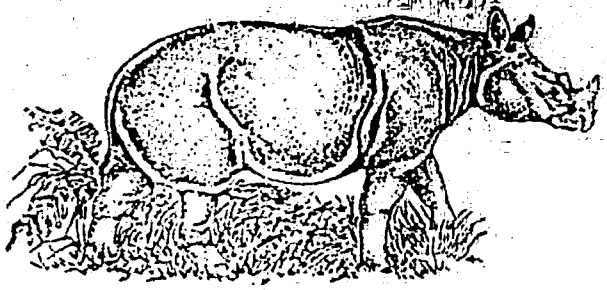
Blouch 1984

CURRENT STATUS OF THE SUMATRAN RHINO AND OTHER LARGE MAMMALS IN SOUTHERN SUMATRA

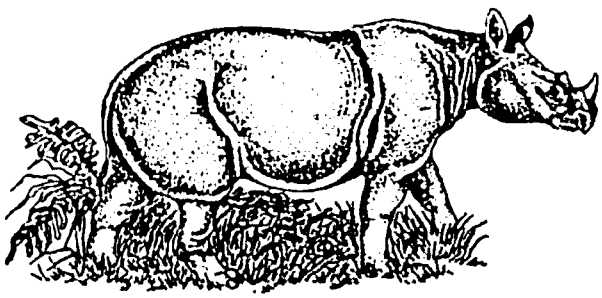


A WORLD WILDLIFE FUND REPORT

PREPARED FOR THE DIRECTORATE GENERAL OF FOREST PROTECTION AND NATURE CONSERVATION (PHPA)

BOGOR JUNE 1984

CURRENT STATUS OF THE SUMATRAN RHINO AND OTHER LARGE MAMMALS IN SOUTHERN SUMATRA



A WORLD WILDLIFE FUND REPORT

PREPARED FOR THE DIRECTORATE GENERAL OF FOREST PROTECTION AND NATURE CONSERVATION (P H P A)

BOGOR JUNE 1984

IUCN/WWF Report No. 4
Project 3033 Field Report

CURRENT STATUS OF THE SUMATRAN RHINO AND OTHER LARGE MAMMALS IN SOUTHERN SUMATRA

Prepared for
The Directorate General of Forest Protection
and Nature Conservation (PHPA)

by

Raleigh A. Blouch

IUCN/WWF Conservation for Development Programme
Bogor, June 1984

TABLE OF CONTENTS

This report presents information on the current distribution, abundance, and habitat preferences of large mammals in the four southern provinces on the Indonesian island of Sumatra (Lampung, Sumatra Selatan, Bengkulu, and Jambi). Some of these data were obtained during an elephant (Elephas maximus) survey conducted from June - November 1983. Further field work in January and February 1984 concentrated on the Sumatran rhinoceros (Dicerorhinus sumatrensis) and was done with financial assistance from the American Association of Zoological Parks and Aquariums. The Sumatran rhino is the main subject of this report which also includes data on Malayan tapir (Tapirus indicus), tiger (Panthera tigris), sambar (Cervus unicolor), Malayan sun bear (Helarctos malayanus), Asia wild dog (Cuon alpinus), bearded pig (Sus barbatus) serow (Capricornis sumatraensis), clouded leopard (Neofelis nebulosa), and Sumatran hare (Nesolagus netscheri). Elephants were covered in an earlier report (Blouch and Haryanto, 1984).

Information on the distribution and relative abundance of rhinos was obtained during six expeditons into potential rhino habitat varying in length of from three to seven days each. No rhinos were directly observed. Evidence of rhino abundance was based on observations of tracks, feces, signs of feeding, urine, and wallows. The extent of established trail systems was not used as an indicator of rhino abundance since these are usually created and maintained by other animals as well, including tapirs, elephants, and humans. We were particularly on the lookout for signs and information of recent hunting. Counts of tracks, feces, and observations of other mammals were also made.

Much information on mammals other than rhino was obtained on shorter walks of less than a day each and was recorded along with observations on the type of habitat and its degree of human disturbance. Reliable reports by local people and parts of animals in their possession were also noted.

SUMATRAN RHINO

The Sumatran rhino is one of the most seriously endangered species of large mammals in the world. Due to decades of uncontrolled hunting and habitat destruction it now exists only in small isolated populations found in the most inaccessible areas of Burma, Thailand, Malaysia and Indonesia. Although there may be more rhinos remaining in Sumatra than in any other region, relatively little is known about their current status and distribution here outside of the Gunung Leuser National Park. The most recent survey of this species on the island was done from 1973 through 1975 by Borner (1979). Newer incidental observations are presented in a report to the IUCN/SSC Asian Rhino Specialist Group by van Strien and Widodo (1982).

Most of the potential rhino habitat in southern Sumatra is included within the two recently declared national parks of Kerinci-Seblat and Bukit Barisan Selatan, both of which were already known to contain rhinos. Since these parks will play an important role in the conservation of the species, four of the areas we surveyed were within their boundaries. We also checked the Mt. Patah area which lies north of Bukit Barisan Selatan Park and was the only place outside of the national parks which seemed likely to harbor rhinos, although none had ever been definitely reported from here. The Berbak Wildlife Reserve in the lowlands on the east coast was also visited since there had been conflicting reports as to their continued existence in these peat swamp forests.

The Javan rhino (Rhinoceros sondaicus) is assumed to be extinct in Sumatra, and we found no evidence to dispute this assumption. In this report the term "rhino" always refers to the Sumatran rhinoceros.

Since no direct observations of rhinos were made during this survey, all evidence of their presence and abundance is based on observation of their tracks, signs of feeding, feces, urine, and

wallows. Tapir and rhino are often found in the same habitats in southern Sumatra and care must be taken to distinguish between their sign since a large tapir is as big as a small rhino. So that the results of this survey can be more easily compared with the results of other field work a summary of the criteria used to determine rhino sign is given below.

Several earlier authors cited by van Strien (1975) give a range of widths of rhino tracks varying from 14 cm to 24.8 cm. This is the measurement from edge of inner toe to edge of outer toe and includes both forefeet and hindfeet. Width of central nails ranges from 5 cm to 8.9 cm. Tapir tracks measured during this survey had widths of 13 cm to 16 cm (not including the fourth toe of the forefoot which occasionally is visible in prints) and central nails up to 5 cm wide. We interpreted tracks as being made by rhino if they were at least 18 cm wide unless it could be seen that an animal with a smaller track was travelling with a rhino, in which case the smaller animal was assumed to be a rhino calf.

Three fresh feces piles made by a single adult tapir at the Ragunan Zoo in Jakarta measured 34 cm X 33 cm, 21 cm X 20 cm, and 13 cm X 11 cm, with the widths measured at the broadest part at right angles to the lengths. These measurements are similar to what we found in the field. Therefore fresh feces piles measuring at least 40 cm X 30 cm were interpreted as rhino sign. Both rhinos and tapirs will sometimes scratch dirt and leaves onto their feces immediately after defecation although this seems to be more often done by tapirs. With the feces of both species individual balls of dung are often not easily distinguishable, vary greatly in size and shape, and disintegrate quickly; therefore size of dung balls was not useful in differentiating between the two species.

The keeper of the tapirs at the Ragunan Zoo reports that both male and female tapirs there always urinate downward; he had never seen one spray its urine behind as a rhino typically does. There-

fore urine drops sprayed over vegetation about 50 cm above the ground was interpreted as evidence of a rhino.

In order to browse on leaves above their reach rhinos often push down and walk over saplings of from 2.5 cm to 5 cm in diameter, leaving them bent or broken at near ground level. This feeding method is well described by Borner (1979), and we interpreted the presence of such saplings definite evidence of rhino.

We frequently found saplings less than 2.5 cm in diameter that a rhino had taken in its mouth and, apparently with a twist of its head, snapped off at heights of between 100 cm and 135 cm above the ground before browsing on the leaves. Borner mentioned a "sapling with a diameter of 2 cm which the rhino had broken down with its teeth at a height of 110 cm", but this was the only occasion on which he observed this method of feeding. On the other hand, Strickland, as quoted by van Strien (1975), seemed to be familiar with this behaviour: "In some cases the trees are merely bent over or partially broken, but more frequently they are completely snapped off at anywhere from a few centimetres to two meters from the ground. The smaller trees are probably broken by the rhino, but the larger ones are broken by first bending them over and then stepping on them." Apparently no one has attributed this feeding method to tapirs, and indeed it seems unlikely that these smaller animals could conveniently break off saplings at heights above 100 cm. Our observations at Ragunan Zoo show that the normal height of a standing adult tapir's mouth is about 80 cm; although by extending their necks vertically they can feed on leaves up to a height of 140 cm, if a tapir were to break off a sapling with its mouth it could be done most efficiently with the head held nearly horizontally and therefore the break would occur less than a meter above the ground.

Kerinci-Seblat National Park

Kerinci-Seblat, declared a national park in 1982, comprises some 1,484,600 ha at elevations of between 300 m and 3,000 m (Fig. 1). It has not yet begun to be managed as a unit and various parts of it are under the administration of four different provincial offices of the Directorate General of Nature Conservation and Forest Protection (PHPA) which operate with little or no coordination. Although their numbers have begun to be increased during the past two years, there are still too few guards for this huge park. Patrolling into the forest is almost never done, and boundary patrols seem to be only slightly more frequent. Illegal settlements within the park are a problem which urgently needs to be dealt with; most are located along the rift valley running northwest from Tambang Sawah in Bengkulu to south of the Sungai Penuh enclave in Jambi.

But despite these troubles Kerinci-Seblat is still a valuable national park which contains vast areas of undisturbed sub-montane forest. There are about 4,000 km2 of potential rhino habitat within its boundaries and although only a small part of this has been field-checked the surveys made so far indicate that an extensive area of the park is inhabited by a population of rhinos that probably ranks as one of the largest remaining in the world. Borner (1979) thought there were from 15 to 20 rhinos in the area, but this must be considered an underestimate. The management plan for the park (FAO 1981b) states that there could quite possibly be as many as 100, and further study will probably show that even this estimate is low.

The most rhino sign we observed anywhere in southern Sumatra was found along the foot trail leading from Lempur near the southern end of the Kerinci enclave to Muko Muko on the coast in Bengkulu. Going south from Lempur for the first 10 km the trail passes through secondary forest and is heavily travelled by people going to and from the illegal settlements farther south; there was no sign of

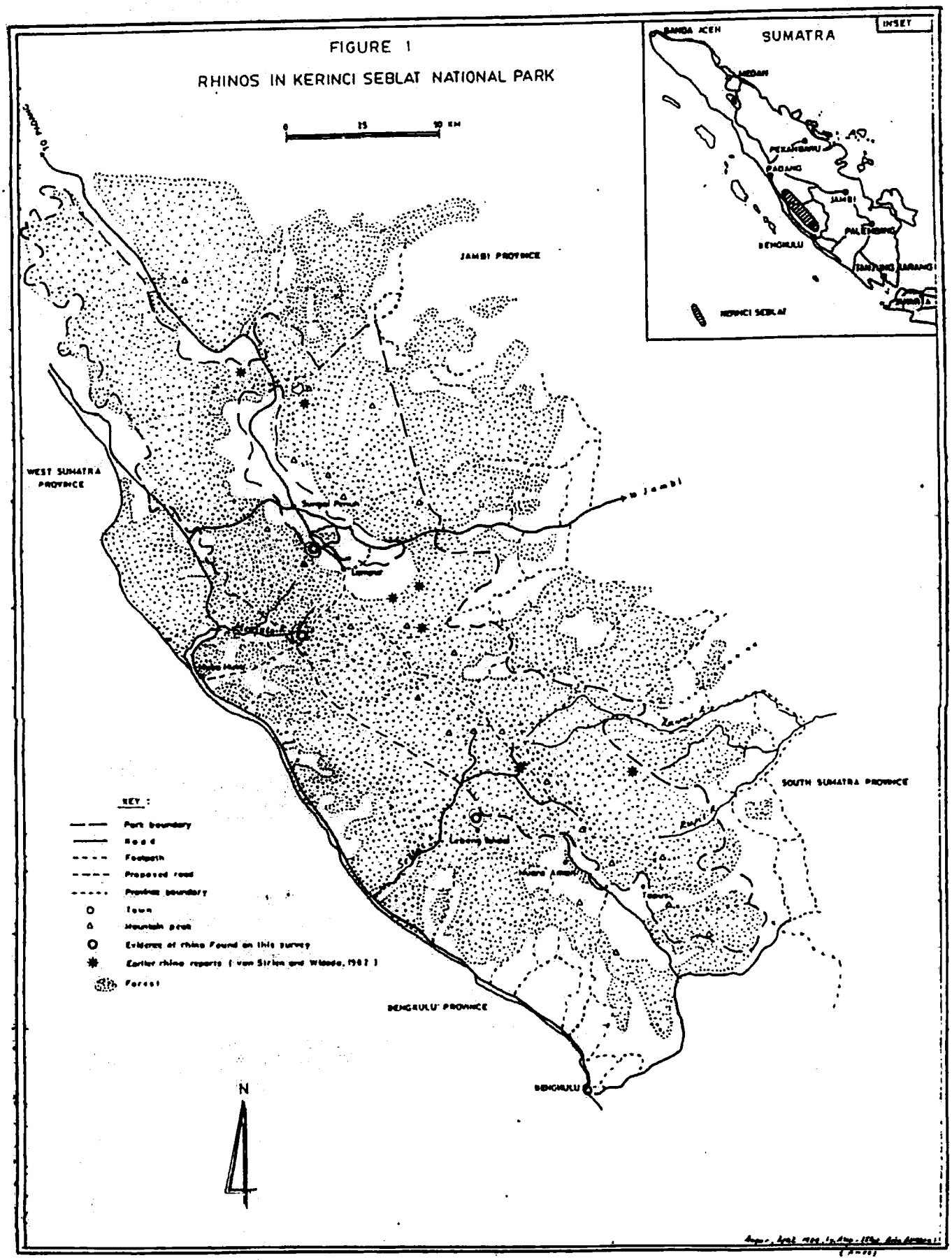


FIGURE 1
RHINOS IN KERINCI SEBLAT NATIONAL PARK
0
15
30 KM
INSET
SUMATRA
BANDA ACEH
MEDAN
PEKANBARU
PADANG
JAMBI
PALEMBANG
BENGKULU
TANJUNG KARANG
KERINCI SEBLAT
JAMBI PROVINCE
WEST SUMATRA PROVINCE
Sungai Penuh
Lempur
Kerinci
Danau Kerinci
Sungai Musi
Lubuk Linggau
Muara Aman
Tebing Tinggi
SOUTH SUMATRA PROVINCE
BENGKULU PROVINCE
BENGKULU
KEY :
Park boundary
Road
Footpath
Proposed road
Province boundary
Town
Mountain peak
Evidence of rhino found on this survey
Earlier rhino reports (van Strien and Wibodo, 1982)
Forest
N

rhinos along this stretch. Branching to the southwest the trail enters primary forest at 1,150 m altitude, climbs to the crest of Mt. Lintang at 1,400 m, then descends along a ridge to the confluence of the Menjuto and Riang Rivers at 400 m altitude. Since the 18th century up until about two years ago this trail was a main access route connecting Kerinci with the coast, but now with the improvement of the motor vehicle road from northern Bengkulu through southern Sumatra Barat and up to Sungai Penuh this foot trail is seldom used. The area is covered with beautiful undisturbed forest and is only occasionally visited by people who come in to fish the rivers.

We encountered rhino sign west of Mt. Lintang from 880 m altitude down to 400 m which was the lowest elevation we surveyed. There were tracks of at least three individual rhinos, the largest with a print measuring 24 cm (total width) and 8 cm (width of center nail). The other two were a cow and calf travelling together with prints of 19 cm/ 7 cm and 13 cm/ 5 cm respectively. The large animal was not in association with the cow and calf since its track was about two weeks old, while the other two had been in the area only a day or so before. Other tracks less than a week old had measurable prints of 20 cm/ 7 cm and 19 cm/ 6 cm; these may or may not have been made by the above mentioned cow.

Near the confluence of the Menjuto and Riang Rivers other rhino sign was abundant and of varying ages indicating that rhinos are regularly and frequently in the area. Checking about 5 km of trail, mostly along the crests of interconnecting ridges, we found: four feces less than three days old; six feces from 2 - 4 weeks old; two places where urine was sprayed onto vegetation, one still wet, the other dried leaving whitish spots; a wallow, dry and not recently used, about 3 m long with a bank on one side about one meter high; many saplings fed on by being broken off with the mouth others pushed over with the body, varying in age from a few days to more than a month. We saw no evidence of hunting.

The other area we checked in Kerinci-Seblat was near the southern tip of the park in the forest along the border between Bengkulu and Sumatra Selatan provinces. We entered from Tapus, southeast of Muara Aman, and seven days later emerged on the Rupit River northwest of Lubuklinggau. There is some encroachment by agriculture along the edges but most of the forest here is still intact from the upper montane moss forest at 1,900 m down to the remaining fringe of hill dipterocarp forest at about 600 m. Extraction of manau rattan (Calamus sp.) is a big local industry and people gathering it enter from both the east and west sides spending weeks at a time in the forest, although they do not penetrate too far in from the large rivers which they use to raft out the manau. Before World War II the trail from Tapus to the Rupit River was heavily travelled but now, with the construction of a road through the mountains farther south, almost no one uses it and in many places it has disappeared.

We found no recent evidence of rhinos in this area. There was one old wallow at about 1,500 m altitude on the west side of the ridge, but it had not been used for years. It is not clear why there are no rhinos here. They may have been hunted out back when people frequently came through this forest, but we did not see any old pit traps to support this idea. It is also possible that this region has never been preferred by rhinos because of its terrain which is dominated by a few large, steep ridges relatively isolated from one another. In areas of southern Sumatra where we found rhinos the ridges tend to be smaller and more interconnected which would facilitate the animals' wandering habits.

Within the past two years at least two rhinos from Kerinci-Seblat have been killed. One, reportedly a female, came into a village on the west side of Lake Kerinci in October 1982 and was killed by villagers. It arrived from the vicinity of Mt. Raya to the southwest and may have been forced down from the mountains in search of water since this was near the end of an exceptionally long dry season.

PHPA guards confiscated the horn and skin which were turned over to the Sub-Balai office in Jambi. In June 1982 an adult rhino of unknown sex was found dead in the forest at the edge of the Lusang River about 4 km upstream from Lebong Tandai, a gold mining town in northern Bengkulu on the edge of the park. A security guard from the gold mine produced a photograph of the animal and reported that it had what may have been a spear wound on the left side of the body. The front horn was said to measure 11 cm long and 7 cm in diameter at the base, and eventually ended up in the hands of a local policeman. All the bones were taken by local people who soak them in vegetable oil in the belief that the oil thus becomes an effective liniment for healing sprains, bruises, broken bones, and wounds.

Kerinci-Seblat is one of the most important places in the world for the conservation of the Sumatran rhino, and this must be one of the primary goals of the area's management as a national park. Thegreatest danger threatening the continued existence of a viable rhino population here is if the remaining continuous forest areas are broken into smaller, isolated blocks of forest by the construction of roads or the spread of illegal land clearing. Since rhinos do not cross roads or cultivated land those animals confined to an isolated pocket of forest have no chance of inter-breeding with rhinos in neighbouring habitats. This reduced genetic potential means that a small, isolated rhino population has little or no chance for long term survival.

Two roads through the national park have recently been proposed by the Provincial Planning Body (BAPPEDA) of Bengkulu. The one to which they give highest priority would go up from Muko Muko along the very route we followed in this survey and connect with the existing road at Lempur in Jambi. Not only would this destroy what we now know is prime rhino habitat along its length but also it would isolate the rhinos found in the forest north of the proposed road and south of the existing road which connects Sungai Penuh with

Tapan in Sumatra Barat. There is no need for a new road here since the existing Sungai Penuh - Tapan road already provides access from the Kerinci area to the coast. Money would be better spent improving this road and its extension from Tapan southward into Bengkulu rather than opening up a new road in the park.

BAPPEDA Bengkulu also proposes building a road northwest from Tambang Sawah near Muara Aman through the middle of the park to Lempur. This would fragment the forest and effectively destroy Kerinci-Seblat as an area for long-term rhino conservation. In addition it would facilitate access to the illegal settlements already within the park causing an influx of people and an accompanying increase in illegal forest clearing. This proposed road is not vital for regional development plans and there seems to be no legitimate need for it. Its negative impact would be enormous since it would irreparably damage many of the conservation values which served as the basis for declaring Kerinci-Seblat a national park.

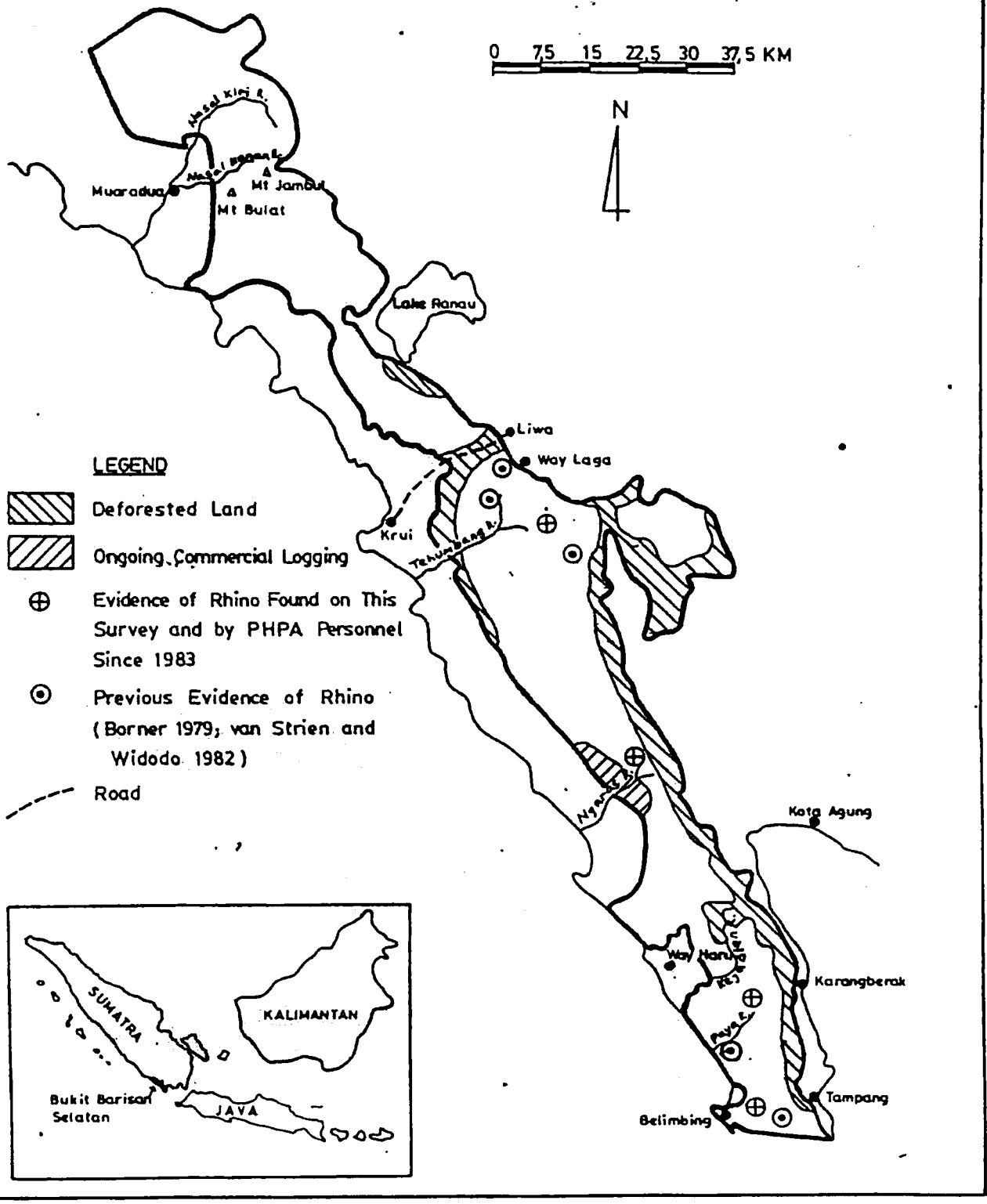
The proposals for these roads are still in the early stages of discussion and by opposing them now PHPA should be able to prevent construction. A more immediate problem is that of the illegal settlements between Tambang Sawah and the Sungai Penuh enclave. These first need to be located, inventoried, and censused by PHPA guards. Monitoring them and preventing their expansion is the next step, and eventually this should be followed by arranging to translocate the people. An increased and more active PHPA guard force is a prerequisite for these vital management activities.

Bukit Barisan Selatan National Park

Although not as abundant as in Kerinci-Seblat, rhinos are also found in the other large national park in southern Sumatra, Bukit Barisan Selatan (356,800 ha). This park, located in the provinces

FIGURE 2 :

RHINOS IN BUKIT BARISAN SELATAN NATIONAL PARK



of Lampung and Bengkulu, covers the southern tip of the Barisan Mountain chain and includes elevations ranging from peaks of over 1,800 m down to sea leavel (Fig 2). Because of its long, narrow shape the park is particularly vulnerable to pressure from the surrounding human population, and indeed cultivated land has already broken the forest into at least four isolated blocks. PHPA presence here is better established than in Kerinci-Seblat and some progress is being made in controlling illegal settlers, but in many areas agricultural incursions still continue.

Borner (1979) found no evidence of rhinos in the southern tip of the reserve when he checked the area in 1975. But occasional reports of rhino tracks by PHPA personnel since then (van Strien and Widodo 1982) made it worthwhile for us to visit the area to attempt confirmation. Although we saw no evidence of rhinos along the trail from Tampang to Belimbing, we did obtain a photograph of a rhino track taken by a guard on this trail in June 1983. The track was encountered near Way Sulaiman, measured 18 cm/ 7 cm, and was less than a day old when the guard photographed it. He also found where the animal had urinated, with the urine droplets still wet on the vegetation. The elevation here is below 50 m and the forest is mostly secondary in nature with scattered abandoned clearings. Near Tampang illegal coffee plantations extend from one to two kilometers into the park; it appears these people are no longer clearing the forest and they have been told they will have to leave before the end of 1984. There are no other settlements along the trail, although it is used every day by people walking back and forth to Belimbing and the village of Pemekahan on the west coast.

About 13 km north of here near the center of the peninsula at an altitude of about 100 m we found a single rhino footprint measuring 23 cm/ 10 cm. Although it was about a week old the print was still clear. This was about 3 km northeast of the upper Way Nenok cave along the route we followed across the

peninsula from the mouth of the Paya River to the town of Karangberak. Here the western one-third of the peninsula as far inland as the Way Nenok cave is covered with undisturbed lowland rain forest. Farther east the forest was heavily cut over by a logging concession using heavy equipment in 1970. Most of the large trees are gone and there is a heavy understory dominated by Zingiberaceae with Dilleniaceae, Acanthaceae, and some Eupatorium and Mikania. It was in this habitat that we found the rhino track. Farther east around Karangberak coffee plantations have intruded at least two or three kilometers into the park.

In 1975 Borner found evidence of rhinos in the central part of the park south of the town of Liwa and concluded that a small resident population of rhinos was still surviving there. Since no one had rechecked the area during the past nine years we needed to know whether the rhinos were still there and so we visited an area about 7 km southeast of where Borner had been. We entered the forest from the settlement of Way Laga where, beginning in 1980, people have planted coffee right up to the boundary of the park. Since there are boundary markers here and since PHPA guards occasionally visit the area the people have not extended their plantations into the park. About 10 km southwest of Way Laga in an area drained by tributaries of the Tenumbang River we found fairly abundant rhino sign on a series of parallel ridges at altitudes of from 750 m to 850 m. There were tracks of two different rhinos; one about one week old measured 25 cm/ 10.5 cm, and the other was about two weeks old with prints measuring between 22 cm and 23 cm wide. Along 3 km of ridgetop trail we found eight rhino feces estimated to be from two weeks to two months old. Signs of feeding were also observed on both snapped off and pushed over saplings.

There is a well maintained system of trails in this area, but they are kept open by elephants as well as rhinos. People seldom enter this forest anymore since most of the valuable

rattan species were practically eliminated by over-harvesting several years ago. We found one old pit trap about three meters deep which was apparently built for rhinos, but it had not been used for several years. Rhinos are probably found throughout this central block of forest which comprises about 75,000 ha. In January 1984 PHPA guards found a 25 cm wide rhino track in the southern part of this region along the upper Ngaras River near the edge of forest currently being selectively logged by a timber company. Just where the park boundary lies here has been in dispute, and PHPA maps show that the area being cut lies within the park while Forestry Department maps show it is outside. Obviously, and typically, timber interests have prevailed since this 4,000 ha block is now being logged. This reduces the width of the park here to only 5 km.

It is likely that there are still rhinos in the northernmost section of the park in Bengkulu Province. We did not have the opportunity to go into the forest and check, but people living near the park's boundary in the village of Muaradua on the Nasal River said that 20 years ago there were rhinos around Mt. Bulat and Mt. Jambul on the upper Nasal Kanan River. No one there knew of anyone who had gone into this area during the past 20 years, although apparently groups of Javanese have recently been extracting rattan from the forests of the upper Nasal Kiri River.

Based on the small amount of data available it is impossible to accurately estimate the total number of rhinos remaining in Bukit Barisan Selatan National Park. But there are certainly more here than was previously suspected as evidenced by the fairly regular reports of rhino sign coming from PHPA guards during the past two years. This does not necessarily mean that the rhino population has increased, rather it is a result of more frequent patrols by guards capable of recognizing rhino sign. For what it is worth, we can guess that there are from five to ten rhinos in the southern

peninsula and about 20 more in the central forest block south of the Liwa-Krui road. Since the Sumatran rhino is one of the most endangered large mammals in the world the protection of even these few animals is of utmost importance in guaranteeing the continued existence of the species.

Obviously the most important aspect of rhino management in Barisan Selatan Park must be to protect the remaining forests, which necessitates removing the illegal settlers. By declaring the area a national park the Indonesian government has committed itself to this goal, and indeed progress has been made in controlling encroachment in the Belimbing-Tampang area as well as near Liwa, but much still needs to be done. It is vital that contact between the central and southern rhino populations be reestablished. This will require the elimination of the illegal settlements around the Kejadian River which now extend almost as far west as the Way Haru enclave and have virtually isolated the southern tip of the peninsula from the rest of the park. As recommended in the Barisan Selatan Management Plan (FAO 1981a) these people should be moved out under the government sponsored translocation program and the deforested land should be replanted with fast growing, indigenous tree species. Although in and of themselves such plantations will probably be of little value as rhino habitat, it can be expected that rhinos will move through them between more intact forest areas to the north and south, thus enabling a degree of genetic interchange between the two populations.

The ongoing logging operation around the Ngaras River also seriously threatens to break the forest connecting the central and southern parts of the park. Ideally this cutting should be stopped, but there seems to be little chance of this happening. The first priority, then, must be to mark the currently accepted boundary in the field and, with the cooperation of Forestry Departmenet personnel, ensure that logging does not extend beyond it.

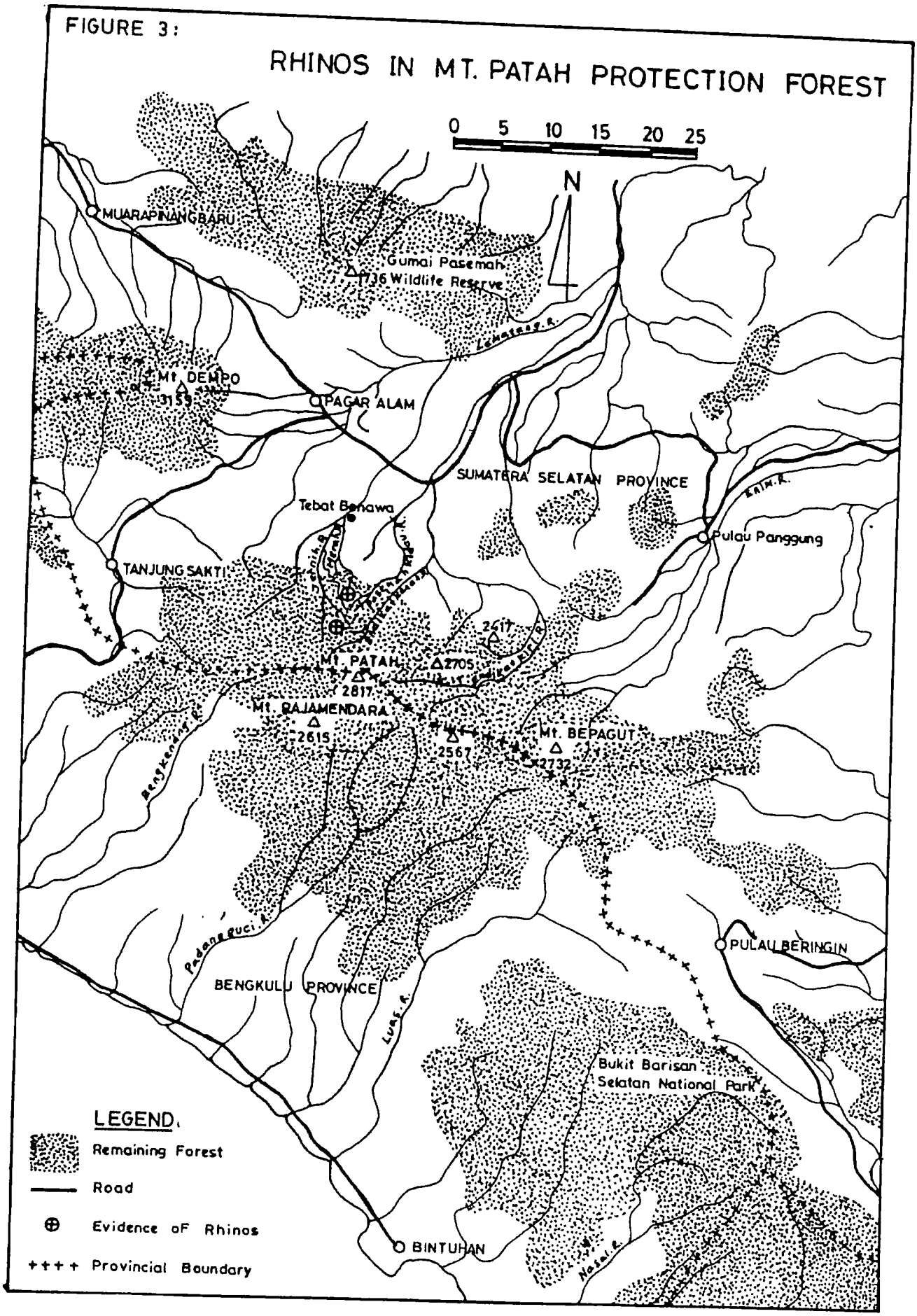
But, even if this boundary is honored, there will remain a corridor of intact forest no more than five kilometers wide. We know from observations in the southern part of the park and elsewhere that, although it is not optimal habitat, rhinos do use selectively cut forest (Table 1): they will certainly not enter areas where such forest has been allowed to be destroyed by shifting agriculture or planted with coffee and clove. Therefore the future fate of the logged over 4,000 ha block is of paramount importance in maintaining contact between the central and southern rhino populations. Recognizing that throughout southern Sumatra the Forestry Department has a dismal record in protecting selectively cut production forests from illegal settlers, it is recommended that, whether or not the current logging operations can be stopped, this 4,000 ha block be included within the park so that PHPA personnel can be given the responsibility to prevent its total destruction. It should be remembered that inclusion of logged forest within a national park is not normally allowable, but in this special case the welfare of the rhinos must take precedence.

Mount Patah Protection Forest

North of the Bukit Barisan Selatan National Park and isolated from it by agricultural land is a high range of mountains in the shape of a "V" with arms about 30 km long and the apex in the west at the tallest peak, Mt. Patah (2,817 m). The remaining forest covers about 70,000 ha beginning on the north side at elevations of from 1,400 m to 1,500 m and going up to extensive moss forests on the mountain crests. This forest lies on the border between Sumatra Selatan and Bengkulu Provinces; it is classified as protection forest which means that it cannot legally be cut or converted to other uses, but it receives little actual protection and coffee plantations are encroaching upon it.

There seem to be no published records of rhinos occurring in these mountains, but when we received reports from local people indicating that they must have been fairly common here 20 years ago we decided to check the area. Although we could only spend three days in the

FIGURE 3:


RHINOS IN MT. PATAH PROTECTION FOREST
0 5 10 15 20 25
N
MUARAPINANGBARU
Gumai Pasemah
1736 Wildlife Reserve
Mt. DEMPO
3159
PAGAR ALAM
SUMATERA SELATAN PROVINCE
Tebat Benawa
Pulau Panggung
TANJUNG SAKTI
2417
Mt. PATAH
2705
2817
Mt. RAJAMENDARA
2615
2567
Mt. BEPAGUT
2732
PULAUBERINGIN
BENGKULU PROVINCE
Bukit Barisan
Selatan National Park
BINTUHAN
LEGEND
Remaining Forest
Road
Evidence oF Rhinos
Provincial Boundary

forest we were at least able to determine that indeed there still are some rhinos left here. We entered from the village of Tebat Benawa located east of the town of Pagar Alam in Sumatra Selatan and walked in a southerly direction toward Mt. Patah. At an altitude of around 1,400 m we climbed out of the last coffee plantations and proceeded through an area which had begun to be illegally cleared in 1980 but was abandoned before being planted to coffee. We only went a short distance into undisturbed forest which begins at about 1,500 m altitude in the vicinity of the uppermost tributaries of the Merah, Pasemah Kidau, and Jernih Rivers.

Rhino sign was encountered in the edge of the undisturbed forest plus in patches of forest where the understory and smaller trees had been cut but the larger trees were left standing. No sign was found in the dense thickets of secondary vegetation where the forest had been entirely cleared. Although we found no clear tracks, one recent but indistinct footprint was measured to be approximately 19 cm wide. Along about 5 km of trail within the three habitat types (undisturbed forest, forest with understory cut, and dense secondary vegetation) there were: two rhino feces, one about a day old measuring 50 cm X 25 cm, the other roughly the same size but about a month old and disintegrating; two places where a rhino had urinated, one where the rhino had scratched dirt back onto the dark-brown, still wet urine located at the base of a tree and on surrounding vegetation up to a height of 50 cm, the other consisting of only a few drops of yellowish urine, still wet, sprayed on vegetation about 50 cm high; many saplings broken over with the mouth at heights of 100 cm to 135 cm above the ground and varying in age from about one week to one month. It can be concluded that at least one rhino regularly visits this area. No saplings were found that had been pushed down and walked over to make them available for browsing. This may be because the cutting in 1980 resulted in the production of an abundance of small palatable saplings which can easily be broken off with the mouth, therefore it is not necessary for rhinos to expend the extra energy required to push over larger saplings.

More surveys are needed to get a better idea of the distribution and abundance of rhinos within this isolated block of forest. We strongly recommend against entering through the village of Tebat Benawa since here the ancient customs of the local Pasemah people are still strongly held and their animistic beliefs connected with the forests make it extremely difficult to work with them in the field or even to pass through their village on the way into the mountains. Future surveys could perhaps enter from the west through Tanjung Sakti and Pulau Timun or from the east through one of the villages south of Pulau Panggung. The region around the Endikat Kiri River and the southern sector of the forest within Bengkulu seem particularly worthwhile to check for rhinos.

As everywhere, the future of the rhinos in the Mt. Patah area depends on the future of the forest, and here that is somewhat in doubt. Viewed from the aspect of watershed protection alone, every effort should be made to maintain forest cover on these mountains. The animistic beliefs of the local people seem to help in this, since villagers hinted that the clearings we passed through had been abandoned because of fear of spirits. But as old beliefs crumble and as Javanese migrate north from Lampung this meager protection will not be enough and stronger efforts will need to be made by the Forestry Department. Mt. Patah's present legal status as protection forest administered by the Forestry Department is appropriate for the area, provided that law enforcement is upgraded. Designating the area as a nature reserve or wildlife reserve is not recommended since the resources of the local PHPA offices are already overtaxed with the administration of the nearby Barisan Selatan and Kerinci-Seblat National Parks.

Frequent downstream flooding of the Lematang River has prompted the provincial government to investigate the possibility of damming the tributaries coming down from the western end of the Mt. Patah forest. It is not clear what stage these plans have reached or exactly where the dam would be located. PHPA through its Sub-Balai

Sumatra Selatan office should check into this situation to determine how it will affect the rhinos. If this already isolated population were to be further fragmented by the artificial lake created behind a dam, then the possibility should be considered of trapping and removing these rhinos for captive propagation or translocation to more secure habitat.

Berbak Wildlife Reserve

In 1976 rhino tracks were reported in the swamp and peat swamp forests of Berbak Wildlife Reserve on the eastern coast of Jambi. From that time until 1982 no sign of rhinos was ever reported again, and van Strien and Widodo (1982) presumed that the rhino is now extinct here. Our observations in the reserve support that assumption. We walked a total distance of 35 km through the forests in the eastern half of the reserve south of the Hitam Laut River and found no evidence of rhino. Three Dutch university students who spent three months here in 1983 conducting surveys of the flora, fauna, and soils also reported that they never came across any rhino tracks. Reports from PHPA guards stationed in the reserve were equally negative.

OTHER LARGE MAMMALS

Places where we observed nine other mammal species and their sign, or where we obtained reliable reports of their occurrence are presented in Figure 4. In Table 1 our direct observations of eight species of mammals, their tracks, or their feces are compiled according to habitat type.

In southern Sumatra much of the forest on inundated soil consists of intergradations between peat swamp forest and fresh-water swamp forest as described by Whitmore (1975). Therefore we made no attempt to separate these communities, but combined them into a habitat type we designate as swamp/ peat swamp forest. Typical tree species here include *Gluta renghas*, *Gonystylus bancanus*, *Dyera costulata*, *Shorea* spp., *Campnosperma* spp., *Alstonia* spp., and *Eugenia* spp.

FIGURE 4:

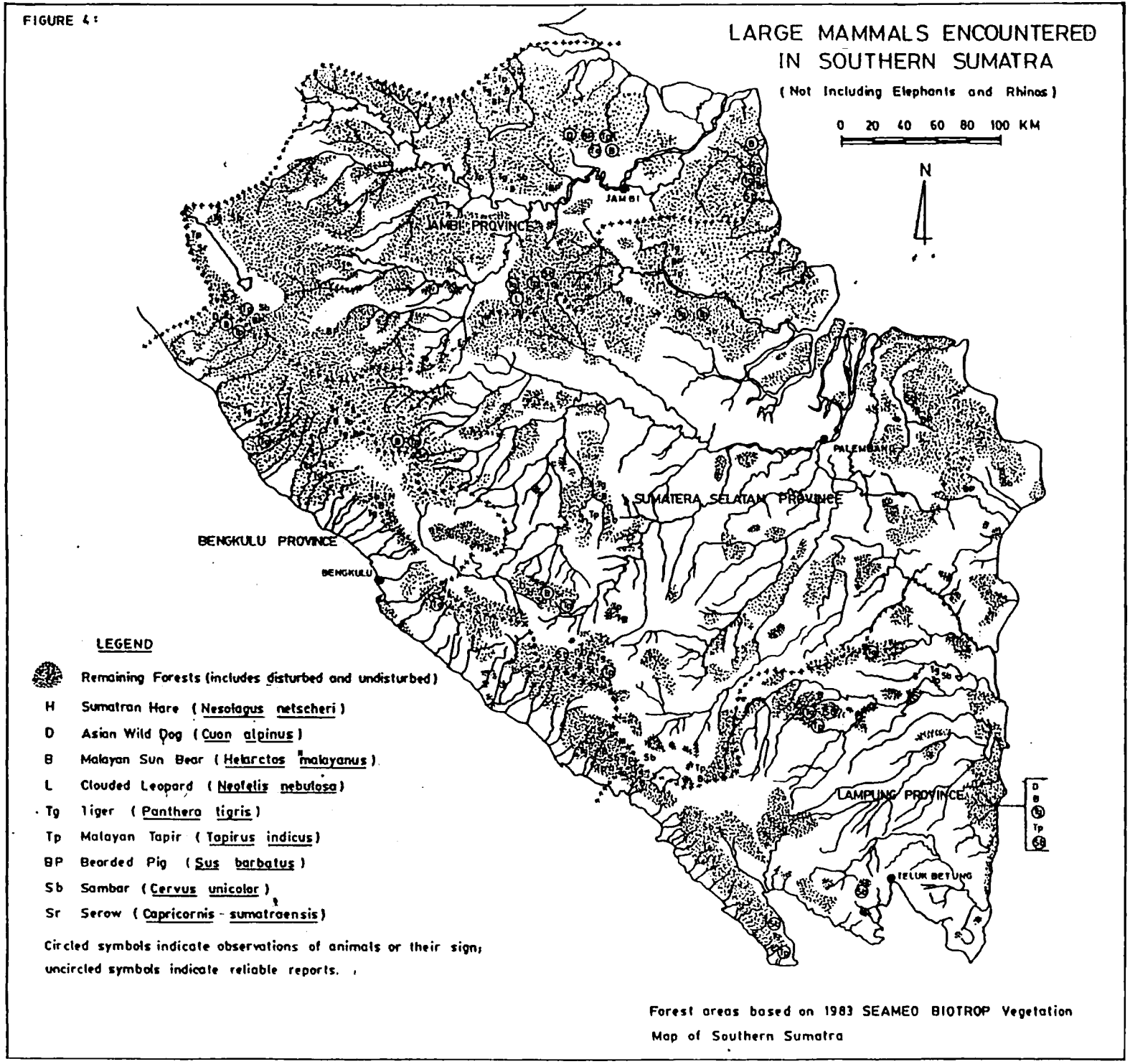

LARGE MAMMALS ENCOUNTERED
IN SOUTHERN SUMATRA
(Not Including Elephants and Rhinos)
0 20 40 60 80 100 KM
N
JAMBI
JAMBI PROVINCE
PALEMBANG
SUMATERA SELATAN PROVINCE
BENGKULU PROVINCE
BENGKULU
LAMPUNG PROVINCE
TELUK BETUNG
LEGEND
Remaining Forests (includes disturbed and undisturbed)
H Sumatran Hare (Nesolagus netscheri)
D Asian Wild Dog (Cuon alpinus)
B Malayan Sun Bear (Helarctos malayanus)
L Clouded Leopard (Neofelis nebulosa)
Tg Tiger (Panthera tigris)
Tp Malayan Tapir (Tapirus indicus)
BP Bearded Pig (Sus barbatus)
Sb Sambar (Cervus unicolor)
Sr Serow (Capricornis - sumatraensis)
Circled symbols indicate observations of animals or their sign;
uncircled symbols indicate reliable reports.
Forest areas based on 1983 SEAMEO BIOTROP Vegetation
Map of Southern Sumatra

Table 1. Evidence of eight large mammals compiled according to habitat type. Each track, feces, or sighting counted as one; sign per kilometer of trail checked in parentheses.

Habitat	Asian Wild Dog	Sun Bear	Clouded Leopard	Tiger	Tapir	Sumatran Rhino	Sambar	Serow
Swamp/ Peat Swamp Forest								
Undisturbed (25 km)	-	1 (0.04)	-	6 (0.24)	11 (0.44)	-	3 (0.12)	-
Disturbed (24 km)	-	-	-	2 (0.08)	-	-	13 (0.54)	-
Total (49 km)	-	1 (0.02)	-	8 (0.16)	11 (0.22)	-	16 (0.33)	-
Lowland Forest on Well-Drained Soil (0 - 300 m)								
Undisturbed (22 km)	-	-	-	5 (0.23)	2 (0.09)	-	-	-
Disturbed (60 km)	2 (0.03)	4 (0.07)	1 (0.02)	5 (0.08)	18 (0.30)	1 (0.02)	31 (0.52)	-
Total (82 km)	2 (0.02)	4 (0.05)	1 (0.01)	10 (0.12)	20 (0.24)	1 (0.01)	31 (0.38)	-
Lower Montane and Hill Forest (300 - 1,500 m)								
Undisturbed (55 km)	-	3 (0.05)	-	3 (0.05)	16 (0.29)	26 (0.47)	2 (0.04)	1 (0.02)
Disturbed (10 km)	-	-	-	-	1 (0.10)	3 (0.30)	7 (0.70)	-
Total (65 km)	-	3 (0.05)	-	3 (0.05)	17 (0.26)	29 (0.45)	9 (0.14)	1 (0.02)
All Habitats								
Undisturbed (102 km)	-	4 (0.04)	-	14 (0.14)	29 (0.28)	26 (0.25)	5 (0.05)	1 (0.01)
Disturbed (94 km)	2 (0.02)	4 (0.04)	1 (0.01)	7 (0.07)	19 (0.20)	4 (0.04)	51 (0.54)	-

What we call lowland forest on well-drained soil includes elevations from sea level up to 300 m and is not subject to a well defined dry season. The dominant family of trees is Dipterocarpaceae, and some of the common tree species of other families are Koompassia malaccensis, Palaquium g tta, Dyera costulata, and Schima wallichii.

The habitat type we refer to as lower montane and hill forest includes a range of floristic zones between 300 m and 1,500 m altitude which have been described by Whitmore (1975) as hill dipterocarp, upper dipterocarp, and oak-laurel. Typical trees here are Altingia excelsa, Dipterocarpus spp., Shorea spp., Quercus spp., and Castanopsis spp.

Each of these three habitat types was further classified as disturbed or undisturbed. Most forests referred to as disturbed had been subjected to commercial selective logging from one to nine years previously. Also included in this category were smaller areas of forest from which scattered timber trees had been cut for use by local people, where forest clearing had been initiated but stopped for one reason or another, or where there had formerly been low intensity shifting cultivation. In all cases an overstory was present.

Numbers used in Table 1 were obtained by assigning a value of one to each sighting, track, or feces: these numbers were then divided by the length of trail checked in each habitat type to obtain an index of sign per kilometer. This table is useful in understanding species habitat preferences but, since some species and their sign are more evident than others, it cannot be used to compare relative abundance of one species with another.

A brief discussion of each species is given below. Some observations are included from an unpublished manuscript written by Dirk Pieters, a Dutch crocodile hunter with years of experience in the swamp forests of Lampung before World War II. His account

gives an idea of the abundance and habits of animals in these forests at a time when man was still a rare visitor to these remote areas. Now, only 50 years later, this once vast wilderness has been reduced to only scattered forest patches. If deforestation is allowed to continue at this rate it is inevitable that even those large mammals which have so far managed to survive in southern Sumatra will eventually follow the Javan rhino into local extinction.

Sumatran Hare

The Sumatran hare, or more accurately the Sumatran short-eared rabbit (Nesolagus netscheri), is by no means a large mammal but it was included in this survey since there is virtually no information on its current distribution and status. It is found only in Sumatra where it lives in the forests of the Barisan Mountains at elevations of above 600 m. These animals are very rarely seen and little is known of their natural history.

We never encountered any direct evidence of Sumatran hares but we did find three places where local people described the animal well enough for us to conclude that it occurs there. In the settlement of Way Laga south of Liwa on the border of Bukit Barisan Selatan National Park it was reported that a group of four including small ones was once seen near the edge of the forest in recently cleared land that was about to be planted with coffee. People say they are usually in the forest and live under rocks. People living on both the north and south sides of the Gumai Pasemah Wildlife Reserve in Sumatra Selatan say that hares are fairly common in the reserve at an altitude of around 1,600 m, and one was once caught and killed by a dog. We found many small snares set within the reserve, apparently used to capture argus pheasants (Argusianus argus); villagers claim that no one bothers to hunt the hares. People in the town of Kurotidur in Bengkulu about 40km north of the provincial capital also report that there are hares in the mountainous protection forest east of the village.

It seems likely that hares are sparsely distributed throughout the length of the Barisan Mountain chain in southern Sumatra. Their survival depends on the continued existence of their mountain forest habitat. Whether or not they can live in disturbed forests is a moot point since in mountainous areas there is little selective timber cutting: either the forest remains in a more or less undisturbed condition or it is cut down completely and converted to agriculture. They apparently are not subjected to much hunting pressure, probably because they naturally occur at such low densities and in such remote areas that it is not worth the effort to hunt them.

Asian Wild Dog

We obtained reliable reports of the wild dog (Cuon alpinus) in seven areas and observed its tracks at one other site. It is found in a variety of habitats from sea level up to at least 1,600 m altitude, but it seems not to occur in peat swamp forest. It lives in both disturbed and undisturbed forests but our observations of sign are too limited to give any indication of the effects of forest disturbance on numbers of wild dogs. In eastern Jambi, we found tracks of two of them travelling together in lowland dipterocarp forest on well-drained soil which had been selectively logged in 1976. In the heavily damaged production forests around the Semangus River in Sumatra Selatan they are reported to occur in areas of scrubby secondary growth mixed with alang-alang (Imperata cylindrica) grassland. In 1983 a wild dog was snared in the logged over production forest invaded by shifting cultivations north of the Way Kambas Wildlife Reserve in eastern Lampung. Other reports are mostly from more intact sub-montane forests. Group sizes reported varied from three to ten individuals.

According to Pieters, wild dogs range over large areas and never remain for long in one place even though there may be an abundance of game there; during the rainy season they are found

on higher ground and they move into the low lying plains only during the dry season. Even in those days when the forests of Lampung were intact Pieters only occasionally saw wild dogs, and he attributed their scarcity to the presence of normal numbers of tigers which are their natural enemies.

The future of wild dogs in southern Sumatra is precarious. They live at low densities and range over wide areas which makes them especially susceptible to habitat destruction. They can apparently adapt to life in secondary or disturbed forests but the presence of some type of forest cover is essential to their survival.

Malayan Sun Bear

Bears (Helarctos malayanus) are still rather common in much of the remaining forest. We directly observed them or their sign in five locations and local people reported their presence in 15 other places. The highest altitudes at which we found bears was 2,800 m on the lower edge of the moss forest zone. They occur at all elevations below this and in virtually all forested habitats including peat swamp forest. They are not hunted or otherwise persecuted by man except in areas where they cause damage to coconut plantations by eating the young palm shoots.

Wilson and Johns (1982) state that in Kalimantan the sun bear does not survive well in disturbed habitat. Our limited observations in southern Sumatra do not support this (Table 1). For both disturbed and undisturbed habitats the rate of bear sign per kilometer is 0.04, however it should be noted that all sign in disturbed habitats was found in only one location, i.e., a tract of lowland forest on well-drained soil in Jambi that was selectively logged about seven years earlier. Pieters found bears in disturbed habitats, mentioning that it is mostly in "secondary jungle" that they build tree nests.

Clouded Leopard

Since clouded leopards (Neofelis nebulosa) are nocturnal and arboreal they make little sign on the ground and special techniques must be used to observe them. Therefore the incidental information we could gather on this species is sparse and of little value in determining its current status or response to habitat alteration.

The only track of a clouded leopard we found was in Jambi in lowland forest on well-drained soil which had been selectively logged one year before. Logging intensity here was light, and at least 50% of the stand was remaining. We never observed a clouded leopard since we never searched for them at night. It is almost impossible to obtain reliable information from local people because of confusion between this species and the smaller cats. Only in the Gumai Pasemah Wildlife Reserve in Sumatra Selatan did we find what we could consider reliable reports of the occurrence of clouded leopards.

Pieters spent much time in the forests at night with a spotlight and he encountered clouded leopards scores of times; he did not find them in the extensive swamp forests but could not speculate on the reason for this. They were almost always in the trees except when on the ground feeding on monkeys which they had killed in the trees and dropped. He felt that this cat was considered rare mainly because people did not look for it at the right times and in the right places, that is, at night in the trees. Probably the situation is much the same today in undisturbed forests.

However there can be little doubt that this arboreal cat is extremely vulnerable to forest destruction. It may not be able to tolerate high intensity selective logging which breaks up too much of the forest stand. Research into the effects of logging on this little known species would be highly worthwhile.

Tiger

We found evidence of tigers (Panthera tigris) in ten places and they were reported to be present in 18 other areas. They are still frequently encountered throughout southern Sumatra but are most common in Jambi where the forests are still relatively intact. Our observations of tiger sign presented in Table 1 are sufficient to allow us to make some general statements about tiger habitat preferences.

In the first place, tigers are much more common below about 300 m altitude than they are above this elevation. The highest altitude at which we observed tiger sign was 1,100 m in the Kerinci-Seblat National Park. They are about equally common in the lowland forests on well drained soil and in the swampy forests, but for some unknown reason they do not seem to occur in the swamp and peat swamp forests east of Palembang in the Air Sugihan and Lebong Hitam area.

Disturbance of the forests seems to reduce tiger abundance by about half (Table 1). Since populations of their prey species such as sambar and wild pigs actually increase as a result of forest disturbance, the tigers' decline must be a result of the increased human activity including hunting which often accompanies opening up of the forest. In the days when the human population was still sparse, Pieters thought that in areas away from settlements there was approximately one tiger per 100 km2, whereas around settled areas the number per 100 km2 amounted to about three or four. This implies a greater abundance in disturbed forests, the opposite of today's situation. The reason for this is that during Pieters' time most villagers were too superstitious to kill tigers. Nothing was done to stop the depredations of a maneater or cattle killer because of the people's firm conviction that they were dealing with some evil spirit in the guise of a tiger that was punishing them for some wrong they had done in the past. This attitude is still occasionally encountered today in southern Sumatra, but for the most part it has either been forgotten or disregarded and people are only too eager to kill tigers despite their legally protected status.

We found evidence or received reliable reports of 10 tigers killed in the four provinces during 1982 - 1983, and this is certainly only a small fraction of the number actually killed during this period. Of the ten, six had been confiscated by PHPA personnel with the skins of four of these being held at the Bengkulu office and two at the Jambi office. The other four reportedly killed were all from northern Sumatra Selatan.

Tiger attacks on humans are most frequent in Jambi where we heard reports of ten people killed from 1978 to 1983. In one outbreak in the Kerinci area four were killed and one wounded during 1982 and 1983. The victims included one girl taken from the edge of a village early in the morning and a man dragged from the passenger seat of a motorcycle on an isolated road at night. Local people attribute these attacks to one female tiger and say they began when a man killed two of her young cubs. In other parts of the province most tiger tiger victims are people who work in forests such as loggers or rubber plantation laborers.

When there are tiger attacks on humans or livestock the understandable response of the local people is to attempt to kill the tiger. Although generally only one tiger is responsible for the attacks in an area, very often several tigers are poisoned, snared, or shot, often quite far from the site of the attacks. So far PHPA has not developed any effective policy for dealing with these problems and the current situation results in continued losses of livestock, tigers, and humans, plus bad public relations.

In Sumatra there are local people known as "pawangs" who are familiar with the habits of tigers and are experienced in capturing them. It is recommended that each PHPA Sub-Balai office in areas plagued with tiger problems should establish contact with a reliable and efficient "pawang". Upon receiving reports of tiger attacks PHPA personnel should immediately investigate to determine whether it is an isolated incident or a recurring problem. If it is deemed

that a tiger must be removed then the "pawang" should be called in to do the job on a contract basis under strict PHPA supervision. With confirmed man killers there is unfortunately little choice but to kill the animal. Tigers guilty only of taking livestock should be captured live and, ideally, released into a remote area such as a national park where the tiger population has been depleted. If such an area is not available then captured tigers should be turned over to zoos. To release a tiger into a habitat which is already supporting a good tiger population is probably counter-productive since if the newcomer is not killed by a resident tiger it is likely to be driven out and wander into populated areas.

Malayan Tapir

In southern Sumatra tapirs (Tapirus indicus) are still quite common, particularly in the northern part of the region, i.e., the provinces of Jambi and Sumatra Selatan. When the data of Table 1 are compiled according to province we find that along 66 km of trail in Lampung tapir sign averaged 0.12/ km; for 55 km in Sumatra Selatan and Bengkulu the figure is 0.24/ km; and in Jambi on 75 km of trail the rate of sign encountered jumps to 0.36/ km. There is the possibility that these differences could be caused by the more fragmented nature of the habitat in the southern part of the region, but an examination of old records seems to indicate that this is not the case and that in fact even when the forests were still intact tapir were rare in the southern tip of Sumatra. In his manuscript, Pieters, who spent all his time in Lampung, mentions tapirs only once and refers to them as "very rare". Of the 19 tapirs collected from 1909 to 1959 and housed at the Bogor Museum of Zoology, none came from what is now Lampung while 10 originated from areas now included within Sumatra Selatan and Jambi. These museum figures can only give a rough idea of relative tapir abundance since we have no idea of the amount of collecting effort expended in each region, but they do seem to indicate a scarcity of these animals in the south. There is no obvious

reason for this, but perhaps the large Musi River in central Sumatra Selatan may act as a natural barrier hindering tapir dispersion into the lowland forests farther south. Tapir are common in the peat swamp forests north of the Musi, particularly in the Berbak Wildlife Reserve in Jambi, but they do not occur in similar habitat found in the Padang Sugihan Wildlife Reserve immediately south of this river.

It can be seen in Table 1 that tapirs are about equally abundant in swamp/ peat swamp forest, lowland forest on well-drained soil, and lower montane and hill forest. We found tapir sign up to an altitude of 2,500 m. Although Boonsong and McNeely (1979) state that tapirs inhabit only dense primary rain forests, we frequently encountered tapir sign in disturbed forests as well. For all habitat categories combined, the sign per kilometer was 0.28 in undisturbed and 0.20 in disturbed. A comparison of tapir abundance between disturbed and undisturbed swamp/ peat swamp forest is not possible with these data since almost the entire length of trail checked in disturbed habitat was in the Padang Sugihan Wildlife Reserve where tapirs do not occur. The data for the lowland forest on well-drained soil and for the lower montane and hill forest indicate opposite responses to disturbance, with the former habitat showing an increase in tapir abundance as a result of forest disturbance while the latter shows a decrease. There is no apparent reason why this should be the case, and these results may be attributable to small sample size.

Results of sign counts in two areas of selectively logged lowland forest on well-drained soil in Jambi seem to indicate that tapirs are more abundant in older logged forest than in recently logged forest, although because of the limited area sampled this must remain a tentative conclusion. Along 7 km of trail through forest in the Pitco concession which was logged from one to three years previously we found tapir sign at a rate of 0.43/ km. About 100 km to the northeast in the Hee Ching concession we checked 11 km of trail in forest logged six to eight years ago and found tapir sign of 0.73/ km. Tapirs are highly mobile animals and in a working

timber concession they probably move among the forest blocks of varying ages since cutting, tending to prefer those in which vegetative succession following disturbance has proceeded longest.

Hunting pressure on tapirs is low, probably because most Muslims consider this animal to be closely akin to a pig. Another belief held in some areas is that the meat in the white part of the animal is edible, but that in the black parts is poisonous. We found only one recent incidence of a tapir being killed by hunters, and this was in northern Lampung where the animal was killed by hunters with dogs who were after crop-raiding pigs and happened to catch a tapir instead.

Bearded Pig

Both the bearded pig (Sus barbatus) and the common wild pig (Sus scrofa) are found in Sumatra. Since their tracks are indistinguishable our information on this species is confined mostly to reports from local people. A characteristic habit of bearded pigs not shared by the common wild pig is that at certain times they will band together in groups of reportedly up to 300 individuals and embark on long migrations. These herds arrive at a given location at irregular intervals, sometimes as often as once a year but more frequently once every two to four years. In the highlands these migrations do not seem to have any relation to the seasons, but in the lowlands the pigs tend to move out of the inundated forests to higher ground during the rainy season and back again during the dry season. No one knows the distances covered by one of these travelling herds, but a large mammal with such migratory habits is liable to be especially vulnerable to fragmentation of its forest habitat.

Indeed, the present distribution of bearded pigs is confined to the areas where intact forest cover is still fairly extensive. We heard no reports of this species south of the Kerinci-Seblat National Park in the west, or south of the Lebong Hitam forest

east of Palembang in the east. In the central part of the island their range extends only as far south as the production forests along the Jambi - Sumatra Selatan border. Museum collections contain at least two bearded pigs collected in Lampung about 50 years ago (Sody 1937, Kelm 1939 and Groves 1981), so it appears that this species has been recently eliminated from southernmost Sumatra, probably by habitat destruction.

Bearded pigs are found from sea level up to elevations of about 1,000 m. Unlike the closely related Javan warty pig (Sus verrucosus) which is adapted to living in grasslands and secondary growth (Blouch et al. 1983), bearded pigs appear to require densely forested habitat. They can survive selective logging, as evidenced by a sow killed by a truck that we found in Jambi in forest that had been selectively cut ten years previously. During their migrations they will sometimes go into cultivated land and destroy crops, and in 1980 a herd numbering in the hundreds even entered the fair-sized town of Muara Bulian in Jambi.

Continuing habitat destruction poses a major threat to this species. If the remaining Sumatran forests are allowed to be reduced and fragmented in a manner similar to that which has already happened in Lampung, then there is little hope that this pig with the intriguing migratory habits can continue to exist on the island.

Sambar

The sambar (Cervus unicolor), the largest deer found in Indonesia, still occurs throughout southern Sumatra wherever forest remains. We encountered them in swamp/ peat swamp forest, lowland forest on well-drained soil, and lower montane forest up to an altitude of 1,500 m. They are most common in

the lowlands where they are found in roughly equal abundance on both well-drained and swampy soils. They are not as numerous in the lower montane and hill forests, apparently because this habitat type is less often interspersed with areas of secondary forest (Table 1).

Of all mammals surveyed the sambar shows the most positive response to forest disturbance. When counts in the three habitat types are combined, we see that sambar sign is about ten times as abundant in disturbed forests as in undisturbed forests (Table 1). Similar results are found when each habitat type is considered separately. This is not surprising since these deer are mainly browsers, and opening up a forest's canopy encourages development of a brushy understory which provides an increased food supply.

The length of time after forest disturbance also appears to strongly influence sambar numbers. In contrast to tapirs, sambar tend to be more abundant in recently logged forest than in older logged forest. On the 7 km of trail in the Pitco concession which had been selectively logged from one to three years earlier sambar sign was found at a rate of 2.71/ km. In the Hee Ching concession, logged six to eight years previously, we found no sign of sambar on 11 km of trail. These deer apparently concentrate in areas where early successional stages of vegetation provide an abundance of palatable forage, then move on to other areas as the plants grow older and the vegetational composition changes.

In contrast to our results, Wilson and Johns (1982) found that in Kalimantan sambar were less abundant in both recently logged and three-to-five year old logged forest than in primary forest. They attributed this unexpected result to the fact that in the areas they checked, hunting was much more intensive in the logged forests since access was facilitated by the system of logging roads.

Sambar hunting is widespread in Sumatra, although in none of the areas we surveyed did it appear to be intensive enough to have appreciably reduced a local population. Hunters from the cities use spotlights and firearms while the rural people generally rely on more traditional methods such as snares and pit traps. Dogs are often used either to drive the deer into pit traps or to bring them to bay so they can be speared. In some localized areas, particularly where firearms are commonly used, sambar populations may have been reduced or eliminated, but on the whole this uncontrolled hunting does not seem to be on a large enough scale to threaten the species. Probably population increases due to forest disturbance are enough to offset losses caused by hunting at current levels.

Serow

According to local reports the goat-like serow (Capricornis sumatraensis) is found along the length of the Barisan Mountains north of the Lampung-Bengkulu border. They spend most of their time in areas of difficult access where the terrain is steepest, and this probably explains why we only once encountered the sign of a serow. This was at 1,200 m altitude in the upper drainage of the Rupit River near the border between Bengkulu and Sumatra Selatan where we found a bedding site under a rocky overhang on the side of a cliff overlooking a small stream. Fresh tracks indicated a solitary animal which may have fled at our approach.

Local people sometimes hunt serow with snares, and mounted horns are occasionally displayed in houses, but in general it seems that hunting pressure is light and not posing a threat to the species. Any attempt to learn more about this animal will require studies specifically designed to investigate serow biology since relatively little can be learned from incidental information.

CONCLUSIONS

All nine mammal species considered in this survey rely on forested habitats and none of them will survive if these forests are destroyed. Of southern Sumatra's total land area of 20,300,000 ha the Forestry Department classifies 11,200,000 ha as various categories of forest, but much of this land is in reality no longer forested. A recent estimate by the Forestry Department is that on 600,000 ha under their administration in southern Sumatra the forest has been destroyed and replaced with secondary scrub and Imperata cylindrica grassland. The accuracy of this figure is highly doubtful, and satellite imagery indicates that the actual amount is much higher. What everyone can agree on is that forest destruction is continuing at an alarming rate, and this is the greatest threat to Sumatra's large mammal fauna.

Selectively logged forest still provides suitable habitat for most large mammals provided the logging is done in accordance with Forestry Department regulations which limit harvestable trees to those over 50 cm in diameter. This survey indicates that sambar populations show an increase as a result of selective logging, while tapirs, sun bears, and probably bearded pigs and wild dogs seem to continue at about the same population density. The indicated decrease in tiger numbers is disturbing and not readily explainable; it may be because of increased hunting or perhaps because tigers avoid areas of human activity. Since the tiger's preferred habitat is lowland forest, almost all of which is scheduled to be logged, further study into the effects of selective logging on tiger populations is urgent. Selective logging is not too relevant to rhinos since for the most part they live in mountainous regions where timber extraction is not feasible.

In southern Sumatra 6,000,000 ha of predominantly lowland forest is classified as production forest; about 2,000,000 ha, mostly in the mountains, is designated as national parks and

nature reserves. It should not be thought that with the creation of these parks and reserves the future of Sumatra's native large mammals is automatically secured. Their long term survival depends to a large extent on the fate of the production forests which must be viewed not only as a source of timber but also as a home for wildlife. The short-sighted destruction of these forests is a major and difficult problem which the Indonesian government should make every effort to overcome, both to ensure the country's future timber resources and to help conserve its priceless heritage of unique large mammals.

REFERENCES CITED

Blouch, R.A., Banjar Y.L., Heri D.S., and Sumaryoto A. 1983. The Javan Warty Pig: Distribution, Status, and Prospects for the Future. Project 3088 final report, IUCN/WWF Indonesia Programme, Bogor. 28pp.

Blouch, R.A., and Haryanto. 1984. Elephants in Southern Sumatra. Project 3033 field report, IUCN/WWF Indonesia Programme, Bogor. 35pp.

Boonsong Lekagul and J.A. McNeely. 1977. Mammals of Thailand. Association for the Conservation of Wildlife, Bangkok. 758pp.

Borner, M. 1979. A Field Study of the Sumatran Rhinoceros (Dicerorhinus sumatrensis Fischer 1814): Ecology and Behaviour Conservation Situation in Sumatra. Juris Druck + Verlag, Zurich. 169pp.

FAO. 1981a. Barisan Selatan Game Reserve Management Plan 1982 - 1987. FO/INS/78/061, field report 21, Bogor. 48pp.

FAO. 1981b. Proposed Kerinci-Seblat National Park Management Plan 1982 - 1987. FO/INS/78/061, field report 14, Bogor. 54pp.

Groves, C. 1981. Ancestors for the Pigs: Taxonomy and Phylogeny of the Genus Sus. Tech. bull. no. 3, Dept. of Prehistory, Australian Nat'l. Univ., Canberra. 96pp.

Kelm, H. 1939. Ein Pustelschwein von Sumatra. Zoologische Anzeiger 125 : 219 - 24.

Pieters, D. Along Jungle Streams and Game Trails: The Swamp Forest Country of Southern Sumatra. Unpublished manuscript. 143pp.

Sody, H.J.V. 1937. Notes on some mammals from Sumatra, Java, Bali, Buru and New Guinea. Temminckia 2 : 211 - 21.

van Strien, N. 1975. Dicerorhinus sumatrensis (Fischer) the Sumatran or Two-horned Asiatic Rhinoceros: A Study of Literature. Mededelingen No. 22. Austerlitz. 82pp.

van Strien, N. and Widodo S. 1982. The present status of the Sumatran rhinoceros (Dicerorhinus sumatrensis) in Indonesia. IUCN/SSC Asian Rhino Specialist Group, unpubl. report. 11 pp.

Whitmore, T.C. 1975. Tropical Rain Forests of the Far East. Clarendon Press, Oxford. 282pp.

Wilson, W.L. and A.D. Johns. 1982. Diversity and abundance of selected animal species in undisturbed forest, selectively logged forest and plantations in East Kalimantan, Indonesia. Biol. Conserv. 24 : 205 - 218.