RATIONALISATION OF THE PROTECTED AREAS SYSTEM OF HONDURAS

VOLUME II: BIODIVERSITY OF HONDURAS

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BIODIVERSITY OF HONDURAS

1. INTRODUCTION

The Map of the Ecosystems of Central America, (Vreugdenhil, 2002) has been produced to give better insights into wealth and distribution of species of Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panama. The Honduran Ecosystems Map forms the Honduras section in that integrated regional map. The current document closely analyses the map as well as the currently available taxonomic data and proposes a number of corrections on classification and polygonisation. In its annexes, it presents important species lists, some of which with the latest available distribution data:

- Volumen II, ANEX I, Lista de Vertebrados de Honduras y su Presencia Conocida en las Areas Protegidas Principales;
- Volume II, ANNEX II: Tables of Marine Evertebrates;
- Volume II, ANNEX III: Distribution of Continental fishes of Central America.

The present document is part of the series: RATIONALISATION OF THE PROTECTED AREAS SYSTEM OF HONDURAS. Files in English and Spanish can be downloaded from: http://www.birdlist.org/cam/honduras/hn_parks_study1.htm.

Parallel to the present work, Vreugdenhil (2003, in press) has worked on a document that expands the theoretical background of this study: **PROTECTED AREAS SYSTEM PLANNING AND MONITORING**. It will be made available electronically starting June 2003, from link http://www.birdlist.org/cam/honduras/hn_parks_study1.htm.

2. BIOGEOGRAPHY

Honduras and Northern Nicaragua form the southern tip of a mountainous region that extends from the North Pole South to Nicaragua. Many northern and even some boreal elements find their southern limit on the peaks of the high mountains of Honduras, as they could not transverse the lowlands of Nicaragua (Gomez 1986). Several coniferous species, like *P. hartwegii, P. ayacahuite, P. maximinoii, Abies guatemalensis, Cupressus lusitanica* and *Taxus globosa* can be found at high elevations in Honduras; but, only *Pinus caribea* and *Pinus oocarpa* extend further south, into Nicaragua.

Being isolated from the Amazonian region by the Andes Mountain region, humid tropical elements in Central America are geographically connected with the Pacific wet tropical forests ranging from the Northern Pacific coast of Ecuador via the Chocó of Colombia into Central America and which extends into Southern Mexico. Even though no major geographic formation has impeded the distribution of species within this forest formation, there exists a clear decrease in forest species diversity and regional differences in the floral composition exist within the Central American humid forests. It seems reasonable to assume that the gradual decrease of precipitation from South to North (At some locations along the Colombian Pacific region the average annual rainfall is well over 10,000 mm per year) contributes to this trend, while further north decreasing minimum temperatures (periodic cold spells) are an increasingly important limiting factor Furthermore, the relatively recent development of the Isthmus and its consequentially relatively recent occupation may have also contributed to this trend.

Within Honduras, important phytogeographic variation also exists in the lowland broad-leaved forests of Honduras, though it is harder to identify the phytogeographic boundaries with precision. It has been suggested that variations within the Isthmus are due to humid forest contraction during the dry Pleistocene period, creating discreet islands or refuges of humid forest. Honduras is placed between the supposed Chiapas-Peten refuge and the Costa Rican -Panamanian refuge (Haffer, 1982). Many plant species in the humid forest belt have regional distributions that extend from Honduras to Southern Mexico, and many others extend from Honduras to Panama. It remains unclear what impact this overlapping of regional floras has on the overall diversity of the Honduran humid forest flora. Haffer (1982) also claims the existence of an overlap of the regional floras in North Honduras with the distribution of both birds and butterflies, which we intuitively would like to agree to, but for which then and even now, are insufficient evenly sampled data to statistically underpin the expectation.

A clear convergence of broadleaved species from both North and South America can be found in the cloud forests of Honduras, between 1500 m and 2800 m. The dominant species in these forests are the oaks (Quercus spp.) – representatives from Boreal North America - which mix with members of the Avocado family *(Persea* spp. *Nectandra* spp. and *Phoebe* spp.), originating from Neotropical South America (Secaira et al, 2001). Yet these forests have more in common with the Cloud forests of Guatemala than with those found south of the Nicaraguan depression in Costa Rica.

The dry forest of the Honduran pacific coast forms part of a forest formation that extends from Southern Mexico down the pacific coast of Central America to Costa Rica. Even though it is clear that Mexico has a particularly rich dry forest flora, the dry forest flora of Pacific Central America is very uniform, with an obvious mix of both North American and South American elements. The intermountain dry forests, found in the larger valleys, are more clearly identified with those of Mexico and Guatemala. Many species having restricted regional distributions and southern limits in Honduras, as is the case with the semiarid forest of the Aguan valley, which is clearly related to the ecosystems of the Motagua valley in Guatemala.

3. ECOSYSTEMS MAP

The Ecosystems Map of Honduras (PAAR/COHDEFOR/BM, 2002, The World Bank, et al. 2002, Vreugdenhil, et. al, 2002), identifies 70 ecosystems, which it breaks down into forests, shrublands, savannahs and wetlands. The Map was produced using the UNESCO physiognomic classification system (Mueller-Dombois 1974), which is fundamentally a species independent physiognomic, hierarchical vegetation classification system that takes into account ecological factors such as climate, elevation, seasonality and human intervention (Vreugdenhil 2001). One of the main advantages of this physiognomic system is that it can be used to classify vegetation types as seen in satellite images. Satellite images normally can clearly identify recent[1] human intervention in primary vegetation; therefore the Ecosystems Map of Honduras shows the actual status of Honduran ecosystems at the time of the taking of the satellite image. The map of Honduras was based on images taken in the period 1994 – 2000, and as a result, some of the shapes of the ecosystem polygons may be somewhat outdated in the sense that the natural ecosystems may have partially contracted, particularly along some of the edges.

Vreugdenhil, et al., (2002, in press), argue that the ecosystem classes mapped in the Central American Ecosystems Map, of which the Ecosystems map of Honduras makes part, represent fairly distinct – though often partially overlapping – sets of species. However, we assume that the UNESCO classes, - particularly if extended with diagnostic species - represent sets of species and their mutual interrelationships and processes. This makes both flora and fauna elements intrinsic to the ecosystem classes of the Central American Ecosystems Map (Vreugdenhil, et al., 2002, in press). The ecosystem classes are therefore currently the closest proxy available to providing a differentiation of species sets that is not biased by such common factors as road-access or institutionalised study areas.

In this chapter we give an overview of the main ecosystem classes, highlighting some of their characteristics.

3.1. SOME HIGHLIGHTS OF THE ECOSYSTEMS

3.1.1. Evergreen Forests

The most species rich ecosystems in Honduras are its Evergreen forests, which are found at all altitudes, from lowland rainforests to high mountain cloud forests. A total of 15 of these evergreen ecosystems are found in the country, most of which are found in the wetter North.

The most extensive of these evergreen systems are the **Lowland Evergreen forests** of the Atlantic Coast, which include both moderately drained forests on the coastal plain and well-drained forests on the surrounding foothills. These forests are Honduras' most species rich ecosystems with as many as 115 species of tree being found per hectare (House 97). They are amply represented in the National Park System in the Río Plátano reserve, and to a lesser extent in the Tawahka reserve. Smaller areas are found in the other north coast reserves such as Pico Bonito, Texiguat, y Capiro y Calentura. These reserves are also particularly rich in amphibious species (26 species corresponding to 31% of the national number of species of amphibians).

[1] Human intervention becomes less and less visible when forests are left to regrow.

The **Submontane Evergreen forests** are very similar to their lowland neighbours though there is a clear decrease in tree species diversity and an increase in epiphyte diversity. These forests are also restricted to the north coast, with a large area found in the Rio Plátano Biosphere Reserve, while additional important areas are found in Pico Bonito and Texiquat reserves.

The lowland and submontane evergreen forests of the Mosquitia are the most extensive and best conserved ecosystems in the country, forming a solid block of forest between the Rio Plátano and Tawahka reserves of well over 500,000 ha. The Mosquitia has always been the single largest block of these ecosystems in the country, and relatively little forest here has been lost. The condition of the lowland and submontane evergreen forest outside of the Mosquitia is very different, most if not all of the moderately drained forest on the flat coastal plain has disappeared. Some areas of well-drained forest survive at the foot of the Pico Bonito and Texiguat reserves. Even though these areas are much smaller in size than their Mosquitan neighbours, they are very important in the conservation of evergreen broadleaved forest across its original range with its expected geographical variation. Strong evidence exists, among other things extremely high levels of endemisum found in the Pico Bonito and Texiguat Reserves, that their two evergreen forests are surprisingly different from the forests in the Mosquitia. Therefore, the biologists in the investigation team considered the lowland and submontane broadleaved forest found at the base of Pico Bonito of considerably higher importance than the surviving areas of evergreen forests found along the Rio Tinto, which appear to be similar to those found in the Rio Plátano reserve. The conservation of the lowland forest around Pico Bonito and Texiguat reserves must be considered of the highest priority.

At the lower and upper mountain level, mixed evergreen forests become more common than pure broadleaved evergreen forests. Evergreen forests at these altitudes are spread over a wider portion of the country being found along Caribbean slope north of the continental divide, some of the larger and more important areas are in La Muralla, Azul Meamber, Agalta, Cusuco, Merendon, Texiguat and Pico Bonito. These ecosystems are all relatively well conserved, though their total area in the country is reducing.

At the Altimontane level, broadleaved evergreen forests are only found on two mountains Cusuco and Yoro. By far the largest and most important fragment is that of Montana Yoro as it is some 10 times larger than that found on Cusuco. The evergreen forest on Montana Yoro is one of the most intervened in the country and despite its large size it must be considered threatened.

Mixed Altimontane evergreen forests are more common being found on the highest peaks across the country, particularly in Celáque and Pico Bonito. The forests on these peaks are inaccessible and therefore very well conserved.

The evergreen forest on karstic soils are considered as separate ecosystems due to their differing species composition. Karstic soils are very well drained, which means that evergreen forest on karstic soils is only found above 1000 m. The only areas that contain these ecosystems are Lake Yojoa and Santa Barbara. The lowest of these ecosystems **the Lower Montane Evergreen Broadleaved forest on karstic soils**, found around Lake Yojoa is severely threatened, surviving as two small fragments of a few hundred hectares each. The Upper Montane Mixed evergreen broadleaved forest on Montana Santa Barbara is also seriously threatened. The Altimontane broadleaved and Mixed karstic ecosystems found on Mount Santa Barbara are relatively intact at the moment.

The **Evergreen Swamp forest** found on the north coast in all of the wetland reserves, are dynamic ecosystems, but they remain the best-conserved lowland evergreen forests along the north coast. Even though they do not have a high diversity of tree species they do support large numbers of epiphytes and a rich fauna in particular bird species. Despite there inhospitable nature these forests are under threat from agricultural expansion, as they can be cut and drained. Its very clear from the satellite images that these forest are being converted, all along their outer rim. The conservation focus in the wetlands tends to be with the coastal ecosystems, beaches, lagoons and mangroves, leaving the swamp forests relatively under protected.

3.1.2. Seasonal Evergreen Forests

The most common ecosystems of Central Honduras are the seasonal Evergreen forests, the most extensive of which are the Pine forests. The ecosystems Map identifies, 9 broad leaved 4 pine and 4 mixed seasonal evergreen ecosystems, making a total of 17 in all.

The most extensive areas of **Seasonal Evergreen broadleaved** forest are found in the East of the country in the department of Olancho, particularly in the Rio Patuca reserve. These forests are clearly seasonal in nature with over 25 % of the trees loosing their leaves for long periods of the dry season. Even though these forests are dryer than the evergreen forests they contain a very rich epiphyte flora including a large number of orchids and bromelias. Smaller areas are found around Lake Yojoa and in the west along the Guatemalan boarder, a one small fragment is found around the ruins of Copan.

The **Lowland Seasonal Evergreen Broadleaved forests on karstic soils** are found in the Tawahka reserve and to a lesser extent in the Patuca. Studies have shown that these ecosystems to be very different from there non-karstic neighbours. Submontane seasonal Evergreen forests on karstic soils are found in the previously mentioned reserves but also in the Lake Yojoa region. In general these Seasonal Evergreen forests are somewhat neglected and understudied.

Large areas of Honduras are covered with **Seasonal Evergreen Pine forest** types dominated by either *Pinus caribaea*, in the lowland or *Pinus oocarpa* at intermediate elevations, which vary from savannah formations to poorly developed forest. All of these forests have been modified by human activity, being periodically burnt and grazed. In the Mosquitia, (Honduras and Nicaragua) were human intervention is less intensive they resemble the pine forests of the Belizean coastal plains. Pine forests are very difficult to map from satellite images, as their physiognomic properties can vary over relatively small distances, as the result of human induced stress and resulting natural regeneration. Perceived physiognomic variety therefore does not in most cases reflect differences in species composition This is very similar to situations observed for the savannahs of Africa, under similar conditions where the rapid structural changes following fires, do not correspond to floristic changes (McDonald et al. 1996 in Grossman 1998).

The difficulties in mapping pine forests, are compounded by the fact that important changes in secondary species composition, (not in dominant pine species) has no impact on overall physiognomic structure. Therefore pine savannah with a diverse and unique herb flora, is no different from a thin, overgrazed, species poor pine forest. The pine forests of Honduras contain areas of increased biodiversity along watercourses, which are to small to map. Areas of pine forest that conserve a diverse herb understory and relatively intact water courses, can be surprisingly species rich, with well over a 1000 species being reported for relatively small areas of pine forest in central Honduras (Nelson per. com.). But present day remote sensing technologies can not differentiate between this small relatively species rich areas and the more common degraded pine forests that dominate the Honduran landscape.

The largest ecosystem in Honduras is the **seasonal submontane pine forest**, which was the dominate ecosystem throughout much of inland Honduras, unbroken areas of which today, are found only in the department of Olancho. No single viable piece of this ecosystem is found within the National Parks System. Despite the doubts about its secondary nature this ecosystems is one of the most characteristic of Honduras, it defines still much of its landscape. Small areas of this forest type do occur in Nicaragua, and Guatemala, but nothing on the scale of what occurs in Honduras. It is recommendable that at least once sizable piece of this ecosystem be include in the National Park System.

Large tracts of seasonal lowland pine forest remain on the Mosquito Coast, sizable areas of which are found protected.

3.1.3. Semideciduous broadleaved forests

The 5 semideciduos forests ecosystems occur in Honduras, 3 of which are found on exposed coastal positions (discussed with the other coastal ecosystems) and 2 are found in dryer inland areas. Both of these ecosystems are Submontane, one broadleaved and one mixed. The areas where semideciduos forest fragments can still be seen are along the rim of the Sula and Aguan valleys, and along the Pacific slope in the south of the country. The protected areas that conserve these ecosystems are in the south Guanacaure and la Botija and in the north Pico Bonito. It has not been possible to confirm the presence of semideciduos forest in the lowland in Honduras, (because of the extent of the habitat loss) though it might be expected to occur. These forests are closely related to deciduous dry forest, found in the south of the country but a significant proportion of the trees in these semideciduos forests do not loose there leaves in the dry season.

These forests have been overlooked in the past and in general they are in a critical state of conservation. It

entirely unknown weather the semideciduos forests found around the rim of the larger dry valleys such as Sula, Aguan and Agalta are different from the forests found on the Pacific slope. Luckily some portions of both are conserved in the National Park System. The largest single area is that found in la Botija reserve in the South. The forest here is very mixed, and seriously intervened. The semideciduos forest here continues over 1000m unto at least 1300 m. The higher up the mountain the forest is more mixed lower down it becomes almost pure semideciduos forest. Despite recent efforts to conserve this important area, it remains a proposed reserve with considerable human intervention.

In the north along the rim of the Aguan valley large areas of semideciduos forest are found some of which is within the Pico Bonito National Park. This area remains the least well protect part of the park and the semideciduos forest is continually under threat.

3.1.4. Deciduous Forests

The only deciduous forest ecosystem found in Honduras survives as nothing more than a few heavily intervened fragments in the south of the country. Some of these fragments are within the Golfo de Fonseca group of reserves. The actual state of conservation of these fragments is unknown. The lager areas of deciduous shrubland found around the base of the Guancuare, would return to deciduous forest if left long enough. It is surprising how rich the deciduous flora of the south remains despite the near total destruction of the ecosystems there.

3.1.5. Mangroves

Honduras processes important areas of mangrove forest both on the North and South coasts. Because of the obvious structural differences, mainly open estuary mangroves in the south and closed wetland mangroves in the north, and differences in species composition, these two mangrove areas are treated as different ecosystems. A number of northern reserves contain important amounts of Mangrove in particular Rio Plátano, Jeannette Kawas and Caratasca. The Pacific Mangrove is only found in the Golf of Fonseca group of reserves. We like to reiterate the conclusion of Vreugdenhil, et al., that even though the plant species of the mangrove ecosystems may be the same, the aquatic fauna, is largely distinct along the Caribbean and Pacific coasts.

3.1.6. Shrublands

The shrubland ecosystems include the deciduous shrubland of the south of the country and the semiarid cactus dominated **Deciduous shrubland** of the Aguan Valley. The Aguan valley ecosystem contains some 10 species of endemic plants as well as an endemic species of bird the Honduran Emerald Hummingbird (*Amazilia luciae*) and an endemic species of Lizard (*Ctenosaura melanosterna*). It appears that Aguan shrubland is a natural shrub or low forest ecosystem, typical of arid and semi-arid regions. The lowland deciduous shrub ecosystems found in the south of the country are almost certainly secondary in nature, and will if left undisturbed in time will return to deciduous forest.

The **Submontane Deciduous shrubland** found both in the south and along the rim of some of the dryer inland valleys, is the only ecosystem not represented in the National Park System. It might be that these shrublands are also secondary in nature, though some in the more arid areas could also be natural. The main difference between natural shrublands and secondary shrubland is the diversity and high number of cactus species in the more natural areas. The only submontane cactus dominated ecosystem outside of the Aguan and Agalta valleys is a very small fragment found close to Palmerola air base in the Comayagua valley. A larger fragment of Submontane shrubland is found in the south of the valley of Comayagua, this region needs to be investigated to assess it ecological value.

3.1.7. Savannahs

The ecosystems map contains 5 savannah ecosystems, mostly found on the Mosquito Coast. The savannahs of the Mosquito Coast are large open ecosystems of many hundreds of thousands of hectares that extend well into Nicaragua. One major fragment of the three main types, are conserved in three different protected areas, Rio Plátano, Caratasca and Rus Rus. These large and isolated savannah ecosystems at this moment do not seem to be seriously threatened, though the dangers of over burning and the possibility of large scale introduction of exotic grass species could endanger these ecosystems.

Mount Celaque in South West Honduras contains small areas of a High Mountain savannah, found nowhere else in Honduras, which both in flora and aspect appear similar to the Guatemalan altimontane grassland ecosystems. A small area of grass savannah is found on Mount Zacate in the south of the country,

a piece of which is conserved in the Golfo de Fonseca group of reserves.

3.1.8. Marshes

The two marsh ecosystems are found distributed across the wetlands of the North Coast, one is a grass dominated marsh and the other a sedge marsh. Important areas of these ecosystems are found in Jeannette Kawas, Rio Plátano, Caratasca and in the Golfo de Fonseca reserves. The exact state of conservation of these ecosystems is unknown due to the difficulty of interpreting satellite images for small inundated ecosystems. Even though they would not be expected to be rich in plant species, the associations of plant and animal species in both ecosystems would almost certainly be unique. Sufficient areas of both ecosystems are found in the National Park System to secure their conservation if water quality and levels can be maintained in these wetlands as a whole.

3.1.9. Coastal Ecosystems

On the Ecosystem Map the coastal ecosystems of Honduras are divided into 8 ecosystems (excluding Mangrove), which include beaches, dune vegetation, and low semideciduous forests, as well as mudflats, and sandbanks. Most of these ecosystems are very linear in nature being long and thin, they are created by a combination of factors, which include exposure to winds, sandy substrate and alternating good and poor drainage depending on tides and seasons. Even though these ecosystems are relatively species poor they play an important role in wetland ecology.

One of the most botanically distinct coastal ecosystems are those of the islands semideciduous forest, which is found on all of Honduras main islands (Bay Islands, Swan Islands and Cayos Cochinos). This ecosystem represents a mix of both continental and Caribbean species, while on the Swan Islands it is more of an exclusively Caribbean in nature. All these islands contain endemic species of reptiles and as well as floristic elements found nowhere else in the country. The conservation status of much of this forest remains in doubt, as they are part of Marine Reserves, which are clearly much more focused on protecting the coral habitat. During the prioritisation process these islands received more points for their unique terrestrial ecosystems than they did for their aquatic ones. It should be noted however, that for technical reasons, the coralline ecosystems and sea meadows could not adequately mapped. What is polygonised as one coralline ecosystem, should contain at least the following ecosystem classes, each with distinct sets of species:

- Marine meadows
- Back Reef
- Reef Crest
- Fore Reef
- Escarpment

Such division would add additional ecosystem value to the insular protected areas if properly mapped. However, since those areas all fall well within the prioritised system on the bases of the mapped ecosystems, there is no need to make changes in the context of the present study. The in reality higher scoring for marine ecosystem values however, should not overshadow the importance of the conservation of the terrestrial habitats of those insular habitats and their conservation needs to be taken seriously as well.

The precise situation of the Bay Islands National Marine Park could not be satisfactorily assessed with the current GIS digital data. With rather unique terrestrial ecosystems and a variety of nationally unique terrestrial species (of Caribbean origin), the terrestrial ecosystems of the Bay Islands are probably not adequately covered and may need expansion to war. Also the territorial cover of the coral reef habitat needs additional analysis and reconsideration. An observation regarding the integrity of the Bay Islands Marine National Park is in order. While the significance of the area's marine environment is and remains paramount, there should be more integration of both marine and the unique Caribbean terrestrial ecosystems into the management attention as well as in the presentation to the visitors.

The species of the coastal ecosystems of the Atlantic coast have been well inventoried and detailed species lists are listed in Volume II, Annex II, based on the work of the Roatan Institute for Marine Science, Proyecto Utila (1999), Cerrato (1986), Britton et al. (1981), Harbor Branch Oceanographic Institution, Inc. (1998), and some other sources.

Table 1: Invertebrates and Urochordates in the coastal waters of the Caribbean.

GROUP	SPECIES
Sponges	28
Celenterata	103
Ctenophores	4
Annelids	11
Mollusks	332
Arthropodes	33
Equinoderms	24
Urochordates	7

GROUP	SPECIES
TOTAL	542

Fish species of the Atlantic Ocean in Honduras are 194, but we don't have a list of the fish species actually found in the Coral Reef zone. Volume II, Annex III, Continental And Estuarine Fishes Of Central America lists the estuarine and fresh water species of Central America, including Honduras.

3.2. CHANGES TO THE ECOSYSTEMS MAP

The Ecosystems Map of Honduras (PAAR/COHDEFOR/BM 2002), identifies 70 ecosystems. We have carefully re-examined the classes and propose a number of changes, as indicated in Table 2. Out of the original 70 ecosystems 59 were used to perform the rationalisation analysis.

In the analysis all of the agro-ecosystems in the original map were combined into one, some aquatic ecosystems that were not evenly mapped such as river courses were discarded[2], as well as a few ecosystems that were considered as minor mapping errors (see Table 1). In total 59 ecosystems were used in the analysis. The previously unidentified karstic ecosystems on Mount Santa Barbara were included in the analysis. Table 2 presents all the ecosystems used in the analysis with their codes.

[2] The consideration was that riversystems are really too small to be adequately mapped at the level of detail of 1:250,000. They occur in many ecosystems and should generate few but relatively permanent points for almost all ecosystems. Therefore they would not be a significant factor of distinction among the protected areas.

Table 2:Code changes[3] to the Ecosystems Map

Code	Ecosystem	Reason for Change	Code Change
7	Evergreen broadleaved submontane forest, karstic	Fieldwork shows this to be a seasonal ecosystem	Combined with 22
12	Evergreen broadleaved upper montane forest	In fact a coffee plantation	Added to Agricultural Systems
14b	Evergreen Mixed upper Montane forest, karstic	A newly identified karstic system	Separated from 14
15b	Evergreen Broadleaved altimonae forest, karstic	A newly identified karstic system	Separated from 15
16b	Evergreen Broadleaved mixed altimontane forest, karstic	A newly identified karstic system	Separated from 16
26	Lowland Seasonal Evergreen broadleaved forest, Moderately drained	An evergreen ecosystem	Combined with 3
36	Seasonal Evergreen Mixed submontane forest	In fact coffee plantations	Added to Agricultural Systems
56	Lowland semideciduos broadleaved forest, well drained	Recovering agricultural land	Added to Agricultural Systems
61	Lower montane semideciduos broadleaved forest	In fact coffee plantations	Added to Agricultural Systems
90	Herbaceous swamp with grass and palms or shrubs	In fact seasonally flooded meadows	Added to Agricultural Systems
97	Salty mudflat with succulent plants	In fact a silting lagoon	Added to Agricultural Systems
107	Coastal Swamp vegetation on recent soils	Combined with ecosystem 105	Combined with 105
115	Agricultural systems	Not considered a natural ecosystem	Considered an element with no conservation value in the weighting
116	Shrimp farms	An agricultural system	Added to Agricultural Systems
131	Open estuary on the Caribbean	A river ecosystem	Combined with 121
136	Urban Area	Not considered a natural ecosystem	Added to Agricultural Systems
132	Pacific semi-closed estuary	In fact an open estuary	Changed to 133

[3] These changes have been made during a regional updating workshop in Guatemala, October 2002

Table 3:Ecosystems used in the analysis (adapted from Mapa de Ecosistemas Vegetales de Honduras PAAR/CODEHFOR, BM 2001[4])

Codigo	Nombre
1	Bosque tropical siempre verde latifoliado de tierras bajas, bien drenado
3	Bosque tropical siempreverde latifoliado de tierras bajas, moderadamente drenado
4	Bosque tropical siempre verde latifoliado de tierras bajas, moderadamente drenado en suelos calcáreo
6	Bosque tropical siempreverde latifoliado, submontano
8	Bosque tropical siempreverde latifoliado montano inferior, cársticas
9	Bosque tropical siempreverde latifoliado montano inferior
10	Bosque tropical siempreverde mixto montano inferior
14	Bosque tropical siempreverde latifoliado montano superior
14b	Bosque tropical siempreverde latifoliado montano superior, cárstica
15	Bosque tropical siempreverde latifoliado, altimontano
15b	Bosque tropical siempreverde latifoliado, altimontano, cárstica
16	Bosque tropical siempreverde mixto, altimontano
16b	Bosque tropical siempreverde mixto, altimontano, cárstica
17	Bosque tropical siempreverde latifoliado aluvial
21	Bosque tropical siempreverde latifoliado pantanoso de tierras bajas, permanentemente inundado, con palmas
22	Bosque tropical siempreverde estacional latifoliado de tierras bajas, bien drenado
23	Bosque tropical siempreverde estacional latifoliado de tierras bajas, en colinas cársticas onduladas
30	Bosque tropical siempreverde estacional mixto de tierras bajas, moderadamente drenado
31	Bosque tropical siempreverde estacional aciculifoliado de tierras bajas, moderadamente drenado
32	Bosque tropical siempreverde estacional aciculifoliado de tierras bajas bien drenado
34	Bosque tropical siempreverde estacional latifoliado, submontano
35	Bosque tropical siempreverde estacional latifoliado submontano en colinas cársticas onduladas
37	Bosque tropical siempreverde estacional aciculifoliado, submontano
38	Bosque tropical siempreverde estacional latifoliado montano inferior
39	Bosque tropical siempreverde estacional mixto montano inferior
40	Bosque tropical siempreverde estacional aciculifoliado montano inferior
41	Bosque tropical siempreverde estacional latifoliado montano superior
42	Bosque tropical siempreverde estacional mixto montano superior
50	Bosque tropical siempreverde estacional latifoliado aluvial de galería de tierras bajas
53	Bosque tropical siempreverde estacional latifoliado pantanoso de tierras bajas, dominado por palmas
57	Bosque semideciduo latifoliado con palmas de tierras bajas, moderadamente intervenido
58	Bosque semideciduo mixto de tierras bajas, bien drenado, intervenido
59	Bosque tropical semideciduo latifoliado, submontano
60	Bosque tropical semideciduo mixto, submontano
64	Bosque tropical semideciduo latifoliado pantanoso de tierras bajas, bien drenado
65	Bosque de manglar del Caribe sobre sustrato limoso
67	Bosque de manglar Pacífico sobre sustrato limoso
69	Bosque tropical deciduo latifoliado de tierras bajas, bien drenado, intervenido
75	Arbustal deciduo latifoliado de tierras bajas en suelos pobres, bien drenado
77	Arbustal deciduo latifoliado submontano en suelos pobres, bien drenado
78	Arbustal deciduo microlatifoliado de tierras bajas, bien drenado

[4] For purposes of consistency with the map, we use the Spanish names.

82	Sabana de graminoides altos con árboles latifoliados siempreverdes y/o palmas, anegada
83	Sabana altimontana con vegetación leñosa
84	Sabana de graminoides cortos, inundable, con árboles latifoliados siempre verdes
85	Sabana de graminoides cortos con árboles aciculifoliados
86	Sabana de graminoides cortos anegada, con árboles aciculifoliados
91	Sabana de graminoides cortos sin cobertura leñosa, submontano o montano
94	Pantano de ciperáceas altas
104	Duna y playa tropical con escasa vegetación
105	Vegetación tropical costera en suelos muy recientes, moderadamente drenado
108	Banco arenoso intermareal o permanentemente emergido
109	Albina con escasa vegetación
111	Carrizal pantanoso de agua dulce
121	Rio de cuenca inferior del Caribe
127	Laguna costera de agua dulce del Caribe
128	Lago del interior
129	Laguna o canal costero de agua salobre del Caribe
132	Estuario semicerrado del Pacífico
134	Arrecife coralino del Caribe

4. SPECIES OF SPECIAL CONCERN

4.1. THE DISTRIBUTIONS OF SPECIES OF SPECIAL CONCERN

During the last decade the national list of vascular plants, mammals, birds, reptiles, amphibians and fishes of Honduras is gradually getting shape, as well as the lists of marine invertebrates for the Caribbean. With this expanded knowledge, the need also arose to prepare an update to the list of species of special concern of Cerrato, 1997, and which we present in VOLUME IV: SPECIES OF SPECIAL CONCERN OF HONDURAS, 2002 UPDATE of this series. All endemic and rare species referred to in this study are listed in that document and its annex.

Table 4: Number of species of vertebrates known to Honduras (2002).

GROUPS	SPECIES REPORTED	ENDEMIC SPECIES
Fishes		
Atlantic	194	0
Pacific	390	
Fresh Water	88	
Amphibians	116	38
Reptiles	211	27
Birds	744[5]	1
Mammals	229	3 [6]
Total	1971	69

However, the lists of invertebrates are still very limited. According to Cave (pers. Com.), of the total number of arthropods that some scientists guesstimate at up to 30,000 species, only 2,500 (in 15 orders and 225 families) are now known for the country. One should realise that knowing whether or not a species exists in the country, does not say much yet about its distribution. In this respect, the problems are several:

Many species have only been recorded once or on a few occasions and no distribution maps may be drawn based on such information.

Sampling patterns are often biased to centres of research and access roads.

Most records older than 5 years have probably been collected without georeference and cannot be mapped easily.

A considerable number of data have been collected by scientists of various national institutions that don't have a policy of openly and broadly sharing their knowledge bases, and as a result, such data – al though collected – are not available to many researchers conservation institutions.

With general distribution patters still so much in question, it is not surprising that the distributions of species of special concern are usually very sketchy at best. While House (2001) has made a first attempt at mapping out the known finding locations of endemic species, this study has made an attempt to put some further order in the distribution of species, partially by publicising national species lists of various taxa, and partly by analysing the presence of the fauna species of special concern per protected area.

In total 170 plant species and 358 animal species where used in the rationalisation analysis. The list is meant to represent the Honduran species of special conservation concern at a national and in many cases at a global level. It is generally considered that species with very limited natural distributions are at particularly high risk of extinction. When a species is found only in one country the responsibility of protecting that species from extinction at a global level becomes entirely a national responsibility. The list therefore contains all but 10 of the 134 plant species confirmed as being endemic to Honduras (House 2001) and all of the 98 fauna species considered endemic for Honduras. Though in an attempt to include other rare and threatened species some 30 other plant species endemic to the total region of Central America were included in the analysis. Some plants have natural distributions, which extend beyond Central America, 6 of these where included in the list because their populations are considered to be very low in numbers. Of the animals, more than 300 additional species were included because national biologists consider their survival vulnerable to threatened.

It should be noted that the list contains rare species which are in fact well protected such as *Oreopanax lempirianus,* a species only found high on Mount Celaque but one which is in no immediate danger,

[5] The list in our Annex has 737 species.

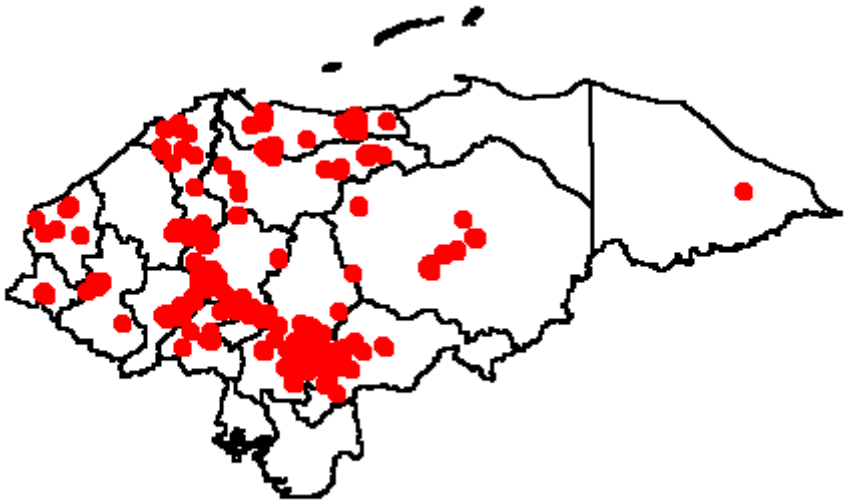
[6] One species is extinct

given the protected status of the area and its difficult access. On the other hand *Rhyncholaelia digbyana,* the national flower of Honduras, is a Mesoamerican endemic, which is not found in any protected area and is probably severely threatened in Honduras and throughout its range, due to excessive over collecting for ornamental purposes. The Honduran Emerald may be considered as one of the most endangered birds in the world, given the limited distribution of its habitat (no more than several thousands of hectares world wide) and its small population size (probably no more than a few hundred bird).

4.2. THE DISTRIBUTION OF ENDEMIC SPECIES

It is clear from the Map of the distribution of endemic plant species in Honduras that there is a strong concentration of collections around the capital city of Tegucigalpa (see map 1). Tegucigalpa is home to the two largest botanical research institutions in Honduras, The National University and the Pan-American Agricultural School at Zamorano; clearly this area has been very well collected. The main high way that connects Tegucigalpa with San Pedro Sula in the north is also clearly highlighted. It is no surprise that botanical collections concentrate along the main access roads, in particular when these are virtually the only paved roads in the country. As so much of Honduras remains unexplored, it is probable that the preliminary data presented here could change dramatically within a number of years. Even though the collection data that does exist gives us an idea of where some very rare and endangered species are found, it would be wrong to divert resources away from relatively unexplored areas as they could contain just as many, if not more rare and endangered species yet to be identified. Despite the obvious sampling problems associated with endemic species in a relatively unexplored country like Honduras, it is possible to learn something from the distribution of endemic species.

Map 1: Map of plant species endemic to Honduras



No precise geographic positions on animal species of special concern were available to the authors at the time of the study. In most cases however, we did have knowledge in which protected area an endemic species was found. Therefore, no similar map has been made for the endemic fauna species, and neither could an analysis be made per ecosystem. However, an analysis per protected areas was feasible and makes part of the overall analysis.

Of the 59 Ecosystems[7] used in the prioritisation process, just 22 have reports of endemic plant species (See table 4). The distribution of endemic species within ecosystems is a combination of what would be genuine natural phenomenon and no-doubt a sampling inconsistency. The most species rich ecosystem would appear to be the Submontane Deciduous Shrub, which by chance is the only ecosystem found outside of the National Park System. The Pan-American Agriculture School has been the single most important national institution in the discovery of endemic plant species, and its campus is found in an area of Submontane Deciduous Shrubland. Which is one reason for the existence so many reports of endemic plants from this ecosystem, but it is unlikely that this is the only reason. Another possible reason is that this heavily intervened ecosystem in all likelihood consists of a number of poorly defined and intervened Deciduous and Semidecidous ecosystems lumped together. It is well possible, that a part of the species reported for this ecosystem may already be extinct.

Geographical isolation is considered to be one of the primary requisites for species development. The first 6 ecosystems in table 4 together contain 60% of all of the reported endemic plant species in the country, yet they only represent 12 % of the total area of ecosystems in the country. These ecosystems all have in common that they are relatively small and geographically isolated, being either montane ecosystems or being restricted to dry intermontane valleys. The natural fragmentation of these ecosystems is possibly one of the reasons for the high numbers of species with restricted distributions. Of these 6 ecosystems, 5 of the best-conserved are very well represented in SINAPH and the National Park System. On the other hand, and fully consistent with our previous observations, the reader may notice that most of the aquatic and wetland ecosystems are absent from this list. This is consistent with our expectations: (1) aquatic and wetland ecosystems have very effective connectivity and (2) usually, aquatic and wetland ecosystems are relatively dynamic which requires mobility and flexibility of their species to survive[8].

Table 5: Endemic Plant Species by Ecosystem

Ecosystem	No of Species
Deciduous Submontane Shrubland	36
Seasonal Evergreen Upper Montane Forest	31
Lower Montane Pine Forest	22
Seasonal Evergreen Lower Montane Forest	19
Evergreen Upper Montane Forest	15
Evergreen Altimontane Forest	15
Evergreen Lowland Forest	14
Submontane Pine Forest	13
Deciduous Microphyllus Lowland Shrubland	10
Seasonal Evergreen Submontane Forest	5
Evergreen Lower Montane Forest	5
Seasonal Evergreen Lowland Forest	3
Evergreen Submontane Forest	3
Evergreen Altimontane, Forest, Karstic	2
Evergreen Lower Montane Forest, Karstic	2
Semideciduous Lowland Forest	1
Seasonal Evergreen Submontane Forest, Karstic	1
Evergreen Mixed Altimontane Forest, Karstic	1
Evergreen Mixed Upper Montane Forest, Karstic	1
Beaches	1
Savannah of Crecentia alata	1
Short Grass Savannah with Pine	1

[7] The mixed ecosystems were combined with their broadleaved counterparts as species overlapped so much that it confused the analysis.

[8] World wide a number of species have 'beaten" these odds and survived mayor geological transformations in isolation.

The lowland evergreen rainforest has a respectable 14 endemic plant species reported, but all of these species are found at the base of the Cordillera Nombre de Dios, with no endemic species being reported from the more extensive Mosquitia Rainforests. The clustering of endemic species at the base of this coastal mountain chain could be explained by the concepts of refuge theory. The refuge theory suggests that during the Pleistocene period, global warming caused a fragmentation of the extensive lowland rainforests creating islands or refuges of moist forest in – at the time restricted - high rainfall areas or around mountain ranges where regional climate change is buffered by local topography and where, altitudinal migration allows humid lowland species to migrate upwards during dry periods. The theory is that these rainforest refuges would have been isolated long enough for new species to develop. It has been suggested that the Cordillera Nombre de Dios was at least a minor Pleistocene refuge, and it is highly likely that many more endemic species will be found on this still relatively unexplored mountain. At least fifteen (18.5%) species of the herpethofauna endemic to Honduras occurs in the broadleaf cloud forest area of the Cordillera Nombre de Dios and Pico Bonito area (Wilson, McCranie & Espinal 2001). The most extraordinary plant species found to date in Honduras *Hepatanthus hazlettii,* was discovered at the base of the Cordillera Nombre de Dios in 1980 in the Texiguat National Park. Its floral structure was so unique it was necessary to create not only a new species but also a new genus and family, with serious discussion about whether this plant represents an endemic order of plants only found on this mountain. All attempts to recollect this species has failed to date.

4.3. SPECIES OF SPECIAL CONCERN IN SINAPH

The representation of species of special concern in SINAPH is very encouraging, as you may see from table 6

Table 6:Species of Special Concern

SSC	Total	Inside PAs	Outside PAs	% protected
All	526	377	149	72
All plants	170	125	45	74
All animals	356	252	104	71
All endemic species	216	158	79	73
Endemic plants	134	92	42	69
Endemic animals	82	66	16	80

Within the National Park System" Model, 116 (68%) of the species of special concern are protected. That does not mean that all the species found outside of the model at this moment in time are excluded. Some species are likely to also exist within the model but so far, they have not been found. Particularly the number of bird SSP within protected areas are expected to rise significantly. Similar percentages apply for the well-studied group of herpetofauna (Wilson, McCranie & Espinal 2001). Of the 9 species found outside of the model but within SINAPH, 4 are found in the Uyuca Biological Reserve, a well conserved area owned and managed by a university. The species found outside of SINAPH are all in heavily intervened areas, and it is probable that a number of them have already disappeared from the places where they were originally found.

Table 7: Protected areas in the National Park System model that contain Plant species of Special Concern.

Protected Area	No.
Celaque	22
La Tigra	12
Arenal	9
Montecillos	9
Tawahka	9
Opalaca	8
Río Plátano	8
Sierra de Agalta	8
Cusuco	7
Pico Bonito	7
Santa Barbara	7
Jardin Botánico Lancetilla	6
Texiguat	6
Lago de Yojoa	4
Azul Meambar	3
La Muralla	3
Montaña Verde	3
Caratasca	2
Montaña de Yoro	2
Pico Pijol	2
La Montana de la Botija	1
Merendón	1
Patuca	1
Punta Sal	1

A summery of the analysis of the species of Special Concern for the National Park System is presented in Table 3. Mount Celáque clearly contains more species of special concern than any other protected area. The reason for this is the high number of national endemics found on Mount Celaque and also the high number of Central American endemics that Mount Celaque shares with some high mountains in Guatemala. Mount Celaque is obviously a unique and important mountain not just at a national level but also at a Central American Level. On the other hand la Tigra National Park would appear to be a more typical mountain differing very little in size and height from other mountains in the south of the country and yet it also contains many National and Central American endemic species. It seems reasonable that the discovery of so many endemic plants here has something to do with La Tigra's accessibility and closeness to the capital city of Tegucigalpa. La Tigra's obvious weighting due to the uneven sampling of the Honduran Flora is just an example of the weaknesses of relying too heavily on endemic species as national indicators of total biodiversity. Many of Honduras' mountains, such as Montaña de Yoro and the Montaña de Botaderos remain completely understudied and basically unknown to science.

The Rio Plátano Reserve and the Tawahka reserve are not known to harbour National Endemic species; the species of special concern here are Central American Endemic species. In fact if Central American endemism was used as the principal criteria for the selection of species of special concern, these two large very species diverse areas would be at the top of the list. The selection of political boundaries as the means of defining species of limited distribution will always underestimate the importance of larger ecosystems that cross the rather close national boundaries of Central America. The presence of so many endemic species in the Botanical Garden of Lancetilla which contains the smallest biological reserve in National Park system yet again shows the importance of sampling in the distribution of Endemic Species; and yet, its close proximity to the Cordillera Nombre de Dios is also a likely cause.

It is a practical impossibility to create a protected area system that could contain all of Honduras' species of special concern. Many rare and endangered species are found in areas too small and to intervened to be efficiently managed as protected areas. One obvious example is *Lonchocarpus sanctuary,* only found in the valley of Tegucigalpa, with the only known surviving individuals living on the campus of the National University. The valley of Tegucigalpa has some 10 endemic species, 8 of which are possibly already extinct. No extensive area of forest survives in Tegucigalpa and its natural flora mostly survives in fragments along streamsides and crevices in steep embankments. As declaring a protected area around each single individual endemic species is not possible, we must resort to other options, such as the conservation ex situ in Botanical Gardens, and the introduction or transferring of species into protected areas, as discussed in Volume I.

The analysis of rare and endemic plants within ecosystems and national parks underpins the principal that ecosystems analysis is a valid proxy for overall biodiversity even in the case of the rare and most unevenly distributed species. Even though 55 species are found outside of the national park system

34 of those are in the one absent ecosystem, Submontane Deciduous Shrubland. The fact that this is an intervened and hybrid ecosystem, makes it very difficult to identify a large area that could be included in the National Parks System. The most logical step at this moment would be to identify small areas of this ecosystem that might already exist within the system, for instance in the Tigra National Park, along the Choluteca River and the Boqueron National Monument or the proposed La Botija National Park. It would be wrong to overstate the absence of one of Honduras most intervened ecosystems within the National Parks systems when so many of its pristine ecosystems – and with it, the vast majority of its species - are found well-protected. It is the firm belief of the investigation team, that with time and more even sampling the overall number and percentage of rare and endemic plants within the system will improve. At this moment in time it would not make sense to divert extensive resources to trying to include these species within the system until we have more detailed information of their real distribution within the country. When these species outside of the system are seen to be critically endangered, a short term solution would be their ex situ conservation within botanical and a herpetofaunal collections until more is know about their distribution and ecology, which might lead to a permanent solution. Until then, the conservationists of Honduras – private and government officials alike – would do well to focus all their energy and resources to keeping alive what is protected in the system recommended in this report.