SUMATRAN ORANGUTAN Conservation Action Plan

Workshop Report

Berastagi, North Sumatra, Indonesia

20-23 September 2005

PanEco

Leuser International Foundation

Conservation International

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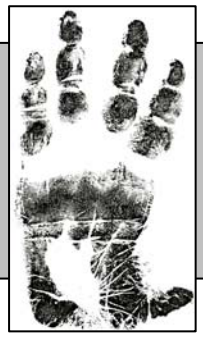
Dedicated to the memory of

Governor Tengku Rizal Nurdin
(1948 – 2005)

Friend of the Orangutan and Sumatra's Forests



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SUMATRAN ORANGUTAN CONSERVATION ACTION PLAN EXECUTIVE SUMMARY

INTRODUCTION

As little as four decades ago, the island of Sumatra was almost completely covered by tropical forests. Old growth forests in Indonesia, on which orangutans depend, have declined by more than 80% in the last 25 years, largely due to logging and conversion for plantation agriculture – resulting in plummeting orangutan populations. The Sumatran orangutan *(Pongo abelii)* thrives in lowland alluvial plains, swamplands and low altitude hill slopes, with orangutan densities declining steadily with altitude. Few or no permanent orangutan populations occur above circa 1,000 to 1,200 m asl. Coastal swamps appear to harbor the highest densities of orangutans on record, anywhere in the world. Low altitude and hillside rainforests are considered the principal habitat type for orangutans in northern Sumatra.

In response to the threats facing the Sumatran orangutan, a Population and Habitat Viability Assessment (PHVA) workshop was held in Jakarta, Indonesia, facilitated by the IUCN/SSC Conservation Breeding Specialist Group in January 2004. In preparation for the PHVA, several investigators assembled information on orangutan distribution and densities in several less known areas in both Sumatra and Borneo, assisted by numerous fieldworkers (van Schaik et al. 2004; Appendix I). Special Sumatran orangutan surveys were carried out since 2000 by Serge Wich, Tine Geurts, Suci Utami and Ian Singleton, and some additional surveys immediately prior to the workshop, to fill in some of the remaining gaps in knowledge, were overseen by Carel van Schaik, with a grant from the Orangutan Foundation UK. The analysis was based on *habitat units,* an area containing one or more forest blocks, as used by Rijksen and Meijaard (1999). The analysis conducted indicated 13 distinct habitat units, some of which are composed of several adjacent smaller forest blocks linked together by secondary/degraded forest, which may be serve as linkages that allow orangutan movement. These habitat units also were used for the present workshop's working group discussions.

The PHVA was attended by numerous scientific investigators working with Sumatran orangutans in the wild (Singleton et al. 2005) and laid a solid foundation for future work by assessing the current scientific data regarding wild Sumatran orangutan populations. PHVA participants acknowledged that saving the orangutan will require input and commitment from all stakeholder groups living in and around orangutan habitat, and that large-scale and coordinated actions are needed so that the limited resources available for Sumatran orangutan conservation are used most effectively. These experts recommended that a Conservation Action Plan workshop, to develop a collaborative strategy for the Sumatran orangutan, be convened, adding additional key people to build upon the work begun at the PHVA and work toward the next level of developing an effective Sumatran orangutan action plan.

The goal of the Sumatran Orangutan Conservation Action Plan workshop was to further develop a common agenda for Sumatran orangutan conservation - with participation by a wide variety of stakeholders, including local communities, local and national government, national and international scientists, the private sector, universities, NGOs and other groups. The workshop was held in Berastagi, North Sumatra from 20-23 September 2005, and was attended by more than 100 participants. Convened under the auspices of the IUCN Primate Specialist Group, the Indonesian Ministry of Forestry – PHKA, Conservation International, the Leuser International Foundation, PanEco, the Sumatran Orangutan Conservation Programme (SOCP), the Indonesian Primatological Society (APAPI), and the South East Asian Primatological Association, the workshop drew on the knowledge, experience and capacities of these stakeholders to identify the most urgent actions needed to save the Sumatran orangutan. Funding was generously provided by the Critical Ecosystem Partnership Fund, the Leuser International Foundation, the Great Ape Action Fund, Conservation International, and the Indonesian Ministry of Forestry.

The workshop began with presentations on the current situation and status of the Sumatran orangutan. Following these presentations, we reviewed the findings from the PHVA, in particular the Habitat Unit information (by Dr. Ian Singleton, SOCP) and the *Vortex* computer simulation modeling results (by Dr. Kathy Traylor-Holzer, IUCN/SSC Conservation Breeding Specialist Group). Four geographic working groups were then formed: (1) Aceh Besar, Aceh Jaya, Aceh Barat, and Pidie districts (encompassing Seulawah, NW Aceh and NE Aceh); (2) the Leuser Ecosystem (encompassing the East Middle Aceh, West Middle Aceh, Tripa Swamp, East and West Leuser); (3) Trumon, Singkil, East Singkil, Dairi and Pakpak Bhara; and (4) West Batang Toru and East Sarulla. Participants chose the working group in which they would participate based on their own interests and expertise.

Each regional working group was asked to:

1. Identify the threats facing Sumatran orangutan populations in habitat areas.
2. Identify opportunities in each habitat area.
3. Identify priority actions to address threats (and taking into consideration opportunities, where possible).

SUMMARY OF WORKING GROUP CONCLUSIONS

Threats to Orangutans

Although threats within each habitat unit differ slightly, workshop participants identified a number of threats present across all habitats. These include:

Habitat loss attributable to legal and illegal logging, conversion for agriculture (especially palm oil plantations), mining, and road development

Illegal logging occurs inside protected areas as well as inside logging concessions, even after legal operations have ceased or slowed down. Illegal extraction of timber also contributes to potential natural disasters such as landslides and resultant flash floods, which affect not only orangutans but local communities. Throughout the orangutan range, all of these practices, legal and illegal, lead to a change in forest function and to fragmentation of habitat.

Shifting cultivation involves communities/villagers selling their land and then immediately clearing and opening up new land. Such conversion tends to be permanent and plots are rarely left fallow to recover. Plantations (palm oil) pose a serious threat to orangutans because they completely convert habitat to a monoculture and cause fragmentation and isolation of remnant orangutan populations. Local governments often/normally see plantation creation as positive as they generate regional revenue. Plantations are often owned by non-local companies or people (often foreign) and often source their labor from outside the local area, causing problems with local communities to the point where they too develop their own plantations/oil palm gardens, thus increasing damage to forests. Oil palm estates also affect water resources as they demand a great deal of water.

Open pit mining destroys all habitat at the surface. Mining also poses a pollution threat, both during processing and in effluent disposal.

New roads open up access to areas for conversion, logging and settlement. There is still no needs study/feasibility study/environmental impact assessment for proposed roads (e.g., Ladia Galaska). Illegal roads branching off into surrounding forests are almost certain to follow the construction of the Ladia Galaska roads network, thus increasing fragmentation of orangutan habitat even further.

Encroachment
New settlements often result in forest encroachment. Many Javanese transmigrants, formerly residing within Aceh, became transmigrants during civil unrest and fled to North Sumatra. Many have settled large areas even within protected areas (e.g., Gunung Leuser National Park), clear-felling the land, converting to agriculture and oil palm plantations, and creating new settlements.

Lack of Law Enforcement
There is a lack of knowledge and a need to educate district governments and their officers to manage natural resources and to stop the involvement of law enforcement personnel in illegal logging. A lack of awareness regarding existing laws, a lack of law enforcement and unclear forest boundary demarcation combine to lead to continued orangutan habitat degradation. Current staffing of protected areas and capacity of existing staff is insufficient for full enforcement of laws against habitat encroachment and poaching.

Hunting and Illegal Trade
Even a low level of hunting threatens the survival of orangutan populations. Although the species is protected in Indonesia, there is a black market which trades in orangutans both domestically and internationally. Hunters can be found among the military and the police, as well as local community members; military and police often are implicated in hunting, either hunting the animals themselves or confiscating them from citizens but not handing them over to the appropriate authorities (instead keeping them themselves, giving them as gifts, or trading them at the markets). The end result is the same with animals either kept as pets or put into trade. There is additional hunting and killing of orangutans when plantations are created, largely because orangutans found in and around plantations are considered pests.

Regional Planning Issues
Regional planning issues, particularly the Aceh reconstruction process, are strongly related to the peace process in Aceh province. Many of the issues center on HPHs (logging concessions) and HGUs (Rights for Business Use). During the conflict years, concessions and estates did not

function because of safety concerns. With the need for timber for rebuilding following the 2004 tsunami, and also the peace process, the moratorium on logging in Aceh has been lifted.

Lack of Awareness
Although nationally there is an emerging awareness of and support for conservation efforts, largely as a result of the attention drawn to these issues by the 2004 tsunami, local populations differ immensely in terms of awareness and education. In general, there is a low level of conservation awareness and concepts of biodiversity conservation, as well as sustainable natural resource management, are poorly understood. Further, linkages between healthy orangutan populations to human well-being and the potential for alternative livelihoods (e.g., from ecotourism) have not been well-articulated or widely disseminated except in very targeted local awareness initiatives.

POPULATION MODELING

Computer modeling is a valuable and versatile tool for assessing risk of decline and extinction of wildlife populations. Complex and interacting factors that influence population persistence and health can be explored, including natural and anthropogenic causes. Models can also be used to evaluate the effects of alternative management strategies to identify the most effective conservation actions for a population or species and to identify research needs. Such an evaluation of population persistence under current and varying conditions is commonly referred to as a population viability analysis (PVA).

At the present workshop, working groups provided new input data and subsequent to the workshop, population models were updated by Dr. Kathy Traylor-Holzer (IUCN/SSC Conservation Breeding Specialist Group) using the simulation software program *Vortex* (v9.61) to examine the viability of orangutan populations on Sumatra. *Vortex* models population dynamics as discrete sequential events that occur according to defined probabilities. For a more detailed explanation of *Vortex* and its use in population viability analysis, see Lacy (2000) and Miller and Lacy (2003).

With current estimated rates and timescale of habitat loss and the associated removal of orangutans, model results indicate that habitat loss and other factors will cause Sumatran orangutan populations to decline about 18-25% in the next 10 years (depending upon conditions) and about 50% over the next 50 years. Sensitivity testing of the baseline model suggests that orangutan populations of about 250 have a high probability of survival in the absence of human-related mortality, habitat loss or unforeseen catastrophic events, but will be significantly reduced in size and genetic variation. Populations of 500 or more are more demographically and genetically stable and may contribute to the long-term conservation of this species. Smaller populations that are linked by occasional exchanges of animals could also contribute to the overall stability of a larger meta-population but are not likely to persist long-term in isolation. Habitat loss decreases viability, and the additional removal of orangutans can quickly drive populations to extinction.

POPULATION MODELING PROJECTIONS AND WORKING GROUP RECOMMENDATIONS FOR ACTION

North Aceh

This region's three Habitat Units (Seulawah, NW Aceh, NE Aceh) hold an estimated 877 orangutans. Threats are primarily attributable to logging (both legal and illegal) and subsequent habitat conversion for agriculture. Illegal logging is found throughout the area. Once cut, forests are being opened up for palm oil plantations, roads, transmigration, mining and slash and burn rice farming – all of which lead to a change in forest function and to fragmentation of orangutan habitat. Human issues, including poverty, and a lack of awareness concerning forest resources and wildlife compound the threats. There is a lack of proactive management of natural resources by the governments in the four districts, including a lack of awareness of laws protecting biodiversity, a lack of enforcement of these laws, and unclear forest boundary demarcation. There are insufficient forest rangers and insufficient capacity in the existing ranger forces to enforce laws against habitat encroachment and poaching. Some forest areas are being opened as a result of the Helsinki Peace Agreement in Aceh Barat and Aceh Besar districts. Transmigration as people move away from coastal areas post-tsunami and concomitant land clearing destroys important habitat too.

Modeling projections for habitat changes in this region suggest that orangutan carrying capacity may decrease by 38% due to expected illegal logging and encroachment, and may decline as much as 75% if logging concessions in NW and NE Aceh are in operation. Orangutans are likely to disappear from Seulawah, even in the absence of further habitat changes. Legal logging concessions will likely cause orangutans to eventually disappear from NE Aceh, and increase the extinction risk for orangutans in NW Aceh to 54% in 1000 years. These projections assume no habitat changes after 10 years; additional habitat loss, fragmentation or removal of orangutans from the wild will lead to decreased viability of orangutan populations in this region.

Recommendations to address threats to orangutans, also taking into consideration opportunities, in North Aceh include:

1. Revitalizing traditional institutions and practices for managing natural resources
2. Utilizing traditional policy for natural resource management
3. Using degraded forests for conservation programs outside existing protected areas
4. Developing a credit scheme for bank(s) to support conservation programs
5. Securing participation from industries for conservation activities
6. Enhancing and strengthening law enforcement against forest and wildlife crimes
7. Re-implementing a moratorium on logging
8. Monitoring the timber supply for rehabilitation and reconstruction
9. Connecting spatial planning for districts to the Aceh and Nias blueprint for reconstruction
10. Revising natural resource regulations

The Leuser Ecosystem Area

The 26,000- km^2 Leuser Ecosystem is by far the largest stronghold of Sumatran orangutans. **This region of core orangutan habitat consists of five Habitat Units (East and West**

Middle Aceh, East and West Leuser, Tripa), totaling an estimated 4280 orangutans [1]. The western portion of the Ecosystem holds approximately 2,611 individuals and the eastern portion supports a population of about 1,389.

Orangutans in Leuser are threatened by the operation of legal logging concessions as well as illegal logging, the latter of which takes place inside protected areas and inside legal logging concessions. Encroachment both by individuals and by community/agriculture migrant groups also usually results in clearing of land for agriculture and oil palm plantations. Plantations, particularly oil palm, pose an extremely large threat as they completely convert habitat to a monoculture, tax water resources and often pollute the local environment. New roads open up access to areas for conversion, logging and settlement, and can result in an increase in natural disasters such as landslides and flashfloods, which have a major impact on orangutan habitat and food sources. Roads also increase fragmentation of habitat and few truly arboreal species (such as orangutans) will cross them. Hunting and trade in orangutans continues due to a black market both domestically and internationally. There is additional hunting of orangutan when plantations are created or forest is converted to agriculture, as they are seen as crop pests. Many orangutan killings occur along the forest edges where orangutans raid crops in areas that were formerly part of their forested home range. Although there is no concrete evidence of major disease epidemics, disease is a continuous potential threat, particularly given the proximity between people and orangutans.

Regional planning issues, including the Aceh reconstruction process, are strongly related to the peace process in Aceh. During the conflict years, many concessions and estates could not function due to safety concerns, but pressure is intense to restart operations to assist with post-tsunami reconstruction. After the peace agreement between the Government of Indonesia and the Acehnese separatists, regional governments are obliged to provide land for agriculture (4 ha per person) to ~3,000 people (thus a total of 12,000 ha have to be found). Mining for coal as well as gold poses a threat not only in terms of habitat destruction, but also by contributing to pollution, both during processing and in effluent disposal. Unfortunately, traditional laws, which governed natural resource management in the past, are no longer practiced or respected in most communities.

Modeling projections for habitat changes in this region suggest that carrying capacity may decrease by about 35% due to expected illegal and legal logging, encroachment, as well as slash and burn conversion. Orangutans are projected to disappear from Tripa in 2-4 years, as 100% of the habitat is expected to be lost. The population in West Middle Aceh is also projected to disappear within the next few 100 years. Reopening the logging concession in East Middle Aceh increases the risk of extinction for that population but has little effect on the regional population as a whole. The majority of the orangutans in this region inhabit East and West Leuser Habitat Units, and are projected to persist in viable numbers for at least 1000 years, even with the projected habitat loss and potential fragmentation due to proposed roads. These projections assume no habitat changes after 20 years; additional habitat loss, a high degree of fragmentation, or removal of orangutans from the wild may decrease population viability.

[1] For the purposes of this workshop this group discussed only East and West Leuser, Tripa Swamp, and East and West Middle Aceh. The Trumon-Singkil swamps, although an integral part of the Leuser Ecosystem, were included in working group discussions with Pakpak Bharat and Dairi.

Conservation action recommendations, also considering the opportunities present in the area, include:

1. Developing a strategy to counter, and reduce pressure to reopen and reactivate 11 new logging concessions, timber utilization permits, and rights for business use in Aceh.
2. Placing more stringent controls on roads and infrastructure development within orangutan habitat.
3. Addressing settlement and land claim issues
4. Stopping the export of illegal timber
5. Increasing coordination and collaboration between government and NGOs
6. Increasing understanding by local communities of conservation concepts
7. Establishing more stringent policies for establishing new provinces/regencies
8. Managing disease risk
9. Clarifying the role of various institutions concerning the Leuser Ecosystem (e.g., the Gunung Leuser National Park Authority, Leuser International Foundation., other NGOs)
10. Clarifying and monitoring adherence to forestry policy in Aceh province post-tsunami
11. Strengthening capacity in traditional laws and enforcement
12. Stopping hunting and trade in orangutans
13. Strengthening law enforcement

South Aceh

This region consists of three Habitat Units (Trumon-Singkil, Dairi-Pakpak Bharat, East Singkil), totaling an estimated 1,794 orangutans. It is important to note that all of the Singkil swamps and much of the Puncak Sidiangkat Habitat Unit also lie within the Leuser Ecosystem. Threats in these areas are similar to other areas, with habitat loss due to deforestation posing the gravest threat. Despite full legal protection, illegal hunting of orangutans is also still a serious threat. There remains a lack of understanding of laws concerning wildlife and natural resource management and a need for increased political will to enforce existing laws. Local regulations (*perdas*) do not yet protect orangutans or their forest habitats.

Modeling projections for habitat changes in this region suggest that carrying capacity may decrease by about 27% due to expected illegal logging, conversion, and encroachment. In addition to animals lost in these habitat alteration processes, additional orangutans are believed to be hunted or otherwise removed from Dairi-Pakpak Bharat. Orangutans are projected to disappear from East Singkil in 4 years, as 100% of the habitat is expected to be lost. The population in Dairi-Pakpak Bharat is projected to disappear within 20-40 years given estimated removal rates; with no additional removals, short-term viability is good, but the risk of extinction is high over the next few 100 years. The Trumon-Singkil Habitat Unit supports a large population of orangutans that is likely to persist, even with projected habitat losses. Projections for south Aceh assume no additional habitat changes after 10 years; additional habitat loss, a high degree of fragmentation, or removal of orangutans from Trumon-Singkil wild may decrease population viability.

Recommendations for action, based on threats as well as opportunities in the area, include:

1. Implementing social-community programs to empower local economies and to develop capacity and productivity in communities living adjacent to orangutan habitat

2. Supporting traditional institutions and integrating traditional knowledge and beliefs into orangutan conservation and awareness campaigns
3. Improving habitat management
4. Supporting research activities, including habitat monitoring, orangutan-human conflict and translocation as a population management tool
5. Enhancing law enforcement and protection of orangutans
6. Strengthening policy to favor orangutan conservation
7. Developing and enhancing communication about orangutan conservation
8. Building capacity in conservation/protected area management at all levels of government and among a wide sector of stakeholders

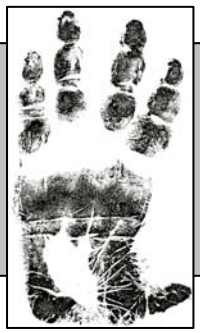
North Sumatra

This region consists of two Habitat Units (East Sarulla, West Batang Toru), totaling an estimated 550 orangutans. Threats include habitat loss from land clearing/ agriculture, mining, and road development. Some hunting of orangutans for food still occurs; practiced by migrants from Nias and indigenous Batak Toba communities. Some 60% of logging concessions in the area are not operational; this contributes to the relatively low annual rate of habitat conversion by logging activities (~2%) compared to other populations. Although the species is fully protected in Indonesia, orangutans are still threatened by trade. There is limited understanding of laws concerning natural resource management, even by government officials, and there is a need to bolster political will to enforce existing laws. Local populations vary in terms of education; in general, there is a low level of conservation awareness, and there has been little community participation in forest management.

Modeling projections for habitat changes in this region suggest that carrying capacity may decrease by 37% due to expected illegal logging and encroachment, and may decline as much as 62% if the logging concession proposed for re-opening does so in West Batang Toru. The additional removal of orangutans is projected to lead to relatively rapid population decline. Even without these removals, the long-term viability of the East Sarulla population is poor. Legal logging jeopardizes the viability of the West Batang Toru population; however, in the absence of legal logging and additional removals, orangutans are projected to persist in this area.

Recommendations for action in these East Sarulla and West Batang Toru include:

1. Improving habitat protection, including expanding protection for good orangutan habitat outside of existing conservation areas/protected areas
2. Providing economic empowerment for community that will support habitat protection
3. Addressing the varied status of area and land ownership to favor orangutan conservation, including investing in efforts to change the status of non-active forest concessions to conservation area
4. Stopping orangutan hunting, including approaching *adat* leaders/religious leaders and other stakeholders for solutions to the hunting problem and facilitating joint law enforcement and monitoring of orangutan populations
5. Proposing and advocating the development of *perda* (traditional law) for protection of the orangutan and its habitat



SUMATRAN ORANGUTAN CONSERVATION ACTION PLAN INTRODUCTION

STATUS AND DISTRIBUTION

As little as four decades ago, the island of Sumatra was almost completely covered by tropical forests. Old growth forests in Indonesia, on which orangutans depend, have declined by more than 80% in the last 25 years, largely due to logging and conversion for plantation agriculture. Deforestation increased acutely after the change in government in 1998, with forest loss rampant regardless of the legal status of the land (Holmes 2000; Jepson et al. 2001; Robertson and van Schaik 2001; van Schaik et al. 2004). As a result, wild orangutan populations have plummeted.

Sumatran and Bornean orangutans merit status as separate species. The Sumatran orangutan, *Pongo abelii,* is listed as Critically Endangered and the Bornean orangutan, *Pongo pygmaeus,* is Endangered on the *IUCN Red List of Threatened Species* (IUCN, 2004). While the viability of both species is in question, the Sumatran orangutan faces a more immediate risk of extinction (Rijksen & Meijaard 1999; van Schaik et al. 2001; Wich et al. 2003; Singleton et al. 2005). Without immediate intervention, orangutan populations are projected to decline even more dramatically within the next few years, and could well become extinct within our lifetime.

Habitat Preference

The Sumatran orangutan thrives in lowland alluvial plains, swamplands and low altitude hill slopes. Orangutan densities decline steadily with altitude with few or no permanent populations above 1,000 to 1,200 m asl. A relatively large portion of the Leuser Ecosystem area (>60%), the species' largest stronghold, is mountainous, with altitudes that reach to 4,000 m asl. Orangutans are distributed in a patchy pattern throughout the region. The most significant demes of orangutans are restricted to the foothills, valley bottoms and the coastal swamps - in particular the Tripa (between Meulaboh and Blangpidie) and Kluet (between Tapaktuan and Bakongan) swamps and in the larger Singkil swamp further south.

The coastal swamps appear to harbor the highest densities of orangutans on record, anywhere in the world. At up to eight or more individuals per km^2 in Kluet, the swamp habitats appear to represent optimal habitat. In dryland forests, such as the alluvial confluence of the Ketambe River and the Alas River at Ketambe research station, densities tend to be lower at around 4 or 5 individuals./km^2, and further east, in the Langkat and Sikundur areas they are lower still, typically between one and three per km^2.

Orangutans seem to favor old growth habitat, especially in Sumatra. Selective logging of these forests results in a decline of orangutan densities by 60% (Rao and van Schaik 1997). It takes more than four decades for a logged-over forest or forest clearance to regenerate back into habitat suitable

to support densities of more than 2 individuals/km^2. Thus, low altitude and hillside rainforests are considered the principal habitat type for orangutans in northern Sumatra.

Determining Sumatran Orangutan Distribution

In response to the threats facing the Sumatran orangutan, in January 2004, a Population and Habitat Viability Assessment (PHVA) workshop was held in Jakarta, Indonesia (see below), facilitated by the IUCN/SSC Conservation Breeding Specialist Group. Prior to the PHVA, several investigators assembled information on orangutan distribution and densities in several less known areas in both Sumatra and Borneo, assisted by numerous fieldworkers (van Schaik et al. 2004; included as Appendix I in this document). Recent surveys had also been undertaken in Sumatra since 2000 (see Wich et. al. 2003). Special additional Sumatran orangutan surveys also were undertaken to fill in some remaining gaps in knowledge, overseen by Dr. Carel van Schaik, and funded by Orangutan Foundation, UK. The analysis was based on *Habitat Units,* an area containing one or more forest blocks, as used by Rijksen and Meijaard (1999). The term refers to distinct areas of orangutan habitat separated by normally impassable barriers such as major rivers or wide swaths of cultivation. A Habitat Unit (HU) corresponds to a separate population, one not easily colonized by individuals from other populations. Where there was doubt about how separate the HUs were, conservative decisions were made so that they could be fused when future work confirms the presence of corridors or corridors can be reconstituted. A single protected area can contain multiple HUs; numbers for protected areas may therefore be split to reflect orangutan HUs.

While Sumatran orangutans are largely concentrated in Aceh, Rijksen and Meijaard (1999) concluded that orangutans might still occur farther south than previously assumed (Wilson and Wilson, 1973; Rijksen, 1978). Recent surveys by Wich (2003; unpublished data) and Singleton (unpublished data) indicate that several of the areas that previously were thought to contain orangutans (Rijksen and Meijaard 1999) did not support populations in 2002 (Wich et al. 2003; Table 1). For at least one of these areas, however (Rimbo Panti), where the presence of orangutans was still considered possible only some 7 years ago, recent habitat loss, degradation and hunting are the most likely causes of their disappearance (Table 1).

Recent surveys (van Schaik et al., 2004) identified three key areas near Lake Toba that contain orangutans: Puncak Sidiangkat, West Batang Toru and East Sarulla (Table 1). Among these three areas, West Batang Toru, the forest block between the towns of Tarutung, Sibolga and Padangsidempuan, is the largest. For the majority of areas south of Lake Toba, previously thought to contain orangutans, van Schaik and colleagues (2004) have confirmed that orangutans are no longer present.

North of Lake Toba, van Schaik and colleagues (2004) reported that no habitat units have disappeared. However, a sharp decline in habitat size has caused a loss of connectivity between major habitat units, specifically the loss of the corridors between the West and East Leuser conservation units, and conversion for palm oil has resulted in considerable losses particularly in the Tripa swamps but also in the northern part of the Singkil swamps.

Table 1. Habitat Units thought to have supported orangutan populations in Sumatra since Rijksen and Meijaard's (1999) overview, and those confirmed in 2000-2002 as habitat units south of Toba (from van Schaik et al. 2004, Appendix I).

Area	Orangutan presence 1994-7*	Orangutan presence 2002**	Reason for absence
Rimbo Panti/G. Talamau	Yes	No	habitat loss/hunting
Pasaman Barat	Yes	No	old information
Baruman	Yes	No	old information
Habinsaran	Yes	No	old information
Ankola-Siondop	Yes	No	old information
Kalang-Anggolia	Yes	No	old information
Tapanuli Tengah	Yes	No	old information
Dolok Sembelin	Yes	No	forest gone
West Batang Toru	Yes	Yes	(south of Toba)
East Sarulla/ Sipirok	Yes	Yes	(south of Toba)

* based on Rijksen and Meijaard 1999

** based on Wich et al. 2003, Singleton unpubl. data, van Schaik unpubl. data, Wich unpubl. data

The process of determining an estimate for the total number of orangutans on Sumatra consisted of two steps (van Schaik et al. 2004). First, a GIS was used to determine the extent of primary forest at different altitudes and, second, surfaces were used to generate population estimates (see van Schaik et al. 2004 for details of the methodology). The survey team first divided the dryland primary forest into Habitat Blocks, which were further divided into 100m height intervals (Singleton et al. 2005). They then defined the HUs by drawing contours around areas of primary forest; secondary forests are believed to be so badly damaged that they are unlikely to contain significant sustainable orangutan populations. It was acknowledged that some of the areas included already have been disturbed and so are not primary forest, but the survey team believed this was offset by not including any orangutans in secondary forest. The team then assigned altitude and site-specific density estimates within each HU.

The analysis conducted indicated 13 distinct HUs (Table 2; see also Figure 1), some of which are composed of several adjacent smaller forest blocks linked to together by degraded forests (van Schaik et al. 2004; Singleton et al. 2005). Only three HUs contain more than a 1000 orangutans. Of these, West Leuser contains the largest population, followed by the Trumon-Singkil swamps and the East Leuser area (Table 2). Of the HUs that contain less than a 1000 orangutans, the North West Aceh area contains the most, followed by Middle Aceh and West Batang Toru. Outside of these six areas there are five smaller HUs, of which the Tripa Swamps is the largest with around 280 orangutans.

The major finding was that habitat had shrunk and was highly fragmented (van Schaik et al. 2004). The Leuser Ecosystem, still the most important stronghold of the Sumatran orangutan, is now fragmented into West Leuser, Trumon-Singkil, East Leuser and Tripa. Inside the two major Leuser blocks, logging and conversion has encroached in such a way that in some parts, much land below 1,000 m is now cleared or degraded, creating jagged edges and possibly a number of habitat

islands (van Schaik et al. 2004; Singleton et al. 2005). Forests in the more densely populated lowland patches are still connected, but animals dispersing between them now are forced to move higher up mountain slopes to do so.

Outside of the Leuser Ecosystem, the North West Aceh and the West Batang Toru HUs are the most important conservation areas for orangutans (van Schaik et al. 2004; Singleton et al. 2005). For consistency, the HUs and population estimates provided by van Schaik, Singleton and colleagues were used for the present workshop.

POLITICAL ISSUES

Indonesia has experienced a profound political and economic transformation over the past decades. Since the implementation of greater regional autonomy, which went into effect in January 2001, after the fall of Suharto, much of the authority for all sectors, including forestry, devolved to the provincial and local governments. Regional autonomy encourages local governments to increase their revenues, often from exploitation of natural resources such as forests, including levying taxes on private and state-controlled operations. District and provincial assemblies are now allowed to pass local regulations that directly affect forest conservation and indigenous livelihoods. This has been viewed as a potentially serious threat to natural resource management, and hence to orangutan habitats, since decisions for further forest conversion can easily be made even if they violate national regulations. However, it can equally be argued that regional governments seem to allow less proclivity towards a '*laissez faire*' approach, and to be more cautious with large scale forest conversion than the central government has been in the past. There is a current trend of re-delineation and fragmentation of *kecamatan* (councils), *kabupaten* (districts), and provinces. This can result in more expedient local policies that facilitate changes in land status within areas and lead to confusion as to who is responsible for their management.

Table 2. Estimated area and orangutan numbers for 13 Sumatran habitat units[2] (from van Schaik et al. 2004 and Singleton et al. 2005).

Habitat Unit	Estimated Orangutan Number	Habit Block	Primary Forest (km^2)	Orangutan Habitat (km^2)
NW Aceh	654	1. Ulumasin (Aceh Besar)	2066	847
		2. Tutut (Woyla; NW Aceh)	1918	832
NE Aceh	180	7. Geumpang (Pidie District)	2116	282
Seulawah	43	6. Seulawah	103	85
West Middle Aceh	103	3. Beutung (W Aceh)	1297	261
		9. Linge	352	10
East Middle Aceh	337	8. Bandar-Serajadi	2117	555
West Leuser	2508	4. Kluet Highlands (SW Aceh)	1209	934
		5. W Mt. Leuser	1261	594
		5A. Kluet swamp	125	125
		10. E Mt. Leuser/Demiri	358	273
		11. Mamas-Bengkung	1727	621
Sidiangkat	134	12. Puncak Sidiangkat/B. Ardan	303	186
East Leuser	1052	13. Tamiang	1056	375
		14. Kapi and Upper Lesten	592	220
		15. Lawe Sigala-gala	680	198
		16. Sikundur-Langkat	1352	674
Tripa Swamp	280	17. Tripa (Babahrot) swamps	140	140
Trumon-Singkil	1500	18. Trumon-Singkil swamps	725	725
E Singkil Swamps	160	19. East Singkil swamps	80	80
West Batang Toru	400	20. West Batang Toru	600	600
East Sarulla	150	21. East Sarulla	375	375
Total	**7501**		**20552**	**8992**

[2] The Sumatra orangutan working group at the PHVA decided to split NW Aceh into NW and NE Aceh; they also split Middle Aceh into West Middle Aceh and East Middle Aceh; therefore, habitat units increased from the initial 11 units to 13 units. This number also was used for the PHVA models and Action Plan models.

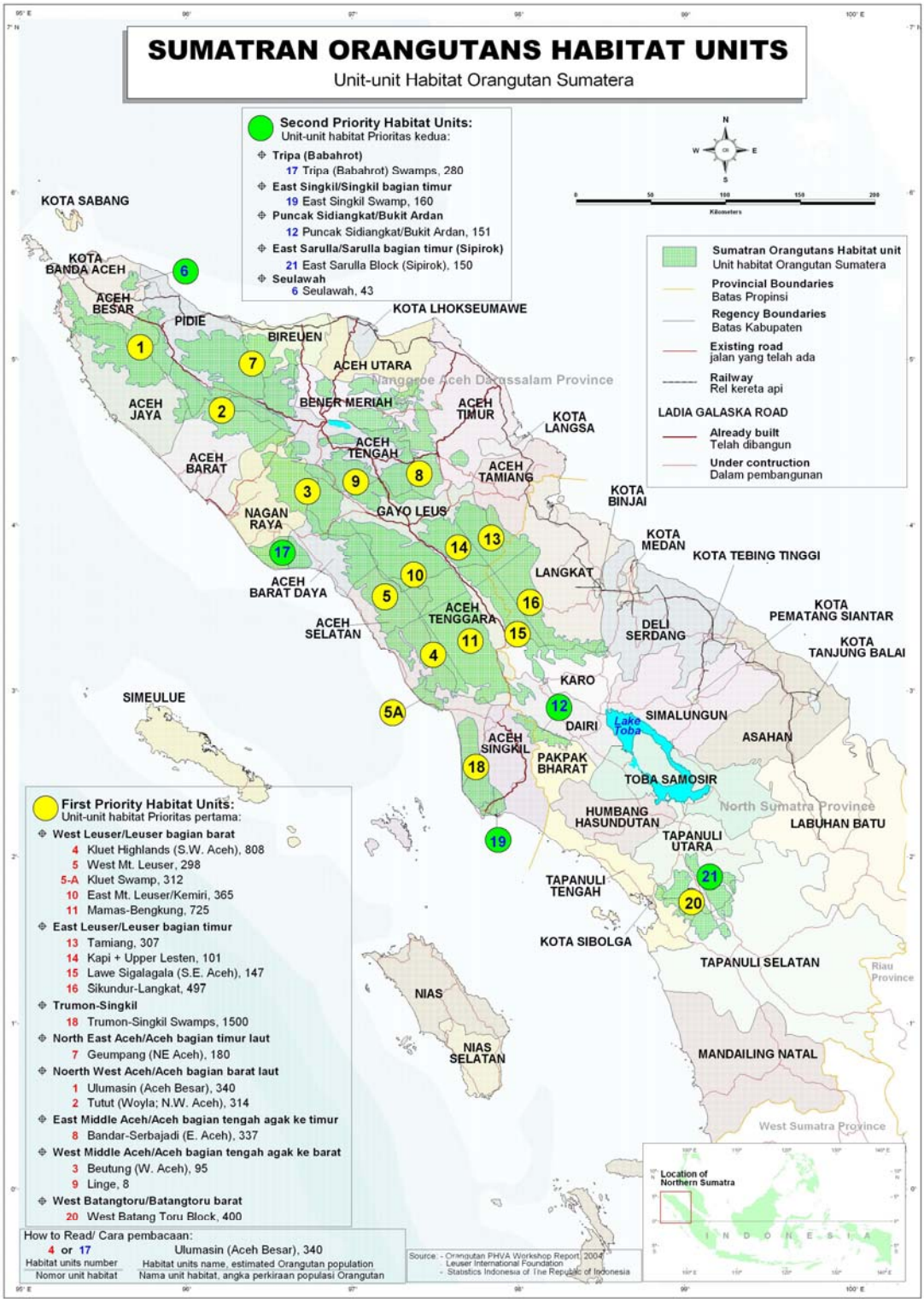


Figure 1. Map of Sumatran orangutan habitat units and habitat blocks used in population calculations and for working group discussions in this workshop.

In *pilkada* (local elections), candidates compete to win votes on the basis of the consumptive desires of their constituents, often planning for infrastructure development which leads to forest fragmentation and uncontrollable encroachment, since these large scale development projects yield more immediate collateral profits.

A key problem is that many district, provincial, and NGO agencies do not yet have the management skills, administrative experience, and information needed to make informed resource management decisions that will balance economic returns with effective biodiversity conservation (Suhandy et al. unpublished). At the community level, traditional (*adat*) management regimes may be waning from lack of use – nevertheless, if they can be successfully reinstated, the *adat* system holds great promise for sustainable natural resource management, the quality of which will inevitably and deeply affect human welfare as well as the survival of biodiversity, including orangutans. Without good management, there is a high probability of destroying watershed functions, soil retention services, and decreasing the quality of life of local communities.

Natural Resource Management

Forest cover has decreased at a rate of up to 2.1 million hectares annually over the last 10 years in Indonesia due to forest fires, large-scale plantations (especially oil palm), infrastructure development, mining and the worst: logging, much of it illegal. Oil palm plantations in Indonesia cover more than 3 million hectares, with 8.7 million hectares allocated overall and total applications for oil palm plantation development at the district level totaling about 32 million hectares. Additionally, more than 140 mining companies hold concessions that overlap with protected areas.

Illegal logging is still the greatest threats to biodiversity in Indonesia with illegally cut timber smuggled across international borders from Sumatra, Kalimantan, and Papua. After being laundered to disguise its illegal origins, wood is shipped to processors and consumers in Malaysia, Singapore, China, as well as Taiwan, Japan, India, Europe, and North America. In 2003, it was estimated that as much as 73% of all timber traded from Indonesia's forest is illegally cut – causing a loss in revenue amounting to US$ 670 million a year (GOI statement in the Consultative Group on Indonesia meeting, January 2003).

The newly elected President, Susilo Bambang Yudoyono (SBY), has just completed his first year term. SBY has made a big leap in combating corruption and enforcing Indonesia's laws. However, escalating domestic fuel prices that severely affect the poor and widespread demands for more democratic and decentralized government have put the country's rich biodiversity areas in jeopardy. Regional governments, especially new ones (*Kabupaten*/Regencies), generally adopt short-sighted economic planning which does not consider the environment and usually promotes inappropriate land-use policies at the expense of Indonesia's biodiversity and forest resources. The Indonesian Ministry of Forestry has collected data that indicate that the decentralization era has not yet been able to sustain natural forests. The deforestation rate from 1985-1997 was 1.6 million ha per year compared to that of 3.8 million ha per year in 1997-2000. Unless profound and rapid interventions are successful, there is concern that an even higher rate of structured deforestation could result in the near future.

Nevertheless, there is an emerging awareness of and support for conservation efforts. This is largely a result of recent devastating natural disasters such as landslides, thought to be primarily caused by illegal logging, that have claimed hundreds lives. Post-disaster recovery costs put an additional,

significant burden on regional government budgets. As a result of these attention-grabbing disasters, and in an effort to avoid similar tragedies, a number of local governments have begun incorporating conservation into their spatial planning. This nascent trend offers a major opportunity to support the creation of regional policies – a setting that is conducive to conservation-driven development.

Special Circumstances in Aceh

Aceh, in which the majority of the Sumatran orangutan population lives, has received a great deal of international attention since the December 2004 earthquake and tsunami (see below).
Prior to the disaster, Aceh province was torn with violent conflict involving Indonesian security forces and the Gerakan Aceh Merdeka (GAM) or Free Aceh Movement. For 12 years, known as the DOM era, Aceh was effectively closed off to the international community. During the DOM era, logging interests were given free reign, resulting in disregard for concession regulation and even a common sense notion of forest resource management. At least 15,000 civilians are reported to have been killed in these conflicts since 1976 (McCulloch, 2005). It is unknown to what extent the armed conflict has facilitated hunting and killing of orangutans by people carrying firearms, though since 2000, many orangutans have been found being kept or transported by military and police personnel.

Under the "New Order" (1965-1998), management of natural resources was vested in the State (Suhandy et al. unpublished). Conglomerates, often controlled by well-educated urban elites, gained rights to harvest Aceh's timber or open plantations in large areas of what was called 'state forest'. Some areas were put aside for strict protection, even though local communities considered these forests to be their own and had long depended on the same area for their livelihoods. Following the collapse of the New Order, *adat* (traditional communities) took action to regain rights over what they previously considered community property. Many reformists argued that the previous practices led to large-scale environmental and social problems. Consequently, during the current reform period (*era reformasi*), academics, NGO activists, and Aceh's community leaders have called for the management of many concessions and protected areas to be handed back to the *adat* communities. The difficulty of reintroducing *adat* resource management is well documented by McCarthy (1999), who concluded that local communities had little choice but to become dependent on logging, and that rapidly shifting economic forces continue to drive villagers to mine their natural resources. Without strong support of key officials, community leaders were powerless to implement rules embodied in government policy that supported *adat* forest management practices. Now, during the reformation era, there is widespread discussion of how to realign natural resource management authority and responsibility, and on more equitable distribution of natural resource use benefits. Current circumstances in Aceh open the door for heretofore inconceivable reform.

In December 2002, the Free Aceh Movement and the Indonesian Government signed a cease-fire agreement, or Cessation of Hostilities Agreement (CoHA), widely seen as the best hope for ending the conflict. Terms of the agreement included: an immediate ceasefire; disarmament of GAM in designated areas; free elections in 2004 to establish an autonomous (but not independent) government; and a revenue-sharing system through which the new provincial government receives 70% of fuel (oil, gas, mineral, forest) revenues. With this deal came significant opportunities to work with the provincial and local governments for long-term conservation and development, and many biologists had great hope that security issues would lessen, allowing field conservation activities in Aceh again.

Unfortunately, the ceasefire agreement did not last. After weeks of uncertainty due to the breakdown of the Cessation of Hostilities Agreement, a presidential decree declared martial law in May 2003. This decree was effective for 6 months, and was subsequently renewed for a second 6-month period – again effectively closing Aceh to the outside world. This conflict benefited a large number of businesses, including illegal logging, in Aceh, and in particular, a large number of Indonesian military and police.

In May 2004, a state of civil emergency was introduced in Aceh by Inpres 1 of 2004 (McCulloch 2005). In July, retired military officer General Susilo Bambang Yudyono (SBY) was elected as President, and was inaugurated in October. One of SBY's stated priorities is reforming the military and ending the conflict in Aceh by peaceful means.

On 26 December 2004, an the earthquake measuring 8.9 on the Richter scale struck about 150 km from Aceh's western coast, followed by a tsunami. While estimates vary, this unprecedented disaster killed approximately 230,000 people in Aceh, and left about 450,000 people homeless.

The tsunami, which prompted the Indonesian government to call on the rest of the world for humanitarian aid, also prompted a renewal of peace talks between the Indonesian government and Acehnese rebels that had collapsed in 2003. On 15 August 2005, Indonesia and separatist rebels in the province of Aceh signed an agreement it is hoped will end a 29-year conflict in the tsunami-battered region. The deal, signed in Helsinki, Finland, will see approximately 50,000 Indonesian troops withdraw from Aceh and 5,000 guerrillas lay down their arms under an amnesty. The accord also breaks a political logjam by allowing representatives of GAM to participate in local elections. The peace deal will likely smooth the way for intensified reconstruction efforts in the province. The Indonesian government and international donors have pledged more than $5 billion to repair post-tsunami damage in Aceh.

As a result of damage from the tsunami, communities are in need of wood to build homes, and therefore seek to extract timber from the forest. There are also plans to relocate affected settlements to forested areas away from the coast, which poses an immediate threat to remaining orangutan populations. Relocating villages and communities to higher ground, near Aceh's threatened forests, with a demand for building materials that is unprecedented, will undoubtedly have a long-term ripple effect on human welfare and biodiversity. Watershed functions will be destroyed, soil retention services will be damaged, and the quality of life for local communities will suffer. It is absolutely essential to ensure that people's needs for homes and income are met, and it is also essential that Sumatra's forests, and their orangutan populations and other rich biodiversity, are not decimated in the process.

THE SUMATRAN ORANGUTAN PHVA WORKSHOP

The Sumatran Orangutan Population and Habitat Viability Assessment (PHVA) workshop in January 2004 (Singleton et al. 2005) was attended by numerous scientific investigators working with Sumatran orangutans in the wild. The PHVA laid a solid the foundation for future work by assessing the scientific data regarding wild Sumatran orangutan populations. PHVA participants acknowledged that saving the orangutan will require input and commitment from all stakeholder groups living in and around orangutan habitat, and that large-scale and coordinated actions are

needed so that the limited resources available for Sumatran orangutan conservation are used most effectively. PHVA participants heartily recommended that a Conservation Action Plan workshop, to develop a collaborative strategy for the Sumatran orangutan, be convened. Conservation International-Indonesia made a commitment to find funds and partners to bring the group together again, plus additional key people who may not have participated originally, to build upon the work begun at the PHVA and work toward the next level of developing an effective Sumatran orangutan action plan.

THE SUMATRAN ORANGUTAN CONSERVATION ACTION PLAN WORKSHOP

The goal of the Sumatran Orangutan Conservation Action Plan workshop was to further develop a common agenda for Sumatran orangutan conservation - with participation by a wide variety of stakeholders, including local communities, local and national government, national and international scientists, the private sector, universities, NGOs and other groups. The workshop was held in Berastagi, North Sumatra from 20-23 September 2005, and was attended by more than 100 participants (Appendix II). The workshop, convened under the auspices of Conservation International, the Indonesian Ministry of Forestry – PHKA, the IUCN Primate Specialist Group, the Leuser International Foundation, PanEco, the Sumatran Orangutan Conservation Programme (SOCP), the Indonesian Primatological Society (APAPI), and the South East Asian Primatological Association. It drew on the knowledge, experience and capacities of these stakeholders to identify the most urgent actions needed to save the Sumatran orangutan. Funding was generously provided by the Critical Ecosystem Partnership Fund, the Leuser International Foundation, the Great Ape Action Fund, Conservation International, and the Indonesian Ministry of Forestry.

The PHVA workshop was an excellent start in developing the scientific foundation for a conservation action plan for the Sumatran orangutan, and Dr. Kathy Traylor-Holzer, IUCN/SSC Conservation Breeding Specialist Group Program Officer, was able to attend the present workshop in order to continue incorporating new information into the Sumatran orangutan population models. Modeling results are presented in the next section. The Conservation Action Plan workshop allowed expansion of discussions begun at the PHVA, involving of a wider body of expertise in terms of input, and also allowing an appraisal of specific problems that affect the species in the different areas in which Sumatran orangutan live, each of which presents unique problems and opportunities for action.

The present document identifies the most urgent needs for conservation action for the Sumatran orangutan as agreed upon by key stakeholders. Using the PHVA results as the scientific underpinning, this report lays a foundation for future conservation activities for the species.

Workshop Process

The workshop began with presentations on the current situation and status of the Sumatran orangutan. Following these presentations, we reviewed the findings from the PHVA, in particular the Habitat Unit information (by Dr. Ian Singleton, SOCP) and the *Vortex* computer simulation modeling results (by Dr. Kathy Traylor-Holzer, IUCN/SSC Conservation Breeding Specialist Group). Four geographic working groups were then formed: (1) Aceh Besar, Aceh Jaya, Aceh Barat, and Pidie districts (encompassing Seulawah, NW Aceh and NE Aceh); (2) the Leuser Ecosystem (encompassing the East Middle Aceh, West Middle Aceh, Tripa Swamp, East and West

Leuser); (3) Trumon, Singkil, East Singkil, Dairi and Pakpak Bharat; and (4) West Batang Toru and East Sarulla. Participants selected their working groups based on their own interest and expertise.

Each working group was asked to:

1. Identify the threats facing Sumatran orangutan populations in habitat areas.
2. Identify opportunities in each habitat area.
3. Identify priority actions to address threats (taking into consideration opportunities, where possible).

Each group presented reports in plenary on each task so that the larger group could review and provide input. Working group reports in subsequent sections of this document represent a consensus view of the group[3].

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[3] Participants not in agreement with the larger group were invited to submit their views in writing for inclusion in this report, however no dissenting views were submitted.

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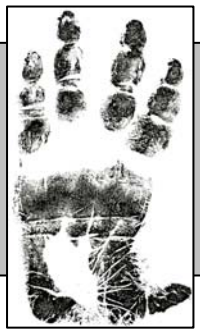

SUMATRAN ORANGUTAN CONSERVATION ACTION PLAN POPULATION MODEL

INTRODUCTION TO SIMULATION MODELS

Computer modeling is a valuable and versatile tool for assessing risk of decline and extinction of wildlife populations. Complex and interacting factors that influence population persistence and health can be explored, including natural and anthropogenic causes. Models can also be used to evaluate the effects of alternative management strategies to identify the most effective conservation actions for a population or species and to identify research needs. Such an evaluation of population persistence under current and varying conditions is commonly referred to as a population viability analysis (PVA).

The simulation software program *Vortex* (v9.61) was used to examine the viability of orangutan populations on Sumatra, both at the PHVA workshop (Singleton et al., 2005), with new input data received at the present workshop and models subsequently updated. *Vortex* is a Monte Carlo simulation of the effects of deterministic forces as well as demographic, environmental, and genetic stochastic events on wild populations. *Vortex* models population dynamics as discrete sequential events that occur according to defined probabilities. The program begins by creating individuals to form the starting population and stepping through life cycle events (e.g., births, deaths, dispersal, catastrophic events), typically on an annual basis. Events such as breeding success, litter size, sex at birth, and survival are determined based upon designated probabilities. Consequently, each run (iteration) of the model gives a different result. By running the model hundreds of times, it is possible to examine the probable outcome and range of possibilities. For a more detailed explanation of *Vortex* and its use in population viability analysis, see Lacy (2000) and Miller and Lacy (2003).

DEVELOPING THE VORTEX MODEL FOR ORANGUTANS

A *Vortex* population model for Sumatran orangutans was developed at the Orangutan Population and Habitat Viability Assessment (PHVA) workshop held in January 2004. This model was developed by the Sumatran Orangutan Working Group based on a general orangutan baseline model developed for this PHVA workshop and modified to reflect Sumatran orangutan populations. Data for age- and sex-specific mortality rates, reproductive lifespan, and inter-birth interval were taken from 30+ years of data from a study site at Ketambe (Wich *et al.*, 2004). Model development and validation details can be found in the PHVA report (Singleton *et al.*, 2005).

This Sumatran orangutan model was used at the Sumatran Orangutan Conservation Action Plan Workshop in September 2005 to provide updated future projections of population viability for Sumatran orangutans based upon revised estimates of habitat loss or alteration and the subsequent effects on orangutans. The input values used for this model are described below.

VORTEX MODEL PARAMETERS

Number of iterations: *1000*
1000 independent iterations (or runs) of the simulation were conducted for each set of parameters tested, in order to provide relatively precise and stable results.

Number of years: *1000*
Due to the long-lived and slowly reproducing nature of this species, it was decided to model populations for 1000 years so that long-term population trends could be observed. It is unlikely that conditions are adequately understood or will remain constant to allow us to accurately predict population status so far into the future; thus both short-term and long-term results are presented.

Inbreeding depression: *Yes*
Inbreeding is thought to have major effects on reproduction and survival, especially in small populations, and so was included in the model (as reduced survival of inbred offspring through their first year). The impact of inbreeding was modeled as 4.06 lethal equivalents, estimated from analysis of studbook data for captive orangutans maintained in zoos (J. Ballou, pers. comm.), with 50% (when $N \leq 1000$) or 100% (when $N > 1000$) of the effect of inbreeding due to recessive lethal alleles.

Concordance between environmental variation in reproduction and survival: *No*
The working group believed that there is little correlation between environmental conditions that affect survival and reproduction and chose to omit it from the model. Large, long-lived species tend to show little correlation between breeding and survival.

Mating system: *Short-term polygyny*
Orangutans have a promiscuous breeding system. Both males and females potentially may have multiple mates, although animals may breed with the same mate(s) for several years. Short-term polygyny was selected for the model, in which animals can select new mates every year.

Age of first reproduction: *15 years (females); 25 years (males)*
Vortex defines reproduction onset as the time at which offspring are born, not simply the age of sexual maturity. The model uses the mean age of first reproduction rather than the earliest recorded age of offspring production. Based on information from Ketambe, the age of first reproduction is typically 15 years for females and 25 years for males.

Maximum age of reproduction: *50 years*
Vortex assumes that animals can reproduce throughout their adult life. One female at Ketambe is known to have produced offspring at about 50 years of age; this was accepted as a plausible maximum age of successful reproduction.

Density-dependent reproduction: *Yes*
Density dependence is defined by specifying parameters of a particular functional shape for the relationship between population density and breeding success. The curve that is often used to represent the functional relationship is: % breeding = $[(P_0-(P_o-P_k)*(N/K)^B)]* (N/(N+A))$. The following parameter values for the Sumatran orangutan population:

P_0 Specifies the % of adult females breeding in an average year when population density is very low relative to the food supply and carrying capacity of the habitat. Data from Ketambe suggest an inter-birth interval as short as 6 years; this was adjusted to 5.5 years by correcting for females that re-breed earlier after loss of their infants, or 18.18% of females breeding each year. Given the shape of the curve (which includes an Allee effect depressing breeding at very low density), P_0 was set to the required value needed to obtain a curve that peaks at 18.18.

P_k*=11.1* Specifies the breeding rate (% females breeding each year) when the population is at its carrying capacity. The maximum inter-birth interval was estimated at 10 years based on Ketambe data. After correcting for females that lose their infants, 9 years was used as the estimated inter-birth interval for populations at high density, or 11.1% of females breeding each year.

A=1 Defines the Allee effect (difficulty in finding mates at low densities).

B=2.0 Defines the steepness with which breeding decreases as population approaches K.

Environmental variation in breeding rate: *5.5%*
This approximates 50% of the mean percent of females breeding at high densities and 30% of the value used at low densities. Given the lifespan of this species, year-to-year fluctuations in demographic rates tend to average out; therefore this value probably has little effect on population projections.

Monopolization of breeding: *50%*
Some males are more likely than others to be successful breeders. The percent of males that were considered to be potential breeders (i.e., available for breeding in a given year) was roughly estimated at 50%. This parameter primarily affects genetics rather than demography and affects small populations. Sensitivity testing using higher values (75% and 100%) in small populations (N=50) showed no effect on population status, so the value of 50% was retained in the model.

Maximum litter size: *1*
Only a single offspring is raised. In rare instances of the birth of twins, at least one always dies.

Sex ratio at birth: *55% male*
Data from a number of field sites suggest a small male bias in births (in Sumatra, 57% at Ketambe, 56% at Suaq). The working group chose to model 55% of births to be male.

Mortality: *See below*
The long lifespan and slow reproductive rate of this species suggest low rates of natural mortality. Mortality rates were extrapolated from over 30 years of field data from Ketambe and are given below. Juvenile males are thought to experience higher mortality than females. Mortality rates rise as offspring become independent of their mothers, while adult mortality is believed to be low. Environmental variation around mortality rates was set at 50% of the mean mortality rates.

	Mean annual mortality		Environmental variation	
Age class	Females	Males	Females	Males
0 – 1	5%	5%	2.5%	2.5%
1 – 2	6%	5%	3%	2.5%
2 – 8	0.5%	3%	0.25%	1.5%
8 – 11	6%	6%	3%	3%
11-15	0.5%	0.5%	0.25%	0.25%
15+	1.75%	1.25%	0.875%	0.625%

Catastrophes: *Yes (3)*
Three types of catastrophes were thought to affect some or all orangutan populations on Sumatra. The risk of a disease epidemic was included for all populations; taken from the preliminary model, disease was modeled to occur in 2% of years (about once every 50 years), killing about 20% of the local population but having no effect on reproduction. The effects of fire and landslides were each modeled for some but not all Sumatran populations based upon elevation, habitat and other factors. Both were modeled as a temporary reduction in carrying capacity (and therefore population size). Fire events occur in 0.2% of years (once every 500 years) and reduce the carrying capacity by 10% (included for Tripa, West Leuser, and Trumon-Singkil Habitat Units). Landslides occur in 2.5% of years (once every 40 years) and reduce carrying capacity by 0.75% (included for NW Aceh, West Middle Aceh, East Middle Aceh, West Leuser and East Leuser Habitat Units).

Initial population size (N): *Population specific*
The estimated population size used for each model was developed with respect to a particular population within a specific habitat unit. *Vortex* distributes the specified initial population among age-sex classes according to a stable age distribution that is characteristic of the mortality and reproductive schedule described for the model.

Carrying capacity (K): *See below*
The model assumes that each population is currently at the carrying capacity of its habitat.

Habitat changes and K:
A primary threat to orangutans in Sumatra is habitat loss or alteration. Logging and other forms of habitat alteration were incorporated into the *Vortex* orangutan model as a permanent reduction in carrying capacity, which removes individuals from the population and reduces the capacity for future growth. The effect on orangutan carrying capacity was believed to differ, depending upon the type of habitat alteration, as follows:

Illegal logging: Reduces K for orangutans by 40% in the logged area
Legal logging: Reduces K for orangutans by 70% in the logged area
Deforestation/conversion: Reduces K for orangutans by 100% (permanent habitat loss)

Harvest: *None*
Orangutans are also hunted or otherwise removed illegally from the wild. The PHVA working group believed that in most cases, the hunting or removal of orangutans is primarily in association with logging or habitat conversion and is already incorporated into the model as immediate reduction in K and associated removal of orangutans. For most model scenarios, harvest was not modeled separately but was taken into account with the reduction of K and N due to habitat loss. Additional

harvest was incorporated into additional scenarios for selected populations as requested by the Action Plan working groups.

Supplementation: *None*
The addition of individuals to the population from captive or other sources was not modeled.

RESULT OF THE *VORTEX* BASELINE MODEL

Deterministic Results
The baseline model describes a population that shows positive deterministic growth (r = 0.015) in low-density conditions (in which 18.18% of adult females breed). This is the average population growth expected based on mean fecundity and mortality rates in the absence of inbreeding, human-related mortality (e.g., logging, hunting), and stochastic processes (e.g., shortage of mates, skewed sex ratio). This is a plausible growth rate for a large, long-lived and slowly reproducing species such as the orangutan.

Population growth is reduced under crowded conditions where resources are limited and the carrying capacity of the habitat is reached. In these conditions, the percent of breeding females drops to 11.1%, resulting in a slightly negative growth rate (r = - 0.002). Thus under the influence of density-dependent reproduction, the model describes a population in sub-optimal habitat that is slightly oversaturated beyond the habitat's long-term carrying capacity. Populations in this model decline to an equilibrium size of about 93-95% of the initial population size in the absence of inbreeding effects and catastrophes.

Effect of Population Size
As populations become smaller, they become more susceptible to the negative effects of inbreeding and stochastic processes. As part of the PHVA analysis, the baseline model was used to assess the relative viability of Sumatran orangutan populations of varying size independent of human threats. Estimated current population sizes range from 43 to 2508 individuals; for this analysis, scenarios were run for population sizes of 50, 100, 250, 500, 1000, 1500 and 2500 individuals.

Table 3 is taken from the 2004 PHVA report (Singleton *et al.* 2005) and gives the probability of extinction, mean population size, and proportion of gene diversity (expected heterozygosity) obtained from 500 iterations for populations of each tested initial size (and K) after 50, 100 and 1000 years. Density-dependent reproduction and mortality rates in combination with the effects of inbreeding, disease and stochastic events led all populations to decline substantially below carrying capacity (to about 83% of K) in a relatively short period of time. Smaller populations remained more vulnerable to these effects over the long-term.

Although short-term projections (i.e., for 50-100 years) under baseline conditions show almost no probability of extinction, this time period encompasses only 2-3 generations for this long-lived species, making it difficult to observe population trends. Projections for 1000 years allow us to better evaluate these trends and those factors that influence them. Populations of 50 and 100 had a high probability of extinction over 1000 years; those that survived were greatly reduced in size and genetic diversity. Although populations of 250 had a very small probability of extinction, they declined on average to almost one-half of their original size and lost substantial genetic diversity.

Populations of 500 or larger were demographically stable and retained over 90% of gene diversity, a common genetic goal for managed populations.

Table 3. Effects of initial population size (N_{init}) on population viability (PE = probability of extinction; N = mean population size; GD = proportion of initial gene diversity).

	50 years			100 years			1000 years		
N_{init}	PE	N	GD	PE	N	GD	PE	N	GD
50	0	41	0.96	1.00	36	0.92	0.99	7	0.40
100	0	83	0.98	0	78	0.96	0.64	28	0.59
250	0	210	0.99	0	203	0.99	0.02	142	0.85
500	0	417	1.00	0	404	0.99	0	342	0.93
1000	0	839	1.00	0	808	1.00	0	732	0.97
1500	0	1269	1.00	0	1206	1.00	0	1149	0.98
2500	0	2085	1.00	0	2020	1.00	0	1947	0.99

ORANGUTAN HABITAT UNITS

Defining Habitat Units in Sumatra

At the 2004 PHVA workshop, the Sumatran Orangutan Working Group reviewed the data available on orangutan distribution and habitat provided by Ian Singleton and Serge Wich, as well as van Schaik and colleagues (2004). This resulted in the identification of 13 separate orangutan populations and Habitat Units (HUs) in Sumatra (see *Status and Distribution* section of this report; also Singleton *et al.* 2005). These habitat units differ in area, estimated orangutan population size, susceptibility to fire and landslides, estimated future habitat changes, and threat of fragmentation. Several very small and isolated groups of orangutans are believed to exist in addition to these 13 identified HU populations but are not likely to be viable and were not included in these analyses. All populations were assumed to be at carrying capacity.

Estimating Future Habitat Alteration

Approximate rates of habitat loss were estimated at the PHVA workshop and modeled using the *Vortex* model. For the purpose of that evaluation, habitat loss was assumed to continue into the future at a diminishing rate of net loss (i.e., constant % loss of habitat remaining at the beginning of the year). This was an effort to simulate a slowing rate of loss as lowland areas were converted, and logging or other forms of habitat loss moved more slowly up slopes. Habitat loss also was assumed to alter the environment such that it could no longer sustain orangutans (100% loss of orangutan carrying capacity in altered areas).

Several changes were made to these estimates and assumptions at the Action Plan Workshop, based on discussions with workshop participants along with subsequent estimates developed by a small post-workshop working group. These assumptions are summarized below:

1. Habitat alteration was estimated to occur over a limited time period, varying from 4 to 20 years depending upon the habitat unit. After this period, no further habitat loss or alteration was modeled, and orangutan habitat (carrying capacity) was assumed to remain stable.

2. Habitat alteration was modeled as a constant linear rate (i.e., constant area lost each year). For example, an estimated loss of 20% of a HU over a 5-year period would be modeled as a 4% loss of the original area each year for 5 years. This differs from the PHVA model, in which, for instance, 4% of the remaining area would be lost (not 4% of the original area).

3. All forms of habitat alteration were not assumed to result in the elimination of orangutans from the altered area. Some types of habitat change were believed to reduce the carrying capacity of the area, leading to an overall lower density of orangutans and smaller population in that area. The following impacts of habitat alteration on the ability of the habitat to sustain orangutan were used in the model:
    - Deforestation/conversion/burning: 100% loss of K
    - Legal logging: 70% loss of K
    - Illegal logging: 40% loss of K

Table 4 details the new estimates of the type, rate and time period of habitat change used in the model along with the resulting final projected carrying capacity (and % loss of K) for each habitat unit.

Removal of Orangutans

Orangutans are hunted or otherwise removed illegally from the wild. The PHVA working group believed that in most cases, the hunting or removal of orangutans is primarily in association with logging or habitat conversion. The *Vortex* model automatically removes these individuals from the population when K is reduced, thereby incorporating this loss of orangutans. Working groups at the Action Plan Workshop, however, believed that additional hunting likely takes place in Dairi-Pakpak Bharat, East Sarulla, and West Batang Toru habitat units unrelated to habitat loss. For these 3 habitat units, additional scenarios were modeled that incorporated this estimated annual loss.

MODEL RESULTS FOR ORANGUTAN HABITAT UNITS

The results for each Habitat Unit (HU) model are provided in the following sections and summarized in Table 5 below (in approximate order of north to south Sumatra), and include the probability of extinction, mean population size and proportion of genetic diversity retained (expected heterozygosity) at 50, 100 and 1000 years. Population projections are presented for estimated "best guess" future conditions (incorporating expected habitat changes). For comparison, projections are also given for scenarios with no habitat changes or change in carrying capacity. Specific HU model results are followed by a general discussion of orangutan populations in Sumatra based upon a compilation of results for the individual HUs.

Table 4. Orangutan population size, carrying capacity, habitat change estimates, and additional removal of orangutans for each of 13 habitat units.

	N = K	Rate / Time period	Source	Final K	Loss of K	Removals	Comments
Aceh (north)							
Seulawah	43	4% per yr x 3 yrs 0.5% per yr x 3 yrs	Illegal logging Encroachment	40	6.3%	--	Protected area; Orangutans probably in lowland fringes at edge or outside PA
NW Aceh *Scenario 1* *(no concessions)*	654	10% per yr x 5 yrs 4% per yr x 5 yrs	Illegal logging Encroachment	392	40%	--	Much of lowland orangutan habitat is badly degraded and patchy. Two proposed concessions are currently under review/ contested. Encroachment and illegal logging likely even without logging concessions. Conversion to palm oil being considered.
Scenario 2 *(with two logging concessions)*	654	10% per yr x 5 yrs 4% per yr x 5 yrs 40% habitat loss w/i 10 yrs	Illegal logging Encroachment Legal logging, followed by burning & total conversion	130	80%	--	
NE Aceh *Scenario 1* *(no concession)*	180	10% per yr x 5 yrs 4% per yr x 5 yrs	Illegal logging Encroachment	108	40%	--	Similar to NW Aceh. Orangutans in badly degraded fringe areas and extremely vulnerable to encroachment and illegal logging.
Scenario 2 *(with reopened concession)*	180	10% per yr x 5 yrs 4% per yr x 5 yrs 30% habitat loss in 10 yrs	Illegal logging Encroachment Legal logging, followed by burning & total conversion	54	70%	--	
Leuser area							
W Middle Aceh	103	10% per yr x 2 yrs, followed by 1% per yr x 15 yrs 2% per yr x 10 yrs	Illegal logging Encroachment	68	34%	--	Orangutans on lower slopes, vulnerable to encroachment/degradation. Ladia Galaska may lead to fragmentation and additional encroachment and logging.
W Leuser	2508	2% per yr x 5 yrs 1.5% per yr x 20 yrs	Illegal logging Legal logging/encroachment	1768	29.5%	--	No current permits here for legal logging
E Middle Aceh *Scenario 1* *(no concession)*	337	10% per yr x 2 yrs, followed by 1% per yr x 15 yrs 2% per yr x 10 yrs	Illegal logging Encroachment	222	34%	--	Similar to W Middle Aceh, but with the addition on one concession that is trying to reopen. Relatively few orangutans, highly fragmented, living in the foothills, and very vulnerable.
Scenario 2 *(with reopened concession)*	337	10% per yr x 2 yrs, followed by 1% per yr x 15 yrs 2% per yr x 10 yrs 20% habitat loss in 10 yrs	Illegal logging Encroachment Legal logging, followed by burning & total conversion	155	54%	--	
E Leuser	1052	2% per yr x 5 yrs 1.5% per yr x 20 yrs	Illegal logging Legal logging/encroachment	741	29.5%	--	Mostly protected; encroachment and illegal logging eroding edges (where orangutans are) in some places.
Tripa	280	45% per yr x 2 yrs, followed by 5% per yr x 2 yrs	Burning/drainage	0	100%	--	Plantations expected to slash and burn; any remaining habitat will dry out

Assumes illegal logging = 40% reduction in K for orangutans; legal logging = 70% reduction in K; conversion = 100% loss in

Table 4. Orangutan population size, carrying capacity, habitat change estimates, and additional removal of orangutans for each of 13 habitat units. (cont.)

Aceh (south)							
Trumon-Singkil	1500	2% per yr x 5 yrs 3% per yr x 5 yrs	Illegal logging Encroachment/drainage	1215	19%	--	Largely protected area. PA boundary disputes allow encroachment in some areas. Evicted settlers may be returning. Some threat of roads. Hopefully law enforcement will improve within 5 years.
E Singkil	160	25% per yr x 4 yrs	Conversion	0	100%	--	In the process of being converted to palm oil plantations.
Dairi - Pakpak Bharat	134	4% per yr x 5 yrs 2% per yr x 10 yrs	Illegal logging Encroachment	96	28%	2F 1inf	Agricultural encroachment and illegal logging eroding lower slopes where orangutans live (not visible from roads).
North Sumatra							
E Sarulla	150	2% per yr x 5 yrs 2.5% per yr x 15 yrs	Illegal logging Encroachment	87	41.5%	1M 2F 1inf	Difficult to predict. Half is high (not attractive for palm oil). Agriculture in center (lowlands) is expected to continue to expand. Small legal logging concession operating in 2004 appears to have ceased. Predict that most lowland orangutan habitat is gone in 20 years.
W Batang Toru *Scenario 1* *(no concession)*	400	2.5% per yr x 5 yrs 3% per yr x 10 yrs	Illegal logging Encroachment	260	35%	--	Higher areas are in the HPH; lowland in Hutan Lindung. Nias settlers gradually converting lowlands (and higher) into small gardens. Hunting still occurs; not sure if removing additional orangutans in addition to those lost due to loss of K.
Scenario 2 *(with reopened concession)*	400	2.5% per yr x 5 yrs 3% per yr x 10 yrs 5% per yr x 10 yrs	Illegal logging Encroachment Legal logging	120	70%	--	
Scenario 3 *(no concession, removals)*	400	2.5% per yr x 5 yrs 3% per yr x 10 yrs	Illegal logging Encroachment	260	35%	1M 4F 2inf	
Scenario 4 *(with reopened concession, removals)*	400	2.5% per yr x 5 yrs 3% per yr x 10 yrs 5% per yr x 10 yrs	Illegal logging Encroachment Legal logging	120	70%	1M 4F 2inf	
TOTAL **(no concessions)**	**7501**			**4763**	**36.5%**		
TOTAL **(with concessions)**	**7501**			**4474**	**40%**		

Assumes illegal logging = 40% reduction in K for orangutans; legal logging = 70% reduction in K; conversion = 100% loss in K

Table 5. Model results for each habitat unit and metapopulation (PE = probability of extinction; N = mean population size; GD = proportion of initial gene diversity).

	At 50 Years			At 100 Years			At 1000 Years		
Habitat Unit	**PE**	**N**	**GD**	**PE**	**N**	**GD**	**PE**	**N**	**GD**
Seulawah	0	33	0.950	0.018	28	0.905	1.000	--	--
NW Aceh - No Concess.	0	315	0.995	0	310	0.991	0.001	246	0.903
NW Aceh - Concessions	0	87	0.986	0	93	0.972	0.539	17	0.633
NE Aceh - No Concess.	0	88	0.984	0	84	0.969	0.648	10	0.608
NE Aceh - Concessions	0	35	0.967	0.002	37	0.930	0.999	0	0.497
W Middle Aceh	0	55	0.973	0	49	0.947	0.966	0	0.389
W Leuser	0	1528	0.999	0	1385	0.998	0	1313	0.980
E Mid Aceh - No Concess.	0	183	0.992	0	171	0.984	0.043	102	0.809
E Mid Aceh - Concession	0	118	0.989	0	119	0.978	0.263	39	0.699
E Leuser	0	648	0.998	0	594	0.995	0	528	0.952
Tripa	1.000	--	--	1.000	--	--	1.000	--	--
Trumon-Singkil	0	1036	0.999	0	973	0.997	0	920	0.972
E Singkil	1.000	--	--	1.000	--	--	1.000	--	--
DairaPkBharat – No Removals	0	82	0.982	0	76	0.964	0.694	8	0.560
DairaPkBharat - Removals	0.999	7	0.917	1.000	--	--	1.000	--	--
E Sarulla – No Removals	0	75	0.981	0	67	0.962	0.846	3	0.510
E Sarulla - Removals	1.000	--	--	1.000	--	--	1.000	--	--
WBatangToru - No Concess.	0	224	0.994	0	209	0.987	0.011	146	0.851
WBatangToru - Concession	0	84	0.986	0	89	0.971	0.567	15	0.617
WBatangT - No Con/Removals	0.974	22	0.983	1.000	--	--	1.000	--	--
WBatangT – Concess/Removals	1.000	--	--	1.000	--	--	1.000	--	--
Metapopulation – No Concess.	0	4267		0	3945		0	3276	
Metapopulation – Concessions	0	3781		0	3508		0	2843	

Seulawah Habitat Unit

Status

The Seulawah Habitat Unit is a small area of orangutan habitat in northern Aceh province of Sumatra (Block 6, refer to Table 2 and Figure 1) that falls partially under Taman Hutan Raya Tjut Nya Dhien Conservation Area. The current orangutan population is estimated at 43 individuals and believed to be at ecological carrying capacity for the area, with no major fragmentation of the population. This is the smallest of the 13 Sumatran orangutan populations analyzed and is isolated from other populations by existing roads. Estimated future habitat loss includes 4% annual loss due to illegal logging and 0.5% annual loss due to encroachment for 3 years, resulting in a total loss of 6.3% of the HU's carrying capacity for orangutans (K_{final} = 40). The model assumes that habitat alteration and removal of orangutans will cease after 3 years, and that the population is an interbreeding unit (not fragmented).

Future Projections

Model results incorporating these expected future habitat changes for Seulawah suggest that the population will undergo a gradual, steady decline that will continue even after habitat loss ceases. Although the population is projected to be at little immediate risk of extinction, long-term projections indicate an increasing risk of extinction after 100 years. This decline and increasing extinction risk is due primarily to the stochastic threats associated with small population size; viability projections are similar even in the absence of future habitat loss or alteration. Inbreeding depression and stochastic events likely will drive the population to extinction within several 100 years without demographic or genetic supplementation or population/habitat expansion. Continued or increased habitat alteration, population fragmentation, or continued removal of orangutans will hasten population decline and may substantially increase short-term extinction risk.

Table 6. *Vortex* model results for the Seulawah orangutan population.

	50 Years			100 Years			1000 Years			Year at PE 5%
	PE	N	GD	PE	N	GD	PE	N	GD	
Future Projection	0	33	0.950	0.018	28	0.905	1.000	-	-	140
No Habitat Loss	0	35	0.951	0.011	30	0.909	1.000	-	-	176

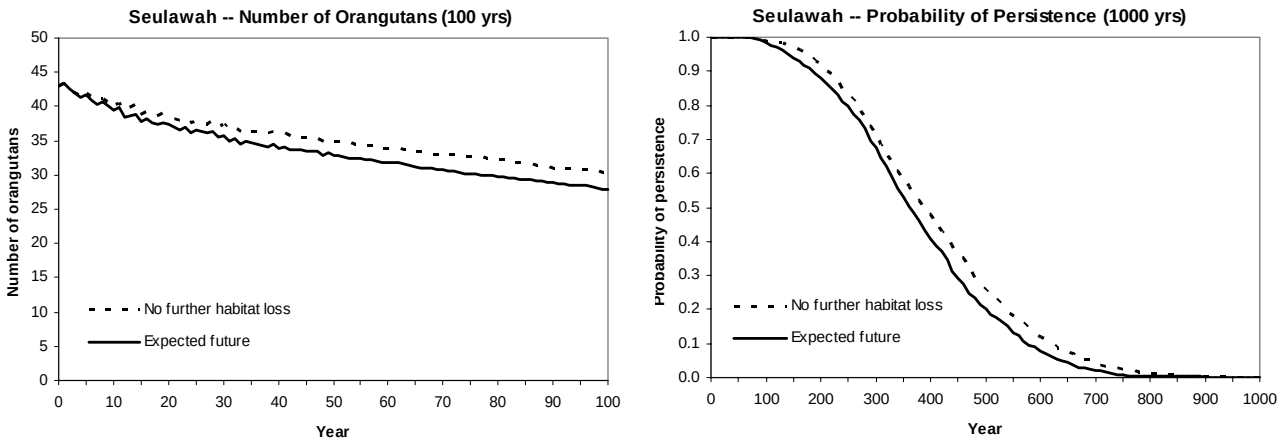

Figure 2. Mean population size (over 100 years) and probability of persistence (over 1000 years) for orangutans in the Seulawah habitat unit, with expected habitat changes and with no habitat loss.

NW Aceh Habitat Unit

Status

The NW Aceh Habitat Unit encompasses a relatively large, elongated area of orangutan habitat in northern Aceh province (Blocks 1 and 2, refer to Table 2 and Figure 1) bordered on the northeast by existing and proposed stretches of the Ladia Galaska road scheme. A small portion of this HU falls within Bio-Genetic Reserve and Cagar Alam Pinus Jantho Conservation Areas. Much of the lowland orangutan habitat is badly degraded and patchy. The orangutan population was estimated at 654 individuals (340 in the north and 314 in the south) in 1998. Habitat loss since that time is unknown due to the instability of this area, and the actual orangutan population may be smaller. The

Vortex model assumed an initial population of 654 orangutans living at the ecological carrying capacity of this HU.

Northern and southern areas of this HU are divided by a road that may limit movement of animals between areas. There is evidence of additional fragmentation of habitat within these two subpopulations. The extent to which orangutans migrate across roads in this area is unknown. At the 2004 PHVA workshop, estimates of animal movement between the north and south areas (50% of subadult males dispersing across the road each year) were used to model potential impacts on population viability. This level of migration appears sufficient for this HU to act as a single population. The NW Aceh orangutan population was modeled here as a single interbreeding population (not fragmented).

Model Scenarios

Two potential future scenarios were modeled for NW Aceh. Scenario 1 incorporates an estimated future habitat loss for this HU of 10% annual loss due to illegal logging and 4% annual loss due to encroachment for 5 years, resulting in a total loss of 40% of the HU's carrying capacity for orangutans (K_{final} = 392). Scenario 2 includes the above illegal logging and encroachment impacts, but also assumes the operation of two logging concessions that are currently under review/ contention. These logging concessions were estimated to result in a total loss of 40% of the HU to orangutans (10 years of legal logging followed by burning and conversion of the logged area). This scenario results in a total loss of 80% of the HU's carrying capacity for orangutans (K_{final} = 130). Both scenarios assume that illegal logging and encroachment will cease after 5 years, that removal of orangutans will cease after 5 or 10 years, respectively, and that the population will not become fragmented.

Future Projections

As might be expected, mean orangutan population size is significantly affected by the degree of habitat loss in this HU. Even with no legal logging concessions, the population is projected to decline by more than 50% in 50 years; in the presence of legal logging operations, the population is estimated to drop by 50% in only 5 years. Populations are then able to sustain their numbers in the absence of additional habitat loss or removal of orangutans, with no short-term risk of extinction. Logging, however, is projected to reduce the population below the level needed for long-term viability, putting the population at risk due to stochastic threats
and inbreeding depression without demographic or genetic supplementation or population/habitat expansion. Continued or increased habitat alteration, population fragmentation, or continued removal of orangutans will hasten population decline and may substantially increase extinction risk.

Table 7. *Vortex* model results for the NW Aceh orangutan population.

	50 Years			100 Years			1000 Years			Year at PE 5%
	PE	N	GD	PE	N	GD	PE	N	GD	
With Concessions	0	87	0.986	0	93	0.972	0.539	17	0.633	481
No Concessions	0	315	0.995	0	310	0.991	0.001	246	0.903	>1000
No Habitat Loss	0	549	0.997	0	526	0.994	0	471	0.946	>1000

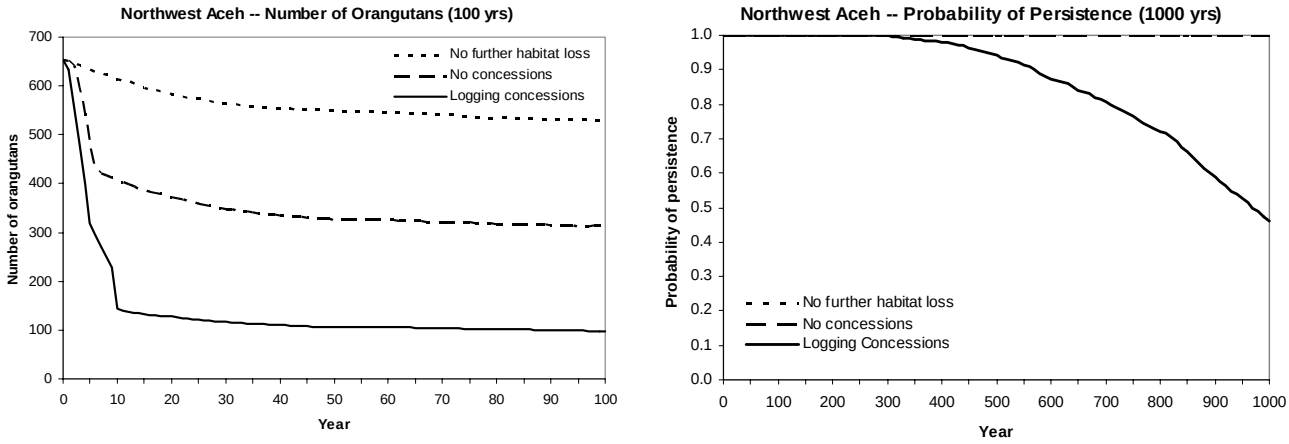

Figure 3. Mean population size (over 100 years) and probability of persistence (over 1000 years) for orangutans in the NW Aceh habitat unit, with expected habitat changes (with and without logging concessions) and with no habitat loss.

NE Aceh Habitat Unit

Status

The NE Aceh (Geumpang) Habitat Unit encompasses an area of orangutan habitat in northern Aceh province (Block 7; refer to Table 2 and Figure 1) and is separated from the NW Aceh HU by existing and proposed stretches of the Ladia Galaska road scheme. Orangutans are believed to occupy only a portion of this area and are spatially disjunct from other orangutan populations. This fragmented orangutan population was estimated at 180 individuals in 1998. It is uncertain to what extent logging has since occurred. This modeling exercise assumed an initial population of 180 individuals, but it is recognized that the actual orangutan population may be smaller. The status of this area is similar to that of NW Aceh – orangutans inhabit badly degraded fringe areas and are vulnerable to encroachment and logging.

Model Scenarios

Similar to the NW Aceh model, two potential future scenarios were modeled for NE Aceh. Scenario 1 incorporates an estimated future habitat loss for this HU of 10% annual loss due to illegal logging and 4% annual loss due to encroachment for 5 years, resulting in a total loss of 40% of the HU's carrying capacity for orangutans (K_{final} = 108). Scenario 2 includes the above illegal logging and encroachment impacts, but also assumes the re-opening and operation of a logging concession. This concession is estimated to result in a total loss of 30% of the HU to orangutans (10 years of legal logging followed by burning and conversion of the logged area). This scenario results in a total loss of 70% of the HU's carrying capacity for orangutans (K_{final} = 54). Both scenarios assume that illegal logging and encroachment will cease after 5 years, that removal of orangutans will cease after 5 or 10 years, respectively, and that the population will not become fragmented.

Future Projections

Model results for the NE Aceh orangutan population mirror those for NW Aceh, with mean population size significantly affected by the degree of habitat loss. The population declines to about

50% of its current estimated size in about 50 years in the absence of legal logging and in about 6 years if the logging concession is reopened. Short-term viability is relatively good; over time, however, extinction risk rises and gene diversity declines even in the absence of no further habitat loss. The estimated impacts of reopening the logging concession are projected to drive this population to eventual extinction. This population is estimated to be much smaller than that in NW Aceh and therefore is more vulnerable to stochastic threats and inbreeding depression without demographic or genetic supplementation or population/habitat expansion. Continued or increased habitat alteration, population fragmentation, or continued removal of orangutans will hasten population decline and may substantially increase extinction risk.

Table 8. *Vortex* model results for the NE Aceh orangutan population.

	50 Years			100 Years			1000 Years			Year at PE 5%
	PE	N	GD	PE	N	GD	PE	N	GD	
With Concessions	0	35	0.967	0.002	37	0.930	0.999	0	0.497	191
No Concessions	0	88	0.984	0	84	0.969	0.648	10	0.608	431
No Habitat Loss	0	151	0.989	0	143	0.979	0.082	76	0.769	899

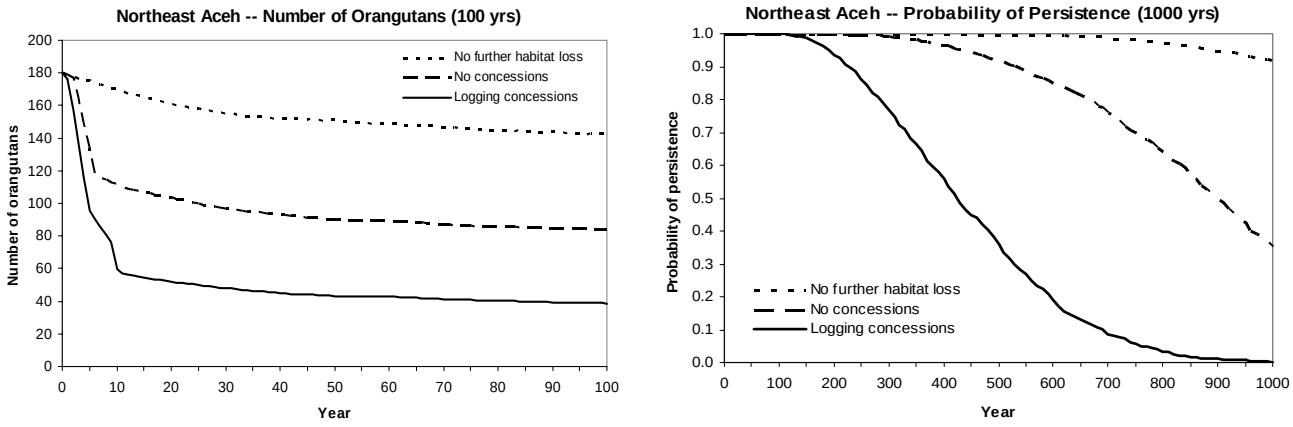

Figure 4. Mean population size (over 100 years) and probability of persistence (over 1000 years) for orangutans in the NE Aceh habitat unit, with expected habitat changes (with and without logging concessions) and with no habitat loss.

East Middle Aceh Habitat Unit

Current Status

The East Middle Aceh Habitat Unit comprises a relatively large area of orangutan habitat in central Aceh province (Block 8; refer to Table 2 and Figure 1) surrounded by existing roads on the north, west and south. Almost all of this HU and its orangutan population fall within the Leuser Ecosystem Conservation Area. The current orangutan population is estimated at 337 individuals and is fragmented into several large and small subpopulations within this area. Orangutans live on the lower slopes and are vulnerable to habitat encroachment or degradation.

Two proposed sections of the Ladia Galaska road scheme threatened to divide this HU into three sections and may restrict or halt movement of orangutans between these areas. The extent to which orangutans will migrate across these roads is unknown. The model investigated here assumes that orangutans will act as one interbreeding population in this HU; however, this is probably an overly optimistic view. Model results from the 2004 PHVA workshop suggest that fragmentation into three isolated subpopulations will reduce population size and viability in East Middle Aceh.

Model Scenarios

Two potential future scenarios were modeled for East Middle Aceh. Scenario 1 incorporates an estimated future habitat loss for this HU of 10% annual loss for 2 years followed by 1% annual loss for 15 years due to illegal logging. In addition, encroachment was estimated to claim 2% annual loss for 10 years. These impacts result in a total loss of 34% of the HU's carrying capacity for orangutans (K_{final} = 222). Scenario 2 includes the above illegal logging and encroachment impacts, but also assumes the re-opening and operation of a logging concession. This concession is estimated to result in a total loss of 20% of the HU to orangutans (10 years of legal logging followed by burning and conversion of the logged area). This scenario results in a total loss of 54% of the HU's carrying capacity for orangutans (K_{final} = 155). Both scenarios assume that all logging, encroachment and removal of orangutans will cease after 17 years, and that the population functions as an interbreeding population and is not fragmented.

Future Projections

As seen in NW and NE Aceh, mean population size is affected by the degree of habitat loss. The population declines to about 50% of its current estimated size in about 50 years in the absence of legal logging and in about 13 years if the logging concession is reopened. Short-term viability is relatively good for all scenarios. Gene diversity and population size decline over time, however; especially with loss of habitat, leading to a substantial risk of extinction (26% over 1000 years) if habitat is lost to the logging concession.

These results do not take into account the likely fragmentation of groups of orangutans in this habitat unit. Baseline model results (Table 4) suggest that populations of 50-100 orangutans are subject to substantial loss of genetic diversity, population decline, and high risk of extinction. PHVA *Vortex* model results also point to decreased viability of this population if fragmented. The current estimated population of 337 orangutans is large enough to be viable in the absence of further habitat loss; the proposed roads may subdivide this population into fragments that are too small for long-term viability and may also dramatically increase logging in this area.

Table 9. *Vortex* model results for the East Middle Aceh orangutan population.

	50 Years			100 Years			1000 Years			Year at PE 5%
	PE	N	GD	PE	N	GD	PE	N	GD	
With Concession	0	118	0.989	0	119	0.978	0.263	39	0.699	651
No Concession	0	183	0.992	0	171	0.984	0.043	102	0.809	>1000
No Habitat Loss	0	277	0.994	0	262	0.989	0.001	201	0.887	>1000

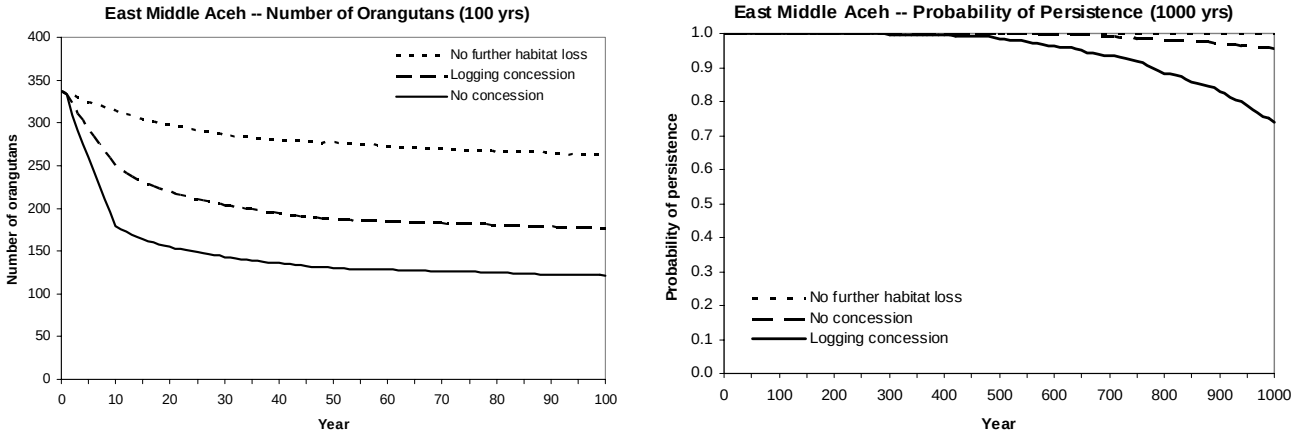

Figure 5. Mean population size (over 100 years) and probability of persistence (over 1000 years) for orangutans in the East Middle Aceh habitat unit, with expected habitat changes (with and without logging concessions) and with no habitat loss.

West Middle Aceh Habitat Unit

Status

The West Middle Aceh Habitat Unit includes an area of orangutan habitat in central Aceh province (Blocks 3 and 9; refer to Table 2 and Figure 1). Part of this HU lies within the Taman Buru Lingga Isaq Conservation Area, but the majority of the HU and almost all of the orangutan population is contained within the Leuser Ecosystem Conservation Area. Three sections of the Ladia Galaska road scheme are proposed that would border this HU to the north, east and south. The current orangutan population is estimated at 103 individuals with some fragmentation. Orangutans live on the lower slopes and are vulnerable to habitat encroachment or degradation. Construction of the proposed roads might isolate a small portion of this population in the south. Estimated future habitat loss for this HU is 10% annual loss for 2 years followed by 1% annual loss for 15 years due to illegal logging. In addition, encroachment was estimated to claim 2% annual loss for 10 years. These impacts result in a total loss of 34% of the HU's carrying capacity for orangutans (K_{final} = 68). The model assumes that habitat alteration and removal of orangutans will cease after 17 years, and that the population is an interbreeding unit (not fragmented).

Future Projections

Model results incorporating expected future habitat changes for West Middle Aceh project that the population will decline by about 50% in 50 years, leaving it vulnerable to stochastic threats and inbreeding. While short-term viability is good, the population is not viable long-term, with a very high risk of extinction (97% in 1000 years) and high loss of gene diversity. Even with no further

habitat loss, the present population is too small for long-term viability, with a 70% risk of extinction over 1000 years. Any population fragmentation, additional habitat loss, or additional removal of orangutan will decrease viability and hasten population decline and extinction. PHVA model results support the increased vulnerability of this population if fragmented due to roads or other causes.

Table 10. *Vortex* model results for the West Middle Aceh orangutan population.

	50 Years			100 Years			1000 Years			Year at PE 5%
	PE	N	GD	PE	N	GD	PE	N	GD	
Future Projection	0	55	0.973	0	49	0.947	0.966	0	0.389	257
No Habitat Loss	0	83	0.980	0	77	0.962	0.695	9	0.575	444

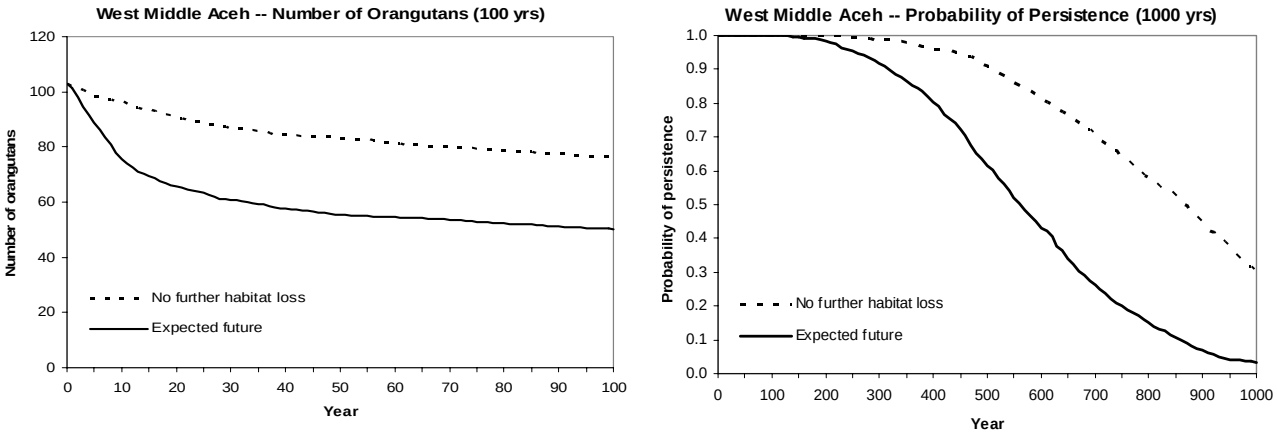

Figure 6. Mean population size (over 100 years) and probability of persistence (over 1000 years) for orangutans in the West Middle Aceh habitat unit, with expected habitat changes (with and without logging concessions) and with no habitat loss.

Tripa Swamp Habitat Unit

Status

The Tripa Swamp Habitat Unit is a small area of orangutan habitat along the southern coast of Aceh province in northern Sumatra (Block 17; refer to Table 2 and Figure 1) and falls within the Leuser Ecosystem Conservation Area. The current orangutan population is estimated at 280 individuals and believed to be at ecological carrying capacity for the area. This area is subject to plantations that are expected to slash and burn about 90% of this area over a 2-year period; any remaining habitat will likely dry out and disappear. Within 4 years, all orangutan habitat is estimated to be eliminated in this habitat unit.

Future Projections

If the expected slash and burn activities by plantations occur as anticipated, orangutans will soon be lost from the Tripa habitat unit. The current population, however, is of sufficient size to be viable in the absence of habitat loss and removal of orangutans. For this habitat unit, the future projection is bleak.

Table 11. *Vortex* model results for the Tripa orangutan population.

	50 Years			100 Years			1000 Years			Year at PE 5%
	PE	N	GD	PE	N	GD	PE	N	GD	
Future Projection	1.000	--	--	1.000	--	--	1.000	--	--	4
No Habitat Loss	0	234	0.993	0	224	0.987	0.003	166	0.863	>1000

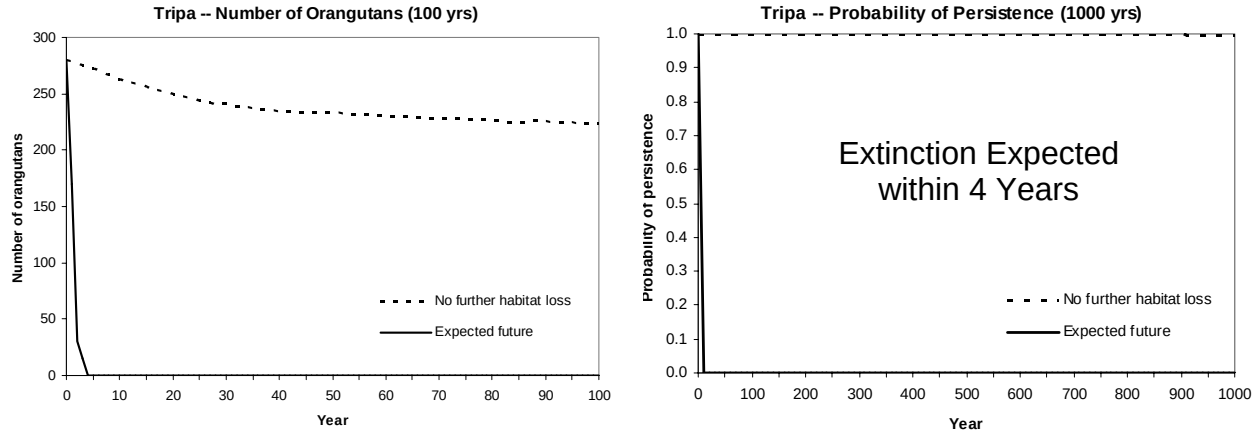

Figure 7. Mean population size (over 100 years) and probability of persistence (over 1000 years) for orangutans in the Tripa habitat unit, with expected habitat changes and with no habitat loss.

East Leuser Habitat Unit

Status

The East Leuser Habitat Unit encompasses a large area of orangutan habitat (Blocks 13, 14, 15 and 16; refer to Table 2 and Figure 1) that falls across two provinces of Sumatra: southern Aceh province and northern North Sumatra province. This HU lies within the Leuser Ecosystem Conservation Area and almost entirely within Gunung Leuser National Park. East Leuser is separated from West Leuser by the Ladia Galaska road scheme, which bisects the National Park. The orangutan population is estimated at 1052 individuals, concentrated primarily in a large (but relatively low density) subpopulation in the southeast and a smaller subpopulation in the northwest. Roads may result in division of the orangutan population into three unequal fragments: 700 orangutans in the north, 130 in the central area, and essentially no orangutans in the southeast fragment.

Estimated future habitat loss includes 2% annual loss for 5 years due to illegal logging and 1.5% annual loss due to a combination of legal logging and encroachment for 20 years, resulting in a total loss of 29.5% of the HU's carrying capacity for orangutans (K_{final} = 741). The model assumes that habitat alteration and removal of orangutans will cease after 20 years, and that the population is an interbreeding unit (not fragmented).

Future Projections

The relatively large size of this population combined with the protected status of this habitat promotes the viability of orangutans in this HU. Mean population size remains relatively large and gene diversity relatively high after 1000 years given the expected habitat loss, with little to no risk of extinction. PHVA and baseline model results suggest that, if dissected by roads, the larger northern subpopulation may remain viable, although the smaller central subpopulation eventually may be lost. Additional habitat loss or removal of orangutans could potentially decrease population viability.

Table 12. *Vortex* model results for the East Leuser orangutan population.

	50 Years			100 Years			1000 Years			Year at PE 5%
	PE	**N**	**GD**	**PE**	**N**	**GD**	**PE**	**N**	**GD**	
Future Projection	0	648	0.998	0	594	0.995	0	528	0.952	>1000
No Habitat Loss	0	878	0.998	0	839	0.997	0	764	0.966	>1000

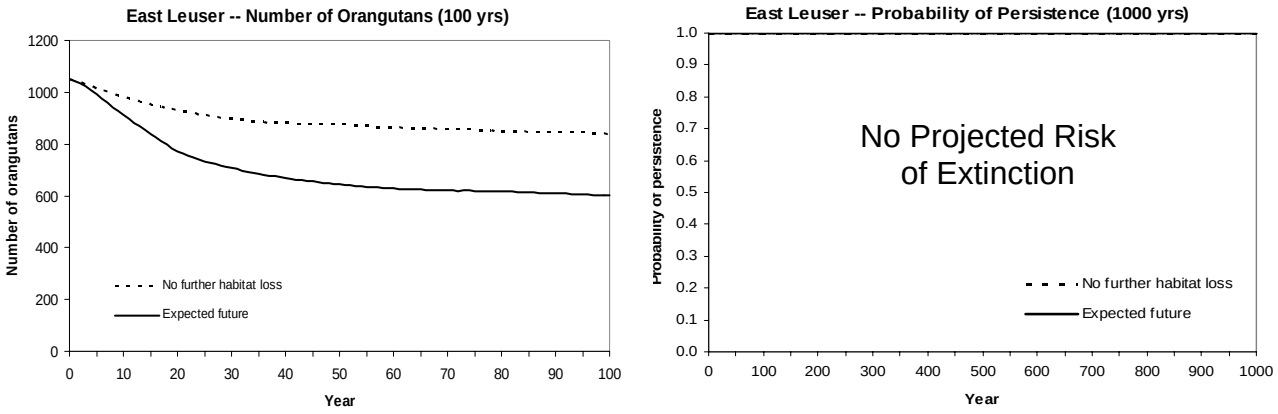

Figure 7. Mean population size (over 100 years) and probability of persistence (over 1000 years) for orangutans in the East Leuser habitat unit, with expected habitat changes and with no habitat loss.

West Leuser Habitat Unit

Status

The West Leuser Habitat Unit in southern Aceh province represents the largest area of Sumatran orangutan habitat (Blocks 4, 5, 5A, 10 and 11; refer to Table 2 and Figure 1) and lies within the Leuser Ecosystem Conservation Area. Although most of this HU falls within Gunung Leuser National Park, a significant portion of the orangutan population is outside of the park boundaries. West Leuser is separated from East Leuser by the Ladia Galaska road scheme, which bisects the National Park. The orangutan population is estimated at 2508 individuals, concentrated primarily in the southern part of West Leuser. A proposed section of the Ladia Galaska road scheme would potentially isolate the most southeastern portion of the population (about 400 orangutans).

Similar to East Leuser HU, estimated future habitat loss includes 2% annual loss for 5 years due to illegal logging and 1.5% annual loss due to a combination of legal logging and encroachment for 20 years, resulting in a total loss of 29.5% of the HU's carrying capacity for orangutans (K_{final} = 1768). The model assumes that habitat alteration and removal of orangutans will cease after 20 years, and that the population is an interbreeding unit (not fragmented).

Future Projections

This large core orangutan population has good long-term viability, even with the anticipated loss of carrying capacity. Mean population size remains large and gene diversity high after 1000 years given the expected habitat loss, with little to no risk of extinction. PHVA and baseline model results suggest that, if dissected by the proposed road, both subpopulations may still be viable. However, substantial additional or continued habitat loss or removal of orangutans beyond that modeled here could potentially decrease population viability.

Table 13. *Vortex* model results for the West Leuser orangutan population.

	50 Years			100 Years			1000 Years			Year at PE 5%
	PE	N	GD	PE	N	GD	PE	N	GD	
Future Projection	0	1528	0.999	0	1385	0.998	0	1313	0.980	>1000
No Habitat Loss	0	2058	0.999	0	1956	0.999	0	1891	0.986	>1000

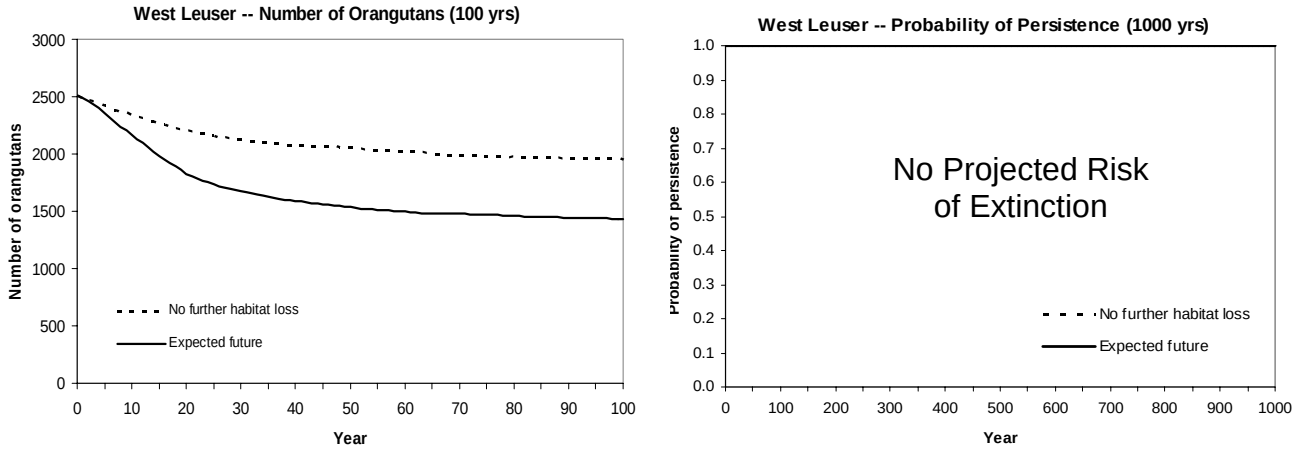

Figure 8. Mean population size (over 100 years) and probability of persistence (over 1000 years) for orangutans in the West Leuser habitat unit, with expected habitat changes and with no habitat loss.

Trumon-Singkil Swamp Habitat Unit

Status

Despite its relatively small area compared to many other habitat units, the Trumon-Singkil Swamp Habitat Unit in southern Aceh province (Block 18; refer to Table 2 and Figure 1) is estimated to contain the second largest Sumatran orangutan population. Bordered by the Indian Ocean to the west and by rivers to the south and east, this coastal swamp lies within the Suaka Marga Satwa Rawa Singkil and Leuser Ecosystem Conservation Areas. The orangutan population is estimated about 1500 individuals and inhabits most of the HU with little fragmentation. Estimated future habitat loss includes 2% annual loss due to illegal logging and 3% annual loss due to encroachment/drainage for 5 years, resulting in a total loss of 19% of the HU's carrying capacity for orangutans (K_{final} = 1215). The model assumes that habitat alteration and removal of orangutans will cease after 5 years, and that the population is an interbreeding unit (not fragmented).

Future Projections

This large orangutan population has good long-term viability, even with the anticipated loss of carrying capacity. Mean population size remains large and gene diversity high after 1000 years given the expected habitat loss, with little to no risk of extinction. Substantial additional or continued habitat loss or removal of orangutans beyond that modeled here could potentially decrease population viability.

Table 14. *Vortex* model results for the Trumon-Singkil orangutan population.

	50 Years			100 Years			1000 Years			Year at PE 5%
	PE	N	GD	PE	N	GD	PE	N	GD	
Future Projection	0	1036	0.999	0	973	0.997	0	920	0.972	>1000
No Habitat Loss	0	1252	0.999	0	1216	0.998	0	1135	0.977	>1000

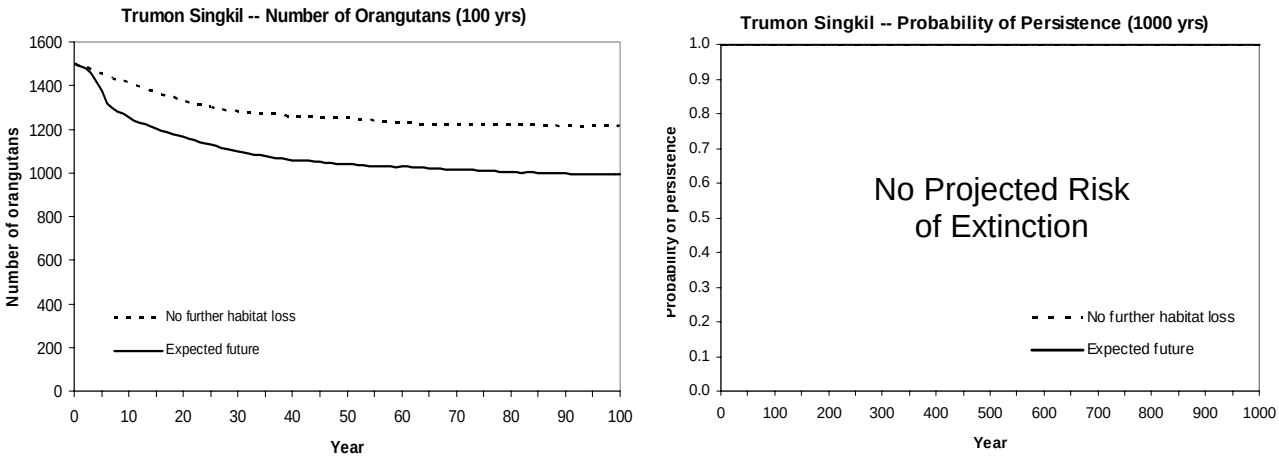

Figure 9. Mean population size (over 100 years) and probability of persistence (over 1000 years) for orangutans in the Trumon Singkil habitat unit, with expected habitat changes and with no habitat loss.

Dairi-Pakpak Bharat Habitat Unit

Status

Dairi-Pakpak Bharat (Sidiangkat) Habitat Unit is a small area of orangutan habitat along the border of Aceh and North Sumatra provinces in northern Sumatra (Block 12; refer to Table 2 and Figure 1) just south of West Leuser HU and the Leuser Ecosystem Conservation Area. The current orangutan population is estimated at 134 individuals, with no major fragmentation of the population. Agricultural encroachment and illegal logging threaten to erode lower slopes where orangutans live.

Model Scenarios

Two potential future scenarios were modeled for this HU. Both scenarios included an estimated future habitat loss of 4% annual loss for 5 years due to illegal logging and 2% annual loss for 10 years due to encroachment, resulting in a total loss of 28% of the HU's carrying capacity for orangutans (K_{final} = 96). Habitat alteration is assumed to cease after 10 years, and the population is modeled as a single interbreeding unit (not fragmented). Scenario 1 assumes that all removal of orangutans from this HU is associated with logging or encroachment; therefore, after 10 years there will be no further removal of individuals. Scenario 2 estimates that additional orangutans are removed from this population independent of habitat changes (e.g., hunting). This scenario incorporates the removal of 2 adult females and 1 infant each year throughout the entire time period modeled (1000 years).

Future Projections

Model results incorporating expected future habitat changes with no additional removal of orangutans project that the population will decline by about 40% in 50 years, leaving it vulnerable to stochastic threats and inbreeding. While short-term viability is good, the population is not viable long-term, with a high risk of extinction (69% in 1000 years) and high loss of gene diversity. Even with no further habitat loss, there is a 28% chance of extinction over 1000 years and reduced genetic

diversity. The removal of two adult females and one infant each year is not sustainable for this population, causing rapid population decline and driving it to extinction in 20-40 years. The continual loss of even a few individuals can greatly affect this small and vulnerable population.

Table 15. *Vortex* model results for the Dairi-Pakpak Bharat orangutan population.

	50 Years			100 Years			1000 Years			Year at PE 5%
	PE	N	GD	PE	N	GD	PE	N	GD	
With Additional Removals	0.999	7	0.917	1.000	--	--	1.000	--	--	25
No Additional Removals	0	82	0.982	0	76	0.964	0.694	8	0.560	406
No Habitat Loss	0	113	0.985	0	105	0.972	0.282	34	0.681	618

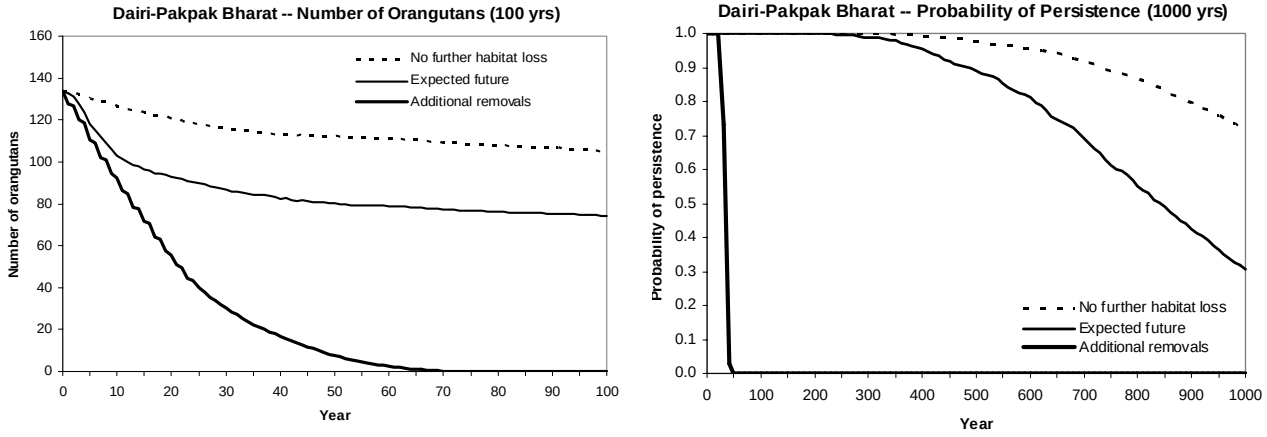

Figure 10. Mean population size (over 100 years) and probability of persistence (over 1000 years) for orangutans in the Dairi-Pakpak Bharat habitat unit, with expected habitat changes (with and without additional removals) and with no habitat loss.

East Singkil Swamp Habitat Unit

Status

East Singkil Swamp Habitat Unit is a small area of orangutan habitat along the southern coast of Aceh province in northern Sumatra (Block 19; refer to Table 2 and Figure 1) and is separated by a river from Trumon-Singkil Swamp HU. A section of the Ladia Galaska roads scheme runs through this area. The current orangutan population is estimated at 160 individuals, with little fragmentation of the population. This area is in the process of being converted to palm oil plantations. Within 4 years, all orangutan habitat is estimated to be eliminated in this HU.

Future Projections

If the expected conversion to plantations occurs as anticipated, orangutans will soon be lost from the East Singkil habitat unit. Even with no habitat loss, this population stills runs some risk of extinction due to its relatively small size. For this habitat unit, the future projection is bleak.

Table 16. *Vortex* model results for the East Singkil orangutan population.

	50 Years			100 Years			1000 Years			Year at PE 5%
	PE	N	GD	PE	N	GD	PE	N	GD	
Future Projection	1.000	--	--	1.000	--	--	1.000	--	--	5
No Habitat Loss	0	134	0.987	0	126	0.977	0.137	57	0.725	804

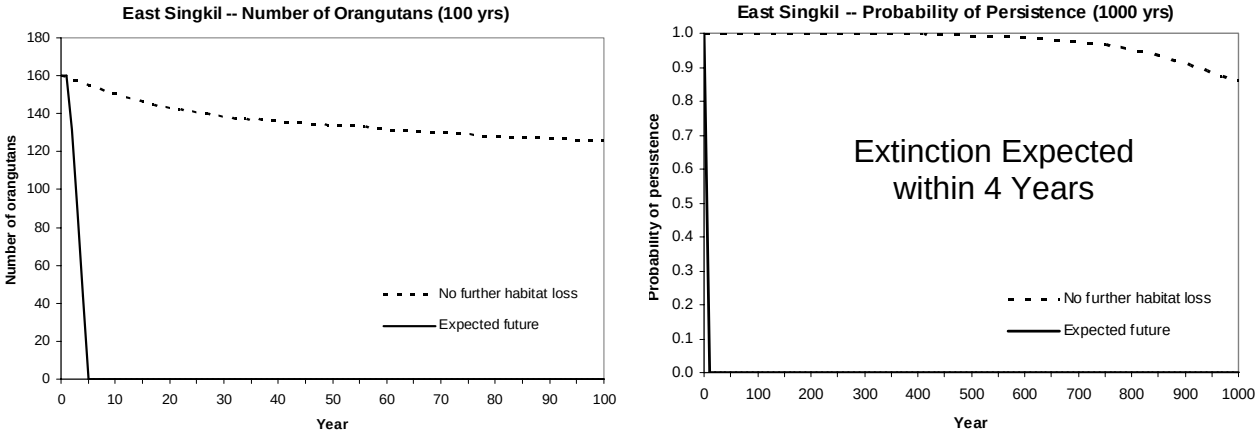

Figure 11. Mean population size (over 100 years) and probability of persistence (over 1000 years) for orangutans in the East Singkil habitat unit, with expected habitat changes and with no habitat loss.

East Sarulla Habitat Unit

Status

East Sarulla Habitat Unit is a small area of orangutan habitat in North Sumatra province south of Lake Toba (Block 21; refer to Table 2 and Figure 1) and is separated from West Batang Toru HU by existing roads. The current orangutan population is estimated at 150 individuals and is likely fragmented. Agricultural encroachment in the central lowlands is expected to continue.

Model Scenarios

Two potential future scenarios were modeled for this HU. Both scenarios included an estimated future habitat loss of 2% annual loss for 5 years due to illegal logging and 2.5% annual loss for 15 years due to encroachment, resulting in a total loss of 41.5% of the HU's carrying capacity for orangutans (K_{final} = 87). Habitat alteration is assumed to cease after 15 years, and the population is modeled as a single interbreeding unit (not fragmented). Scenario 1 assumes that all removal of orangutans from this HU is associated with logging or encroachment; after 15 years there is no further removal of individuals. Scenario 2 estimates that additional orangutans are removed from this population independent of habitat changes (e.g., hunting). This scenario incorporates the removal of three adults (one male, two females) and one infant each year throughout the entire time period.

Future Projections

Model results incorporating expected future habitat changes with no additional removal of orangutans project that the population will decline by about 50% in 50 years, leaving it vulnerable to stochastic threats and inbreeding. While short-term viability is good, the population is not viable

long-term, with a high risk of extinction (85% in 1000 years) and high loss of gene diversity. Even with no further habitat loss, there is a 21% chance of extinction over 1000 years and reduced genetic diversity. The removal of three adults and one infant each year is not sustainable for this population, causing rapid population decline and driving it to extinction in 20-40 years.

Table 17. *Vortex* model results for the East Sarulla orangutan population.

	50 Years			100 Years			1000 Years			Year at PE 5%
	PE	N	GD	PE	N	GD	PE	N	GD	
With Additional Removals	1.000	--	--	1.000	--	--	1.000	--	--	27
No Additional Removals	0	75	0.981	0	67	0.962	0.846	3	0.510	376
No Habitat Loss	0	126	0.986	0	119	0.975	0.208	44	0.703	686

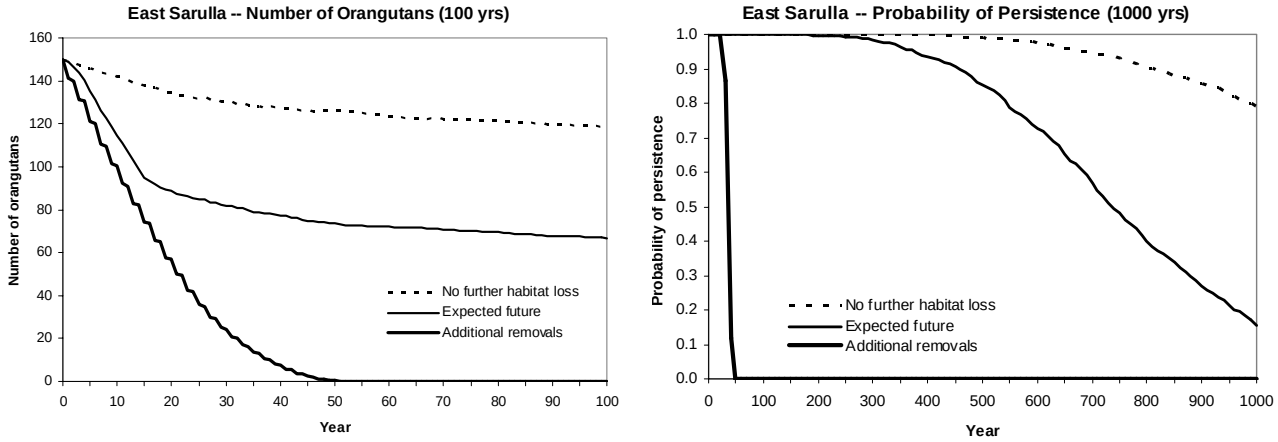

Figure 12. Mean population size (over 100 years) and probability of persistence (over 1000 years) for orangutans in the East Sarulla habitat unit, with expected habitat changes (with and without additional removals) and with no habitat loss.

West Batang Toru Habitat Unit

Status

West Batang Toru Habitat Unit comprises an area of orangutan habitat in North Sumatra province south of Lake Toba (Block 20; refer to Table 2 and Figure 1) and surrounded by existing roads, separating it from the East Sarulla HU. The current orangutan population is estimated at 400 individuals with little fragmentation. Lowland areas are gradually being converted to agriculture. Hunting of orangutans still occurs in this area.

Model Scenarios

Four potential future scenarios were modeled for West Batang Toru, involving the various combinations of incorporating addition removals and the reopening of a logging concession. Scenario 1 incorporates an estimated future habitat loss for this HU of 2.5% annual loss for 5 years due to illegal logging and 3% annual loss for 10 years due to encroachment, resulting in a total loss of 35% of the HU's carrying capacity for orangutans (K_{final} = 260). Scenario 2 includes the above illegal logging and encroachment impacts, but also assumes the re-opening and operation of a logging concession. Legal logging was modeled as a 5% annual loss for 10 years. This scenario

results in a total loss of 70% of the HU's carrying capacity for orangutans (K_{final} = 120). Both scenarios assume that logging, encroachment and removal of orangutans will cease after 10 years and that the population will not become fragmented. Scenarios 3 and 4 mirror Scenarios 1 and 2, with the addition of the annual removal of 5 adults (one male, four females) and two infants from the population for the entire 1000-year period.

Future Projections

Population viability is relatively good given the expected future habitat changes in the absence of the logging concession and the additional removal of orangutans, although mean population size and gene diversity are reduced. The re-opening of the logging concession significantly reduces long-term viability, with a 57% risk of extinction in 1000 years, a pattern similar to that projected for NW and NE Aceh. The additional removal of orangutans has a dramatic impact on the population, with or without the logging concession. This level of removal is not sustainable for this population, causing rapid population decline and driving it to extinction in 20-40 years.

In the 2004 PHVA workshop model results, the West Batang Toru population was projected to be the last stronghold of orangutans in Sumatra. At that time, this population was the only relatively large population (N>250) with a relatively low rate of estimated habitat loss (2%). Increased habitat loss due to logging and the potential hunting or removal of orangutans from this (or any other) HU can greatly decrease the viability of these populations.

Table 18. *Vortex* model results for the West Batang Toru orangutan population.

	50 Years			100 Years			1000 Years			Year at PE 5%
	PE	N	GD	PE	N	GD	PE	N	GD	
Removals, w/ Concession	1.000	--	--	1.000	--	--	1.000	--	--	30
Removals, No Concession	0.974	22	0.983	1.000	--	--	1.000	--	--	35
With Concession	0	84	0.986	0	89	0.971	0.567	15	0.617	480
No Concession	0	224	0.994	0	209	0.987	0.011	146	0.851	>1000
No Habitat Loss	0	337	0.995	0	319	0.991	0.001	268	0.909	>1000

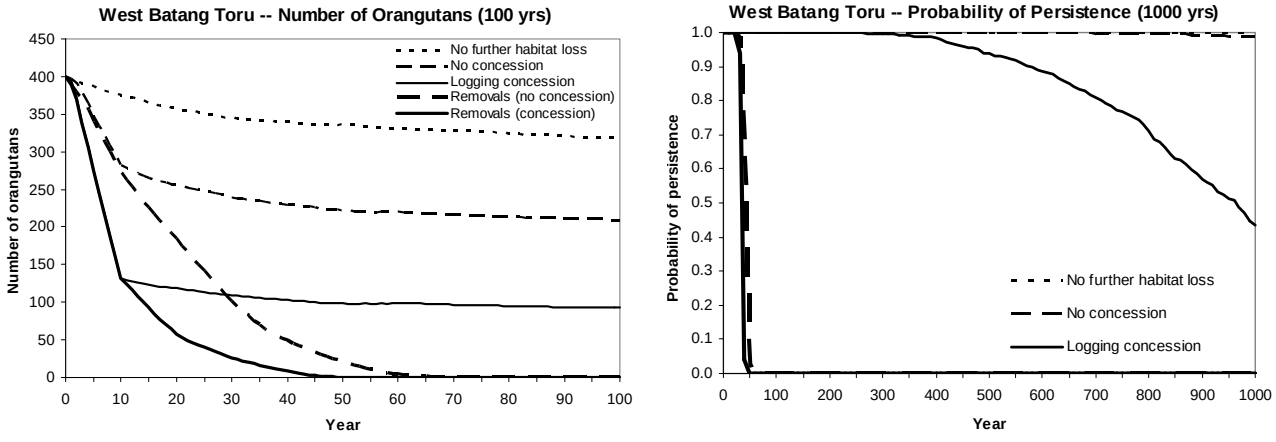

Figure 13. Mean population size (over 100 years) and probability of persistence (over 1000 years) for orangutans in the West Batang Toru habitat unit, with expected habitat changes (with and without concession), with and without additional removals, and with no habitat loss.

SUMMARY OF MODEL PROJECTIONS FOR ORANGUTAN POPULATIONS ON SUMATRA

North Aceh
This region consists of three habitat units (Seulawah, NW Aceh, NE Aceh), totaling an estimated 877 orangutans. Projections for habitat changes in this region suggest that carrying capacity may decrease by 38% (to K_{final} = 540) due to expected illegal logging and encroachment, and may decline as much as 75% (to K_{final} = 224) if logging concessions in NW and NE Aceh are in operation. Orangutans are likely to disappear from Seulawah, even in the absence of further habitat changes. Legal logging concessions will likely cause orangutans to eventually disappear from NE Aceh, and increase the extinction risk for orangutans in NW Aceh to 54% in 1000 years. These projections assume no habitat changes after 10 years; additional habitat loss, fragmentation or removal of orangutans from the wild will lead to decreased viability of orangutan populations in this region.

Leuser Area
This region of core orangutan habitat consists of five habitat units (East and West Middle Aceh, East and West Leuser, Tripa), totaling an estimated 4280 orangutans. Projections for habitat changes in this region suggest that carrying capacity may decrease by about 35% (to K_{final} = 2732-2799) due to expected illegal and legal logging, encroachment, and slash and burn conversion. Orangutans are projected to disappear from Tripa in 2-4 years, as 100% of the habitat is expected to be lost. The population in West Middle Aceh is also projected to disappear within the next few 100 years. The reopening of the logging concession in East Middle Aceh increases the risk of extinction for that population but has little effect on the regional population as a whole. The majority of the orangutans in this region inhabit East and West Leuser HUs, and are projected to persist in viable numbers for at least 1000 years, even with the projected habitat loss and potential fragmentation due to proposed roads. These projections assume no habitat changes after 20 years; additional habitat loss, a high degree of fragmentation, or removal of orangutans from the wild may decrease population viability.

South Aceh
This region consists of three habitat units (Trumon-Singkil, Dairi-Pakpak Bharat, East Singkil), totaling an estimated 1794 orangutans. Projections for habitat changes in this region suggest that carrying capacity may decrease by about 27% ((to K_{final} = 1311) due to expected illegal logging, conversion, and encroachment. In addition to animals lost in these habitat alteration processes, additional orangutans are believed to be hunted or otherwise removed from Dairi-Pakpak Bharat. Orangutans are projected to disappear from East Singkil in 4 years, as 100% of the habitat is expected to be lost. The population in Dairi-Pakpak Bharat is projected to disappear within 20-40 years given estimated removal rates; with no additional removals, short-term viability is good, but the risk of extinction is high over the next few 100 years. Trumon-Singkil HU supports a large population of orangutans that is likely to persist, even with projected habitat losses. Projections for south Aceh assume no additional habitat changes after 10 years; additional habitat loss, a high degree of fragmentation, or removal of orangutans from Trumon-Singkil wild may decrease population viability.

North Sumatra
This region consists of two habitat units (East Sarulla, West Batang Toru), totaling an estimated 550 orangutans. Projections for habitat changes in this region suggest that carrying capacity may decrease

by 37% (to K_{final} = 347) due to expected illegal logging and encroachment, and may decline as much as 62% (to K_{final} = 207) if the logging concession re-opens in West Batang Toru. The additional removal of orangutans is projected to lead to relatively rapid population decline and extinction in these HUs at the removal rates modeled. Even without these removals, the long-term viability of the East Sarulla population is poor. Legal logging jeopardizes the viability of the West Batang Toru population; however, in the absence of legal logging and additional removals, orangutans are projected to persist in this HU.

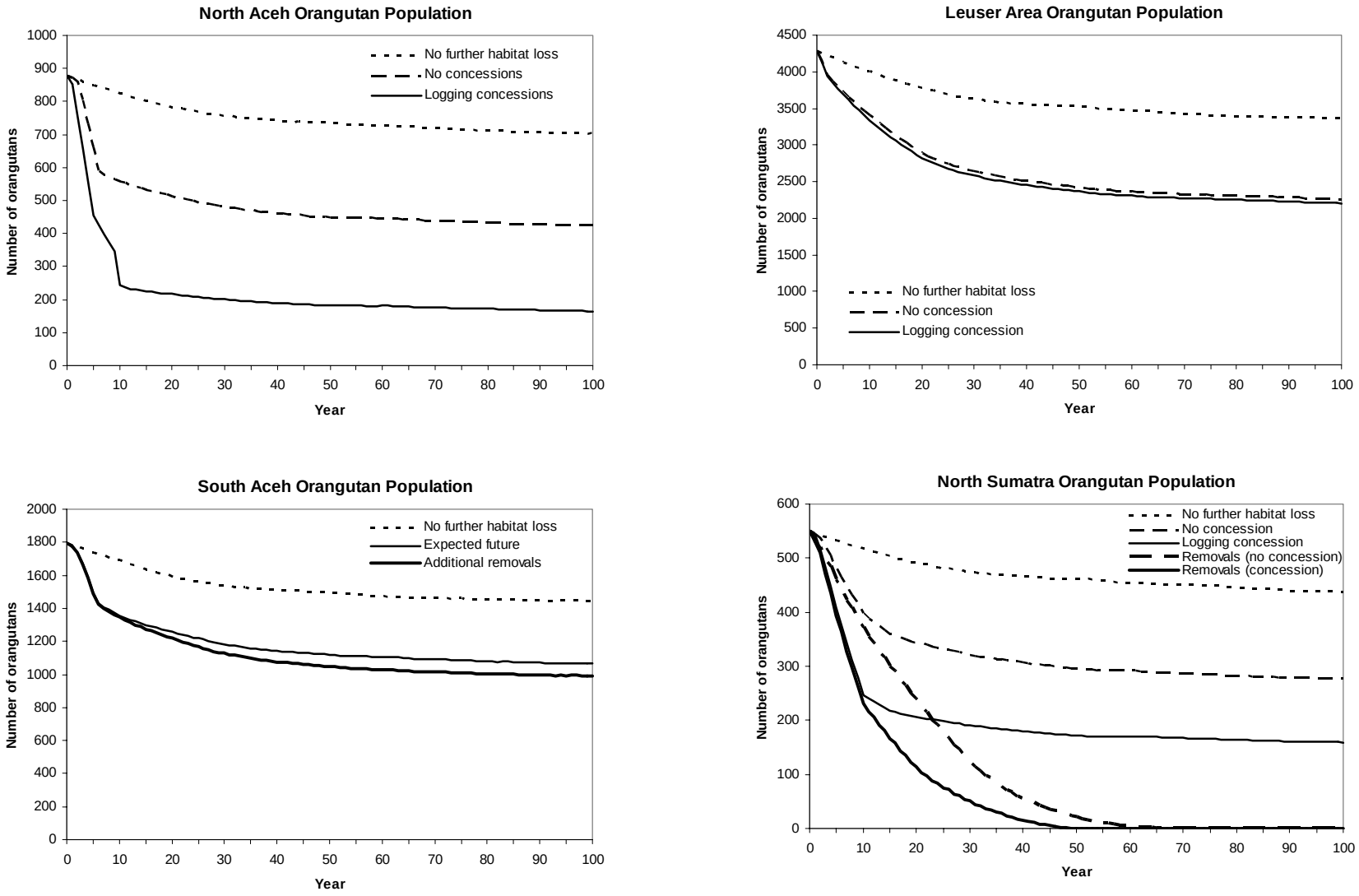

Figure 14. Mean population size (over 100 years) for orangutans in each of the four regions of Sumatra addressed by the Action Plan Working Groups. Results include projections with and without logging concessions, with and without additional removal of orangutans, and with no further habitat loss.

Metapopulation Summary

Participants at the 2004 PHVA and 2005 Action Plan workshops used the most current field data and other expertise and resources to develop a baseline and habitat unit-specific population models that appears to be a reasonable representation of wild Sumatran orangutan populations. These *Vortex* models are based upon the best available estimates of orangutan biology and threats to orangutan populations. Because our understanding of orangutan dynamics may be incomplete or estimates of future habitat changes inaccurate, it is difficult to produce accurate population projections over hundreds of years. However, these models can be useful in predicting population trends and evaluating the relative impact of various threats to orangutan habitat and populations. Just as the models from the 2004 PHVA were revised for the 2005 Action Plan, these results can be re-evaluated to promote effective conservation action as more accurate information is gathered, threats change, and management actions are implemented.

With current estimated rates and timescale of habitat loss and the associated removal of orangutans, model results indicate that habitat loss and other factors will cause Sumatran orangutan populations to decline about 18-25% in the next 10 years (depending upon conditions) and about 50% over the next 50 years. Sensitivity testing of the baseline model suggests that orangutan populations of about 250 have a high probability of survival in the absence of human-related mortality, habitat loss or unforeseen catastrophic events, but will be significantly reduced in size and genetic variation. Populations of 500 or more are more demographically and genetically stable and may contribute to the long-term conservation of this species. Smaller populations that are linked by occasional exchanges of animals could also contribute to the overall stability of a larger meta-population but are not likely to persist long-term in isolation. Habitat loss decreases viability, and the additional removal of orangutans can quickly drive populations to extinction.

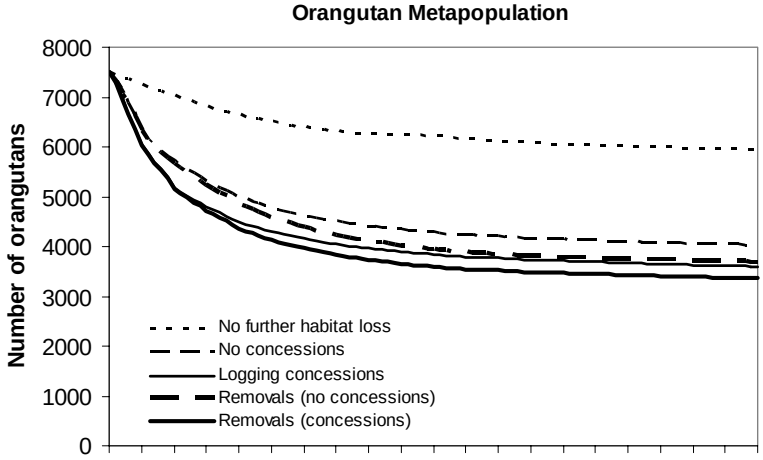

Figure 15. Mean population size (over 100 years) for the Sumatran orangutan metapopulation. Results include projections with and without logging concessions, with and without additional removal of orangutans, and with no further habitat loss.

Of the 13 identified orangutan populations/habitat units on Sumatra, only seven are estimated to contain 250 or more individuals. Of these 7 habitat units, five are projected to retain suitable habitat to sustain at least 250 orangutans in the future. These five habitat units – NW Aceh, East Leuser, West Leuser, Trumon-Singkil, and West Batang Toru – are the only areas that were associated with long-term viable orangutan populations based on *Vortex* model projections. Operation of logging

concessions in NW Aceh and West Batang Toru would threaten the viability of these populations, potentially reducing orangutan core areas to East and West Leuser and Trumon-Singkil.

Populations in the eight other habitat units are subject to population decline and risk of extinction, depending upon the degree of threats to each population. Model projections suggest that orangutans will most likely be lost from Seulawah and West Middle Aceh due to small population size, from Tripa and East Singkil due to expected habitat conversion, and in NE Aceh if the logging concession reopens. Populations in the southern portion of the range may face relatively rapid decline if hunting or removal continues.

These model results assume no additional habitat degradation or loss after 20 years and no fragmentation of orangutan populations within the habitat units. It is possible, however, that the construction of roads such as the proposed Ladia Galaska system may lead to increased logging and habitat erosion, resulting in additional reductions and fragmentation of orangutan populations and habitat. If such impacts cause orangutan subpopulations to drop below 250-500 individuals, even the current large core orangutan populations could be at risk of extinction. Roads may also provide increased accessibility, which could potentially lead to the additional loss of orangutans.

Most of these projections assume that there is no removal of orangutans (e.g., hunting) in the absence of logging. Those scenarios that do incorporate additional removals illustrate the potential devastating effect of the loss of orangutans from a population, particularly breeding adults. The slow growth rate of this population under optimal environmental conditions indicates that Sumatran orangutans cannot withstand a rate of removal above 1% annually, even with no loss of habitat. For many of the orangutan populations, this represents the loss of only 1-2 orangutans per year. It is therefore important to minimize the removal of orangutans from the wild population, including hunting that occurs independent of habitat loss (also see Singleton *et al.* 2004).

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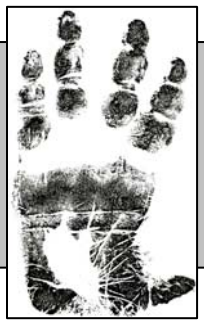

WORKING GROUP REPORT: SEULAWAH, NW ACEH, AND NE ACEH

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AREA PROFILE

Seulawah Habitat Unit

The Seulawah Habitat Unit is a small area of orangutan habitat in northern Aceh province of Sumatra (Block 6, refer to Table 2 and Figure 1) that falls partially under Taman Hutan Raya Tjut Nya Dhien Conservation Area. The current orangutan population is estimated at 43 individuals and believed to be at ecological carrying capacity, with no major fragmentation of the population. This is the smallest of the 13 Sumatran orangutan populations discussed at this workshop. The population in Seulawah is isolated from the others; a narrow road goes between the NW and NE Aceh forest blocks, through Geumpang. It may be possible that the forest is still close enough to the road edges in places for some orangutans to be able to move across as needed. Estimated future habitat loss includes 4% annual loss due to illegal logging and 0.5% annual loss due to encroachment for 3 years, resulting in a total loss of 6.3% of the HU's carrying capacity for orangutans. Modeling assumed that habitat alteration and removal of orangutans will cease after 3 years, and that the population is an interbreeding unit (not fragmented).

Modeling summary. Model results suggest that the Seulawah population will undergo a gradual, steady decline that will continue even after habitat loss ceases. Although the population is projected to be at little immediate risk of extinction, long-term projections indicate an increasing risk of extinction after 100 years. This decline and increasing extinction risk is due primarily to the stochastic threats associated with small population size; viability projections are similar even in the absence of future habitat loss or alteration. Inbreeding depression and stochastic events likely will drive the population to extinction within several 100 years without demographic or genetic supplementation or population/habitat expansion. Continued or increased habitat alteration, population fragmentation, or continued removal of orangutans will hasten population decline and may substantially increase short-term extinction risk.

NW Aceh Habitat Unit

The NW Aceh Habitat Unit encompasses a relatively large, elongated area of orangutan habitat in northern Aceh province (Blocks 1 and 2, refer to Table 2 and Figure 1) bordered on the northeast by existing and proposed stretches of the Ladia Galaska road scheme. A small portion of this HU falls within Bio-Genetic Reserve and Cagar Alam Pinus Jantho Conservation Areas. Much of the lowland orangutan habitat is degraded and patchy. In 1998, the orangutan population was estimated

at 654 individuals (340 in the north and 314 in the south). Habitat loss since that time is unknown due to the instability of this area; the actual orangutan population may be smaller.

Northern and southern areas of this HU are divided by a road that may limit movement of animals between areas. There is evidence of additional fragmentation of habitat within these two subpopulations, and the extent to which orangutans migrate across roads in this area is unknown. At the 2004 PHVA workshop, estimates of animal movement between the north and south areas (50% of subadult males dispersing across the road each year) were used to model potential impacts on population viability. This level of migration appears sufficient for this HU to act as a single population. For the purposes of this workshop, the NW Aceh orangutan population was modeled as a single interbreeding population (not fragmented).

Modeling summary. As might be expected, mean orangutan population size is significantly affected by the degree of habitat loss in this HU. Even with no legal logging concessions, Vortex modeling of the population projects a decline by more than 50% in 50 years. In the presence of legal logging operations, the population is estimated to drop by 50% in only 5 years. Populations are then able to sustain their numbers in the absence of additional habitat loss or removal of orangutans, with no short-term risk of extinction. Logging, however, is projected to reduce the population below the level needed for long-term viability, putting the population at risk due to stochastic threats and inbreeding depression without demographic or genetic supplementation or population/habitat expansion. Continued or increased habitat alteration, population fragmentation, or continued removal of orangutans will hasten population decline and may substantially increase extinction risk.

There is some evidence of additional fragmentation of habitat within the NW Aceh forest block due to heavy degradation by concessionaires and illegal loggers, especially in the area southwest of Geumpang, but orangutans probably do still traverse these degraded parts.

NE Aceh Habitat Unit

NE Aceh (Geumpang - Pidie) Habitat Unit encompasses an area of orangutan habitat in northern Aceh province (Block 7; refer to Table 2 and Figure 1) and is separated from the NW Aceh HU by existing and proposed stretches of the Ladia Galaska road scheme (Figures 1 and 2). Orangutans are believed to occupy only a portion of this area and are spatially disjunct from other orangutan populations. This fragmented orangutan population was estimated at 180 individuals in 1998. It is uncertain to what extent logging has since occurred.. Modeling in this workshop assumed an initial population of 180 individuals, but it is recognized that the actual orangutan population may be smaller. The status of this area is similar to that of NW Aceh – orangutans inhabit badly degraded fringe areas and are vulnerable to encroachment and logging.

Modeling summary. Model results for the NE Aceh orangutan population mirror those for NW Aceh, with mean population size significantly affected by the degree of habitat loss. The population declines to about 50% of its current estimated size in about 50 years in the absence of legal logging and in about 6 years if the logging concession is reopened. Short-term viability is relatively good; over time, however, extinction risk rises and gene diversity declines even in the absence of no further habitat loss. The estimated impacts of reopening the logging concession are projected to drive this population to eventual extinction. This population is estimated to be much smaller than that in NW Aceh and therefore is more vulnerable to stochastic threats and inbreeding depression without demographic or genetic supplementation or population/habitat expansion. Continued or

increased habitat alteration, population fragmentation, or continued removal of orangutans will hasten population decline and may substantially increase extinction risk.

Figure 2 shows the Orangutan Habitat Blocks discussed by this working group.

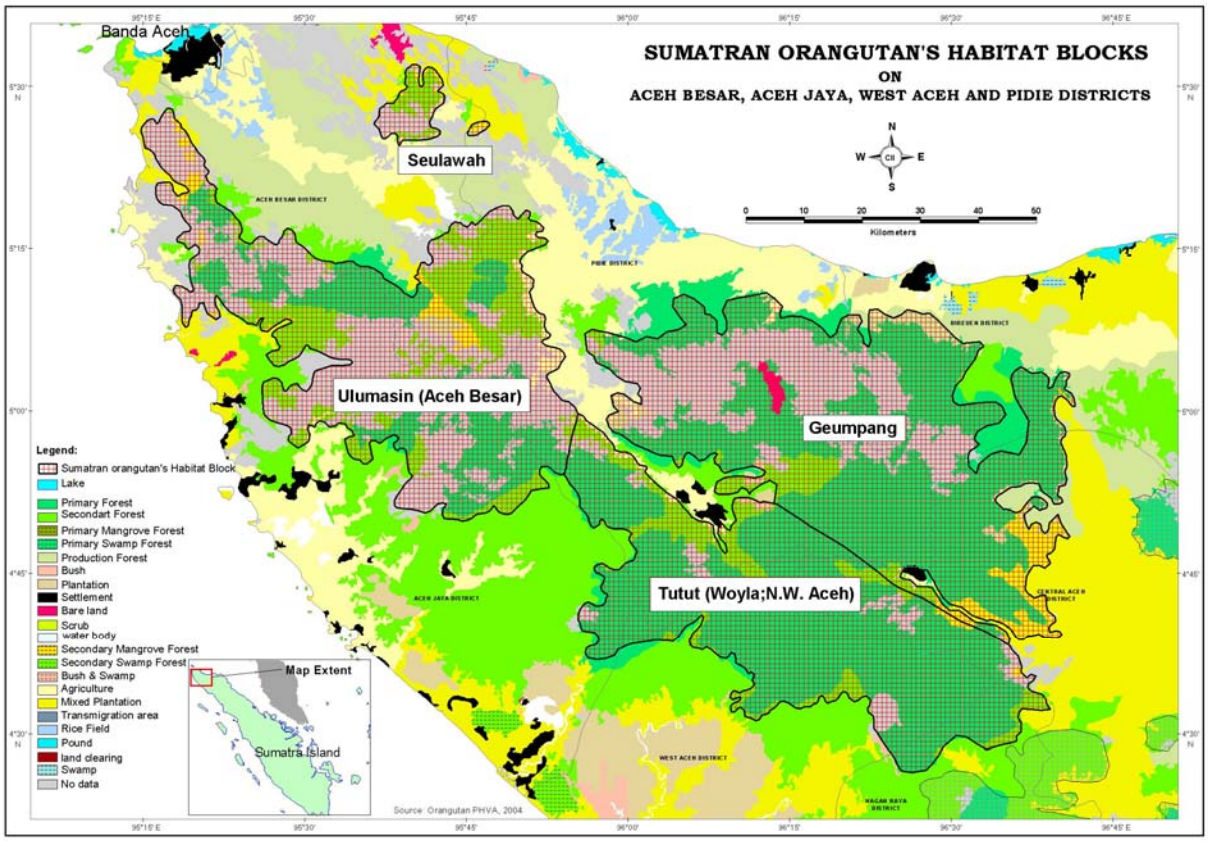


Figure 2. Seulawah, NW and NE Aceh, and the Geumpang Habitat Units (Habitat Blocks 6, 1 and 2, and 7, respectively; refer to Table 1 and Figure 2)

PEOPLE

In Aceh Besar district, 90% of the population is of the coastal Acehnese ethnic group. Aceh Jaya's population also is predominantly coastal Acehnese (90%), with Aneuk Jamee and Barus ethnic groups making up 7% and 3% of the population, respectively. In Aceh Barat, 80% of the population is coastal Acehnese, 10% is Aneuk Jamee, 5% Barus, and 5% Javanese. In Pidie, coastal Acehnese comprise 99% of the population with 1% being of other extraction.

Table 3 shows a breakdown of ethnic groups found in each of the four districts discussed by this working group, as well as special issues faced by this area.

THREATS

Habitat Conversion

Forests are being opened up for palm oil plantations, agriculture, roads, transmigration, mining, and slash and burn farming for a number of crops including rice, nilam (patchouli) and others. These practices lead to a change in forest function and to fragmentation of orangutan habitat.

Legal and Illegal Logging

Legal and illegal logging and resulting forest conversion continue to be serious threats as the intensity of logging in the four districts is increasing. Opening of new forest concessions (*Pengusahaan Hutan* or HPH) and timber utilization permits being issued by the head of the district government for logging (*Izin Pemanfaatan Kayu* or IPK), as well as illegal extraction of timber also has the potential to cause serious natural disasters here due to the terrain.

In the four districts discussed by this working group, timber concession data are as follows:

District	Timber Concession (HPH)
Aceh Besar	790 ha
Pidie	51,908 ha
Aceh Jaya	193,731 ha
Aceh Barat	126,405 ha

Illegal logging is found in Aceh Jaya (Jaya, Setiabakti, Krueng Sabee, and Teunom), Aceh Besar (Lhoong, Leupung, Lembah Seulawah, and Seulimum), Pidie (Geumpang, Mane, Tangse), and Aceh Barat (NA).

Table 3. Demographic data table including human ethnic population and issues affecting Sumatran orangutan population.

District	Ethnic group	Number	Special Issues
Aceh Besar	Aceh Pesisir 90%	292.000	**General Issue** • Conservation is based on social structure and religion • *Mukim* have *adat* (customary) land, which is important for forming new districts or provinces that will allow them to obtain more income, especially from forest products. • Open pit mining is taking place in protected forest (gold: Geumpang and Mane/Kabupaten Pidie, peat: Aceh Barat district) **Post-tsunami Issues** • There is a high pressure for cutting timber for reconstruction which leads to damaging the forest • There is no agreed-upon provincial spatial planning process or plan. • Road Development in Banda Aceh through to Meulaboh will cross protected forest. • Beginning October 2005 IPK will abstracted, and 11 HPH in total could ultimately be reactivated again. • Many people moving out from Banda Aceh / Calang to Lhok Bot • Eleven villages in Arongan Lam Balek subdistrict (Aceh Barat) being relocated 7 m (m or km?) from coastal area. **Issues related to the Helsinki Agreement** • The government is opening forest as a compensation for the Helsinki Agreement. Aceh Barat 4000 ha, Aceh Besar 2000 ha. • Returning of Transmigration (IDP), cause of conflict result (Aceh free movement)..
Aceh Jaya	Aceh Pesisir 90% Barus 3% Aneuk Jamee 7%	90.000	
Aceh Barat	Aceh Pesisir 80% Aneuk Jamee 10% Barus 5% Jawa 5%	160.000	
Pidie	Aceh Pesisir 99% Dan lain-lain 1%	500.000	

Mining

Other extractive industries such as mining also present an increasing threat, particularly as governments allow concessions in and around protected areas. Gold mining concessions in Geumpang and Mane are being operated by PT. Miwah and PT. Rikit Alas Mineral.

Human Issues
Human issues also pose threats, particularly poverty, increasing population pressure, a lack of education, a lack of awareness concerning forest resources and wildlife, and a lack of understanding in communities about the need for orangutan conservation. Hunting of orangutans as pests or for the pet trade is an ongoing threat.

Policy and Law
There is a lack of knowledge and a need to educate the governments of the four districts and their officers to manage natural resources, and to stop the involvement of law enforcement officials in illegal logging. A lack of awareness about the law, a lack of law enforcement, and unclear forest boundary demarcation will lead to continued orangutan habitat degradation. There are also currently insufficient forest rangers and insufficient capacity in the existing ranger forces to enforce laws against habitat encroachment and poaching.

The logging moratorium in Aceh is in the process of being cancelled due to timber needs for rebuilding after the tsunami. Many local governments do not fully understand the need for forest resource conservation and are not proactively conserving habitat, nor utilizing traditional wisdom from local communities in forest management.

Transmigration
Transmigration is an ongoing threat, particularly as people move away from coastal areas following the tsunami. Transmigration is taking place in Geumpang and Manee sub-district (Pidie), Krueng Sabee sub-district (Aceh Jaya), Kaway XVI, Sungai Mas Sub-district (Aceh Barat), and Seulimum/Jantho (Aceh Besar). Land clearing for transmigrant settlement and agriculture are destroying important habitat for orangutans.

Natural Disasters
In addition to other threats, there is always a looming threat of stochastic disasters, including disease outbreaks, forest fires, tsunamis and earthquakes.

OPPORTUNITIES

Habitat Conversion

- *Mukim* (traditional leader) organizations are becoming active.
- *Qanun* (local regulation) formation is underway for plantations.
- Conditions of credit for the opening of forest farms
- Implementation of High Conservation Value Forest scheme as a means to ensure that the most important forests are correctly managed.
- There is an opportunity to implement GNRHL/GERHAN (National Movement on Forest and Land Rehabilitation) program and implement High Conservation Value Forest system, using certification timber, and credit pre-requirement for forest opening to provide better opportunities for orangutan habitat protection.
- There may be ways to obtain Moslem regulations and conservation regulations including *qanun* (traditional law) and support from high quality of law enforcement personnel to gain sustainability of natural resource management.

- It may be possible to include orangutan and habitat conservation issues into the BRR program and the Multi-Donor Trust Fund priorities.
- There is an opportunity to strengthen local institutions and increase independency of local communities in conserving orangutan and its habitat and build on existing networks (*mukim, adat* leader, NGO, and between villages).
- The stability of the local political situation will increase community awareness after the tsunami, with reconstruction and other activities supported by international commitments. Determining spatial planning needs and existence of blueprint will provide additional opportunities to conserve the orangutan and its habitat.

Logging
- Presidential instruction (Inpres) No. 4, 2005, 2005 which is intended to combat illegal logging throughout Indonesia
- Possibility exists to refuse government's plan to reactive 11 HPH (logging concessions) in Aceh
- Insisting on use of certified timber
- Using alternatives to timber for construction (e.g., using coconut timber to build houses)

Law and Human Issues
- Political stability is improving – increasing intensity of forest patrols
- Existence of the blueprint for Aceh reconstruction
- Involving forest police authority in direct investigation
- Moslem Syariat becoming more popular –conservation as integral part of Moslem faith
- Certified wildlife crime investigators (PPNS) authority imposes investigation of conservation cases
- Revision of Indonesia Regulation (UU No. 5, 1990) about conservation of natural biological resources (KSDAH)

Hunting
- Many NGOs are working in conservation activities in Indonesia (many with funding from the Multi-Donor Trust Fund)
- Confiscation of endangered species held as pets in community continued with jurisdiction processes.
- Capacity building for law enforcement personnel beginning
- Revision of Indonesia regulation (UU No. 5, 1990) about conservation of natural biological resources (KSDAH)

Mining
- There has been one situation where open pit mining in protected area (No. 1, 2004) was refused.
- Indonesia regulation number 41, 1990 delineating types of forests in Indonesia and forestry planning and use
- Revision of Indonesia regulation (UU No. 5, 1990) and conservation of natural biological resources (KSDAH)

RECOMMENDATIONS FOR ACTION

1. Revitalize traditional institutions and practices for management of natural resources.
    - Increase knowledge of and role for *mukim* institutions in the sustainable management of natural resources, with special emphasis of Sumatran orangutan conservation.
    - Increase conservation awareness among the general public by using a 'conservation through religion' approach.

2. Utilize traditional policy for natural resource management.
    - Emphasize *qanun* authentication about plantations and socialize *qanun* and its value in natural resource management, including for orangutans.
    - Monitor activities for *qanun* implementation about plantations as well as other *qanun* for orangutan and orangutan habitat conservation.

3. Use degraded forests for conservation programs outside of conservation areas.
    - Identify and determine location and plant types.
    - Implement forest rehabilitation so new areas can be readied to accommodate orangutan conservation programs.
    - Implement the above with adequate socialization to local communities and stakeholders.
    - Transparency and accountability in implementation process using FAST (*fathanah, Amanah, Siddiq dan tabliq*) accountability principal
    - Monitoring and evaluation needs to maintain good relationships with local stakeholders (e.g., local government, universities, and NGOs).
    - Improvement of channeling funds (which previously has always been late).

4. Develop a credit scheme for bank(s) to support conservation programs
    - Provide data implicating companies engaged in illegal logging to banking corporation.
    - Advocate provision of credit for environmentally-friendly activities.
    - Adapt a Credit Union concept in Aceh and North Sumatra to mitigate forest conversion.

5. Secure participation from industries for conservation activities
    - Advocate companies with forest concessions to implement the high conservation value forest concept.

6. Enhance and strengthen law enforcement against forest crimes
    - Move forward customary law to force implementation of Inpres (presidential instruction) No. 4, 2005 – the law to combat illegal logging throughout Indonesia.
    - Budget allocation for operational though the regional revenues and expenditures budget (APBD).
    - Increase understanding and comprehension of natural resources and conservation law by law enforcement personnel (e.g., police, judges, prosecutors)
    - Explicit punishment required for government officers that participate in illegal logging activities. Implement chainsaw inventory in *Mukim* through *Mukim* head.
    - Confiscate rare wildlife held as pets and pursue prosecution of owners/traders.
    - Advocacy for using the Government of Indonesia's revised money laundering regulations to include forest crime activities (illegal logging, illegal wildlife trade).

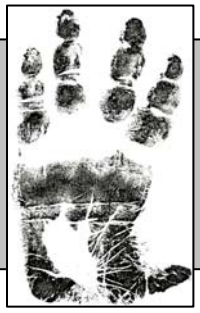
- Increase patrol system to protect the forest, increase the number of government officers able to assist in drawing up document(s) for prosecution and jurisdiction processes.
- Disseminate information to communities concerning natural resource management regulations.

7. Re-implement a moratorium on logging
   - Develop and implement campaign to refuse reactivation of 11 production forest concessions/companies in Aceh.

8. Monitor timber supply for rehabilitation and reconstruction
   - Encourage forest companies outside of Aceh to prioritize timber supply for rehabilitation activities.
   - Advocate timber certification for reconstruction.
   - Monitor reconstruction and rehabilitation activities related to use of illegal timber.
   - Develop and implement a campaign for alternative materials for reconstruction.

9. Connect district spatial planning to the Aceh and Nias blueprint
   - Socialize reconstruction blueprint so that it is clearly connected to the environment and good natural resource management practices.
   - Increase human resource management and strengthen local institutions through participation of NGOs.
   - Include protection of the orangutan and its habitat in spatial planning.

10. Revise natural resources regulations
   - Provide input for natural resources regulation revision, conservation of natural biological resources (KSDAH - no. 5 tahun 1990).
   - Develop and implement a campaign to raise public awareness of the dangers of allowing open pit mining in protected forest.
   - Document and report forest crime activities to house of representative, *komisi IV DPR Republik Indonesia.*



WORKING GROUP REPORT: EAST MIDDLE ACEH, WEST MIDDLE ACEH, TRIPA SWAMP, EAST AND WEST LEUSER

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AREA PROFILE

This Working Group discussed the area comprising the main parts of the 26,000 km^2 Leuser Ecosystem - East and West Leuser, Tripa Swamp and East Middle Aceh (Block 8, see Table 2 and Figures 1). and West Middle Aceh (Block 3 and 9, see Table 2 and Figure 1). For the purposes of this workshop, this working group, which focused on most of the Leuser Ecosystem, did not include the Singkil swamps, even though they are an integral part of the Leuser Ecosystem. For manageability of discussions, this area was considered by the Pakpak Bharat and Dairi working group.

Most of the area discussed by this group falls within the Leuser Ecosystem Conservation Area. The Leuser Ecosystem is a large conservation management concession established under presidential decree no. 33/1998. Under this decree, management of the ecosystem, including the designated Gunung Leuser National Park (Taman Nasional Gunung Leuser or TNGL) which lies within it, is delegated to the Leuser International Foundation (YLI) which was formally established in 1994 by Notarial Deed. The Leuser Ecosystem area has been designed to contain viable populations of the most spectacular northern Sumatran fauna. It covers almost three-quarters of the remaining old growth (primary) forest areas North of Lake Toba, and is contiguous with a stretch of equally valuable forest in the northern part of Aceh province, now commonly known as the Ulu Masen ecosystem. The Leuser Ecosystem area can be divided into a Western portion and an Eastern portion. The Western portion holds an estimated 2,818 km^2 of suitable low altitude primary forest habitat (mostly dryland) that stretches from the coast up to higher altitudes. It also contains some swamp forest in Tripa (Nagan Raya and Aceh Barat Daya Regencies) and in Kluet (Aceh Selatan Regency), and in Singkil (Aceh Selatan and Aceh Singkil regencies; but see note above explaining why the Singkil portion was dealt with by a different group). The Eastern parts of the Ecosystem are all dryland forests, from low to high altitude, with no swamps.

Given that orangutans in Sumatra are not normally found above an altitude of 900 m asl, many of the forests in the interior of this area contain very few or no orangutans. Instead, orangutans are concentrated in the lowland forests (i.e., foothills and swamps) and, in particular, in alluvial forests along water courses, the very same forests that are under the greatest threat.

The 800,000-ha Gunung Leuser National Park, which was established as a wildlife reserve during the colonial period (1935) is one of three national parks in Sumatra that comprise the Sumatran

Rainforest World Heritage Site. Surveys during the 1970-1980s revealed that more than 60% of the park was of an elevation (> 800 m) which was sub-optimal or unsuitable for the survival of the orangutan, and several other endangered species. This was the primary reason why the Presidential Decree expanded the protective management status to include the contiguous remaining (limited production and protection) forest areas outside of the existing National Park. Less than optimal cooperation between the Ministry of Forestry and the delegated management authority (i.e., YLI) in the past led to the loss or damage of some 600,000 ha of primary lowland forest through logging and third-party conversion activities.

East Middle Aceh Habitat Unit

The East Middle Aceh Habitat Unit comprises a relatively large area of orangutan habitat in central Aceh province (Block 8, Table 2 and Figure 1) surrounded by existing roads on the north, west and south. Almost all of this Habitat Unit (HU) and its orangutan population fall within the Leuser Ecosystem. The current orangutan population is estimated at 337 individuals and is fragmented into several large and small subpopulations within this area. Orangutans live on the lower slopes and are vulnerable to habitat encroachment or degradation.

Two proposed sections of the Ladia Galaska road scheme threatened to divide this HU into three sections and may restrict or halt movement of orangutans between these areas. The extent to which orangutans will migrate across these roads is unknown. The model investigated here assumes that orangutans will act as one interbreeding population in this HU; however, this is probably an overly optimistic view. Model results from the 2004 PHVA workshop suggest that fragmentation into three isolated subpopulations will reduce population size and viability in East Middle Aceh.

Modeling summary. As for NW and NE Aceh, modeling projections show that mean population size is affected by the degree of habitat loss, with the population declining to about 50% of its current estimated size in about 50 years in the absence of legal logging and in about 13 years if the logging concession is reopened. Short-term viability is relatively good for all scenarios. Gene diversity and population size decline over time, however; especially with loss of habitat, this leads to a substantial risk of extinction (26% over 1000 years) if habitat is lost to the logging concession.

Modeling results did not take into account the likely fragmentation of groups of orangutans in this Middle East Aceh. Baseline model results suggest that populations of 50-100 orangutans are subject to substantial loss of genetic diversity, population decline, and high risk of extinction. PHVA *Vortex* model results also point to decreased viability of this population if it becomes fragmented. The current estimated population of 337 orangutans is large enough to be viable in the absence of further habitat loss, but the proposed roads may subdivide this population into fragments that are too small for long-term viability and may also dramatically increase logging in this area.

West Middle Aceh Habitat Unit

West Middle Aceh Habitat Unit includes an area of orangutan habitat in central Aceh province (Blocks 3 and 9, Table 2 and Figure 1). Parts of these lie within the Taman Buru Lingga Isaq Conservation Area, but the majority of the HU and almost all of the orangutan population is contained within the Leuser Ecosystem. Three sections of the proposed Ladia Galaska road scheme would border this HU to the north, east and south. The current orangutan population is estimated at 103 individuals with some fragmentation. Orangutans live on the lower slopes and are vulnerable to habitat encroachment or degradation. Construction of the proposed roads will likely isolate a small

portion of this population in the south. Estimated future habitat loss for this HU is 10% annual loss for 2 years followed by 1% annual loss for 15 years due to illegal logging. In addition, encroachment was estimated to claim 2% annual loss for 10 years. These impacts result in a total loss of 34% of the HU's carrying capacity for orangutans (K_{final} = 68).

Modeling summary. Model results incorporating expected future habitat changes for West Middle Aceh projected that the population will decline by about 50% in 50 years, leaving it vulnerable to stochastic threats and inbreeding. While short-term viability is good, the population is not viable long-term, with a very high risk of extinction (97% in 1000 years) and high loss of gene diversity. Even with no further habitat loss, the present population is too small for long-term viability, with a 70% risk of extinction over 1000 years. Any population fragmentation, additional habitat loss, or additional removal of orangutan will decrease viability and hasten population decline and extinction.

Tripa Swamp Habitat Unit

The Tripa Swamp Habitat Unit is a small area of orangutan habitat along the southern coast of Aceh province in northern Sumatra (Block 17, Table 2 and Figure 1) and falls within the Leuser Ecosystem. The current orangutan population is estimated at 280 individuals and the area is believed to be at ecological carrying capacity.

Modeling summary. Tripa Swamp is subject to plantations that are expected to slash and burn about 90% of this area over a 2-year period; any remaining habitat will likely dry out and disappear. If this expected slash and burn plantation activity occurs as anticipated, within 4 years, all orangutan habitat will be eliminated in this HU and orangutans will be lost. If habitat loss and removal of orangutans is stopped, the current population, is of sufficient size to be viable. However, the future looks bleak.

East Leuser Habitat Unit

East Leuser Habitat Unit encompasses a large area of orangutan habitat (Blocks 13, 14, 15 and 16, Table 2 and Figure 1) that falls across two provinces of Sumatra: Aceh and North Sumatra. This HU lies within the Leuser Ecosystem Conservation Area and almost entirely within Gunung Leuser National Park. East Leuser is separated from West Leuser by the Ladia Galaska road scheme, which bisects the National Park. The orangutan population is estimated at 1052 individuals, concentrated primarily in a large (but relatively low density) subpopulation in the southeast and a smaller subpopulation in the northwest. Roads may result in division of the orangutan population into three unequal fragments: 700 orangutans in the north, 130 in the central area, and essentially no orangutans in the southeast fragment.

Modeling summary. The relatively large size of this population combined with the protected status of this habitat promote the viability of orangutans in this HU. Mean population size remains relatively large and gene diversity relatively high after 1000 years given the expected habitat loss, with little to no risk of extinction. PHVA and baseline model results suggest that, if dissected by roads, the larger northern subpopulation may remain viable, although the smaller central subpopulation eventually may be lost. Additional habitat loss or removal of orangutans could potentially decrease population viability.

West Leuser Habitat Unit

The West Leuser Habitat Unit in southern Aceh province represents the largest area of Sumatran orangutan habitat (Blocks 4, 5, 5A, 10 and 11, Table 2 and Figure 1) and lies within the Leuser Ecosystem Conservation Area. Although most of this HU falls within Gunung Leuser National

Park, a significant portion of the orangutan population is outside of the park boundaries. West Leuser is separated from East Leuser by the Ladia Galaska road scheme, which bisects the National Park. The orangutan population is estimated at 2508 individuals, concentrated primarily in the southern part of West Leuser. A proposed section of the Ladia Galaska road scheme would potentially isolate the most southeastern portion of the population (about 400 orangutans).

Modeling summary. Similar to East Leuser HU, estimated future habitat loss includes 2% annual loss for 5 years due to illegal logging and 1.5% annual loss due to a combination of legal logging and encroachment for 20 years, resulting in a total loss of 29.5% of the HU's carrying capacity for orangutans (K_{final} = 1768).

This large core orangutan population has good long-term viability, even with the anticipated loss of carrying capacity. Mean population size remains large and gene diversity high after 1000 years given the expected habitat loss, with little to no risk of extinction. PHVA and baseline model results suggest that, if dissected by the proposed road, both subpopulations may still be viable. However, substantial additional or continued habitat loss or removal of orangutans beyond that modeled here could potentially decrease population viability.

Figure 3 shows the Habitat Units discussed by this working group.

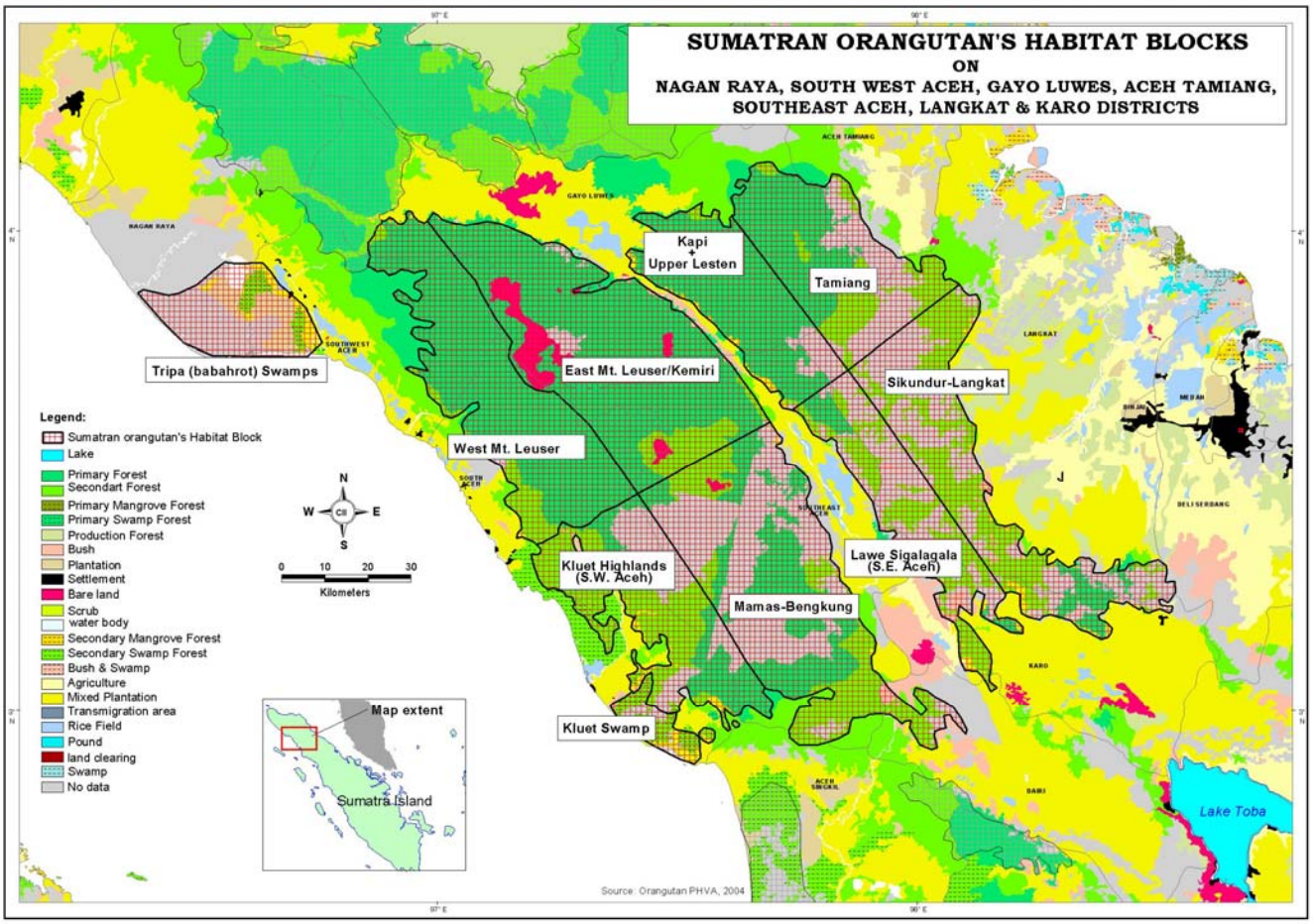

Figure 3. East and West Leuser, Tripa Swamp and Middle Aceh Habitat Units

Encroachment has been particularly extensive in the designated National Park, in Aceh Tenggara regency, and in the extensive lowlands of the Jambu Aie water catchment area. The two other parks that comprise the World Heritage Site (Kerinci Seblat and Bukit Barisan Selatan) contain no orangutans.

On the basis of a GIS analysis of the forests and terrain (following the same methodology used to estimate populations sizes in the Orangutan PHVA 2004, i.e. considering density estimates within each 100m altitudinal range), it has been estimated that the Leuser Ecosystem contains around 5,598 orangutans whilst the Gunung Leuser National Park alone supports less than half that number. Thus, approximately 75% of the remaining 7,300 Sumatran orangutans can be found within the Leuser Ecosystem boundaries, but only around 24% survive within the National Park itself (and hence within the World Heritage Site).

The Leuser Ecosystem covers parts of two provinces. The largest part (85%) lies within the Province of Nanggroe Aceh Darussalam (NAD; also referred to in this report as Aceh) and the smaller part (15%) mostly to the south and east, sits within the Province of North Sumatra. The Ecosystem further overlaps part of 13 regencies (*kabupatens*).

PEOPLE

Approximately 4 million people live in Aceh, and a large percentage of these depend on the Leuser Ecosystem for water supplies and other natural resources, as well as erosion and flood prevention. The major ethnic groups include Acehnese, Gayo, and Alas, Singkil, Kluet, Ane Jame, Karo Batak, Melayu and Javanese. Virtually all adhere to Islam, with the exception of the Karo Batak people who mostly adhere to Christian beliefs. Only Muslims are forbidden by their religion to consume orangutans but they may still hunt them for trade or persecute them as pests.

THREATS

Illegal Logging

Illegal logging occurs inside protected areas but also inside Hak Pengusahaan Hutan (HPH; logging concessions). Illegal logging exists both at small and large scales. The effect on orangutans depends on the scale and the timber species harvested. Often the tree species taken are not major food trees for orangutans (e.g., some of the large *Shorea* spp.) but the felling nevertheless causes enormous collateral damage to the surrounding forest, affecting orangutan food tree species. In some cases (e.g., *Neesia* spp. in the swamps), the target species for logging are in fact very important food trees for orangutans.

In HPHs, illegal logging is often encouraged, in order to further damage the forest after legal operations have ceased or are winding down. This is a technique that makes it easier to then seek permission for total clearance of the forest, frequently with the aim of conversion to palm oil estates.

Illegal logging is thought to be on the increase as a result of the need for timber for post- tsunami reconstruction, and also the improved safety situation in the forests after the Helsinki peace accord. At the small scale, timber is often only sought to meet local villagers' housing needs, but at the large scale, powerful criminal middlemen (*cukong*) and industrial tycoons provide the money and backing for industrial scale timber theft. Targets sometimes include fruit trees that are utilized by orangutans and their loss directly reduces the survival prospects of the apes. Furthermore, even after logging activities cease, an area that has been charted and opened up by tracks and roads facilitates poaching and further encroachment. Such areas are often then completely cleared to make way for agricultural land and plantations.

Encroachment

Encroachment takes place both by individuals and community/agricultural groups, and can be either small- or large-scale. Sometimes outside players encourage encroachment by communities for their own personal gain. For example, there are refugees (mostly Javanese) from Aceh settled within a protected area in the Langkat Regency. These refugees have also been followed by numerous Acehnese and North Sumatran residents, from villages adjacent to the protected area. At the time of writing, this new community has cleared at least 4,000 ha of protected forest.

Legal Logging

This is carried out in areas outside of protected forests under HPH permits and *Izin Pemanfaatan Kayu* (IPK; Timber Utilization Permits). It is also notable that there are presently a number of companies that possess permits for concessions but have not yet activated them, or which have been dormant for some years due to the civil conflict in Aceh. Timber felling frequently occurs outside of

the legally permitted area (and is therefore illegal) and/or includes trees that are too small, or at too low a density - such that they are illegal as well, even within the concession boundaries. Legal concessions often encourage illegal logging in their areas in order to ease the process of obtaining permission to totally clear the land after legal logging has ceased (e.g., for conversion to estates).

This kind of exploitation sometimes also conflicts with the local communities since the spin-off benefits to them tend to be tiny in comparison to the profits made by the companies themselves, their owners (who in many cases are non-local, or even from overseas), and their employees, who may not necessarily be local residents either. This conflict often leads to communities stealing timber from the concessions themselves, leading to even greater habitat destruction than might otherwise occur.

Plantations

Plantations range from small- to large-scale, starting from small, locally owned gardens up to large, international estate businesses operating under *Hak Guna Usaha* (HGU; Rights for Business Use). These plantations pose an extremely serious threat because they completely convert habitat to a monoculture. Plantations are often owned by non-local companies or people (often foreign). Labor for plantations is often sourced from outside the local area, in accordance with the central government's transmigration policy, and results in jealousy among local communities to the point that they also develop their own plantations/oil palm gardens, increasing damage to forests. Oil palm estates have a significant effect on water resources since the oil palm demands a great deal of water. Pollution from processing factories is a major concern, as is the health of workers employed in administrating pesticides, fertilizers, etc. In addition, there is a national government plan to seek alternative fuels using palm oil (so-called bio-fuel or bio-diesel), to replace traditional fossil fuels, and this will further increase pressure for both new plantations and the expansion of existing plantations. Oil palm plantations cause fragmentation and isolation of remnant orangutan populations. In Langkat, there are at least two known small orangutan populations that are cut off from the forest, surrounded by palm oil estates, and frequently persecuted (shot) for raiding villager's fruit crops. Plantation creation is seen as positive by local governments for regional revenue generation.

Related issues include:

- Concern that the legality/completeness of permits and documentation is rarely transparent and frequently questionable
- Whether plantations are already operational or not, as some have not been active.
- Adherence to law, environmental and soil structure regulations.
- Documentation of whether plantations are genuinely productive and/or profitable.

New Roads

New roads open up access to areas for conversion, logging and settlement. The expansion of districts or areas is not in accordance with the regional land use plan and has a high risk in time of causing landslides, flash floods, and other disasters. There are still no needs studies/feasibility studies/environmental impact assessments for proposed roads (e.g., Ladia Galaska).

Additional, illegal roads, branching off into surrounding forests are almost certain to follow the construction of the Ladia Galaska roads network. Roads increase fragmentation of habitat, although in some cases this may be mitigated by development of effective wildlife corridors.

Forest Fires
Forest fires are a major large-scale problem in neighboring Borneo and southern Sumatra, but still only small-scale within the Leuser Ecosystem. Forest fires are normally started by farmers clearing gardens for agriculture and by plantation estates. Some fires are deliberately started for particular reasons (e.g., to create roads, etc). In addition, as a result of the Helsinki peace agreement, the government is obliged to provide new agricultural land for some members of the community (including former GAM rebels), which will also involve burning.

New Settlements
New settlements result in encroachment. Javanese transmigrants, formerly residing within Aceh, became refugees during the civil unrest and fled to North Sumatra. The clearest example of this is in the Besitang area of Langkat, where transmigrants have settled large areas within protected areas (e.g., TNGL and the larger Leuser Ecosystem), clear felling the land, converting to agriculture and oil palm plantations, and creating new settlements. These refugees have been joined by North Sumatrans and Acehnese from other villages, and have been encouraged and supported by unscrupulous business interests to clear and convert the land.

Natural Disasters
Tsunami, earthquakes, landslides, and floods - which for the most part cannot be predicted - each have an effect on orangutan habitat and orangutan food resources. Landslides and their resulting flash floods have been a major problem along the Alas valley (Aceh Tenggara Regency) in the last year. Such disasters are often erroneously termed 'natural' and have been largely attributed to rampant illegal logging. They are thus frequently considered preventable. Such incidents can also cause conflicts between national government ministries, since those responsible for funding the clearing up operations and repairs are not those profiting from the exploitation of the forests.

Hunting and Trade in Orangutans
There is a black market that trades in orangutans both domestically and internationally. The trade is thought to be especially common in Aceh Tenggara Regency but also exists throughout the rest of the region. Hunters can be found among the military and police and among local communities. At least 15 locations in Langkat Regency alone are thought to practice orangutan hunting. In Jambur Lak Lak (Aceh Tenggara Regency), there is the potential for orangutan hunting, also in the Benkung and other areas. There is additional hunting and killing of orangutans when plantations are created, largely because orangutans found in plantations are considered pests. Creditors often state to the industry that the area must be free of pests and disease as a condition for loans. Despite the above, it appears that hunting and the trade in orangutans in northern Sumatra occurs at relatively low levels, at least compared to Kalimantan, and also compared to what the potential might be.

The military and police are often implicated in hunting, either hunting the animals themselves, or confiscating them from citizens – with the end result being the same, either that they keep them for themselves or trade them (e.g., on their return to Java). Numerous examples exist of orangutans being confiscated from military and police personnel (OKNUM) and of Military and Brimob vehicles transporting orangutans (and countless other species) out of the region. Approximately 60-70% of all Sumatran orangutans that have been received by the Sumatran Orangutan Conservation Programme's (SOCP) orangutan quarantine near Medan were previously owned by military or police personnel. A further 20% tend to be local government officials (often *Bupatis* [District Regents] themselves). Most orangutan killing occurs along the forest edges, as orangutans resident in the area

are found raiding crops in gardens that where formerly part of their forested home range. As a result, they are often shot (as with any crop pest) and if infants survive the ordeal, they are then traded, given away, or 'taken' by military or police personnel (who then keep them as pets).

A relatively small number of orangutans from Sumatra have been smuggled overseas in recent years (dozens of animals, as opposed to the hundreds of animals from Borneo). Six of these were repatriated by SOCP/PHKA from Malaysia in December 2005.

Shifting Cultivation/Habitat Conversion
"Shifting cultivation" can make sound economic sense as communities/villagers are able to sell their existing land, and then immediately clear and open up new land. This is happening in Singkil and Dairi, and elsewhere. Shifting cultivation is not generally an appropriate term in this region, however, since seldom, if ever, are small agricultural plots left fallow to recover. Instead, such conversion tends to be permanent. The issue of soil fertility also is important since there are a number of plant types that are best planted on newly cleared soils. Nilam (for patchouli oil) is one such crop and probably the greatest threat at the lower end of the economic scale. It does best on newly cleared soils and is still a popular crop in Aceh. Ownership of land is normally arranged via decrees (*surat keputusan*) from the local *Camat* (district) offices.

Exploitation of Non-Timber Forest Products
Non-timber forest products often include orangutan diet species such as rotan. The species of rotan most frequently taken is already extinct, or close to it, in many localities. Akar tanduk is collected and results in the death of the plant. Lianas are particularly vulnerable to exploitation since they die immediately when no longer connected to the ground. Collection of liana (e.g., for decoration, such as at tourism sites) results in reduced food resources and climbing options for orangutans.

Regional Planning Issues and the Aceh Reconstruction Process Post-Tsunami
Regional planning issues, including the Aceh reconstruction process are strongly related to the peace process in Aceh province. Many of the issues center on HPHs and HGUs (Rights for Business Use). During the conflict in Aceh, many concessions and estates could not function due to safety concerns, but pressure is intense to restart operations in order to assist with the reconstruction process. Illegal logging was also reduced during the conflict but may once again increase dramatically as a result of the peace accord. A moratorium on logging in Aceh has also been lifted. The blueprint for Aceh reconstruction does have an environmental component – adherence to this component is critical. It is unfortunate that illegal timber from some areas within Aceh (e.g., Bengkung/Singkil) still seems to be being exported to other provinces or overseas, despite the increased demand within Aceh itself.

Human Population Migration
There is a planned transmigration program to Aceh, where the population is considered reduced. The justification is that it will help to rebuild regional economies. There is also migration away from the coasts, especially in Nagan Raya and Aceh Barat Daya Regencies, as families return to their original villages.

Traditional Wisdom/Laws
Traditional laws are often no longer respected by communities.

Disease
There is currently no concrete evidence of any major epidemics of disease affecting orangutans in this region. This is unlike Africa, where Ebola virus is a major threat to great apes and has already destroyed several great ape, and human, populations. The ebola situation in Africa is one of the main reasons behind the establishment of GAHMU (Great Ape Health Monitoring Unit), an international collaborative initiative geared towards monitoring the health of all wild ape populations.

Although there are no data sets, it is possible that disease has been a problem in the past for orangutans, and in theory disease could be a future threat. It should be noted here that disease is thought to have been responsible for the die-off of Siamang *(Simias concolor)* in the Alas valley during the 1990's. The intensity/proximity of contact between people and orangutans (and wildlife generally), such as still occurs regularly in Bukit Lawang, means that disease transmission between people and wild orangutans is an ever-present risk. It should also be noted that infant orangutans born to released ex-captive orangutans at Bukit Lawang seldom survive longer than 5 years. The cause of death remains unknown, but this phenomenon warrants detailed study and should serve as a reminder that health issues among orangutans in the region are still poorly known, poorly understood, and may not in reality be as small a threat as is generally considered. In recognition of the considerable potential of a disease pandemic affecting all Sumatran orangutan populations (since they all occur in one relatively small portion of Sumatra), zoonotic disease issues should not be underestimated and practioners as well as the Government of Indonesia should be encouraged to take a more pro-active role in wildlife disease research and monitoring.

The Helsinki Peace Accord
After the peace agreement between the Government of Indonesia and Acehnese separatists (GAM), regional governments are obliged to provide land for agriculture (4 ha per person) to ~3,000 people; thus, a total of 12,000 ha needs to be found. Prior to the peace agreement, activities in forest areas (e.g. HPH, HGU, illegal logging and hunting) all appeared to be reduced (due to safety concerns) but it is expected that all will now increase as it again becomes safer to re-enter the forests.

Mining
The large cement factory in Langkat regency is still proposed and there are plans for coal mining by the Media Group in Nagan Raya. Gold mining is planned in Gayo Lues regency by PT. Jagmining Corp. Ltd (Australia), in an area 10,625 ha. There is also gold prospecting by local villagers in the Manggamat region of Aceh Selatan. Open pit mining operations obliterate all habitat at the surface. Mining also poses a pollution threat, both during processing and in effluent (tailings) disposal.

Research
There are claims that poor management of research sites and programs can lead to jealousy among some factions of communities, leading to reprisals in the form of increased illegal logging activities, encroachment, etc. However, examples of such cases are exceedingly rare. In the vast majority of cases, research programs provide for patrolling of protected areas, employ local people, and educate local communities. Examples where researcher presence in an area has prevented or slowed illegal logging are far more numerous than any examples to the contrary. Of the sites in the Leuser Ecosystem, it can be clearly seen that encroachment north and south of Ketambe along the Alas River has proceeded unchecked, while at Ketambe itself the forest still reaches the river banks. At Suaq Balimbing, the study area was the very last part of the forest to be entered by illegal loggers

after the escalation of hostilities due to the civil conflict. Research should therefore be considered as positive for orangutan conservation, and not as a threat.

OPPORTUNITIES

Illegal Activities, including Logging and Hunting/Trade in Orangutans

- There are environmental education programs aimed at decision makers and law enforcers that can strengthen the capacity to address illegal logging and trade issues.

Plantations

- The round table on sustainable palm oil represents an unprecedented attempt by an industry to clean up its practices.

Legal Logging

- Numerous HGU and HPH already have their official permits but have either not started opening up their concessions or have only partly done so as a result of safety concerns during the conflict. Some parts that have been cleared in the past are even regenerating naturally (e.g., parts of oil palm plantations in the Tripa swamps and in the Singkil swamps).
- Implementation of eco-labeling schemes for sustainable timber production and other management uses.

New Roads

- It is still not too late to halt the proposed Ladia Galaska roads scheme, if there is sufficient political will.
- There is good access to monitor roads.

Policy, Regional Planning Issues, and the Aceh Reconstruction Process Post-Tsunami

- Regional/provincial spatial planning within Aceh Province is currently being revised.
- Numerous villages and small towns in the region are empty/abandoned as a result of evacuation during the conflict (e.g., in and around the Lingga Isaq Hunting Park).
- Land use regulations and policies are being modified.
- There is potential new funding for conservation of areas, especially coasts, as a result of the tsunami and the Aceh recovery program.

Policy and Natural Resource/Habitat Management, including Conversion

- The law, Act of the Republic of Indonesia No. 5 Concerning the Conservation of Natural Resources and their Ecosystems (UU No. 5/1990), is currently being revised.
- There are already numerous NGOs, domestic and international, established and working in the area.
- There is still a possibility of improving the corridor connecting the middle Aceh forest blocks and the main Leuser blocks.
- There is still an opportunity to create/improve a corridor re-linking the eastern and western parts of Leuser.

- The creation of the proposed new province 'Leuser Antara' could place environmental issues as a higher priority than they previously have been.
- The Government of Indonesia is a range state member of the UNEP/UNESCO Great Ape Survival Project (GRASP) and has signed the 2005 Kinshasa Declaration on Great Ape Conservation (Appendix III).
- The water catchment function of this area is becoming an increasingly critical issue and communities are increasingly aware of the important role forests play in providing a reliable and clean water supply.
- The wildlife corridor between West Leuser and the Trumon-Singkil swamps is regenerating well.
- The area is already designated as the Leuser Ecosystem and has considerable government support for its conservation (especially under presidential Decree no. 33/1998). Part of the area also falls within the Gunung Leuser National Park and the Sumatran Rainforest Heritage World Heritage Site.
- There is a possibility of promoting the Sumatran orangutan as the first World Heritage Species under a new concept being proposed to UNEP/UNESCO.
- A Ministerial decree regarding collaboration and coordination between communities, NGOs and government in support of collaborative management of protected areas.
- Communication is becoming more open between NGOs and government institutions (e.g., local government, Gunung Leuser National Park, PHKA, Indonesian Institute of Sciences [LIPI], etc.).

Traditional Wisdom/Laws and Awareness

- Local communities are now more aware than ever that if the forests are damaged, disasters such as floods and landslides become increasingly likely.
- Traditional and local wisdom (*adat*) that promotes nature conservation (e.g., traditional laws and beliefs) already exists and can be utilized further.
- There are a number of NGOs working on environmental education and actively promoting a return to the *adat* system.

The Helsinki Peace Accord

- The success of the peace process creates a situation that is more conducive for monitoring and for establishing new field projects.

Funding and Livelihoods

- There are numerous significant potential donors for this area.
- There is considerable potential for ecotourism in the area, which, if it is well planned and controlled, could boost local economies without depleting natural resources.

Research

- The existence of Research Stations provides opportunities to protect habitat and orangutan populations.

Challenges associated with these opportunities include:

1. Conserving the orangutan and its habitat
2. Weakness in the laws and regulations governing the environment and their implementation

3. Corruption and lack of political will
4. The psychology of local communities/villagers.
5. Bureaucracy.
6. Lack of transparency in NGO projects and a need for greater consultation with local government and the Gunung Leuser National Park Authorities.
7. Developing more effective management and zonation of protected areas.
8. Inadequate training and capacity among PHKA personnel in the field.

RECOMMENDATIONS FOR ACTIONS

1. Develop a strategy to reduce pressure to reopen and reactivate 11 new HPH, IPK (Timber Utilization Permits) and HGU (Rights for Business Use) in NAD (important note: at time of editing, five have in fact already been reinstated in NAD although only one lies within the Leuser Ecosystem).
    - Publicly re-affirm the conservation status of the area; the Ministry of Forestry should restate publicly to the domestic and international community the existence of the Leuser Ecosystem and the significance of Presidential Decree No.33/1998. With such a statement, international donors who may be dissuaded from investing support for the ecosystem may be more forthcoming with conservation funds.
    - Reforms supporting the conservation status of the area, including:
        - conducting environmental impact assessments that are ultra-independent and objective;
        - not issuing new permits for HPHs and IPKs;
        - reviewing publicly all IPKs and HGUs; and
        - canceling HGUs in the area.
    - Acknowledge that all the remaining peat swamp forests within the Leuser Ecosystem are optimal habitat for Sumatran orangutans and prioritize their rehabilitation, restoration and protection as strict Wildlife Reserves.

2. Implement more stringent controls on roads and infrastructure development within orangutan habitat areas.
    - Donor institutions should publicly review the needs of such developments according to all factors (economic, geographic, environmental, etc.) prior to committing funds.
    - All aid for infrastructure development within the Leuser Ecosystem should be reviewed by neutral parties and recommendations provided to donors.

3. Address encroachment and land claims
    - Settlers in the Gunung Leuser National Park should be translocated to other areas.

4. Stop export of illegal timber
    - Pressure needs to be provided from the presidential level to close the ports at Bakongan and Susoh, among others, according to legislation already available under Presidential Directive No.5/2000.

5. Increase coordination and collaboration between government and NGOs

- The Government of Indonesia needs to take a more progressive and active role in coordinating work programs and activities in the field toward orangutan conservation, part of Sumatra's rich biological heritage.

6. Increase understanding by local communities of conservation concepts
   - Assess local communities to find ways of increasing public support for conservation actions. Improve education regarding natural history and the environment as part of school curricula and other education initiatives.

7. Develop more stringent policies regarding establishing new provinces/regencies.
   - Prior to creating new provinces or regencies, conduct thorough assessment/evaluation of the effects they will have on the management of the orangutan's forest habitat.

8. Manage disease risk
   - Non-invasively monitor the health of wild orangutan populations in a standardized and coordinated fashion.
   - Streamline the process of sample collection, testing and export in the interests of facilitating more extensive research and improved efficiency and thoroughness in the monitoring of wild and captive great ape health. In particular, the Department of Forest Protection can streamline sample collection from wild orangutans (feces, hair, organs, etc.) and their testing, wherever such testing is simplest and most effective.
   - Inform related institutions (PHKA, LIPI) regarding new initiatives concerning great ape health, such as that of the Great Ape Health Monitoring Unit (GAHMU).
   - Establish an emergency response system in anticipation of future disease problems.

9. Clarify the role of various institutions concerning the Leuser Ecosystem (e.g., among the Gunung Leuser National Park Authority, NGOs, etc.).
   - The Government of Indonesia should supervise, build capacity and knowledge, and delegate conservation activities to designated conservation management specialists.
   - Seek World Heritage Status for the entire Leuser Ecosystem. This is particularly important because the majority of orangutans in the Ecosystem live outside of the boundaries of the Gunung Leuser National Park.
   - Facilitate/build more effective government and NGO relationships and support for the management of the Leuser Ecosystem, which is granted to the Leuser International Foundation by the Government of Indonesia.
   - Develop a clear memorandum of understanding to delegate responsibility among relevant institutions in the management of the Leuser Ecosystem, namely between the Department of Forestry and the Leuser International Foundation.
10. Clarify and monitor adherence to forestry policy in NAD post-tsunami
   - Enhance transparency concerning the role of the Dinas of Forestry in NAD so that its aims and interests regarding forest management are clear within the post-tsunami reconstruction process.
   - Exert pressure to reinstate the moratorium on logging in Aceh.
   - Stop the issuing of SKSHH (permissions to transport of forest timber).
   - Review existing IPKs and cancel as appropriate.

- Establish a special team to monitor the supply of timber to Aceh during the reconstruction process. The team should be comprised of representatives from local NGOs, Gunung Leuser National Park, the Leuser International Foundation, and international NGOs. The team should report its findings directly to the president of Indonesia, the Minister of Forestry, local communities, mass media and both multilateral and bilateral donor institutions.

11. Strengthen capacity in traditional laws and enforcement
    - Reinforce and strengthen traditional laws and mechanisms with a view to better protection of natural forests.

12. Stop hunting and trade in orangutans.
    - Cancel/revoke the Instruction by the Director general of Forest Protection and Nature Conservation No 762/DJ-IV/ins/121/2001 regarding the voluntary handing over of illegally kept protected animals which allows exemption from prosecution for illegal pet owners that voluntarily hand over their animals, even in cases where Conservation Department officers have already entered the premises to confiscate the animal.
    - Take serious actions against perpetrators of the keeping, traffic and smuggling of protected species (including OKNUM [military, police, etc.]).
    - Encourage direct intervention of the President of the Republic of Indonesia, the Minister of Forestry, Military commanders, Intelligence agency, Chief of Police RI (KAPOLRI) in poaching incidents.
    - Encourage intervention by the International bilateral and multilateral funding agencies, GRASP, IUCN, CITES, US senate, etc., as appropriate, in the form of political pressure and financial aid in the framework of reinforcing the principles agreed to by the Government of Indonesia in signing the GRASP Kinshasa Declaration.

13. Strengthen law enforcement
    - Encourage direct intervention by the President of the Republic of Indonesia in the Supreme Court in order to complete prosecution cases related to conservation offenses.
    - Increase the role and capacity of NGOs to assist the legal process, in cases of forest loss, hunting and trade, and implementing forestry legislation generally.
    - Implement Operation Forest Conservation II, to focus on illegal timber being stolen from Gunung Leuser National Park and the Leuser Ecosystem.
    - Increase pressure to ensure that funding for projects that have a negative effect on orangutan habitat are consistent with the Principles of the GRASP Kinshasa Declaration (Appendix III).

CONCLUSIONS

The importance of the Leuser Ecosystem for biodiversity conservation cannot be overstated. It represents the last real hope for the long term survival of the Sumatran orangutan, Sumatran tiger, Sumatran rhino and possibly also the Sumatran elephant, to name just the well known megafauna. This area also represents a major resource to the people of Aceh and North Sumatra with more than 4 million people dependent on it for their daily needs, including water and other agricultural needs.

The Leuser Ecosystem has been managed in a unique way since the mid 1990s, as part of a Government of Indonesia and European Union collaborative project known as the Leuser Development Programme. Had this not been the case, it is almost certain that damage to these forests during the economic crisis and in the late 1990s, following the fall of Suharto, and the civil unrest in Aceh, would have been far greater than actually did occur.

Numerous threats to these forests remain. Among the threats noted during this workshop are the usual ones of illegal logging, conversion of habitat for plantations, encroachment and others. However, what is also clear from the above is that additional threats are facilitated by poor management, lack of transparency and in some cases, unscrupulous business (i.e., exploitation) practices.

It is therefore in this area that the solutions may well lie. Improved transparency within government, both local and national, and especially within the Ministry of Forestry and its Department of Forest Protection and Nature Conservation (PHKA), is seen as essential if any of these threats are to be reduced. While great strides have been made, the PHKA itself acknowledges numerous problems with staff capacity, low salaries, and insufficient training and motivation. It is suggested that future prospects will be greatly improved if collaboration between the Ministry of Forestry, NGOs, and local governments can be improved. It is further suggested that PHKA's effectiveness could be enhanced by delegating some tasks to conservation bodies, PHKA thereby assuming a more supervisory role. By doing so, the PHKA could free itself of many tasks that can be more generously funded and more efficiently implemented by others.

Local governments are also increasingly under scrutiny for corruption and some high profile cases have even led to imprisonment of offenders. The reforms being made by the current President are to be congratulated and encouraged as they represent the first steps towards more openness and accountability, and hence better law enforcement. It could easily be argued that all the threats to orangutans and their habitat could be resolved by more effective law enforcement alone.

Enforcing the law not only involves arresting and punishing perpetrators, but also means ensuring that regulations and policies are followed from the outset. Many deals appear to be brokered without following required legislation and procedures. The Ladia Galaska Roads system is a classic example. Oil palm plantations that do not possess HGUs and do not perform AMDALs (Environmental Impact Assessments) are another. In fact, there are numerous oil palm plantations located in areas where their economic contribution is questionable, even to the point where they have been accused of simply being a means to launder money. The round table on sustainable palm oil has been established in recognition of some of these problems and represents an unprecedented attempt by an industry to clean up its image, tarnished in recent years by often illegal practices that have been brought to light by conservation NGOs.

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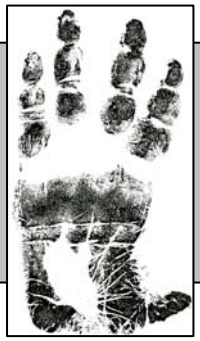


WORKING GROUP: TRUMON-SINGKIL, EAST SINGKIL, DAIRI, AND PAKPAK BHARAT

Participants: Affan Absori, Noviar Andayani (facilitator), Herbet Aritonang, Sri Suci Utami Atmoko (facilitator), Ebdi Zuhri Berutu, Kadar, Karyadi, Krismanto Padang, Safwan, Dame Sianipar, Mardongan Sigalingging, Susilo Sudarman, Enny Sudharmonowati, Zulham Wahyudi

AREA PROFILE

Trumon-Singkil Swamp Habitat Unit

Despite its relatively small area (725 km^2) compared to many other habitat units, the Trumon-Singkil Swamp Habitat Unit (Block 18, Table 2 and Figure 1) in southern NAD province contains the second largest Sumatran orangutan population (Singleton et al. 2005) and to-date, has experienced little fragmentation. Bordered by the Indian Ocean to the west and by rivers to the south and east, this coastal swamp lies within the Suaka Marga Satwa Rawa Singkil and the Leuser Ecosystem Conservation Areas (see Figure 1 and Figure 4). Approximately 1500 Sumatran orangutans inhabit the Trumon-Singkil swamps. The estimated level of logging in this area is 10% per year of the available orangutan habitat (Singleton et al. 2005).

Modeling summary. PHVA modeling suggested that despite the large number of orangutans, the population will undergo rapid and steady decline due to habitat and population loss from logging (Singleton et al. 2005). At an annual loss of 10%, the carrying capacity of the population will decrease by 50% in the next 6 -7 years and almost all habitat will disappear within about 50 years, leading to population extinction.

East Singkil Swamp

The East Singkil Swamp Habitat Unit is a small area of orangutan habitat along the southern coast of Aceh province in northern Sumatra (Block 19, Table 2 and Figure 1) and is separated by a river from Trumon-Singkil Swamp HU. A section of the Ladia Galaska roads scheme runs through this area. The current orangutan population is estimated at 160 individuals, with little fragmentation of the population. This area is in the process of being converted to palm oil plantations. Within 4 years, all orangutan habitat is estimated to be eliminated in this HU.

Modeling summary. With the expected conversion of orangutan habitat to plantations, orangutans will soon be lost from the East Singkil habitat unit. Even with no habitat loss, this population stills runs some risk of extinction due to its relatively small size. The future for orangutans in the East Singkil Swamp area looks bleak.

Dairi-Pakpak Bharat Habitat Unit

The Dairi-Pakpak Bharat (Sidiangkat) Habitat Unit is a small area of orangutan habitat along the border of Aceh and North Sumatra provinces in northern Sumatra (Block 12, Table 2 and Figure 1) just south of West Leuser HU and the Leuser Ecosystem Conservation Area. The current orangutan population is estimated at 134 individuals, with no major fragmentation of the population. Agricultural encroachment and illegal logging threaten to erode lower slopes where orangutans live.

Modeling summary. Model results incorporating expected future habitat changes with no additional removal of orangutans project that the population will decline by about 40% in 50 years, leaving it vulnerable to stochastic threats and inbreeding. While short-term viability is good, the population is not viable long-term, with a high risk of extinction (69% in 1000 years) and high loss of gene diversity. Even with no further habitat loss, there is a 28% chance of extinction over 1000 years and reduced genetic diversity. Even the removal of 2 adult females and 1 infant per year is not sustainable for this population, causing rapid decline and driving it to extinction in 20-40 years. The continual loss of even a few individuals can greatly affect this small and vulnerable population.

Figure 4 depicts the Habitat Units discussed by this group.

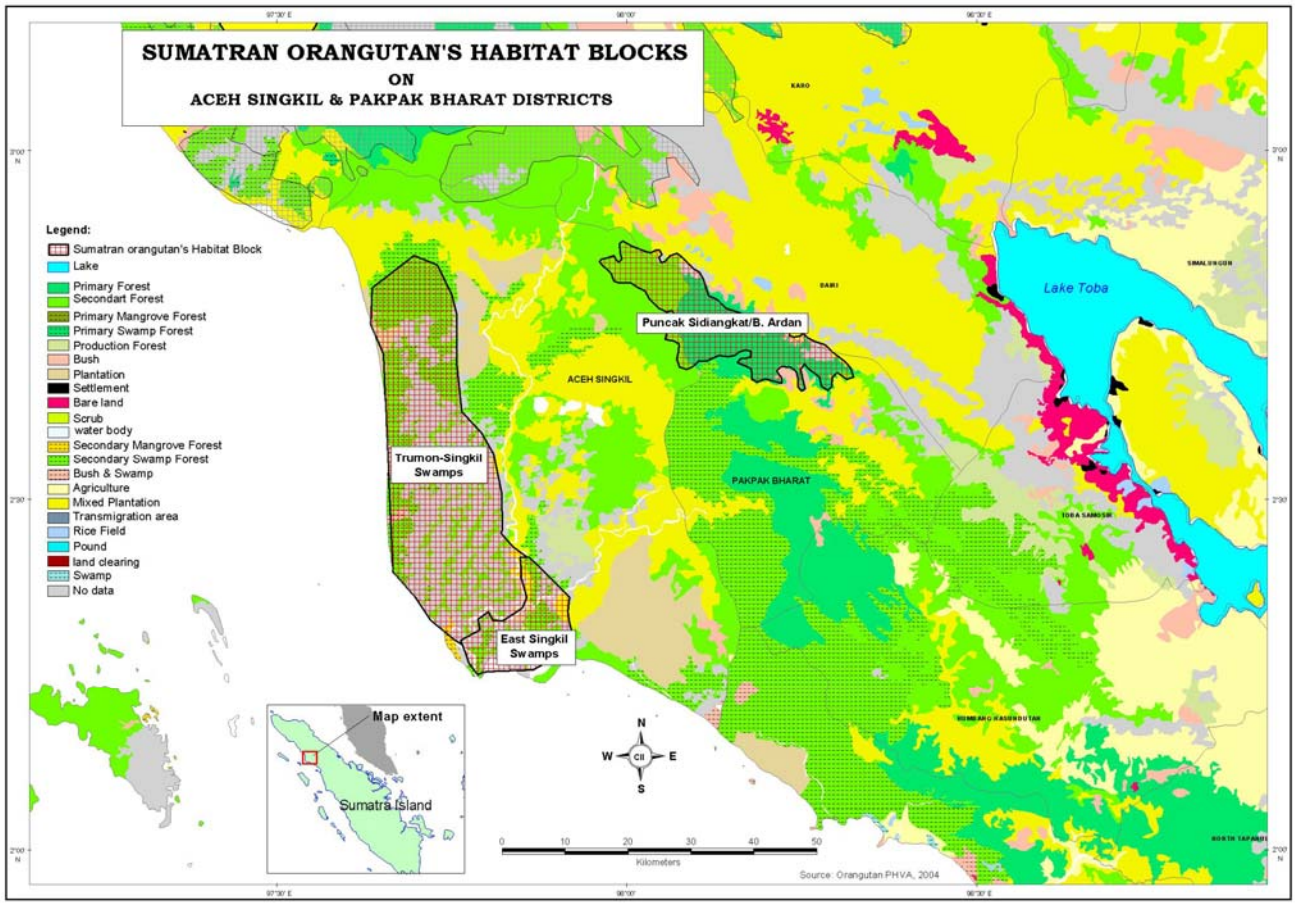


Figure 4. Trumon, Singkil, Dairi and Pakpak Bharat Habitat Units

THREATS

Threats to orangutans in these areas included:

Habitat loss

Habitat loss due to deforestation is the gravest threat facing Sumatran orangutans in these areas. The group estimated deforestation rates based on the best available information. For Trumon-Singkil, the deforestation rate is 10% per year, East Singkil is more than 20% per year, and Dairi and Pakpak Bharat 5% per year.

Poaching

Illegal hunting of orangutans threatens their survival, and a number of orangutans have been confiscated in these areas.

Lack of Law Enforcement

Although the species is protected in Indonesia, there is still a black market trade in Sumatran orangutans. There is still a lack of understanding of laws concerning natural resource management and a lack of political will to enforce existing laws. Local regulations (perdas) do not yet exist to protect orangutans or their forest habitats.

OPPORTUNITIES

- Socio-economic empowerment
- Traditional wisdom
- The uniqueness of the orangutan population in Trumon-Singkil
- Recent increased involvement of stakeholders at many levels

RECOMMENDATIONS FOR ACTION

1. Implement social-community programs to empower the local economies and develop capacity and productivity in communities adjacent to orangutan habitat.
   - Support and expand agroforestry programs
   - Utilize barren and unproductive land with multi-purpose tree species (including gaharu, kemenyan and sutra), apiculture, and seed gardens (for seed transfer) in the Pakpak Bharat area, Dairi, Singkil and Trumon.
   - Develop an ecotourism program in TWA Sicikecike, Suaka Margasatwa Singkil and Danau Anak Laut, Singkil.
   - Conduct an assessment for ecotourism potential in Sidiangkat.
   - Build capacity for business development for local stakeholders.

2. Support traditional institutions (*Lembaga Adat*) and integrate traditional knowledge and beliefs into orangutan conservation and awareness campaigns.
   - Revive traditional wisdom and history, such as the fable "*Si Maung*".

3. Improve habitat management
   - Explore the possibility of upgrading the status of Rawa Singkil and Sidiangkat to a National Park to improve orangutan habitat management.
   - Investigate the possibility of forming a corridor between Dairi and Southeast Aceh.
   - Develop a reforestation program in Singkil, Dairi and Phakpak Bharat.
   - Develop integrated management for all orangutan areas.

4. Support research activities (including habitat monitoring, orangutan-human conflict and the potential of translocation as a management tool)
   - Conduct orangutan population survey in Rawa Singkil.
   - Promote research and develop new research stations and information centers in areas where illegal activities are rampant.
   - Build an orangutan research station and information center at Rawa Singkil Wildlife Reserve.
   - Investigate the potential of translocating orangutans from smaller areas to larger areas, as appropriate, as a management tool. Document potential benefits vs. costs for further discussions (note: translocations should not be attempted at this time.)

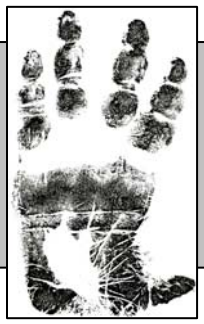
5. Enhance law enforcement and protection.
   - Put in place orangutan patrol units for all populations.

- Encourage and support NGO involvement in law processes regarding illegal capture, killing, trading, and possession of orangutan, and the destruction of its habitat.
- Implement an integrated training program in law enforcement (involving police, judges, state attorneys, forest rangers, and NGOs).

6. Strengthen policies favoring orangutan conservation.
   - Encourage legislative bodies to make conservation policies (*perdas*) favoring orangutan conservation in their respective municipalities.
   - Establish a national forum for the conservation of orangutan and its habitat, involving district governments, the central government, universities, NGOs, and communities.
   - Create a people's traditional congress as a means of developing conservation policies in Dairi and Pakpak Bharat.

7. Develop communications to support orangutan conservation and raise community awareness.
   - Intensify informal communication concerning conservation issues in Pakpak Bharat, Dairi, Singkil, and Trumon.
   - Set up information boards for orangutan conservation in and around habitat areas.
   - Incorporate local beliefs in orangutan and its habitat conservation into awareness campaign programs.
   - Socialize orangutan conservation information through a national media campaign, using numerous tactics including, for example an essay competition, drawing competition, nature tours, TV, radio and newspaper public service announcements.

8. Build capacity in conservation/protected area management at all levels of government and among a wide sector of stakeholders.



WORKING GROUP REPORT: WEST BATANG TORU AND EAST SARULLA

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AREA PROFILE

These Habitat Units spread across several districts in North Sumatra province. West Batang Toru is distributed within Central, North and South Tapanuli, while East Sarulla spans North and South Tapanuli districts (Figure 5).

West Batang Toru Habitat Unit

West Batang Toru Habitat Unit comprises an area of orangutan habitat in North Sumatra province south of Lake Toba (Block 20, Table 2 and Figure 1). It is surrounded by existing roads, separating it from the East Sarulla HU. The current orangutan population is estimated at 400 individuals with little fragmentation. Lowland areas are gradually being converted to agriculture. Hunting of orangutans still occurs in this area.

Modeling summary. Models suggest that population viability is relatively good given the expected future habitat changes in the absence of the logging concession and the additional removal of orangutans, although mean population size and gene diversity are reduced. Re-opening the logging concession significantly reduces long-term viability, with a 57% risk of extinction in 1000 years, a pattern similar to that projected for NW and NE Aceh. The additional removal of orangutans has a dramatic impact on the population, with or without the logging concession. This level of removal is not sustainable, causing rapid population decline and driving it to extinction in 20-40 years.

East Sarulla Habitat Unit

The East Sarulla Habitat Unit is a small area of orangutan habitat in North Sumatra province south of Lake Toba (Block 21) and is separated from West Batang Toru HU by existing roads. The current orangutan population is estimated at 150 individuals and is likely fragmented. Agricultural encroachment in the central lowlands is expected to continue.

Modeling summary. Model results incorporating expected future habitat changes with no additional removal of orangutans project that the population will decline by about 50% in 50 years, leaving it vulnerable to stochastic threats and inbreeding. While short-term viability is good, this population is not viable long-term, with a high risk of extinction (85% in 1000 years) and high loss of genediversity. Even with no further habitat loss, there is a 21% chance of extinction over 1000 years

and reduced genetic diversity. Even the removal of three adults and one infant per year will cause a rapid population decline and drive it to extinction in 20-40 years.

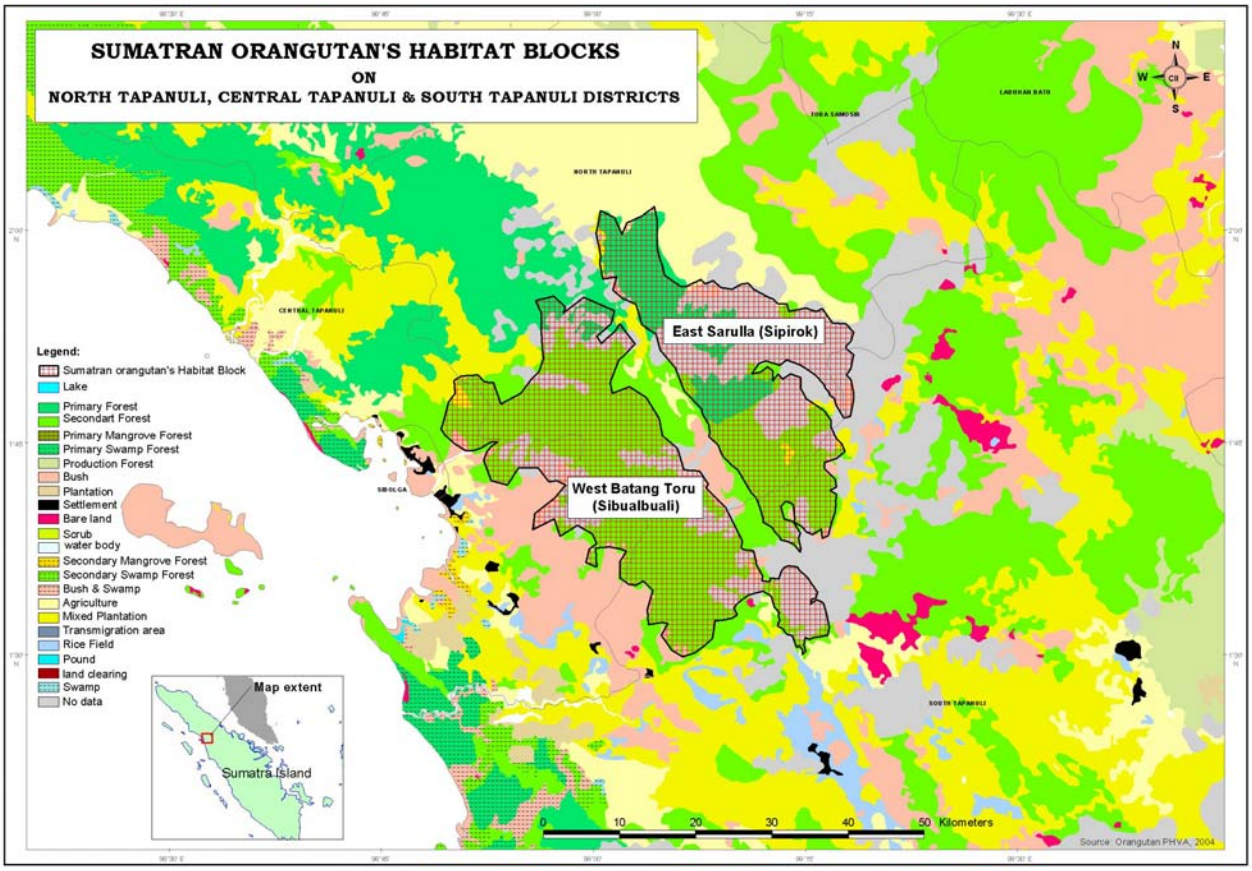

Figure 5. West Batang Toru and East Sarulla Habitat Units.

PEOPLE

In the Central and North Tapanuli segments of West Batang Toru the predominant ethnic groups are Nias settlers, Batak Toba, and Batak Angkola. In the South Tapanuli segment, Nias, Batak Toba, Batak Angkola, Mandailing, and Javanese are the predominant ethnic groups. In East Sarulla, North Tapanuli's major ethnic groups are Batak Toba and Batak Angkola; South Tapanuli's major ethnic groups are Batak Angkola and Batak Toba Mandailing. Batak is a collective term that refers to a number of ethnic groups found in North Sumatra, these groups each have their own distinct, but related, traditional languages and customs. The level of education in the area is highly varied. In all areas, the remaining forests constitute critical watersheds for the human populations who depend on the for potable water, agricultural resources and also for industrial uses (e.g., the PT Sipansihaporas hydroelectric scheme).

THREATS

Habitat Reduction, Conversion, and Fragmentation

Habitat loss from land clearing, including for agriculture, mining, new land clearing to accommodate human population growth, logging, and road development have resulted in a reduction of the orangutan population in these areas. Much encroachment is for small scale agricultural use, especially by Nias settlers in West Batang Topru but also by indigenous Batak Toba people (in East Sarulla in particular)

Unclear Land Status and Ownership

Land status and ownership vary in both West Batang Toru and East Sarulla. There is wide variation in land use practices including agriculture estate and traditional agriculture practice, *adat* land, forest protected area, mining and forest concessions and HPHs.

Hunting

There are some hunting activities in these areas which are contributing to the reduction of the orangutan population. Most notably, some hunting for food has been observed among the migrant settlers from Nias and reports persist of orangutan eating among both Nias settlers and some indigenous Batak communities. Orangutans from these areas are also believed to be threatened by trade.

Logging

Currently, the single forest concession, which covers approximately 60% of forest concessions in West Batang Toru, is not in operation but that could easily change. The population of orangutans in this area is relatively large (about 400 individuals) and Batang Toru has a relatively low estimated rate of habitat loss (2% annually). Modeling suggests that this population may persist longer than other populations if data estimates are accurate and current conditions continue, but will also eventually go extinct even with a 2% rate of habitat loss annually. Therefore, it is critical to slow even this already low rate of habitat loss attributable to logging if the population is to survive. A smaller logging concession in East Sarulla, active in 2003, also appears to have closed down and ceased its activities.

Lack of Law Enforcement

Although the species is protected in Indonesia, orangutans are still threatened by trade. Even among government personnel, there is limited understanding of laws concerning natural resource management and a lack of political will to enforce existing laws.

Lack of Awareness

Local populations vary in terms of education. In general, there is a low level of conservation awareness, and there has been little community participation in forest management. The concept of biodiversity conservation has not been socialized.

OPPORTUNITIES

Habitat

- Good forest area and orangutan habitat are still present and potentially can be protected
- There is support from institutions, including local government, to place the area under protected status.
- There already are three conservation areas in West Batang Toru and East Sarulla.

- People are dependent on the watershed services of these areas, including the electric water plant Sipan Sihaporas, local communities and the Water Supply Board.
- Because the habitat is still pristine, there is good potential for developing ecotourism, including whitewater rafting, jungle trekking, and hot springs.
- Conservation practitioners such as NGOs are present in the field and can contribute to habitat protection and monitoring.
- The area's high biodiversity piques the interest of researchers and non-timber forest product developers.
- Land is fertile and permanently utilized by the people - there are opportunities to improve agricultural practices.
- There is an opportunity to change the status of the non-active forest concession (e.g., Teluk Nauli) to a conservation area. Presently, this concession covers approximately 60% of West Batang Toru area, but it currently is non-operational.

Orangutan Population

- These areas contain significant populations of orangutan (West Batang Toru, 400 individuals; East Sarulla, 150 individual); these populations represent the southernmost distribution of the species and some researchers believe they may be genetically and culturally distinct from more northern populations.

Traditional Leadership and Natural Resource Management

- There are opportunities to raise community awareness through religious leaders.
- The strong role played by adat leaders provides an opportunity to socialize and build conservation understanding in communities.

RECOMMENDATIONS FOR ACTION

1. Improve habitat protection

- Expand protection for good orangutan habitat outside of conservation area/protected area
- Develop agreement regarding habitat/protected area borders, and socialize it among communities
- Provide economic empowerment for community that will support habitat protection
- Strengthen protection system for existing conservation area
- Build capacity for business enterprise development

2. Address varied status of area and land ownership to favor orangutan conservation

- Invest in efforts to change the status of non-active forest concession to conservation area
- Secure public acknowledgement and acceptance of need for protection in West Batang Toru and East Sarulla
- Conduct participatory mapping of both West Batang Toru and Sarulla

3. Stop orangutan hunting

- Approach *adat* leaders/religious leaders and other stakeholders for solutions to the hunting problem

- Facilitate joint law enforcement and monitoring of orangutan populations
- Develop a more effective awareness program
- Create ecotourism program and alternative income for communities, related to orangutans
- Assess possible environmental values which can be utilized in the long run to support the management of the area.
- Develop independent enforcement (perhaps community-based security forces) to protect orangutans
- Propose and advocate the development of *perda* (traditional law) for protection of the orangutan and its habitat

Appendix I.

THE STATUS OF THE ORANGUTAN IN INDONESIA, 2003

Report to the Orangutan Foundation, UK (Ashley Leiman)
January, 2004

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Abstract

The objective of this report is to provide an overview of the status of wild orangutans in Indonesia, and to develop recommendations for conservation action by listing the conservation units of top priority.

We first considered changes in the known orangutan distribution since the situation in the early 1990s. For Sumatra, many areas south of Lake Toba that were thought to contain unknown numbers of orangutans at that time are now known not to contain any at all. The main northern population has not seen major reductions in its distribution area, except through extensive forest loss at their edges and severe fragmentation due to the loss of key lowland corridors. This process has resulted in 11 conservation units where orangutans occur, of which only one probably has a population of larger than 2000 individuals, which is approximately an effective population of 500 individuals. For Kalimantan, 4 of the original 44 blocks are gone and 7 are no longer considered to be containing orangutans (older information is now considered to be too generous). Another 10 blocks have lost more than half of their forest or have been badly fragmented.

Analysis of deforestation indicates that Kalimantan has lost at least 39% of its orangutan habitat within the orangutan's range over the last decade (1992-2002). Similar studies are not available for Sumatra, but the available information suggests very similar trends.

Detailed knowledge of distribution and densities in Sumatra allowed us to make an estimate of the total number as of 2002. We estimate that Sumatra still contains about 7,300 orangutans, distributed over 21 forest blocks. Only three of these contain over 1,000 orangutans, all part of the Leuser Ecosystem, and the four habitat units that currently make up the Leuser Ecosystem were all

connected until a decade ago or less. Reconnecting the four separate habitat units in the Leuser Ecosystem would produce a large and viable population. For Kalimantan, the information is presented separately for the three subspecies. Of them, *P. p. wurmbii* is the best represented, with at least 5 remaining areas with 2,500 individuals or more. For P. *p. pygmaeus*, no strong population probably remains in Indonesia, whereas for *P. p. morio* in Indonesia, the Gunung Gajah/ Berau/ Kutai population may offer the last hope.

Introduction

Serious downward trends in the integrity of Indonesia's forest estate occurred throughout the 1990s due to widespread logging and conversion for plantation agriculture, although protected areas were, in retrospect, left relatively unscathed. Since the change in government in 1998, however, conservation in Indonesia has seen a virtual collapse and deforestation has been enormous regardless of the legal status of the land (Holmes 2000; Jepson et al. 2001; Robertson and van Schaik 2001). As a result, wild orangutans are in steady decline due to logging, habitat conversion, fires and poaching. Based on case studies of single populations, predictions have been made that the ecological extinction of the orangutan is only decades away (Rijksen & Meijaard 1999; van Schaik et al. 2001; Wich et al. 2003; Galdikas pers. comm.).

A new PHVA of the orangutan was therefore held to develop a strategic recovery plan for this threatened species and its habitat. At the PHVA they were integrated with estimates of human-based threats, such as current and projected land-use patterns. Computer models were used to evaluate current and future risk of population decline or extinction under alternative management scenarios. This report compiles all the known data on population demography, genetics and ecology in preparation of the workshop.

To properly prepare for the workshop, we decided to assemble information on orangutan distribution and densities in several less known areas in both Sumatra and Borneo. In this task, we received help from numerous fieldworkers. We were also able to commission special surveys overseen by Simon Husson, Erik Meijaard and Ian Singleton (see appendix). Funding for these surveys was kindly provided by the Orangutan Foundation, UK and the Golden Arc Foundation, The Netherlands. Note that the results reported here only cover the territory of Indonesia.

The goals of this report are:

1. synthesize all the information on current distribution and numbers in conservation units,
2. document trends in forest cover and quality as well as numbers where available, and
3. identify the major conservation units and develop an estimate of the number of orangutans therein, including new areas that have not received adequate protection yet, in order to make possible that protection priorities for the last remaining viable orangutan populations be developed at the PHVA.

The analysis is based on *habitat units*. A habitat unit contains one or more forest blocks, as used by Rijksen & Meijaard (1999). It refers to distinct areas of orangutan habitat separated by normally impassable barriers such as major rivers or wide swaths of cultivation. A habitat unit therefore corresponds to a separate population, one not easily colonized by individuals from other populations. Where there was doubt about how separate the habitat units are, conservative decisions were made so that habitat units could be fused when future work confirms the presence of corridors or corridors can be reconstituted. Note that a single protected area can contain multiple habitat units. For instance, the new Mawas reserve in Central Kalimantan contains three separate

blocks: one west and two east of the Kapuas Murung, with the latter two separated by large canals. Numbers for protected areas may therefore be split to reflect orangutan habitat units.

For the purpose of this report, we consider four separate taxonomic units. Nomenclature follows Groves (2001), which corresponds to the divisions in Kalimantan made by Warren et al. (2001), and is consistent with the impressions of fieldworkers and rehabilitation experts:

1. the Sumatran species (*Pongo abelii*; there is now sufficient genetic evidence to regard Bornean and Sumatran orangutans as distinct species [Zhang et al. 2001], and ecological and life-history differences also seem significant [e.g. Delgado & van Schaik 2000]);
2. the northwestern Bornean subspecies, north of the Kapuas and into Sarawak (*Pongo pygmaeus pygmaeus*);
3. the central Bornean subspecies, south of the Kapuas and west of the Barito (*Pongo pygmaeus wurmbii*); and
4. the northeastern Bornean subspecies, in Sabah and East Kalimantan (*Pongo pygmaeus morio*).

1. Distribution

In this section, we provide information on current distribution. Figures 4.36 and 5.19 provide the best estimate of the current distribution for Sumatra and Kalimantan, respectively. This distribution map differs from the previous distribution map (Rijksen & Meijaard 1999) due to three kinds of changes: (i) changes that reflect corrections on earlier information now considered to be false, (ii) changes that reflect loss of populations due to loss of habitat or loss of animals, and (iii) changes that reflect the discovery of hitherto unknown populations. The changes relative to their map, which reflected the state of knowledge and forest around 1992, over the past decade are provided in Fig. 7.1 for Kalimantan and 7.3 for Sumatra.

Sumatra

It has been known since the earliest work in the 1930s that the Sumatran orangutan distribution is concentrated in Aceh, but there has been much speculation as to the distribution farther south. Recent survey work on Sumatra (Wich et al. 2003, Singleton unpubl. data, Wich unpubl. data) has indicated that several of the areas that previously were considered to contain orangutans (Rijksen & Meijaard 1999) do not contain these anymore (Wich et al. 2003, Table 7.1). The occurrence of orangutans in several of these areas was based on old and possibly inaccurate reports, and it is unlikely that some of these areas actually contained orangutans in the recent past (Table 7.1). Rijksen & Meijaard (1999) and Rijksen (pers. com.) mention a further 14 areas that they expected to possibly contain orangutans, although they did not provide numerical estimates for the populations in them (see Table 7.1 in Wich et al. 2003). We could not confirm the presence of orangutans in any of these blocks, and they should therefore henceforth be considered as outside the current distribution area. For at least one of these areas, however (Rimbo Panti), where the presence of orangutans was still ascertained only some 7 years ago, recent habitat loss, degradation and hunting are the most likely causes for their disappearance (Table 7.1).

Recent surveys nonetheless identified three key areas near Lake Toba that contain orangutans: Puncak Sidiangkat, West Batang Toru and East Sarulla (Table 7.1). Among these three areas, West Batang Toru, the forest block between the towns of Tarutung, Sibolga, and Padangsidempuan, is the largest and therefore the most interesting from a conservation perspective (see below).

Table 7.1. Habitat units lost in Sumatra since Rijksen & Meijaard's (1999) overview, and the remaining habitat units south of Toba.

Habitat Unit	Orangutan presence 1994-1997*	Update orangutan presence 2002**	Reason for absence
Rimbo Panti/G. Talamau	Yes	No	habitat loss/hunting
Pasaman Barat	Yes	No	old info
Baruman	Yes	No	old info
Habinsaran	Yes	No	old info
Ankola-Siondop	Yes	No	old info
Kalang-Anggolia	Yes	No	old info
Tapanuli Tengah	Yes	No	old info
Dolok Sembelin	Yes	No	forest gone
West Batang Toru	Yes	Yes	(south of Toba)
East Sarulla/ Sipirok	Yes	Yes	(south of Toba)

* based on Rijksen and Meijaard 1999

** based on Wich et al. 2003, Singleton unpubl. data, van Schaik unpubl. data, Wich unpubl. data

North of Lake Toba, no habitat units have disappeared. However, the main changes there are a sharp decline in habitat size and loss of connectivity between major habitat units. This has resulted in the loss of the corridors between the West and East Leuser conservation units.

In conclusion, although the actual distribution of Sumatran orangutans has not changed much in the past 10 years, we now know that most of the areas south of Lake Toba, previously thought to contain orangutans, are now confirmed as having no orangutans.

Kalimantan

Since the last survey (Rijksen & Meijaard 1999), many changes have taken place in the forests of Kalimantan. Here, we present a qualitative comparison, recording whether the forest blocks recognized by them are still present, whether they have become badly fragmented, or have lost much of their area. Table 7.2 compiles these blocks (the numbers follow the codes used in Rijksen & Meijaard 1999). The assessment of the recent situation is based on the TREES (Tropical Ecosystem Environment Observations by Satellites) map produced by the European Union and the analysis of recent MODIS images (provided by Dr. D. Fuller, U Michigan) by Erik Meijaard (see below), both with a resolution of about 0.25 km^2.

Table 7.2. Habitat units for Kalimantan that existed in the orangutan range in Kalimantan in 1994-1997, as recognized by Rijksen & Meijaard (1999), which had disappeared, been fragmented or seriously reduced by 2002.

No.	Subspecies	Orangutan Presence ca 1992	Orangutan Presence 2002	Nature of major change
A.	**WEST KALIMANTAN**			
1	Sambas	Yes	Yes	Badly fragmented
2	Mempawah	Yes	No	Nearly gone
3	Gunung Niut	Yes	Yes	Badly fragmented
10	Kapuas swamps	Yes	Yes	Badly fragmented
11	Sukadana-Kendawangan	Yes	Yes	Badly fragmented
B.	**CENTRAL KALIMANTAN**			
12	Jelai-Lamandau-Arut	Yes	Yes	Badly fragmented
14	East Pembuang-Seruyan	Yes	Yes	Southern half nearly gone
15	W.Sampit floodplains	Yes	Yes	Nearly gone
16	Katingan floodplains	Yes	Yes	Northern half nearly gone
20	Sebangau-Kahayan	Yes	Yes	Some 30% remains, fragmented
22	Kapuas Murung-Barito plains	Yes	Yes	Northern and southern ends converted
28	Bandang East	Yes	No	Probably ecologically extinct due to hunting
29	Upper Dusun	Yes	No	Probably ecologically extinct due to hunting
30	Busang Hulu	Yes	No	Probably ecologically extinct due to hunting
C.	**EAST KALIMANTAN**			
31	Liangpran	Yes	No	Probably ecologically extinct due to hunting
32	Boh catchment	Yes	No	Probably ecologically extinct due to hunting
33	Pari-Sentekan	Yes	No	Probably ecologically extinct due to hunting
34	Belayan-Kedangkepala	Yes	No	Probably ecologically extinct due to hunting
35	West Muara Kaman	Yes	Yes	Nearly gone, mainly burned
36	Coastal Kutai	Yes	Yes	Nearly gone, mainly burned
38	Tinda-Hantung Hills	Yes	Yes	Southern half nearly gone

The results indicate that of the 44 forest blocks recognized by Rijksen & Meijaard, 4 are now nearly gone, with tiny parts of the original forest remaining, making it unlikely that any viable orangutan populations still exist in these areas. This set includes Coastal Kutai (#36) where virtually no forest remains in what was once a national park. We also note that 5 blocks have become badly fragmented as shown on both the TREES and MODIS maps. Another 5 have lost half or more of their forest.

Finally, 7 blocks, mainly near the uplands in the central Bornean mountain range are now considered to contain no more than transient orangutan populations (sightings of males only), and are therefore better no longer regarded as orangutan habitat.
In conclusion, over the past 10 years, the distribution area of the Kalimantan orangutans has shrunk considerably due to habitat loss and fragmentation, and due to the recognition that foothill and hill areas in the center of the island do not currently contain viable populations.

2. Trends in Forest within the Orangutan Distribution Area

Over the past few years, much attention has been focused on the state of Indonesia's forests. Tropical deforestation rates in Indonesia are among the highest in the world. Estimates based on satellite-image interpretation, show that between 1985 and 1997, the average annual loss was about 10,000 km^2, (Holmes 2000; FWI/GFW 2002). By the mid 1990s, the deforestation rate for Kalimantan had increased to about 12,640 km^2 / year (Holmes 2000), or 14,000 km^2 / year (FWI/GFW, 2002). Considering this high deforestation rate and the likelihood that the figure is even higher in 2002 due to recent (1997–1998 and 2002) forest fires and rampant illegal logging, there is an urgent need to reassess the species' distribution and status.

The analysis undertaken by Erik Meijaard and Rona Dennis for this project (Fig. 7.2) showed that in 2002, the total area of breeding habitat for Kalimantan orangutans amounted to 85,835 ± 4,500 km^2, divided over some 300 spatially distinct areas. This is down from some 141,500 km^2 in the early 1990s as indicated by the habitat classification in Rijksen and Meijaard (1999), or a decline of 39% in about a decade (Fig. 7.1). This number actually paints a rosy picture of the situation because the remaining areas are increasingly fragmented. For instance, 148 of the currently recognized 306 habitat units are less than 100 km^2, and together cover 4,716 km^2 (or 5.5% of the total area).

In addition, we also assessed the quality of the remaining forests, based on the MoF classification (see methods). We found that most of the remaining forest is now classified as degraded, especially in East and Central Kalimantan, where only 22 % and 11 %, respectively, of the remaining habitat consists of primary forest (Table 7.3), the rest being affected by logging.

Table 7.3. Subdivision of remaining Orangutan habitat in Indonesian Borneo by forest quality

Forest class (MoF, 2002)	West Kalimantan (total Orangutan habitat = 15,670 km^2)	Central Kalimantan (total Orangutan habitat = 33,517 km^2)	East Kalimantan (total Orangutan habitat = 8,319 km^2)
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The low resolution of the imagery and the necessarily arbitrary decisions made in assigning each pixel to forest or non-forest may lead to some ambiguities in this map. For instance, almost none of the remaining patches in the former Kutai national park are recognized due to their very small size. This weakness is shared by other similar large-scale approaches; thus the TREES map produced by the European Union does not recognize them either. Nonetheless, these results strongly agree with the overall trend noted in various case studies that focus on smaller regions relevant to orangutan conservation, for Gunung Palung; Danau Sentarum (R. Dennis, pers. com.), Muara Wahau (R. Dennis, pers. com.), Sebangau (S. Husson, pers. com.), and Mahakam Lakes.

We do not have an equally quantified overview of changes in the Sumatran forests beyond Fig. 7.3. One detailed study is available for West Batang Toru, which is being converted into agricultural land and degraded by illegal logging at most of its edges. This has resulted in a reduction of forest cover or degradation of around 12% between 1990 and 2001 (Wich pers. comm.). The map of changes in forest inside the orangutan range shows a spectacular decline (Fig. 7.4). As discussed above, most of the changes south of Toba result from new information that show that areas previously thought to hold orangutans no longer do so. However, the northern part of the range also shows rapid loss of habitat at the edges of the habitat units.

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In this section, we develop the best possible estimates of orangutan numbers in each of a series of conservation units or habitat units. The analysis for Borneo closely corresponds to the forest blocks and codes used in Rijksen & Meijaard (1999), whereas the study for Sumatra uses an independent classification of habitat units.

3.1 Sumatra

The process of determining an estimate for the total number of orangutans on Sumatra consisted of two steps. In the first step, GIS was used to determine the extent of primary forest at different altitudes and the second was to use the surfaces to generate population estimates.
Using LANDSAT images (kindly made available by Unit Management Leuser) of North Sumatra and Aceh, a comprehensive and detailed coverage of vegetation was digitized by Nick Jewel. This map was then overlain on a coverage of altitude. In this way it was possible to summarize each vegetation class by altitude to give the total area of each class within each 100 m interval up to 1600 m asl. We then identified key forest blocks within Sumatra according to inferred geographical

boundaries or according to known variations in density between areas at similar altitudes. Thus we identified 16 areas of primary forest, and three swamp forests from the area north and west of Lake Toba. An additional two populations are known to the South of Lake Toba and these were examined separately using up to date information from the field. This work allowed us to use altitude specific density estimates within each forest block ranging all the way from Toba in the South to Seulawah in the extreme north.

Densities were derived based on extensive line transect work conducted by a range of workers (especially R. Buij, I. Singleton, S. Wich, and C. van Schaik) in this region. Because Sumatran orangutans are known to respond negatively to selective logging and because individual knowledge of areas digitized as degraded suggested that these areas were very heavily damaged we decided to ignore the area of degraded forests (this procedure was not adopted for Bornean forests because of the different biology of the Bornean orangutans; see below). Furthermore, field knowledge also suggests that less heavily degraded areas were often included as primary forest during the digitizing process (which inevitably has led to overestimates of populations in most areas). Thus, we assumed that the small errors produced by ignoring disturbed forests and by including some disturbed forests into the primary forest class would tend to cancel each other. Nonetheless, we acknowledge the uncertainty in the estimates derived here.

The LANDSAT images used in these analyses were from 2002, except for the ones in Aceh north of the Leuser Ecosystem (Conservation unit 1, the North West Aceh Block and Seulawah), which were from 1998. Given an estimated loss of orangutans in the Leuser Ecosystem of 45% over a 6.5-year period (van Schaik et al. 2001), we therefore felt it necessary to reduce the estimates for North West Aceh according to estimated forest loss there. Assuming that the rate of loss is similar in areas farther south, we could then argue that estimates for the North West Aceh block should be reduced by 35% over the 5-year period (1998 – 2002). However, there is considerable uncertainty concerning the extent to which concessionaires and illegal loggers have continued operations in these war torn areas since hostilities intensified in 1997/98. To allow for this we conservatively reduced population estimates for North West Aceh by only 20%. In contrast, the small forest area at Seulawah is considered unlikely to have been reduced considerably during the period because it is a well-known local protected area. Some illegal logging will undoubtedly have occurred but probably has had relatively little impact on the orangutan population there to date.

Table 7.4. Estimated numbers of *Pongo abelii* in the confirmed Sumatran habitat units, approximately representing the situation in 2001/2. (OU = orangutan)

Area	Habitat unit	Primary Forest (km^2)	Est'd. OU number	OU Number per habitat unit
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7-Geumpang	1	*2116*	*180*	***667* (N W Aceh)***
6- Seulawah	2	*103*	*43*	***43***
3- Beutung (W. Aceh)	3	*1297*	*95*	
8- Bandar-Serbajadi (E.Aceh+)	3	*2117*	*337*	
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20- West Batang Toru Block	10	*600*	*400*	***400***
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TOTALS		**20177**		**7334**

*Total before removing 20% (see text) = 834.

Conclusion for Sumatra

The analysis of the remaining forests on Sumatra indicates that we can recognize 11 distinct habitat units, some of which are composed of several adjacent smaller forest blocks. The results show that three habitat units contain more than a 1000 orangutans. Of these the West Leuser block contains the largest number of orangutans, followed by the Trumon-Singkil swamps and the East Leuser area. Of the habitat units that contain less than a 1000 orangutans the North West Aceh area contains most orangutans, followed by Middle Aceh and the West Batang Toru area. Outside of these six areas there are five smaller habitat units, of which the Tripa swamp is the largest with around 280 orangutans.

The major finding is that of habitat shrinkage and fragmentation. The Leuser Ecosystem is still the most important stronghold of the Sumatran orangutan, but is now fragmented into 4 major areas: West Leuser, Trumon-Singkil, East Leuser and Tripa. A decade ago, only the West-East Leuser connection was more or less severed. Conservation action aimed at restoring the connections between these habitat units is therefore a top priority. Inside the two major Leuser blocks, logging and conversion has encroached in such a way that most land below 1,000 m is now cleared, creating jagged edges and numerous habitat islands. Forests in the more densely populated lowland patches are still connected, but any dispersing animals between them are now forced to move deep into the mountains. This may lead to de facto isolation of these patches.

Outside of the Leuser Ecosystem, the North West Aceh and the West Batang Toru habitat units are the most important conservation areas for orangutans. Hence conservation efforts should focus on these areas.

The total number of orangutans presented here is higher than that by Wich et al. (2003). This difference is mainly due to the fact that the Wich et al. (2003) estimate was based on orangutan numbers estimated by Rijksen and Meijaard (1999). These authors based their estimates on less detailed information than is available now and were therefore conservative. The number is also somewhat higher than the one presented for the Leuser Ecosystem presented by van Schaik et al. (2001). This discrepancy is probably due to the fact that this classification necessarily recognizes more primary forest than is truly present (a trend that we tried to counteract by not including the badly damaged forest at all). We cannot decide which of these different sets of numbers are closer to the truth. Nonetheless, the differences in numbers should not detract from the very real trends in habitat loss noted above. It is clear that this trend is steeply negative and that as a result of this orangutan numbers are declining rapidly.

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are still connected, but any dispersing animals between them are now forced to move deep into the mountains. This may lead to de facto isolation of these patches.

Outside of the Leuser Ecosystem, the North West Aceh and the West Batang Toru habitat units are the most important conservation areas for orangutans. Hence conservation efforts should focus on these areas.

The total number of orangutans presented here is higher than that by Wich et al. (2003). This difference is mainly due to the fact that the Wich et al. (2003) estimate was based on orangutan numbers estimated by Rijksen and Meijaard (1999). These authors based their estimates on less detailed information than is available now and were therefore conservative. The number is also somewhat higher than the one presented for the Leuser Ecosystem presented by van Schaik et al. (2001). This discrepancy is probably due to the fact that this classification necessarily recognizes more primary forest than is truly present (a trend that we tried to counteract by not including the badly damaged forest at all). We cannot decide which of these different sets of numbers are closer to the truth. Nonetheless, the differences in numbers should not detract from the very real trends in habitat loss noted above. It is clear that this trend is steeply negative and that as a result of this orangutan numbers are declining rapidly.

3.2 Kalimantan

As shown by Meijaard and Dennis (appendix 1), the number of distinct forest blocks in Kalimantan has grown dramatically over the past decade. It is therefore impossible to attempt a detailed description and discussion of all these areas. Instead, we will present descriptions and reviews of (i) the areas with major orangutan concentrations, (ii) the areas that were surveyed especially for this report, and (iii) the major protected areas that contain orangutan populations. The aim is to arrive at a list of priority areas that are either high-quality habitat units or protected areas (which may contain multiple habitat units) rather than an exhaustive estimate of all remaining numbers. All habitat units in Kalimantan follow the number codes given by Rijksen & Meijaard (1999).

3.2.1 West Kalimantan: *Pongo pygmaeus pygmaeus*

3.2.1.1 Danau Sentarum (area code 5)

Two national parks, Betung Kerihun and Danau Sentarum in the upper Kapuas area in West Kalimantan contain significant areas of orangutan habitat, although in the former area the habitat appears to be concentrated in the swamps that lie south of the park's border, whereas the forest in the latter area is now cut off from the Betung Kerihun forest by road construction and logging.

Russon et al. (2001) estimated the population in the Danau Sentarum (D.S.) National Park at 1,024, with an additional 1,717 orangutans occurring outside the national park. Given new knowledge of nesting parameters in Kalimantan, these estimates were probably too high by about one quarter to one third, producing a total population for D.S. in 1996 of approximately 750 individuals, and a total estimate for the greater D.S. area of ca 2,050 (as defined in their paper). Intensive illegal logging is likely to have reduced these numbers since then. We know that some of the areas surveyed by Russon have been converted, whereas others have been subject to intensive logging. In 2003 A. Erman (see appendix 2) surveyed the eastern part of this area. He found relatively low densities in the swamp areas (<1 orangutan/km^2), while towards the north in drier forest nest densities declined to zero. In the latter areas orangutans were allegedly hunted for food, while illegal logging and forest clearance for agriculture provides another likely explanation for the absence of orangutans. In

conclusion, the D.S. and greater D.S. areas will currently have far fewer orangutans than estimated in 1996. Our most optimistic guesses are ca 500 and ca 1,400 for the current numbers.

3.2.1.2 Betung Kerihun (area code 5)

Little is known about the orangutan population in the large Betung Kerihun national park. Takahashi et al. (2003) estimated an orangutan density of 0.38 orangutans/km^2 on the southern edge along the upper Embaloh River, based on 12 km of line transects and using the parameters of Russon et al. (2001). The best density estimate may therefore be even slightly lower. It is not known to what extent this number can be extrapolated to the rest of the park, although most of the park is at higher altitude on dry land. Illegal logging was rampant throughout the upper Embaloh region. However, it may be premature to write off the park because it is still connected to Batang Ai and Lanjak Entimau in Malaysia and therefore may represent an important re-colonization sink in the future.

3.2.1.3 Upper Kapuas swamps (North) (adjacent to area code 5)

North of the Upper Kapuas River lies a region with much swampy forest and gradually grading into the foothills of the Betung Kerihun forests. While recognized by Rijksen & Meijaard (1999), this area was not discussed in their text. It was therefore surveyed by Andi Erman in 2003. His results indicate that hunting is common in this area, but that there are pockets with reasonable density (>1 orangutan/km^2), e.g. the aptly named Mayas River. Given these findings, it is worth considering the recommendation that the area north of the Putussibau-Lanjak road be added to the Betung Kerihun national park because of the low densities in most of the uplands in this park.

3.2.2 West Kalimantan: *Pongo pygmaeus wurmbii*

3.2.2.1 Upper Kapuas swamps (South) (adjacent to area code 7)

The lower parts of the Melawi River valley and its tributaries were not recognized by Rijksen & Meijaard as orangutan habitat. However, the area north of the Sintang- Putussibau road, still contains a large area of somewhat fragmented swamp forests. Andi Erman's surveys (appendix 2) indicate the presence of orangutans throughout this area. However, reports do indicate hunting at places and the survey suggests moderate to low densities (probably largely <1 orangutan/km^2). Thus, although the area contains orangutans, it is not of the highest conservation priority.

3.2.2.2 Bukit Baka (area codes 8)

Previous reports had indicated a modest presence of orangutans in the Bukit Baka part of the Bukit Baka/Bukit Raya National Park (and virtually none in the Bukit Raya portion in Central Kalimantan). Husson's survey team went into the northwestern part of Bukit Baka, and found an area of primary hill dipterocarp forest that contained orangutans at low density (ca 0.5 individuals/km^2). It is suspected that because this site represents a small lowland pocket in the park, the distribution of orangutans in the extensive high-altitude forests of Bukit Baka is likely to be patchy at best. The area below 500 m is about 350 km^2; and could therefore contain ca 175 orangutans. The national park is still largely intact and protection of this modest orangutan population is therefore feasible.

3.2.2.3 Rongga Perai (area code 9)

This is a large area of remote, hilly foothill forests in the upper reaches of the Sungai Pawan, near the peaks of Bukit Rongga and Bukit Perai. Orangutans had been reportedly common within logging concessions in the region. However, nearly all of the lowland floodplain forest in the area has been

badly damaged by logging or cleared. It seems likely that any remaining orangutan populations here are limited to small pockets in the hills. Local informants claim that the western part of this complex, known as Bukit Lawang near the township of Senduruhan, has a large population of orangutans. In reality, few nests were found in all but one site, probably as a result of heavy hunting in the recent past. Illegal logging is rampant throughout the area. Apart from a single pocket of reasonable density (ca 1.6), densities were low at all sites. Thus, because most of the area is highland and hunting and illegal logging are known to be intense in parts, it is unlikely that the Rongga Perai complex (ca 4,200 km^2) contains more than some 1000 orangutans. This area is apparently contiguous with the Arut-Belantikan habitat unit in Central Kalimantan, however, raising its importance.

3.2.3.4 Lower Kapuas Swamps (area code 10)

The Lower Kapuas swamps have become badly fragmented since the early 1990s. An over-flight in early 2003 indicated logging activity and slash-and-burn activity in several parts. The orangutan status in this region remains unknown.

3.2.2.5 Gunung Palung and surroundings (area code 11)

The eastern and southern edges of block 11 have disappeared. This block includes Gunung Palung National Park and surroundings. By June 2001, 58% of this park had been affected by illegal logging and only 9% of the total forest area was still in very good condition (Dermawan 2003). Johnson et al. (in press) estimated that the park currently has a population of 2,500 individuals. If surrounding contiguous areas are included, higher numbers are still possible, but no published figures exist. It should be noted that the impact of selective logging are less than has been found in Sumatra; Felton et al. (2003) found a 21% decline in nest densities due to logging in peat swamp, whereas Johnson et al. (in press) found 22% in peat swamp, and a mere 7% in lowland forest on dry land.

This block also includes the Kendawangan nature reserve. Imagery indicates, however, that this has largely disappeared, and the reserve is no longer indicated as such on maps of PHKA (the Indonesian conservation authority).

3.2.3 Central Kalimantan: *Pongo pygmaeus wurmbii*

3.2.3.1 Tanjung Puting National Park (area code 13)

This national park contains a mosaic of habitat types, including dry land and swamp forests and areas recovering from shifting agriculture. Despite its high national and international profile, since 1998, Tanjung Putting has suffered from widespread illegal logging and gold mining. Also, large tracts of the park, particularly in the south, were damaged by forest fires in 1997/98. Government action in early 2003 has reduced the pressure from illegal logging, but mining and other illegal activities continue to threaten the integrity of the park.

Results of surveys carried out across the park indicate high nest densities in all areas, ranging from >2 individuals/km^2 in minimally disturbed dry land forest and peat swamp forest, down to 1.6 in heavily disturbed dry land forest. The survey concludes that of the park's 4016 km^2, 3132 km^2 (78%) remains inhabited by orangutans, with a mean density of 1.9 individuals/km^2. Thus, a population of 6,000 orangutans is estimated (Galdikas et al., MS).

3.2.3.2 Katingan-Sampit catchment (area code 16)

The Katingan floodplain is a large expanse of peat swamp forest and mangrove (in the south). The entire area has been logged by the logging concession system (HPH). Illegal logging is now widespread but still recent. Hunting occurs but is believed to be light, as the local Dayaks tend to be Muslims and are restricted from eating certain wildlife. Four separate tributaries were surveyed, three on the eastern (i.e. Katingan) side and one on the western (i.e. Sampit) side. Orangutans occur throughout the area. Densities varied from 1 to 3 orangutans/km^2, with a mean of 1.9. If the interior parts away from the rivers are conservatively considered to have a density of 0.8 animals/km^2 (equivalent to low pole density in the Sebangau) we obtain a preliminary minimum estimate for the whole area of (1,000*1.9 + 1,800*0.8 = 3340). Thus, this is a hitherto unrecognized major orangutan population that needs to be examined in greater detail and, if these numbers are confirmed, deserves a high conservation priority.

3.2.3.3 Sebangau (area code 17)

The Sebangau catchment is a large area of peat swamp forest habitat, of which 5,782 km^2 is currently still under forest. The entire area has been logged under the concession system in the past. This regime finished by 1997. Since then, illegal logging has become ubiquitous, and a dense network of small canals (tatah's) has been established. These tatah's are draining the swamp in the dry season, leading to degradation of peat and high tree mortality and increasing the risk of forest fires. Orangutans are distributed continuously throughout the catchment, with the probable exception of the extremely wet low interior forest. The highest-density areas are found in the tall interior forest on the top of the peat domes, a habitat type unique to Sebangau. The majority of the orangutan population is found in the mixed swamp forest, which occurs on the outskirts of the peat domes and near the rivers. The best estimate for the 1996 situation was 13,000 orangutans in 6,573 km^2. Since 1996, 1000 km^2 has been lost (=15% in 7 years), and logging has continued in the remaining forests. For 2002, Husson et al. (MS) estimate a total population of 6,900, corresponding to a 49% decline in numbers since 1996. A compression effect is strongly implicated in this decline with a third of the total population perishing during the one year period following the heaviest logging (Husson et al., MS). Illegal logging is slowing as the forest has been largely logged out. The number one priority for conservation is damming the illegal logging canals and reversing the damaging effects of drainage.

3.2.3.4 Rungan- Kahayan catchment (area code 19)

No detailed information is known for this area, the lower half of which is likely to contain significant peat swamp forests, and thus potentially harbours a significant orangutan population. Applying a conservative density estimate of 0.5 individuals per square kilometre to the ca. 2,000 km^2 of forest remaining in the block gives a minimum estimate of 1000 individuals in the region. The long narrow shape of the block is vulnerable to encroachment and hunting pressure. Surveys remain necessary.

3.2.3.5 Sebangau- Kahayan catchment (area code 20)

This area has been badly damaged by drainage and massive forest fires. It is estimated to have contained some 2,700 orangutans before the fires in 1996 (Husson et al, MS, based on Morrogh-Bernard et al. 2003). At present, some fragments remain, the largest of which is just southeast of Palangkaraya (near Kalampangan), and covers only 130 km^2. In total 12 major fragments occur containing ca. 700 orangutans. This general area is heavily drained, the forest fringes burn every year, and there is little hope for the future. Numerous orangutans must have perished in this region. There is little hope that these unconnected fragments can be adequately protected in the future.

3.2.3.6 Mawas Reserve (area codes 21 and 22)

With a total area of ca 510,000 ha, the Mawas Reserve is a substantial part of the ex-PLG area. Most of the forest has been subject to logging at various intensities, first by logging concessions and then by informal loggers. The southern part contains two main peat domes, now dissected by large drainage canals; the western part contains a degrading peat dome. Peat depth declines toward the north and toward the major rivers (Kapuas Murung and Barito). During 2002 and 2003, detailed aerial and ground surveys in its eastern unit (Blok E, ca 2730 km^2, and Blok AB, ca 400 km^2) have been done by Odom, A. Russon, C. van Schaik, and S. Wich, whereas most work in the western unit has been from the air (aerial estimates have been ground-truthed and found to provide a reliable density index). The minimum estimate based on detailed work for the eastern part is 2,500 animals (2070 in Blok E; 430 in Blok AB); the minimum estimate for the western part is 850 animals in three fragments separated by rivers (using a conservative 0.5 ind/km^2, lower than indicated by limited surveying along the Mangkutup and Morrogh-Bernard et al.'s surveys near Palangkaraya). The minimum estimate for the total Mawas Reserve is therefore 3,350 orangutans.

3.2.3.7 Seruyan – Sampit – Katingan uplands (area code 14)

This is a large, fairly unknown area of dipterocarp forest swathing the hills and plains surrounding the headwaters of the Seruyan and Sampit Rivers and extending up into the main body of the Schwaner range. The entire area is likely to be subject to varying levels of logging, hunting, fragmentation and conversion threats. Most of the area is designated HPH with the northern part, bordering the provincial boundary, classed as *hutan lindung*. Surveys carried out by Husson's team in the area nearest to the Seruyan River recorded a density of 1.5 individuals per square kilometre. This is likely to vary considerably across the area, in probable correlation with hunting pressure. Nevertheless the population is likely to number at least 1,000 individuals in an unknown number of fragments, which are mainly divided by logging roads. If habitat quality and the absence of hunting are as in the Upper Arut, this may also be an important orangutan population.

3.2.3.8 Uplands enclosed by Katingan and Samba rivers and Bukit Raya National Park (area codes 26/27)

The habitat here is similar to the Samba-Rungan-Kahayan uplands. Hunting seems to have removed most of the orangutans from this area. Very few are reported from Bukit Raya National Park and only a small number of nests (0-2 per km of transect) were encountered in extensive dipterocarp plains west of the Samba River. The total population of this area may number less than 500 individuals in an unknown number of habitat blocks.

3.2.3.9 Upland between Samba, Rungan and Kahayan Rivers (area codes 26/27)

The upper reaches of these three rivers enclose an area with steep topography covered in dipterocarp forests at altitudes below 400 m. Husson's team estimated a mean density of 0.7 orangutans/km^2, reaching 1.25 in the easternmost parts. There is potentially 1,500 km^2 of contiguous low hill forest, which implies a population of ca 1,050 orangutans in this area. Hunting and past logging damage appears to be lower here than west of the Samba river, perhaps owing to the steep topography.

3.2.3.10 Arut-Belantikan region (area code 12)

This is an area of dipterocarp forest clothing the foothills of the Schwaner mountains and surrounding the upper reaches of the Arut and Belantikan rivers at altitudes of roughly 140 to 300 m asl. It is defined by the Lamandau River to the west, Seruyan River to the east and the provincial

border to the north. Part of the area (5%?) surveyed by Togu Simorangkir (OF-UK) and Husson's team (OuTrop) is former dry rice fields, and thus covered in secondary forest. The rest of the area has been lightly logged by concessions, and nearly all is planned to be logged under the HPH system over the next 30 years. However, orangutans are common here, and extensive surveys in three separate areas have estimated densities of between 2.2 and 2.6 orangutans/km^2. Local people do not hunt orangutans here. With a total area of ca 5,800 km^2 this area may support a very large orangutan population of at least 6,500 orangutans. It is apparently contiguous with a further 4,200 km^2 of forest in the Rongga-Perai complex, further raising its importance. This area is the most promising upland area for orangutans on dry-land forest in Kalimantan and of high conservation priority.

3.2.4 East Kalimantan: *Pongo pygmaeus morio*

3.2.4.1 Coastal Kutai district (area code 36)

This region has been subject to devastating fires during the 1997/98 droughts. Recent satellite imagery indicates that the only remaining forest in this district is in the Kutai National Park, where some primary and secondary dipterocarp forest appears to remain, especially among rivers. Nonetheless, orangutans have survived, and nest counts by Borneo Ecology & Biodiversity Conservation (BEBSiC, 2003) suggest remarkably high densities (minimally 2 - 4 orangutans/km^2, well above the earlier estimates of long-term researchers in the intact forest (2 individuals/km^2). This undoubtedly reflects concentration of the orangutans into the remaining intact forest patches. It is difficult to extrapolate the estimates in the three patches sampled to the entire area lacking knowledge of the relative surface area of the intact patches. However, A. Suzuki (unpubl.) recently estimated the orangutan population of the Kutai national park at ca 600 individuals in almost 2,000 km^2. Time will tell whether these animals can survive in the long run in the degraded habitat.

3.2.4.2 Gunung Beliung (East Kutai)

Partly protected limestone forest. 1997 survey data (Suzuki, unpubl. report) suggested a population of 1,000 animals at that time. This is likely to have reduced since then given the high degree of threats.

3.2.4.3 Gunung Gajah (area code 38 [and not 40!])

The hill dipterocarp forest of Gunung Gajah area (mean altitude ca 350 m) in the Berau district has recently been surveyed. In the 1,400-km2 area, seven nest surveys conducted by The Nature Conservancy (December 2001 to present) indicate a mean density of 2.0 orangutans/km^2. If the area is homogeneous, this would produce a total estimate of about 2,800 animals, which would make this population the most important one of the eastern subspecies in Indonesia. If it is not, as suggested by other reports, 1,450 is the most reasonable estimate. The lower estimate has been adopted. Meijaard/Suzuki previously surveyed this area in 1997 and much lower density estimates were obtained. A tentative hypothesis is that orangutans made homeless by the 1997-98 fires moved to this area, however an alternative hypothesis is that historical hunting pressures have been low.

3.2.4.4 Sungai Lesan.

This is an excellent quality forest, with high biodiversity recorded. Estimated orangutan densities of 4.6 individuals per km^2 are among some of the highest recorded in Borneo, although there is uncertainty about whether compression may play a role in this high density. The Nature Conservancy conducted surveys in 2004, but only in the eastern portion of this site. The western portion is logged primary forest (20+ years) so it may contain lower densities. Some 400 individuals are estimated to occur across this site.

3.2.4.5 Balikpapan and Samarinda

The orangutans here are all reintroduced. The Wanariset-Samboja project reintroduced ca 70 individuals into Sungai Wain protectin forest, as well as over 300 individuals into the Meratus area. In both cases, an unknown percentage survives. Near Samarinda, a few small pockets with a few orangutans still occur.

3.2.5 Kalimantan Overview

The estimated numbers for the areas discussed above have been compiled in Table 7.5. This compilation contains estimates for the major areas, assuming there is information, and leaves out various small pockets with unknown but small numbers of animals. The sum totals therefore do not refer to the total known number of animals remaining in the wild, but rather to estimates of the larger or better-known populations.

Table 7.5. Estimated numbers of orangutans in the Kalimantan habitat blocks discussed in this report (numbers refer to codes used in Rijksen & Meijaard 1999).

No.	Name of area	Area in 2002 (km^2)	Current orangutan population estimate
A.	***P. p. pygmaeus***		
5	Danau Sentarum	1090-1500	ca 500 (ca 1,500 for greater DS)
5	Betung Kerihun	4500	1330-2000 (**prelim. est.**)
5	Upper Kapuas swamps (north)	?	Unknown
B.	***P. p. wurmbii***		
7	Upper Kapuas swamps (south)	?	Unknown
8	Bukit Baka lowlands	350	ca 175
9	Rongga Perai	4,200	max 1000
10	Lower Kapuas swamps		unknown
11	Gunung Palung	900	2,500
13	Tanjung Puting	4,000 (3132 forested)	6,000
16	Katingan-Sampit catchment	2,800	Min 2,800
17	Sebangau	5,584 (forested)	6,900
19	Rungan-Kahayan	2000	ca 1000
20	Sebangau-Kahayan	720	ca 700 in 12 pockets
21 + 22	Mawas Reserve	5,100	Min 3350 (east: 2500; west: 850)
26/27	Upland between Samba, Rungan and Kahayan	1,350	Ca. 950
25/26	Upland between Katingan, Samba and Bukit Raya	ca. 2000	<500
14	Seruyan	4000	Min 1000
12	Arut-Belantikan	5800	Min 6000
C.	***P. p. morio***		
36	Coastal Kutai district	2,000 (% habitat unknown)	< 700
39	Gunung Gajah	1,450 (proposed reserve)	Min 1,550
	Sungai Lesan	?	400
	Gunung Beliung	?	980 (1997 estimate)
41-44	Sebuku/Sembakung area	?	Unknown but few

Discussion

Methodological issues

Differential bias?

Different teams have produced divergent numbers over the years, due to variation in methods and degrees of conservatism in arriving at the extrapolated total numbers (the last few years have seen a trend away from using highly conservative estimates toward using far more liberal ones). Most of the teams have now settled on using line transect estimates of nests. Most recent studies have made an effort to estimate production rates and disappearance times of nests that were more appropriate for the areas they were applied to. Hence, density estimates based on nest counts, while biased, can now be compared across areas.

Recent experience suggests that most estimates derived in this way are too low. Several comparisons (Johnson et al., in press; van Schaik et al., MS; Husson et al. MS) now suggest that, compared to a single-pass line transect estimate, (i) a double pass of the same line produces an increase in the estimated density of 12-30% (n=3 tests), (ii) multiple repeat passes produce an increase of 37% (n=1), whereas (iii) plot counts increase the estimated density by almost 50% (n=2). Since we may safely assume that plot counts in fact provide the least biased estimates (all estimates were based on the same parameter values), then it follows that many of the estimates published the past few years, including the ones used in this study, may yield density estimates that are too low by as much as 33% of the actual values. However, many of the estimates used in this report are based on repeat surveys, leading to much smaller underestimates.

This bias serves to build in a downward correction for the errors associated with extrapolation. Direct extrapolation inevitably involves upward bias (because estimates are never taken in habitat that is so disturbed that no animals occur and because it is never certain that a larger area actually contains orangutans everywhere). Earlier estimates (e.g. used in the 1993 PHVA; Rijksen & Meijaard 1999) used a correction factor to correct for this, but because most recent ones do not, the errors are in opposite directions and may in fact tend to cancel.

Thus, while there is still variation across studies in bias, variation in methods is not a major factor in variation in the estimated densities and population numbers used in this report.[4]

Different orangutans

Over the past few years, we have also come to appreciate the important biological differences among the various orangutans. The more frugivorous Sumatran orangutans tend to live at higher densities, but are quite sensitive to logging. Among the Bornean orangutans, *Pongo pygmaeus wurmbii* and *P.p. pygmaeus* seem to be somewhat sensitive to logging, losing some 20% or less of their densities in logged areas, whereas the eastern *P.p. morio* displays a remarkable tenacity to coping with damage by logging and even fire. These figures obviously refer to the direct ecological impact of

[4] Another issue, not relevant to this report, is whether aerial surveys produce comparable results to those of ground surveys. Experience in Mawas (van Schaik, Wich, Russon, unpubl.) and in Sabah (Ancrenaz et al., MS) suggests that estimated nest densities produced by aerial and ground surveys show very good correlations across sites.

logging. In many areas, this impact cannot be measured because logging is accompanied by an increase in hunting pressure, compounding any possible impact of logging. We should stress that these assessments are still preliminary in that the species and subspecies may differ more in the speed with which they respond to habitat damage rather than in the extent of this response. It is not inconceivable that the improved ability of the Bornean orangutans to deal with low-quality fibrous foods allows them to survive for longer after logging has reduced the abundance of fruits, but that eventually serious population losses will still be incurred when animals finally succumb after several years of starvation diets.

It is also becoming apparent that *Pongo abelii* has the slowest life history, whereas *P.p. morio* may have the fastest among orangutans. Because of these differences, it is important to separate these four taxonomic units for conservation and management purposes, and to ensure that any confiscated animals will be reintroduced only into the range of their original species or subspecies.

The important conservation message that emanates from this recent work is that forest damaged by logging can still represent important orangutan habitat, especially in Kalimantan, and perhaps even more so in the eastern subspecies (*P.p. morio*). While this is not to be construed as an endorsement of selective logging (many other organisms remain highly sensitive and may disappear after logging), it does suggest that populations in logged areas can form the nucleus of viable populations in future.

Another important conclusion is that we should consider these four taxa as separate conservation units as much as possible.

Trends in distribution, habitat quality and numbers

The data compiled in Tables 7.1 and 7.2 and Figures 7.1-7.4 leave little room for complacency: Indonesia's orangutans are declining as rapidly as ever. These trends mirror the now widely known general trends in deforestation.

Nonetheless, the improved coverage by distribution surveys and especially the presence of improved or less conservative estimates of numbers in limited areas have led to larger numbers of orangutans known in the wild than were reported in the past few years. It should be pointed out immediately, however, that the total number of orangutans on a given island is a meaningless number for conservation purposes. The only meaningful numbers are the numbers per habitat unit or protected area, for each separate species or subspecies.

The total known from Sumatra (*P. abelii*) now stands at somewhat over 7,000. However, the Sumatran orangutans are distributed over at least 11 distinct and separate habitat units, the largest of which contains some 2,500 orangutans. If the four Leuser blocks can be reconnected, we would have a single population of about 5,400 (this number may be slightly inflated by 10 or 20%, but indicates the ballpark).

For Kalimantan, we consider the three subspecies separately.

P. p. pygmaeus is in poor shape in Indonesia, with its stronghold Danau Sentarum being badly affected by logging and hunting, with a mere 1,500 or so remaining. Many nearby swamp areas are small and fragmented and subject to hunting. The main hope is that adjacent Betung Kerihun can be expanded with some lowland habitat to the south, and be connected effectively to its transnational

counterparts in Sarawak. There is an urgent need to get good information on Kerung Betihun, or at least that available information be properly analyzed and published.

P. p. wurmbii has the largest population by far, especially in the large swamp areas of Central Kalimantan, with a current estimate of at least 35,000, with major strongholds in Tanjung Puting, Sebangau and Arut-Belantikan, a very respectable population in Mawas, and an interesting far-west population in Gunung Palung. Various other once sizeable populations are disappearing fast.

P. p. morio has its main stronghold in the Berau/Gunung Gajah population, although the remnants in what was once Kutai national park may be worthy of protection. There is a need to explore the establishment of corridors between these areas. It is becoming clear that *P.p. morio* has a strong presence in Sabah.

We leave it up to the PHVA workshop to integrate this information with the data from Sarawak and Sabah and use the total update to develop recommendations for conservation policy. Although two of the Bornean subspecies have populations in both Malaysia and Borneo, we should not forget that conservation of species in multiple political units is best served when each country takes its measures as if it is the only one in the species' range.

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APPENDIX 1: METHODS USED BY MEIJAARD AND DENNIS (2003)

We used the absence/presence data from Rijksen and Meijaard's (1999) surveys, and combined these with a 2002 forest/non-forest classification kindly provided by Doug Fuller of George Washington University (in association with The Nature Conservancy). This classification was based on imagery from the Moderate Resolution Imaging Spectrometer (MODIS) on board the NASA Terra satellite imaging almost the entire surface of the Earth every day[5]. The nominal spatial (or ground) resolution of MODIS imagery used for this classification is 500m x 500m; for comparison the spatial resolution of Landsat TM is 30m x 30m. The classification provided by Fuller was based on imagery selected and processed for the period from 10 February - 22 April 2002[6] to create composite reflectance images largely free of cloud and other atmospheric perturbations. He then classified these images using standard image-processing algorithms to derive a forest/non-forest map of Borneo.

We visually compared the 2002 forest/non-forest cover product with the Orangutan distribution map (Rijksen and Meijaard, 1999), and used this and recent information from the field to digitally update boundaries for the remaining Orangutan habitat using ESRI ArcView 3.2a software.

The accuracy of the classification was checked against a number of sources, including recent Landsat ETM imagery, the forest-/non-forest classification provided by the Indonesian Ministry of Forestry (MoF)[7], the TREES map produced by the European Union in 2003 (based on 1999 satellite images), and several detailed vegetation studies by Dennis et al, (2000; 2000; 2002), Suyanto et al. (2000), and Colfer et al (2000). We used the Landsat ETM images and detailed vegetation studies by Dennis et al. to adjust our 2002 habitat classification, whenever we found areas that had been classified on the MODIS imagery as non-forest, but which clearly appeared as forest on the Landsat ETM images. We then compared our classification with the MoF land cover classification, which is based on 1999–2000 satellite data, to assess the differences between these two classifications. Because, the MoF classification only covers Indonesian Borneo, we could not assess the accuracy of our classification for the Malaysian states of Sabah and Sarawak. The accuracy checking was done by converting both classifications to a raster format (using the ArcView Spatial Analyst extension), and counting the grid cells that both classifications had in common, or where one classification excluded the other. Also, because the MoF classification classified the following forest types: Primary dry, primary swamp, secondary dry, secondary swamp, we were able to assess what percentage of the remaining habitat consisted of these forest quality types.

In comparison with the MoF classification, our classification overestimated orangutan habitat in ca. 5% of the grid cells (i.e. we classified such grid cells as orangutan habitat, whereas the MoF classification classified them as non-forest); we underestimated orangutan habitat by about 27% in comparison with the MoF classification. Taking into consideration that the MoF classification is based on 1999–2000 data and that the Kalimantan forest area declines by about 10,000 km^2/year

[5] Perhaps the greatest benefit of MODIS for land cover monitoring is the daily imaging capability for almost any point on the earth. Other satellites such as Landsat have a higher spatial resolution but provide imagery of the same point on the earth only 1-2 times per month which means that the likelihood of receiving a cloudless image is severely reduce, especially in the humid tropics.

[6] Prior to the 2002 fires.

[7] Land cover classification produced by Badan Planologi of the Ministry of Forestry, Indonesia. The classification is based on a mosaic of Landsat satellite imagery dated between 1999 and 2000.

(FWI/GFW 2002), justifies a lower margin or error of our classification of 5%. We thus decided to use a confidence interval of -5% and +5% for all estimates, unless we had detailed Landsat ETM imagery to check our initial MODIS classification results.

APPENDIX 2: SUMMARY OF ORANGUTAN SURVEY IN THE UPPER KAPUAS AREA, WEST KALIMANTAN, INDONESIA; JUNE-AUGUST 2003.

Written by Andi Erman and Erik Meijaard

The following 15 sites were visited for the survey (numbers refer to Fig. 7.1). Sites 1 through 6 are part of the extended Madi plateau and Melawi catchment recognized by Rijksen and Meijaard (1999) as area 7, but in the more downstream and swampy parts. Sites 7 through 13 are foothills and swamps to the south of Betung Kerihun and Kapuas Hulu mountain blocks (area codes 5 and 6), whereas 14 & 15 are adjacent to the Danau Sentarum area.

Nr	Locality	Description	Transect coordinates	Transect length	Total number of nests	Remarks
1	Silat River; Desa Nanga Lungu (1)	Hilly area with *ladang* and some logging; logging concessions have expired	N 0 12' 00" E 112 11' 19"	2,300 m	10	1 orangutan killed and eaten in 2001
2	Silat River; Desa Nanga Lungu (2)	Good forest with tall trees (40-50 m). Hutan adapt.	N 0 11' 39" E 112 12' 13"	2,250 m	3	Will be logged soon
3	Danau Tang area	Previously logged peat swamp forest	N 0 37' 46" E 112 26' 10"	2,250 m	12	
4	Danau Selogan area	Previously logged peat swamp forest	N 0 38' 12" E 112 25' 59"	2,350 m	15	
5	S. Bunut	Previously logged peat swamp forest	N 0 33' 09" E 112 33' 54"	2,100 m	10	Orangutan often seen in the transition zone between peat and hills
6	Dusun Jongkong Mandai	Parts good forest, parts secondary.	N 0 42' 40" E 112 48' 41"	2,000 m	25	Orangutan often hunted in the *Kecamatan* Nanga Bidak
7	Nanga Erak	Hill and peat swamp forest	N 0 46' 41" E 113 11' 12"	1,700 m	12	
8	Sibau Hilir/Sibau Hulu	Peat swamp with ongoing selective logging	N 0 57' 53" E 112 57' 53"	2,050 m	3	
9	S. Mayas/S. Potan/S. Pekaran/S. Mungin/S. Long Gurung	Hill forest (probably surrounded by swamps)	N 1 03' 21" E 112 58' 34"	2,000 m	44	Orangutan skulls found in a local village suggest that hunting occurs
10	Tanjung Kerja	Old *ladang* and hill and peat swamp forest	N 1 01' 55" E 112 46' 31"	?	26	Orangutan often seen in fruit season and hunted for meat

Nr	Locality	Description	Transect coordinates	Transect length	Total number of nests	Remarks
11	Ulok Palin (Dayak Embaloh)	Old rubber plantations, *ladang*, and peat swamp forest; expired logging concession, but timber extraction still common	N 1 03' 17" E 112 48' 49"	?	7	Orangutan often hunted
12	Apan (Dayak Iban)	Forest very much affected by logging and few forested patches were left	N 1 07' 27" E 112 30' 09"	?	0	Taboo against eating orangutan, but also orangutan had been eaten as recently as 1999
13	Ulak Pauk	Logged riparian and peat swamp forest with mostly small trees	N 1 04' 06" E 112 30' 17"	?	0	Orangutan are eaten and have apparently never been seen on the west side of the Embaloh River, but many on the east side
14	Ulak Pauk (Dayak Embaloh); Danau Tunggal	Peat swamp forest with *rengas* and *gerunggan*	N 1 02' 07" E 112 33' 27"	?	17	Orangutan often seen
15	Klawik (Dayak Kantuk)	*Ladang*, logged forest and degraded forest patches	N 0 54' 46" E 112 32' 38"	?	30	Orangutan often encountered in this area; sometimes killed and eaten

APPENDIX 3: SUMMARY OF ORANG-UTAN SURVEYS 2003 IN SCHWANER FOOTHILLS

Compiled by Simon Husson

(NB: density estimates produced using DISTANCE. p = 0.9, r = 1.1, t = 300)

Nr	Location	Team	Description	Start coordinates	Total transect length (m)	Total nests	Nests /km	Nest density (/km2)	Orang-utan density (/km2)	Remarks
A	**North and East of Sendurahan, in SW Schwaner range, edge of so-called Rongga-Perai complex**	OuTrop (Hearn, Ross, Ella)	Hill dipterocarp forest, some primary, some logged, some heavily logged		14950	85	5.7	137	0.46	Information from Ketapang and Sandai suggested a sizeable population North and East of Sendurahan (particularly the Sungai Bahana area). In Sendurhan, however, we were told the area north of Senduruhan was extremely logged and devoid of orangutans, but the NE was still good, more specifically the Bukit Lawang area. In reality we found few nests in all but one area. The effects of past hunting in most of this area is believed to explain low densities from within otherwise very good forest - many people said they used to hunt in this area up to about 5 years ago. Other forest speces abundant. Despite repeated attempts, it proved impossible to travel further upriver, or past Batulapis, as planned because of low water levels.
A1	Sungai Bahana - 14km NE of Senduruhan	OuTrop	Primary dipterocarp forest. Transects started 100m in from logging road	00.951° S, 110.873° E	2450	11	4.5	not approp.	not approp.	Steep, hilly topography. Two logging companies, Korunia Hutan Lestari and Alas Kusumer, operate in this area. Logging of the Sungai Bahana area occurred during 2001 but was limited to 25 m from the river. No evidence of further logging was found within The area surveyed, although chainsaws were heard daily.

Nr	Location	Team	Description	Start coordinates	Total transect length (m)	Total nests	Nests /km	Nest density (/km2)	Orang-utan density (/km2)	Remarks
A2	Sungai Bahana - 14km NE of Senduruhan	OuTrop	Primary dipterocarp forest. Transects started 100m in from logging road	00.950° S, 110.854° E	2500	5	2.0	not approp.	not approp.	Illegal logging is also present in this region. In Sandai we spoke with the head of an illegal logging team, which operates between Senduruhan and Nanga Sokan. There is a long history of forest use by the local people, which continues to this day; human pathways, both old and new, were abundant. Anecdotal evidence suggests that hunting by local villagers is abundant, although orangutan hunting is now largely opportunistic due to the low population, which has apparently decreased significantly over the past 6-7 years. To the south of the survey area lies Bukit Lawang which has been afforded some legal protection and is apparently unlogged. Villagers in Senduruhan suggest that orangutan are abundant in this area, and that few people go there due to its' poor accessibility.
A3	East of Sungai Kerabai - 45km NE of Sandai	OuTrop	Logged dipterocarp forest	01.100° S, 110.856° E	2500	50	20.0	[487]	[1.64]	Steep, hilly topography. In this area signs of illegal logging were abundant; logging pondoks were visible along all of the parts of the S. Kerabai that we travelled along. As we travelled from Randujungkal we saw many open areas of forest adjacent to the river, which reduced in abundance and size with increased distance from the last village. Illegal logging activity within the area of both midlines was in progress at the time of survey.
A4	East of Sungai Kerabai - 45km NE of Sandai	OuTrop	Logged dipterocarp forest	01.100° S, 110.856° E	2500	8	3.2	not approp.	not approp.	

Nr	Location	Team	Description	Start coordinates	Total transect length (m)	Total nests	Nests /km	Nest density (/km2)	Orang-utan density (/km2)	Remarks
A5	West of Sungai Kerabai - 45km NE of Sandai	OuTrop	Logged dipterocarp forest	01.098° S, 110.845° E	2500	8	3.2	not approp.	not approp.	Steep, hilly topography. Illegal logging activity was ongoing at the time of study within the area of midline 5, but had recently ceased within the area of midline 6. Disturbance as a result of logging was intense (greater than midlines 3 and 4), with large areas of open forest and many gaps in the canopy.
A6	West of Lower Sungai Kerabai	OuTrop	Logged dipterocarp forest	01.111° S, 110.832° E	2500	3	1.2	not approp.	not approp.	
B	**Bukit Baka**	OuTrop (Hearn, Ross, Sampang)	Hill Dipterocarp forest, mainly primary on podzolic soils. Altitude varied between 150-350 m a.s.l.		7500	44	5.9	128	0.43	North-western corner of the Bukit Baka-Bukit Raya National Park (181.090 ha), on the KalBar side. The timber company Pt. Sari Bumi Kusumah owns a large concession neighbouring the park boundary, and appears to be practising clear felling. There appears to be some contention over the exact location of the northeastern boundary of the national park. The area between the S. Ella Hulu and the logging road (mapped as national park land) has been subject to logging by local people, however, there was no evidence of illegal logging in the areas surveyed within the park to the east of the S. Ella Hulu. Effectively, therefore, the Sungai Ella Hulu is now considered the northeastern boundary of the park.
B1	NW corner T.N. Bukit Baka/Bukit Raya	OuTrop	Primary dipterocarp forest	00.604° S, 112.240° E	2500	6	2.4	not approp.	not approp.	Steep, hilly topography. Access to the forest was via a patrol pathway (well-walked, ~ 1-2m wide) which ran north east from the logging road (km 37). The start of midline B1 was situated 2.5 km along this pathway.

Nr	Location	Team	Description	Start coordinates	Total transect length (m)	Total nests	Nests /km	Nest density (/km2)	Orang-utan density (/km2)	Remarks
B2	NW corner T.N. Bukit Baka/Bukit Raya	OuTrop	Primary dipterocarp forest	00.627° S, 112.255° E	2500	20	8.0	[169]	[0.57]	Steep, hilly topography. Access to midlines B2 and B3 was approximately 2.7 km further south east along the logging road. They followed a bearing of 120º and began 2 km and 3 km in from the road, respectively.
B3	NW corner T.N. Bukit Baka/Bukit Raya	OuTrop	Primary dipterocarp forest	00.627° S, 112.255° E	2500	18	7.2			
C	**Sungai Arut**	Togu (OFI)	Generally logged/lighty logged or secondary dipterocarp habitat with some swamp		15000	346	23.1	not analysed	not analysed (~1.7-2.2)	Survey carried out around Riam, Penahan and Penyombaan villages in North Arut District. Discussions in all these villages suggest orang-utans are not hunted, even though they are considered a pest as they eat durian fruit from plantations. Numbers are reported to have decreased with loging however. The major industry is farming (esp. rice), and many HTI's have been set up in the area, although the local people are resisting selling their land to the concessions because of low price. Pests from nearby HTI / kelapa sawit plantations are attacking rice-crops. Around Penyombaan mining is a major activity.
C1	Kampung Gambir (2km from Riam)	Togu	Secondary (~30-40yrs)	01°55.1' S 111°52.8' E	2500	64	25.6			This area used to be rice field approximately 30-40 years ago. The general forest condition is good; bamboo is dominant vegetation in this area. Some places have swamp forest. We heard the sound of chainsaws from nearby HTI.
C2	Selombang (6km from Riam)	Togu	Foothill	01°54.1’ S 111°51.6' E	2500	16	6.4			Selombang, a foothill of Bukit Balang. This place used to be a PT. Korindo concession. Now, HTI (forest of industry planting) running by PT. Aspek (Korindo group) has begun. The general

Nr	Location	Team	Description	Start coordinates	Total transect length (m)	Total nests	Nests /km	Nest density (/km2)	Orang-utan density (/km2)	Remarks
										forest condition is heavily logged and disturbed by company roads.
C3	Tahap (5km from Penahan)	Togu	Foothill	01°52.3' S 111°56.5' E	2500	79	31.6			Tahap is a hill in Penahan village administration. . One concession, PT. Alaska works in this area but the general forest condition, although lightly logged, is still good.
C4	Tongkip (6km from Penahan)	Togu	Hill	01°52.4' S 111°57.0' E	2500	67	26.8			PT. Alaska has concession in this area but the general forest condition is still good. On the top of the hill there is a concession road.
C5	Nyampa (2 km from Penahan)	Togu	Secondary (~10-20 yrs)	01°51.9' S 111°53.0' E	2500	23	9.2			Survey area use to be rice field approximately 10-20 years ago. Just 150 metres from the river we saw rice fields to be planted in September 2003.
C6	Batu Tutup (5km from Penyombaan)	Togu	Hill	02°01.1' S 111°54.0' E	2500	97	38.8			PT. Daya Bambu used to work here but they left the area about 6-8 months ago. General forest condition is lightly logged.
D	Sungai Samba (Upper Katingan)	OuTrop (Husson, D'Arcy, Ciscoes, Topan)	Hill dipterocarp forest, some primary, some logged (5-15 yrs ago)		12300	65	5.3	not approp.	not approp.	NB: transects here only surveyed once. All surveys carried out within PT. Dwima Jaya Utama logging concession. Forest within this area generally good condition. However, neighbouring concessions through which we passed had large cleared areas, areas of ladang agriculture and HTI development. Illegal logging appeared widespread near rivers, virtually absent in steeper, hillier areas. Hunting seems to have been widespread 10 years ago and before,

Nr	Location	Team	Description	Start coordinates	Total transect length (m)	Total nests	Nests /km	Nest density (/km2)	Orang-utan density (/km2)	Remarks
										judging from discussions with village elders, and still occurs (3 infants recently confiscated from Tumbang Manggu logging base).
D1	Camp Kecubung area, E of Sg.Samba	OuTrop	Dipterocarp, mostly primary, some lightly logged 1986 (and poss 1997 also)	UTM 49 07427 00 E 98829 00 N	4900	51	10.4	214	0.72	Steep, hilly topography. Very good forest, nests highly spatially clumped, particularly around ridges and the steepest hllsides. Areas of past-logging almost deviod of nests. Locals say that orang-utans are common from the area we surveyed into the forest extending north and east, probably to the upper Kahayan river.
D2	Camp Kucu area, E of Sg. Samba	OuTrop	Dipterocarp, lightly logged 1989, also some illegal	UTM 49 07365 00 E 98835 00 N	2800	4	1.4	not approp.	not approp.	Steep, hilly topography. More badly logged than Kecubung area, but loggers say that they never saw orangutans here even when they first started working in the area. As this area is only 8km from Kecubung (despite a couple of small roads between) this difference is strange. Fruiting ficus, lianas and durian were seen
D3	W of Sg. Samba	OuTrop	Dipterocarp, illegally logged 15-20 yrs ago, also last 3 years	UTM 49 07186 00E 98816 00 N	4600	10	2.2	not approp.	not approp.	Fairly, flat topography, not concession logged but illegally, possibly by neighbouring concession 20 yrs ag and also by illegal loggers within the last 3 years. Some quite high damage associated with the latter. Generally nice forest bu very few nests. Contiguous with area in the north-west of the concession (~700000 E, 989000N) where loggers reported many orang-utans 10-12 years ago when this area was logged.

Nr	Location	Team	Description	Start coordinates	Total transect length (m)	Total nests	Nests /km	Nest density (/km2)	Orang-utan density (/km2)	Remarks
E1	Katingan swamps (between Katingan and Sampit rivers)	OuTrop	Peat swamp forest. Southern part mangrove (unsurveyed)		18300	355	19.4	576	1.94	Entire area has been concession logged at some time, illegal logging now widespread but still recent. Hunting probably occurs but believed to be at low levels, Dayak community surrounding this area is generally muslim. Orangutans appear distributed throughout.
E1	Sungai Tarantang (8km SE of Kotabesi)	OuTrop (Hearn, Ross, Sampang	Peat swamp forest. Highly illegally logged (ongoing)	02.453° S 110.143° E	4000	63	15.8	502	1.69	Two areas 3km apart were surveyed. Illegal logging began 1997, stopped in first area 2000, the other still ongoing. All reports confirm orang-utans have always been abundant here.
E2	Sungai Kalaruan (15km SW of Asem Kumbang)	OuTrop (McLardy, Agus, Amat)	Peat swamp forest (shallow). Highy illegally logged, ongoing	UTM 49 0755700 E 9755100 N	4300	44	10.2	279	0.94	East of Sg. Kalaruan very damaged. West side pretty good. Peat very shallow. Plenty of illegal logging, based out of Telaga village.
E3	Sungai Kajang Pamali (5km W of Galinggang)	OuTrop (D'Arcy, Sampang Arie)	Peat swamp forest, some illegal logging	UTM 49 0754000 E 9714100 S	5000	104	20.8	579	1.95	Some good forest, some cleared. Many canals and skids. Illegal loggers present (average age 16!!), been logging here since 2002. About 1/2 of the area has yet to be logged, but it is due. Logging teams coordinated - not opportunistic.
E4	Sungai Perigi (~5km W of Perigi)	OuTrop (Ella, Arie)	Peat swamp forest, some illegal logging	02.520° S 113.142° E	5000	144	28.8	873	2.94	Illegal logging about to start, survey team camped at pondok (hut) village of ~20 people.

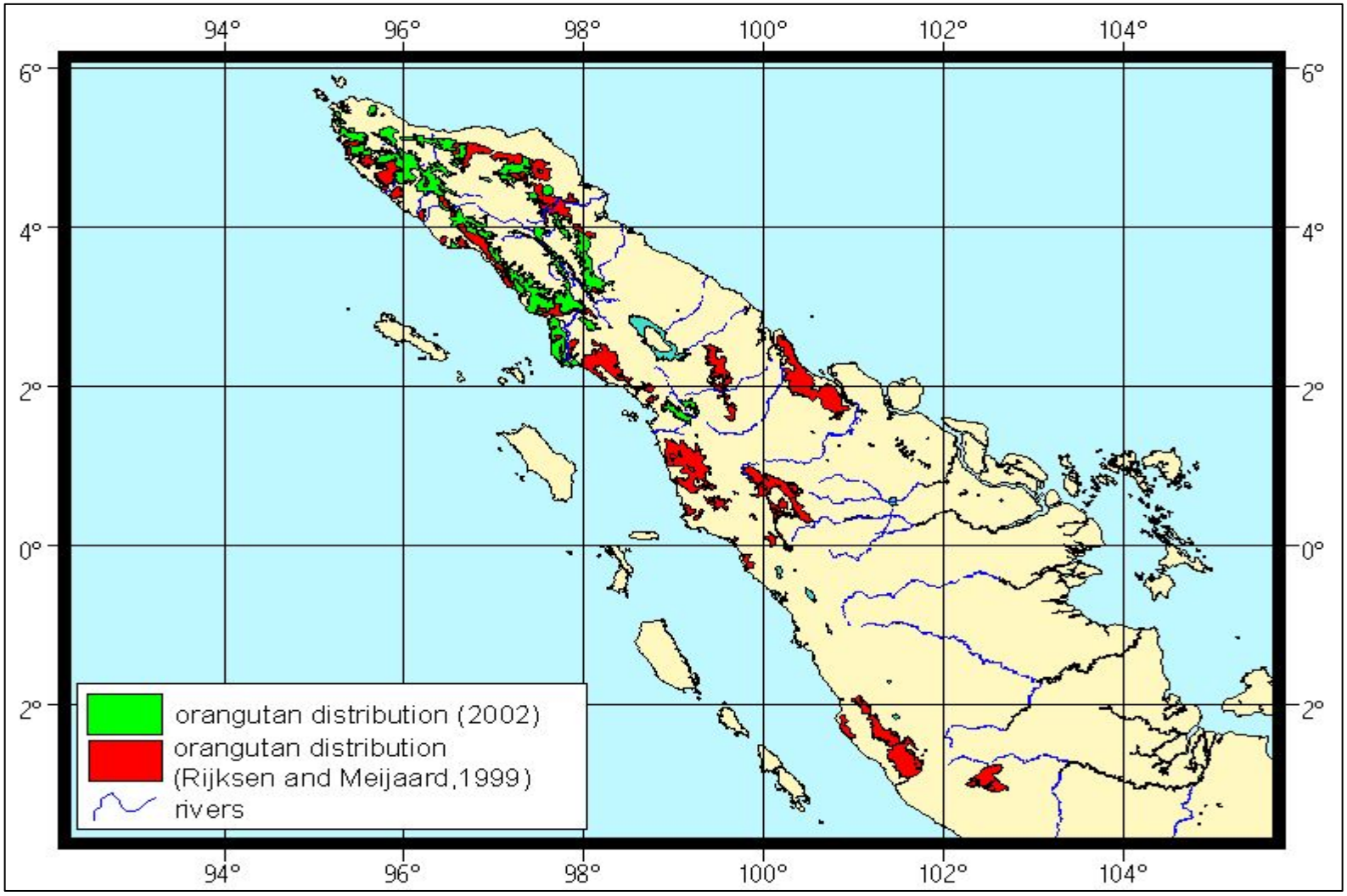
94°
96°
98°
100°
102°
104°
6°
4°
2°
0°
2°
orangutan distribution (2002)
orangutan distribution
(Rijksen and Meijaard,1999)
rivers

Figure 7.3. Comparison of the distribution of Sumatran populations 1992-2002.

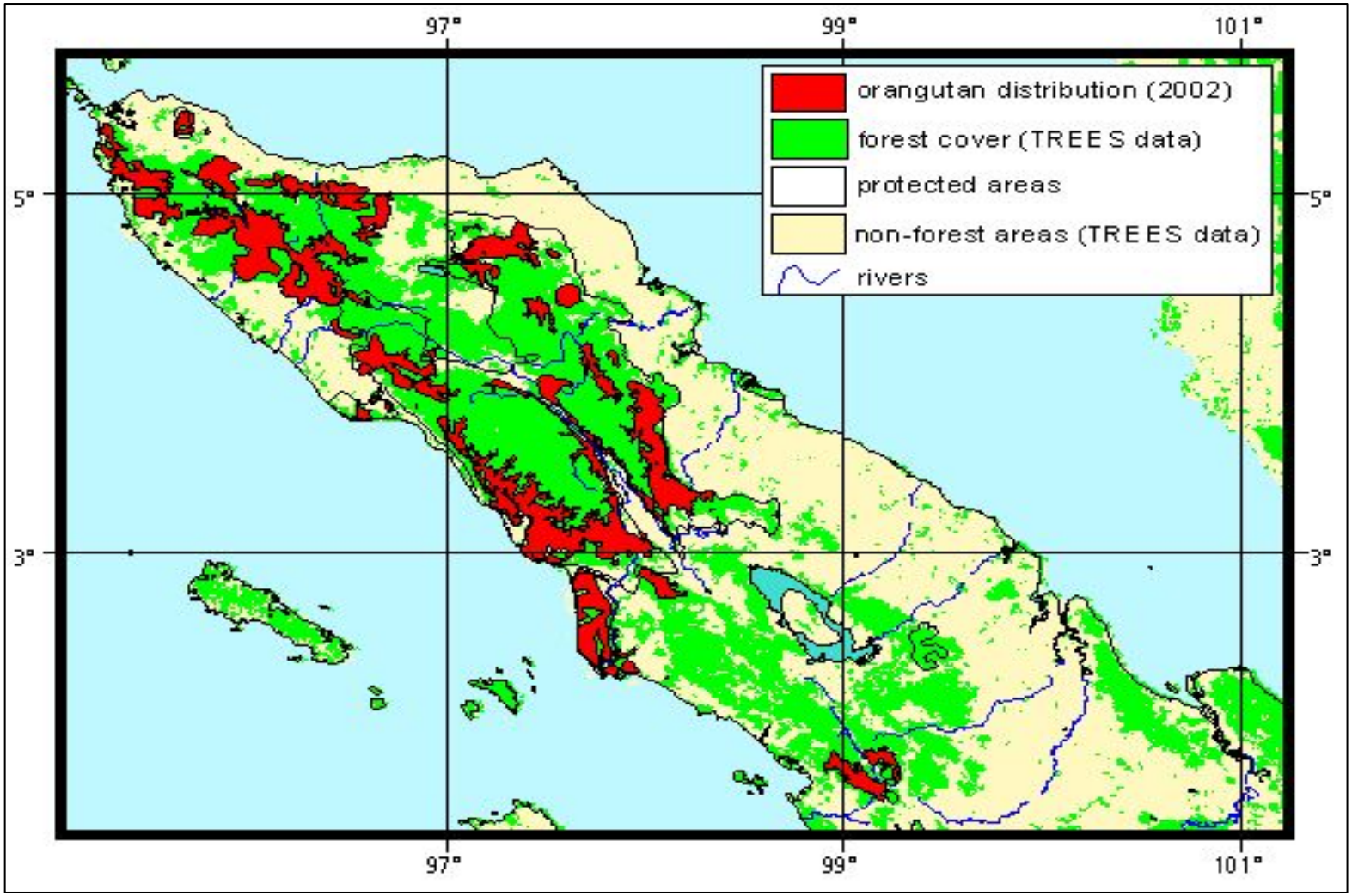

Figure 7.4. Distribution of breeding populations of Sumatran orangutans, based on 2002 forest classification data.

Appendix II. List of Participants

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Appendix III. GRASP Kinshasa Declaration on Great Apes

Great Apes Survival Project
Projet pour la survie des grands singes
GRASP

Kinshasa Declaration on Great Apes

We, the representatives of the great ape range States, donor and other States, international and intergovernmental organizations, academic and scientific communities, non-governmental organizations, industry and the private sector, meeting at Kinshasa, Democratic Republic of the Congo, on 9 September 2005,

Aware that there is a high risk of extinction in the wild for all great ape species, due largely to the destruction of forests and other habitat; threats from human activities, including increasing encroachments by human populations on their habitat; civil disturbances and wars; poaching for bushmeat and for the live animal trade; and diseases such as ebola which can decimate ape populations,

Recognizing that great apes are flagship species for tropical forests and woodland areas and play a key role in maintaining the health and diversity of their ecosystems, and that their decline and potential extinction may precipitate the decline of other culturally, economically or ecologically important species,

Also recognizing the intrinsic value of great apes as part of the world's natural heritage, which we have a moral duty to conserve and share with future generations,

Recognizing further that great ape populations and their habitats can provide direct and indirect benefits to local communities and other stakeholders, and contribute to poverty alleviation through the development of carefully regulated ecologically sustainable ecotourism and other non-destructive enterprises and through the environmental services that forests provide,

Recognizing moreover that all species of great apes are afforded the highest level of legal protection under relevant wildlife law in their respective range States,

Recalling the World Charter for Nature, adopted by the United Nations General Assembly by its resolution 37/7 of 28 October 1982, which underscores the importance of not compromising the genetic viability on the earth,

Also recalling the Millennium Development Goals which, among other things, aim to ensure environmental sustainability and to halve by 2015 the proportion of people who live in extreme poverty,

Further recalling the Johannesburg Plan of Implementation of the World Summit on Sustainable Development, which included the agreement to achieve a significant reduction in the current rate of loss of biodiversity by 2010,

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Recognizing the sovereignty of the great ape range States and the role of these States and their citizens in the implementation of conservation strategies for these species and their habitats,

Also believing that global partnership, collective action and the acceptance of common but differentiated responsibility can help to halt and reverse the decline of great ape populations,

Acknowledging that the provisions of the Convention on Biological Diversity, the Convention on the International Trade in Endangered Species of Wild Fauna and Flora, the Convention on the Conservation of Migratory Species and the World Heritage Convention, together with decisions

taken by their Parties, are directly relevant to the survival of great apes, particularly in the fields of conserving forest diversity, extending and effectively managing protected areas, eliminating illegal trade, developing national and regional legal frameworks, and protecting key sites and habitats,

Recognizing that range States, donor States, international institutions, non-governmental organizations and industry and the private sector have already allocated substantial funds towards great ape conservation, but that further resources must be raised urgently so as to allow essential conservation work to be undertaken to secure the future of those species and their ecosystems,

Recognizing also that securing further funding from donor States and international institutions is more likely if, where appropriate, great-ape conservation projects are proposed and formulated as part of a wider poverty-reduction strategy, such as a durable rural-development project which recognizes that the sustainable development of rural communities depends in large part on the sustainable use of their environmental resources, including great-ape habitats,

Welcoming the present and future role of the Great Apes Survival Project Partnership as a cooperative, global enterprise that harnesses the skills, resources and commitment of range States, donor States, multilateral environmental agreements and other international bodies, non-governmental organizations, industry and the private sector, and academic and scientific communities,

Expressing gratitude to the President, Government and people of the Democratic Republic of the Congo for their generosity and far-sightedness in hosting the present intergovernmental meeting,

Convinced of the urgent need to take appropriate measures,

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1. *Affirm* our commitment to the Global Strategy for the Survival of Great Apes;

2. *Affirm also* our commitment, as a matter of urgency, to support and, for the range States, to implement effective measures to counter the threats facing great apes;

3. *Emphasize* the need to stimulate and enhance cooperation among range States and their neighbours to ensure the effective enforcement of legislation protecting great apes and the coordination of efforts to halt activities that have a detrimental effect upon the populations of great apes;

4. *Also emphasize* the important role of appropriate national and international measures, and participation in regional initiatives such as the Lusaka Agreement Task Force, and encourage ratification and compliance with international treaties such as the Convention on the International Trade in Endangered Species of Wild Fauna and Flora, the Convention on Biological Diversity, the Convention on the Conservation of Migratory Species and the World Heritage Convention which provide a framework for the conservation of great apes;

5. *Urge* the development and implementation of national great apes survival plans and other appropriate actions by range States, as part of their overall sustainable-development strategies, in order to conserve great apes and their habitats and to halt and reverse the decline of great ape populations, while ensuring the participation of relevant stakeholders, in particular local communities;

6. *Further urge* partners to the Global Strategy for the Survival of Great Apes and other interested parties to support range States in the implementation of their great apes survival plans and any other appropriate actions;

7. *Encourage* the provision of long-term ecologically sustainable direct and indirect economic benefits to local communities, for example, through the introduction or extension of carefully regulated sustainable ecotourism enterprises in areas of great ape habitat, and the creation of long-term research projects operating in or near these areas;

8. *Invite* all relevant international institutions and aid and development agencies to make it a priority to develop and implement policies which promote ecologically sustainable livelihoods for local and indigenous communities and which prevent actions and activities that are detrimental to the survival of great ape populations;

9. *Reaffirm* our commitment to work together to ensure that the Great Apes Survival Project Partnership has the capacity to realize its full potential as a key component of the international effort to save great apes by:

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(a) Urging all 23 great ape range States to become or remain active partners of the Great Apes Survival Project Partnership;

(b) Also encouraging other States which either already support or participate to a significant extent in programmes for the conservation of great apes and their habitat, or could contribute to such an effort in such a way as to become full partners of the Great Apes Survival Project Partnership;

(c) Encouraging other international organizations, in addition to the United Nations Environment Programme, the United Nations Educational, Scientific and Cultural Organization and the biodiversity-related conventions, to become or remain active partners of the Great Apes Survival Project Partnership;

(d) Encouraging non-governmental organizations that have historically either played an important role in efforts to conserve the great apes, or could contribute to such an effort in such a way, whether at the national or international level, to redouble their efforts in that regard and to become or remain partners of the Great Apes Survival Project Partnership;

(e) Encouraging the academic and business communities, industry and the private sector, which either already support or participate to a significant extent in programmes for the conservation of great apes and their habitat, or could contribute to such an effort in such a way as to become full partners of the Great Apes Survival Project Partnership;

(f) Forming strategic active partnerships with private sector ecotourism organizations to create sustainable economic development that enhances livelihoods for local communities in the range States;

10. *Resolve* to set ourselves and all concerned the target, by the year 2010, of securing a constant and significant reduction in the current rate of loss of great ape populations and their habitats; and, by 2015, securing the future of all species and subspecies of great apes in the wild, by:

(a) Ensuring the integrity of those sites supporting the key wild populations that would conserve the genetic, ecological and cultural diversity of all great apes for all time;

(b) Protecting those sites from further degradation and loss of habitat and working with local and indigenous communities to ensure that any human use of habitats is ecologically sustainable and consistent with maintaining healthy, viable great ape populations;

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(c) Working to ensure interconnectivity of protected areas, where relevant, in order to avoid isolation of protected great ape populations, for example by establishing corridors where necessary;

(d) Developing ecologically sustainable local poverty-reduction strategies which recognize and integrate the needs of local communities sharing great ape habitats, while securing the lasting health of the environmental resources upon which they depend;

(e) Improving the protection of individual great apes and their habitats everywhere by demonstrably improving where necessary the quality and the enforcement of relevant laws, as well as the capacity of law-enforcement agencies;

11. *Invite* the international community in the widest sense, including donor States, international institutions, non-governmental organizations, industry, the private sector, and academic and scientific communities, to provide effective and coherent support, including funding, to assist efforts made by the great ape range States.

In respect of the above intentions, aspirations and actions set out in this Kinshasa Declaration, we, the signatories, pledge to do everything in our power to ensure the long-term future for all great-ape species and to encourage the citizens of the world, in whatever capacity, to assist and support this initiative.

Adopted at Kinshasa, on 9 September 2005.

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Democratic Republic of the Congo**
Equatorial Guinea**
Gabon**
Ghana**
Guinea
Guinea-Bissau**
Indonesia
Mali
Nigeria
Republic of the Congo**
Republic of Rwanda**
Senegal
Sierra Leone
Sudan
Uganda**
United Republic of Tanzania**

Donor countries

Belgium
France
Italy
Sweden
United Kingdom of Great Britain and Northern Ireland**
United States of America

Intergovernmental organizations

European Commission
Commission of Forestry in Central Africa

United Nations Environment Programme

Dr. Klaus Töpfer

* Signatories as at 6 July 2006
** Signed by a Minister

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GRASP Scientific Commission

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Prof. Richard Wrangham

Multilateral environment agreements

Convention on International Trade in Endangered Species of Wild Fauna and Flora

Convention on the Conservation of Migratory Species of Wild Animals

GRASP non-governmental organization partners

African Wildlife Foundation

Ape Alliance

Bonobo Conservation Initiative

Born Free Foundation

Bristol Zoo Gardens

Care for the Wild

Conservation International

Dian Fossey Gorilla Fund Europe

Dian Fossey Gorilla Fund International

Fauna and Flora International

GRASP Japan

Great Ape World Heritage Species Project

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Wild Chimpanzee Foundation
Wildlife Conservation Society
World Society for the Protection of Animals
World Wide Fund for Nature

GRASP supporting partners

Volcanoes Safaris
International Ranger Federation

Other non-governmental organizations

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David Shepherd Wildlife Foundation
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Other organizations and individuals

Action Communautaire pour la Protection des Primates du Kasai
Centre d'Accueil des Enfants Abandonnés
Earth Negotiations Bulletin
Forêt au Service des Communautés Autochtones et Locales
Institut Congolais pour la Conservation de la Nature
Institut des Jardins Zoologiques et Botaniques du Congo
Journal Officiel / RDC
King Leopold III Fund for Nature Exploration and Conservation
Ligue Nationale des Associations Autochtones Pygmées du Congo
Lola Ya Bonobo
New England Anti-Vivisection Society
Organisation Concertée des Ecologistes et Amis de la Nature
The Fauna Sanctuary

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