

CRITICAL ENDANGERED PRIMATES AS FLAGSHIP SPECIES TO REDUCE DEFORESTATION: LESSON LEARNED FROM CONSERVING ORANGUTAN IN NORTH SUMATRA, INDONESIA

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Introduction

Sumatra is the fifth largest island in the world with 1,800 kilometers long and 400 kilometers wide. As little as four decades ago, the island of Sumatra was almost completely covered by tropical forests. The island contains an extraordinary wealth of natural resources and habitat diversity includes 14 primate species with 8 endemics. Some has been categorized as critical endangered, Sumatran orangutan, and 6 more species are endangered includes 4 species distributed in the small island of Mentawai (Supriatna 2001).

Historically, the Sumatran orangutan was distributed over the entire island of Sumatra, but its range has now been restricted to the Northern part of the island, and it has now been confirmed that orang-utans inhabit the majority of the areas south of Lake Toba where they were previously thought not to exist. It is estimated that Sumatra has about 7.500 orangutans, distributed over 21 forest blocks. Of these, only three forest blocks contain over 1.000 orangutans, and are found in the Leuser Ecosystem, one of the largest tracts of forest in the volatile northern part of the island. There are 13 identified orang-utan populations on the island, of which probably only 3 contain more than 500 individuals, with 7 estimated to contain 250 or more individuals. Six of the seven are believed to be losing 10-15% of their habitat each year to logging, and it is expected that these populations will rapidly decline. Where populations are smaller, such as in West Batang Toru, and the estimated rate of habitat loss is relatively low (2% annually), numbers may persist longer than other populations if current conditions do not change (WWF, 2007). But, a recent study shows that orang-utan in Batang Toru forest block is potentially under serious threats (Sitaparasti 2007, Perbatakusuma, et al 2006; Perbatakusuma, et al, 2007, Perbatakusuma, et al, 2008).

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The Sumatran orang-utan (*Pongo abelii*) is listed as critically endangered by the 2004 IUCN Red List of Threatened Species. The orang-utan is very vulnerable to extinction, due to large-scale habitat destruction and hunting for the pet trade (Rijksen and Meijaard, 1999), and also a long mean inter-birth interval (Galdikas and Wood, 1990). In fact, the orang-utan lives at fairly low densities (0-7 individuals/km² in Sumatera (van Schaik et al., 1995), and requires large home ranges that represent large forest blocks (Singleton and van Schaik, 2001); they are mainly restricted to lowland forest areas (Rijksen and Meijaard, 1999). PHVA results in 2004 estimated that there are 7.501 remaining orangutans in Sumatra, indicating that they are at immediate risk of extinction.

The habitat of Sumatran orangutan has been decreased rapidly due to habitat conversion to commercial and subsistence agriculture, logging, open pit mining, forest fires, infrastructure development, local encroachment and many others. Sumatran forests are considered to be at the highest rate of conversion in the world (Collins et al., 1990), causing the loss of orangutan's habitat. Surveys on density estimation and ecological factors are needed to identify suitable habitat for orangutan (van Schaik et al., 1995). Tree availability, as sources of food and nesting sites for orangutan, has become the most influential factor on the density of orangutan (van Schaik et al., 2001; Ancrenaz et al., 2004). In 2005 researchers predicted that all undisturbed lowland forests of Sumatera will have vanished (Jepson et al., 2001). Forest degradation rate has reached 20% of the total forest area in Sumatra each year (Rijksen and Meijaard, 1999). The Sumatran orangutan is very sensitive to disturbance caused by logging and hunting activities. As a result, the orangutan will have little chance to survive in fragmented or converted forests.

Threat of extinction of orangutan in the north Sumatra forest can be reduced by efforts to conserve the remaining habitat and population. Long-term and continuous research as well as population monitoring, are needed to develop more thorough knowledge that is crucial in developing measures for orangutan and habitat conservation. Building forest corridors that connect fragmented habitat will also enlarge the orangutan home range in search for food. Community participation in the conservation of orangutan and its habitat will eventually become important in developing comprehensive efforts for orangutan conservation. In the end this new population will have a chance to live longer and to survive. In order to reverse further deforestation in Sumatra, we have used a multi-layer approach which is basically combined methods of socio-economic and conservation biology techniques. These techniques include: investigate biodiversity sensitive land-use planning, develop sustainable economic alternatives, develop or revise conservation strategy in the provinces and districts, stakeholders mapping, tenure and access rights, and reviews on policy and regulations on wildlife at local governments.

Conservation strategies included improved protection of orangutan habitat and support communities and partners to develop sustainable economic alternatives in Batang Toru.

The outcome of this approach is the inclusion of orangutans and other wildlife into the local government decision making processes toward better management of natural resources. Two pilot project have been developed in the area of Mentawai and Northern Sumatra. The aim is to assess the appropriateness of different approaches in developing conservation programs at the local situation. This pilot is expected to be cost-effectively, but it should be scaled up for larger landscape unit and provide leverage and demonstration program policy in the future. The strategy to conserve this flagship species, orangutan, and their habitat has in some instance placed very well in the strategic planning at local governments but sometimes hampered by political and financial supports by donors and stakeholders.

1. Current orangutan habitat and population in the North Sumatra: Batang Toru Forest

1.1. State of the orangutan habitat

The Batang Toru Forest consisted two forest block is called West and East Batang Toru or Sarulla Forest Range. The Batang Toru Forest is located in North Sumatra Province south of the second world largest lake of Lake Toba. Roads separate West Batang from the East Sarulla area, in which orangutans also are found. Geographically, the Batang Toru Forest is located at $98^{\circ} 50' - 99^{\circ}18'$ East Longitude and $1^{\circ} 26' - 1^{\circ} 56'$ North Latitude. This landscape are predicted to have suitable habitat for orangutans in the southern part population of North Sumatra Province (Rijksen and Meijaard, 1999 ; Wich et al., 2003 ; Djojoasmoro et al., 2004).

Orangutan habitat in Batang Toru Forest is also important water catchments area that encompasses four regencies: North Tapanuli, Central Tapanuli, Sibolga and South Tapanuli. Primary rain forest dominates the vegetation cover, which grows on steep hillsides with more than a 60-degree slope and mountainous area with highest peat at Mt. Lubuk Raya (1.856 meter above sea level). The region is mountainous and the results of historic volcanic activity called Toba Super Volcano and the formation of geology is Volcanic Toba Tuff as the dominant geology rock type. Soil type is dominated by Podsollic Red-Yellow and Aluvial (Perbatakusuma, et al, 2008)

The Batang Toru Forest Block holds at least six principal habitat types including moss forest (above 600 meter), hill side moist forest (dominant between 200 m -600 m), lowland, cliffs and talus slopes, secondary forest, and riparian forest. Forest landscape of Batang Toru has 234,399 ha which included four districts Tapanuli Utara (North Tapanuli), Sibolga, Tapanuli Tengah (Middle Tapanuli), and Tapanuli Selatan (South Tapanuli). Based on satellite imagery

classification that was analyzed by Conservation International Indonesia, primary forest cover in 2000 was 148.000 ha with infrastructure undeveloped in frontier areas. The area includes of mix of official forest status and land use classifications such as nature reserve, protection forest and production forest. The forest area is covered by five big watershed: Batang Toru with 92.121 ha wide, Aek Kolang 42.663 ha, Watershed Bila, Barumon, and Batang Gadis (Perbatakusuma, et al, 2008)

This various habitat type in Batang Toru Forest is a suitable habitat for many endangered wildlife species since it provides food/prey resources, nest sites, forest space for seasonal and arboreal and terrestrial movement and protection from predator. The forest areas within Batang Toru Forest also have a high scientific value and are important to be protected, because it is thought to be a biogeography transition area between the convergence point of southern and northern Toba Lake biogeographic assemblages, where distributions of species such as orangutan, mitered leaf-monkeys (*Presbytis melalophos*), Malayan tapir (*Tapirus indicus*), Sumatran serow (*Capricornis sumatraensis sumatraensis*) and *Rafflesia gadutensis* overlap. This situation is of course thought to have big consequences for the value and uniqueness of its biodiversity. The Batang Toru Forest Block will provide effective management for an area of a globally biodiversity significance, and was defined one of the remaining a Key Biodiversity Area in Sumatra Island based on the CI's Conservation Outcomes Definition Process. (Perbatakusuma, et al, 2007).

Recent survey by Conservation International in 2006 and other institution revealed that the Batang Toru and adjacent areas are home to a rich variety of the Sumatran species, particularly mammals, birds and plants, which are globally threatened. Sixty-seven species of mammals, two hundred eighty-seven of birds and one hundred ten of herpetofauna have been recorded in the area. Of this total number of mammals species, twenty species are protected under Indonesian law and twelve are globally threatened. Among these are Sumatran Orangutan (*Pongo abelli*), Sumatran tiger (*Panthera tigris sumatrae*), serow (*Capricornis sumatrensis*), Malayan tapir (*Tapirus indicus*), Malayan sun bear (*Helarctos malayanus*), slow loris (*Nycticebus coucang*), Golden Cat (*Pardofelis marmorata*). The survey also discovered rich avifauna diversity in the region, including rare as well as threatened species. Of this total number of bird species fifty-one species are protected under Indonesian law and sixty-one are globally threatened, such as Sunda Blue Flycatcher (*Cyornis caerulatus*), Wallace's Hawk-eagle (*Spizaetus nanus*), Blackcrowned (*Pitta venusta*). Initial data from the Batang Toru suggest that it holds some of the highest levels of vascular plant biodiversity, with 688 different species. Of this total number of plant species, 138 species of orangutan food resources, 8 species globally

threatened, including *Nepenthes sumatrana* (Miq.), the largest flower in the world *Rafflesia gadutensis* Meijer,Becc and the tallest flower in world *Amorphophalus baccari* and *Amorphophalus gigas* (Perbatakusuma, et al, 2008).

The results of the vegetation study on inventory of trees with DBH 10 cm and greater in primary forest in Aek Silemes and Aek Game-game areas showed, that Batang Toru Forest Block is rich in plant biodiversity with 332 plant species in 161 genus and 70 families. A total number of tree species is relatively higher compared to other natural forests in and outside Sumatra. The Batang Toru forest is richer in tree species than other natural forests in North Sumatra and outside Sumatra, but poorer than those in Borneo and the Malay Peninsula. the tree density is higher than that in Ketambe and Batang Gadis National Park, Tesso Nilo National Park and Rimbo Panti Nature Reserve (Sumatra), Bukit Lagong and Sungai Menyala (the Malay Peninsula), and Ladan and Belalong (Brunei), but lower than those in Malinau and Sebulu (East Kalimantan), Gunung Mulu (Sarawak) and Andulau (Brunei). The study reveals that each tree species in Batang Toru Forest has low tree density per-species, only 1-10 individual per-hectare and non cluster distribution ($\leq 20\%$). The ecological consequence is that Batang Toru forest is highly susceptible to wildlife species losses due to selective timber exploitation and forest conversion to various economic purposes. (Perbatakusuma, et al, 2006, 2008)

Orangutan landscape in Batang Toru Forest also contributes to mitigation climate change. Based CI's research on the ground survey, the sum of biomass in trees (DBH ≥ 2 cm), ground vegetation, and necromass, revealed the averages of carbon content from secondary forest as 77.72 ton C/ha. This is equivalent to 280,2 CO₂ ton per-hectare. Primary forest in Batang Toru obtains 305,73 ton C per-hectare, equivalent to 101,3 ton CO₂ per-hectares. According to the imagery classification process, Batang Toru area has secondary forest 20,747.26 hectares. This means that Batang Toru Forest Block has stored 1,612,477 ton Carbon or 5,813,382 tons equivalent CO₂. The imagery process also determined that Batang Toru area has 135,476.090 hectares in primary forest, creating a carbon content in primary forest in the Batang Toru Forest of 4,149,105 ton Carbon and or 137,006,970 ton equivalent CO₂. Assuming that average deforestation in Batang Toru Forest from 1990-2007 totaled about 142 ha per year. Assuming that the driving factors of deforestation are linear and no conservation incentives occur to avoid deforestation, the Batang Toru Forest area will lose an estimated 700 - 1600 hectares of forest cover by 2015. This is equivalent with 707,910–1,618,080 ton CO₂ and will contribute significantly to increasing global climate change (Perbatakusuma, et al 2008).

3. Orangutan population and habitat conservation effort

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There are two conservation strategies was implemented to conserving orangutan population in Batang Toru Forest Block. E.g catalyze improved protection of orangutan habitat and support communities and partners to develop sustainable economic alternatives in Batang Toru. Here described orangutan conservation effort according to the strategies as follows

3.1. Catalyze improved protection of orangutan habitat

Two key elements in managing wildlife populations are: (1) having accurate information on species distribution and habitat requirements and (2) having support for and capacity within local stakeholders to use this information to formulate and apply appropriate conservation interventions. All of the activities are designed to promote capacity building of local partners by sharing data and engaging in participatory process that allow for 'learning by doing'. The following are the activities implemented to map orangutan distribution and habitat and to formulate a strategy to improve orangutan population and its habitat protection.

3.1.1. Orangutan Population and Distribution

Rijksen and Meijaard (1999) concluded that orangutans may still occur further to the south on Sumatra than previously assumed (Wilson and Wilson, 1973; Rijksen, 1978). We now know that there is a southern population in West Batang Toru, in the Sibolga – Tarutung – Padangsidempuan area of Northern Sumatra, and it has been suggested that this population may be genetically distinct from its northern relatives (Wich and Geurts, 2001).

Orangutan density varies with elevation and habitat availability (Delgado and van Schaik, 2000). According to Buij et al. (2002), even though there is forest clearance in Sumatra, there are still some areas assumed to be suitable for orangutan habitat in the future. Forests of Batang Toru, especially the lowland and mixed forests, have been highly fragmented due to logging, road opening, and land-use change for agriculture. Because of this, the density of orangutans in Batang Toru Watershed tends to increase in line with increase in elevation. With decreasing number of fruit trees and other sources of food in lowland forest, the orangutan will move to higher elevations in search of suitable habitat and sources of food.

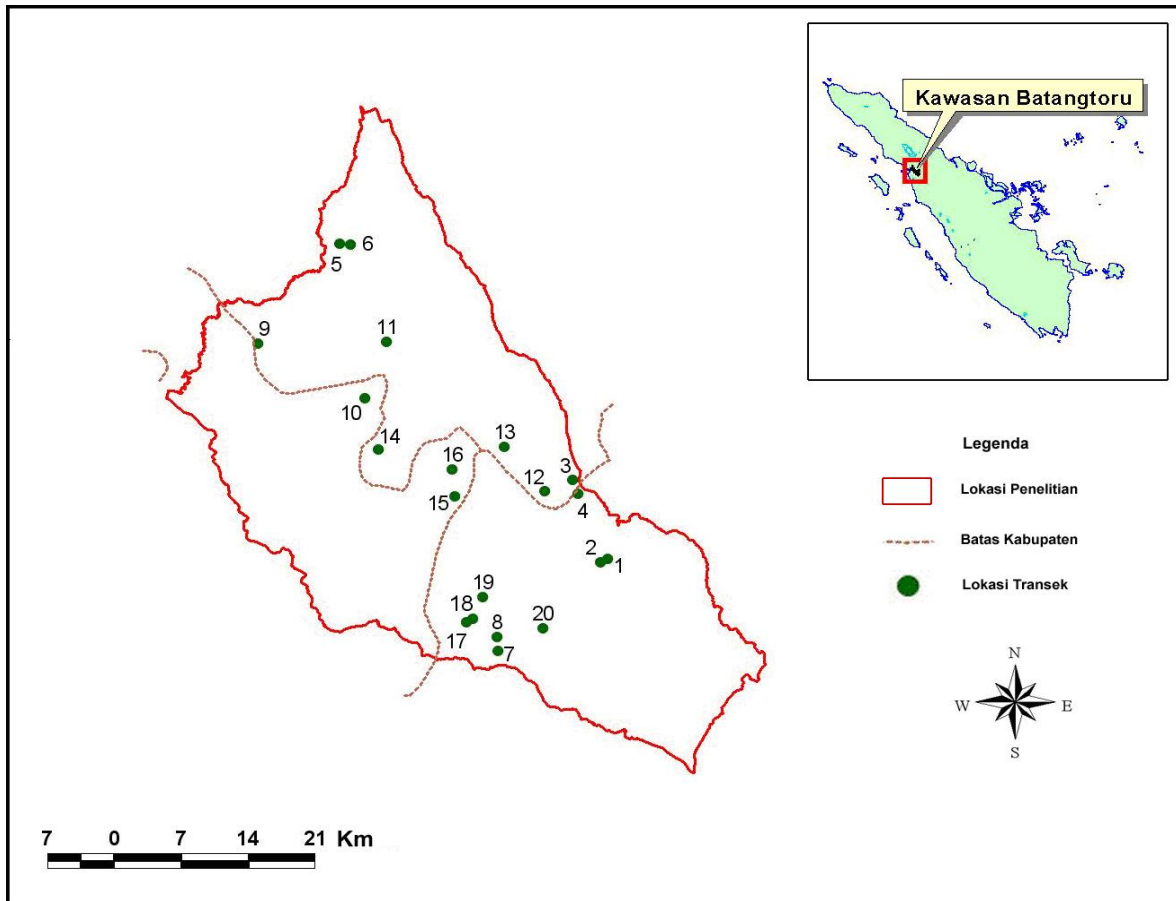
Identifying species population and distribution is a very useful way to establish the priority on conservation management unit, especially for the species under the critically endangered criteria such as Sumatran orangutan. Critically Endangered criteria refer to a 50% probability of extinction in five years. Deforestation rate and high population decline are believed

as major causes of species extinction. Habitat loss and degradation also increased the vulnerability of orangutan to poaching. Estimation on orangutan population density will help design the conservation efforts for Batang Toru watershed forest (known as Batang Toru forest block).

A population survey of the orang-utans at Batang Toru watershed in North Sumatera, Indonesia was conducted over a period of 10 month from November 2005 to September 2006 (Sitaprasasti 2007). Through three extensive and broad surveys in 16 locations with total 40.6 km transect length (varies between 750-1,500 meter above sea level), also regular monthly monitoring in existing transects in five model sites (Lobu Pining, Sibulan-bulan, Sipetang, Sitandiang and Uluala) throughout three regencies, it was estimated that the orangutan density was between 0.2-0.82 individual/km² distributed in a landscape unit of 74.886 ha, which is known as a potential orangutan habitat over the total area of 90,000 ha (Figure 1). The nest count and line transect methods were used in determining population density, and the verification of orangutan presence was done through nest sightings, direct sightings and vocalizations (Figures 2 and 3). Survey result showed population densities were found to be higher in the old, moist secondary forest (0.82 individuals/km²) compared to those in the mixed forest (0.26 individuals/km²). Habitat disturbance caused by forest conversion is believed to reduce the orangutan density within mixed and lowland forests. Habitat disturbance caused by land conversion seemed to affect the orangutan density within mixed and lowland forests. Orangutan density in West Batang Toru forest is lower in comparison with the other forest area in North Sumatera, for instance in Aceh with density >6 individuals/km² (van Schaik *et al.*, 1995). The orangutan distribution pattern is highly affected by food resources availability, altitude, river shed and human economic activities in the habitat of orangutan.

Further research and long-term monitoring of the population at Batang Toru, is necessary to ensure the long-term survival of this critically-endangered species. Surveys were conducted in 20 different sites with a total length of transect 40.6 km. The number of nests found along the transect was 287 nests. For each site, the density of orangutans varied from 0.1–1.3 individual/km². This is low compared to those in other forests in Sumatera, such as lowland forest of Aceh, which can reach more than 6 individuals/km² (van Schaik *et al.*, 1995; Singleton, 2000). This value will probably increase during the fruit season and decrease during fruit-scarce season (Singleton, 2000). If each survey site is categorized according to forest type (Table 1), the highest density value (0.82 individual/km²) was found in the hill forest category at elevations of 900 to 1200 m, and the lowest density (0.26 individual/km²) was found in mixed forest. Orangutan densities tend to increase in relation to the increase of elevation. The entire orangutan population

in Batang Toru watershed forest was predicted by extrapolation from LANDSAT TM Images of 2001 for each forest type (Table 2). From 90.000 ha of Batang Toru watershed forest area, around 74.886 ha are estimated as potential orangutan habitat. The result shown that the number of orangutans in Batang Toru is about 380 individuals.



Map 1. The location of Batang Toru area in North Sumatera, showing the transect location (Sitaprasasti et al in press)

Table 1. Forest type and density of orangutans (D_{OH}) used in Batang Toru population estimate.

Forest type	L (km)	Σ nest	t (days)	D_{OH} (ind/km ²)	D^{lcl} - D^{ucl}
Lowland (100-400 m)	3.3	21	206.1	0.47	0.16-0.51
Mixed (400-700 m)	6.0	23	215.8	0.26	0.20-0.72
Hillside, secondary (700-900 m)	20.2	139	188.7	0.60	0.47-0.72
Hillside, moist secondary (900-1200 m)	11.1	103	187.4	0.82	0.64-1.03

*Note: Lower and upper 95 % confidence limits indicated by “lcl” and “ucl”
L=transect length, t=total days, D_{OH} =orangutan density*

Table 2. Orangutan population estimates for each forest type in Batang Toru

Forest type	Total area (km ²)	% of total area	Density estimate (ind/km ²)	Population estimate
Lowland (100-400 m)	184.81	24.68	0.47	94
Mixed (400-700 m)	213.37	28.50	0.26	55
Hillside, secondary (700-900 m)	247.06	32.99	0.60	146
Hillside, moist secondary (900-1200 m)	103.62	13.83	0.82	85

Forest conversion into agricultural purposes is identified to be the main cause of the decrease of orangutan natural habitat in West Batang Toru forest. Moreover, human population pressures (Nias community in Uluala) in some parts of the forest, road construction (connecting Aek Nabara to Sipirok) contributed the damaged of the forest and eventually become the real threats for the existence of orangutan in West Batang Toru forest. Nests, indicated the orangutan presence, and were found in secondary forests bordered with human plantation. Nest and direct sighting were mostly found within the forest area with a good vegetation condition, although some part of the area are fragmented and converted into plantation.

Trees for the orangutan are their home, where they built nest, and food sources, also they spent more than 50% of their activities up in trees. This condition indicates that the rates of land conversion (forest to non-forest area) are significantly high, and yet population of orangutan can still be found. Orangutan research during this period has shown that the orangutan existence (nest

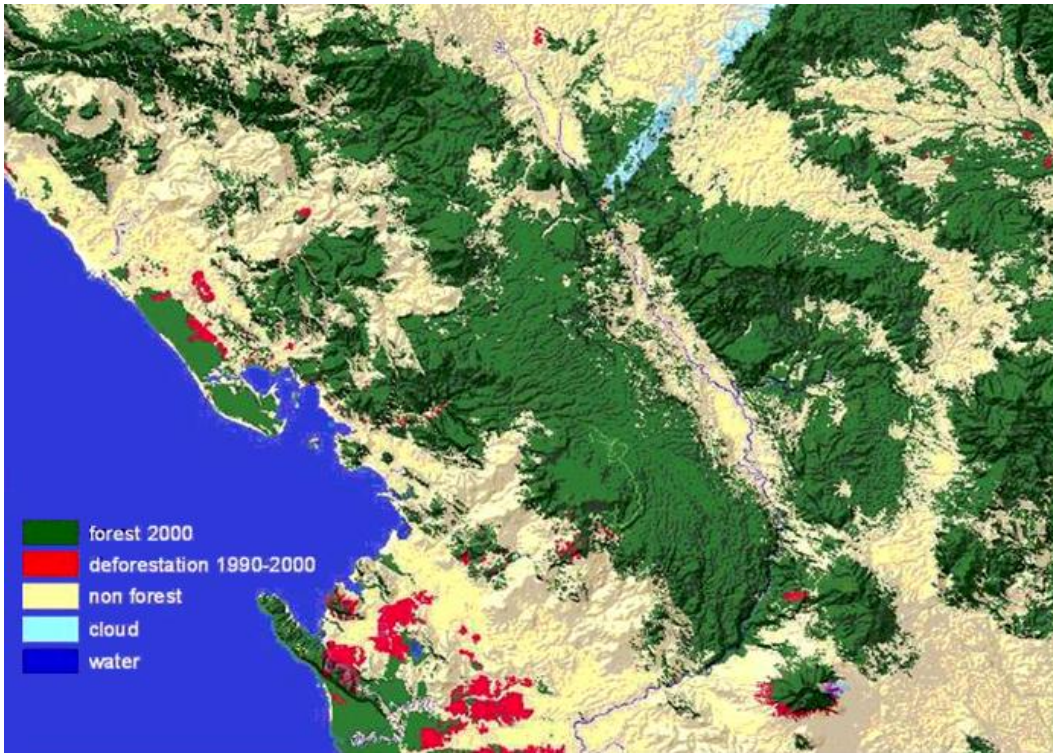
finding and direct sighting) usually in the elevation above 900 m. This result was slightly different from research that was conducted by Van Schaik & Azwar (1991), which indicated the distribution of orangutan usually occurs in lowland forest (Sitaparasti, 2007). Furthermore, there are more individual orangutan found in Southern part of the Batang Toru forest, supported by the qualitative observation that shown more food availabilities than in central and northern part of the area.

3.1.2 Threats to orangutan population and habitats

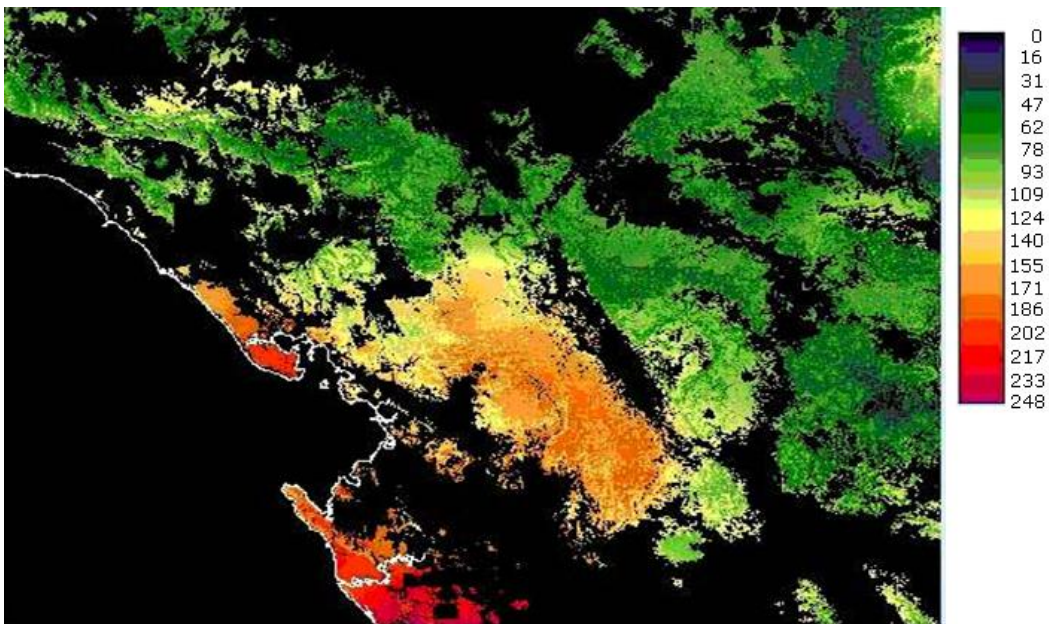
Loss of natural habitat, habitat fragmentation and poaching are the most significant factors contributing to the reduction of orangutan populations in the Batang Toru area. Although investigation in orangutan hunting and poaching has not obtained any direct evidence of such activities, even though some people claimed that they poached the orangutans for meat. Root causes of key threats were analyzed to prepare a threat reduction plan. CI has conducted a thorough threats analysis for the Batang Toru area and engaged decision makers in the three district governments covering the West Batang Toru area, local NGOS, and affected communities in a participatory process to develop a plan to manage threats. This included developing indicators of success, identifying responsible parties to carry out threat reduction actions, with accurate estimates of the costs and a timetable for executing the plan. This activity also built the capacity of local government to carry out these kinds of analytical and planning activities.

Threats on orangutan population in Batang Toru forest were determined using a GIS analysis which resulted in a prognostic map of future orangutan habitat loss patterns in Batang Toru and surrounding areas. This analysis could help identify the relative vulnerability of different habitats to degradation and human activity.

A total of 6.34 km² of forest was cleared between 1990-2000 in Batang Toru area equivalent to an average deforestation rate of 0.05% per year. Previous studies showed that total forest loss across Sumatra region was 25%, representing over 5 million hectares, from nearly 20.6 million ha in 1990 to approximately 15.5 ha in 2000 (WCS, CI, MoF, 2007). During the period of 1990-2000, the probability of an area being cleared of forest was found to be significantly and negatively related to elevation, slope, distance to plantation areas, distance to transmigration) and distance to logging concession.



Map 2. Map of deforestation from 1990-2000 for around Batang Toru area (subset from Sumatra deforestation map 1990-2000 (Perbatakusuma, et al, 2007))



Map 3. Deforestation likelihood map Note : Result of MCE produces map of continuous values ranging from 0-255, with 255 (highest values) representing the highest likelihood of deforestation (Perbatakusuma, et al, 2007)

The result of this process is a map of continuous values representing a composite index of suitability (or likelihood) for deforestation (Map 2). The analysis indicated that most of all forests in the Batang Toru area were facing high deforestation threat, so that the orangutan population in this area has been as well under high pressure. In addition, this prediction can occur in the future since the area is surrounded by provincial and regency level roads, new settlements are continued to appear upward penetrating the forest. Disturbance to orangutan habitat made by human in the area through forest conversion to agriculture and plantation areas, either legal or illegal and logging and mining activities have occurred as well (Map 3). Therefore, monitoring forest conversion to agricultural land and modeling future threats for the network of protected areas are very important to the maintenance of the orangutan populations.

3.1.2. *Orangutan habitat under deforestation threats through forest cover change detection.*

The GIS analysis described above has produced the likelihood of deforestation that threatening the orangutan population. These information were shared with district government officials and communities close to areas of high deforestation as part of a long-term effort to build their capacity to use this information as they adapt and refine their conservation activities.

Sumatra-wide deforestation map of 1990 - 2000 showed forest loss of 25%, representing over 5 million hectares. The total forest area declined from 20.6 million ha in 1990 to 15.5 ha in 2000 (Table 3). The largest percentage loss occurred in the province of Sumatera Selatan, where over half of the forest was cleared between 1990 and 2000. The largest forest loss by area occurred in Riau: almost 18 million ha in ten years. The lowest percentage losses were found in Aceh and Sumatra Barat, with just over 8% forest loss. Both areas retained a high percentage of forest cover, and both areas contain forest within national parks.

Table.3 Forest cover and forest loss statistics by province of Sumatera.

Name of Province	Forest Year 1990 (ha)	Forest Year 2000 (ha)	Forest loss (ha)	% Loss
Aceh	3,607,008	3,302,431	304,577	8.4
Bengkulu	1,085,377	851,507	233,870	21.5
Jambi	2,485,547	1,843,960	641,587	25.8
Lampung	529,024	340,043	188,981	35.7
Riau	5,609,316	3,825,715	1,783,601	31.8
West Sumatra	2,401,657	2,192,883	208,774	8.7
South Sumatra	2,599,651	1,161,306	1,438,345	55.3
North Sumatra	2,255,248	1,971,248	284,001	12.6
	20,572,828	15,489,093	5,083,735	25.0 (Average)

In Batang Toru area, forest loss occurred in the period from 2000 – 2007 equaling 1,382 ha from 168,881 ha total area, or greater than 0.1 % per year (Table 4). Meanwhile in period from 1990-2000, Batang Toru area lost 880 ha, or 88 ha per year. This means that forest loss from 88 ha per year in period 1990-2000 increased to 197 ha per year in the following period. The drivers of deforestation were subsistence agriculture expansion, small holder plantation, gold mining exploitation, illegal logging, unsustainable timber exploitation, hydro power plant construction, road infrastructure development, human settlement expansion and natural factors (land slide, earthquake). (Perbatakusuma, et al, 2008)

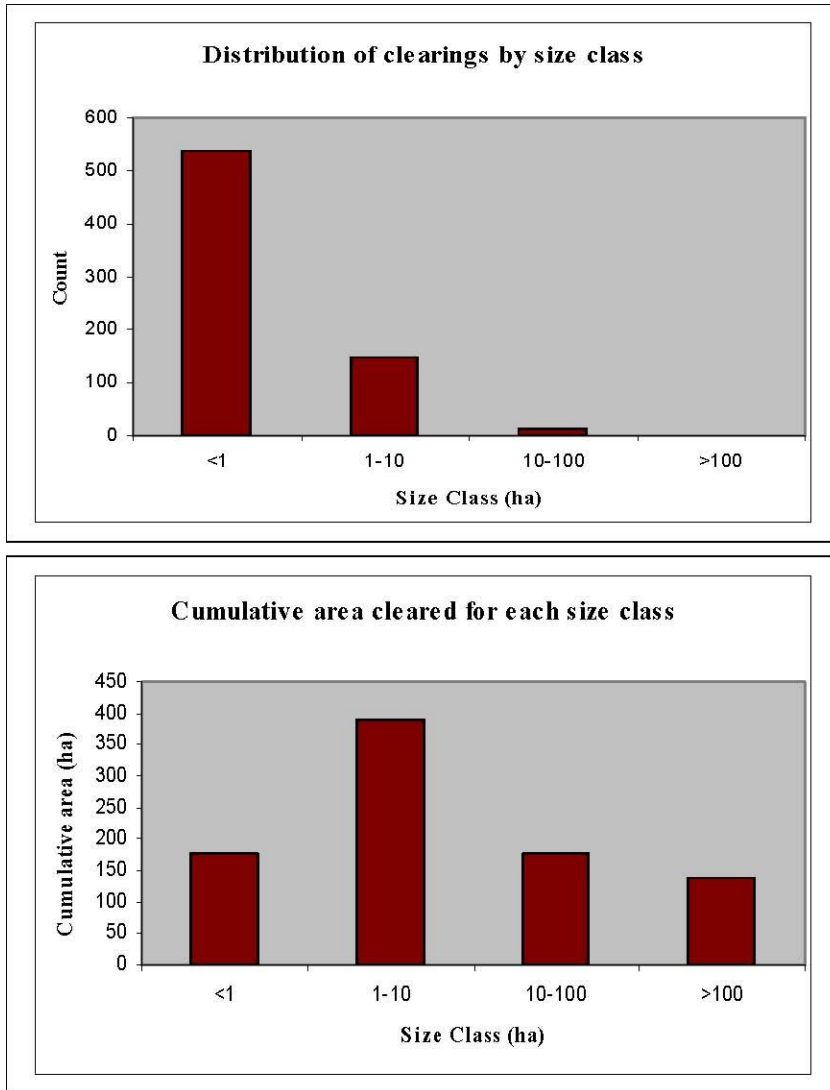
Based on CI's study (2008), forest clearing recorded at 699 sites, totaling 882 hectares, were detected within the Batang Toru key biodiversity area from 2003 through 2007 (Map 4). Of these, 532 clearings encompassed less than one hectare, 148 were between one and ten hectares, 12 covered between 10 and 100 hectares, and one clearing measured 138 hectares. The clearings of 1 to 10 ha accounted for 391 ha of deforestation, while clearings of less than 1 ha and 10 to 100 ha accounted for similar amount (about 180 ha) of deforestation (Graph 1). With the exception of scattered clearings in the northeast section of Batang Toru, in Tapanuli Utara (North Tapanuli), most clearings occurred within three kilometers of the project site boundary.

No	Class No	Class Description	Area (ha)
1	5	Cloud in 2007	392.526
2	6	Shadow in 2007	204.214
3	10	Secondary Forest 2007	3,909.986
4	11	Forest 2007	135,476.090
5	12	Deforestation 2007	1,381.634
6	13	Regrowth (Secondary Forest) 2000 - 2007	16,835.273
7	22	Non-Forest in 2007	10,376.861
8	40	Water Body	303.920
		TOTAL	168,880.504
		Total Area	168,880.504 ha
		Total Secondary Forest	20,745.258 ha
		Total Primary Forest	135,476.090 ha
		Total Non-Forest (Agricultural, Settlement)	10,376.861 ha
		Uncertainty	596.740 ha

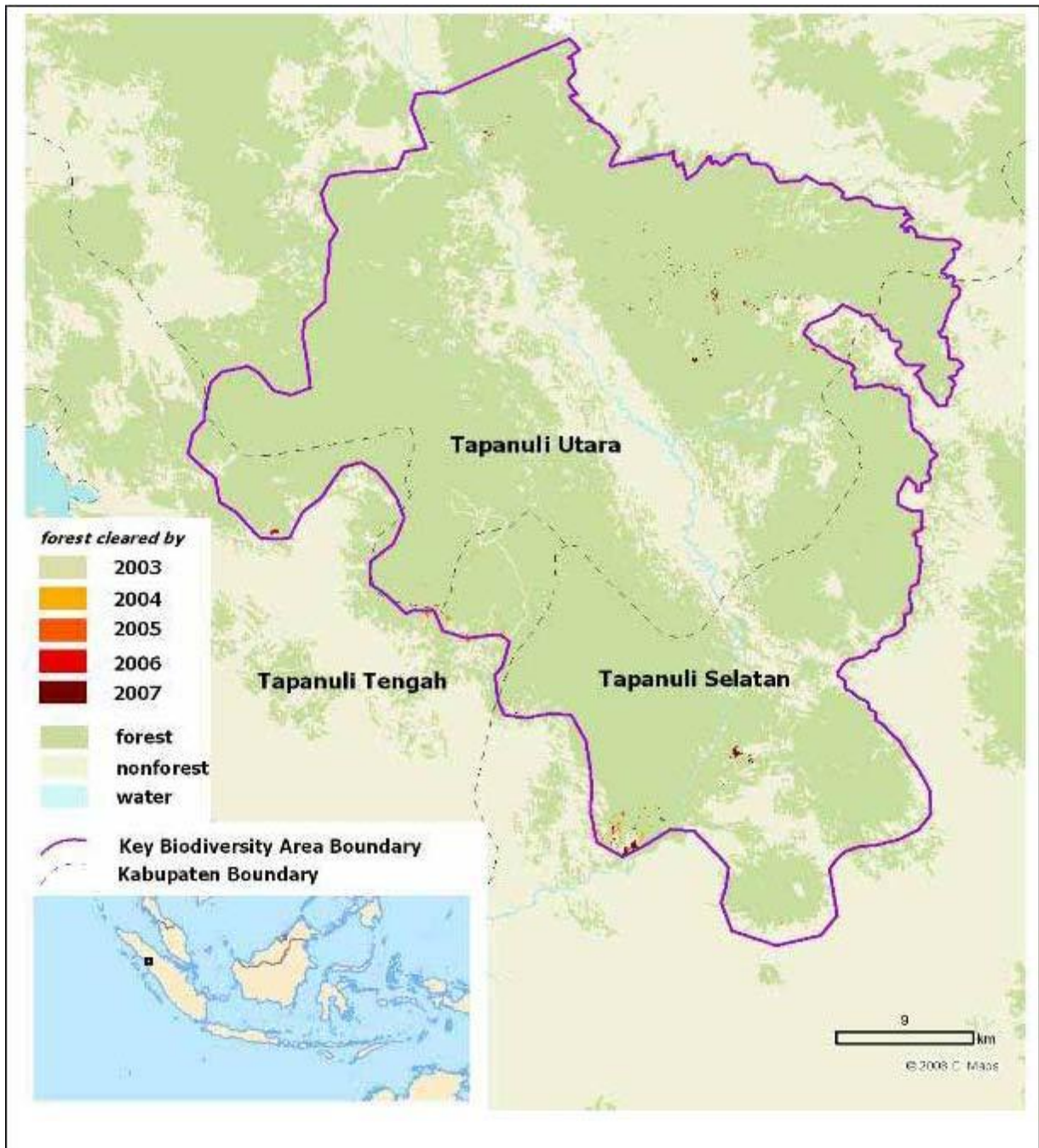
Table 4. Show the recapitulation of forest cover, non-forest cover and deforestation in Batang Toru Forest Block

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The majority of the scattered clearings in Tapanuli Utara are from 2007. There are a few clearings from 2004 and 2005 near the forest edge in Tapanuli Tengah, and in 2004 a pre existing logging road network entering the forest block in Tapanuli Tengah shows a few extensions. There are clearings from all five years along the southwestern forest edge in Tapanuli Selatan, with the largest clearings from 2007. There are a few additional clearings along the eastern forest edge further north in Tapanuli Selatan from 2005 and 2006



Graph 1. Distribution of clearings by size class in Batang Toru and cumulative area cleared for each size class in Batang Toru



Map 4. Forest clearance in Batang Toru Forest Block Year 2003-2007.

Logging is a very serious threat throughout Sumatra. A June 2000 report by the Ministry of Forestry officially stated an opinion that had been prevalent for some time: "Illegal logging has come to constitute a well-organized criminal enterprise with strong backing and a network that is so extensive, well-established and strong that it is bold enough to resist, threaten, and in fact physically tyrannize forestry law enforcement authorities. Illegal cutting occurs in concession areas, unallocated forest areas, expired concessions, state forestry concessions, areas of forest slated for conversion, and in conservation areas and protected forests.

Illegal logging is increasing in conservation areas, since these areas have better timber potential than production areas. The actors in illegal logging are: (a) laborers from communities in the forest areas and also many who are brought there from other areas; (b) Investors, including traders, concession holders, or holders of legal timber cutting permits (IPK), and buyers of illegal timber from processing industries; and (c) government officials (both civilian and military), law enforcement personnel, and certain legislators (Dephut, 2000)

The latest forest-cover maps published by the Ministry of Forestry and Agriculture show that at least 1.7 million hectares of forested areas were destroyed annually from 1985 to 1997, significantly more than earlier conservative estimates of 0.6 million to 1.3 million hectares per year and one of the highest rates of forest destruction in the world (Woldbank, 2001). The world Bank prediction in 2001, it shows that the lowland peneplain forest of Sumatra will disappear in 2005, while the wetland in 2010.

Loss of natural habitat and poaching are the most significant factors contributing to the reduction of orangutan populations in the West Batang Toru area (Singleton *et al.*, 2004). Root causes of key threats must be fully analyzed to prepare a threat abatement plan. With local and provincial government, We have conducted a thorough threats analysis for the Batang Toru area, and develop a plan to manage threats, including developing indicators of success, identifying responsible parties to carry out threat abatement actions, with accurate estimates of the costs and a timetable for executing the plan. This activity will include building the capacity of local government to carry out these kinds of analytic and planning activities.

The result of overlaying maps of forest status shows that there are considerable threats to orangutan habitat. Large numbers exist in non-conservation forest, such as limited production forest, converted forest, and community forest. The existence of orangutan in the study area is so close to, or even within, timber concessions, mining areas, plantation and human settlement. This would suggest that human-orangutan conflict is likely to occur in search for these natural

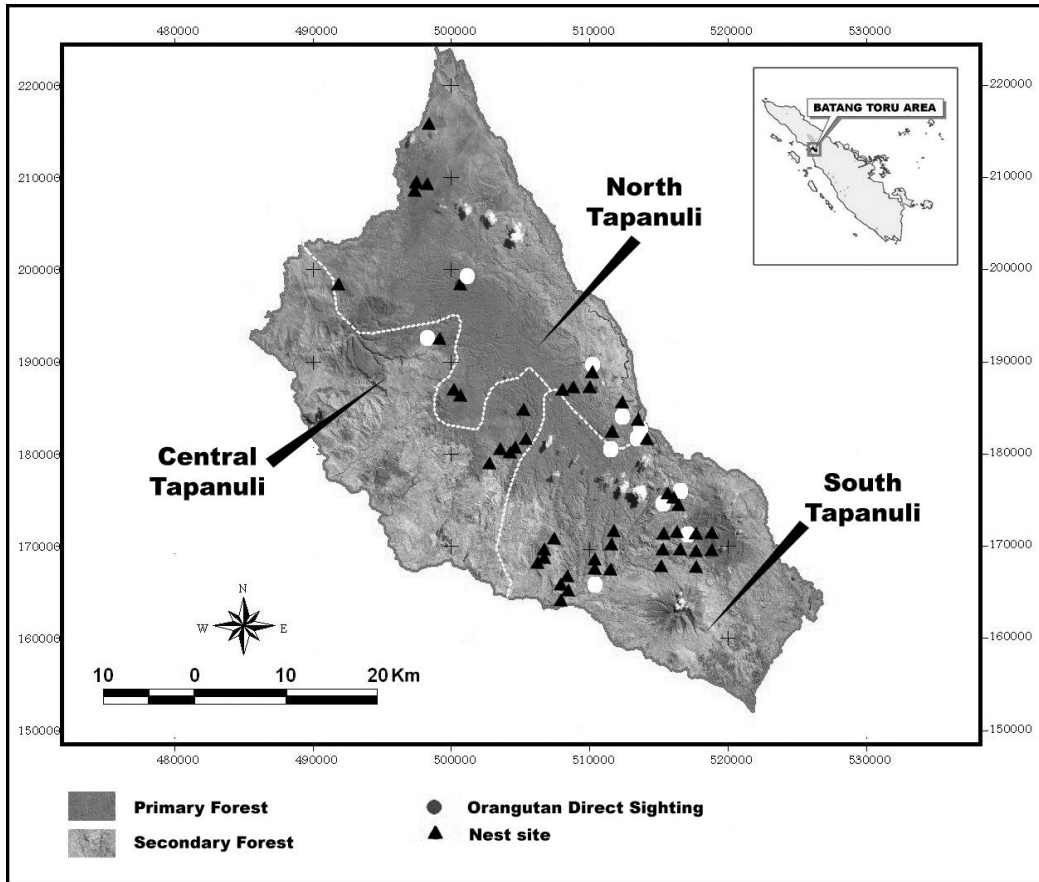
resources. It was regularly observed that orangutan frequently disturbed the local people's plantation for fruits and other food items.

On the other hand, forest clearance has come closer to the habitat of orangutan, which would eventually increase the opportunity of wildlife hunting, including orangutan. Forest clearance has certainly become the primary threat to the existence of orangutan and its habitat in Batang Toru Watershed. Fragmented forest causing a limited movement of the orangutan and inducing local extinction needs to be considered. Orangutan and its habitat conservation efforts urgently need to be addressed in order to stop the population decline See. Map 5

Mapping and measuring the nearest human settlement (village or sub-village) and road to orangutan sightings were conducted in this research as a parameter to determine potential threat to orangutan habitat. The distance of the nearest orangutan habitat to the main road is only 1.6 km, and to the nearest sub-village is also 1.6 km. Since the home range of orangutan is about 2.500 ha (25 km²) for individual male and 850 ha (8,5 km²) for individual female (Singleton and van Schaik, 2001), the nearest sub-village is predicted to be within the orangutan home range area. Thus, this confirms the very existence of actual threat to the orangutan population in this study area. The conflict between human and orangutan is then inevitable. In such a conflict, the orangutan will always be defeated. Hunting of orangutan and other wildlife will keep increasing if access to their habitat is available (Sugardjito and van Schaik, 1991).

The existence of orangutan population in Batang Toru Watershed and its potential threats are highlighted, but long-term research is still needed to monitor the most recent orangutan distribution, more accurate of population size and degree of habitat destruction. The forest area of Batang Toru Watershed should be managed sustainably to ensure the survival of the orangutan. Habitat restoration and promoting the local community involvement in forest conservation should be considered as a strategy for conservation of orangutan and its habitat.

Threats from extractive industries are expanding rapidly, i.e. mining, oil and gas, oil palm, logging etc.. One factor that has contributed to ecosystem degradation, such as from mining threats is the presidential decree issued by former President Suharto giving mining activities priority over all other land uses, then recently from President Megawati Sukarnoputri who gave 13 mining companies right for mining at the protected forest. Indonesia experienced a mining boom in the 1990s, bringing unprecedented prosperity to a small segment of the population. Agricultural and agroforestry expansion is a very serious threat throughout Sumatra. Outside of protected areas, the major threat is oil palm plantation expansion. The major threat inside protected areas is local communities establishing food, cinnamon, and oil palm gardens.



Map 5. . The distrubution records of Sumatran orangutans (nest and direct sighting) in Batang Toru (Sitaprasasti, et al in press)

Agricultural expansion is a very serious threat throughout Sumatra. Outside of protected areas, the major threat is oil palm plantation expansion. The major threat inside protected areas is local communities establishing food, cinnamon, and oil palm gardens. Forest Fires Forest fires are rampant throughout Sumatra, especially in central and southern regions. In 1997/98, the El Niño Southern Oscillation - a cyclical warming and cooling of the Eastern Pacific - brought drought conditions to Sumatra, rendering forests on peaty soils especially vulnerable to fire. At the same time, the price of palm oil increased, and plantation developers in Sumatra, eager for land, deliberately burned large areas of forest. Fuelwood is collected for home consumption and for use by small- and medium-sized industries. The latter is a casual yet significant factor in high-impact deforestation and is a source of employment for many farmers between harvests. Until 10 years ago, when shortages in fuelwood first became noticeable, fuelwood collection for home energy use was not a major factor in deforestation. This was a result of the increase in concession development and conversion of forestland to oil palm plantations

3.1.4 Policy strategic and law enforcement intervention for orangutan protection

Therefore, to sustain a viable number of individual orangutans for population survival, improved protection is essential. However, first, there will be an assessment and a development of the most strategic interventions or cost-effective investment or mechanisms to address the problems as identified. With extensive local law enforcement input, there will be an analysis on the weaknesses in the enforcement system, and development of a least-cost investment strategy to address them. The enforcement escalation efforts would be focused solely on assisting in protecting and maintaining orangutan habitats and supporting anti-poaching measures.

Accurate information concerning the ‘players’ who influence the existing habitat and orangutan population, including persons acting ‘behind the scenes’ is a key entry point in resolving enforcement problems. Potential constraints/misperceptions among stakeholders, especially enforcement agencies, can be avoided from the beginning by socializing efforts and obtaining political and technical support. All possible local or traditional enforcement systems to use traditional knowledge to protect the orangutan and its habitat were assessed. Further, a series of consultative meetings were undertaken with enforcement agencies and stakeholders in each district, aiming at collecting information regarding capacity, resources, infrastructure, skills, and knowledge of each institution, and strengths also weaknesses of enforcement agencies.

In accordance to the Indonesian Criminal Justice System, the enforcement chain for conservation and forestry crimes is the responsibility of forest rangers, Forest Civil Investigators (=PPNS), the police, attorneys, and the court. Poor performance by any one of these parties will reduce the effectiveness or performance of law enforcement. Under this activity, the enforcement performance was assessed using quantitative and qualitative data for existing crimes. Data are used in calculating the probabilities of each step in the enforcement chain and the overall value of the enforcement disincentive presented by the government enforcement system. A number of tasks were accomplished, namely: (a) Dissemination of the analysis results (b) Building up consensus critical for improvement and securing results; (c) Development of a strategy with stakeholders, including identifying key interventions and partners; and (d) An in-house training for law enforcement personnel and NGOs involved in enforcement work.

A series of consultative meetings were regularly undertaken, when CI proposed recommendation on law enforcement relevant to orangutan protection in the three districts and at the province level. The consultations successfully gained support from these agencies for law enforcement activities. With these stakeholders, CI drafted the intervention strategy to protect

orangutans and their habitats in Batang Toru Forest Block through increased and improved law enforcement. All the enforcement agencies that participated in the consultations expressed respective official commitment to support CI's efforts on protection of the orangutan and its habitat. For the first time ever, these agencies also endorsed specific action plans to combat threats against orangutans. Finally, with CI's facilitation, the enforcement agencies endorsed the concept and organization structure of Community Participatory Monitoring Unit (CPM) or to be specific sometimes it called as Orangutan Protection Unit (OPU) in selected villages.

The intervention developed under a close collaboration with the Office of the Species Protection and Nature Conservation Unit (BKSDA Sumut II) responsible for patrolling all protected forests in DAS Batang Toru. The establishment of Community Participatory Monitoring Unit (CPM) or Orangutan Protection Unit (OPU) – both combined into CPM-OPU has been the main intervention supported by the BKSDA Sumut II. A decree on the CPM-OPU establishment, outlining the roles and responsibilities of the officers/members within the contexts of local, provincial and national laws, has also been issued through SK No. 3875/IV-K3/KKH. Members of the CPM-OPU are individuals selected from local communities and forest rangers

Old growth forests in Indonesia, on which orangutans depend, have declined by more than 80% in the last 25 years. Deforestation has caused orangutan numbers to plummet in the region's exhaustively logged areas, as demonstrated by broad surveys throughout the species' entire range (Rijksen and Meijaard, 1999).

Human invasion of orangutan habitat has also become one of several important factors affecting the existence of orangutans. Human activities are considered as the main cause of forest fragmentation and the loss of orangutan natural habitat (Meffe and Carroll, 1994). Fragmentation will affect the dispersal of orangutan in the Batang Toru watershed, hence their home range will be limited, and, furthermore it will cause isolation of orangutan sub-populations and competition for habitat. Habitat isolation caused by forest fragmentation will speed eventually up local extinction and formation of metapopulations (Monaghan et al., 2001). Limited home range and isolation of population will reduce the population size and ability to survive (Cowlshaw and Dunbar, 2000).

Then, efforts to conserve orangutan also must succeed at the community level and will be the ultimate measure of effectiveness. Therefore, we have worked with stakeholders at local level to build the community-level conservation program, including ; facilitating to establish community-based conservation agreement and community-led taks force for orangutan habitat protection, establish inter-village institution for conserving Batang Toru Forest Block, and build community conservation learning and information center

Conservation efforts will be successful only if people support them, now and well into the future. This support must be public and broad-based to withstand the inevitable periodic efforts by parts of society to divert resources or support for natural resource management efforts to other priorities. Alliances of civil society, communities, the private sector, and government are a powerful tool to create this support. Creating alliances will require building awareness and creating incentives for people to support conservation efforts. These alliances will be most effective if members actively participate in developing and implementing such conservation efforts. Fostering this participation will require helping the relevant decision-making and resource management agencies develop mechanisms to seek public input and active support.

Then, we have worked with key stakeholders, such as local non government organization, local government, community based organization and private sector at local level to build the multi stake holder conservation program, including fostering efforts to establish new conservation areas in production forest for more suitable orangutan habitat (grand forest park, protection forest) , including building the capacity to manage them effectively; facilitating multi stakeholder efforts to establish participatory conservation sensitive regional spatial planning processes at district and provincial level, assisting to establish multi-stakeholder collaborative management institution and multi-stakeholder legitimate conservation action plan, assist local government to establish research center and ecotourism center and facilitating alternative sustainable financial mechanism for long-term orangutan conservation in Batang Toru Forest. This effort need long term processes through multi stake holder meeting. We recorded eight times a big meeting events to this effort.

3.2 Support communities and partners to develop sustainable economic alternatives

There are many economic incentives for community members in Batang Toru to cut down the forest and hunt orangutans. If we are going to preserve the orangutans and their habitat in this area, we need to create positive incentives to counter the negative incentives. We worked with community members and other local partners to develop new ways for them to earn income without destroying the forest or the orangutans. In order to do this, we need to: (1) gain in-depth knowledge of the livelihood systems and to identify potential incentives to motivate the local people towards conservation-oriented activities, including macro-economic drivers; (2) understand which high-quality habitats are critically threatened and create sustainable land use matrices to connect the core habitats across the landscape; (3) develop diverse sustainable livelihood opportunities rooted in local knowledge and resources; (4) assist communities, local

government and park managers to develop spatial planning strategies that best meet all parties' objectives.

3.2.1 Develop local support for conservation-based income alternatives.

The Batang Toru watershed includes part of three different districts - North Tapanuli, Central Tapanuli, and South Tapanuli. The three districts have similar history, demographic, livelihood and economic characteristics. All three have large rural-based populations with population densities varying from 126/km² in Central Tapanuli, to 69/km² in North Tapanuli, to 54/km² in South Tapanuli. The population is dominated by the indigenous Batak Toba, Batak Pesisir, Batak Angkola-Mandailing ethnic groups with some communities of Javanese or Nias. The watershed covers approximately 100,000 ha, includes 251 villages with a human population of 133,971 in 27,906 households.

Natural forest and agroforests are the primary land cover. Elevations range from 200 m to 1500 m, with slopes of 30° to 60°. The local communities have a long history of sustainable forest resource management through a gradient of landuse intensities ranging from mixed tree gardens where species composition is largely controlled by farmers and management is intermediate, to natural forests where impact from human intervention is light with small quantities of products harvested. In between are various types of agroforests (forest farming systems) where human management favors plant species that provide useful/valuable products but management remains extension rather than intensive. Mixed tree garden and agroforest systems are collectively referred to as upland agroforestry systems.

Land ownership varies from 1 to 2 hectares/family. Agriculture is dominated by irrigated rice production and upland agroforestry systems, which include: (1) rubber agroforestry (jungle rubber) systems; (2) durian agroforestry systems; (3) rubber monoculture systems; (4) homegarden systems; (5) fruit-cacao systems; (6) pinang-cacao agroforestry systems; (7) cinnamon monoculture systems; (8) upland rice-banana-cassava-cacao systems, and (9) coffee monoculture systems. Key products of these systems include rice (*Oryza sativa*), rubber (*Hevea brasiliensis*), cacao (*Theobroma cacao*), coffee (*Coffea arabica* and *C. robusta*), kemenyan (*Styrax benzoin*), aren (*Arenga pinnata*), durian (*Durio zibethinus*), petai (*Parkia speciosa*), candlenut (*Aleurites moluccana*), salak (*Salacca zalacca*), and banana (*Musa* sp). Other fruits, medicinal crops and timber are also produced in these systems. Rice, medicinal crops and timbers are primarily produced for home use. Rubber, cacao and kemenyan are exclusively market crops. Other crops are both consumed in the home and marketed. None of the agroforestry systems are intensely because farmers lack access to high quality germplasm, technical support, infrastructure, and market information.

Initial consultative meetings were held with approximately 500 local stakeholders representing 50 villages aimed at evaluating and selecting priority villages where the project pilot would be implemented. Five villages were selected for that purpose, namely: Sibulan-bulan (of

North Tapanuli District), Hutagurgur (of Central Tapanuli District), Sitandiang, Wek I and Aek Nabara (of South Tapanuli District). The project's livelihood-conservation strategies and model sites were implemented in those five focal villages.

Supporting the improvement of local agroforestry system was undertaken in those villages, where cacao and rubber have been the main plantations that provide income to the local communities. A series of trainings in sustainable farming practices and nursery development were provided to the local communities, under a close collaboration with CI-Indonesia and its local NGO partners. Altogether, there were over 1,300 farmers involved in 13 sessions of trainings and supervision held in those focal villages. This expectedly made 600 hectares of farmer agroforestry systems under improved management, where 120 farmers (22.5% women) were actively involved in all project activities. In addition, there were five nurseries established, where 25,000 rubber seedlings were produced, although the seedlings were not all utilized by the farmers as yet. In turn, this would expectedly make 10,000 ha of natural forests benefiting from improved natural resource management.

A Rapid Land Tenure Assessment (RATA) was conducted to explore conflicting claims among the stakeholders, linked to property rights and legal terms. The study also focused on historical land tenure, landuse and land access and recognized community's traditional role in natural resource conservation. It also intended to provide policy options to avoid/resolve landuse conflict. The biggest potential for landuse conflict is the proposal to develop a national park in Batang Toru based on the forest gazettement. Some of the Batang Toru Area was gazetted as state forest land in the 1920s, however no further gazettement has been conducted, despite government claim that most of the Batang Toru Area is state forest land. Legally, the unfinished gazettement process leaves the land open to claims by local communities. Furthermore, the designation of the state forest zone in North Sumatra, based on Ministry Decree No. 44/2006 and 201/2006, has not been accepted locally because some of the area was already allocated to local governments for development or infrastructure. Local government resistance has been recorded in North Tapanuli and Central Tapanuli.

In contrary to the government claim, communities have legal claim to the forest in Batang Toru have been legalized recognized by the National Land Agency. Approximately, 17,391 ha of land in the proposed national park is registered as customary land. However, spatial analysis indicates that about 32,573 ha are actually under traditional landuse (classified as agroforests). These overlapping land claims strongly indicate that conflict may result if the national park is

established with transparency and opportunity for communities to voice their claims. The study concludes that the Batang Toru Area should be fully gazetted so that the area is clear of overlapping landuse claims. All stakeholders' views and interests should be considered during the gazettment and national park development processes – particularly those of the local communities

3.2.2 Facilitation of village conservation agreement and livelihood improvement supports

Prior to implementing activities at village levels aimed at achieving common consensus to the conservation of natural forest and its biodiversity, strategic issue and objectives were initially assessed using a participatory appraisal methodology. The local strategic issue was identified as the preservation of water source due to the fact that the local people significantly rely on water supply for their own agriculture, mainly paddy fields. And to maintain such an important water supply, the forests surrounding the village need to be conserved. The strategic objectives were therefore: (a) to foster the need for village agreement on the conservation of forest resources; and (b) to support the development or improvement of village livelihood through appropriate facilitation.

The activities were undertaken in four villages, namely Sibulan-bulan and Sitandiang villages from North Tapanuli District, and the villages of Aek Nabara and Uluala from the South Tapanuli District. Main activities undertaken to achieve those objectives in each village were: (a) encouraging the villagers' awareness on the importance of water sources through presentation of film on natural resources and environment; (b) developing village mapping and appraisal using PRA methodology aimed at prioritizing livelihood aspects to be addressed; (c) provision of trainings in producing growth stimulant for crops, bio-pesticide and compost; (d) rehabilitation of water irrigation; (e) generating village conservation agreement based on activity b above; (f) provision of village library as a media for education improvement.

For the local people, film presentation has always been the most effective way to convey messages on nature conservation, with which the people could learn the importance of water sources for their own livelihood. However, most appropriate films could only be available in foreign language, namely English, which is surely difficult to comprehend without subtitles. The most effective film – as suggested by the local people themselves – would be an animated or cartoon film about wildlife conservation, about which has always been neglected by national film industry.

Village appraisal and mapping resulted in a number of livelihood priorities specific to respective villages that were recommended to be addressed. It was only the provision of trainings in producing growth stimulant for crops, bio-pesticide and compost, and the rehabilitation of water irrigation that could be provided for those villages during the project implementation. In addition, as one of priorities being acquired by Aek Nabara village, a village library was

developed as the main media for people education in the village. Another important conclusion was to generate village conservation agreement, with which the local people in respective villages would consent to the committed arrangement for conserving the village natural resources.

The approach adopted by Conservation International and ICRAF was to work with communities and local government agencies to develop *community conservation-livelihood strategies* that provide frameworks for: (i) recognizing communities' traditional role in conserving natural resources; (ii) recognizing which local agricultural/forest livelihood systems are compatible with environmental conservation; and (iii) strengthening communities/other stakeholders' understanding/commitment to conservation as an approach to protect the environmental services (biodiversity, watersheds and carbon stocks). Strategies also identified/facilitated technical and marketing services/improvements to enable communities to enhance the productivity/profitability of their agroforestry livelihood systems. All five focal villages developed conservation-livelihood strategies that included recognition of priority crops, a prioritization of technical training and relevant follow-up activities, and commitment to conservation. Three of the communities Sibulanbulan, Aek Nabara and Sitandiang. Have developed strategy working documents called *livelihood-conservation strategy agreements*. Agreements consist of introduction, background, goal, objectives, plans to achieve objectives, roles and responsibilities of the stakeholders, terms of the agreement, activities, and monitoring plan. Additional clauses can be included as necessary. Agreements are intended to be transparent, equitable, realistic and flexible.

3.2.3 Develop Model Simulation of Durian-Rubber Agroforestry System.

The Conservation International and ICRAF Team conducted simulation study the **SeXI-FS** (*Spatially Explicit Individual-based Forest Simulator*) model to predict the dynamic growth and yield of durian-rubber agroforestry systems in the Batang Toru area. Rubber was selected because it is the main smallholder crop in Batang Toru. Durian was selected because it is favored by farmers, has a high and lucrative market demand, and also can sustain orangutan populations by providing both food and habitat. The data used in the model was based on biophysical and farmer surveys that determined the relationship between durian fruit production and tree structure. Four durian-rubber compositions were compared, durian as 7%, 17%, 33% and 50% of a 1 ha agroforestry system. Other parameters were: durian production starts at 15 years and fruits are harvested every 2 years; rubber production starts after its diameter is 15 cm; the price for durian is Rp 3000/fruit and for dry rubber latex price Rp 6000/kg.

Model results show that increases in the durian component increased overall income of the system, although not at a statistically significant level. Changes in the species composition have little impact on the overall income from rubber-durian agroforest, when prices of both commodities are constant. However, the prices of both durian and rubber commonly fluctuate. Farmers constantly alter their management practices, and even the components of their agroforestry systems, based their expectation of future prices. Mixed agroforestry systems

provide farmers greater flexibility to respond to dynamic market forces and price fluctuations. The model results support the development of multiple species agroforestry systems.

3.2.4 Implement the strategy for promoting sustainable economic activities.

To assist focal villages implement/achieve their livelihood-conservation strategies, the Conservation International and ICRAF team, conducted a number of trainings and expert consultations with several theme, such as Agroforestry Product Marketing, Rubber Seedling Production & Management, Conservation-Livelihood Strategy Development, Vegetable Production and Marketing, Rubber Management and Tapping, Cacao Management and Production, Tree System Management, Smallholder Livestock Production, Rubber Grafting , Rubber Pest & Disease Management, Cacao Production & Post-Harvest Management, Sugar Palm Production & Processing and Conservation-Livelihood Strategy Development

Most of these activities were held in each of the five focal villages or the activity was held in a centralized location with two or more farmer groups attending. Exceptions include *conservation-livelihood strategy development* which was focused in the three communities mentioned previously; *sugar palm production and processing* which was held in Aek Nabara and Sitandiang; and *vegetable production and marketing* which occurred in Aek Nabara, WEK I and Sibulan-bulan. On average about 100 farmers and other stakeholders attended each of the activities, so total number of direct beneficiaries from these activities is approximately 1300 peoples. The training activities were interrelated and mutually support to maximize capacity enhancement and development of sound sustainable economic alternative activities.

Impacts from these technical capacity building activities have been realized. Based on experience and observations at the site a 10-15% increase in rubber and cacao production is estimated in communities that have adapted improved management of those crops. Additionally, a total of 25,000 rubber seedlings have been produced in focal villages. This is enough to establish approximately 80 hectares of smallholder rubber agroforestry systems. Experience at similar sites indicate that under smallholder management conditions clonal rubber seedlings will start to produce latex 5-6 years after establishment and yield a minimum of 100% more latex annually than local rubber germplasm, which do not produce latex until 10-15 years after establishment.

3.3. Public awareness and dissemination on orangutan in North Sumatra

We believe that public awareness of the key environmental services (e.g., watershed, erosion control) that forests provide will be a key component in stopping or slowing illegal logging and, ultimately, in conserving orangutans. It is clear that without efforts to reduce fragmentation and link orangutan populations, continued habitat loss and losses to poaching will soon drive this species close to extinction. To counteract this threat, local communities must recognize the importance of the species and the forests in which they live, and efforts must be made to reduce further loss of habitat through cessation of logging and/or habitat restoration, and through providing alternative livelihood opportunities for local communities.

To reach the broadest audiences possible with the orangutan conservation and ecosystem services message, we have used a number of methods, including a radio talk show series discussing orangutan conservation and other related topics, and radio spots or Public Service Announcements on orangutan conservation and related issues in Sumatra. Information also has been disseminated in printed form, including fact sheets, posters, displays, PowerPoint presentations, and several editions of *Buletin Dakwah* (sermon sheets) to promote, from the perspectives of both Islam and Christianity, the importance of protecting orangutan and nature. All of our awareness activities were preceded by an awareness needs assessment for the general public (including refugees) and key decision makers.

For the past 2 years, we have been operating the **Sibolangit Interpretive Center**, about an hour's drive from Medan, in partnership with **Regional Natural Resources Conservation Agency**. The Center uses the Sumatran orangutan as a 'flagship' species to increase public awareness concerning natural resource management and biodiversity conservation. The Center, situated on the main road between Medan and Lake Toba, targets public awareness and conservation education in the communities surrounding the area, which is near the Gunung Leuser National Park. The Center staff is supported by volunteers from surrounding communities, all of whom have undergone intensive training in nature interpretation.

To reach audiences that otherwise might not otherwise have the opportunity to learn about orangutan conservation, we also operate an **Orangutan Mobile Education Unit** that takes the conservation message beyond Sibolangit's gates to remote areas, including refugee villages. This project was begun in 2001 with USAID funding, and has continued with funding from the

Critical Ecosystem Partnership Fund (CEPF). Additional funding has just been secured from a private donor, which will allow the Mobile Unit to expand its area of work to West Batang Toru in FY 05. The Unit travels to remote villages and camps out for 3-4 days, with regular return visits periodically throughout the year. During the visit, the the team conducts informal learning sessions ranging from school visits and puppet shows to interactive games and daytime forest walks. This Unit has been warmly received by local communities and has been very effective in raising awareness among target audiences. To-date, the Mobile Unit has reached villages and refugee camps in regencies in North Sumatra, with hundreds of people attending each session, particularly a popular evening “orangutan film series”. The Mobile Education Unit is an integral part of our conservation education work in North Sumatra, and also has an important entry point to reach local decision makers.

In Batang Toru context, surveys were conducted in three villages, namely Sibulan-bulan, Sitandiang and Aek Nabara, with a total respondents of 98 peoples. In general, it was found that the local people perceived the natural forests as the main life supporting system for their own livelihood where they are obliged to maintain the natural forest ecosystem. This is the most crucial finding that deserves more consideration in any attempt to develop any sustainable management of the natural forests in the area. A fraction of local people regarded that the forests have been either the sources for timber or non-timber. Such a divided opinion might have stemmed from the facts that the forests have always been exploited for both timber and non-timber products, although rattan collection has been long abandoned by the local people for it has been rarely found in the forests. However, there were a small fraction of local people regarded the forests as the only available land for their agricultural expansion. This might need a thorough consideration for this could become an alarming threat in the future when agriculture is developed as such that ignores the need for sustainable agriculture. At the same time, another small fraction of local people considered the forests as the ‘protector’ for natural disaster. This is also another good point to account since it can be utilized as the entry point for community outreach activities in the future.

The assessment also showed that the local people comprehended the fact that orangutan has been protected by National Laws, and therefore any attempt to poach and hunt orangutan has been legally forbidden. At the same time, the local people showed minimal understanding about the importance of a national park as the area for both developing community livelihood and conserving biodiversity. The local people expressed their anxiety on the issue of national park establishment in Batang Toru. This is a common sense when they do not have appropriate understanding on the national park issue.

4. Constraints, Lesson Learnt and Prospects

Overall, the CI's orangutan conservation project has been successfully implemented in Batang Toru Forest Block, of which the results could become the valuable foundation for further developing any kind of management plan for the forested areas in Batang Toru Forest. However, reservation should be made and considered in order for any nature conservation programme to succeed in the area. Here are constraints and lessons learnt from the project implementation, and the prospects for successful conservation of biodiversity in the areas in the future, described according to the themes as follows.

4.1 Community-level successes

It is indeed true that efforts to conserve biodiversity must succeed at the community level and will be the genuine measure of effectiveness. During the project implementation, however, a number of constraints were found in developing a common commitment to conserve biodiversity (*e.g.*, orangutan) and the forests as the habitat for many biodiversity species. Conflict of interests within the policy makers in the region of Northern Sumatra on forest utilization seemed to be the main obstacle for further developing nature conservation measures. Batang Toru Forest Block is not an uninhabited and undeveloped watershed area. It comprises legally designated areas with various functions and uses such as settlements, agricultural lands, mining concessions, logging concessions, hydrological electricity power plant, town expansions, and reserved for other land conversion purposes. These are the sources of such conflicting interests that emerge both at the governmental level and the community level.

Within the local communities, especially new immigrants from Nias, agricultural expansion seemed to be the only way of improving their livelihood. Meanwhile, the need for livelihood improvement seems to be the main constraint across the communities in the areas of West Batang Toru. In any consultative meeting with the village communities, it has always been the main inquiry for developing sustainable economic development at village level that is capable of incorporating orangutan conservation. Lack of economic options seemed urgent to deal with prior to endorsing any system of nature conservation management. And yet, there are potentials to diversify economic generating activities at the local levels.

Along the course of project implementation, it proved that a micro-spatial planning (*i.e.*, spatial planning at village level developed using a participatory approach) has been a better way

to augment the local people perception and willingness to promote sustainable development principles. In this way, the local people would have been able to express their needs and to find better ways to fill their own needs, provided that the local government would supervise and facilitate their articulation. In this way, the integration of nature conservation into economic development can be engaged in achieving the sustainable development from village to district levels.

It would then be favourable to all parties when the village development could be based upon participatory micro-spatial planning, which is later accommodated by the local government as the basis for developing a district spatial planning. Only then, the success of nature conservation at community levels can be achieved.

4.2. Building alliances to foster support for orangutan conservation

Alliances of civil society, communities, the private sector, and government are indeed a powerful tool to create this support. However, it proved difficult to build any alliance when the stakeholders did not have the same perception on orangutan conservation. Awareness building in fact was not as easy as it was expected in the communities with a variety of interests and livelihood problems. Creating incentives for people to support conservation efforts is just as problematical as the others when there was limited option for leveraging sustainable funding. Diversifying livelihood income at the local level is surely the superlative option to provide incentives to the people, but this will require a comprehensive approach involving all levels of stakeholders, i.e. the availability of private sectors supporting market for new income generating initiative, the willingness of local governments to facilitate any new initiative in alternative activities at the community level, and the readiness of local community themselves in developing new income generating alternatives. Along the course of project implementation, there has been little support to develop such alternatives, except at the very end of project period there was found a possibility to collaborate with a private company, with which such a feasibility is going to be explored (by the mid of December 2007).

Co-management of protected forests will need a gazetted area to be managed and yet the creation on a national park for Batang Toru forest block is so problematical that impossible to deal with during the period of project implementation. As an alternative the project has proposed a creation of a Batang Toru Conservation Collaborative Forum where all relevant stakeholders could be allied and could actively participate in developing and implementing conservation plans for the area. Such a forum is also expected to help the relevant decision-making and resource management agencies develop mechanisms to seek public input and active support.

4.3. *Integrating conservation and and monitoring into planning*

The most significant constraint for developing any measure of biodiversity conservation (not only orangutan, but also other wildlife species) in the Tapanuli region has been the lack of integration of biodiversity conservation into the regional spatial planning. Apart from providing the relevant government agencies at both provincial and district levels with updated data from the fields, the project could only recommend to incorporate the need for biodiversity conservation in their respective spatial planning. At the same time, indeed the spatial planning at both provincial and district levels has been in processes of revision, where the provided data could be utilized, although their use is much more questionable since the process of spatial planning development involves a consultant company with less participatory mechanism for the local people.

In order to show the importance of participatory process in developing a spatial planning, the project has started developing a model of village spatial planning that incorporate the needs for local livelihood development and biodiversity conservation. This would provide the local governments with the more appropriate model of spatial planning development while promoting good-governance processes. This village model will be completed by the end of December 2007. And it is expected that the local governments would adopt the processes accordingly in the future.

5. Conclusions

The needs for biodiversity conservation action in Sumatra are arguably some of the most urgent on the planet. However, the needs are too complex, varied, and widespread for any one organization or donor to tackle successfully. The need to have an integrated program which can serve as a catalyst encouraging and fostering alliances at the district level and below that can effectively address these needs in the short term while setting up mechanisms to maintain these efforts over the long term

Illegal logging, forest conversion for agriculture include oil palm plantation, road construction, and wildlife trade are rampant, while there have been many integrated conservation and development programs launched in Indonesia since the 1980s, only a few have shown promise in enhancing conservation. However, successful models for improving the economic condition of communities near protected areas while enhancing conservation should be replicated in Sumatra. Overall, awareness of the benefits of, and necessity for, biodiversity conservation is low in key sectors in Sumatra.

One of the most uncertain aspects of Indonesia's ongoing decentralization process is the extent to which the country's provinces and districts will be allowed to manage and benefit from their local natural resources. By necessity, the shift to sustainable resource management demands a much larger role for provincial and district stakeholders. It also requires that these stakeholders are well informed about resource management issues, including biodiversity conservation and the potential results of not acting to change current practices.

Highlights of success for the CI's conservation project in Batang Toru Forest Block are summarized below:

1. Law enforcement institutions, including the police and army regional offices, regional courts and attorneys, have officially committed to supporting the orangutan protection in West Batang Toru, and developed detailed action plans for law enforcement activities.
2. The Community Participatory Monitoring Unit for Orangutan Protection consisting of the local people and forest rangers has been established to continue patrolling the forest and existing orangutan transects.
3. All key stakeholders (*i.e.*, communities, all district governments, national government, private sectors) concurred to establish a network (in a form of Batang Toru Collaborative Management Forum) that would promote the sustainability of existing natural resources of Batang Toru for the benefits of both the local people and wildlife in the areas.
4. A series of consultative meetings, there has been a notion from the three districts (North Tapanuli, Central Tapanuli and South Tapanuli) about the needs for incorporating nature (*e.g.*, orangutan) conservation into their respective spatial planning. The government of South Tapanuli District has allocated the district annual budget (*i.e.*, APBD) for initiating such a process for the fiscal year 2008 and 2010 for establish research station and ecotourism center.
6. The government of South Tapanuli District has also submitted an inquiry to the Ministry of Forestry about the possibility of establishing a locally-designed and managed protected area named Grand Forest Park area under a collaboration with CI-Indonesia.
7. The project has facilitated the local communities in fulfilling a number of needs at village levels. Rehabilitation of irrigation system has been done in two villages, rubber nurseries have been developed in five villages, trainings in sustainable agriculture practices were provided to the farmers in two villages, a village library functioning as a village information center was established in one village, and a curriculum model incorporating the orangutan conservation was participatorily developed with a local school in one village.

8. Promoting a regional biodiversity sensitive spatial planning based on sustainable development principles would be one of crucial tasks in the future, where economic development could go hand in hand with nature conservation and social development. Sustainable livelihood development (*i.e.* diversifying economic options to the local people) also seems crucial to be addressed if nature conservation to succeed at community levels.
9. Not only is Batang Toru a home for orangutan but it is also foraging area for other threatened wildlife species such as Sumatran tiger, Malayan tapir and Malayan bear. Therefore, West Batang Toru deserves an appropriate management, which can be incorporated into the regional spatial plan. However, at a landscape or rather ecosystem scale, this area is connected to the area of Aek Sarulla at the western side, including the two nature reserves (Dolok Sibual-buali and Dolok Sipirok) at the southern side. This would demand thorough consideration in incorporating these areas into such a management. In turn, this will require an ecosystem approach as the basis for further developing nature and biodiversity conservation based upon sustainable development principles.
10. Last but not least, it is also vital to explore the linkages between cultural practices, livelihood options, ecosystem and biodiversity. Since Batang Toru area encompasses three districts land-marked with dramatic contrasts in terrain, histories, cultures and religious beliefs, an incredible diversity in ecological landscape will help human communities evolve an equally diverse mosaic of traditions and cultural practices, rooted in the knowledge of biodiversity wealth. Therefore, each eco-region will have its particular set of livelihood practices.

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References

Ancrenaz, M., Goossens, M., Gimenez, O., Sawang, A., Ancrenasz, I.L., 2004. Determinant of ape distribution and population size using ground and aerial surveys: a case study with orangutans in lower Kinabatangan, Sabah, Malaysia. *Animal Conservation* 7, 375—385.

- Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., 1993. Distance Sampling: Estimating Abundance of Biological Populations. Chapman and Hill, London.
- Buij, R., Wich, S.A., Lubis, A.H., Sterck, E.H.M., 2002. Seasonal movements of the Sumatran orangutan (*Pongo pygmaeus abelii*) and consequences for conservation. *Biological Conservation* 107, 83—87.
- Buij, R., Singleton, I., Krakauer, E., van Schaik, C.P., 2003. Rapid assessment of orangutan density, *Biological Conservation* 119, 103—113.
- Collins, N.M., Sayer, J.A., Whitmore, T.C., 1990. The Conservation Atlas of Tropical Forests: Asia and the Pacific. Macmillan Press, London.
- Cowlshaw, G., Dunbar, R., 2000. Primate Conservation Biology. The University of Chicago Press, Chicago and London, pp. 191—192.
- Delgado, R.A., van Schaik, C.P., 2000. The behavioural ecology and conservation of the orangutan, *Pongo pygmaeus*: A tale of two islands. *Evolutionary Anthropology* 9, 201—218.
- Djojoasmoro, R., B.M.F. Galdikas, C.N. Simanjuntak & T. Wibowo. 2004. Orangutan distribution in North Sumatra. Survey Report for Orangutan PHVA Workshop, Jakarta, Indonesia.
- Galdikas, B.M.F., Wood, J.W., 1990. Birth spacing patterns in humans and apes. *American Journal of Physical Anthropology* 83, 185—191.
- Jepson, P., Jarvie, J.K., MacKinnon, Monk, K.A., 2001. The end for Indonesia's lowland forests. *Science* 292, 859—861.
- Meffe, G.K., Carroll, R., 1994. Principles of Conservation Biology. Sinauer Associates, Sunderland, MA, pp. 269—271.
- Monaghan, M.T., Spaak, P., Robinson, C.T., Ward, J.V., 2001. Genetic differentiation of *Baetis alpinus* Pictet (Ephemeroptera:Baetidae) in fragmented alpine stream. *Journal Heridity* 86, 395—403.
- Perbatakusuma, EA, Supriatna, J, Siregar, R.,S.E, Wurjanto, D, Sihombing, L, and Sitaparasti, D . 2006. Mainstreaming Biodiversity Conservation and Life Support System Policies in Natural Forest in Batang Toru Water Cachment Area North Sumatra Province. Policy Technical Report. Conservation International Indonesia and Department of Forestry. Pandan.
- Perbatakusuma EA, Siregar R.S.E and Adhikerana, A. 2007 Development of Collaborative Orangutan Habitat Protection in Batang Toru Watershed, North Sumatra, Technical Report. Under USAID Cooperative Agreement #497-A-00-05-00036-00 Conservation International Indonesia. Medan

- Perbatakusuma, E.A, Dewantara, B, Wijayanto, I, Kemp, N, Damanik, A, Tamura, Y, Natori, Y Hibi, Y, Samsedin, I, Heriyanto, N.M and Onrizal .2008. A Feasibility Assessment for Calculating Carbon Stock in The Batang Toru Forest Ecosystem for REDD Opportunity. Research Report to Japan Bank for International Development Conservation International, Jakarta, Indonesia.
- Rijksen, H.D., Meijaard, E., 1999. Our Vanishing Relative: Status of Wild Orangutan at the Twentieth Century. Kluwer Academic Publisher, Dordrecht, Netherlands.
- Singleton, I. 2000. Ranging behaviour and seasonal movements of Sumatran orangutan (*Pongo pygmaeus abelii*) in swamp forests. *International Journal of Primatology* 22, 877—911.
- Singleton, I., van Schaik, C.P., 2001. Orangutan home range size and its determinants in a Sumatran swamp forest. *International Journal of Primatology* 22, 877—911.
- Sitaparasti, D., 2008. Population and distribution of the Sumatran Orangutan (*Pongo abelii* Lesson, 1827) in Batang Toru Watershed, North Sumatera. Master thesis, Departemen of Conservation Biology, Faculty of Mathematic and Life Science, University of Indonesia.
- Thomas, L., Laake, J.L., Strindberg, S., Marques, F.F.C., Borchers, D.L., Buckland, S.T., Anderson, D.R., Burnham, K.P., Hedley, S.L., Pollard & J.H. 2001. Distance 4.0 Beta 3. Research Unit for Wildlife Population Assessment. University of St.Andrews, UK.
- Tilson, R., Seal, U.S., Soemarna, K., Ramono, W., Sumardja, E., Poniran, S., van Schaik, C.P., Leighton, M., Rijksen, H.D., Eudey, A., 1993. Orangutan population and habitat viability analysis report. Orangutan population and habitat viability analysis workshop, Medan, North Sumatera, Indonesia.
- van Schaik, C.P., Azwar, 1991. Orangutan densities in different forest types in the Gunung Leuser National Park (Sumatera), as determined by nest count. In: Report to PHPA, LIPI, and L.S.B. Leakey Foundation, Durham, NC, USA.
- van Schaik, C.P., Priatna, D., Priatna, A., 1995. Population estimates and habitat preferences of orangutans based on line transects of nests. *In: The neglected Ape*. R.D. Nadler, B.M.F. Galdikas, L.K. Sheeran, N.Rosen (Eds.). Plenum Press, New York, pp. 129—147.
- van Schaik, C.P., van Hoff, J.A.R.A.M., 1996. Toward and understanding of the orangutan's social system. *In: McGrew, W.C., Marchant, L.F., Nishida, T. (Eds.), Great Ape Societies*. Cambridge University Press, Cambridge.
- van Schaik, C.P., Monk, K., Robertson, J.M.Y., 2001. Dramatic decline in orangutan numbers in the Leuser Ecosystem, Northern Sumatra. *Oryx* 35, 14—25.
- Wich, S.A., Singleton, I., Utami-Atmoko, S.S., Geurts, M.L., Rijksen, H.D., van Schaik, C.P., 2003. The status of Sumatran Orangutan *Pongo abelii*: an update. *Oryx* 37, 49—54.

Wich, S.A., Singleton, I, 2004. Sumatran Orangutan Distribution. Orangutan PHVA Workshop, January 15-18, Jakarta.

World Wildlife Fund. 2007. Current Population and Distribution of Orangutan. Downloaded from:http://panda.org/about_wwf/what_we_do/species/about_species/species_factsheets/great_apes/orangutans/sumatran_orangutan/sumorangutan_population_distribution/index.cfm