alouatta palliata	1 grp. heard	*Alouatta palliata*	3+ groups
		Artebius jamaicensis	4 captures
		Artebius lituratus	1 capture
		Artebius toltecus	2 captures
Artebius watsoni	5 captures	*Artebius watsoni*	4 captures
Ateles geoffroyi	2 grps. (12+)	*Ateles geoffroyi*	1 solitary male
Carollia brevicauda	18 captures	*Carollia brevicauda*	3 captures
		Carollia castanea	5 captures
		Cebus capucinus	3 grps. (50+)
		Ectophylla alba	1 capture
Potos flavus	1 heard	*Potos flavus*	Many heard
Sciurus deppei	3 sightings	*Sciurus deppei*	3+ sightings
		Sciurus variegatoides	2 sightings
NECTAR FEEDERS			
Glossophaga commissarisi	1 capture		
Glossophaga soricina	1 capture		
INSECT FEEDERS			
Rhynchonycteris naso	1 capture		
Tamandua mexicana	3 sightings	*Tamandua mexicana*	1 sighting
CARNIVORES			
Felis concolor	Many tracks		
Felis onca	Many tracks	*Felis onca*	3 sightings
Felis yagouaroundi	1 sighting	*Felis yagouaroundi*	1 sighting
Eira barbara	2 sightings		

[I] Unless otherwise noted, data refer to individual animals.

Correspondingly, the data from the Tiro Creek study locality were collected during approximately 50 person-days, less interrupted by trail-cutting than on the Mairin Tingni. Twenty-six specimens were collected in 10 Tomahawk Traps for 90 trap-nights, 30 Shermans for 270 trapnights, and one mist net for nine nights. In rough comparisons of effort and yield, the trapping effort at the Tiro Site was less than 20% of that at the Mairin Tingni, but the corresponding yield was over twice as large (7% vs. 3%), suggesting a more abundant and diverse small fauna, especially for the bats, at Quebrada Tiro. Moreover, it was strongly suspected that someone was letting animals go in the early morning before the traps were checked by the mammalogist. This was neither suspected nor really feasible at the Mairin Tingni Site, because of the greater number of people present and the more dispersed placement of the traps.

In general, there are three rather apparent differences in the faunal composition of the two study sites. The most obvious is the rarity or absence of forest floor browsers at the Tiro locality. There were no signs, let alone any observations of *Cuniculus, Dasyprocta,* or *Tapirus.* Only a solitary *Tayassu pecari* was observed near the gardens at Búlebar. All of these animals are favored game by the Miskito hunters. The greater rarity of *Ateles* (one solitary male) at the Tiro Creek site may have the same explanation, especially since some other arboreal frugivores were more abundant here than at the Mairin Tingni Site.

This second difference in frugivorous species between the two sites is most notable in the greater diversity of the bat fauna at Quebrada Tiro. The *Carollia* prefer ripe fruit, while the *Artebius* eat green fruit. *Artebius jamaicensis* and *lituratus* are large bats, the other species are similar in size to the small *Carollia.* In addition to the bats, some other frugivores and omnivores were also more common at Quebrada Tiro. *Potos, Nasua,* and *Cebus* were moderately abundant, and *Alouatta* was not uncommon. Nonetheless, expected animals such as *Sciurus* sp. were still extremely rare, with the smaller taxon more common than the large.

Finally, there is a striking difference in the numbers of rodents which prefer wet habitats. While the rice rat *Oryzomys* was common at the Mairin Tingni, it was apparently absent at the Tiro. Moreover, only two *Hoplomys* spiny rats were caught at the latter locality on a wet hillside, whereas *Proechimys* was common in the Mairin Tingni watershed.

D. DISCUSSION OF BIOLOGICAL DATA

HUNTING PRESSURE

Although it has been claimed that the direct pressure of hunting exploitation on the fauna of the Reserve is low (RENARE, n.d.), the depauperate status of favored prey such as pigs, pacas, and tapirs at the second study site on the Tiro would argue otherwise. In accord with the hunting preferences of the Miskito inhabitants, the provisioning of the initial scientific expedition to the Reserve in 1977 was planned with the objective of obtaining one of the species of pigs (*Tayassu*) or the white-tailed deer (*Odocoileus virginianus*), with supplementation by *Ateles, Cebus, Cuniculus, Dasyprocta,* and *Tapirus,* when the occasion presented itself (Cruz, et al., 1978). A more complete list of mammalian game animals used for food by the Miskito also includes *Dasypus, Mazama, Nasua,* and *Sciurus variegatoides* (Marcus, 1981), with some of these more commonly on the dinner table because they were all that was left near habitation.

We learned from our informants that they considered small animals such as capuchin monkeys and squirrels to be less desirable given the high cost of ammunition. However, the ideal of always having wild meat on the table frequently overcame this reluctance, when game was encountered opportunistically enroute to the gardens. Many trips of a day or two in duration are made upriver or overland in pursuit of the preferred prey, albeit the yield may not be in balance energetically with the effort. This suspected imbalance underscores the strength of the hunting ethic among these people.

With regard to the faunal composition of our Quebrada Tiro Study Site, our local informants explained that they used to hunt there in the past, but no longer do so because the game was depleted. Although the drier, more mature forest around the Tiro is generally less preferred habitat for the pigs, there were still very extensive areas of second growth on the hillsides. The near absence of spider monkeys, where fruit seemed moderately abundant, supports the idea of over-exploitation, especially since other frugivorous, but less hunted mammals were frequently encountered. Moreover, the highly favored avian game animal, the curassow, was also abundant, suggesting a faster rate of repopulation by birds than mammals. Thus we conclude that the

impact of unregulated hunting on the mammalian fauna is great, with the effects being apparent long after the direct pressure has ceased.

FAUNAL COMPARISONS

The greater abundance of monkeys and large fruit-eating bats at the second study site supports the idea that much of the Tiro watershed is a more mature and productive tropical rain forest than the Mairin Tingni. This "selva" habitat is favored by the treetop fauna, while forest floor browsers prefer the more tangled, second growth "Breña" and "jungle" habitats (Carr, 1950: 585-586). Thus, some, but not all, of the differences in the browsing fauna may have a natural explanation. Nevertheless, only small patches, never larger than one hectare, were truly climax "selva", with "cathedral-like interiors" as described by Carr (1950:585), despite statements to the contrary about the Reserve (Glick, 1980).

Another striking difference between the two study areas is the paucity of wetland rodents in the Tiro watershed. The corresponding rockier terrain and apparently better drainage in the sandy clays of the Tiro area may partially explain the greater proportion of mature forest here than around the Mairin Tingni. Certainly the abundance of suita palms on the forest floor in the Mairin Tingni area connotes both the penetrance of sunlight and poor drainage (Carr, 1950). Nevertheless, the question remains as to why such extensive areas around the Mairin Tingni were so thickly second-grown, especially on the presumably better-drained uplands? Moreover, why were some expected animals, such as the squirrels and the large, browsing rodents, so scarce in both study areas? Perhaps the abundant non-human predators, such as raptors and cats, have taken a heavy toll, but we think that another hypothesis, namely the frequent destructiveness of high winds, is worthy of consideration.

HURRICANE DAMAGE

According to the draft management plan for the Reserve, the past decade has witnessed four hurricanes which have disturbed the area of the Reserve, but the only discussion is of

damage to houses in Brus and Barra Plátano due to winds and flooding (RENARE, n.d.). From a review of storm tracks in the Atlantic tropical cyclone basin (Neumann, et al., 1981; Tannehill, 1945), it is apparent that this rate of hurricane impact on the northern Honduran coast is not exceptional. In Table III-5, the data for the past 50 years are summarized, showing that the average rate for hurricanes (winds greater than 73 mph) is two per decade, with twice as many tropical storms (windspeed 39 to 72). Two of those ten documented hurricanes passed directly over the foothills of the Plátano Reserve. Although our informants talked more about the last major hurricane (Greta on 17 September 1978), which destroyed 3% of the houses in Barra Plátano (RENARE, n.d.), perhaps the most newsworthy recent hurricane was Fifi in September 1974. With winds of 130 mph (New York Times, 21 September 1974), an estimated 5000 Hondurans were killed and the damage to public and private industry alone exceeded $250 million (New York Times, 23 September 1974). But what was the effect of such a storm on the tropical rain forest and its inhabitants?

Table III-5. Summary of tropical cyclones affecting the Río Plátano Biosphere Reserve area during 50 years (1931-1980), based on the data of Neumann, Cry, Caso, and Jarvinen (1981).

Storm Track	Cyclone Status	
	Tropical Storms	Hurricanes
Over Present Reserve (w/i 25 nau. mi.)	9	6[I]
Near Present Reserve (w/i 100 nau. mi.)	9	4

[I] Of these six, four passed along the coastline and two tracked inland, directly over the Río Plátano watershed.

Howard Odum (1970) has described two types of tropical rain forest, based on the frequency of hurricanes in an area. His "hurricane type" (e.g. Dominica) seems to describe the flood plain and mountains of the Mairin Tingni Site quite well. His criteria for hurricane forests include enormous buttressing of the "virgin" giant trees; irregular tree crowns; few emergent, umbrella-shaped crowns; *Cecropia* trees only near rivers; and most importantly, large trees

which have lost their limbs a few at a time until they die in place, with the surrounding vegetation closing in around the remaining "skeleton." For the Far East, Whitmore (1975) offered a comparable description, especially over a wider belt of forest not devastated directly by blowdown. In Western Samoa, Wood (1970) described similar forests damaged by cyclones in the 1960's which became dense with creepers and *Convolvulus* climbers. In the extremely wet conditions of the Río Plátano watershed, this enveloping vegetation is frequently the morning-glory vine (*Merremia* spp.), which reached convoluted heights of 30 m around the standing trunks of dead trees. Isolated examples of these were found even at elevations of 250 m on the slopes of Cerro Il Bila, but on the flat flood plain near the Mairin Tingni, most of the forest was a tangled mass of shrubs and dead trees, roped together by vines.

Informants claimed that this area had never been farmed either in their memories or their legends, yet the appearance of the forest was that of second growth resulting from human disturbance within the last half century. Carr (1950:586), in commenting on similar forests elsewhere in eastern Honduras and in eastern Nicaragua, noted that "it seems possible that the curiously subclimactic character of the forest may have been due to damage, possibly repeated blowdown, by hurricanes..." In the Mairin Tingni area, these effects may be potentiated by the funneling effect of the mountains and the poor drainage of the soils, whereas the Tiro area has the protection of coastal foothills (e.g. Cerro Baltimore) and kilometers of forest at the same elevation. Indeed, Wadsworth and Englerth (1959) have commented on the difficulties of making general statements about storm damage on a tropical forest in their study of the 1956 hurricane in Puerto Rico. Topography, soil depth, moisture retention, and the species of tree were all found to be relevant variables. Thus, the more mature forest at Quebrada Tiro is not inconsistent with the hurricane damage hypothesis.

In addition to the obvious long-term effects of such forest disturbance on the fauna which prefer second-growth browsing habitats, we believe that there are more immediate effects of tropical cyclones (both hurricanes and tropical storms), with a frequency of every two years. After the Fifi hurricane of 1974, it was reported that *milpa* fires burned for more than a year on

the blowdown debris in the mountains behind Trujillo (John Buckley, personal communication[3]). The forest was tangled and impenetrable. Moreover, it was only after four years that the howler monkeys were once again heard in Trujillo. According to the indigenous people, the monkeys had gone over the mountains to escape the hurricane (Buckley, personal communication). Interestingly, we heard a similar folk myth from our informants. When the high winds come, the mammals are said to go over the mountains, while the birds seek refuge along the coast. Presumably, mammal populations are drastically truncated, while the birds are able to recolonize at a faster rate. We would predict that the densities of arboreal frugivores such as monkeys and squirrels, are much greater on the leeward side of the mountains, in the headwaters of the Plátano, thus resulting in the "myth" that they had gone there to escape storms.

Major wind and rain storms with a periodicity of two years could produce bottlenecks in the fruit supply of such severity that the population density of dependent mammals is maintained only at a low level. Unusually heavy rains during the "dry" season, such as those we experienced in February, could aggravate this situation by disrupting the normal phenology of fruit trees. The major impact of such adverse rainfall on an entire cohort of monkeys has been well-documented in Panamá (Froehlich et al, 1981). Thus, we feel that a major factor in the faunal composition of Río Plátano foothills is the frequent interference of bad weather, potentiated by native hunting practices, and influenced by topography and drainage. Only further comparative studies in areas such as Costa Rica, where only one tropical storm has impacted in the last 110 years (Neumann, et al., 1981), will determine the extent of this hurricane factor. The implications of this environmental parameter on management planning for the Río Plátano Reserve have, heretofore, not been considered. Certainly the vulnerability of this fragile ecosystem to unregulated hunting, compounded by unpredictable, but severe weather damage, makes a firm management plan obligatory.

IV. SUMMARY AND RECOMMENDATIONS: THE FUTURE OF THE RÍO PLÁTANO RESERVE

Karl H. Schwerin and Jeffery W. Froehlich

OVERVIEW

Although our data collection was attenuated both temporally and spatially by insoluble logistical problems and a paucity of support from the distant central administration of the Reserve, these difficulties in themselves also underscore our primary impression that much of the designated Core Zone in the Río Plátano watershed is an historically undisturbed, natural biological refuge *because of* its geographic remoteness and topographic inaccessibility. Although the recently discussed military road to the Nicaraguan border may increase access to within 3 km of Reserve's boundary (New Scientist, 7 April 1983), the Core Zone's large size of 1300 km^2 makes it unlikely that its remoteness will change in the future, regardless of the status or the administrative policies of the Reserve. Nevertheless, the *fact* that the Río Plátano Biosphere Reserve does exist as a legal entity in Honduras makes it essential that an enlightened management plan be developed for the maximum benefit of the human inhabitants and for the maximum preservation of natural ecosystems, especially when these two objectives are in conflict. Such a plan obviously must begin with a detailed understanding of the cultural and biological ecology of the Reserve.

Despite our brief visit, it is still possible, on the basis of our observations and informant data, to identify some areas of critical concern for effective management, and to suggest some ways in which policies might be implemented in order to confront these issues. At present, only 6% (or 166) of the human population in the Reserve actually live along the Río Plátano and journey further inland, with impact on the fauna and flora of the Core Zone. Based on our observations of current farming and of available, suitable land along the river below the highest human habitation, there is more than twice as much land as would be needed by the *entire* population of the Reserve. Yet only one-third (or 888) of this population actually or potentially use the river bank for agriculture; thus the existing arable land greatly exceeds the current need and there is no

necessity for cultivation further upstream or along the Quebrada Baltiltuk as presently occurs.

Moreover, the human population of the Reserve has tended to relocate further downstream and to engage in nonagrarian economic systems during the last 100 to 200 years. Assuming that these trends continue and the growing dependence on purchased foodstuffs increases with further economic development along the coast, restrictive horticulture, occupation, and travel policies along the upper course of the river should not adversely affect the present inhabitants. Some of these people might benefit from the tourism and scientific business engendered by the Reserve; their direct dependence on the land may decrease as the Reserve is established and publicized.

It is likely, however, that a confrontation will occur when much-needed regulations and restrictions on hunting and fishing are instituted. The people living in the interior of the Reserve have a very strong hunting ethic. Wild meat is considered essential for adequate family support by the male head of each household. Interestingly, the more acculturated coastal people view some of this wild meat consumption with disdain. But the men of Las Marías carry their guns wherever they go. One of us (J.W.F.), upon spotting his first wild mammal (a *Sciurus variegatoides*) near this hamlet, had it almost immediately shot by his guide; and two days later our expedition into the interior was provisioned by tapir meat, over our objections. The severe impact of such hunting is apparent from our data on the scarcity of many mammal species near habitation. Although the success rate of hunting seemed low to us, given the apparent effort, the effects of overhunting in the accessible areas of the Reserve were remarkable. If hunting efficiency were improved technologically, along with greater ease of travel into the interior, the results could be devastating. During the past decade, for example, it is likely that such improvements as the speargun, face mask, and flippers have increased the exploitation of aquatic resources beyond their productive capacity.

The effect of hunting on the mammal populations of the coastal foothills in the Río Plátano Reserve is probably further aggravated by the suspected impact of the frequent tropical cyclones which strike the Honduran coast. This is especially the case for arboreal frugivores, such as spider monkeys or coatis, whose populations must be limited by the frequent bottlenecks in their food supply. The contrast between the paucity of these animals and the abundance of large birds, which

are also hunted, seems to corroborate a folk myth of the Miskito that the mammals go over the mountains during a hurricane, while the birds come down to the shore. If future survey work does confirm the suspected larger mammal populations on the leeward side of the mountains near the southern border of the Reserve, then this boundary is even more important for hunting regulation than along the northern border of the Core Zone where our observations were made.

Even with depauperate populations of some mammals due to overhunting and adverse weather in the areas we visited, our mammalian census work yielded some very significant results. Range extensions for several taxa emphasize how poorly the Mosquito Coast is known to science. Obviously the Reserve contains endangered species which must be conserved, but more importantly the mixture of species identifies this region as critically important for understanding Central American faunal interchange after the Isthmus of Panamá connected two continents. With the added complexity of frequent storm disturbance, the Reserve is an invaluable resource for scientific inquiry, as well as conservation and tourism.

A similar and perhaps even stronger case could be made for preserving the botanical resources in the Reserve. The large number of range extensions for Honduras (4 genera and 9 species) is indicative of how little previous work has occurred on the Mosquito flora. Ecologically, the complexity of the forest has also been increased by storm damage and subsequent second growth, which benefits the browser populations, such as pigs or tapirs, where they have not been overhunted. Moreover, in our very limited work, we discerned some fascinating floral communities, with unusual aggregations and habitat extensions for some taxa. Clearly, the Río Plátano Reserve is a critical link in the Biosphere system, representing a unique biome; it must receive adequate management and extensive scientific study.

MANAGEMENT RECOMMENDATIONS

1. Since the key to the existence of undisturbed habitats in the Core Zone of the Reserve is the logistical difficulty of penetrating the rugged mountains and unnavigable rivers, any management plan must incorporate these factors and no development, scientific or otherwise, should

alter these transportation and travel difficulties. A network of trails, as presently proposed, would be utilized more for hunting than for science or tourism; such a plan should be discouraged.

2. In order to facilitate scientific inquiry, a field station might be established in the interior, with access primarily by air. Because of transportation difficulties and the disturbance adjacent to human habitation, the two field stations that have already been built are essentially useless, except as basecamps. Particularly for the one near Las Marías, they might better serve the function of guard stations.

3. Travel by boat into the Core Zone should be restricted except for tourism, scientific research, and perhaps also for the annual expedition to fish for *cuyamel.* The existing field station at Las Marías could serve as a guard station, beyond which travel would not be permitted. Alternatively, a guard station could be placed at the area known as Buena Vista near the Quebrada Sulawala.

4. Because the headwaters of the Quebrada Baltiltuk within the Core Zone are presently a primary hunting area, travel on this tributary should also be restricted. Since farming presently takes place on this stream near its mouth, this travel restriction should be a gradual transition, during which new fields are discouraged. It should be noted that we previously concluded that this land (ca. 500 ha) is not essential for present or anticipated subsistence.

5. In addition, the boundaries of the Core Zone should be redefined so that inviolate protection of this area can exist in more than name alone. Corridors which run from the mountains to the coast should be eliminated, since they cannot possibly be regulated and consequently would be abused. The travel restrictions mentioned above could serve the purpose of protecting the Core Zone. Travel by foot into the interior might be permitted but limited to a day or two, which is probably all that is feasible for hunting.

6. Since hunters rarely travel further than one day on foot, the appropriate area between habitation or permitted river travel and the Core Zone should be defined as a buffer area, in which hunting and wood exploitation are permitted, but settlement and horticulture are restricted. This area could also be patrolled on a regular basis for possible infringements of the Core Zone and to monitor the impact of hunting.

7. Hunting within this "one day buffer area" should be regulated, but at present we have insufficient data to say precisely how. Obviously, the hunting of endangered and/or scarce animals, such as spider monkeys or tapirs, should be banned until such time as their populations require culling. Indeed, hunting within a buffer area surrounding the Core Zone could serve just such a purpose. There is definitely a need to obtain more precise documentation on hunting practices, the frequency with which men or boys go out purposefully to hunt, the distances they travel, their success rate, and the numbers of each species obtained during a year. This kind of information, as well as continuing census work by scientists and Reserve guards in the buffer area, is essential before it will be possible to decide whether and precisely how hunting of each potential game taxon is to be regulated.

8. Since aquatic resources also appear to be overexploited, annual censusing and regulation by a quota system is needed. Travel upriver to fish for *cuyamel* might be permitted *only* when their populations can sustain it. Perhaps studies of annual yield over several years, coupled with scientific collecting, could be used to determine quotas for subsequent years.

9. In all cases, hunting should be strictly limited to the inhabitants of the Reserve, and then *only* for the purpose of directly providing subsistence. The existing market for trophies, pelts, or other wild animal products could easily lead to an intensification of the already severe hunting pressures. One of us (K.H.S.) was approached by an individual offering to sell a jaguar skin or a nutria pelt.

10. Likewise, gold mining and panning for placer deposits of gold should be restricted to permanent residents of the Reserve. These deposits are a natural resource of the Reserve and should be protected in the same way that the biological resources are being protected. There is no evidence that they are large enough to represent an important exploitable resource for the nation as a whole. Yet the evidence indicates that greater numbers of gold seekers have entered the region in recent years, and that they are introducing increasingly complex and sophisticated machinery for its extraction. This can only cause greater disturbance within the local environment and increase the pressures on the local resources. At the same time, there seems no reason to

prohibit the intermittent and casual search for gold as it is practiced by the local inhabitants using manual techniques.

11. Although one guard station has been established near the southern border of the Reserve in order to prevent intrusive colonization of the Plátano watershed by peasants from Olancho Province, we suspect that regulation and enforcement along this boundary is even more important for protecting mammal populations than along the lower course of the Plátano, due to recent overhunting and the disturbance of frequent tropical cyclones in the latter area. But because of the vast area involved and the difficulty of patrolling it on a regular basis, we suggest regular overflights of the Reserve margins once or twice each month. Should a clearing for horticulture, habitation or mining be observed within the Core Zone, a Reserve guard could then be dispatched. Obviously, such a patrolling strategy would require certain financial support.

12. The Reserve administration should continue to permit agriculture along the course of the lower Río Plátano. This zone is already heavily utilized for this purpose.

13. At the same time, there is a critical need for more information on the nature of riverbank agriculture. It is important to document the intensity with which this zone is exploited, the productivity of this type of agriculture as currently practiced, and whether or not it could be intensified without seriously disturbing adjacent areas or depleting the soil. If this could be done with minimal impact, it might in fact be desirable to intensify the agricultural utilization of this zone not only for subsistence, but for sales to coastal inhabitants with outside incomes.

14. One way in which this might be done would be to experiment with higher yielding varieties of the species currently being planted in order to determine whether improvements in productivity might be achieved. In general, however, it does not seem desirable to try to introduce new staple crops. Local populations are adapted to the crops currently being planted, and appear to derive an adequate diet from them. Without extensive nutritional research on the current alimentary regime, the introduction of a new staple could easily upset an established nutritional balance.

15. The data on livestock are extremely deficient, which makes it difficult to adequately

assess their present impact or to make informed recommendations for livestock management within the Reserve. Most of the coastal residents have given up the raising of pigs because of the damage they cause to fields and gardens. Pigs are, however, raised at Las Marías and along the Río Plátano. Horses, and especially cattle, are of much more concern as regards their impact on management of the Reserve. There is no accurate count of the numbers of head currently being run within the bounds of the Reserve. There is a total paucity of data on local techniques of animal husbandry – breeding, care and management, use of milk, culling or harvesting, sale, slaughter, use of animal products – or of the numbers involved in each of these activities. Because of the impact which large grazing animals can have on the ecosystem and the apparently frequent necessity of protecting them from wild carnivores, it would seem to be extremely important to investigate the whole subject of animal husbandry rather thoroughly. It would then be possible to make much more pragmatic recommendations for future management of livestock within the Reserve.

16. Looking to the longer term, a more ambitious objective might be to encourage experimentation in the cultivation of lacustrine and/or riverine species. The successful reproduction and management of one or more edible native species in the two lagoons which border the Reserve would contribute not only to the preservation of these species, but could come to represent an important food resource for the population of the whole Mosquitia. The experience of state and federal fish and game agencies in stocking game fish in the U.S. might serve as a useful model. Possible species which might be investigated include several different species of fish, as well as shrimp, turtles, and even aquatic birds.

17. Although certain species of trees are continually being cut from the forest for their lumber, it appears that the quantity actually removed each year is relatively insignificant. More forest is undoubtedly removed for agricultural purposes than through lumbering. It thus appears that, for the present time at least, there is little need to control the use of native timber by local inhabitants *outside* the Core Zone. It would be useful, however, to have better quantitative data on just how much is used each year for purposes of construction. It is conceivable that the demand

for certain species (yagua palm, e.g.) is so great that there is some threat to its continued survival within the entire area. If so, then substitute building materials could be suggested.

18. The historical data indicate the existence of a long-term tendency for the populations living on the river to move progressively further downstream. Since this predilection already exists, it could be relatively easy to encourage its continuation. The further downstream people maintain their permanent habitations, the less likely they will be to want to travel long distances upstream. In this way the Core Zone can be further protected. At the same time, the inhabitants living along the river should be encouraged to gradually abandon those fields located upstream above the present site of Las Marías, i.e. the drainage of Baltiltuk Creek and Quebrada Sulawala. It seems likely that should the principal settlement move further downstream, people would be less inclined to travel that far, even for purposes of planting crops.

19. Similarly, every effort should be made to encourage the residents occupying the western section of the inhabited coastal zone to concentrate their agricultural and herding activities along the Río Paulaya. This is already the common practice. To the extent that it continues or increases, it will serve to diminish pressure within the Reserve for agricultural and grazing land.

20. Although the area of exploitation lies outside the boundaries of the Reserve, the lobster industry does exert a very definite impact on the population which lives within the Reserve. It might be useful for the appropriate agency of the Honduran government to investigate the lobster industry in order to determine whether the lobster beds are able to continue producing adequate numbers of this valuable resource at the current level of exploitation. Collapse of the lobster industry would most certainly bring about economic depression within the Río Plátano Reserve and possibly reverse the trend towards resettlement downstream.

21. During our stay in the Reserve we observed that the local personnel were experiencing numerous difficulties stemming from poor communication with the central offices in Tegucigalpa, and from difficulties in obtaining supplies. Mail was being sent to Brus Laguna or Puerto Lempira (our mail was not forwarded at all for 3 months!), even though mail is delivered more or less regularly to Cocobila by the Moravian missionary planes. Through a combination of factors such as

the Reserve. This sometimes meant that in order to keep the Reserve operation going at all, the Reserve Director was forced to purchase locally, out of his own pocket, small quantities of essential items at much higher prices. Installation of two-way radio communication between the Director and RENARE offices in Tegucigalpa and/or La Ceiba might help to ease some of these problems. Even though it could not avoid bad weather or breakdowns of equipment, more rapid communication would enable personnel at both ends of the channel to respond more quickly when problems arise, and to seek alternative strategies, rather than having to assume that everything is proceeding according to plan.

22. The local people remain relatively uninformed and uncertain about the objectives of the Reserve and what implications it might have for their future way of life. In order to avoid the emergence of conflict between the Reserve administration and local population, it will be essential to maintain *constant* communication with the inhabitants about the short-term activities as well as the long-term goals of the Reserve. At the same time the Reserve administration should try to be sensitive to the values and goals of the local residents. There may be times when choices will have to be made between protection and preservation of the wild areas (Core Zone) and the immediate interests of the human inhabitants, such as the issuance of free, but limited hunting permits for certain animal taxa. If free communication already exists among all the personnel resident within the Reserve, it may be easier to make and implement such choices.

23. New policies should be developed for the local Reserve guards, emphasizing education in conservation principles and the skills of game censusing and management. By censusing the animal populations under hunting pressure in the buffer zone, they could help to set yearly quotas or encourage the use of alternative hunting areas. The present local guards are in the best position to communicate to the inhabitants these conservation concepts, as well as to convey to them the importance of *their* Reserve. They should also continue to act as guides into the interior. For enforcement of regulations, however, we suggest that native forest rangers from other areas be exchanged with some local guards, so that conservation management does not become a matter of family conflict.

24. Because the Moravian Church appears to be so influential among the Miskito populations inhabiting the Reserve, it may be desirable (or even essential) to conclude a more formal relationship with the Church in matters relating to the Reserve. One mechanism which suggests itself is to utilize the ministers and lay pastors as formal channels of communication with local inhabitants. The pastors could be extremely helpful in disseminating information about management matters, and might even be utilized to help educate people about some of the underlying reasons for the Reserve and the major objectives in setting it up. At the same time, they are in a position where they would be immediately aware of local problems and could readily communicate individual and community concerns to the Reserve administration.

25. It will also be important for both the Reserve administration in particular, and for RENARE in general, to keep informed about development in the surrounding region. Introduction or expansion of any one of a variety of activities such as lumbering or cattle grazing could potentially have serious repercussions on the Reserve, even though they were being conducted outside the boundaries of the Reserve. Even offshore activities in the Caribbean could affect the Reserve – expansion or collapse of the lobster industry would have economic repercussions on the inhabitants of the region. Something like offshore oil drilling could affect the area both economically and ecologically.

RECOMMENDATIONS FOR FURTHER RESEARCH

The information presented here is impressionistic and based on limited data. There was little opportunity for first-hand ethnographic observation or verification of data obtained from informants. Faunal and floral studies were confined to two small areas determined more by chance and logistical exigencies than by scientific sampling. Further research is indicated merely to corroborate the data obtained thus far.

This, however, is the least of the rationales for continued research. It is quite evident that there is a very great need to obtain comprehensive quantitative data on the extent of the various exploitative practices – agriculture, hunting and fishing, cattle grazing, lumbering, lobstering –

the amount of productivity, their impact on the local ecosystem, and the advisability of imposing restrictions or allowing expansion in any one of these. There also needs to be a more precise determination of the degree to which local inhabitants depend upon territory within the Reserve relative to areas outside (as, e.g., along the Río Paulaya and the Río Sico) for their major exploitative activities. It is distinctly possible that certain activities could be readily redirected to areas outside the Reserve but adjacent to it, thus diminishing the exploitative pressure on the protected area.

There is an almost total lack of information on local social and political organization. Detailed data on these topics could provide valuable comparative insights with Nicaraguan Miskito. It would also facilitate development of optimal channels of communication for Reserve matters. Although there are several excellent studies in Nicaragua, there has been almost no research among the Honduran Miskito, and certainly nothing which could be used for satisfactory comparison.

There is need for detailed data on the nature of family and household composition. What differences, if any, are there in marriages between Miskito and with members of other ethnic groups? Do children of mixed marriages always identify with Miskito? What is the nature of interethnic relations? Are extended families important, and if so, how? What role does a woman's father play toward her and her husband after she has married? What are the relative economic contributions of a husband and wife? What kinds of child-rearing practices obtain, and what is expected of a child as it grows up? What is the role of formal education, and is it viewed as a way to get away from farming, or even to move to the city?

In demographic terms there is need to determine the rate of population growth, as well as the rate of emigration from the Reserve. Where do people go when they emigrate? Is there any significant immigration into the Cultural Zone of the Reserve? If so, can it or should it be curtailed?

We also need to determine whether there is a formal political organization within the Reserve settlements, or whether they function on a strictly informal basis. In any case, the nature of informal political action and informal leadership is an extremely fascinating subject which has to

date been very little investigated. This area further offers a rather unique situation in that the Moravian Church plays such a central role in most communities. Since most congregations are headed by lay pastors, the religious leadership occupies the status more of a peer with other members of the congregation, than of a superior such as is the case with a Roman Catholic priest. The Río Plátano Reserve appears to offer excellent opportunities for pursuing investigations of both aspects of local leadership.

Another potentially important research topic concerns the process of culture change. Change has come about through the influence of the Moravian Church in Belén, Cocobila and Ibans. This influence is particularly powerful at the moment because Cocobila serves as administrative center for the Church throughout Honduras. The most profound change, however, has come about in response to the lobster industry. Although none of the littoral communities has been unaffected, the greatest impact has occurred in Barra Plátano where, the evidence suggests, there has been considerable economic and social disruption. An investigation of the ways this community has responded as it struggles to adapt to a host of new influences would undoubtedly constitute an important contribution to the literature of culture change.

The population of the Reserve also offers intriguing possibilities for genetic studies. The Miskito are a mixed population, and mixture with other racial and ethnic groups continues at present. It appears that there is a particularly high rate of genetic mixture going on in Barra Plátano, and this would seem an ideal population for pursuit of such research. In the past, mixture also occurred among the Garífuna. We do not know how much admixture is going on at present, but the population of Plaplaya might be another very interesting subject for genetic research.

Finally, this is an ideal time, since the Reserve is just now being formally set up, to establish a cultural baseline from which to document the changes that will inevitably come about through the existence of the Reserve itself. It is likely that, to be effective, this would have to be a longitudinal study extending over several years' time, perhaps as long as a decade.

Since certain mammals are rarely encountered in the northern parts of the Core Zone, adjacent to human habitation, and because of logistical difficulties of travel into the interior, bio-

logical research should focus more on floral censusing, with incidental observations of mammals or birds. If the latter are ever to be studied intensively, it must be away from the disturbance surrounding habitation and the suspected interference of hurricanes. Moreover, the current practice of following the water courses because of the density of second growth is not efficient, because obstructions to visibility and the attending noise of moving water prevent observations. Nevertheless, as already mentioned, it is imperative that a network of maintained trails *not* be considered, unless it is well inside the Core Zone and removed from the possibility of use by hunters. Perhaps a scientific study area could be established near the southern boundary of the Core Zone, approachable by air from Olancho Province. We suspect that ecological studies here will be more fruitful because there has been less disturbance of the fauna.

It is clear that the establishment of the Río Plátano Biosphere Reserve has opened up many opportunities for valuable research, in the biological as well as the anthropological sciences. The topics suggested here are only the most obvious, although some, such as the investigation of resource utilization, or the study of current culture change, are also quite urgent. It would indeed be unfortunate if proper advantage were not taken of these opportunities to add both to our substantive and our theoretical knowledge, while at the same time contributing to the Honduran authorities at RENARE more effective means for achieving their goals of protection and enlightened management of this valuable natural and genetic resource.

FOOTNOTES

CHAPTER II

1. In the figures which follow all mixed-blood Miskito are counted as Miskito, except for Miskito-Paya mixture. The history of the Miskito has indicated a great openness to intermarriage and to assimilation of outsiders. The fact is that most Miskito have mixed ancestry to begin with. Thus, it seems reasonable to conclude that most, if not all, current hybrids are socialized and treated as Miskito. This is probably true of the Miskito-Paya mixture as well, but since the RENARE figures show a nearly equivalent number of both ethnic groups in the vicinity of Las Marías, the mixed-bloods have been kept separate here.

2. It is not clear whether this figure refers to the whole of the Municipio de Brus Laguna, or whether it is restricted to the Río Plátano area.

3. More extensive listings of endemic fauna and flora within the Reserve have been published by Gilbert and Glick (1978:102-131). However, since they treat domesticated plants only in passing, I have compiled a separate list of cultivated plants in Table 2.

4. One interesting sidelight on his position as a social and economic leader in the community, is his attitude concerning the Nicaraguan Sandinistas. Most people in the area knew about the Nicaraguan Revolution; some even listened to the daily broadcast in Miskito from Radio Sandino. The general attitude, however, seemed to be one of detachment or even apathy. Not so in this case. This entrepreneur was worried about the possibility of Sandinista intervention or influence in Honduras. While the average *campesino* might hope to benefit from a social revolution like that in Nicaragua, he seemed to feel that he would lose everything that he had accomplished, everything he had achieved through his own hard work and perspicacity. While it is true that a socialist revolution would be concerned primarily with the place of corporate and multinational enterprises within the country, it also seems likely that petty entrepreneurs such as those in Ibans might very well get caught in the middle. Were the same rules and laws devised to apply to the large corporations to be enforced all the way down the line, these men would certainly be vulnerable.

CHAPTER III

1. The numerical coordinates for square kilometer "sections" are based on the Instituto Geográfico Nacional 1:50,000 map series.

2. A complete floral list is included as an appendix, with Standley (1931, 1937) being consulted for spelling and systematic conventions, such as the order and naming of families, since the senior author has no formal botanical training.

3. John Buckley, a graduate student in anthropology at The University of Texas, Austin, worked in Trujillo, Honduras for two years from 1978-1980.

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Appendix Table 1. Systematic list of the flora documented at the Quebrada Tiro Study Site and the area adjacent to the Río Plátano near Búlebar and Las Marías. Incidence is given only as present (X), two, or more than two (Σ) specimens. One or two asterisks indicate specific or generic range extensions, respectively. Elevations are given in parentheses whenever they are not typical for the collecting area.

Family/Taxon	Spanish Vernacular (Miskito)	COLLECTION SITE				
		Quadrat[I] Trail	Parkia Trail	Qda. Tiro[II] Bank	Ridge Trail	Río Plátano Bank
Ferns, etc.						
Asplenium serratum		X				X
Blechnum sp.				X	X(600 m)	
Bolbitis sp.		X		X		
Cyathea sp.				X		
Didymochlaena trunculatum				X		
Diplazium grandifolium				X		
Metaxya rostrata					X(450 m)	
Niphidium crassifolium				X		X
Pleopeltis sp.					X(600 m)	
Thelypteris cf. *porteana*					X(450 m)	
Selaginella sp.					X(700 m)	
Pinaceae						
Pinus caribaea						X
Graminae						
Pharus cornutus					X(450 m)	
Cyperaceae						
Hypolytrum longifolium (subsp. *nicaraguensis*)					X(600 m)	
Palmae						
Bactris mexicana				X		
Chamaedorea ernsti-angusti	(sihwah)		X			
Reinhardtia simplex				X		
Welfia sp.					X(450 m)	
Indet.					X(450 m)	
Araceae						
Caladium sp.						X
Smilacaceae						
Smilax subpubescens					X(450 m)	
Amaryllidaceae						
Bomarea sp.				X		
Musaceae						
Heliconia sp.	(ringruk)					X
Zingiberaceae						
Costus villosissimus						X
Costus sp.						X
Marantaceae						
Calathea lutea						X
Calathea microcephala				X		
Ischnosiphon pruinosis						X

Orchidaceae						
Epidendrum nocturnum				X		
Epicendrum selligerum			X			
Pleurothallis sp.					X(450 m)	
Scaphyglottis sp.				X		
Indet.				2		
Piperaceae						
Piper sp.				X		X
Lacistemaceae						
Lacistema aggregatum				X	X(700 m)	
Ulmaceae						
Ampelocera cf. *hottlei*				X(90 m)		
Moraceae						
Brosimum alicastrum		X		X		
Cecropia peltata	(plam)	X	X			X
Coussapoa sp.			X			
Ficus insipida	(mistruk)	X		2		
**Ficus nymphaefolia*			X	X		
**Ficus obtusifolia*			X			
Pourouma aspera		2	X	X		
Pseudolmedia oxyphyllaria		2		2(90 m)		
Sorocea sp.? (shrub)		X				
Urticaceae						
Myriocarpa longipes	(kaoput)			X		
**Urera laciniata*						X
Olacaceae						
Heisteria macrophylla				X		
Polygonaceae						
Coccoloba tuerckheimii	(wahan)			X		
Nyctaginaceae						
Pisonia aculeata				X		
Phytolaccaceae						
Phytolacca rivinoides						X
Magnoliaceae						
Magnolia sororum					X(700 m)	
Annonaceae						
Desmopsis panamensis		2		X		
Guatteria amplifolia	aguacatillo		X			
Malmea depressa			X			
Xylopia frutescens	(paikara)			X		
Myristicacae						
Compsoneura sp.				X		
Virola sebifera			X			
Virola sp.		X				
Monimiaceae						
Mollinedia puae	(tahmatanika)		X	X		
Siparuna nicaraguensis	(sahsap)			X		
Lauraceae						
Nectandra globosa						X
Ocotea sp.	(kuhlan)			2		

Hernandiaceae					
**Hernandia didymantha*		X		X	
Rosaceae					
**Hirtella paniculata*	pasa		X	X	
Hirtella racemosa	(suhlapatah)		X		X
Hirtella triandra	(turturia)		X		
Leguminosae					
Albizzia adinocephala		X			
Bauhinia sp.		X			
Cassia alata					X
Centrosema plumierii					X
**Cynometra* n. sp.?	guapinolito		X		
Cynometra sp.		X			
Dialium guianense	paleto	X	X	X	
Entada monostachya		X			
Inga sapindoides					X
Inga sp. (*pubescent*)			X		
Inga sp.	guama de cerro (brikbrak)		X		
Machaerium kegelii		X			
Ormosia coccinea (var. *subsimplex*)		X			
***Parkia pendula*	barbalote (tuburo)		Σ	X	
***Piptadenia* sp. ?	carbón				X
Pithecolobium arboreum	(sahsan)		X	X	
Pterocarpus offinialis		X	X	X	
Schizolobium parahybum		X(250 m)	X		
Swartzia simplex (var. *ochracea*)		2	X		
Vatairea sp.	(susun)	X	X	X	
Indet.	(kahwi)		X		
Erythroxylaceae					
Erythroxylon cf. *tabuscense*			X		
Rutaceae					
Erythrochiton incomparabilis			X		
Zanthoxylum setulosum				X	
Burseraceae					
Bursera simaruba	indio desnudo (nigrito)	X	2		
Protium sp.	kerosin		2		X
Tetragastris panamensis	kerosin	X	2		
Meliaceae					
Guarea sp.	(basparrat)		X	2	
Swietenia humilis	paleto	X	X	X	
Malpighiaceae					
Byrsonima crassifolia					X
Vochysiaceae					
Vochysia hondurensis	San Juan			X	
Euphorbiaceae					
Acalypha diversifolia	baranegra			X	X
Croton glabellus					X
Hieronyma alchorneoides	(embra/macho)	2			
Mabea occidentalis					X
Pausandra trianae	(tabacon)	X	2	X	
Anacardiaceae					
***Tapirira guianensis*		X		X	
Celastraceae					
Crossopetalum parviflorum				X	

Sapindaceae						
Allophylys sp.				X(90 m)		
Cupania cubensis						2
Cupania rufescens						X
Rhamnaceae						
Gouania polygama						X
Tiliaceae						
Apeiba membranacea			X	X		
Luehea seemannii						X
Sloanea meianthera				X(100 m)		
Sloanea zuliaensis	comida de lapan	X	2	X		
Sloanea sp. (lg. fruit)	comida de guaro	X		2		X
Sloanea cf. *meianthera*	laca	X	X			
Sloanea sp.	(bapnini)		2			
Trichospermum caribeum				X		
Triumfetta sp. (shrub)		X				
Bombacaceae						
Pachira aquatica	sapotón (pukru)	X	Σ			
Quararibea sp.	(yayo)	2	X			
Dilleniaceae						
Davilla aspera var. *matudas*						X
Doliocarpus multiflorus		X				X
Actinidiaceae						
Saurauia selerorum						X
Ochnaceae						
Cespedesia macrophylla			X	X		Σ
Marcgraviaceae						
Marcgravia sp. (vine)			X			
Souroubea sp.			X			
Theaceae						
Ternstroemia tepezapote					X(450 m)	
Guttiferae						
Calophyllum brasiliense var. *rekoi*	Santa María	X	2			
Clusia quadrangulare						X
Clusia salvinii					X(700 m)	
Clusia sp. (epiphyte)	mato palo (shirom)	X				
Rheedia intermedia		2		2	X(450 m)	X
Symphonia globulifera	(samo)		X	X		
Bixaceae						
Bixa orellana						X
Violaceae						
Rinorea guatemalensis				X(100 m)		
Flaucourtiaceae						
Carpotrache platyptera	(lactuce)		2	X		
Casearia arborea			2	X		
Casearia sylvestris	(sinagwaikika)		X			
Laetia procera			X			
**Lunania parviflora*		X(80 m)				
Pleuranthodendron mexicanum	(yahnan)			X		

Rhizophoraceae						
Cassipourea guianensis		X				
Combretaceae						
Combretum cacoucia						2
Terminalia sp.	(labina)		X	X		
Myrtaceae						
Eugenia sp.	pimienta	X	Σ	X		
Melastomataceae						
Aciotis levyama						X
**Bellucia axianthera*						X
Clidemia septuplinervium				X		
Clidemia sp.				X		
Miconia chrysophylla				X		
Miconia impetiolaris						X
Miconia microcarpa						X
Miconia serrulata				X		
Miconia tomentosa						X
Miconia sp.	(sihayah)		X	X		
Miconia sp.	(sihinuk)		X	2		Σ
Araliaceae						
Dendropanax arboreus		X	X	X		
Ericaceae						
Satyria warscewiczii					X(600 m)	
Myrsinaceae						
Ardisia nigropunctata						X
Ardisia tigrina					X(450 m)	
Ardisia sp.					X(700 m)	
Sapotaceae						
Pouteria campechiana	sapotillo de la guatuza (kiakikoorkah)		X			
Pouteria izabalensis	chillión (tasmo)			2		
Pouteria sp.		Σ	X	X		
Indet.	comida de mico de noche		X	X		
Loganiaceae						
Strychnos sp. (shrub)				X		
Apocynaceae						
Aspidosperma sp. ?				X		
Odontadenia macrantha		X		X		
Stemmadenia sp.				X		
Tabernaemontana amygdalifolia						X
Tabernaemontana chrysocarpa						X
Tabernaemontana sp.				X		
Convolvulaceae						
Merremia tuberosa				X		
Boraginaceae						
Cordia bicolor		X				
Tournefortia cuspidata						X
Labiatae						
Scutellaria sp. (shrub)					X(600 m)	

Solaneceae						
Lycianthes aff. *synanthera*				X		
Markea sp. (shrub)				X		
Bignoniaceae						
Callichlamys latifolia		X				
Mussatia hyacintha				X		
Tabebuia guayacan				X		
Xylophragma seemangianum				X		
Gesneriaceae						
Beslaria laxiflora				X		
Drymonia sp. (shrub)				X		
***Paradrymonia decurrens*				X		
Acanthaceae						
Aphelandra deppeana			X			X
Justicia aurea						X
Odontonema callistachyum						X
Rubiaceae						
Appunia guatemalensis				X		
Cephaelis elata				X	X(600 m)	
**Genipa americana*	(yare)	2				
Hamelia longipes						X
Palicourea guianensis						X
cf. *Portlandia*					X(700 m)	
Psychotria elata					X(700 m)	
Psychotria sp.	flor de noche			X		
Rondeletia buddleoides					X(600 m)	
Curcurbitaceae						
Gurania makoyana				X		
Lobeliaceae						
Lobelia tatea ?					X(600 m)	
Compositae						
Indet.						2

[I] Elevations of 110 to 200 m, except where noted.

[II] Elevations of ca 70 m, except where noted.

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