Orangutan Action Plan

Carey Yeager, Editor

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Foreword

An excellent comprehensive review of the orangutan's status was published as the outcome of a PHVA workshop (Population Habitat and Viability Analysis) conducted in Medan, Sumatra in 1993 (Tilson, et al., 1993). This document is intended as a brief review and update, and is based upon an electronic conference held in November 1998.

It is organized to provide an overview of each topic, with major recommendations from the conference given in bold face type. This is intended as a working document that can be used by PHPA and others in addressing conservation issues, formulating management plans, etc. We have attempted to include enough detail that someone newly assigned to species conservation in the Department of Forestry can quickly understand the important issues. This document is not intended as an exhaustive literature review.

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Introduction

Orangutans are found solely on the islands of Borneo and Sumatra. They are endangered, with total population estimates ranging from approximately 20,000 - 25,000 individuals as of 1993 (Tilson, et al., 1993). Rijksen and Meijaard (in press) estimated that as of 1996, Sumatra contained 12,770 individuals and that Borneo had 23,133 individuals remaining. Habitat degradation and loss has been the major threat to this species, although poaching (for food or the pet trade) has also been a sizeable problem. The recent major drought and fires in Indonesia (1997-1998) are believed to have destroyed hundreds of thousands of hectares of forest. Protected areas were not spared from this devastation; approximately 95% of lowland forest within Kutai National Park burned in 1998 (informal information from GTZ). Not all burned areas suffered equally; anywhere from approximately 50% to 95% of the trees were lost (Yeager and Frederiksson, preliminary data from WWF surveys in 1998). Direct and indirect losses to the orangutan population and their habitat appear to be severe.

Life history characteristics and ecology

Orangutans are large bodied sexually dimorphic, arboreal primates. Frugiverous species, orangutans prefer sweet pulpy fruits (Sugardjito, 1986; Galdikas, 1988; Leighton, 1993). They also eat insects, young leaves and mature leaves, flowers, bark, sap, the pith of a wide range of species (e.g., many *Pandanus*, palms, and rattans), honey, mushrooms, and, on rare occasions, animal flesh. Stripping trees of their bark to eat the cambium beneath is characteristic of times of food stress (Knott, 1998). During times of low food availability, up to 40% of the orangutan diet may consist of bark (C. Knott, personal communication). This activity can often lead to the death of the tree (C. Yeager, A. Russon, W. Smits, C. Knott, personal observations). Bark-stripping of acacia trees in plantations have led to requests from corporations for the removal of orangutans from some areas (W. Smits, personal communication). Depending on the tree replacement rate, bark stripping activities generally translate into reduced food resources and hence, lowered carrying capacity for an area.

Some keystone orangutan food resources, such as rattans and other palms, are economically important to humans (A. Russon, W. Smits, C. Knott, personal communications). Humans also compete with orangutans for fruit. Unfortunately, access to fruit is often gained through felling the fruiting tree (W. Smits, A. Russon, C. Yeager, personal observations). This competition has serious ramifications for orangutan conservation. Reduced amounts of high quality fruit leads to decreased fertility, increased interbirth intervals, and reduces long term potential for species survival (Knott, 1997). Reductions in keystone resources can have an immediate impact, and may lead to rapid local extinctions.

PHPA policy currently allows adjacent communities to extract resources from both use and wilderness zones in National Parks on a "sustainable" basis (PHPA, 1996). In calculating carrying capacities in parks and reserves, human extraction rates (legal and illegal) need to be taken into account (see appendix for list of orangutan food species). **Long term survival of the orangutan does not appear to be compatible with human resource extraction; therefore we strongly recommend that extraction of orangutan food resources, particularly keystone resources, be prohibited in parks and reserves.** Economic alternatives for humans need to be developed in buffer areas outside parks and reserves. Both sugar palms and dipterocarps have been used in buffer zones as economic alternatives that are less at risk of crop raiding by orangutans.

Orangutans are typically described as solitary, although more recent research indicates that at least some populations may be more social than previously thought (van Schaik

& Fox, 1996; Knott, in press). Adult males spend less than 2% of their time in association with others (Galdikas, 1985). Females are more social, associating with other females (perhaps kin) on occasion (Galdikas, 1984). Sumatran orangutans appear to be much more social than Bornean orangutans; this may be due to the comparative abundance of large fig trees, a keystone species, in some parts of Sumatra relative to Borneo (Rijksen, 1978). Groups of up to 9 orangutans have been observed feeding in one tree. Orangutans, in general, appear to become more social when there is higher fruit availability (Knott, 1998b). **Orangutans prefer feeding in fruit trees with large crops (Leighton 1993); this argues strongly for the protection of old growth forest for orangutans. In logged forests, extra care should be taken to protect and preserve Ficus sp.**

Orangutans have large (40- 600 ha [Rodman, 1973; Mitani, 1985b; Suzuki, 1992; Galdikas, 1988]) highly overlapping home ranges (van Schaik and van Hooff, 1996). An adult male's home range generally encompasses the home ranges of several adult females. There appear to be both resident, and non-resident individuals. In some areas, orangutans migrate, tracking food resources (MacKinnon, 1974). Loud calls made by adult males appear to serve a dual function; they repel other adult males and may attract adult females in estrus (Mitani, 1985). **The ability to migrate is very important from a conservation management perspective. Migration allows animals to track food resources as necessary, reduces potential for inbreeding depresion, and reduces the probability of local extinctions by allowing for recolonization.Corridors connecting orangutan populations are strongly recommended.**

Each evening an orangutan will make a nest in a tree. This activity involves breaking tree branches and intertwining them in a characteristic manner. Nests are also occasionally made during the day. As nests persist over time, they are often used as trace indicators in calculating populations estimates (e.g., van Schaik). Rates of nest decay are highly variable locally. Nests have been documented to last over 16 months (C. Yeager, W. Smits, personal observations), but may last only 3 or 4 months on average, based on samples of short-term changes in nests, in other areas (van Schaik et al, 1995; Russon et al., unpub. report). Tree species, location in the canopy, nest size, etc. are all factors that may affect decay rates. **In using nests as trace indicators of density, it is important to do recensuses along the same trail within a few months. A onetime census is most probably overestimating the number of orangutans present, and cannot provide an estimate of local nest decay rates.**

Population densities range from ‹1 to 7 individuals per km^2 (see review in Rijksen and Meijaard, in press); differing habitat quality, hunting pressure, and data collection methods account for the variation. Bornean habitat regularly supports only 1/2 to 2/3 of the orangutan density of comparable Sumatran habitat (Soemarna et al., 1995; van Schaik et al.,1995). Orangutans are found in lowland dipterocarp forest, heath forest, peat and fresh water swamps. There have been occasional sightings in submontane forest, but these are not common.

Females reach maturity at approximately 11-15 years of age (Galdikas, 1981), males at approximately 10 to 20 years (Knott, in press). There has been some suggestion that sub-adult males may facultatively delay reaching maturity. Interbirth intervals are approximately 8 years in Borneo (Galdikas and Wood, 1990). Interbirth intervals may range from 5 to 10 years depending on the conditions. A single young is typically born after a gestation period of about 8.5 months (Markham, period 1990). Infants are carried by their mothers for several years and often continue to suckle until they are 5 or 6. Infant mortality has been estimated at 10% (Tilson, et al., 1993). Females are more likely to conceive during times of high food availability (Knott, in press). Prolonged droughts, fires, and other

factors that decrease food availability may result in longer interbirth intervals.

Based on the PHVA conducted in 1993, orangutans have a relatively high risk of extinction (Tilson, 1993). This is not surprising, given their slow reproductive rate and high energy requirements. In the PHVA conducted in Medan, a 5% probability of a catastrophic event each year was used in the calculations. Mean interbirth intervals of 7 to 8 years, and average annual infant mortality rates of 2-15% per year, were also used in the model. Orangutan populations were only able to maintain positive mean stochastic growth rates when adult mortality was set at 1% (Tilson, et al., 1993). Given the enormous loss of habitat in the last 5 years, and the apparently greater levels of environmental stochasticity (Kalimantan has had 5 major droughts and fires since 1982), we redid the PHVA. **Preliminery indications are that even large population fragments (approximately 2,000 individuals) wil not persist long term, unless there is migration.**

Taxonomic issues

Taxonomists agree that there are significant morphological and genetic differences between Bornean and Sumatran orang utans. Two subspecies are generally recognized in the literature:*Pongo pygmaeus pygmaeus* and *Pongo pygmaeus abelli*.

More recently, molecular geneticists have suggested that the two subspecies are actually separate species (Ruvelo, et al., 1994; Zhi, et al., 1996; see Muir, et al., 1998 for a conflicting view). This has also been supported based on morphological evidence (Groves, 1998). According to Melnick (personal communication), fixed differences in mtDNA allozymes, and chromosomal inversions indicate a rather long separation between the two populations, with each island harboring a significant amount of orangutan genetic variation and evolutionary potential. They may also represent separate co-adapted gene complexes, which would be disrupted, if they were mixed. **Thus, it is the group's recommendation that the two populations continue be managed as separate conservation units, and that hybridization be avoided.**

In addition, it has also been suggested that Bornean orangutan should be split into at least two subspecies (Groves, et al., 1984), and perhaps as many as four subspecies (Groves, 1998), based on morphological evidence. Some genetic evidence suggests that there are no differences great enough for subspecies categorization in the Bornean population (Zhi, et al., 1996). As this was a relatively small sample size, additional work is still being done (e.g., Melnick's lab). In Sumatra, there may be two subspecies (Rijksen, personal communication) based on morphological differences. **From a conservation management perspective, it was the group's recommendation to use the term *management unit* as opposed to subspecies, since subspecific status still has not been resolved. The preliminary units on Sumatra were identified as the Leuser population and the "southern" population. On Borneo, the preliminary management units were identified as Northwest Kalimantan, Southwest Kalimantan, Sabah, and Northeast Kalimantan.** The geographic borders and validity of these preliminary management units needs to be explored using current genetic techniques.

Fragmentation of populations may lead to problem of inbreeding depression in the future. **If an inbred population shows sign of deterioration or decline and needs an influx of new genes to recover demographic processes, new individuals may be brought in from another management unit within the same conservation unit to enrich the gene pool** (e.g., translocate an individual from Sabah to Northeast Kalimantan).

Given the rapid loss of habitat and the fragmentation of populations, from a genetic perspective, an all-out effort is needed to collect geographically verifiable samples from both Sumatra and Kalimantan and to do detailed genetic surveys using mtDNA, Y-chro-

mosome, and autosomal nuclear DNA sequences. These data will provide information concerning the extent of female and male dispersal, and overall gene flow within each island, as well as provide a measure of overall genetic variation. This information is important from a management perspective, in order to determine whether translocations will be necessary in a fragmented population, and if translocations are necessary, which sex and approximately what proportion of the population should be translocated. **We recommend that, where feasible, orangutan hair or blood samples be collected along with complete provenance information for genetic testing. Where possible, arrangements for analysis should be made with NGO or university partners and PHPA and the MoF should facilitate permits.**

Distribution pattern

Orangutans are found primarily in low land habitat, and appear to prefer at least two major geomorphological landscape types (Rijksen and Meijaard, in press). These landscapes are a freshwater-fringe (i.e., a floodplain, swamp or an alluvial valley) and an adjacent dry upland region (usually foothills). **Protection of this lowland habitat is essential to the long-term survival of the orangutan.** Occasional individuals are observed in submontane areas; these may be migrating individuals. On the island of Borneo, orangutans are found in three of the provinces of Kalimantan and in the Malaysian provinces of Sabah and Sarawak. But they are unevenly distributed across this range (e.g., there is a large gap in East Kalimantan.). There are no orangutans in Brunei Darussalam. On Sumatra, orangutans are primarily found in the North Central region.

One potential limitation to orangutan distribution may be nutritional. Payne (1992) has suggested that the availability of soil minerals may result in the patchy distribution pattern observed in orangutans. Diseases, such as malaria, have also been mentioned as potentially limiting distribution (Payne, et al., 1985).

Another limitation appears to be altitudinal. Davies and Payne (1982) present data indicating that orangutan density declines with altitude, with less than .4 individuals per km^2 at altitudes of 500 to 1,500 m. They report no individuals present over 1,500 m. The altitudinal limitation may be a function of nutrition, because fruit availability falls off sharply with altitude (van Schaik et al., 1995).

Hunting may have limited the orangutan's distribution in historic times (Rijksen and Meijaard, in press). Hunting pressure may have caused local extinctions in some areas.

Mountains and rivers may form effective barriers to dispersal, resulting in isolated populations. Geographic fragmentation has led to at least morphological differences amongst orangutan populations on Borneo (Groves, 1992, see appendix). **Currently, habitat loss (through fire, agricultural conversion and large-scale logging) appears to be the major contributor to distribution patterns.**

Distribution pattern with respect to geo-political location

Sumatra:
Aceh – present in southern portion
Sumatra Utara – present in central and western portion
Sumatra Barat – present in northern portion
Borneo:
Sabah – present in southern portion
Sarawak – present in the southern portion
Brunei Darussalam – no orangutans present
Kalimantan Timur – present in the central east and northern portion
Kalimantan Selatan – no orangutans present
Kalimantan Tengah – present throughout the province
Kalimantan Barat – present in the northeast, southern, and western portions

Threats

The primary threats to orangutan viability are the loss of adult females due to human poaching, and habitat loss and fragmentation (Tilson, et al., 1993). Illegal hunting for food, sport, or to obtain infants for the wild animal trade, all contribute to increased risks for adult females. Adult females are found at higher densities than adult males, and thus are more likely targets for hunters. In addition, adult females are typically killed if the infant is captured for trade.

Loss due to hunting and / or the pet trade may be sizeable. Taiwan alone has 283 captive orangutans registered; this is probably an underestimate (Leiman and Gahaffar, 1996). Recent reports in the newspapers indicate an increase in poaching, primarily as a response to the economic crisis in Indonesia. Habitat losses due to the fires have exacerbated the problem, driving animals into increased contact with humans. Orangutans have even been advertised for sale in the newspaper ads. Fires, drought, changing socio-economics, and the new political regime, have probably all had significant impacts on hunting and trade. **Population losses need to be evaluated and poaching needs to be eliminated. Based on the 1993 PHVA, an increase by only 1% per year in adult mortality over "normal" will lead to extinction within approximately 5 decades. This translates into a loss of only 5 adults per year per 1000 individuals.**

Habitat loss and fragmentation are generally due to human activities. These activities include logging, mining, agriculture, road building, industrial development, etc. Development and resource extraction pressures will continue to increase given continued human population growth and increased resource demands tie to the external cash market. Even selective logging can have a large impact; selectively logged forest and old secondary growth contain only 30% –50% of the orangutans found in primary forest (van Schaik, Azwar and Priatna, 1996). Natural disasters also play a role, and their effects appear to be exacerbated by environmental degradation. Fires and droughts have ravaged Kalimantan repeatedly over the past two decades (1982/1983, 1987, 1991,1994,1997/1998). Approximately 40% of the total fire hot spots for Kalimantan occurred within orangutan habitat in 1997 and 1998 (K. Dedy,WWF, personal communication). Fire hot spots are not equivalent to burn scars, but they are indicative of areas that have probably been damaged by fire. From hot spot maps, it appears that fires affected 60% of the orangutan habitat in East Kalimantan. In Central and West Kalimantan, approximately 25% of the orangutan habitat were affected by fire hot spots. Fire and drought appear to be relatively new threats in Sumatra, and were not considered for the Sumatran threats evaluation at the 1993 workshop (Tilson, et al., 1993). Approximately 5% of the total fire hot spots for Sumatra occurred within orangutan habitat in 1997 and 1998 (K. Dedy,WWF, personal communication).

Approximately 78% of all trees died in burned swamp areas examined in 1997 and 1998 (Yeager, preliminary unpublished data). Over 70% of the tree species were lost as well. In lowland forest, approximately 55% of the trees were lost, with a loss of approximately 39% of the tree species. Even unburned areas lost significant amounts of forest cover. Tree mortality rates in unburned peat swamp affected by drought and haze increased from an average of approximately 1.3% per year to over 5% for the 97/98 time period (Yeager, unpublished data). According to recent predictions concerning climate modeling, El Nino events are becoming more frequent. **Predictions now are for a major drought approximately every 3 to 5 years. Given the amount of degraded land, and the vast amount of standing deadwood from the last major fire, future fires may be even larger in size. This indicates that fire will continue to be a major threat.**

Based on WWF/WCMC/ABS maps (WWF U.S. Conservation Science Program, 1997), if all planned land conversions within Indonesia are carried out, remaining popula-

tions of orangutans will be severely fragmented. Many parks have, or may be, fragmented by road building. Displacement of individuals by logging, fire, or other activities, may lead to overcrowding in remaining habitat remnants. Overcrowding can lead to increased physiological and psychological stress (see reviews by Clarke, and others). Stress often has negative impacts on reproduction (e.g., Wasser and Barash, 1983; Dunbar, 1984). MacKinnon (1974) reported reduced birth rates in an overcrowded orangutan population displaced by logging. **The group strongly recommends that conservation policy be integrated into governmental policy at all levels and across Departments. Spatial planning should be required to take into account environmental and conservation impacts. Enforcement of laws and regulations must be improved, and habitat fragmentation should be minimized.**

Disease has played a major role in the decline of some primate populations. It may act to limit some primate populations (Young, 1994). Orangutans are susceptible to the same diseases as infect humans. Disease transmission from humans to orangutans is common. Typhoid, tuberculosis, hepatitis, scabies, intestinal parasitic infections, and infectious respiratory illnesses are typical. Orangutans released into areas where they interact with a wild population can spread diseases. **Disease is a significant threat to long term orangutan survival. Human-orangutan interactions should be eliminated if possible. Re-introductions of ex-captive animals into wild populations should be prohibited.**

Protected areas

Potentially viable orangutan populations are located in the reserves or parks (from Tilson, et al., 1993; Rijksen and Meijaard, in press; WWF Indonesia Data Base; Gurmaya, et al., 1998) listed below (**see table**).

The total protected area on Borneo and Sumatra is approximately 45,677 km^2, of which 7,585 km^2 is orangutan habitat according to Rijksen and Meijaard (in press). The total protected population is probably at least 8,276 individuals, but this population is fragmented. There is a high probability of local extinctions within these fragments, if migration between populations is eliminated.

Rehabilitation

Rehabilitation of primates is a conservation tool employed both in Indonesia and Malaysia for orangutans. Rehabilitation implies a process in which animals in captivity are given medical treatment, protective care,

Park or Reserve	Area (Ha)	Population estimates : Habitat*	Min.	Max.	Env. Quality
Tanjung Puting National Park	415,040	75,300	488	1,800	Degraded >45%
Kutai National Park	198,629	48,600	277	2,100	Degraded >90%
Bentuang Karimun National Park	800,000	131,000	1,330	2,000	Degraded >10%
Bukit Baka/Bukit Raya Nat. Park	181,090	30,700	301		Degraded >30%
Gunung Palung National Park	90,000	25,000	143	2,100	Degraded >20%
Gunung Nyuit Nature Reserve	110,000	30,000	17	500	Degraded >80%
Gunung Leuser National Park	792,485	200,000	5,070	7,779	Degraded >40%
Sikunder Reserve			200	2,554	Degraded >70%
Lanjuk Entimau Reserve (M)	187,172	21,700	226	1,000	Degraded >10%
Danum Valley Reserve	43,800	13,100	224		Degraded >10%

* =orangutan habitat as defined by Rijksen and Meijaard, in press

and experience or training necessary for successful life in the wild (Yeager, 1997).

Numerous orangutans continue to be confiscated by the PHPA (Indonesian Department of Forest Conservation) as part of their enforcement policy. Many of these are young infants. Currently individuals taken into custody are taken to one of several rehabilitation stations (Sepilok in Sabah, Semonggok in Sarawak, Wanariset in E. Kalimantan, Bohorok in Sumatra). Individuals typically are quarantined for some time period, given some medical care, if deemed necessary, then released at the site. Feedings are provided on a regular basis at these stations.

At Wanariset, animals are group caged for several months, then released with provisioning provided for as long as needed, from a few weeks to several years. Animals may be recaged if they do not appear to be doing well.

Rehabilitation of primates has come under criticism (e.g., Aveling and Mitchell, 1980; Bennett, 1992; Yeager, 1997). Programs have been criticized on their lack of documentation, the high costs involved, and the low probability of success.

Factors such as age at captivity, length and conditions of captivity, and personality traits, all have an impact on the probability of "success". Individuals that are captured at an older age, and that are in captivity for short periods of time in appropriate caging, have the best chance of surviving, reproducing and rearing offspring, without continued support (Hannah and McGrew, 1991). Individuals kept in captivity often exhibit behavioral abnormalities, which may be permanent (e.g., Kleiman et al., 1991; Mason, 1986; Suomi, 1986).

In some parts of the world, conservation of the wild population and rehabilitation do not compete for funding from the same sources. In Indonesia, however, scarce government resources have to be divided between the two activities. Private sector funds earmarked for "conservation" activities within the country are also so divided. Alternative funding mechanisms should be explored for humanitarian care.

The group made the following recommendations:

1) In allocating scarce resources, priority should be primarily given to in-situ efforts (conserving the wild population), as opposed to ex-situ conservation efforts (ex-captive care).
2) Preventing poaching is the most effective solution to the "rehabilitation" problem.
3) Awareness and fund-raising campaigns should emphasize the realities, not the myths, and should not mislead people into believing that they are contributing effectively to the conservation of the wild population through providing care to ex-captive orangutans.
4) Individuals should not be released into areas with existing wild orangutan populations.
5) Ex-captive individuals that cannot be released (e.g., due to illness, insufficient skills, or aggressive behavior) should be put into an appropriate captive situation.
6) Appropriate veterinary care and handling procedures should be followed (see recommendations from 1993 Medan conference).
7) Where feasible, hair and blood samples should be collected for genetic testing.
8) "Rehabilitation" centers should be licensed and monitored, and all pertinent regulations should be followed.
9) "Rehabilitation" methods should be appropriately assessed, and the most effective methods should be used. Record keeping should be improved and made freely available.

Translocation

Translocation (moving of individuals or groups to a different area) has been used as a conservation tool for primates (e.g., Caldecott and Kavanagh, 1983; Nakhasathien, 1989; Koontz, et al., 1994).

Translocation can be a useful tool (albeit expensive), providing appropriate habitat can be found and appropriate methods are used (Yeager and Silver, in press). Loss of habitat due to land conversion or fires in Indonesia and Malaysia has led to the displacement of presumably thousands of orangutans. Translocation of orangutans has occurred as a response to this displacement in Kalimantan and Sabah.

In translocations within Sabah (Andau, et al., 1994), animals were moved in order to rescue them from an area being converted to oil palm. They were captured and moved to an existing reserve that had a wild population. They were placed in a portion of the reserve with few residents.

In Kalimantan, orangutans driven out by large scale fires were picked up along the sides of roads and from people's gardens. This was undertaken by Wanariset and the Balikpapan Orangutan Society, some local NGOs and student groups in Kalimantan Tengah, and by individuals. Many captured orangutans were taken into custody, held for medical care if necessary, and then moved to a remaining patch of unburned forest in the area and released. There has been no systematic follow-up of released individuals.

Translocation is primarily viewed as an emergency response to a situation. The benefits are primarily from an ethical and public relation's perspective. The costs involved are high. The conservation benefits are arguable, as the translocated individuals:

1) may not survive in the new area (due to: capture stress, disease, decreased foraging ability),
2) may disrupt existing social networks (causing rises in aggression),
3) may introduce disease to a new population, and
4) may increase resource competition, bringing the population above carrying capacity.

The group made the following recommendations concerning translocations:

1) In allocating conservation resources, priority should be primarily given to in-situ efforts (conserving the wild population), as opposed to other conservation efforts, such as translocation.
2) Preventing habitat loss is the most effective solution to the "translocation" problem.
3) Awareness and fund-raising campaigns should emphasize the realities, not the myths, and should not mislead people into believing that they are contributing effectively to the conservation of the wild population through providing funds for translocation.
4) Individuals should not be released into areas with existing viable wild orangutan populations.
5) Translocated individuals should be given a health check before release. Appropriate veterinary care and handling procedures should be followed (see recommendations from 1993 Medan conference).
6) Where feasible, hair and blood samples should be collected for genetic testing.
7) Environmental Impact Assessments need to be done prior to releasing translocated individuals into an area. The EIA should take into account the impact of food competition with other threatened species present in the area. Depending on the area, these species might include sunbears, other primate species, hornbills, binturong, etc.

Captive breeding

Orangutans breed well in captivity. There appear to be sufficient individuals to maintain genetic diversity within the captive populations. One problem is hybrid-

ization. Many hybrids (Sumatran and Bornean crosses) were produced before this was recognized as an issue. If there are additional subspecies, this will complicate the picture.

Captive individuals serve an educational and research function. They may serve as a source of zygotes or sperm for use in the future, if it is necessary to use assisted reproduction techniques in order to maintain genetic diversity among fragmented wild populations. **Captive born individuals should not, however, be seen as a source of individuals for repatriation to the forest to augment the wild population.**

Conservation priorities

1) Improve protection in existing parks and reserves
   a) Active enforcement of existing regulations, including prosecution of those engaged or supporting illegal activities
   b) Increase public awareness
   c) Assessment of the degree and impact of local resource extraction
   d) Train rangers and students
   e) Create economic incentives for conservation
2) Establish new protected areas in areas with significant wild populations (including corridor establishment to link populations)
3) Improve protection in areas outside parks and reserves
4) Improve habitat quality in degraded areas through enrichment planting
5) Locate remaining populations and determining population size
6) Conduct genetic studies to address migration, dispersal, and speciation questions
7) Translocate and establish new populations
8) Rehabilitation

Recommendations by region and protected area

BORNEO

Kalimantan Tengah:

Tanjung Puting National Park is located on the southcentral coast of Borneo. It is approximately 400,000 ha of fresh water peat swamp, lowland dipterocarp forest, and heath forest. Approximately 1/3 to 1/2 of the park is degraded. Despite this, the park contains a large viable population of orangutans. Main threats include continuing environmental degradation from illegal logging, mining, and fires set within the park. In addition, rehabilitant orangutans are released in at least three different areas of the park and pose a significant hazard to the wild population (Yeager, 1997).

Recommendations:

1) extend North boundary of park to include the North shore of the Sekonyer river (this will give control of the river system to PHPA and make it difficult for illegal loggers to float out logs)
2) establish corridor to eastern forests if possible
3) environmental restoration to increase carrying capacity
4) consolidate all rehabilitants in one location in the area of lowest wild orangutan density to reduce their impact (or ideally, remove them from the park).
5) The park should be provided greater nature protection agency support (e.g., more staff, better training, facilities for dealing with orangutans).

UNPROTECTED (needs investigation)

Sungai Sebangau – approximately 20 km southwest of Palangkaraya. Primarily peat swamp forest, the area has been partially commercially logged. All logging concessions expired in 1997, however illegal logging is

common. Orangutan densities varied from 0.6 to 2.2 individuals per km^2, depending on degree of disturbance. Page et al. (1997) estimate that the total Sungai Sebangau population could approach 4,000 individuals.

Recommendations:

1) evaluate impacts of 97/98 fires on area, approximately 15% is reported to have been affected
2) propose protected area status for it if appropriate
3) mitigate logging impacts in area through enforcement of existing regulations

Sungai Katingan is reported have a high orangutan density, with approximately 1,406 orangutans in the area (Meijaard, 1997).The lower and middle reaches of the Sungai Kapuas and Sungai Kahayan are also reported to have a high orangutan density, with approximately 627 orangutans (Meijaard, 1997).

Barito Ulu is primarily heath and lowland dipterocarp forest with watershed protection designation. It has a low population density of orangutans (approximately 180) (Rijksen and Meijaard, in press).

Kalimantan Timur:

Kutai National Park is approximately 200,000 ha of lowland dipterocarp forest, as well as approximately 10,000 ha of ladang and mangrove. Fires in 1983, 1987 and 1998 have destroyed most of the forest (95% of the lowland dipterocarp forest in the park burned in 1998). There are still orangutans present, but the park's carrying capacity has been severely reduced. Continuing threats include the access provided by several logging roads bisecting the park, mining adjacent to the park, and poaching.

Recommendations:

1) a re-evaluation of the value of this park to conservation
2) environmental restoration of degraded habitat if appropriate
3) proposals for the support/assistance of the remaining orangutans present
4) The park should be provided greater nature protection agency support (e.g., more staff, better training, facilities, and equipment).

Kayan Mentarang National Park is 1,400,000 ha of lowland, submontane and montane forest. Orangutans have been sighted occasionally, but do not appear to be resident. There have been suggestions that orangutans could be translocated here.

Recommendations:

1) No translocations should be made without a thorough study of the potential impacts, both on the orangutans and on the other species already present.
2) The park should be provided greater nature protection agency support (e.g., more staff, better training, facilities, and equipment).

Meratus mountain protection forest - lowland dipterocarp and hill forest. Probably less than 50,000 ha, it has been used as a relocation site for orangutans from Wanariset. To date, about 70 ex-captive orangutans have been released in this area.

Recommendations:

1) assessment of carrying capacity for released orangutans
2) assessment of human-orangutan interfaces and their potential impact

PROPOSED:

Sangkulirang / Mangkilat Nature Reserve - approximately 200,000 ha of lowland dipterocarp and limestone forest. Verbal reports of good size orangutan population.

Recommendations:

1) finish gazzettement quickly

Sebuku / Sembakung Nature Reserve (agreed in principle) - contains a small size resident orangutan population (approximately 165 orangutans) in an isolated area of swamp and low-

land dipterocarp forest within the reserve, the entire proposed reserve is approximately 400,000 ha. There has been a proposal for introducing orangutans into an adjacent area that appears appropriate without a wild population present.

Recommendations:

1) finish gazzettement quickly
2) no translocations should be made without a thorough study of the potential impacts, both on the orangutans and on the other species already present.

UNPROTECTED (needs investigation)

Swamp forest west of the Kedung Kepala River (affected by 98 fires)

Lowland dipterocarp forest near upper Bengalun River (affected by 98 fires)

Swamp forest near Sungai Senyiur (affected by 98 fires)

Swamp Forest near Sungai Sebulu and Sungai Separi (affected by 98 fires)

Kalimantan Barat:

Gunung Palung National Park contains lowland, submontane and montane forest, as well as peat swamp and freshwater swamp forests. The park contains one of the largest populations of orangutans in Borneo. There is serious danger of encroachment from illegal logging and agricultural activities abutting the park.

Recommendations:

1) The park should be provided greater nature protection agency support (e.g., more staff, better training, facilities, and equipment).

Bukit Raya / Bukit Baka National Park- may contain a small population of orangutans that are at high risk of being isolated. No direct visual confirmation of their presence (R. Merrill, personal communication).

Bentuang Karimun National Park - the park contains approximately 800,000 ha of lowland dipterocarp, sub-montane and montane forests. A large scale biodiversity survey was conducted during the month of September 1997 in five areas: Derian, Pait, Condong, Pakararu, and Benalik. All survey areas were below 1200 m asl. The forest condition appears to be good. These areas appear to have a relatively low density (25 trace indications along 25 km of transect) of orangutans (Gurmaya, et al., 1998), but the total population within the park should be viable. Based on the same report, orangutans are only located in the western half of the park.

Recommendations:

1) Swamp forest located along the southern edge contains high densities of orangutans and should be added to the park.
2) The park should be provided greater nature protection agency support (e.g., more staff, better training, facilities, and equipment).

Gunung Niut - this is a small reserve (110,000 ha) currently threatened by agricultural encroachment, poaching, and logging. The orangutan population is in danger of isolation through habitat fragmentation, and is probably not viable.

Danau Sentarum - this is a small reserve (132,000 ha) of freshwater and peat swamp. It has a small population of wild orangutans present (approximately 130 –244 individuals estimated) (Russon, et al, unpublished report). Approximately half the reserve is degraded and unusable as orangutan habitat. A large population (approximately 1000 animals) is present just outside the reserve borders.

Recommendations:

1) The reserve should be expanded to include the large orangutan population in the areas immediately adjacent.
2) The reserve should be provided greater nature protection agency support (e.g.,

more staff, better training, facilities, and equipment).

3) Consideration should be given to establishing a corridor linking Danau Sentarum with Bentuang Karimun.

Mandor Nature Reserve – this reserve contains approximately 2,000 ha, including 500 ha of peat swamp. Orangutans are reported to be present, but have been hunted within the reserve (Meijaard, 1997). At last estimate, there were less than 10 orangutans left and orangutans may now be locally extinct in this area.

Muara Kendawangan Nature Reserve – the reserve contains 140,000 ha of swamp forest. An orangutan population is present (Tilson, et al., 1993), and may be quite large (Rusila and Widjanarti, 1994 as cited by Meijaard, 1997). Transmigration, agricultural encroachment and habitat degradation are major threats to this area (Tilson, et al.,1993). It has been considered for degazettement by PHPA.

Recommendations:

1) a re-evaluation of the value of this reserve to conservation
2) environmental restoration of degraded habitat if appropriate
3) proposals for the support/assistance of the remaining orangutans present if appropriate
4) The reserve should be provided greater nature protection agency support if deemed appropriate following evaluation (e.g., more staff, better training, facilities, and equipment).

Sumatra

Gunung Leuser National Park (subsumed into the Gunung Leuser Ecosystem Project) - This park contains the largest protected population of orangutans in the world. The park is approximately 863,000 ha of lowland, sub-montane, and montane tropical forest, swamps, tropical alpine, and beach forests and is now managed as part of a 24,000 km^2 integrated protection system. Illegal logging in the park and surrounding area are the major threat. Orangutan density in South Kluet declined from 4.1 individuals per km^2 in unlogged areas to 1.3 individuals per km^2 in logged areas (Lusli, et al., 1997).

Recommendations:

1) The area should be provided greater nature protection agency support (e.g., more staff, better training, facilities, equipment).

Sekundur Reserve- primarily lowland forest, degraded through logging. This reserve contains a viable orangutan population, but the population is likely to be fragmented (Tilson, et al., 1993).

Singkil Barat Reserve- composed primarily of swamp forests. It contains approximately 1176 orangutans (Rijksen and Meijaard, in press).

Malaysia

Sabah

Kinabalu – approximately 120 orangutans estimated to be present (Rijksen and Meijaard, in press).

Danum Valley – approximately 224 orangutans estimated to be present (Rijksen and Meijaard, in press).

Sarawak

Lanjak Entimau Wildlife Sanctuary- the sanctuary contains primarily lowland and hill Dipterocarp primary forest. The sanctuary is approximately 187,000 ha. In a short WWF/ITTO expedition to this area (8.5 days), orangutans were found in very low density. The expedition recorded 7 orangutan traces along 18 km of transect (Gurmaya, et al., 1998). Approximately 349 orangutans are estimated to be present (Rijksen and Meijaard, in press).

Tabin – approximately 530 orangutans estimated to be present (Rijksen and Meijaard, in press).

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Appendix 1

Orangutan Food Lists

Cheryl Knott and Anne Russon have provided orangutan food lists for their specific sites (Gunung Palung, West Kalimantan, and Sungai Wain, East Kalimantan).

Peter Rodman has put together a website for the great apes. The website includes food lists for the great apes. The address is:

http://www.cast.uark.edu/local/icaes/conferences/wburg/posters/psrodman/GAMHD.htm

On this webpage you will find links to Appendix 1 and Appendix 2, which list the species of plants identified for all apes, including orangutans.

Orangutan food lists have been published in numerous articles and dissertations.

The Minnesota Zoo Conservation Office and the IUCN/SSC Captive Breeding Specialist Group have compiled an Orangutan Bibliography (1972 – 1992). Copies of the bibliography are available for US$50 from:

IUCN/SSC CBSG Office
12101 Johnny Cake Ridge Road
Apple Valley, MN
USA

Orangutan Food Lists

Gunung Palung Orangutan Food List - "Cheryl Knott, Harvard University"					Sungai Wain Orangutan Food List - Anne Russon & Helga Peters			
FAMILY	GENUS	SPECIES	LOCAL NAME	MOST IMPORTANT	FAMILY	GENUS	SPECIES	LOCAL NAME
						Dysoxylum	sp.	
Zingiberaceae						Melanochylla	augustifolia	
Leguminosae	Adenanthera					Melanochylla	fulvinerius	
Rubiaceae	Adina				Anacardaceae	Bouea	oppositifolia	
Araucariaceae	Agathis			*	Anacardiaceae	Mangifera	sp.	
Meliaceae	Aglaia	dookko	Duku	*	Ancistrocladaceae	Ancistrocladus	tectorius	
Simaroubaceae	Ailanthus				Annonaceae	Fissistigma	manubriatum	
Alangiaceae	Alangium				Annonaceae	Polyalthia	sp.	
Apocynaceae	Alstonia				Annonaceae	Polyalthia	sumatrana	
Olacaceae	Anacolosa				Annonaceae	Uvaria	sp.	
Moraceae	Antiaris	toxicaria			Annonaceae	Xylopia	sp.	
Euphorbiaceae	Antidesma				Apocynaceae	Alstonia	sp.	
Euphorbiaceae	Aporusa			*	Apocynaceae	Dyera	costulata	
Arecidae	Araceae				Araceae	Aglaonema	sp.	
Leguminosae	Archidendron				Asclepiadaceae	Dischidia	sp. A	
Annonaceae	Artabotrys			*	Asclepiadaceae	Dischidia	sp. B	
Moraceae	Artocarpus		Cempedak	*	Asclepiadaceae	Dischidia	sp. C	
Moraceae	Artocarpus			*	Asclepiadaceae	Dischidia	sp. D	
Moraceae	Artocarpus	anisophyllus	Mentawa	*	Asclepiadaceae	Dischidia	sp. E	
Moraceae	Artocarpus	elasticus	Cempedak air	*	Asclepiadaceae	Hoya	sp.	
Moraceae	Artocarpus	fulvicortex		*	Bombaceae	Durio	(biasa)	
Moraceae	Artocarpus	integer		*	Bombaceae	Durio	dulcis	
Moraceae	Artocarpus	rigidus		*	Bombaceae	Durio	oxleyanus	Derantungan
Euphorbiaceae	Baccaurea			*	Bombaceae	Durio	kutejensis	Lai
Euphorbiaceae	Baccaurea	angulata	Belimbing darah	*	Bombaceae	Neesia	synandra	
Euphorbiaceae	Baccaurea	macrocarpa		*	Burseraceae	Canarium	sp.	
Euphorbiaceae	Baccaurea	stipulata		*	Burseraceae	Dacryodes	rugosa	
Euphorbiaceae	Baccaurea	tempoi		*	Combretaceae	Combretum	sp.	
Euphorbiaceae	Blumeodendron			*	Dilleniaceae	Dillenia	sp. A	
Euphorbiaceae	Blumeodendron	kurzii			Dilleniaceae	Dillenia	sp. B	
Euphorbiaceae	Blumeodendron	tokbrai			Dilleniaceae	Dillenia	sp. C	
Anacardiaceae	Bouea	oppositifolia			Dilleniaceae	Tetracera	sp.	

Gunung Palung Orangutan Food List -					Sungai Wain Orangutan Food List -			
FAMILY	GENUS	SPECIES	LOCAL NAME	MOST IMPORTANT	FAMILY	GENUS	SPECIES	LOCAL NAME
Palmae	Calamus				Dipterocarpaceae	Dipterocarpus	tempehes	
Guttiferae	Calophyllum				Dipterocarpaceae	Dipterocarpus	cornutus	Keruing
Guttiferae	Calophyllum	macrocarpum			Dipterocarpaceae	Shorea	laevis	Bangkirai
Guttiferae	Calophyllum	sclerophyllum			Ebenaceae	Diospyros	sp. A	
Guttiferae	Calophyllum	woodii			Ebenaceae	Diospyros	borneensis	
Burseraceae	Canarium				Ebenaceae	Diospyros	sp.	
Fagaceae	Castanopsis	borneensis		*	Ebenaceae	Diospyros	sp. B	
Fagaceae	Castanopsis	megacarpa		*	Euphorbiaceae	Aporusa	dioica	
Fagaceae	Castanopsis	psilophyllum		*	Euphorbiaceae	Aporusa	frutescens	
Casuarinaceae	Casuarina				Euphorbiaceae	Aporusa	nitida	
Linaceae	Cenolophon	parifolius			Euphorbiaceae	Baccaurea	parviflora	
Euphorbiaceae	Chaetocarpus				Euphorbiaceae	Baccaurea	sp. A	
Sapotaceae	Chrysophyllum				Euphorbiaceae	Baccaurea	sp. B	
Connaraceae	Connarus				Euphorbiaceae	Baccaurea	sp. C	
Menispermaceae	Coscinium	fenneistratum			Euphorbiaceae	Baccaurea	stipulata	
Linaceae	Ctenolophon				Euphorbiaceae	Chaetocarpus	castanocarpus	
	Cynoptera				Euphorbiaceae	Cleistanthus	sp.	
Burseraceae	Dacryodes				Euphorbiaceae	Drypetes	cf. pangifolia	
Theophrastaceae	Dehaasia				Euphorbiaceae	Drypetes	longifolia	
Leguminosae	Dialium			*	Euphorbiaceae	Drypetes	sp.	
Dilleniaceae	Dillenia			*	Euphorbiaceae	Macaranga	conifera	
Dilleniaceae	Dillenia	excelsa		*	Euphorbiaceae	Macaranga	hyploleuca	
Sapindaceae	Dimocarpus				Fagaceae	Castanopsis	oviformis	
Ebenaceae	Diospyros	confertiflora	kayu malam	*	Fagaceae	Castonopsis	motleyana	Rambutan hutan
Ebenaceae	Diospyros	maingayi		*	Flacourtiaceae	Hydnocarpus	polypetala	
Ebenaceae	Diospyros	phillipenensis	kayu malam	*	Flagelleriaceae	Flagelleria	sp.	
Dipterocarpaceae	Dipterocarpus	sublamellatus	kerwing	*	Gnetaceae	Gnetum	sp.	
Dipterocarpaceae	Dipterocarpus	tempenes			Gramineae	Scrotocloa	urceolata	
Asclepiadaceae	Dischidia				Guttiferae	Garcinia	manggostana	Mangis hutan
Anacardiaceae	Dracontomelon				Guttiferae	Garcinia	parvifolia A	Kemanjing
Euphorbiaceae	Drypetes				Guttiferae	Garcinia	parvifolia B	Kemanjing
Bombacaceae	Durio			*	Guttiferae	Garcinia	sp.	
Bombacaceae	Durio	acutifolius	Durio hutan		Guttiferae	Gironneira	nervosa	
Bombacaceae	Durio	dulcis	Durio hutan		Lauraceae	Eusideroxylon	zwageri	Ulin

Orangutan Food Lists

Gunung Palung Orangutan Food List -

FAMILY	GENUS	SPECIES	MOST LOCAL NAME	IMPORTANT
Bombacaceae	Durio	griffithii	Durio hutan	
Bombacaceae	Durio	lanceolatus	Durio hutan	*
Meliaceae	Dysoxylum			
Elaeocarpaceae	Elaeocarpus			
Myrtaceae	Eugenia			
Myrtaceae	Eugenia	bankensii		
Lauraceae	Eusideroxylon		billian	
Moraceae	Ficus			
Moraceae	Ficus	bennedikti		
Moraceae	Ficus	calophylla		
Moraceae	Ficus	cucurbitina		
Moraceae	Ficus	deltoidea		*
Moraceae	Ficus	dubia		*
Moraceae	Ficus	kalocarpa		*
Moraceae	Ficus	kalocyce		*
Moraceae	Ficus	kerkhovenii		
Moraceae	Ficus	microphylla		
Moraceae	Ficus	pellucida pinctata		
Moraceae	Ficus	sicidium		
Moraceae	Ficus	stupenda		*
Moraceae	Ficus	subgelderi		
Moraceae	Ficus	subtecta		*
Moraceae	Ficus	sumatrana		*
Moraceae	Ficus	uro		
Moraceae	Ficus	xylophylla		
Annonaceae	Fissistigma			
Guttiferae	Garcinia			
Guttiferae	Garcinia	atroviridis		*
Guttiferae	Garcinia	cowa		*
Guttiferae	Garcinia	mangostana	Manggis	*
Ulmaceae	Gironierra			*
Ulmaceae	Gironierra	nervosa		
Anacardiaceae	Gluta	renghas	Rengas	*
Gnetaceae	Gnetum			*

Sungai Wain Orangutan Food List -

FAMILY	GENUS	SPECIES	LOCAL NAME
Lauraceae	Litsea	sp.	
Lecythidaceae	Barringtonia	angulata	
Lecythidaceae	Barringtonia	sp.	
Leguminoseae	Archidendron	sp.	
Leguminoseae	Archidendron	splendens	
Leguminoseae	Dialium	indum var. bursa	
Leguminoseae	Fordia	splendidissima	
Leguminoseae	Koompassia	malaccensis	
Leguminoseae	Parkia	timoriana	
Leguminoseae	Sindora	sp. A	
Leguminoseae	Sindora	sp. B	
Leguminoseae	Sindora	wallichii	
Leguminoseae	Spatholobus	ferrugenius	
Leguminoseae	Spatholobus	sp.	
Magnoliaceae	Magnolia	borneensis	
Melastomataceae	Pternandra	sp.	
Meliaceae	Aglaia	sp.	
Meliaceae	Aglaia	simplicifolia	
Meliaceae	Aglaia	tomentosa	
Moraceae	Artocarpus	anisophyllus	Kledang
Moraceae	Artocarpus	elasticus	
Moraceae	Artocarpus	integer	Cempedak
Moraceae	Artocarpus	lanceofolius	
Moraceae	Artocarpus	sp.	
Moraceae	Ficus	benjamina	
Moraceae	Ficus	deltoidea	
Moraceae	Ficus	grassulariodes	
Moraceae	Ficus	lowii	
Moraceae	Ficus	sp.	
Moraceae	Ficus	sp. A	
Moraceae	Ficus	sp. B	
Moraceae	Ficus	sp. C	
Moraceae	Ficus	sp. D	
Myristicaceae	Knema	glanca	

Orangutan Food List

Gunung Palung Orangutan Food List -					Sungai Wain Orangutan Food List -			
FAMILY	GENUS	SPECIES	LOCAL NAME	MOST IMPORTANT	FAMILY	GENUS	SPECIES	LOCAL NAME
Thymelaeaceae	Gonystylus				Myristicaceae	Knema	palleus	
Tiliaceae	Grewia				Myristicaceae	Knema	sp.	
Myristicaceae	Gymnacranthera				Myristicaceae	Myristica	maxima	
Sterculiaceae	Heritiera				Myristicaceae	Myristica	venulosa	
Myristicaceae	Horsfieldia				Myrsinaceae	Ardisia	sp.	
Flacourtiaceae	Hydnocarpus				Myrtaceae	Eugenia	sp.	Jambu hutan
Simaroubaceae	Irvingia	malayana		*	Orchidaceae		sp. A	
Myristicaceae	Knema			*	Orchidaceae		sp. B	
Leguminosae	Koompassia				Palmae	Borassodendron	borneensis	Bandang
Leguminosae	Koompassia	excelsa		*	Palmae	Calamus	caesius	
Leguminosae	Koompassia	malacensis		*	Palmae	Calamus	fimbriatus	
Meliaceae	Lansium				Palmae	Calamus	flabellatus	
Chrysobalanaceae	Licania				Palmae	Calamus	javensis	
Fagaceae	Lithocarpus		Kempeting babi	*	Palmae	Calamus	marginatus	
Fagaceae	Lithocarpus				Palmae	Calamus	nigricans	
Lauraceae	Litsea				Palmae	Calamus	ornatus	
Logoniaceae	Logonia				Palmae	Calamus	sarawakensis	
Celastraceae	Lophopetalum				Palmae	Ceratolobus	concolor	
Euphorbiaceae	Macaranga				Palmae	Daemonorops	didymophylla	
Euphorbiaceae	Macaranga	pruinosa			Palmae	Daemonorops	fissa	
Sapotaceae	Madhuca				Palmae	Daemonorops	sabut	
Anacardiaceae	Mangifera			*	Palmae	Korthalsia	echinometra	
Anacardiaceae	Mangifera	foetidum			Palmae	Korthalsia	ferox	
Melastomataceae	Medinilla				Palmae	Korthalsia	furtadoana	
Anacardiaceae	Melanochyla				Palmae	Korthalsia	rigida	
Memecyloideae	Memecylon				Palmae	Licuala	spinosa	Daun biru
Annonaceae	Mezzettia				Palmae	Livingstonia	kingiana	
Annonaceae	Mezzettia	leptopoda			Palmae	Oncosperma	horridum	
Tiliaceae	Microcos				Palmae	Pinanga	sp.	
Tiliaceae	Microcos	hirsuita	Sempel Hidung	*	Palmae	Plectomiopsis	geminaflora	
Annonaceae	Monocarpia				Pandanaceae	Pandanus	sp. A	Pandan
Annonaceae	Monocarpia	marginalis			Pandanaceae	Pandanus	sp. B	Pandan
Myristicaceae	Myristica			*	Passifloraceae	Adenia	sp.	
Bombacaceae	Neesia		Bengang	*	Polygalaceae	Xanthophyllum	affine	

Orangutan Food Lists

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FAMILY	GENUS	SPECIES	LOCAL NAME	MOST IMPORTANT	FAMILY	GENUS	SPECIES	LOCAL NAME
Euphorbiaceae	Neoscortechinia				Polygalaceae	Xanthophyllum	griffithi	
Sapindaceae	Nephelium				Polygalaceae	Xanthophyllum	obscurum	
Sapindaceae	Nephelium	rapaseum			Polygalaceae	Xanthophyllum	sp.	
Lauraceae	Nothaphoebe				Polypodiaceae	Asplenium	nidus	
Annonaceae	Orophea				Rubiaceae	Mussaenda	sp.	
Rubiaceae	Paederia				Rubiaceae	Porterandia	anisophylla	
Sapotaceae	Palaquium	leiocarpum	jungkang	*	Sapindaceae	Dimocarpus	longan	
Sapotaceae	Palaquium	obovatum	Nyatuh Gunung	*	Sapindaceae	Pometia	pinnata	
Pandanaceae	Pandanus			*	Sapotaceae	Madhuca	elmeri	
Moraceae	Parartocarpus			*	Sapotaceae	Madhuca	kingiana	
Chrysobalanaceae	Parinaria				Sapotaceae	Madhuca	pallida	
Anacardiaceae	Parishia				Sapotaceae	Madhuca	sp.	
Leguminosae	Parkia			*	Sapotaceae	Palaquium	sp.	
Leguminosae	Parkia	singularis	Petai hutan	*	Sapotaceae	Payena	lucida	
Anacardiaceae	Pentaspadon				Sapotaceae	Pouteria	sp.	
Icacinaceae	Phytocrene				Simaroubaceae	Eurycoma	longifolia	Pasak bumi
Leguminosae	Pithecellobium				Simaroubaceae	Irvingia	malayana	
Lecythidaceae	Planchonia				Sterculiaceae	Sterculia	rubiginosa	
Urticaceae	Poikilospermum	suaveolens			Sterculiaceae	Sterculia	sp. A	
Annonaceae	Polyalthia	sumatrana	Mempisang	*	Sterculiaceae	Sterculia	sp. B	
Annonaceae	Powpowia				Thymelaeceae	Aquilaria	malaccensis	
Rosaceae	Prunus				Tiliaceae	Pentace (cf.)		
Leguminosae	Pseudosindora				Tilliaceae	Microcos	crassifolia	
Melastomataceae	Pternandra	gibbosa			Tilliaceae	Microcos	sp.	
Fagaceae	Quercus				Tilliaceae	Microcos	tomentosa	
Myrtaceae	Rhodamnia			*	Vitaceae		sp.	
	Rotan		Rotan	*	Zingiberaceae		sp.	Laos
Flacourtiaceae	Ryparosa							
Meliaceae	Sandoricum							
Burseraceae	Santiria							
Sterculiaceae	Scaphium							
Sterculiaceae	Scaphium	macropodum	Semangkok	*				
Burseraceae	Scutinanthe	brunnea						
Dipterocarpaceae	Shorea	gibbosa	Meranti	*				

Orangutan Food Lists

Gunung Palung Orangutan Food List -					Sungai Wain Orangutan Food List -			
FAMILY	GENUS	SPECIES	LOCAL NAME	MOST IMPORTANT	FAMILY	GENUS	SPECIES	LOCAL NAME
Dipterocarpaceae	Shorea	ovalis	Meranti	*				
Dipterocarpaceae	Shorea	parviflora	Meranti	*				
Dipterocarpaceae	Shorea	parvistipulata	Meranti	*				
Leguminosae	Sindora			*				
Celastraceae	Siphonodon							
Elaeocarpus	Sloanea							
Leguminosae	Spatholobus							
Sterculiaceae	Sterculia							
Olacaceae	Strombosia							
Logoniaceae	Strychnos	lucida		*				
Myrtaceae	Syzygium			*				
Apocynaceae	Tabernaemontana							
Theaceae	Ternstroemia	magnificum						
Tetrameristaceae	Tetramerista	glabra	puna/punak	*				
Annonaceae	Uvaria							
Apocynaceae	Willughbeia		Jantak susu	*				
Apocynaceae	Willughbeia	macropodum	Jantak susu	*				
Xanthophyllaceae	Xantthophyllum							
Xanthophyllaceae	Xantthophyllum	obscunim						
Xanthophyllaceae	Xantthophyllum	scotichini						
Sapindaceas	Xerospermum							
Annonaceae	Xylopia							
Rhamnaceae	Ziziphus							

The taxonomy of Orang-utans

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Introduction

The external phenotypic differences between Bornean and Sumatran orang-utans were given by Weitzel et al. (1988), and cranial and other differences were discussed by Groves (1986); further cranial differences were elucidated by Rõhrer-Ertl (1984).

Uchida (1998) has found significant differences between the teeth of Bornean and Sumatran orang-utans, and between those from north and south of the Kapuas River in western Borneo.

The differences between Bornean and Sumatran orang-utans have been brought to a head by the molecular data, which seem to indicate a very long separation time between them, about 1.5 million years (Janczewski et al., 1990; Ryder & Chemnick, 1993). There is a fixed difference in chromosome 2, and apparently fixed differences in several amino acids, and in mtDNA cleavage sites (Ryder & Chemnick, 1993). The mitochondrial control region and NADHI, COII, ATPase 6, ATPase 8 and Cytochrome *b* genes are more different than are Pygmy from Common Chimpanzees (Xu & Arnason, 1996).

What are we to make of these differences?

Species in orang-utan?

Orang-utan from the two islands differ greatly, and there is every indication that some of the differences between them are genetically fixed: that is, they are diagnostically different, as required under the polygenetic Species Concept of Cracraft (1983). Such a concept of species status has to be use in the case of allopatric taxa, where no objective criterion of reproductive isolation can apply; there are good grounds for being consistent and using such a species concept generally.

Sumatrans, relative to Borneans, have a relatively small paracone on both P^3 and M^1; M^1 is larger than M^2 (instead of equal in size); and M_3 is broader. Samples from the two islands are quite separate in canonical analyses based on teeth (Uchida,1998).

Borneans are more stockily built; they have a maroon pelage; the face is more prognathous, and figure-8 shaped, due to un underlying suborbital fossa. Sumatrans are more linear in build; the pelage is often (not invariable) more cinnamon-coloured; the face is more orthognathous, and oval, without underlying suborbital fossae.

The adult male Bornean's cheek pads are large, tend to be forward-curving, and sparsely haired; his laryngeal sac is extensive and sags well down into the chest. The cheek pads of the Sumatran male are flat, and covered with downy hair; the laryngeal sac is smaller, and does not sag down into the chest.

The interorbital pillar is rather prominent in Borneans, flatter in Sumatrans; the foremen

magnum is shrter in Borneans. The radius is longer than the humerus in Borneans, but shorter in Sumatrans.

Many genetics workers, most lately Xu & Arnason (1996), have proposed that the two island taxa should be classified as distinct species, and I agree.

Subspecies within Borneo?

Groves (1986) first raised the question of whether there is geographic variation within Borneo; he noted that the skulls of males from south of the Kapuas are larger than those from north of it, and that limited evidence suggested that those from Sabah are biorbitally narrower. Groves et al. (1992) found some multivariate separation between Bornean samples; after iteratively grouping samples from more restricted regions, they ended up with three grossly (though not absolutely) separable samples: southwest Kalimantan (south of the Kapuas); northwest Kalimantan (north of the Kapuas, presumably extending into western Sarawak); and Sabah.

Uchida (1998) has found that the upper molars average longer in the population south of the Kapuas, the metacone on M^1 is smaller, and other differences. She found that the two Bornean population overlap in an odontometric canonical analysis (unlike the Sumatrans which are quite separate from either).

Recently, Dr Anne Russon has kindly sent me measurements of skulls confiscated in Samarinda, and thought to be from the Kutai region. I entered these into a canonical analysis as unknowns, and they identified themselved with the Sabah group.

There are clearly three subspecies within Borneo. It is well worth keeping them separate in rehabilitation; first, because if possible it is desirable as a general conservation principle to keep gene-pools separate; secondly because the males, at least, differ in size, which presumably has implications for dominance. Basal skull length measurements, in mm., for adult males (i.e. those with fully basilar sutures) are as follows:

Northwest Kalimantan	173.8,	8.91	(15) -	158-188
Southwest Kalimantan	180.4,	7.39	(7) -	170-192
Sabah + Samarinda	167.9,	7.04	(8) -	154-175

Note that the ranges for the largest (SWK) and smallest (Sabah) populations barely even overlap. The females are not as different in size:

Northwest Kalimantan	140.8,	5.31	(69) -	129-155
Southwest Kalimantan	141.0,	9.13	(11) -	130-161
Sabah + Samarinda	134.3,	9.98	(12) -	116-145

(The figures for Sumatran orangs are close in each case to those for Northwest Kalimantan).

I should add that there are proportional differences between the skulls of the three Bornean groups, but these size differences alone should give pause for thought before rehabilitation is attempted.

Nomenclature

Rõhrer-Ertl (1984) argued that the name *Simia satyrus* Linnaeus, 1758, is the prime reference for the orang-utan; in combination with the generic name *Pongo*, this gives *Pongo satyrus*. But Groves & Holthuis (1985) pointed out that this name can never be used, as it was suppressed (because it has been confusingly misused) by the International Commission on Zoological Nomenclature in 1929.

The earliest available name is *Simia pygmaeus*, which appeared in Hoppius's thesis written in 1760, and based on the description of a young orang-utan by Edwards (which was also mentioned in Linnaeus's references under his *Simia satyrus*, though it was not his only reference). As Groves & Holthuis (1985) noted, in those days in Sweden the professor wrote the thesis, and the student had to learn it! Hoppius was a student of Linnaeus; the author of the name *Simia pygmaeus* is therefore not Hoppius but Linnaeus. In combination with the generic name *Pongo*, we get the commonly used *Pongo pygmaeus*. - Linnaeus, incidentally, thought it was probably the "pygmy" of the classical world, which explains why this enormous ape bears the incongruous name *pygmaeus*.

Rõhrer-Ertl (1984) likewise maintained that international relations in the mid-18th century made it more likely that Edwards' orang-utan was from Sumatra, so the names *satyrus* and *pygmaeus* would refer to the Sumatran orang-utan. He called the Bornean orang-utan *borneensis*, citing this name from van Wurmb in the 1780s. Again, Groves & Holthuis (1985) disputed his interpretation of history, and showed that a name *borneensis* does not exist in van Wurmb's writings. It is most unfortunate that Rõhrer-Ertl's misuse of nomenclature has marred his path-breaking work on taxonomy and morphology.

The Bornean orang-utan must be called *Pongo pygmaeus* (Linnaeus, 1760). The name for the Sumatran species is *Pongo abelii* Lesson, 1827.

The three subspecies on Borneo are:

- *Pongo pygmaeus pygmaeus* (Linnaeus, 1760). The Northwest Kalimantan form.
- *P.p.wurmbii* (Tiedemann, 1808). Southwest Kalimantan.
- *P.p.morio* (Owen, 1837). From Sabah and northeast Kalimantan.

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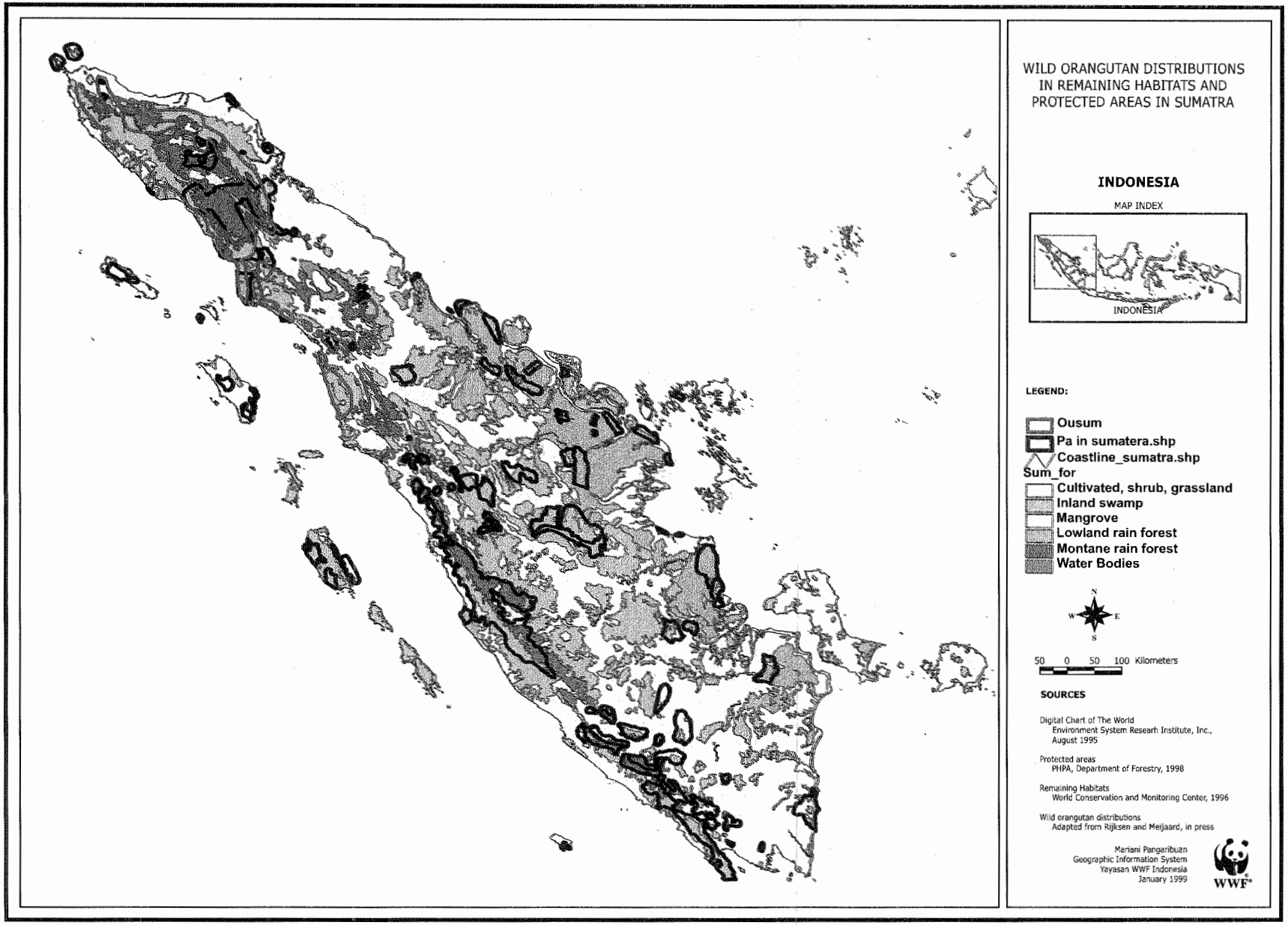
WILD ORANGUTAN DISTRIBUTIONS
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Cultivated, shrub, grassland
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Environment System Research Institute, Inc.,
August 1995
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PHPA, Department of Forestry, 1998
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World Conservation and Monitoring Center, 1996
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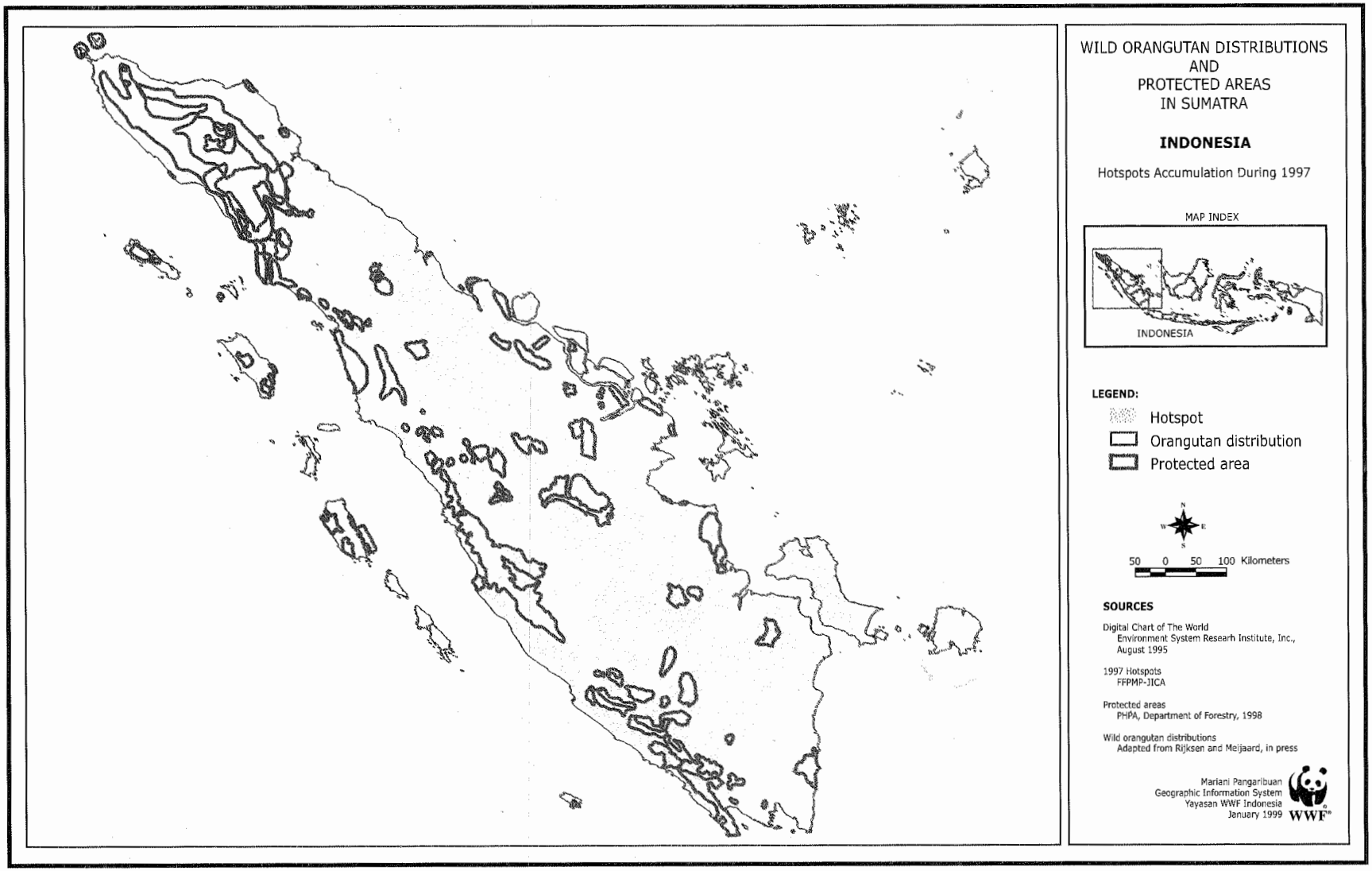

WILD ORANGUTAN DISTRIBUTIONS
AND
PROTECTED AREAS
IN SUMATRA

INDONESIA

Hotspots Accumulation During 1997

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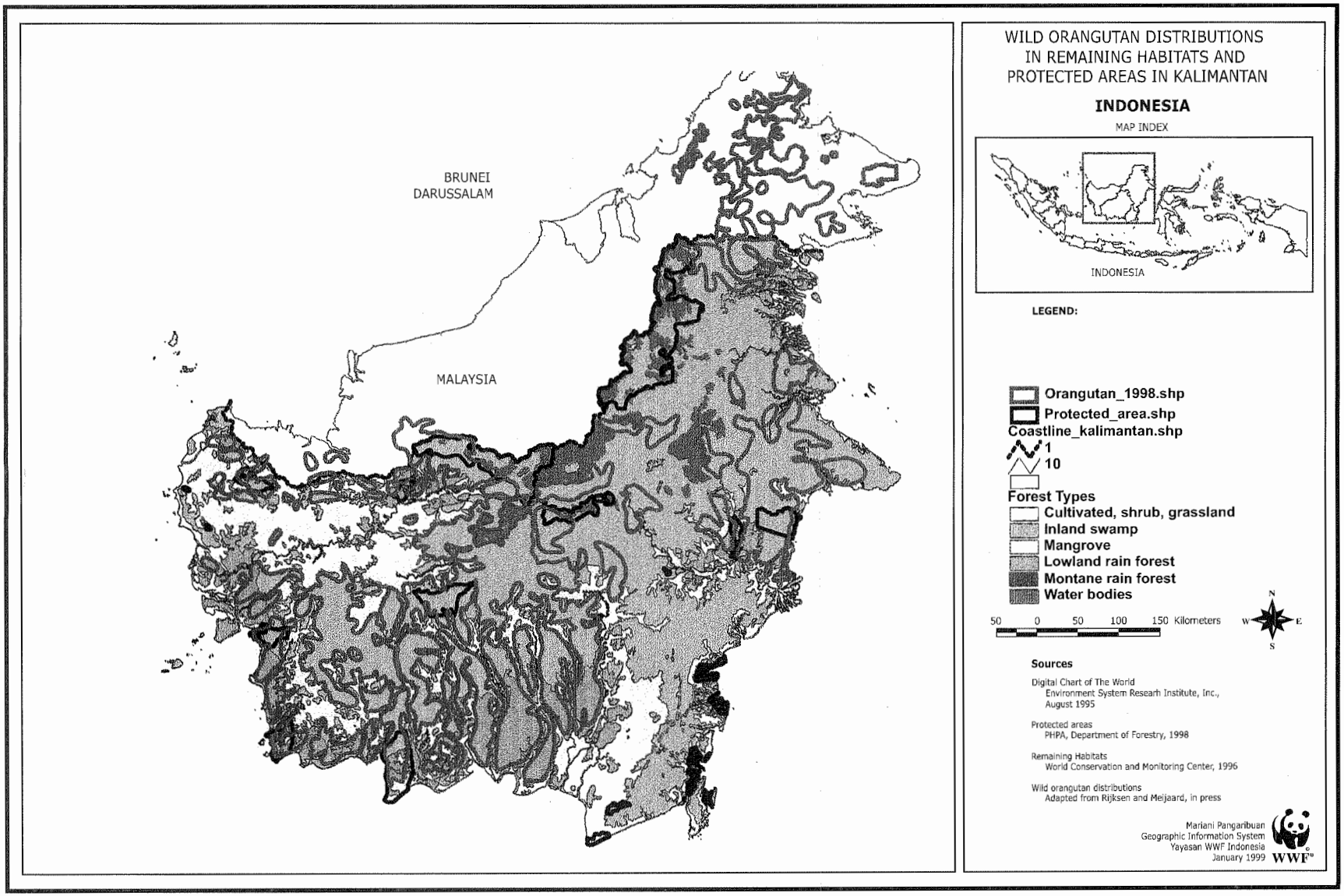
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Lowland rain forest
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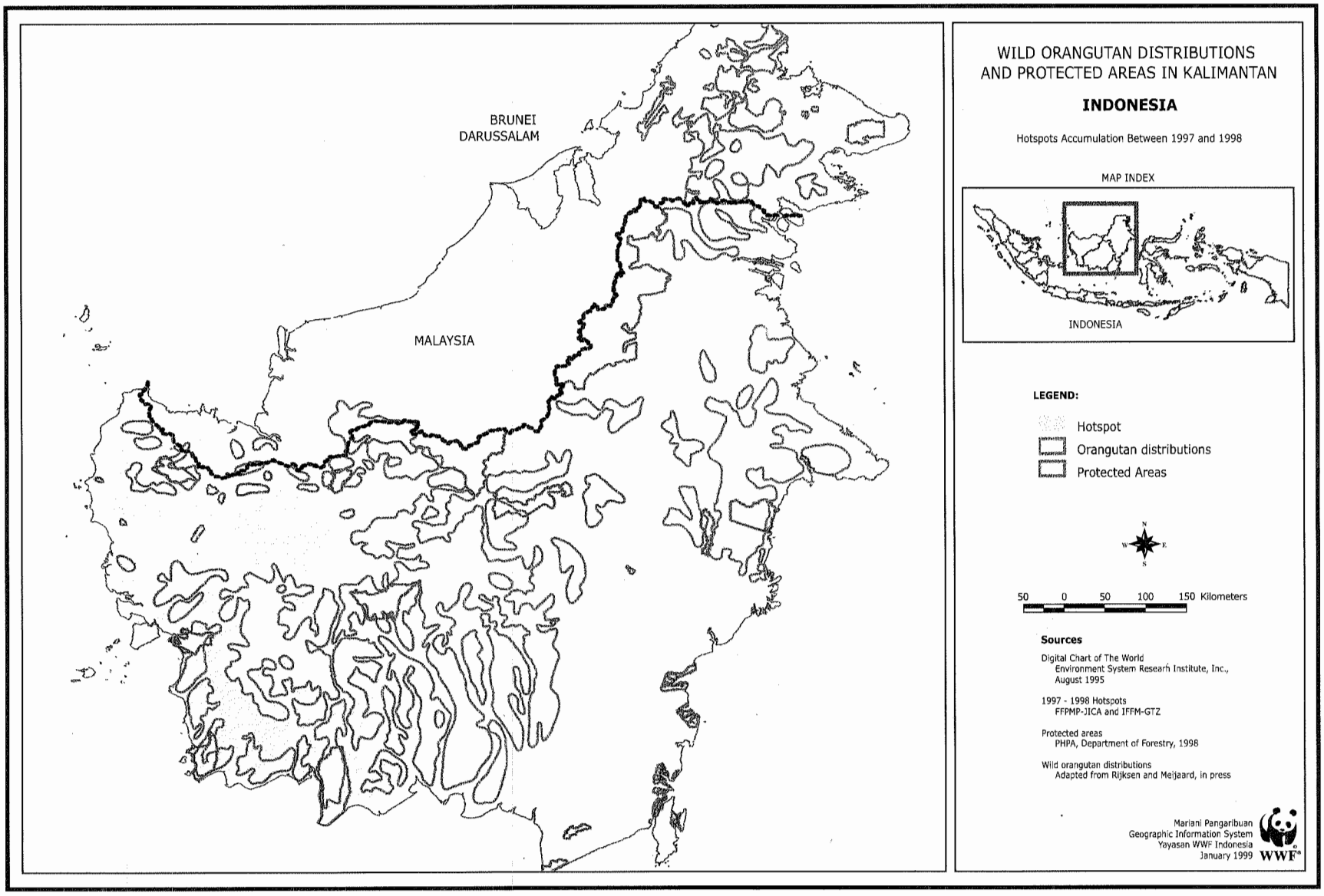
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