



II

CURRENT STATUS OF BIOLOGICAL RESOURCES

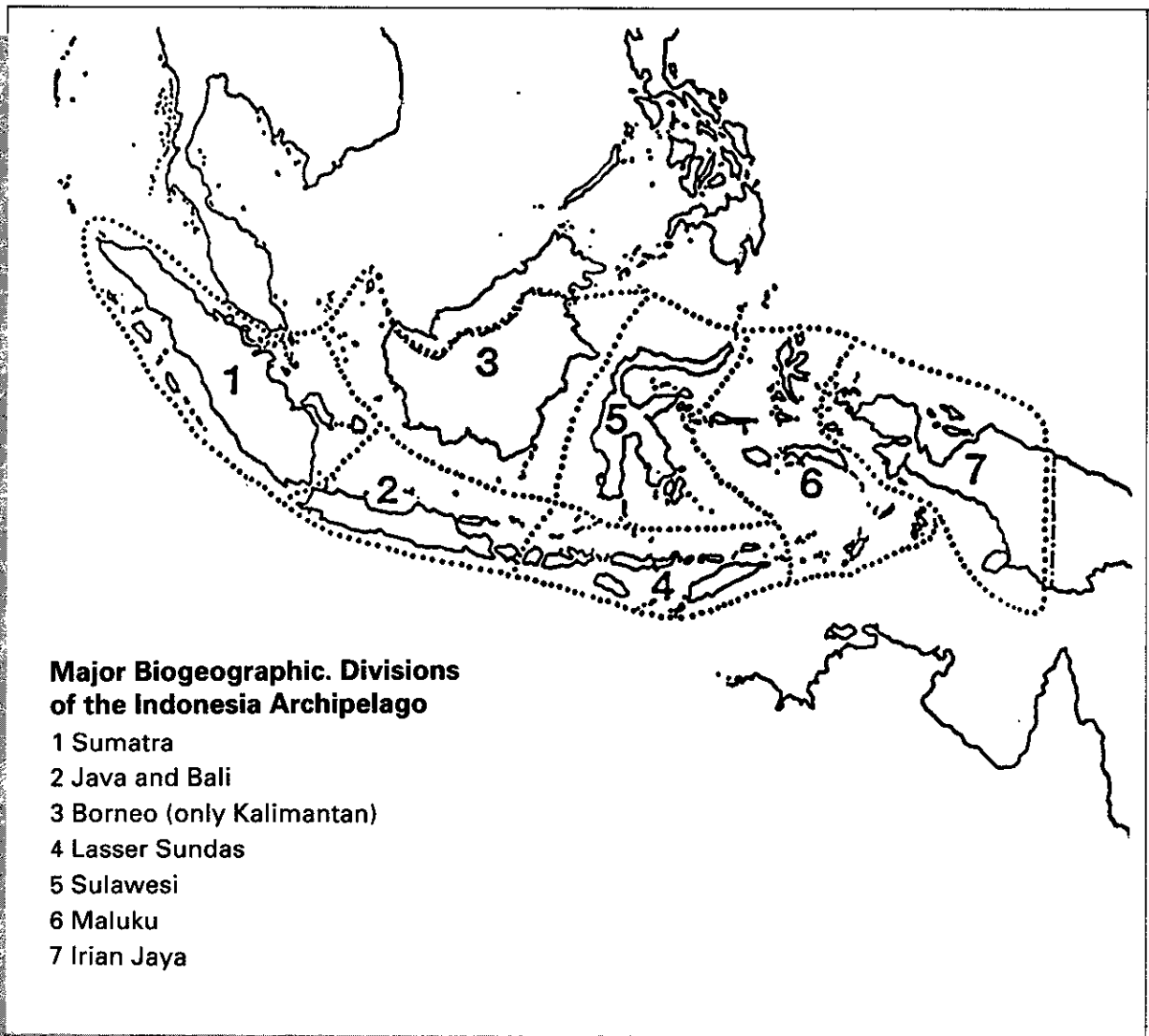
A. *Biogeography of Indonesia*

1. Indonesia is an archipelago of more than 17,000 islands extending 5,000 km along the equator and spanning two major biogeographical realms, Indomalaya and Australasia, as well as several distinct biogeographical provinces. The western islands of Sumatra, Borneo, Java and Bali, lying on the Sunda Shelf, were joined to mainland Asia at times of lowest sea level during the Pleistocene. Similarly the eastern province of Irian Jaya and the Kai and Aru islands on the Sahul Shelf were once connected to Australia. The biota change in species composition west to east but the flora remains

dominantly Malesian throughout the archipelago. Faunal distributions more closely reflect ancient land connections with placental mammals in the west and marsupials in the east. The islands of Sulawesi, Maluku and Nusa Tenggara lie in a major transition zone, Wallacea, between the Indomalayan and Australasian realms. Many of the Indonesian islands have been isolated for millennia and consequently show high levels of species endemism. Due to its unique biogeography, Indonesia is one of the most biologically diverse countries in the world.

2. There are seven major biogeographic regions in Indonesia, centred on the major islands and groups and their surrounding seas: 1) Sumatra and offshore islands; 2) Java and Bali; 3) Kalimantan, including the Natuna and Anambas islands; 4) Sulawesi, and offshore islands including Sula; 5) Nusa Tenggara; 6)

Maluku; and 7) Irian Jaya, including the Kai and Aru islands - map 1. These biogeographic divisions do not always correspond to provincial boundaries. Thus Wetar and Tanimbar (Maluku) lie within the Nusa Tenggara biogeographic region and Aru and Kai (Maluku) are included with Irian Jaya.



B. Habitat Types

1. Indonesia has the largest expanse of lowland rainforests in tropical Asia, some of the most species-rich forests on Earth. Habitat types are diverse, ranging from evergreen lowland dipterocarp forests in Sumatra and Kalimantan, to seasonal monsoon forests and savanna grasslands in Nusa Tenggara and non-dipterocarp lowland forests and alpine ecosystems in Irian Jaya. Other major habitat types are peat swamp and freshwater swamp forests (extensive in Sumatra, Kalimantan and Irian Jaya), heath forests (Kalimantan supports the largest area of kerangas in Southeast Asia); forests on limestone and ultrabasic rocks (Sulawesi has the most extensive ultrabasic habitats in the world); lower and upper montane forests and alpine meadows as on the highest Javan, Sumatran and Irian mountains.

2. Coastal and marine habitats include some of the most extensive mangrove forests in Asia, sea grass beds and spectacular coral reefs, including Taka Bone Rata in the Flores Sea, the third largest atoll in the world. Mangroves are particularly extensive on the east coast of Sumatra, east and south coasts of Kalimantan and in Irian Jaya which has 69 percent of Indonesia's mangrove habitat (Silvius et al., 1987).

3. The extent and conservation importance of these various habitat types have been described in many scientific documents and in the National Longterm Development planning buildline. Table 1 lists the extent and protection of major terrestrial habitats in the seven biogeographic regions. Maps 2a-f in Appendix II show original habitat types.



Sigura-gura Waterfall, North Sumatra, is an attractive tourist attraction and rich with the diversities of flora and fauna

Table 1:
Habitat Coverage for Indonesia

Habitat	Original km ²	Area Rem.%	Prot. area km ²	Prot.%	Prop. area km ²	Prop.%
FL	135793	39.3	5626	4.1	4835	3.6
FS	103054	46.8	5398	5.2	5632	5.5
HF	91660	28.6	1100	1.2	1990	2.2
IF	3420	34.2	280	8.2	20	0.6
LR	896157	57.5	44057	4.9	78753	8.8
MF	206233	77.1	43567	21.1	24049	11.7
PS	219252	78.8	14326	6.5	8641	3.9
SER	150877	28.3	3050	2.0	4580	3.0
TPF	3215	60.0	500	15.6	220	6.8
Mn	50800	43.9	5687	11.2	2978	5.8
UB	8299	46.9	30	0.4	970	11.7
MSF	24192	38.0	1060	4.4	2325	9.6
BV	390	39.7	10	2.5	95	24.4
Alp	2170	100	740	34.1	258	11.8
Total	1895512	55.8	125431	6.6	135346	7.1

Sources: MacKinnon and Artha 1981, MacKinnon & MacKinnon, 1986,
Petocz and Raspado, 1989.

C. Species Richness and Endemism

1. Table 2 lists species numbers and endemics for major plant and animal groups for the seven biogeographic regions. At both the species and generic level endemism is high. Of 429 locally endemic birds 251 are unique to single islands (ICBP, in litt.). Similarly most of Indonesia's insect fauna is endemic to the archipelago with many genera confined to individual mountain tops. Because of their localised distribution many endemics are threatened by habitat loss and/or overexploitation. The three major biodiversity centres are Irian Jaya (high species richness and endemism), Kalimantan (high species richness, moderate endemism) and Sulawesi (moderate species richness, high endemism).



Komodo iguana, the biggest type of species, can still be found in Komodo Island

Table 2
Comparative Biotic Richness and Endemism

Island	Resident Bird spp.	% Bird Endemism	Mammal spp. Richness	% Mammal Endemism	Reptile spp. Richness	% Reptile Endemism	Relative Plant spp. Richness	% Plant Endemism
Sumatra	465	2	194	10	217	11	820	11
Java	362	7	133	12	173	8	630	5
Borneo	420	6	201	48	254	24	900	33
Sulawesi	289	32	114	60	117	26	520	7
Lesser Sundas	242	30	41	12	77	22	150	3
Maluku	210	33	69	17	98	18	380	6
Irian	602	52	125	58	223	35	1030	55

Source: FAO/MacKinnon 1981, *National Conservation Plan*, vol. I.

D. Resource Trends

1. Indonesia's forests cover two-thirds of the country's land area and are the nation's most valuable resource. Official MoF figures list the total area of forests as 143 million hectares: 113 million hectares of permanent forests (protection 30.3 million ha, conservation 18.7 million ha and production 64.3 million ha) and 30 million hectares as forests for conversion to agriculture. Data from the National Forestry Inventory, however, show natural forest extent as only 109 million hectares, much less than previously believed (MoF/FAO, 1991). The rate of forest loss is not accurately known but was estimated as between 700,000 and 1.2 million hectares a year in the early 1980s (RePPProT, 1990). Forest loss results from logging activities and forest clearance for agriculture and plantations, with pioneer farmers often following logging roads into newly-opened areas. The extent of forest loss varies from island to island and province to province - appendix 2. Thus although Kalimantan retains 74 percent of forest cover overall the figure declines to 48 percent in Kalimantan Selatan and 59 percent in Kalimantan Barat (RePPProT, 1990).

2. Forest loss will continue while timber remains a major export earner. Outside Java most timber is derived from natural forests. Timber concessions cover 53.4 million hectares on the Outer Islands and yield 93.5 percent of all timber produced from Indonesia. The demand for logs is about 40 million cu.m per year. Selective logging yields 45 cu.m. per hectare per year so 890,000 ha of forest must be felled each year to meet the demand. Present levels of logging are widely believed to be unsustainable. Between 1986 and 2010, 19.5 million hectares of forests will be felled on a selective or clear-cut basis. All concession forests will be logged in the next 30 years (KLH, 1989). Unless logging is better regulated to minimize environmental disturbance and to allow subsequent natural

regeneration, logging activities will lead to considerable forest loss and erosion of biodiversity.

3. Shifting and pioneer agriculture have affected extensive forest areas, an estimated 38.9 million hectares (RePPProT, 1990). This represents a large proportion of the 'uncontrolled' forest clearance in the last twenty years. Shifting cultivation has created more than 10 million hectares of critical *alang-alang* lands in the Outer Islands (RePPProT, 1990). Wild fires spreading from burning *ladangs* destroy an estimated 25,000 hectares of forests every year. In 1982/1983 large areas of Bornean forest were lost when drought and fire affected 3.6 million hectares of forest (an area the size of Belgium) in East Kalimantan (Lennertz and Panzer, 1983). This ecological disaster was caused by a combination of unusually dry weather and poor land-use practices, with logged forests suffering significantly more damage than primary forests. The area affected by the fire was equal to that of the entire gazetted protected area network for the whole island of Borneo. Forest clearance for agriculture is probably the greatest threat facing Indonesia's biodiversity. As with logging, the habitats most affected are those richest in species, the lowland forests. Improving agricultural practices and rehabilitation of critical lands will be major issues in slowing loss of biodiversity.

4. Government-sponsored forest clearance and habitat conversion to increase food production will also further erode natural habitats. It has been estimated that food crop production will require an area of 17.4 million hectares by the year 2000. This means an additional 1 million hectares of irrigated rice fields and 500,000 hectares of dryland farming will have to be developed (KLH, 1989). Plantation lands already cover 35 million hectares with the greatest areas under coconut (3 million ha) and rubber (2.7



A Transmigration settlement in Southern Irian Jaya

million ha). It is estimated that an additional 2.8-5.6 million hectares will be needed by the year 2000 to increase production of palm oil, coconut, rubber and tree crops. Plans for industrial timber plantations (HTI) will lead to further loss of biodiversity with species-rich primary or secondary forests being replaced by monocultures.

5. Wetland and marine habitats and species face the same threats as forests: massive loss of natural habitats due to changing land use and loss of biodiversity through environmental

damage and overexploitation of resources. Marine, coastal and wetland ecosystems are also particularly vulnerable to activities outside their boundaries, e.g. pollution, dumping of industrial and domestic waste, siltation and changes in water flow caused by alterations in land use onshore or upstream. These pressures are likely to increase with increasing population pressure, expanding industrialisation and economic development. For instance, 95 percent of all mangrove habitats in Kalimantan are already allocated as production forests for chipwood. Similarly the area of mangroves allo-

cated for conversion to tambaks (brackish water ponds) in South Sulawesi is believed to exceed the area of remaining stands. Freshwater fisheries are under pressure from habitat changes (e.g. drainage) and from overfishing, the result of new technologies and expanded markets.

6. It has been estimated that there may be as many as 30 million species of plants and animals worldwide (only 5 percent so far described) and that 25 percent of all species may go extinct by the year 2000. Many of the unrecognised species will be small and apparently insignificant but may be crucial to many life-supporting processes. Conservation measures are, therefore, a matter of urgency. Total species lists for Indonesia's flora and fauna are not yet available but some estimates are presented in appendix 1. It is certain that a number of Indonesian animals have already become extinct. Since the Pleistocene 35 mammals have become extinct on Java, including 20 which still occur elsewhere (McNeely, 1978). As habitat loss continues more extinctions can be expected at both the local and species level. The Javan tiger became extinct in the last decade and at least 18 species of birds formerly found on Java have not been recorded in recent times, including the endemic Javan lapwing *Vanellus macropterus* (MacKinnon,



The rare Sumatran tiger, a protect species

1988). The Red Data Books of IUCN and ICBP list 126 birds (Collar and Andrew, 1988), 63 mammals, 21 reptiles and 65 other Indonesian animal species (IUCN, 1988) as threatened with extinction - Appendix 4.

E. Threats to Habitats and Species

1. Pressure on habitats and species results from a combination of increasing population pressure, poor land use practices and national economic and development policies. Census results show that the population of Indonesia increased from 96 million in 1960 to 179 million in 1990, i.e. almost doubled over 30 years. The population growth rate is now 1.97 percent per annum with 40 percent of the population com-

posed of children under 15 years of age and 13 percent of the population under five. The birth rate is still high and the population will continue to increase substantially to an estimated 216 million people by the year 2000. The population is not evenly spread throughout Indonesia, varying from 800 people/km² on Java to 76/km² on Sumatra, 16/km² on Kalimantan and only 3 people/km² in Irian Jaya. Most of

the population rely on agriculture for a livelihood. As Java and the more fertile parts of the other islands become overcrowded there will be further emigration to the Outer Islands and more forest clearance, habitat loss and environmental destruction.

2. Population and economic growth result in greater pressures on land and forest resources. Forests outside Java are logged, converted to agricultural lands, mining areas and plantations. Often such activities make land unproductive for other purposes. Issues of land tenure and traditional rights are often ignored to the detriment of sound land management. Programmes aimed at increasing food production and alleviating population pressure (e.g. transmigration programmes) have contributed to forest clearance and the opening up of new lands, often leading to soil erosion, reduction in soil fertility and loss of wildlife habitats. Human activities have destroyed, and continue to destroy, large areas of natural habitats.

3. Wetland and coastal ecosystems are especially vulnerable to environmental changes outside their immediate boundaries. Industrial and domestic waste and oil spills pollute rivers, wetlands and coastal habitats, reducing and destroying biodiversity. Inland lakes, important sources of clean water and fresh water fisheries, are contaminated by sedimentation from forest clearance, fertiliser run-off and industrial effluent.

4. Indonesia's marine and littoral habitats are coming under increasing pressure from development and the dependence of the expanding population on marine and coastal resources for food, utilities and market products. The main threats to reefs and other coastal habitats are siltation and increased water turbidity caused by deforestation and erosion in watersheds; coral mining; destructive harvest-

ing and fishing methods (dynamite and poison) and dredging to maintain boat channels. Sedimentation, alterations in water flow, drainage, pollution and conversion to *tambak* are the main threats facing mangroves.

5. Current economic policies, strategies for resource utilisation and management of natural resources (e.g. poor implementation of forestry regulations, lack of a coastal zone management policy, the breakdown of traditional community management systems to protect the sustainability of common property rights) all have adverse impacts on biodiversity. Artificially maintaining low timber prices and subsidies to convert forest to monoculture plantations (usually fast-growing exotic species) act as perverse incentives to conservation of biodiversity.



6. Species populations already threatened by habitat loss and disturbance are particularly vulnerable to pressures such as overexploitation or poaching. Marine turtles, maleo birds, parrots and birds of paradise are threatened by over exploitation.



Shifting cultivation can be very productive, and is sustainable when population pressure is low. More often nowadays, short fallow periods lead to soil degradation until only rank grasses survive

7. Introduction of exotics can also be a serious threat to native species. The introduction of exotic fish species to isolated lake systems, such as the Malili lakes, may lead to the extinction of endemic fishes. The endemic fish *Weberogobius amadi* is already lost from Lake Poso (Whitten et al., 1987b).

8. Current agricultural policy and land use practices have adverse impacts on biodiversity. The emphasis on land conversion to cereal crops is not always ecologically sound, especially on

the poor soils of the Outer Islands. Moreover the emphasis on monocultures rather than traditional mixed farming systems further reduces species diversity.

9. Emphasis on cultivation of new high-yielding crops may lead to loss of indigenous cultivars and thereby decrease genetic diversity. With the adoption of new 'improved' varieties of rice, 1500 local varieties of paddy rice have become extinct in the last 15 years (KLH, 1989).

F. Threatened critical ecosystems

1. Lowland rainforests are some of the most important habitats from a conservation point of view since the greatest richness of species are concentrated in rain forests below 350m. In Borneo, for instance, 78 percent of all resident birds depend on some form of closed woodland and 244 species (61 percent) are confined to mixed lowland rain forests. Of these 146 species (60 percent) are Sunda endemics (Wells, 1985). Unfortunately lowland rainforests, together with wetlands and mangroves, are among the most threatened natural habitats throughout Indonesia. All are under-represented in the protected area network - appendices 2a-f.

2. Several forest sites have been identified as areas of major conservation importance for plants (Appendix 5). Many of the same sites or

localities also score highly for species richness for birds, primates or other indicator species.

3. Endemism is particularly high in island habitats, mountains and in closed ecosystems such as caves and freshwater lakes.

4. Wetlands of major conservation importance are listed in the Indonesian Wetland Inventory (Silvius et al. 1987) - Appendix 6.

5. The richest coral reef systems occur in eastern Indonesia but the most vulnerable and threatened are those near major urban and industrial centres. Pollution in Jakarta Bay, for instance, is a major threat to the fine coral reefs of Pulau Seribu.

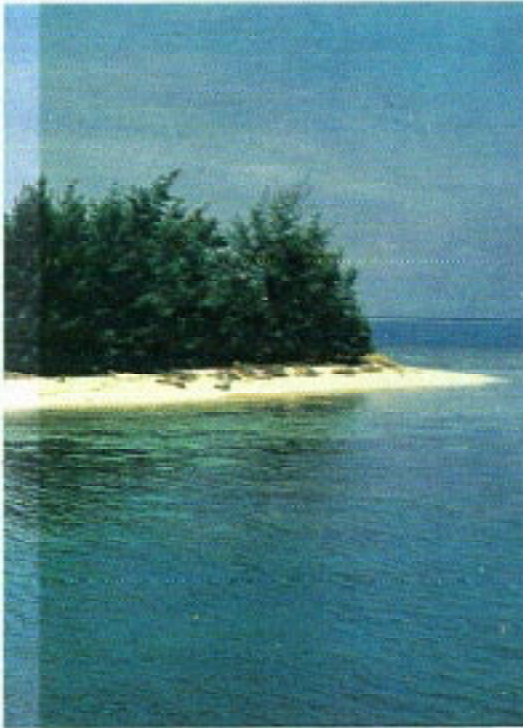
G. Importance of Biodiversity to Resource Sectors

1. Indonesia's biological resources are of vital importance to the nation's welfare and economy. More than 100 species of rain forest trees are harvested commercially supporting a timber industry valued at \$4.5 billion in 1988. Timber ranks second only to oil in terms of export revenues. 86 percent of timber exports come from the Kalimantan lowland dipterocarp and swamp forests.

2. Non-timber forest products are also of value to local and national economies. Rattan exports alone earned \$200+ million in 1988 (de Beer and McDermott, 1989). Many forest plants and animals have little or no market value but are widely utilised as foods, utilities, medicines, fuel, housing and handicraft materials. Such forest products, e.g. wild pig and deer meat,

have significant local value yet are never included in national accounting.

3. Wetlands are important sources of freshwater fish. The Kapuas lakes produce 75 percent of all freshwater fish consumed in West Kalimantan. The Mahakam lakes of East Kalimantan produce more than 30 percent of all dried freshwater fish consumed on Java as well as supplying local markets. Mangroves and estuaries are important nurseries for many commercial fish and prawn species. Mangrove-linked fisheries earned \$194 million in export earnings in 1978, more than seven times the combined export value of mangrove forestry products (charcoal, logs and chips). By 1988, penaeid prawns alone supported an export market worth more than \$482 million (Buku Statistik, 1988).



4. Income from collection and sale of products from forests and freshwater and marine ecosystems can be estimated. It is far more difficult to put a monetary value on the environmental and ecological values of forests, wetlands and coastal habitats. The long-term values of these functions may be worth far more than any short-term income derived from exploitation. The fisheries and coastal protection functions of mangroves, for instance, may far outweigh the value of any other form of alternative land use (Hamilton and Snedaker, 1984).

5. Forests protect watersheds, prevent soil erosion, regulate water flow, modify climate, protect genetic resources and maintain clean air and water. The watershed forests of Kerinci-

Seblat National Park, for instance, protect water supplies to 3 million people and 7 million hectares of agricultural land. Wetlands such as peat swamps perform vital hydrological functions, regulating and maintaining water flow on which agriculture and industry depend.

6. Tourism generated an estimated income of \$1.8 billion in 1990 when Indonesia attracted more than 2 million overseas visitors. The tourist target for 1991 is 2.5-3 million visitors. Indonesia's biological diversity could become one of its major tourist attractions if it is marketed correctly and appropriate infrastructure is developed in national parks to safeguard against over-utilisation. Development of terrestrial and marine areas for tourism fits well with the government policy to expand the tourism sector.

7. Improvement of national health depends on an adequate supplies of clean water, which are safeguarded by natural habitats. Health care, especially in rural areas, relies heavily on traditional knowledge and use of forest plants. They are cheap, familiar, readily accessible and often of proven therapeutic value. The *jamu* industry in Java utilizes local herbs; it would be extremely expensive to replace these herbal concoctions with imported medicines.

8. Habitat destruction can lead to serious environmental damage which can have devastating social and economic consequences. Environmental disasters in Indonesia over a recent five years period resulted in losses of Rp 1.1 trillion (US\$625 million), almost 5,000 deaths and 25,000 injured and an estimated 100,000 people rendered homeless (RePPPProT 1990). Most of these disasters were caused by floods and landslides, usually related to forest clearance and poor land use practices.