ORANGUTAN POPULATION AND HABITAT VIABILITY ANALYSIS WORKSHOP

MEDAN, NORTH SUMATRA, 1993

ORANGUTAN
POPULATION AND HABITAT
VIABILITY ANALYSIS REPORT

OF THE CAPTIVE BREEDING SPECIALIST GROUP
SPECIES SURVIVAL COMMISSION OF THE IUCN

20 OCTOBER 1993

Workshop Editors:

Ronald L. Tilson
Minnesota Zoo, Apple Valley, MN, USA

Ulysses S. Seal
IUCN/SSC CBSG, Apple Valley, MN, USA

Komar Soemarna
Indonesian Forest Protection and Nature Conservation, Indonesia

Widodo Ramono
Indonesian Forest Protection and Nature Conservation, Indonesia

Effendy Sumardja
Indonesia Forest Protection and Nature Conservation, Indonesia

S. Poniran
Gunung Leuser National Park, Sumatra, Indonesia

Carel van Schaik
Duke University, Durham, NC, USA

Mark Leighton
Harvard University, Cambridge, MA, USA

Herman Rijksen
Instituut voor Bosbouw en Groenbeheer, Netherlands

Ardith Eudey
IUCN/SSC Primate Specialist Group, Asian Section

A Joint Endeavor of the
Indonesian Forest Protection and Nature Conservation (PHPA) &
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POPULATION AND HABITAT
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MEDAN, NORTH SUMATRA, INDONESIA
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INDONESIAN FOREST PROTECTION AND NATURE CONSERVATION (PHPA)

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ORANGUTAN
POPULATION & HABITAT VIABILITY ANALYSIS REPORT

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ORANGUTAN POPULATION AND HABITAT VIABILITY ANALYSIS REPORT

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The first Population and Habitat Viability Analysis (PHVA) Workshop for Orangutan (*Pongo pygmaeus*) was held in Medan, North Sumatra, Indonesia on 18-20 January 1993. PHVA workshops use computer models (called Vortex) to simulate the deterministic and stochastic, or random, processes that threaten small populations and to explore what effects various management options may produce on the survival of the population. The workshop was conducted by Ulysses Seal, Chairman of the IUCN/SSC Captive Breeding Specialist Group (CBSG), and Ronald Tilson, Director of Conservation, Minnesota Zoo, and coordinated by the CBSG and the Indonesian Directorate of Forest Protection and Nature Conservation (PHPA). Widodo Ramono, Sub-directorate of Species Conservation, PHPA, Mike Griffiths, WWF-Gunung Leuser National Park, Sukianto Lusli, WWF-Kerinci Seblat National Park, and Jansen Manansang, Taman Safari Indonesia were the organizers. Close to 40 people, primarily Indonesians and a significant number of orangutan field workers, were in attendance. Sponsors of the workshop included: the IUCN/SSC CBSG; Indonesian PHPA; Zoo Atlanta and the Orangutan AAZPA Species Survival Plan (SSP); Taronga Zoo and the Orangutan ASMP (Australia); and Jersey Wildlife Preservation Trust, U.K.

The workshop focused on the status of wild populations of orangutans on Sumatra and Borneo, with major emphasis on the Sumatran population *(Pongo pygmaeus abelii).* A Sumatran Tiger PHVA Workshop previously held in November 1992 had created a map-linked database that integrated vegetation types, satellite imagery, and land use patterns for the protected areas of Sumatra; the map for Gunung Leuser National Park proved invaluable for developing more precise estimates of the size and distribution of orangutan populations in the park. At the workshop three working groups were established: Sumatra, Borneo and Life History Characteristics and Vortex Modelling. The workshop provided a unique opportunity to bring together field workers who have studied, or are presently studying, orangutans at Ketambe in Gunung Leuser National Park (Sumatra): these include Herman Rijksen, Jito Sugardjito, Carel van Schaik, Suharto Djojosudharmo, Tatang Mitra Setia, and Sri Suci Utami.

Estimates of habitat and population numbers for orangutans were derived in the working groups through consensus of the field biologists; for Sumatra, the estimates were probably more reliable because of the database than they were for Bornean populations of orangutans. For Sumatra, the exact boundaries of orangutan distribution are not known, but there are several distinct populations, including the lesser-known Singkil population and the Sembabala-Dolok Sembelin population. The Greater Leuser orangutan population, which extends beyond the national park boundaries, is thought to cover approximately 11,710 km^2 and has two distinct populations: using a correction or "safety" factor to derive population estimates, the western population is thought to number 5,700, and is the most important orangutan population in Sumatra; the eastern population is thought to number 3,500. Within the more restricted boundaries of Gunung Leuser National Park, the area covered by the western population is 5,570 km^2 and the corrected population size is about 3,450; the area covered by the eastern population is 2,957 km^2 and the corrected population size is about 2,400. The total number of orangutans in the park probably is about 5,800. The Greater Leuser populations were

judged to be among the best in the world, in terms of numbers and potential for protection, and Gunung Leuser National Park was considered to be vital to the long-term survival of the Sumatran orangutan.

Long-term study and familiarity with Gunung Leuser National Park and surrounding areas made possible the identification of specific threats to its integrity, such as road construction and illegal encroachment and logging in lowland areas, and the effects that these acts would have on components of the orangutan population. The following are some of the recommendations made to safeguard the Greater Leuser population:

- Add forested lowland areas to the park wherever possible (lowland and swamp forests are optimum orangutan habitats);
- Restore the connection between western and eastern populations to create a larger unit, to minimize the effects of genetic erosion (the population should be no less than 10,000 to ensure the long-term survival of the species);
- Refrain from building roads dissecting the park; and
- Maintain an absolute commitment to protection of the park, establishing buffer zones wherever possible.

A recommendation also was made to continue to keep poaching to a minimum because "the population is known not to withstand any significant poaching pressure."

For Borneo (Kalimantan, Sabah and Sarawak), the known distribution of orangutans comprises eight regions with currently isolated populations. No published or unpublished data are available on population numbers for any of these areas, with the exception of Gunung Palung, Kalimantan, where long-term research is being carried out by M. Leighton. For each region, the area in square kilometers and orangutan density based on habitat type were estimated, again using a correction factor to compensate for the inherent overestimation caused by studies being conducting in lowland prime habitat. An additional 5,000 km^2 was added to account for regions where significant orangutan populations may occur in unprotected or unidentified areas. The total area of orangutan habitat on Borneo was calculated at 22,360 km^2, and the estimate of total population numbers ranged from a minimum of 10,282 to a maximum of 15,546. These figures suggest a more serious decline in the Bornean population than was previously thought.

A degree of specificity comparable to that for Sumatra could not be achieved for Borneo in identifying threats to known populations, and an "estimate of impact" of a variety of threats on population survival was calculated instead. The primary recommendation stemming from this exercise was that protection of existing national parks and other protected areas should be improved: at least 60% of the present orangutan populations on Borneo could be protected by implementation of current authority or protection laws. As an adjunct to enhanced enforcement, logging and habitat degradation should be banned in parks and proposed conservation areas, and funding should be secured for boundary demarcation.

The working group on Life History Characteristics relied primarily on unpublished data collected at Ketambe, Gunung Leuser National Park, and Tanjung Puting National Park, Kalimantan. The orangutan appears to be the ultimate K-selected species, in that survivorship is high, interbirth interval is long (mean = 8 years), and the female makes a high investment in her offspring. Vortex modelling indicated that adult females are the most valuable members of an orangutan population and that the death of an adult female has the greatest influence on increasing extinction rates of all life history variables. Infants in illegal trade may be thought of as representing dead females.

On the last day of the workshop a comprehensive set of recommendations for the conservation management of orangutans were reviewed, intensively discussed, and consensus was reached. These recommendations covered the following issues:

- Management strategies for orangutans and protected areas occupied by orangutans in Sumatra and Borneo. As stated above, this included stronger protection measures for orangutans and forest, prevention of fragmentation (both species and habitat), and restoration of degraded habitat.

- Reintroduction of captive orangutans into wild populations has no conservation value in terms of enhancing population viability, and may even have negative effects through the introduction of diseases or inappropriate genetic subspecies.

- Establishment of new viable populations of ex-captive orangutans, in habitat formerly occupied by orangutans, but where they do not now occur, may contribute to the viability of metapopulations.

- Updated recommendations on medical procedures during quarantine for orangutans intended for reintroduction.

- Additional surveys and more comprehensive map-linked databases are needed for Borneo before an in-depth PHVA can be performed for Bornean orangutan populations.

At the request of the Sub-directorate for Species Conservation (PHPA), a series of guidelines concerning the reintroduction of orangutans was prepared. The Borneo Working Group had recommended reintroduction of orangutans into forests without wild orangutans (if possible) to protect/conserve worthwhile forests (production/protection forests). The Sub-directorate was holding approximately 100 orangutans, in anticipation of returning them to the wild. The problem of orangutan reintroduction was not addressed by a specific working group at the workshop, but questions concerning the captive population of orangutans (and reintroduction) should be examined at a workshop of the IUCN/SSC Reintroduction Specialist Group.

Following the workshop on 21 January, the Bohorok River Visitor Center in Gunung Leuser National Park was dedicated by WWF-Indonesia to the Directorate General of Forest Protection and Nature Conservation of Indonesia.■

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ORANGUTAN PHVA WORKSHOP

Problem Statement: Orangutan PHVA Workshop

Editors' note: The following statement reflects information available prior to the Orangutan PHVA Workshop; some of these numbers were revised during the workshop.

Good quantitative census data on the orangutan (*Pongo pygmaeus*) are not available. It is estimated that suitable orangutan habitat in Indonesia and Malaysia has declined by more than 80% in the last 20 years and that orangutan numbers have declined by 30-50% over the last 10 years. Recent estimates place the number of Bornean orangutans (*P.p. pygmaeus)* between 19,000 and 30,000 and the number of Sumatran orangutans (*P.p. abelli)* at between 7,000 and 11,000.

There are 16 major protected areas inhabited by orangutans. Fifteen of these areas, totalling almost 2,300,000 ha, are on the island of Borneo: in Kalimantan, Sabah and Sarawak. Less than one-half of this area is suitable orangutan habitat. The estimated number of orangutans in the protected areas on the island of Borneo is 15,000. The only protected area within the range of the Sumatran orangutan is Gunung Leuser National Park, covering about 900,000 ha. Much of this park is mountainous and therefore unsuitable orangutan habitat. It is estimated that the orangutan population within Gunung Leuser numbers between 5,000 and 7,400.

The major threat to orangutan populations is habitat conversion for timber, plantations and agriculture. Timber activities occur inside, as well as outside of protected areas. A secondary threat is capture for the pet trade. Recent estimates suggest there may be as many as 1,000 pet orangutans on the island of Taiwan.

Current conservation measures for this species in the wild include increasing the effectiveness of rain forest protection efforts in Indonesia and Malaysia and research into, and implementation of, habitat restoration techniques. It is also proposed to utilize the orangutan as an umbrella species to protect rain forest areas of high biological diversity.

An international conference on the Great Apes, conducted in Indonesia in December 1991, identified many of the problems confronting the orangutan in the wild and proposed programs to address these problems. This Workshop will extend this process by conducting a Population and Habitat Viability Analysis (PHVA).

The Population and Habitat Viability Analysis will provide an in-depth assessment of factors that impact wild orangutan populations, will explore the effects of various management options, and will attempt to formulate more explicit objectives for management of this species. The PHVA will assemble field managers and researchers for this species as well as population biologists and model builders. Simulation models will be developed using available information on the biology of the species. The model development process will require that data and assumptions be formulated in an explicit way. This process tends to lead to consensus building. The models can serve as a basis

for continuing consideration of management alternatives and adaptive management of the species. The models will facilitate evaluation of various management scenarios. This approach may also assist in evaluating the management contributions of ongoing and proposed research for this species.

Goals of the Orangutan PHVA Workshop

1) Assess the current status of wild orangutans.

2) Assemble unpublished information on orangutan distribution, population numbers, and habitat trends to assist development of management strategies.

3) Identify and evaluate the deterministic and stochastic threats to wild orangutan populations.

4) Operationally review life history information of the species as needed for simulation models.

5) Employ computer simulation models to evaluate risks of extinction to wild orangutan populations under current conditions and to explore effects of various management scenarios.

6) Define requirements for "viability" and delineate metapopulation structures that could be used to achieve viability.

7) Determine critical habitat requirements needed to achieve viability of wild orangutan populations and evaluate the status of current protected areas to satisfy these needs.■

Opening Address

Sutisna Wartaputra, Director General of Forest Protection and Nature Conservation

Distinguished Guests, Ladies and Gentlemen,

It is a pleasure to welcome you all to this international workshop convened to discuss strategies to perpetuate the survival of one species of Great Ape, the Orangutan (*Pongo pygmaeus*). This workshop is organized in relation to cooperation between the Directorate General of Forest Protection and Nature Conservation (PHPA) of the Ministry of Forestry of the Republic of Indonesia and the IUCN Species Survival Commission (IUCN/SSC).

We understand that the wild populations of orangutans of the world are at present found on two islands, Sumatra and Borneo. There are two subspecies respectively, one confined to Sumatra (*Pongo pygmaeus abelli*), and the other confined to Borneo (*Pongo pygmaeus pygmaeus*). Because of destruction of orangutan natural habitat, habitat and population fragmentation, and the illegal trade of this species, orangutans have become an endangered species. Further, rapid development in the last two decades has caused the status of orangutans to become even more critically threatened.

Being a country which is blessed as a major global biodiversity area, Indonesia regards orangutans as the most charismatic among the 31 species of primates found in this country. We also understand that orangutans can act as an umbrella species to help conserve other species sharing its environment. Realizing this status, the orangutan has become the pride of Indonesia, and the Government of Indonesia has made serious attempts to conserve the species, such as curtailing illegal international trade and preserving orangutan habitat, as well as the rehabilitation and reintroduction of confiscated orangutans to the wild. These conservation measures were made official by the legislation of a series of Acts, Laws and Ministerial Decrees concerned specifically with wildlife conservation, and by the creation of more than 400 conservation areas consisting of 30 declared National Parks and hundreds of Wildlife Sanctuaries.

In relation to the topic of this workshop "Orangutan Population and Habitat Viability Analysis", I believed that this time all of the participants should try to achieve the following goals:

- prepare a population viability assessment for wild Sumatran Orangutans;
- formulate a quantitative strategy with risk assessment to prevent the extinction of wild orangutans; and
- prepare a conservation plan including schedules, priorities and cost estimates with the objective of preventing the extinction of wild orangutans, by developing management strategies for viable, self-sustaining wild populations.

So far, population models can be classified as either energy flow models, population-parameter models, or habitat-evaluation models. Such approaches should be analyzed for meeting selected goals. Consideration should be aimed at gathering information from the field based on objectivity, the cost of collecting this data, and the ability of this data to estimate population levels as well as carrying capability to predict changes in orangutan populations relative to management activities. New technology might be available to do so, and Indonesia is keen to learn how this technology will help conserve this great ape.

It has been proven that rehabilitation of confiscated orangutans has a positive political, as well as conservation, purpose. The Government of Indonesia has currently established National Parks for conserving orangutans in Gunung Leuser National Park (North Sumatra); Kutai National Park (East Kalimantan), and Tanjung Puting National Park (West Kalimantan). These three parks are large enough to preserve orangutans; but according to ecosystem analysis of suitable habitats for orangutans, these conservation areas are considered still too small. Each of the parks which provide centers for rehabilitation of orangutans has limited capacity to harbor additional re-introduced orangutans confiscated from illegal captivity. Furthermore, we realize that there are additional areas suitable for reintroduction, such as the Semboja Protection Forest (South Kalimantan) where another Orangutan Rehabilitation Center is being established. According to some literature, this area together with other areas embordered by the Barito and Kahayan rivers, was formerly occupied by orangutans. Some catastrophe, most probably heavy hunting, caused the disappearance of orangutans from this area. Concerning rehabilitation activities, a new method has been developed in feralizing orangutans. It was found that a colony of rehabilitated orangutans make no difficult start and adapt well in the wild (thanks to Wanariset). I believe we have to encourage this approach and we need assistance to support it. Zoos and related wildlife parks can play important roles in supporting such activities.

Conservation is a long-term effort, and we must look far into the future. It is our policy that we have to conserve the biodiversity of Indonesia, which is not confined to a single species. In this respect, orangutans have been proven to be a good flagship species whereby protecting it, many other animal and plants species are also protected. We have undertaken many activities to preserve Indonesia's biodiversity, including the attempt to enhance biodiversity in production forests and by propagating wild species under semi-wild and captive conditions. At this time, as our planet faces serious global problems, including the depletion of stratospheric ozone and global warming, so our task in maintaining and increasing protected areas will certainly have a very important value. At this workshop we should exchange our ideas. Information from the IUCN/SSC as well as from other international experts will be useful to Indonesia to help maintain wild populations of orangutans and their habitat.

Again, I wish you every success at this workshop in conserving orangutans.
Ladies and Gentlemen, thank you.■

Keynote Address:
Raja Inal Siregar, Governor of North Sumatra

Distinguished Ladies and Gentlemen.

Allow me to give a brief speech as a host of this International Workshop for orangutans which is now being held in North Sumatra, where orangutans still exist.

It is especially wonderful to us that this workshop can be held in this province. Why is this so? Because we are aware that the distribution of this species of great ape not only is found not only in north Sumatra, it is also found in Kalimantan inside and outside of protected areas such as National Parks. Moreover, this animal also exists in Sabah and Sarawak, Malaysia. However, you all choose Medan as the site for your workshop. This is why we are happy at the beginning of this year. It is also our happiness to welcome you to the Year of the Environment, the declared Government of Indonesia theme for this year.

We are alive and well on this earth. Generally such life can be classified into two environments. One is Nature with its natural resources which are created by God, and another environment is where humans like us live in social environments, and strive to improve our lives. To achieve a better standard of living we set up developments, through mental spirituality or people welfare along with infrastructures, to carry out the development and achieve people welfare are needed an available natural resources. This creates an interaction of resource utilization. Human beings as God's creations are given more superiority than other living organisms, including intelligence, and the ratio is perhaps the one to be the winner. Orangutans, also called "*mawas*", compete with farmers who harvest forest products and cut trees to improve their living conditions in lowland agricultural communities. The increasing human population in our country is paralleled with an increasing need for land for agriculture. Currently many people are landless, and this creates a threat for the intactness of conservation areas such as in Gunung Leuser National Park. Even though there are boundaries around to the park, they are insufficient to guarantee the intactness and security of the park. Therefore, other solutions must be found by creating new activities. In this case, the concept of self-sustainability of the environment must be encouraged.

Agreement among many governments internationally has been mentioned at Earth Summit in Brazil last year, in which Indonesia was a signatory. A consequence is that we have the task to conserve all of our species of fauna and flora in this country, including the orangutan, Asian elephant, Sumatran rhino, Sumatran tiger, and all of the other species. To enable our people and regional governments to uphold this national responsibility it is important to consider that species richness and landscape beauty of Gunung Leuser National Park can also provide advantages. For example, species richness in the park can function to attract tourism and can be developed as a Tourism Market Place (TMP). With an increasing number and quality of recreational projects,

people gain new employment and gradually shift away from clearing forest for cultivation or harvesting products inside the park. Orangutans can function as an important attraction for ecotourism, too, as at Bukit Lawang, Bohorok (Gunung Leuser National Park). The long-term viability of orangutans in Gunung Leuser National Park, especially in northern Sumatra, needs to be maintained. However, rural development of buffer areas around the park also need to be considered, so that there is a positive interaction between the species in the park, its habitat and the people who live on the periphery of the park.

It is clear that we should focus our attention to support any goal undertaken by the government and international organizations to conserve orangutans and other mega wildlife species such as Sumatran rhino, Sumatran tiger and Asian elephant as part of our awareness of God's creations. We do this by protecting habitats, and by so doing we protect species. To all participants of this workshop, we hope that you will provide worthwhile recommendations not only for orangutans, but also for our people who live in marginal conditions adjacent to the park or its buffer zone, that will establish a balanced policy between our orangutans and our people. Finally, I should say "Congratulations" to all of you for your concern at this workshop.

Thank you.■

Acknowledgements
PHPA Organizing Committee

Your honorable
Governor of Province of North Sumatra
Director General of Forest Protection and Nature Conservation
Director of Nature Conservation, PHPA
Director of Nature Conservation Extension, PHPA
District of Government of Southeast Aceh
District of Government of South Aceh
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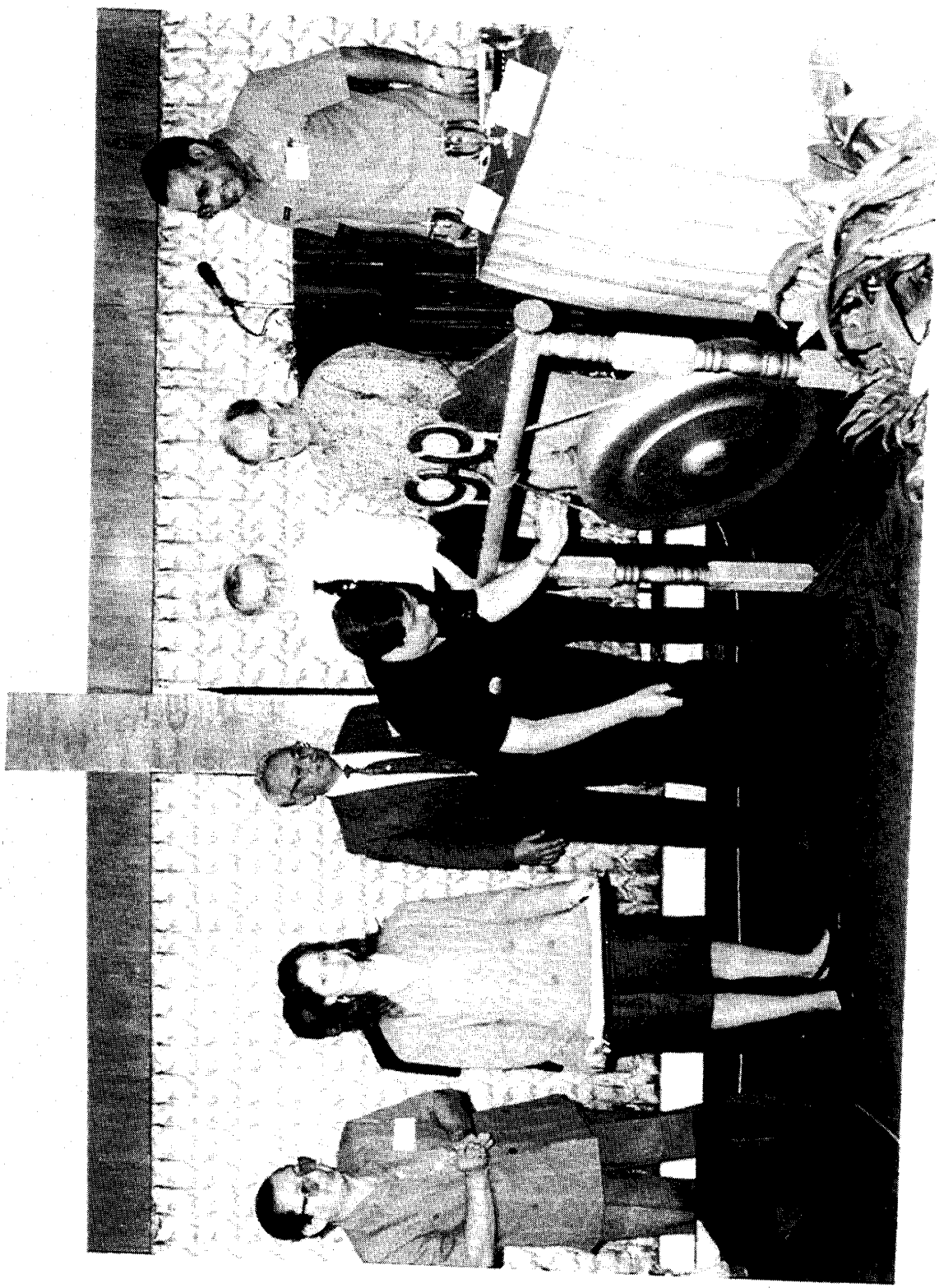
Participants

We would like to take this opportunity to report to you that this Workshop will be held for three days starting from 18 January 1993 at Garuda Plaza Hotel, Medan. This workshop is organized according to the Decree of the Director General of Forest Protection and Nature Conservation No. 11/Skpt/Dj-VI/93 dated 15 January 1993, concerning the Organizing Committee. The participants will be about 50 individuals who come from inside and outside of Indonesia, either in the form of governmental or non-governmental bodies. They are only small parts of people who pay attention on nature conservation, especially in preserving endangered species.

For practical works, this Workshop is supported through the secretariat consisting of PHPA, BKSDA I Medan, Sub-Balai KSDA Sumut, Gunung Leuser National Park, and WWF. With limited facilities, the committee tries working hard to enable the achievement of this workshop such as formulating a program of Orangutan protection in Indonesia especially, and in the world generally.

The committee also wishes to thank the IUCN/SSC CBSG, which coordinated and partly funded this Workshop. We also wish to thank the Government of North Sumatra and Dl Aceh, which actively participated in this Workshop.

Thank you.■



ORANGUTAN
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WORKING GROUP: ORANGUTAN
DISTRIBUTION AND STATUS IN SUMATRA

Working Group: Orangutan Distribution and Status in Sumatra
Members: C. van Schaik, Suharto DJ, S. Poniran, Suci Utami, Kunkun Gurmaya, Kuppin Simbolon, M. Griffiths, N. Rosen, and T. Faust

DISTRIBUTION

The Sumatran subspecies of orangutan (*Pongo pygmaeus pygmaeus*) occurs only in the northern part of the island of Sumatra, where most of the forest has been uninhabited by humans since historical times.

The exact boundaries of the distribution of orangutans are not known. The best information is that compiled by Rijksen in the early 1970s. Here we ignore the orangutans that might still occur south and southeast of Danau Toba, because their numbers are likely to be very small. This leaves several distinct populations:

a) The Singkil population -- The Singkil Barat Reserve consists of extensive swamp forests. However, we don't know the extent of suitable habitat, because there are conflicting reports on the degree of disturbance and habitat loss.

b) The Sembabala-Dolok Sembelin population -- A population in production forests; the exact boundaries are not known, but the numbers are likely to be small, and the prospects for maintenance are poor [*Editors' note: Production Forest is an official term used by the Ministry of Forestry to denote forests that are meant to serve for the permanent production of timber in accordance with the officially approved selective logging system*].

c) The Greater Gunung Leuser west population -- This is by far the largest orangutan population anywhere. Its boundaries coincide with those of Gunung Leuser in the north and the northwest, but are wider in the west and especially the south.

d) The Greater Gunung Leuser east population -- Recently, the southern and the northern sub-populations have become separated because the Kutacane-Blangkejeren road has spawned development around it. The northern population consists of the National Park, along with the remaining part of Tamiang (production forest) and of the Lesten area (designated production forest). To the east, there is a small sub-population separated by the Wampu River. The exact northern boundary of this population is not known, but grades uninterrupted into the forest north and northeast of Blangkejeren. However, ongoing construction of the road from Blangkejeren to Pereulak through Uring, Pinding and Lokop, will undoubtedly sever this link, and create a separate northern population, of which the boundaries are only vaguely known.

e) There may possibly still be a population west of Takengon, but there are contradictory reports.

This overview demonstrates that the boundaries of the Greater Leuser orangutan population are known in detail in virtually all places. However, there is very little information on the potentially important Singkil and Takengon west populations. We recommend that field surveys be conducted so that better estimates of these orangutans can be made. In particular, the orangutan population at Singkil is of some importance, because there is a potential for connecting it to the Greater Leuser population by constructing a corridor.

THREATS AND OPPORTUNITIES

Cyclones and large-scale forest fires can be ignored as causes of loss. Gunung Leuser is outside of the cyclone belt. Forest fires, when they occur, are small scale. Large-scale fires are not expected and should have occurred over the past decades given the frequent occurrence of bush fires set by local farmers. Moreover, the unpredictable long droughts as experienced on Borneo (where a major fire event occurred in 1982-1983) are not found in this region.

Ecotourism could affect the orangutan population if tourists cause habitat loss or disturbances. In the case of orangutans, however, these losses are negligible except those caused by the construction of roads and the resulting fragmentation, which we will discuss below.

This leaves habitat loss and fragmentation as the major threats to wild orangutans. These losses can take various forms:

a) change in the legal status of land, from protected to non-protected;
b) encroachment by illegal agriculture (which, even if stopped or reversed, leaves important long-term negative impacts;
c) road construction for tourism or for connecting cities outside the park;
d) encroachment from enclaves (human settlements).

All of these threats have a component of direct habitat loss and an indirect threat by way of fragmentation. In practice, this leads to several possible cases, each of which is examined below. In addition to losses, there also may be opportunities to gain through land acquisitions to the park. The consequences of such acquisitions will be examined as well.

PROCEDURES

The densities used here are based on the censuses of van Schaik and Azwar with more recent estimates by van Schaik (personal communication) and compared with those obtained by Rijksen in 1978. Vegetation information is based on the WCMC map, stored in the Atlas GIS by Faust (*Orangutan PHVA Briefing Book*).

BASELINE NUMBERS OF ORANGUTANS

Before we do any calculations we should address a problem. The way we usually produce species estimates is that an area is divided into several habitat types. In each of these habitat types a density estimate is produced, and extent of habitat times density summed over all habitats gives us the total population. However, this figure is inevitably an overestimate. First, in our choice of sampling areas, we tend to stay away, consciously or not, from disturbed areas. Often, when we separate disturbed from undisturbed we do not have enough data on the extent of disturbed habitat. Second, if some areas lack animals, for instance because of past hunting, we are by pure chance unlikely to select areas without animals. Third, we almost always are forced to use maps that reflect the situation as it was sometime in the past. In most cases, there is some encroachment reducing the amount of habitat available. For all these reasons, we should use a correction factor in all our estimates that are derived from extrapolation from samples. In this population, estimates of orangutans, given the rate of encroachment, and the fact that some parts unaccountability seem to be empty, a **correction factor of 0.75** is suggested as a reasonable value.

The first two cases to be considered are our baselines:

> **a) The Greater Leuser populations.** The area covered by these orangutan populations is approximately 11,710 km^2. The crude estimate of the populations in the entire area is 12,275; the **corrected number is 9,200**. The western population of these two, covering an area of 7,352 km^2, has a total estimated number of 7,639, and a **corrected number of 5,700**. The eastern population has an area of 4,358 km^2 of interconnected habitat, with an estimated total population of 4,636 individuals, and a **corrected total of 3,500**. Hence, both of these populations are currently quite sizable.
>
> **b) The (Gunung Leuser National Park) population.** The area covered by the west population is 5,570 km^2, with an estimated 4,605 orangutans, and a **corrected estimate of 3,450**. The area covered by the east population is 2,957 km^2, with an estimated number of 3,174, and a **corrected estimate of 2,400**. The total number of orangutans in the GLNP is estimated at 7,779, and the **corrected estimate is 5,800**.

[*Authors' note: This estimate is based on a fairly crude estimate of the area, uses 500 m as the boundary between lowland forest and hill forest, and leaves out the area east of the Wampu River, which is slated to become part of the Tahura, and thus will no longer be managed by TNGL staff.*]

In conclusion, despite recent attrition the Greater Leuser orangutan populations are still the largest in the species' range. In particular, the western population, even if restricted to GLNP, is the most important orangutan population of Sumatra.

THREATS

Effect of road construction

Road construction in this region tends to be associated with forest clearing along its edge. In some cases this actually leads to extensive conversion. At the least, the road and its associated opened-up strip, will act as a barrier to orangutan dispersal and fragment the resident populations.

A tourist road from Bukit Lawang to near Kutacane has been proposed. This road would isolate part of the eastern orangutan population. We estimate that this area contains 767 orangutans, or a **corrected estimate of 575**. The construction of this road is not recommended from the point of view of protecting orangutans.

Another proposed road between Lubuk Keranji and Pucuk Lembang would dissect the Kluet Reserve. This small area is of great importance because it contains the only swamp forest of the park. This forest has the highest orangutan density found anywhere in the world. The estimated number of orangutans isolated by this road will be between 470 and 600 (uncorrected), which gives us a **corrected estimate of about 400 individuals.**

Loss of all Production and Protection Forest outside of GLNP

Loss of all forests outside the park will leave two populations within the boundaries of the park as currently defined, approximately 3,450 and 2,400 animals, respectively.

Loss of all lowland areas due to attrition

If all the forests below 500 m were lost, for instance because of illegal encroachment and logging, we would be left with an uncorrected estimated 3,809, and a **corrected number of 2,850 in the west**, and with an uncorrected estimated 2,406, and a **corrected 1,800 in the east.**

These numbers may seem reassuring. However, with seasonal access to the lowlands gone, the highland habitats may have a reduced carrying capacity, and we may well lose numbers in the future. It is, therefore, strongly recommended that lowlands are not lost, because of this risk.

Loss due to encroachment and changes in legal status

The Sikundur Reserve, with its magnificent lowland forest has been degraded by selective logging in the late 1970s, while officially protected, and is currently recovering. Several parts of the park have been lost in the past due to changes in legal status of land use patterns. Subsequently, these areas were subjected to legal or illegal logging. Serbolangit, which was in the park initially, was reclassified to Protection Forest (and is now subject to some logging). A part of the Bengkung basin was deleted

from the park recently, and has subsequently been subjected to selective logging. The eastern part of the park near Berastagi will soon be reclassified to become part of the Taman Hutan Raya.

Given these developments in the past, it is realistic to expect that some such attritions will continue in the future. We have therefore constructed a worse case scenario in which many of the accessible marginal areas of the park will be lost, and also some of the flatter upland parts in the Kapi. The eastern boundary is much more stable, and unlikely to change much.

As a result of this realistic worse case scenario, we have produced the following estimates of the western and eastern park orangutan population. For the eastern population, we have an uncorrected estimate of 1,869 individuals, and a **corrected estimate of 1,400**. For the western animals, we have an uncorrected estimate of 2,554 individuals, and a **corrected estimate of 1,925**. However, the effect of the loss of lowland areas, would almost certainly lead to fragmentation into two new populations. Each of these can be estimated separately; the northwestern population would be 425 (uncorrected) or **corrected to 325 individuals;** and the southern population would be 2,129 (uncorrected) or **corrected to 1,600 individuals.**

In this scenario, it is impossible to restore the link between the three populations. Clearly, this situation would lead to appreciable loss of genetic variability, and a significant probability of extinction of at least the smaller of the three populations.

Loss due to hunting and/or pet trade

[*Editors' note: This issue was not addressed at the workshop, but the fact that there are several hundred confiscated orangutans in Indonesia, and several hundred more living in Taiwan, suggests that wild orangutans have been captured for the pet trade at some time in the past. It is not established where these orangutans were captured. Although past levels of removal are unknown, it is believed that it has greatly diminished in recent years.*]

Loss due to disease transmission through rehabilitation programs

[*Editors' note: See Recommendations on Medical Procedures During Quarantine for Orangutans Intended for Reintroduction*].

OPPORTUNITIES

Translocating human inhabitants from enclaves

The current separation of the Park's two orangutan populations is due to the explosive human population growth in the enclaves and along the rest of the road between Kutacane and Blangkejeren. Plans exist to translocate the human inhabitants of the areas inside the Park, and, in some scenarios, those inhabiting the enclaves as well. In any case, this will in due course (less than 25 years), restore the unity of the Park. All other things being equal, especially without further attrition of park habitat, this will create an orangutan population in the GLNP of about 5,800 individuals.

Reintroducing confiscated orangutans

[*Editors' note: See Recommendations for Reintroduction].*

WORKING GROUP RECOMMENDATIONS

1) The two orangutan populations present in the Gunung Leuser National Park and surroundings (the Greater Leuser area) are among the best in the world, in terms of numbers and in terms of potential for protection. The Gunung Leuser National Park is therefore vital to the long-term protection of the Sumatran orangutan.

2) Other important orangutan populations may occur south of the park (Singkil Barat) and northwest of the park (Takengon-West). Field Surveys in these areas are needed to establish detailed information on the orangutan distribution.

3) Given the currently estimated population of 5,800 animals, to minimize the loss of genetic erosion we suggest the following recommendations for the greater Gunung Leuser population:

- Add forested lowland areas to the park wherever possible, because the lowland and swamp forests are optimum orangutan habitats.

- Restore the connection between the western and eastern populations, so as to create a larger unit.

- Refrain from building roads dissecting the protected area and modify the design of established roads so that they do not prevent arboreal passage of orangutans and other animals.

- Maintain an absolute commitment to protection of the park. Specifically, buffer zones should be established wherever possible, e.g. sago plantations around the Kluet part of the Park.

4) While poaching pressure is currently very low, it is essential that it is kept to a minimum because the population is known not to withstand significant poaching pressure.

5) Research is needed to assess whether and to what extent animals in highlands without seasonal access to lowlands can survive.

POSSIBLE ADDITIONAL RECOMMENDATIONS

6) To support the ecological data on the forest outside of the park where orangutans occur, it is recommended that:

- Regular field surveys on orangutan densities inside and outside GLNP be conducted.
- A GIS satellite imagery map of vegetation and land use patterns be constructed for the long-term monitoring of available orangutan habitat.
- These two activities together can be used to monitor long-term viability of wild orangutan populations.

7) Since the income of rural population is very low, it is recommended to increasing their income through:

- Ecotourism
- Improvement of agricultural yield in the established area.
- Managing buffer zones surrounding the park

8) Establish nature conservation education programs in which local people and others must be well targeted.

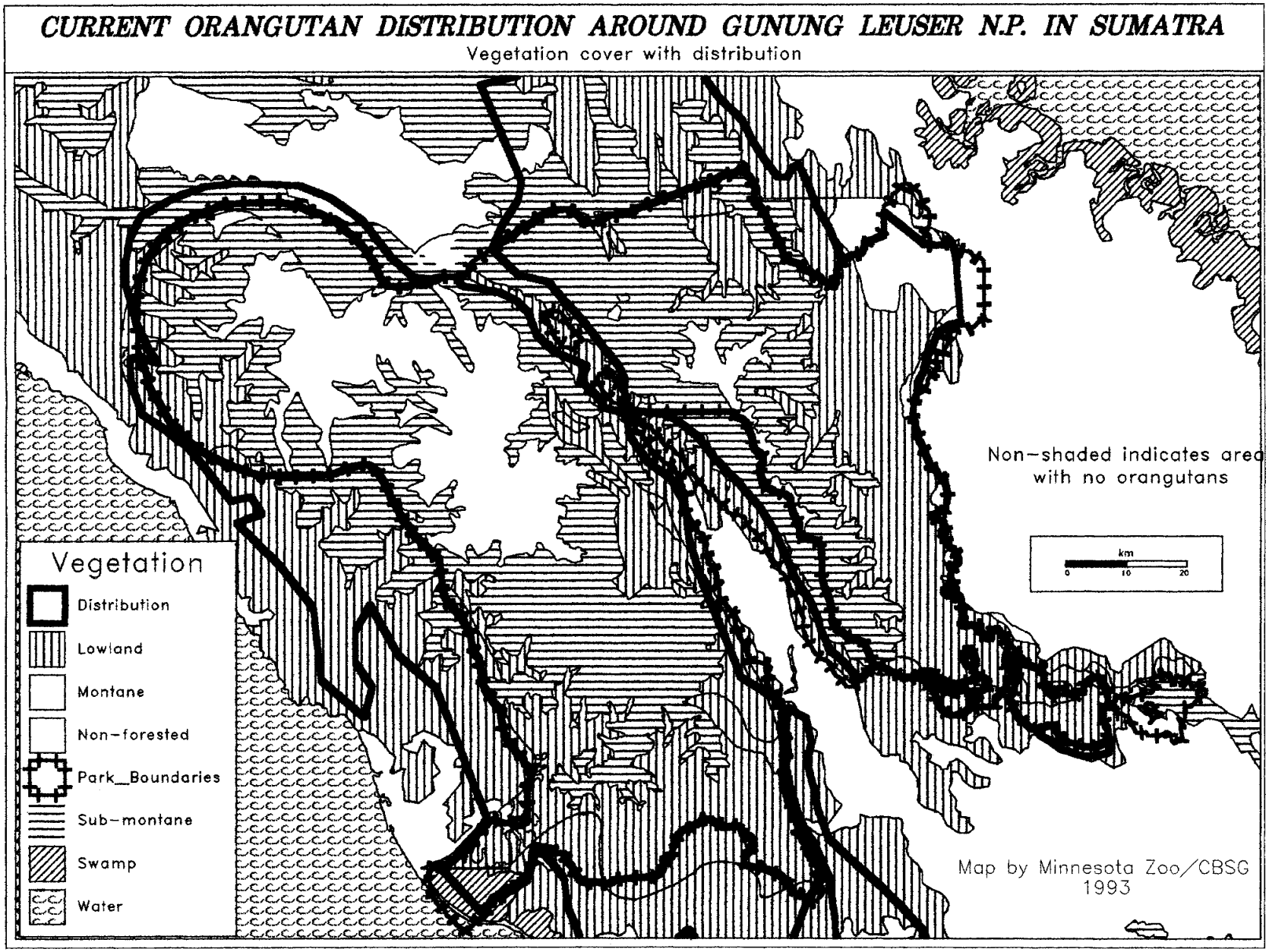
9) Although poaching of orangutans is considered limited in Sumatra, it is recommended that regular monitoring should be performed to identify and confiscate illegal captive animals.

10) Recognize that the Ketambe Research Station in GLNP is an important site for long-term field research on orangutans, and should be given priority in its role in developing the Orangutan Management Strategy.■

Table 1. Estimated numbers of the Greater Leuser orangutan population and the Gunung Leuser National Park orangutan population.

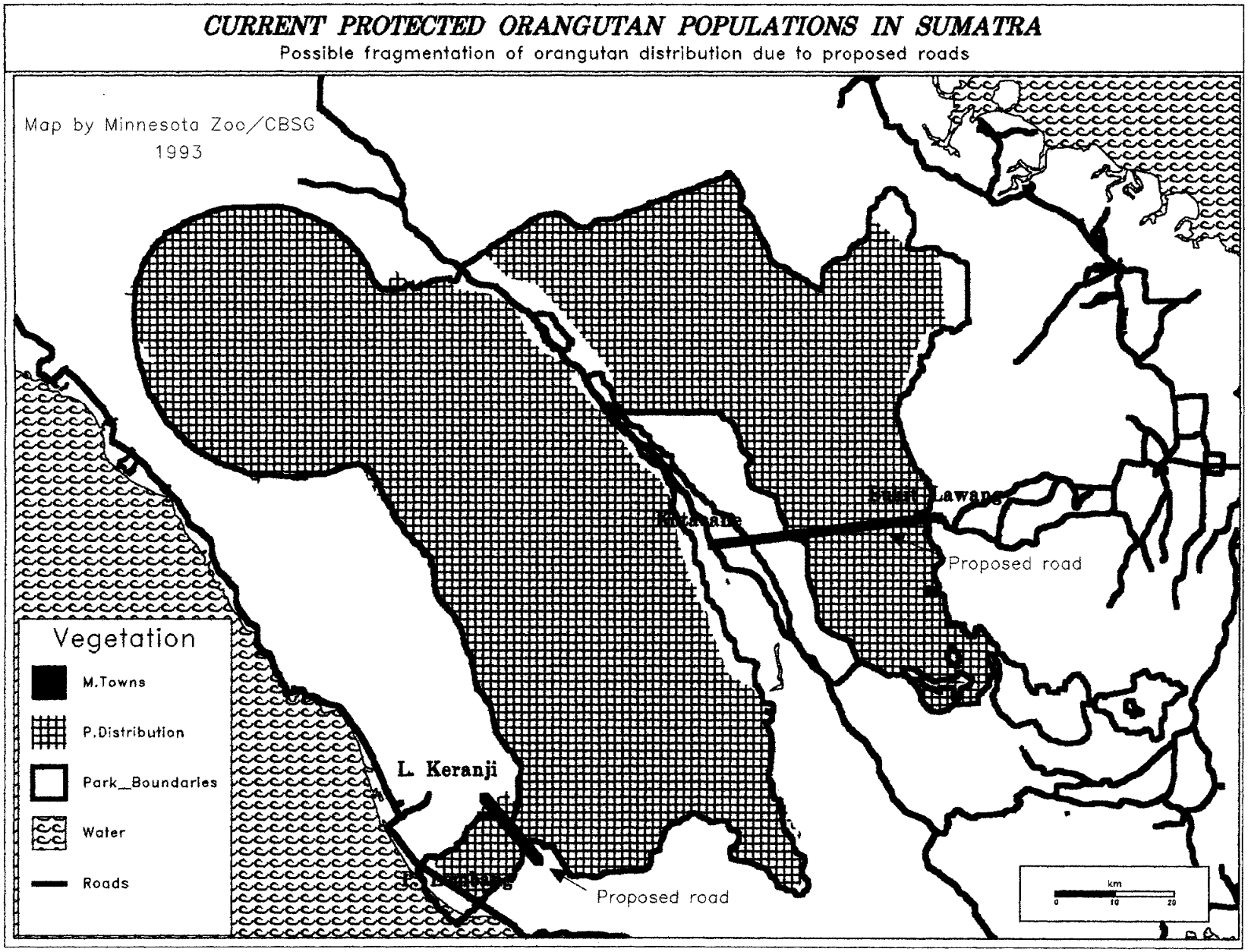
	TOTAL AREA				PROTECTED AREA		
WEST	area (km^2)	density	number	corr.n	area (km^2)	number	corr.n
secondary	12.23	0.5	6		0	0	
swamp	50.97	5	255		50.97	255	
< 500	831.77	2.5	2079		216.38	541	
< 1000	2311.92	1.8	4161		1576.44	2838	
< 1800	2845.83	0.4	1138		2426.67	947	
> 1800	1299.47	0	0		1299.47	0	
TOTAL:	7352.19		7639	5700	5569.93	4605	3450

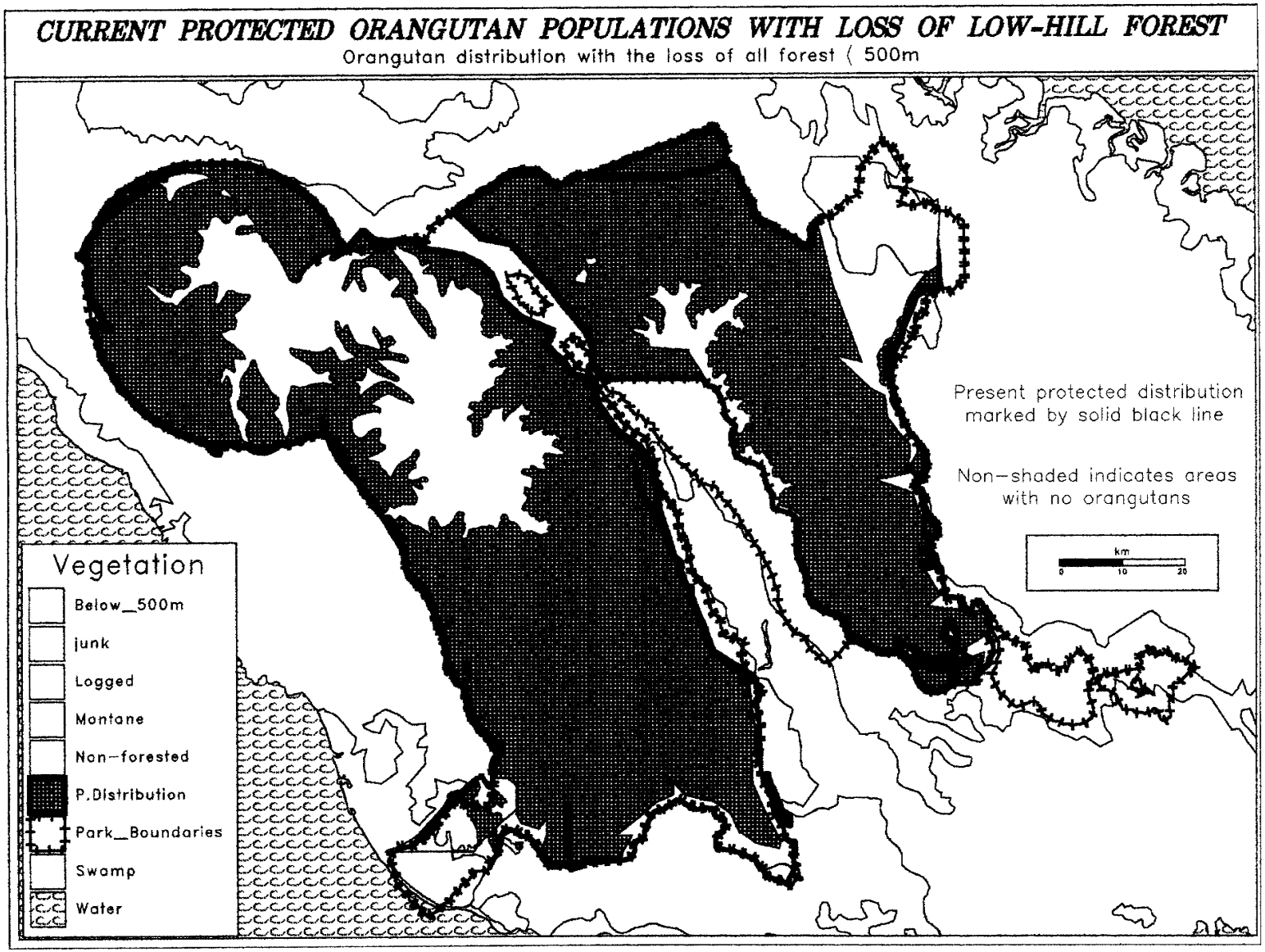
	TOTAL AREA				PROTECTED AREA		
EAST	area (km^2)	density	number	corr.n	area (km^2)	number	corr.n
secondary	86.63	0.5	43		0	0	
< 500	236.88	2.5	592		236.88	592	
logged lowland	176.74	1	177		176.3	176	
< 1000	1674.85	1.8	3015		1037.79	1868	
< 1800	2021.43	0.4	809		1344.04	538	
> 1800	161.56	0	0		161.56	0	
TOTAL:	4358.09		4636	3500	2956.57	3174	2400
GRAND TOTAL:	11710.28		12275	9200	8526.50	7779	5850


CURRENT ORANGUTAN DISTRIBUTION AROUND GUNUNG LEUSER N.P. IN SUMATRA
Vegetation cover with distribution
Non-shaded indicates area with no orangutans
km
0
10
20
Vegetation
Distribution
Lowland
Montane
Non-forested
Park_Boundaries
Sub-montane
Swamp
Water
Map by Minnesota Zoo/CBSG
1993

CURRENT PROTECTED ORANGUTAN POPULATIONS IN SUMATRA

Present and protected orangutan distribution


CURRENT PROTECTED ORANGUTAN POPULATIONS IN SUMATRA
Possible fragmentation of orangutan distribution due to proposed roads
Map by Minnesota Zoo/CBSG
1993
Proposed road
Proposed road
L. Keranji
Vegetation
M.Towns
P.Distribution
Park_Boundaries
Water
Roads
km
0
10
20


CURRENT PROTECTED ORANGUTAN POPULATIONS WITH LOSS OF LOW-HILL FOREST
Orangutan distribution with the loss of all forest ⟨ 500m
Present protected distribution marked by solid black line
Non-shaded indicates areas with no orangutans
km
0
10
20
Vegetation
Below_500m
junk
Logged
Montane
Non-forested
P.Distribution
Park_Boundaries
Swamp
Water

ORANGUTAN
POPULATION AND HABITAT
VIABILITY ANALYSIS REPORT

WORKING GROUP: ORANGUTAN
DISTRIBUTION AND STATUS IN BORNEO

Working Group: Orangutan Distribution and Status in Borneo

Members: H. Rijksen, Widodo Ramono, Jito Sugardjito, Agus Lelana, Dondin Sajuti, A. Eudey, W. Karesh, G. Shapiro, Ling-Ling Lee, M. Phipps, and I. Singleton

DISTRIBUTION

The following eight areas were identified as currently isolated populations of orangutans on the island of Borneo (Kalimantan, Sabah, and Sarawak).

PROCEDURES

For each area, an estimate of area in square kilometers is given and an estimate of orangutan density has been estimated based on habitat types. Additionally, **a correction factor (0.6)** is used to compensate for the inherent overestimation due to studies being conducted in prime, high density study sites and the extrapolation of these data to outdated map information. These two figures provide an upper and lower estimated population size (Table 1).

THREATS

An estimate of impact by a variety of factors was developed (see Table 2).

Table 1. Estimates of population sizes of orangutans in Borneo.

Area	Km^2	Area Density	Min. Est.	Max. Est.	NOTES
Sabah	1,520	0.5	456	760	1
Kutai/Sanlieu	2,100	1.0	1,260	2,100	
Central	6,800	0.4	1,632	2,720	2
B. Raya/Balia	1,540	0.4	370	616	
T. Puting	1,800	1.0	1,080	1,800	
G. Palung	700	3.0	2,100	2,100	3
	1,100	1.5	1,650	1,650	
Kendawang	800	1.0	480	800	
G. Nuit/Becapa	1,000	0.5	300	500	
Fudge	5,000	0.5	1,500	2,500	4
Totals	22,360		10,830	15,546	

1 = Figures for Sabah are based on current protected areas where naturally existing populations of orangutans are known to exist. Orangutans living in unprotected areas or at rehabilitation facilities are not included.

2 = This area includes the National Parks and protected areas in the border area of West Kalimantan and Sarawak (Batang Ai, Lanjak Entimau, Bentuang, Karimun).

3 = The figures for the Gunung Palung area include higher density figures for prime habitat within the park and also lower density areas within the park and the adjacent area on the west. Due to confidence levels with these data, the **0.6 correction factor was not used.**

4 = An additional estimate of 5000 km^2 was added to account for areas where significant orangutan populations may exist in unprotected or unidentified areas.

Table 2. Estimates of impact of various factors on wild orangutan populations.

Cause	Sabah	Kutai	T. Puting	G.Nyiut/Becapa	Central	B.Raya/B.Baka	G.Palung	Kendawangan
[1]Habitat destruction								
Forest conversion/transmigr.	0	0	0	100% OF 30%	50% of 25%	50% of 25%	95% of 25%	75% of 25%
Mining	0	50% of 50%	95% of 1%	0	0	0	0	0
Recurrent fires	0	25% of 60%		0	0	0	0	0
[2]Fragmentation (permanent)	0	cut in half						
Logging	0	100% of 5%	0	0	0	0	0	0
Agricultural development	0	100% of 15%	0	0	0	0	0	0
Mining	0	100% of 5%	0	0	0	0	0	0
Roads	0	100% of 1%	0	100% of 1%	0	100% of 1%	0	100% of 1%
[3]Degradation (temporary quality decline)								
Logging	50% of 50% dr	0	100% of 5% dr	0	0	95% of 50% dr	0	0
Agricultural encroachment	0	100% of 10%	0	0	0	0	0	0
Fire	0	100% of 50%dr	100% of 20%dr	0	0	0	10% of 50%	0
Drought		10% of 50% dr	0	0	0	0	0	0
Illegal hunting		0.5%		2%	95% of 2%	95% of 2%	unknown	unknown
[4]Disease	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown

Figures expressed as % probability of occurrence in 100 years of either a certain % loss or % animal density reduction (dr).

1 = Permanent habitat destruction, generally set by policy decisions; Forest conversion/transmigration = intentional changes in land use practices, destroying habitat for other uses; Recurrent fires = resulting in permanent habitat destruction.

2 = Activities which separate existing continuous populations into subpopulations permanently; Agricultural development = permanent establishment of areas of agricultural use.

3 = Temporary qualitative decline of habitat, resulting in reduction of orangutan densities; Logging = illegal or legal selective logging or non-mechanized logging; Agricultural encroachment = local people clearing forest for short-term use.

4 = Introduction of a new disease or health factor that is currently not playing a role in the population dynamics of orangutans. A general figure is given that covers infectious diseases, toxicologic events or the introduction of other pathogens.

WORKING GROUP — GENERAL RECOMMENDATIONS

Considering that: Indonesia has a good law for the protection of orangutans, has an excellent conservation area network which covers more than 60% of the supposed current distribution range of orangutans in Kalimantan and has a substantial organization for Protection of Forests (habitat) and Nature Conservation.

Recognizing that: The orangutan population of the world is subject to increasing dangers of persecution and habitat degradation as well as fragmentation.

Recognizing that: the IUCN/SSC CBSG PHVA workshop, on the basis of scientific processing of available information, has concluded that at the species level:

1) The major threat to the orangutan population level is the loss of adult females and the low rate of population increase which is natural for this species.

2) Given the life history of orangutans, continuous vigilance and strengthened enforcement of existing laws is required to protect existing populations because they are unable to withstand significant levels of removal through poaching.

3) The major threat on the habitat level is habitat loss as well as degradation and fragmentation, especially in lowland forest.

WORKING GROUP — SPECIFIC ISSUES AND RECOMMENDATIONS:

KALIMANTAN IN GENERAL

1) Vast areas of Borneo require thorough field surveys on a park-to-park basis to identify orangutan population status and habitat types in relation to forest status.

2) The development of a management strategy of the current metapopulations of the Bornean orangutans needs to be initiated in the near future.

3) The fragmentation of populations and need for metapopulation management, it is essential that the genetic studies regarding intra-subspecific variation be completed immediately. Until this is done, it is important not to mix (through reintroductions) orangutans from widely separated populations.

SABAH:

The Sabah orangutan population can be considered as an isolated population from all other Bornean populations. Given the potential small numbers and limited protected habitat, appropriate authorities should be aware of the high level of need for aggressively managing this population. Because they are small isolated populations, they appear to be severely threatened.

KUTAI REGION

The significant orangutan population (1,200-2,100) in this area is contained in Kutai National Park and the unprotected and protected areas to the north. A considerable gap or fragmentation currently exists in the center of the distribution of the area. Expansion of human activities threaten to eliminate the northern half of this population (1,000 animals). The park itself is also under threat of conversion to mining activities; this would result in the loss of the other half of this population (1,000 animals).

The current status of orangutans, coupled with habitat loss and fragmentation, requires increased management efforts and immediate habitat protection to prevent loss of this population. The northern part of this area has not been surveyed in decades. Information on the wildlife in this area is essential for further management decisions.

Given the severe reduction of orangutan populations in East Kalimantan, serious consideration should be given to establishing additional populations of East Kalimantan animals.

CENTRAL BORNEO

Very little good ground data is available on the Kalimantan side of this area. Surveys in this area are essential to establish the degree of fragmentation, hunting pressure and relative orangutan densities in this area. Logging activities threaten this area; control of logging is essential to maintaining orangutan habitat. The other threat to this animal in this area is from hunting. Enhancing enforcement activities in the west Kalimantan and Sarawak portions would significantly enhance the possibility of orangutan populations' survival.

BUKIT RAYA/BUKIT BAKA

This is a small orangutan population and it is not clear if connections with populations to the south at Tanjung Puting still exist. Surveys to determine the range of this population is important. Control of logging and agricultural expansion in this area is critical to protecting this small population. Extension of protected habitat across permanently forested areas towards or joining up with the other major conservation areas (Gunung Bentuang/Karimum and/or Tanjung Puting) should be explored.

TANJUNG PUTING

Logging around the park and encroachment into the park need to be monitored and controlled to eliminate any further reduction of orangutan populations in this area. Park expansion to the north could expand the habitat available and allow enlargement of this population. Elimination of mining activities and small scale hunting within the park would also significantly enhance the viability of this population.

KENDAWANGAN

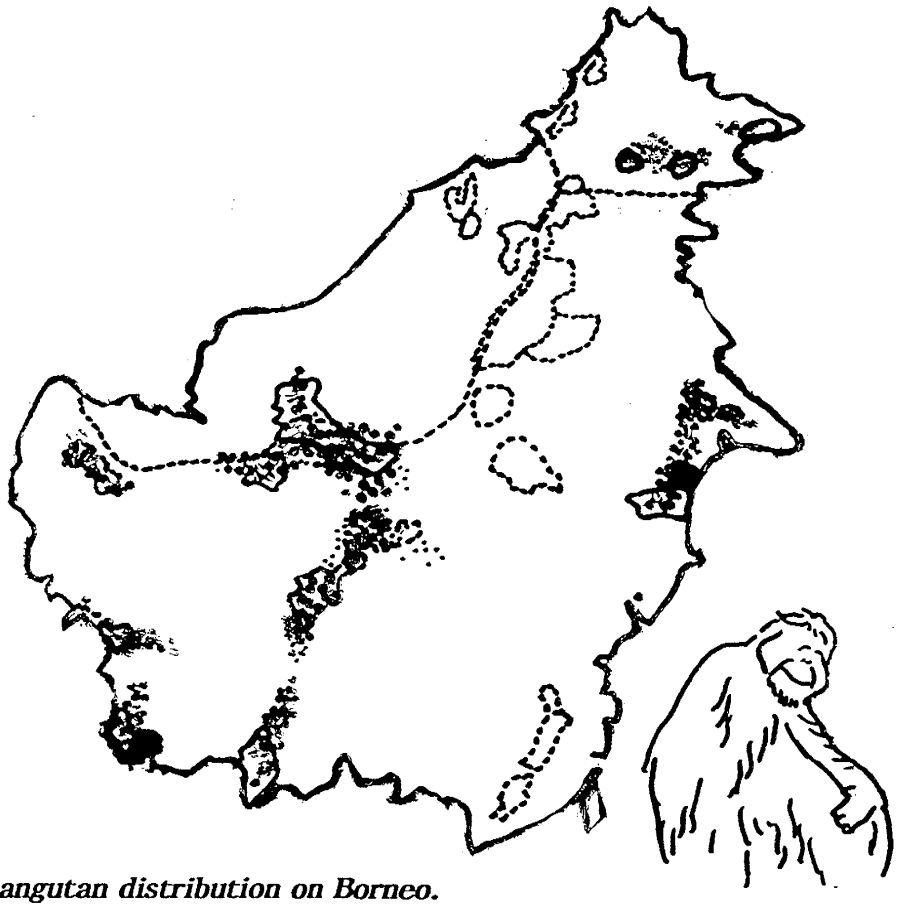
This small area being proposed for higher protection status is little known. Further studies are needed to evaluate this area and also to explore connections with other orangutan populations. Transmigration is planned for the adjacent area to the south and threats from agricultural encroachment and habitat degradation must be controlled to prevent the loss of this small population.

GUNUNG PALUNG

There is a significant population of about 3,750 orangutans within the park and to the west of the park. The most significant threats to this population come from logging activities and agricultural development outside of the park. Expanding protection to the west of the park would protect an additional 1,000 orangutans living outside of the park.

GUNUNG NYUIT

This is a small population of about 300-500 orangutans in a park that is particularly rich in biodiversity. The small park is severely threatened by agricultural encroachment and could potentially be fragmented through the center by human activities. Enhancing protection of this park is essential to maintain the orangutan population.■



Map of orangutan distribution on Borneo.

ORANGUTAN
POPULATION AND HABITAT
VIABILITY ANALYSIS REPORT

WORKING GROUP: ORANGUTAN
LIFE HISTORY AND VORTEX ANALYSIS

Working Group: Orangutan Life History and Vortex Analysis

Members: M. Leighton, Tatang Setia, U. Seal, Komar Soemarna, Adjisasmito, Muladi Wijaya, G. Shapiro, and L. Perkins

Life History Variables

We estimated baseline values, and lower and/or higher values around the baseline for sensitivity analysis, based on several sources of evidence and lines of argument. For all variables, data from the field were preferentially used. However, in a few cases, small sample sizes, or expected biases from fieldwork, slightly influenced selections. In a few cases, we felt the best estimates were guided by data from captive orangutans, or from other mammalian populations.

We especially tried to examine if different estimates for the Sumatran and Bornean populations of subspecies were justified. Fortunately, the field data that guided selections were from Tanjung Puting and Ketambe. These sites not only represent the two subspecies, but also differ dramatically in habitat and important ecological factors (e.g., food resources and predators) that might be expected to affect life history variables, if strong variation were to be found. Although sample sizes are usually small for at least one and usually both studies, no variables seemed to differ between the two studies sufficiently to suggest different selections of values. For both the Tanjung Puting and Ketambe populations, better estimates for variables were obtained by using unpublished data. The review by Rodman (1988) and other original published sources, especially those from Mentoko in the Kutai National Park (East Kalimantan), have also supported the result that estimates for life history variables can be generalized across studied orangutan populations. However, no orangutan populations have been studied in montane or hill areas where individuals do not have access to a relatively rich mosaic of lowland habitats. It may be that these populations, which are apparently at lowest densities, show different life history characters reflecting poorer habitat quality.

Below, we treat each variable in the sequence they are encountered when running the VORTEX model. We list the values selected for the computer simulations, and briefly describe the rationale for these selections. Data from Tanjung Puting are indicated by TP and from Ketambe by KT.

1) Correlation between juvenile and adult survivorship?: No

Deaths in wild populations have seldom been observed or reliably inferred, but the sample indicates that most deaths occur as isolated events, as expected for species of similar ecology and life history. However, note that the "mild" catastrophe explored in the simulations assumes that high mortality is shared equally across age classes (see below).

2) Monogamous or polygynous?: Polygynous

Field studies provide conclusive evidence for polygyny in all populations (Mitani & Rodman 1987). We should be cautious, however, when modeling small populations of sparse orangutans. The VORTEX model assumes that no female goes unmated when her interbirth interval expires, even in populations with very low numbers or proportions of adult males. For these cases, the model may have to be adjusted if it is expected that low rates of encounter, perhaps exacerbated by the exercise of mate choice by females, might conceivably lengthen the interbirth interval. For instance, this might affect populations in montane habitats or in logged forest.

3) Different catastrophes:

A) Extreme food shortage: Rate = 5 times/100 yr (Range = 1,10)
P(survival) = 0.85; P(litter>0) = 0

The large body mass and generalized diet of orangutans buffers them from starvation. Adults, especially adult males store fat, and can probably survive prolonged periods while at negative energy balance while feeding on energy-poor, fibrous foods (leaves, bark phloem layers and pith). However, i) this is less true for juveniles and infants, ii) the phenology of foods they prefer are wildly unpredictable in space and time, and iii) it is reasonable to hypothesize that orangutan carrying capacities and typical population densities are determined by fluctuations in the food supply (see Leighton 1993).

Extreme food shortages causing episodes of mortality or reproductive failure have not been observed in field studies. However, the locations of field studies, the presumed rarity of these events, and the ranging patterns of orangutans may conspire to cause these food crisis events to go unrecorded. First, all long-term studies providing demographic information (KT, TP, Gunung Palung and Mentoko), are probably located where resident orangutans enjoy nearly optimal habitat quality compared to other individuals in the population, perhaps biasing our estimates of mean per capita demographic values. All research sites have been located along rivers, and consequently contain a rich habitat mosaic, usually including productive alluvial bench and seasonally flooded forests, well-drained lowland forest, and often swamp forests. This habitat mosaic probably best buffers orangutans from fluctuating food supplies, compared to orangutans with home ranges more restricted to single habitats, located solely in upland forests or swamps. Second, all four of these sites have reported episodes where individuals shift home ranges, especially adult males and subadults and adolescents of both sexes. These individuals migrate in and out of the research sites in response to local food supplies. The data from Gunung Palung strongly suggest that these habitat shifts support high overall densities. It may be that some of these individuals are most vulnerable to starvation. Because these migrants or transients are unmonitored by researchers, as they leave during periods of poor food supply, mortality on this subset of

orangutans would go unrecorded. Third, comparative evidence from other large-bodied herbivores indicate that aperiodic, rare events causing starvation influence their long-term population dynamics. Therefore it seems wise to explore demographic simulations that include unpredictable extreme food shortages.

Several possible scenarios suggesting which age and sex classes might disproportionately suffer from extreme food shortages. We considered an example in which juveniles (J) and infants (I) suffer 30% mortality in the year when the event occurs, and all older (O) individuals suffer 10% mortality. Ratios of (I+J)/(O) in "snapshots" of population structure at TP (during November, 1975, Galdikas 1978), and at Ketambe (during October, 1989, Tatuno, 1992?), were 0.33 and 0.23, respectively, so we estimated the proportion of I+J as 30%. We then calculated the per capita risk of mortality, and converted (and rounded) this to the average value of P (survivorship) = 85% for the year when the food crisis occurs. We also assumed that no females would reproduce during the year. Note that field workers would have a hard time noting a nutritionally-based delay of reproduction, because on average only one of eight females reproduce per annum (see below), exceeding or near the sample sizes of the females monitored during a field study.

The frequency of a mild catastrophe of this sort is of course completely unknown. However, judging from the frequency of extended periods when orangutan subsistence is on foods of low preference and low energy density, and thinking that the range of values in our simulations might indicate approximately 95% confidence intervals, then a range of values from 1-10 times per century seems useful to explore.

B) Other types of "natural" catastrophes:

We should recognize that other ecological factors (diseases) might be rare, but normal events affecting long term (50-several hundred yr) population dynamics. These could occur as part of the natural ecology of the species, unrelated to effects of habitat transformation or disturbance of the forest community. We should be hesitant to expect we would be aware of such rare event, given that our studies have been too limited in space and time to adequately understand and adequately model the population dynamics of animals with population biologies like orangutans. They live as sparse populations of long-lived individuals that shift in space on scales much larger than our study sites.

4) Age at first reproduction (AFI): **Females: 15 (13-17)**
Males: 20

The sample used for estimating this variable is comprised of six females: three from KT (12, 16 & 16 yrs) and three from TP (15, 16 & 16 yrs), giving a mean value of 15 years, and indicating consistency between the two sites. Note that the range for the simulations is guided not by what might be the variation among females in a population, but what the true population mean might be, given our small samples. Note also that there is a bias to underestimate this variable, because later maturing females would be less likely to enter the sample population. We were unable to explore how this affected the data from either study population (Galdikas and Ford, 1990).

The mean AFI value we used for males does not rest on any field data, which would require paternity analysis. The value of 20 years was entered merely because in polygynous mammals, males typically have AFI's later than females. We did not put any effort into better estimating this (for instance, from comparative data of mammals with similar mating systems and life histories) because the population dynamics modeled for polygynous species with VORTEX is insensitive to male AFI, unless the number of males is very few (less than 5-10).

5) Maximum longevity: 45 (for both males and females)

Again, because of the structure of the model, only the value for the females is important. There are no accurate field estimates for this, but we have been guided by two factors. First, in a large sample of captive orangutans for which the age at death was known (n = 1239), the maximum age for females was 57 years, and the maximum age for males was 58. Although health care and nutritional status of these individuals undoubtedly varied dramatically, it is likely that a large subset received nearly optimal care, extending longevity beyond the maximum achieved in the wild, as is typical in comparisons of zoo vs. wild ranging individuals of other mammals. Therefore orangutan field workers reliably estimate that individuals are as old as 40 or slightly more, an estimate at about 45 seems warranted.

Secondly, we should err on the side of underestimating this variable because of the structure of the VORTEX life history parameters we are using. Because we are entering a constant age-specific mortality for all individuals above one year of age, the model does not include the typical, and extreme increased age-specific mortality common to long-lived mammals as they approach senility. The effect of this is that under conditions of low average mortality (e.g., mortality rates of 1-1.5%), an artificially high number of females would reach a maximum longevity of 50 (if that were the estimate). This would translate into an average increased reproductive life span of five years, increasing average number of births from 3.75 (=(45-15)/8) to 4.4 (=(50-15)/8) per female surviving to maximum age (= 45 and 50, respectively, with an interbirth interval of 8 yr, see below).

6) Sex ratio at birth: 0.50 (0.55) used for both sexes

The most relevant data are large samples of births from the wild. Because there is now evidence for several primate species that the immediate social and demographic context of breeding females can influence sex ratio at birth, we are ill advised to use data from captive females to estimate the sex ratio. Therefore, we used 50% as a baseline value, derived from the large TP sample (n approx. = 30). In a recent (1989-92) sample from KT, 7 of 9 births were males, but this degree of skew in small samples occurs with a high frequency under the binomial distribution (i.e., coin-flipping samples). Considering that males in polygynous species typically have higher age-specific mortalities, a hard look at the population structure of orangutans might indicate there are too many males, and that perhaps the true sex ratio is slightly skewed towards males. Hence, because the sex ratio can importantly influence population dynamics through the rate and which females are recruited into the breeding population, examining the effects of a 55% male bias might be explored with the model. However, because we do not have samples over a large enough spatial scale to avoid confusion from migrating or transient individuals, there is not field evidence to support a skewed sex ratio at this time.

Although not influencing the basic demographic model for orangutans, we noted that the sex ratio of individuals brought to rehabilitation centers should advise model scenarios that include a harvesting component. A sample from the 70's from Bohorok was reported to be 53% males (n=98), whereas a current sample brought to a center in East Kalimantan is skewed towards males (Rijksen, pers. comm.).

7) Proportion of adult females producing litters of different sizes each year:

P (no litter) = 87.5%
P (litter=1) = 12.5%
SD (P(litter=1)) = 6%

or for mean interbirth interval (IBI): 8 yr (7,9)

This was calculated from the mean interbirth interval, and actually explored in computer simulations as variation in the interbirth interval (this is possible because all litters are of size = 1). From Ketambe we have seven observations from five females: 1) 2 & 12; 2) 7 & 7 (a rehabilitant); and three others with values of 11, 6 and 8-9 years. The mean of these values is 8 years. The estimated mean from a sample of approximately 20 events (successive births of the same female) at TP is also 8 yr, with a range of 6-10 yr (Galdikas, pers. comm.).

At this time we do not know if the TP data include observations of intervals beginning or ending with early deaths of neonates or stillbirths. Because infant mortality (from age 0-1, see pt. 8, below) includes these deaths, it is important to include these in the

calculation of interbirth interval. For instance missing only 10% of these shifts the estimate in this model from 8 to 7 years. Counteracting this bias, there is a tendency for analysis of field data to underestimate this because longer intervals are more likely to be excluded from analysis, as their endpoints (the next successive birth) are less likely to have occurred at any point in a field study.

Although the data set from KT is small and variable, the mean value is similar to that from TP. The data would seem to indicate that the true population mean for orangutan is likely to fall between 7 and 9 years, and this range of values probably should only be explored in the basic demographic model for natural populations. However, note that in populations in which significant ecological factors change birth rates (female nutritional status) or cause higher infant or juvenile mortality (e.g., predation, diseases), the interbirth interval can be substantially affected.

The variance in the mean proportion of adult females giving birth each year is unknown, but if we expect stochastic variation in this, then a standard deviation of approximately half the mean is not an unreasonable guess.

8) Infant mortality (age 0–1): **Mean = 10% (5,15)**
SD (10%) = 6%

Of 4 births at KT from 1989-92, one was a miscarriage, while one of roughly 20 births resulted in early neonatal death at TP. There is a likely bias towards under reporting the incidents of these in the wild, because females followed sporadically, a few days month or every few months, may not be known to be pregnant with certainty, and give birth to a dead or early dying infant, and the observer be unaware of this. Further, we are advised that neonatal mortality rates range from 10-20% in captivity for many mammals. On balance, we suggest that a baseline value might be 10%, with 5-15% capturing the range of the true population mean for sensitivity analysis.

The SD of the mean (of the 10% baseline value) was generated from a hypothetical data set of 10 cohorts of 10 infants each, in which 6 cohorts suffer 1 death each, and 2 cohorts each suffer 0 and 2 deaths.

9) Adult age-specific mortality: 2% (1.5,2.5%) (for both males and females)

Recall that "adults" are defined as all individuals over one year of age. Although individual orangutans survive very well, even long-term studies of large demographic samples are challenged to distinguish age-specific mortality rates that vary by 0.5-1.0%. Single deaths among small numbers of known females, for instance, may go unreported because females who "disappear" may shift ranges outside of the study site. But changing the mortality rate from 1% to 2% changes the % of one year old females that

mature to reproductive age (=15) from roughly 88% to 77%, thereby dramatically influencing the relative numbers of births contributed by a cohort of females. We tried to explore a range of reasonable mean values for orangutans by examining the stable age distribution generated from initial simulations using values of 1% and 2%, paying attention especially to the proportion of adult females over 30 years old, given either assumption. If age-specific mortality is 2%, then the proportion of all adult females over 30 yr old is expected to be 40%; if mortality is 1%, this number is 35%. Among the current 10 adult females known at KT, three are estimated to be over 30 yr old, whereas Galdikas (pers. comm.) estimates that half the adult females are over 30. The results are therefore not definitive. We have rejected a mortality rate of 1% as too low, given comparative mammalian data, but we have no empirical basis for rejecting this value for orangutans. We can probably exclude mortality rates of 3% as unreasonably high, however, because this implies that nearly half of the females born fail to reach reproductive age.

10) The SD in K due to environmental variation (EV): 10% (0,20%)

As occurs for all mammalian populations, the carrying capacity fluctuates over time because of changes in the effects of critical ecological factors, especially the food supply. Orangutans are slow breeding, and easily shift diets for long periods to survive fruit-poor periods, so they will be relatively immune to shifts in carrying capacity causes by short term changes in K (e.g., that occur every few years). However, shifts over time in the relative productivity of food plants of different taxa, and stochastic changes in the densities of important key food species, certainly occur. Therefore it is most realistic to model orangutan demography including a component of stochastic change in K. It is difficult to imagine what this value should be. However, the fact that orangutan densities between widely spaced sites within the same habitat (e.g., swamp/peat forest, or lowland forest) suggests that the effective temporal change in K for any single population should not be very large. Therefore, we suggest a narrow range of values (0-20%) should be explored in demographic simulations.

Simulation Model Scenarios and Results

The interactions of infant mortality, adult mortality, and interbirth interval on r and the population size at 200 and 300 years, over the ranges of values suggested by the available field data, were examined systematically with step wise changes in each of the 3 variables (Figure 1). The ranges of values were 1) 1,2, and 3% mortality for all ages from 1 through adult, 2) 2, 5, and 10% infant mortality, and 3) interbirth intervals of 6, 8, and 10 years. The other conditions of these scenarios were a starting population of 1000 with K=1000, no inbreeding,, all adult males in the potential breeding pool, age of first reproduction 15 for females and 20 years for males, and 45 years as the age of senescence.

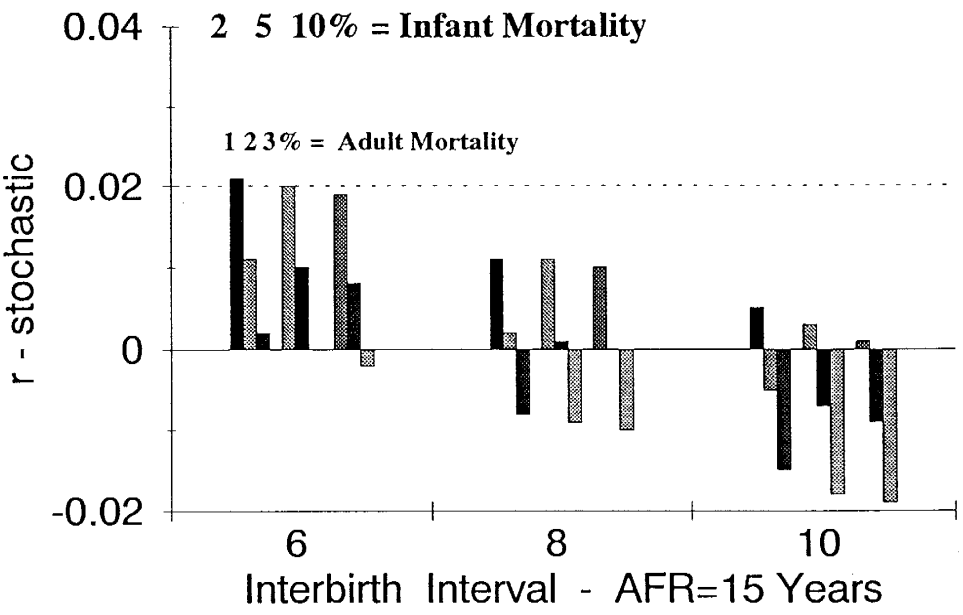


Fig. 1. Effect of mortality rate and interbirth interval on r (AFR=15 yrs).

The scenario results for values of r (rate of increase) from this 3-way matrix of interactions yielded values ranging from 0.02 to -0.02. They indicate very little sensitivity to infant (0 to 1 year) mortality over the range of 2-10% within a given interbirth interval (The word infant is used by orangutan biologists to refer to the time that the young animal is carried by the mother - about 4 years.). Increasing the interbirth interval in 2 year steps resulted in a 50% decline in 'r' for each step. An increase in adult mortality from 1% to 2% per year produced a 50% or greater reduction in r. At 3% adult mortality most values of r were negative under the conditions of these scenarios.

Estimates of projected surviving population sizes at 200 (about 6.5 orangutan generations) with age of first reproduction for females of 15 years and a starting population of 1000 and K=1000 indicate that all populations decline when adult mortality is set at 3% and all will eventually become extinct (Figure 2). When the interbirth interval is 8 years or greater, the populations decline with 2% adult mortality and this also leads to eventual extinction.

Current field data indicate that the orangutan population studied in Sumatra and Kalimantan have an interbirth interval of about 8 years. However it is not know whether a shortening on this interval occurs if the infant or juvenile dies. Data from breeding in captivity indicate that the interval could be shortened to 3 years. The simulations of the wild population indicate that they cannot sustain an increase in adult

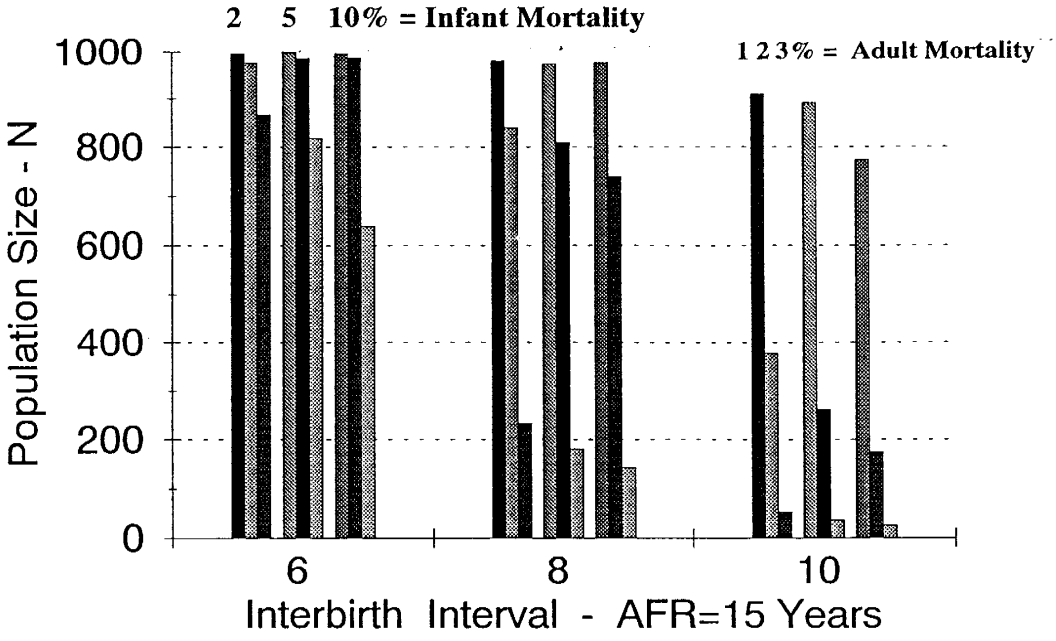


Fig. 2. Effect of mortality rate and interbirth interval on population size (AFR=15 yrs).

female mortality. The stable age structure of the population shows that about 50% of the animals are adults. Thus removal of 5 adults per year from a population of 1000 animals would increase adult mortality by 1%, which under this schedule of mortality and fecundity rates, would lead to a long term decline of the population. If the primary target of the removals is females, as might occur with collection of infants for a market, then the increase in annual adult female mortality would be 2%. This would increase the projected rate of decline and increase the risk of extinction. These scenarios were simulated using the harvest module of VORTEX.

These populations are thought to be at or near carrying capacity. At lower densities orangutan populations might be able to respond by an increase in reproductive rates as can occur in captivity. This might occur by a decrease in the interbirth interval or reproduction at an earlier age or both. Both are observed in captive orangutan populations as is evident from analysis of the data in the International Studbook. However, on average in the studbook data, there is a far greater likelihood of a reduction in the interbirth interval which averaged 3-4 years for 800 births. This shortening of the interval in captivity may partly be a consequence of infant removal from the family unit, partly a consequence of good nutrition, and partly a behavioral effect of space limitations in captivity. Either of these strategies, or a combination, would allow greater resilience of wild orangutan populations to environmental variation and to occasional catastrophic losses.

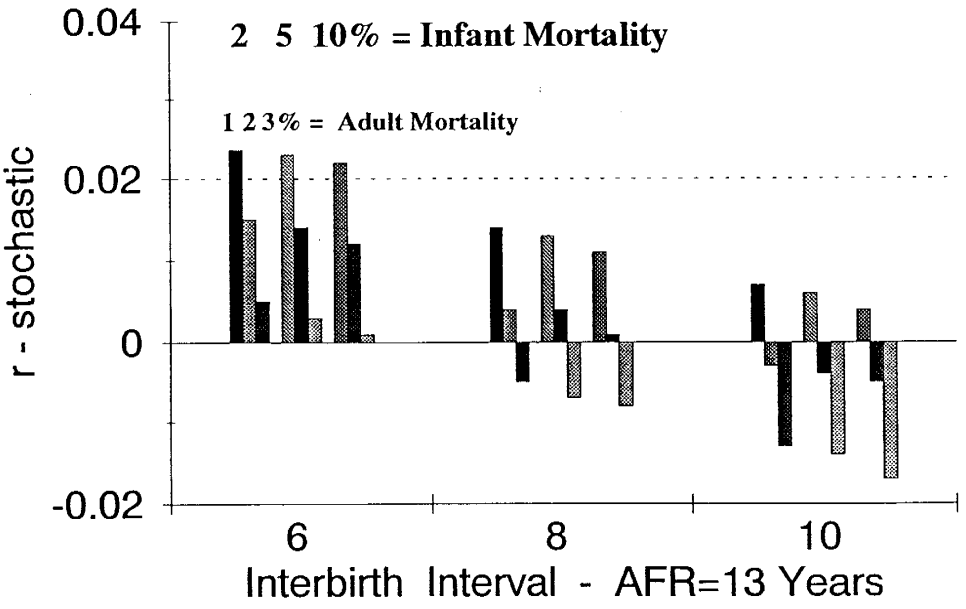


Fig. 3. Effect of mortality rate and interbirth interval on r (AFR=13 yrs).

A decrease of the age of first reproduction in females to 13 years yielded a small increase in mean stochastic growth rate (r values) with the result that all were positive, with adult mortalities of 1, 2, and 3 % at an interbirth interval of 6 years (Figure 3). The rate of increase was positive for 1 and 2% adult mortalities at an interbirth interval of 8 years.

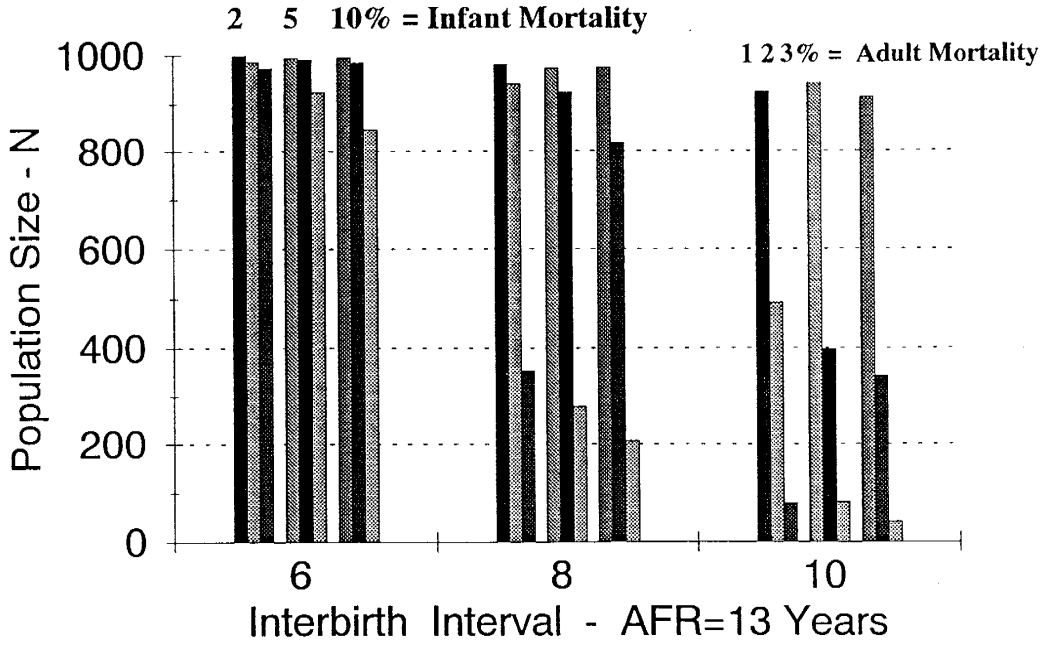


Fig. 4. Effect of mortality rate and interbirth interval on population size (AFR=13 yrs).

Similarly the projected population sizes at 200 years (Figure 4) are near K at the interbirth interval of 6 years for all except the highest levels of infant (10%) and adult (3%) mortality. The populations still decline at an interbirth interval of 8 years and adult mortality of 3%. Measurement of such shifts in a wild population would require following a substantial number of marked animals. Alternatively, if a population were depleted by some event without a decline in habitat, studies might yield information on the strategy employed by wild orangutan populations. Such information would then allow construction of a density dependent function of changes in reproduction to include in the simulations of orangutan population dynamics.

The effects of a catastrophic event on the modeled orangutan population occurring with a probability of 5% each year but on the average of once in 20 years. The effects chosen were a 5% increase in mortality and elimination of reproduction in the year of occurrence. The interaction of first year mortalities of 2, 5, 10, and 15% with adult mortalities of 1, 2, and 3% and an interbirth interval of 7, 8, and 9 years (the 3 columns under each adult mortality level are the results for the 7, 8, and 9 year interbirth intervals respectively) with this catastrophe indicate an overall decline in mean stochastic population growth rates (Figure 5). The simulations with 1% adult mortality maintained positive mean stochastic growth rates for the 7 and 8 year interbirth intervals at levels 2-15% average annual infant mortality.

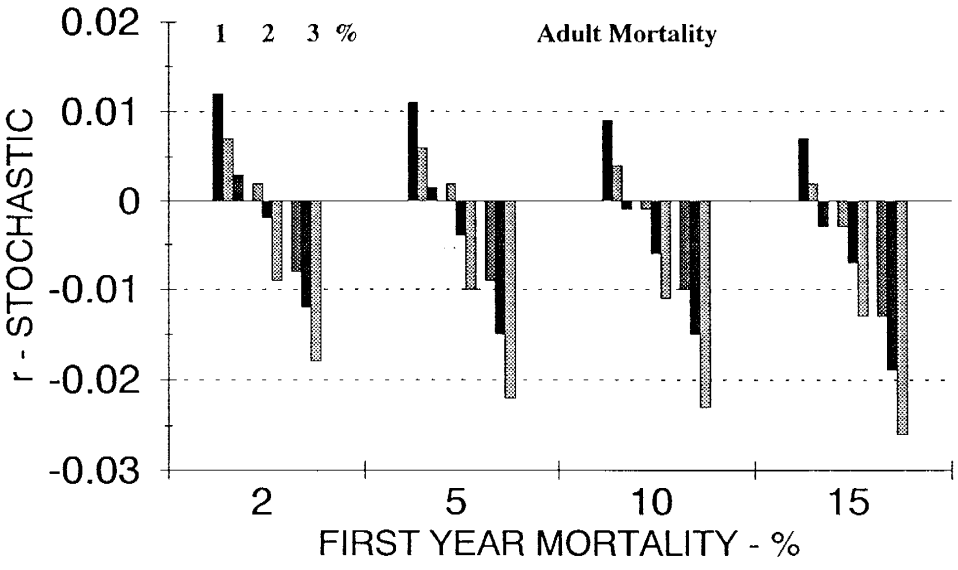


Fig. 5. Effect of catastrophe and mortality rates on r.

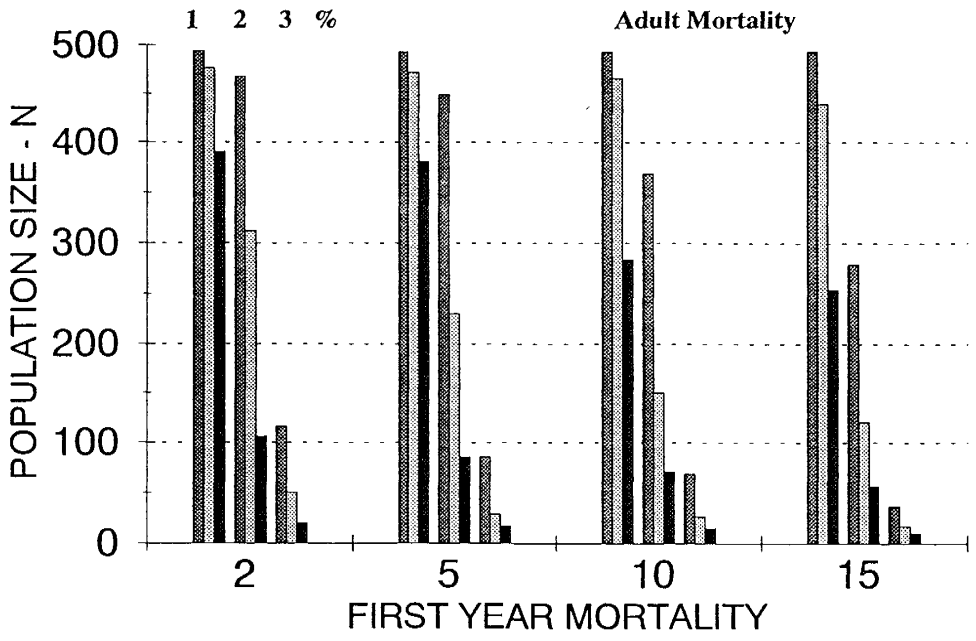


Fig. 6. Effect of catastrophe and mortality rates on population size.

Population sizes at 200 years reflected the trends indicated by the growth rates (Figure 6). None of the populations with 3% average annual adult mortality were viable and an interbirth interval of 9 years resulted in a declining population at all levels of adult and first year mortality.■

ORANGUTAN
POPULATION AND HABITAT
VIABILITY ANALYSIS REPORT

ORANGUTAN ACTION PLAN

Orangutan ACTION PLAN
Leaders: Komar Soemarna, Widodo Ramono, S. Poniran, C. van Schaik, H. Rijksen, M. Leighton, and Workshop Participants

Recommendations for Sumatra:

Orangutan Strategy for the Greater Leuser Ecosystem

Introduction
On the basis of the best evidence available from the orangutan workshop, the population of orangutans in the Greater Leuser ecosystem should be no less than 10,000 individuals to ensure the long-term survival of the species.

To achieve this, the following steps must be taken:

1) Give full protection to the South Bengkung.

2) Incorporate the Lesten valley and surrounding hills inside the Park.

3) Build no further roads through the park to prevent fragmentation.

4) Reunite the two halves of Leuser National Park by relocating settlers in the Upper Alas valley and reforesting the vacated land.

5) Modify the road between Ketambe and Agusan so that there can be free passage of orangutans across this right of way.

6) Develop appropriate buffer zone plantations around key areas of the park (e.g., Sago Plantations around the vulnerable Kluet area of the park).

7) Strengthen protection against the removal of orangutans, especially around the periphery of the Leuser Ecosystem -- most orangutans are caught as they feed in durian orchards on the forest edge.

8) Maintain continuous forest cover over the Blangkejeren-Lokop road.

Recommendations for Borneo:

Emphasizing the immediate need for action, THE BORNEO GROUP RECOMMENDS THAT

At the Species level:

1) Special attention is to be paid to protection of orangutans according to the legal framework; notably law enforcement pertaining to hunting, marketing and sale -- law enforcement can serve to diminish the killing of adult females carrying infants desired by the pet-market.

And at the Habitat level:

1) More attention and support for protective measures for existing conservation areas, especially with a focus on lowland and swamp forest.

2) Pay utmost attention to boundary demarcation and zoning -- standardize maps at the Ministry of Forestry, seeking consultation between PHPA and the Directorate Generals of the Ministry of Forestry in cases where Orangutan habitat outside of conservation areas is concerned.

3) Seek effective control of logging operations in relation to habitat requirements of orangutans, regulating timber concession activities.

4) Complete protected area network with permanent forested areas under special management (buffer zones, etc.) for orangutan habitat protection.

5) Restore degraded habitat and protect regeneration with respect to orangutan habitat requirements.

6) Reintroduce confiscated orangutans in permanent forested areas of good habitat quality which are isolated from other wild orangutan populations.

Recommendations for Reintroduction:

The results of the population and habitat viability analysis demonstrate that supplementing natural populations of orangutans has no conservation value in terms of enhancing population viability. We expect that recent population declines in protected forests are due to habitat loss and degradation in most cases, and to hunting in some cases. In addition, introduction of former captive orangutans into existing populations can have well-known negative effects, such as the damaging mixing of gene pools and the introduction of diseases. Therefore, we strongly endorse the recommendations of the Reintroduction Group of the IUCN/SSC, emphasizing that reintroductions not occur into existing wild populations.

In contrast, our analysis indicates that establishing a new viable population of ex-captive orangutans, in habitat formerly occupied by orangutans, but where they do not now occur, would likely contribute to the viability of the metapopulations on both Borneo and Sumatra. Our workshop did not adequately discuss all the biological issues which should be considered in this strategy. However, we can suggest the following guidelines, if this strategy is pursued:

1) Selection of areas to harbor a population of ex-captives should be guided by projections of population viability.

2) Population viability is maximized at maximal projected carrying capacity (K) of the area. Hopefully, the projected (K) of the selected area would be more than 500 individuals.

3) The carrying capacity (K) can be estimated by mapping the mosaic of the habitats in the proposed area, then multiplying each habitat-specific K by the area of each habitat.

4) A mosaic of lowland forest habitats, extending into hill forests, but more importantly including swamp and/or peat forests, will probably provide maximum population densities. Because montane forests are well-represented in protected areas, the overall conservation value of the area from the perspective of overall biodiversity is also maximized by selection of lowland forest habitats.

5) Areas that include a large proportion of selectively logged forest, if in the lowlands, may be best alternatives, as these forests will recover both in their overall conservation value, and in their carrying capacity for orangutans, if protected from continued degradation.

6) An important value in establishing a new population is that it lowers the risk of overall extinction of the metapopulation on each island, if catastrophic events or continued habitat destruction cause the extinction of local populations. Therefore, areas furthest and/or in a distinctive ecological setting from other established populations, might best contribute this benefit. However, this criteria for selecting areas for the establishment of populations of ex-captives should be secondary to the projection of long-term viability of the population.

Recommendations for Current Captive Populations:

Although the following subject is outside of the scope and objectives of this workshop, the participants:

Recognize that a sizable captive population of orangutans exist in private hands in Indonesia, Malaysia, Taiwan and elsewhere;

Recognize that the long-term care and management of these captive orangutans is quickly exceeding the capabilities of organizations and individuals involved in their care;

Recognize that neither current orangutan rehabilitation programs nor other facilities are adequate to effectively deal with the problem;

Recognize that the issues surrounding the management of these orangutan is too pressing to ignore and;

Request that the variety of options for potential release candidates, as well as non-releasable animals be specified, explored, and evaluated by the appropriate national and international agencies.

Updated Recommendations on Medical Procedures During Quarantine for Orangutans Intended for Reintroduction:
Submitted by Dondin Sajuthi, Agus Lelana, and William Karesh

The confiscation of pet orangutans and their release back into a native habitat allowing contact with naturally occurring populations poses a serious threat to the health of wild populations of orangutans and other indigenous species. In order to mitigate this risk, serious efforts must be made to ensure the health of every animal prior to entering a rehabilitation program aimed at release. At this point in time, we can not in good consciousness recommend the release of any orangutans into areas where viable populations of wild orangutans exist. Additionally, we cannot recommend the transfer to a rehabilitation program or release of any ill or possibly chronically infected individuals. To ensure that only healthy animals are released, a period of quarantine and evaluation is necessary.

To ensure health, strict medical protocols are necessary and must be followed in a concerted and rigorous fashion. The following recommendations are intended to serve as a basis for a more comprehensive program which will be continuously refined according to ongoing experience and updated medical knowledge.

Before entrance into a rehabilitation program, orangutans should undergo the following:

1) A minimum quarantine period of 180 days, with records, observations, tests, and treatments as outlined below.

2) Upon admission to quarantine, a complete history should be obtained from the previous owner and a medical record initiated.

3) A one week stabilization period to allow close scrutiny of behavioral patterns, food preferences, and general condition, and allow the animal to adjust to the new environment. Observed medical problems may warrant immediate examination and attention.

4) A complete physical examination and permanent identification (tattoo and other methods as appropriate) must be performed as soon as the animal has adjusted to quarantine or within one week of arrival (the sooner of the two). Follow-up examinations will be done anytime chemical restraint is necessary for routine testing (e.g. Tb or blood tests) or schedule dictates if animals are small enough to handle without anesthesia.

Chest radiograph, Hepatitis-B surface antigen test, CBC and chemistry panel, and serum banking will be done upon initial examination and again at the end of quarantine.

6) Intradermal Tb test on the upper eyelid, utilizing mammalian old tuberculin will be performed on initial examination and again on the second, third, and sixth month of quarantine.

7) The animals will be placed in separate housing quarters of sufficient space and with separate air and water circulation. Attention should be paid to maintaining psychological well-being in the face of this isolation.

8) Young animals may be housed in groups of two, though they must both clear quarantine together at the end. Accommodations should be made on a case-by-case basis to provide more intimate human contact as needed with appropriate disease precautions considered.

9) Fecal bacteriological examination for Salmonella, Shigella, and Campylobacter should be performed on samples collected at the initial examination and again at the end of the third and sixth month of quarantine.

10) Fecal parasite examinations should be done on samples collected during the initial examination and again at two, four, and six months of quarantine. The last examination should be done 14 days prior to the end of quarantine.

11) Routine anthelmintic treatment will be done every month using ivermectin, pyrantel pamoate, fenbendazole, mebendazole, and/or any other appropriate medications. A rotating schedule may be used if necessary. Routine antiprotozoal treatments may be incorporated into the schedule if protozoal parasites are commonly found in the confiscated animals as a whole.

12) Vaccination against Polio, DPT, Measles, Hepatitis-B, and Rabies should be performed as appropriate for each disease entity and only after blood sampling and adequate serum banking has occurred.

13) Genetic analysis for subspecific identification will be performed using karyotypic and electrophoretic methods at some time during the quarantine period.

14) In light of the current lack of available information regarding the definitive diagnosis, treatment, and epidemiological implications of various infectious diseases (most notably Tuberculosis and Hepatitis-B), a positive test to any or all of these will disqualify an animal from release into areas with wild primates.

15) All animals which die during or following the quarantine period will undergo a full necropsy examination and histopathology. No animals in contact with the individual which died can be released from quarantine until the cause of death and all related abnormal findings are reported in writing by a pathologist to supervising authorities for quarantine procedures.

Additional recommendations:

1) Thorough and complete records should be kept at all times to facilitate proper tracking and control of animals, study of diseases and treatments, and facilitate reporting. Quarterly reports will be provided to supervising authorities and copies of all reports and records will be maintained in a central location.

2) Thorough training and health surveillance of quarantine staff should be a high priority. Poorly performing or ill staff members should not be permitted to work with the animals. Accurate records of surveillance will help to track any zoonotic episodes.

3) A manual containing all operating procedures should be prepared and kept on-site at each facility. This will delineate all quarantine procedures listed above as well as those defining the activities of support and maintenance staff. An updated copy of this manual or these procedures must be kept on file with the Department of Forestry.

4) Procedures should be developed to deal with and expand on all situations involving animals that "drop-out" of or fail the quarantine process as described above.

5) All quarantine facilities, daily procedures and routines, and staff management and procedures should meet the standards of primate quarantine and handling accepted internationally in the biomedical field. Inadequate facilities or procedural aspects will invalidate all of the efforts for disease control or surveillance. These standards must be met at any facility used for the quarantine of orangutans.

6) A special panel of veterinarians, public health experts, ecologists, and others should be formed under the supervision of the Dept. of Forestry of the Republic of Indonesia to evaluate current and ongoing research that will facilitate the development of appropriate protocols and plans for dealing with the health issues related to orangutan rehabilitation.

* These recommendations modified from:

Sajuthi, et. al., 1991, Proceedings of the Great Apes Conference, Ministry of Forestry and Ministry of Tourism, Post, and Telecommunication, Jakarta.

ORANGUTAN
POPULATION AND HABITAT
VIABILITY ANALYSIS REPORT

WORKSHOP AGENDA AND PARTICIPANTS

Workshop Agenda

17 January	Workshop participants arrive at Garuda Plaza Hotel Coordinators' organization meeting (1700)
18 January	Workshop convenes (0900) Opening comments Introductions Overview of orangutan biology Current systematic status of orangutans Presentation of map-linked database for Sumatra Population biology overview (1330) Formulation of initial orangutan population models Working groups for distribution of wild orangutans Data verification for protected, managed and other areas Working groups continue (1930-?)
19 January	Workshop convenes (0830) Status reports from wild orangutan distribution working groups Status report from modeling working group Overview of threats to wild populations Overview of wild orangutan management needs and strategies Working groups convene (1300) Data verification and evaluation of management strategy for each protected area Working groups continue Working groups continue (1930-?)
20 January	Workshop convenes (0830) Working group reports Monitoring of wild orangutan populations Genetic and demographic management of metapopulations Information needs and future workshops: Captive populations, reintroductions, and rehabilitation Integration of wild orangutan management strategies Workshop draft report and recommendations: overall and site-specific
21 January	Field trip to Bukit Lawang, Gunung Leuser National Park All day excursion, lunch in park, return to hotel in afternoon

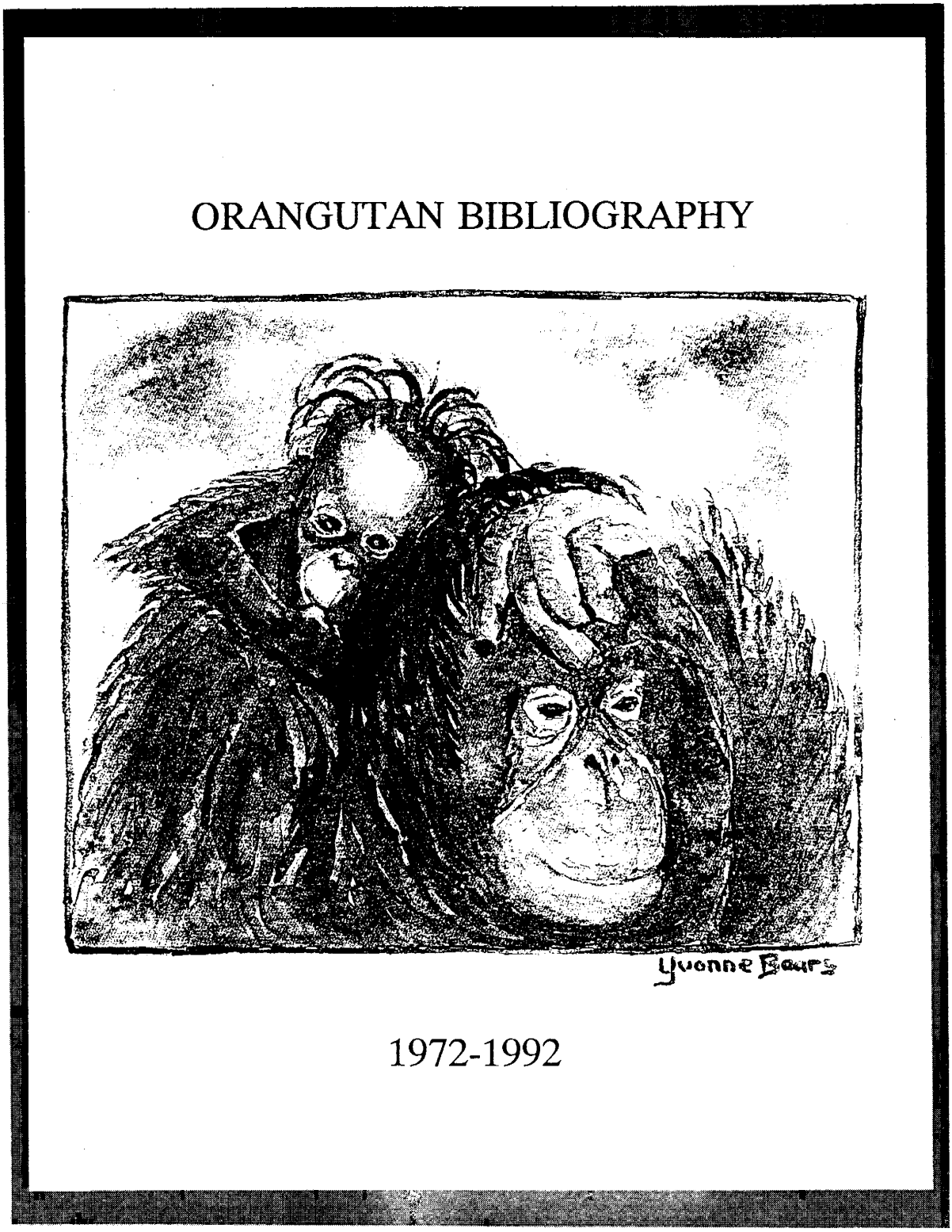
Workshop Participants

Ir. Sutisna Wartaputra, Director General of PHPA
Ir. Komar Soemarna, Director of Conservation, PHPA
Ir. Widodo Ramono, Chief Sub-directorate of Species Conservation, PHPA
Ir. Raja Inal Siregar, Governor of North Sumatra
Ir. Adjisasmito, Kepala Balai KSDA I, Medan
Ir. S. Poniran, Kepala Taman Nasional Gunung Leuser
Ir. Muladi Wijaya, Kepala Sub Balai Sumatera Utara
Drs. Suharto Djojosudharmo, KSDA-Medan
Dr. Kunkun Gurmaya, Indonesian Primate Society
Drs. Kuppin Simbolon, Indonesian Primate Society
Drs. Tatang Mitra Setia, Universitas Nasional
Dr. Dondin Sajuti, Primate Research Center, Bogor Agriculture University
Ir. Agus Lelana, WWF-Medan
Mr. Oliver Nelson, WWF-Medan
Sri R. Steenbeck, WWF-Medan
Drs. Antong Hartadi, KSDA-Medan
Drs. Dolly Priatna, KSDA-Medan
Ir. Sukianto Lusli, WWF-Kerinci Seblat
Ir. Totak Sediyantoro, WWF-Kerinci Seblat
Ir. Ahpal Effendi, WWF-Kerinci Seblat
Sri Suci Utami, Universitas Nasional
Mr. Mike Griffiths, WWF-Gunung Leuser

Dr. Carel van Schaik, Duke University
Dr. Ulysses Seal, IUCN/SSC CBSG
Dr. Ronald Tilson, IUCN/SSC Primate Specialist Group, CBSG & Minnesota Zoo
Mr. Thomas Faust, University of Minnesota
Dr. Billy Karesh, NYZS/International Wildlife Conservation Park
Dr. Mark Leighton, Harvard University & IUCN/SSC Primate Specialist Group
Ms. Lori Perkins, Zoo Atlanta
Dr. Ardith Eudey, IUCN/SSC Primate Specialist Group
Dr. Jito Sugardjito, WWF-U.S. & IUCN/SSC Primate Specialist Group
Mr. Ian Singleton, Jersey Wildlife Preservation Trust
Dr. Ling-Ling Lee, National Taiwan University
Dr. Herman Rijksen, Instituut voor Bosbouw en Groenbeheer & IUCN/SSC Primate SG

Mr. Norm Rosen, California State University
Ms. Lizzie Green, Partridge Films, ABC-Kane (Bristol)
Dr. Gary Shapiro, Orangutan Foundation (USA)
Mr. Marcus Phipps, Orangutan Foundation (Taiwan)
Ms. Li-hung Lin, Orangutan Foundation (Taiwan)
Dr. Richard Tenaza, College of the Pacific & IUCN/SSC Primate Specialist Group

An *Orangutan Bibliography* was compiled by the Minnesota Zoo Conservation Office and the IUCN/SSC Captive Breeding Specialist Group in preparation for the Orangutan PHVA Workshop. Copies of the bibliography (booklet and computer disk) are available for US$ 50 from the IUCN/SSC CBSG Office, 12101 Johnny Cake Ridge Road, Apple Valley, MN, USA.



ORANGUTAN BIBLIOGRAPHY

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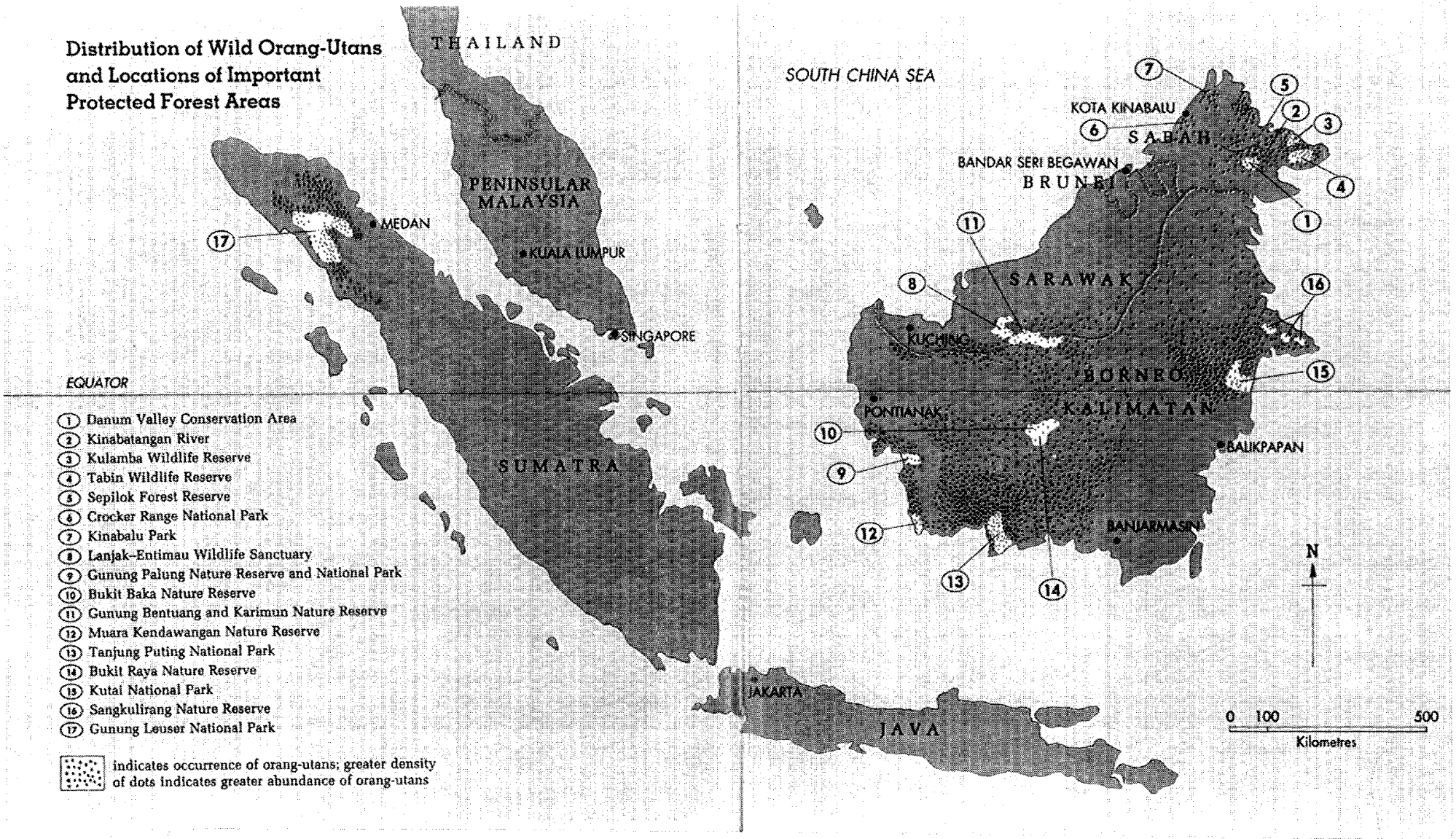
Compiled by Minnesota Zoo Conservation Office and Captive Breeding Specialist Group

January 1993

Map from:

Orang-utan: Malaysia's Mascot
Berita Publishing, 1989


Distribution of Wild Orang-Utans and Locations of Important Protected Forest Areas
THAILAND
SOUTH CHINA SEA
PENINSULAR MALAYSIA
MEDAN
KUALA LUMPUR
SINGAPORE
EQUATOR
SUMATRA
KOTA KINABALU
SABAH
BANDAR SERI BEGAWAN
BRUNEI
SARAWAK
KUCHING
BORNEO
KALIMANTAN
PONTIANAK
BALIKPAPAN
BANJARMASIN
JAKARTA
JAVA
N
0 100 500
Kilometres
1 Danum Valley Conservation Area
2 Kinabatangan River
3 Kulamba Wildlife Reserve
4 Tabin Wildlife Reserve
5 Sepilok Forest Reserve
6 Crocker Range National Park
7 Kinabalu Park
8 Lanjak–Entimau Wildlife Sanctuary
9 Gunung Palung Nature Reserve and National Park
10 Bukit Baka Nature Reserve
11 Gunung Bentuang and Karimun Nature Reserve
12 Muara Kendawangan Nature Reserve
13 Tanjung Puting National Park
14 Bukit Raya Nature Reserve
15 Kutai National Park
16 Sangkulirang Nature Reserve
17 Gunung Leuser National Park
indicates occurrence of orang-utans; greater density of dots indicates greater abundance of orang-utans