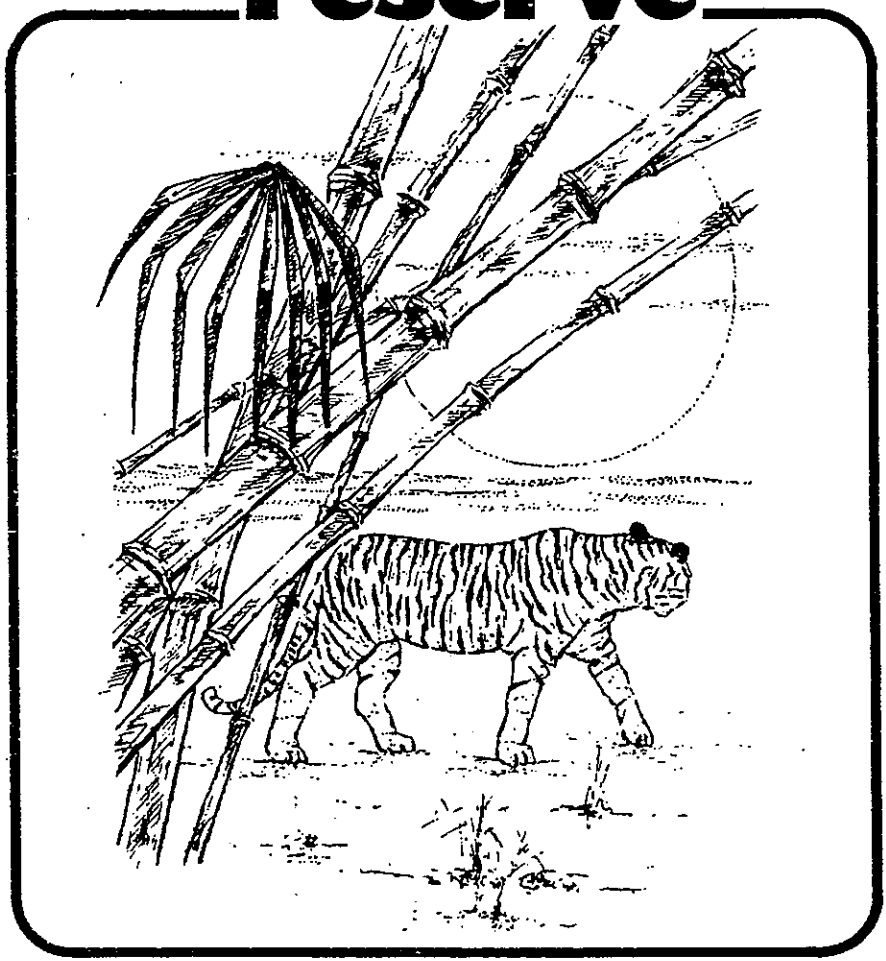
the javan tiger and the meru·betiri reserve



a plan for management

The Javan Tiger and the Meru-Betiri Reserve

A Plan for Management

A World Wildlife Fund Report

Published with the Financial Assistance
of the Netherlands Van Tiehoven Foundation

International Union
for Conservation of Nature and Natural Resources

Gland, Switzerland

1980

COVER: Batik by Tomi, Yogyakarta 1976

The beauty and genius of a work of art
may be reconceived . . . a vanished harmony
may yet inspire the composer;

but when the last individual of a race
of living things has breathed its last,
another heaven and earth must pass
'ere such a one can be again.

William Beebe

THE JAVAN TIGER AND THE MERU-BETIRI RESERVE

A Plan for Management

From: Direktorat Jenderal Kehutanan
Direktorat Perlindungan dan Pengawetan Alam
Bogor

and

World Wildlife Fund
1196 Gland, Switzerland

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With the assistance of the P.P.A staff,
Bogor and Meru-Betiri

Funded by: WWF/IUCN Project No. 1015:
"Operation Tiger", Indonesia
Meru-Betiri Wildlife Reserve, Java

These proposals express the views of the consultant,
which are not necessarily those of
International Union for Conservation of Nature and Natural Resources
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SYNOPSIS

The Javan tiger (Panthera tigris sondaica) is in imminent danger of extinction. There are no specimens in zoological gardens. The known wild population is no more than four or five individuals, all of which are living in the Meru-Betiri complex, a mountainous forest on the south coast of East Java. The best chance of preserving the Javan tiger in the wild lies in:

a. Developing public awareness and sympathy for its plight;

b. Strict protection from any further killing;

c. Careful management of the Meru-Betiri Reserve, with provision for the tiger's needs as a primary management goal.

These three factors are equally important and interdependent.

This report summarizes information available on the socio-economic and ecological conditions in the Meru-Betiri area and presents a detailed five-year Management Plan for the Javan tiger and the Meru-Betiri Reserve.

MANAGEMENT PRESCRIPTIONS IN BRIEF

Goals of Management

Manage the Meru-Betiri Reserve in a way that its essential character and value remain intact - that the natural fauna, flora, and scenic features of the area are conserved. Promote regulated use of natural resources of the Reserve for educational, aesthetic, recreational and scientific purposes in such a manner that the natural character of the area will be preserved.

Management Plan

Manage the Reserve according to the work/operations plan (management plan), commencing in 1977.

Legal Status and Boundaries

Upgrade the legal status of the Reserve from Suaka Margasatwa (game reserve) to Cagar Alam (nature reserve); extend the borders to include:

- The production and protection forests north of Gn. Betiri and south of the Kali Sanen where Javan tigers sometimes range
- The offshore islets
- A 500 m zone extending from the shore into the sea.

Authority and Administration

Overall authority will be vested in P.P.A.; the Section Chief is responsible for supervision and planning; a Manager will be responsible for management operations and administration of the Reserve.

Staff Organization, Duties and Training

Total staff for the Reserve includes the Manager, 32 basic level, eleven mid-level, and eight advanced level personnel who are to be organized in five divisions:

- Management and Protection
- Administration and Service
- Research
- Interpretation and Public Relations
- Settlements

All staff are to be given permanent government appointments. The Manager will be assisted in implementation and development of certain

programmes by special teams from the Central Office of P.P.A.

Training of basic-level personnel is the responsibility of the senior Reserve staff; the Manager, advanced and medium-level personnel are to attend special training sessions conducted by the Central Office. All senior staff are to periodically visit other working reserves as part of their training.

Protection and Control of Exploitation

To maintain the ecological integrity of Meru-Betiri and to provide the degree of security needed to protect the last Javan tigers, P.P.A. must:

- Embark on an upgrading programme to systematically phase out exploitation from all areas of the Reserve within the period of the plan;
- Control the movement of people in the Reserve through the use of checkpoints and an active patrol system;
- Acquire control of the plantation enclaves, close down their operations and turn these into wildlife management areas;
- Prevent any further expansion of cultivated areas, effect control of all inholdings and move the people now living there from the Reserve;
- Establish and enforce a 20 km no-hunting zone around the Reserve.

Sea Turtle Conservation

The turtle conservation project must be brought under the full control of P.P.A. All nesting beaches are to be completely protected. The collection of eggs must be stopped.

Wildlife Management

Manage the "feeding grounds" at Nanggelan, Pringtali, and Sukamade Barat and the plantation enclaves as habitat for large ungulates. No additional feeding grounds are to be cleared. Re-introduce rusa (Cervus timorensis) and banteng (Bos javanicus) to Sukamade Barat, and rusa to Nanggelan and Kali Sanen.

Research

Two research programmes should be undertaken:

- Management-oriented basic studies to be conducted by the Reserve

staff under the direction of the Resident Ecologist. These will consist mainly of completing lists of the natural resources of the Reserve and monitoring population trends of certain animals and plants;

- Detailed studies on selected topics, conducted in cooperation with Universities, visiting scientists, and government agencies. These will consist of special projects of importance to the future management of the Reserve. Other research will be encouraged if it does not interfere with ongoing programmes and is in keeping with the management goals.

All research in the Reserve is to be coordinated through the sub-directorate of Planning, P.P.A. and the Reserve Ecologist.

Education and Visitor Use

A programme of education and interpretation to explain the history, purpose and value of the Reserve and the significance of its unique flora and fauna will be initiated; facilities to assist visitors in enjoying the amenities of the Reserve are required, but these must be in keeping with the primary goal of conservation.

The Reserve staff, in cooperation with interested Universities, will provide an extension programme to encourage an understanding of the value and function of the Reserve and to assist in teaching sound conservation principles. The value and survival needs of the Javan tiger are to be emphasized in this programme.

Public Relations

The Reserve staff has the responsibility of integrating the existence of a viable nature reserve into the lives of local people through education and demonstration of conservation principles that will enhance their lives. A four-point programme is outlined in the plan.

Estate Management

All building construction and other developments within the Reserve boundaries are to be kept to the minimum necessary for management purposes; the design of all facilities will be in harmony with the natural surroundings. The location and construction schedule for all accommodation and facilities is detailed in the management plan.

All trails and roads, except those needed for control purposes, are to be closed; no new trails, except those absolutely necessary for the protection of the Reserve, are to be built.

Transport and Equipment

The Manager is to have a four-wheel drive vehicle; other senior staff a some mid-level staff will be provided with motorcycles. All other staf will be issued bicycles. A launch will be needed to patrol the coast.

The staff must be provided with adequate field equipment. No additiona firearms will be required.

If the provisions of the Management Plan are met, Meru-Betiri Reserve will meet all criteria for inclusion in the United Nations List of National Parks and Equivalent Reserves.

INTRODUCTION

MERU-BETIRI AND THE PRESERVATION OF THE JAVAN TIGER

Through the 1800s and early 1900s, Java's largest carnivore, the tiger, was bountied, hunted and killed until, by the beginning of the Second World War, it survived only in a few scattered forest-clad mountain areas and in a few nature reserves (Fig. 1).

Even before the Second World War, there was considerable international concern about the survival prospects of the Javan tiger (2); after the War there was little chance for the situation to improve (3). By the mid-1960s, it was apparent that even in many of the remotest regions of the island the tiger had not survived; it could no longer be found in the most famous and well-protected nature reserve in all of Indonesia, Ujung Kulon, an area set aside specifically for the conservation of the Javan tiger and Javan rhinoceros (Rhinoceros sondaicus) (4). With good reason, many conservationists thought that yet one more irreplaceable animal form was lost forever (5).

There have been continuing scattered reports of tigers living in some of Java's wilder regions - reports of a large cat seen at night in the headlights of a car or a large cat track seen on an isolated beach or beside a mountain stream. Subsequent examinations have shown the animal to be a leopard (Panthera pardus) (5, 6). In the late 1960s, however, there were particularly persistent reports of tigers still living in the Gunung (Mount) Betiri area, a rugged mountain complex on Java's south coast, 60 km southwest of the town of Banyuwangi.

In 1961 a Danish hunter killed a tiger and a melanistic leopard in these mountains; knowledgeable observers insisted a few tigers could still be found living there.

Dr. R. van der Veen, a botanist long familiar with East Java, visited the area in 1971 and reported that a population of tigers probably did exist (7). Later that year the eminent naturalist, A. Hoogerwerf, surveyed the region and established with certainty that there was a small population of tigers (8). If there was to be any chance of preserving the Javan tiger, this is where it would be (9-11).

The survival of the Javan tiger in the wild is dependent upon strict protection and the preservation of its habitat. When the presence of a small population was established with certainty, nature conservation authorities moved quickly. The blocks of protection forests, known collectively as Meru-Betiri, were declared Suaka Margasatwa (game reserve) by decree of the Minister of Agriculture in June 1972. To

assist the government of Indonesia in protecting the last Javan tigers, the World Wildlife Fund and the International Union for Conservation of Nature and Natural Resources began providing financial support for the Meru-Betiri Reserve, through WWF/IUCN Project No. 1015 in 1973 (12).

The legal establishment of the Meru-Betiri Reserve and the provision of financial support for its maintenance were the first steps in providing protection for the tiger and its habitat. In the last four years, a number of surveys have been made to determine the tiger's status and to establish management priorities (13-18). These surveys have provided useful observations on the tiger's status and important information on the other fauna and flora of the Reserve. The report by Bartels and van der Veen (17), for example, identified the value of Meru-Betiri as one of the last remaining lowland rain forests in Java, with such rare plants as Rafflesia zollingeriana and Balanophora fungosa. Special emphasis has been given to the need for protecting the sea turtle nesting beach in the Reserve. Since the establishment of Meru-Betiri as Suaka Margasatwa, a small guard force has been established, some staff accommodation constructed and four habitat management projects initiated.

Yet for all this, neither the future of the Javan tiger, nor the future of the Reserve, was secure. The principal problems so far identified were:

- No reproduction had been reported in the tiger population since 1971 when an older female was shot at Sukamade Plantation;
- Protection of the area was far from adequate;
- The ecological integrity of the Reserve was seriously disrupted by the two large plantation enclaves that cover the lower reaches of the major river valleys, appropriating the most suitable habitat for the tiger and its prey (16).

At the request of P.P.A. Director Ir. Prijono, the authors conducted a survey of the Meru-Betiri complex from June to September, 1976 to assess the survival needs of the tiger and to identify the physical and biological features and processes that have implications for future management.

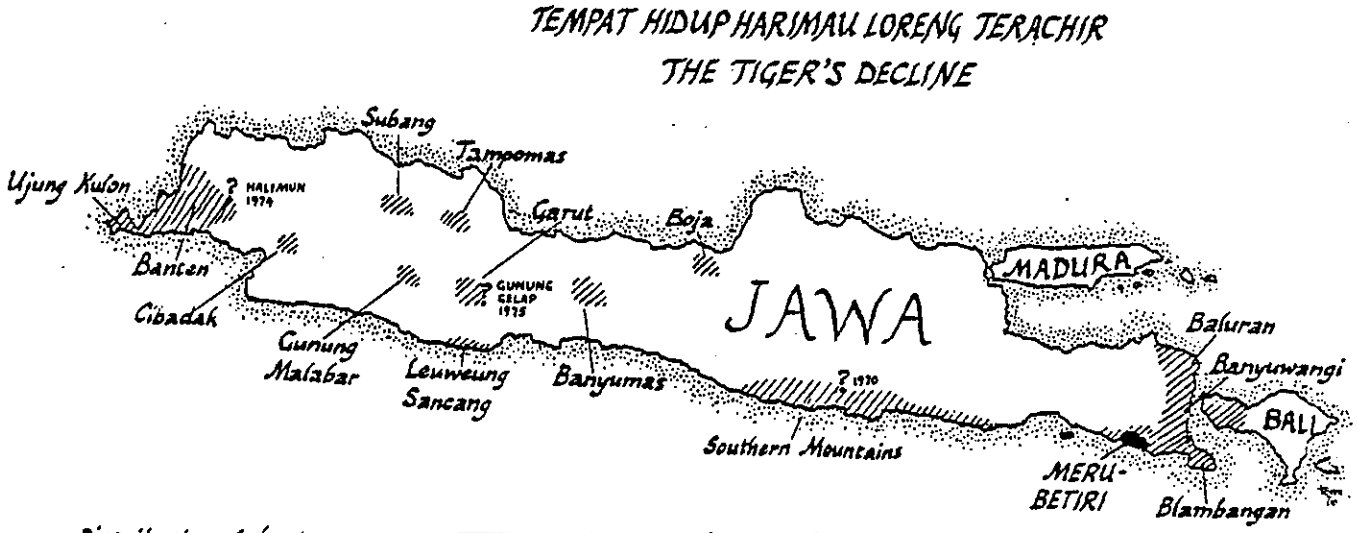
THE MANAGEMENT PLAN

We found Meru-Betiri to be a magnificent area, and we also found that the programme for the management of the Reserve had reached an important juncture. In our judgement, Meru-Betiri can become a fine reserve if appropriate management action is taken, and taken soon. If action is not taken, the Javan tiger will surely disappear and the chance to conserve an extensive selection of Java's natural vegetation types,

Figure 1 The Reduced Range of the Javan Tiger

One hundred and fifty years ago the tiger ranged over most of the island of Java, and was considered a nuisance in some populated areas. By 1940 it was found only in the most remote mountain and forested areas (after Treep, 9).

By 1970, the only known population was in the Gunung Betiri complex on the eastern south coast. This is an isolated region of the Southern Mountains, protected in the past from extensive habitat alteration by its precipitous and dissected topography. While the last Javan tigers have managed to survive in this rugged area, it is not prime tiger habitat. Careful planning and management are required to ensure that the tiger's ecological needs are met in the future.


TEMPAT HIDUP HARIMAU LORENG TERACHIR
THE TIGER'S DECLINE
Subang
Tampomas
Ujung Kulon
? HALIMUN 1974
Garut
Boja
Bantan
? GUNUNG GELAP 1975
MADURA
JAWA
Cibadak
Gunung Malabar
Leuweung Sancang
Banyumas
? 1970
Baluran
Banyuwangi
BALI
Southern Mountains
MERU-BETIRI
Blambangan
Distribution of the tiger ca. 1940
Distribusi harimau loreng ca. 1940
Distribution of the tiger ca. 1970
Distribusi harimau loreng ca. 1970
Unconfirmed reports
?
Laporan, belum tentu

a range of vegetation extending from the sea to 1200 m will be lost.

The management programme for Meru-Betiri, or any reserve or national park, will not succeed in the long-run if policy and programmes are formulated on a day-to-day ad hoc basis. Accordingly, the Director General of Forestry is requiring that every designated reserve and park in Indonesia be managed according to a work/operations or management plan. The management plan provides guidelines for the conservation and development of the Reserve over a number of years; it is the control document which guides the preparation of more detailed plans as they are needed.

We have prepared the Meru-Betiri management plan in two parts (19):

The first identifies the Reserve's values, its resources, its relationship to surrounding areas, and the human needs that can be met in keeping with conservation principles;

The second part is a management document which details management goals and guidelines and provides a plan for the protection, interpretation, use, and administration of the Reserve.

Emphasized throughout the plan are the conservation measures necessary if there is to be any possibility for preserving the last remaining Javan tigers.

ACKNOWLEDGEMENTS

This investigation was funded under WWF/IUCN Project No. 1015 and carried out with the full cooperation and assistance of P.P.A. We thank Ir. Prijono and Dr. H. Jungius for making all preliminary arrangements. John Blower provided valuable advice and assistance. Dr. Rudy Tarumingking and Dr. C. Imboden assisted with administrative details.

Our work in Meru-Betiri received the assistance of Section Chief Soetarsono and his staff. We thank the members of the P.P.A. staff and others who accompanied us in the field at various times: A. van der Zon, Hamit, Bambang, Ringo, Jalal, Binner Sinaga, Soeparman, Saman, Nirman, Bistak Sinaga, Sarkan, Wismanyo, Kusmariyanto, and Sajak. David Hadikesuma, Kusmariyanto, Sarkan, Dr. A. van der Zon, Ir. J. Wind, Dr. R. van der Veen, J. West, H. Bartels and B. Galstaun provided important background information. David Hadikesuma, Lucas Hadisinoto and Ir. H. Ghozi made our stay on the plantations very pleasant.

We thank Ms J. Block, Dr. Chew Wee-Lek, Dr. J. Eisenberg, Dr. C. Holloway, Dr. Kuswata Kartawinata, Mr. J. McNeely, Dr. T. Reed, and Dr. Rudy Tarumingking for reviewing the draft plan.

Figure 2 The Landscape of East Java:

a. Lines of commerce and forest areas (including teak plantations);

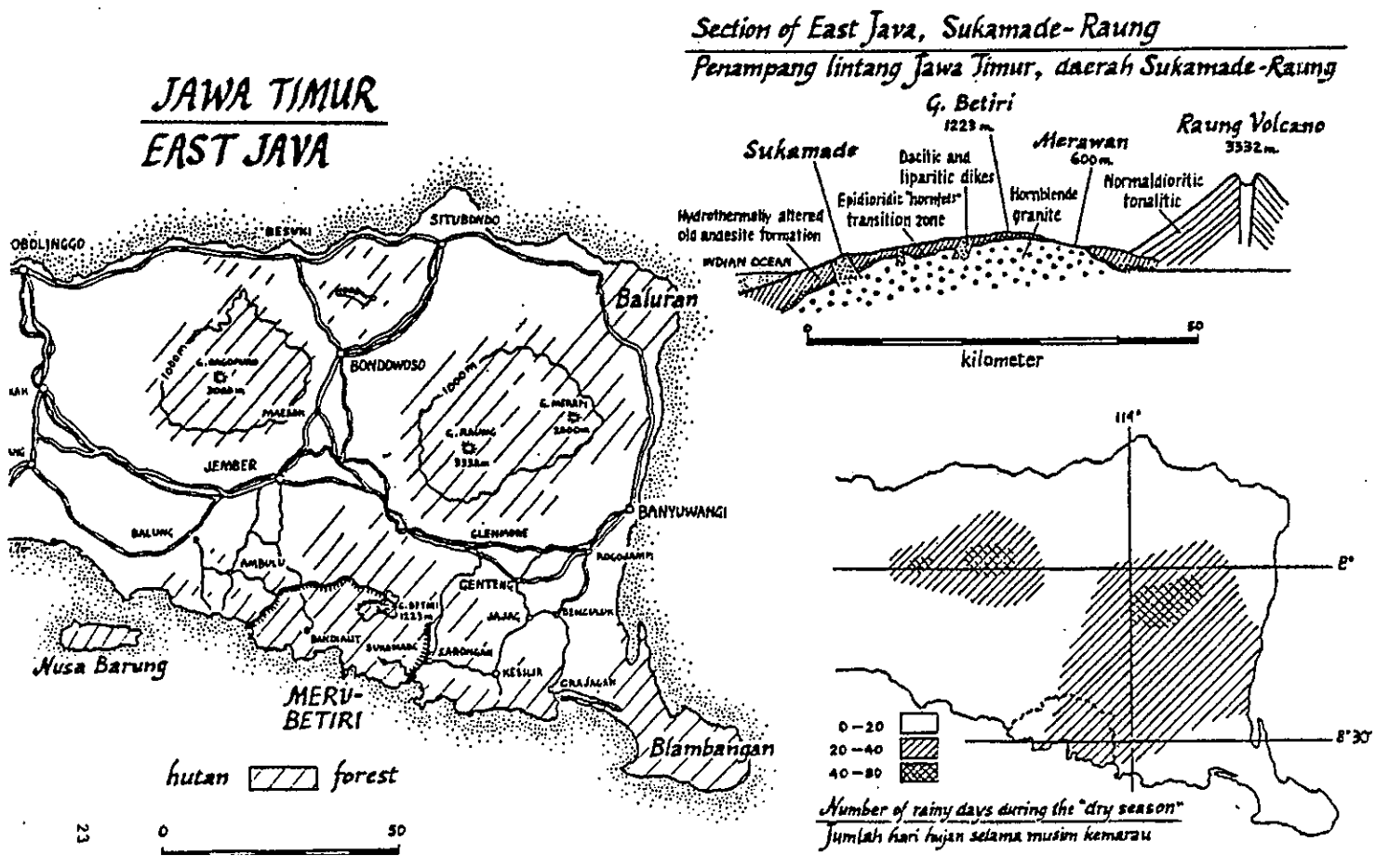
b. Underlying geology, Sukamade Beach to Raung Volcano (after van Bemmelen, 20);

c. The intensity of the dry season (after van Steenis, 27).

The Gunung Betiri complex is a distinct physiographic region. The older geological formations underlying this region contrast with the young volcanic complexes that dominate the East Javan scene. The dry southeast winds (June - September) give off rain as the air masses rise over the volcanoes and higher ridges. Pockets of rain forest occur in these wetter areas in a region that is otherwise dominated by monsoon vegetation. The higher areas in the Meru-Betiri Reserve are blanketed with rain forest. The lower areas are transitional forest.

Unfortunately, and to the detriment of the tiger, the critical wildlife habitat in the major river valleys of the Reserve has been converted to plantations of coffee and rubber.

Figure 2


JAWA TIMUR
EAST JAVA
OBOLINGGO
BESUKI
SITUBONDO
Baluran
BONDOWOSO
JEMBER
BANYUWANGI
GLENMORE
BALUNG
AMBULU
GENTENG
SRAJAN
Nusa Barung
MERU-
BETIRI
Blambangan
hutan
forest
0
50
kilometer
Section of East Java, Sukamade-Raung
Penampang lintang Jawa Timur, daerah Sukamade-Raung
G. Betiri
1223 m.
Raung Volcano
3332 m.
Sukamade
Merawan
600 m.
Dacitic and
liparitic dikes
Epidioridic "hornfels"
transition zone
Hydrothermally altered
old andesite formation
Hornblende
granite
Normaldioritic
tonalitic
INDIAN OCEAN
50
kilometer
114°
8°
8°30'
0–20
20–40
40–80
Number of rainy days during the "dry season"
Jumlah hari hujan selama musim kemarau

THE MERU-BETIRI RESERVE

NATURAL FEATURES AND PROCESSES

THE SETTING

Travelling southeast from Banyuwangi, you drive along canals and pass by small towns. The land is flat, a mosaic of paddy fields dotted with palms and scattered clumps of bamboo. This is a countryside where man has completely altered the natural vegetation in order to produce food and fibre for his needs. Travelling further, the mountains surrounding Gn. Betiri loom in the distance, at first just a dusty green in the haze; closer, the details begin to emerge on the steep slopes. There is good forest with great emergent trees; the forest and the mountains stand in vivid contrast to the flat, densely populated agricultural land you are travelling through.

The Meru-Betiri Reserve is an area of about 50,000 ha lying on the south coast of East Java (Fig. 2a). Its extent is reflected by its name: from Meru Bay to the top of Gn. Betiri (1223 m). This is a remote region and access is limited. During World War II the Japanese attempted to build a road along this coast, but fortunately for its natural features, they failed. From Jember through Ambulu, it takes more than one hour to reach the plantation enclave of Bandialit, a distance of 30 km. The Sukamade plantation enclave in the east is three to four hours' drive from Banyuwangi by turning off the Banyuwangi-Jember highway either at Genteng (70 km) or Glenmore (100 km). The northeast corner of the Reserve can be reached from the plantation Malangsari, about one hour's drive from Glenmore. For the most part, the roads are unimproved. Travel by jeep or truck is recommended. There is a telephone line from the Sukamade estate to Banyuwangi.

Several physiographic and geological considerations are pertinent to an understanding of the Meru-Betiri ecosystem and its historical development. The Reserve lies in a disjunct section of the Southern Mountains, a belt that extends all along Java's south coast. These mountains are the south flank of the Javan geanticline. The belt is severed in several places by wide valleys, which are depressions where the geanticline disappears below sea level. The Southern Mountains consist of volcanic deposits of the Miocene. Later in the Miocene, the ridge sank below sea level and was covered by a thick layer of limestone. Some time later a regression of the sea took place and the region remained slightly above sea level until the Pleistocene. The upper and middle Pleistocene was a time of great geological turmoil in Java. The arching up of the Javan geanticline elevated and tilted southward the belt which we see as the Southern Mountains today. The top of this geanticline sank in relation to its southern flank, forming a depression called the Solo Zone, covering the Miocene deposits with new material. Today, these young volcano complexes, some of which rise to more than 3000 m, are the dominant physiographic feature of the East Javan landscape (Fig. 2, 20).

The physiographic distinctness of the mountain complex of which Meru-Betiri is a part is reflected in present land-use and by the routing of railroads and highways. The main lines of commerce between Jember and Banyuwangi pass through the low-lying juncture between the Raung Volcano and this section of the Southern Mountains (Merawan, Fig. 2b). Agricultural development and settlements are concentrated on the floors of the wide, adjacent valleys. Forest areas, both natural and plantations of teak (Tectona grandis), are found on the steeper slopes (Fig. 2a).

Within the Betiri complex, the most suitable river ("kali") valleys, the Sanen, Curah Nongko, Bandialit, Sukamade and Karangtambak, were cleared and converted to plantations, primarily of coffee and rubber, by the Dutch early in this century. Since World War II parts of these areas have been used for growing rice (Oryza sativa), corn (Zea mays) and cassava (Manihot utilissima). On the eastern and western flanks of this complex, where slope and climate are conducive, the natural forest has been replaced with extensive plantations of teak. Many of these vegetation alterations are comparatively recent. It has only been since World War II that the natural connection between Meru-Betiri and the South Banyuwangi Wildlife Reserve (Blambangan) to the east has been severed (11).

The Meru-Betiri Reserve lies in the core of this isolated region of the Southern Mountains, protected in the past from extensive habitat alteration by the ruggedness of the topography; and it is only in this rugged area that the last Javan tigers have managed to survive.

THE LAND AND WATER

The superficial expression of the Meru-Betiri landscape is the result of dynamic natural processes. Climatic and mechanical processes over the ages have modified the underlying geological formations, which accounts for the current physiography, drainage system and distribution of soils. These, in turn, influence the distribution of plant associations which, in turn, influence the distribution of the wildlife species.

The landscape is precipitous and dissected (Fig. 3a; 23). In 16 km the elevation rises from sea level to 1223 m at the top of Gn. Betiri. From this highest point, a ridge extends east to Gn. Mandilis (843 m) and west to Gn. Tajen (1036 m). To the north, the land drops away to the Kali Sanen, which forms a magnificent canyon in the upper reaches. At the headwaters of the Sanen, Baru and Karangtambak, just north of Gn. Tajen, is a high rolling landscape at 500 to 800 m, known as Malangsari, most of which has now been converted into a plantation of coffee and cocoa. The western end of Gn. Mandilis

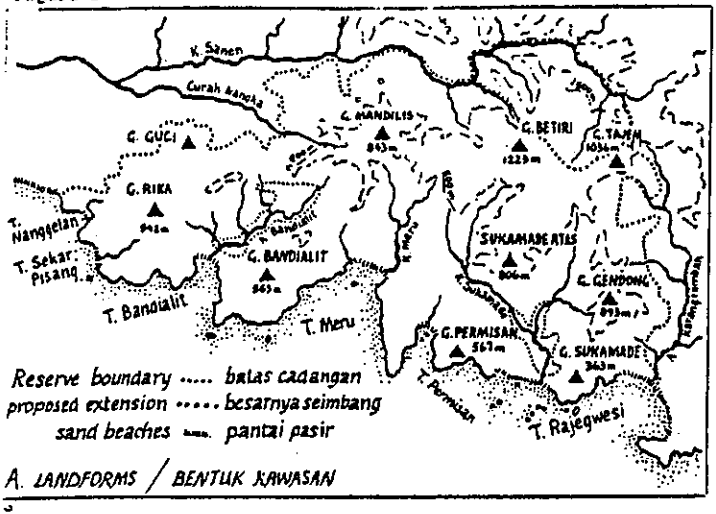
Figure 3 The Meru-Betiri Reserve 1976:

Protection and management of Meru-Betiri can only be achieved through an ecosystem approach, employing sound conservation principles. Some of the first steps in planning for the future management of the Reserve include:

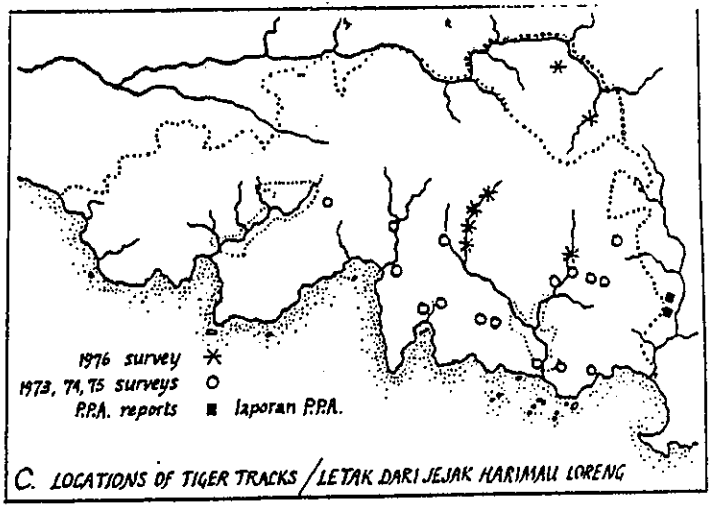
- Assessing the natural features and processes of the region;
- Determining physiographic and regional relationships;
- Locating the threatening and disruptive influences that disrupt the completeness and integrity of the ecosystem;
- Identifying where boundaries must be set to include the seasonal and life-cycle needs of the flora and fauna;
- Establishing where careful guidance of the complex natural processes is required to sustain the extinction-prone species.

This information is compared with the present management and protection programme to determine what further actions are required.

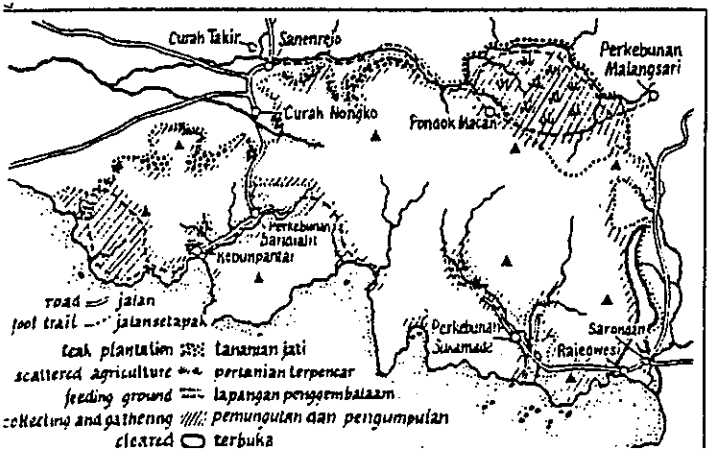
Figure 3

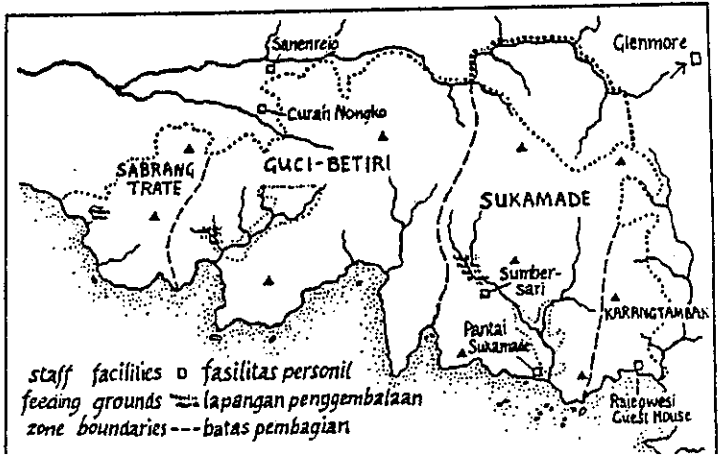


A. LANDFORMS / BENTUK KAWASAN



C. LOCATIONS OF TIGER TRACKS / LETAK DARI JEJAK HARIMAU LORENG





is also cut by a deep canyon drained by the Curah Nongko. Extending south from the high ridge are a number of fingers that eventually meet the sea. The downward slope of these ridges is gradual until the last few kilometers, producing a rugged and picturesque coastline dominated by the high points, Gn. Rika, Bandialit, Permisan and Gendong, all more than 500 m.

The major drainages between these ridges are the rivers Bandialit, Meru and Sukamade. The east edge of the Reserve is drained by the Kali Karangtambak. Where these major rivers enter the sea, there are extensive sand beaches, along with smaller sand beaches at Nanggelan, Sekar Pisang and Permisan. Most of the coast is steep and rocky.

Underlying the Betiri complex is an enormous hornblende granite batholith (Fig. 2; 20), but with the exception of a few dikes and eroded areas, the batholith is covered by material from volcanic activity of the Miocene. The limestone deposits, which were laid down over the andesite in the upper Miocene, have mostly been eroded away and can be seen now only in a few places on the higher ridges. The most commonly encountered surface materials are what van Bemmelen (20) terms hydrothermally-altered old andesite. Specifically, this material seems to be volcanic breccia and conglomerates consisting of pyroxene and hornblende andesite (22, 23). In the major river valleys, alluvium has collected.

The exploratory soil map of Java (22) lists the soils in the Reserve area as a complex of red-yellow mediferraear and lithosol. The soils in the Reserve are poor, but in the north they have been enriched by material from the volcanoes, Raung and Ijan (17). Our survey revealed at least three major soil types - alluvial, regosols and latosols (24) - but no detailed soil analysis has yet been carried out. The alluvial soils are confined to the lower valleys and the areas behind the sand beaches. These are the most attractive sites for agriculture. The regosols and latosols are found on the steep slopes. Regosols are young soils, almost without profile development. They generally occur as almost unweathered volcanic material near active volcanoes (25). Regosols are most apparent in the north where we found small-scale agricultural development. Through the south, the soils are older. Laterization appears to have been more extensive. Latosols quickly lose their fertility under cultivation because leaching has removed the nutrients in all but the surface layer, but they can support a luxuriant growth of broadleaf evergreen rain forest. Unlike the western and northern parts of the Reserve, the southeastern area does not have the extensive stands of bamboo on the hillsides that suggest the occurrence of past agriculture.

There is a subtle, but important influence of parent material on the distribution of ungulates that has scarcely been recognized, much less studied intensively in tropical areas. This is the phenomenon of

mineral deficiencies and how this affects carrying-capacity and movements (26). We did not locate a single salt-lick in our survey and we question if any occur in the Reserve. The wild swine (Sus spp.) appear not to be dependent upon the mineral in licks, but this is not true for the cervids and bovids. Van Steenis (27) relates how in the past there were at regular intervals spectacular migrations of rusa from the Jang plateau (3000 m) to the coast to drink sea water. Halder (28) noted that there are no mineral licks in the Ujung Kulon or the Baluran reserves and that the banteng covered their need for salt by occasionally drinking sea water. We do not know how this factor would influence distribution and movement of larger ungulates in Meru-Betiri, but it is certainly a factor that must have attention in future detailed studies.

East Java characteristically has a long distinct dry period during the southeasterly monsoon from June to September, and a rainy period during the northwest monsoon from November to March. The mountains, however, modify this general pattern. The dry southeast winds give off rain against the south-facing slopes as condensation occurs through cooling at higher altitudes (27). This results in isolated "wet islands" situated on the south slopes of mountains in the east (Fig. 2c). These "wet islands" support areas of rain forest in a region that is dominated by monsoon climate vegetation (27).

Gn. Betiri and Gn. Tajen markedly influence the climate of Meru-Betiri, resulting in both an increase in total yearly rainfall and a reduction of the severity of the dry periods that so strongly influence the surrounding area (Fig. 2c). In Table 1, we present rainfall data recorded at the plantation enclaves at Sukamade and Bandialit and from the Malangsari plantation in the north. These figures can most readily be compared using the Schmidt and Ferguson ratio of wet and dry periods (24). Both Sukamade and Malangsari have a value of A; Bandialit is classed as C. In both total amount and yearly distribution of rainfall, the belt from Sukamade northward to Malangsari is similar to the climate which supports the magnificent rain forests in West Java. The western side of the Reserve, as evidenced from the rainfall data at Bandialit, is subject to a severe dry season, which has a marked effect on the vegetation, as we discuss later. This region is much more typical of the dry monsoon climate of East Java.

There is considerable variation in total rainfall from year to year (Table 1b). At Sukamade, for example, the total rainfall in the last five years has varied from 1219 to 6574 mm, by a factor of more than five. During the driest year there was a period of five months without rain. Van Steenis (27) points out that rain forest trees react to spells of excessive drought by dropping more leaves than normal to keep evapo-transpiration in balance. Yet these extensive drought

TABLE 1
DAFTAR 1

RAINFALL DATA FOR MERU-BETIRI 1971-1975
CURAH HUJAN DI MERU-BETIRI 1971-1975

A) Jumlah : Hujan rata2

	Malangsari		Sukamade		Bandialit	
Bulan	mm	hh	mm	hh	mm	hh
J	491	19	420	15	324	12
F	483	19	481	17	348	16
M	492	20	363	15	339	17
A	253	14	203	8	133	8
M	318	15	215	11	190	10
J	208	9	86	5	31	2
J	155	8	55	5	21	2
A	80	7	61	3	42	2
S	286	10	379	11	168	6
O	291	13	521	15	186	10
N	279	16	612	15	356	11
D	412	17	585	16	404	15
Jumlah	3748	167	3981	136	2544	117

B) Jumlah : hujan rata2

	Malangsari		Sukamade		Bandialit	
Tahun	mm	hh	mm	hh	mm	hh
1971	3342	165	2863	127	2764	122
1972	2367	109	1219	68	1083	73
1973	6046	199	4616	171	2602	141
1974	3296	157	4634	139	2535	120
1975	3690	193	6574	177	3725	133
V.	3748	167	3981	136	2542	117

C)

	Q(%)	Termasuk Type Schmidt Ferguson
Malangsari	9.09	A
Sukamade	11.10	A
Bandialit	33.30	C

Notes

Bulan = Monch
Tahun = Year
Rata2 = Average

years have a more marked effect on the flora of Meru-Betiri and the forest contains a greater number of drought-resistant tree species than is typical for a rain forest in the western part of the island.

During a "normal" year, water flows in the small streams all through the periods of reduced rainfall (11). During a drought year, many of the small streams and the lower reaches of the bigger rivers are dry.

It is hard to judge what effect these drought years have on the carrying-capacity of the Reserve and the distribution of the larger mammals, but the effect of drought cannot be discounted. We would not expect the drought to affect the large mobile mammals as much as it would the smaller less mobile forms, for example, chevrotain (Tragulus javanicus) and muntjac (Muntiacus muntjak) (29). What is important is that care is taken when discussing what is "normal". What is "normal" even in this "wet island" of East Java is the regular occurrence of droughts.

VEGETATION

The Vegetation Types

Our broad examination of Meru-Betiri revealed five of the eleven vegetation types defined for Java by van Steenis and Schippers-Lammertse (30, 31). There are:

a. Two formations of beach vegetation
b. Mangroves
c. Lowland swamp forest
d. Rheophyte vegetation
e. Mixed lowland and hill rain forest

It is possible that off the coast there is a limited extent of submerged littoral vegetation and at the very top of Gn. Betiri, there is mountain rain forest, although this is not in evidence at 1100 m. There is no true monsoon forest now, but this was once the most extensive forest type in the adjacent lowland areas (30).

The Pescaprae formation is a low, largely herbaceous plant fringe growing from the drift zone on to the dike behind sandy beaches. Most plants are creeping and rooting, producing runners. Dominants include Ipomoea pescaprae and Spinifex littoreus. This formation is only found on coasts where sand is being deposited; if sand is not deposited, the waves reach the beach dike on which grows the Barringtonia formation. In Meru-Betiri we found a well-developed Pescaprae formation on the beach at Sukamade and to a limited extent on the beaches at Meru and Bandialit.

There are some excellent Barringtonia formations along the coast of Meru-Betiri. We noted Calophyllum inophyllum, Hibiscus, Terminalia, Pandanus, and a few other species (Table 2).

The mangrove type is limited to a few bays and estuaries, such as Sukamade and Permisan. This vegetation type is vulnerable to alteration. If cut off from the tides, the grove will die because a fluctuating water level is essential for respiration through the root system. The species composition of the type is simple. We noted Rhizophora, Avicennia marina, and Bruguiera.

Behind the mangroves at Sukamade, Permisan and Manggelan, there are small stands of swamp forest that include Mangifera, Gluta renghas, Alstonia angustilobia and Barringtonia spicata.

On the flood plains of the major rivers such as the Sukamade and, to a lesser extent, the Sanen and Bandielit, a Rheophytic vegetation type can be seen. According to van Steenis (30) "This is composed of plants which are not only riverine, but are restricted to the rocky, gravelly and sandy areas between the flood zones, which means the plants must be subjected to the overflow of swift-running water masses. Java is very poor in such plants" (p.10-11). In the Sukamade valley there are extensive stands of glagah (Saccharum spontaneum) in this zone. Important in this zone are the ephemeral herbs and grasses growing in the dry parts of riverbeds during the periods of low water. These are extensively fed upon by muntjac in some areas.

The fifth vegetation type, and most extensive, is the "mixed lowland and hill rain forest on dry land". Van Steenis reports this formation occurs below 1000-1500 m in areas which are over-wet or are subject to only a feeble dry monsoon with at least 30-40 rainy days during the four driest consecutive months of the year. It is of a highly mixed character with few dominants. It grows in a variety of soils. In these forests there are a large number of epiphytes, such as orchids and ferns. Bamboo groves occur, most species introduced from Southeast Asia (for example, Gigantochloa). The more extensive stands of bamboo are derived from former cultivation.

In the van Steenis vegetation map of Java (30), the Meru-Betiri area is shown as mixed monsoon forest, but Bartels and van der Veen (17) and van der Zon (32) state the principal vegetation type is or, at least, "has the character of" (17) tropical rain forest. In Meru-Betiri this vegetation type is complex and confusing, largely because of the large elevational gradients and the variation of the rainfall regime.

To help clarify the situation we have listed this vegetation type under van Steenis' category of "mixed lowland and hill rain forest on dry land", but we feel that this type can be separated into at least three fairly distinct sub-types. Within these sub-types there are

distinct seres (33, 34). Our purpose in making these distinctions is to fulfil present management and conservation needs and to group the vegetation into series of habitat types that reflect the distribution of the larger mammals. A precise delineation of the boundaries of these sub-types, and of all the vegetation types, must await the availability of aerial photographs accompanied by detailed field investigations.

In the dry season there is a noticeable leaf-shedding by many of the larger trees over much of the Reserve. This foliage reduction is mainly confined to the larger emergents and not the main canopy, which is primarily evergreen. This is most apparent in the western part of the Reserve, particularly in the forests under Gn. Rika, Gn. Bandialit and Gn. Mandilis. An examination of Fig. 2c shows this is the driest zone of the Reserve with fewer than 20 rainy days in the four driest consecutive months of the year. To a lesser extent some of the emergent trees in the lower reaches of the Sukamade drainage lose their leaves, but this is restricted to a zone below 400-500 m. In this sub-type, there are many of the trees which van Steenis lists as species typical of a monsoon forest (Table 2; 34), but many of the indicator species are also absent. Apparently, this sub-type represents a transitional stage between semi-deciduous and evergreen rain forest, such as Jacobs (34) found occurring over much of Blambangan.

Above 400-500 m in the east and on the scattered high points in the west, the emergent trees are evergreen and their vegetation has the appearance of tropical rain forest in the classic sense. From the rainfall data at Malangsari (at 700 m), there is an average of 35 rainy days during the four driest consecutive months. In observing weather patterns at Sukamade, it was apparent that 400-500 m was the elevation where clouds collected against the mountains during the southeast monsoon, giving rise to a more even distribution of rainfall in this area, as we have discussed previously. In the Sukamade drainage, there are many pockets of what have the appearance of good rain forest below the 400 m zone. At the plantations, there are an average of 25 rainy days during the four driest consecutive months (Table 1). On the hill in the lower Sukamade, drought-resistant trees are evident, as we have noted, but not in the high proportion seen in the west. The forest on the hills in the lower Sukamade drainage could be classed as one more intermediate step between rain forest and seasonal forest, but for our purpose here, we will include it with the rain forest formation.

What is distinct in the Sukamade drainage is the forest occupying the alluvial plain behind the beach formation. This has a strong component of drought-resistant trees, such as Kleinhovia hospita and Lagerstroemia spicata. In times past, much of the area now under cultivation within

TABLE 2
DAFTAR 2

SOME PREVALENT PLANTS IN MERU-BETIRI
BEBERAPA TUMBUHAN YANG BANYAK TERDAPAT

DI MERU-BETIRI

BEACH VEGETATION/HUTAH PANTAI

Pandanus tectorius

Hibiscus tiliaceus

Callophylum inophyllum

Lantana camara

Terminalia catappa

Cycas sp.

Wedelia sp.

Sterculia foetida

Cerbera manghas

MANGROVES/HUTAN PANYAU

Avicenia marina

Bruguira sp.

Rhizophora sp.

Sonneratia ovata

Nipa fruticans

SWAMP FOREST/HUTAN RAWA

Barringtonia sp.

Gluta renghas

Mangifera sp.

Alstonia angustifolia

Mixed Lowland and Hill Rain Forest, Rheophytic Vegetation/Hutan Campur Dataran Rendah dan Hutan Hujan Pegunungan, Rheophytic

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TREE AND TREE-LIKE PLANTS

Artocarpus elastica

Tetrameles nudiflora

Dracontomelon mangiferum

Anthecephalus cadamba

Kleinhovia hospita

Lagerstroemia sp.

Pterospermum javanicum

Adenanthera microsperma

Spondias pinnata

Durio zibethinus

TREE AND TREE-LIKE PLANTS (Continued)

Metrophora javanica

Aglaia eusideroxylon

Albizia sp.

Picus annulata

Pterospermum difersifolium

Aleuritas moluccana

Daemonorops elongata

Daemonorops melanochaetes

Daemonorops hygropilus

Tectona grandis

Corypha gebanga

Diospyros cauliflora

Arenga pinnata

Photinia notaniana

Lansium domesticum

Eugenia desiflora

Antidesma bunius

Evunines javanicum

Strochlus asper

Michelia sp.

Dioscorea hirsuta

Erythrina variegata

BAMBOOS/BAMBU

Gigantochloa sp.

Schizostachyum blumei

Dendrocalamus asper

Bambusa bambos

GRASSES/RUMPUT

Imperata cylindrica

Panicum distachyum

Saccharum spontaneum

Cynodon dactylon

Andropogan aciculatus

Panicum flavidum

Panicum pilipes

Panicum pertusun

Panicum muticum

Ageratum conyzoides

Prepared by Ir. Suyono

the plantation was probably under this vegetation type. The Director of Sukamade told us that this area was not cleared until the early 1950s.

From a management point of view, a distinction between these sub-types of rain forest is important; while the general structure of the mature forest is similar, each sub-type appears to respond to mechanical disturbances in a slightly different way. Fire, for example, is a threat to the dry forest type in the west. The response of the forests in the west to clearing by man is noticeably different from the seral vegetation produced in the wetter types. It is important, then, to discuss the impact of man on the vegetation from this basis.

The Influence of Man on the Vegetation

The vegetation surrounding the Reserve, except for small corridors in the north and northwest, has been completely altered by man. Within the present Reserve boundary and the proposed northern extension, the forests have been cleared from the plantation enclaves at Bandialit and Sukamade, up to about the 100-150 m contour in the Karangtambak drainage, and the area between the sea and the Bandialit plantation. About 100 ha, 25 ha and 50 ha have been recently cleared at Sukamade, Pringtali and Nanggelan respectively, as feeding grounds i.e., wildlife habitat improvement projects. Scattered along the western boundary under Gn. Guci and Gn. Mandilis are plantations of teak, dating from when the area was under the administration of Perhutani. There are 1100 ha of teak plantation within the present Reserve boundaries.

Aside from these comparatively recent vegetation alterations, there are signs throughout the Reserve of human disturbance of more ancient origins. The extent of these anthropogenic seres is difficult to assess, but extensive alterations are apparent on the hills above Bandialit Bay, on the lower slopes between Sekar Pisang and Nanggelan and on the north slopes of Gn. Mandilis and Gn. Betiri.

The disturbed hillsides surrounding Bandialit Bay are covered with tall grasses and wild pisang (Musa spp.). Their origin is older than the memory of the plantation manager, but it is possible they date only from the period of Japanese occupation, cleared as part of the coastal fortification effort. This is only speculation; what is certain is that this is not primary vegetation, as present management personnel believe, and that even after more than 30 years, there is no sign that the original forest is recovering. It is doubtful that the present vegetation here is suitable as food for banteng, but it would have been more desirable to clear small scattered patches of this secondary growth than to clear the forest from the steep slopes at Pringtali, a few kilometers to the north, with the objective of creating a feeding

area for these wild cattle (18).

Large groves of bamboo occur between Sekar Pisang and Nanggelan, in the valley bottom above the Sukamade plantation, and scattered on the north slopes of Gn. Betiri and Gn. Handilis. These are certainly the result of past cultivation. In the Nanggelan-Sekar Pisang area and the lower slopes above the Sanen River, these stands are open, with areas of alang-alang (Imperata cylindrica). In the Sukamade drainage, the bamboo grows in closed stands. The difference in stand structure is probably related to climate, specifically the soil-moisture regime. The drier sites with scattered alang-alang openings are the most suitable habitat for large ungulates, such as banteng and rusa. It is in these drier areas in the north and west that the banteng in the Reserve are found.

There is some question about the origin of the bamboo stands above the Sukamade plantation, which are being cleared as a habitat improvement project. Judging from the pattern of stumps and the remaining bamboo, this was a 150 ha area of bamboo with a few emergent Ficus, covering the valley bottom and extending up the lower slopes. The line between the bamboo and forest is distinct and does not seem to follow any observable land feature. Undoubtedly this was cleared for cultivation in the past. One of the common bamboos is Gigantochloa; this species is not native to Java, but was introduced (34).

On the hills in the lower Sukamade drainage, the forest contains stands of bamboo, not as extensive and easily identifiable as seen in the west and north. The forest undergrowth here in this drier area is extremely thick. The forest canopy is more open than at higher elevations (11). In the past this region was probably subject to more disturbance than the forests at higher elevation, but it does not appear that these slopes were subject to agricultural development.

We are uncertain as to what percentage of the forest in the Reserve represents primary forest or, at least, a climax forest type. The published estimate is 50% (35, 36). Bartels and van der Veen (17) have remarked that the area is "almost wholly covered by dense primeval forest" and this is the chief impression one has upon viewing the forests from a distance. An accurate determination of the area of primary and climax forest within the Reserve will have to await a detailed vegetation analysis, but we would tentatively place the figure at 75%, using the definition in Mueller-Dombois and Ellenberg (33).

The exact percentage of the forest in a primary state is not the index of the value of Meru-Betiri as a nature reserve. More important is the diversity and extensiveness of the vegetation types. Meru-Betiri is a forested island surrounded by agricultural areas. Five of the major vegetation types occurring in Java are represented here. As such, this area is unique and unparalleled in Java today.

Figure 4 Rafflesia and Balanophora:

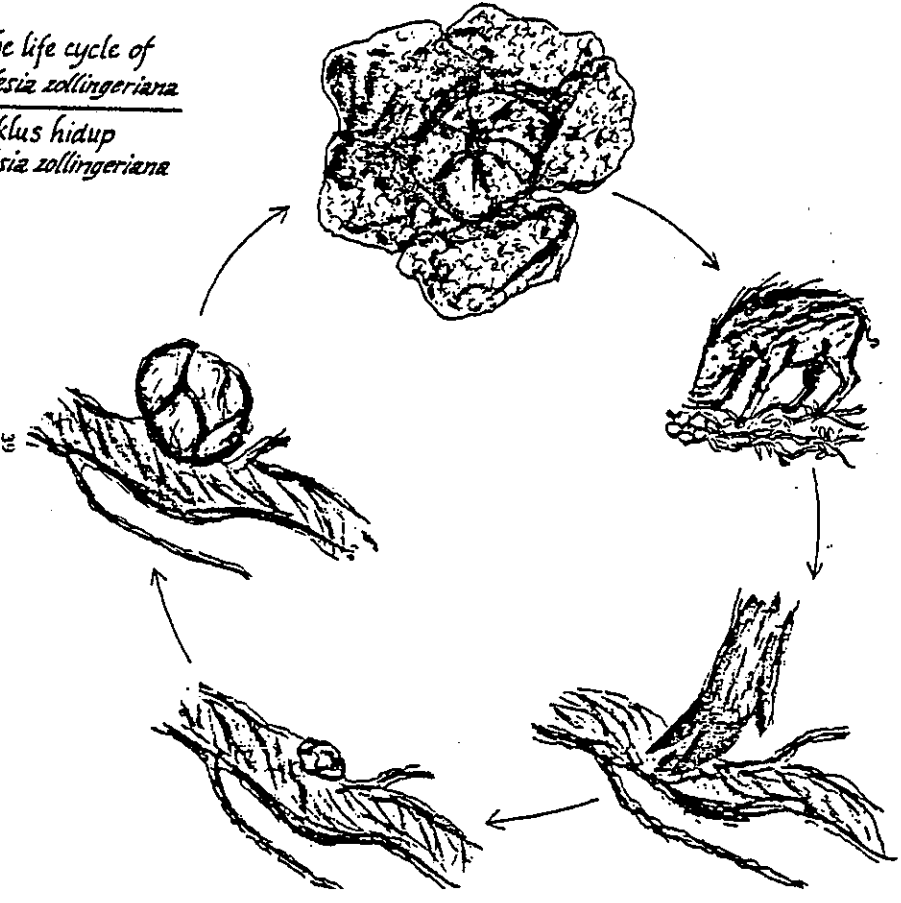
Meru-Betiri is the only known location of Rafflesia zollingeriana. Another rare root-parasite, Balanophora fungosa, is also found here.

The life cycle of Rafflesia is complex. It lives only on the Tetrastigma lianas; there are both male and female flowers, and pollination is apparently accomplished by carrion flies (Lacilia) attracted to the distinctive odour of the flowers; seeds are dispersed on the hooves of large mammals; the animal's hoof must injure the host liana for the infection to begin (after Jacobs, unpublished).

Balanophora is not as specific in its host plant as Rafflesia, but we do not know why these root parasites are so rare.
To preserve these and all the rare and extinction-prone species of the Reserve will require careful monitoring of population trends and research to understand their survival needs.

The life cycle of
Rafflesia zollingeriana

Siklus hidup
Rafflesia zollingeriana



Balanophora fungosa

ACTUAL SIZE
UKURAN BESAR

Rafflesia and Balanophora

There are three species of Rafflesia in Java; Meru-Betiri is the only known location for Rafflesia zollingeriana (17), although it was once found in a number of locations in the Southern Mountains (37). Rafflesia is protected by Indonesian law and its preservation, and the preservation of the rare root parasite, Balanophora fungosa, is a primary management concern for the Reserve.

These parasites are devoid of life-sustaining chlorophyll and are dependent on other plants for nutrients. The conservation program for Rafflesia will have to be based on understanding its life cycle, which has been summarized by van Steenis and van der Veen (38). Rafflesia lives in the tissue of the woody vitaceous liana, Tetrastigma. The lianas have limited life spans and it is necessary for new lianas to be infected regularly for the parasite to perpetuate. It has been determined from experiments that the Rafflesia's very minute seeds can only grow in wounded places where animals have trod on the basal parts of the lianas, injuring them with their hooves. In an early study, van Steenis (37) noted that a bud of 3 cm took an additional six months to open. It appears there is no distinct flowering season. Pollination is accomplished by carrion flies (Lucilia), which are apparently attracted to the distinctive odour of the flower.

The characteristics of both Rafflesia and Balanophora are shown in Fig. 4. An inventory of locations where these rare plants grow is a primary management need.

THE AVIAN FAUNA

The Forest and the Seashore

In the gathering dusk of July evenings, flight after flight of hornbills crossed the valley of the upper Sukamade River, returning to their roosting trees after a day of foraging. We frequently encountered the wreathed hornbills (Rhyticeros undulatus) on the higher ridges in Meru-Betiri; lower in the valley and along the streams we sometimes startled groups of smaller pied hornbills (Anthracoceros convexus). Depending on the fruits of the great trees for food, the hornbills are primarily birds of undisturbed rain forest. The sudden whish of air through the stiff wing feathers of a hornbill startled in its feeding tree at a streamside and the laboured reverberating wing beats of family groups flying high above the valleys at dusk are familiar sounds in Meru-Betiri, a subtle reminder of the importance of maintaining large tracts of undisturbed rain forest to assure their survival and the survival of so many climax forest birds.

In the harsh glare of the midday sun, a little falcon (Falco moluccensis) swoops toward the low vegetation bordering the sandy beach; it checks its dive, detected by an alert prey animal, and continues down the narrow strip of vegetation with powerful strokes of pointed wings. Two reef egrets (Egretta sacra) dart after receding waves, searching for invertebrates. Out away from the land, a black-naped tern (Sterna sumatrana) plunges into the waves, disappears, then rises slowly with a small fish in its bill; it swallows its prey on the wing. In a tall dead snag, an osprey (Pandion haliaetus) sits looking over the open stretch of water at the river mouth behind the sand beach. It seems to be watching for fish moving into the brackish water with the incoming tide. At this hour there are no people on the Sukamade beach and it vibrates with life processes; it is a study of food webs and feeding niches, of hunting strategies and predator-avoidance behaviour.

What a contrast this is to the beach at Rajegwesi just around the point where man's presence dominates: motorcycles race along the sand; the shore and bay are sprinkled with fishing boats; and groups of people gather on the beach to talk, to work, or to walk. Rajegwesi is a quiet village inside the Reserve. The people there are dependent on the sea for food; the beach serves their needs as a work area and path. Yet some beaches should be left alone so that the lives of other animals can go on undisturbed. Man can visit here in an unobtrusive manner, sit and watch, and learn about the natural world upon which he is so ultimately dependent.

The Diversity of Birds

We did not attempt to conduct systematic studies of the birds during our brief survey, but an investigation of the avian fauna of the Reserve has been carried out by H. Bartels (39) and A. Hoogerwerf (8). More than 140 species have been recorded here, and there may be as many as 180 living in the Reserve (Table 3). This compares with 233 species of birds known to occur in the Ujung Kulon Reserve in West Java and 460 species for the island as a whole (1). The disparity between the numbers of birds found in Meru-Betiri and Ujung Kulon is probably due to habitat differences and the position of the Reserve in relation to major migration routes (40), although some migratory birds do pass through Meru-Betiri.

The Problem of Extinction-Prone Birds in Rain Forest Reserves (41)

The tropical forests of the world contain a rich assemblage of birds, characterized not by the number of any one species, but by the multitude of different species present. The tropical forest birds have been the subject of intensive scientific study, yet out of this research have come few specific guidelines to help the manager in his custodian role of maintaining the ecological integrity of natural areas.

TABLE 3

BIRDS OF MERU-BETIRI

\+ Indicates species which are characteristic of lowland rain forest
++ Indicates rain forest birds found at moderate elevations in Java based on the experience of H. Bartels
( ) Page in ref. 43

Hydrobatidae: Storm petrels (31)
Oceanodroma monorhis
Sulidae: Boobies (37)
Sula leucogaster
Ardeidae: Herons (40)
Ardea purpurea
Ardea sumatrana
Ardoela speciosa
Butorides striatus
Egretta alba
Egretta sacra
Ixobrycnus cinnamomeus
Ciconiidae: Storks (50)
Ciconia episcopus
Pandionidae: Osprey (69)
Pandion haliaetus
Accipitridae: Hawks (70)
Haliaeetus leucogaster
Accipiter trivirgatus
Spizaetus nipalensis ++
Spizaetus cirrhatus
Hieraaetus kieneri +
Ictinaetus malayensis ++
Spilornis cheela
Falconidae: Falcons (93)
Falco moluccensis
Phasianidae: Pheasants (99)
Arborophila sp. ++
Gallus gallus
Gallus varius
Pavo muticus
Turnicidae: Button quail (110)
Turnix suscitator
Rallidae: Rails (115)
Amaurornis phoenicurus
Scolopacidae: Sandpipers (126)
Crocethia alba
Actitis hypoleucos

Burhinidae: Thick-knee (151)
Esacus magnirostris
Laridae: Terns (153)
Sterna dougallii
Sterna anaethetus
Sterna sumatrana
Columbidae: Pigeons (167)
Ptilinopus melanospila
Ducula sp.
Macropygia phasianella +
Geopelia striata (introduced)
Streptopelia chinensis
Treron pompadora
Psittacidae: Parrots (178)
Psittacula alexandri
Loriculus vernalis
Cuculidae: Cuckoos (180)
Cacomantis sonneratii
Cacomantis merulinus
Cacomantis variolosus
Chrysococcyx xanthorhynchus +
Surniculus lugubris
Eudynamis scolopacea
Phaenicophaeus curvirostris +
Phaenicophaeus javanicus +
Centrops nigrorubus
Centropus sinensis
Centropus bengalensis
Strigiformes: Owls (189)
Otus bakkamoena
Glaucidium castanopterum ++
Strix sp.
Caprimulgidae: Nightjars (199)
Caprimulgus macrurus
Apodiae: Swifts (201)
Apus affinis
Phaphidura leucophygialis ++
Collocalia fuciphaga

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BIRDS OF MERU-BETIRI (Continued)

Gallocalia gigas ++
Collocalia esculenta
Cypsiurus batasiensis
Hemiprocnidae: Tree swifts (206)
Hemiprocne longipennis
Trogonidae: Trogons (206)
Harpactes oreskios ++
Alcedinidae: Kingfishers (210)
Lacedo pulchella +
Halcyon chloris
Halcyon cyanoventris
Alcedo euryzona ++
Meropidae: Bee-eaters (214)
Merops leschenaulti
Coraciidae: Rollers (216)
Eurystomus orientalis
Bucerotidae: Hornbills (216)
Rhyticeros undulatus ++
Anthracoceros convexus +
Buceros rhinoceros +
Picidae: Woodpeckers (227)
Dendrocopos macei
Hemicircus concretus ++
Dryocopus javensis +
Chrysocolaptes sp.
Eurylaimidae: Broadbills (235)
Eurylaimus javanicus ++
Pittidae: Pittas (238)
Pitta guajana
Hirundinidae: Swallows (248)
Hirundo thhitica
Capitonidae: Barbets (221)
Megalaima javensis + (+)
Megalaima australis +
Megalaima haemacephala
Motacillidae: Wagtails (398)
Anthus novaeseelandiae
Campephagidae: Cuckoo-shrikes (251)
Hemipus hirundinaceus
Lalage nigra
Pericrocotus cinnamomeus
Pericrocotus flammeus +
Laniidae: Shrikes (404)
Lanius schach
Nectariniidae: Sunbirds (412)
Anthreptes malacensis
Anthreptes singalensis +
Nectarinia jugularis
Arachnothera longirostra
Arachnothera affinis
Sturnidae: Stralings, Mynas (406)
Aplonis panayensis
Aplonis minor
Sturnus melanopterus
Sturnus javanicus
Gracula religiosa +

Artamidae: Wood-swallows (403)
Artamus leucorhynchos
Chloropseidae: Leafbirds (260)
Aegithina tiphia
Chloropsis sonnerati +
Chloropsis cochinchinensis ++
Pycnonotidae: Bulbuls (261)
Pycnonotus atriceps +
Pycnonotus melanicterus
Pycnonotus aurigaster
Pycnonotus goiavier
Pycnonotus simplex +
Criniger bres +
Turdidae: Thrushes (331)
Copsychus saularis
Copsychus amoenus
Copsychus malabaricus +
Enicurus leschenaulti
Saxicola caprata
Myophonus coeruleus
Timaliidae: Babblers (293)
Trichastoma sepiarium
Napothera macrodactyla
Macronous kelleyi
Stachyris melanothorax
Sylviidae: Old World warblers (350)
Megalurus palustris
Cisticola exilis
Prinia familiaris
Abrosopus superciliaris
Orthotomus ruficeps
Muscicapidae: Old World flycatchers
Rhipidura javanica
Cyornis banyumas
Philentoma velatum +
Hypothymis azurea +
Trepsiphone paradisi +
Paridae: tits (282)
Parus major
Dicaeidae: Flowerpeckers (420)
Dicaeum chrysorrheum +
Dicaeum trochilcum
Dicaeum trigonostigma

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