

# Distribution and conservation of the proboscis monkey (*Nasalis larvatus*) in Kalimantan, Indonesia

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Received 29 August 1998; received in revised form 8 April 1999; accepted 23 April 1999

## Abstract

The proboscis monkey *Nasalis larvatus* is endemic to the island of Borneo. A review of the species' distribution reveals that it occurs throughout Kalimantan, the Indonesian part of Borneo, from the coastal areas to the headwaters of probably all major rivers. Proboscis monkeys are more widely distributed than has been thought previously, and were never confined to the coastal and downstream areas of rivers on the island of Borneo (including what is now Sabah, Sarawak, Brunei and Kalimantan) as has been assumed in some primate literature. Proboscis monkey habitat, i.e. riverine and coastal forest, is the most threatened of all vegetation types in Borneo, owing to conversion into agricultural land and logging. Another threat to their survival is hunting. The combination of these threats has reduced populations of *N. larvatus* in Sabah, Sarawak and East Kalimantan, and based on this it is expected that other populations elsewhere in Borneo are likewise threatened. Our study shows the present low efficiency of conservation programmes in Kalimantan, which adds to the problem of protecting *N. larvatus*. For the survival of the species the populations in Kalimantan are still of great significance, as they are considerably larger than those in Sabah, Sarawak, and Brunei. We therefore recommend the protection of some of the largest populations in order to ensure the long-term survival of the species. © 1999 Elsevier Science Ltd. All rights reserved.

**Keywords:** Borneo; Distribution; *Nasalis larvatus*; Primate conservation; Proboscis monkey

## 1. Introduction

The proboscis monkey (*Nasalis larvatus*) (van Wurmb, 1787) is a large, sexually dimorphic Colobine, endemic to the island of Borneo. It is closely associated with waterways, returning to the water's edge in the evening, and rarely ranging far from rivers, generally < 1 km (Bennett and Sebastian, 1988; Yeager, 1991, 1993; Bennett and Davies, 1994; see, however, Sebastian, 1994). *N. larvatus* is restricted to lowlands and is typically associated with coastal forest, including mangroves, and riverine, peat swamp and fresh water swamp forests.

In Sarawak, one of the two Malaysian states in Borneo, the species is endangered, with an estimated population size of < 1000 animals (Bennett et al., 1987). These populations were previously reported to be sparsely and patchily distributed (Payne et al., 1985). In Sabah the only large populations occur in the fresh water wetlands

of the Kinabatangan flood plain, and around Dewurst Bay in the Eastern Deltas (Davies and Payne, 1982; Boonratana, 1993 in Sebastian, 1994). The mangroves and estuaries in the Brunei and Padas Bay also support a population (Kawabe and Mano, 1972; MacDonald, 1982; Payne et al., 1985; Yeager, 1989). *N. larvatus* has rarely been recorded along Sabah's north-eastern coast (Davies and Payne, 1982), nor on most of Sarawak's north coast (K. Proud in Jeffrey, 1982; Salter and MacKenzie, 1985), isolating the population in Brunei Bay. Within Kalimantan, the Indonesian part of Borneo, *N. larvatus* occurs in many localities in all four provinces.

The species is considered "vulnerable" according to the IUCN threat criteria (IUCN, 1996), and was given a "Very High" conservation rating by Eudey (1987). MacKinnon (1987) estimated the total population size within Kalimantan to be > 250,000, with ca. 25,000 protected inside reserves. Yeager and Blondal (1992) considered this last figure too high and made an adjustment to < 5000 animals inside protected reserves. *N. larvatus* is protected by law throughout its range, and is listed on Appendix 1 of the CITES convention.

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The aim of this paper is twofold: (1) to provide information on the distribution of *N. larvatus* throughout Kalimantan in historic and present times, and (2) to provide information on threats facing the species.

## 2. Methods

Information was obtained by direct observation and by interviewing local people on the status of *N. larvatus*: by the author EM from 1994–1997 in the course of a Kalimantan-wide orang-utan *Pongo pygmaeus* survey, and by VN in the framework of a WWF-Indonesia survey in 1996, which concentrated on Colobine monkeys. For the orang-utan survey a total of 78 field-checks involving 208 field days were made in Kalimantan. In addition, 69 days were spent in towns and villages for official visits and interviews. During that period a total of almost 35,000 km were travelled by various means of transportation, including transects on foot. The surveys covered all major river systems of West, Central, and East Kalimantan, all main towns in Kalimantan, and mountainous areas in Central and East Kalimantan. The WWF survey was conducted between September and December 1996, totalling 78 field days, and covered the north-eastern part of East Kalimantan. Because of the limited means of transportation in Kalimantan, survey routes were mostly dictated by the course of rivers and roads and were not randomly chosen. Additionally, 32 days were spent in Sabah, Sarawak, and Brunei. Figure 1 shows the survey routes. Interviews were conducted in a semi-structured fashion. Questions were asked in Indonesian, which is also understood in

the Malaysian states and Brunei. Interviews always started as an informal conversation, and if the informant knew about general wildlife subjects, the interviews became more specific. As the orang-utan was the main focus of the larger part of the survey, questions initially addressed that particular species, after which information about other wildlife species was collected, including proboscis monkeys. Questions mostly concerned absence or presence of the species and threats to its survival. The anecdotal information used in this survey provides only subjective data, and information on absence of proboscis monkeys was not recorded. We only include locations from where the species was reported by at least two independent sources (c.f. Salter and MacKenzie, 1985).

Additional information was obtained from literature, and from biologists and conservationists working in Kalimantan. The Environmental Impact Assessment reports of Kalimantan's logging concessions also provided information on the present distribution of *N. larvatus*. A total of 115 reports were consulted.

All *N. larvatus* records were given a latitude/longitude coordinate and entered in a computerized geographic information system (GIS), using PC ArcInfo and PC ArcView software. Other data layers contain information on the 1993 forest cover [World Conservation Monitoring Centre (WCMC) data base], and topography. Habitat was classified according to personal observation, data from literature, and via personal communication. The distance from the *N. larvatus* locations to the coast was calculated by proximity analysis in the spatial query builder of PC ArcView. For analysis we only included recent data. This was arbitrarily taken as records (published) after 1980. We have listed all information on the occurrence of *N. larvatus*, regardless of the numbers in which they may occur. For the 15 of what are probably the largest populations we give an indication of population sizes based on personal observation, personal communication, and information in the literature, taking into account the approximate extend of suitable habitat. Population sizes are classified as: 1: < 100; 2: 100–1000; and 3: > 1000.

## 3. Results

### 3.1. Distribution

Groups of *N. larvatus* were observed at 30 locations during the survey, and an additional 123 records were derived from literature and interviews (Fig. 2, Appendix 1). The species is scattered throughout Borneo from the mangroves and small islands in the coastal deltas, along virtually all major rivers to numerous inland sites. Eight per cent (12/153) of the presence reports were > 200 km directly inland from the coast; 18% ( $n = 28$ ) between 100 and 200 km; 16% ( $n = 25$ ) between 50 and 100 km;

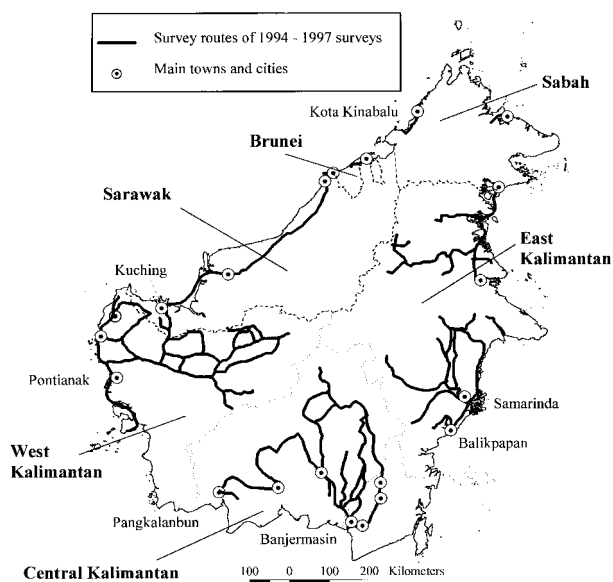


Fig. 1. Area covered during the 1994–1997 survey. Thick lines indicate the survey routes.

and 58% ( $n = 88$ ) < 50 km from the coast. Distances to the coast following the course of the rivers are even larger, often > 300 km, and sometimes as much as 750 km. Our

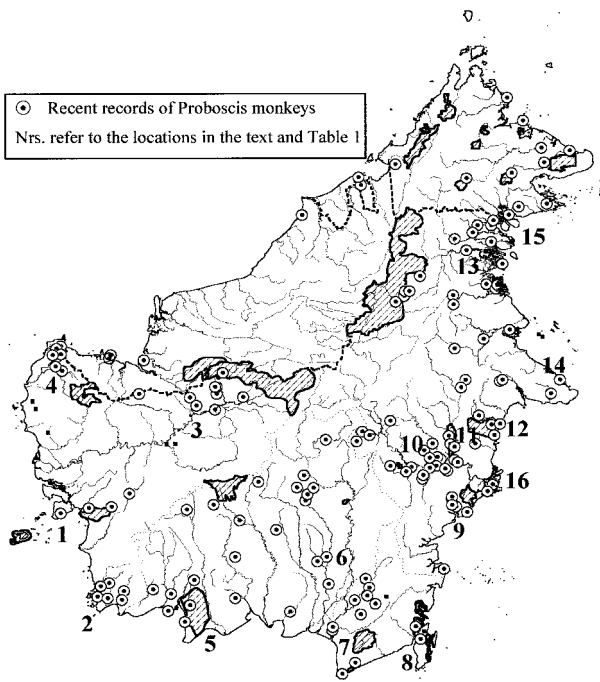


Fig. 2. The 153 recent records of proboscis monkey (*Nasalis larvatus*) on Borneo as mentioned in the text. The numbers 1–16 refer to priority areas for *N. larvatus* mentioned in the text and Table 1. Protected areas in Borneo are cross-hatched.

data suggest that *N. larvatus* does not occur at high altitudes. Over 90% ( $n = 138$ ) of the presence records were from altitudes < 200 m a.s.l., and the highest reports are from ca. 350 m a.s.l. (c.f. Medway, 1977). The occurrence of inland groups have sometimes been thought to consist of wandering males only (C. Yeager, pers. comm.). It is, therefore, important to note that our inland sightings included groups of *N. larvatus* comprising juveniles and females with dependent young.

Within Kalimantan large populations have been reported from Danau Sentarum Wildlife Reserve (No. 3 in Fig. 2 and Table 1. Protected areas in Borneo are cross-hatched; ca. 600, Sebastian, 1994), and from Gunung Palung National Park (No. 1; “several hundreds”, Yeager and Blondal, 1992), Tanjung Puting National Park (No. 5; ca. 2000, Yeager and Blondal, 1992), and the Mahakam delta (No. 16; 600–900, Alikodra et al., 1992). Our data indicate that within Kalimantan a number of other areas remain where there are relatively large populations of *N. larvatus*. Notably, this includes the delta of the Sungai Sesayap (Sungai = River, hereafter abbreviated as “S.”), S. Sembakung and S. Sebuku (No. 15), the Mahakam lakes area (No. 10), the fresh water and peat swamp forest areas of central Kalimantan (No. 6), and the Kendawangan area (No. 2).

### 3.2. Threats

The only direct threat to the survival of *N. larvatus* recorded during this study was hunting. Hunting was

Table 1  
Priority areas for the protection of proboscis monkeys *Nasalis larvatus* in Kalimantan, Indonesia

No. <sup>a</sup>	Priority areas <sup>b</sup>	Status <sup>c</sup>	Numbers <sup>d</sup>	Habitat <sup>e</sup>	Main threats	References <sup>f</sup>
1	G. Palung	NP	2	F, P, Ri, LoD	Illegal logging	2, 3
2	Kendawangan	NR	2–3	F, P	Illegal logging	4, 5
3	Danau Sentarum	WR	2–3	F, P, Ri	Fire, hunting, logging	1, 6, 15
4	Sambas Paloh	UNP	2	Ni, Ma, LoD, P	Logging	1, 7, 8
5	Tanjung Puting	NP	3	F, P, LoD	Goldmining, logging, hunting	1, 3
6	Cent. Kal. Rivers	NR/UNP	2–3	F, P, Ri	Swamp reclamation	1
7	Lower S. Barito	UNP	2	Ri	Logging	1
8	P. Laut	UNP	?	Ri, LoD, F	Logging	9
9	Balikpapan Bay	UNP	1–2	Ri, Ma, F	Logging	1
10	S. Mahakam and Lakes	UNP	2	Ri, F, P	Logging, disturbance, hunting	1, 5, 8, 14
11	S. Kedang Kepala	NR/UNP	1–2	Ri, F, P	Logging, fire	1
12	Kutai	NP	1	Ri, F, P, LoD	Logging, fire	1, 10, 11, 12
13	S. Kayan	UNP	1	Ri, F, Ma, Ni	Logging, hunting	1, 8
14	Sangkulirang	UNP	1–2	Ri, F, Ma, Ni	Logging	1, 13
15	S. Sesayap, S. Sebuku, S. Sembakung	UNP	3	Ri, Ma, Ni, F	Shrimp farming, logging	1, 5, 16
16	Mahakam Delta	UNP	2	Ma, Ni	Shrimp farming, logging	17

<sup>a</sup> Cf. Fig. 2

<sup>b</sup> G = Gunung (Mountain); P = Pulau (Island); S = Sungai (River).

<sup>c</sup> NP = National Park; NR = Nature Reserve; WR = Wildlife Reserve; UNP = unprotected.

<sup>d</sup> Indication of population sizes: 1 < 100 individuals; 2 100–1000 individuals; 3 > 1000 individuals. See text for details.

<sup>e</sup> Mangrove forest (M), Freshwater swamp (F), Peat swamp (P), Riverine (Ri), Lowland Dipterocarp (LoD), and Nipah palm (Ni).

<sup>f</sup> 1 = personal observation; 2. MacKinnon and Warsito, 1982; 3. Yeager and Blondal, 1992; 4. Noor and Hanafia, 1994; 5. K. Jeanes, pers. comm.; 6. Sebastian, 1994; 7. McCarthy, 1991; 8. Silvius et al., 1987; 9. W. Smits pers. comm.; 10. Suzuki, 1984; 11. MacKinnon et al., 1994; 12. Rodman, 1978; 13. Wibowo pers. comm.; 14. R. Sözer pers. comm.; 15. R. Dennis pers. comm.; 16. Momberg et al., 1998; 17. Alikodra et al., 1992.

reported at six locations during the 3 year surveys. In the northern Mahakam lakes, in East Kalimantan, *N. larvatus* is increasingly hunted to serve as bait for monitor lizards (*Varanus salvator*), whose skins are highly valued. Further inland the species is hunted for food (R. Sözer, pers. comm). In the Danau Sentarum Wildlife Reserve, West Kalimantan, at least two proboscis monkeys were shot by army or police hunters in late 1996 (R. Dennis, pers. comm.). Iban people from the area north of the Reserve will opportunistically shoot the monkeys while on turtle hunting expeditions during the dry season, much to the annoyance of local Muslim fishermen (pers. obs.). Three instances of hunting along the S. Kayan and S. Pangean (where the species is rare) were reported by two Dayak hunters in 1996. Finally, it was reported by inhabitants of Tanjung Selor and its surroundings, East Kalimantan, that since the early 1990s the population of proboscis monkeys had declined dramatically due to hunting by non-Muslim Dayaks.

Another threat to *N. larvatus* survival is habitat destruction. Table 1 shows that in the 16 priority areas for protection, the main factors contributing to habitat destruction are logging (both legal and illegal), forest fire, gold mining, swamp reclamation and shrimp farming. Unfortunately, the proboscis monkey's specialised habitat coincides with the areas on Borneo that are the first to be colonised, farmed, industrialised, and least protected by man. Table 2 shows that of the most important *N. larvatus* habitat types, only ca. 39% has survived, of which 15% is protected. Hereby we need to note that the data in Table 2 are based on MacKinnon and Artha's 1981 study, as no more recent data are publicly available. After almost two decades of a continuous logging regime (for reviews see Sunderlin and Resosudarmo 1996, Rijkssen and Meijaard, in press) considerably less habitat remains.

During the survey only seven instances of proboscis monkeys held in captivity were reported or recorded (D. Kreb, pers. comm.; W. Smits, pers. comm.; R. Sözer, pers. comm., pers. observ.), and capturing for the pet trade does not appear to be a serious threat.

## 4. Discussion

### 4.1. Distribution

Early work on this species suggested that *N. larvatus* was dependent on mangrove forests for food and cover (e.g. Davies, 1962; Kawabe and Mano, 1972; Kern, 1962). Bennett and Gombek's (1993) map showed the species to be largely restricted to coastal and nearby swamp forest, while Oates et al. (1994), Chivers and Burton (1988) and Bodmer et al. (1991) all considered it to be an essentially coastal species with rare individuals inland. However, it was certainly not just a coastal species in the past. The most detailed accounts of *N. larvatus* historic distribution are given by Zondag (1931) who includes all downstream parts of essentially all major rivers in what is now East, Central and South Kalimantan, but also several upstream areas: middle and upper S. Kahayan; middle and upper S. Kapuas (Central Kalimantan); middle S. Barito; middle S. Kayan; upper S. Sesayap. Upstream areas were also given by Westermann (1938), Gyldenstolpe (1920) and Pfeffer (1958): S. Kedang Kepala, upper Barito, S. Murung (the same S. Murung as in Chivers and Burton, 1987 and Bodmer et al., 1991), middle Mahakam, Tumbang Maruwe on the upper S. Barito, S. Liang, and S. Nggang. Other earlier upstream records were by Van der Aa (1884) and Jentink (1897).

Our own records show that proboscis monkey populations are still present in the upstream parts of Borneo's rivers. Because of the small numbers observed inland, it appears that proboscis monkeys are most frequent in coastal areas, with the possible exception of the inland swamps surrounding the Danau Sentarum and Mahakam lakes. Owing to the nature of our study we cannot provide estimates of (a change in) population numbers.

### 4.2. Threats

In the interior of Borneo hunting appears to be an important supplement to rural people's diet and all

Table 2  
Proboscis monkey habitat (km<sup>2</sup>) in Kalimantan (after MacKinnon et al., 1996)

Vegetation type	Original area	Total remaining (1995) (% of original area)	Total in reserves (% of total remaining)
Freshwater swamps	38,950	17,170 (44%)	3,620 (21%)
Peat swamps	44,030	35,310 (80%) <sup>a</sup>	2,570 (7%) <sup>a</sup>
Mangrove forest	15,600	9,200 (59%)	780 (8%)
Wet lowland forest (alluvium)	22,010	2,650 (12%)	160 (6%)
Moist lowland forest (alluvium)	870	250 (29%)	0
Dry lowland forest (alluvium)	210	0	0

<sup>a</sup> A total of 17,000 km<sup>2</sup> of land, originally designated as protected forest will be used for agricultural purposes in the Central-Kalimantan province (Jakarta Post, 18 November 1996). The majority of this area consists of peat swamp forest. The total area of peat swamp forest in Kalimantan remaining will be some 18,300 km<sup>2</sup> or 42% of the original area, of which 2570 km<sup>2</sup>, or 14% of the remaining total, will be inside a protected area.

primates including *N. larvatus* are hunted when the opportunity arises (Van der Aa, 1884; Pfeffer, 1958; Caldecott, 1992). Additionally, *N. larvatus* is sometimes hunted for the highly valued *bezoar* stones which are sometimes found in the intestines of this and other Colobine species, and used in traditional Chinese medicine (Banks, 1931; Westermann, 1938). Jeffrey (1982), working in east Kalimantan, found that hunting and farming had eliminated proboscis monkeys from large areas of river and coast. Likewise, in Sarawak, Bennett (1988) reports hunting to be a major threat to *N. larvatus*. Davies and Payne (1982) mention an increase in hunting throughout the mangroves of Sabah's west coast, and in several localities the species is now rare or absent in places where they were once common. The decrease in abundance occurred markedly within the past 10–35 years, coinciding with guns and outboard motors becoming available to local people (Davies and Payne, 1982).

The results of our survey indicate that *N. larvatus* is hunted both inland and in coastal areas. There is a possibility that hunting in the coastal areas is mainly limited to Dayak people and sport hunters, because for the Muslims, who predominate along the coast, consumption of monkeys is forbidden (Cleary and Eaton, 1992). Jentink (1897) already noted this along the S. Kapuas. There are indications (mainly information from interviewees) that hunting by indigenous people (especially since the availability of guns and outboard motors) has had a significant impact on populations of *N. larvatus*. Not only the larger rivers, but now also most smaller rivers have become easily accessible because of an extensive network of logging roads.

The occurrence of *N. larvatus* close to waterways and its lower densities in inland areas have been explained by limited food availability, shortage of essential resources, and competition with other primates (e.g. Bennett and Sebastian, 1988). However, our data suggest that hunting might be a factor largely overlooked. Hunting has been, at least until recently, restricted to Borneo's interior, and may have reduced population densities and caused local extinctions. In those areas in Kalimantan's interior where hunting is traditionally forbidden for the local Muslim fishermen, e.g. Danau Sentarum and surroundings and the Mahakam lake area, the species thrives. Therefore, it is worth noting that a hunting-related distribution pattern has also been found for the orang-utan, another lowland specialist primate on Borneo (Rijksen and Meijaard, in press).

The major cause for the recent decline of *N. larvatus* has undoubtedly been habitat destruction (Wilson and Wilson, 1975; Salter and MacKenzie, 1985; MacKinnon, 1987), since this primate frequents some of the riverine habitats most favoured by people for logging, cultivation, and village settlement. As an illustration (Fig. 3) we show the planned land use in the province of Central Kalimantan. This indicates that almost all of the most

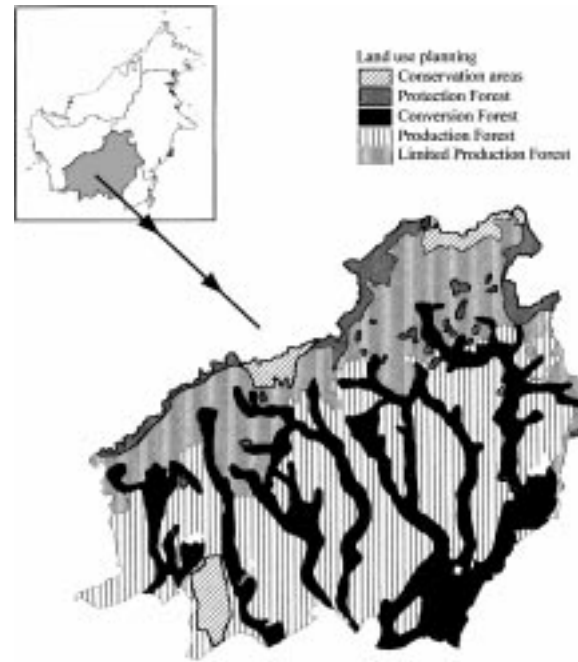


Fig. 3. The land use planning in Central Kalimantan, Indonesia, based on forest use classification (TGHK) maps.

suitable habitat, i.e. riverine forest is scheduled for conversion. Watershed protection forest and protected areas (with the exception of Tanjung Puting National Park) are situated in upland areas. Within the remaining habitat populations are being fragmented (Yeager and Blondal, 1992; MacKinnon, 1987; Sebastian, 1994). The main factors limiting migration along and across rivers are the extensive use of waterways and river banks by humans and the severe degradation and conversion of the forest along the rivers. Furthermore, the species' association with the riverine forest combined with the preference for low altitudes may limit migration between river systems.

Finally, forest fires appear to be an increasingly serious threat to *N. larvatus* habitat. Fuller and Fulk (1998) report that fire hot spots during the 1997–1998 forest fires were more likely to occur near rivers. Yeager and Frederiksson (1998) state that proboscis monkey probably has the greatest proportion of its remaining habitat destroyed by fire of any primate in Kalimantan.

#### 4.3. Failing conservation in Kalimantan

Out of the 16 priority areas for conservation described in Table 1, seven are (partially) included in the protected area network system of Kalimantan. In at least four of these areas conservation measures seem to be completely inadequate for the long-term protection of the proboscis monkey populations.

1. Pulau Kaget (included in No 7 in Table 1), a 0.85 km<sup>2</sup> reserve was gazetted on this island in 1985, mainly for the preservation of a relatively large

population of *N. larvatus*. When visited by EM in 1996 only ca. 10% of the reserve was covered with forest, 90% was agricultural land. Many of the remaining trees had been ring-barked or poisoned and were dying. At that time, an estimated 300 proboscis monkeys remained (Purwasuka, pers. comm.). In 1999 it was reported that proboscis monkeys were dying due to lack of food and loss of habitat. The conservation authorities concluded that all monkeys had to be evacuated to nearby unprotected islands. So far 130 animals have been translocated and ca. 60 have been brought to Surabaya Zoo and Taman Safari Zoo, both on Java (Anonymous, 1999).

2. Tanjung Puting (No. 5; 3000 km<sup>2</sup>): this area contains the largest protected population of *N. larvatus*. Nevertheless it has been badly affected by illegal logging, gold mining, and forest fires. Logging inside the park has left behind large patches of poorly regenerating fern wilderness on sand. Due to gold mining operations, north of the park, the original tea coloured waters of the black-water river of the park have permanently turned into thin mud solution containing > 200 times the toxic level of mercury (Rijksen and Meijaard, in press). River traffic has increased from ca. 10–15 boats per month during 1984–1985 to an average of 27.5 boats per day in 1989, making it difficult for proboscis monkeys to cross the river (Yeager and Blondal, 1992). Burned freshwater forest in Tanjung Puting lost ca. 75% of its tree stands in 1997 and almost all vegetation had been reduced to charcoal (Yeager, 1998).
3. Kutai National Park (No. 12; 1980 km<sup>2</sup>): this reserve was established in the 1930s. In the late 1960s, however, a large sector of the reserve was given out as a timber concession, and the coastal lowlands were soon occupied by illegal settlers. In the 1970s two large industrial complexes were established in the reserve and a third of the area was degazetted (MacKinnon et al., 1994; Rijksen and Meijaard, in press). Major forest fires occurred in this park in 1982–1983, 1987 and 1998, and an estimated 5% remains forested. For proboscis monkeys the area has lost its value.
4. Kendawangan Nature Reserve (No. 2; 650 km<sup>2</sup>): although gazetted in 1981, strengthened in 1982, and demarcated in 1992, the Kendawangan Nature Reserve does no longer appear on the official map of conservation areas in Indonesia. In 1997, conservation officials recommended that conservation efforts in the area should be halted as the reserve was too isolated and illegal logging was rampant.

The above mentioned examples demonstrate that in situ conservation of proboscis monkeys on Kalimantan

has been problematic. Conservation authorities seem to be failing at different fronts. Even though the species is legally protected, law enforcement is weak. During the survey, only once active law enforcement with reference to proboscis monkey was observed, when an animal trader was apprehended, although many illegal activities (including hunting, illegal logging, disturbance and capturing) were encountered and reported to the authorities. Within reserves the situation seems to differ little from areas outside the protected area network. It is important to note that law enforcement seems to be equally lax independent of the status of the area (National Parks, nature reserves or wildlife reserves), its remoteness, its size, and the time since its gazettelement.

For ex-situ conservation the odds do not seem to be any better. The species requires a specialised diet and is difficult to maintain in captivity (Collins and Roberts, 1978). Relatively few proboscis monkeys have been kept in international zoos, and in general these animals did not seem to thrive (Kern, 1964). No European zoos hold the species at the moment, while in North America two males and a female remain in the Bronx Zoo, New York (K. Brouwer, in litt. Nov. 1997). A number of Indonesian zoos do have ca. 70 animals on display (R. Sözer pers. comm., 1998; Anon, 1999). Neither the European nor the North American zoos have included the species in their regional collection plans for primates. Considering the above, and, more importantly, in view of the lack of release sites (without a resident population), ex-situ conservation will contribute little to the survival of the species.

We have demonstrated that *N. larvatus* has declined in parts of East Kalimantan, Sabah and Sarawak. For the other parts of the species range hard data are not yet available, but we expect the trend to be similar. Of the species potentially suitable habitat ca. 39% remained in 1981, and possibly much less now. This study indicates that the distribution range was larger than previously assumed, and subsequently the reduction in population numbers must have been more drastic. Evidence is lacking, but, based on our study, the conservation authorities should seriously question whether the species can persist under the present conservation regime or that it is facing a nose dive to extinction.

## 5. Conclusions

It is beyond the scope of the present study to address the underlying causes of the failure of the Indonesian conservation authorities (and conservation NGOs) to safeguard either the proboscis monkeys or their habitat. What is clear, however, is that if sufficiently large areas of habitat can be protected and persistent law-enforcement can be ensured, *N. larvatus* could survive. Because

of their spectacular appearance and ease of observation in the wild the species is an excellent tourist attraction. If eco-tourism is well-guided and disturbance levels can be kept low, the species may serve as a flagship for many protected wetland sites.

Several unprotected areas may still provide enough habitat for viable populations of *N. larvatus*. The improved protection of the following areas (see Fig. 2) would significantly increase the survival of this primate: (1) The extensive and largely pristine mangroves and peat swamp forests of the S. Sebuk, S. Sesayap and S. Sembakung delta; (2) The 80,000 ha area of little disturbed swamp forest to the north of the Mahakam Lakes and west of the Muara Kaman Nature Reserve; (3) Kendawangan Nature Reserve; (4) Danau Sentarum Wildlife Reserve; (5) Tanjung Puting National Park, and (6) Gunung Palung National Park.

### Acknowledgements

We thank the Indonesian Institute for Science (LIPI) for sponsoring our research and the Directorate General of Forest Protection and Nature Conservation (PHPA) for their cooperation. The help of Dr A. Rachmat (KSDA, Samarinda) is kindly acknowledged. The WWF-Indonesia, and in particular Mr A. Purmono, Dr T.C. Jessup, Dr C. Eghenter, are thanked for their cooperation.

Financial support was received from the Society for the Advancement of Research in the Tropics (VN), the Netherlands Foundation for International Nature Protection (VN, EM), the World Society for the Protection of Animals, World Wide Fund for Nature Netherlands, the Balikpapan Orang Utan Society and the Lucie Burgers Foundation for Behaviour Studies (EM).

We want to thank all people who generously shared their proboscis monkey data with us, or otherwise provided information, amongst which Dr W.T.M. Smits (Tropenbos-Kalimantan Programme), Dr R. Puri (East West Centre, Hawaii), G. Limberg (formerly WWF-IP), R. Sözer (ISP/ZMA, University of Amsterdam), D. Krebs (ISP/ZMA), R. Dennis (formerly ODA-Wetlands International), A. Erman (ODA-Wetlands International), G. Frederiksson (ISP/ZMA-Wanariset), S. van Balen (Wageningen Agricultural University); K. Jeanes (formerly ODA-Wetlands International), P. Jepson (formerly Birdlife International), Wibowo (Wetlands International), and K. Brouwer (European Association of Zoos and Aquariums).

Finally, comments on earlier drafts were received from Dr H. Albrecht (Dept. Animal Behaviour, University of Amsterdam), Dr D. Kitchener (WWF Indonesia Programme), and S. van Balen. Dr B.N.K. Davis and two anonymous reviewers made constructive comments on the manuscript.

### Appendix A

Localities (records published after 1980) where Proboscis monkeys *Nasalis larvatus* have been recorded in Kalimantan, Indonesia, the Malaysian states of Sarawak and Sabah, and Brunei. (D = Danau = Lake; G = Gunung = Mountain; S = Sungai = River; P = Pulau = Island; PT = Perseroan Terbatas = Inc. or Ltd.)

#### West Kalimantan

Benua Martinus [112°25/1°07N]; Danau Sentarum WR [112°03/0°47 N]; G. Palung NP [110°05/1°06 S]; G. Senuju [109°29/1°30 N]; Hutan Sambas [109°26/1°43 N]; Muara Kendawangan [110°27/2°28 S]; PT Duadja Corporation II [110°49/0°50 S]; PT Erna Djuliawati [111°52/1°08 S]; PT Jamaker KalBar Bl. Nanga Sei [111°00/1°00 N]; PT Jamaker KalBar Blok S. Haji [109°30/1°40 N]; PT Jamaker KalBar Blok Unit 1 [109°30/1°50 N]; PT Jamaker KalBar Jaya Bl. Lanjak [112°25/1°00 N]; PT Jamaker KalBar S. Sentimau [109°36/1°25 N]; PT Sinar West Kalimantan Timber [110°43/2°37 S]; PT Sumber Jaya Baru Utama [110°30/1°05 S]; S. Bangkul Besar [110°25/2°45 S]; S. Blamban [110°14/2°43 S]; S. Embaloh [112°23/1°07 N]; S. Embaloh Ulu [112°32/1°23 N]; S. Membuluh [110°18/2°32 S]; S. Mentangan [110°41/2°47 S]; S. Seriang [111°56/0°56 N]; S. Tang [112°29/0°39 N]; Tanjung Satay [109°34/1°12 S]; upper S. Kapuas [112°54/0°56 N].

Sources: MacKinnon and Artha, 1981; MacKinnon and Warsito, 1982; MacKinnon et al., 1996; Noor and Hanafia, 1994; Silvius et al., 1987; Sebastian, 1994; Yanuar et al., unpubl. data; R. Dennis, pers. comm.; S. van Balen pers. comm.; pers. observ.

#### Central Kalimantan

PT Bina Samaktha [112°00/2°25 S]; PT Bintang Arut [111°35/2°40 S]; PT Brata Jaya Utama [113°45/3°00 S]; PT Carus Indonesia [113°10/0°37 S]; PT Gajah Seno Sakti [112°45/2°45 S]; PT Gunung Meranti [114°00/0°30 S]; PT Hutan Mulya [112°50/1°20 S]; PT Rathitara [113°30/1°30 S]; PT Sehati Barito, S. Bila [111°15/2°35 S]; PT Yusmin Trading [112°45/2°00 S]; S. Dason [114°58/0°07 N]; S. Gula [114°11/0°44 S]; S. Hanyu [114°02/0°58 S]; S. Kapuas Murung [114°25/2°25 S]; S. Mandau [113°53/0°43 S]; S. Mengkutup [114°15/2°05 S]; S. Murung PT LAAS [114°24/0°09 N]; S. Pinang [114°04/0°51 S]; Tanjung Penghujan [111°32/2°59 S]; Tanjung Puting extension [111°50/3°11 S]; Tanjung Puting NP [111°56/2°53 S]; Tumbang Mahub [112°21/1°02 S].

Sources: Bodmer et al., 1991; Chivers and Burton, 1988; MacKinnon and Artha, 1981; MacKinnon et al., 1996; Payne et al., 1985; Silvius et al., 1987; Yeager and Blondal, 1992; Yanuar et al., unpubl. data; S. van Balen pers. comm.; pers. observ.

### South Kalimantan

Hutan Bakau Pantai Timur [116°02/3°16 S]; Muara Muning [114°50/2°50 S]; P. Kaget [114°31/3°20 S]; P. Kembang [114°32/3°17 S]; P. Laut [116°13/3°48 S]; P. Pinang [115°03/3°05 S]; Pleihari Martapura [114°56/3°56 S]; Pleihari Tanah Laut [114°41/4°08 S]; S. Kacang [115°10/2°40 S]; S. Negara [114°56/2°47 S]; S. Tapin [115°15/2°55 S].

Sources: MacKinnon and Artha, 1981; MacKinnon et al., 1996; Silvius et al., 1987; S. van Balen pers. comm.; pers. observ.

### East Kalimantan

Balikpapan Bay [116°43/1°03 S]; Balikpapan Bay, north [116°42/0°55 S]; Bunua Puhun, S. Mahakam [116°49/0°16 S]; D. Jempang [116°10/0°34 S]; D. Kendang Murung [116°35/0°23 S]; D. Wis [116°11/0°30 S]; D. Melintang [116°18/0°22 S]; D. Semayang [116°25/0°20 S]; Lamin Pulut [116°16/0°01 S]; Lower Mahakam delta [117°21/0°48 S]; Mahakam delta [117°27/0°40 S]; Miau Baru [116°57/1°15 N]; Muara Kayan [117°32/2°59 N]; Muara Sebuku [117°28/4°10 N]; PT Adindo Hutani Lestari [116°45/3°50 N]; PT Alas Helau [116°45/1°50 N]; PT Daisy Timber [118°40/1°15 N]; PT Dana Mula Bhakti [117°25/3°47 N]; PT ITCI-Weyerhäuser [116°43/0°53 S]; PT Jaya Maha Kerta [117°10/4°05 N]; PT Rejosari Bumi [117°45/2°10 N]; PT Surya Hutani Jaya [117°08/0°05 N]; PT Timberdana [115°35/0°20 S]; PT Tungal Yudi Sawmill Plywood [115°35/0°30 N]; S. Alango Ulu [115°56/2°52 N]; S. Baai [117°38/1°15 N]; S. Bahau Long Alango [115°51/2°52 N]; S. Bahau Long Peleran [115°50/2°47 N]; S. Bulungan [117°30/2°55 N]; S. Jelau [115°52/0°26 S]; S. Kahala [116°21/0°05 S]; S. Karang [117°51/1°14 N]; S. Kayan [116°43/2°48 N]; S. Kedang Kepala [116°41/0°04 N]; S. Kedang Rantau [116°45/0°01 N]; S. Kelai Long Lanuk [117°17/2°00 N]; S. Kendang [116°37/0°25 S]; S. Kendang Pahu [115°58/0°21 S]; S. Lurah [115°41/2°41 N]; S. Mahakam, Long Bagun [115°04/0°18 N]; S. Pangean [116°44/2°38 N]; S. Ratah [115°12/0°14 N]; S. Samboja [116°59/1°11 S]; S. Sebukuh [117°25/4°05 N]; S. Sebukuh [117°05/3°57 N]; S. Sembakung [117°20/3°48 N]; S. Sengatta, Kutai NP [117°26/0°26 N]; S. Sesayap [116°58/3°37 N]; S. Tubu [116°07/3°09 N]; S. Wahau [116°52/1°07 N]; Sangkulirang [118°31/1°00 N]; Senggata estuary [117°35/0°27 N]; S. Wain [116°47/1°05 S]; Tarakan [117°37/3°22 N]; Teluk Apar/ Teluk Adang [116°34/2°13 S]; Teluk Kaba [117°29/0°14 N]; Teratak, S. Mahakam [116°45/0°13 S]; Tubuan [116°18/0°11 S]; upper S. Senggata [117°12/0°36 N]; West of Muara Kaman NR [116°39/0°13 N].

Sources: Alikodra et al., 1992; Azuma and Suzuki, 1984; Jeffrey 1982; MacKinnon and Artha, 1981; MacKinnon et al., 1996; Momberg et al., 1998; Silvius

et al., 1987; Suzuki, 1984; Yanuar et al., unpubl. data; Yasuma, 1994; S. van Balen pers. comm.; G. Frederiksson, pers. comm.; D. Krebs, pers. comm.; G. Limberg pers. comm.; McCarthy, pers. comm.; R. Puri, pers. comm.; R. Sözer, pers. comm.; P. Jepson, pers. comm.; pers. observ.

### Sarawak

Bako NP [110°29/1°43 N]; Limbang mangroves [115°03/4°49 N]; S. Sarawak [110°27/1°39]; West of Miri (113°45/3°50 N); P. Bruit [111°21/2°34 N]; Rajang Delta [111°30/2°24 N]; Rajang Mangrove [111°21/2°13 N]; S. Maludam [111°14/1°28 N]; Samunsam wildlife sanctuary [109°35/1.52 N]; Trisu and Maludam peat swamps [111°05/1°37 N].

Sources: Bennett, 1988; Bennett and Sebastian, 1988; Bennett et al., 1997; MacKinnon et al., 1996; Payne et al., 1985; Salter and MacKenzie, 1985; Salter et al., 1985.

### Brunei

S. Brunei [115°00/4°58 N]; Brunei Bay [115°10/4°58 N].

Sources: MacDonald, 1982; MacKinnon et al., 1996; Payne et al., 1985; Yeager, 1989.

### Sabah

Cowle delta [117°55/4°25 N]; Danum Valley [117°47/5°02 N]; Eastern deltas [118°50/5°27 N]; Kabili-Sepilok Forest Reserve [117°59/5°49 N]; Kelompok G. Asuan-sang [109°35/1°43 N]; Kinabatangan [118°20/5°30 N]; Klias Peninsula [115°30/5°20 N]; Kulamba Wildlife Reserve [118°02/5°40 N]; Lawas Mangroves [115°27/4°55 N]; Maliau Basin [116°50/4°45 N]; Padas Bay [115°30/5°10 N]; P. Sebatik [117°55/4°25 N]; S. Sugut, middle reaches [117°29/6°17 N]; Salim Batu [117°20/3°00 N]; Samporna lowlands [118°26/4°28 N]; Sandakan peninsula [118°00/6°00 N]; Segama [118°23/5°14 N]; Sungut delta [117°43/6°25 N]; Tempasuk Plain [116°25/6°28 N]; Trusan-Sundar Mangroves [115°14/4°55 N].

Sources: Davies and Payne, 1982; MacKinnon et al., 1996; Marsh, 1995; Payne et al., 1985.

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