

SECURING A FUTURE FOR THE WILD ORANGUTAN

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INTRODUCTION

The orangutan is Asia's only great ape. Although orangutans once used to occur throughout Southeast Asia, they are now found exclusively on Borneo and Sumatra, but on both these islands, their distribution is not continuous. In Sumatra, they are strongly concentrated in the narrow northern tip, whereas in Borneo, the southern and central parts are their main stronghold. Over 90% of wild orangutans live on the territory of Indonesia, the world's fourth most populous nation (Rijksen and Meijaard 1999).

Compared to the wave of studies on other primates, fieldwork on the "Man of the Woods" was off to a slow start, with a few of the early studies coming up empty. However, during the last 30 years, several long-term field studies have been ongoing, all in Indonesia. Three of these are in Borneo: Camp Leakey Tanjung Puting National Park (by Biruté Galdikas), Mentoko in Kutai National Park (by Peter Rodman and John Mitani, and A. Suzuki), and Cabang Panti in Gunung Palung National Park (by Cheryl Knott); and two in Sumatra: Ketambe (Herman Rijksen, Chris Schürmann, Jito Sugardjito, Tatang Mitra Setia and Suci Utami) and Suaq Balimbing (Beth Fox, Ian Singleton and myself), both in the Leuser National Park.

These efforts have uncovered much fascinating new knowledge (for recent reviews see Galdikas and Briggs 1999; van Schaik and van Hooff 1996; Delgado and van Schaik, 2000), but some aspects of the orangutan's life remain as elusive as ever. Reasons for this elusiveness are: (i) orangutans are so long-lived that any social change is very slow; (ii) the dispersed nature of the ape makes it very difficult to identify any social units or even social relationships; and (iii) by now, it is getting increasingly difficult to separate baseline situations from effects of the disturbance affecting the forest nearby.

In this paper, I will try to give an overview of our knowledge of the red ape's life history, ecology and densities, social organization, and cultural variation, and will try to point to gaps in our knowledge. I will then discuss its conservation status, and end with some recommendations as to how we can improve its prospects for survival in the wild.

ORANGUTAN LIFE HISTORY

Orangutans are long-lived, slow-breeding animals (Table 1). In the wild, females become sexually active at an early age, and quite active from about 10 years of age, but generally do not give birth until they are about 15 years old. Infants are carried continuously for about the first year, and occasionally until they are about four years old. Mothers are very gentle and patient with their young, who sleep in their mothers' nest until they are weaned, around mother's next pregnancy. The next offspring is born after some eight years on average (Galdikas and Wood 1990). Even after that, juvenile offspring often associate with their mother. It is estimated that in the wild, females live until they are over 45 years (Leighton et al. 1995).

All this adds up to wild adult female orangutans producing only four or maximally five surviving young over their lifetime, perhaps the lowest reproductive potential of all mammals. This slow

life history means that it takes decades for orangutan populations to build up numbers again after decimation of the population. It also makes them very vulnerable to exploitation. A simulation study showed that even minute increases in adult female mortality rates in the order of 1 to 3%, for instance due to hunting, can drive orangutan populations into extinction (Leighton et al. 1995).

Another peculiarity of orangutan life history is the presence of two kinds of sexually mature males. Fully developed males are over twice the size of adult females, with cheek flanges of fibrous tissue that broaden their face, a big throat pouch, and long cape-like hair on arms and back. They alone give the booming "long call." The inflated throat pouch acts as a resonance chamber, whereas the flanges maybe act as bullhorns. So-called subadult males lack these characteristics. They are smaller than these fully developed males, but they have been sexually mature since they were about the size of primiparous females. There is long-standing speculation that these males can remain "developmentally arrested" in the presence of dominant flanged males. In no other primate is there evidence for such a dramatic developmental arrest.

The adaptive significance of this phenomenon is easily recognized. Adult males can only get a substantial number of matings if they are dominant to the other males in the area (van Schaik, unpubl. data), whereas subadult males can get at least some matings in all conditions (e.g., Fox 1998). A subadult should therefore only mature into the flanged phase if the indications are that he will become locally dominant. The greatest obstacle to testing this speculation is good long-term field data on individually recognized subadult males. This is quite difficult because they cannot easily be marked and tend to roam widely. Recent work from Ketambe by Utami Atmoko (2000) confirms that at least some males may take many years, perhaps as much as 20 years, to mature into the fully developed phase. But the samples are minute, and conclusions are preliminary.

Maggioncalda et al. (1999) have focused on the physiological mechanisms. Most importantly, this work has excluded social stress and nutritional inadequacy as direct causes of the developmental arrest. However, there is ample scope for further work.

ORANGUTAN ECOLOGY: FOOD AND DENSITIES

Orangutans are the largest arboreal mammals, and apart from Bornean adult males, also do most of their travel in trees: a costly life style. This means that they have to eat copious amounts of food. Ideally, that food comes in large packages of easily digested and energy-rich items, such as ripe fruits. This is indeed what we find.

First, orangutans take fruits with sugary or fatty pulp far more than their availability in the habitat, as shown by Djojosedharmo and van Schaik (1992) at Ketambe, and can therefore be said to prefer such fruits. To illustrate this point, by far the most commonly eaten fruit species in the swamp forest of Suaq Balimbing (and at Tanjung Puting: Galdikas 1988) is malaka, *Tetramerista glabra*, a very juicy fruit similar to the better known Kandis, *Garcinia*. Second, detailed work by Leighton (1993) in Borneo has shown that orangutans prefer large crops, patches where they can have a large

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Table 1
Summary of Orangutan Life History Features

	Females	Males
Age at puberty (y)	10+	10+
Age at first birth (y)	ca 15 ?	
Adult body mass (kg)	36	78
Inter-birth interval (y)	ca 8	
Max. life span (wild) (y)	> 45	>45
Max. life span (captivity)	57	58

energy intake in one sitting. In most dryland sites, the rather bland fruits from large strangling fig trees form their staple, because they come in huge crops and are easily harvested and digested. Adult males, especially, may spend days on end in a fig tree. Orangutans complement their fruit staples with smaller amounts of young leaves and shoots, invertebrates, occasionally mineral-rich soil, and sometimes even the odd vertebrate, such as slow loris (Utami et al. 1997).

But what do orangutans do when their favorite food, ripe fruit, is scarce? Simply moving over larger areas in search of fruit is an option that is more easily taken by hornbills or flying foxes than by orangutans, although a few orangutans seem to be doing this. Most, however, respond to fruit scarcity by switching to other sources of food, less rewarding, but still acceptable. Almost all of that food is not supposed to be eaten by orangutans, and therefore protected or hidden. Orangutans overcome these defenses in two ways. The first is brute force, e.g., by destroying a termite nest, or by stripping the bark from trees and lianas to eat the sweet but wafer-thin layer of cambium underneath it. Compared to those of other apes, orangutan teeth and jaws are massive and incredibly strong (Rodman 1988).

A second technique involves skill, the use of complex manipulation techniques, e.g., in order to gain access to the pith of spiny palms and rattans (Russon 1999). Great apes may be most skilled foragers among primates. Tool use is another expression of such skillful behaviors. At my Sumatra swamp site, Suaq Balimbing, the resident orangutans regularly use two kinds of tools in the feeding context (van Schaik et al. 1996): (1) they make stick tools to extricate seeds from the large husks of the *Neesia* fruit, which protects its fatty, and therefore highly nutritious seeds in a mass of stinging hairs; and (2) they also use tools to extract honey from stingless bees, or ants or termites, from treeholes. I will have more to say about this very chimpanzee-like tool use later.

With this knowledge of their diet, we can now turn to their population densities. Usually large animals live at lower densities. And usually, fruit eaters live at lower densities than leaf eaters do. It is therefore not surprising that orangutan densities are usually low, around one per km². In areas where orangutans are not hunted, densities correspond well with fruit productivity, especially with the relative abundance of fruit with fleshy pulp (van Schaik et al. 1995). This relationship explains the variation in densities across the landscape. Fruit productivity is higher in river valleys than on slopes or ridges, and higher in the lowlands than in the mountains. In addition, swamps have high productivity, as well as a high proportion of trees with the right kinds of fruits. Moreover, in general, fruit production is higher in geologically more active Sumatra than in Borneo, which explains the generally higher densities in Sumatra, where animals also generally reach higher altitudes (Rijksen and Meijaard 1999).

Although the mother-infant bond among orangutans is unusually close and long-lasting, social bonds among independent animals gradually weaken with age, until by the time they are fully adult, orangutans in most places have turned into unsociable recluses, traveling and foraging mostly on their own. When several adult orangutans meet, as when attracted to the same major fruit tree, their social intercourse largely consists of throwing a few askance glances from a safe distance. Often, they just pass each other like ships in the night.

Females tend to stay near the range in which they were born, and maintain somewhat friendly relations with other females, probably close relatives, although they still rarely associate with anybody but their immediate kin. Males move away, and either settle in a very large range or are wanderers at one or more stages in their lives. As subadults, they still occasionally travel together, but as adults, they are strict loners. The adult male long calls serve to advertise personal space. Encounters between adult males are avoided but when they occasionally do meet, violently aggressive displays inevitably ensue, sometimes leading to chases and fights on the ground. Adult males will tolerate the smaller subadult males so long as they maintain a respectful distance, if only because the subadult males can flee faster than the adult can chase them.

Even the most solitary of animals still need to find a mate, and in orangutans social behavior among adults largely revolves around mating. Young females become gradually more sexually attractive as they mature, as do adult females as their infants are about to be weaned, or a few months after they have lost an infant. Subadult males try to associate with such potentially receptive females as much as possible, but once they are ready to conceive females seek the company of the dominant adult male in an area. They form a tightly coordinated consort pair, and mate. The adult male tends to keep all but the most daring subadult males from mating with her. The nonpreferred males, either adult or subadult, must therefore resort to forcing matings when they encounter a lone female, often biting her viciously to restrain her, which the female fiercely resists. It is still unclear what benefit the female derives from having such strong and evidently costly mating preferences, although we suspect that it involves some form of protection by the resident dominant adult male (Delgado and van Schaik, 2000).

It is important to note that there is still no sign of communities in which animals share a common range (as in chimpanzees), or even some other kinds of social units in which individual members of both sexes form predictable associations. Orangutan social systems are best described as neighborhoods, where residents know many others, but know them less well as the home range overlap decreases.

The simplified description holds true for the wild orangutan in general, but it does not cover a few exceptions. At the Sumatran sites, Ketambe but especially Suaq Balimbing, orangutans are quite sociable, often forming travel parties (van Schaik 1999). Except nondominant adult males, all classes of animals like being in the company of others. We often see females with infants travel together in what may be called nursery groups. Adolescents often travel together, or join mothers. Consortships are also much longer and often involve larger parties, because several females converge on the same dominant adult male, and because this party attracts subadult males and adolescents. We can see large parties of ten or more independent animals traveling through the swamp for weeks on end.

Comparisons between the descriptions for Borneo and Sumatra suggest that there is a real difference in orangutan socioecology

between the study sites on the two islands (Table 2), beginning with density (higher at the Sumatran sites). As to diet, the Sumatrans are more frugivorous and insectivorous, and are the only ones where meat eating (especially slow loris) is rather common, whereas Borneans show a lot more bark eating. Sumatrans are more sociable, forming travel parties more often; they are also more tolerant, sharing food occasionally; and their sexual behavior is quite different with longer consortships and far fewer forced matings. This latter difference we interpret as a result of the fact that dominant resident adult males can more easily monopolize matings, so other males can approach the females less. Perhaps related to this monopolization potential, there are more adult males for each subadult male at the Bornean sites. This might suggest that Sumatran subadults are more likely to inhibit their maturation into flanged males. Finally, we see a difference in the incidence of population-wide tool use.

It is not clear at this time whether this is truly a difference between the islands and the subspecies or species, or whether the sites that were sampled simply happened to be at extreme ends of the productivity continuum. The main ecological factor here clearly is food abundance. Animals that are better fed have enough energy to engage in social life. This simple fact explains why healthy and well-fed rehabilitant orangutans seem to be so intensely social: the smaller ones play most of their waking hours, whereas the larger ones have bonobo-like interests in sexual behavior. Similar patterns can be seen in zoos. As we shall see, the consequences of this difference in sociability across sites or islands are profound.

CULTURAL VARIATION

So far, I have not said much about the chimpanzee-like feeding tool use. At Suaq Balimbing, all individuals that we have seen feeding on *Neesia* fruits use tools to extract the seeds. In the same vein, all individuals followed long enough used tools to probe into tree holes and extract honey from stingless bees or termites. Yet, at other Sumatran sites, such as Ketambe, nobody shows any of this

tool use. Is that simply due to ecological differences among the sites? That is unlikely. Treeholes are found everywhere, yet orangutans are only known to use these tools at Suaq, and only at Suaq would you see a tool sticking out of a tree hole like this. *Neesia* fruits are found in several study sites, for instance in Gunung Palung in Borneo, yet orangutans are known to use tools to extract the fruits only in and near Suaq.

We took a closer look at the geographic distribution of *Neesia* tool use, because we can find the tools in or near the fruits on the ground at the end of a fruiting season in swamps inhabited by orangutans. This makes it unnecessary to habituate orangutans first, and therefore allows us quickly to establish whether orangutans use *Neesia* tools. In this way, we documented tool use in the three major coastal swamps at Sumatra's northwest coast (van Schaik and Knott, 2001). But, surprisingly, no *Neesia* tool use was found in this smaller swamp across the Alas river. The river is very wide in this section, and clearly impassable by orangutans, so no direct contact between populations on the two sides is possible. The animals east of the river were breaking off, with great effort, the woody valves of the fruit, just as they have been seen to do in Gunung Palung on Borneo.

What these results show is (i) that much tool use has an all-or-nothing distribution in orangutan populations; and (ii) that some very sharp geographic boundaries exist. Only one conclusion is reasonable and fits all the evidence: these tool-using skills are not invented anew by every individual. Instead, they are socially learned—maintained by vertical transmission (from mother to infant), horizontal transmission (among unrelated animals), and diffusion (transmission by new immigrants). This is, of course, exactly the same conclusion as drawn by researchers of local traditions in chimpanzees (Boesch et al. 1994; Whiten et al. 1999).

Perhaps this conclusion is surprising because orangutans are such solitary animals that they are unlikely to pick up many skills, except from their mothers. However, the populations in which tool use is shown are the ones with the highest recorded densities, and the Suaq animals are the most sociable ever observed. Moreover, orangutans are intelligent enough to pick up new skills even after relatively few exposures. In fact, among both orangutans and chimpanzees variation in tool-using skills is linked to variation in the frequency of opportunities for social learning in a foraging context (van Schaik et al. 1999).

Depending on one's definitions, these orangutans show local traditions or culture. Tool use is a good trait in which to study local traditions, because it is so striking and a good candidate for socially learned behaviors. Now that we have this evidence, we should look for other behaviors that may rely for their maintenance on social transmission. Right now, the evidence is still sparse. I know of eat least one set of behaviors, related to nest building. All animals at Suaq, when they are about to finish their nests, add some soft twigs to the top, and make sputtering sounds as they pat these twigs with their knuckles. Interestingly, this behavior is not seen at all at Ketambe: an all or nothing distribution again. Clearly, systematic study of geographic variation in orangutan behavior is very interesting and should be a high priority. This kind of variation provides us with a model system for the conditions in which the culture of our hominid ancestors could begin to flourish beyond the great ape level and become elaborated to its present complexity.

REMAINING CHALLENGES

What emerges from all this work is an orangutan that is more complex, more social and more variable than many had expected. This complexity raises several questions that need to be answered.

Table 2
Inter-Island Differences in Orangutan Socioecology

	Borneo	Sumatra
Density	lower	higher
Diet:		
frugivory	lower ($\leq 60\%$)	higher ($> 60\%$)
insectivory	lower ($< 5\%$)	higher ($> 10\%$)
meat eating	rare	less rare
bark feeding	higher ($> 10\%$)	lower ($\leq 5\%$)
Food sharing (among adults)	absent	present—common
Party sizes	small (mean=1.1)	larger (mean=2.0)
Consortships	short (days)	long (weeks)
Adult/subad. male	higher (> 1)	lower (< 1)
Forced matings	most ($\pm 90\%$)	less ($\pm 45\%$)
Routine tool use for feeding	absent	present (high density swamps)

1. We noted an unexpectedly large difference between Bornean and Sumatran orangutan social organization in the wild (see Delgado and van Schaik, in press, for further details). Is this simply a reflection of site differences, or does it reflect due a systematic difference between the two orangutan taxa. In other words, are Sumatran orangutans intrinsically more sociable than Bornean ones?
2. The extent of developmental arrest or delay needs to be examined more in both field and zoo settings. The question needs to be addressed whether Sumatran males are perhaps more susceptible to the inhibitory presence of flanged males (cf. Table 1).
3. There is an urgent need to map local traditions as much as possible before it is too late to do so. This is a task similar to the ethnography of cultural anthropology.
4. We do not understand the functional basis for the evidently costly female mating preferences, favoring certain males while resisting others. The most likely explanation involves some form of protection by the dominant resident flanged male, but what the protection is against is not entirely clear (see Delgado and van Schaik, 2000, for discussion).

Zoos can play a major role in solving the first two of these questions, but study of wild orangutans is important or even essential for all of them. Is there enough time to accomplish these tasks before wild populations are gone? To assess this, we must turn to conservation issues.

ORANGUTAN TRENDS

A critical question for conservation is: how many wild orangutans are there, and are their numbers stable or declining? Before we can answer this question, we must know more about how orangutans respond to habitat disturbance. It is obvious that orangutans do not live outside forests, so forest clearing reduces their density to zero. However, orangutans are also highly sensitive to selective logging, the predominant mode of forest exploitation. The various studies all agree that selective logging reduces orangutan density to between 30% and 50% of pre-logging densities (for review see Rijksen and Meijaard 1999). In some areas, human hunting is stepped up, compounding the effects of logging. Indeed, hunting has led to local extinction in quite a few areas.

In light of the high rate of forest degradation, of deforestation, and most recently, of forest fires, in the region, we must not expect a very rosy story. This expectation is confirmed by two recent quantitative studies. One is a large-scale survey of the whole range, undertaken by Herman Rijksen and Erik Meijaard, and recently published in their book *Our Vanishing Relative* (1999). The second is a finer-grained study of changes in northern Sumatra's Leuser Ecosystem (van Schaik et al. 2001).

Rijksen and Meijaard used satellite imagery and GIS to recognize 61 forest blocks in Borneo and 23 in Sumatra in which the presence of orangutans was known or strongly suspected. For each of these blocks, they estimated the overall area, the percentage of area of suitable habitat, the geographic distribution of hunting pressure, and thus the estimated population size (assuming equilibrium density). Because it covers the whole range, this approach is necessarily somewhat crude, but it is extremely valuable in that it has given us the first complete coverage, and first detailed estimates of the whole range. The results are not very reassuring (Table 3a). Rijksen and Meijaard estimate that in 1996, some 35,000 orangutans were left in the wild, or ca 11% of the number thought to be present

around 1900. The devastating forest fires in Borneo during 1997 caused the further loss of another estimated 8,000 animals. Note that this estimate is already out of date, because (1) it does not include the losses incurred in eastern Borneo due to the continuing fires in early 1998, and (2) it does not incorporate the effects of the wave of illegal logging in all accessible forests on both islands that began in 1998. Thus, at the dawn of this new millennium, we are left with well below 10% of the number of wild orangutans there were exactly one century ago.

The bad news does not end there. These orangutans are distributed over many separate populations. Orangutans are very poor dispersers, reluctant to cross open land, and are therefore among the forest denizens most vulnerable to fragmentation. Accordingly, Rijksen and Meijaard estimate that all but one of the separate populations are "vulnerable" or worse ("in danger" or "critical").

The second, more detailed survey is for the one population thought to be the least vulnerable, and easily the largest. This is the population, or rather populations, inhabiting the Leuser Ecosystem in northern Sumatra, where both Ketambe and Suaq Balimbing are located (van Schaik et al., 2001). The Leuser Ecosystem was established in 1995, and expanded in 1998, and contains the Gunung Leuser National Park, as well as much other state forestland allocated to protection forest and permanent production forests subject to legal selective logging. It covers ca 25,000 km², and contains over 75% of the distribution area north of Lake Toba, where all the significant Sumatran orangutan populations are located. It probably contains an even greater proportion of the actual numbers because the high densities reached in parts of Leuser are not found anywhere else. A healthy population in Leuser is therefore vital for the survival in the wild of the Sumatran subspecies.

Based on an interpreted satellite image taken at the start of 1993, and habitat-specific densities, in what was going to be the Leuser Ecosystem, we first estimated the baseline number: ca. 12,000 individuals at the start of 1993 (Table 3b). The next step was to assess the losses, based on detailed field visits all through this vast area, satellite images, and photo mosaics based on overflights with a fixed wing airplane. These activities were supported by the Leuser Development Program, a collaborative European Union-Government of Indonesia program. Habitat loss is the main source of decline in this region, with hunting and capture being minor and secondary problems.

Three sources of habitat loss were: (1) conversion of swamp forest, largely for plantation agriculture, and in smaller part for transmigration areas; these swamps are the most suitable orangutan habitats with the highest densities; (2) losses in the logging concessions, which are partly due to selective logging and thus habitat degradation, partly due to conversion toward plantation agriculture and encroachment by local farmers; and (3) losses due to illegal logging and encroachment into the National Park, especially in the orangutan-rich upper Alas valley (but also in many other places, where we did not estimate the losses—so this is a gross underestimate). It should be stressed that part of this loss was due to legal activities, but that much of it was the result of activities that were illegal or of questionable legality (cf. Robertson and van Schaik 2001). If the numbers are added up, it turns out that in some 6 and a half years, the Leuser Ecosystem lost about 46 % of its orangutans, or about half in seven years. These losses accelerated during the past several years, for various reasons, but especially due to the dramatic increase in illegal logging and conversion, suggesting a precipitous decline. I should stress that these numbers, like those of Rijksen and Meijaard, are already out of date, and that over the past year, the destructive processes have shown little sign of slowing down.

Table 3
Trends in Orangutan Numbers
(A) Throughout the Geographic Range, and
(B) in the Leuser Ecosystem

(A) Estimated reduction in orangutan numbers in Borneo and Sumatra during the twentieth century (after Rijksen and Meijaard 1999).

Year	Borneo	Sumatra	Total	Lost Since 1900
1900	230,000	85,000	315,000	0
1996	23,000	12,000	35,000	89%
after 1997 fires	15,000	12,000	27,000	91%

(B) Estimated decline in orangutan numbers inside the Leuser Ecosystem between early 1993 and mid-1999 (after van Schaik et al., 2001).

Baseline (early 1993)	12,000
Losses	
coastal swamps	2,850
nonswamp logging concessions	2,500
National Park	>>200
Left (around mid-1999)	<6,500 (ca 54%)

So, whether we rely on the broad survey by Rijksen and Meijaard, or on the detailed study in Leuser, the conclusion is the same: the wild orangutan is in rapid decline, and the current trend, if not broken somehow, inexorably points to extinction in the wild within one or two decades, even in the best population in Leuser. The reason for alarm is not simply that the populations are in decline—they have been in decline for a long time—but that no place is safe any more: logging concession are converted, even though they are supposed to be permanent production and protection forests, national parks everywhere are invaded and logged with impunity by organized logging gangs.

Some may feel I am overly alarmist. After all, there are plenty of orangutans in zoos and in rehabilitation centers to repopulate the forests. However, the current wave of logging and clearcutting will reduce the available acreage of suitable forest for decades to come. Moreover, we are not only strongly reducing the genetic variation of the species by letting it go extinct in so many places, but also, and probably very seriously, we are about to lose all the cultural variation as well. Local cultures may get lost as a result of local extinction of the orangutans, but also, more insidiously, may erode to the point of disappearance, due to several processes that do not drive the local population extinct, but do remove the very basis for the maintenance of culture: the social transmission (van Schaik, in review: Fig. 1). Hunting makes animals cryptic and avoid company; logging reduces carrying capacity and so makes it too costly for animals to be in the company of others; fragmentation reduces the influx of skilled individuals, who can bring in new skills into a local community (diffusion). In other words, culture is incredibly fragile to

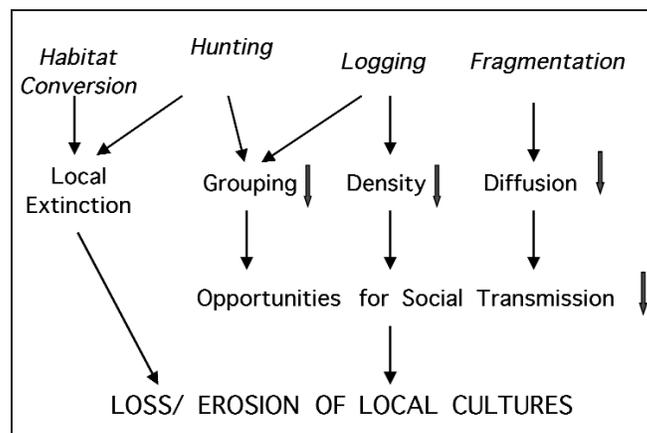


Figure 1. Overview of the various ways human disturbance can impact local traditions or cultures in orangutans (or other great apes).

breaking the chain of transmission. I cannot prove this, but I suspect that insults to orangutan populations in the past, especially due to hunting, may have already snuffed out a substantial amount of the cultural variation in the remaining wild orangutans, sending them back to the great ape equivalent of the dark ages.

CAN WE SAVE THE WILD ORANGUTAN?

What can be done to stop this rapid slide into extinction? The solution is quite simple. Orangutans need forests that are not over-exploited or clear-cut and converted to some other land use. All that is needed is respect for the existing laws and regulations and adherence to the existing official land use plans. Thus, the first item of business is to squelch the illegal logging. During the past years of anarchy, the illegal logging sector has become even bigger than the official logging. However, an additional step is also needed because of the massive and uncontrolled losses in the recent past: *a moratorium on all logging in old-growth forests* until there has been a re-assessment of the forest situation.

It will not be easy to implement this simple solution. Certain powerful players have benefited from exploiting the forests and converting them to plantations. Obviously, the country as a whole has not benefited from this, due to ecologically inadequate siting of these plantations, lack of revenues from logging, and serious long-term damage to the ecological infrastructure (the ability of forested areas to provide ecological services to the surrounding regions). These players are still very powerful at a time of political transition to a more stable and civil society. However, for the first time in decades, there are reasons for optimism. First, there are encouraging signs that there is a genuine political commitment on the part of the new government to deal with the conservation crisis. Second, there is a receptive audience for environmental messages: a free press, and many new and idealistic NGOs. And finally, we see that some legal NGOs have started to take alleged perpetrators to court, which should have a discouraging effect on the remaining illegal loggers and converters.

Effective orangutan conservation requires protected areas, simply because the red apes only thrive in unexploited old-growth forests. To stop the destruction and degradation of protected areas, we need a renewed emphasis on park protection. At the same time, once government-level support for parks is secured, we need more external support for the management of these parks, since Indonesia is economically in a difficult position to allocate enough money to conservation.

This is all high-level action, involving governments, intergovernmental organizations and large international NGOs. Fortunately, things are moving in the right direction, if at glacial pace. However, there is also an opportunity for more modest initiatives that are within the reach of organizations and individuals represented at this conference.

First, the data we have are all generated by small private organizations, many based in zoos, such as the Wildlife Conservation Society (which makes my own work possible). Survey, census, and monitoring are critical activities that are only marginally supported by the large government-level or inter-governmental institutions, and the smaller private foundations play a critical role in this endeavor. Without the data generated by these projects, there is no public concern, and hence no action! Hence, these foundations should continue to support this valuable work, and if possible, even expand it.

There is also another set of activities within the capability of zoos, foundations and private individuals, which is called the Orangutan Network. The Orangutan Network has two aims: (i) to improve the protection of orangutan habitat, and (ii) to stimulate the study of orangutan cultures.

The Orangutan Network

Establishing parks is a necessary first step but it is not enough. Parks also need supporters. As shown by several primatologists, a combination of nationals and foreigners, with sufficient resources and a long-term commitment to a local area, can be very effective conservation agents. Primatologists have been in the forefront of such activities, because the long-term nature of their studies means they establish a true local presence and a local network of contacts. Orangutan studies are no exception; indeed, the areas surrounding the research stations tend to be the only intact patches of forest left. Thus, if we can multiply these examples, we can achieve cost-effective conservation.

How will these projects achieve conservation? First, the researchers can act as eyes and ears, report infringements, support the enforcers, and create public support for the park. Second, they can train new conservationists. Conservation is part rational and part emotional. Often the rational arguments are internalized only after an emotional connection with nature has been established. We should act on that knowledge, and give as many future leaders as possible an opportunity to learn to love nature. In the experience of many tropical field biologists, the best way to turn an initially indifferent person into an ardent conservationist is to give him or her the privilege to follow habituated wild primates, ideally great apes. People cannot but be awed by the intelligence and impressive behavior of these beasts in the forest—a forest that almost always seemed so foreign and even hostile to most people—and after sufficient exposure most will come to see these animals as worthy of protection.

Finally, just like other great apes, orangutans are the perfect subjects for carefully designed ecotourism efforts. Most of us who study wild orangutans still remember the magic moment of our first encounter; and we who follow these creatures day in day out get tired but not bored because every day something unusual and unexpected will happen that enhances our insight into these magnificent animals. If that is true for us, it must be true for others as well. After a positive forest experience, the ecotourist should come away with renewed respect for orangutans, and a determination not to let them go extinct. Although I am well aware of the negative sides of ecotourism, they pale into insignificance compared to the threats that

are now faced by the wild orangutans. Obviously, if it is organized right, the ecotourism can generate strong and lasting local support for protection of orangutan habitat as well.

The second objective is a scientific one. The proper documentation of geographic variation, including the existence of socially transmitted traditions, requires systematic descriptions of behaviors across a range of sites. Likewise, testing hypotheses to explain the geographic variation in the incidence of particular skills or repertoire size requires careful studies at long-term study sites with habituated animals. Better appreciation of the extent of these traditions will also lead to a greater respect accorded to great apes, due to their similarity to human culture.

These aims can be reached by establishing a network of field sites where one or more scientists and local university staff and students, along with international volunteers and students, collect systematic data on the local orangutans or run an effective reintroduction program, and form an active lobbying organization to protect the study areas and their surroundings.

SUMMARY

Orangutans are fascinating creatures, showing geographic remarkable variation in socioecology and in local traditions. Their numbers are in dramatic decline. Urgent conservation action is needed, at two levels. It is my hope that these measures help to avert what might otherwise be inevitable: the extinction of the orangutans in the wild. We just cannot let that happen.

At the high level, support the Indonesian government in the following measures:

- Stop illegal logging
- Impose a moratorium on all logging in old-growth forest, legal or illegal.
- Strengthen the government's commitment and capacity to protect its parks (and provide the long-term foreign assistance to achieve this)

At the smaller scale, foundations and individuals can:

- Continue to support census and monitoring programs
- Continue efforts toward rehabilitation and reintroduction
- Support the Orangutan Network

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