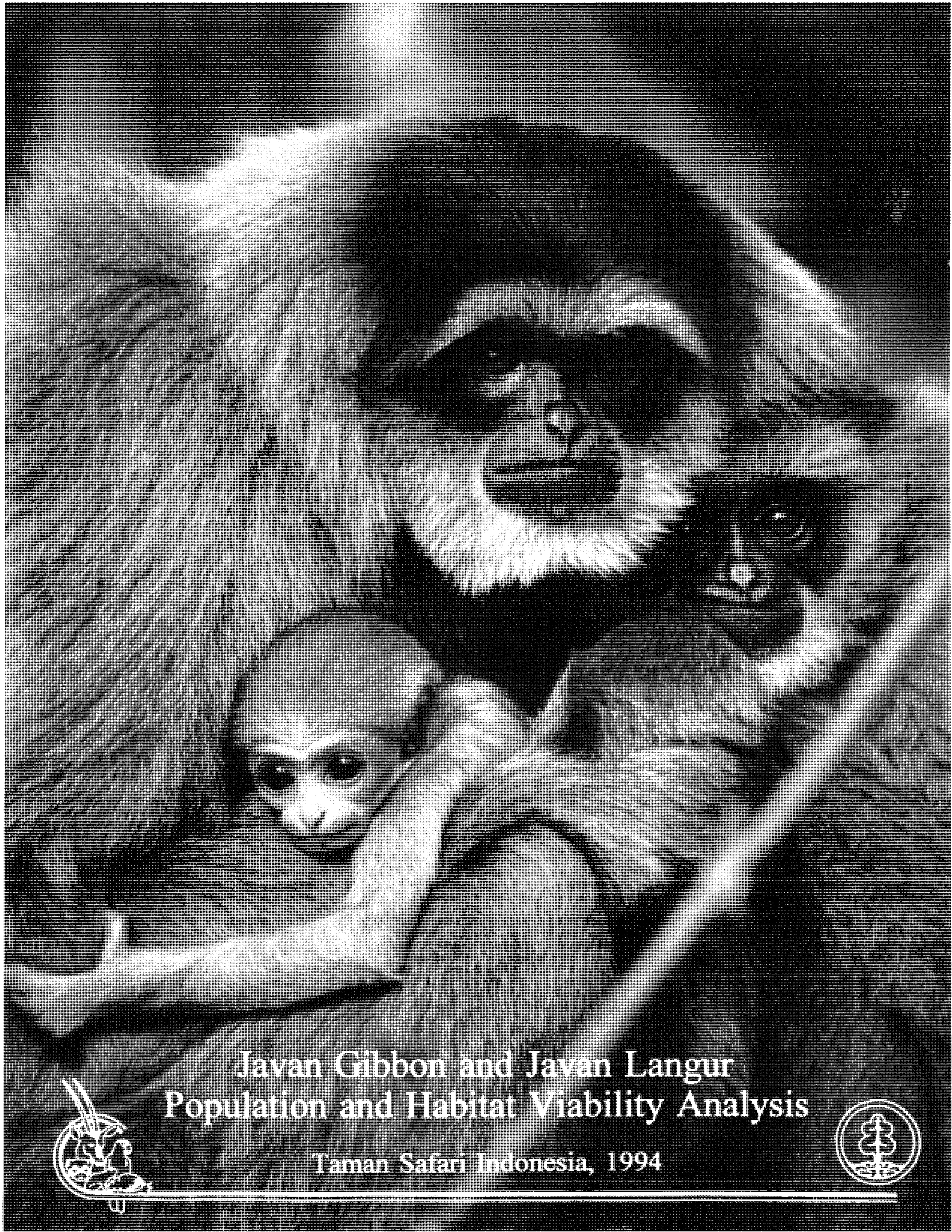

Javan Gibbon and Javan Langur Population and Habitat Viability Analysis

Taman Safari Indonesia, 1994

Javan Gibbon and Javan Langur

Population and Habitat Viability Analysis Report

of the Captive Breeding Specialist Group Species Survival Commission of the IUCN

12 July 1994

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The Primary sponsors of the PHVA workshop include: Taman Safari Indonesia (TSI), Perth Zoo Silvery Gibbon Project, Conservation International (CI), the European Endangered Species Program (EEP)--London, Twycross, Paigton, Fota WP, Edinburgh and Duisburg Zoos; and the American Zoo and Aquarium Association Gibbon Species Survival Plan--Minnesota Zoo and Milwaukee Zoo.

Cover Photo: Adult female, juvenile and infant Javan Gibbon (Hylobates moloch). Photo by Ernie Thetford, Howletts Zoo.

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Javan Gibbon and Javan Langur Population and Habitat Viability Analysis Report

Submitted to the

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A Collaborative Effort of the
Captive Breeding Specialist Group
Species Survival Commission of the IUCN
with the following organizations:

Indonesian Primatological Society (IPS)
Indonesian Forest Protection and Nature Conservation (PHPA)
Taman Safari Indonesia (TSI)
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SEBAGAI MASTERPLAN LOKAKARYA HARIMAU SUMATERA DAN BADAK SUMATERA.

Javan Gibbon and Javan Langur
Population and Habitat Viability Analysis Report

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Executive Summary

Javan Gibbon and Javan Langur Population and Habitat Viability Analysis

A Population and Habitat Viability Analysis (PHVA) Workshop for Javan gibbons *Hylobates moloch* and Javan langurs *Presbytis comata* was held at Taman Safari Indonesia, Cisarua-Bogor on 3-6 May 1994. The workshop was organized and conducted by Jatna Supriatna (University of Indonesia), Kunkun Gurmaya (University of Padjajaran, Bandung), Jansen Manansang (Taman Safari Indonesia), Ronald Tilson (Minnesota Zoo), and Ulysses Seal (IUCN/SSC Captive Breeding Specialist Group--CBSG). Sponsors of the workshop included: the Indonesian Primatology Society (IPS); the Indonesian Directorate of Forest Protection and Nature Conservation (PHPA); Conservation International (CI); Taman Safari Indonesia (TSI); Minnesota and Milwaukee Zoos and the AZA Gibbon Species Survival Plan (SSP); Perth Zoo's Silvery Gibbon Project; and the European Endangered Species Program (London, Twycross, Paignton, Fota WP, Edinburgh and Duisburg Zoos).

The workshop at Taman Safari Indonesia was attended by over 50 participants, primarily members of the Indonesian Primatological Society. Other organizations represented included: PHPA; the Biological Science Club; the Indonesian Zoological Parks Association (PKBSI); Pusat Studi Biodiversitas (UI); Yayasan Bina Sains Hayati Indonesia (YABSHI); the Primate Research Center at Bogor Agricultural University; the Captive Breeding and Primate Specialist Groups of the IUCN/SSC; the Perth (Australia), Milwaukee (USA), and Minnesota (USA) Zoos.

The workshop focused primarily on the distribution, status and threats of wild populations of gibbons on the island of Java; secondarily on the distribution and status of wild populations of Javan langurs. At the workshop seven working groups were established: Habitat and Population Status; Life History and Vortex Analysis; Human Demography; Establishment of a PKBSI Javan Gibbon Program; Captive Management; Diseases; and Capture Techniques. The workshop provided a unique opportunity to bring together Indonesian primate biologists who have censused, or are presently censusing, primates at sites in Java and elsewhere in Indonesia, Chiefs and PHPA staff of Ujung Kulon and Gunung Gede Pangrango National Parks, and international representatives from the IUCN/SSC Specialist Groups and Australian and North American zoos. The workshop concluded with the drafting of a *Javan Gibbon and Javan Langur Action Plan.*

Estimates of habitat and population numbers for wild Javan gibbons and Javan langurs were derived in the **Habitat and Population Status Working Group** through consensus of the field biologists. There were two categories of estimates: one was derived from direct observations of all known individual family groups based on long-term presence in Halimun, Gunung Gede Pangrango and Ujung Kulon National Parks; the second was derived from estimating population numbers by measuring the size of the forest, then estimating the extent and type of available habitat within each forest, and multiplying that figure by estimated gibbon or langur densities for different habitats (established earlier in the workshop for lowland, hill and submontane rain

forest). The first estimate (from direct observations) resulted in a total population of approximately 386 gibbons living in 21 sites and 427 (range of 244-732) langurs in 19 sites; the second estimate (from available habitat extrapolations) resulted in a total population of about 1,957 gibbons in eight sites and about 2,285 langurs in seven sites. In the second estimate, very small populations were discounted as not being viable and thus were not included. The first estimate resulted in numbers that were considered too conservative (because some gibbon groups were probably overlooked) while the second estimate resulted in numbers that were considered too large to be realistic (because this method implied complete habitat saturation, which was not substantiated by field observations of workshop participants). A consensus was reached that somewhere between these two estimates, but nearer the conservative number, probably approximates the real status of wild Javan gibbons and Javan langurs.

The working group on **Life History and Vortex Analysis** relied primarily on data derived from the Thai Gibbon Population and Habitat Viability Analysis Workshop held the previous week in Khao Yai National Park, Thailand for the white-handed *(Hylobates lar)* and pileated *(H. pileatus)* gibbons, for which more comprehensive and long-term observations on population dynamics were available. Because of the similarity of these species, life history characteristics for the Thai species were considered valid for the Indonesian species. Vortex modelling indicated that adult females are the most valuable members of a gibbon population and that the death of an adult female is the life history variable that has the greatest influence on increasing extinction rates for all population sizes. Infants in illegal trade may be thought of as representing dead family groups because of how infants are captured and because of the gibbon's monogamous and family-oriented social system.

Even if the approximately 400 gibbons left on Java were considered a single interbreeding population, their total numbers would not be sufficiently large enough to be considered an evolutionary viable population. Because they live in multiple fragmented populations, they will need to be managed as a metapopulation through some form of genetic supplementation. Even populations of 200 or fewer individuals, in habitat that will not support a larger population, will require continuing monitoring and will require periodic genetic supplementation. These small populations should be evaluated and monitored individually and suitable conservation management plans developed for their particular needs. The removal of one adult female with young per year from stable populations of 100 or fewer individuals (considered to be at or near maximum densities) will approximately double the risk of extinction. The protection of these small populations from removals should be of the highest priority.

The seven subpopulations of 10-26 gibbons are not viable over 100 years. The risk of extinction varies from 20 to 100% depending upon the amount of environmental variation. If these populations are to survive they will require active genetic and demographic management as part of the metapopulation. The 11 populations of fewer than 10 individuals are at high risk of extinction and need to be evaluated for more extreme management strategies, such as rapid habitat expansion, genetic supplementation, translocation, captive propagation, or a combination of these options.

The situation is not much improved even if we consider gibbon populations at the upper limit of almost 2,000 gibbons. Of the more than 30 sites in Java where gibbons previously existed, many sites no longer have gibbons. Their habitat now has been reduced so severely that there are only an estimated eight sites left in Java that are considered as effective conservation units for the species. Only Gunung Halimun National Park has the potential to maintain populations numbering 1,000 individuals. The next best available gibbon habitats, in Gunung Gede Pangrango and Ujung Kulon National Parks, Gunung Simpang Nature Reserve, and Gunung Wayang and Gunung Kendang Production Forests, have the potential to maintain gibbon populations in the 100's only. Thus, even if gibbons could increase their numbers to maximum densities in these remaining habitats, they would still need continuing monitoring and genetic supplementation for long-term viability. These projections are only achievable with near-zero levels of poaching and further habitat degradation.

The working group on **Human Demography and Community Participation in Conservation** examined past and future human population trends adjacent to the gibbon protected areas, estimated the potential impact of these human populations on forest resources and gibbon habitat, and considered recommendations on how to minimize future negative impacts. Their recommendations focused primarily on ways to broaden community participation in managing each park's resources, encouraging NGOs to support these efforts, and training park staff in participatory community planning exercises. When these goals are achieved, gibbon habitat will be more effectively protected.

It was decided on the first day of the workshop that the **PKBSI Javan Gibbon Program Working Group** should set guidelines for establishing a captive management program for Javan gibbons regardless of its status in the wild because it is an endemic species of Java that is considered critically endangered by the IUCN/SSC Primate Specialist Group and because there are only 14 Javan gibbons in the PKBSI zoos. Recommendations included establishing a Javan Gibbon Studbook and appointing a Studbook Keeper, developing a minimum captive population of 10 reproducing pairs of gibbons, preparing a gibbon husbandry manual, and training PKBSI staff in gibbon health and husbandry techniques. The working group on **Captive Management of Javan Gibbons** then developed a comprehensive set of gibbon management guidelines to serve as the basis for implementing the PKBSI recommendations.

The working group on **Javan Gibbon Diseases** acknowledged that infectious diseases pose a significant risk to gibbons, both for long-term maintenance of captive populations and for any suggested translocation or reintroduction program for wild populations. They provided general recommendations for disease control through quarantine procedures and disease testing, and identified several diseases that represented unacceptable risks to wild populations. The working group on **Wild Gibbon Capture Techniques** considered ways in which wild gibbons could be captured if translocations of wild gibbons were ever to be considered as a conservation management strategy by PHPA.

On the last day of the workshop a comprehensive set of recommendations for the conservation management of gibbons and langurs were reviewed, intensively discussed, and consensus was reached. These recommendations formed the basis for the *Javan Gibbon and Javan Langur Action Plan.* There are several problems which challenge conservationists in the long-term management of remaining habitat of wild Javan gibbon and Javan langur populations. These highly endangered Javan primates, because of their restricted habitat, fragmented populations, and small population numbers, will need wise conservation management strategies for their long-term survival. Problems identified during the workshop were:

- Inconsistent and incomplete database for censusing wild Javan gibbon and Javan langur populations;
- Need for improved training of PHPA and field staff in populations censusing techniques;
- Uncertain present and future status of current habitats with gibbon and langur populations;
- Continued high levels of human encroachment and habitat degradation of protected areas;
- Insufficient law enforcement and lack of funds for habitat protection.

With these five problems in mind, the following prioritized recommendations were made to address immediate and critical conservation issues of Javan gibbon and Javan langur populations:

- To assess the current extent of gibbon and langur habitat protected areas using all available technology -- satellite imagery, current aerial photographs, available geological, vegetation and PHPA land-use forest status maps, geographic position system (GPS) units to ground-truth field observations -- to develop a comprehensive geographic information system (GIS).
- To complete a Java-wide population and habitat survey for gibbons and langurs at all sites less than 5 km^2 in extent, and at sites of uncertain land-use forest status. The Indonesian Primatological Society needs to form a research team comprised of individuals from universities, PHPA, NGOs and research institutions to assess sites that have been positively determined to have gibbon and langur populations. The 15 most significant Javan gibbon sites and the six most important Javan langur sites to be surveyed were identified and prioritized.
- To train and educate PHPA staff and local NGOs by IPS representatives and other primate professionals on how to census and monitor primate populations and how to collect ecological data on primates in their respective parks and conservation areas.
- To census annually gibbon and langur populations and evaluate their habitat by trained PHPA staff and primatologists in the national parks and other conservation areas identified in the Java-wide census. This database is to be linked with the National Biodiversity Network Database.

- To increase public awareness and encourage local community participation in the conservation of gibbons and langurs by PHPA staff and NGOs. This recommendation is further expanded upon by recommendations of the Human Demography and Community Participation in Conservation Working Group.

- To integrate conservation management policies of PHPA to strengthen law enforcement in protected and important conservation areas as identified as priority sites in the Java-wide census.

Given the low population estimates of wild Javan gibbons and Javan langurs, their extreme fragmentation, their low reproductive potential, the continued encroachment and degradation of their habitat, and insufficient habitat protection and law enforcement measures, the workshop participants recommended that a captive management program for both species be developed immediately. The following recommendations will guide this program:

- It is recommended that a captive management program be initiated immediately that is linked with, and in support of, the long-term conservation of Javan gibbons and Javan langurs.

- These captive management programs should be under the direction of the PKBSI and be formulated to be a regional Javan gibbon and Javan langur program for Indonesia.

- The PKBSI captive management program for gibbons and langurs should be based on founders already in captivity, and not extracted from wild populations.

- Wild populations of less than 10 individuals (which are at high risk of extinction) should be evaluated for their possible role in translocation programs, other conservation programs and captive management programs.

- Registered Javan gibbons and Javan langurs that are privately held should be considered for confiscation by PHPA and incorporation into the PKBSI regional captive management program.

The combination of the above objectives form the basis of the PHPA conservation management strategy for Javan gibbons and Javan langurs. This document was prepared in draft form during the workshop, and will be reviewed and revised by key participants before it is published. It will include specific recommendations and priorities to PHPA for the long-term conservation, management and research of wild populations of Javan gibbons and Javan langurs, as well as specific recommendations for captive populations. ■

Javan Gibbon and Langur Population and Habitat Viability Analysis Report

Section 1:

PHVA Workshop Information

DEPARTEMEN KEHUTANAN
DIREKTORAT JENDERAL PERLINDUNGAN HUTAN DAN PELESTARIAN ALAM

Alamat : Gedung Pusat Kehutanan Jl. Jend. Gatot Subroto Telp. 583033 - 583037 JAKARTA
Jl. Ir. H. Juanda No. 15 Telp. (0251) 324013 Bogor

Nomor : B. 175/VI/Prog-4/94.

April, 1994

Mr. Ullysses Seal
and Mr. Ronald Tilson
PHVA Workshop Coordinators
Captive Breeding Specialist Group

Dear Mr. Seal and Mr. Tilson.

JAVAN GIBBON AND LANGUR PHVA WORKSHOP

Following your letter on 7 April 1994, we are very grateful on your invitation and we would like to participate the Javan Gibbon and Langur PHVA Workshop on 3-6 May 1994 at Taman Safari, Indonesia. Since the workshop has an interesting subject, it would be benefit to us if you could allow up to 10 participants from the Directorate General of PHPA to participate the Workshop.

We much appreciate your attention and looking forward your reply soon.

Sincerely,

EFFENDY A. SUMARDJA
Director of Conservation Programme

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Depok, 5 April 1994

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Hal : Undangan Javan Gibbon and Langur Workshop

Kepada yth.

1. ~~Kepala Taman Nasional Gunung Gede Pangrango~~
2. Kepala Taman Nasional Ujung Kulon
3. Kepala Balai III KSDA
4. Kepala Subdit Konservasi Jenis
5. Kepala Perhutani Jawa Barat
6. Kepala Perhutani Jawa Tengah
7. Kepala seksi Multilateral Dit. Perencanaan PHPA
8. Kepala Sub Balai KSDA Jawa Barat
9. Kepala Sub Balai KSDA Jawa Tengah
10. Kepala Bag. Satwa Liar Litbang Dept. Kehutanan

Dengan hormat,

Kami bekerjasama dengan Taman Safari Indonesia, Ditjen PHPA, Universitas Padjadjaran dan Captive Breeding Specialist Group (CBSG) IUCN akan mengadakan international workshop berjudul "Javan Gibbon and Langur & Primate Camp Workshop" yang akan diselenggarakan :

Tanggal : 2-5 Mei 1994
Tempat : Safari Garden Hotel, Cisarua Bogor

Dengan surat ini kami mengundang anda untuk berpartisipasi aktif dalam workshop tersebut. Kami juga mengundang beberapa pakar dari perguruan tinggi dan lembaga riset baik dari Indonesia maupun luar negeri. Untuk itu kami mohon diberitahu secepatnya apabila sdr. berkenan hadir baik melalui surat atau telp/fax: 021-777-3180. Bersama ini pula kami kirimkan tentative jadwal pelaksanaanya.

Atas perhatian dan kerjasamanya kami ucapkan terima kasih.

Direktur Pelaksana,

Dr. Jatna Supriatna

Tembusan:
1. Dekan FMIPA-UI
2. Drs.Effendi Sumardja M.Sc, [illegible]
3. Taman Safari Indonesia
4. Dr. Kunkun D. Gurmaja-UNPAD
5. Dr. Ronald Tilson, CBSG-IUCN
6. Arsip.

Problem Statement

Javan Gibbon and Javan Langur Population and Habitat Viability Analysis

OVERVIEW

In 1993 the Indonesian Primatological Society requested the IUCN/SSC Captive Breeding Specialist Group (CBSG) Office to prepare and conduct a Population and Habitat Viability Analysis (PHVA) Workshop on Javan primates, specifically the Javan Gibbon (*Hylobates moloch*) and the Javan Langur (*Presbytis comata*). One of the goals of this workshop would be to develop a structured conservation program for these two species, which could then be used as a model to develop similar programs for the entire primate community across all of Indonesia.

The family *Hylobatidae*, which is strongly represented in Indonesia by six species (and a number of subspecies), includes *Hylobates lar, H. syndactylus* and *H. agilis* in Sumatra, *H. muelleri* [and *H. agilis*] in Kalimantan, *H. klossii* in the Mentawai Islands off west Sumatra, and *H. moloch* in Java. The langurs (or leaf-monkeys) are even more abundantly represented; this workshop will focus on the Javan species, *Presbytis comata.* Using IUCN criteria, all of these species are threatened, the Javan species in particular. No conservation strategy is currently in place with the Directorate General of Forest Protection and Nature Conservation (PHPA), there are no organized captive breeding programs in the Indonesian Zoological Parks Association (PKBSI), the protected areas where these species live in Java are small and extremely fragmented, and the wild populations continue to be decimated for the pet trade and as food.

In the *IUCN/SSC Primate Specialist Group Action Plan for Asian Primate Conservation: 1987-1991*, it was recommended:

> "*Only fragmented pockets of moist evergreen forest remain in west (and central) Java, to which these two rare species are restricted. Human population pressure makes it impossible to declare new reserves. Upgrading of protection at Ujung Kulon/Gunung Honje (768 km²) and Gunung Halimun (400 km²), where the largest populations of these endemics probably occurs, are needed to conserve the two species. Population trends of both* Hylobates moloch *and* Presbytis comata *should be monitored, and the status of* P. comata fredericae *in central Java should be determined. The endemic subspecies* Trachypithecus auratus sondaicus *also would benefit from this action.*"

It is arguable whether any or part of the above recommendation was ever implemented. Regardless of what course of action has or has not been taken, it is clear from numerous discussions with PHPA, the Indonesian Primatological Society, the IUCN/SSC Primate Specialist Group, field primatologists, and university students that more needs to be done. That is why we are here.

WHAT IS A POPULATION AND HABITAT VIABILITY ANALYSIS (PHVA) WORKSHOP?

An endangered species is, by definition, at risk of extinction. The goal in the recovery of such a species is to reduce this risk to some acceptable level, that is, as close as possible to the background or "normal" extinction risk all species face. To do this we need to improve our estimation of risk as a result of different management options, to improve objectivity in assessing risk, and to add quality control to the process (through internal consistency checks).

In the last several years the discipline of Conservation Biology has grown into some of the space between Wildlife Management and Population Biology. A set of principles loosely known as **"Population and Habitat Viability Analysis" (PHVA)** is powerful enough to improve the recognition of risk, rank relative risks and evaluate options. It has the further benefit of changing part of the decision making process from unchallengeable internal intuition to explicit (and hence challengeable) quantitative rationales. One consequence of a PHVA is that critical aspects of the biology of a species can be identified, indicating where further knowledge may substantially increase our ability to predict the fate of a population and where management actions to change population dynamics might be especially effective.

In widely distributed species, local populations may be lost, but are readily re-established from adjacent populations. A single or a few remnant populations isolated from any possible source of supplementation and recolonization typically will not survive indefinitely. Thus, it is not sufficient to protect a remnant population from those causes of decline that eliminated other populations. Rather, aggressive action must be taken to increase the population and to establish or re-establish additional populations. The goal of recovery is to extract a population out of the extinction vortex by returning its numbers, range and diversity to such levels that normal population dynamics, including temporary local extinctions, preclude the extinction process.

A population is considered to be those animals, perhaps further divided into smaller subpopulations, that exchange individuals sufficiently often so that each subpopulation exchanges, on average, at least one migrant per generation with other subpopulations. Simulation modelling of some of the known causes of variability in gibbon populations will be needed to estimate the size of wholly isolated populations needed for demographic stability. It is likely that populations containing less than 50 adults will not be stable over periods of 100-200 years. On the other hand, habitats unable to support 50 adults may be important to their recovery. Natural or managed migration can connect small remnant subpopulations to those in other such habitat patches, thereby constituting a larger, stable population (with a total of 50 or more adults).

Because every isolated population is vulnerable to extinction (for example, a disease epidemic can decimate even a large population), species viability requires at least three populations sufficiently discrete to be subject to independent fluctuations in numbers. If each population has a moderately low probability of extinction, and if the populations fluctuate independently of one another, then it is highly unlikely that species extinction will occur.

The rationale for demographic goals explained above applies equally to genetic goals set forth here. Populations of 50 breeding adults maintain sufficient genetic variation to minimize inbreeding (expected mean increase in the inbreeding coefficient less than 1%) and therefore this number has been recommended as a minimum size for isolated populations of domestic livestock, and for short-term minimum population sizes for wildlife. If subpopulations consist of fewer than 50 breeding adults, migration and immigration (one or more per generation) can genetically link these subpopulations, possibly leading to viable populations.

For long-term maintenance of the genetic variation necessary for adaptive evolution, minimum total population sizes of about 500 have been suggested for species protection. A population of such size of breeding adults will lose hereditary phenotypic variation no more rapidly than variation is regained by recurrent mutation (for gibbons and langurs this may mean a census population size of 2-3,000 animals per species). Thus, adequate genetic variation upon which natural selection can act to adapt the population to novel stresses and environments is always available.

WHAT ARE THE PHVA WORKSHOP OBJECTIVES?

1) Estimate probable populations of gibbons and langurs in protected areas of Java, the degree of fragmentation of these populations, and their probabilities for long-term survival with no intervention;
2) Determine subpopulation sizes required for various probabilities of survival and preservation of genetic diversity for specified periods of time;
3) Project the potential expansion or decline of gibbon and langur population numbers due to environmental changes, habitat alteration and differing management plans;
5) Explore the role of exchanges among disjunct gibbon and langur populations to maintain viable populations;
6) Identify field methods to monitor population status and assess habitat quality;
7) Evaluate possible role of captive propagation as a component of the above management options; and
8) Produce an Indonesian conservation strategy for Javan gibbons and Javan langurs that presents the results and recommendations of the PHVA workshop.

The combination of the above objectives form the basis of the national conservation management strategy for Javan gibbons and Javan langurs. This document will be prepared in draft form during the workshop, and will be reviewed and revised by all participants during the workshop to achieve agreement on its content before departure. It will include specific recommendations and priorities for management and research of wild populations, and if necessary, for captive populations. Once consensus is reached the document will be translated into Bahasa Indonesia for distribution and implementation throughout Indonesia. The results of this workshop will be refined and used as a model for developing PHVAs for remaining extant subspecies elsewhere in Southeast Asia. ■

Submitted by Ronald Tilson and Ulysses Seal, IUCN/SSC CBSG

Workshop Agenda

Javan Gibbon and Javan Langur PHVA Workshop
Taman Safari Indonesia, Cisarua, Bogor
2-6 May 1994

2 May Workshop Coordinators Meeting (PM) [Jatna, Kunkun, Jansen, Seal & Tilson]

3 May Workshop convenes (9:00 AM); Opening comments [Effendy (PHPA), Jansen, Seal and other guests]

Overview of Gibbons in Southeast Asia [Tilson]
Review of Thai Gibbon PHVA [Seal and Tilson]
Overview of Javan Gibbons & Javan Langurs--Distribution, Status, and Threats [Jatna, Kunkun and others]
PHVA Overview and Modelling of Gibbon Populations [Seal and Tilson]

Working Groups:
Javan Protected Areas and Primate Populations [Jatna, Kunkun, PHPA and others]
Javan Gibbon Life History and Vortex Analysis [Seal and Tilson]
Captive Management [Jansen, Castle, Teare, Gates, and zoo staff]
Human Demography [Wahyudi, Agoes, and Williams]

Discussion and Data Verification of Working Groups
Evening Working Groups

4 May Status of Working Groups [Tilson and Seal]

Working Groups:
Habitat Restoration and Translocations [Jatna, PHPA and others]
Diseases of Captive Populations [Dondin and Teare]
Captive Management [Jansen, Castle, Gates and others]

Evening Working Groups: Integration of Reports

5 May Development of Conservation Recommendations [Seal]

Wild Javan Gibbon & Javan Langur Conservation Action Plan [PHPA, Effendy, Jatna, Kunkun, and others]
Captive Javan Gibbon & Javan Langur Recommendations [Jansen, Castle and others]

Began Primate Conservation Assessment and Management Plan (CAMP) [Seal]

6 May Continue PHPA policy recommendations

Continue CAMP

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Javan Gibbon and Langur Population and Habitat Viability Analysis Report

Section 2:

Working Group Reports

Working Group Report:
Javan Gibbon and Javan Langur
Habitat and Population Status

Working Group Members: Kunkun J. Gurmaya, Jatna Supriatna (Chairs), Nigel Asquith, Martarinza, Lusiana Nogo Ladjar, Hario Tabah Wibisono, Yayat Ruchiyat, M. Taufan Suranto, Djuwantoko, Erri Noviar Megantara, Dones Rinaldi, Kuswandono, Agus Sumarna, Sutandi, Ardith Eudey, Haryanto, Kathy Castle, and Ronald Tilson.

INTRODUCTION: JAVAN GIBBON *(Hylobates moloch)*

In order to estimate gibbon populations in Java, biologists in this working group identified and defined several habitat characteristics and made several assumptions about the biology of this species. These include:

- **Group/family size:** Kappeler (1978) estimated the group size for Javan gibbons to be comprised of 3.3 individuals per group. Data were compiled from the biologists in this working group to identify the group size of Javan gibbons within their study sites (see below). Group sizes ranged from one to six individuals per group with an average of 3.2 individuals per group (N = 46).

Biologist	Location	Year	Observed group sizes
Kunkun	Ujung Kulon	1992	4, 3, 2, 2
Purwanto	Ujung Kulon	1987	6, 5, 4
Purwanto	Halimun	1992	6, 1
Purwanto	Halimun	1992	3, 3, 2, 2
Dones	Ujung Kulon	1992	3, 4, 2
Suranto	Ujung Kulon	1992	4
Suranto	Gde-Pangrango	1994	4, 3, 3
Suranto	G. Porang	1993	2
Suranto	G. Simpang	1993	2
Martarinza	Halimun	1992	1, 3, 4
Martarinza	Leuweung Sancang	1992	3
Martarinza	G. Slamet	1992	4, 4, 3
Martarinza	G. Salak	1992	3
Martarinza	G. Papandayan	1992	2
Ghofir	Halimun	1989	3, 3, 3, 3, 3, 3, 3, 3, 4, 4, 4, 4, 4, 4, 4

These observations comprise 149 individuals in 46 different groups in at least nine different areas of West Java, resulting in, on average, 3.239 individuals/group. Thus, for purposes of this report, Javan gibbon groups are considered to be comprised of 3.2 individuals per group.

- **Altitudinal vegetation zones:** Kappeler's (1978) definition of vegetation zones in Javan gibbon habitat was utilized in this report: lowland rain forest (0-500m); hill rain forest (500-1000m); and lower montane (1000-1500m).

- **Density/habitat estimates:** A number of published density/habitat estimates were compiled for the Javan gibbon. Biologists were surveyed for their estimates of gibbon density/habitat (see below).

Biologist	Location	Year	Altitud. zone	Gibbon pop. density (km^2)
Kappeler	Ujung Kulon	1984	lowland	4-13
Kunkun	Ujung Kulon	1992	lowland	1
Rinaldi	Ujung Kulon	--	lowland	2.7
Kappeler	Ujung Kulon	1984	low montane	1-3
Suranto	---	1994	low montane	1.6
Kappeler	Ujung Kulon	1984	hill	2-7
Kool	---	1992	hill	8.6
BScC	Halimun	1988	hill	3-15
Anonymous	Halimun	1992	hill	5.8
Supriatna	G. Slamet	1992	hill	6.47

The two sets of data were compared and it was agreed that the following figures would be used in this report: lowland rain forest (1-3/km^2); hill rain forest (7/km^2); and lower montane (2/km^2).

- **Gibbon song rate:** Gibbon song rate was used to extrapolate gibbon populations of *H. lar* and *H. pileatus* in the *IUCN/SSC CBSG Thai Gibbon Population and Habitat Viability Analysis Report* (1994). However, this factor was not considered in these estimates due to the lack of current and specific data on song frequency in the Javan gibbon.

METHODOLOGY FOR JAVAN GIBBON POPULATION ESTIMATES

In most cases, edge effect (defined as the first kilometer of habitat on the forest periphery not occupied by wild gibbons) was considered when estimating occupied gibbon habitats. This was calculated in the same manner used in the *IUCN/SSC CBSG Thai Gibbon Population and Habitat Viability Analysis Report* (1994). The square root of the available habitat was multiplied by one km depth by four sides to estimate the area around the perimeter of the total area undesirable for gibbons. This edge effect area was then subtracted from the total area to estimate suitable gibbon habitat. This area was then multiplied by the appropriate gibbon population density estimate for that altitudinal vegetation zone in order to estimate the gibbon population for that particular area.

Forest Area - Edge Effect x Pop. Density (Alt. Zone)
x Group Size (3.2) = Total Gibbons

Table 1. Javan gibbon (*H. moloch*) habitat areas in effective conservation units in Java.

Units/Areas	Available Habitat (km2)	Status	Forest Type	# Groups Observed	# Individuals (3.3/group)
1. Ujung Kulon	--	--	--	--	--
G. Payung *	30	NP	L/undisturbed	0	0
G. Honje	85	NP	L/disturbed	11	36
2. G. Halimun	235	NP	H/SM/undisturbed	16	53
3. G Jayanti	<5	PF	L/disturbed	3	10
4. Lengkong	<5	PF	L/disturbed	4	13
5. G. Porang	<5	PF	L/disturbed	2	7
6. G. Salak	70	PF	H/SM/disturbed	7	23
7. Telagawarna *	<5	NR	H/SM/disturbed	0	0
8. Gde-Pangrango	50	NP	H/SM/undisturbed	28	90
9. G. Kancana	<5	PF	H/SM/disturbed	--	--
10. G. Malang	<5	NR	H/SM/disturbed	4	13
Takokak	--	--	--	--	--
Cadas Malane	--	--	--	--	--
11. G Sanggabuana	50	PF	L/H/SM/disturbed	2	7
12. Bojongpicung	<5	PF	L/H//disturbed	1	3
13. Pasir Susuru	<5	PF	L/disturbed	2	7
14. G. Masigit	--	--	--	--	--
G. Halu	<5	PF	H/SM/disturbed	2	7
15. G. Simpang	140	NR/PF	H/SM/undisturbed	3	10
16. G. Tilu	30	NR	H/SM/undisturbed	3	10
17. G. Tangkuban Perahu*	--	--	--	0	0
18. G. Malabar *	--	--	--	0	0
19. G. Bukittunggul *	--	--	--	0	0
20. Gr. G. Pernhu (proposed)	--	--	--	--	--
G. Kendang	120	PF	H/SM/?	8	26
21. Gr. G. Limbung (proposed)	--	--	--	--	--
G. Wayang	85	PF	H/SM/undisturbed	3	10
22. G. Cikuray *	--	--	--	0	0
23. Lwng Sancang	<5	NR	L/disturbed	4	13
24. G. Slamet	?	PF	H/SM/dist(proposd NR)	5	17
25. G. Masigit	12.8	GR	H/SM/disturbed	2	7
26. G. Burangrang	27	NR	H/SM/M/undisturbed	2	7
27. G.A. Takokak	--	NR	--	--	--
28. Cikepuh/Cibatang	--	GR	L	--	--
29. D. Janpong	--	PR	L	--	--
30. Cisolok	3	NR	L/H/disturbed	4	17 (actual)
TOTALS	**793 km^2/18 areas (with gibbons)**			**Observed Groups: 116**	**Observed Est. Total: 386**

Table 2. Javan gibbon (*H. moloch*) habitat areas and population estimates in effective conservation units in Java.

No. Units	Total Size (km^2)	Available Habitat (km^2)	Occupied Habitat (km^2)	Edge Effect (km^2)	Core Area (km^2)	Projected Pop. (ind)	Observed Est. Pop. (ind)
National Parks							
1. Ujung Kulon	--	--	--	--	--	--	--
G. Payung *	--	--	--	--	0	0	0
G. Honje	550	150 (L)	50 (L)	28	22	66	36
2. G. Halimun	400	296 (w/ edge)	--	--	296	908	75 (pooled)
military	--	--	-- (H)	--	62 <1000m	440	22 (Kunkun)
---	--	--	-- (SM)	--	234 >1000m	468	53
3. Gde-Pangrango	150	50 (SM)	28	22	--	43	90 (pooled)
Production Forest							
4. G. Salak	--	70 (SM)	--	20	50	100	51 (pooled)
5. G Sanggabuana	--	50	--	28	22	43	7
6. Gr. G. Perahu (proposed)		--	--	--	--	--	--
G. Kendang	250	--	120 (SM)	44	76 (SM)	152	29 (pooled)
7. Gr G. Limbung (proposed)		--	--	--	--	--	--
now G. Wayang	100	85	--	--	75	338	6 (pooled)
					37.5 (H)	263	--
					37.5 (SM)	75	--
Nature Reserve							
8. G. Simpang	150	110 (SM)	--	42	68	306	10 (pooled)
					34 (H)	238	
					34 (SM)	68	
TOTALS						1956	304

NP = national park; NR = nature reserve; PRF = production forest; GR = game reserve; * = no gibbons observed; L = lowland rain forest (1-3 gibbons/km^2; H = hill rain forest (7 gibbons/km^2); SM = submontane forest (2 gibbons/km^2). Projected population estimates were derived by multiplying core area size by population densities typical for habitat type (see text).

Ujung Kulon National Park: The area available for gibbons in 1984 was estimated to be 85 km^2 with an edge effect included for eastern section. In 1992, it was estimated that 50 km^2 were occupied by gibbons. Kunkun surveyed the northern edge of this area in 1992 and found no gibbons. Two groups of gibbons have been identified in a western area and do not appear to be contiguous with the eastern populations.

Gede Pangrango: Observed gibbon populations: Bedogol-Cibodas = 13; Situ Gunung = 5; Cimungkat = 9; Selabintana = 1. Total group = 28 groups x 3.2 individuals = 89.6 individuals.

THREATS

Pets and Confiscations

Data were not available at this workshop from PHPA biologists on the number of gibbons removed from the wild. Several known reports of gibbons in the pet trade are given below:

- 1.5 yr old, south of Gde Pangrando (sale price 100,000 Rp = US$ 50)
- 1-2 yr old sold in Jakarta (sale price 300,000 Rp = US$ 150)
- 2nd gibbon sold by source in (2), approx 2-3 yrs old
- +2 yr old in Batuireng village (G. Simpang site)
- 2 yr old in Cisalak village (G. Sanggabuana)
- 5-6 yr old in G. Slamet

The following privately kept gibbons have been donated to PKBSI zoos.

- 2 males, 1 infant gibbons at Taman Safari Indonesia, Cisarua-Bogor
- 2 males, 2 females at Ragunan Zoo, Jakarta
- 4 males, 2 females at Bandung Zoo
- 1 male, 1 female at Yogyakarta Zoo

Habitat Loss and Encroachment

- Ujung Kulon National Park: habitat loss (8% over 10-year period, about 300 ha per year), poaching (8% over 5-year period), human activities (traffic, ecotourism, etc.) (<1%).

- G. Halimun National Park: habitat loss (2% over 10 years), gold mining (?), military training (?), poaching/hunting (?).

- Gde Pangrango: habitat loss (0.1% over 10 years), ecotourism (?).

- G. Salak: UNOCAL Geothermal project, tea plantation incursion, human traffic.

- G. Sanggabuana: habitat loss, military training.

- G. Kendang: habitat loss, poaching.

- G. Wayang: will be logged in 1995.

- G. Simpang: habitat loss, poaching.

JAVAN LANGUR (*Presbytis comata*) POPULATION AND HABITAT STATUS

The Javan langur (or grizzled leaf eating monkey), *P. comata,* locally known as "surili," is rarely reported in articles by biologists. This species evades easy observation with its preference for higher elevations and extremely quiet means of moving through the forest. Its distribution through available habitat appears uneven and the characteristic forest composition preferred is unknown at this time. However, for the purpose of extrapolating population sizes, it is assumed that they are evenly distributed through its habitat. The working group biologists suspect that this species prefers younger rather than mature forest stands possibly driven by dietary preferences.

The Javan langur prefers ecotones, edges and riverborders with thicker lower and middle stories at elevations of 1200-1800m. Individuals have rarely been noted below 1200m elevation. Although two groups from different locations have been documented to be sympatric with Javan gibbons, all other groups were not found with gibbons. Langurs prefer lower strata, sometimes seen on the forest floor. Little is known about the ecology of this species, particularly its distributions and populations. Groups have been determined to be comprised of one adult male, up to several females and multiple juveniles. Group density has been documented to be 11-12 individuals/km^2 and 35 individuals/km^2.

Known Javan langur groups were identified in 19 protected areas in West Java. The following information was used to extrapolate the total population in the largest nine sites and estimate the total known population in 19 sites.

- **Group size:** 4-12, mean of 7 (typical habitat)

- **Population density:** Densities vary from 4/km^2 at lower elevation to 21/km^2 and 35/km^2 at elevations of 1600-1800 m. A conservative density of 5/km^2 was used to extrapolate the total estimated population (see table below).

Biologist	Location	Year	Altitud. zone	Langur pop. density
Wedana	Patengang	1993	1600-1800 m	35/km^2
Ruhiyat	Kawah Kamojang	1983	1300-1600 m	11/km^2
Maitar	Halimun	---	900-1200 m	4-5/km^2

METHODOLOGY FOR EXTRAPOLATING TOTAL POPULATION

Available habitat figures were used from the Javan gibbon database. Since Javan langurs are not found inside the core of a forested area, the edge effect was calculated based on the fact that they range in a 3-5km deep band around the perimeter of the area. Since this occupied band is often not contiguous, the occupied band was estimated to be 2 km.

The unoccupied core was estimated by taking the square root of the available habitat, subtracting 2 (2 km) and squaring this distance. The unoccupied core area was then subtracted from the total available habitat to derive the area of the 2 km wide band occupied by Javan langurs. This figure was similar to the area derived assuming the configuration of the areas involved to be circular.

The occupied edge was multiplied times a population density of 5 individuals/km^2 to extrapolate the total population of Javan langurs in this area.

THREATS TO JAVAN LANGURS

The greatest threat to langur populations appears to be destruction of habitat and human encroachment. There appears to be little to no occurrence of poaching or hunting. The rate of langur habitat destruction is estimated at less than or equal to 1% per year.

Potential for captive Javan langur programs may be low. Few captive individuals have been reported and none have survived in captivity. Much information is needed about the wild diet.

Javan langurs are impacted by military training operations in east G. Halimun. It has been reported in local newspapers that langurs and other species were shot during training sessions. It has also been reported by the news media that langurs have been killed as a result of gold mining operations by individual prospectors for their meat and skins.

REFERENCES

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I. Wedana, and Adi Putra. 1993. Perilaku makan surila *Presbytis comata comata.* J. Barst Master's Degree Thesis, Padjajaran University, Bandung, Indonesia.

Table 3. Javan langur (*Presbytis comata*) habitat areas in effective conservation units in Java.

No. Units	Available Habitat (km^2)	Status	Forest Type	Unavailable Core (km^2)	Edge Habitat (km^2)	Est. Pop. (ind)	# Groups Observed	Est. Total Observed
1. Ujung Kulon								
G. Payung	30	NP	L/undisturbed				3	12-36/21
2. G. Halimun	400	NP	H/SM/undisturbed	256	144	720	9	36-108/63
3. G. Salak	70	PF	H/SM/disturbed	19	51	255	4	16-48/28
4. Telagawarna *	<5	NR	H/SM/disturbed					
5. G Gde-Pangrango	50	NP	H/SM/undisturbed	9	41	205	7	28-84/49
6. G. Kancana *	<5	PF	H/SM/disturbed					
7. G. Malang *	<5	NR	H/SM/disturbed					
8. G Sanggabuana	50	PF	L/H/SM/disturbed	9	41	205		
9. G. Masigit								
G. Halu	<5	PF	H/SM/disturbed				3	12-36/21
10. G. Simpang	140	NR/PF	H/SM/undisturbed	64	76	380		
11. G. Tilu	30	NR	H/SM/undisturbed				2	8-24/14
12. G. Tngkban Perahu*	3.7							
13. G. Malabar *								
14. G. Bukittunggul *								
15. G Papandayan	120	NR	G/S/M/?	49	71	355	4	16-48/28
16. Kawah Kamojang	4 (18)	NR	M/disturbed	0	18	198	7	28-84/49
17. G. Limbung								
now G. Wayang*	85	PF	H/SM/undisturbed					
18. Leuweung Sancang	<5	NR	L/disturbed					
19. G. Slamet	?	PF	H/SM/disturbed.				3	12-36/21
20. Cisolok	?	PRF	L/undisturbed				2	8-24/14
21. G. Jagat	12.5	NR	H/SM/undisturbed				2	8-24/14
22. Burangrang,	27	NR	H/SM/undisturbed				2	8-24/14
23. Rawa Danau	25	NR	L/undisturbed				1	4-12/7
24. T. Patengan	0.6	NR	M/disturbed				4	16-48/28
25. G. Tikukur	?	PRF	M/disturbed				1	4-12/7
26. G. Batu	?	PRF	M/disturbed				1	4-12/7
27. TB Kareumbi	124.2	GR	H/SM/undisturbed	51	332		3	12-36/21
28. CA Cibanteng	4.7	NR	L/undisturbed				1	4-12/7
29. SM Cikepuh	81.3	WR	L/undisturbed				2	8-24/14
TOTALS						**2285**	**n=61**	**est range: 244-732** **est mean: 427**

NP = national park; NR = nature reserve; PRF = production forest; PF = protection forest area; GR = game reserve; WR = wildlife reserve; * = no information; L = lowland; H = hill forest 500-1000m; SM = submontane 1000-1500m; M = montane 1500 and above.

WORKING GROUP SUMMARY RECOMMENDATIONS

There are several problems which challenge conservationists in the long-term management of remaining habitat of wild Javan gibbon and Javan langur populations. These highly endangered Javan primates, because of their restricted habitat, fragmented populations, and small population numbers, will need wise conservation management strategies for their long-term survival. Problems identified during the workshop were:

- Inconsistent and incomplete database for censusing wild gibbon and langur populations;
- Need for improved training of PHPA and field staff in populations censusing techniques;
- Uncertain present and future status of current habitats with gibbon and langur populations;
- Continued high levels of human encroachment and habitat degradation of protected areas;
- Insufficient law enforcement and lack of funds for habitat protection.

With these five problems in mind, the following prioritized summary recommendations were made to address immediate and critical conservation issues of Javan gibbon and Javan langur populations:

- To assess the current extent of gibbon and langur habitat protected areas using all available technology -- satellite imagery, current aerial photographs, available geological, vegetation and PHPA land-use forest status maps, and geographic position system (GPS) units to ground-truth field observations -- to develop a comprehensive geographic information system (GIS).
- To complete a Java-wide population and habitat survey for gibbons and langurs at all sites less than 5 km^2 in extent, and at sites of uncertain land-use forest status. The Indonesian Primatological Society needs to form a research team comprised of individuals from universities, PHPA, NGOs and research institutions to assess sites that have been positively determined to have gibbon and langur populations. The 15 most significant Javan gibbon sites and the six most important Javan langur sites to be surveyed were identified and prioritized.
- To train and educate PHPA staff and local NGOs by IPS representatives and other primate professionals on how to census and monitor primate populations and how to collect ecological data on primates in their respective parks and conservation areas.
- To census annually gibbon and langur populations and evaluate their habitat by trained PHPA staff and primatologists in the national parks and other conservation areas identified in the Java-wide census. This database is to be linked with the National Biodiversity Network Database.

- To increase public awareness and encourage local community participation in the conservation of gibbons and langurs by PHPA staff and NGOs. This recommendation is further expanded upon by recommendations of the Human Demography and Community Participation in Conservation Working Group.

- To integrate conservation management policies of PHPA to strengthen law enforcement in protected and important conservation areas as identified as priority sites in the Java-wide census. ■

SITE-SPECIFIC SUMMARY RECOMMENDATIONS for National Parks

Problems	Ujung Kulon	Halimun	Gde Pangrango
Inconsistency of Population Data	More extensive habitat and population inventories in G. Honje areas	Comprehensive inventory of habitat & populations for entire area (not only Cikanki)	Comprehensive habitat & population inventories for entire area
	Yearly monitor of habitat & populations by PHPA, primatologists	Yearly monitor habitat & populations by PHPA, primatologists	Yearly monitor habitat & populations by PHPA, primatologists
Lack of Experience in Field Conditions	Train park rangers & local NGOs to collect field data & monitor primate ecology	Increase number & quality of staff	Increase number & quality of staff
	Establish field research station to coordinate research activities	Strengthen cooperation between relevant institutions including local NGOs, local communities, researchers, universities	Strengthen cooperation between relevant institutions including local NGOs, local communities, researchers, universities
	Involve researchers to train staff & interpret data		
Rate of Human Encroachment up to 1-2% per Year	Increase awareness, involvement & participation of local people about conservation of gibbon & langur through: a. information extension b. participatory planning process		Increase awareness, involvmnt & participation of local people about conservation gibbon & langur through: a. information extension b. participatory planning process
	Wise management should be considered for human encroachment problems by analyzing socio-economic & anthropological approaches		Participatory programs for habitat & population improvements & social welfare for rural people
Law Enforcement Activities	Appraise causal factors & illegal activities	Appraise causal factors & illegal activities	Appraise causal factors & illegal activities
	Selectively & wisely enforce the law relevant to local situations	Selectively & wisely enforce the law relevant to local situations	Selectively & wisely enforce the law relevant to local situations
Insufficient Funds	Activity of foundations		

SUMMARY RECOMMENDATIONS for Nature Reserves, Protected Forests or Proposed for Protection, and Forests < 5 KM^2

Problems	**G. Simpang** (nature reserve)
Inconsistency of Population Data	More extensive habitat and population inventories Yearly monitor of habitat & populations by PHPA, primatologists
Lack of Experience in Field Conditions	If low habitat & population figures, then take no action. If high habitat & population figures, take the following action: a. Train park rangers & local NGOs to collect field data & monitor primate ecology b. Establish field research station to coordinate research activities c. Involve researchers to train staff & interpret data

Problems	**G. Salak** (protected forest)	**G. Sanggabuana** (proposed sanctuary)	**G. Kendang & G. Wayang** (proposed sanctuary)
Status	----------	Propose change to nature reserve	Immediate research priorities to assess gibbon populations & habitats If figures for pop/habitat low, then take no action. If high, propose change to nature reserve.
Lack of Information	---------	-----------	
Geothermal Project Activities	Improve protection area in cooperation with Unocal & consultant/scientists		

FORESTS < 5 KM^2: **Sites: G. Tilu NR, G. Slamet NR, Leuweung Sancang NR, G. Jayanti, Lengkong, G. Porang, G. Kancana, G. Malang, Bojongpicung, Pasir Susuru, G. Masigit, Cisolok, G. Burangrang.**

Problems	
Status	Conduct annual population surveys and monitor habitat with PHPA, IPA as coordinators Conduct genetic & behavioral studies on remnant populations

MAP LEGENDS

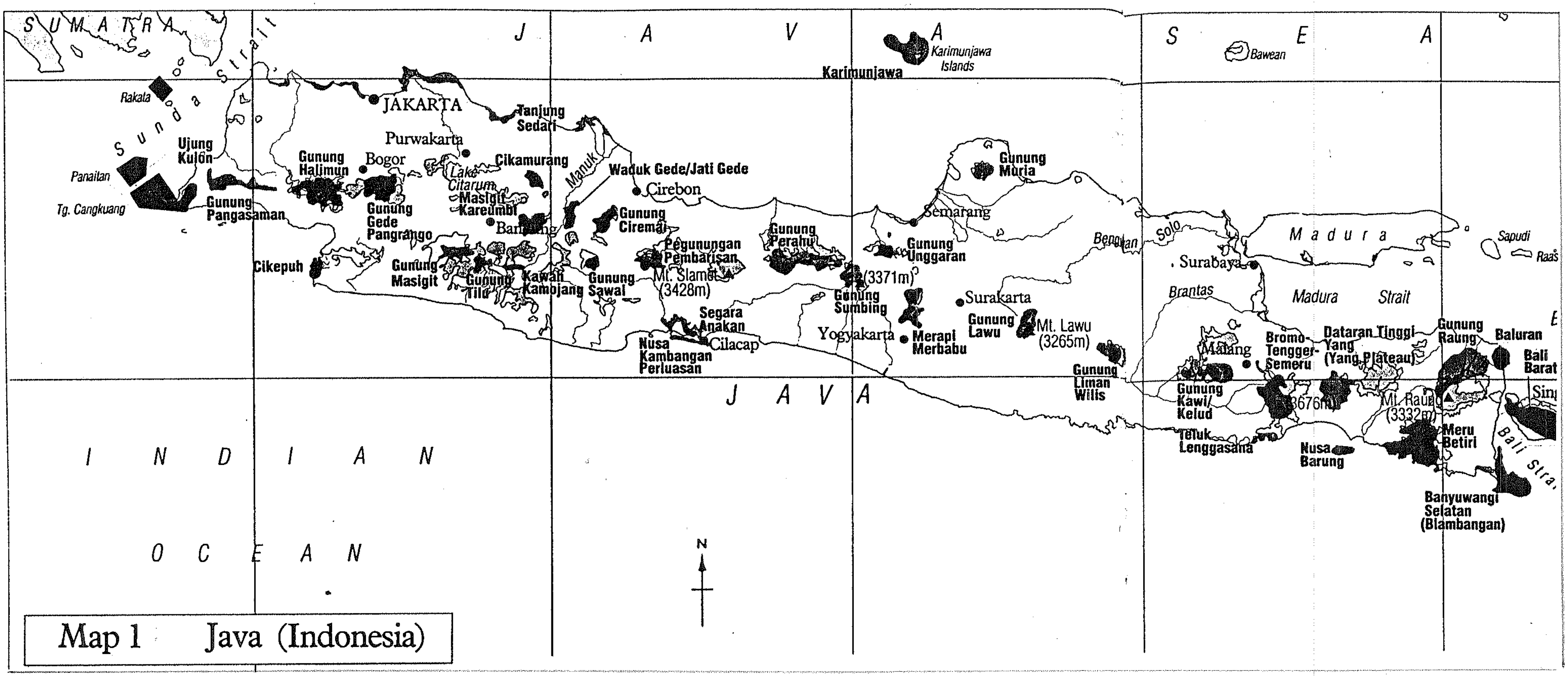
Map 1. Overview of protected areas in Java (IUCN, *Conservation Atlas of Tropical Forests*, 1991).

Map 2. Map of Ujung Kulon National Park showing Gunung Payung and Gunung Honje (Indonesia Land-Use and Forest Status Map, Series RePPProT, 1988; scale 1:250,000).

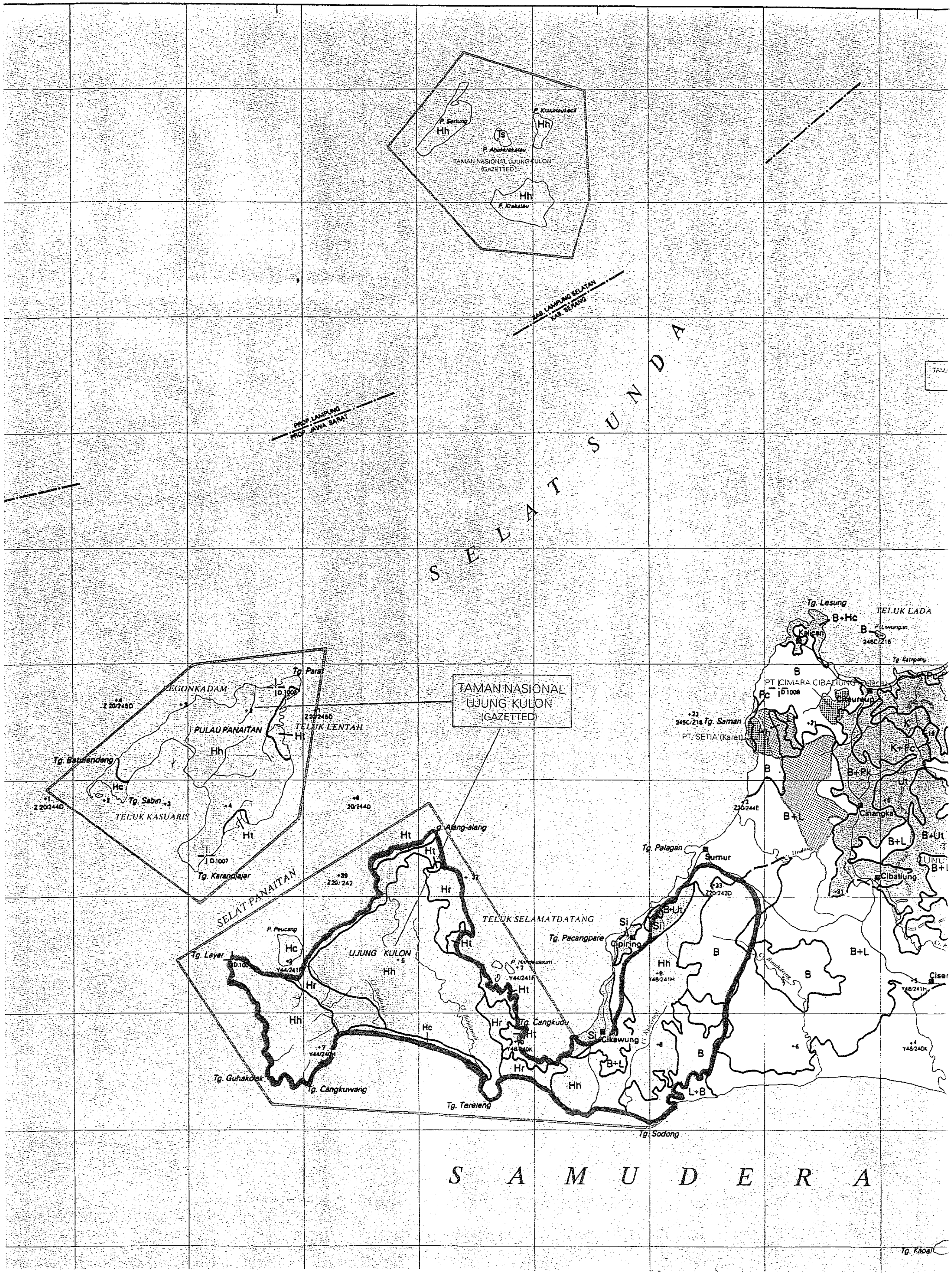
Map 3. Map of Gunung Halimun National Park (Indonesia Land-Use and Forest Status Map, Series RePPProT, 1988; scale 1:250,000).

Map 4. Map of Gunung Gede-Pangrango National Park (Indonesia Land-Use and Forest Status Map, Series RePPProT, 1988; scale 1:250,000).

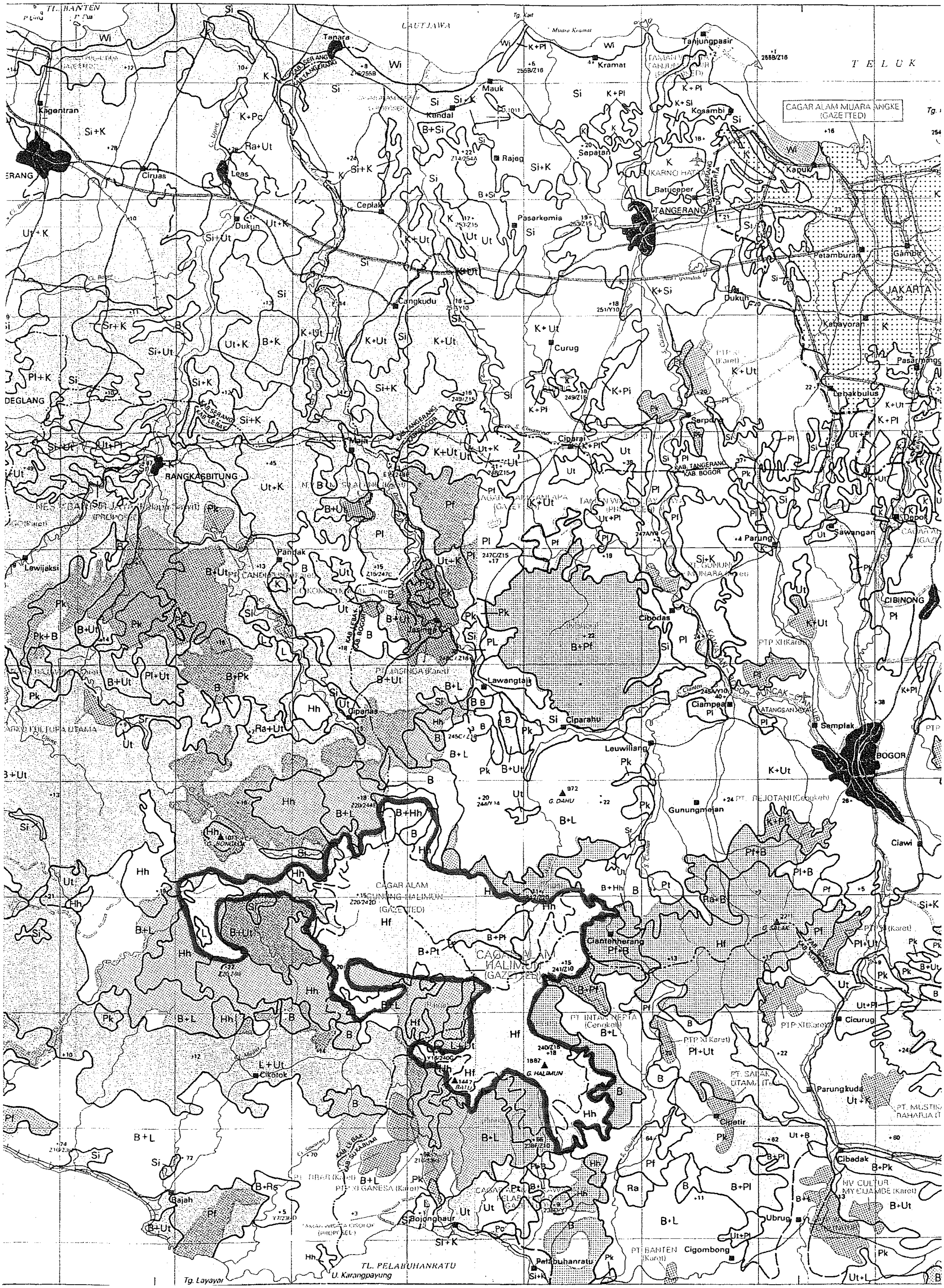
Map 5. Map of Gunung Slamet Protected Forest, a proposed Nature Reserve (Indonesia Land-Use and Forest Status Map, Series RePPProT, 1988; scale 1:250,000).



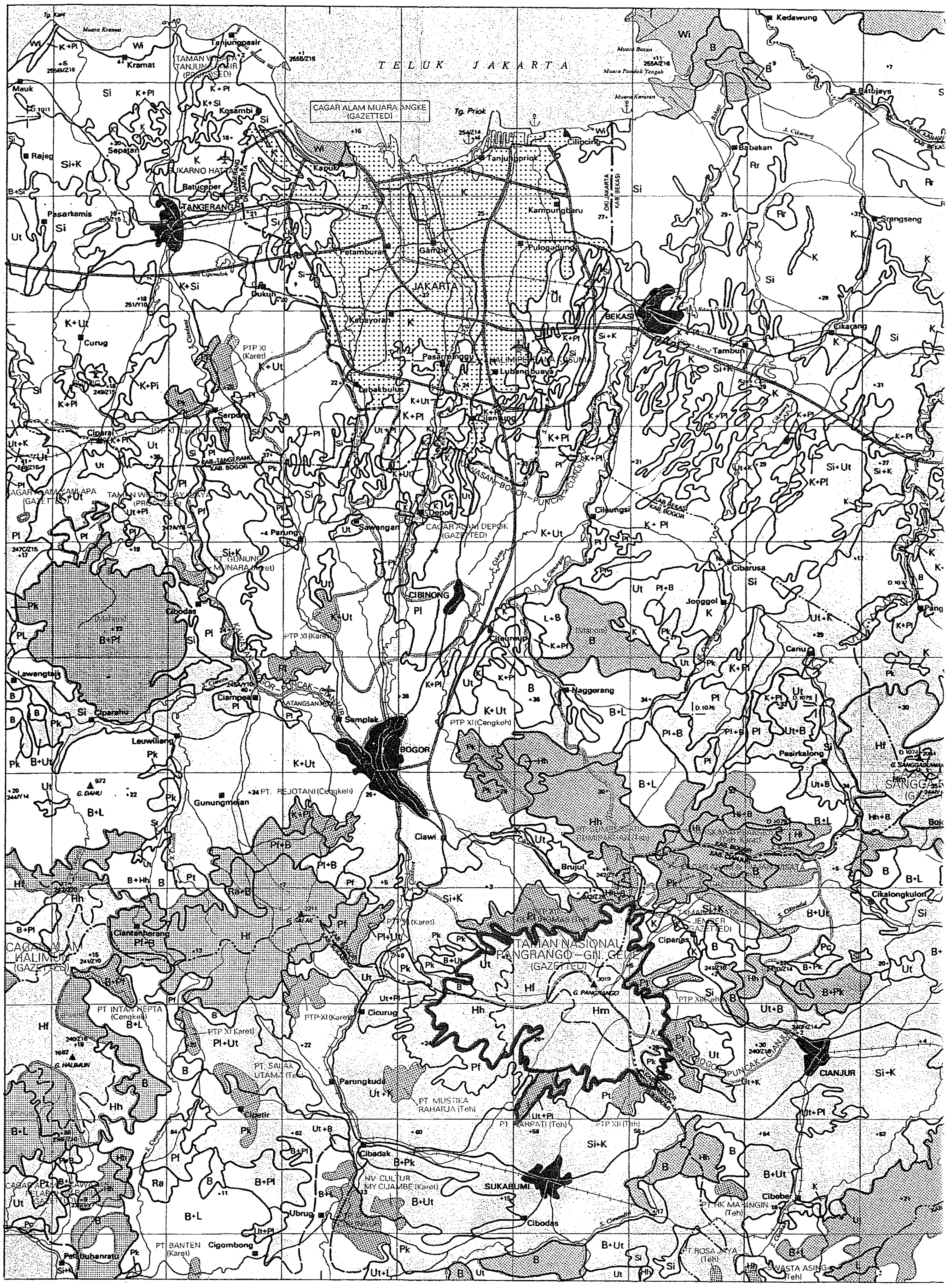
Map 1 Java (Indonesia)



SELAT SUNDA
SAMUDERA
TAMAN NASIONAL UJUNG KULON (GAZETTED)
P. Sertung
P. Anakkrakatau
P. Krakataukecil
P. Krakatau
KAB. LAMPUNG SELATAN
KAB. SERANG
PROP. LAMPUNG
PROP. JAWA BARAT
PULAU PANAITAN
LEGONKADAM
TELUK LENTAH
TELUK KASUARIS
SELAT PANAITAN
Tg. Parat
Tg. Batulendeng
Tg. Sabin
Tg. Karangjajar
TAMAN NASIONAL UJUNG KULON (GAZETTED)
g. Alang-alang
UJUNG KULON
P. Peucang
Tg. Layar
Tg. Guhakolak
Tg. Cangkuwang
Tg. Tereleng
Tg. Sodong
TELUK SELAMATDATANG
Tg. Pacangpare
Tg. Cangkudu
Cipiring
Cikawung
Sumur
Tg. Palagan
Tg. Lesung
TELUK LADA
Kalicau
PT. CIMARA CIBALIUNG
PT. SETIA (Karet)
Tg. Saman
Cinangka
Cibaliung
Tg. Kapal



TL. BANTEN
LAUT JAWA
TELUK
Tanara
Tanjungpasir
Kramat
Mauk
Kagentran
Kundal
Kosambi
CAGAR ALAM MUARA ANGKE
(GAZETTED)
Rajeg
Sepatan
Ciruas
Leas
Kapuk
Batuceper
Ceplak
Pasarkemis
TANGERANG
Dukun
Petamburan
Gambir
JAKARTA
Cangkudu
Kebayoran
Curug
Pasarminggu
DEGLANG
Lebakbulus
Serpong
Maja
Ciparai
RANGKASBITUNG
KAB. TANGERANG
KAB. BOGOR
Parung
Sawangan
Depok
Pandak
Lewijaksi
CIBINONG
Cibodas
Lawangtaji
Ciampea
Cipanas
Ciparahu
Semplak
Leuwiliang
BOGOR
G. DAHU
Gunungmenjan
Ciawi
CAGAR ALAM
GUNUNG HALIMUN
(GAZETTED)
Ciantenherang
G. SALAK
CAGAR ALAM
HALIMUN
(GAZETTED)
Cicurug
G. HALIMUN
Cikotok
Parungkuda
Cipetir
Cibadak
Bajah
Bojonghaur
Ubrug
Cigombong
TL. PELABUHANRATU
Pelabuhanratu
Tg. Layayar
U. Karangpayung



TELUK JAKARTA
CAGAR ALAM MUARA ANGKE (GAZETTED)
Tg. Priok
Tanjungpasir
Kramat
Mauk
Kosambi
Rajeg
Sepatan
SUKARNO HATTA
Batuceper
TANGERANG
Pasarkamis
Kapuk
Tanjungpriok
Cilincing
Babakan
Kedawung
Batujaya
Kampungbaru
Srengseng
Petamburan
Gambir
Pulogadung
JAKARTA
Dukuh
Kebayoran
BEKASI
Cikarang
Tambun
Curug
PTP XI (Karet)
Pasarminggu
HALIM PERDANA KUSUMA
Lubangbuaya
Lebakbulus
Serpong
Cijantung
Ciparai
Cileungsi
Depok
CAGAR ALAM DEPOK (GAZETTED)
Sawangan
Parung
Cibarusa
CIBINONG
Jonggol
Cibodas
Citeureup
Lawangtaji
Nagrerang
Ciampea
Ciparahu
Semplak
BOGOR
PTP XI (Cengkeh)
Leuwiliang
Pasirkalong
G. DAHU
Gunungmenjan
PT. REJOTANI (Cengkeh)
Ciawi
Brujul
Cikalongkulon
CAGAR ALAM HALIMUN (GAZETTED)
G. SALAK
TAMAN NASIONAL PANGRANGO - GN. GEDE (GAZETTED)
G. PANGRANGO
Cipanas
PT. INTAN HEPTA (Cengkeh)
Cicurug
PTP XII (Teh)
CIANJUR
G. HALIMUN
Parungkuda
PT. MUSTIKA RAHARJA (Teh)
PT. PARPATI (Teh)
PTP XII (Teh)
Cibadak
SUKABUMI
NV. CULTUR MY CIJAMBE (Karet)
Cibeber
Ubrug
Cibodas
PT. BANTEN (Karet)
Cigombong
PT. ROSA JAYA (Teh)
SWASTA ASING (Teh)
Pelabuhanratu
KAB. TANGERANG
KAB. BOGOR
KAB. BEKASI
DKI JAKARTA


CAGAR ALAM GUNUNG MASIGIT
Hh + Pf
(PROPOSED)
CAGAR ALAM
GUNUNG TILU
(GAZETTED)
CAGAR ALAM
Hf
GUNUNG SIMPANG
(GAZETTED)
CAGAR ALAM
CIOBONG
(PROPOSED)
CAGAR ALAM
BOJONG LARANG
(GAZETTED)
SUAKA MARGA SATWA
CIMOPAG
(PROPOSED)
PT. CONDONG GARUT
PT. HARJOSARI
(Kina)
PT. KIMIA FARMA
(Kina)
PT. CIBOGO GEDUS
(Karet)
PT. CIGEBANG
(Karet)
Sukanagara
Gununghalu
Soreang
Banjaran
Cipara
Ciwidey
Babakan Jampang
Cianjur
Marujung
Pangalengan
Santosa
Pagelaran
Kedupandak
Tonjongkarang
Cibinong
Cigarendeng
Cisalada 2
Cibalindung
Cibintaro
Sindangbarang
Cidaun
Pamajalan
Pameungpeuk
Tg. Bojong Kranchong
B + L
B + Si
L + B
K + Ut
Si + K
B + Ut
Pt + B
Pc + B
Hh + B
B + Pk
B + Pf
Ut + B
Ut + K
B + Hf
Hn + B
D E R A H I N D I A

Working Group Report:
Javan Gibbon Life History and Vortex Analysis

Working Group Members: Ulysses Seal, Jatna Supriatna (Chairs), Sofian Iskandar, Irvan Sidik, M. Indrawan, Noviar Andayani, M. Tyson, Tony Suhartono, and Ronald Tilson.

INTRODUCTION

Populations separated by barriers that reduce or eliminate the opportunity for recolonization or occasional gene flow will each be subject to population fluctuations and at risk of extinction from local environmental hazards. Small populations are also subject to the potential risks of inbreeding depression. Thus, small and isolated gibbon populations are at risk of extinction from the interaction of random and deterministic processes (e.g., skewed sex ratio, failure to locate mates, disease, genetic drift, inbreeding depression, fighting, fluctuations in food resources, and poaching). These populations will require intensive management if the gibbons are to survive for even 50 or 100 years.

The need for and effects of intensive management strategies can be modelled to suggest which practices may be the most effective in preserving the individual gibbon populations. A simulation modeling package, VORTEX written by Robert Lacy and Kim Hughes was used as a tool to study the interaction of multiple variables treated stochastically to gain assist a better understanding of the effects of different management manipulations.

The VORTEX program is a Monte Carlo simulation of the effects of deterministic forces as well as demographic, environmental, and genetic stochastic events on wildlife populations. VORTEX models population dynamics as discrete, sequential events (e.g., births, deaths, catastrophes, etc.) that occur according to defined probabilities. The probabilities of events are modeled as constants or as random variables that follow specified distributions. VORTEX simulates a population by stepping through the series of events that describe the typical life cycle of sexually reproducing, diploid organisms.

VORTEX is not intended to give absolute answers, since it is projecting stochastically the interactions of the many parameters which enter into the model and because of the random processes involved in nature. Interpretation of the output depends upon your knowledge of the biology of the gibbon, the conditions affecting each of the individual populations, and possible changes in the future. The output is limited by the input. Where needed input data are questionable or questionable, data from other gibbon populations or best guesses by gibbon experts were provided as input. The results from the simulations can be used to suggest the most critically needed data to provide more reliable results and thus assist the design of needed research for management of the populations.

Application of these models to a release or reintroduction program would benefit from modelling and analysis of the results from the ongoing gibbon reintroduction program. An appreciation of the high frequency of random adverse events (stochasticity) and their impact on the perceptions of the success or failure of a program is essential to formulate expectations of probable outcomes. It is also useful to appreciate how many ideas fail even with the best possible advice. The importance of a continuing objective reporting process describing events and distributed to all interested parties cannot be over emphasized.

STARTING POPULATION

Carrying Capacity: K defines an upper limit for the population size, above which additional mortality is imposed in order to return the population to K. In other words, VORTEX uses K to impose a ceiling model of density-dependence on survival rates.

Habitat size, altitude, and forest type are indicators of carrying capacity of the respective Parks and Protected Areas and surrounding areas. Estimates of possible and probable gibbon carrying capacities in the respective protected areas fell between 10 (or fewer) and about 200 animals (see **Habitat and Population Status Working Group Report**). Therefore, four starting population sizes and carrying capacities of 10, 25, 50, and 100 total gibbons (adults and young) to encompass the range of observed populations were included in the sets of scenarios simulated. Scenarios with carrying capacities of 40, 100, 200 and 400 for the population sizes of 10, 25, 50 and 100 also were tested since many of the habitats are thought to have gibbon populations well below the possible carrying capacity.

We included trends in carrying capacity over time since the projected impact would in some locations indicates a complete loss of habitat. For the larger protected areas the areas were assumed either to be stable or to be impacted by an increasing human population. We did not include any annual variation in K since this tends to have minimal effects on large slow breeding populations (as opposed to sustained changes).

Age First Reproduction: VORTEX defines breeding as the time when young are born, not the age of sexual maturity. VORTEX also assumes discrete intervals of years in the case of gibbons. For gibbons on average the age of first reproduction for females appears to be 8 years although younger animals in captivity can breed and reproduction may be delayed in wild populations at high densities or near carrying capacity. For males in wild populations the age was set at 8 and 10 years based upon observations of wild gibbons by Brockelman and of captive animals. These values were used in all of the simulation scenarios.

Litter Size: Environmental variation in reproduction is modelled by the user entering a standard deviation (SD) for the percent females producing young each year. VORTEX then determines the percent breeding each year of the simulation by sampling from a binomial distribution with the specified mean (e.g., 50%) and SD (e.g., 12.5%). Thus about 66% of the time, the percent of females breeding will fall within ± 1 SD of the mean; about 95% of the time it will fall within ± 2 SD of the mean. The relative proportions of litters of each size (0 or 1) are kept constant; what is varied from year to year is the percent breeding (litter size > 0) and the percent not breeding (litter size = 0).

The proportion of females breeding each year determines the mean interbirth interval. This interval is reported to be three years in wild gibbons so that 67% of adult females, on average do not produce litters each year. Annual variation was estimated at a SD=17% based upon variation observed in the captive population and the fact that observations in some of the wild populations indicate fewer and a variable number of young per family group. Sex ratio at birth is taken as equal or 0.500

Males Breeding: Gibbons are monogamous in a given season and breed with the same mate for several years. However, the breeding system modeled by VORTEX assumes that mates are randomly reshuffled each year and that all animals that can breed have an equal probability of breeding. Some animals may be excluded from the breeding pool in a given year if needed. One condition for male gibbons was modelled with all adult males in the breeding pool.

Age of Senescence: VORTEX assumes that animals can breed (at the species typical rates) throughout their adult lifespans. The maximum life expectancy is not used if the species does not reproduce throughout its entire life. This maximum age was estimated as 25 years for wild gibbons based upon senescence of known age animals in captivity in several studies and this value was used in all of the scenarios.

Mortalities: Mortality as a percent (between 0.0 and 100.0) may be included for each age class of immature females and males. Once reproductive age (adult) is reached, the annual probability of mortality remains constant over the life of the animal and is entered only once. The mortality schedule used in all of the scenarios for the gibbons is drawn from studies by Brockelman on *H. lar* in Thailand and by several Indonesian investigators on individual populations of the Javan gibbon, *H. moloch*. It was believed that the mortality rates would be higher in the marginal habitat occupied by parts of the populations of the Javan gibbon. Estimates of 10, 15, and 20% for 0-1 year in combination with 5 and 6% for the juvenile and adult age classes of both sexes were examined. Mortality may be greater in the years of dispersal, ages 7-8 so that scenarios with 10% and 15% mortality in these age classes also were analyzed.

Threats: Major potential threats for the populations of gibbons in Java include further fragmentation and loss of the remaining habitat for timber and agriculture and removal of animals by hunting or poaching. Gibbons are not known to have been affected by epidemic diseases, but this may be due a lack of data since unexplained disappearance of subpopulations has occurred. Also the effects of disease can be more subtle with a 10-20% reduction in reproduction and a 2-3% increase in mortality resulting in an increase in risk of extinction. These effects were modelled as one kind of catastrophe. The impact of habitat loss has been modelled by using different carrying capacities as a guide to the changing risk of extinction with decreasing population size. Scenarios that included losses due to catastrophes were done with and without systematic harvests or removals to allow evaluation of their relative effects on the risk of extinction and population sizes.

Catastrophes: Catastrophes can be thought of as the extreme of environmental variation. Catastrophes are events that impact either reproduction or survival or both. Catastrophes can be habitat destruction, floods, fire, disease, poaching, etc. Catastrophes do happen and are very real considerations when attempting to model the fate of small populations. The impact of these catastrophes is defined in terms of effects on reproduction and survival. A catastrophe may have occurred when a rate is noted that is statistically higher than the normal variation. The reproduction and survival rates for catastrophe years are obtained by multiplying the (non-catastrophe) probability of reproduction or survival by a severity factor. The severity factor ranges from 0.0 to 1.0. Entering 0.0 indicates a total loss of reproduction or survival for the population and 1.0 indicates that the catastrophe, if it occurs, will have no effect.

Catastrophes in wild gibbon populations might include forest cutting, diseases, illegal removals, volcano eruptions, fires, and hurricanes as examples. Since resource shortage, disease, and poaching events might be episodic, occurring at uncertain intervals we modelled separately the impact of events occurring on the average either at approximately 5 (20% probability - catastrophe 1) year intervals with the event for type 1 (occasional removals) was given a severity effect of 0.95 on survival (about 5% additional loss of animals to the population) and an 1.00 severity effect on reproduction of the remaining animals. This may underestimate the negative effects on reproduction of the potential social disruptions that may occur.

Age Distribution: We initialized all of the models with a stable age distribution which distributes the total population among the various age classes. The initial population sizes used were 10, 25, 50, and 100. VORTEX automatically enters values for all age classes, proportionate to the stable age distribution.

Inbreeding: A population with the level of inbreeding depression of one lethal equivalent per diploid genome may have one recessive lethal allele per individual (as in the Recessive Lethals model in VORTEX); or it may have two recessive alleles per individual, each of which confers a 50% decrease in survival; or it may have some combination of recessive deleterious alleles which equate with one fully lethal allele per individual. Natural selection does not remove deleterious alleles at heterotic (or over-dominant) loci (because all alleles in this model are partly deleterious when homozygous), thus the effects of inbreeding are unchanged during repeated generations of inbreeding. The default number of lethal equivalents for the Heterosis model is 3.14 which is a median value obtained in a study of 40 mammalian species.
Inbreeding depression has been observed in inbred lines of captive primates. To include this potential threat in these models the Heterosis model in VORTEX was used in which we entered the number of "lethal equivalents" as 3.4. The inclusion of inbreeding was varied systematically in the scenarios developed for the gibbon populations so that comparisons can be made under identical conditions with this factor present or absent.

RESULTS FROM SIMULATION MODELLING

The simulation scenarios were run 500 times (iterations) with projections for 100 years. Output results were summarized at 10 year intervals and used for the time series figures. Each individual scenario is identified with a file number in column 1 of the tables. The simulations were run using VORTEX version 6.2.

The base scenario was run under the conditions developed in the plenary session and in the modelling group with the data provided by the participants and other working groups. This included mortality rates of 5, 10, and 15% for the 0-1 year age class, 5 and 6% for all other age classes, an interbirth interval of 3 years, maximum age of 25 years, equal sex ratio at birth, all males available for breeding, age of first reproduction for females = 8 years and for males = 8 or 10 years. Effects of catastrophes and inbreeding depression effects and harvesting were not included in the base scenario but were added systematically in other scenarios. The population size was started at 10, 25, 50 and 100 animals and K was set at 10, 25, 50, and 100, or 40, 100, 200 and 400 animals.

Deterministic Results

Growth rate - r: The deterministic growth rate calculated by a Leslie matrix algorithm is recorded in the 5th column in all of the tables. Positive values are necessary for a population to survive and in principle a zero value would characterize a population neither growing or declining. The deterministic growth rate is not sensitive to differences in carrying capacity. It also is not sensitive to the presence of environmental variance included as standard deviations in mortality and reproduction. The addition of catastrophes does reduce the deterministic r since their effects on reproduction and survival are averaged into the calculations of the Leslie matrix. It is also not affected by the inclusion of inbreeding.

Other Deterministic Values: The generation times in most of the scenarios were about 15-16 years for females and males. Thus a 100 year projection spans about 6-7 generations. The sex ratio of adult males to females in a stable population was equal. Lambda is calculated from r and can be used as an estimate of the % annual growth rate (i.e.: [lambda - 1.000] x 100 = annual % growth rate). The stable age distribution for each sex and age class will be the same regardless of K if the other values are the same. These are useful estimates for comparison with collected field data on population age structure as a check on census methods or detection of unusual events in the population.

The base scenario gibbon population had a deterministic r value = 0.015 which yields an annual growth rate of about 1.5% per year. The doubling time of this population would be about 46 years. The stable age distribution yields about 18% adult males and 22% adult females.

Stochastic Simulation Results

Carrying Capacity: The probability of extinction was sensitive to carrying capacity under all conditions tested, particularly in the range of 10 to 50 animals (Figures 1-4). The probability of extinction (Pe) in 100 years for populations of 10 was greater than 80% under all conditions tested (Table 1A). The probability of extinction (Pe) for populations of 25 ranged from 0.1 to 1.0 at 100 years depending upon catastrophes, adult mortality, and the inclusion of inbreeding effects (Tables 2A & 2B). Extinctions occurred beginning at 20 years and continued at an approximately linear rate during the 100 years of the projections. Populations of 100 had low extinction rates under the base conditions and at 15% and 20% mortality in the 0-1 age class. Increase of mortality of the 1-Adult age classes to 6% resulted in extinction probabilities of 20% to 75%. Adding catastrophes increased the risk of extinction under all conditions (Figure 4).

Comparison of results in the A and B portions of all 5 tables indicates that if the current populations are below carrying capacity, they should be able to expand to carrying capacity by natural reproduction. Their failure to do so suggests that either removals from the populations are high or that the carrying capacity may be lower that estimated. Protection of the populations and expansion of suitable habitat should allow the development, with minimal management intervention, of viable populations of the Javan Gibbon. Habitat supporting populations of 100 or more animals is needed to achieve this management goal. The smallest populations have a high probability of extinction from random factors even if there is no further removal of animals. These small fragments need to be individually evaluated for their contribution to the survival, management, and conservation of the species on Java.

The stochastic r values were also dependent upon carrying capacity with population growth rates decreasing with decreasing carrying capacity and becoming negative under all conditions for populations of 10 and under most conditions for populations of 25 (Figures 5 & 6). The deterministic r values were positive except for mortality rates of 7%. A deterministic model would yield projections of growing populations under many of the scenarios modelled here.

Mean surviving population sizes were within about 70 to 90% of the carrying capacity but with standard deviations ranging from 25 to 50% of the mean so that the range of surviving population sizes could vary from 20% to 100% of K (Figures 7 & 8).

The proportion of starting genetic heterozygosity remaining in the surviving populations ranged from 40 to 95% depending upon the carrying capacity and hence the mean effective population size (Figures 9 & 10). Mean heterozygosity remaining at 100 years was slightly affected by differences in adult mortality or the catastrophes or inbreeding. Population sizes of 100 or more will be necessary to minimize the rate of inbreeding and the risk of inbreeding depression.

Adult Mortality: Increase of annual male and female adult (1 year to adult) mortality from 5 to 6% resulted in decreased population growth rates (Figures 5 & 6) and increased extinction rates in all populations (Figures 1-4). The effects of catastrophes and inbreeding were also increased (Figures 3 & 4).

The mean surviving populations sizes were about the same at both levels of adult mortality but the standard deviation was less at the lower mortality rate. The mean proportion of heterozygosity remaining was not increased significantly.

Catastrophes: The effects of catastrophes are to increase the risk of extinction and decrease the population deterministic and average stochastic growth rates (Tables 1-5; Figures 3 & 4). Periodic losses, whether from poaching, controlled removals, or disease, increases the vulnerability of the population to other stochastic environmental events such as a rapid decline in the prey base. It is extremely important to include these possibilities in thinking about the hazards that small population may encounter. This has been illustrated in the events occurring with all reintroduction and recovery programs which have been described.

Inbreeding: The addition of a small amount of inbreeding (3.14 lethal equivalents under the heterosis option) to the scenarios (Tables 5A & 5B) resulted in an accelerated risk of extinction in the population of 25 (Figures 3 & 4) and a decrease in the stochastic r values that reflects the increased mortality imposed upon the populations by the inbreeding depression. These effects would be minimal in a population of 100 or larger over the time span of 100 years.

Harvest and Habitat Loss Effects

We examined the effects of removing 1 adult female every 2 years or every year, 1 adult female and 1 young male or 1 young female per year. Scenarios were run with and without inbreeding depression effects included. The results are summarized in the following table. Removal of 1 female a year produced a 21% Pe (probability of extinction) in 100 years. The loss of 1 adult female and 1 young male resulted in a Pe = 15% . The loss of 1 adult female and 1 young female per year resulted in an 86% Pe. If we started at a population of 200 animals and removed 2 females and 1 young male and 1 young female the Pe = 91%.

The rate of decline of these populations was very slow and would not be easily detected with routine surveys. The effects of this rate of removal would be difficult to detect by surveys over a 10-20 year period or observations of range contraction.

Effects of removal of adult female and young gibbons from a population of 100 with a carrying capacity of 200. Inbreeding effects were also examined but had minimal effects in these scenarios. The deterministic rd = 0.026 for all scenarios.

File#	Harv	Inbrd	rs	Pe	N	Te
11	1/2	Yes	.018	0	190	-
12	1/1	Yes	.002	.21	166	83
13	2/1	Yes	-.046	1.00	-	-
14	1+1/1	Yes	-.0007	.18	150	73
15	1+1/1	No	.004	.15	177	72
16	1+1/1	Yes	-.025	.90	105	51
17	1+1/1	No	-.022	.86	116	53
19	2+1+1	No	-.030	.91	117	67

Definitions of Data Columns: Harv = harvest of animals from the population. These were done annually with removal of 1 adult female per 100 of starting population. Inbrd = inbreeding using the heterosis option with 3.14 lethal equivalents per individual; rd = the deterministic intrinsic rate of increase or growth rat; rs = the stochastic rate of increase; Pe = the probability of extinction in 100 years; N = the population size of the surviving populations at 100 years; Te = the mean or median time to extinction of populations that went extinct.

Removal of 18 animals per year (6 adult females, 3 one year females, 3 one year males, and 3 adult males) from a population of 600 gibbons annually for 100 years (Figure 3) resulted in an 83% probability of extinction in 100 years. The surviving populations also declined steadily in size over this time. If the harvest was stopped after 30 years the population recovered to original levels over the next 20 years.

Removal of 18 animals in alternate years (6 adult females, 3 one year females, 3 one year males, and 3 adult males) from a population of 600 gibbons annually for 100 years (Figure 3) resulted in a 0% probability of extinction in 100 years. The surviving populations showed no change in size over this time. If the harvest was stopped after 30 years the population was at the same levels as the population with a continuing harvest.

SUMMARY AND RECOMMENDATIONS

Summary Points

- The potential growth rate of wild populations of *H. moloch* is estimated at a minimum of 1.5% per year. Populations with this growth rate can double in size in about 46 years. This minimum growth rate estimate is based upon an interbirth interval of 3 years, age of female first reproduction of 8 years, annual mortality in the 0-1 year age class of 10% and in all other age classes and both sexes of 5±1 %, age of senescence of 30 years, with no inbreeding effects or catastrophes included. Females might begin reproduction at an earlier age in harvested populations with a resultant increase in r.

- The total population in protected areas in Indonesia is currently estimated to be (from direct observations) about 386 gibbons living in 21 sites, or (from available habitat extrapolations) about 1,957 gibbons in eight sites (these second estimates discounted very small populations as not being viable and therefore were not included). Eleven (11) of these populations are estimated at 10 or fewer individuals with estimated effective population sizes of 2-3. Seven (7) populations have 10-26 individuals. Only three (3) populations are greater than 26, numbering 36, 53 and 90 individuals each.

- Based upon loss of forest and habitat estimates and backward projections, the population may have declined from greater than 3000 individuals over the past 20 years to the current estimate of 386 individuals solely on the basis of habitat loss.

- Populations of less than 50 animals have a risk of extinction of up to 20% in 100 years particularly if the species is subject to inbreeding depression. These populations may require genetic supplementation every 20-30 years. This could be accomplished by the addition of 2-3 individuals or of their genetic material at this interval. If the population is below carrying capacity the population has the potential to double in size in about 25 years by natural reproduction depending upon local threats and chance events. If demographic extinction occurs, then the sites would be suitable for recolonization either by translocation or by reintroductions from a captive population.

- Populations (that are not disturbed or hunted) containing about 100 animals (about 25 average groups of 4 animals) have a low probability of extinction over 100 years of less than 1%. The generation time is about 16-17 years or 5.9 generations per 100 years.

- Populations of about 100 individuals will lose about 6% of their heterozygosity in 100 years. These populations might benefit from periodic genetic supplementation (2-3 individuals at perhaps 20-40 year intervals) from other populations in the region as part of a regional metapopulation management strategy.

- Theoretically, given an annual growth rate of 1.5%, the total *H. moloch* gibbon population in Java could have sustained a maximum total loss of about 1-2 individuals per 100 of population per year. This rate of loss would not result in a decline of the total population, provided the losses were distributed over the total population or all of the subpopulations or if there were continuing demographic exchange between the subpopulations. However, if the losses are concentrated in a few subpopulations and if all of the other subpopulations are at carrying capacity, then a net decline in the total population would occur.

- Removal (by hunting, poaching, disease, or other causes) of 3 or more animals (1 adult female, 1 adult male, and 1 young) per 200 of population per year will result in extinction of the population. The rate of extinction will depend on the number of animals removed, the frequency of removal, and the size of the population. Thus if 18 animals per year are removed from a population of 600 animals, there is an 83% probability of extinction in 100 years with a median time to extinction of 76 years. If this rate is reduced to 9 animals per 100 years, the risk of extinction is about zero in 100 years. Removal of 18 animals per year from a population of 300 animals results in a median time to extinction of 25 years with all populations extinct in less than 40 years.

- Populations of 200 to 1000 individuals would be at essentially zero risk of extinction over the next 100 years if their habitat remains intact and if their losses due to hunting are less than 1 adult female and 1 female infant per 200 individuals per year. The loss of genetic heterozygosity in these populations would range from 3% to 0.6% over 100 years or 0.5% or less per generation. These populations *might* benefit from the addition (by translocation) of 1 or 2 suitably chosen individuals from neighboring wild populations every 20-40 years. They would not benefit genetically or demographically from the addition of individuals from the captive population.

- Populations of 1000 or more individuals would lose less than 0.5% of their heterozygosity in 100 years. Populations of this size would not benefit, genetically or demographically, from the addition of individuals from captive populations or other wild populations over the next 100 years.

Working Group Summary Recommendations

All of the following recommendations depend upon there being no loss of protected habitat and protection of the populations from hunting and poaching.

- Population management goals for the entire wild population of the Javan gibbon (*Hylobates moloch*) need to be developed to ensure the long-term survival of the species.

- The current combined subpopulations of *Hylobates moloch* in all of the protected subpopulations on Java (approximately 386 gibbons at 21 sites) are not sufficiently large to be considered an evolutionary viable population. These 21 fragmented populations will require exchange management as a metapopulation.

- The approximately 18 subpopulations of *Hylobates moloch* smaller than 27 are not viable over 100 years (this includes 7 populations of 10-26 animals and 11 populations of fewer than 10 animals). The risk of extinction varies from 20 to 100% depending upon the amount of environmental variation. If these populations are to survive they will require active genetic and demographic management as part of the metapopulation.

- The 11 populations of less than 10 individuals are at high risk of continuing decline and extinction even if their habitat is expanded. They are vulnerable to early extinction and if they have been at low levels for 10-20 years they may already be an aging group at high risk of immediate extinction. They need to be considered as candidates for rapid habitat expansion and supplementation or translocation or a captive population or a combination of these options.

- Populations of about 100 individuals (about 25 average groups of 4 animals) that are not disturbed and are not hunted, have a low probability of extinction over 100 years of less than 1%. These populations, as well as the remaining smaller populations, will require continuing monitoring and will require periodic genetic supplementation. These small populations should be evaluated and monitored individually and suitable conservation management plans developed for their particular needs.

- Subpopulations of 200-1000 individuals (no populations of this size have been directly observed), in habitat capable of sustaining larger populations, should be protected and allowed to expand in numbers naturally.

- The removal of 1 adult female with young per year from stable populations of 100 or fewer individuals (considered to be at or near maximum densities) will approximately double the risk of extinction. The protection of these small populations from removals should be of the highest priority.

- The history of the decline and the current status of the Javan gibbon support its being classified as critical by the Mace/Lande criteria being considered by the IUCN/SSC for threatened species. ■

FIGURE LEGENDS

Figure 1. Projected probability of extinction at 100 years in simulated starting populations of K = 10, 25, 50, and 100 whose current population size (N) is equal to K. Scenarios with four combinations of 0-1 year and 1-Adult annual mortality rates (5% & 5%, 10 & 5, 5 & 6, and 10 & 6 respectively) were tested as noted in the legend. The age of first reproduction was set at 10 years, the interbirth interval at 3 years, and life expectancy at 25 years as noted in the text.

Figure 2. Projected probability of extinction at 100 years in simulated starting populations of K = 10, 25, 50, and 100 whose carrying capacity was set at 4 times the current used in the simulations presented in Figure 1. Other conditions were as described for Figure 1 and in the text.

Figure 3. Projected probability of extinction at 10 year intervals in simulated starting populations of K = 10, 25, 50, and 100 whose current population size (N) is equal to K. Scenarios with four combinations of 0-1 year and 1-Adult annual mortality rates (5% & 5%, 10 & 5, 5 & 6, and 10 & 6 respectively) were tested as noted in the legend. The effects of inbreeding depression using the heterosis option with lethal equivalents set at 3.14 per diploid genome is shown in a starting population of 25 animals. The age of first reproduction was set at 10 years, the interbirth interval at 3 years, and life expectancy at 25 years as noted in the text.

Figure 4. Projected probability of extinction at 10 year intervals in simulated starting populations of K = 10, 25, 50, and 100 whose carrying capacity was set at 4 times the current used in the simulations presented in Figure 1. Other conditions were as described for Figure 1 and in the text.

Figure 5. Projected mean stochastic growth rates averaged over 100 years in simulated starting populations of K = 10, 25, 50, and 100 whose current population size (N) is equal to K. Scenarios with four combinations of 0-1 year and 1-Adult annual mortality rates (5% & 5%, 10 & 5, 5 & 6, and 10 & 6 respectively) were tested as noted in the legend. The age of first reproduction was set at 10 years, the interbirth interval at 3 years, and life expectancy at 25 years as noted in the text. No catastrophe was included in these scenarios.

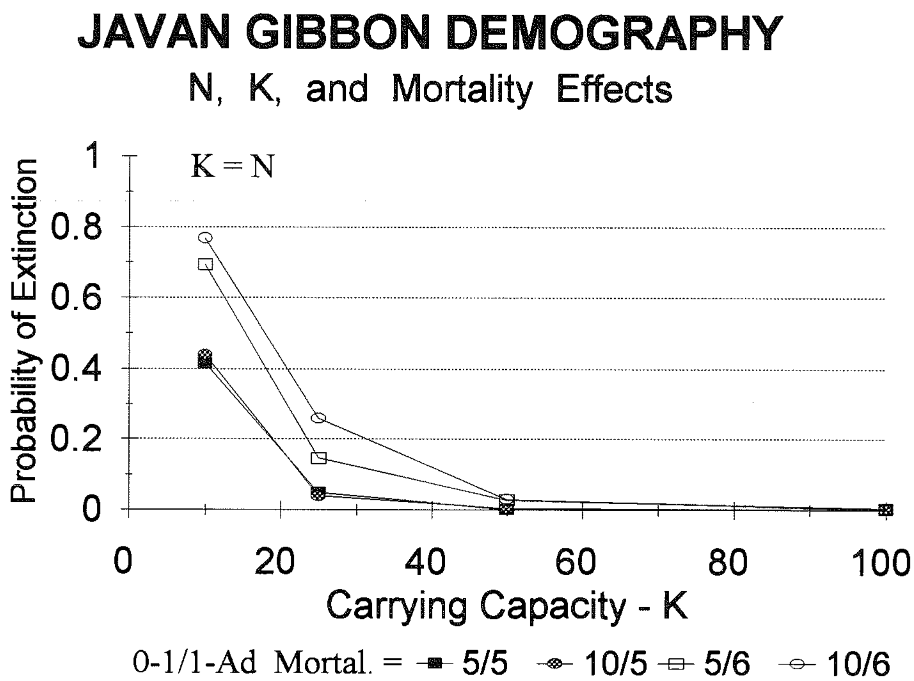
Figure 6. Projected mean stochastic growth rates averaged over 100 years in simulated starting populations of K = 10, 25, 50, and 100 whose carrying capacity was set at 4 times the current used in the simulations presented in Figure 1. Other conditions were as described for Figure 1 and in the text. A catastrophe with 20% probability of occurrence and a 5% reduction in survival and no effect on reproduction was included in these scenarios.

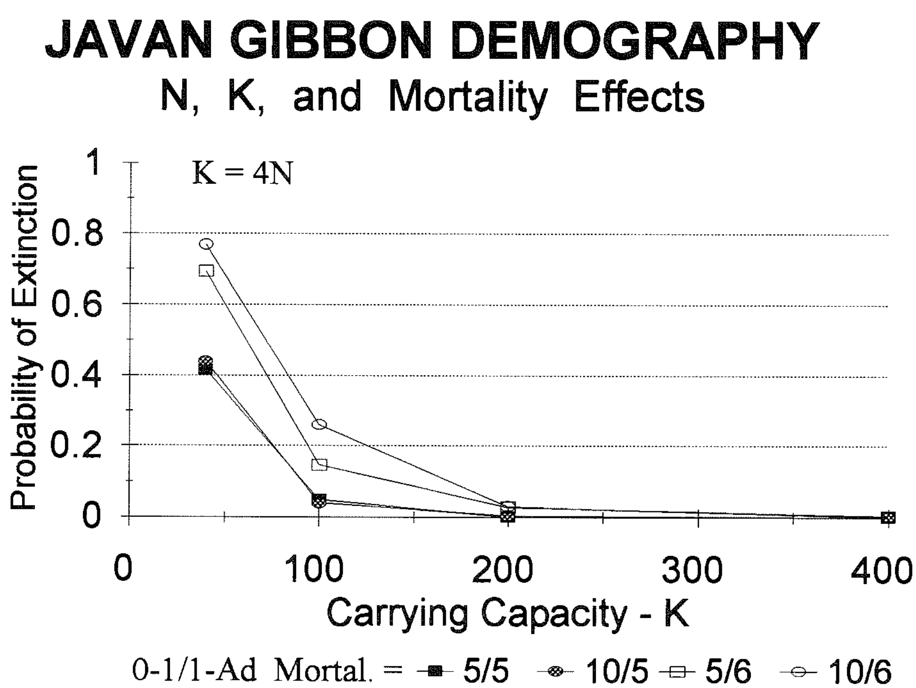
Figure 7. Projected mean surviving population sizes at 10 year intervals over 100 years in simulated starting populations of K = 10, 25, 50, and 100 whose current population size (N) is equal to K. Scenarios with four combinations of 0-1 year and 1-Adult annual mortality rates (5% & 5%, 10 & 5, 5 & 6, and 10 & 6 respectively) were tested as noted in the legend. The age of first reproduction was set at 10 years, the interbirth interval at 3 years, and life expectancy at 25 years as noted in the text. No catastrophe was included in these scenarios.

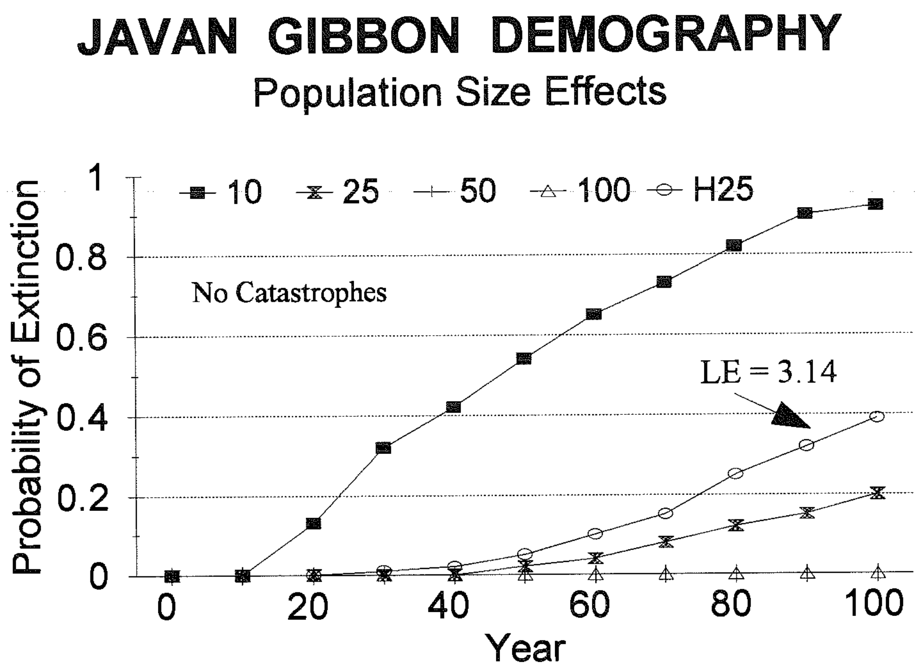
Figure 8. Projected mean surviving population sizes at 10 year intervals over 100 years in simulated starting populations of K = 10, 25, 50, and 100 whose carrying capacity was set at 4 times the current used in the simulations presented in Figure 1. Other conditions were as described for Figure 1 and in the text. A catastrophe with 20% probability of occurrence and a 5% reduction in survival and no effect on reproduction was included in these scenarios.

Figure 9. Projected mean heterozygosity remaining at 100 years in simulated starting populations of K = 10, 25, 50, and 100 whose current population size (N) is equal to K. Scenarios with four combinations of 0-1 year and 1-Adult annual mortality rates (5% & 5%, 10 & 5, 5 & 6, and 10 & 6 respectively) were tested as noted in the legend. The age of first reproduction was set at 10 years, the interbirth interval at 3 years, and life expectancy at 25 years as noted in the text. No catastrophe was included in these scenarios.

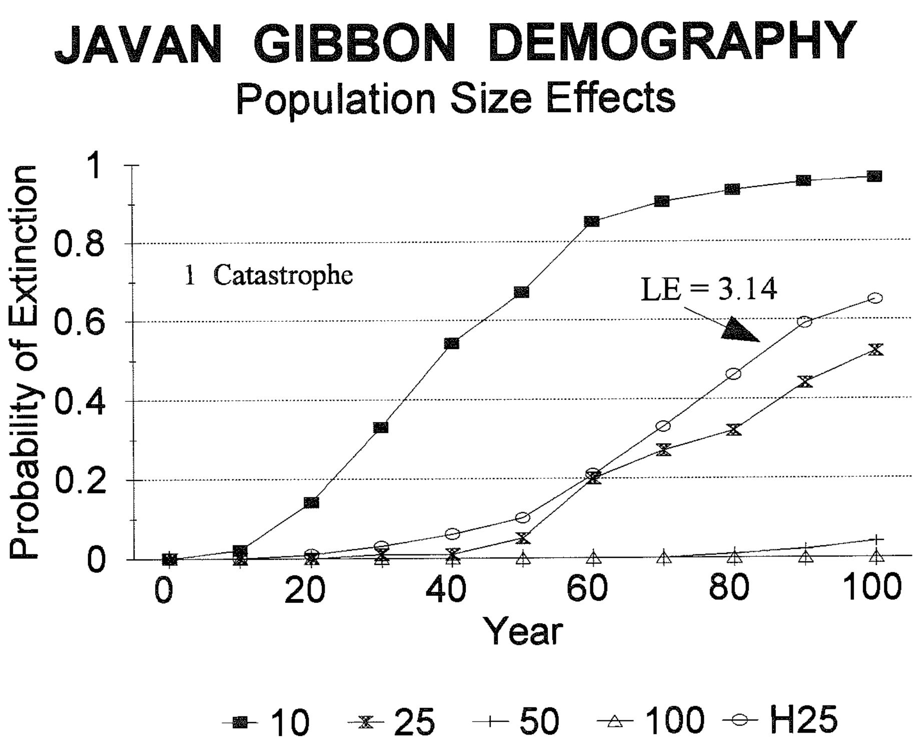
Figure 10. Projected mean heterozygosity remaining at 100 years in simulated starting populations of K = 10, 25, 50, and 100 whose carrying capacity was set at 4 times the current used in the simulations presented in Figure 1. Other conditions were as described for Figure 1 and in the text. A catastrophe with 20% probability of occurrence and a 5% reduction in survival and no effect on reproduction was included in these scenarios.


JAVAN GIBBON DEMOGRAPHY
N, K, and Mortality Effects
K = N
Probability of Extinction
1
0.8
0.6
0.4
0.2
0
0
20
40
60
80
100
Carrying Capacity - K
0-1/1-Ad Mortal. = 5/5 10/5 5/6 10/6

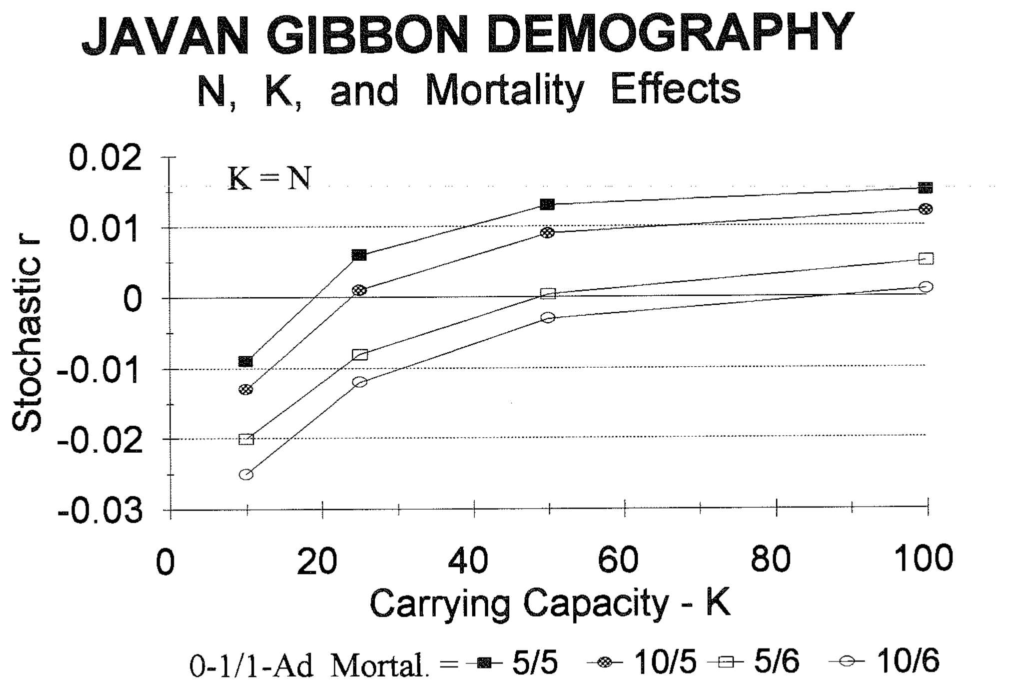

JAVAN GIBBON DEMOGRAPHY
N, K, and Mortality Effects
K = 4N
Probability of Extinction
1
0.8
0.6
0.4
0.2
0
0
100
200
300
400
Carrying Capacity - K
0-1/1-Ad Mortal. = 5/5 10/5 5/6 10/6



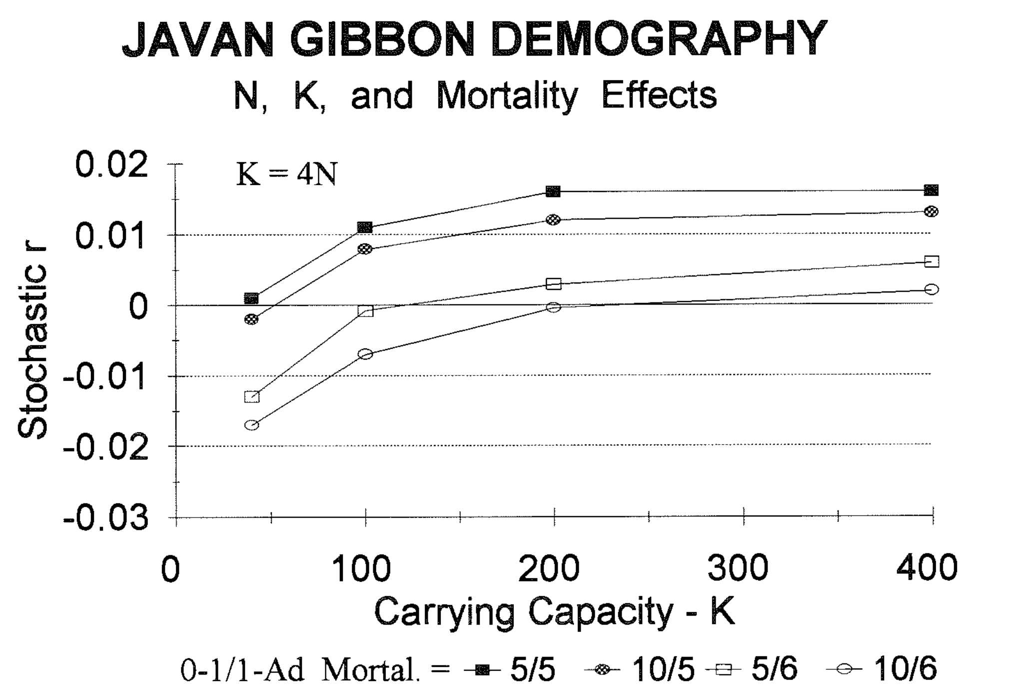
JAVAN GIBBON DEMOGRAPHY
Population Size Effects
10
25
50
100
H25
No Catastrophes
LE = 3.14
Probability of Extinction
1
0.8
0.6
0.4
0.2
0
0
20
40
60
80
100
Year



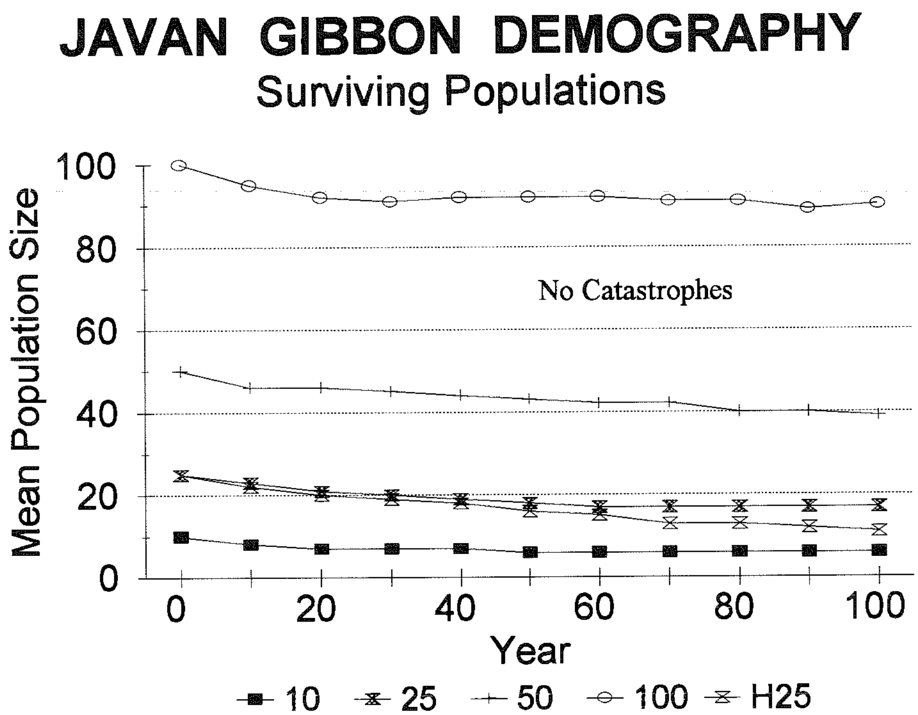
JAVAN GIBBON DEMOGRAPHY
Population Size Effects
1 Catastrophe
LE = 3.14
Probability of Extinction
1
0.8
0.6
0.4
0.2
0
0
20
40
60
80
100
Year
10
25
50
100
H25

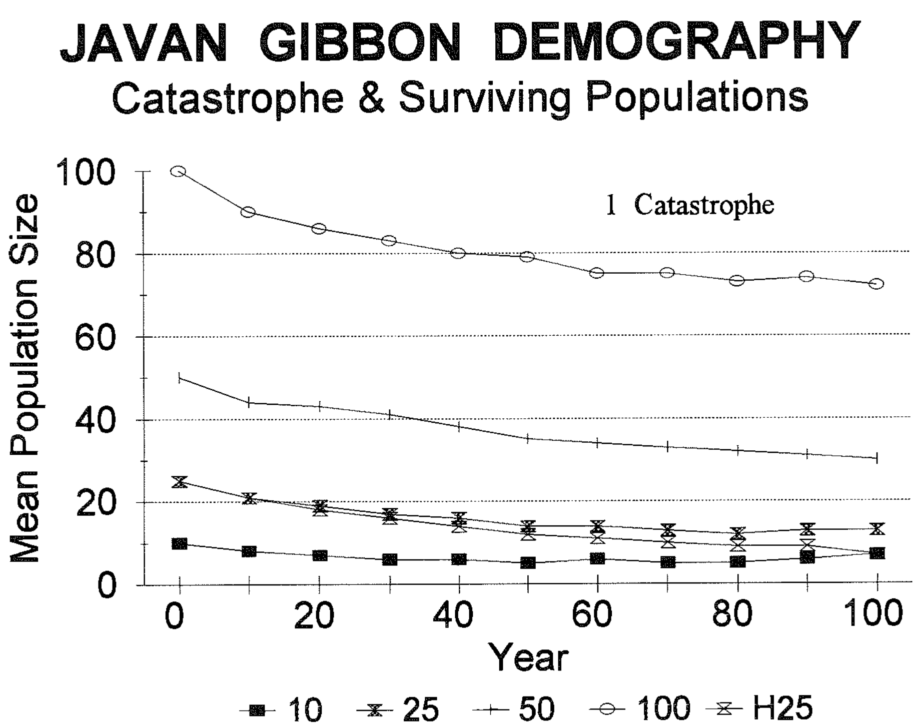


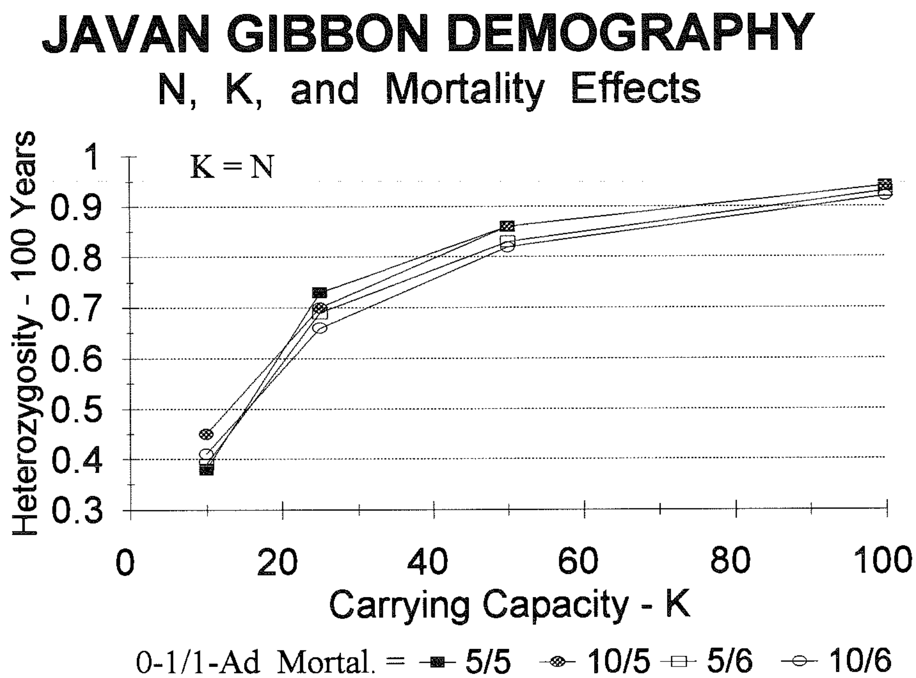
JAVAN GIBBON DEMOGRAPHY
N, K, and Mortality Effects
K = N
Stochastic r
0.02
0.01
0
-0.01
-0.02
-0.03
0
20
40
60
80
100
Carrying Capacity - K
0-1/1-Ad Mortal. = 5/5 10/5 5/6 10/6



JAVAN GIBBON DEMOGRAPHY
N, K, and Mortality Effects
K = 4N
Stochastic r
0.02
0.01
0
-0.01
-0.02
-0.03
0
100
200
300
400
Carrying Capacity - K
0-1/1-Ad Mortal. = 5/5 10/5 5/6 10/6


JAVAN GIBBON DEMOGRAPHY
Surviving Populations
No Catastrophes
Mean Population Size
100
80
60
40
20
0
0
20
40
60
80
100
Year
10
25
50
100
H25


JAVAN GIBBON DEMOGRAPHY
Catastrophe & Surviving Populations
1 Catastrophe
Mean Population Size
100
80
60
40
20
0
0
20
40
60
80
100
Year
10
25
50
100
H25


JAVAN GIBBON DEMOGRAPHY
N, K, and Mortality Effects
K = N
Heterozygosity - 100 Years
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0
20
40
60
80
100
Carrying Capacity - K
0-1/1-Ad Mortal. = 5/5 10/5 5/6 10/6

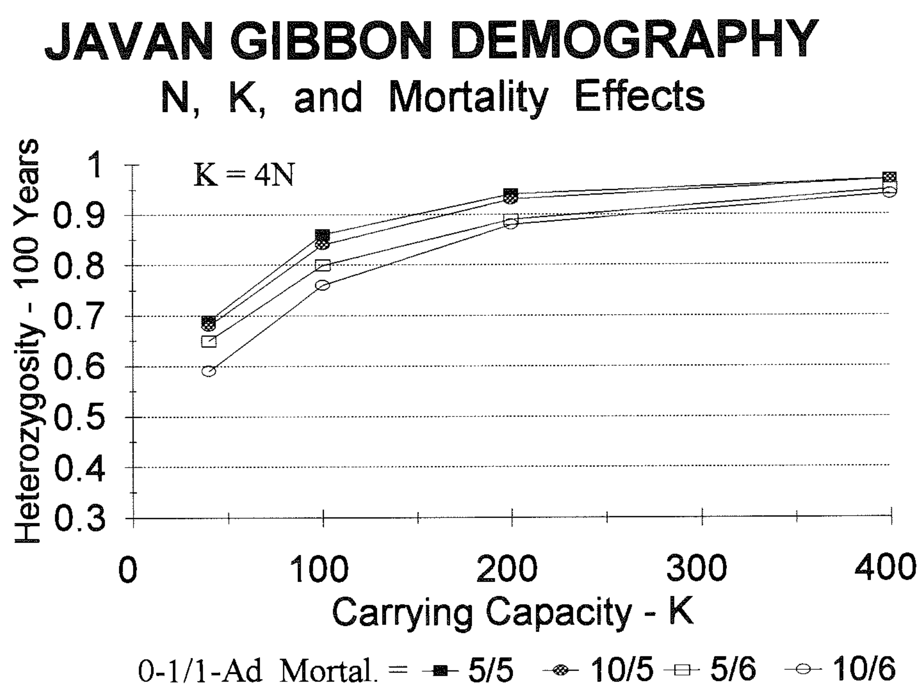

JAVAN GIBBON DEMOGRAPHY
N, K, and Mortality Effects
K = 4N
Heterozygosity - 100 Years
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0
100
200
300
400
Carrying Capacity - K
0-1/1-Ad Mortal. = 5/5 10/5 5/6 10/6

Table 1A. Population simulations for wild populations of the Javan gibbon (*Hylobates moloch*). Population size (N) and carrying capacity (K) of 10 animals as may apply to about 21 population fragments. Simulations run 100 years with 500 repetitions.

File #	0-1 Mort %	1-Ad Mort%	Age 1st R	r detr	r stoc	Pe % 100 Y	Te - Years	Pop-N Mean	Pop SD	Heter
No Catastrophe										
129	5	5	10	.019	-.009	83.8	51	7	2	.38
130		6	10	.009	-.020	93.8	39	5	2	.39
131		5	8	.019	-.005	81.0	55	7	3	.41
132		6	8	.009	-.017	92.2	40	5	2	.38
25	10	5	10	.015	-.013	89.2	46	7	2	.45
26		6	10	.005	-.025	95.4	35	5	2	.41
27		5	8	.015	-.008	84.0	51	7	2	.46
28		6	8	.005	-.018	92.6	41	6	2	.44
29	15	5	10	.011	-.017	92.4	40	6	2	.42
30		6	10	.001	-.027	96.8	34	6	2	.48
31		5	8	.011	-.010	85.2	48	7	2	.48
32		6	8	.001	-.024	97.0	37	6	2	.46
33	20	5	10	.007	-.020	93.4	42	6	2	.45
34		6	10	-.003	-.031	97.6	35	5	2	.46
35		5	8	.007	-.017	90.6	43	7	2	.38
36		6	8	-.003	-.027	96.2	36	5	2	.38
Catastrophe - Freq=20%, 0.95 Surv										
133	5	5	10	.009	-.021	93.6	39	6	2	.35
134		6	10	-.001	-.033	98.6	31	5	2	.39
135		5	8	.009	-.016	92.8	44	6	2	.38
136		6	8	-.001	-.026	95.6	34	6	2	.36
37	10	5	10	.005	-.024	95.0	37	6	3	.37
38		6	10	-.005	-.036	99.0	28	5	3	.32

39		5	8	.005	-.019	92.0	39	6	2	.40
40		6	8	-.005	-.031	98.8	31	5	2	.42
41	15	5	10	.001	-.027	96.8	36	6	2	.45
42		6	10	-.009	-.039	99.2	29	4	2	.29
43		5	8	.001	-.023	94.8	35	5	2	.43
44		6	8	-.009	-.033	98.6	30	6	2	.47
45	20	5	10	-.003	-.032	98.2	34	5	2	.52
46		6	10	-.013	-.042	99.2	27	5	2	.47
47		5	8	-.003	-.029	97.8	33	6	2	.48
48		6	8	-.013	-.040	98.6	28	6	3	.30

Table 1B. Population simulations for wild populations of the Javan gibbon (*Hylobates moloch*). Population size = 10 and carrying capacity = 40 animals as may apply to 21 population fragments.

File #	0-1 Mort %	1-Ad Mort%	Age 1st R	r detr	r stoc	Pe % 100 Y	Te Years	Pop-N Mean	Pop SD	Heter
No Catastrophe										
K129	5	5	10	.019	.001	41.6	50	26	12	.69
K130		6	10	.009	-.013	69.4	63	17	11	.65
K131		5	8	.019	.007	31.2	47	29	11	.69
K132		6	8	.009	-.008	58.4	78	19	12	.61
K25	10	5	10	.015	-.002	44.0	50	23	13	.68
K26		6	10	.005	-.017	76.8	54	17	11	.59
K27		5	8	.015	.003	37.8	44	26	11	.67
K28		6	8	.005	-.015	69.8	62	17	12	.60
K29	15	5	10	.011	-.009	59.0	75	19	12	.64
K30		6	10	.001	-.023	81.0	49	12	9	.58
K31		5	8	.011	-.003	45.8	50	22	12	.66
K32		6	8	.001	-.015	71.6	58	16	10	.57
K33	20	5	10	.007	-.013	67.2	69	17	12	.62

K34		6	10	-.003	-.028	91.0	44	9	6	.54
K35		5	8	.007	-.010	62.0	69	18	11	.62
K36		6	8	-.003	-.022	83.6	47	13	8	.58
Catastrophe - Freq = 20%, 0.95 Surv										
K133	5	5	10	.009	-.013	68.2	62	20	12	.64
K134		6	10	-.001	-.028	89.2	41	12	7	.58
K135		5	8	.009	-.007	56.8	83	21	12	.64
K136		6	8	-.001	-.020	80.4	50	14	10	.58
K37	10	5	10	.005	-.018	77.4	54	16	10	.63
K38		6	10	-.005	-.034	93.2	39	10	8	.56
K39		5	8	.005	-.013	69.0	67	19	12	.63
K40		6	8	-.005	-.025	86.8	45	12	9	.54
K41	15	5	10	.001	-.024	83.4	52	11	8	.59
K42		6	10	-.009	-.036	95.6	38	7	5	.45
K43		5	8	.001	-.017	75.6	53	16	11	.58
K44		6	8	-.009	-.032	93.2	38	9	6	.53
K45	20	5	10	-.003	-.027	89.2	43	12	9	.56
K46		6	10	-.013	-.040	97.6	34	5	4	.44
K47		5	8	-.003	-.023	84.6	45	13	9	.57
K48		6	8	-.013	-.036	95.4	35	7	5	.47

Table 2A. Population simulations for wild populations of the Javan gibbon (*Hylobates moloch*). Population size and carrying capacity of 25 animals as may apply to 6 population fragments.

File #	0-1 Mort %	1-Ad Mort%	Age 1st R	r detr	r stoc	Pe % 100 Y	Te Years	Pop-N Mean	Pop SD	Heter
No Catastrophe										
137	5	5	10	.019	.006	13.0	77	18	6	.73
138		6	10	.009	-.008	37.6	69	14	7	.69
139		5	8	.019	.008	13.0	67	19	6	.72
140		6	8	.009	-.003	31.4	69	16	7	.69
49	10	5	10	.015	.001	20.6	71	17	6	.70
50		6	10	.005	-.012	44.4	71	13	7	.66
51		5	8	.015	.005	17.2	70	18	6	.71
52		6	8	.005	-.008	39.0	69	14	6	.67
53	15	5	10	.011	-.003	24.0	70	16	7	.70
54		6	10	.001	-.016	56.0	92	12	6	.67
55		5	8	.011	-.0008	23.8	70	16	7	.70
56		6	8	.001	-.013	48.4	65	13	7	.66
57	20	5	10	.007	-.007	34.6	68	14	7	.70
58		6	10	-.003	-.021	65.0	80	10	6	.65
59		5	8	.007	-.004	26.2	70	15	7	.69
60		6	8	-.003	-.018	59.0	89	11	6	.62
Catastrophe - Freq=20%, 0.95 Surv										
141	5	5	10	.009	-.008	38.8	68	14	6	.68
142		6	10	-.001	-.022	67.0	77	10	6	.63
143		5	8	.009	-.005	30.6	68	15	7	.67
144		6	8	-.001	-.017	59.2	87	12	7	.64
61	10	5	10	.005	-.013	47.0	70	12	7	.65
62		6	10	-.005	-.026	75.2	74	9	5	.60

63		5	8	.005	-.010	41.2	66	14	7	.67
64		6	8	-.005	-.021	62.4	87	10	6	.61
65	15	5	10	.001	-.016	54.6	93	11	6	.65
66		6	10	-.009	-.027	78.4	70	8	5	.62
67		5	8	.001	-.011	43.4	67	13	7	.66
68		6	8	-.009	-.026	77.0	69	8	6	.56
69	20	5	10	-.003	-.022	66.4	80	10	6	.64
70		6	10	-.013	-.035	86.8	59	7	5	.58
71		5	8	-.003	-.017	57.6	92	12	7	.66
72		6	8	-.013	-.028	78.6	70	8	5	.61

Table 2B. Population simulations for wild populations of the Javan gibbon (*Hylobates moloch*). Population size = 25 and carrying capacity of 100 animals as may apply to 6 population fragments.

File #	0-1 Mort %	1-Ad Mort%	Age 1st R	r detr	r stoc	Pe % 100 Y	Te Years	Pop-N Mean	Pop SD	Heter
No Catastrophe										
K137	5	5	10	.019	.011	4.8	66	73	28	.86
K138		6	10	.009	-.0008	14.6	68	43	29	.80
K139		5	8	.019	.014	2.0	68	77	28	.86
K140		6	8	.009	.003	12.0	68	51	30	.81
K49	10	5	10	.015	.008	4.0	64	63	31	.84
K50		6	10	.005	-.007	26.0	69	33	26	.76
K51		5	8	.015	.010	4.4	63	71	29	.85
K52		6	8	.005	-.005	21.8	67	36	27	.76
K53	15	5	10	.011	.003	9.8	70	54	31	.83
K54		6	10	.001	-.013	36.6	68	23	18	.75
K55		5	8	.011	.004	8.2	72	56	31	.81

K56		6	8	.001	-.009	30.6	68	29	23	.76
K57	20	5	10	.007	-.002	18.0	72	41	27	.81
K58		6	10	-.003	-.018	48.8	66	19	18	.71
K59		5	8	.007	.001	11.4	69	46	28	.80
K60		6	8	-.003	-.015	41.8	65	20	17	.70
Catastrophe - Freq=20%, 0.95 Surv										
K141	5	5	10	.009	-.002	18.8	67	42	29	.79
K142		6	10	-.001	-.018	52.2	97	22	19	.72
K143		5	8	.009	.0004	14.6	65	48	30	.80
K144		6	8	-.001	-.014	42.4	65	24	21	.73
K61	10	5	10	.005	-.009	30.6	70	30	24	.74
K62		6	10	-.005	-.022	61.4	84	17	14	.70
K63		5	8	.005	-.005	23.4	69	37	26	.77
K64		6	8	-.005	-.019	54.8	92	20	18	.70
K65	15	5	10	.001	-.013	40.4	70	25	21	.75
K66		6	10	-.009	-.028	73.0	74	11	9	.67
K67		5	8	.001	-.008	28.2	70	31	24	.76
K68		6	8	-.009	-.023	62.8	86	14	11	.69
K69	20	5	10	-.003	-.020	54.2	96	17	15	.70
K70		6	10	-.013	-.032	80.2	66	11	9	.62
K71		5	8	-.003	-.016	45.8	65	20	16	.71
K72		6	8	-.013	-.029	73.4	73	11	10	.62

Table 3A. Population simulations for wild populations of the Javan gibbon (*Hylobates moloch*). Population size and carrying capacity of 50 animals as may apply to 6 population fragments.

File #	0-1 Mort %	1-Ad Mort%	Age 1st R	r detr	r stoc	Pe % 10 Y	Te Years	Pop-N Mean	Pop SD	Heter
No Catastrophe										
121	5	5	10	.019	.013	0	-	42	9	.86
122		6	10	.009	.0004	4.6	81	32	13	.83
123		5	8	.019	.015	0.2	81	43	8	.86
124		6	8	.009	.003	3.2	69	35	12	.83
1	10	5	10	.015	.009	0.4	71	40	11	.86
2		6	10	.005	-.003	8.4	80	30	14	.82
3		5	8	.015	.010	1.6	73	40	11	.86
4		6	8	.005	-.002	6.8	81	31	13	.82
5	15	5	10	.011	.005	2.0	78	37	12	.86
6		6	10	.001	-.008	14.6	78	25	14	.80
7		5	8	.011	.006	1.4	77	38	12	.85
8		6	8	.001	-.006	10.2	79	27	14	.81
9	20	5	10	.007	.001	3.0	88	34	13	.85
10		6	10	-.003	-.013	17.8	80	20	12	.79
11		5	8	.007	.001	2.6	80	34	13	.84
12		6	8	-.003	-.011	21.2	80	24	13	.79
Catastrophe - Freq=20%, 0.95 Surv										
125	5	5	10	.009	.0009	4.4	81	32	13	.84
126		6	10	-.001	-.013	24.0	80	22	13	.78
127		5	8	.009	.003	4.4	80	35	13	.83
128		6	8	-.001	-.001	19.4	80	25	14	.79
13	10	5	10	.005	-.003	9.4	76	30	14	.82
14		6	10	-.005	-.017	32.8	77	17	12	.76

15		5	8	.005	-.0006	5.6	81	32	13	.83
16		6	8	-.005	-.014	26.0	78	21	13	.76
17	15	5	10	.001	-.009	16.6	80	25	13	.81
18		6	10	-.009	-.022	46.0	77	15	10	.74
19		5	8	.001	-.006	10.2	77	26	14	.80
20		6	8	-.009	-.020	36.4	76	17	11	.74
21	20	5	10	-.003	-.013	22.0	78	21	13	.79
22		6	10	-.013	-.027	52.6	99	12	8	.71
23		5	8	-.003	-.012	19.0	78	22	13	.78
24		6	8	-.013	-.024	47.0	74	14	10	.72

Table 3B. Population simulations for wild populations of the Javan gibbon (*Hylobates moloch*). Population size = 50 and carrying capacity of 200 animals as may apply to 6 population fragments.

File #	0-1 Mort %	1-Ad Mort%	Age 1st R	r detr	r stoc	Pe % 100 Y	Te Years	Pop-N Mean	Pop SD	Heter
No Catastrophe										
K121	5	5	10	.019	.016	0	-	169	43	.94
K122		6	10	.009	.003	2.8	77	90	54	.89
K123		5	8	.019	.106	0.2	95	172	39	.93
K124		6	8	.009	.005	1.2	74	104	57	.90
K1	10	5	10	.015	.012	0.4	78	152	51	.93
K2		6	10	.005	-.0004	3.0	80	68	46	.88
K3		5	8	.015	.013	0.2	60	152	52	.93
K4		6	8	.005	.001	2.0	77	78	53	.88
K5	15	5	10	.011	.008	0.6	75	121	57	.91
K6		6	10	.001	-.006	8.6	81	47	36	.85

K7		5	8	.011	.008	0.2	76	124	57	.91
K8		6	8	.001	-.004	7.2	80	54	41	.86
K9	20	5	10	.007	.003	1.8	85	85	53	.90
K10		6	10	-.003	-.012	15.4	80	32	27	.82
K11		5	8	.007	.003	2.2	79	93	55	.90
K12		6	8	-.003	-.010	15.6	77	38	31	.82
Catastrophe - Freq=20%, 0.95 Surv										
K125	5	5	10	.009	.004	0.4	85	95	57	.89
K126		6	10	-.001	-.011	16.2	77	37	33	.82
K127		5	8	.009	.004	1.6	86	94	57	.89
K128		6	8	-.001	-.008	11.2	77	46	38	.83
K13	10	5	10	.005	-.0007	4.8	79	71	47	.88
K14		6	10	-.005	-.016	24.0	76	25	20	.79
K15		5	8	.005	-.0005	3.4	82	72	52	.87
K16		6	8	-.005	-.014	21.4	77	31	29	.81
K17	15	5	10	.001	-.006	7.6	79	45	36	.84
K18		6	10	-.009	-.020	33.2	74	20	18	.76
K19		5	8	.001	-.005	7.2	80	52	41	.85
K20		6	8	-.009	-.018	30.0	76	22	18	.78
K21	20	5	10	-.003	-.012	14.6	79	31	27	.82
K22		6	10	-.013	-.025	44.0	77	13	11	.74
K23		5	8	-.003	-.010	13.4	75	37	31	.83
K24		6	8	-.013	-.024	43.8	75	17	16	.74

Table 4A. Population simulations for wild populations of the Javan gibbon (*Hylobates moloch*). Population size and carrying capacity of 100 animals as may apply to 3 population fragments.

File #	0-1 Mort	1-Ad Mort%	Age 1st R	r detr	r stoc	Pe % 100 Y	Te Years	Pop-N Mean	Pop SD	Heter
No Catastrophe										
153	5%	5%	10	.019	.015	0	-	91	12	.94
154		6	10	.009	.005	0	-	80	19	.93
155		5	8	.019	.016	0	-	91	11	.93
156		6	8	.009	.006	0.2	91	79	20	.93
97	10	5	10	.015	.012	0	-	89	13	.94
98		6	10	.005	.001	0.2	83	69	24	.92
99		5	8	.015	.013	0	-	89	15	.93
100		6	8	.005	.002	0.6	89	70	24	.92
101	15	5	10	.011	.008	0	-	85	17	.93
102		6	10	.001	-.003	0.4	92	59	25	.91
103		5	8	.011	.009	0	-	85	17	.93
104		6	8	.001	-.002	0.8	85	63	25	.91
105	20	5	10	.007	.004	0.2	90	76	21	.93
106		6	10	-.003	-.007	3.4	86	49	26	.89
107		5	8	.007	.004	0	-	79	20	.93
108		6	8	-.003	-.006	1.0	94	53	26	.90
Catastrophe - Freq=20%, 0.95 Surv										
157	5	5	10	.009	.005	0	-	76	21	.92
158		6	10	-.001	-.006	1.8	86	52	26	.90
159		5	8	.009	.006	0	-	78	21	.92
160		6	8	-.001	-.005	2.0	85	52	25	.89
109	10	5	10	.005	.001	0.8	85	69	23	.92
110		6	10	-.005	-.012	5.2	85	37	24	.87
111		5	8	.005	.002	0	-	70	23	.92

112		6	8	-.005	-.010	3.4	89	42	24	.88
113	15	5	10	.001	-.004	1.8	87	57	26	.91
114		6	10	-.009	-.017	11.8	84	28	19	.85
115		5	8	.001	-.003	0.2	86	58	27	.90
116		6	8	-.009	-.015	9.4	83	31	22	.85
117	20	5	10	-.003	-.008	2.6	89	46	26	.89
118		6	10	-.013	-.021	16.2	82	21	16	.81
119		5	8	-.003	-.007	1.4	84	48	26	.89
120		6	8	-.013	-.019	14.0	83	24	18	.83

Table 4B. Population simulations for wild populations of the Javan gibbon (*Hylobates moloch*). Population size = 100 and carrying capacity of 400 animals as may apply to 3 population fragments.

File #	0-1 Mort %	1-Ad Mort%	Age 1st R	r detr	r stoc	Pe % 100 Y	Te Years	Pop-N Mean	Pop SD	Heter
No Catastrophe										
K153	5	5	10	.019	.016	0	-	354	67	.97
K154		6	10	.009	.006	0.4	94	208	100	.95
K155		5	8	.019	.017	0	-	356	65	.97
K156		6	8	.009	.007	0.2	98	221	101	.95
K97	10	5	10	.015	.013	0	-	319	87	.97
K98		6	10	.005	.002	0	-	151	87	.94
K99		5	8	.015	.013	0	-	318	84	.96
K100		6	8	.005	.003	0	-	163	95	.94
K101	15	5	10	.011	.009	0	-	259	101	.96
K102		6	10	.001	-.002	0.6	80	102	69	.93
K103		5	8	.011	.009	0	-	250	106	.96
K104		6	8	.001	-.001	0.4	79	115	76	.93

K105	20	5	10	.007	.005	0	-	187	99	.95
K106		6	10	-.003	-.007	1.8	88	68	49	.91
K107		5	8	.007	.005	0.4	94	189	95	.95
K108		6	8	-.003	-.007	1.6	85	70	50	.91
Catastrophe - Freq=20%, 0.95 Surv										
K157	5	5	10	.009	.006	0	-	202	104	.95
K158		6	10	-.001	-.006	2.4	88	80	63	.91
K159		5	8	.009	.006	0	-	210	110	.95
K160		6	8	-.001	-.004	2.0	84	88	61	.91
K109	10	5	10	.005	.002	0.2	100	153	93	.94
K110		6	10	-.005	-.010	3.8	89	54	42	.89
K111		5	8	.005	.002	0	-	155	91	.94
K112		6	8	-.005	-.009	3.2	87	60	48	.89
K113	15	5	10	.001	-.003	0.6	82	99	70	.93
K114		6	10	-.009	-.015	8.4	89	37	30	.86
K115		5	8	.001	-.002	0.4	94	104	71	.93
K116		6	8	-.009	-.016	9.6	86	39	32	.86
K117	20	5	10	-.003	-.008	4.0	87	64	46	.91
K118		6	10	-.013	-.021	18.2	85	25	21	.84
K119		5	8	-.003	-.007	2.0	81	71	50	.91
K120		6	8	-.013	-.019	15.2	85	29	23	.84

Table 5A. Population simulations for wild populations of the Javan gibbon (*Hylobates moloch*). Population size and carrying capacity of 25 animals as may apply to 6 population fragments. These simulations include inbreeding depression using the Heterosis option and with Lethal Equivalents = 3.14. The results may be compared with Table 2.

File #	0-1 Mort %	1-Ad Mort%	Age 1st R	r detr	r stoc	Pe % 100 Y	Te Years	Pop-N Mean	Pop SD	Heter
No Catastrophe										
145	5	5	10	.019	-.006	32.6	77	13	7	.70
146		6	10	.009	-.018	64.4	89	9	5	.68
147		5	8	.019	-.003	26.2	78	13	6	.71
148		6	8	.009	-.014	54.0	97	10	6	.68
73	10	5	10	.015	-.009	37.4	75	12	6	.70
74		6	10	-.005	-.023	71.0	67	9	5	.66
75		5	8	.015	-.006	34.8	78	12	6	.71
76		6	8	-.005	-.019	61.6	90	10	6	.66
77	15	5	10	.011	-.014	52.8	97	11	6	.70
78		6	10	-.009	-.025	78.2	76	7	5	.63
79		5	8	.011	-.011	43.2	74	11	6	.69
80		6	8	-.009	-.024	72.8	77	7	4	.66
81	20	5	10	.007	-.016	54.4	97	9	5	.68
82		6	10	-.013	-.029	82.6	68	7	4	.64
83		5	8	.007	-.015	52.8	99	10	6	.67
84		6	8	-.013	-.027	80.6	74	7	5	.60
Catastrophe - Freq=20%, 0.95 Surv										
149	5	5	10	.009	-.019	62.8	89	8	5	.65
150		6	10	-.001	-.031	86.4	68	6	4	.62
151		5	8	.009	-.016	57.0	95	10	6	.66
152		6	8	-.001	-.027	79.8	72	8	5	.62
85	10	5	10	.005	-.024	75.0	79	8	4	.66
86		6	10	-.015	-.036	92.4	63	6	3	.61

87		5	8	.005	-.020	64.4	88	8	5	.64
88		6	8	-.015	-.031	87.4	68	6	4	.62
89	15	5	10	.001	-.024	74.2	75	7	5	.68
90		6	10	-.019	-.037	95.2	58	6	4	.62
91		5	8	.001	-.023	72.8	80	8	5	.65
92		6	8	-.019	-.033	91.8	64	7	4	.62
93	20	5	10	-.003	-.030	87.8	72	9	5	.67
94		6	10	-.023	-.040	96.8	56	5	4	.51
95		5	8	-.003	-.028	81.0	76	7	5	.63
96		6	8	-.023	-.037	94.0	59	5	3	.61

Table 5B. Population simulations for wild populations of the Javan gibbon (*Hylobates moloch*). Population size = 25 and carrying capacity of 100 animals as may apply to 6 population fragments. These simulations include inbreeding depression using the Heterosis option and with Lethal Equivalents = 3.14. The results may be compared with Table 2.

File #	0-1 Mort %	1-Ad Mort%	Age 1st R	r detr	r stoc	Pe % 100 Y	Te Years	Pop-N Mean	Pop SD	Heter
No Catastrophe										
K145	5	5	10	.019	.004	10.2	71	54	30	.85
K146		6	10	.009	-.010	30.6	72	27	22	.79
K147		5	8	.019	.006	7.8	74	60	30	.84
K148		6	8	.009	-.008	25.8	72	29	23	.78
K73	10	5	10	.015	.0000	12.2	77	44	29	.83
K74		6	10	.005	-.016	45.4	71	20	18	.75
K75		5	8	.015	.002	10.0	77	48	31	.83
K76		6	8	.005	-.015	43.0	72	21	19	.74
K77	15	5	10	.011	-.007	24.4	75	33	26	.80
K78		6	10	.001	-.020	53.6	95	14	12	.72
K79		5	8	.011	-.005	20.0	74	35	26	.80

K80		6	8	.001	-.017	49.4	74	18	15	.74
K81	20	5	10	.007	-.010	28.0	74	25	21	.79
K82		6	10	-.003	-.027	72.2	83	13	12	.73
K83		5	8	.007	-.007	25.0	73	30	24	.79
K84		6	8	-.003	-.024	63.2	90	11	9	.70
Catastrophe - Freq = 20%, 0.95 Surv										
K149	5	5	10	.009	-.012	39.2	73	26	22	.78
K150		6	10	-.001	-.028	73.2	77	11	12	.68
K151		5	8	.009	-.009	27.8	72	30	25	.78
K152		6	8	-.001	-.025	66.8	82	15	14	.70
K85	10	5	10	.005	-.018	48.4	71	18	19	.74
K86		6	10	-.005	-.032	82.6	71	9	7	.67
K87		5	8	.005	-.015	42.2	74	22	18	.76
K88		6	8	-.005	-.028	72.0	74	10	8	.67
K89	15	5	10	.001	-.020	57.2	93	16	14	.73
K90		6	10	-.009	-.034	88.2	66	7	6	.64
K91		5	8	.001	-.018	49.4	69	18	16	.75
K92		6	8	-.009	-.031	80.6	70	9	6	.68
K93	20	5	10	-.003	-.027	71.2	80	11	10	.72
K94		6	10	-.013	-.039	92.2	62	5	3	.61
K95		5	8	-.003	-.024	66.0	84	13	11	.71
K96		6	8	-.013	-.037	90.6	63	7	6	.64

Working Group Report: Human Demography and Community Participation in Conservation

Working Group Members: Wahyudi Wardojo, Agoes Sriyanto, John Williams (Chairs), Didik Purwanto, Listya Kusumawardhani, Hario Tabah Wibisono, Irvan Sidik, and Noviar Andayani.

INTRODUCTION

The working group was given the mandate of looking at past and future projected changes in human populations, examine the effects of those population changes on national parks and protected areas in West Java that were pertinent to the habitat of the Javan gibbon. The work broke down into three parts:

- Estimating past changes in human population, and projecting future populations in selected areas for the next 30 years.
- Looking at the ways that human population interacts with the natural resources of the park, and estimating the manner in which changes in human population will degrade or result in loss of habitat for the gibbon.
- Make recommendations with regard to minimizing future negative impacts of human populations on remaining gibbon habitat.

As a general rule, the working group cautions that there is no necessary direct link between human populations and the habitat of the gibbon. That link is mediated by a number of factors, including the social organization of the local communities, the management of the national park and the protected areas, and the technology available for the human population. Human populations may in fact increase with great or little impact upon the habitat based upon other factors, some of which may be programmable by policy initiatives.

Further, the projections here provided for the human population are based on narrow assumptions with regard to fertility, mortality, and migration. Three different projections are provided. All three projections assume a reduction of fertility to replacement levels by the year 2000, and continued improvement of health conditions. The only difference in the three projections is the level of migration for the period 1990-2020.

Migration for small areas, such as those that surround national parks, can make great differences in the size, composition and distribution of population. Over a 20 or 30-year period, changes in migration patterns are likely to have far greater impact on population than changes in fertility and mortality.

NATURE OF HUMAN POPULATION CHANGE

Human population growth has gradually declined over the course of the last ten years, a function of reduced fertility, which is characteristic of most parts of West Java. The data shown in Table 1 show mortality and fertility conditions as reflected in rural parts of Java during the last 20 years. These changes have resulted in a decline in the proportion of children from 16% in 1970 to a currently estimated 11%. The proportion of adults 15-65 has increased from 55% to approximately 63%. The reduction in fertility and proportion of children is associated with smaller households. Hence the number of households has increased more rapidly than the population at large, and has approximately doubled during the last 23 years (see Table 1).

The projections were made using a demographic projection program (DEMPROJ) prepared by the Future's Group, Washington DC, and distributed by the United Nations. The base for the population is an assumed 10,000 persons living in villages in and around Gunung Halimun National Park, which has evolved from several previously existing conservation areas.

The group decided to focus primarily on two National Parks: Gunung Halimun and Ujung Kulon National Park. Little information was available at the workshop for other areas, and more expertise was present in the working group for looking at these protected areas.

Ujung Kulon National Park

In Ujung Kulon National Park, population growth during the last two decades was increased by in-migration into the area. However, the natural rate of increase of the communities adjacent to the park is lower than average within rural West Java.

The eastern end of the park is bordered by 19 villages, 7 in Kecamatan Sumur, and Kecamatan Cimanggu. The two districts today comprise 45,788 people, approximately double the 23,000 people of 1970[1]. Further, there are approximately 1100 families cultivating and/or living on encroached land within the National Park[2], and there was discussion of relocating these families to other areas. The current rate of growth of population is 1.7%, which would result in a doubling of the population in approximately 40 years.

While the figures in Table 1 were developed for Gunung Halimun Park, similar patterns of demographic change have taken place at Ujung Kulon. However, the rate of in-migration was probably double that of Gunung Halimun.

Gunung Halimun National Park

Gunung Halimun is a large park of 40,000 hectares surrounded by 18 villages, 8 of them found in enclaves within the park. These villages in turn consist of several small communities of perhaps 100 houses each.

Villages toward the south of the park are highly traditional in life style and culture, and are less accessible to the larger towns. Sirnarasa Village, for example, is located 18 kilometres from the nearest medical clinic. Families there have 3-4 children, higher than typical in West Java.

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1 Personal communication from the Head of Ujung Kulon National Park. The present population of 19,278 have an average population density of 163 people per sq. km in the buffer zone, and a population growth rate of 1.7%.

2 A survey conducted by the Park staff in 1992 recorded that 1127 families were either resident on, or were cultivating park land. Of these, 154 families (615 individuals) were resident in the park, the others cultivating land within the park boundaries.

To the north of the park, more accessible to the towns, villages are less traditional. These areas have received more in-migration over the last two decades, migrants in general coming from elsewhere within the Kabupaten (regent administrative area which usually comprises 10 to 20 Kecamatan [districts]). The peripheral villages will have approximately doubled in number of households over the last 25 years.

The current growth rate of villages around the park is estimated to be between 1.7% and 2%, with a fertility rate below the average of rural West Java. The fertility rate has fallen sharply during the last 20 years (total fertility rate from 4.8 to 2.8).

USE OF RESOURCES BY COMMUNITIES ADJOINING NATIONAL PARKS

Populations in communities adjoining these two national parks are to a considerable degree dependent upon the parks for food, fuel and other resources:

Food: People living around the park collect fruit, honey, ubi, mushrooms and medicinal plants from the forest. These products are almost entirely collected for use within the villages. The more traditional villages, such as those to the south of Halimun, have a greater dependency on the forest resources. The collection of these forest resources does not pose a major threat to the integrity of the park and provides substantial support for some households. Should the socio-economic conditions of life of the local people improve, the dependency on forest products should decrease, even with increasing population.

Fuelwood: All adjacent villages depend on fuelwood collected in the national park or buffer zones that are nearby for individual household use. To the extent that collection includes the cutting of live trees, it degrades the habitat. In the absence of fuel substitutes, the future consumption of fuelwood could be closely correlated to increases in population growth. If fuelwood causes unacceptable degradation, villagers could be encouraged to use alternative sources of fuel or fuel efficient stoves.

Timber: Cutting of timber for house construction and making furniture invariably lead to considerable deforestation. This damage is most noticeable in the north of Halimun Park and on the east of Ujung Kulon. Rapidly increasing populations require additional housing construction, which could result in substantial increases in need for timber.

Illegal cutting has mostly taken place in the eastern and northern parts of Halimun, and sold commercially to urban traders. Timber and forest products from the western and southern parts of the park are taken primarily for the villagers' own needs.

Wildlife Poaching: Poaching for wildlife, particularly birds, is quite marked within Halimun Park. In addition, recreational hunting by townspeople who do not live near the park does occur. As far as known, there is little hunting of gibbons for the pet trade near Halimun. Environmental education programs aimed at villagers can be used to reduce poaching of all kinds. Further, improving cooperation between village and park staff has been demonstrated to be a useful way to reduce poaching. Poaching is not dependent upon the size of the local population.

Land Encroachmnt: By far the most significant long-term threat to the national park is encroachment for housing, crops, grazing, fishponds, mining, and roads or paths. The rapid increase of population over the last 25 years puts additional pressure on land. Land encroachment around Halimun has been minimal in the last few years. The recent increases in park staff combined with expanded community development efforts may help to contain the problem.

If resource use continues in proportion to population growth, the degradation of the national parks will accelerate. It is thus necessary and desirable to work with the villages that surround the park to minimize future activities that will cause further loss of habitat and biodiversity.

WORKING WITH LOCAL COMMUNITIES

It would be a mistake to attribute all or even most degradation of national park lands to local communities. Encroachments, poaching, logging, and mining are often instigated by those who live far from the park. One way to decrease encroachment is to gain the cooperation of local villagers, who can then act as a buffer to maintain the biodiversity of the park resources, and to provide at little cost to the park assistance in monitoring threats to it.

EXPERIENCE AND MODEL FOR FURTHER COMMUNITY DEVELOPMENT

There is already substantial experience in working with human communities that are within and on the border of Halimun National Park. Community development activities by Biological Sciences for Community Foundation have been supported by both the PHPA and by external funding sources (U.S. AID). There has developed a collaboration between this NGO and the management of the park, which is very supportive of these activities.

In Ujung Kulon National Park, the national park office seeks to coordinate its program with local government, local people, NGOs, national government agencies, and supporters of community development agencies, including international AID organizations. An Indonesian NGO, Yayasan Mandiri, is starting work in two villages for the development of an improved water distribution system, important for rice paddy, fish ponds, as well as drinking water. This water system should support increased food production, income generation, and better health.

A project working with the Worldwide Fund for Nature is supporting ecotourism through housing improvements for local villagers to a standard for tourists, to direct tourist dollars to the benefit of local people. The park management is also planning a community forestry project.

In Halimun, park management has developed a co-operative partnership with Biological Science for Community Foundation, an Indonesian NGO that has two important roles: research and promoting links with local communities. This group has conducted considerable research activity in different regions of Indonesia. Its primary focus for community work in nine of the 18 villages in and around Halimun.

Community development workers for BSC have been working in the communities for the last five years. The activities are multi-purpose, and done in a participatory manner with local residents. The objectives of the program are to reduce dependency on the resources within the park, to generate income, to develop agriculture and agroforestry, and to associate traditional knowledge systems with sustainable use of local resources. The organizers work with groups within the community in the development and implementation of different activities. The project team has also helped to bring community members into meetings with forestry officials to promote their local perspectives in managing the park.

The community members with the support of BScC, have contributed effectively to the development of the new management plan for the park. Park officials have become sensitized to the individual needs of the communities, and relationships between park managers and community members has improved significantly. This approach provides a model for expansion of participatory planning and community development in areas adjoining all parks and protected areas in West Java.

WORKING GROUP SUMMARY RECOMMENDATIONS

The working group focused primarily upon Gunung Halimun and Ujung Kulon National Parks. However, human populations near other protected areas that harbor gibbon follow similar trends.

Population

Population growth in the areas around Halimun and Ujung Kulon Park continues, and places additional pressure on park resources. Fertility levels in most rural villages in West Java have been falling rapidly. Some isolated villages in and around protected areas do not have the benefit of Puskesmas (health clinics). Priority needs to be given to bring such services to these local people. Park managers should work in support of village leaders in obtaining such services.

Efforts should be made to discourage the migration of people from outside into these peripheral areas. There can be benefits to very low levels of out-migration from these villages. One way of accomplishing this would be to increase the levels of education and job skills of people living in the villages. Such skills serve to open up better employment opportunities available elsewhere. We recommend support for better schools and training programs.

Use of Resources Along the Periphery of Protected Areas

Discouraging encroachment of park lands is the chief priority, and requires improved cooperation among residents, park managers, government agencies, and NGOs.

In selected areas, on the southern boundary of Halimun park, traditional use zones should be carefully demonstrated in participatory planning with community members.

Broadening Community Participation in Park Management

In the words of the Head of Halimun Park, one of the most essential and exciting initiatives is the attempt to involve local communities and NGOs in managing the park.[3] This working group endorses his recommendations that the local communities must be involved in designing and implementing programs. A "bottom up" planning process may be applied to encourage local communities to fulfil their responsibilities in implementing the programs. Programs developed by the communities themselves should be given priority.

There are existing very limited community development funds that may be allocated by park officials as part of a strategy to improve the well-being of local communities. The expansion of these funds would greatly increase the capability of park staff to support the sustainable development of local communities and to gain their cooperation in park management. Additional support for these activities should be sought from both domestic and external sources.

NGO Involvement

Further support for involvement of NGOs in their work with local communities is desirable. The involvement of NGOs enables more flexible support to local communities then can be provided by National Park Offices, which have limited capability and jurisdiction. This cooperation with NGOs involves the following steps.

- Acknowledgment of the NGOs as a partner in establishing co-operation;

- The setting of clear lines of responsibility and jurisdiction according to capabilities and expertise in order to determine who will do what, and to achieve coordination and cooperation in activities; and

- The involvement of NGOs and community representatives in the management processes through communication, planning, organization, implementation, and evaluation of the agreed programs and activities.

Staff

Park officials and staff should be provided with direct training in workshops concerned with conflict resolution and participatory community planning exercises. NGOs may play a useful role in support of these training exercises. These field staff are the front line defense of the most valuable biodiversity in West Java. Proper compensation and promotion policies need to be adhered to. ■

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[3] Wahjudi Wardojo. "Promoting the Role of Local Communities and NGOs in the Management of Indonesia's Halimun National Park." in Anatole Krattiger, McNeely et al, editors. Widening Perspectives on Biodiversity. IUCN - The World Conservation Union and The International Academy of the Environment. Geneva:1994. Pp. 165-170.

Table 1. Demographic Projection Model: Summary Demographic Indicators for Communities Near Halimun Park 1970-2020.

I. Projection with no migration after 1990

Hypothetical Starting Population of 10,000 in 1970.

Year	**1970**	**1975**	**1980**	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**	**2020**
Total	10000	11701	13647	15641	17528	19091	20523	21878	23323	25970
Male	5104	5943	6926	7936	8882	9663	10373	11043	11760	13072
Female	4934	5758	6721	7705	8646	9427	10150	10835	11562	12899
%0-4	15.9	15.5	15.2	13.8	12.0	10.6	9.8	9.0	9.0	7.8
%5-14	27.5	25.6	24.7	24.7	24.0	22.1	19.9	18.3	17.0	15.9
%15-49	44.0	45.9	46.8	48.0	49.1	50.4	50.9	50.4	49.4	46.4
%15-64	54.5	56.8	57.8	58.9	61.0	63.9	66.5	68.6	69.1	68.4
%65+	2.2	2.2	2.3	2.6	3.1	3.4	3.7	4.1	5.0	7.8
%fe 15-49	45.0	46.8	47.3	48.3	49.4	50.3	50.5	49.9	48.8	45.7
Sex ratio	103.5	103.2	103.1	103.0	102.7	102.5	102.2	101.9	101.7	101.3
Dependency ratio	0.796	0.723	0.690	0.652	0.590	0.513	0.447	0.399	0.376	0.347

Projection of base population of 10,000 people in West Java areas surrounding Halimun Park, estimated 1970-1990, projected 1995-2020. In -migration of .25 for 1970-1990. No migration 1990-2020.

Year	**70-75**	**75-80**	**80-85**	**85-90**	**90-95**	**95-00**	**00-05**	**05-10**	**10-15**	**15-20**
Fertility---										
TFR	4.80	4.40	3.80	3.20	2.80	2.50	2.20	2.20	2.10	2.10
GRR	2.34	2.15	1.85	1.56	1.37	1.22	1.07	1.07	1.02	1.02
NRR	1.97	1.85	1.63	1.40	1.24	1.13	1.01	1.02	0.99	0.99
Mean age of childbear	29.8	29.9	29.8	29.2	28.7	28.2	27.7	27.7	27.6	27.6
Child/Woman ratio	0.66	0.62	0.61	0.54	0.45	0.39	0.35	0.32	0.33	0.31
Mortality---										
Male-LE	56.0	58.0	60.0	61.0	62.0	64.0	66.0	68.0	70.0	72.0
Fem.-LE	58.0	60.0	62.0	64.0	65.0	68.0	70.0	72.0	74.0	76.0
Total-LE	57.0	59.0	61.0	62.5	63.5	66.0	68.0	70.0	72.0	74.0
IMR	65	58	52	47	44	37	31	26	21	17
U5MR	89	78	68	62	57	47	39	32	25	20

Year	**70-75**	**75-80**	**80-85**	**85-90**	**90-95**	**95-00**	**00-05**	**05-10**	**10-15**	**15-20**
Immigration										
Male	25	30	30	30	10	0	0	0	0	0
Female	25	30	30	30	10	0	0	0	0	0
Total	50	60	60	60	20	0	0	0	0	0

Year	70-75	75-80	80-85	85-90	90-95	95-00	00-05	05-10	10-15	15-20
CBR/1000	35.9	34.9	31.2	26.6	23.3	21.2	19.2	19.1	17.5	16.4
CDR/1000	9.9	8.9	8.0	7.5	7.3	6.7	6.4	6.3	6.2	6.2
RNI%	2.6	2.6	2.3	1.9	1.6	1.4	1.3	1.3	1.1	1.0
GR%	3.1	3.1	2.7	2.3	1.7	1.4	1.3	1.3	1.1	1.0

Births-and-Deaths

Births	390.4	442.3	456.2	441.7	427.0	420.1	407.6	432.0	419.5	415.4
Deaths	107.8	113.2	117.4	124.3	134.4	133.6	136.7	143.0	148.6	156.8

II. Projection with in-migration 1990-2020 (60 persons per year)
(Projections use same mortality and fertility assumptions)

Year	1970	1975	1980	1985	1990	1995	2000	2005	2010	2020
Total	10038	11701	13647	15641	17528	19307	21092	22830	24684	28201
Male	5104	5943	6926	7936	8882	9772	10657	11517	12438	14179
Female	4934	5758	6721	7705	8646	9535	10436	11313	12246	14021
%0-4	15.9	15.5	15.2	13.8	12.0	10.6	9.9	9.1	9.1	7.9
%5-14	27.5	25.6	24.7	24.7	24.0	21.9	19.7	18.2	16.9	15.9
%15-49	44.0	45.9	46.8	48.0	49.1	50.6	51.1	50.7	49.7	46.7
%15-64	54.5	56.8	57.8	58.9	61.0	64.0	66.7	68.6	69.0	68.6
%65+	2.2	2.2	2.3	2.6	3.1	3.4	3.7	4.1	4.9	7.6
%fem15-49	45.0	46.8	47.3	48.3	49.4	50.5	50.8	50.3	49.3	46.3
Sex-ratio	103.5	103.2	103.1	103.0	102.7	102.5	102.1	101.8	101.6	101.1
Dependency ratio	0.796	0.723	0.690	0.652	0.590	0.509	0.443	0.398	0.377	0.348

III. Projection with out-migration 1990-2020 (60 persons per year)
(Projections use same mortality and fertility assumptions)

Year	1970	1975	1980	1985	1990	1995	2000	2005	2010	2020
Total	10038	11701	13647	15641	17528	18658	19708	20659	21681	23436
Male	5104	5943	6926	7936	8882	9447	9966	10436	10944	11815
Female	4934	5758	6721	7705	8646	9211	9742	10223	10737	11622
%0-4	15.9	15.5	15.2	13.8	12.0	10.6	9.7	8.8	8.9	7.7
%5-14	27.5	25.6	24.7	24.7	24.0	22.4	20.3	18.5	16.9	16.0
%15-49	44.0	45.9	46.8	48.0	49.1	50.1	50.5	50.1	49.1	46.2
%15-64	54.5	56.8	57.8	58.9	61.0	63.6	66.4	68.6	69.2	68.2
%65+	2.2	2.2	2.3	2.6	3.1	3.4	3.7	4.1	5.0	8.1
%fem15-49	45.0	46.8	47.3	48.3	49.4	50.0	50.1	49.5	48.3	45.0
Sex ratio	103.5	103.2	103.1	103.0	102.7	102.6	102.3	102.1	101.9	101.7
Dependency ratio	0.796	0.723	0.690	0.652	0.590	0.519	0.451	0.398	0.373	0.348

Working Group Report: Establishment of a PKBSI Javan Gibbon Program

Working Group Members: D. Ashari, Jansen Manansang (Chairs), Sharmy Prastiti, Henny M. Asnam, Made Wedana, Ermaria, Bambang Triana, Kamil Oesman, J. Andrew Teare, Reg Gates, and Diana Gates.

Editors' note: This working group was formed on the first day of the workshop with the goal of setting guidelines for establishing a captive management program for Javan gibbons regardless of the status of this species in the wild. On the last day of the workshop, results from the Habitat and Populations Working Group and the Life History and Vortex Analysis Working Group made it abundantly clear that the status of wild populations was critical (using the IUCN Mace-Lande criteria). A recommendation in the Javan Gibbon Action Plan is that the PKBSI should develop a regional captive management program for Javan gibbons that is linked with, and in support of, the long-term conservation of this species.

INTRODUCTION

There are seven zoos on the island of Java, Indonesia that are members of the Perhimpunan Kebun Binatang Se Indonesia (PKBSI - Indonesian Zoological Parks Association) and all may be willing to participate in a propagation and management program for the Javan gibbon *(Hylobates moloch)*. The PKBSI has already established a similar program for the Sumatran tiger *(Panthera tigris sumatrae)*, which can serve as a model for the Javan gibbon (*IUCN/SSC CBSG Sumatran Tiger Population and Habitat Viability Analysis Final Report, 25 March 1994; PKBSI Sumatran Tiger Masterplan, 15 June 1994).*

CURRENT JAVAN GIBBON POPULATION

There are currently 9 male and 5 female Javan gibbons held in Javan zoos (2 male & 2 female adults; 4 male subadults; 2 male & 2 female juveniles; and 1 male & 1 female of unknown age). None of the current population appear to have been bred in captivity and none of the current adults have produced offspring. There are an unknown number of Javan gibbons that are privately held and registered with the Ministry of Forestry's Perlindungan Hutan dan Pelestarian Alam (PHPA). It may be possible to bring some of these privately held animals into the captive management program.

JAVAN GIBBON CAPTIVE MANAGEMENT PROGRAM IN THE PKBSI

A minimum of 10 reproducing pairs of founder gibbons would be required to initiate a long-term captive management program. Experience in zoos outside Indonesia has indicated some difficulty in establishing reproductively active pairs, and the gibbon has not yet been regularly bred in captivity in Indonesia. For this reason, the program should target a minimum of 14 pairs of gibbons. This would allow a greater flexibility when attempting to produce new pairs, if initial pairing did not reproduce.

Population modelling (VORTEX software) indicates that a gibbon population starting with 10 reproductive pairs will grow to 40 animals in 36 years, if the females start reproducing at 8 years of age and overall annual mortality is 5%. If overall annual mortality is reduced to 2%, then the same 10 pairs will grow to 40 animals in only 14 years. The age of first reproduction for females will also impact the population growth rate. If females can be managed to reproduce at 7 years age instead of 8 years, then the population will expand to 40 animals in 12.5 years (retaining a 2% annual mortality rate). It is apparent that annual mortality will be a key factor in the success or failure of the propagation program.

The Javan Gibbon Captive Management Program will need to appoint a Javan gibbon studbook keeper to maintain the captive Javan gibbon database who would report annually to the PKBSI on the total numbers, births, deaths, and transfers of the captive population. A veterinary medical advisor should also be appointed to assist with developing protocols for disease testing and disease control. The veterinary medical advisor would also produce annual reports on the causes of mortality in the population. It would be the responsibility of the PKBSI to encourage participating zoos to meet minimum husbandry standards (*see Working Group Report: Captive Management of Javan Gibbons*).

PKBSI RESOURCES

Because the core for the captive breeding population already exists in PKBSI zoos or as privately held animals, one priorities is to establish suitable enclosures for 14 pairs of Javan gibbons (*see Working Group Report: Captive Management of Javan Gibbons*. It may be possible to modify some existing enclosures to meet the recommended standards, but it is likely that several new enclosures would need to be built.

As the facilities are being prepared, the PKBSI will need to prepare a husbandry manual detailing minimum standards for captive management of Javan gibbons. Training of gibbon keeper staff and veterinarians will also be required.

A survey of veterinarians attending the workshop indicated that annual mortality of Javan gibbons in zoos was in the range of 8-20%. Even under favorable conditions (regarding female reproductive rates), a gibbon captive population with this annual mortality rate would not be viable. If the captive population is to grow, significantly more resources will need to be expended on daily sanitation, training of gibbon keepers, dietary quality and veterinary medical care of the Javan gibbon to reduce the annual mortality rate to below 5%.

WORKING GROUP SUMMARY RECOMMENDATIONS

The working group recommends that the PKBSI support the conservation of the remaining wild populations by working cooperating with PHPA and Indonesian NGOs to focus attention on the Javan gibbon, the only gibbon species endemic to Java. Recommendations to guide this process are:

- It is recommended that a captive management program be initiated immediately that is linked with, and in support of, the long-term conservation of Javan gibbons and Javan langurs.

- These captive management programs should be under the direction of the PKBSI and be formulated to be a regional Javan gibbon and Javan langur program for Indonesia.

- The PKBSI captive management program for gibbons and langurs should be based on founders already in captivity, and not extracted from wild populations.

- Wild populations of less than 10 individuals (which are at high risk of extinction) should be evaluated for their possible role in translocation programs, other conservation programs and captive management programs.

- Registered Javan gibbons and Javan langurs that are privately held should be considered for confiscation by PHPA and incorporation into the PKBSI regional captive management program.

The combination of the above objectives form the basis of the PHPA conservation management strategy for Javan gibbons and Javan langurs.■

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Working Group Report: Captive Management of Javan Gibbons

Working Group Members: Jansen Manansang, Tony Sumampau, J. Andrew Teare, Reg Gates, Kathy Castle (Chairs), Sharmy Prastiti, Ida Yuniati Masnur, Henny Asnam, Made Wedana, Ermaria, Bambang Triana, Kamil Oesman, D. Ashari, Dondin Sajuthi, Diana Gates, and Pamela Lorentz.

INTRODUCTION

The Perhimpunan Kebun Binatang Se Indonesia (PKBSI - Indonesian Zoological Parks Association) adheres to the World Zoo Conservation Strategy as published by the International Union of Directors of Zoological Gardens (IUDZG).

The recommendations contained in this document provide for the general management of Javan gibbons in captivity. Should the decision be reached that a captive breeding program is in the best interest of the conservation of this species, this working group has reached consensus that these recommendations should be followed by the Javan gibbon captive management program. This document also articulates the basis for Indonesian zoo staff to produce a complete and more detailed husbandry manual in the future (*Editors' note: This recommendation was formally approved on the last day of the workshop*).

SUMMARY RECOMMENDATIONS: IDENTIFICATION AND RECORDS

- Every gibbon should be permanently identified and assigned an accession number. Permanent identification should consist of a transponder implant (between shoulder blades) and tattoo (right leg tattoo males, left leg tattoo females). The tattoo should consist of 1 or 2 letter code that identifies the first captive facility within Indonesia to acquire the animal (e.g. TS could be used by Taman Safari). The letter code should be followed by the accession number at that facility.

- Permanent behavioral, medical and nutritional records should be kept for individual gibbons. Ideally this should be computerized to maximize benefit of this data for addressing management problems.

- For donated animals, it is critical to establish whether the animal was wild caught or captive born. When wild caught, every effort should be made to establish the province where originally caught. All details regarding origin of wild caught gibbons and supporting documents should be included as part of the animals permanent records.

- Zoos and long-term holding facilities should participate in the International Species Inventory System (ISIS) and information should be exchanged between facilities. Participation in ISIS also benefits the institution by making Animal Record Keeping System (ARKS) software available for local record management.

SUMMARY RECOMMENDATIONS: SHIPPING

- Shipping containers should be of adequate size and strength to transport the animal safely and to protect handling personnel and the public. Shipping containers must be well ventilated (mesh windows on all 4 sides are recommended). Options include: airline shipping kennels for small animals) with locks, heavy-duty hardware, smaller mesh size over doors and windows; or wooden crates that conform to International Airline Transport Association (IATA) regulations. Airline shipping kennels should only be used for short journeys.

- Travel considerations:
  - need to provide bedding, food and water or juicy fruit to provide moisture in crates
  - make arrangements to minimize travel time
  - contact staff at zoos near transit airports and arrange for the animals to be checked in the event of flight delays or long stopovers
  - consider having staff (from either originating or receiving institution) accompany animal if travel time or distance is extended
  - reduce stress by familiarizing animal with crate prior to shipment

- International travel: Shipping containers must comply with IATA regulations or shipment may be refused by the airlines.

- Label crates appropriately as containing live animal. Warn public and cargo handlers not to put fingers or other objects into the crate.

SUMMARY RECOMMENDATIONS: PUBLIC SAFETY

- All personnel involved with the care and handling of gibbons must be aware of the potential for disease spread between gibbons and humans. Every effort should be made to protect personnel by providing latex gloves and eye protection. Good sanitation and personal hygiene should always be practiced.

- Personnel involved with the care and handling of gibbons should be tested regularly for diseases of concern and, when feasible, protected against those diseases by vaccination.

SUMMARY RECOMMENDATIONS: QUARANTINE

- All gibbons entering any captive institution should undergo a quarantine period to protect the existing animal collection from introduced diseases.

- The quarantine period will be used to screen the new animal for diseases or other problems and to provide appropriate treatment for any problems discovered. The length of quarantine and disease testing protocols should follow the recommendations of the Working Group Report: Javan Gibbon Diseases (see below).

SUMMARY RECOMMENDATIONS: FACILITIES

General Considerations

These design considerations apply equally to all enclosures intended to house gibbons.

- It is critical that all enclosures be designed so that animals can be confined in a separate holding area. This space serves a variety of functions: a place to hold the animal while cleaning the main enclosure; a place to medicate or administer anesthetics; as a place to temporarily separate an overly-aggressive individual from other group members; a place to introduce new group members or pairs of animals for breeding; a place to isolate injured, sick, pregnant or lactating gibbons.

- All animals should have continuous access to a source of fresh, clean, drinkable water. Food should be in a container placed in an elevated position within the enclosure to reduce contamination from feces or urine.

- Shelter from direct sun, rain, and strong winds should be incorporated into the design of the enclosure. Enclosed shelters should be designed for easy cleaning and disinfection.

- The enclosure should be furnished with removable ropes and branches to encourage brachiation. Resting spaces or benches should be constructed of nonabsorbent materials that allow for disinfection. Resting areas should be large enough to allow family groups to rest together, numerous enough to allow individual members separate sites and be placed at different heights and locations within the enclosure.

- All access and shift doors must be capable of being locked.

Quarantine Enclosures

- Need to be completely separate from existing animal collection and should be designed to minimize contact (and potential disease transmission) between animals undergoing quarantine.

- Floors should be constructed of concrete or some other nonporous material that can be disinfected. The floor should be sloped to a drain outside the exhibit.

- Minimal dimensions for each individual enclosure are: 3 m long x 1.5 m wide x 2 m high. Holding areas could have squeeze panels incorporated into the design to facilitate physical restraint and medical procedures.

Exhibit Enclosures

- Minimum exhibit size recommendations are: 7 m long x 4 m wide x 4 m high or approximately 30 m^2 of floor space. Public access to the enclosure should be limited to two sides (one side is better).

- Visual barriers should be placed between breeding groups of gibbons.

- Glass should be tempered, laminated and at least 2 cm thick.

- Wire barriers should be constructed of 5 cm x 5 cm or 5 cm x 2.5 cm, chain-link or welded wire mesh. A barrier should keep the public a minimum of 2 m from the mesh to reduce physical contact and feeding by the public.

- Holding areas should be a minimum of 1.5 m x 1.5 m x 2 m in size. Each exhibit should have access to at least two holding areas to allow separation of animals, yet allow routine keeper functions.

- Water moats are not recommended for Javan gibbons because they do not swim, and several zoos have reported that gibbons have drown in water moats. Given the critical status of the Javan gibbon, the working group recommended that Javan gibbons not be put at risk in water moat exhibits.

Permanent, Off-Exhibit Enclosures

- Exhibit size should be a minimum of 7 m long x 2 m wide x 4 m high or approximately 15 m^2 of floor space. Public should not have access to the enclosure.

- When a series of enclosures are constructed, the design should incorporate features to prevent animals in adjacent enclosures from injuring each other. This can be accomplished by spacing the enclosures 2 m apart, using a fine mesh between enclosures or using solid walls between enclosures.

- Visual barriers should exist between breeding groups of the same gibbon species.

- The design should incorporate features to allow gibbons to be shifted between enclosures.

Manual Restraint

- Preferable methods of manual restraint are:
  - Netting or squeezing animals up to age 4 years
  - Squeeze units for animals of age four years and above. Squeeze units should be used with caution in adult gibbons as some zoos have reported self-inflicted injuries when attempting to use squeeze units with *H. moloch.*

Chemical Restraint

- When any gibbon over four years of age requires a veterinary medical examination, chemical restraint should be administered. When an animal over four years age cannot be transferred into a crate for movement to another location, chemical restraint should be administered to allow safe loading of the animal. Ketamine and/or tiletamine/zolazepam are probably the drugs of choice.

Introduction of Gibbons

- When possible, adult gibbons should be housed as compatible pairs. Offspring should remain with the parents during the maturation of at least one other offspring. It would be preferable to leave offspring with parents until the offspring reach sexual maturity (about 8 years).

- Both juvenile or adult animals should be familiar with the introduction area by having the individual animals use the area for several days prior to introduction of the animals to each other.

- Animals should be housed in adjacent enclosures with olfactory, visual, and limited tactile contact, until behavioral signs of compatibility are noted (generally defined as the absence of overt aggression between individuals).

- Gibbons should be supervised by staff when initially introduced to each other in the same enclosure. As signs of behavioral compatibility between gibbons are noted, staff supervision can be decreased.

- When adult gibbons exhibit signs of incompatibility during introductions, two options exist:
  - If multiple animals are available, try different pairings.
  - If limited animals are available, attempt to introduce the male when the female is in estrus (undefined in this report).

- Juvenile gibbons can be successfully housed in multiple gibbon groups. They can be introduced when they achieve independence from their mothers and will need to be separated when they approach reproductive maturity (which is before 8 years of age or earlier). Caution should be used to reduce competition over food by using multiple feeding sites.

Food Presentation

- Feeding gibbons several times per day increases activity options for animals and can be used as a management tool for moving animals as needed.

- The development of undesirable behaviors can be avoided by feeding gibbons in ways that increase feeding time, such as:

- Provide whole food items that are not cut into bite-sized pieces
- Place food in several places throughout the enclosure
- Present food in a manner that requires manipulation to obtain and eat (ie., place on top of chain-link caging). ■

Selected Diets for Gibbons (and Langurs)

Taman Safari Indonesia: twice daily per animal

1 each salak (snake fruit), guava, jambu air (apple-like fruit), Bengkuang (fruit)
1 quarter papaya
1 piece of watermelon
1 half apple, 1 half orange
3 bok choy leaves (similar to Chinese cabbage)
5 each lettuce/spinach/pumpkin/jambu mete leaves

Ragunan Zoo: daily for each animal (gibbon or langur)

2 each, bananas and jambu air (like an apple)
1 papaya leaf
long beans
300 g sweet potato
peanuts, handful in shell
Zoo volunteers bring in leaves once per week

Bandung Zoo Gibbon diet: daily for each animal

225 g of banana
250 g of papaya
125 g carrot
65 g soya beans
1 boiled potato per week
1 boiled egg daily
1 orange per month
Sawo given once per month
50 g lettuce

Bandung Zoo Langur diet: daily per animal

125 g banana
160 g kangkung (leafy green vegetable; similar to Nasturtium)
65 g soya bean
250 g papaya
125 g carrot
1 boiled potato and boiled egg per week
2 papaya leaves, 2 tomatoes
1 each kedondong (starchy fruit); sawo (sweet fruit); and salak per week

Working Group Report:
Javan Gibbon Diseases

Working Group Members: Dondin Sajuthi, J. Andrew Teare (Chairs), Jansen Manansang, Ida Yuniati Masnur, Ligaya Tumbelaka, Ermaria, and Bambang Triana.

INTRODUCTION

Mortality of captive gibbons due to infectious diseases appears to be a major problem facing long-term captive propagation programs in Indonesia. A rough estimate of gibbon mortality rates, obtained from Indonesian zoo veterinarians present, yielded annual rates of 8-20%. Population modelling (VORTEX software), using the typical life history characteristics of gibbons, indicates that annual mortality rates need to be below 5% to expand the captive population.

Diseases of greatest concern in Indonesia (those currently causing the greatest mortality), include all the causes of diarrhea-enteritis and pneumonia. The most common etiologies are *Strongyloides, Salmonella, Shigella*, and *Balantidium*; a variety of other protozoa, nematodes and bacteria are implicated less often. Diseases that currently cause a low mortality, but could become significant for a long-term propagation program include tuberculosis and hepatitis B.

This document provides general recommendations regarding disease control and testing for Javan gibbons in captivity. This document could form the basis for Indonesian zoo staff to produce a complete and detailed disease testing and control manual as part of a Javan gibbon captive management program. Protocols for disease testing of orangutans (*Pongo pygmaeus*) already exist and could also be used as a model for developing gibbon disease testing protocols (see *Orangutan Population & Habitat Viability Analysis Report, 20 October 1993*).

WORKING GROUP SUMMARY RECOMMENDATIONS

- All facilities holding Javan gibbons should have an attending veterinarian knowledgeable about the diseases of gibbons.

- All Javan gibbons that die should have a complete necropsy to determine cause of death. Copies of the necropsy report should be forwarded to the Javan gibbon studbook keeper.

  Editors' note: Dr. Dondin (Director of Primate Research Center, Research Institute of Bogor Agricultural University) offered to make the laboratory facilities at IPB available to support a Javan gibbon propagation program by providing histopathology and culture services; he could not estimate the cost of such services at the workshop.

- All Javan gibbons entering the captive population from the wild or from a private individual should be quarantined for at least 12 weeks. During this period, the gibbon should be tuberculin tested at 2 week intervals, enteric cultures (Shigella-Salmonella-

Campylobacter) collected and fecal examinations for parasites be completed in conjunction with each tuberculin test. The animal should be tested for hepatitis B and SIV/HIV during this quarantine period. The animal should also receive a complete physical exam and blood samples be collected for hematology and chemistry analysis. When possible, serum should be frozen for future diagnostic screening studies (serum banking). Animals should receive rabies, poliomyelitis and DPT vaccines. Animals that are hepatitis B antigen and antibody negative should be vaccinated for hepatitis B. The animal should not be released from quarantine until deemed healthy by the attending veterinarian.

Editors' note: This is the protocol used by Dr. Dondin at IPB and was accepted by the working group as reasonable for new animals that enter the managed population.

- All Javan gibbons transferring between zoo facilities should be quarantined for at least 30 days. During this period, the gibbon should be tuberculin tested. At least three enteric cultures (Shigella-Salmonella-Campylobacter) should be performed and three fecal examinations for parasites be completed. The animal should be tested for hepatitis B, and SIV/HIV during this quarantine period. The animal should receive a complete physical examination and a blood sample be collected for hematology and chemistry analysis (serum banking). When possible, serum should be frozen for future studies. Animals should receive rabies, poliomyelitis and DPT vaccines. Animals that are hepatitis B antigen and antibody negative should be vaccinated for hepatitis B. The animal should not be released from quarantine until deemed healthy by the attending veterinarian.

- All Javan gibbons in captivity should be tuberculin tested annually. Animals that are tuberculin reactors should be treated for tuberculosis. When possible, thoracic radiographs and mycobacterial culture of a gastric wash should be obtained to confirm the diagnosis.

- If reintroduction of captive gibbons becomes a viable possibility, detailed prerelease quarantine and disease testing protocols need to be developed **prior** to release of any animals. In any case, gibbons with a history of tuberculin reaction or that test positive for hepatitis B (antigen or antibody) should not be considered for a release program, as these animals may represent an unacceptable risk to the wild population.

- If translocation becomes a PHPA management strategy for wild Javan gibbon populations, disease surveys of the wild populations needs to be completed **before** wild gibbons are translocated from one population to another. If gibbons are translocated to a site that does not contain gibbons, then disease testing could occur as the animals are moved. ■

REFERENCE

R. Tilson, U. Seal, Komar Soemarna, Widodo Ramono, Effendy Sumardja, S. Poniran, C. van Schaik, M. Leighton, H. Rijksen, and A. Eudey. 1993. *Orangutan Population and Habitat Viability Analysis Report.* IUCN/SSC Captive Breeding Specialist Group, Apple Valley, MN, 54pp.

Working Group Report:
Wild Gibbon Capture Techniques

Working Group Members: Jansen Manansang (Chair), Sharmy Prastiti, Ida Yuniati Masnur, Henny M. Asnam, Made Wedana, Ermaria, Bambang Triana, Kamil Oesman, D. Ashari, J. Andrew Teare, Reg Gates, and Diana Gates.

Editors' note: No capture of wild gibbons was contemplated during the workshop. However, if PHPA decides to interactively manage the metapopulation, it may need to capture gibbons for translocation programs or for other reasons. The following suggestions may be of use in developing these techniques if capture of free-ranging gibbons becomes necessary.

INTRODUCTION

A number of possible capture techniques for wild gibbons were considered. These are discussed below and are presented in the order of probable success (highest to lowest) as agreed by group consensus. The group recommends that discussions with gibbon poachers take place prior to any capture attempts, as these poachers may provide useful information regarding gibbon capture techniques. The group also believes that any capture technique that is attempted will require extensive preparation and careful planning for all contingencies to maximize the chances for success. Finally, the group believes that captured gibbons, scheduled for a captive management program, should initially be housed in large enclosures at the capture site. This will allow the animals to adjust to captivity and to be gradually switched to a captive diet before being moved to permanent facilities.

CAPTURE TECHNIQUES FOR CONSIDERATION

Night capture: Locate a gibbon sleeping tree. Dart the animals with an anesthetic. As the drug takes effect, the gibbon is likely to fall out of the tree and will need to be caught with nets before it hits the ground. If the animal becomes lodged in the tree, experienced climbers and climbing equipment needs to be available.

Net traps: Habituate gibbons to a feeding station which has spring loaded hoop nets mounted on either side. Once the animals are habituated to the feed station, the net trap can be sprung remotely, trapping one or more gibbons in the nets. It seems unlikely that the remainder of a family group will return to a feeding station once the first animal has been caught, although it may be possible to use the first animal to lure at least a portion of the remainder of the group to a trap. It would probably take months to get a group of gibbons habituated to a feeding station (if it is even possible at all).

Darting: Attract gibbons to a darting area by using recorded gibbon calls or habituating to a feeding station. Assuming that a gibbon could be darted, it would probably be quite difficult to follow this animal as it moved through the canopy. Failure to keep the animal in sight could result in a dangerous or fatal fall for the animal after the drug took effect. It may be possible to use a captured gibbon as a lure to attract other members of the family group to the darting site. The problems of tracking and preventing a potentially fatal fall would apply equally to each gibbon darted.

Remnant forest patch: Divide the forest patch containing the gibbons by cutting a 30 m wide path. Locate the gibbon group and divide the forest patch again with a clear cut. Keep dividing the forest patch with clear cuts until the gibbon group is trapped in a relatively small patch of forest (about 100 m diameter). Dart the animals. Flight distance will be limited by the size of the forest patch, making it more likely that the gibbons can be caught in nets as they fall out of the trees. If this technique works, it would probably be the most stressful on the gibbons, but might be accomplished in days or weeks instead of months.

Box traps: Same as net traps, but lure the animal into a box trap. This technique suffers from the same problems as the net trap technique and has the additional problem of persuading a wild gibbon to enter an enclosed space (the box trap). ■

Javan Gibbon and Langur Population and Habitat Viability Analysis Report

Section 3:

PHPA Action Plan

Javan Gibbon and Javan Langur Action Plan

Jatna Supriatna, Ronald Tilson and Workshop Participants

RECOMMENDATIONS FOR WILD JAVAN GIBBON POPULATIONS

The following recommendations for conservation management focus primarily on wild populations of gibbons, which were derived from the results of Vortex modelling simulations based upon current knowledge of wild gibbons. Wild langur populations were not modelled, mostly due to time constraints. The simulations for gibbon populations assumed that there would be no future loss of protected habitat and no loss from hunting or poaching.

1) Population management goals for the entire wild population of the Javan gibbon (*Hylobates moloch*) need to be developed to ensure the long-term survival of the species.

2) The current combined subpopulations of approximately 400 *Hylobates moloch* left in Java are not sufficiently large enough to be considered an evolutionary viable population. Because they live in multiple fragmented populations (at 21 sites), they will need to be managed as a metapopulation through some form of genetic supplementation.

3) Populations of 200 or fewer individuals, in habitat that will not support a larger population, will require continuing monitoring and will require periodic genetic supplementation. These populations should be evaluated and monitored individually and suitable conservation management plans developed for their particular needs.

4) The removal of one adult female with young per year from stable populations of 100 or fewer individuals (considered to be at or near maximum densities) will approximately double the risk of extinction. The protection of these small populations from removals should be of the highest priority.

5) The approximately 18 subpopulations of *Hylobates moloch* smaller than 27 gibbons are not viable over 100 years (this includes seven populations of 10-26 animals and 11 populations of fewer than 10 animals). The risk of extinction varies from 20 to 100%, depending upon the amount of environmental variation. If these populations are to survive they will require active genetic and demographic management as part of the metapopulation.

6) The 11 populations of fewer than 10 individuals are at high risk of continuing decline and extinction even if their habitat is expanded. These populations need to be considered as candidates for more extreme management strategies, such as rapid habitat expansion, genetic supplementation, translocation, captive propagation, or a combination of these options.

7) The history of the decline and the current status of the Javan gibbon support its being classified as critical by the IUCN/SSC Mace-Lande criteria for threatened species.

RECOMMENDATIONS FOR JAVAN GIBBON AND LANGUR HABITAT PROTECTION

The Javan gibbon and Javan langur, because of their restricted habitat, fragmented populations, and small population numbers, will need wise conservation management strategies for their long-term survival. The following prioritized recommendations for habitat conservation address immediate and critical conservation issues for these two species:

8) Assess the current extent of gibbon and langur habitat protected areas using all available technology--satellite imagery, current aerial photographs, available geological, vegetation and PHPA land-use forest status maps, geographic position system (GPS) units to ground-truth field observations--to develop a comprehensive geographic information system (GIS).

9) Complete a Java-wide population and habitat survey for gibbons and langurs at all sites less than 5 km^2 in extent, and at sites of uncertain land-use forest status. The Indonesian Primatological Society needs to form a research team comprised of individuals from universities, PHPA, NGOs and research institutions to assess sites that have been positively determined to have gibbon and langur populations. The 15 most significant Javan gibbon sites and the six most important Javan langur sites to be surveyed were identified and prioritized.

   The 15 most important Javan gibbon sites to be surveyed include G. Jayanti, Lengkong, Porang, G. Salak, Telagawarna, G. Kancana, G. Malang, G.Sanggabuana, Bojongpicung, Pasir Susuru, G. Simpang, G. Tilu, G. Kendang, G. Slamet and G. Wayang.

   The six most important Javan langur sites to be surveyed include G. Jagat, Rawa Danau, Patenggang, G. Slamet, G. Halu and Cisolok. Other critical sites include G. Simpang, G. Tilu, G. Telagawarna, G. Bukittunggul, G. Papandayan, Kamojang and Leuweung Sancang.

10) Train and educate PHPA staff and local NGOs by IPS representatives and other primate professionals on how to census and monitor primate populations and how to collect ecological data on primates in their respective parks and conservation areas.

11) Census annually gibbon and langur populations and evaluate their habitat by trained PHPA staff and primatologists in the national parks and other conservation areas identified in the Java-wide census. This database is to be linked with the National Biodiversity Network Database.

12) Increase public awareness and encourage local community participation in the conservation of gibbons and langurs by PHPA staff and NGOs. This recommendation is further expanded upon by recommendations of the Human Demography and Community Participation in Conservation Working Group.

13) Integrate conservation management policies of PHPA to strengthen law enforcement in protected and important conservation areas as identified as priority sites in the Java-wide census.

14) Local communities must be involved in designing and implementing park management programs using a "bottom up" planning process to encourage local communities to fulfil their responsibilities.

15) Community development funds should be expanded to increase the capability of PHPA staff to support the sustainable development of local communities and to gain their cooperation in park management.

16) Partnerships should be sought with NGOs because they can provide more flexible support for local community involvement in sustainable development than can be provided by National Park Offices.

17) PHPA park staff should be provided with training in workshops concerned with conflict resolution and participatory community planning exercises.

RECOMMENDATIONS FOR JAVAN GIBBON & LANGUR CAPTIVE MANAGEMENT

Given the low population estimates of wild Javan gibbons and Javan langurs, their extreme fragmentation, their low reproductive potential, the continued encroachment and degradation of their habitat, and insufficient habitat protection and law enforcement measures, the workshop participants recommended that a captive management program for both species be developed immediately. The following recommendations will guide this program:

18) It is recommended that a captive management program in Indonesia be initiated immediately that is linked with, and in support of, the long-term conservation of Javan gibbons and Javan langurs.

19) These captive management programs should be under the direction of PKBSI, in cooperation with PHPA, and formulated as a regional Javan gibbon and Javan langur program for Indonesia.

20) The PKBSI captive management program for gibbons and langurs should be based on founders already in captivity, and not extracted from wild populations.

21) Registered Javan gibbons and Javan langurs that are privately held should be considered for confiscation by PHPA and incorporation into the PKBSI regional captive management program.

22) Every PKBSI Javan gibbon and Javan langur should be permanently identified with a transponder implant and tattoo and assigned an institution accession number.

23) Permanent PKBSI behavioral, medical and nutritional records should be kept in a computerized database for individual gibbons and langurs.

24) Each gibbon and langur donated to PKBSI will need supporting documentation regarding whether it was wild-caught or captive born; if wild-caught, supporting documents need to be furnished regarding capture location and PHPA records if available.

25) PKBSI zoos and long-term holding facilities should participate in the International Species Inventory System (ISIS) and information should be exchanged between facilities.

26) Specific recommendations for PKBSI gibbon management protocols, including shipping, public safety, facilities, enclosures, feeding, and gibbon introductions were established by the Javan Gibbon Captive Management Working Group.

27) All Javan gibbons entering the PKBSI captive population from the wild or from a private individual should be quarantined for at least 12 weeks and disease tested, examined, blood serum banked, and immunized according to recommendations made by the Javan Gibbon Diseases Working Group.

28) All PKBSI Javan gibbons transferring between zoo facilities should be quarantined for at least 30 days and disease tested, examined, blood serum banked and immunized according to recommendations made by the Javan Gibbon Diseases Working Group.

29) All PKBSI Javan gibbons in captivity should be tuberculin tested annually and all tuberculin reactors should be treated for tuberculosis.

30) If reintroduction of PKBSI gibbons becomes a viable possibility by PHPA, detailed prerelease quarantine and disease testing protocols need to be developed **prior** to release of any animals. In any case, gibbons with a history of tuberculin reaction or that test positive for hepatitis B (antigen or antibody) should not be considered for a release program, as these animals may represent an unacceptable risk to the wild population.

31) If translocation becomes a PHPA management strategy for wild Javan gibbon populations, disease surveys of the wild populations needs to be completed **before** wild gibbons are translocated from one population to another. If gibbons are translocated to a site that does not contain gibbons, then disease testing could occur as the animals are moved.

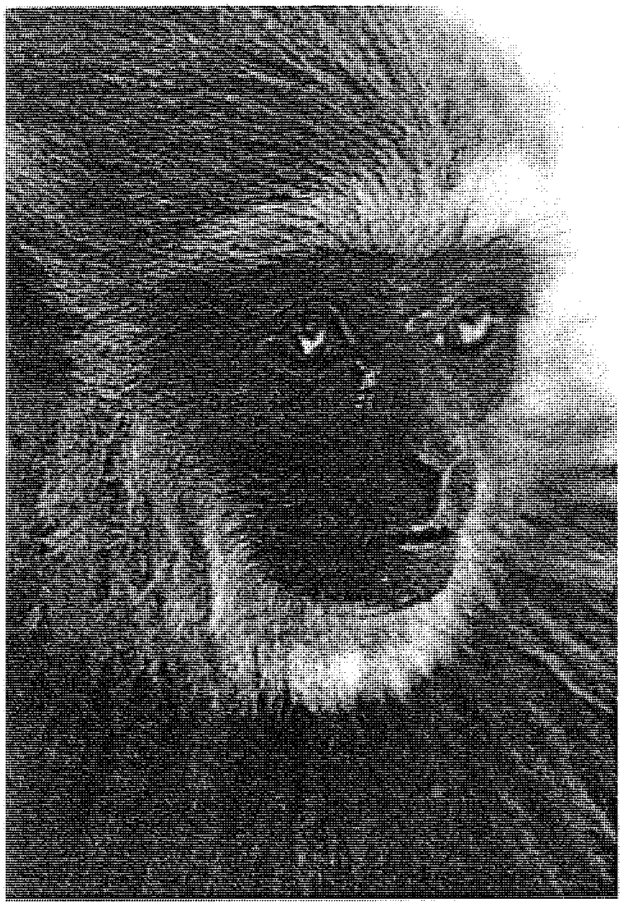
The combination of the above objectives form the basis of the PHPA conservation management strategy for Javan gibbons and Javan langurs. This document was prepared in draft form during the workshop, and will be reviewed and revised by key participants before it is published. It will include specific recommendations and priorities to PHPA for the long-term conservation, management and research of wild populations of Javan gibbons and Javan langurs, as well as specific recommendations for captive populations. ■

Javan Gibbon and Langur Population and Habitat Viability Analysis Report

Section 4:

Supporting Reports and Articles

Computers to the rescue of rare species



A Javan Silvery Gibbon *(Hylobates moloch)*. A recent workshop on the Javan Gibbon and the Langur in Puncak, West Java, introduced the use of VORTEX computer software to learn about the state of these primates and their chances for survival.

By Pamela Lorentz

PUNCAK, West Java (JP): Every animal in our world today has an extinction time clock ticking away. It is only in our lifetime that this sad but true realization has been accepted by much of the world community.

Indonesia has taken another historic step to try and slow down the clock by holding its fifth Population and Habitat Viability Analysis Workshop (PHVA) in Puncak, West Java, from May 3 to May 6.

The Javan Gibbon and Langur conference/workshop was hosted by the Ministry of Forestry, the Indonesian Primatological Association, and Taman Safari Indonesia. It brought together scientists, government agencies, and non-governmental organizations (NGOs) concerned with primates to learn a process for the recovery of i: formation and how to use new computer software.

This program is emerging as a breakthrough in the seemingly impossible task of predicting the future of an animal species on our planet. Through the use of simulated models, it gives concerned governments a realistic picture of what must be done to save the species existence and most importantly when to do it before it is too late.

This was a computer workshop with an important twist. The software program, named VORTEX, was brought into Indonesia by the Captive Breeding Specialists Group of the Species Survival Program, a division of the World Conservation Union (IUCN).

VORTEX is useless without the wealth of knowledge and expertise that only Indonesians can provide about their country and their animals. This is not a case of foreigners coming to Indonesia to tell Indonesians what to do with their country. That has rarely been successful, or beneficial in the past.

Simulation

Two primates, the Javan Gibbon and Javan Langur, were chosen in advance of the workshop for case study simulation models and utilize the VORTEX program. Research data from Indonesian primatology students was used to estimate the number of Javan Gibbons and Langurs remaining and the current state of their habitat.

This data is never easy to gather as counting the number of any species over a large area is scientific guess work at best and primates such as the Gibbon are extremely difficult subjects due to their natural avoidance of humans and their mobility in dense vegetation.

Indonesian scientists, representing many different fields such as population biologists, primatologists, conservation management specialists, forestry ecologists, reproduction biologists, geneticists, human demographers, zoo biologists, veterinarians, park managers, and species field researchers, all came together to learn and work with this new conservation computer system. Government agencies were also well represented by high level individuals.

Everyone at the workshop worked at a fever pace once they saw how PHVA and VORTEX worked. This workshop with its information sharing process and the program, VORTEX, takes everyone's research data, their personal knowledge of Indonesia and the current environmental picture and in a mater of seconds, the computer can analyze the wealth of information from their lifelong hard work. The result is a fairly definite estimate of the time count-down to extinction of the chosen example.

The frustration and helplessness commonly felt by scientists, knowledgeable government and NGO employees in conservation and wildlife, is severe. They spend their professional life watching and researching what is happening to the world, but suffer the inability to change it all.

'Do something'

The public wants someone to save the plants and animals, but they also want to live well and have freedom to prosper as they see fit for themselves. Because the public doesn't have any idea of how to have both — the freedom to exploit the environment and at the same time to save it — they look to these same scientists, the government and NGOs and say "Do something".

The scientists know that human prosperity through exploitation equals environmental disaster as is now being realized. PHVA and VORTEX gives them a small tool to forecast the results of this collision between humans and their environment.

It gives the government a small tool to use in the form of scientific extinction calendar, to try and not only make the (possibly unpopular) necessary decisions but it is also a useful tool to justify the need for these decisions and to educate the public as to why.

Everyone wants to see that human prosperity can be achieved with as minimal an amount of destruction as is feasible and without total species extinction. It also gives the concerned NGOs a clearer picture of the difficulty the scientists, government agencies and they themselves face. The best part about all of this is the fact that it is Indonesians coming together in a workshop to try and help Indonesian animals.

The three parts of the PHVA program are:

1. Gathering the most current and correct species environmental and population data.

This is a slow and difficult part as every imaginable thing that happens in the environment to the species effects its survival. It does not matter whether it's a natural disaster such as fires, floods, storms, diseases, or a human-made impact such as habitat destruction for man's use, poaching, hunting, pet trade, use of the animal for food or human induced diseases. They all speed up the ticking of the extinction time clock.

Each Indonesian researcher, in the concerned field, has a wealth of knowledge which must be written down from their heads or data research into a format to answer specific questions for the computer program.

Valuable knowledge

To underestimate the value of their observations and knowledge (even to the lowest position worker) is to lose valuable knowledge that could help save the wild species.

The government and NGO personnel do the same. They are inputting into another program all the recorded human demographics. They also input the current and future industrial, agricultural or private business plans for the environmental habitat of the species, and the number of privately-owned registered pets of the species.

Their knowledge and cooperation is also invaluable as they are the record keepers, planners and regulators. Without their information the results form the computer program will be incomplete.

Next comes the captive species specialists who input all the known data on the number of that species in captivity such as zoos, private institutions and captive breeding programs. They add their knowledge about the life cycle, reproduction, genes and health requirements of the species when in captivity.

They too are an imperative source of knowledge and data which must be written down so it is not lost. All of these questions must be answered for the computer program to be as close to an accurate picture as possible.

2. The second part of the PHVA is the inputting of all this data as collected by each group and making sure that some "unique questions" that must be included and answered because of the uniqueness of the species are not left out of the program.

VORTEX and the workshops themselves are constantly changing and improving with each workshop given. As Indonesians learn the program, so does the program improve through use. The program will never be a perfect system and must constantly improve and change to meet the ever-changing situation and parameters.

Next the computer does the fast part. Before your eyes in a matter of seconds, VORTEX analyses everything and a time table year by year is printed out starting today until extinction.

Anticipation

In the Gibbon and Langur workshop at Taman Safari Indonesia, the anticipation of the results of all of this was so intense that you could feel each representative holding their breath. As the computers first started to extrapolate and print out the extinction "clock calendar", the magnitude of the answer to be realized was well known, the results were not.

Waiting even the seconds to find out how long the Javan Gibbon and Langurs would grace this island (or the world) was like waiting for a human doctor to figure out your own estimated time of death from some dreaded disease.

A full dataset has yet to be collected on the Javan Langur. Until all the information is complete, no results can be obtained. Unfortunately the completed results for the Javan Gibbon are not good.

Through all the discussion and data gathering, a consensus was reached and it read: Approximately 300 Javan Gibbons were observed in the wild which leads the scientists to believe approximately 2,000 or 2,500 may be left as you cannot possibly see them all. Hence the scientists guess work. This is a critically low number and puts this Gibbon at very high risk of extinction.

Whatever actions to save the Javan Gibbon will have to be in a speedy fashion. Numbers are deceptive! One major fire can kill or destroy the habitat or many animals in just hours or days.

3. The third part is the decision making section and perhaps the most difficult for humans. Once you have an estimate of how many months, or years, the species has before extinction, the workshop must make recommendations for the actions that are imperative to be taken to save the species.

Again it requires the complete cooperation and dedication of all the different groups. The scientists, government and NGOs must all be realistic in terms of saving the species within the realm of what is possible to do taking into consideration the desire of all humans for more freedom and a better personal life.

The two do not mix easily and the loser is usually the animal species unless realistic goals and timely implementation take place. The workshop groups must plan for the wild species population, the current captive species population and the possible captive breeding steps.

All of these steps must be taken in concert to ensure that you don't wake up one morning and realize you have too few live breeding pairs to save the species and the clock has stopped ticking!

It is important to remember that this workshop was only the fifth of its kind in Indonesia, and only the 15th in all of the Far East. Hopefully this type of workshop will prove to provide a giant step in the right direction for conservation and the possibility of saving for your children their natural birthright.

That birthright is to inherit the responsibility of caring for their planet which holds as many of the living species as we can save for them to carry on with and so it will hopefully go on to their next generation.

Any sharing of scientific tools and cooperation between nations, the scientific community, the Indonesian scientists, the Indonesian government, NGOs, conservationists and the Indonesian population that will help this goal is to be congratulated and greatly appreciated by everyone because of its benefit to us all.

If computers can help humans save plants and animals in Indonesia through the efforts of Indonesians with the scientific and financial support from us all, then it is a giant conservation step. Indonesia has not only recognized the benefit for their country of these scientific tools but also come together and worked cooperatively to learn and use it.

The current distribution and status of the Javan Gibbon

Report to Javan Gibbon PHVA workshop, Cisarua, W. Java, May 3-5, 1994.

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Introduction

The status of the Javan gibbon is probably critical (Mace & Lande category). Kappeler (1984) estimated that fewer than 8000 gibbons remained in 1978. Subsequent habitat degradation has further endangered the species. A comprehensive survey of the distribution and status of the Javan gibbon (*Hylobates moloch*) was undertaken in March 1992, September 1993 and March-April 1994. The data collected during this survey are presented in this paper.

Management recommendations from the survey results are presented in "Javan Gibbon Conservation: an Action Plan" (Asquith *et al.* 1994), presented at the Javan Gibbon PHVA workshop, Cisarua, May 1994. In the action plan, we recommend improved protection of Gunung Halimun National Park and the Gunng Honje section of Ujung Kulon National Park, protected status for Gunung Wayang and Gunung Salak forest plantations and further research into the viability of gibbon populations in Gunung Simpang Nature Reserve and the forestry plantation around Gunung Kendang. We do not recommend a captive breeding program at present, but suggest that if an *ex situ* conservation program is commenced, funding be concentrated on the reintroduction of gibbons into the Gunung Payung section of the Ujung Kulon National Park.

The 1992-4 survey concentrated on areas where Kappeler found gibbons in 1978, but we also visited other potential gibbon habitat. At each location we surveyed for audio and visual cues of gibbon presence and interviewed local informants. The summary statistics presented here rely on our own personal observations. Secondary sources are treated only as additional data. However, all data collected by the survey are presented in table 1.

Results

Kappeler (1984) found that gibbons inhabited 37 patches in 22 areas, plus potentially another 3 patches in 2 areas. The 1992-4 survey found that gibbons were no longer evident at 16 of these patches in 11 areas (table 2). Of these 16 patches 12 had been severely disturbed and were no longer suitable habitat. The other 4 patches, though still comprising suitable forest were too small to support gibbon populations. We found gibbons still inhabiting 23 patches in 16 areas. We also discovered a gibbon population on Gunung Salak which was missed by Kappeler. We did not visit one site in central Java (Gunung Lawet) where Kappeler recorded gibbons.

There appears to have been substantial loss of gibbon habitat since 1978, although different methodological assumptions preclude precise assessment of the magnitude of this trend. Previously quite large gibbon populations have disappeared from Telagawarna, Gunung Masigit, the Gunung Papandayan massif and parts of Gunung Simpang. Other destroyed habitat areas include Gunung Kancana, Gunung Malang, Gunung Malabar, Gunung Bukittungal and Tangkuban Perahu. However, many of the larger areas of gibbon habitat protected in National Parks and Nature Reserves have remained relatively intact. A discussion of the implications of these results are presented in Asquith *et al.* (1994).

For the larger areas of gibbon habitat we have made crude estimates of population size (table 3). These were made using the gibbon density estimates of Kappeler (1984) and RePPProT landuse maps (1989) to assess forest extent. Details of the methodology used in making these estimates is given in the appendix of Asquith *et al.* (1994). It must be stressed that the estimates are based on out-of-date and incomplete data, but we believe they are currently the best available.

We estimate a total population of less than 3000 gibbons, 2020 of which are within the protected areas of Gunung Halimun N.P. (870), Gunung Honje (Ujung Kulon N.P.)(550) and Gunung Simpang Nature Reserve (600). Other potentially substantial populations are in the unprotected forest plantations around Gunung Wayang (300), Gunung Salak (140) and Gunung Kendang (250). Gibbon populations in other areas probably number less than 300 individuals.

These figures represent the maximum total for each gibbon population. Actual population size is probably much lower, owing to habitat degradation since the landuse maps were published. With fewer than 3000 individuals remaining and a high rate of habitat loss the status of the Javan gibbon is critical. We therefore urge that the management recommendations in the Action Plan be adopted.

Table 1. Results of survey of the Javan gibbon in West and Central Java

Sites/location	Presence or absence	Group sighted	Notes
1. **Ujung Kulon**			
a. Cibandawoh	+	Gurmaya *et al.* 1992	
b. Karang Ranjang	+	(2groups/A cue)	
c. Kalajetan G. Payung	+	Asquith 1993	
d. Kelapa Beureum	*	We found no evidence of gibbons, but habitat quality is very good.	
e. Sanghiang Sirah-Cibunar	*	″	
Gurmaya *et al* (1992) and Asquith (1993) reported the distribution of gibbons in Ujung Kulon Nat. Park. and G. Honje			
2. **G. Honje**			National Park
a. Honje utara	+	Gurmaya *et al.*1992	
b. Honje selatan	+	″	
3. G. Halimun			National Park
a. Nirmala	+	(2 groups/AV cue)	
b. Cikaniki	+	(2-3 groups/AV cue)	
c. Cianten Herang	+		
Kool (1992) and Ghofir (1989) studied the Javan gibbon in G. Halimun.			
4. **G. Jayanti**			
a. G. Batu/Legok Muncang	+	(1 groups/A cue)	small patch protected forest under Perhutani
b. Citepus, Jayanti	+	(1 groups/A cue)	small patch protected forest under Perhutani
c. Tangkuban Perahu	+	(1 groups/A cue)	Natural Reserve
5. **Lengkong**			
a. Puncak Bule	+	(1 group/V cue)	Remnant Forests in forestry plantation area
b. Desa Ciletuh	+	(1group/V cue)	
c. Cimonyet	+	PHPA guard (Pers. comm.)	
d. Mayapati	+	″	
6. **G. Porang**			
a. Pasir Muncang	+	(2 groups/V cue)	Gibbons only inhabited two small patches of forest, one group living in a 2 ha patch (within forestry plantation)
7. **G. Salak**			
a. G. Perbakti	+	(1 group/A cue)	
b. Javana Spa Area	+	(2 grups/A cue)	Natural forest in forestry plantation
c. S. Cianten Herang	+	(1 group/V cue)	
In the area controlled by UNOCAL Geothermal Project, only 0.5 km from G. Halimun Nat. Park we found 1 group (V-Cue). There is no connection between the G. Salak and G. Halimun forests.			
8. **Telagawarna**			Natural Reserve
a. Puncak Pass	-		
b. Telagawarna Lake	-		Recreation Park
We checked 2 places i.e Puncak Pass and Telaga Warna Recreation Park but did not extensively check the 4.000 ha Natural Reserve. There may be gibbons in this area, but this is unlikely as the forest seems very disturbed.			

9. **G. Gde-Pangrango**		National Park
a. Cibeureum waterfal	+ (2 groups/A cue)	
b. Pasareang	+ (1 group/V cue)	
c. Situgunung	+]	Data from Taufan (Pers. comm.)
d. Salabintana	+]	
e. Bedogol	+]	
f. Cisarua	+]	Data from National Park Guard (Pers. comm.)
g. Ciawi	+]	
10. **G. Kancana**	-	Forestry plantation
11. **G. Malang**		
a. G. Beuleud	+]	Data from Perhutani staff (Pers. comm.)
b. Ciguha	*]	
c. Cadas Takokak	+ (1 group) (PHPA)	Remnant forest (50 ha)
d. Cadas Malang	+ (1 group) (PHPA)	Remnant forest (50 ha)
12. **G. Sanggabuana**		
a. Cisaat	+ (1 group/AV cue)	Protected Forest under Perhutani
b. Telaga Bawah/G. Ayunan	+ (1 group/AV cue)	Forestry Plantation

We also found one juvenile Gibbon Pet at Cisalak

13. **Bojongpicung**		Remnant forest
a. G. Tugu	+ (1 group/V cue)	
14. **Pasir Susuru**		Forestry Plantation
a. Cicadas-Citembong	+ (1 group/A cue)	
b. Cimangsud	+ Data from Perhutani staff	
15. **G. Masigit**		
a. Rancabali	-]	Tea/Forestry plantation
b. Cibeber	-]	
c. G. Halu	-]	
16. **G. Simpang**		
a. Londok	+ (1 group/A cue)	
b. Pasir kuda	- forest being cut by Tea Plantation Company	
c. Cibatuireng	+]	Data from Taufan (Pers. Comm.)
d. Cikupa	+]	
17. **G. Tilu**		
a. G. Tilu	-	
b. S. Cikahuripan	+ (1 group/AV cue)	
b. G. Sumbul	+ (2 groups/V cue)	
c. Puncak Cacing	-	

We found no gibbons in G. Tilu (Gambung) (1400 m to 2100 m), but gibbons were found at G. Sumbul and Cikaahuripan (southern Dewata Tea Plantation) in Tilu Nature Reserve.

18. **G. Tangkuban Perahu**		
a. Jayagiri	-	Recreation Park/Plantation
b. Ciater	-	Protected forest
19. **G. Malabar**		
a. G. Puntang	-]	Tea/forestry plantation
b. G. Haeruman	-]	
c. G. Malabar	-]	
20. **G. Bukittunggul**		
a. Desa Bukittunggul	-	Plantation

21. **G. Papandayan**			
a. Kawah G. Papandayan		-	Forestry Plantation
b. Ciangkrong		+ (1 group/V cue)	
c. Pasir Negla	Arjuna	+	Data from Perhutani staff
d. Pasir kohol	Arjuna	+	Data from Perhutani staff
e. Tumaritis	Arjuna	+	Data from Perhutani staff
f. Kawah Kamojang		-	Forestry plantation and Recreation Park
22. **G. Limbung**		-	Logged forest

G. Wayang: Kappeler (1984) showed as a patch of G. Limbung forest

a. G. Wayang	+ (2-3 group/A cue)	
c. G. Kasang-G. Wayang	+	Data from Perhutani staff
d. Nyomplong	+	Data from Perhutani staff
e. G. Halimun	+	Data from Perhutani staff
23. **G. Cikuray**	-	Forestry Plantation
24. **Leuwiang Sancang**		
a. S. Cipangisikan	+ (2 group/A cue).	PHPA staff recognise a population of 4 groups.
b. S. Cipunga	+ Data from PHPA Staff	
c. Bantarlimus	+ (1 group/V cue).	Gibbons were observed in small remnant forest outside Leuwiang Sancang Nature Reserve
25. **G. Slamet**		
a. Kramat	+ (1 group/V cue)	
b. Pancuran Tujuh	+ (2 groups/AV cue)	
c. Serang	*	

Martarinza *et al.* (1992) reported distribution, density and habitat of gibbons in G. Slamet, Central Java.

Notes:

(+) : Forest inhabited by gibbons; (-) : No evidence of gibbons
(x) : Forest with very few gibbons;
(?) : Forest not visited; occurence of gibbons unknown
(*) : Forest potentially inhabited by gibbons. Survey found no evidence of gibbons.

Table 2. Distribution of the Javan gibbon in 1978 and 1994 and patterns of forest disturbance

LOCATION	Kappeler 1978	Martarinza *et al.* 1994	Reason for very few gibbons	Level of Disturbance
West Java				
1. Ujung Kulon	x	x	Fragmented lowland forest	Low
2. G. Honje	+	+		Low
3. G. Halimun	+	+		Medium
4. G. Jayanti	+	x	Small patch	High
5. Lengkong	+	x	Small patch	High
6. G. Porang	+	x	Small patch	High
7. G. Salak	–	+		Medium
8. Telagawarna	+	–		High
9. G. Gde-Pangrango	+	x	Fragmented lowland forest	Low
10. G. Kancana	+	–		High
11. G. Malang	+	–		High
12. G. Sanggabuana	?	x	Fragmented lowland forest	High
13. Bojongpicung	?	x	Small patch	High
14. Pasir Susuru	+	x	Small patch	High
15. G. Masigit	+	–		High
16. G. Simpang	+	+		Low
17. G. Tilu	x	+		Low
18. G. Tangkuban Perahu	x	–		High
19. G. Malabar	+	–		High
20. G. Bukittunggul	x	–		High
21. G. Papandayan	+	+		High
Kawah Kamojang	?	–		High
22. G. Limbung	+	–		High
Now G. Wayang	+	+		High
23. G. Cikuray	–	–		High
24. Leuwiang Sancang	+	x	Fragmented lowland forest	Medium
Central Java				
25. G. Slamet	x	x	Fragmented Lowland forest	High

Notes:

(+) : Forest inhabited by gibbons; (–) : No evidence of gibbons
(x) : Forest with very few gibbons;
(?) : Forest not visited; occurence of gibbons unknown

Table 3. Gibbon habitat and population size in West and Central Java

LOCATION	Forest status	Patch number after Kappeler (1978)	Estimated (square km)	Estimated population
West Java				
1. Ujung Kulon	NP	1	85 (1 and 2 combined)	550
2. G. Honje	NP	1		
3. G. Halimun	NP	3	269	870
4. G. Jayanti	FP & NR	1	small	
5. Lengkong	FP	1	small	
6. G. Porang	FP	1	small	
7. G. Salak	FP & PP	2	70	140
9. G. Gde-Pangrango	NP	1	medium	
11. G. Malang	FP & NR	2	small	
12. G. Sanggabuana	FP	2	medium	
13. Bojongpicung	FP	1	small	
14. Pasir Susuru	FP	1	small	
15. G. Masigit	FP & NR	3	small	
16. G. Simpang	NR & FP	4	140	600
17. G. Tilu	P & NR	1	medium	
21. G. Papandayan	PP & FP	2	120	250
22. G. Limbung	FP	2	-	
Now G. Wayang	FP		85	300
24. Leuwiang Sancang	NR & FP	5	small	
Central Java				
25. G. Slamet	FP	1	medium	
Total		35	Estimated population in 6 largest areas 2710. Maximum probable population 3000.	

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