JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
DEPARTMENT OF TOURISM (DOT), PHILIPPINES

THE STUDY ON ENVIRONMENTALLY SUSTAINABLE TOURISM DEVELOPMENT PLAN FOR NORTHERN PALAWAN IN THE REPUBLIC OF THE PHILIPPINES

Supplemental Report No. 2

Terrestrial Environment of Northern Palawan

March 1997

JICA Study Team

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1. Terrestrial Biological Resources

Based on the 1874 forest map of the Philippines Palawan was originally almost totally covered by thick primary forests from the seashore to the tallest mountains. Understandably its flora and fauna composition is so rich and diverse that it is probably the best preserved natural ecosystem in the country. However, with rapid development and urbanization numerous primeval forests were cut down to give way to roads, settlements, farms, fishponds, etc.. As a result only few areas remain forested in northern Palawan so much so that it is first on the list of critical habitats in the Philippines.

1.1. Flora

Vegetation in the Philippines is classified in the Malaysia Region. Forest type occurring in Southeast Asia is summarized in Table 1-1.

1) Major Types of Natural Vegetation in Northern Palawan

The six major types of natural vegetation in Northern Palawan are defined and described as follows:

(1) Lowland Evergreen Rainforest (Dipterocarp): This type of forest, which occurs from seal level to about 800 m altitude, is characterized by the presence of evergreen trees and shrubs in close association with lianas, herbs and epiphytes found in the forest floors or climbing on trunks and branches of trees. The dominant an characteristic families of plants in this type of forest are the Dipterocarpaceae, Lauraceae, Rubiceae, and Leguminosae for trees and shrubs, and Orchidaceae, Araceae and epiphytic ferns for the herbaceous elements.

(2) Lowland Semi-deciduous Rainforest: This type of forest, which also occurs from sea level to about 800m altitude, is characterized by the predominance of semi-deciduous trees in association with evergreen species of trees and shrubs. Among the indicator species are Vitex parviflora, Garuga floribunda, Pterocymbium tinctorum, etc. This type of forest is more popularly know as molave-type forest.

(3) Submontane Forest: This type of forest is found at higher altitudes form 100m and above. Characteristic species are Agathis philippinensis, and other gymnosperms. In come places it is dominated by ericaceous plants such as Vaccinium, Rhododendrons, etc. There are also plenty of orchids, epiphytic ferns, mosses and liverworts perched on the trunks and branches of trees and shrubs. The ground cover is also usually covered with terrestrial ferns, mosses and lichens, etc. With increased elevation, trees correspondingly become characteristically shorter and trunks become more crooked. It is the equivalent of the mossy type forest.

(4) Forest Over Ultrabasic Rocks: This type of forest is confined to areas where there is a high concentration of metal in the substratum. The plants which grow in these areas are usually stunted, growing no more than 6m tall, with thin an crooked trunks and branches. They grow very close to each other and form a characteristic stand unique to this type of vegetation. Some of the characteristic families in this vegetation are Dichapetalum gelonioides, Phyllanthus elaeagnifolia, Gymnostomma sp., etc.

(5) Forest Over Limestone: This forest is confined to areas where the predominant geological formation is limestone such as in many islands of Northern Palawan. The plants in this forest type are able to tolerate extremely hot conditions, low water supply, and poor soil nutrients. Therefore, only a few species of plants are able to adapt and flourish. Among the characteristic plants in these areas are Veitchia merrillii, Euphorbia spp., Hoya spp. etc.

Table 1-1 Vegetation Type Occurring in South East Asia

MacKinnon (1986)	Whitmore (1984)	Continent	Island
Lowland Rainforest	Tropical Evergreen Rainforest	O	O
Heath Forest	Heath Forest		O
Forest on Ultrabasic	Forest over Ultabasic		O
Forest on Limestone	Forest on Limestone	O	O
Tropical Semi-evergreen Forest	Tropical Semi-evergreen Forest	O	O
Mixed Deciduous Forest		O	
Monsoon Forest	Tropical Moist Deciduous Forest	O	
Mangroves	Mangrove Forest	O	O
Peat Swamp	Peat Swamp Forest	O	O
Freshwater Swamp	Fresh Water Swamp Forest	O	O
Dry Dipterocarp Forest		O	
Tropical Montane Deciduous Forest		O	
Tropical Evergreen Montane Forest	Tropical Upper Montane Rainforest	O	O
Savannah Forest		O	
Tropical Thone Scrub		O	
Sub-tropical Pine Forest		O	O
Sub-alpine Forest	Tropical Sub-alpine Forest	O	
Sub-montane Dry Evergreen Forest		O	

Source: Terrestrial Survey, Study Team

Table 1-2 Vegetation Type Occurring in the Study Area

Vegetation Type	N. Palawan	Dumaran	Linapacan	Culion	Coron	Busuanga
Lowland Evergreen Rainforest	O	O	O	O	O	O
Lowland Semi-evergreen Rainforest	O					
Submontane Forest	O					
Forest Over Ultrabasic Rock	O					
Forest Over Limestone	O				O	
Mangrove Forest	O	O	O	O	O	O
Forest Plantation	O	O				

Source: Terrestrial Survey, Study Team

2) Forest Types in Northern Palawan

(1) Calamian Islands

Busuanga Island: This island used to be fully covered by primary lowland evergreen rainforest. However, logging and kaingin destroyed many parts of the forest and at present, only patches of remnant forest remain in some hills while many parts are now converted to open grassland and second growth forests. The remaining forests in the island have mostly been logged so that very few tall timber trees could be found. The island is home to some endemic plants, notably Pandanus sp., Globba aurea, etc.

Culion Island: This island also used to be thickly forested, but due to human activity, many parts of the island are denuded and converted to agriculture areas, open grasslands, and homesteads. The leper colony was formerly an exclusive enclave of lepers but due to the increase of immigrants, many parts of the island have been cleared and opened. Today, the central part of the island remains vegetated by secondary forest or regenerating logged-over primary forest. There are many endemic species, such as the famous Cycass wadei.

Coron Island: Coron harbors a type of flora that is especially adapted to Karst Limestone. The vegetation s actually a climax formation where many trees, shrubs and herbs are able to withstand prolonged drought, extreme heat, poor soil nutrients and low moistures. The greater part of the original forest of the island is still intact. No notable sign of damage can be detected in the existing vegetation spread over the steep and rugged limestone hills which comprise about two thirds of the total island area. In two areas where there are Tagubanua settlements, the surrounding original vegetation has been cleared for agriculture and coconut plantations.

Coron Island's flora is rich and diverse, and contains several endemic species not found in other areas of the country. Among the interesting plant are Veitchia merrilli, Hoya spp., Euphorbia spp., Cycas wadei, and many others.

(2) Lake Manguao, Taytay

This area is surrounded by regenerating lowland evergreen rainforest. In earlier times the forest was logged over and the primary timber species were selectively cut. In some parts, kaingin was rampant and this accounts for the numerous open areas surrounding the lake. From a botanical viewpoint, the vegetation surrounding Lake Manguao is still rich in species. It is in this area where the Hillshog team collected interesting species including a wild citrus.

(3) Pagdanan Mountain Range, San Vicente

This is the most extensive forested area north of Palawan. It is predominantly a lowland evergreen rainforest characterized by numerous species of timber trees belonging to the Dipterocarp family as well as other associated species of palms, Rubiaceae, Lauraceae, Leguminosae, etc.

(4) St. Paul's Bay National Park and Mt. Bloomfield

The vegetation in St. Paul's Bay National Park is varied. It is predominantly a lowland forest with unique vegetation type adapted to limestone (calciferous type). In the estuarine part of the park, another type of vegetation occurs and this is dominated by trees and shrubs that tolerate estuarine conditions such as Oncosperma igillarium (Palmae), Acrostichum aureum, etc.

(5) Irawan Forests: Mr. Beaufort/Thumb Peak

The forest in the Irawan area, particularly Mt. Beaufort and Thumb Peak, are important watershed areas that provide the main source of water supply for Puerto Princesa. The forest in Irawan can be classified into three: lowland evergreen rainforest, lowland semi-deciduous, and submontane forest. The first two types sometimes integrate with each other making it difficult to clearly demarcate the two. The third type is found at higher altitudes and is characterized by the other gymnosperms. The extensive Irawan forest, particularly the Mt. Beaufort and Thumb Peak areas, are still pristine and relatively in tact compared to that in the northern part of the island. However, it is said that the area was formerly logged and the forests have since regenerated.

(6) Iwahig Mountain Range

The lowland forest that extends south of Irawan belongs to the Iwahig Penal Colony. Being a restricted area, the forests in Iwahig are still intact and have not been subjected to extensive logging operations. Like Irawan mountain range, the forests in Iwahig are teeming with wildlife so much so that it is perhaps the richest faunal diversity in Palawan. There are still numerous Dipterocarp species such as apitong (Dipterocarpus grandiflorus) etc., and other important timber trees, such as ipil, narra, akle, dau, kamagong, etc., found in the Iwahig forest.

2) Key Indicator Species

(1) Dipterocarpus grandiflorus and Other Dipterocarpus spp.

The dipterocarp species are indigenous and common in the lowland rainforest of Palawan. They constitute the major timber species of the island

and are logged for local and international trade. The dipterocarp species used to be abundant throughout the island but due to logging, legal and illegal, and kaingin, many species have suffered. Hence, the presence of this species, especially the mature ones in a particular lowland forest, indicates that the forest is still relatively undisturbed or not affected by human activity.

(2) Gymnostomma sp.

This is a medium-sized tree growing to 10m tall. It closely resembles the more common Casuarina species but differs in its reproductive and vegetative characters. It is found in Mt. Bloomfield and in some parts of western Palawan (near Puerto Princesa) where the underlying rocks are mostly ultrabasic. The plant is confined to ultrabasic soil and is therefore indicative of a distinct habitat.

(3) Veitchia merrillii

This is a small to medium- sized solitary tree growing to 4m. It is confined to limestone areas in northern Palawan especially in Coron Island and Saint Paul's Bay National Park. It is usually found on steep slopes of Karst limestone hills and is able to thrive even with shallow soil. It is confined to this habitat but germinates easily and can be propagated as an ornamental plants in the lowlands.

(4) Calamus manillensis and other rattan species

Rattans used to be common and abundant throughout Palawan. It grows in various habitats from primary lowland evergreen forests, secondary forests to submontane forests. Due to over collection of commercial rattan species in the island, they are no longer found in the more accessible parts of the forest but are restricted to more remote places. The presence of rattan in a forest, especially the commercial species, indicates that the place has not been drastically destroyed.

(5) Agathis philippinensis (Almaciga)

This is a relatively tall and robust tree growing to 40 m. It is confined to higher elevations of the mountain from 900m and above. Its resins is a source of Manila copal and is sold in local and international markets. The presence of mature trees in the forest in northern Palawan indicates that the place has not been drastically altered by man.

1.2. Fauna

Southern and northern Palawan significantly differ based on geological characteristics, and hence, along the lines of fauna species. This uniqueness of Palawan has created many indigenous fauna such as the Palawan Tree Shrew (*Tupaia palawanensis*), Calamian Deer (*Cervus calamianensis*), Palawan Porcupine (*Thecurus pumilis*) and the Palawan Peacock (*Polyplectron emphanum*) which can only found in the islands.

An inventory of Philippine fauna confirmed in Palawan, a list of priority species in the Philippines and a listing from the appendix in Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES) are summarized in Annex A. Due to very limited studies and surveys on reptiles, amphibians and insects in Palawan, occurrence of such species are not well understood yet.

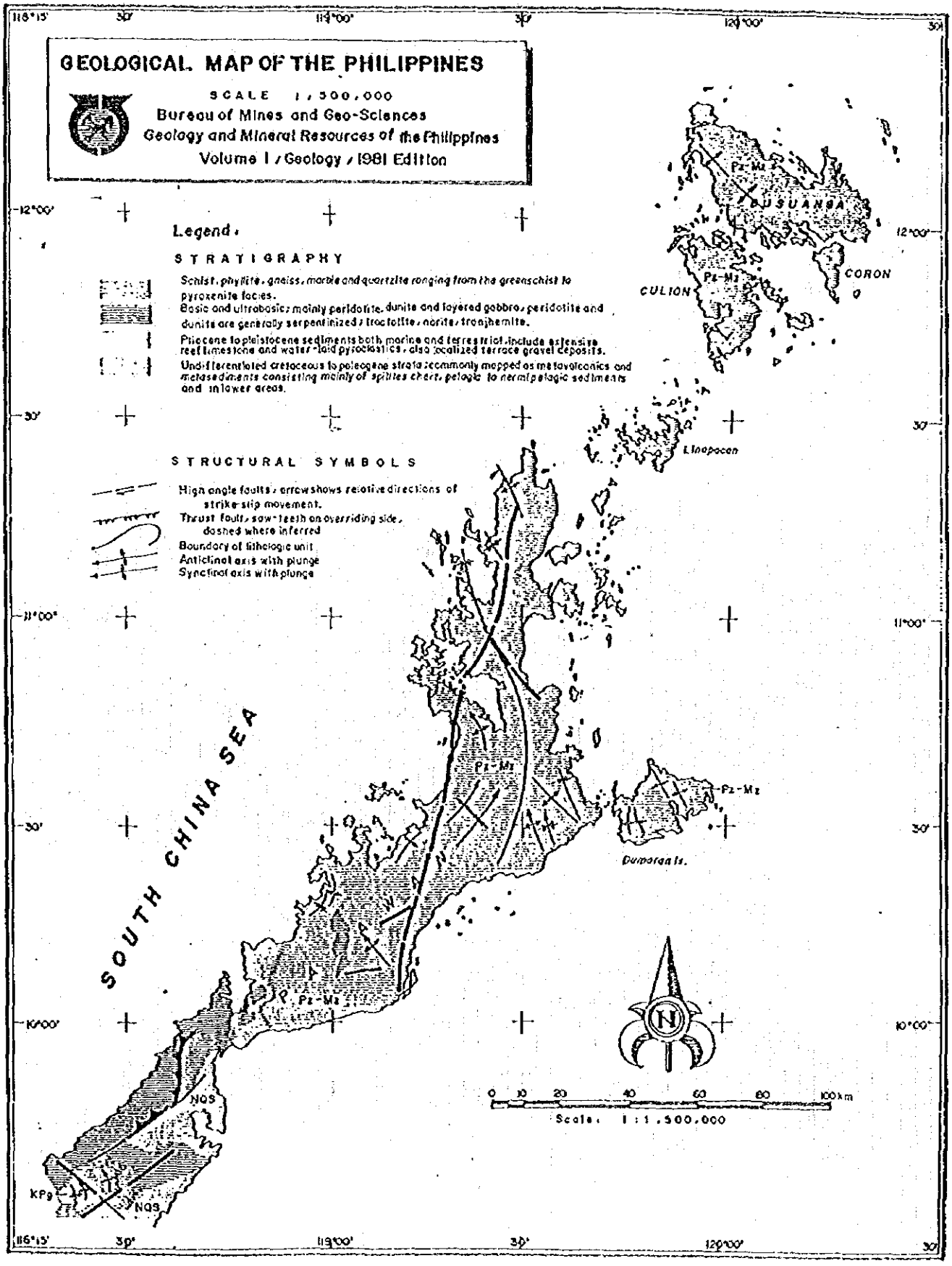
1) Key Indigenous Species

(1) Calamian Deer (*Cervus calamianensis*)

Calamian deer which are probably the biggest mammals in the Palawan ecosystem now occur only in Calauit Island Game Preserve and Wildlife Sanctuary. An intensive conservation program in the sanctuary recovers the population successfully: A recent survey concluded that more than 1,000 deer from 30 initial stock had been bred and raised (Philippine FAUNA, vol.1, No.2, 1995). Due to the uniqueness of the sanctuary, it is not suggested that indigenous species habitats be mixed with the African wildlife in the area. Moreover, it is quite dangerous to keep the remaining population only in one small habitat. If one catastrophic event or change occurs, it would cause extinction of the species in the Philippines. Careful reintroduction into at least another carefully selected protected area with strict conservation management should be considered o ensure the species existence.

(2) Palawan Tupaia (*Tupaia palawanensis*)

Two genera in Tupaiidae occur in the Philippine. In Palawan, Tupaia palawanensis occur with four subspecies based on their distribution, namely (1) T. p. palawanensis (Thomas 1894, mainland Palawan, Balabac and Calamian islands), (2) T.p. moellendorffi (Matshie 1898, Cuyo islands), (3) T.p. cuyonis (Miller 1910, Culion island, and (4) T.p.busuangae (Sanborn 1952, Busuanga island. A recent study conducted in the Iwahig penal colony, revealed that 9.5 -25.0/hector of primary forest. However, recently little study has been done on the other subspecies.


GEOLOGICAL MAP OF THE PHILIPPINES
SCALE 1 / 500,000
Bureau of Mines and Geo-Sciences
Geology and Mineral Resources of the Philippines
Volume I / Geology / 1981 Edition
Legend :
STRATIGRAPHY
Schist, phyllite, gneiss, marble and quartzite ranging from the greenschist to pyroxenite facies.
Basic and ultrabasic; mainly peridotite, dunite and layered gabbro; peridotite and dunite are generally serpentinized; troctolite, norite, tronjhemite.
Pliocene to pleistocene sediments both marine and terrestrial include extensive reef limestone and water-laid pyroclastics, also localized terrace gravel deposits.
Undifferentiated cretaceous to paleogene strata commonly mapped as metavolcanics and metasediments consisting mainly of spilites chert, pelagic to neritpelagic sediments and in lower areas.
STRUCTURAL SYMBOLS
High angle faults; arrow shows relative directions of strike-slip movement.
Thrust fault; saw-teeth on overriding side, dashed where inferred
Boundary of lithologic unit
Anticlinal axis with plunge
Synclinal axis with plunge
SOUTH CHINA SEA
BUSUANGA
CULION
CORON
Linapacan
Pz-Mz
Dumaran Is.
NQS
KPg
0 10 20 40 60 80 100 km
Scale: 1 : 1,500,000

(3) Palawan Porcupine (*Thecurus pumilis*)

The Palawan Porcupine usually inhabit lowland secondary and primary forest. Extensive clearings of their habitat will drive them and eventually decrease their population.

(4) Palawan Peacock(*Polyplectron emphanum*)

This beautiful species of Phasianidae is restricted only to the islands, and its habitat is confined to forest. The rapid destruction of the primary forest in Palawan, has contributed to the decline of the population. Mr. Marcelo R. Caleda studied its population in St. Paul Subterranean National Park in 1991 and found 18.12 individual peacocks per square km. Thus, at most the park can have 706 birds. It seems that conservation of the remaining low and mid elevation primary forest is required for existence of this species.

(5) Talking Myna(*Gracula religiosa palawanensis*)

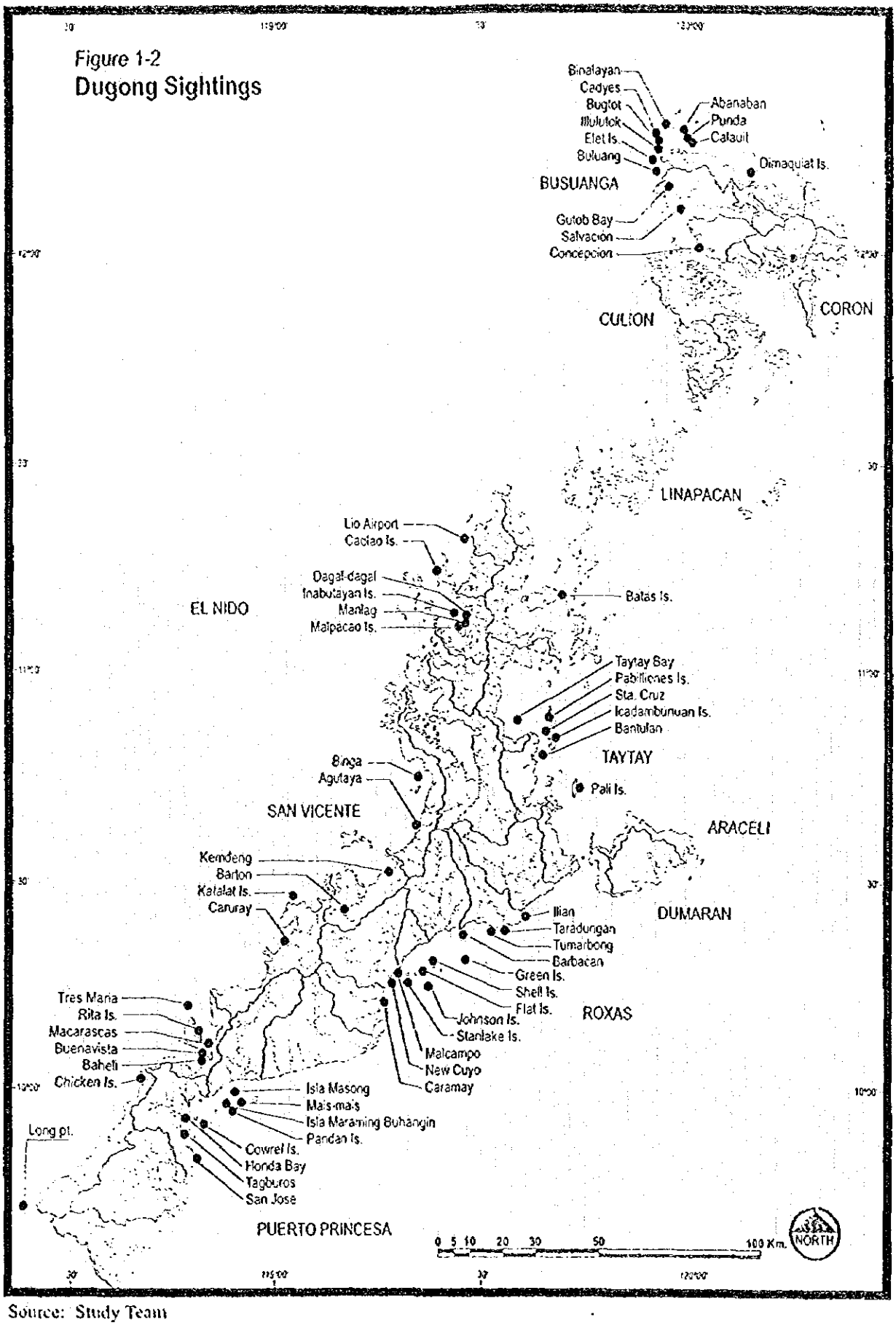
The population of the Talking Myna bird decreased in some areas in Palawan where young or newly hatched birds are highly commercialized for their ability to mimic the human voice. Too much exploitation, commercialization, could lead to the dwindling of its population.

2) Key Endangered Species

(1) Dugong Dugon (Müller, 1776)

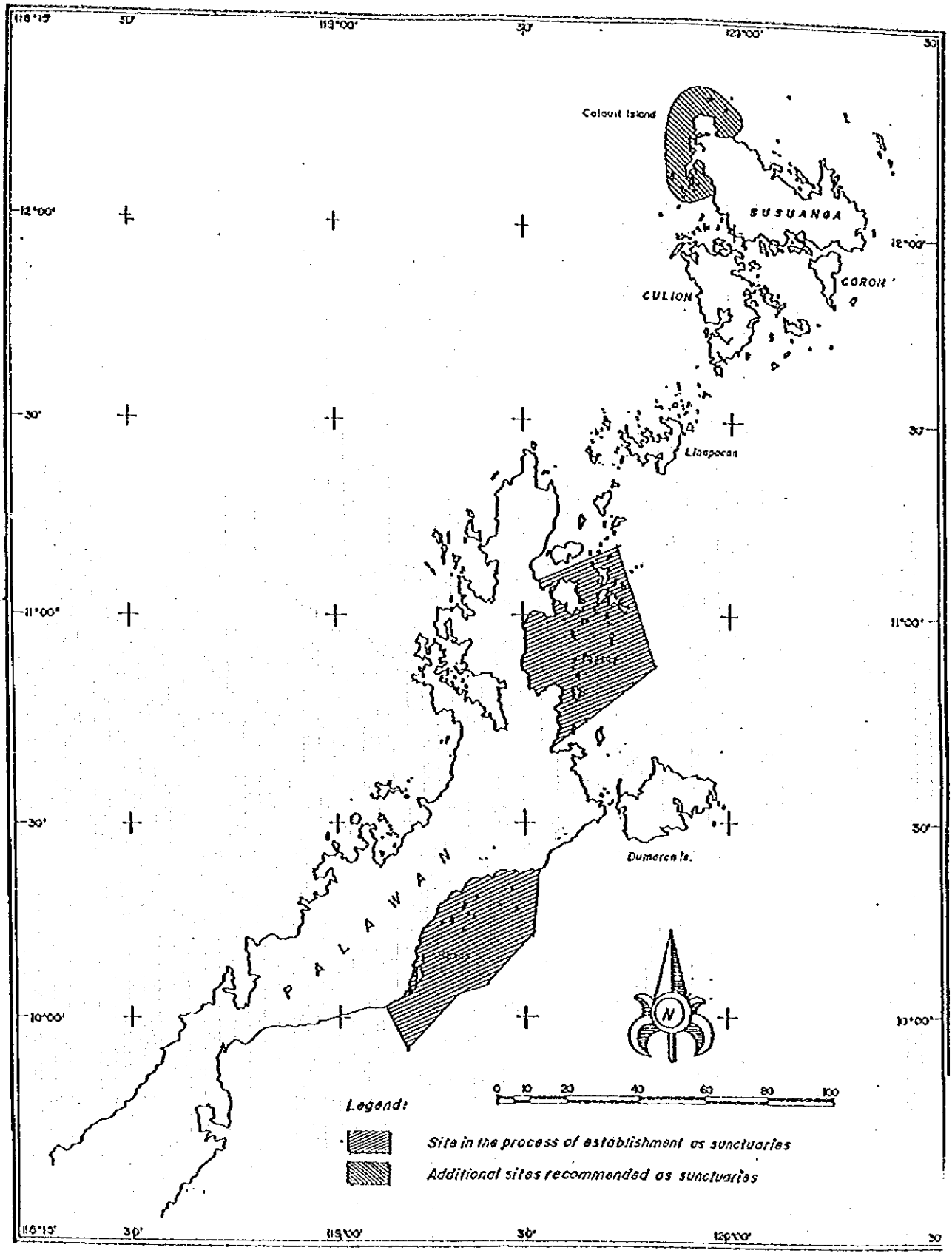
Dugon is the only species in the family Dugonidae with only one genera now. The closest relative, the Hydromalis gigas which is the largest of all Sirenia species, once distributed throughout the northern Pacific coast from Japan to Mexico, became extinct in 1767. Thus, the closest surviving relatives are the three species of Trichechus manatus (Manatee) in West Indies and West Africa. They are found in tropical and subtropical seas from the Gulf of Suez (Red Sea) up to New Habrides (East of north Australia). The present population size is not known, however, it is declining in the most of its range. This decline is caused by various threats such as hunting, incidental catches, pollution and destruction of seagrass beds. A 1994 survey in Palawan revealed that dugong can still be found throughout the province which is the only area in the Philippines where sighting and reports are confirmed (Figure 1-2). The surveys on dugong in northern Palawan by PAWB in collaboration with the Toba aquarium has been well documented and proposed dugong sanctuaries to be set up in Northern Palawan (Figure 1-3).

Figure 1-2
Dugong Sightings



Source: Study Team

Figure 1-3 Proposed Dugong Sanctuary



Source: Terrestrial Survey, Study Team

(2) Felis bengalensis bengalensis

This car inhabits agricultural land and forest. It is heavily haunted being as it preys on domestic fowl.

(3) Manis javanica

Externally resembling reptiles, it inhabits lowland to mid-elevation secondary and primary forest since its food preference is termites and true ants. At present, they are heavily hunted for commercial and aesthetic purposes.

(4) Philippine Cockatoo (*Cacatoe haematuropygia*)

The Philippine Cockatoo is one of the endemic species in the Philippines which occurs in the study area. Due to the demands of the cage bird trade, it is illegally trapped and traded in the Philippines. A recent survey revealed that only 8 islands of the 18 islands known to be inhabited by the species actually are.

The species favors lowland forests and coastal regions. Thus, Palawan is reported to have on of the major populations remaining in the Philippines. Mangrove forests and lowland primary forest are the most important habitat component for its survival and recent logging in lowland forests and trapping for trade in Palawan has been seriously threatening the species.

(5) Palawan Hornbill(*Anthracoceros marchei*)

All black, the upper parts of this species are glossed with green, except for the tail which is white with cream-colored shafts. The main habitat of the Palawan Hornbill is the dipterocarp forests. Occasionally it goes to feed on fruiting trees in clearings close to the original forests or on fruiting trees of second growth patches in well forested areas. It is an endemic species to Palawan (Calamianes to Balabac).

(6) Three Species of Marine Turtle

Chelonia mydas: Seagrass areas in the study area serve *Chelonia mydas* as feeding grounds but nesting sites are found in the southern islands near Tawi Tawi.

Erectmochelys imbricata: These turtles mostly eat which eat sponges and utilize small sand beaches with some vegetation for their nesting areas. Sponges can only grow in coral areas which are now endangered throughout the Palawan waters due to severe siltation caused by intensive and extensive logging. These events may further the decline of the species or its moving out of Palawan waters. Recent records of nesting beaches by *E. imbricata*

are summarized in Table 1-3, and Figure 1-4 This indicates that the species primarily utilizes the beach ecosystems in Northern Palawan

Dermochelys coriacea: The most endangered of the three, this species occasionally occur in Palawan waters. Their confirmed nesting beaches are in Malaysia. Therefore, occasional appearance of the species are most probably during their migration to and from their nesting beaches.

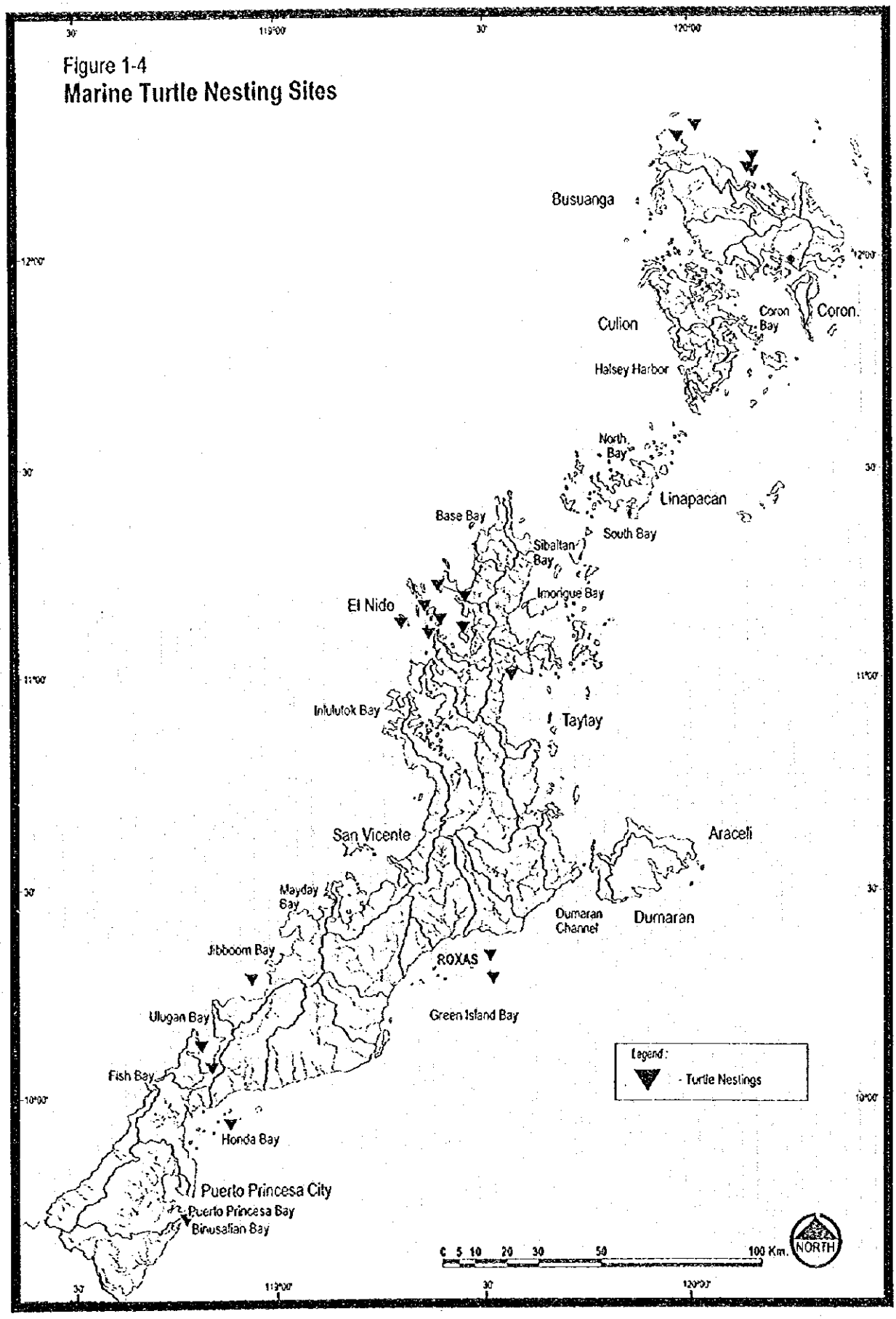
How to conserve a wide enough area of the ecosystems related to the marine turtles in the Study Area-the nesting beach ecosystem, coral feeding grounds of *E. imbricata* and feeding seagrass bed of *Chelonia mydas*-is a great concern. PAWB and DENR has been conducting the PAWIKAN PROJECT. A monitoring program on marine turtle nesting behavior was implemented with the cooperation of fishermen in Palawan. Essential data were obtained and summarized by the project team of PAWB.

Table 1-3 Recent Confirmed Marine Turtle Nesting Sites

City/ Municipality	Nesting Sites	
1. El Nido	a. Malapakao b. Bayan c. Matinloc d. Pangalucian	e. Gintungawan f. Dilumkad g. Binagkulay
2. Puerto Princesa	a. Sabang (St. Paul's Bay) b. Honda Bay (islands) c. Urugan Bay d. Mangingisda e. Barwang, Macarascas	f. Tubutaha Marine Park i. South Islet ii. Amos Rock iii. North Wall
3. Busuanga	a. Calauit Island b. Tanobong Island c. Isla Walang Langaw	d. Isla Walang Tao e. Isla Walang Langaw
4. Cuyu	a. Pamalican Island b. Manamoc Island	c. Halong Island
5. Taytay	a. Busybees	
6. Roxas	a. Puerco Island, Tunarbong	b. Green Island

Source: PAWIKAN Project, PAWB

Figure 1-4
Marine Turtle Nesting Sites



Source: Study Team

1.3. Research and Studies on Terrestrial Ecosystem

A number of studies on Palawan flora and fauna have either been done or are currently taking place. Biodiversity Information Center of the National Museum is conducting outstanding studies on Palawan biodiversity of flora and fauna. Ecosystem Research and Development Bureau of Department of Environment and Natural Resources, and Philippine Council for Research on Agriculture, Forestry and Natural Resource Development also conducting various studies.

As for universities, the University of the Philippines has been conducting studies on terrestrial ecosystem and Siliman University has been studying marine ecosystems. Universities located in Palawan, Palawan National Agricultural College, Holy Trinity College and Palawan State College, are also initiating studies and surveys on Palawan flora and fauna and it' related indigenous tribal cultures.

A list of publications on Palawan fauna and flora is summarized in Annex A. Studies and surveys on mammalia and avifauna have been documented and a certain amount of information is available. However, studies and surveys on reptiles and amphibians, which would serve as a good index of ecosystem modification and degradation by human activities, have not yet been done at a level necessary for ecosystem assessment. Therefore, assessment of the ecosystems can only be done with presently available information especially fresh water and swamp ecosystems.

1.4. National Parks and Protected Areas

The location of National Parks and Protected Areas in the Study Area are shown in Figure 1-5 and Table 1-4. National Parks are selected mainly for their scenery or history. 60 percent of Protected Areas of the Philippines are found in Palawan and Mindoro. However, logging and kaingin have occurred and many squatters occupy large portions of the areas. These areas are largely not fulfilling conservation functions.

1) St. Paul Subterranean National Park

The park, with an area covering 3,901 hectors, has been conserved relatively well and is serving now as the best example of the previous forest ecosystem from low to high elevation in Palawan. The park has ultrabasic forest, low to high elevation forests, coastal forest, a fresh water river, and the famous cave ecosystem. Expansion of the park has been planned to 5,753 ha and the other expansion plan up to 85,766.3722 ha including marine environment (land:74,289.3962 ha, marine:11,476.976 ha) has been considered and coordinated for cross sector acceptance with special consideration given to the indigenous people of the area.

2) Proclamation 219

This proclamation declares a large portion of Palawan main island as a Game Refuge and Bird Sanctuary and a majority of small islands (less than 50,000 ha) as national reserves. However, many areas have been excluded by amendments and other proclamations. Furthermore, many exploitation permits such as logging concessions, and aquaculture developments were still issued even after the declaration, and the exploitation and settlements have been done intensively. Thus, this proclamation has been largely ineffective.

3) El Nido Marine Reserve

This reserve, which covers 9,500 ha, was declared on April 27, 1991 in order to conserve mainly the marine ecosystem of Bacuit Bay. Since then, the environmental conservation in the area has been focused and the community has realized the importance of environmental conservation. However, though El Nido had 45% old growth forest coverage in 1985, a 1992 survey revealed that only 8.7 % of the area was covered by such forest. This data apparently demonstrates that the intensive exploitation of the forest in the catchment area, from which most siltation runs off to the bay marine ecosystem, had taken place prior to the proclamation.

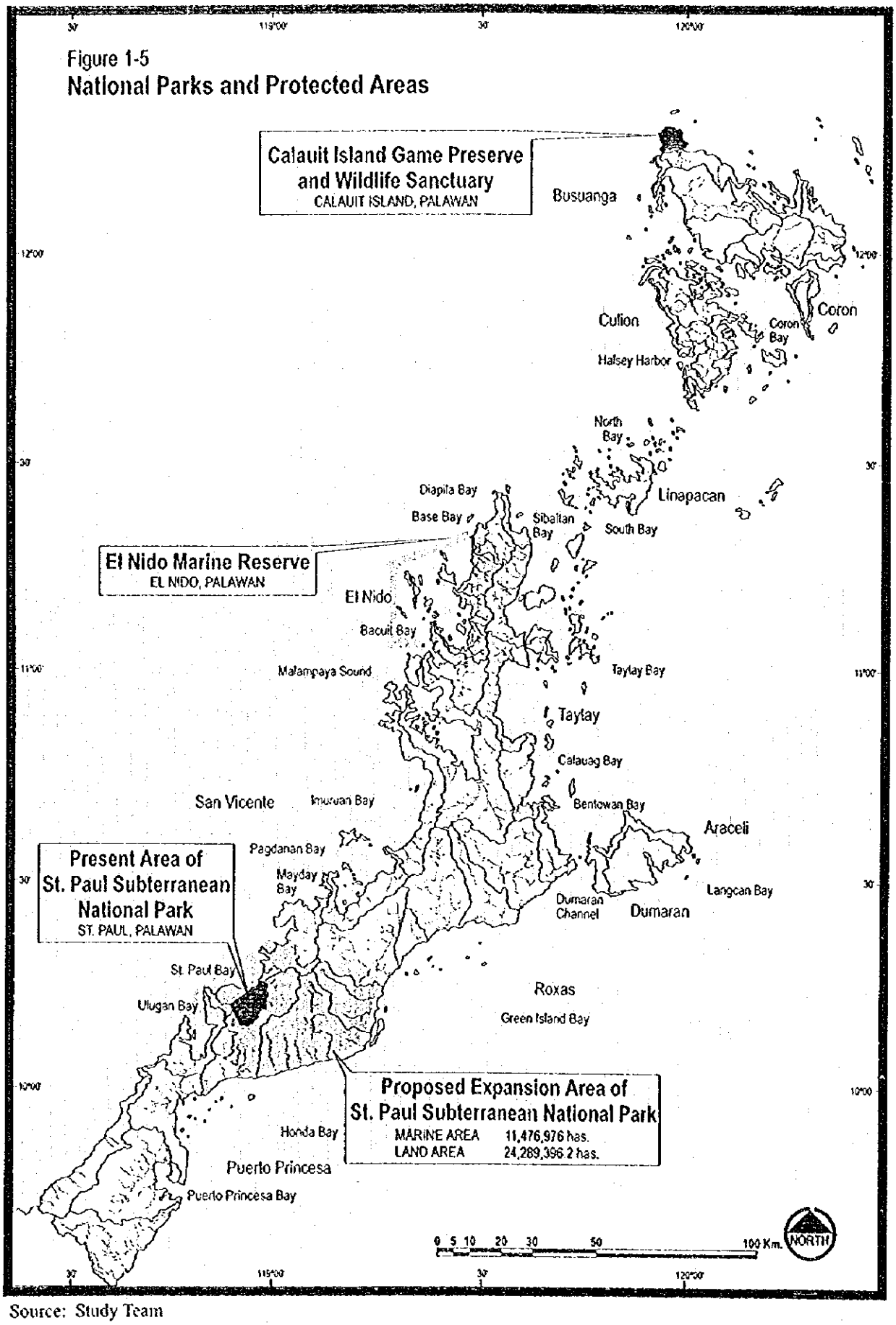
In addition, the zoning of the reserve conflicts with its name which gives the impression that conservation of marine ecosystems is taking place. Core zones of the reserve are set mainly on island terrestrial ecosystems. The marine ecosystem is considered to include most tidal area. Marine turtles which are one element of the marine ecosystem use the coastal ecosystems for their nesting sites. Therefore, the marine ecosystem should be extended to coastal beach ecosystem.

4) Calauit Island Game Preserve and Wildlife Sanctuary

Declared in August 1976, this unique sanctuary brought together Philippine indigenous species and African wildlife. Per the proclamation, involuntary resettlement was forced on inhabitants which later became a social issue.

Some indigenous species and African origin species adapted well to the habitat and increased in number in the reserve. Due to peculiarity of the reserve, it has attracted media attention and tourism. Calamian deer, an indigenous specie in Palawan, exist only in the reserve and its population is up to 1,000 now. In situ conservation of this species must be considered. In addition to the above mentioned national parks and protected areas, watershed forest reserves have been established (refer to Table 1-5). Though the reforestation areas would be human-modified ecosystems, it would serve good measure to protect the remaining old growth natural forests in the upper areas of and beyond mountains to provide the opportunity for expansion to the natural forest in the future.

Figure 1-5
National Parks and Protected Areas



Source: Study Team

Table 1-4 National Parks and Protected Areas in the Study Area

Protected Area	Name	Legislation	Date	Area (ha)
National Park	St. Paul Subterranean River	Proc. 835	Mar-71	3,901
Game Refuge and Sanctuaries	Palawan	Proc. 219[1/] Proc. 530-B	Jul-71	763,399
	Calauit Island Game Preserve and Wildlife Sanctuary	Proc. 1578	Aug-76	3,400
Marine Reserve	El Nido Marine Reserve	DENR A.O.4	Apr-91	95,000
UNESCO: Biosphere Reserve - Palawan IUCN: Tropical Rain Forest Hot Spot - Phillipine				

1993 Statistics on Philippine Protected Areas and Wildlife Resources
1/ Proc. 219 declared all of Palawan as a game refuge and bird sanctuary. Under the proclomation, islands smaller than 50,000ha are declared National Reserve which is closed to exploitation and human settlement

Table 1-5 Watershed Forest Reserves in the Study Area

Name	Location	Area (ha)	Proclama-tion #	Date
Bacuit Watershed Forest Reserve	Bacuit	94	785	3/28/35
Palawan Flora, Fauna, and Watershed Forest Reserve	Puerto Princesa City	4,776	2221	7/14/82
Palawan Flora, Fauna, and Watershed Forest Reserve (Parcel2)	Puerto Princesa City	3,224	2425	12/3/90
	Total	8,094ha		

From Philippine Forestry Statistics, Forest Management Bureau

Table 1-6 Reforestation in Northern Palawan

Project Name	Location	Area (ha)	>1986	'87	'88	'89	'90	'91	Total
Central Palawan Restoration	Puerto Princesa	2,791	5	32	28	26	29	25	145
Coron Restoration	Coron	3,100	6	40	35	19	13	18	131
Northern Palawan Reforestation	Roxas	4,424	1,126	153	79	64	20	15	1,457
Palawan Flora and Fauna Reforestation	Puerto Princesa	4,776	0	0	52	50	14	0	116
Taytay Reforestation	Taytay							19	19

Accomplishment report of regular reforestation projects as of December 1991

1.5. Activities of Environment Conservation

1) Central Government

(1) Department of Environment and Natural Resources (DENR)

The department is the primary agency for environment conservation and development in the Philippines. National parks and protected areas are basically managed by PAWB, DENR through the department field operation. CITES management authority is assigned to PAWB which issues the CITES permit as well as all permits and licenses regarding wildlife utilization (killing, trapping, transport, possession and farming) through field operation offices. Matters regarding Ramsar Convention in the Philippines are also managed by PAWB.

(2) Palawan Council of Sustainable Development (PCSD)

PCSD is the organization directly under the office of president and has been formed to govern and make development activities sustainable in Palawan. The council consists of representatives from various sectors such as local government units, DENR, Department of Agriculture, Public, Tribal, NGO and Military. Strategic Environment Plan (SEP) was formulated as a guideline for environment conservation. PCSD is the principle organization to implement SEP in Palawan.

2) Local Government

Both the Provincial Government and Puerto Princesa City Hall are now implementing environmental law enforcement programs covering all of Palawan. These programs are quite new in the Philippines which indicate a growing local concern for the environment.

(1) Bantay Palawan

This program was created by the Provincial Government of Palawan in March, 1993, for the protection of terrestrial and marine environments of Palawan excluding Puerto Princesa City. The program is coordinated with all government and non-government agencies including the military for law enforcement of Republic Act 7611. Thus, authorities needed for the enforcement are coordinated toward the ultimate goal of sustainable development. The program principally consists of six major committees namely: (1) Enforcement; (2) Prosecution and Adjudication; (3) Community Development; (4) Education and Training; (5) Monitoring and Evaluation; (6) Logistics and Finance.

(2) Bantay Puerto

This program was created by the Puerto Princesa City Government as a counterpart program of Bantay Palawan Program. The program consists of five components namely: (1) The Bantay Gubat Program to address the problems of illegal logging and destructive farming; (2) The Bantay Dagat to enforce the law on illegal fishing; (3) Monitoring Group to obtain information on illegal activities; (4) The Civilian Task Force to act on actual law enforcement for assisting the local police and the military; (5) The Cyanide Detection Test to detect cyanide and other chemicals used in fishing along city jurisdiction.

(3) Non-government Organizations (NGOs)

Haribon Foundation: The premier environmental NGO in the Philippines, the foundation has the largest number of members in the Philippines and is very active in environmental conservation. The first debt-nature swap on St. Paul National Park and El Nido Marine Reserve was done through the Haribon Foundation and the United States World Wildlife Foundation.

Wildlife Foundation of the Philippines: The foundation manages the El Nido Marine Reserve.

Philippine Wildlife Conservation Society: The society formulates red data books in the Philippines.

El Nido Foundation: This foundation aims to implement the community based Environment Management Program in El Nido Municipality which is developed by the initiative of Ten Knots Development Philippines which operates a resort in the area.

Ulugan Bay Foundation: The foundation has been mainly working in community organizing and reforestation of mangrove in the Ulugan Bay area.

Calauit Development and Multipurpose Cooperative: The cooperative manage Calauit Game Refuges and Wildlife Sanctuary.

Marine Turtle Foundation: The foundation conducts surveys on marine turtles and manages the El Nido Marine Reserve.

Foundation for Philippine Environment: This is the funding agency for environment conservation activities in the Philippines.

1.6. Modification of Ecosystem

The main conflict between human activity and wildlife started with the conversion of the swamp ecosystems to rice fields which forced water fowl and migratory birds to change their habitats. However, small scale agriculture and hunting of wildlife did not seriously impact the whole ecosystem.

Recent economic development in the Philippines has rapidly increased the demand for resources which lead to intensive and extensive use of ecosystems as early as 50 years ago. Logging, mono-culture plantations, the expansion of rice fields and fish cultures without consideration given to the impacts of such activity on the ecosystem as a whole went unhindered.

1) Forest Coverage

Changes of forest coverage in the Philippine is shown in Table 1-7 which indicate that the steady decrease of forest has taken place over the last 50 years. However, the aerial photo survey conducted by National Mapping and Resource Information Authority (NAMRIA) revealed that mainland Palawan had almost 46% old growth forest coverage in 1985 (Table 1-8), which was probably the widest virgin forest coverage in the Philippines at the time. This data suggested that the utilization of the Palawan ecosystem had been set aside from intensive use by people largely due to the lack of accessibility and to population numbers until 1985. The terrestrial ecosystem as well as the marine ecosystem of mainland Palawan enjoyed rich biodiversity from the point of ecosystem, species and gene at that time.

Swedish Space Corporation (SSC), with NAMRIA, conducted a forest coverage survey utilizing 1987 SPOT satellite images. Though classification of forest differed from previous surveys, the map indicated good forest coverage in the study area. The figure demonstrated clearly that human utilization of forest ecosystem had been along the river line.

Japan Forest Technical Association (JAFTA) with NAMRIA conducted the Information System Development Project for the Management of Tropical Forest in Palawan and made the Land Use and Forest Type Map and Forest Register interpreted from 1992 Land Sat TM sensor images (refer to Figure 1-6). The forest register results on the Study Area are summarized in Table 1-9. 1992 survey results indicate old growth forest coverage in the total study area at only 24.3% which is larger than the national average of the Philippines. However, the residual and marginal forests that are mainly secondary growth occupied 24% of the land which indicates recovery of the forest in the area. The 1987 and 1992 maps indicate that quite intensive logging and expansion of human activities took place in the mainland of Palawan from 1987 to 1992.

In order to compare with 1985 data, forest register data was recalculated for the same areas of 1985 survey which are summarized in Table 1-9, 1-10. The data

reveals the dramatic changes in old growth forest down to less than 30% coverage in the same area within 7 years. This apparently means very drastic changes in the ecosystem occurred during that period. Rapid utilization of ecosystems usually associated with poor planning caused the degradation of the biodiversity of the forest ecosystems. Poor planning also caused soil erosion, and as a result, severe siltation to coral areas occurred. Areas of dead coral were consequently taken over by seagrass communities.

Moreover, logging roads gave subsistence farmers access to new areas for kaingin farming. If this farming had been done in the traditional manner of the many mountain tribes, it would have limited the impact on the ecosystem. However, rapid population increase and quite low productivity of the soil in Palawan encourage the expansion of farming areas which in turn seriously impacted the entire ecosystem.

In 1992, logging and kaingin activities were completely banned in Palawan. However, these activities still take place though the province. Since the implementation of the conservation strategies of Bantay Palawan and Bantay Puerto, law enforcement has intensified (refer to Table 1-11).

Table 1-7 Changes of Forest Coverage in the Philippines (1950 - 1990)

Year	Forest Coverage (%)	Source of Information	
1950	49.10	Projection from 1969	
1957	44.30	NEC (1959)	
1969	33.50	PFS (1973) as interpreted by Revilla	
1969	34.90	P-GFI (1988)	
1973	38.00	Lanchowski et al.	LANDSAT
1974	29.80	Bruce (1977)	LANDSAT
1976	30.00	Bonita and Revilla (1977)	LANSAT
1976	20.00	Eckholm (1976)	
1977	25.00	Scott (1979)	
1980	25.90	FDC (1985)	LANDSAT
1980	27.10	P-GFI (1988)	
1987	23.70	SSC (1988)	SPOT
1987	22.20	P-GFI (1988)	
1990	20.50	DENR	

NEC: National Economic Council
PFS: Philippine Forest Statistics
P-GFI: Philippine-German Forestry Resources Inventory Project
SSC: Swedish Space Corporation
DENR Department of Environment and Natural Resources

Table 1-8 Forest Coverage and Type 1985

AREA	Old Growth Forest	Mossy Forest	Residual Forest	Marginal Forest	Mangrove Forest	Total Forest	Others	Total
Araceli	0	0	829	0	2,614	3,443	8,277	11,720
Dumaran	13,349	110	7,212	982	3,486	25,139	29,446	54,585
El Nido	23,825	5	2,089	864	1,351	28,134	25,252	53,386
Puerto Princesa	89,279	4,731	34,012	7,813	6,065	141,899	62,826	204,724
Roxas	47,734	557	7,487	259	2,630	58,667	32,697	91,363
San Vicente	23,564	0	29,310	149	953	53,975	13,260	67,235
Tay Tay	55,785	187	10,652	2,483	4,042	73,148	34,512	107,660
Total	253,535	5,590	91,590	12,549	21,141	384,403	206,268	590,671
Araceli	0.0%	0.0%	7.1%	0.0%	22.3%	29.4%	70.6%	100%
Dumaran	24.5%	0.2%	13.2%	1.8%	6.4%	46.1%	53.9%	100%
El Nido	44.6%	0.0%	3.9%	1.6%	2.5%	52.7%	47.3%	100%
Puerto Princesa	43.6%	2.3%	16.6%	3.8%	3.0%	69.3%	30.7%	100%
Roxas	52.2%	0.6%	8.2%	0.3%	2.9%	64.2%	35.8%	100%
San Vicente	52.2%	0.6%	8.2%	0.3%	2.9%	64.2%	35.8%	100%
Tay Tay	51.8%	0.2%	9.9%	2.3%	3.8%	67.9%	32.1%	100%
Total	42.9%	0.9%	15.5%	2.1%	3.6%	65.1%	34.9%	100%

Source: NAMRIA aerial photos, 1985

Table 1-9 Forest register data based on the islands in the Study Area

Area	Old Growth	Mossy Forest	Residual Forest	Marginal Forest	Mangrove Forest	Reproduction Brush	Coconut Plantation	Other Plantation	Grass Land
North Palawan Island	173,093	11,489	135,140	7,114	16,967	113,006	4,807	-	79,203
Dumaran	235	-	762	-	16,967	12,468	162	-	13,668
Linapacan	1,032	-	2,852	-	4,569	2,407	4	-	3,461
Culion	4,605	-	11,351	-	473	7,634	400	50	8,893
Coron	-	-	-	3,713	1,852	77	3	-	148
Busuanga	13,102	-	28,485	-	21	13,557	1,968	1,379	26,837
Total	192,067	11,489	178,590	10,827	2,812	149,149	7,344	1,929	1,322,160
North Palawan Island	28.70%	1.90%	22.40%	1.20%	2.80%	18.70%	0.80%	0%	13.10%
Dumaran	0.70%	0%	2.30%	0%	13.80%	37.60%	0.50%	0%	41.30%
Linapacan	9.90%	0%	27.30%	0%	4.50%	23%	0%	0%	33.10%
Culion	11.80%	0%	29.10%	0%	4.70%	19.50%	1%	1.40%	22.80%
Coron	0%	0%	0%	51.30%	0.30%	1.10%	0%	0%	2%
Busuanga	13.70%	0%	29.80%	0%	2.90%	14.20%	2.10%	1.40%	28.10%
Total	24.30%	1.50%	22.60%	1.40%	3.40%	18.90%	0.90%	0.20%	16.70%

Table continued below

Area	Paddy Field	Crop Land	Bare/Rocky Land	Mining Area	Built-up Area	Fish Pond	Water Body	Shallow Coast	Cloud	Shadow	Total
North Palawan Island	18,961	3,534	3,411	-	887	101	2,658	945	20,265	12,265	604,144
Dumaran	349	14	-	-	53		331	-	308	209	33,128
Linapacan	-	-	80	-	-	-	137	-	7	4	10,457
Culion	1,358	1,847	44	-	51	-	320	-	95	65	39,065
Coron	34	-	2,148	-	-	-	557	-	294	248	7,243
Busuanga	1,454	4,318	59	-	192	-	457	-	429	422	95,471
Total	22,156	9,713	5,742	-	1,183	101	4,460	945	21,696	13,213	789,508
North Palawan Island	3.10%	0.60%	0.60%	0%	0.10%	0.02%	0.40%	0.16%	3.40%	2%	100%
Dumaran	1.10%	0%	0%	0%	0.20%	0%	1%	0%	0.90%	0.60%	100%
Linapacan	0%	0%	0.80%	0%	0%	0%	1.30%	0%	0.10%	0%	100%
Culion	3.50%	4.70%	0.10%	0%	0.10%	0%	0.80%	0%	0.20%	0.20%	100%
Coron	0.50%	0%	29.70%	0%	0%	0%	7.70%	0%	4.10%	3.40%	100%
Busuanga	1.50%	4.50%	0.10%	0%	0.20%	0%	0.50%	0%	0.40%	0.40%	100%
Total	2.80%	1.20%	0.70%	0%	0.10%	0.01%	0.60%	0.12%	2.70%	1.70%	100%

Source: JAFTA/NAMRIA, 1992

Table 1-10 1992 Forest Coverage and Type of Municipalities surveyed in 1985

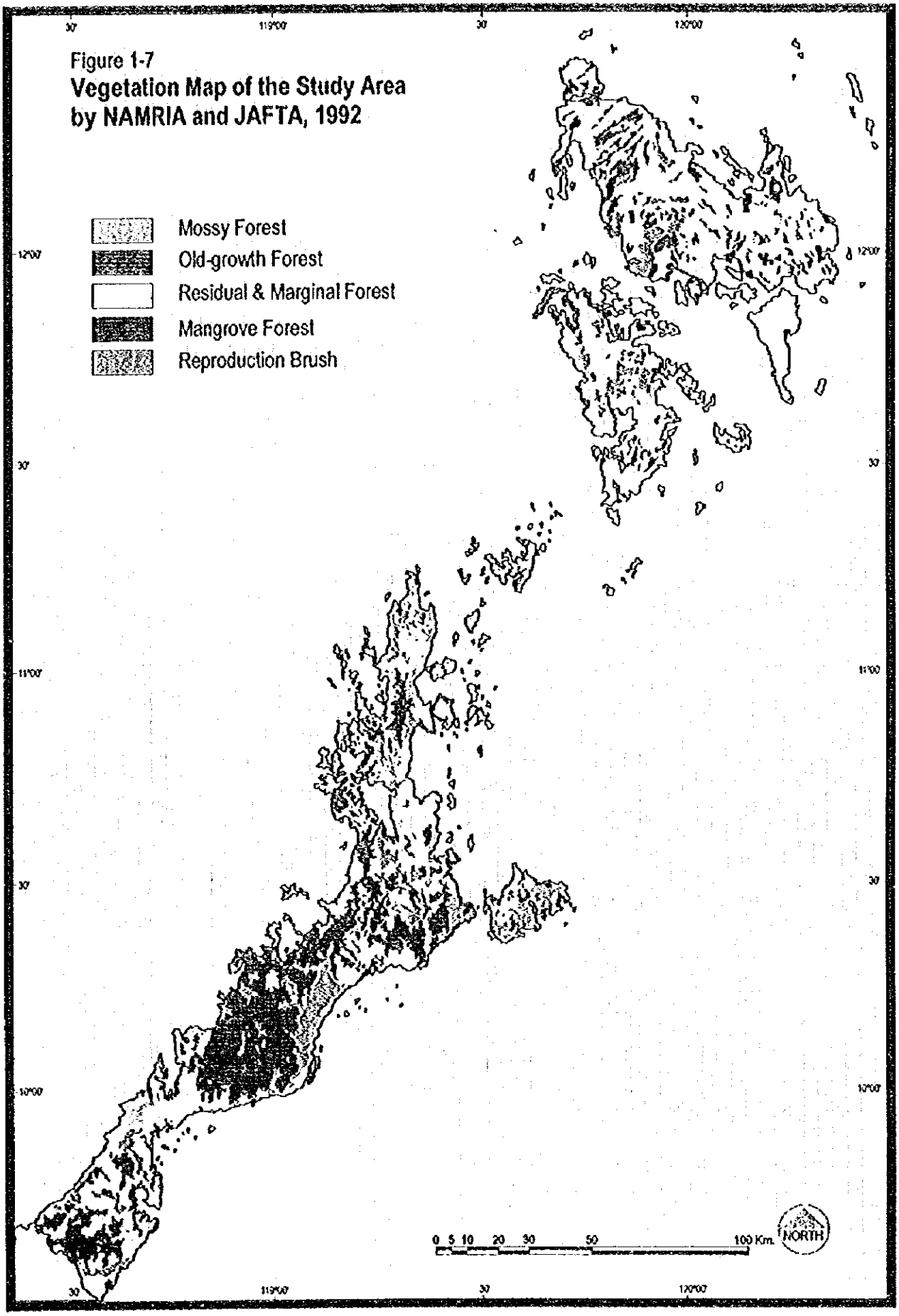
AREA	Old Growth Forest	Mossy Forest	Residual Forest	Marginal Forest	Mangrove Forest	Total Forest Area	Others	Total
Araceli	50	0	173	0	2,800	3,023	17,272	20,295
Dumaran	13,267	0	9,779	0	3,890	26,936	31,659	58,595
El Nido	4,081	0	11,265	51	1,244	16,641	30,171	46,812
Puerto Princesa	85,700	11,460	57,959	5,477	4,296	164,892	80,963	245,855
Roxas	31,561	0	20,515	0	1,733	53,809	45,970	99,779
San Vicente	20,565	29	7,941	7	899	29,441	15,879	45,320
Tay Tay	18,104	0	28,270	1,579	6,674	54,627	65,989	120,616
Linapacan	1,032	0	2,852	0	473	4,357	6,100	10,457
Culion	4,605	0	11,351	0	1,852	17,808	21,257	39,065
Coron	6,983	0	17,074	3,713	1,872	29,642	37,820	67,462
Busuanga	6,119	0	11,411	0	961	18,491	16,761	35,252
Total	192,067	11,489	178,590	10,827	26,694	419,667	369,841	789,508
Araceli	0.2%	0.0%	0.9%	0.0%	13.8%	14.9%	85.1%	100%
Dumaran	22.6%	0.0%	16.7%	0.0%	6.6%	46.0%	54.0%	100%
El Nido	8.7%	0.0%	24.1%	0.1%	2.7%	35.5%	64.5%	100%
Puerto Princesa	34.9%	4.7%	23.6%	2.2%	1.7%	67.1%	32.9%	100%
Roxas	31.6%	0.0%	20.6%	0.0%	1.7%	53.9%	46.1%	100%
San Vicente	31.6%	0.0%	20.6%	0.0%	1.7%	53.9%	46.1%	100%
Tay Tay	15.0%	0.0%	23.4%	1.3%	5.5%	45.3%	54.7%	100%
Linapacan	9.9%	0.0%	27.3%	0.0%	4.5%	41.7%	58.3%	100%
Culion	11.8%	0.0%	29.1%	0.0%	4.7%	45.6%	54.4%	100%
Coron	10.4%	0.0%	25.3%	5.5%	2.8%	43.9%	56.1%	100%
Busuanga	17.4%	0.0%	32.4%	0.0%	2.7%	52.5%	47.5%	100%
Total	24.3%	1.5%	22.6%	1.4%	3.4%	53.2%	46.8%	100%

Table 1-11 Illegal Logging Confiscated by Bantay Palawan and Bantay Puerto Programs

YEAR	AVES	MAMMALS	TOTAL
1993	210	13	223
1994	183	2	185
1995	6	0	6
TOTAL	399	15	414

The accomplishment report of Bantay Puerto Program

Figure 1-7
Vegetation Map of the Study Area by NAMRIA and JAFTA, 1992



2) Utilization (Hunting) Pressure on Wildlife

Confiscated wildlife by the Wildlife Monitoring Team of Protected Area and Wildlife Bureau (PAWB) at Ninoy Aquino International Airport in the last two years is shown in Table 1-12. This data is only on out-going ports, and thus represents on the tip of iceberg of the Philippine illegal wildlife trade industry.

Because of the uniqueness and abundance of valuable fauna in Palawan, a lot of species are also targeted by illegal utilization. Wildlife confiscated by Bantay Puerto Program of Puerto Princesa City Hall is summarized in Table 1-11. Apart from local consumption which is not indicated, the utilization pressure is concentrated on the avifauna. The most frequently confiscated is *Gracula religiosa palawanensis* (Talking Myna) followed by *Prioniturus lucinensis* (Green Headed Racket Tailed Parrot) and *Cacatoe haematuropygia* (Philippine Cacatoe). They mostly inhabit the primary forest at low and mid elevation. And a small number of mammals such as *Macaca fascicularis* (Philippine Long Tailed Monkey), and *Arctictis binturong* (Palawan Bear Cat) were also confiscated by the program, but not at a significant trading amount.

Table 1-12 Number of Confiscated Wildlife at NAIA

	Phylum	1993	1994	1995
Fauna		90	67	1792
	Mammals	0	0	12
	Aves	34	0	0
	Amphibians	4	4	20
	Reptiles		63	66
	Insects	52	0	1694
FLORA		4891	172	
	Orchid	4856	168	151
	Cactus	2		
	Cycas	17		5
	Sabila	5	3	22
	Birds' Nest	1		
	Ferns	10		
	Palm			
BY-PRODUCTS		1998	257	95
	Frozen Fruit Bats			46
	Stuffed Marine Turtle	48	13	
	Stuffed land Turtle	21		
	Stuffed Monitor Lizard	7	5	
	Snake Skin (Python)	1		
	Stuffed Homing Pidgeon			
	Stuffed Wild Birds	2		
	Stuffed Wild Cat	1		
	Guitar made of Turtle Carapace	2		
	Butterfly Pupae	1916	239	

Report of NAIA Wildlife Monitoring Team, PAWB

2. Supplemental Survey

In order to conduct a rapid assessment of the present ecosystem in Palawan within the given time frame and other conditions for the Survey, possible methodology was quite limited. Therefore, the supplemental survey to assess human pressure on the ecosystem was conducted by means of the aerial observation and field interview/questionnaires for key/index species distribution. Human pressure on the ecosystem in the Study Area was assessed through aerial observation, and changes in distribution of key/index species were employed as indicators for the quality of the ecosystem (refer to Table 2-1).

Flight paths of covered as much area as possible within the study frame and are shown in Figure 2-1. In addition, the flights of the aerial survey on the marine and coastal environment were utilized as additional aerial observation though it was concentrated on the coast. Findings of the aerial observations are summarized in Figure 2-2

Intensive and extensive land slides were found on almost all hill forests of the west side of Pagdanan Range and Flat Range up to Central Range in San Vicente. The same events were observed in the secondary growth forest and kaingin areas of hills along the Lañgogan river, the east wall of Sharp Peak and Dome Peak, Barbacan Range, the east hills of Central Range, Mount Baring and Taradungan, the east hills of Mt. Ynantagung, and the east hills of mountains in El Nido though not as intensive as in San Vicente. Other serious land slides were observed along the national roads on the steep areas near the coast line in Mount Baring and Taradungan.

In addition to the above, it was found that small scale logging was not taking place in the good forest 5 to 7 km south of Lake Manguao in Taytay municipality. Also, numerous fish pond preparations in mangrove forests, as well as preparation for kaingin were noted in some places.

Results from the aerial observation, Iwahig, Irawan Valley, Taytay, San Vicente and El Nido area were identified as suitable for the field interview/questionnaire survey within the given conditions of the Study. During the last heavy rainy season, various national roads in the Study Area became inaccessible. Thus, the survey team was not able to get to El Nido within the given time. Field interview/questionnaire survey sites are shown in Figure 2-3.

2.1. Vegetation

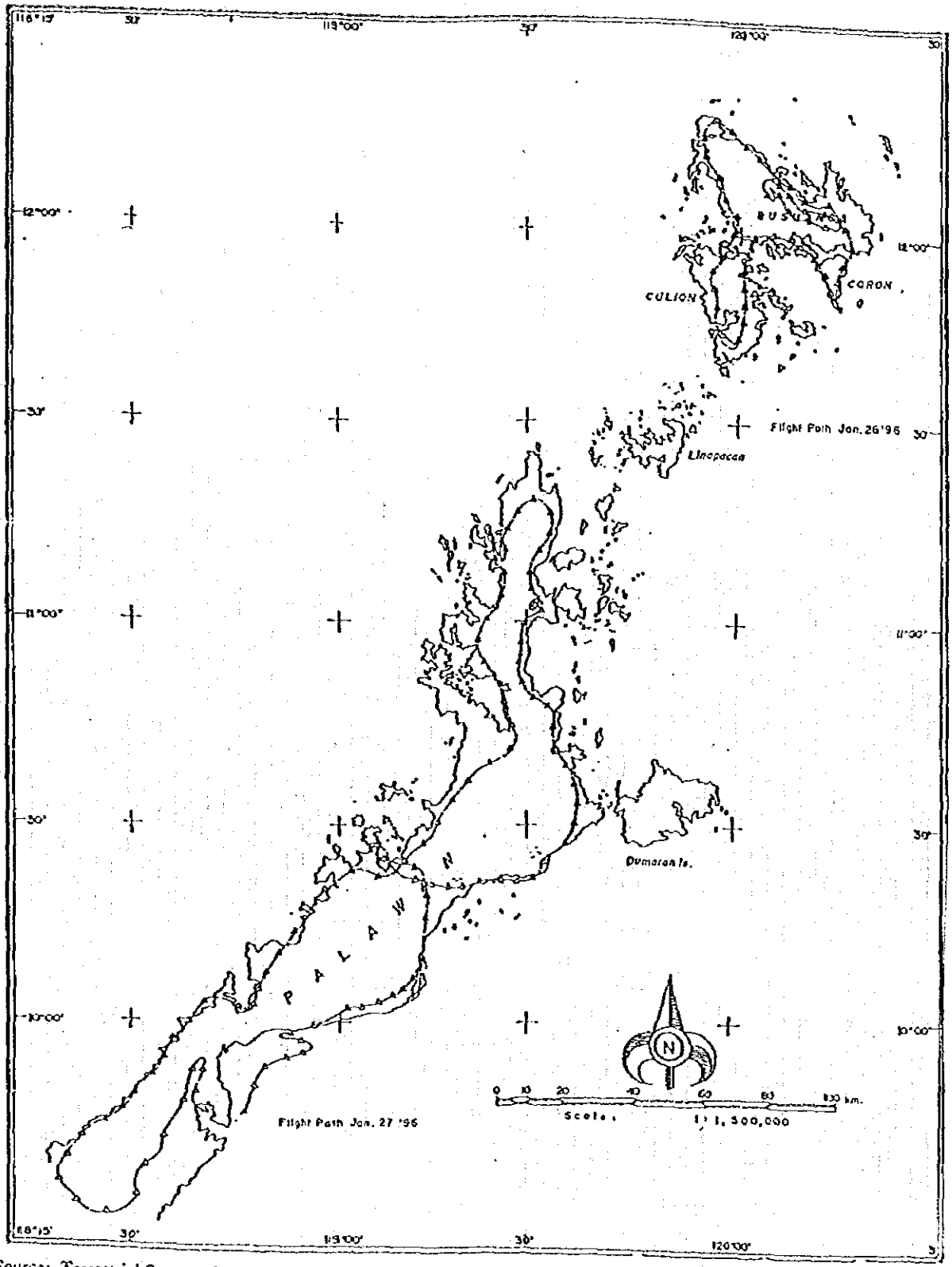
The aerial observation revealed that destructive land slides on the cleared forests in San Vicente had occurred along logging roads. It appears that initially, serious soil erosion took place along the logging roads as they were not planned properly and constructed without drainage facilities. Consequently, the logging roads themselves served as water ways and the rain water, which saturated the soil, changed the slope and shape of the road. When heavy rains came, vegetation could not hold the soil and landslides ensued.

Table 2-1 Key Species Employed in the Survey

Key Species	Group	Scientific Name	Common Name	Ecosystem
Fauna	Mammals	Manis javanica	Palawan Scaly Anteater	Grass Land, Lowland Evergreen Rainforest (Secondary Forest)
		Arctictis binturong	Palawan Bear Cat	Lowland Evergreen Rainforest (Primary, Secondary Forest)
		Sundasciurus spp.	Squirrels	Lowland Evergreen Rainforest (Primary, Secondary Forest)
		Tupaia p. palawanensis	Palawan Tree Shrew	Lowland Evergreen Rainforest (Primary, Secondary Forest)
		Hystrix pumila	Palawan Porcupine	Primary Forest
	Bird	Collocalia fuciphaga	Swift Nido	Cave, Limestone Cave
		Cacatura haematuropygia	Philippine Cockatoo	Lowland Evergreen Rainforest (Primary Coastal Forest), Mangrove Forest
		Polyplectron emphanum	Palawan Peacock	Lowland Evergreen, Semidecidous Rainforest (Primary Forest)
		Gracula religionsa palawanensis	Talking Myna	Lowland Evergreen, Semidecidous Rainforest (Primary Forest)
		Anthracoceros marchei	Palawan Hornbill	(Mid to High Elevation) Submontane Forest
		Prioniturus platenae	Racket-tailed Parrot	Lowland Evergreen, Semidecidous Rainforest (Primary Forest)
	Reptile	Crocodilus mindorensis	Philippine Crocodile	Freshwater Swamp
		Python reticulatus		
		Naja naja		
		Borbourula busuanguensis		
	Butterfly	Trogonoptera trojana	Birdwing Butterfly	Lowland Evergreen Rainforest (Primary Forest)
		Papilio karna		Lowland Evergreen Rainforest (Primary Forest)
		Troides plateni		Lowland Evergreen Rainforest (Primary Forest)
Flora	Flora	Dipterocarpus grandiflorus	Diptercarps	Lowland Evergreen Rainforest
		Agathis philippinensis	Almaciga	Submontane Forest
		Casuarina nodiflora	Mountain Agoho	Ultrabasic Forest
		Veitchia merrilli	Palawan Palm	Limestone Forest
			Rattan	Lowland Evergreen, Semideciduous (mid to high elevation) Rainforest

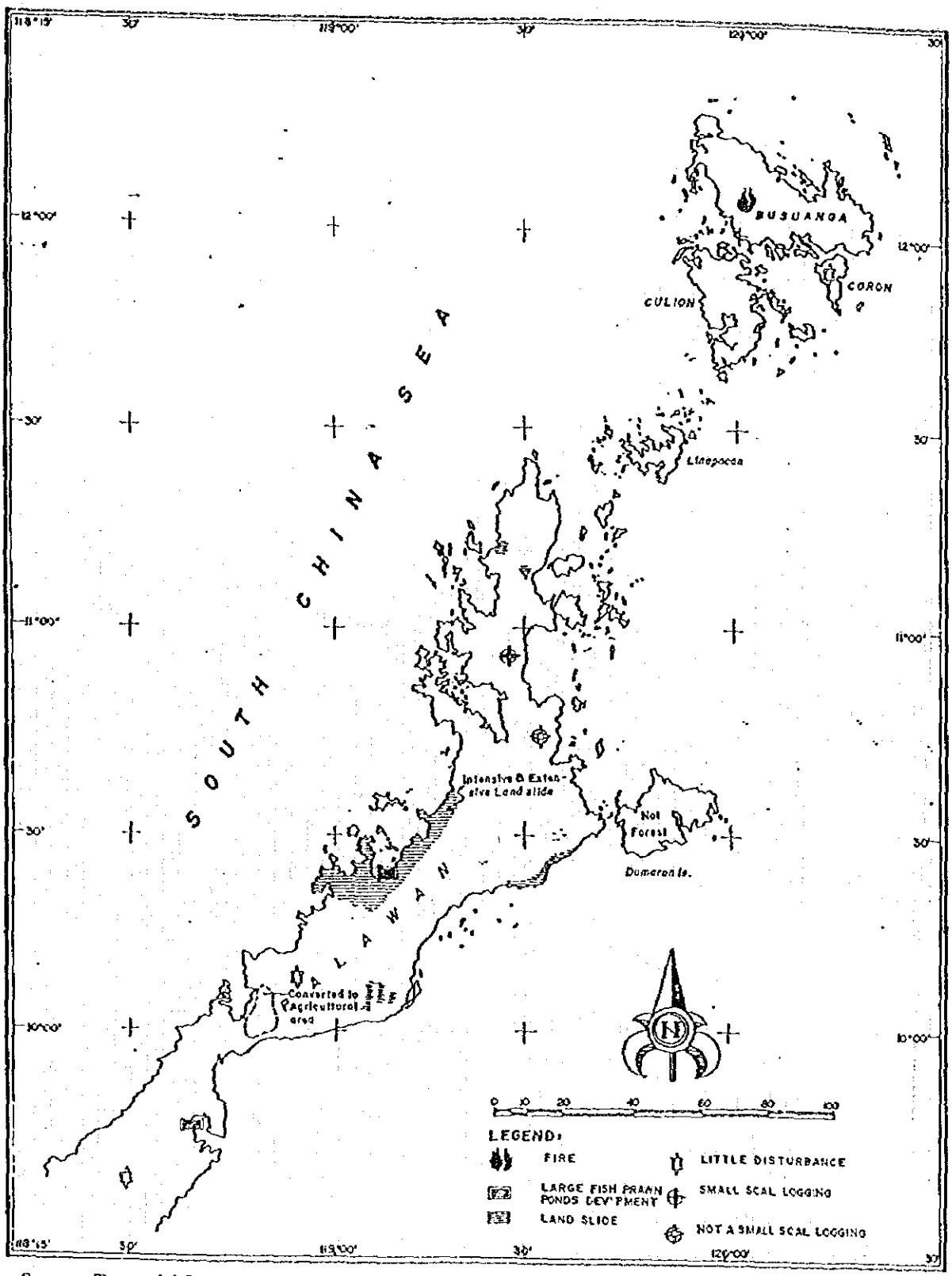
Source: Terrestrial Survey, Study Team

Figure 2-1 Flight Paths of Aerial Observation Survey



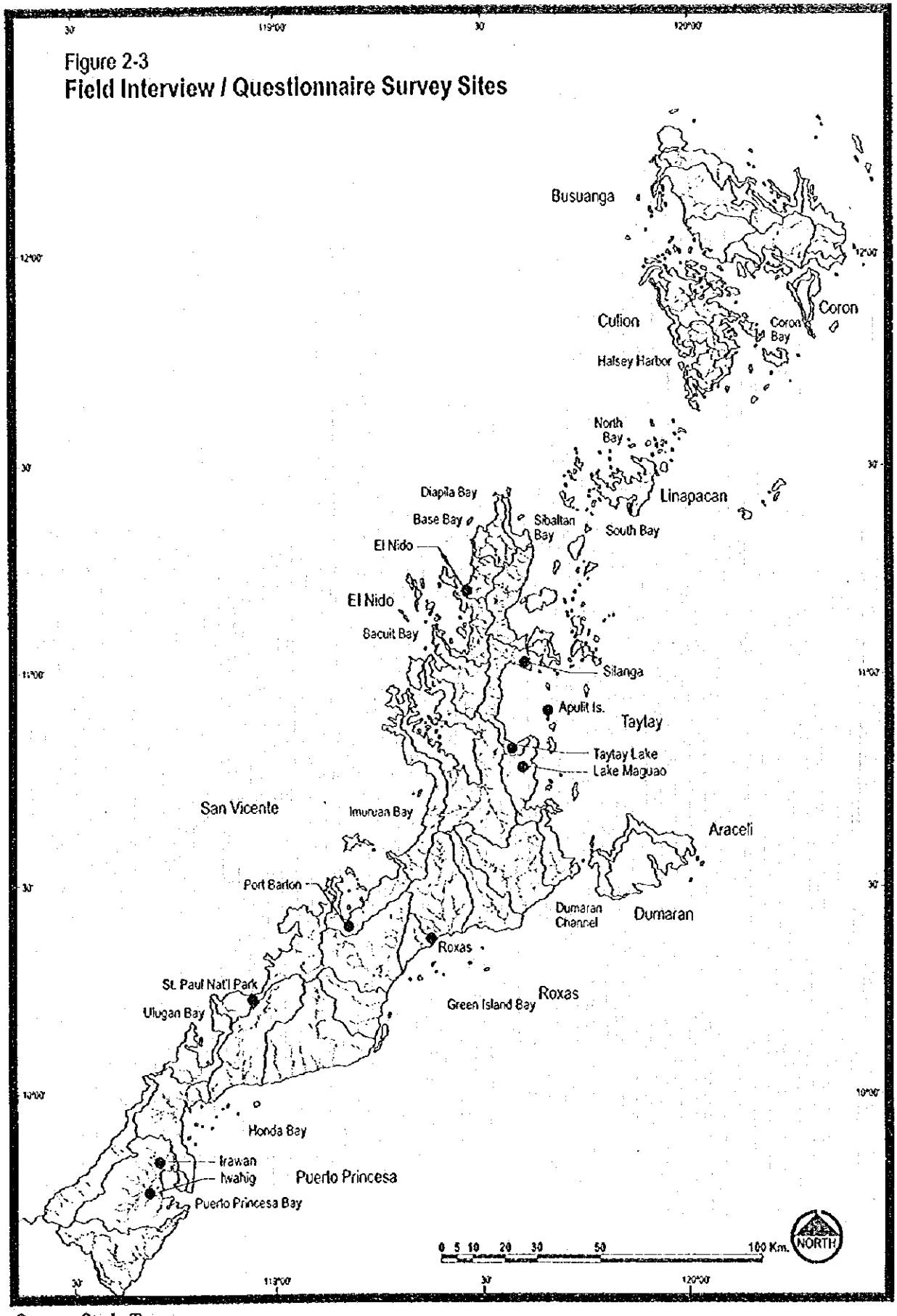
Source: Terrestrial Survey, Study Team

Figure 2-2 Findings of Aerial Survey



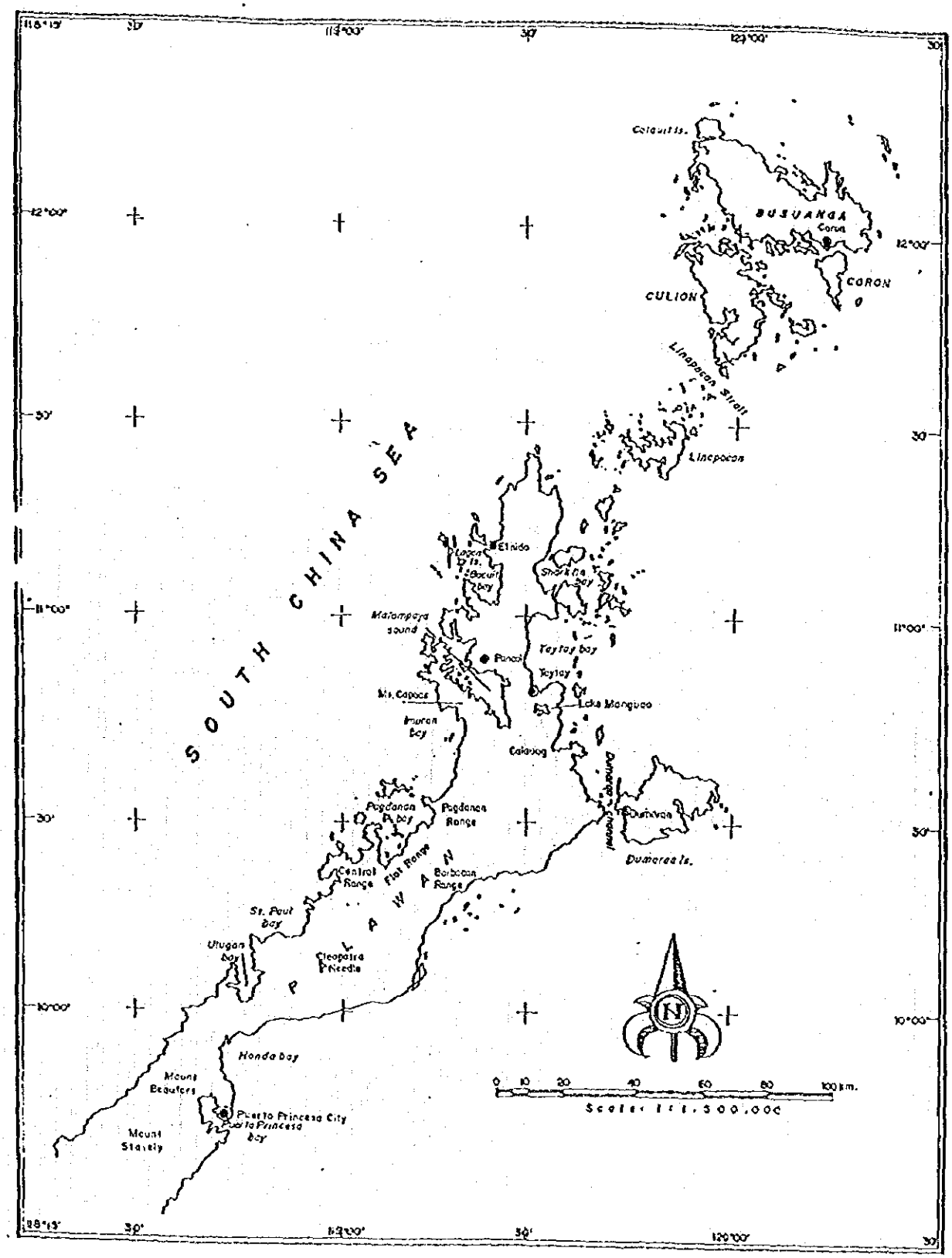
Source: Terrestrial Survey, Study Team

Figure 2-3
Field Interview / Questionnaire Survey Sites



Source: Study Team

Figure 2-4 Location of Key Vegetation Areas



Source: Terrestrial Survey, Study Team

1) Busuanga Island

This is the largest island in Calamian Group with approximately 95,000 hectors. The island is of volcanic origin with central flat planes and rolling volcanic hills whose highest point is 600m. The aerial survey revealed that the flat area has got virtually no forest. Good growth forests are only found along mountain gullies. And the wide ridge area of many mountains are without any vegetation at all. The 1987 vegetation map indicates very limited forest in the islands. This most probably means that intensive logging and ecosystem utilization had started earlier here than in mainland Palawan. However, due to the geological and soil characteristics of the island, the forest and agriculture production have been very limited though annual rainfall reaches 2,500 -3,000mm. These characteristics and early start of continuous ecosystem exploitation may account for the present peculiar distribution and shape of forest in the island.

2) Coron Island

Coron island is a spectacular island with remarkable ruggedly-contoured limestone hills, the out-most of which are surrounded by an almost vertical wall. Coron is one of the larger islands of the Calamian Islands with approximately 7,500 hectors and eleven (11) mysterious large and small lakes at sea and higher elevation-there is no river. The limestone formations account for the limited human access to the ecosystem. The aerial survey proved that the island's vegetation is largely intact from human activities. There are two settlements in the flat areas around a cove which can be reached by small boat. The inhabitants are mostly Tagubanua people and number less than 100.

The island is almost completely covered by the typical limestone forest ecosystem which accommodates many unique fauna. Due to relative preservation from human activity some species of birds which are threatened must have been moved to the island in recent years. All lakes are said to have brackish water. However, virtually no studies on the ecosystem of those lakes have published.

3) Culion Island

The island is the second largest island in the Calamian Group with approximately 40,000 hectors. Due to the presence of the leprosarium, the island remained isolated from other parts of the country. Thus, little study on the vegetation and ecosystem had been done and only little information has been available up to now. The island was thickly forested when the first vegetation map was made 1874. The aerial survey found that extensive kaingin has been taking place and very limited old growth forest currently remains. However, the remaining old growth forest reaches up to the ridge of the hills in the island and seems to be in better condition than that of Busuanga island when compared with the 13.8% coverage observed in the 1992 survey. Though quite young, mangrove with good growth was observed.

4) Linapacan Island

This is the third largest island of the Calamian Group with approximately 11,000 hectors and small rolling hills. Flat areas in the island are mostly utilized for agricultural production. The old growth forest remains only in a small hilly area (less than 10%) and are threatened by kaingin farming. However, some secondary growth was observed in abandoned kaingin areas.

5) Dumaran Island

This very flat island belongs to the Agutaya Group together with the Cuyo islands with approximately 33,000 hectors. The aerial survey confirmed the 0.7% old forest coverage and the 2.3% residual forest coverage recorded in the 1992 forest register data. A 1987 vegetation map whose data covered only half of the island indicated very little forest remaining at that time even with over 2,000 -- 2,500 mm rain annual fall. However, quite well developed mangrove forests were found around the island especially inside deep coves.

6) Northern Mainland of Palawan

Puerto Princesa City has the most old growth forest coverage in the Study Area mainly found in Iwahig Penal Colony, Palawan Flora and Fauna and Watershed Reserve (Irawan and) St. Paul Subterranean National Park.

(1) Iwahig Penal Colony ; Mt. Stavely, Central Peak, Triple Top Range, Anepahan Peaks

Forests in Iwahig Penal Colony were proved to be the best and largest cluster of forest ecosystem from low up to high elevation by the aerial survey. Low land forests in the colony are the most threatened due to the agricultural utilization of the land. Mid to high elevation forests were relatively in better condition.

(2) Irawan Forest ; Mt. Beaufort/Thumb peak

Irawan Forest was also found to be well preserved though the low elevation forest are disturbed at a certain level. The secondary growth of low elevation is developing which indicates that the recent law enforcement in the area is working.

(3) St. Paul Subterranean National Park, Mt. Bloomfield, Cleopatra's Needle

This area seems to have the only large single cluster of forests of low to mid elevation with little disturbance. Well-preserved limestone forests have enjoyed rich diversity and the ultrabasic forest on Mt. Bloomfield has received little disturbance as is well represented.

(4) Puerto Bay, Honda Bay, Ulugan Bay

Large area of mangrove forests in Puerto Bay and Honda Bay were transformed to fish ponds. No virgin mangrove seems to remain in that area where mangrove forest ecosystem were once quite healthy and produced numerous fishing resources. Mangrove forests in Ulugan Bay are now also quite seriously threatened with the logging of old growth trees and the conversion of the area to agricultural land and settlements.

(5) Barbacan range (Roxas)

Kaingin has been taking place up to high elevation and steep hills, causing many recent landslides which caused the destruction of lowland evergreen rainforest. This destruction in turn caused soil erosion. It will take the forest much longer to regenerate now and thus, vegetation in the range is in serious danger.

(6) Pagdanan, Flat and Central range (San Vicente)

As described previously, destructive landslides occurred in all areas from low to high elevation in the ranges. All landslides were associated with logging roads and/or logged areas. These landslides are now causing serious soil erosion even with minimal rain. Thus, forest vegetation is seriously endangered by the remains of intensive logging.

(7) Mt. Ilian (Dumaran)

The forest on this mountain seems to be in the same condition as that on the Barbacan range. Kaingin has been taking place in high elevation and in steep slope areas. Thus, landslide occurred in kaingin areas though not as extensive as in the San Vicente area. The vegetation is now endangered.

(8) Mt. Big Peak

The forest on this mountain is in the same situation as Mt. Ilian and forest vegetation is seriously endangered.

(9) Lake Manguao (Taytay)

This lake had been surrounded by various types of thick forests in the past. However, intensive logging has taken place since 1988. Thus, not only forest vegetation but also fresh water lakes have been significantly altered. Three types of vegetation were recorded by previous studies but all types of vegetation area endangered at present.

(10) Mt. Capoas

The mountain has a characteristic geological base (refer to Figure 2-5). Lowland evergreen rainforest and sub-montane forest were recorded by previous studies. Lowland forest is significantly changed by agricultural activities. Consequently, upper forests were observed to be threatened.

2.2. Distribution of Index/Key Species

Due to the time frame and other constraints, representing parameters for ecosystem disturbances had to depend on sightings and the impressions of local people. Therefore, the results of this survey could serve as a reference but should not be used for future terrestrial ecosystem monitoring.

1) Flora

As expected by the aerial survey, only Iwahig and Irawan and the St. Paul National Park area are recorded as stable in Apitong (*Dipterocarpus grandiflorus*).Other areas where there used to be an abundance of species, such as Roxas, Pagdanan Range, Taytay and El Nido, have recorded a decrease. This is mainly attributed to recent intensive logging and small-scale illegal logging.

Almaciga (*Agothis philippinensis*) which is a typical species in high elevation sub-montane forest, was found to be decreasing in all areas except Irawan and Iwahig. Procurement of data for St. Paul National Park was not possible. However, from the results of the aerial observation survey, the area is expected to be stable.

Mountain Agoho (*Casuarina nodiflora*) which is an indicative species of ultrabasic forest, appeared to be stable in the Iwahig area. However, in the Irawan area and the Silanga area in Taytay, they were recorded as decreasing due mainly to human activities. Palawan palm (*Veitchia merrilli*), which is an indicative species for limestone forest, was recorded stable in St. Paul National Park area and Coron island, as expected. Apulit island which is a limestone island in Taytay was also recorded as stable.

Rattan, which grow in various habitats from primary evergreen forest to secondary up to montane forests in Palawan, and which is also an indicative species for human utilization, were recorded to be on the decline in all areas except in Iwahig where human activity is quite restricted.

Table 2-2 Status and Distribution of Key Flora Species in the Study Area

Key Species	Locality				
	Iwahig	Irawan	St. Paul	Roxas	Pagdanan Range (San Vicente)
1. Dipterocarpus (apitong)	abundant stable	abundant stable	———	abundant decreasing	abundant decreasing
2. Agathis (almaciga)	abundant stable	abundant stable	———	abundant decreasing	abundant decreasing
3. Casurina nodiflora (agoho del monte)	abundant stable	scarce decreasing	———	———	———
4. Veitchia (palawan palm)	———	———	scarce stable	———	———
5. Rattan	abundant stable	abundant stable	———	abundant decreasing	abundant decreasing

Key Species	Taytay				El Nido
	Lake Manguao	Mt. Capoas	Silanga	Apulit Island	
1. Dipterocarpus (apitong)	scarce decreasing	abundant decreasing	scarce decreasing	———	scarce decreasing
2. Agathis (almaciga)	———	abundant decreasing	———	———	———
3. Casurina nodiflora (agoho del monte)	———	———	scarce decreasing	———	———
4. Veitchia (palawan palm)	———	———	———	abundant stable	scarce decreasing
5. Rattan	abundant decreasing	abundant decreasing	abundant decreasing	———	abundant decreasing

Key Species	Busuanga Island	Culion Island	Coron Island
1. Dipterocarpus (apitong)	———	———	———
2. Agathis (almaciga)	———	———	———
3. Casurina nodiflora (agoho del monte)	———	———	———
4. Veitchia (palawan palm)	———	———	abundant stable
5. Rattan	scarce decreasing	scarce decreasing	———

Source: Terrestrial Survey, Study Team

2) Fauna

Distribution and status of key species employed for the survey are summarized in Table 2-3. The status of the key species are quite similar to that of the flora. Only Iwahig, Irawan and St. Paul National Park were recorded to have an increasing occurrence of some key species. All other areas are recorded as decreasing or consistent. In Iwahig, and Irawan, *Phyton reticulatus* and *Naja-naja* are recorded to be decreasing which might indicate selective human pressure on their habitat or directly on themselves.

Most key species of the mammal and two bird species of (*Cacatoe haematurophygia, Gracula religiosa*) are recorded increasing in St. Paul National Park. However, these species are decreasing in neighboring habitats: Roxas, San Vicente, Taytay and El Nido. These significant changes in their distribution indicate habitat loss in surrounding areas of St. Paul National Park. Most probably not only the key species but also other birds and mammals are now migrating into the Park because of habitat destruction or other development activities. Thus, the park will soon be congested with migrated species and some conflict between fauna and flora might occur in the future. Therefore, expansion of the Park is now essential and an important issue for terrestrial ecosystem conservation.

Strange results of decreasing status of birds species in Coron island are recorded. The island was observed almost intact by the aerial survey and typical limestone forests are well preserved. However, Nido hunting is reported to be taking place which might cause some disturbances for the fauna. Further studies and surveys are apparently needed to clarify the status of the terrestrial ecosystem of Coron island.

Table 2-3 Status and Distribution of Key Fauna Species in the Study Area

FAUNA	LOCALITY								
	Iwahig P.C.	Roxas Area	Taytay	Port Barton	St.Paul	El Nido	Busuanga	Culion Island	Coron Island
BIRDS									
Cacatua haematuropygia (Pilippine cockatoo)	C	D	D	C	I	D	-	-	D
Gracula religiosa (Hill myna)	I	D	C	C	I	D	C	D	D
Anthracoceros marchei (Palawan hornbill)	C	D	D	C	C	D	D	-	D
Prioniturus platenae (Palawan raket-tailed parrot)	I	D	D	C	C	D	C	C	D
Polyplectron emphanum (Palawan peacock pheasant)	C	D	D	C	C	D	-	-	-
Collocalia sp. (Swiflet)	C	C	C	C	C	C	C	C	C
MAMMALS									
Manis javanica (Palawan pangolin/ Scaly an eater)	I	D	C	C	I	C	C	C	-
Sundasciurus sp. (Squirrels)	C	C	C	C	I	C	C	C	C
Tupaia palawanensis (Tree shrews)	C	D	C	D	I	D	C	C	C
Arctictis whitei (Bearcat)	C	D	D	D	-	-	-	D	-
Hystrix pumila (Porcupine)	C	C	C	C	I	C	D	-	C
REPTILES & AMPHIBIANS									
Crocodylus mendorensis	-	-	-	C	-	-	-	-	-
Python reticulates	D	D	C	C	C	C	-	-	-
Naja naja	D	-	C	C	-	-	-	-	-
Borbourula busuanguensis	C	C	C	C	-	-	-	-	-
BUTTERFLIES									
Trogonoptera trojana	I	C	-	C	C	-	-	-	-
Papilio karna	I	-	-	-	-	-	-	-	-
Troides plateni	C	D	C	-	C	C	C	-	C

Source: Terrestrial Survey, Study Team

Legend: C - Consistent; I - Increase; D - Decrease

2.3. Rapid Assessment of Ecosystem

Modification and disturbances by human has occurred in various elements of the ecosystems of Palawan. Serious modifications occurred in coastal forest, lowland ever green forest, mid-elevation evergreen forest, fresh water lake/swamp and brackish water swamp ecosystems. Logging, kaingin agriculture and plantation development are the main human activities that cause the modification.

In order to perform the rapid assessment, past data, especially with regard to flora (forest type, coverage) and fauna when human settlement started are essential. Forest Management Bureau (FMB), National Museum, Department of Agriculture (DA) and other agencies have been accumulating and summarizing such information. However, it was quite difficult to acquire the necessary data within the given time. Hence, the rapid assessment of the ecosystem was done with available secondary data and the supplement survey. Therefore, area coverage of old growth forests and its possible coverage estimated by map image supplemented with flora and fauna utilization were used as indices.

The present rapid ecosystem assessment was relatively subjective and limited though various information maps were used. The results are summarized in Table 2-4.

1) Busuanga Island

(1) Lowland Evergreen Rainforest Ecosystem **Rating: Endangered**

Once thickly forested, this island now has only small valley forest ecosystems. The forest is still mainly secondary growth but has much less flora diversity. Due to soil characteristics, only a few species are able to grow naturally. It is very important now to protect the remaining forest so that it may return to its original full form.

(2) Mangrove Forest (Brackish Water Swamp) **Rating: Threatened**

Brackish water swamp ecosystem is developed between Calauit and Busuanga islands. It seems to have limited human pressure. However, in other areas, it is regularly exploited by local communities.

2) Coron Island

(1) Limestone Forest Ecosystem **Rating: Intact**

Due to inaccessibility, the ecosystem is well preserved. Present survey reveals more fauna elements which might mean that human pressure to other areas forced some species, especially birds, to migrate into this ecosystem. Thus, careful monitoring and surveying is needed to ensure the health of the ecosystem.

(2) (Brackish or Fresh Water) Lake Ecosystem **Rating: Intact**

Only a few people have ever been recorded to reach the lakes apart from tribal people. Thus, virtually no information on the ecosystem is available. Presently the lakes have not received any modification by human activities. Surveys are needed to understand the lake ecosystem.

(3) Cave Ecosystem **Rating: Good**

Several caves were reported to exist in the limestone in which swift birds nest. It is rather difficult presently to assess human impact through Nido hunting. However, it can be said that the cave ecosystem is quite well protected from hunters simply due to the landscape of the island.

3) Culion Island

(1) Lowland Evergreen Rainforest Ecosystem **Rating: Endangered**

Once thickly forested, this island now has only 11.8% old growth coverage which most probably is secondary growth and remnant primary forest. Geological and soil characteristics of this island are the same as those of Busuanga island. Thus, original diversity of flora and fauna should be conserved.

2) Mangrove Forest Ecosystem **Rating: Threatened**

The mouths of Balanga, Catigmalan rivers and deep in the Halsey harbor has relatively well developed mangrove forests. However, human utilization has usually started in primary forests which have fully developed ecosystems, because of its value. Though forest coverage looks quite wide, the quality of the forests is not really well developed due to human activities.

4) Linapacan Islands

(1) Lowland Evergreen Rainforest Ecosystem **Rating: Endangered**

Forest ecosystem remaining in the third biggest island in the Calamian Group is also in a similar situation as the other two bigger islands. The old forest coverage was already less than 10 % in 1992. Remnant forest is threatened by kaingin and it is essential to conserve it.

(2) Mangrove Ecosystem **Rating: Endangered**

This ecosystem is almost the same as hill forests. Utilization of mangroves have been constantly pressuring this ecosystem.

Table 2-4 Rapid Assessment of Ecosystems

Island	Location	Ecosystem	Rating
Busuanga		Lowland Evergreen Rainforest	E
		Mangrove Forest	T
Coron		Limestone (Karst Forest)	G
		Brackish Water Lakes	G
		Cave	F
Culion		Lowland Evergreen Rainforest	E
		Mangrove Forest	T
Linapacan		Lowland Evergreen Rainforest	E
		Mangrove Forest	T
Dumaran		Lowland Evergreen Rainforest	E/T
		Mangrove Forest	F
Palawan	Iwahig: Mt. Stavely, Anepahan Peaks, Central peak, Village, Triple Top Range		
		Lowland evergreen Rainforest	F
		Lowland Semi-deciduous Rainforest	F
		Submontane Forest	G
	Irawan Valley: Mt. Beaufort, Thumb peak, Mt. Hershel and Mt. Airy		
		Lowland Evergreen Rainforest	F
		Lowland Semi-deciduous Rainforest	F
		Submontane Forest	G
		Ultrabasic Forest (forest on heavy-metal rich soils)	T
	Puerto Princesa Bay	Brackish Water Swamp	E
	Honda Bay	Brackish Water Swamp	T
	Ulugan Bay	Brackish Water Swamp	E
	St. Paul's Bay	Lowland Evergreen Rainforest	F
		Submontane Forest	G
		Limestone (Karst) Forest	G
		Coastal Forest	T
		Cave	F
	Mt. Bloomfield	Ultrabasic Forest (Stunted Pole Forest on heavy-metal rich soil)	F
	Barbacan Range	Lowland Evergreen Rainforest	E
	Pagdanan, Central and Flat Range	Lowland Evergreen Rainforest	E
	Lake Manguao	Lowland Evergreen Forest (Lake Margin, Stream-Valley, High Forests)	E
		Freshwater Lake/Swamp Ecosystem	E
	Mt. Capoas	Lowland Evergreen Forest	E
		Submontane Forest	T
	Silinga	Limestone Forest	E
	Apulit Island	Limestone Forest (forest over limestone)	G
	Malampaya Sound	Brackish Water Swamp	E

Legend:

I: Intact	90 – 100% of Original Area
G: Good	70 – 90% of Original Area
F: Fair	50 – 70% of Original Area
T: Threatened	30 – 50% of Original Area
E: Endangered	10 – 30% of Original Area
ET: Extinct	< 10% of Original Area

Source: Terrestrial Survey, Study Team

5) Dumaran Island

(1) Lowland Evergreen Rainforest Ecosystem **Rating: Extinct**

Old growth forest coverage was already 0% in Araceli municipality in 1985. By 1992 Landsat data analysis proved the entire island was covered by 0.7%. No real forest cluster and no real secondary growth was observed by the aerial survey, thus, no forest ecosystems exist in this island.

(2) Mangrove Forest Ecosystem **Rating: Fair**

Mangrove forest ecosystem in most of this island has a few disturbances by human activities compared to lowland forest. However, some pressure on the primary growth and fish pond development were noticed.

6) Northern Mainland of Palawan

Iwahig Penal Colony (Mt.)

(1) Lowland Evergreen Rainforest **Rating: Good**

Though the forest in Irawan and Iwahig areas are relatively preserved well, lowland forest is the most endangered due mainly to agricultural development.

(2) Lowland Semi-deciduous Rainforest **Rating: Fair**

This is in the same condition as the evergreen rainforest ecosystem.

(3) Submontane Forest **Rating : Good**

The high elevation of this ecosystem is not conducive to human access. Thus it is well-preserved and seems to be enjoying its original diversity.

Irawan Valley and Iwahig Penal Colony:
Mt. Beaufort, Thumb peak, Mt. Herschel, Mt. Airy

(1) Lowland Evergreen Rainforest **Rating: Fair**

Though the forest in Irawan and Iwahig areas are relatively preserved well, lowland forest was the most endangered due mainly to agricultural development. Test excavation for minerals took place in the area and kaingin was common from 1985 to 1992 while modification of the ecosystem advanced. However, effective law enforcement has enabled regeneration.

(2) Lowland Semi-deciduous Rainforest **Rating: Fair**

The condition of this ecosystem is the same as the lowland evergreen rainforest.

(3) Submontane Forest **Rating: Good**

The only pressure was test excavations for mineral resources. However, since the activities have ceased, little disturbance has occurred.

(4) Ultrabasic Forest (on heavy-metal rich Soils) **Rating: Threatened**

Only a limited number of species can survive such soil conditions. Therefore, if vegetation is once cleared, it would take a long time for it to regenerate. Moreover, it is not suitable for agricultural production.

Puerto Princesa Bay

(1) Mangrove Forest (Brackish Water Swamp) **Rating: Endangered**

Large fish and prawn pond developments have taken place. So far, these developments have not had large impacts on the ecosystems. On the other hand, the large demand for mangrove logs in Puerto Princesa City has greatly impacted the ecosystem. C. porosus existed until recently. Catchment area of the bay is Irawan watershed forest reserve and Iwahig penal colony where forests are relatively well preserved. Therefore, if the mangrove forests were well protected, the only threat to the swamp ecosystem would be discharges from the city. The brackish water swamp functions as a buffer to protect the marine ecosystem from siltation and as a reproduction habitat for fishing resources. If this is sustained, Puerto Princesa may enjoy better fishing yields.

Honda Bay

(1) Mangrove Forest Ecosystem **Rating: Endangered**

The situation seems the same as that in Puerto Princesa Bay. To make things worse, a large portion of forests in the catchment area were totally logged from 1987 to 1992 although forest in Cleopatra's needle was preserved. In order to protect the Honda Bay marine ecosystem, the mangrove forest ecosystem should be large enough to perform its full function as a buffer zone.

Ulugan Bay

(1) Brackish Water Swamp Ecosystem **Rating: Endangered**

This ecosystem was once know to have a fully developed primary mangrove forest ecosystem, which served as very productive breeding and rearing grounds for valuable fishing resources. However, due to increasing human demand, a large area was found to be utilized by the survey.

St. Paul's Bay

(1) Lowland Evergreen Rainforest Ecosystem **Rating: Fair**

This is the only remaining large single cluster of this kind of ecosystem in Northern Palawan. The survey found distributions in the surrounding areas which may cause disturbances to ecosystems in the near future.

(2) Submontane Forest Ecosystem **Rating: Good**

Due to the higher elevation of this ecosystem, the survey was not sufficient to make a proper rating. However, in accordance with the vegetation map and information of other studies it is evaluated to be in good condition.

(3) Limestone Forest (Karst Forest) **Rating: Good**

Due to inaccessibility, little disturbance was recorded.

(4) Coastal Forest **Rating: Endangered**

Because the coastal area is the easiest point for humans to access, all the coastal forest in the Study Area has been disturbed by human activity such as plantation and agricultural development. This forest ecosystem will always be vulnerable to any kind of development.

(5) Ultrabasic Forest (Mt. Bloomfield) **Rating: Threatened**

Due to high contents of heavy metals, only a limited vegetation can grow. This means that the ecosystem is very vulnerable once disturbed. The forest has low commercial value and the soil is not productive at all. Thus, the area is not attractive for any agricultural and forestry development. The ecosystem looks fairly preserved at all. Thus, the area is not attractive for agricultural or forestry development. The ecosystem looks fairly preserved.

(6) Cave Ecosystem **Rating: Fair**

Since the completion of the road form Puerto Princesa City, this ecosystem has become a big tourist attraction. Disturbance to the down stream portion

of the underground river has been observed since the greater influx of tourists. A recent visit by PAWB researchers gave the impression that the number of swallows inhabiting the cave has decreased. A detailed survey is necessary to study the balance between human use of the cave and the need for its conservation.

Barbacan Range (Roxas)

(1) Lowland Evergreen Rainforest Ecosystem **Rating: Endangered**

Due mainly to kaingin, the once heavily forested area is seriously threatened. The last heavy rain season caused landslides in the second growth forest area and abandoned kaingin areas.

Pagdanan, Flat and Central Range (San Vicente)

(1) Lowland Evergreen Rainforest Ecosystem **Rating: Endangered**

This is probably the most productive forest area in Northern Palawan. Hence, the extensive logging of the area caused serious landslides and consequently has endangered the ecosystem. It is recommended that the logging road be closed immediately to allow for regeneration.

Lake Manguao (Taytay)

(1) Lowland Evergreen Forest Ecosystem
(Lake Margin, Stream-Valley, High Forest) **Rating: Endangered**

Logging in forest adjacent to the lake was confirmed to still be taking place. The forest around the lake is reported to have unique diversity but the ecosystem is now seriously endangered.

(2) Fresh Water Lake/Swamp Ecosystem **Rating: Endangered**

At present the water level in Lake Manguao has been gradually decreasing due to deforestation in its catchment area and to other human activities. As the only fresh water lake/swamp ecosystem, there must be numerous resources and species yet to be found. It is imperative that logging in the catchment area be stopped and that human activity around the lake/swamp area be controlled.

Apulit Island (Taytay)

(1) Limestone Forest Ecosystem **Rating: Endangered**

This steep slope limestone island which is home to the indigenous Palawan Palm, was recently developed and opened during the time of the survey as a

resort island. The development may cause small impacts to the ecosystem. At present, the ecosystem seems to be fair but close monitoring of the indigenous flora and fauna species should still be implemented.

Mt. Calauag (Taytay)

(1) Semi-deciduous Forest Ecosystem **Rating: Endangered**

Though the mountain exists on rather poor soil, evergreen rainforest developed. However, recent agricultural development and logging has endangered the ecosystem.

Malampaya Sound

(1) Brackish Water Swamp Ecosystem **Rating: Endangered**

The fully developed mangrove forest once became famous for being the best quality ecosystem in the Philippines. However, due to deforestation in almost the entire catchment area, serious siltation is taking place. Continuous agricultural and aquacultural activities have also significantly degraded the primary forest.

Guinaraton, Barbacan, and Ilian Rivers

(1) Fresh Water (river) Ecosystem **Rating: Endangered**

This ecosystem is in the lest known area and therefore is home to many resources. However, the need for fresh water attracted human activity to the area and disturbance to the ecosystem began along the river line. Due to population increases, the ecosystems of three main rivers in the Study Area have been continuously disturbed. Long-term conservation plans to balance human necessity and the ecosystem conservation is now needed for these three rivers.

3. Proposed Zoning for Conservation

Zoning for conservation must serve to insure the following three principal objectives:

Principle Objective	Expected Output
1 Conserve habitat of endangered/threatened species	Indefinite existence of endangered/threatened species
2. Ensure the existence of valuable colonies/communities of flora and fauna	Indefinite existence of colonies/ communities of flora and fauna
3. Protect species and gene levels in terms of quantity and quality	Indefinite diversity and quality of species and gene levels

However, at the same time, conservation measures must give local communities opportunities to develop and enhance the livelihoods of their people. Thus, following the criteria of zoning in Man and Biosphere Program (MAB) of United Nation Education and Science Organization (UNESCO), core and buffer zones must be wide enough to ensure the above principal.

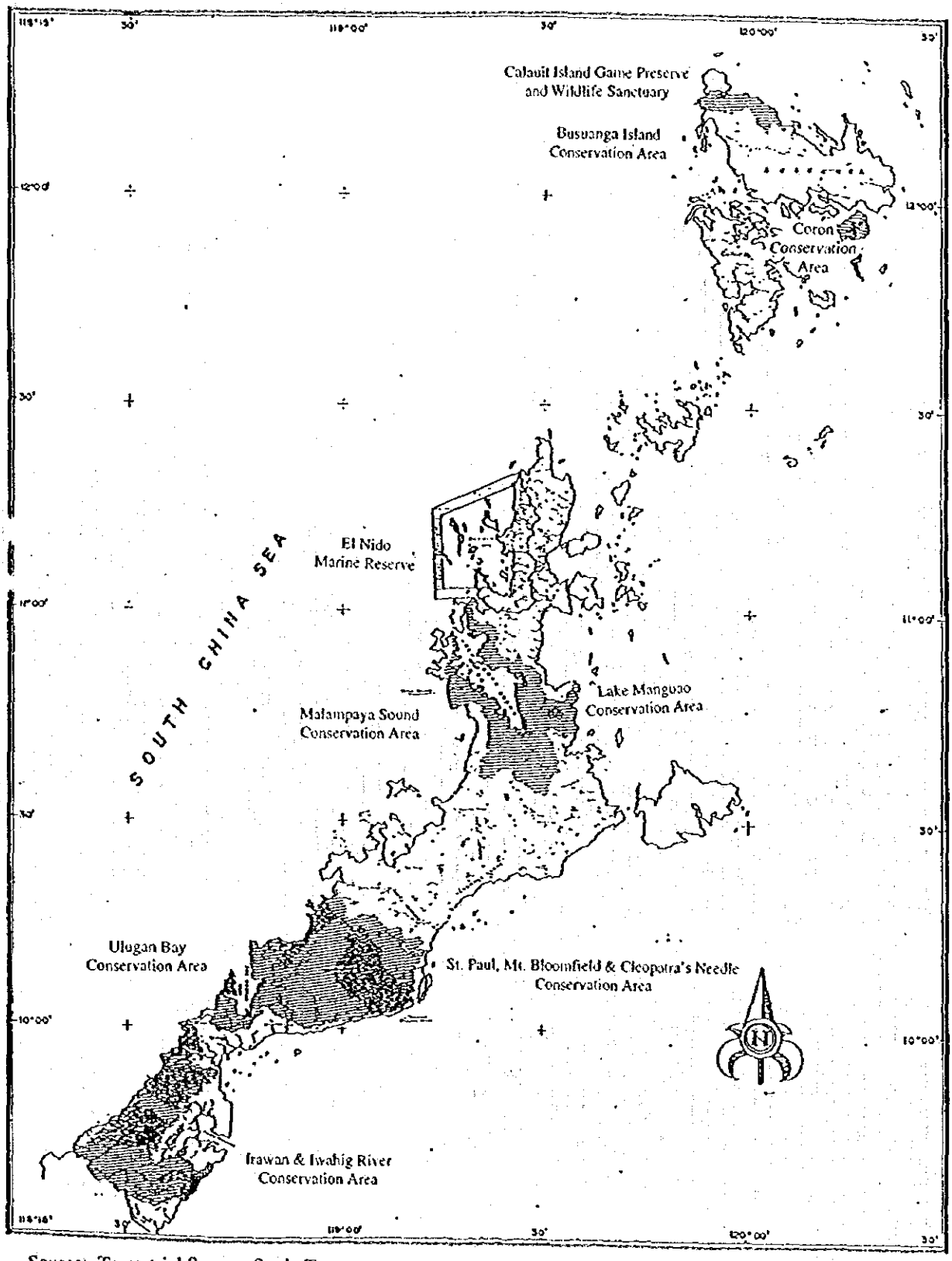
Ecosystems within northern and southern Palawan are both distinctly different in geological origin and consequently, the flora and fauna they maintain. As the core zone in Ecologically Critical Network (ECAN) Zoning covers only single ecosystems of high elevation submontane (mossy) forest, it does not match the objectives of the Philippine Strategy for Sustainable Development, and Strategic Environmental Plan (SEP), Biodiversity Convention, CITES, Ramsar Convention and other environment conservation principals and programs. Hence, ECAN zoning must be revised to incorporate the concept of ecosystem conservation.

3.1. Conservation Area

Recent intensive logging substantially degraded lowland and mid-elevation forest ecosystem. Following this event, subsistence farmers mainly from other parts of the Philippines migrated along logging roads and started kaingin farming. Due to the geological nature of Northern Palawan (very thin top soil and rocky layers with holes), agricultural production was not as high as in other areas. Therefore, farmers needed wider areas to sustain their livelihoods. Thus, even mid and high elevation forests were desecrated.

Aside form Proclamation 219 that declared almost all of Palawan a protected area and which has been highly ineffective, the present national parks and protected areas are apparently not covering all ecosystems and are not wide enough to house viable populations of the element species of Palawan. The aerial and field surveys identified that low and mid elevation forest ecosystems were mostly endangered. Therefore, the conservation areas should cover the remaining old growth forests at low and mid elevation as much as possible. Proposed high priority conservation areas, as delineated through secondary data and the survey, are shown in Figure 3-1 and Table 3-1.

Figure 3-1 Conservation Area and Possible Zoning



Source: Terrestrial Survey, Study Team

Table 3-1 Proposed High Priority Conservation Areas, and Established Protected Areas

Island	Municipality	Name	Conserving Ecosystem
(Proposed High Priority Conservation Area)			
Busuanga	Coron	Coron Island Conservation Area	Limestone Forest, Brackish Water Lake
	New Busuanga	Busuanga Conservation Area	Mangrove Forest (ecological restoration)
Mainland of Palawan	Puerto Princesa City (PPC)	Iwahig and Irawan Conservation Area	Lowland Evergreen Rainforest, Semi-deciduous Rain Forest, Submontane Forest, Ultrabasic Forest, Coastal Forest,
	PPC, Roxas, San Vicente	St. Paul and Cleopatra Needle Conservation Area	Lowland Evergreen Rainforest, Lowland Semi-deciduous Rainforest, Submontane Forest, Limestone Forest, Ultrabasic Forest, Coastal Forest, Fresh Water (river), Cave
	PPC	Ulgan Bay Conservation Area	Brackish Water Swamp
	Taytay	Lake Manguao Conservation Area	Fresh Water Lake/Swamp
		Malampaya Sound Conservation Area	Brackish Water Swamp
(Established National Parks and Protected Area)			
Busuanga	New Busuanga	Calauit Game Preserve and Wildlife Sanctuary	
Mainland of Palawan	PPC	St. Paul Subterranean National Park	Cave, Limestone forest
	PPC	Palawan Flora, Fauna and Watershed Forest Reserve	(fresh water)
	El Nido	El Nido Marine Reserve	Marine Ecosystem
		Bucuit Watershed forest Reserve	(fresh water)
(Proposed Conservation/Restoration Areas)			
Busuanga	Coron	Butobo bay and Coron Bay Catchments	Remnant and Regenerating Forest
Culion	Culion	Halsey Harbor Catchment Reforestation	Remnant and Regenerating Forest
Mainland of Palawan	PPC	Honda Bay	Mangrove Forest (Brackish Water Swamp)
		Puerto Bay	Mangrove Forest (Brackish Water Swamp)
	San Vicente	Pagdanan, Central and Flat Range	Lowland Evergreen Forest
	Roxas	Guinaraton, Barbacan, Taradunga River Catchment	Lowland Evergreen Forest, Fresh Water (river)
	Dumaran	Ilian River Catchment	Lowland Evergreen Forest, Lowland Semideciduous Forest, Fresh water (river)

Source: Terrestrial Survey, Study Team

1) Conservation Areas in the Calamian Islands

The spectacular Coron Island whose ecosystem has been little studied nor disturbed, must be set as a high priority conservation area.

The catchment of well-developed mangrove forest between Busuanga and Calauit islands should be preserved. The Busuanga conservation area will serve for a future in situ reintroduction areas for indigenous specious, especially the Calamian Deer.

The Calamian Islands which used to have unique forest ecosystems now only have small patches of remnant or regenerating forest. In order to restore the original ecosystems, the remnant or regenerating forests in Busuanga, Culion, and Linapacan islands should be designated ecosystem conservation/restoration areas.

2) Conservation Areas in mainland of Palawan

(1) Forest Ecosystem

Forest ecosystems in Iwahig Penal Colony, Irawan Valley, and St. Paul National Park are relatively well preserved at present. Furthermore, past studies indicated that St. Paul could represent the ecosystems in the northern mainland of Palawan whereas the forests in Iwahig and Irawan Valley could represent that in the south. Thus, wide enough areas of Iwahig and Irawan Valley and St. Paul National Park with Cleopatra's Needle including Mt. Bloomfield, which are basically separated by catchment line, a river line and a 100m contour, are selected as conservation areas.

Due to recent intensive use of forest ecosystem and continuing human activities, it is always advantageous to have two conservation areas where similar ecosystems occur. As for the ecosystems in Northern Palawan, the Flat and Central ranges, Mt. Ilian and Big Peak could represent lowland evergreen rainforest, semi-deciduous rainforest, and others. These areas have already received significant human modification. Therefore, they should initially be assigned as reproduction forestry areas. When circumstances allow, portions of these areas may be selected as conservation areas.

(2) Freshwater lakes/swamp ecosystem conservation area

Fresh water lake/swamp ecosystems occur in Lake Manguao whose surrounding forests have been degraded substantially over the past 10 years. As the only existing fresh water lake ecosystem, Lake Manguao and its catchment area are selected as conservation area.

(3) Freshwater River Ecosystem Conservation Area

As for fresh water river ecosystems, Iwahig, Babuyan, Langogan, Guinaraton, Barbacunan and Ilian rivers are be the major ones in the Study Area. St. Paul National Park with Cleopatra's Needle conservation area includes the Babuyan and Langogan rivers. The Iwahig area would include the Iwahig river ecosystem.

Due to the little study done on the ecosystem, Barbacunan and Ilian rivers with portions of catchment forests can be selected as second priority conservation areas for fresh water ecosystems.

(4) Brackish Water Swamp Ecosystem Conservation Area: Mainland Palawan

Malampaya Sound, Ulugan Bay, Honda Bay and Puerto Princesa Bay are the major brackish water swamp ecosystems. Due to the pressure of human activities and logging in their respective catchment areas, the ecosystems have changed gradually. The Malampaya Sound and Ulugan Bay should be given high priority as conservation areas. It should be noted that the conservation of these swamp ecosystems requires extensive restoration as the catchment areas have been deforested.

3) Established National Parks and Protected Area as a conservation area

(1) Calauit Game Preserve and Wildlife Sanctuary

Although from an ecological standpoint, this sanctuary is significantly disturbed, with the establishment of a conservation zone, it can be fully utilized as a unique zoological park and tourism attraction. The beach ecosystem is marine turtle nesting grounds which is perhaps the only drawback to its utilization. However, with proper management, disturbance of nesting sites can be avoided.

(2) El Nido Marine Reserve

As aforementioned, the reserve needs to revise its zoning plan to conserve the marine ecosystem even though the area coverage of the reserve is sufficiently environmentally systematic. The only constraint on the reserve is the deforestation of the Bacuit Bay catchment. Reforestation in the catchment should be done as quickly as possible in order to avoid permanent modification of the marine ecosystem.

3.2. Zoning in Conservation Areas

Considering catchment areas and the continuity and extent of ecosystems occurring in the high priority conservation areas, a core zone which can sustain viable populations of all component flora and fauna species must be identified in. Sufficient buffer zones which conserve core zones well must also be selected based on the characteristics of the ecosystems in the respective core zones.

1) Calamian Islands

(1) Coron Island Conservation Area

The quality of the ecosystems available here is rare not only in Palawan but also all over the Philippines. Until proper management is implemented, the largest main catchment of the island should be strictly protected as a core zone. Moreover, declaration of the whole island as a strictly protected national park should be considered seriously and a management and study plan should be prepared.

2) Busuanga Ecosystem Conservation/Restoration Area

This conservation areas has dual objectives: To conserve well-developed mangrove forest between Busuanga and Calauit islands, and to restore the original ecosystem in Busuanga Island.

Calauit Wildlife Sanctuary does not serve as a conservation area because of the introduction of African wildlife. Therefore, the less populated catchment which is adjacent to the sanctuary is to be designated for mangrove forest conservation. While conserving the forest with careful planning and management, regeneration of original vegetation should take place gradually. When the ecosystem recovers so that it may hold enough indigenous species and enforce conservation management, reintroduction of original fauna elements, such as Calamian Deer, should be carefully planned.

3) Mainland of Palawan

(1) Iwahig and Irawan Valley Conservation Area

This conservation area has low up to high elevation evergreen forest, mossy forest, ultrabasic forest, and freshwater (river) ecosystems. In order to conserve viable populations of component species in the ecosystems, the core zone should cover coastal area and low to high elevation in different soil condition areas.

Mt. Hershel and Mt. Airy which are above 400m in altitude and have a corridor between them at 300m altitude, are to be core zones to conserve ultrabasic forest ecosystems. Between the northwest stream of the Iwahig

and Irawan rivers covering Mt. Beaufort above 300m, it to be a core zone where ecosystems and species are diversified. The area between Tagnarunis River and Tagduan River in Triple Top Range is to be a core zone since different components of ecosystem were recorded around those areas.

(2) St. Paul Bay & Cleopatra's Needle Conservation Area

This conservation area has coastal forest, lowland evergreen forests, semi-deciduous forest, submontane and limestone forest, ultrabasic forest as well as freshwater rivers and the cave ecosystem. In order to conserve all elements occurring in the area, three river catchment areas (Puga, Pangaguman, Langogan), Mt. St. Paul and Mt. Bloomfeild with corridors on their ridges are to be core zones. Mt. St. Paul represents limestone forest ecosystems, Mt. Bloomfield represents ultabasic forest ecosystems, and other areas in the core zone well represent lowland evergreen rainforest, semi-deciduous rainforest and submontane forests. Conservation of the cave ecosystem shall be further studied to balance its tourism utilization and conservation.

(3) Lake Manguao Conservation Area

As the only fresh water lake/swamp ecosystem in the Study Area, as much area as possible is to be assigned core zone. Thus tentatively, all freshwater and swamp area is to be core zone. All catchment area is to be assigned as buffer zone. In light of ongoing illegal logging activities and other uncontrolled developments, very strict guidelines should be imposed on the use of this buffer zone.

(4) Malampaya Sound Conservation Area

The aim of this conservation area is to conserve the brackish water swamp ecosystem. Therefore, large clusters of mangrove forest is to be core zone and its catchment area buffer zone.

The most recent survey found the catchment area of the swamp to have little natural vegetation. This means a significant amount of soil is burying the swamp. If this continues, not only the swamp area but also shallow areas will be silted up soon. Malampaya Sound has been serving as a breeding and rearing habitat for valuable fishing resources such as crustaceans, squid and groupers for the huge marine area. These events will eventually result in significant decreases in fishing yields. Therefore, very strict catchment management and a reforestation program to stop siltation should be established.

(5) Ulugan Bay Conservation Area

This area is almost the same as the Malampaya Sound conservation area. However, Tuft and Banog hills have unique ultrabasic forests and therefore, are to be a core zone. The rest of the bay catchment area is to be designated as buffer zone.

The condition of the bay catchment seems to be almost the same as that of Malampaya Sound. However, the bay is not only deeper but is also wider than the sound. Nevertheless, the same type of strict bay catchment management and reforestation program should be put into place.

3.3. Proposed Ecosystem Restoration

The terrestrial ecosystem in Palawan has been degraded substantially during past 10 years. Apparent causes of the degradation are intensive logging, kaingin, forest fires and aquaculture development. Laws for environment conservation which prohibit these harmful activities have been enacted in the Philippines for long time. However, difficulties in the enforcement of these laws have made them largely ineffective.

The programs for terrestrial ecosystem conservation should be based on the above facts and must remain effective even under certain conditions. Ecosystems within priority areas that are in need of restoration are preliminarily identified as conservation/restoration areas as shown in Figure 3-2.

1) Busuanga, Culion, and Linapacan Islands

Kaingin and continued logging must be strictly prohibited in these islands until the development of full forests ecosystems occurs. Catchment areas where remnant forests are remaining or regenerating are to be reforested with the best of efforts in order to conserve the terrestrial ecosystem, and for future human needs and possible development.

2) Northern Mainland Palawan

(1) Puerto Princesa

Puerto Bay Brackish Water Swamp

Forests in the catchment area are identified as high priority conservation areas. Control of development activities is needed to conserve the brackish water ecosystem. Once the mangrove forest is developed and restored to its original state, terrestrial and marine ecosystems will acquire continuity. This continuity will make ecosystems healthier and stronger. Finally, high production of fishing resources in the bay will resume.

Honda Bay Brackish Water Swamp

It is difficult to control the development of the catchment in this area due to the size of the bay and the extent of human population. Only the resumption of a fully developed mangrove forest ecosystem will enhance the terrestrial and marine ecosystems.

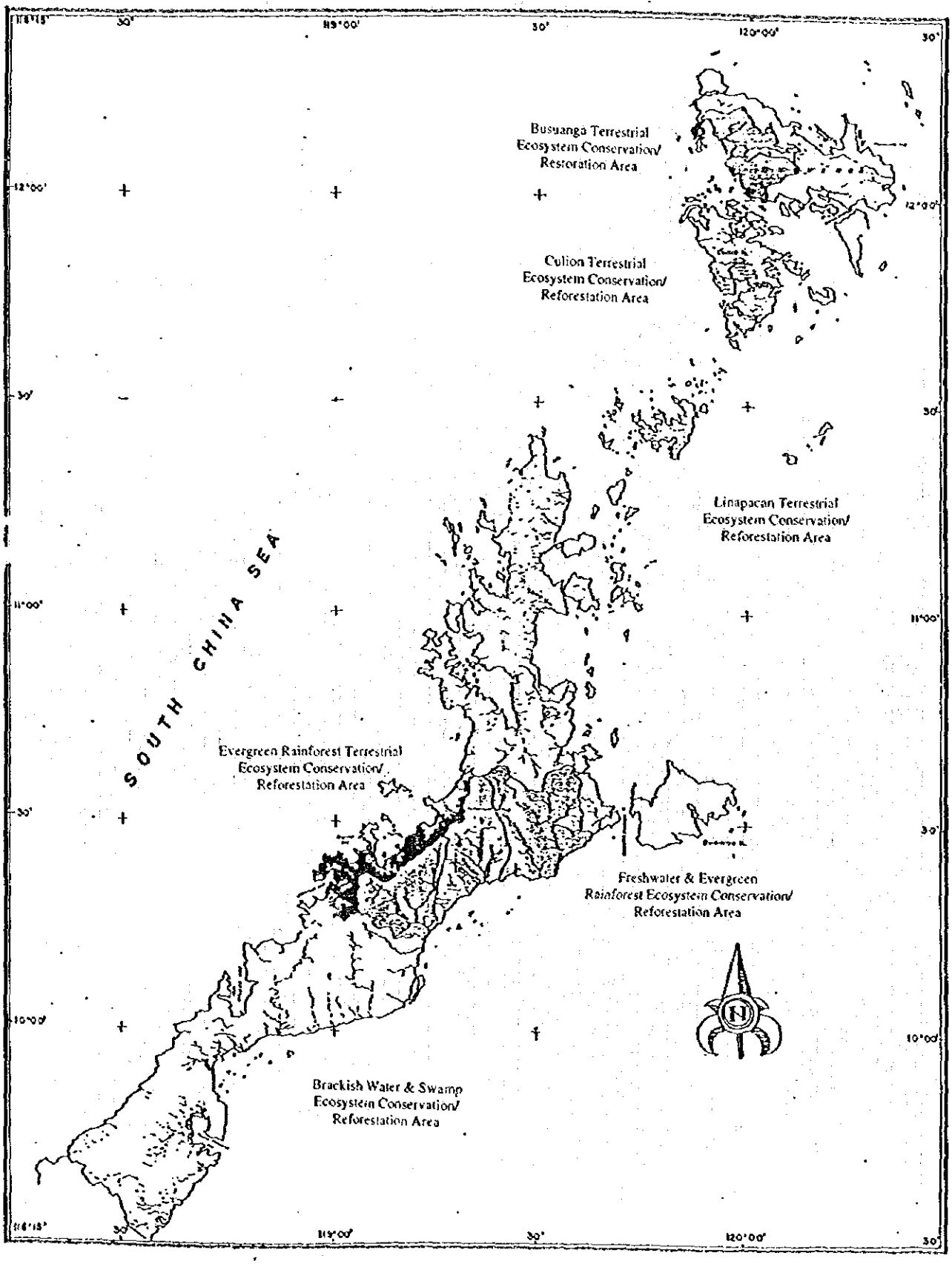
(2) Roxas, Dumaran

The major freshwater ecosystems of Guinaraton, Taradungan, Barbacan and Ilian Rivers and their respective catchment areas are disturbed to a certain level. It would be advantageous to restore the river ecosystems with catchment reforestation for the needs of future generations and for ecological conservation.

(3) San Vicente

The reforestation of the forest ecosystem is and urgent issue for freshwater resources in Roxas and San Vicente. A good management program for the remnant forest ecosystem should be implemented. The first possible step would be to close down all logging roads in order to avoid further destruction. Them reforestation in areas where it is feasible shall be done with the species occurring in those areas.

Figure 3-2 Proposed Ecosystem Restoration Areas



Source: Terrestrial Survey, Study Team

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