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Irian Jaya: Nature Reserve Design in a Pristine Environment

Few places remain where a planner can select the most important biogeographic elements and structure a comprehensive protected area design without having to compromise with the development that has arrived first. Perhaps the wildest parts of Brazil still offer this opportunity in the western hemisphere; so too does Irian Jaya, the western half of New Guinea.

In Irian Jaya the government of Indonesia has had the foresight to make protected area planning a major component of the development of its most remote and least developed province. The implementation of these plans, together with the integration of rational resource utilization in other sectors of provincial development, may eventually earn recognition of this little known part of the world as one of Southeast Asia's most important conservation initiatives.

Irian Jaya, with its surrounding offshore islands, forms the western half of New Guinea and Indonesia's largest (410,660 km² — 158,556 sq. mi.) province. Its human population, including recent immigrants from other parts of the archipelago, is slightly over 1.2 million, which is about one third of that in neighboring Papua New Guinea to the east. About 40 percent of the population is settled in agricultural communities in the cool and more temperate central highlands, and the Kebar-Anggi Lakes region of the Bird's Head (Vogelkop) in the western part of the province. Most of the remaining population is located in ten major towns on the coast.

Irian Jaya's history includes many accounts of the indigenous inhabitants as primitive stone age peoples, with headhunting, cannibalism, ritual warfare, and superstitious beliefs. These are large realities of the past, but as attitudes, customs and life styles change, both the people and the land are beginning to show signs of change as well. Still, with the bulk of its population concentrated in cities, most of the land is still natural, undisturbed and, in some cases, even unexplored. Nature conservation has entered the development picture in Irian Jaya at a challenging time.

One of the Mani people harvesting food and fiber on Irian Jaya, Indonesia. The proposed reserve system provides incentives for the local people as well as conservation measures to protect the natural resources.

Irian Jaya contains the largest and most diverse area of pristine natural lands in southeast Asia. The number and diversity of its undisturbed hatitats and associated biota are truly staggering. So is its topography: at 4,884 m (16,024 ft) New Guinea's highest point, Mount Jaya, overlooks nearly 7 km² (2.7 sq. mi.) of equatorial glaciers. Although receding, these are the only permanent icefields in southeast Asia and one of only three places on earth where glaciers occur on equatorial mountains. Below the ice are rocky moraines, glacier-fed lakes and mires, with shrub heath, tussock grassland and alpine tundra among the main vegetation types.

This apline area changes abruptly into subalpine forests and shrubland that includes tree fern *(Cyathea)* tussock grasslands in wetter valleys. There is a dramatic change in the forest where the grey-brown canopy of southern beech *(Nothofagus)* appears. These beech forests intergrade into montane and sub-montane forests, with increasing diversity of structure and species, until the floristically richest zone of luxuriant lowland rainforest is encountered below 1000 m (3,281 ft), covering thousands upon thousands of square kilometers in the foothills and dry areas of the river floodplains. Where drainage slows in the lowlands vast areas of swamp occur, cut by meandering rivers and ox-bow lakes, such as the plains of the Mamberamo river system. On the coasts extensive mangrove swamps shelter Sago *Metroxylon sagu)* and Nipa palm *(Nypa fruticans)* stands, trapping muddy river sediments. The surrounding marine environment is equally diverse and rich, containing extensive sea grass beds and some of the finest coral reefs in Indonesia.

Within this vast and largely uninhabited landscape is a distinctive biota — a unique mixture of Asian (Oriental) and Australian forms. New Guinea rests on the northern part of the Sahul Shelf and thus has had intermittent land connections with the Australian sub-continent in prehistoric times since at least the Cenozoic period. On the other hand, it has never been connected by land to the Indonesian islands to the west which, together with the southeast Asian peninsula, rests on the Sunda Shelf. New Guinea has thus been a meeting place and crossroads of colonizing and dispersing forms originating from both southeast Asia (over sea) and Australia (overland and sea). The large size of the island combined with its history of mountain building and climatic fluctuations have promoted extensive speciation. It thus contains the most fascinating communities of exotic and endemic biota in this part of the world.

The Flora

Irian Jaya's luxuriant forests lie almost entirely within the tropical rainforest belt and contain a diversity of plant life of almost unbelievable magnitude. Elements of Indo-Malayan flora dominate the lowlands but the highlands contain distinctive Australian and sub-Antarctic elements. Here on high mountain slopes just below the equator are found northern oaks and acorn-bearing trees from south China alongside Antarctic beeches. The many dipterocarps so common to Borneo have filtered down from the distant Himalayas to their southernmost extent on the slopes of New Guinea's mountain ranges. The woodlands and savannas of the dry monsoonal south are, however, considered extensions of Australian communities.

New Guinea's flora is included in the eastern sub-division of the Indo-Malesian floral region, the richest in the world in terms of plants useful to man (van Balgooy, 1976). A total of 1,465 angiosperm genera have been recorded for New Guinea as a whole (van Balgooy, 1976). At least 124 of these genera are found nowhere else in the world; this endemic rate is 50 percent more than that found on Borneo, second largest island in the archipelago (MacKinnon, in litt.). Although far from accurately counted, there are about 16,000 species of plants represented, of which an astounding 90 percent are endemic (Hope, 1982 in litt.). Orchids are one of the best represented and most fascinating groups of colourful plants in New Guinea; more than 2,770 species (about one-third of the angiosperms) have been documented for 134 genera (Millar, 1978). Despite these impressive statistics, the present state of knowledge of the flora of Irian Jaya and its vegetation patterns still is scanty; differences have been noted between the east and west divisions of New Guinea (Paijmans, 1976; Hope, 1976), but much taxonomic and ecological study remains to be done.

The Fauna

New Guinea's fauna is as diverse as it is prolific. Derivitives among Australian elements dominate the mammals, birds and reptiles (Ziegler, 1982; Pratt, 1982; Allison, 1982) but the amphibians (see Zweifel and Tyler, 1982) and invertebrates, especially the insects, are predominantly of Oriental origin (Gressitt, 1982 A & B). The native mammals of New Guinea belong to only four orders: Monotremata, Marsupialia, Rodentia and Chiroptera. Common and widely distributed mammals of other orders such as the rusa deer *(Cervus timorensis)*, Papuan pig* *(Sus scrofa)* and wild dog *(Canis familiaris)* have all been introduced at one time or another. In all, there are 199 mammal species thus far documented on the island, 123 which are endemic (Ziegler, 1982).

Reflecting its dominant Australian origins, there is very little overlap of Irian's mammalian fauna with the rest of Indonesia which stretches westward toward the Asian continent, ranging from only 10 percent with faraway Java and Sumatra to 54 percent with the nearby islands of Maluku (MacKinnon, in litt.). The more interesting forms include the long- and short-beaked echidnas *(Tachyglossus aculeatus)* and *(Zaglossus bruijni)* representing the monotremes; cuscuses *(Phalanger* spp), tree kangaroos, agile and forest wallabies *(Macropodidae)*, gliders and possums *(Petauridae)* and bandicoots *(Peramelidae)* among the marsupials; an array of rodents including true giant rats *(Muridae)* and numerous species of bats.

*Now considered a hybrid of two distinct species *S. scrofa* x *S. celebensis* (Groves, 1981).

Misoon Island provides habitat for some of Irian Jaya's prolific and diverse flora and fauna. Much of this area is still natural and undisturbed. Some portions have not yet been explored.

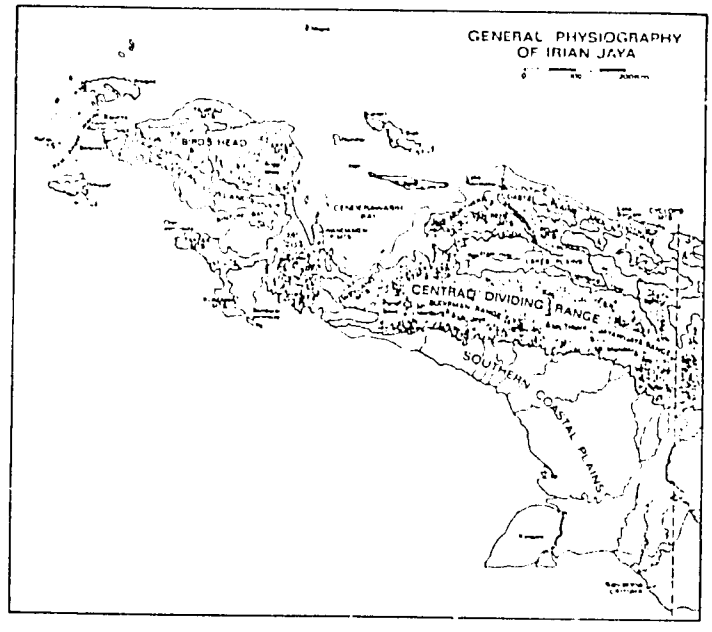
The New Guinea avifauna is even more rich and diverse; some 717 bird species from the mainland and the surrounding islands have been found, including 602 residents and 290 endemics (Beehler & Finch, 1983). Among the best known birds of Irian Jaya are the flightless cassowary *(Casuarius* spp) (the largest naturally occurring animal in New Guinea), birds of paradise *(Paradisaeidae)* and bower birds *(Ptilonorhynchidae)*, giant crowned pigeons *(Goura* spp), honeyeaters *(Meliphagidae)*, kingfishers *(Alcedinidae)* and numerous parrots and lorikeets *(Psittacidae)*. Although knowledge of the bird species distribution throughout New Guinea is still incomplete, birds are the most studied vertebrates of the province, and have been an important key in directing the design of the reserve system of Irian Jaya.

Less studied, but world famous nevertheless, is the colourful butterfly and moth fauna thought to number over 5,000 species. Most conspicuous in flight are the Ornithopterids or giant birdwing butterflies. The world centre of species diversity of this important family lies in the Arfak Mountains along the east coast of the Bird's Head region.

The rest of the insect fauna is so varied and numerous that it is impossible to give a fair estimate of their numbers. The largest group, the Coleoptera (beetles), probably number over 30,000 species (Lindgren, 1975); with all insect groups included there are over 100,000 species in New Guinea, but no one really knows for sure.

Reptiles are also numerous, with about 253 species known (Scott, Parker & Menzies, 1977; Zweifel and Tyler, 1982). On the big and bulky end of the scale are the salt and fresh water crocodiles, *Crocodylus porosus* and *C. novaeguineae*, giant monitor lizards (*Varanus* spp), and the endangered leatherback *(Dermochelys coriacea)*, green *(Chelonia mydas)*, and hawksbill *(Eretmochelys imbricata)* turtles. The skink family is one of the most commonly represented among the smaller lizards. Also of interest are a variety of nocturnal gekkos, and the fearsome looking dragon lizards with their deep throat patches and prominent scaly crests. Snakes are represented, too (about 90 species), and range from colourful tree pythons to venomous sea snakes. Among the amphibians, newts and salamanders are completely absent, but there is a very diverse frog fauna of about 175 species (Menzies, 1975; Scott, Parker & Menzies, 1977; Zweifel & Tyler, 1982).

The proposed Teluk Bintuni reserve will be Indonesia's largest mangrove reserve. It covers 450,000 ha (1,111,950 ac).

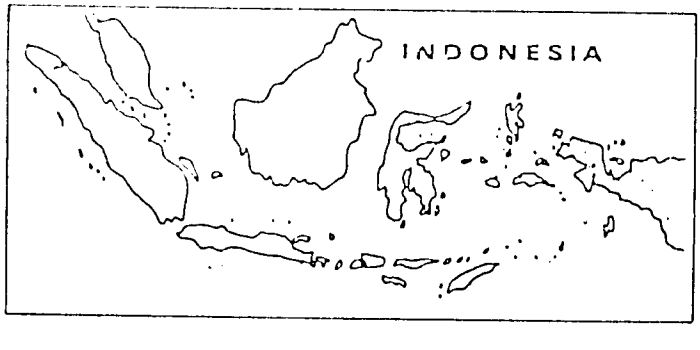


Why So Many?

Low tropical latitudes are known for their diversity of flora and fauna, but in New Guinea additional factors have been operating to create such a remarkable list of endemic species. The Central Dividing Range, the backbone of the island, and other mountain blocks isolated from the cordillera jutting into coastal plains and lowland swamps have created bridges for and physical barriers to dispersal and an altitudinal zonation of vegetation types which has separated populations and promoted speciation, especially among the fauna. This amazing diversity of life in a vast area of natural and little-explored terrain is both a gift and a challenge to those responsible for its conservation.

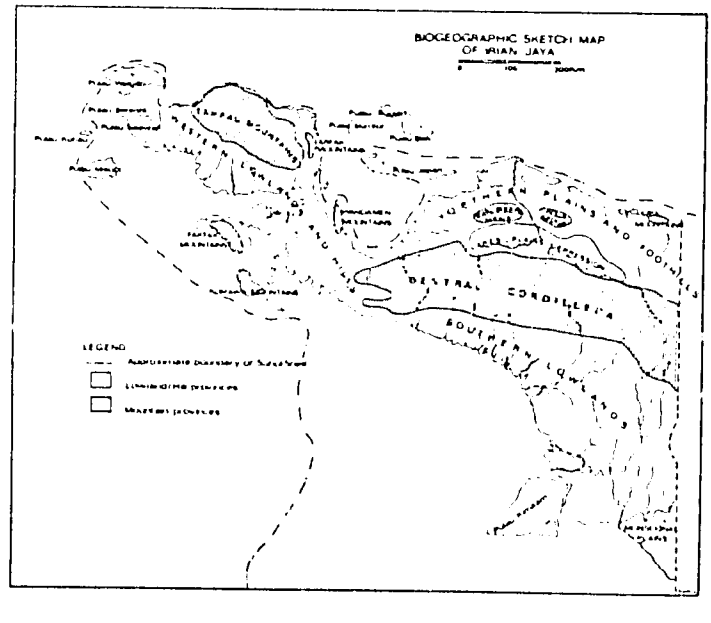
A Reserve System

In the late 1970s the Government of Indonesia requested IUCN and the World Wildlife Fund to assist in designing a total reserve system for Irian Jaya, integrating conservation into overall development plans for the province. Even with the Government's support and cooperation the task has not always been easy. Short planning deadlines and negotiating the limitations on the total area that could reasonably be requested for reserves have sometimes caused delays. There have also been technical conflicts in judging the relative merits of potential reserves which have required careful resolution. For example, the floristically richest areas, the lowland rain forests, had to compete for attention with the cordillera and outlying mountainous areas that have high faunal endemism, but which are considered by some to be of lesser botanical significance.



In designing a comprehensive reserve system with taxonomic information incomplete and much of the territory unexplored, we have had to rely heavily on known physical factors in the environment, such as topographic, climatic and altitudinal barriers which we know influence speciation and diversity. This basic approach, combined where possible with our current knowledge of the biology of certain groups of animals (particularly birds) and plants, has allowed formulation of a plan that represents all major habitat types and known centres of endemism. Figure 1 illustrates the overall reserve design proposed for the province. The areas selected provide a full representation of all the major biogeographic districts and recognized areas of endemism in Irian Jaya, which is apparent by comparing the reserve design (figure 1) with the physiographic map (figure 2) and the biogeographic sketch map (figure 3).

The Central Dividing Range forms the major mountainous district. The high altitude section of three reserves — Jayawijaya, Lorentz, and Weyland Mountains — adequately cover both known and expected species diversity in the cordillera from east to west. Included is Mount Jaya, New Guinea's highest mountain, capped with equatorial glaciers, as well as the highest peaks in both the eastern and western extremities of the range in Irian Jaya.



Aside from their intrinsic biological value, the highest mountains and alpine areas of these reserves offer some of the most spectacular scenery on the whole island.

The four major lowland districts are the northern coastal plains and foothills, the south coastal plain, the lakes-plains depression and the southern lowland of the Bird's Head. Three of these units have been covered in the large Mamberamo-Foja, Jayawijaya and Lorentz reserves. Taken together they comprise a 4 million hectare (9.9 million acre) north-south cross section completely across the country through the Central Dividing Range.

The Wasur-Rawa Biru complex in the southeast of the country, represents the climatically driest area, characterized by a mosaic savanna, *Melaleuca — Eucalyptus* woodlands, and swamplands. Also in the southeast, the Kumbe-Merauke river reserve contains an important transition zone where monsoonal forests intergrade with lowland rainforest. Finally, the lowlands of the Bird's head are represented by what will be Indonesia's largest mangrove reserve, located at the head of Bintuni Bay.

This sequence of protected areas gives a good representation of all major terrestrial habitats in Irian Jaya, but much of the spectacular richness of the province's animal life is known to come from various exceptional areas of speciation. Isolated from the Central Range, and also separated from each other by expanses of lowlands, are seven smaller outlying mountainous areas each containing endemic forms. To recognize the contribution of these important areas to the overall natural resource picture of the province, six more reserves have been proposed, including Cyclops, Wandamen, Arfak, Tamrau, Fakfak and Kumawa Mountains. Only one of these seven areas, the van Rees Mountains, has not been included, since its features are adequately covered in the higher and faunistically more diverse neigboring Foja mountains in the large Mamberamo-Foja reserve.

Various islands lying offshore are also major centres of endemism. These islands fall into two groups: island which lie on the Sahul shelf and were at one time connected to New Guinea (including Japen to the north and the Raja Ampat group to the northwest), and those which have not had any recent land connection with New Guinea (the Schouten Islands of Biak-Supiori, and Numfor, and tiny Kofiau in the extreme northwest). Both island groups contain endemic forms and have been given representation within the reserve system. Kofiau, whose two known endemic birds a paradise Kingfisher (*Tanysiptera ellioti*) and a flycatcher (*Monarcha julianae*), may now be threatened by large scale logging, is not within a proposed reserve.

In addition to covering the major biogeographical districts, certain other special purpose reserves have been incorporated; for example, refuges for migratory waterfowl, or to protect major population concentrations of salt and freshwater crocodiles (Danau Bian, Pulau Kimaam and the Rouffaer River). Eight small parks have been proposed as recreational centres or to safeguard unusual environments. In total, the terrestrial reserves comprise approximately 7,771,340 hectacres (19,202,981 acres), or about 18.9 percent of the province.

Representing the marine environment are three very large reserve proposals: Teluk Cenderawasih, Teluk Lelintah and Raja Ampat. In addition to open waters, these include adjacent coastlines, numerous small islands and submerged coral reefs. Besides supporting a diversity rivailing that of Australia's Great Barrier Reef, these reserves specifically harbour endangered giant clams, dugongs, marine turtles, and saltwater crocodiles. Of great economic consequence, they constitute an important reservoir of marine resources for the expanding fishing industry of eastern Indonesia. Coastal zone components of an additional five smaller island groups have also been included in order to protect marine turtles and nesting sea birds, pigeons and eagles.

The range of this scarce long-beaked echidna (Zaglossis bruijnii) *is covered in the Irian Jaya reserve design. This endemic mammal is well equipped to dig and tear apart ant and termite nests to satisfy its hunger.*

Six different localities recognized as major nesting areas for green, leatherback and hawksbill turtles have been selected for protection, containing more than 100km (247ac) of beach. Among these is a newly-discovered beach that is the most important nesting site for the endangered leatherback turtle (*Dermochelys coriacea*) in all the southeast Asia. Additional marine reserves will probably be identified along the south coast after further survey.

As proposed, the reserve system for Irian Jaya represents nearly 40 percent of all the programmed conservation areas in Indonesia. It has already been approved in principle by the Government (November 1982); some reserves have been fully gazetted and others are in process. In all aspects it is the most comprehensive reserve design in all of the provinces of Indonesia, and probably one of the most ambitious in the Pacific basin.

The Future

The task that now lies ahead in further planning and in management and protection of these areas is tremendous. In addition to government support it will require the full support of the indigenous peoples who find themselves residing within areas now declared as protected. Full recognition will be given to the preservation of their way of life and cultural identity. Through their intimate knowledge of local natural history, they will have a unique opportunity to participate in reserve management, thereby enhancing their own economy and becoming integrated into the development process.

Conservation in Irian Jaya, however, should not be restricted to reserve areas alone. Conservation and rational utilization of wildlife resources on a sustained yield basis must play an important role in the development of the province's rural economies, especially for isolated peoples who otherwise have limited alternatives for economic betterment. Plans are under study for the development of a large crocodile farming industry. As envisioned, this will provide an equitable share of profits to rural riverine people as well as ensure the survival of these animals over a considerable portion of their range. Insect farming, particularly focussed on Irian Jaya's diverse and colourful butterfly fauna, holds promise for rural economic assistance with an added benefit in conserva-

tion and monitoring of the Lepidoptera. Cooperative farming of introduced Rusa deer for meat and antlers can also benefit local economies, and in the southeast can complement conservation activities already begun by Papua New Guinea on the other side of the border.

Though much remains to be done, it is encouraging to report that conservation in Irian Jaya is now progressing to the critical next steps: reserve gazettement, management and rational development of wildlife resources. Success in this stage will hopefully place Irian Jaya in the forefront of Indonesia's conservation program, a program which in many ways is providing a model system for southeast Asia.

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All photos were taken by the author and made available by the World Wildlife Fund.

Change in Volume Numbers

Since its innauguration, the volume numbering system for PARKS has not coincided with the calendar year. This has proved unnecessarily confusing for many readers who maintain a chronological file of the journal.

Therefore the editor has arbitrarily designated this issue as Volume, 9, Number 3/4; no other changes have been made to the publishing schedule or the contents of this or future issues.

The January-February-March, 1985, issue will be Volume 10, Number 1, with the volume number coinciding with the calendar year.