THE CONSERVATION STATUS OF BIOLOGICAL RESOURCES IN THE PHILIPPINES

A REPORT BY THE IUCN CONSERVATION MONITORING CENTRE

Prepared by Roger Cox

for the International Institute for Environment and Development (IIED).

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SUMMARY

1. This report discusses the conservation status of the biological resources of the Philippine archipelago. These include a wide variety of tropical moist forest formations, a rich and diverse flora and fauna with a high proportion of endemic species, and several important marine and coastal ecotypes.

2. Tropical forests originally covered almost 95% (28.5 million ha) of the total land area of the Philippines but human population density is now very high on all the major islands (with the exception of Palawan) and much of the natural vegetation has been destroyed or modified by slash-and-burn cultivation. This form of forest clearance is not controlled in any way and is mostly illegal. Estimates of the rate of habitat destruction vary but official figures indicate that in 1981 there were only 2.2 million ha of undisturbed virgin rain forest in the Philippines and that these were being felled at a rate of approximately 170,000 ha per annum. Where native vegetation survives it consists mainly of mixed dipterocarp, tropical montane, mossy (subalpine), molave and pine forest formations.

3. The forests of the Philippines support a fauna that is characterized by a high degree of species endemism. For example, of approximately 89 species of indigenous non-flying land mammals identified from the archipelago at least 70 (or 78.7%) are found nowhere else in the world. The conservation status of most Philippine animals is poorly documented but in view of the substantial loss of natural habitats which has occurred in recent years many species are now probably vulnerable to extinction. Surveys are urgently needed in several parts of the country (including some of the smaller islands of the archipelago) to assess the current distribution and status of much of the Philippine wildlife.

4. Important Philippine coastal and marine environments include mangroves, coral reefs and seagrass beds. Vast areas of mangrove forest have been cleared for fishponds and for use as commercial, industrial and human settlement sites. By 1981, total mangrove forest area had been reduced from about 450 000 ha to approximately 239 000 ha of which only 34% could be described as old-growth forest.

5. More than 70% of Philippine coral reefs, which cover an area estimated at 27 000 sq. km, now have less than 50% living coral cover. Slow growing and highly sensitive to disturbance, reefs have been extensively damaged by sedimentation, particularly in those localities around the larger islands where deforestation has taken place on a massive scale. Destructive fishing methods and the indiscriminate collection of ornamental coral for trading purposes have also had a serious impact.

6. The conservation status of Philippine seagrass beds, which are an integral component of many shallow coastal marine communities, is satisfactory and they are generally not threatened except near urban areas, mining sites and places where siltation and turbidity have increased as a result of land-based activities.

7. A large number of sanctuaries and marine parks have been established to protect the biological resources of the Philippines. At least 60 national parks have been created for the conservation of the country's terrestrial environment but these cover only 1.3% of the Philippines' total land area and although the legal status of these reserves is quite suitable for their declared management objectives, all habitat types are inadequately represented. The present network of protected areas should be expanded to include larger areas of all vegetation types, particularly mixed dipterocarp and other lowland forest formations.

8. Many protected areas receive little effective protection and most exist only on paper. At least two-thirds of Philippine national parks now contain human settlements and 27% of their total land

surface represents disturbed or exotic vegetation. Furthermore, park boundaries are not demarcated; law enforcement is lacking and staff are poorly paid and under-trained.

9. The protected area system is currently under review by the Haribon Foundation but there is unlikely to be any improvement in the levels of protection afforded the Philippine fauna and flora without a significant increase in the amount of funding currently available for park administration, a widespread campaign to gain public support and the establishment of a well-trained unit of forest guards and wildlife officers.

ACKNOWLEDGEMENTS

A great many people have contributed in a variety of ways to the preparation of this report. IUCN would particularly like to thank the following people and organizations for responding to requests for advice and information: Jesus B. Alvarez, Jnr. (Philippine Protected Areas and Wildlife Bureau), Walter C. Auffenberg, Wim Bergmans, Karen Bjorndal, John Burton, Edgardo Gomez, Haribon Foundation, Ian Grimwood, Dennis Johnson, F. Wayne King, Alan Leviton, Helene Marsh, Don McAllister, Andrew Podzorski, Colin Rees, Roberto Rubio, Roy Tsuda, Alan White and Roland Wirth.

A special debt of gratitude is owed to Dr Larry Heaney who permitted the IUCN to have advance access to material contained in a draft manuscript on the distribution and status of Philippine land mammals. Data provided to the International Council for Bird Preservation by Dr Robert Kennedy proved invaluable in assessing the conservation status of species in the Philippine avifauna.

Finally, Paul Goriup acted as advisor to this project and his assistance is gratefully acknowledged.

1. INTRODUCTION

1.1. BACKGROUND

The Philippines are an archipelago of almost 7100 islands of which only slightly more than 450 exceed 2.5 sq.km in area. Situated between 5° and 22° N Lat. and 117°E and 127°E Long., the archipelago has a total land area of almost 300 000 sq. km (30 million ha), approximately 27 million ha of coastal waters and 18 000 kms of coastline (Figure One). This diverse environment supports a wide range of terrestrial and marine ecosystems which include coral reefs, seagrass beds, mangroves and at least five broad types of tropical moist forest formations (FAO/UNEP 1981).

The entire archipelago was once covered by a dense and complex mosaic of tropical rain forest formations but much of the natural habitat has now been greatly modified by the actions of man. Vast areas of forest growth have been destroyed and either replaced by cultivated fields or simply allowed to regenerate to low productivity scrub and tropical grassland. In some areas complete ecosystems, including those which once provided essential vegetative cover for upland catchment areas, have been indiscriminately logged by timber concessionaires or converted by a rapidly expanding rural population using a system of shifting agriculture based on fire clearing techniques. Many coastal and marine ecosystems have also undergone conversion in the development of aquaculture, and as a result of pollution and siltation. Mangrove forests have been extensively cut to produce high quality charcoal for fuel and to construct brackish-water fishponds while coral reefs have suffered greatly through the widespread use of dynamite and poisons and from destructive muro-ami fishing techniques.* The rapid degradation of both the marine and terrestrial environments of the Philippines has been responsible for a number of species extinctions and in many areas the unique faunal populations of the region have been devastated.

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* Muro-ami fishing involves the use of poles which are pounded on the reef to scare fish sheltering in coral crevices into large drive-in nets.

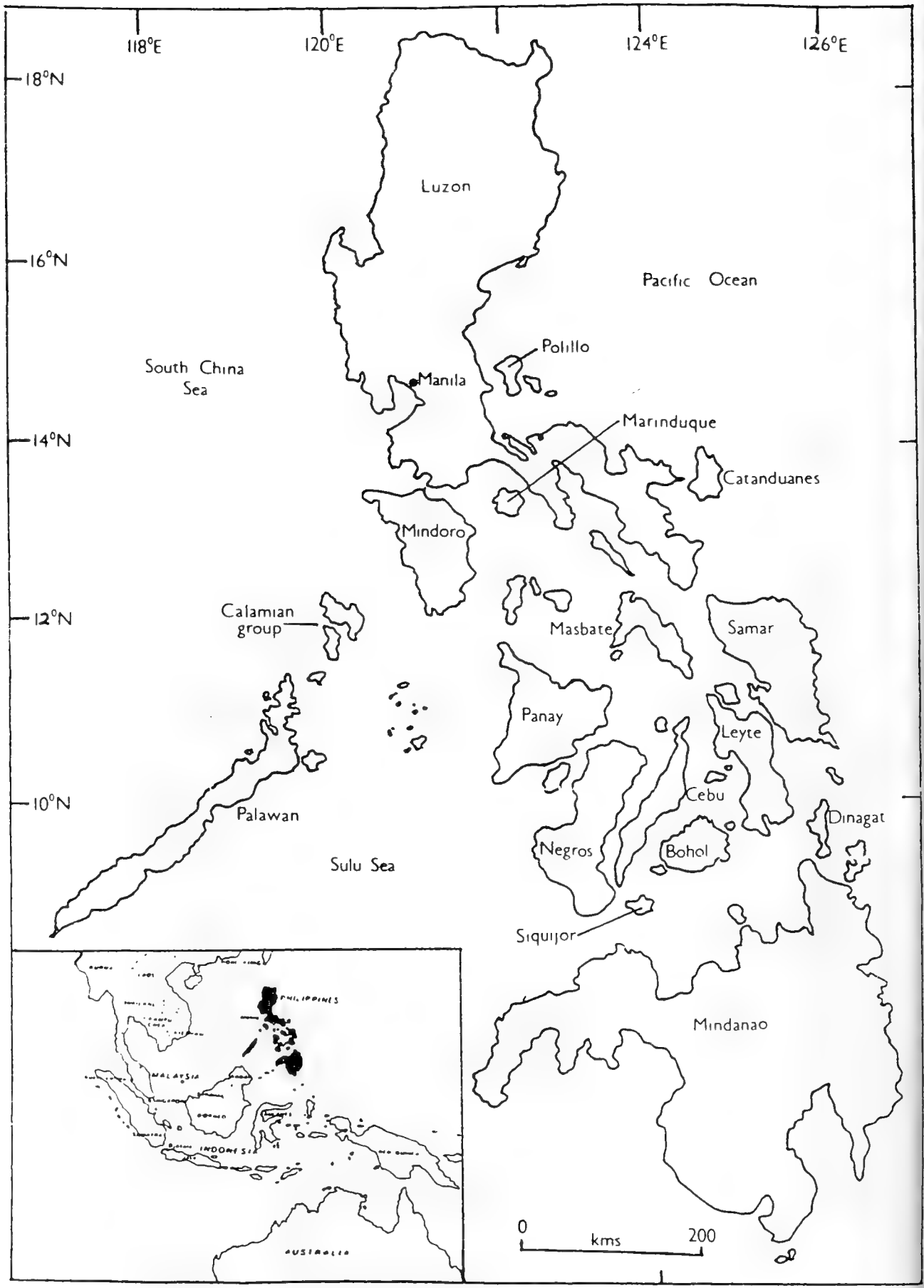

Figure One. The Philippine Archipelago

1.2 OBJECTIVES

The main objective of this report is to summarize and assess the current conservation status of the biological resources of the Philippines. The vast majority of native terrestrial species in all faunal groups appear to be dependent on forest habitats, and Section 3 includes a summary account of the nature and extent of the main forest formations present in the archipelago. This section also includes data on the causes and estimated rates of habitat destruction; known threatened plant sites, and threatened plant taxa. Critical habitat areas requiring future research, survey and conservation effort are identified on the basis of recommendations provided by IUCN's Threatened Plants Unit at Kew and from information obtained through correspondence.

The tropical moist forest formations of the Philippines have been extensively modified by logging, mining and human agricultural activities. In many areas the soil protection functions of forest habitats have been destroyed, causing increased sediment loading of streams emanating from the exploited forests that has adversely affected important coastal and marine environments (see Section 4). Forest conversion activities have also affected many Philippine bird and animal populations, the great majority of which require the presence of undisturbed habitats for their survival. These communities cannot survive in the simple secondary growth that develops after forests have been felled. Those species of the Philippine fauna that are known to be threatened by deforestation and other extraneous factors such as hunting are identified in Section 5. Reliable, contemporary data on the conservation status of many faunal populations (with some notable exceptions) are lacking, however, and so attention is also drawn to those species which are potentially the most vulnerable to habitat destruction. Section 6 of this report includes an assessment of the adequacy and effectiveness of the Philippine national park system in protecting the country's unique biological heritage.

2. METHODS AND COMPILATION OF DATA

The information included in this report is derived primarily from literature and correspondence in the possession of the IUCN's Conservation Monitoring Centre at Cambridge (Fauna) and Kew (Flora). In view of the extremely rapid rates of habitat destruction in the Philippines however, much of this information is now outdated and where possible it has been supplemented with data obtained through correspondence with relevant government departments, institutions and scientists who have had recent fieldwork experience in the region. A list of personnel who were contacted for assistance in this regard appears in Appendix Six.

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3. FLORA, VEGETATION AND FOREST COVER

3.1 DESCRIPTION OF THE NATURAL VEGETATION

The Philippine flora is composed principally of forest plants and has affinities with those of Borneo, peninsular Malaysia, the Sino-Himalayan region and Australia. Endemism is estimated at about 27%, with at least 33 endemic genera (IUCN/UNEP 1986). There are some 8000 species of flowering plants in the Philippines of which over 3000 are arborescent species that can attain a diameter at breast height of 30 cm or more (FAO/UNEP 1981). In addition there are about 900 fern species (Parris 1985).

3.1.1 THE FORESTS

It is convenient to subdivide the forest vegetation of the Philippines into five very broad formations: mixed dipterocarp, tropical montane, mossy (subalpine), molave and pine forests. The following descriptions are based mainly on a report by FAO/UNEP (1981).

i) Mixed dipterocarp forests: These occur generally up to an elevation of approximately 800 m on well drained soils and on the lower slopes of mountains in localities where the dry season is not pronounced. The family Dipterocarpaceae is represented by approximately 50 species, belonging to eight genera. The more common dipterocarp species include: apitong Dipterocarpus grandiflorus, hagakhak D. validus, tangile Shorea polysperma, red lauan S. negrosensis, almon S. almon, mayapis S. palosapis, yakal S. astylosa, guijo S. guiso, and white lauan Shorea contorta. The composition of dipterocarp forests shows considerable variation depending upon local site factors. On both the larger and the smaller islands there are many microclimatic variations in precipitation and groundwater conditions within short vertical and horizontal distances which are crucial to the composition of particular associations within the broad grouping of dipterocarp forests. Four sub-formations are recognized on the basis of species dominance. They are 'true' lauan; lauan-apitong; yakal-lauan; and lauan-hagakhak. Dipterocarp forests provide the bulk of the timber for the country's log export industry as well as most of the wood required for domestic building constructon and infrastructure development.

ii) Tropical montane forests: Tropical montane forests occur in the areas extending from the upper limits of the mixed dipterocarp forest formations to the lower limits of the pine or mossy (subalpine) forest types. The forest composition is mixed and the undergrowth is prolific. Rattans, palms, bamboos and epiphytes are numerous. Tangile Shorea polysperma and oaks Quercus spp. are the main tree species but Hopea, Vatica, Agathis, Cinnamomum, Tristania and Eugenia species are also common.

iii) Mossy (subalpine) forests: Mossy forests are found in the high mountainous regions of the Philippines at an altitude ranging from 1000 to 2950 m a.s.l. (Ramoran 1980). This montane forest type consists of a stunted tree vegetation that is often clothed with clinging mosses, liverworts, lichens, epiphytic herbs and ferns. In the Central Cordillera of northern Luzon plant families commonly occurring in mossy forest formations include Fagaceae, Melastomataceae, Podocarpaceae,

Myrtaceae, Euphorbiaceae, and Lauraceae (Penafiel 1980). Mossy forests have little commercial value but they have an important role to play in ensuring watershed stabilization.

iv) Molave forests: Molave forests occur in regions with a very pronounced wet and dry season and are usually associated with the presence of well drained, limestone-derived soils. The molave tree Vitex parviflora, a member of the teak family, is the dominant species from which the whole forest association takes its name. The woods of the molave forest trees are noted for their natural beauty and durability but since these forests are easily accessible - they usually occupy the areas immediately behind the beach woodland or mangrove forest where climatic conditions are too dry for dipterocarps - most have now been felled.

v) Pine forests: Two species of pine forming pure stands are found in the Philippines. They are the Benguet pine Pinus insularis and the Mindoro or tapulau pine P. merkusii. Benguet pine forests occur in regions with distinct wet and dry seasons at elevations between 700 and 1800 m a.s.l. The two known tapulau pine forests occupy an area mainly between 100 and 500 m a.s.l. Grasslands are an integral part of the pine forests and most stands of pine occur as groves on grass meadows. The Benguet pines are used as mining timbers and for general construction purposes but the tapulau pine has practically no economic importance in the Philippines.

All the forest formations of the Philippines have been considerably reduced by agricultural development and logging, and in many areas they have been replaced by tall tropical grasslands composed primarily of Imperata, Saccharum and Phragmites species. These grasslands occur on almost every type of relief from mountain summits and ridge tops to rolling hill country, plateau land and flat coastal plains. They are a minor source of thatching materials. They are also used for grazing purposes but because they are of relatively low nutritive value they provide only a very poor pastureland.

3.1.2 OTHER VEGETATION TYPES

Compared with the forests, other types of vegetation in the Philippines are relatively insignificant. However, beach woodlands, brackish-water swamplands, and freshwater wetlands add to the diversity of the country's terrestrial environment and deserve conservation attention in their own right.

i) Beach woodlands: Beach woodlands occur both in narrow bands immediately above high-tide levels where the sand dunes have stabilized and, occasionally, on the flood plains of larger rivers. The conifer Casuarina equisetifolia is often the dominant tree species. The leaf-fall from the casuarina forests is heavy and consequently the undergrowth is confined to a few semi-herbaceous vines (e.g. Wedelia biflora) and thorny bushes (e.g. Prosopis judiflora). Casuarina equisetifolia is an important source of canoe and boat-building materials. It also produces a yellow dye which can be used to colour wool and silk.

ii) Brackish-water swamplands: Brackish-water swamplands occupy areas along tidal rivers where brackish, rather than saline, water conditions prevail. This vegetation association is dominated by the nipa palm Nypa fruticans. The long fronds of the nipa palm are widely used for roofing purposes and in areas close to dense settlements it is usually absent (unless under cultivation) because of indiscriminate harvesting.

iii) Freshwater wetlands: Philippine freshwater wetlands cover a total area of approximately 114 000 ha (Alvarez, not dated). Most are seasonal in character and during the dry season present extensive mud flats. In general they are created by the flooding of large rivers. The vegetation of these areas is composed mainly of low-growing marsh plants and tall reed-like grasses. In the southern part of the archipelago the sago palm Metroxylon sagu is abundant in freshwater swamps at low altitudes and is a valuable source of starch. The following wetlands have been identified as priorities for conservation action (Alvarez, not dated).

a) Candaba Marsh, Northern Luzon

Candaba Marsh (500 ha) is an alluvial floodplain subject to seasonal flooding. It is an important wintering station for thousands of migratory waterfowl but water is regularly abstracted in large quantities for irrigation purposes, and parts of the floodplain have been converted into fishponds. Watermelons are cultivated on the floodplain during the dry season and recreational hunting is common.

b) Laguason Marsh, Mindanao

Laguason Marsh is an extensive inland freshwater system covering almost 30 000 ha. Like the Candaba Marsh it is a winter refuge for many migratory bird species but large areas have been reclaimed for fish farming and agriculture.

c) Naujan Lake, Eastern Mindoro

This lake has a total area of 10 000 ha In some areas large patches of water lotus extend 100 m from the shore into the body of the lake. 2000 ha of marsh grasses provide an excellent haven for resident and migratory species of waterfowl. The whole ecosystem is threatend by the establishment of fish cages and the construction of fish ponds adjacent to the lake.

3.2 CONSERVATION STATUS OF THE PHILIPPINE FLORA

3.2.1 INTRODUCTION

Tropical forest formations originally covered almost 95% (28.5 million ha) of the total land area of the Philippine archipelago but they have now been extensively modified and reduced in size. There are many published estimates of the extent of the remaining forested areas in the Philippines but these are based on different definitions of forest cover and on different sources of information extracted over different periods of time so overall synthesis of the existing situation is difficult. Official statistics indicate, however, that there were only

2.2 million ha of undisturbed rain forest in the Philippines in 1981 (BFD 1981) and that these forests were being felled at a rate of approximately 170 000 ha per annum (Alvarez 1984).

The area covered by virgin dipterocarp formations in 1981 was probably no greater than one million ha while unmodified mossy forests occupied an area of 331 000 ha, pine forests about 195 000 ha and tropical montane forest formations almost 600 000 ha (BFD 1981). The extent of molave forest ecosystems is not recorded. The approximate location of forested lands with a crown cover of at least 40% is shown in Figure Two.

3.2.2 CAUSES OF HABITAT DESTRUCTION

There are two principal causes of deforestation in the Philippines. They are logging and conversion to agricultural lands by illegal occupants.

i) Logging: Logging operations entrusted entirely to private entrepreneurs through a system of licences, leases and permits have contributed substantially to the overall decline in the country's forest resources. Particularly intensive logging took place in the Philippines from the end of the Second World War until the early 1970s when heightened conservation awareness prompted an initiative to curb timber exports through a variety of forest protection ordinances. Logging was banned in parts of Luzon, Catanduanes, Masbate, Leyte and Negros as well as on all small islands with an area of less than 50 000 ha but effective implementation of the law has been limited by short-term economic considerations and illegal timber smuggling continues to be a problem. In 1981, for example, it was estimated that the volume of logs smuggled to Japan exceeded one million cubic metres (NEPC 1982).

ii) Forest conversion by illegal occupants: The most widespread form of forest clearance is caused by rural people and unemployed villagers or town-dwellers who practise a type of shifting cultivation known as kaingin. It is estimated that between 800 and 1400 sq. km of forest (including previously logged forest) are destroyed annually by

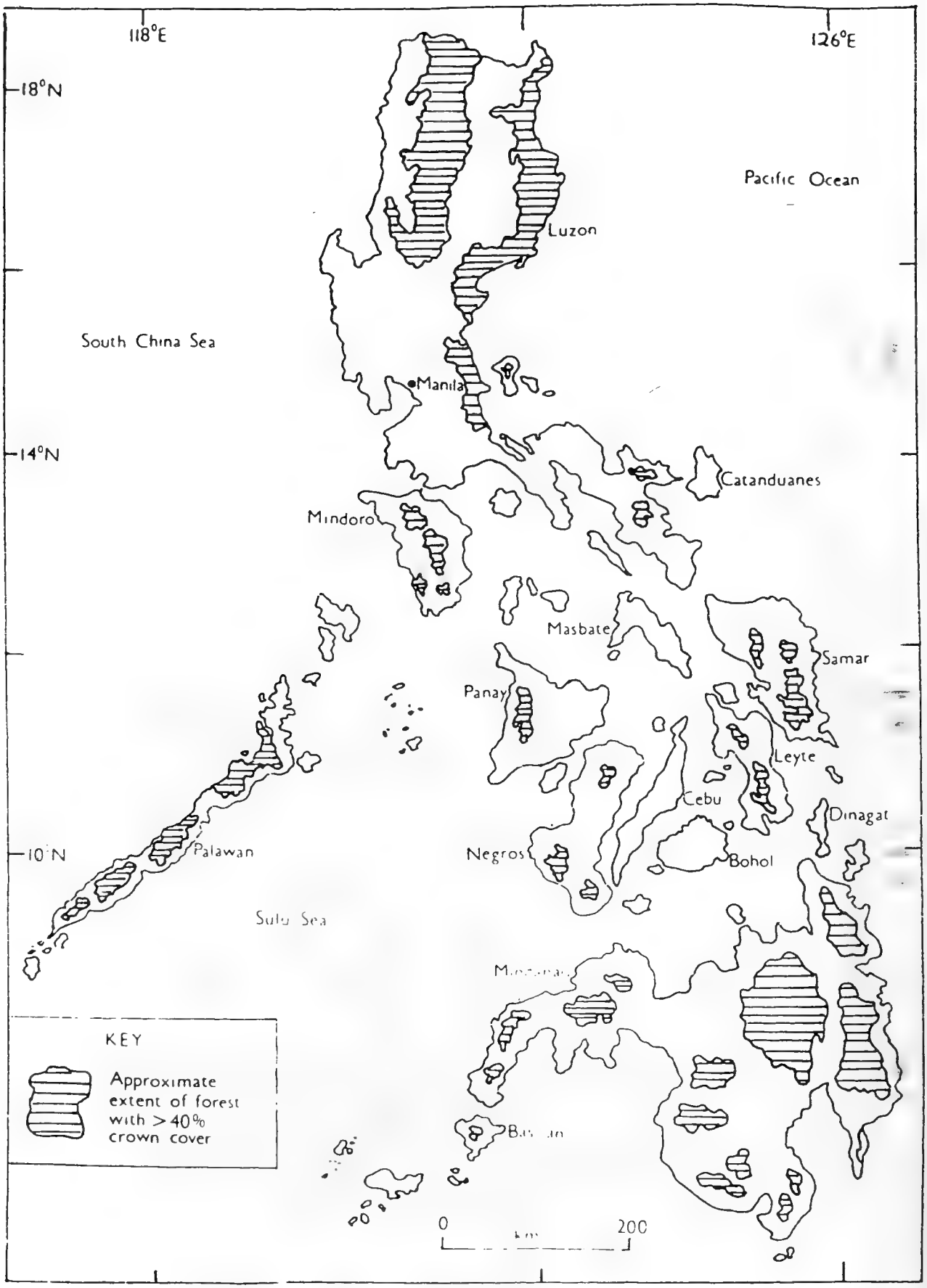

Figure Two. Approximate extent of Philippine forest cover (Adapted from Revilla 1986)

shifting agricultural practises in the Philippines (Myers 1980). This form of forest clearance is not officially controlled in any way and is mostly illegal. It is encouraged by the widespread belief that people have a traditional right to settle on a piece of land of their own, that forest land is available to all, and that traditional rights of ownership still apply to many of the forested areas in spite of the land classification policy initiated by the Government.

A variety of other factors has also contributed to the general decline in the status of the Philippine vegetation. These include the widespread overcollection of ornamental plants, particularly orchids and aglaonemas, and the commercial harvesting of minor forest products such as rattan. Rattan serves as the main raw material in the manufacture of cane furniture. In 1981 foreign exchange earnings generated by the rattan industry amounted to US$45.9 million and rattan furniture accounted for 52.6% of total furniture exports. The rapid development of the cane furniture industry in the Philippines has adversely affected the rattan resource base in some forest areas and the country is already having to import rattan poles from Indonesia. The National Rattan Corporation has established plantations with the assistance of the private sector in Bislig (Mindanao) and the Saba-a river basin (Leyte) but these two projects are still in the initial stages of implementation.

3.2.3 THREATENED PLANT SPECIES

The forest ecosystems of the Philippines support at least 12 000 species of flowering plants, pteridophytes, bryophytes, algae and fungi. Of these, approximately 3500 are endemic (Madulid 1982). Many are threatened by the intense demand for forested land generated by logging companies and shifting cultivators. Two lists of Philippine plant species important for conservation are presented in the Resource Book which accompanies this report. These lists are the latest print outs from the IUCN Threatened Plants Unit database.

LIST ONE: A preliminary list of endemic rare and threatened plants of the Philippines.

This list includes those endemic species which have so far been identified as Extinct (Ex), Endangered (E), Vulnerable (V), Rare (R), or Indeterminate (I) and which have been incorporated into the IUCN database.* It therefore excludes taxa which are 'not threatened' (nt) or which are threatened in the Philippines but widespread elsewhere (see below). The list is derived both from recently published accounts of threatened species and from data supplied by Dr Benito Tan and Dr Domingo Madulid. It is only complete for Cyatheaceae (tree ferns), Cycadaceae (cycads) and the genus Nepenthes (pitcher plants). There are many other endemic species, orchids in particular, for which the TPU has no conservation data. Dr Dennis Johnson is currently engaged in a WWF Project on the Utilization of Palms in S.E. Asia; one of the outputs from this project will be a revised list of palms together with the latest IUCN categories based on recent fieldwork.

LIST TWO: List of threatened non-endemic plant taxa of the Philippines.

This list includes those non-endemic taxa which have so far been identified as rare or threatened in the Philippines. It therefore includes nationally threatened species which may be common elsewhere, as well as those species which are under threat both in the Philippines and throughout the rest of their range. As with the above list, List Two is far from complete and has not been systematically reviewed.

3.2.4 CENTRES OF PLANT DIVERSITY AND ENDEMISM

Although the IUCN database at Kew holds information on a considerable number of threatened Philippine plant species the list is not exhaustive and future botanical research will undoubtedly demonstrate

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* Full explanations of threatened species categories are provided in Appendix One.

that many other species also merit inclusion. A species-by-species approach to plant conservation is severely limited by time and manpower constraints, however, and even if it were possible to identify all the threatened species in the Philippines it would not be feasible for government agencies to initiate a policy designed to protect individual taxa. The only practical alternative is to identify centres of species diversity and endemism and species-rich plant communities which can be protected without necessarily requiring that all the component species be identified first (IUCN 1987).

The Threatened Plants Unit at Kew is preparing a book to be called Centres of Plant Diversity: A guide and strategy for their conservation. It will include approximately 150 botanical sites worldwide which are considered to be of top priority for conservation action (IUCN 1987). The criteria for inclusion of sites and vegetation types in the book will be based principally on a requirement that each must have one of the following two characteristics:

1. The site is evidently species-rich, even though the total number of species present may not be accurately known;
2. The site is known to contain a large number of species endemic to it.

The following characteristics will also be considered in the selection process:

a. The site is threatened or under imminent threat of large scale devastation.
b. The site includes a diverse range of habitat types.
c. The site contains a significant proportion of species adapted to special edaphic conditions (e.g. limestone and ultrabasic floras).
d. The site contains an important gene pool of plants of value to man or plants that are potentially useful.

The term "site" is used here to mean either a geographical unit or a vegetation type.

The Centres of Plant Diversity book will not be a comprehensive account of all important plant sites, but is intended to be a representative selection of those where species diversity and/or endemism is particularly high, irrespective of whether the areas are under immediate threat.

Two candidate sites have so far been identified in the Philippines for possible inclusion in the Centres of Plant Diversity book (Figure Three). They are:

i) Mount Apo, Mindanao

Mt Apo is one of only two ASEAN Natural Heritage Parks in the Philippines and covers an area of approximately 73 000 ha It includes both Mt Apo (2954 m) and Mt Sibulan and supports many endemic plants and animals. Extensive mossy (subalpine) forest consisting primarily of Lithocarpus spp. and Podocarpus spp. occurs between 1500 and 2700 m a.s.l. Below 1500 m the mossy forest is replaced by a forest formation containing larger and taller trees such as Shorea polysperma, S. almon, and species of Quercus, Cinnamomum, Tristania and Eugenia (Lewis, not dated). Logging, shifting cultivation and massive human encroachment are major threats and parts of the park are no longer viable as forest reservations.

ii) Mount Pulog, Luzon

The flora of Mount Pulog has affinities with the montane floras of Sabah (Mount Kinabalu in particular), Sulawesi and New Guinea. Pulog attains 2880 m and has a mosaic of species-rich montane rain forest, mossy forest, pine forest and grasslands. Pine and grassland areas are increasing at the expense of primary rain forest as a result of both natural and man-made fires.

A number of additional locations representing limestone-based vegetation and lowland dipterocarp forests are also scheduled for

inclusion in the Centres of Plant Diversity book. Exact site localities have still to be determined but Madulid (in litt., 1987) has suggested that the following four areas merit consideration (Figure Three).

i) Samar Samar, at 13 080 sq. km, is the third largest of the Philippine islands. Unlike most of the other larger islands of the archipelago, however, Samar lacks a true mountain range and most of the rugged interior lies between the 150 and 300 m contours. It has extensive tracts of primary lowland rain forest and limestone vegetation from which many new plant species have recently been described.

ii) Sibuyan Island Sibuyan (277 sq. km) is a relatively small island which forms part of the Romblon group. It is composed of several volcanic mountain masses that reach their highest point on the summit of Mt Giting-giting (2030 m). Several plant species are already known to be endemic to Mt Giting-giting but botanical surveys are incomplete and more detailed information is required.

iii) Sierra Madre Mountains, Northern Luzon The Sierra Madre is composed essentially of a large uplifted and tilted igneous block of land with a scarp facing east to the Pacific Ocean and with a more gentle descent west to the Cagayan Valley. Mt Cresta, the highest peak in the Sierra Madre, reaches an elevation of 1860 m. It is a very rugged area, heavily forested in parts with lowland dipterocarp formations. The western margins of this mountain range are botanically well known but the eastern side remains unexplored.

iv) Palawan The island of Palawan (11 785 sq. km) has the highest percentage (59%) of forest cover in the Philippine archipelago. It supports numerous vegetation types including those which occur in ultrabasic and limestone areas (Madulid, in litt. 1987). A three month botanical survey conducted by Hilleshög Forestry AB in 1984 identified the Thumb Peak - Mt Beaufort - Irawan Valley area west of Puerto Princesa in central Palawan as an optimum area for future conservation activity (Hilleshög Forestry AB 1984:30). Southern Palawan remains botanically unexplored.

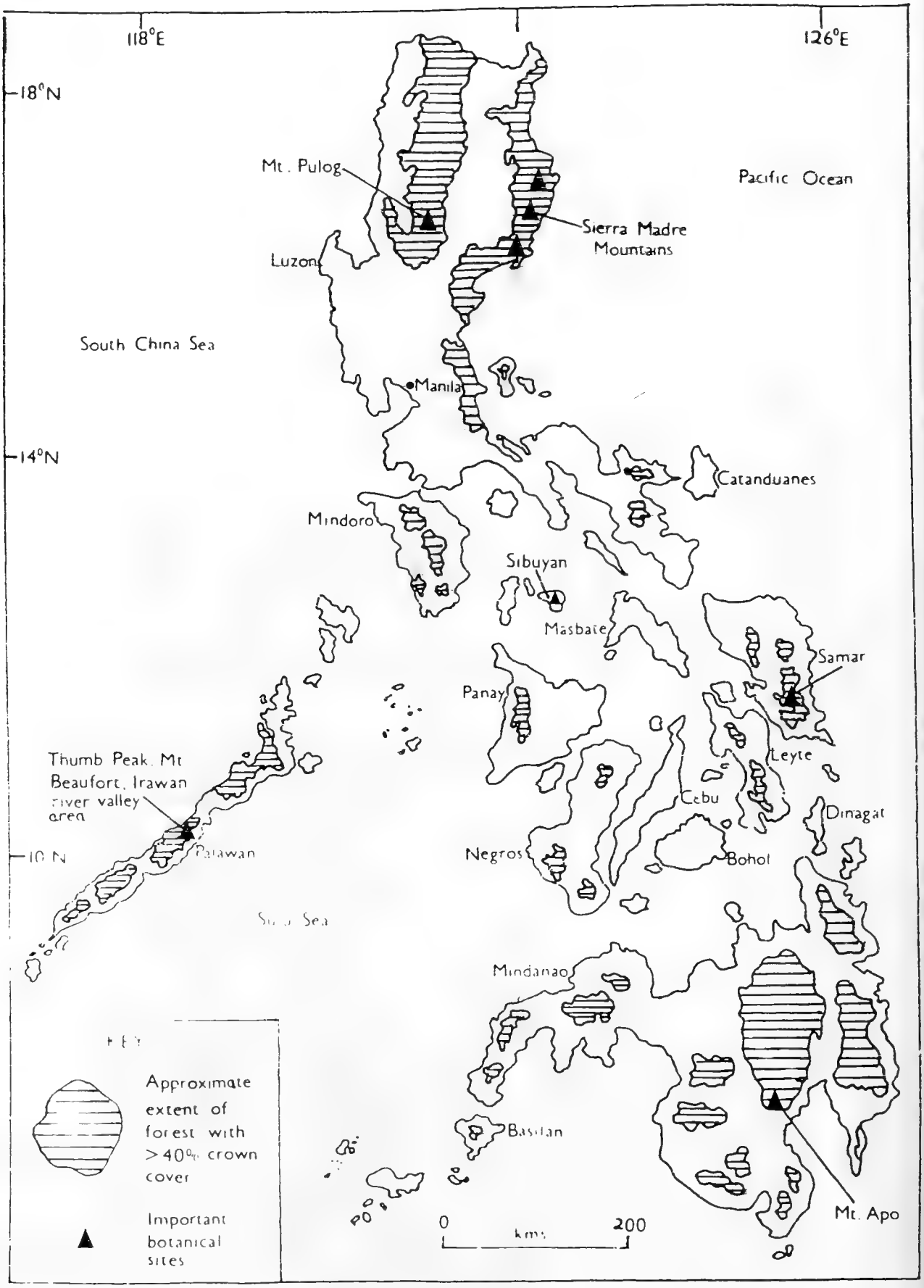

Figure Three. Centres of plant diversity and other important botanical sites

4. COASTAL AND MARINE ECOSYSTEMS

4.1 BACKGROUND

The larger islands of the Philippine archipelago have 18 417 km of shoreline (NEPC 1979): coastal and marine ecosystems which include coral reefs, seagrass beds, river estuaries, tidal mud-flats and mangrove forests are significant elements of the nation's environment. These coastal areas provide a diversity of habitat types for fish, amphibians and terrestrial wildlife. Seagrass beds are important feeding areas for several species of marine turtle (Green turtle Chelonia mydas, Hawksbill Eretmochelys imbricata, Olive Ridley Lepidochelys olivacea, Leatherback Dermochelys coriacea) and the dugong (Dugong dugon) while coral reefs, like mangroves, serve as vital spawning and nursery grounds for fish. Coastal and marine resources also contribute substantially to the livelihood of the Filipino people and approximately 5% (2.75 million) of the human population relies solely on fishing as a source of income. Nationally, fish account for 60% of all annual animal protein consumption (NEPC 1982).

The Philippine coastal zone* has been subjected to enormous stresses owing to the continued multiplicity of demands placed on it. Although 50 or so government institutions are directly or indirectly involved with coastal zone management (Tolentino 1984), the intense exploitative pressures on the environment have caused immense conservation problems. The status of the three most important Philippine coastal habitats: mangroves, coral reefs and seagrass beds are described below.

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* A legal definition of the Philippine coastal zone was adopted in 1983 and is included in Appendix Two.

4.2 MANGROVES

Mangroves usually occur in brackish water near the mouths of large rivers, particularly where they empty into protected bays. They are also found behind shallow coral reefs where the sea waters are relatively quiet and on wave-cut terraces off rocky headlands. There are about 86 species of vascular plants occurring in Philippine mangrove areas of which 48 are small to medium sized trees (Zamora 1985). The rhizophora mangroves (Rhizophora candelaria and R. mucronata) and the bruguiera mangroves (Bruguiera conjugata, B. parviflora and B. sexangula) are the most common species. Tengel mangroves (Ceriops tagal and C. roxburghiana) are less frequently encountered and usually occur only in protected bays as subdominant species.

Mangrove forests do much to ensure the stability of the nearshore environment. They help to limit coastal erosion by lessening the impact of ocean surges associated with tropical storms and they also trap the sediments resulting from upland soil erosion, thus shielding coral reefs and other fragile ecosystems from excessive siltation. The ecological benefits which can be derived from maintaining a substantial mangrove resource base in the Philippines have now become obscured, however, by the economic gains to be obtained from clearing large areas of these valuable forests for commercial purposes. A valid case can sometimes be made for felling limited areas of mangrove forest for economic development but these important Philippine environments have not been treated as a renewable resource and their conservaton status has been adversely affected by short-term financial considerations.

In 1920, the area of Philippine mangrove forests was estimated at between 400 000 and 500 000 ha (Zamora 1985). By 1981, however, total mangrove forest area had been reduced to 239 382 ha (BFD 1981) of which only 34% (81 390 ha) could be classified as old growth forest* (NEPC 1982). This massive loss of mangroves has been attributed to several

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* Old growth forests: This expression is used in the Philippines to indicate virgin, undisturbed or unlogged forest.

factors including the expansion of human settlements, land reclamation projects for industrial and commercial purposes, and the clear-cutting of mangrove trees for timber, firewood and viscose rayon manufacture. The most significant threat to the Philippine mangrove ecosystems, however, is their continuing impoundment for ponds which are used primarily for breeding milkfish Chanos chanos (IUCN 1983). Rapid development has led to the area devoted to fishponds increasing from 88 681 ha in the early 1950s to 195 832 ha in 1981 (BFAR 1981). Licence applications from 3300 fishpond operators for an additional 70 300 ha of mangrove areas were under consideration in 1982 (IUCN 1983).Although the government has issued two presidential decrees (Nos. 704 and 705) and three conservation decrees (Nos. 950,1121 and 1152) to protect mangrove forests they are still being destroyed at a rate of about 17 000 ha per annum (Penaranda 1984). Unless effective protection measures and reseeding programmes are rapidly introduced it is unlikely that any viable mangrove ecosystems will remain in the Philippines by the end of the century.

4.3 CORAL REEFS

Philippine coral reefs cover an area that has variously been estimated at 27 000 sq. km in extent (UNEP/IUCN, in press). More than 90 genera (Gomez, in press) and at least 488 species (Nemenzo 1981) of coral are known from the Philippines. The largest concentration of reef areas is located in the south-west of the country (UNEP/IUCN 1987) with some 60% of the coral lying on a shelf surrounding the island of Palawan (White 1987). The approximate distribution of Philippine coral reefs is shown in Figure Four. More detailed accounts of reef distribution may be found in UPMSC (1979, 1980 and 1982), White (1984), and UNEP/IUCN (in press).

Coral reef environments are highly productive and they provide shelter for a wide variety of plants, invertebrate animals and fish. Many Filipinos depend on reef ecosystems for their livelihood and in the southern Philippines coral reef resources provide 80% of the diet for the human population (Rubec, in prep). In 1976 the University of the Philippines Marine Sciences Research Institute was commissioned by the Department of the Environment and Natural Resources to undertake an

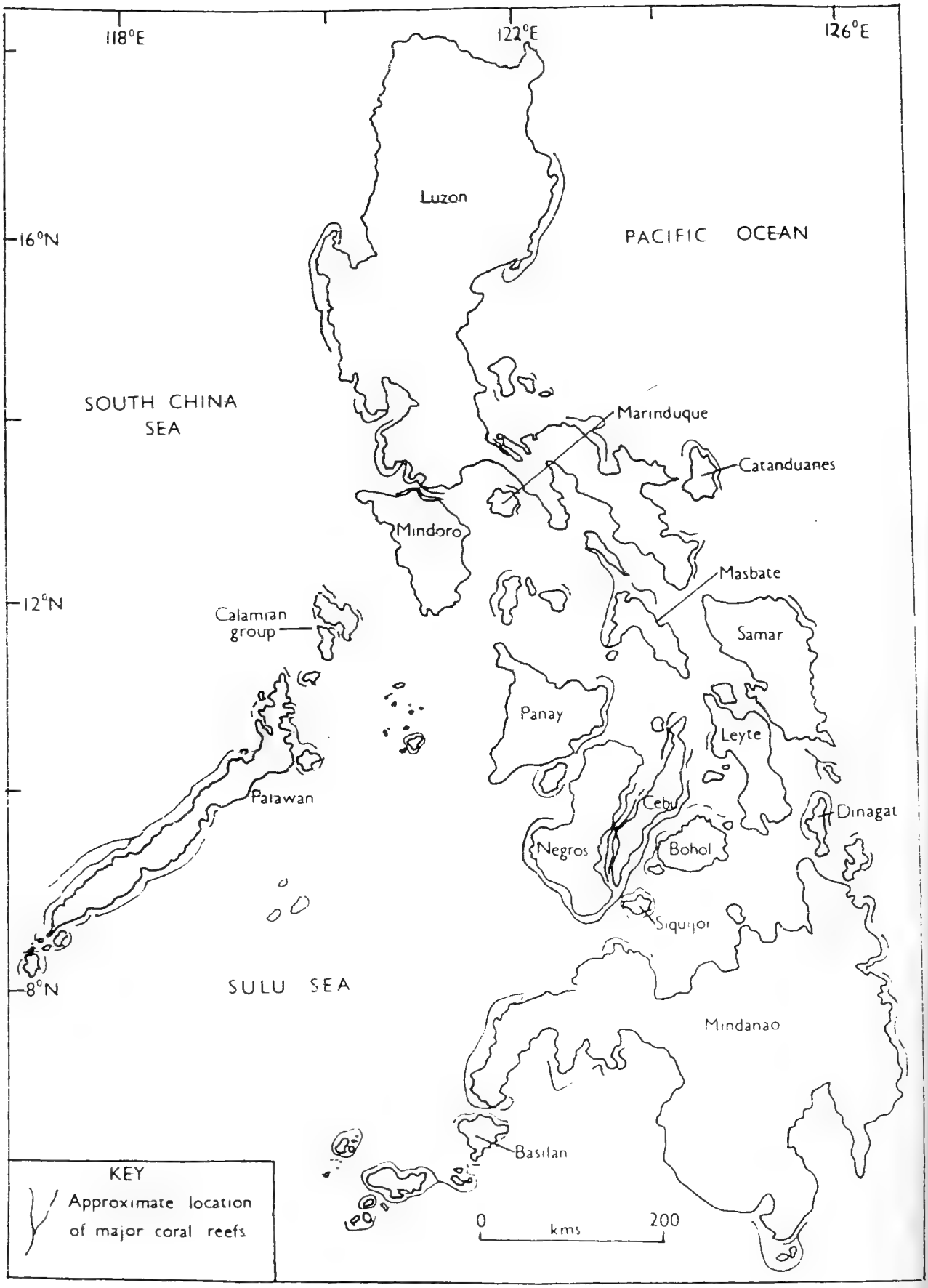

Figure Four. Philippine coral reefs

assessment of the coral resources of the country. The living coral cover was described and evaluated in terms of four categories of condition: poor (0-24.9% of living coral cover), fair (25-49.9%) good (50-74.9%) and excellent (75-100%). The results of this survey indicated that Philippine coral reefs were among the most abused in the world (Gomez et al. 1981). Only 5.5% of the coral examined could be described as being in 'excellent' condition whereas more than 70% was assigned to the categories 'fair' (38.3%) and 'poor' (32.1%) (NEPC 1982).

The main cause of Philippine coral reef degradation is probably siltation (Gomez et al. 1981) caused by mining, logging and forest conversion for agriculture. In some areas the effects of excessive siltation on coral reef resources have been catastrophic. Copper mine tailings discharged into the Pagatban river in Negros Oriental from 1979 to 1982, for example, led to the complete burial of one coral reef, and to the asphyxiation of another which was situated in 10 fathoms of water 2 km from the river mouth. During this period all fish and shrimp species which were living in the Pagatban river estuary disappeared and two (of three) species of fiddler crab (Uca spp.) were extirpated (NEPC 1982).

Destructive fishing practices have also contributed to the overall decline in the status of coral reef ecosystems. 'Blast fishing' has caused extensive reef damage throughout the archipelago (Alcala and Gomez 1979) and although fishing with explosives was declared illegal in 1972 (Presidential Decree Nos 1058 and 1081) the law has proved difficult to enforce. Muro-ami and kayakas fishing techniques which make use of poles for smashing corals and scare-lines attached to heavy objects such as rocks have also caused considerable damage (Carpenter and Alcala 1977). Muro-ami and kayakas fishing were banned in December 1986 (Fisheries Administrative Order No.163) but in some areas the structural damage to coral reefs caused by these methods of fish capture is probably irreversible. Localized damage to Philippine reef areas has also been caused by the harvesting of ornamental corals for export (UNEP/IUCN 1987; Wells 1981, 1982). During the 1970s it was estimated that more than 90% of ornamental coral on the world market originated in the Philippines and many populations have been seriously

depleted (Wells 1981). As yet, however, there is no evidence to suggest that the commercial collection of coral has resulted in any species extinctions (Wells 1981).

Other reef resources which are commercially harvested include giant clams, ornamental shells and aquarium fish. Many are over-exploited. Giant clams, which can attain a length of 137 cm and a weight of over 200 kg (Rosewater 1965) have been particularly adversely affected since they are highly sought after both for their shells and their meat (see Resource Book). The two largest species of giant clam (Tridacna gigas and T. derasa) are listed as Vulnerable in the IUCN Invertebrate Red Data Book (Wells et al. 1983) and the results of a recent survey conducted between February 1984 and October 1985 suggest that both may now be extinct in the Philippines (Alcala, in press).

The international demand for aquarium fish and ornamental shells from Philippine coastal waters has caused problems on many reefs. In 1982 over 1.9 million aquarium fish were exported to the USA alone (Albaladejo and Corpuz 1981; Anon. 1987) and in some areas where cyanide in the form of hydrocyanic acid has repeatedly been used to stun fish populations the entire support system has also been eliminated (Rubec, in prep.). The demand for ornamental shells and shellcraft products is substantial (Wells 1981) but exports have declined recently possibly because of a reduction in the abundance of molluscs (Rubec, in prep.).

4.4 SEAGRASS BEDS

At least 16 species of seagrass are found in Philippine waters (Anon. 1985) and of these 11 occur on Philippine reefs (White 1987). The most common reef-associated species are Enhalus acoroides, Thalassia hemprochii, Haladule uninervis, Syringodium isoetifolium and Halophila ovalis (White 1987). IUCN has little information on the conservation status of seagrass resources but White (pers. comm. 1987) has indicated that "most coral reef areas in the Philippines have seagrasses associated and, for the most part, they are not threatened except near urban areas, mining sites and places where siltation and turbidity have increased as a result of land-based activities".

Those seagrass species which occur in dense stands play an important ecological role in the conservation of shallow coastal zones because their roots and rhizomes bind sediments together thereby reducing surface erosion. Seagrasses are also valuable as primary producers, providing important grazing areas for sea turtles, sirenians and some fish. Four species of marine turtle are known to occur in the Philippines. All are seriously endangered (Groombridge 1982). The Leatherback Dermochelys coriacea and Olive Ridley Lepidochelys olivacea are present only as occasional vagrants, but the Green turtle Chelonia mydas and the Hawksbill Eretmochelys imbricata nest sporadically and in small numbers on islands throughout the archipelago (Alcala, pers. comm. 1986). The only healthy breeding populations of these two species are located in the southern and south-western Philippines on islands fringing the Sulu Sea (Groombridge and Luxmoore 1987). Full details of the distribution and conservation status of Chelonia mydas and Eretmochelys imbricata are included in the Resource Book.

The dugong Dugong dugon feeds almost exclusively on seagrasses and occurs in very small numbers throughout the Philippine archipelago. Sightings of this strictly marine mammal have been recorded from the coastal waters of Luzon, Palawan, Panay, Cebu and Mindanao (Nishiwaki et al. 1979), but it is threatened by uncontrolled hunting and netting throughout its range (see Resource Book).

5. THE PHILIPPINE FAUNA

5.1 INTRODUCTION

The fauna of the Philippine archipelago is characterized by a high degree of species endemism (Table One).

Table One: Philippine faunal endemism

	Approx. no. of species	Approx. no. of endemic species	% endemism
Non-flying mammals	96	71	74
Bats	69	27	39
Birds	541	162	30
Lizards	101	74	73
Snakes	86	45	52
Amphibians	65	41	63

More than 950 terrestrial vertebrate species are known to occur in the Philippines and many of these are now threatened by habitat destruction and other extraneous factors such as hunting. In this section, the information that is currently available on the species composition and conservation status of Philippine land mammals, birds, amphibians, reptiles and swallowtail butterflies is summarized. The conservation status of freshwater and terrestrial molluscs, non-marine crustacea and other non-arthropod invertebrates are for the most part very poorly known and they are not considered in this report.

5.2 LAND MAMMALS (EXCLUDING BATS)

5.2.1 SPECIES COMPOSITION AND DISTRIBUTION

Analysis of the distribution patterns of the Philippine land mammals suggests that four major faunal regions (Luzon, Mindanao, Negros and Palawan) may be identified on the basis of species richness, composition and degree of endemism (Steere 1890; Heaney 1986; Heaney and Rabor 1982). Mindoro and the islands of the Sulu archipelago are also often considered to be distinct. These faunal regions are highly

concordant with the limits of Late Pleistocene islands defined by the 120 m bathymetric line (see Figure Five). A summary account of their extent and species composition has been provided by Heaney (1986) and a copy of this article is included in the Resource Book.

It is estimated that 96 species of non-flying land mammals comprising eight orders (Insectivora, Scandentia, Dermoptera, Primates, Pholidota, Rodentia, Carnivora and Artiodactyla) occur in the Philippines (Heaney et al. in prep). The islands support at least 17 endemic genera of rodents and two of insectivores as well as many endemic species of more widespread genera (Heaney 1986). Approximately 43 species occur as single island endemics i.e. their range is confined to only one island within the archipelago (Hauge et al. 1986).

1) **Insectivora** The insectivores of the Philippines comprise representatives of two families - the Erinaceidae (hedgehogs and gymnures) of which one endemic genus with two species (Podogymnura aureospinula and P. truei) occurs, and the Soricidae (shrews). The taxonomy of the Soricidae is unstable but eight species in two genera probably occur (Heaney et al. in prep.).
2) **Scandentia** Two species (Tupaia palawanensis and Urogale everetti) in the family Tupaiidae (tree shrews) are represented. Both are single-island endemics in the Mindanao faunal region.
3) **Dermoptera** A single endemic species, Cynocephalus volans, is known from specimens collected on the islands of Basilan, Bohol, Dinagat, Leyte, Mindanao, Samar and Siargao in the Mindanao faunal region (Heaney et al. in prep.).
4) **Primates** This order is represented by three species in three different families. Macaca fascicularis (family Cercopithecidae - monkeys) is widely distributed throughout south-east Asia and is locally common to uncommon in the Philippines (Heaney et al. in prep.). Tarsius syrichta (family Tarsiidae - tarsiers) is endemic to the Philippines. Records are confined to the Mindanao faunal region. The range of Nycticebus coucang (family Lorisidae - lorises and coucangs) reaches the Philippines only in the Sulu Archipelago.

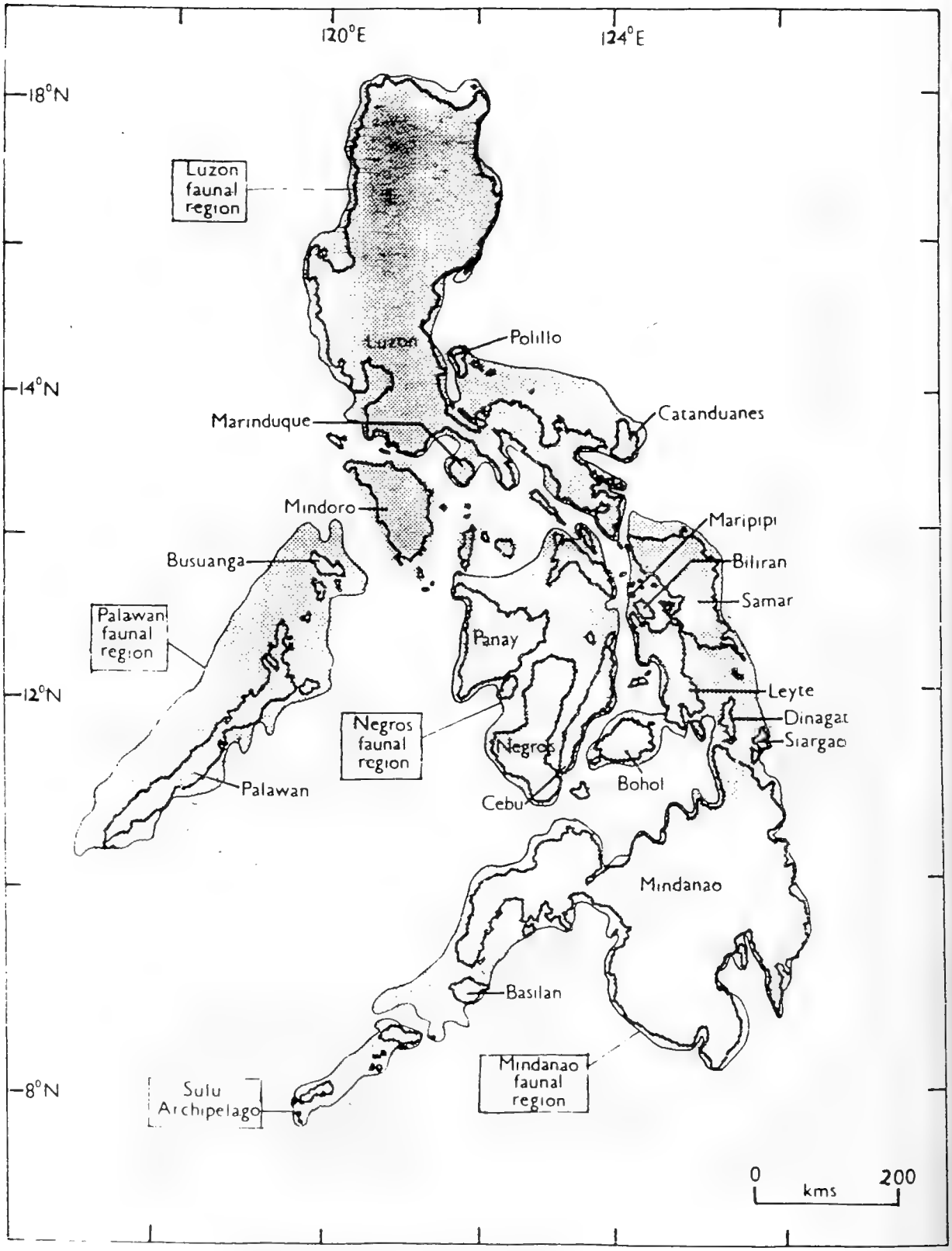

Figure Five. Philippine faunal regions

5) **Pholidota** One species, Manis javanicus (family Manidae - pangolins), occurs in the Palawan faunal region only.

6) **Rodentia** Rodents are numerically the most dominant of the terrestrial mammals of the Philippines. Heaney et al. (in prep.) recognize at least 60 species in three different families - the Sciuridae (squirrels), Muridae (mice and rats) and Hystricadae (porcupines). The family Muridae is represented by a large, diverse assemblage of species and they have been extensively studied in recent years. Five new genera (Abditomys, Anonymomys, Archboldomys, Palawanomys and Sundamys) have been described since 1981, and new species have been named in the genera Batomys, Crateromys, Crunomys, Haeromys, Rattus and Rhynchomys (Heaney et al in prep.). Murid distribution patterns are poorly known but many species appear to be geographically restricted. Representatives of the family Sciuridae (13 species in 4 genera) appear in the Mindanao and Palawan faunal region. One species in the family Hystricidae has been recorded from the islands of Busuanga and Palawan.

7) **Carnivora** There are seven species of carnivore in the Philippines. Only one species, the mustelid Mydaus marchei, is endemic. It is known from specimens obtained on the islands of Palawan and Busuanga. Other carnivores occurring in the archipelago include the Leopard-cat Felis bengalensis, the mustelid Aonyx cinerea, the viverrids Arctictis binturong, Paradoxurus hermaphroditus and Viverra tangalunga and a single mongoose species of the family Herpestidae - Herpestes brachyurus.

8) **Artiodactyla** This order is represented by the families Suidae (pigs), Tragulidae (mouse-deer), Cervidae (deer) and Bovidae (cattle and goats). The taxonomy of the Philippine pigs has recently been reviewed by Groves (1981) who assigned all populations to Sus barbatus rather than to S. celebensis. Sus barbatus occurs throughout the Philippines, but it is much hunted and populations are declining. The mouse-deer Tragulus napu is widely distributed in South-east Asia but in the Philippines a restricted population occurs only on Balabac island (Heaney et al. in prep.). The family Cervidae has four representatives in the Philippines. The Philippine spotted deer Cervus alfredi is

endemic and probably now occurs only in small populations on the islands of Negros and Panay. Cervus mariannus is present on all the major islands in the archipelago with the exception of Cebu, Masbate, Negros and Panay. Cervus porcinus is widespread in Indochina and southern Asia but in the Philippines it is restricted to Busuanga and Culion. Axis calamianensis is known from islands in the Calamian group. The only member of the Bovidae occurring in the Philippines is the tamaraw Bubalus mindorensis. This animal is endemic to the island of Mindoro and is severely endangered.

5.2.2 CONSERVATION STATUS OF PHILIPPINE LAND MAMMALS (EXCLUDING BATS)

The following endemic land mammals have been assigned threatened species status in the 1988 IUCN Red List of Threatened Animals (IUCN 1988):

E	Tamaraw Bubalus mindorensis
E	Tarsier Tarsius syrichta
E	Philippine spotted deer Cervus alfredi
V	Calamian deer Axis calamianensis
V	Mindanao gymnure Podogymnura truei
V	Visayan wild pig Sus barbatus cebifrons
I	Forest rat Batomys granti

The tamaraw Bubalus mindorensis is the largest land mammal native to the Philippines. This small buffalo had been reduced by hunting to about 80 to 100 animals by 1969 (Whitmore and Grimwood 1976) but active conservation measures have since checked its decline. The current population status is not known but numbers have certainly increased in recent years. (More detailed information on the conservation status of the tamaraw and other threatened species listed below is included in the Resource Book).

Although the tarsier Tarsius syrichta is included in the IUCN Red List of Threatened Animals the results of recent fieldwork suggest that "this animal is widely distributed and fairly common, with good populations in overgrown agricultural land and in secondary and primary forest. They are rarely hunted (except as pets), and tend to be left alone because they are often thought to be associated with spirits" (Heaney pers.comm. 1987).

The Philippine spotted deer Cervus alfredi is almost certainly in imminent danger of extinction. The largest and possibly only viable population of this animal is located in the Mt Madja-as/Mt Baloy area of western Panay but the forest habitat of this remote region is rapidly being depleted by uncontrolled agricultural expansion (Cox 1985, 1987). A proposal to create a national park for the protection of Cervus alfredi has been submitted to the Philippine Bureau of Protected Areas and Wildlife for consideration.

The Calamian deer Axis calamianensis is endemic to islands in the Calamian group which are situated in the Sulu Sea north of Palawan. A survey conducted in 1975 suggested a maximum of 900 animals, but recent reports indicate that numbers have probably decreased since then (Grimwood pers. comm. 1987). A population of approximately 400 Calamian deer occurs on the island of Calauit where effective protection measures have limited illegal hunting and habitat destruction.

The Visayan wild pig Sus barbatus cebifrons was once distributed throughout the Visayan islands but it is now extinct on Cebu, Bohol and Siquijor and seriously threatened by habitat destruction and hunting on Panay and Negros. Population levels are also declining on the islands of Leyte and Samar (Cox 1985, 1987).

The Mindanao gymnure Podogymnura truei is listed as Vulnerable in the IUCN Red List but may be more common than is generally supposed (Grimwood pers. comm. 1987). It is at risk through loss of habitat.

The Forest rat Batomys granti is known only from Mt Data, Benguet Province, Luzon. Further fieldwork is required to determine its exact status.

Batomys granti is not the only Philippine land mammal for which conservation status data is lacking. There is hardly any recent information on the status of most Philippine mammals. A list of possibly threatened animals for which the IUCN's Conservation Monitoring Centre has little or no recent data is included in Appendix Three. Many of these mammals are single-island endemics known only from type-site localities. Most occur on three large islands - Luzon, Mindanao and Palawan - but some are endemic to much smaller islands (e.g. Dinagat) and are especially vulnerable since their habitats are relatively small and easily destroyed. It is important that field surveys be initiated at the earliest possible opportunity to determine both the distribution and status of these species.

All those species identified as possibly threatened in the Luzon faunal region are endemic rodents. The vast majority appear to be sympatrically distributed in the mountains of north-central Luzon which includes Mt Data. However, two species (Archboldomys luzonensis and Rhynchomys isarogensis) have only been recorded from the poorly known Bicol peninsula of south-east Luzon suggesting a high level of allopatric endemism within the island (Heaney 1986). The range of some murid rodents occurring in the Cental Cordillera of northern Luzon may extend eastwards to the Sierra Madre Mountains, but further field data is required to substantiate this observation. The Sierra Madre Mountains are a priority area for future survey and research activities, especially in view of the fact that their eastern margins also remain botanically undescribed (see Section 3.2.4).

Of the ten mammal species identified as possibly threatened in the Mindanao faunal region three are endemic to the island of Dinagat. Two of these (Batomys sp. and Podogymnura aureospinula) have their closest relatives on Mindanao and one (Crateromys australi) has relatives known only from Luzon and Ilin island near Mindoro (Heaney 1986). Six of the remaining seven species (two insectivores and four

rodents) have been recorded from widely dispersed localities on the island of Mindanao. Crunomys rabori is restricted to mossy forest formations in the highlands of northern Leyte. No known threatened mammals species occur in Samar, the second largest island in the Mindanao faunal region, but a review of the literature suggests that very little fieldwork has been carried out there in recent years. Samar still has extensive tracts of primary lowland rain forest and limestone vegetation, and field surveys are urgently required to describe both the fauna and flora of many parts of the island.

Eight species of land mammals are identified as possibly threatened in the Palawan faunal region. Two tree squirrels (Sundasciurus hoogstraali and S. mollendorffi) are restricted to small islands in the Calamian group. The remaining six species occur on the island of Palawan which is still heavily forested in parts. The fauna of the island of Mindoro includes two possibly threatened endemic species which have been recorded at high elevations in the Mt Halcon range. The cloud rat Crateromys paulus has been described only from Ilin island, south of Mindoro. One endemic species, Crocidura negrina, is recognised as possibly threatened in the Negros faunal region.

5.3. LAND MAMMALS - BATS

Some 69 species of bats have been recorded in the Philippines. Approximately 30 of these are endemic although three (Saccolaimus pluto, Taphozous philippinensis and Coelops hirsuta) may be subspecies of more widespread populations (Heaney et al. in prep). The taxonomic composition of the Philippine bat fauna is as follows:

Family	species (genera), endemic species
Pteropodidae (Fruit bats)	23 (15),18
Emballonuridae (Sheath-tailed bats)	3 (3),2
Megadermatidae (False vampire bats)	1 (1),0
Rhinolophidae (Horseshoe and roundleaf bats)	17 (3),10
Vespertilionidae (Common bats)	21 (10),0
Molossidae (Free-tailed bats)	4 (3),0

The following bat species are included in the 1988 IUCN Red List of Threatened Animals (IUCN 1988):

Ex	Acerodon lucifer	
Ex?	Dobsonia chapmani	Chapman's Bare-backed Fruit Bat
E	Nyctimene rabori	Philippine Tube-nosed Fruit Bat
K	Otopteropus cartilagonodus	
K	Alionycteris paucidentata	

Acerodon lucifer is one of eight species of large flying foxes in the Philippines. Originally named from the island of Panay, this bat has not been seen since 1888 and is presumed to be extinct (Heaney and Heideman 1987).

The last specimen of Dobsonia chapmani was obtained from the island of Negros in 1964. Recent field surveys have failed to rediscover this cave-dwelling species (which was only described in 1952) and it is probably now extinct. Widespread hunting and habitat destruction have contributed to its decline (Heaney and Heideman 1987).

Viable populations of the Philippine Tube-nosed Fruit bat Nyctimene rabori still occur in the mountainous regions of southern Negros(including the Twin Lakes region) where they feed on figs and other fruit in the forest canopy (Heaney and Heideman 1987). Although Twin Lakes has been designated a protected area by the national authorities, deforestation continues to be a problem and this species is vulnerable to further habitat destruction.

Otopteropus cartilagonodus is known only from Luzon where it is suspected to be threatened by deforestation. Further research is required to determine its exact conservation status.

Alionycteris paucidentata has been recorded from Mt Katangland, Bukidnon Province, Mindanao. The conservation status of this species is uncertain but it has a restricted range and is probably uncommon.

5.4 BIRDS

Bruce (1980) has listed 541 species in the avifauna of the Philippines. Of these approximately 388 are breeding residents, 119 are passage migrants and 34 occur only as 'stragglers' or irregular visitors. The majority of the 388 resident breeding species are derived from the Malaysian subregion (Diamond and Gilpin 1983). A small minority of Philippine residents also arrived from China, Celebes, the Moluccas and New Guinea. At least 162 species in the Philippine avifauna are endemic (a list of endemic species is provided in Appendix Four). Among these 162 species, there are eight endemic genera - *Pithecophaga*, *Phapitreron*, *Bolbopsittacus*, *Rhabdornis*, *Leonardina*, *Micromacronus*, *Sarcops* and *Hydrocryptadius*. All are monotypic except *Phapitreron* (3 species) and *Rhabdornis* (3 species).

The conservation status of most Philippine bird species is poorly known but many are probably threatened by the widespread demand which exists throughout the country for use of the remaining forested areas as agricultural lands. The great majority of species in the Philippine avifauna are forest-dwelling and when their habitat is modified by slash and burn cultivators or logging companies population levels decline dramatically. The results of a recent ornithological survey on the island of Cebu in the central Visayas, for example, where almost all of the natural forest cover has been removed, indicate that only one (of ten) endemic species and subspecies has managed to adapt to new habitat requirements (Rabor 1977).

Birds which represent a valuable source of food to the rural human population (e.g. pigeons, doves and hornbills) are additionally threatened by unregulated hunting activities. Yet others are extensively trapped to satisfy the intense demand which has developed for some birds as pets. The Red-vented Cockatoo *Cacatua haematuropygia* and various members of the parrot family have been particularly

adversely affected. The International Council for Bird Preservation (ICBP) has received information from ornithologists and other scientists with recent field experience in the Philippine archipelago which suggests that as many as 34 species may be immediately threatened by habitat destruction, hunting and trapping for cage display. These species are listed in Appendix Five.

The conservation status of all the species included in this list gives grave cause for concern. Some have been recorded only from type-site localities (e.g. Negros Fruit-Dove Ptilinopus arcanus and Mindoro Scops-Owl Otus mindorensis) while others have not been seen in the field by ornithologists for many years (e.g. Mindoro Imperial Pigeon Ducula mindorensis). Virtually all have restricted ranges which are threatened by habitat destruction and human encroachment. Deforestation is the main cause of breeding failure among the Philippine Eagle Pithecophaga jefferyi population which is seriously endangered and probably now numbers no more than 200 birds in the wild (Kennedy 1987). The Philippine Eagle Conservation Program has played a key role in focusing international attention on the plight of this magnificent raptor but it remains the only species in the avifauna of the Philippines which has received any significant conservation attention. An appraisal of the successes and shortcomings of the Philippine Eagle Conservation Programme has been undertaken by ICBP (see Resource Book).

5.5 REPTILES AND AMPHIBIANS

5.5.1 SPECIES COMPOSITION

More than 240 indigenous species of amphibians, lizards and snakes occur in the Philippine herpetofauna and they represent an important part of the archipelago's biota.

1. Reptiles: All but two families of Asian snakes have been reported from the Philippines. The two exceptions are the Uropeltidae, which is confined to peninsular India and Sri Lanka, and those of the Aniliidae, a single species of which enters western Indonesia (Leviton 1963).

Species endemism in the Philippine snake fauna is estimated at approximately 52%, but only three (of 33) genera are endemic. They are Cyclocorus, Hologerrum and Oxyrhabdium (Brown and Alcala 1970). Cyclocorus and Hologerrum are related to each other and have no known close relatives in south-east Asia or elsewhere. Both genera are monotypic. Oxyrhabdium is related to the genus Xylophis which is restricted to the Western Ghats in India (Leviton 1963). It includes two species, Oxhyrhabdium leporinum and O. modestum, which are both widely distributed throughout the archipelago. Summary accounts of the species composition and distribution of the non-endemic genera of Philippine snakes are provided in Leviton (1963) and Brown and Alcala (1970).

Of approximately 105 species of indigenous lizards recognised in the Philippines, 85 occur in two families: Gekkonidae and Scincidae. None of the genera of skinks are endemic, although one (Brachymeles) has thirteen of fourteen species limited to the Philippines, with a single species known only from Borneo (Brown and Alcala 1980). A typical relict distribution pattern (with several of the species isolated from each other and limited to one or a small group of islands) is evident for this genus in the Philippines. In contrast to the fact that none of the skink genera are endemic to the Philippines, a large proportion (52 of 64 or 81.3%) of the species are known only from the archipelago (Brown and Alcala 1980). Eleven of the twelve non-endemic species of skinks are shared with Borneo.

Two of the ten genera of gekkos represented, Luperosaurus and Pseudogekko, are endemic to the Philippine islands. Both genera include four species and all exhibit relict distribution patterns. Fifteen other species of gekko in more widespread genera are also endemic. A detailed summary of the zoogeography and species composition of the family Gekkonidae is provided by Brown and Alcala (1978).

Other important elements of the Philippine reptile fauna include marine turtles (which are considered in Section 4.4) and two species of crocodile. The Saltwater crocodile Crocodylus porosus is widely

distributed in the Indo-Pacific region from Sri Lanka to northern Australia and New Guinea, but in the Philippines its range is severely restricted. The Philippine crocodile Crocodylus mindorensis is endemic to the archipelago. The current distribution of this species is very limited and few extant populations are now believed to occur outside captivity. Sightings of Crocodylus mindorensis have been reported from the Upper Pagatban River on Negros Island and from two localities on Mindanao. It may also occur in very small numbers in Lake Naujan on Mindoro (Ross and Alcala 1983).

2. Amphibians: With a single exception all of the seven families to which the Philippine amphibians belong are found in the Oriental region. The non-conforming family, the Discoglossidae, which is represented in the Philippines by a single species, is distributed throughout the Palearctic region (Inger 1954). The amphibian fauna of the Philippines, like the reptiles, demonstrates a high level of species endemicity and at least 41 of 65 (or 63.1%) of the species identified have not been recorded outside the archipelago. The taxonomic composition of the Philippine amphibia is as follows:

Family	Species/genera
Ranidae	26 (4)
Rhacophoridae	19 (4)
Caeciliidae	1 (1)
Discoglossidae	1 (1)
Bufonidae	7 (3)
Pelobatidae	3 (3)
Microhylidae	8 (4)

5.5.2 CONSERVATION STATUS OF PHILIPPINE REPTILES AND AMPHIBIANS

The conservation status of most of the Philippine herpetofauna is uncertain because, although a substantial amount is known about the species composition of reptiles and amphibians in the archipelago, insufficient fieldwork has been carried out to establish whether any

given species is threatened. In response to a request from IUCN's Conservation Monitoring Centre for information on the conservation status of Philippine reptiles and amphibians, Prof. A.E. Leviton (in litt., Nov. 1987) has offered the following general observations:

"It would be difficult, if not impossible, to compile a list of threatened or endangered species of amphibians and reptiles in the Philippines.....I could make wild guesses about probable threatened or endangered species, or those which would quickly become endangered if habitats were destroyed or animals collected indiscriminately, but I would be hard put to justify my guesses save that these animals appear infrequently in collections and have never been found in large numbers even in well-collected localities..... A large percentage of the Philippine amphibian and reptile fauna is endemic to the archipelago, and within the islands, taxa are often restricted to one or two islands. For instance, among the snakes, Calliophis calligaster calligaster is known only from Luzon and Mindoro; C. calligaster gemianulus from Cebu, Negros and Panay; C. calligaster mcclungi from Polillo; Opisthotrophis alcalai is known only from Mt Malindang, Zamboanga del Norte; Maticora intestinalis suluensis from Jolo; Liopeltis philippina from Busuanga and Palawan, and L. tricolor from Bubuan and Palawan. Many other examples can be cited, and for the lizards (e.g. Luperosaurus labialis, Dibamus argentus) and amphibians, too. At one time the frog Barbourula busuangensis was thought to be rare. It is in the sense that it is found on only a couple of islands in the Palawan Archipelago, but in recent years it has been found to occur in larger populations than previously thought. Nonetheless, the taxon is certainly at risk, as are nearly all the endemic species in the islands, since island habitats are of finite size, and habitats easily destroyed."

IUCN has also received information which suggests that two species of frogs, Platymantis insulatus and P. spelaeus, may be threatened. A few specimens of P. insulatus have been obtained from two limestone caves on the small island of South Gigante which is located in the Sibuyan Sea north-east of Panay. A recent survey of these caves failed to yield any further examples of this species, however, and unless it

is eventually found on Panay it may already be extinct (Brown in litt., 1984). P. spelaeus, also a cave-dwelling form, is similarly known from small populations in two caves on Negros Island (Brown in litt., 1984).

The IUCN Red List of Threatened Animals (IUCN 1988) identifies five Philippine reptiles as threatened. They are:

I Leyte Pond Turtle Heosemys spinosa
E Philippine Crocodile Crocodylus mindorensis
E Saltwater Crocodile Crocodylus porosus
V Sail-fin Lizard Hydrosaurus pustulatus
R Gray's Monitor or Butaan Varanus grayi

Crocodylus mindorensis and Varanus grayi are endemic to the Philippines but Crocodylus porosus, although a nationally rare species in the archipelago, is widely distributed elsewhere in South-east Asia and Australia. Full details of the distribution and conservation status of these animals are included in the Resource Book.

Hydrosaurus pustulatus occus in primary and secondary forests along river banks and streams on most of the major Philippine islands. A valuable source of food, this lizard is heavily hunted in some areas and is vulnerable to extinction. Little is known of the Leyte Pond Turtle Heosemys spinosa which was described in 1920 from a single specimen obtained in southern Leyte.

5.6 SWALLOWTAIL BUTTERFLIES

The swallowtail fauna of the Philippines includes 49 species, 21 of which are endemic. The conservation status of these unique insects has

recently been reviewed by Collins and Morris (1985) who identify nine threatened species:

E	Papilio chikae
V	Graphium sandawanum
V	Atrophaneura schadenbergi
V	Papilio osmana
V	Papilio carolinensis
V	Papilio benguetanus
R	Graphium idaeoides
I	Graphium megaera
I	Atrophaneura atropos

Papilio chikae is endemic to Luzon where it is found in the Baguio and Bontoc regions of the Central Cordillera. Essentially a species of areas over 1500 m a.s.l., this naturally rare butterfly is believed to be endangered by over-collecting and habitat alteration.

Graphium sandawanum is confined to Mt Apo in Mindanao where it was discovered as recently as 1977. Mt Apo suffers constant encroachment by squatters and the forest habitat of this species is rapidly being cleared for agricultural purposes.

Atrophaneura schadenbergi is restricted to northern and central Luzon and the Babuyan islands where it occurs in lowland wooded areas and grass meadows. It is threatened by loss of habitat caused by the demands of the rapidly expanding human population.

Papilio osmana is an extremely rare swallowtail from southern Leyte and north-eastern Mindanao. Very little is known about this butterfly, but its habitat is rapidly being degraded by human activities.

Papilio carolinensis is known only from Agusan and Bukidnon provinces in Mindanao. An inhabitant of the rich dipterocarp forests of the island, it is believed to be threatened by deforestation.

Papilio benguetanus has a limited distribution in the Central Cordillera of northern Luzon where it is vulnerable to further habitat disturbance.

Graphium idaeoides occurs in the eastern Philippines from Luzon to Mindanao. This species prefers lowland rain forests less than 330 m a.s.l. where the rainfall is continuously high. Although widely distributed, G. idaeoides seems to be rare and local throughout its range and is often very difficult to locate.

Full details of the distribution, ecology, threats and conservation measures required to protect these species are included in the Resource Book.

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6. PROTECTED AREA SYSTEM

6.1. TERRESTRIAL RESERVES

The adequacy and effectiveness of the Philippine national park system in protecting the country's unique biological heritage has been comprehensively reviewed by the Philippine Development Academy (DAP/DNR 1975), Pollisco (1982), Whitmore and Grimwood (1976) and, more recently, by MacKinnon and MacKinnon (IUCN/UNEP 1986). In addition, Hunting Technical Services Ltd (1985) has provided recommendations for expanding the network of reserves on the island of Palawan. The existing protected area system is currently under further review by the Haribon Foundation and only a few brief observations are included in this report.

There is already an extensive and long-established system of over 60 protected areas in the Philippines (Figure Six), but these cover only 1.3% of the country's total land area and an inadequate range of biomes. Moreover, very few of the threatened faunal populations

Key to Figure Six: Philippine National Parks with area greater than 3000 ha.

1. Mt Data National Park (5512 ha)
2. Agoo-Damortis National Park (10 947 ha)
3. Bataan National Park (23 853 ha)
4. Naujan Lake National Park (21 655 ha)
5. Mt Iglit-Baco National Park (75 445 ha)
6. St Paul's Subterranean River National Park (3590 ha)
7. Mt Canlaon National Park (24 557 ha)
8. Central Cebu National Park (11 894 ha)
9. Mt Malindang National Park (53 262 ha)
10. Mt Apo National Park (72 814 ha)
11. Leyte Mountains National Park (42 000 ha)
12. Bulusan Volcano National Park (3673 ha)
13. Mayon Volcano National Park (5459 ha)
14. Mt Isarog National Park (10 112 ha)
15. Bicol National Park (5201 ha)
16. Taal Volcano National Park (4537 ha)
17. Mt Arayat National Park (3715 ha)
18. Aurora Memorial National Park (5676 ha)

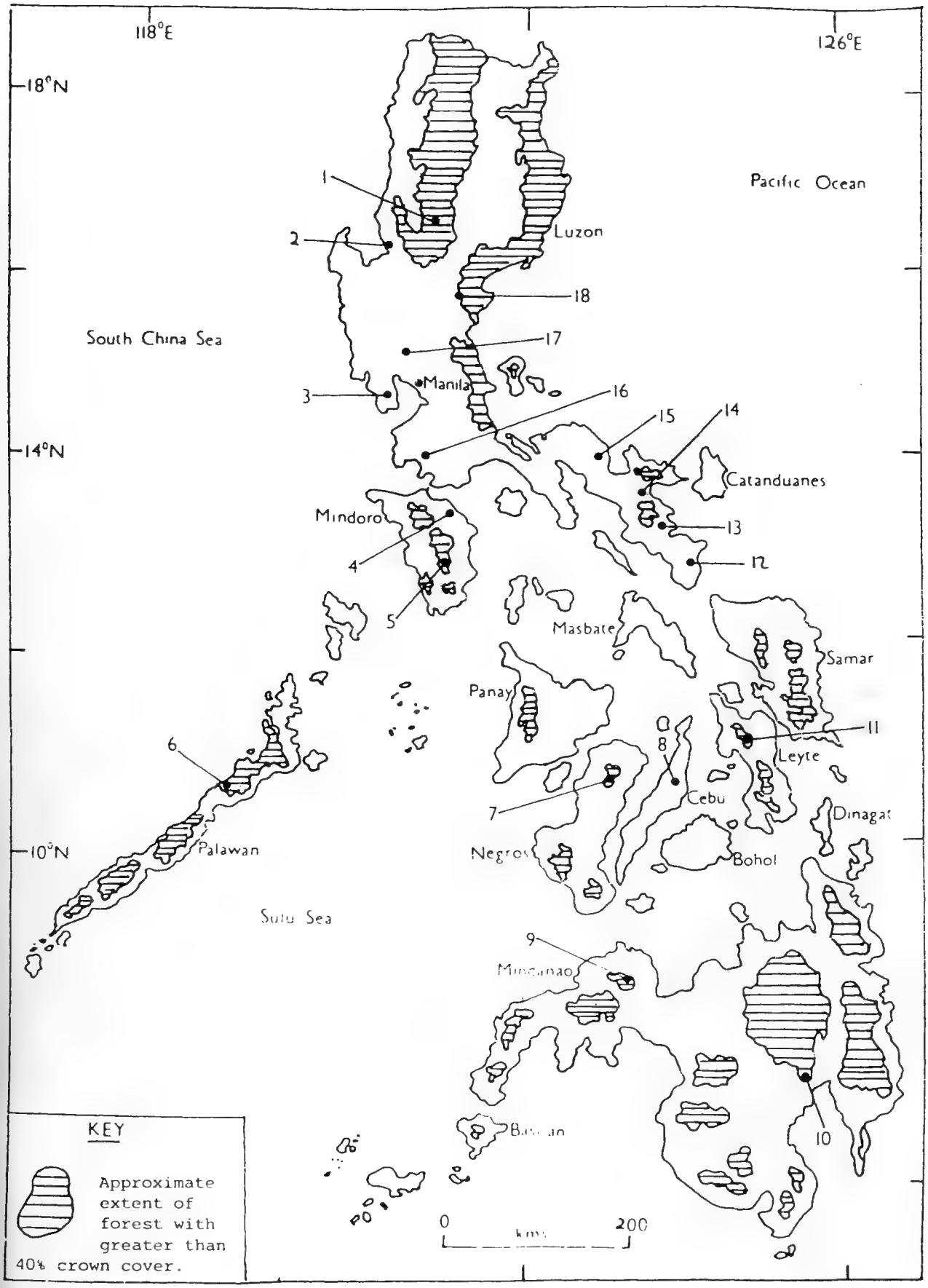

Figure Six . Philippine National Parks with area greater than 3000 ha.

identified in this report are afforded any real measure of protection. Although the legal status of these protected areas is quite suitable for their declared management objectives (IUCN/UNEP 1986), virtually all vegetation types are under-represented. MacKinnon and MacKinnon (IUCN/UNEP 1986) conclude that "the only habitat type adequately covered is the very small area of forest on limestone. There is no effective protection at all for freshwater swamp, mangrove or tropical pine forest habitats and the areas of lowland forests protected are pathetically small. Many existing reserves are too small to be viable and the protected area system as a whole does not give adequate coverage to the country's rich variety of habitat types". The need for an expanded protected areas system to conserve important habitat areas is recognised by the Philippine authorities. In 1979, for example, Letter of Instruction No. 917 was issued in recognition of the vital role played by mossy forest types in ensuring watershed stabilization. This ordinance provides that all mossy forest areas shall be declared wilderness areas and closed to any form of exploitation (Lechoncito 1985).

Despite attempts to introduce legislation designed to improve the conservation status of the Philippine vegetation, implementation of the law is problematic and most laws are extremely difficult to enforce (Roque 1986, Tolentino 1986). In 1975 it was estimated that approximately 76 000 agricultural settlers were living inside national parks and other protected areas (Haribon Foundation, not dated), where 27% of the total land surface supported disturbed or exotic vegetation (Whitmore and Grimwood 1976). In theory, one of the principal tasks of the Bureau of Protected Areas and Wildlife is to prevent illegal logging and human encroachment but in practice funding for forest protection activities is very limited. As a result at least two-thirds of Philippine national parks now contain settlements and/or have been partly logged; boundaries are not demarcated; and staff are poorly paid and under-trained.

The following national parks have been identified as high priority areas for conservation activity in the Philippine archipelago (IUCN/UNEP 1986):

i) St Paul's Subterranean River National Park (3590 ha). The St Paul's N.P. is situated on the west coast of Palawan, northeast of Ulugan Bay. Over 90% of the park comprises 'tropical karst' limestone ridges around Mt St Paul. It also includes one of the longest underground rivers in the world. Three vegetation types (lowland semi-evergreen forest, karst forest and beach forest) are present. These generally appear not to have been disturbed by human encroachment except for small sections of the beach forest which are now severely degraded. As the only existing national park on the island, St Paul's could be invaluable in preserving examples of most of Palawan's distinctive fauna but its present size is inappropriate and proposals to extend the park's area to include forest formations currently outside the northern boundary should receive serious consideration.

ii) Mt Iglit-Baco National Park (75 445 ha). The Mt Iglit-Baco N.P. is one of only two ASEAN Natural Heritage Sites in the Philippines and is important for its population of tamaraw Bubalus mindorensis. The park spans the central northwest-southeast divide of the island of Mindoro and consequently it includes several distinct physiographic regions. The vegetation of much of this reserve is fire-maintained secondary savanna with Imperata cylindrica and Sacchareum spontaneum occurring in dense stands. Some areas of mixed dipterocarp forest are also present, and mossy forest prevails at elevations over 1500 m above sea level. Mt Iglit-Baco is inhabited by the Tabuid people who burn large parts of the park annually for grazing by large herds of cattle. Ranching and uncontrolled hunting activities have contributed substantially to the decline of the tamaraw.

iii) Leyte Mountains National Park (approximately 42 000 ha). This park is situated in the central mountain range of the island of Leyte in the Eastern Visayas. There are numerous waterfalls in the area as well as several interesting phenomena (e.g. highly coloured hot springs and multicoloured muds) associated with the geologically recent

volcanic activity of the region. The vegetation includes both lowland dipterocarp forest formations and stunted mossy forests. A small number of slash-and-burn cultivators occupy the park and although their impact is minimal at present further human encroachment is likely as the population of the island increases.

iv) Mt Apo National Park (72 814 ha). Mt Apo (2954 m), the highest peak in the Philippines, is located on the southeast coast of Mindanao close to the Davao Gulf. The park is an ASEAN Natural Heritage Site and supports many species of plants, birds and animals endemic to the archipelago. It is one of the last remaining localities inhabited by the endangered Philippine eagle Pithecophaga jefferyi. The natural habitat still includes extensive tropical montane and mossy forest associations but most of the areas originally covered by lowland dipterocarp forests have now been cleared by slash-and-burn cultivators. There is no effective management regime for the Mt Apo National Park and few protective regulations are adequately enforced. Consequently, human encroachment is an enormous problem and it is estimated that at least 20 000 people probably live within the park's boundaries.

v) Mt Canlaon National Park (24 557 ha). This national park includes the whole of the Mt Canlaon volcano (2438 m) which is situated in northern Negros some 15 km east of Bacolod city. The park area is mostly forested but some grasslands are present near the crater. The vegetation on the lower slopes of the volcano has been extensively modified by human agricultural activities.

6.2. MARINE PARKS

In 1977 the National Environmental Protection Council (NEPC) initiated a Coastal Zone Management Programme, and a Marine Parks/Reserves Development (MPRD) Inter-Agency Task Force of 22 agencies was established. This has carried out a variety of assessments and studies including an inventory of coastal zone resources. A Master Plan for coastal zone management was formulated

and its implementation is now being worked on, including the preparation of recommendations for improved legislation and enforcement. Under Presidential Declaration 1698, jurisdiction of all coral reef resources was given to the Bureau of Fisheries and Aquatic Resources (BFAR) which initiated a management scheme aimed at creating a variety of forms of protected area. A comprehensive review of these marine parks has recently been completed by IUCN's Conservation Monitoring Centre at Cambridge as part of a wider project designed to provide a description of all coral reef areas of international significance. The relevant section of this directory (UNEP/IUCN, in press), which includes an exhaustive list of references, is provided in the Resource Book which accompanies this report.

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7. CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

i) The tropical moist forests of the Philippines have been extensively modified by logging, mining and human agricultural activities, and the area of degraded forest lands is large and increasing rapidly. Marine ecosystems have also suffered severe damage and degradation. The archipelago still retains a diverse flora and fauna however, with high levels of endemism in both, but the conservation status of these biological resources is poor and under the existing network of protected areas few ecosystems can be expected to maintain their genetic diversity in the medium-term (10 to 100 years).

ii) There have been few recent faunal field surveys conducted in the Philippines and a national assessment of the conservation status of the archipelago's wildlife resources is urgently required. A research proposal for a faunal survey of the Philippines has been drawn up by the Haribon Foundation as part of this organization's Scientific Research and Development Program and a project of this nature should be

an important component of any future assessment of the nation's biological diversity. Full details of the Haribon Foundation's proposed faunal survey of the Philippines are not available. However, a summary account of this project's objectives and proposed methodology has been published in Enviroscope, the quarterly bulletin of the Haribon Foundation, and the relevant issue of this publication is included in the Resource Book.

iii) An analysis of the distribution patterns of 625 indigenous Philippine terrestrial species (excluding bats) has demonstrated that the vast majority occur on three large islands in the archipelago - Mindanao, Luzon and Palawan (Hauge et al. 1986). Together these islands contain 86% of all terrestrial vertebrate species. They also include 72% of all single-island endemics. Smaller fringing islands may act as important regugia for species from these large land masses, however, and in some cases (e.g. Dinagat and islands in the Calamian group) they may also protect taxa which are found nowhere else in the archipelago. Although small islands generally do not contain anything like as wide a range of species as a piece of comparable habitat of similar size on the adjacent mainland. they are often worthy of protection in their own right and should be included in any proposed survey of the Philippines' wildlife resources.

iv) The Philippine protected area system covers only 1.3% of the nation's terrestrial environment and all habitat types are under-represented. In view of the extremely high levels of deforestation throughout the archipelago and the difficulties encountered by the Philippine authorities in maintaining the integrity of most protected areas, a national inventory of the natural vegetation is needed to:

- Ennumerate those habitat types currently represented in the existing protected area system.

- Establish the area covered by each habitat type and assess the extent to which these have been modified by human agricultural activities.

- Identify important habitat types not represented in the existing protected area system which merit inclusion in an expanded network of national parks.

v) Specific recommendations for extending the Philippine terrestrial protected area system to include a broader spectrum of the archipelago's natural vegetation have already been put forward by MacKinnon and MacKinnon (IUCN/UNEP 1986) as part of a wider project undertaken on behalf of the IUCN to assess the status of the protected areas system of the Indo-Malayan Realm. They are:

1. The areas presently covered by the Victoria Peaks, Mt Data and Mt Apo National Parks should all be extended.
2. New extensive reserves should be established on the moist eastern hills of Mindanao, the dry south-western corner of Mindanao and the Sulu archipelago.
3. The mangrove forests of Negros and Panay should be protected.
4. Areas of Pinus merkusii should be protected on both Luzon and Mindoro.
5. A substantial reserve should be established on the north-east corner of Luzon, extending both sides of the hills which form the limits of the cyclone zone.
6. The St Paul's National Park should be enlarged and examples of Palawan's monsoon forest should be protected.
7. Reserves should be established on the Calamian islands.

Research to assess the feasibility of implementing these recommendations in the context of existing regional development scenarios is urgently required.

vi) An integral environmental planning study of the island of Palawan undertaken by Hunting Technical Services Ltd (1985) includes recommendations for the creation of six terrestrial reserves which would, inter alia, afford protection for examples of the island's lowland casuarina forests. Consideration should be given to implementing these proposals at the earliest possible opportunity.

vii) While an expanded system of protected areas in the Philippines is highly desirable, the effective administration of such areas would be problematic given the meagre financial resources and inadequate administrative capabilities of the government bureaux charged with their protection. The capacity of the Bureau of Protected Areas and Wildlife to execute effective conservation management in national parks should be strenghened. This will involve:

- the introduction of suitable legislation to prevent human encroachment
- the development of a well-paid, well-trained cadre of forest guards and park rangers to enforce this legislation.
- proper boundary demarcation
- more effective monitoring of biological resources to enable protected area managers to check the condition of the environment through time, identify trends or changes and gauge the effectiveness of their actions.

viii) The Philippine authorities have put considerable effort into the development of an extensive network of marine parks but enforcement of legislation promulgated to maintain the integrity of park boundaries is poorly implemented and many of the existing declared areas require improved management. The Bureau of Fisheries and Aquatic Resources does not have the financial resources or the manpower to provide adequate protection for the marine ecosystems of the Philippines and much stronger support of ongoing research and conservation activities is needed if this bureau is to carry out its work effectively.

8. APPENDICES

APPENDIX ONE

THREATENED SPECIES CATEGORIES

EXTINCT (Ex).

Species not definitely located in the wild during the past 50 years (criterion as used by CITES).

ENDANGERED (E).

Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating.

Included are taxa whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction. Also included are taxa that are possibly already extinct but have definitely been seen in the wild in the past 50 years.

VULNERABLE (V).

Taxa believed likely to move into the Endangered category in the near future if the causal factors continue operating.

Included are taxa of which most or all the populations are decreasing because of over-exploitation, extensive destruction of habitat or other environmental disturbance; taxa with populations that have been seriously depleted and whose ultimate security has not yet been assured; and taxa with populations that are still abundant but are under threat from severe adverse factors throughout their range.

RARE (R).

Taxa with world populations that are not at present Endangered or Vulnerable, but are at risk.

These taxa are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range.

INDETERMINATE (I).

Taxa known to be Endangered, Vulnerable or Rare but where there is not enough information to say which of the the categories is appropriate.

OUT OF DANGER (O)

Taxa formerly included in one of the above categories, but which are now considered relatively secure because effective conservation measures have been taken or the previous threat to their survival has been removed.

INSUFFICIENTLY KNOWN (K).

Taxa that are suspected but not definitely known to belong to any of the above categories, because of lack of information.

APPENDIX TWO

DEFINITION OF THE PHILIPPINE COASTAL ZONE

In 1982 the National Environment Protection Council formulated an act which established a coastal zone management system for the Philippines. This act was introduced to the Batasang Pambansa (Philippine Parliament) as Parliamentary Bill No. 3027 and includes the following definition of the Philippine coastal zone (quoted in NEPC 1982:127):

> ".....the waters around, between and connecting the islands of the archipelago, irrespective of their breadth and dimensions that forms part of the internal waters of the Philippines and within the baseline established pursuant to Republic Act No.3046 as amended by Republic Act No.5446 together with a three kilometer seaward marginal belt measured therefrom, including its seabed, subsoil and superjacent waters, and the areas extending one kilometer landward from the shoreline or from places where recognizable maritime influences such as mangrove, marshlands, beach vegetation, sand dunes, salt beds and the like exist."

APPENDIX THREE

LIST OF POSSIBLY THREATENED PHILIPPINE LAND MAMMALS (EXCLUDING BATS) (* = ENDEMIC, ** = SINGLE ISLAND ENDEMIC)

ERINACEIDAE - HEDGEHOGS AND GYMNURES	
Podogymnura aureospinula	Dinagat island**
SORICIDAE - SHREWS	
Crocidura grandis	Mt Malindang, Mindanao**
Crocidura mindorus	Mt Halcon, Mindoro**
Crocidura negrina	Negros**
LORISIDAE -LORISES AND COUCANGS	
Nycticebus coucang	Philippine records from Sulu Archipelago only
MANIDAE - PANGOLINS	
Manis javanica	Philippine records from Palawan faunal region only
SCIURIDAE - SQUIRRELS	
Hylopetes mindanensis	Misamis Oriental Province, Mindanao**
Hylopetes nigripes	Palawan**
Petinomys crinitus	Minadanao faunal region*
Sundasciurus hoogstraali	Busuanga island **
Sundasciurus mollendorffi	Culion island**
Sundasciurus rabori	Mt Mantalingajan, Palawan**
MURIDAE - MICE AND RATS	
Abditomys latidens	Mountain and Laguna Provinces, Luzon**
Anonymomys mindorensis	Ilong Peak, Halcon Range, Mindoro**
Apomys abrae	Central Cordillera, Luzon**
Apomys datae	Mountain Province, Luzon**
Apomys hylocetes	Mt Apo, Davao Province, Mindanao
Apomys musculus	Highlands of Luzon and Mindoro*
Apomys sacobianus	Pampanga Province, Luzon **
Archboldomys luzonensis	Mt Isarog, Camarines Sur Province, Luzon**
Batomys dentatus	Benguet Province, Luzon**
Batomys granti	Mt Data, Benguet Province, Luzon
Batomys sp.	Dinagat island**
Carpomys melanurus	Benguet Province, Luzon**
Carpomys phaeurus	Benguet and Ifugao Provinces, Luzon**
Celaenomys silaceus	Benguet Province, Luzon**
Chiropodomys calamianensis	Palawan faunal region*
Chrotomys whiteheadi	Benguet Province, Luzon**
Crateromys australis	Dinagat island**

Crateromys paulus	Ilin island, south of Mindoro**
Crateromys schadenbergi	Benguet and Ifugao Provinces, Luzon**
Crunomys fallax	Isabella Province, Luzon**
Crunomys melanius	Mindanao**
Crunomys rabori	Northern Leyte**
Haeromys sp.	Palawan and Calauit islands*
Limnomys sibuanus	Mts. Apo and Malindang, southern Mindanao**
Palawanomys furvus	Mt Mantalingajan, Palawan**
Phloemys cumingi	Luzon**
Rattus tawitawiensis	Tawitawi island, Sulu Archipelago**
Rhynchomys isarogensis	Mt Isarog, Camarines Sur Province, Luzon**
Rhynchomys soricoides	Mt Data, Benguet Province, Luzon**
Tarsomys apoensis	Mindanao**
Tryphomys adustus	Benguet, Laguna and Tarlac Provinces, Luzon**
CARNIVORA - CARNIVORES	
Felis bengalensis	Busuanga, Cebu, Negros, Palawan and Panay
Aonyx cinerea	Philippine records from Palawan only
Mydaus marchei	Philippine records from Palawan and Busuanga only
Herpestes brachyurus	Philippine records from Palawan and Busuanga only.

APPENDIX FOUR

ENDEMIC BIRDS OF THE PHILIPPINES

L = Luzon and associated small islands, including the islands of Luzon Strait
M = Mindanao and offshore islands
P = Palawan and associated islands on the Sunda Shelf, including Cagayan Sulu
C = Central Islands of the Philippines, between Luzon and Mindanao
S = The Sulu Archipelago, including Basilan

Philippine Serpent Eagle Spilornis holospilus	L	M	-	C	S
Philippine Eagle Pithecophaga jefferyi	L	M	-	C	-
Philippine Hawk-Eagle Spizaetus philippensis	L	-	P	C	S
Philippine Falconet Microhierax erythrogonys	L	M	-	C	-
Philippine Duck Anas luzonica	L	M	P	C	S
Palawan Peacock Pheasant Polyplectron emphanum	-	-	P	-	-
Worcester's Buttonquail Turnix worcesteri	L	-	-	-	-
Spotted Buttonquail Turnix ocellata	L	-	-	-	-
Brown-banded Rail Rallus mirificus	L	-	-	-	-
White-eared Brown Dove Phapitreron leucotis	L	M	-	C	S
Amethyst Brown Dove Phapitreron amethystina	L	M	-	C	-
Dark-eared Brown Dove Phapitreron cinereiceps	-	M	-	-	S
Flame-breasted Fruit-Dove Ptilinopus marchei	L	-	-	-	-
Cream-bellied Fruit-Dove Ptilinopus merrilli	L	-	-	-	-
Yellow-breasted Fruit-Dove Ptilinopus occipitalis	L	M	-	C	S
Black-chinned Fruit-Dove Ptilinopus leclancheri	L	M	P	C	S
Negros Fruit-Dove Ptilinopus arcanus	-	-	-	C	-
Pink-bellied Imperial Pigeon Ducula poliocephala	L	M	-	C	S
Mindoro Imperial Pigeon Ducula mindorensis	-	-	-	C	-
Spotted Imperial Pigeon Ducula carola	L	M	-	C	-
Luzon Bleeding-heart Dove Gallicolumba luzonica	L	-	-	-	-
Mindanao Bleeding-heart Dove Gallicolumba criniger	-	M	-	C	S
Mindoro Bleeding-heart Dove Gallicolumba platenae	-	-	-	C	-
Negros Bleeding-heart Dove Gallicolumba keayi	-	-	-	C	-
Sulu Bleeding-heart Dove Gallicolumba menagei		-	-	-	S
Mindanao Lorikeet Trichoglossus johnstoniae	-	M	-	-	-
Red-vented Cockatoo Cacatua haematuropygia	L	M	P	C	S
Sulu Racket-tail Prioniturus verticalis	-	-	-	-	S
Green Racket-tail Prioniturus luconensis	L	-	-	C	-
Blue-crowned Racket-tail Prioniturus discursus	L	M	-	C	S
Blue-headed Racket-tail Prioniturus platenae	-	-	P	-	-
Red-crowned Racket-tail Prioniturus montanus	L	M	-	-	S
Guaiabero Bolbopsittacus lunulatus	L	M	-	C	-
Colasisi Loriculus philippensis	L	M	-	C	S
Red-crested Malkoha Phaenicophaeus superciliosus	L	-	-	C	-
Scale-feathered Malkoha Phaenicophaeus cumingi	L	-	-	C	-
Black-hooded Coucal Centropus steerii	-	-	-	C	-
Philippine Coucal Centropus viridis	L	M	P	C	S
Black-faced Coucal Centropus melanops	-	M	-	C	S
Rufous Coucal Centropus unirufus	L	-	-	-	-
Philippine Scops-Owl Otus megalotis	L	M	-	C	S
Luzon Scops-Owl Otus longicornis	L	-	-	-	-

Mindoro Scops-Owl Otus mindorensis	-	-	-	C	-
Mindanao Scops-Owl Otus mirus	-	M	-	-	-
Giant Scops Owl Mimizuku gurneyi	-	M	-	-C	-
Philippine Eagle-Owl Bubo philippensis	L	M	-	C	-
Philippine Boobook Ninox philippensis	L	M	-	C	S
Philippine Frogmouth Batrachostomus septimus	L	M	-	C	S
Pygmy Swiftlet Collocalia troglodytes	L	M	P	C	-
Philippine Needletail Mearnsia picina	-	M	-	C	-
Philippine Trogon Harpactes ardens	L	M	-	C	S
Dwarf River Kingfisher Ceyx cyanopectus	L	-	-	C	-
Silvery Kingfisher Ceyx argentatus	-	M	-	C	S
Jungle Kingfisher Ceyx melanurus	L	M	-	C	S
Rufous-lored Kingfisher Halcyon winchelli	-	M	-	C	S
Spotted Wood Kingfisher Halcyon lindsayi	L	-	-	C	-
Blue-capped Wood Kingfisher Halcyon hombroni	-	M	-	-	-
Tarictic Hornbill Penelopides panini	L	M	-	C	S
Writhed Hornbill Rhyticeros leucocephalus	-	M	-	C	-
Sulu Hornbill Anthracoceros montani	-	-	-	-	S
Palawan Hornbill Anthracoceros marchei	-	-	P	-	-
Rufous Hornbill Buceros hydrocorax	L	M	-	C	S
Philippine Pygmy Woodpecker Picoides maculatus	L	M	-	C	S
Sooty Woodpecker Mulleripicus funebris	L	M	-	C	-
Wattled Broadbill Eurylaimus steerii	-	M	-	C	S
Whiskered Pitta Pitta kochi	L	-	-	-	-
Azure-breasted Pitta Pitta steerii	-	M	-	C	-
Blackish Cuckoo-shrike Coracina coerulescens	L	-	-	C	-
McGregor's Cuckoo-shrike Coracina mcgregori	-	M	-	-	-
Black-bibbed Cuckoo-shrike Coracina mindanensis	L	M	-	C	S
White-winged Cuckoo-shrike Coracina ostenta	-	-	-	C	-
Philippine Pied Triller Lalage melanoleuca	L	M	-	C	-
Philippine Leafbird Chloropsis flavipennis	-	M	-	C	-
Yellow-throated Leafbird Chloropsis palawanensis	-	-	P	-	-
Yellow-wattled Bulbul Pycnonotus urostictus	L	M	-	C	S
Sulphur-bellied Bulbul Hypsipetes palawanensis	-	-	P	-	-
Philippine Bulbul Hypsipetes philippinus	L	M	-	C	-
Zamboanga Bulbul Hypsipetes rufigularis	-	M	-	-	S
Streaked-breasted Bulbul Hypsipetes siquijorensis	-	-	-	C	-
Yellowish Bulbul Hypsipetes everetti	-	M	-	C	S
Ashy-headed Babbler Malancocincla cinereiceps	-	-	P	-	-
Bagobo Babbler Leonardina woodi	-	M	-	-	-
Melodious Babbler Malacopteron palawanense	-	-	P	-	-
Streaked Ground Babbler Ptilocichla mindanensis	-	M	-	C	S
Falcated Ground Babbler Ptilocichla falcata	-	-	P	-	-
Luzon Wren-Babbler Napothera rabori	L	-	-	-	-
Pygmy Tree Babbler Stachyris plateni	-	M	-	C	-
Rusty-crowned Tree Babbler Stachyris capitalis	-	M	-	C	S
Black-crowned Tree Babbler Stachyris nigrocapitata	L	-	-	C	-
Golden-crowned Tree Babbler Stachyris dennistouni	L	-	-	-	-
Flame-templed Tree Babbler Stachyris speciosa	-			C	-
Chestnut-faced Tree Babbler Stachyris whiteheadi	L	-		-	-
Striped Tree Babbler Stachyris striata	L	-	-	-	-
Negros Tree Babbler Stachyris nigrorum	-	-		C	-
Buff-capped Tree Babbler Stachyris hypogrammica	-	-	P	-	-
Brown Tit-Babbler Macronous striaticeps	-	M	-	C	S
Miniature Tit-Babbler Micromacronus leytensis	-	M	-	C	-

White-browed Shama Copsychus luzoniensis	L	-	-	C	-
White-vented Shama Copsychus niger	-	-	P	-	-
Black Shama Copsychus cebuensis	-	-	-	C	-
Luzon Water Redstart Rhyacornis bicolor	L	-	-	-	-
Ashy Thrush Zoothera cinerea	L	-	-	C	-
Long-tailed Bush-Warbler Bradypterus caudatus	L	M	-	-	-
Philippine Leaf-Warbler Phylloscopus olivaceus	-	M	-	C	S
Lemon-throated Warbler Phylloscopus cebuensis	L	-	-	C	-
Grey-backed Tailorbird Orthotomus derbianus	L	-	P	-	-
White-eared Tailorbird Orthotomus cinereiceps	-	M	-	-	S
White-browed Tailorbird Orthotomus nigriceps	-	M	-	C	-
White-throated Jungle Flycatcher Rhinomyias albigularis	-	-	C	-	
Luzon Jungle Flycatcher Rhinomyias insignis	L	-	-	-	-
Slaty-backed Jungle Flycatcher Rhinomyias goodfellowi	-	M	-	-	-
Little Slaty Flycatcher Ficedula basilanica	-	M	-	C	S
Palawan Flycatcher Ficedula platenae	-	-	P	-	-
Cryptic Flycatcher Ficedula crypta	L	M	-	-	-
Blue-breasted Flycatcher Cyornis herioti	L	-	-	-	-
Short-crested Monarch Hypothymis helenae	L	M	-	C	-
Celestial Monarch Hypothymis coelestis	L	M	-	C	S
Blue Paradise Flycatcher Terpsiphone cyanescens	-	-	P	-	-
Blue Fantail Rhipidura superciliaris	-	M	-	C	S
Blue-headed Fantail Rhipidura cyaniceps	L	-	-	C	-
Black and Cinnammon Fantail Rhipidura nigrocinnamomea	-	M	-	-	-
Philippine Whistler Pachycephala plateni	-	-	P	-	-
Yellow-bellied Whistler Pachycephala philippinensis	L	M	-	C	S
Elegant Tit Parus elegans	L	M	-	C	S
Black-headed Tit Parus amabilis	-	-	P	-	-
White-fronted Tit Parus semilarvatus	L	M	-	-	-
Striped-sided Creeper Rhabdornis mysticalis	L	M	-	C	-
Striped-breasted Creeper Rhabdornis inornatus	-	M	-	C	-
Long-billed Creeper Rhabdornis grandis	L	-	-	-	-
Mountain Shrike Lanius validirostris	L	M	-	C	-
Apo Myna Basilornis miranda	-	M	-	-	-
Coleto Sarcops calvus	L	M	-	C	S
Balicassiao Dicrurus balicassius	L	-	-	C	-
Grey-throated Oriole Oriolus steeri	-	-	-	C	-
White-lored Oriole Oriolus albiloris	L	-	-	-	-
Isabela Oriole Oriolus isabellae	L	-	-	-	-
Philippine Fairy Bluebird Irena cyanogaster	L	M	-	C	S
Grey-hooded Sunbird Aethopyga primigenius	-	M	-	-	-
Apo Sunbird Aethopyga boltoni	-	M	-	-	-
Flaming Sunbird Aethopyga flagrans	L	-	-	C	-
Metallic-winged Sunbird Aethopyga pulcherrima	L	M	-	C	S
Lovely Sunbird Aethopyga shelleyi	L	M	P	C	S
Naked-faced Spiderhunter Arachnothera clarae	L	M	-	C	-
Olive-backed Flowerpecker Prionochilus olivaceus	L	M	-	C	S
Palawan Flowerpecker Prionochilus plateni	-	-	P	-	-
Striped Flowerpecker Dicaeum aeruginosum	L	M	P	C	-
Whiskered Flowerpecker Dicaeum proprium	-	M	-	-	-
Olive-capped Flowerpecker Dicaeum nigrilore	-	M	-	-	-
Flame-crowned Flowerpecker Dicaeum anthonyi	L	M	-	-	-
Bicolored Flowerpecker Dicaeum bicolor	L	M	-	C	-
Orange-backed Flowerpecker Dicaeum quadricolor	-	-	-	C	-
Red-striped Flowerpecker Dicaeum australe	L	M	-	C	S

Scarlet-collared Flowerpecker Dicaeum retrocinctum	-	-	-	C	-
Buzzing Flowerpecker Dicaeum hypoleucum	L	M	-	C	S
Pygmy Flowerpecker Dicaeum pygmaeum	L	M	P	C	-
Philippine White-eye Zosterops meyeni	L	-	-	-	-
Yellowish White-eye Zosterops nigrorum	L	-	-	C	-
Mindanao Ibon Lophozosterops goodfellowi	-	M	-	-	-
Cinnamon Ibon Hypocryptadius cinnamomeus	-	M	-	-	-
Red-eared Parrotfinch Erythrura coloria	-	M	-	-	-
Green-faced Parrotfinch Erythrura viridifacies	L	-	-	-	-
White-cheeked Bullfinch Pyrrhula leucogenys	L	M	-	-	-

Eleven species in the Philippine avifauna which may be endemic have been omitted from the list because their taxonomic rank is unstable. They are:

Mindanao Racket-tail Prioniturus waterstradti = P. montanus waterstradti?
Philippine Hawk-Cuckoo Cuculus pectoralis = C. fugax pectoralis?
Whitehead's Swiftlet Aerodramus whiteheadi = A. brevirostris whiteheadi?
Ground-nest Swiftlet Collocalia isonota = C. esculenta isonota?
Grey-rumped Swiftlet Collocalia marginata = C. esculenta marginata?
Sulphur-billed Nuthatch Sitta oenochlamys = S. frontalis oenochlamys?
Rufous-headed Tailorbird Orthotomus heterolaemus = O. cucullatus heterolaemus?
Philippine Tailorbird Orthotomus castaneiceps = O. atrogularis frontalis?
Rufous-fronted Tailorbird Orthotomus frontalis = O. atrogularis frontalis?
Yellow-breasted Tailorbird Orthotomus samarensis = O. nigriceps samarensis?
Ashy-breasted Flycatcher Muscicapa randi = M. latirostris randi?

APPENDIX FIVE

A PRELIMINARY LIST OF THREATENED OR NEAR-THREATENED BIRDS OF THE PHILIPPINES

1. Philippine Eagle *Pithecophaga jefferyi*
2. Palawan Peacock Pheasant *Polyplectron emphanum*
3. Brown-banded Rail *Rallus minificus*
4. Worcester's Buttonquail *Turnix worcesteri*
5. Negros Fruit-Dove *Ptilinopus arcanus*
6. Mindoro Imperial Pigeon *Ducula mindorensis*
7. Mindoro Bleeding-Heart Dove *Gallicolumba platenae*
8. Negros Bleeding-Heart Dove *Gallicolumba keayi*
9. Sulu Bleeding-Heart Dove *Gallicolumba menagei*
10. Red-vented Cockatoo *Cacatua haematuropygia*
11. Green-headed Racket-tail *Prioniturus luconensis*
12. Black-hooded Coucal *Centropus steeri*
13. Mindoro Scops-Owl *Otus mindorensis*
14. Blue-capped Wood Kingfisher *Halcyon hombroni*
15. Sulu Hornbill *Anthracoceros montani*
16. Whiskered Pitta *Pitta kochi*
17. Steere's Pitta *Pitta steerii*
18. Blackish Cuckoo-shrike *Coracina coerulescens*
19. White-winged Cuckoo-shrike *Coracina ostenta*
20. Streaked-breasted Bulbul *Hypsipetes siquijorensis*
21. Bagobo Babbler *Leonardina woodi*
22. Luzon Wren-Babbler *Napothera rabori*
23. Flame-templed Babbler *Stachyris speciosa*
24. Negros Babbler *Stachyris nigrorum*
25. Black Shama *Copsychus cebuensis*
26. Luzon Water Redstart *Rhyacornis bicolor*
27. White-throated Jungle Flycatcher *Rhinomyias albigularis*
28. Blue-breasted Flycatcher *Cyornis herioti*
29. Short-crested Monarch *Hypothymis helenae*
30. Celestial Monarch *Hypothymis coelestis*
31. Long-billed Creeper *Rhabdornis grandis*
32. Isabela Oriole *Oriolus isabelae*
33. Red-eared Parrotfinch *Erythrura coloria*
34. Green-faced Parrotfinch *Erythrura viridifacies*

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