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ABSTRACT

THE PROBLEMS IN THE PRESERVATION OF THE SELADANG IN THE MALAYSIAN NATIONAL PARK

By

LES E. WEIGUM

A study was conducted in the Malaysian National Park from September 1967 to November 1969 to determine the present status and ecological requirements of the Malaysian gaur (Bos gaurus hubbacki).

A survey in the 1,677 square miles of park located four resident herds varying from 5+ animals to 19 animals. Three of these herds were in or close to areas which were recently disturbed by man.

Vegetation analysis based on the diet of the Kuala Tahan herd indicated that the grass Paspalum conjugatum was the most important food plant of the gaur. It was found that 96 per cent of all plant species eaten occurred mainly in the early secondary vegetation of river edges, clearings, and secondary forest. Based on forest succession studies it was found that a lowland dipterocarp forest when cut, burned, cultivated, and then abandoned will produce seladang (gaur) forage during the first 3 years after abandonment.

Natural salt licks occurred within the home range of each existing herd. Mineral analysis of one lick showed it to be rich in sodium, calcium, and magnesium. A station artificially salted with NaCl was used immediately

and frequently by a seladang herd.

The population of one herd which had been known since 1947 had maintained a stable population of 10-19 animals. The ratio of immature animals to adults indicated it to be a growing herd, but since there was a lack of evidence showing high mortality due to either disease or predation, emigration was thought to be the major stabilizing factor.

The seladang is an animal of the early stages in vegetative succession. To establish or maintain herds in the park it is recommended that 45 acres of land be clearcut preferably in 15 acre plots 1/2 mile apart and be recut every three years. The immobilizing drug M.99 was found to be apparently suitable for capturing gaur for possible relocation and/or study.

THE PROBLEMS IN THE PRESERVATION OF THE SELADANG
IN THE MALAYSIAN NATIONAL PARK

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To Florence and Emil Weigum

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TABLE OF CONTENTS

LIST OF TABLES	Page v
LIST OF FIGURES	vi
INTRODUCTION	1
THE STUDY AREA	3
METHODS AND PROCEDURES	6
RESULTS AND DISCUSSION	11
RECOMMENDATIONS.	36
SUMMARY	38
LITERATURE CITED	41
APPENDIX 1	44

LIST OF TABLES

Table	Page
1. Seladang herd census results in the Malaysian National Park, 1967-1969	12
2. Seladang forage survey in a 240 acre rubber tree plantation near Kuala Tahan, Malaysia, October 1969	18
3. Seladang forage survey in a 21 acre experimental clearing at Kuala Tahan, Malaysia, October 1969	19
4. Dominant-codominant plants recorded in a vegetative succession study in a lowland dipterocarp forest area, 1946-1950 by Wyatt-Smith (1949) with reference to the seladang . . .	21
5. Mineral analysis of soil samples from the salt lick, a termite mound and forest soil at Jenut Belau in the Malaysian National Park, 1969	28
6. Observed composition of the Kuala Tahan seladang herd, Malaysian National Park	30

LIST OF FIGURES

Figure	Page
1. A two-year old seladang cow	2
2. The Malaysian National Park	5
3. Observation blind in a <u>Koompassia excelsa</u> tree overlooking the experimental clearing	10
4. The distribution of seladang herds in the Malaysian National Park	16
5. The changes in dominant or codominant plant frequencies on 72 milliacre squares in a cleared lowland dipterocarp forest in Malaysia, 1947-1953 (adapted from Wyatt-Smith, 1955)	24
6. Salt licks in the Malaysian National Park. Note the white crystalline material at the Jenut Jintoh salt lick. The bag of rock salt has been exposed at the Kuala Tahan arti- ficial salt lick	27
7. The range of the Kuala Tahan seladang herd on the borders of the Malaysian National Park	34
8. Seladang grazing in the experimental clearing	35
9. Seladang bull immobilized with the drug M.99	37

INTRODUCTION

The Malaysian wild ox known locally as the seladang (Bos gaurus hubbacki) was thought in danger of extinction in 1937 (Hubback, 1937). Foenander (1952), Kitchener (1961), and Stevens (1968) also have written of the bleak future of this animal. The IUCN in 1969 considered the seladang "critically endangered and in immediate danger of extinction without special protective measures" (Simon, 1969).

The Indian gaur (Bos gaurus gaurus) differentiated into the Malaysian and Burmese (B. g. readei) subspecies, is a member of the family Bovidae and is one of the six species of true cattle (Walker, 1968). The pelage of adult seladang varies from dark brown to jet black. The legs from just above the hock to the hooves have white or light yellow stockings. A dorsal ridge runs from the neck to the middle of the back (Figure 1). A dewlap hangs beneath the neck and chin, with a greater development in bulls. Gaur are the largest species of true cattle (Lydekker, 1907). A seladang bull may measure six feet tall at the withers (Foenander, 1952), and weigh a ton (Hubback, 1937). Two bulls shot in India weighed over 2000 pounds (Morris, 1947). The heavy horns of the male are wider and less incurved than those of the female.

The gaur was previously found throughout India, Nepal, Assam, Burma, Thailand, Laos, Cambodia, Viet Nam and the Malay peninsula (Ellerman and Morrison-Scott, 1951). Reports from many of these countries (Schaller, 1967; Peacock, 1933; Lekagul, 1964; and Stevens, 1968), however, indicate that the species is threatened throughout its range. Schaller (1967)



Fig. 1. A two-year old seladang cow.

believes that the Indian gaur is endangered by heavy poaching, elimination of habitat and epidemics of cattle diseases. There has been no known previous investigation of the seladang.

From September 1967 to November 1969, under the auspices of the Malaysian Game Department I undertook a study to determine the ecological requirements of the seladang to aid in its management and preservation. This study was supported by the U. S. Peace Corps and grants from the New York Zoological Society and Canadian Wildlife Service.

THE STUDY AREA

The investigation was conducted in the Malaysian National Park (Taman Negara), an area of approximately 1,677 square miles (Figure 2). Established in 1938, the park lies in west central Malaya along the state boundaries of Kelantan, Trengganu, and Pahang. The hilly terrain consists primarily of sedimentary rocks (Hua et al. 1971). Mt. Tahan (7,186 feet), the highest peak in West Malaysia, occurs within the park but 57.6 per cent of the park area lies below 1000 feet (Hua et al., 1971). The boundaries of the park are delineated by branches of three major river systems. Small Malay villages are common along these boundaries. Kuala Tahan, park headquarters and a small village, served as a base. Park personnel provided labor and made transportation available during the study.

The tropical rain forest vegetation found here is considered by Richards (1952) to be one of the oldest and most luxuriant of all existing rain forests. Undergrowth in the mature forest is sparse, consisting mostly of woody shrubs and saplings.

Temperature extremes recorded at Kuala Tahan ranged from 65.5°F.

Fig. 2. The Malaysian National Park.

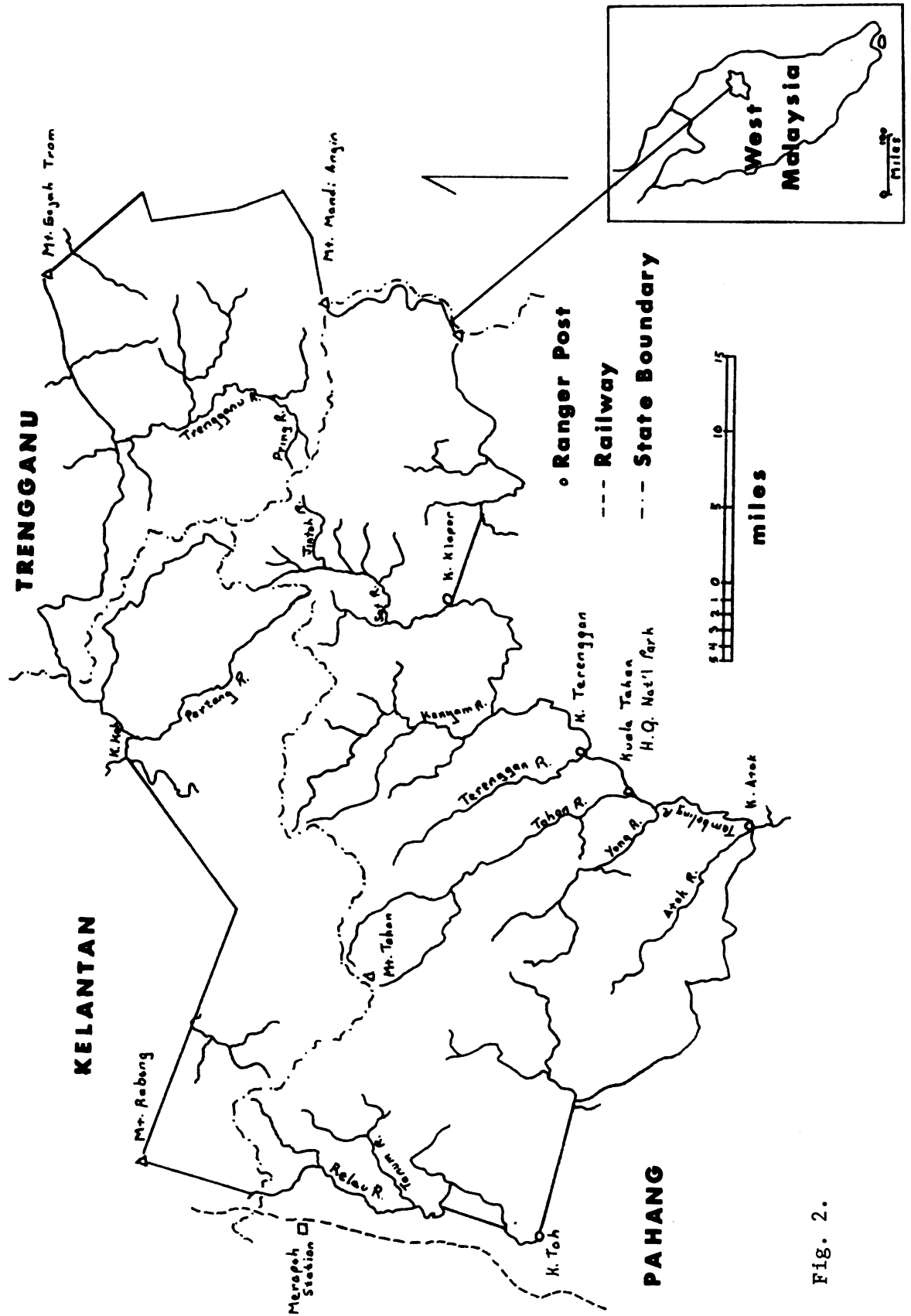


Fig. 2.

to 99°F. The mean air temperature over the duration of the study was 83°F.

Rainfall varied seasonally. The annual average precipitation at Kuala Tahan is 87.99 inches (Wyatt-Smith, 1963) but during 1968 was only 59.18 inches. There is a local annual drought in February, the last month of the northeast monsoon, perhaps due to the rain shadow cast by the Tahan massif (Johnson, 1969).

METHODS AND PROCEDURES

Seladang Census: Five surveys were conducted to determine seladang population levels in the park. The areas investigated were all reported to contain seladang. River banks, clearings, and salt licks were checked. The large deer-like tracks unique in the park to the seladang were the primary means of identification. The presence of five or more sets of tracks was adopted as the criterion to establish that a herd occurred in the area. Travel was made even to remote areas and was by boat, raft, and foot.

Food Studies: The herd near Kuala Tahan was studied more closely than the others. Plants observed to be eaten were collected and later identified. Each plant species was noted as to its habitat and classified as common, rare, abundant, or scattered (Appendix 1).

A more intensive vegetative analysis was conducted in a 240-acre rubber tree plantation. The browse survey method developed by Aldous (1944) was used there. This method was slightly modified to include all plants, their utilization, their importance in the seladang diet, and their preference ratings. Data on availability and utilization were recorded for all vegetation up to a height of six feet. Two line transects 200 paces

apart were run across the plantation. A hand-held compass kept the transects equidistant. Twenty circular plots each 1/100 acre in size (11.8 ft. radius) and spaced every 100 paces were laid out. Ocular estimation was used to determine plant densities on the plots.

The survey data were calculated as follows:

1. Percentage frequency = $\frac{\text{Number of plots with species present} \times 100}{\text{Total number of plots}}$
2. Average percentage density(D) = $\frac{\text{Total densities of each species} \times 100}{\text{Total number of plots}}$
3. Percentage of each species available(d) = $\frac{\text{Average percentage density of each species}}{\text{Total of average percentage densities}} \times 100$

$$d = \frac{D}{\sum D}$$
4. Average percentage eaten(E) = $\frac{\text{Total amount of each species eaten} \times 100}{\text{Number of plots that species occurred}}$
5. Use factor(U) = Average percentage density of each species X Average percentage eaten of each species

$$U = D \times E$$
6. Percentage of each species in diet(e) = $\frac{\text{Usage factor of each species} \times 100}{\text{Total of all usage factors}}$

$$e = \frac{U}{\sum U}$$
7. Preference rating(P) = $\frac{\text{Percentage of each species in diet}}{\text{Percentage of each species available}}$

$$P = \frac{e}{d}$$

Values above 1.00 indicate preferred species (Petrides, 1953)
8. Relative importance(I) = Percentage of each species available X Percentage of each species in diet

$$I = d \times e$$

(Petrides, 1953)

In addition to the plantation area, a transect with six 1/100 acre plots was also placed across an experimental clearing at Kuala Tahan.

This clearing previously of six acres was enlarged to $11\frac{1}{2}$ acres in August 1967 and to 21 acres in February 1969. Near the center of this field, a 5 pound bag of rock salt (NaCl) was buried one foot deep. Overlooking the field and the artificial salt lick, an observation blind was constructed 106 feet up in a twalang tree (*Koompassia excelsa*) (Figure 3). The field was cut annually, allowing only grasses and small forbs to persist.

Mineral Analysis: Soil samples from the natural salt lick at Jenut Belau, from a termite mound, and from a forest area were analyzed for their mineral concentrations by atomic absorption procedures.

Sex and Age Classification: The age criteria used were based on size, pelage color, and horn development. Calves up to one month old were distinctively orangish (Ogilvie, 1951). Calves one to eight months old were slightly larger and had distinct stockings, small black horns, and brown pelage. Yearlings, approximately eight months to two years old also had brown pelage, but were $\frac{3}{4}$ adult size (Schaller, 1967), and possessed bi-colored upright horns. Adults were full size, with dark brown to black pelage and well-developed incurved horns.

Range and Movements: Day by day movements were recorded for the Kuala Tahan herd. Data were gathered mainly by tracking since seladang are active mainly at dawn and dusk (Weigum, 1970) and move between feeding areas during the night.

Immobilization: The oripavine derivative 6, 14-endoetheno-7a(1-(R)-hydroxy-1-methylbutyl)-tetrahydro-oripavine hydrochloride better known as M.99 (Reckitt) was tested for its ability to immobilize seladang. A 3 ml capacity syringe projectile was shot from a Palmer Cap-Chur gun. Four adult animals were injected with dosages varying from 1.5 mg

Fig. 3. Observation blind in a Koompassia excelsa tree overlooking the experimental clearing.



Fig. 3.

to 8 mg M.99. The drug antagonist cyprenorphine (N-cyclopropylmethyl- 6, 14-endoetheno-7-(1-hydroxy-1-methylethyl)-tetrahydro-nororipavine) known as M.285 (Reckitt) was also tested.

RESULTS AND DISCUSSION

Seladang Census

The presence of seladang was known before the establishment of the National Park. Hubback (1905, 1937, and 1939), the person most responsible for founding the park, published pictures and stories of his experiences with seladang in the Pahang forests. Foenander (1952) named several rivers in the park as being traditional haunts of these animals. The location of herds in the park had been recorded through the years and was summarized by Khan (1971). Hislop (1961) wrote that finding the herds was not difficult since each was localized. The status of many of these herds at the time of the study (Table 1) was not known due to difficulties in reaching herd areas.

The Kuala Tahan herd was first reported by Ogilvie (1951) in 1947. Hislop (1961) pinpointed two other herds, one of which frequented the Jintoh salt lick and another the Pring valley. Thong (Khan, 1971), the Chief Game Warden since 1966, found evidence of two herds along the western park boundary and tracks of six seladang in the upper reaches of the Atok River (Figure 4).

I investigated the Jintoh salt lick and found fresh tracks of five seladang as well as those of tapir and elephant. I also found tracks of three single seladang further down the Sat River. This riverine habitat apparently then contained a resident herd.

At the mouth of the Pertang River, tracks of about 11 seladang were

Table 1. Seladang herd census results in the Malaysian National Park, 1967-1969

Location	Type of Evidence	Date	Numbers	Remarks
Kuala Tahan	Seladang observed	Throughout study	10-19	Resident herd
Jenut Jentoh	Tracks observed	October 1, 1967	5+	Resident herd
Merpoh	Tracks observed	October 7, 1967	12+	Resident herd
Sat River	Tracks observed	September 29, 1969	10+	Resident herd
Kuala Trengganu	Seladang observed	September 20, 1968	5	Migrant herd
Kuala Tahan to Mt. Tahan	-----	July 7-14, 1967	---	No signs found
Jenut Kumbang	-----	October 10, 1967	---	No signs found
Jenut Atai	-----	October 11, 1967	---	No signs found
Sat River to Kuala Koh	-----	September 28 - October 7, 1969	---	No signs found

seen. This area had long been cultivated by the Malay villagers now living outside the park. Rice and vegetable gardening was no longer practiced here and dense secondary forest had nearly eliminated the former fields but fruit from the orchards still within the park was still being collected. As the grassy vegetation dwindles under forest regrowth, it is not likely that this herd will remain.

A former Game Ranger (Pak Chik Manan in conversation) said that he had seen ~~salad~~adang in the area near Kuala Koh in 1941 before the Japanese occupation. A two-week trek was made to this area but while elephant were common there, no signs of seladang were seen. A group of nomadic forest people confirmed that seladang were no longer found here. They reasoned that the elephants had driven them away but, since an abandoned overgrown rubber plantation was the only evidence that agriculture had ever been practiced here, it seemed evident that seladang habitat had been completely eliminated by second-growth forest.

The area along the western boundary where two herds were reported (Khan, 1971) also was investigated. In the Relau River valley, tracks of two seladang were seen entering a nearby padi field outside the park. At the natural salt licks Kumbang and Atai (Figure 4) only elephant, tapir, and deer sign were seen. Local Malay people reported that a seladang herd was sometimes seen $2\frac{1}{2}$ -3 miles outside the park near the railroad tracks at Merpoh (Figure 4). The Relau valley had once been logged, but secondary forest had shaded out the grasses and herbaceous plants. Khan (1971) reported that one of these herds was being poached by the villagers. I judged that only one herd still occupied the area and because of the lack of grasses and open vegetation in the park, this herd remains outside the park. Its continued existence seems in doubt.

Kuala Atok was reported by Hislop (1961) to be the southern limit of the Kuala Tahan herd. The land adjacent to the Atok River was marked on the 1951 Malaysian Government Survey map as agricultural land, but now there is a ranger post here and former fields have reverted to forest. The Kuala Tahan herd did not range this far south during the study and there was no evidence of any seladang there. Reports of herds in the upper reaches of the Atok River (Khan, 1971) and in the Pring valley (Hislop, 1961) could not be investigated.

Vegetation and Food Analysis

Seladang are both grazers and browsers. Hubback (1937) stated that their main food was grasses, with buffalo grass (Paspalum conjugatum) preferred. Young shoots of lalang (Imperata cylindrica) and the leaves of several shrubs also are eaten (Hubback, 1937). Foenander (1952) believed that rumput chenkenit (P. conjugatum) was an important food. He found that the seladang ate the young shoots of bamboo (Bambusia spp.) and fallen fruits of the simpoh (Dillenia spp.) and kerayong (Parkia javanica) trees. Schaller (1967) stated that the Indian gaur preferred green grass when available, but otherwise consumed dried grasses, forbs and leaves.

Of 89 species of plants observed to be eaten in the present study, 43 per cent were grasses and sedges. Trees, shrubs and vines browsed by the seladang represented 36 per cent. Herbaceous vines and forbs were represented by 19 species. During April, seladang sought the fruiting pods of the kerayong tree. The fallen fruits of the simpoh and fig (Ficus spp.) trees were occasionally sampled.

A browse survey similar to that suggested by Aldous (1944) was

Fig. 4. The distribution of seladang herds in the Malaysian National Park.

conducted in a 240 acre rubber tree plantation. Eupatorium odoratum (37.6%), Mikania cordata (20.1%) and Paspalum conjugatum (13.1%) were most common, making up 70.8% of the total forage available (Table 2). Of these species, P. conjugatum represented 43.8%, M. cordata 17.5% and E. odoratum 3.4% of the food in their diet. The most important food plants in the seladang diet were P. conjugatum, M. cordata, E. odoratum and Athyrium spp. Highly preferred foods such as Scleria multifoliata, miscellaneous woody species, and Merremia umbellata were relatively unimportant because of their low availability (Table 2). Of the three most important food plants P. conjugatum was preferred over M. cordata and E. odoratum. Eupatorium odoratum the most abundant of the food plants was least preferred of all species eaten.

Using the above method in a 21 acre experimental clearing (Table 3), it was found that grasses and sedges made up 49.7% of the available forage. Forbs were also 49.7% of the vegetation there. Mikania cordata (26.2%), Paspalum conjugatum (24.2%), Eupatorium odoratum (14.1%) and Ottochloa nodosa (11.2%) made up 75.7% of the total forage available. The plants most eaten were P. conjugatum (35.7%) and M. cordata (16.2%). In this clearing as in the rubber plantation the most important food plants were P. conjugatum and M. cordata. The sedges Gahnia baniensis, Cyperus kyllingia and Cyperus distans were the most preferred species but because of their low availability not very important. Of the most important food plants, P. conjugatum and Ottochloa nodosa were more preferred than either M. cordata or E. odoratum.

Nearly all (96 per cent) of the seladang's food plants were found in open areas of early successional vegetation. Of the 89 plant species utilized as food only one was confined to the primary forest.

Table 2. Seladang forage survey in a 240 acre rubber tree plantation near Kuala Tahan, Malaysia, October 1969

Forage Species	Percentage Frequency	Average Percentage Density (D)	Percentage of Each Species Available (d) $= \frac{D}{\sum D}$	Average Percentage Eaten (E)	Use Factor (U) $= (D \times E)$	Percentage of Each Species in Diet (e) $= (U / \sum U)$	Preference Rating $= (e/d)$	Relative Importance $= (d \times e)$
Grasses								
<u>Paspalum conjugatum</u>	80.0	15.0	13.1	11.7	173.4	43.8	3.34	573.78
<u>Imperata cylindrica</u>	15.0	6.5	5.7	0.0	0.0	0.0	0.0	0.0
<u>Panicum sarmentosum</u>	35.0	2.5	2.2	2.1	5.4	1.4	.64	3.08
<u>Panicum trigonum</u>	15.0	.8	.7	1.7	1.3	.3	.43	.21
<u>Digitaria marginata</u>	5.0	.8	.7	5.0	3.8	.9	1.29	.63
Sedges								
<u>Scleria multifoliata</u>	5.0	.3	.2	100.0	25.0	6.3	31.50	1.26
Forbs								
<u>Eupatorium odoratum</u>	80.0	43.0	37.6	.3	13.3	3.4	.09	127.84
<u>Athyrium spp. (fern)</u>	15.0	4.3	3.7	5.0	21.3	5.4	1.46	19.98
<u>Musa spp.</u>	10.0	5.8	5.0	0.0	0.0	0.0	0.0	0.0
Herbaceous Vines								
<u>Merremia umbellata</u>	10.0	1.0	.9	27.5	27.5	6.9	7.66	6.21
<u>Mikania cordata</u>	75.0	23.0	20.1	3.0	69.0	17.5	.87	351.75
<u>Pasiflora foetida</u>	25.0	2.8	2.4	2.0	5.5	1.4	.58	3.36
Shrubs								
<u>Melostoma malabathricum</u>	25.0	7.3	6.4	0.0	0.0	0.0	0.0	0.0
<u>Uncaria cordata</u>	5.0	.3	.2	0.0	0.0	0.0	0.0	0.0
<u>Calanus spp.</u>	5.0	.3	.2	0.0	0.0	0.0	0.0	0.0
<u>Misc. woody spp.</u>	10.0	1.0	.9	50.0	50.0	12.7	14.11	11.43

Table 3. Seladang forage survey in a 21 acre experimental clearing at Kuala Tahan, Malaysia, October 1969

Forage Species	Percentage Frequency	Average Percentage Density (D)	Percentage of Each Species Available (d) $= \frac{D}{\sum D}$	Average Percentage Eaten (E)	Use Factor (U) $= (D \times E)$	Percentage of Each Species in Diet (e) $= (U / \sum U)$	Preference Rating $= (e/d)$	Relative Importance $= (d \times e)$
Grasses								
<u>Paspalum conjugatum</u>	100.0	30.0	24.2	25.8	775.0	35.7	1.48	863.94
<u>Ottochloa nodosa</u>	66.7	14.2	11.2	18.8	265.7	12.2	1.09	136.64
<u>Imperata cylindrica</u>	16.7	10.0	8.1	10.0	100.0	4.6	.57	37.26
<u>Brachiaria brizantha</u>	16.7	4.2	3.4	50.0	208.8	9.6	2.82	32.64
<u>Panicum sarmentosum</u>	16.7	.8	.7	0.0	0.0	0.0	0.0	0.0
Sedges								
<u>Gahnia baniensis</u>	16.7	.8	.7	100.0	83.0	3.8	5.43	2.66
<u>Cyperus kyllingia</u>	16.7	.8	.7	100.0	83.0	3.8	5.43	2.66
<u>Cyperus distans</u>	16.7	.8	.7	100.0	83.0	3.8	5.43	2.66
Forbs								
<u>Eupatorium odoratum</u>	83.3	17.5	14.1	6.0	105.0	4.8	.34	67.68
<u>Athyrium</u> spp. (fern)	33.3	1.7	1.4	0.0	0.0	0.0	0.0	0.0
<u>Selaginella</u> spp.	33.3	1.7	1.4	0.0	0.0	0.0	0.0	0.0
Herbaceous Vines								
<u>Merremia umbellata</u>	33.3	1.7	1.4	20.0	33.4	1.6	1.14	2.24
<u>Merremia vitifolia</u>	50.0	2.5	2.0	0.0	0.0	0.0	0.0	0.0
<u>Mikania cordata</u>	100.0	32.5	26.2	10.8	352.0	16.2	.62	424.44
Shrubs								
<u>Euphorbia</u> spp.	66.7	3.3	2.7	25.0	83.3	3.8	1.41	10.26
<u>Misc woody</u> spp.	16.7	.8	.7	0.0	0.0	0.0	0.0	0.0
<u>Mimosa pudica</u>	16.7	.8	.7	0.0	0.0	0.0	0.0	0.0

As was also evident from the seladang census, all herds in the park (with the exception of the Jintoh herd) were associated with padi fields which are generally abandoned after one crop. Seladang feed primarily on early seral vegetation in these abandoned fields.

Vegetative succession was studied by Wyatt-Smith (1949) on a 50 acre plot of lowland dipterocarp forest. This forest was similar to the lowland areas occupied by the seladang in the park. It was cleared, the slash burned, and rice planted. After one crop, it was abandoned. Four quadrats were laid out and observed at varying intervals. Quadrat B, typical of well drained soils was observed for five years. One year after abandonment, pure stands of Paspalum conjugatum mixed with Eupatorium odoratum and the trees Mallotus macrostachys, Macaranga gigantea, Glochidion sericeum, and Trema spp. came in. The trees averaged 6-7 feet tall. After two years, a closed canopy was being formed at a height of 6-14 feet. Paspalum conjugatum then became reduced and Trema spp. began dying. By the end of three years, Mallotus macrostachys and Macaranga gigantea were 20 feet in height. Trema spp. had disappeared, though Mikania cordata was common. One open area which had been dominated by P. conjugatum was being invaded by the coarse grass Imperata cylindrica. After four years, there was a continuous canopy of M. gigantea and M. macrostachys 25-30 feet high. Though M. cordata, Imperata cylindrica and Eupatorium odoratum were still present, they were much reduced. In five years, the canopy of M. gigantea was 40 feet high and the shrub layer was nearly absent (Table 4).

Lalang (Imperata cylindrica), a common invading grass in open fields, can suppress other vegetation and temporarily arrest succession after a fire (Mitchell, 1964). This fire-climax species invaded quadrat E after an accidental fire and completely dominated the area (Wyatt-Smith, 1949).

Table 4. Dominant-codominant plants recorded in a vegetative succession study in a lowland dipterocarp forest area, 1946-1950 by Wyatt-Smith (1949) with reference to the seladang

Scientific name	Plant type	Eaten by seladang
<u>Imperata cylindrica</u>	Grass	New shoots
<u>Paspalum conjugatum</u>	Grass	Yes
<u>Eupatorium odoratum</u>	Forb	Occasionally
<u>Mikania cordata</u>	Creepers	Yes
-----	Fern	Yes
<u>Macaranga gigantea</u>	Tree	No
<u>Mallotus macrostachys</u>	Tree	No
<u>Glochidion sericeum</u>	Tree	Yes
<u>Trema spp.</u>	Tree	Yes
Other woody spp.	--	--

To determine the proportion of plant changes from year to year in this area, a one percent milliacre survey over 34 acres was carried out (Wyatt-Smith, 1955). Changes in plant frequency were observed for 6½ years (Figure 5). The increase in Paspalum conjugatum (Figure 5) in December 1949 was due to man's disturbance (Wyatt-Smith, 1955). The data indicates that at the end of three years important seladang food plants rapidly declined in frequency as the canopy formed.

A survey of this area in 1963 (Kochummen, 1966) showed that Macaranga gigantea was still dominant at an average height of 65 feet. Paspalum conjugatum and Mikania cordata were represented by only a few plants. Sample plots indicated that M. gigantea was being replaced. Kochummen (1966) estimated that a lowland dipterocarp forest when cut, burned, cultivated, and abandoned would take 50 years to return to its original vegetation.

Salt Licks

Natural salt licks could be important in the distribution of seladang. Wharton (1957) found evidence suggesting that without salt licks hoofed mammals would either perish or migrate. In the park, this seemed to be indicated by the occurrence of one or more natural licks within the home range of each seladang herd (Figure 4).

Opinions vary as to why salt licks are necessary. Hubback (1937) stated that sulfur and salt taken at the licks rids the seladang of intestinal parasites. Cowan and Brink (1949) suggested that the function of licks was to alter the intestinal flora and fauna. Experiments by Stockstad and Morris (1953) indicated that ungulates in western Montana were seeking a specific mineral, in that case sodium which is not readily

Fig. 5. The changes in dominant or codominant plant frequencies on 72 milliacre squares in a cleared lowland dipterocarp forest in Malaysia, 1947-1953 (adapted from Wyatt-Smith, 1955).

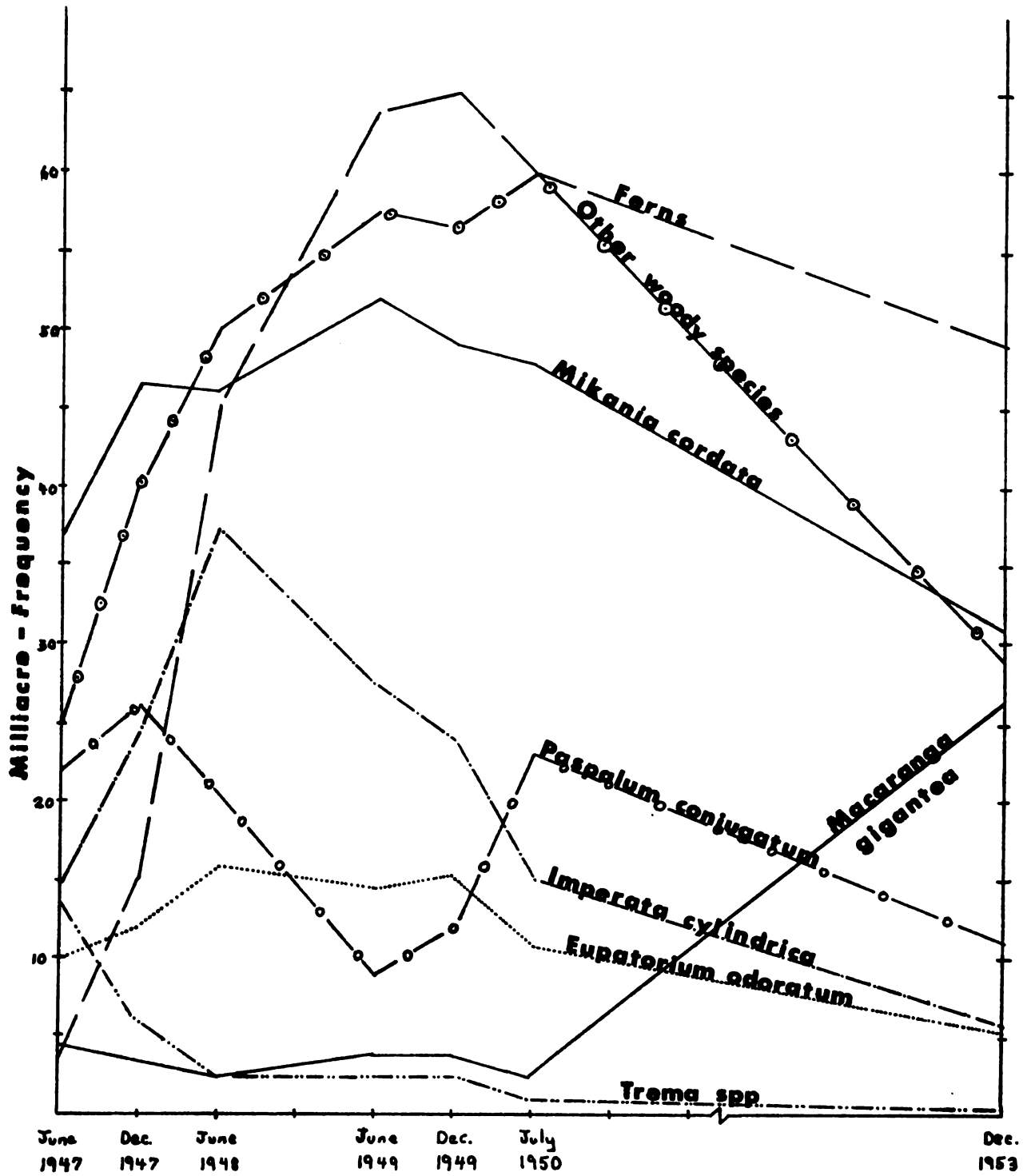


Fig. 5.

absorbed by plants.

The natural licks in the park were located in boggy areas or along streams. The Kumbang (Trenggan River), Jintoh, and Belau salt licks each centered around a 3-4 foot rock which, where it edged the water, had a crystalline material at the water line (Figure 6). These licks did not appear to have a particular licking area. Though Foenander (1952) believed that seladang drink only the 'salty' water, at mineral licks in Cambodia (Wharton, 1957) and at the artificial lick at Kuala Tahan, the soil was eaten.

The analysis of several soil samples from the Malaysian National Park showed that Jenut Belau salt lick had a much higher concentration of sodium, calcium, and magnesium than the surrounding forest soil (Table 5). Termite mounds were used as salt licks in Cambodia (Wharton, 1957) but in the park the mineral concentration of one such mound did not differ appreciably from the nearby forest soil.

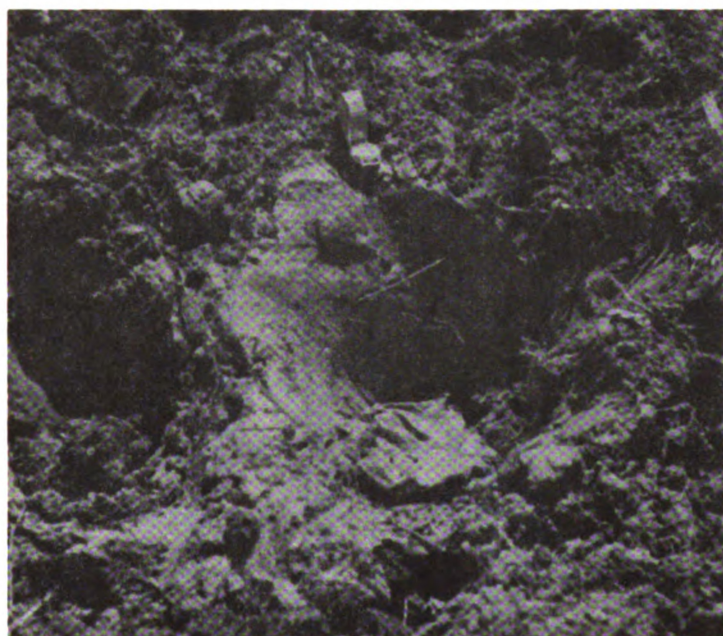
Seladang consumed soil from the artificial salt lick at Kuala Tahan on the day that the salt bag was buried. The herd visited this clearing six times throughout the study as compared with only two visits to the natural lick. The seladang utilized the artificial lick on the first 3-4 days of every visit remaining generally at the lick for 30 to 45 minutes each time. Although the animals remained in the clearing many more days, they did not again move to the lick en masse.

The use of the artificial salt lick and the mineral content of the natural salt lick seems to indicate that the seladang were seeking sodium. The instant and ready utilization of the artificial lick indicated its importance. Such licks could be an important management factor in establishing new herd areas.

Fig. 6 Salt licks in the Malaysian National Park. Note the white crystalline material at the Jenut Jintoh salt lick. The bag of rock salt has been exposed at the Kuala Tahan artificial salt lick.



Jenut Jintoh Salt Lick



Artificial Salt Lick

Fig. 6.

Table 5. Mineral analysis of soil samples from the salt lick, a termite mound and forest soil at Jenut Belau in the Malaysian National Park, 1969

Collection	pH	Minerals in parts per million			
		Calcium	Magnesium	Potassium	Sodium
Salt lick crystals	8.0	4800	1900	11.9	4114
Salt lick soil	7.6	1980	11.6	2.9	
Termite mound	4.6	240	16.8	22	
Forest soil	4.6	250	17.6	22	992.4

Reproduction and Mortality

The Indian gaur mates in December and January in central India and from November to March in southern India (Schaller, 1967). Hubback (1937) noted new seladang calves throughout the year except from October to December. My data also indicated that calves were born throughout the year including October to December. Nine calves were born during the study.

The gestation period of the gaur is about nine months (Jarvis and Morris, 1959). Since a gaur cow from India gave birth to 13 calves during 16 years in the New York Zoological Park (Reed, 1959), seladang cows can probably produce a calf every year. Like females of the banteng (Hoogerwerf, 1970) and the Indian gaur (Schaller, 1967), seladang cows can likely mate initially at two years of age.

Schaller (1967) estimated that 80 per cent of adult gaur cows should be accompanied by calves after the calving season. He found that only 53 per cent of the cows had calves, and that the yearling to cow percentage was 24 per cent. Schaller attributed this difference to tiger predation.

The Tahan herd composition (Table 6) indicated that natality was quite high. The cow to yearling ratio was 1:1 during the peak population. Since this herd has never been reported to contain more than 19 animals (Ogilvie, 1951 and 1954) there is an apparent loss. Hislop (1961) stated that this herd is prolific but did not increase in proportion to the calves produced.

Tigers are present in the park and their tracks were found occasionally in the vicinity of the Tahan herd. Ogilvie (1954) attributed the disappearance of three calves from the Kuala Tahan

Table 6. Observed composition of the Kuala Tahan seladang herd, Malaysian National Park

Date	Orange calf	Brown calf	Yearling	Adult female	Adult male	Total	Calf:Cow:Yearling
November 7, 1967	0	4	5	5	3	17	.80 : 1 : 1
May 9, 1968	0	5	0	7	4	16	.71 : 1 : 0
March 5, 1969	2	4	5	5	3	19	1.2 : 1 : 1
June 27, 1969	0	5	5	5	3	18	1 : 1 : 1
August 13, 1969	0	1	3	6	1	11	.16 : 1 : .50

herd to tiger predation. Shuttlesworth (1965) observed two herd bulls kill an attacking tiger. A tiger was driven away from the Kuala Tahan herd in 1967 (Weigum, 1970). During the study no seladang remains were ever found. I believe that predation by tigers is of minor importance in the study region.

Mortality in the Indian gaur due to the cattle virus diseases hoof and mouth and rinderpest have been locally very high (Inverarity, 1889; Schaller, 1967; and Weigum, 1971). There has been no known seladang mortality due to these diseases. No parasitic ova (worm) were found in four dung samples from the Kuala Tahan herd.

Rather than mortality, the population stability of the Kuala Tahan herd seems to be due to emigration or splitting of the herd. Hislop (1961) recorded the fresh tracks of a herd near Kuala Kenyam an area which was never known to contain a resident herd. Thong (Khan, 1971) found tracks of six seladang above the upper reaches of the Atok River. In September 1968, five seladang were seen crossing Jenut Kumbang (Trenggan River), though the nearest resident herd was at Kuala Tahan, four miles southwest. In June 1969, the Kuala Tahan herd numbered 18, but in August 1969 this herd with the same master bull and lead cow had only 11 animals (Table 6). Later, tracks of five seladang in the rubber tree plantation indicated that a group was moving together yet independent of the main herd.

The Tahan herd from 1947 to 1954 varied between 11 and 18 animals (Ogilvie, 1951 and 1954). During the present study, the herd varied from 10 to 19 animals. Perhaps the basic herd of 10-12 animals (Hubback, 1937) loses cohesiveness as its numbers increase.

Home Range

Movements of the Kuala Tahan herd extended over five square miles (Figure 7). The greatest part of this range, however, was outside the park on the east bank of the Tembeling River. Four Malay villages are in this area and shifting cultivation has resulted in a swath of secondary vegetation approximately $\frac{1}{2}$ mile wide and $4\frac{1}{2}$ miles long.

The herd moves between feeding areas on old established trails. They enter and leave the park at shallow crossing points near Kuala Tahan and the Yong River (Figure 7). At Kuala Tahan, the herd visited the experimental clearing (Figure 8) on six occasions each time remaining from 9 to 15 days. During a period of 408 days however, the herd spent only 144 days in the park.

The close proximity of the villagers and the Kuala Tahan herd has been an advantage to the seladang. Because most of these people are either park employees or relatives, there was no poaching.

Immobilization

The problems of capturing large animals such as the seladang for study or translocation purposes have been greatly reduced with the perfection of new immobilizing drugs and the projectile syringe. The habitat pressures on certain seladang herds may mean that their translocation is the only alternative to extermination.

The oripavine derivative M.99 has been tested successfully as an immobilizing drug on many African animals (Wallach, 1967). The small dosages required and its relative safety give this drug many advantages. Harthoorn (1966) found that the injection of M.99 into hoofed animals in

Fig. 7. The range of the Kuala Tahan seladang herd on the borders of the Malaysian National Park.

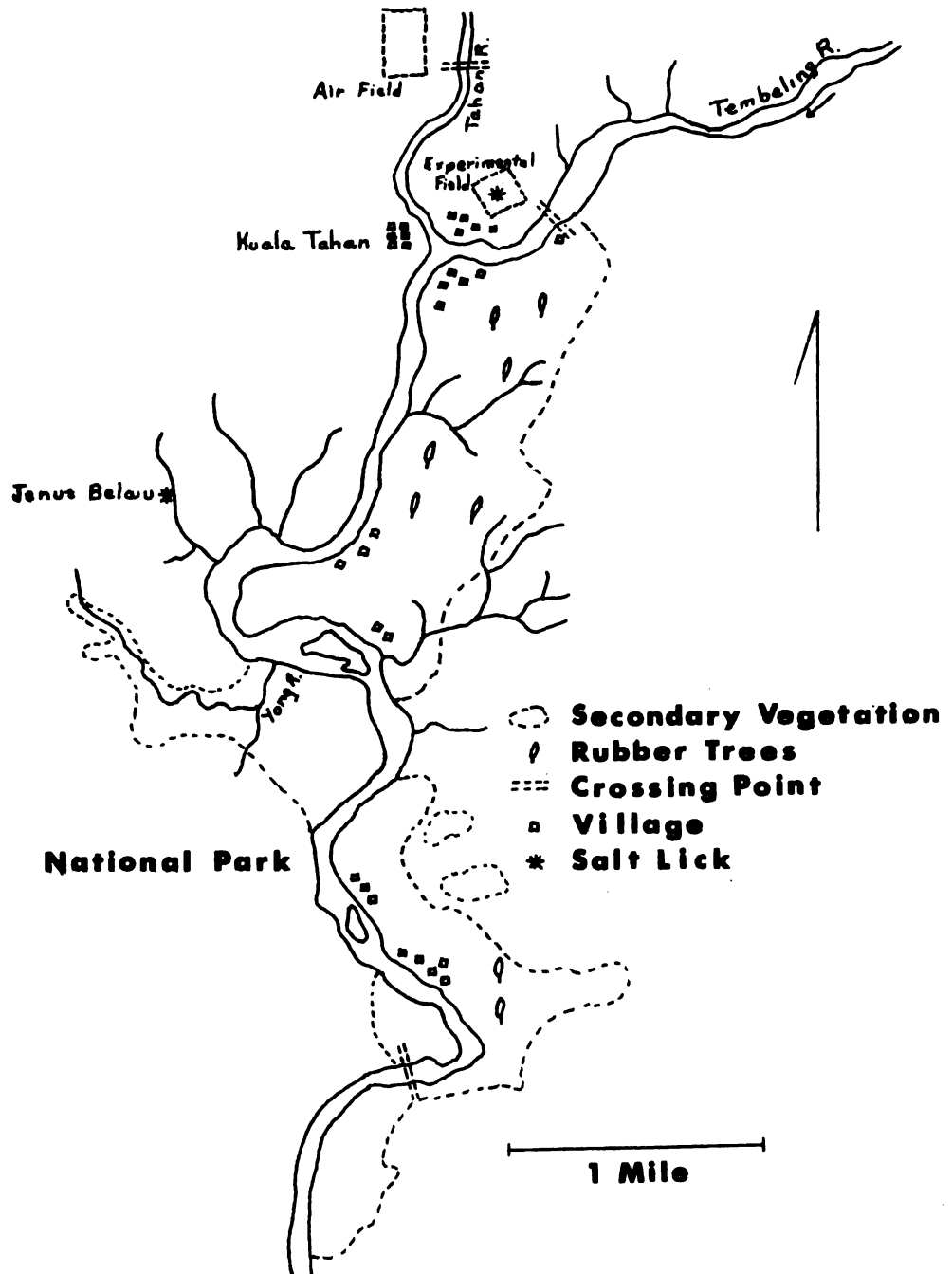


Fig. 7.

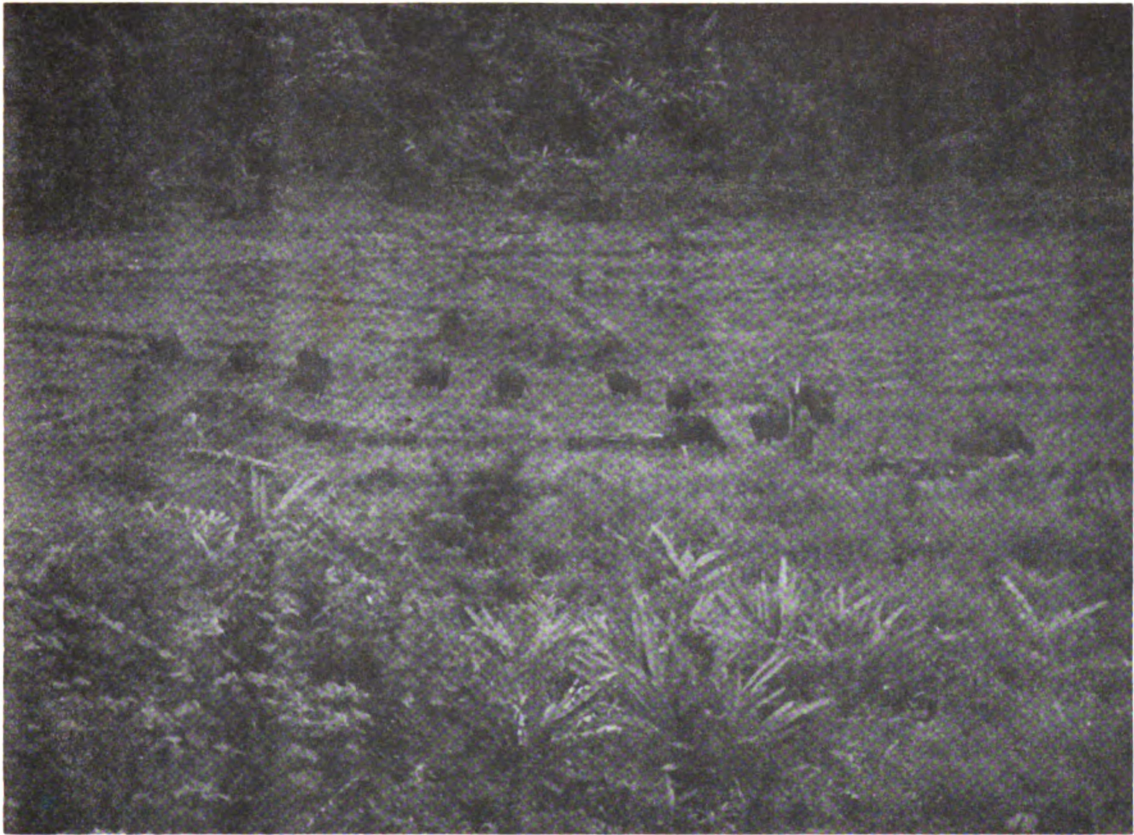


Fig. 8. Seladang grazing in the experimental clearing.

immobilizing doses produced minor depression of respiration, cessation of ruminal movements and a stiffness of the musculature of the neck and limbs. No visible effects were noted when two cows were injected with 1.5 and 2.5 mg of M.99 nor was a bull affected when injected with 3.0 mg. However, a two-year old bull injected with 8 mg of M.99 in the left shoulder stopped after moving 984 feet. This bull remained on his feet but exhibited labored breathing accompanied by continuous moaning. He had a 'hunched' appearance (Figure 9) and unsteady legs. He showed fear and was not aggressive. Yet, he could not be handled. He fell four times in his attempts to escape. He first fell 50 minutes after injection and after 1½ hours lay thrashing on his back. Twenty mg of the antagonistic drug M.285 were injected into the muscles of the rump. The excited animal regained his feet and ceased moaning within 10 seconds after the injection. He stood quietly for five minutes before walking into the brush. He rejoined the herd with no apparent ill effects. The dosage rate of 8 mg M.99 could probably be increased and with the addition of a tranquilizer undue excitement could be reduced (Wallach, 1967).

RECOMMENDATIONS

Seladang feed in areas of early successional vegetation. Without man's influence such vegetation is found primarily along river edges. Of the four herds in the park, only the Jintoh herd was considered to occupy such a riverine habitat. With the present secure park boundaries, shifting agriculture is no longer practiced in the park. The seladang herds in these areas have either disappeared, as at Kuala Koh, or have moved outside the park as at Merapoh.

The Kuala Tahan herd appeared to become stabilized by frequent



Fig. 9. Seladang bull immobilized with the drug M.99.

emigrations. These 'surplus' animals could form other resident herds if more habitat were available. Evidence from the experimental field suggests that forest clearcutting can create suitable seladang habitat and will also benefit other large animals such as the sambar deer (Cervus unicolor) and the wild pig (Sus scrofa). The 11½ acre clearing supported the herd for nearly two weeks. Allowing one month for vegetative recovery, three such fields could support a herd year round. It is therefore recommended that to maintain a herd of 10-12 animals: (1) three 15 acre plots ½ mile apart be clearcut and burned, (2) these plots be recut every three years but not burned again, and (3) an artificial salt lick be made in one of these plots by burying a 5 pound bag of rock salt one foot deep.

The Merpoh and Sat herds are immediately threatened by the loss of suitable habitat and should be given first priority in clearcutting.

SUMMARY

To aid in preserving the Malaysian subspecies of gaur (Bos gaurus hubbaki), known locally as the seladang, a study of the Kuala Tahan and other herds was conducted in the National Park of Malaysia from September 1967 to November 1969.

A survey in the park located only four herds. The herds which occupied the Pertang valley previous to the Japanese occupation in 1942 are no longer present. With the exception of one herd, all were in or close to areas which are being cultivated or recently have been disturbed by man.

Of the 89 plant species observed in the diet of these wild cattle, 96 per cent occurred mainly in the early secondary vegetation of river edges, clearings and secondary forest. The most important food plant was the grass Paspalum conjugatum. Also important were herbaceous creepers, especially Mikania cordata.

An experimental 6 acre field was expanded to 11½ acres and finally to 21 acres. Invading vegetation consisted primarily of grasses, especially Paspalum conjugatum and the vine Mikania cordata. The Kuala Tahan herd visited this field and remained from 9 to 15 days.

One or more natural mineral licks occurred within the home range of each existing herd and may be important in determining the suitability of an area for seladang. Mineral analysis of one lick showed it to be rich in sodium, calcium, and magnesium. A station artificially salted with NaCl was found to be more frequently visited than was a nearby natural lick.

The Kuala Tahan herd has maintained a stable population of 10-19 individuals since 1947. The ratio of immature animals to adults indicated it to be a health growing herd. Lack of evidence showing high mortality due to disease or predation suggested that emigration may be the major stabilizing factor in this population.

The Tembeling River which runs through the five square mile range of the Kuala Tahan herd is part of the park boundary. The herd was observed to remain on the east bank of this river and outside the park at least 65 per cent of the time, mostly in a rubber plantation and old fields.

The immobilizing drug M.99 was found to be apparently suitable for capturing seladang for possible relocation and study.

The seladang is an animal of the early stages in vegetative succession. Vegetative succession studies by the Malaysian Forestry Department indicated that tracts of lowland dipterocarp forests which are cut, burned, planted, and abandoned will return to a climax stage in about 50 years. By the end of four years however, there is complete canopy which shades out the important food plants of the seladang. Seladang herds cannot be expected to survive in the Malaysian National Park unless efforts are

made continuously to maintain those early stages.

It is recommended that in each area where a resident herd is desired, 45 acres of land must be clearcut preferably in 15 acre plots one half-mile apart. These plots should be recut every three years but without further burning. The Merpoh and Sat herds are in immediate danger and should be given first priority in clearcutting. Animals occupying areas outside the National Park can be relocated in the park, but only if further habitat is developed for them.

LITERATURE CITED

- Aldous, S. E. 1944. A deer browse survey method. *J. Mammal.* 25:130-136.
- Cowan, I. McT. and V. C. Brink. 1949. Natural game licks in the Rocky Mountains National Parks of Canada. *J. Mammal.* 30:379-387.
- Ellerman, J. R., and T. C. S. Morrison-Scott. 1951. Checklist of palaeartic and Indian mammals, 1758-1946. London, Brit. Museum. 810 pp.
- Foenander, E. 1952. Big game of Malaya. London. 208 pp.
- Harthoorn, A. M. 1966. Restraint of undomesticated animals. *J. Am. Vet. Med. Assoc.* 149(7):875-880.
- Hislop, J. A. 1961. The distribution of elephant, rhinoceros, seladang and tapir in King George V National Park, Malaya. 95-99 pp. In *Nature Conservation in Western Malaysia, 1961.* Malayan Nat. J. special issue.
- Hoogerwerf, A. 1970. Ujung Kulon the land of the last Javan rhinoceros. Leiden, Netherlands. 512 pp.
- Hua, H. T., E. Soepadmo, and T. C. Whitmore. 1971. Taman Negara. *Malayan Nat. J.* 24:113.
- Hubback, T. R. 1905. Elephant and seladang hunting in the Federated Malay States. Rowland Ward, Ltd. London. 289 pp.
- _____. 1937. The Malayan gaur or seladang. *J. Mammal.* 18(3): 267-279.
- _____. 1939-40. Wildlife photography in the Malayan Jungle. *Bombay Nat. Hist. Soc. J.* 41:48-63.
- Inverarity, J. D. 1889. The Indian bison with some notes on stalking him. *Bombay Nat. Hist. Soc. J.* 4:294-319.
- Jarvis, C. and D. Morris, editors. 1959. The international zoo yearbook. 1:160.
- Johnson, A. 1969. A forest quadrat in the national park: the flora other than trees. *Malayan Nat. J.* 22:152-158.

- Khan, M. 1971. The distribution of large animals in Taman Negara. *Malayan Nat. J.* 24:125-131.
- Kitchener, H. J. 1961. The bleak future for the seladang or Malayan gaur. 197-201 pp. In *Nature Conservation in Western Malaysia, 1961.* *Malayan Nat. J.* special issue.
- Kochummen, K. M. 1966. Natural plant succession after farming in Sungei Kroh. *Malayan Forester.* 29:170-181.
- Lakagul, B. 1964. Conservation problems in Thailand. *Conservation News, S.E. Asia.* 4:13-15.
- Lydekker, R. 1907. The game animals of India, Burma, Malaya, and Tibet. London. 408.
- Mitchell, B. A. 1964. Periodical cropping of Imperata cylindrica for paper pulp. *Malayan Forester.* 27:22-45.
- Morris, R. C. 1947. Weight of bull bison. *J. Bombay Nat. Hist. Soc.* 47(1):153.
- Ogilvie, C. 1951. Mammals. Game Department Nature Notes. Ed. by A. H. Featherstonhaugh. 19 pp.
- _____. 1955. A game warden looks at the Malayan seladang. *Anim. Kingd.* 58:2-12.
- Peacock, E. H. 1933. A game book for Burma and adjoining territories. Edinburgh Press, London. 292 pp.
- Petrides, G. A. 1953. Computing food preference ratings. Unpublished notes.
- Reed, T. H. 1958. Report on the National Zoological Park for the year ended June 30, 1958. Smithsonian Institution Report. 140-179.
- Richards, P. W. 1952. The tropical rain forest - an ecological study. Cambridge Univ. Press. 450 pp.
- Schaller, G. B. 1967. The deer and the tiger - a study of wildlife in India. Univ. of Chicago Press. 370 pp.
- Shuttlesworth, C. 1965. Malayan safari. Phoenix House, London. 156 pp.
- Simon, N. 1969. Mammalia a compilation. In *Red Data Book.* IUCN publ. 1:122.
- Stevens, W. E. 1968. The conservation of wild life in West Malaysia. Office of the Chief Game Warden, Fed. Game Dept. Seremban Malaysia. 123 pp.

- Stockstad, D. S., M. S. Morris, and E. C. Lory. 1953. Chemical characteristics of natural licks used by big game animals in western Montana. North Am. Wildl. Conf. Trans. 18:247-257.
- Walker, E. P. 1968. Mammals of the world. Johns Hopkins Press, Baltimore. 2ne ed. 2 v.
- Wallach, J. D., R. Frueh, and M. Lentz. 1967. The use of M.99 as an immobilizing and analgesic agent in captive wild animals. J. Am. Vet. Med. Assoc. 151(7):870-875.
- Weigum, L. E. 1970. Seladang. Anim. Kingd. 73(1):2-9.
- _____. 1971. The last refuge. Malayan Nat. J. 24:132-137.
- Wharton, C. H. 1957. An ecological study of the kouprey, Novibos sauveli (Urbain). Manila Bureau of Printing. 111 pp.
- Wyatt-Smith, J. 1949. Natural plant succession. Malayan Forester. 12:148-152.
- _____. 1955. Changes in composition in early natural plant succession. Malayan Forester. 18:44-49.
- _____. 1963. Environmental factors and tree properties, part 2, chapt. 1, p. 1-21. In manual of Malayan silviculture for inland forests. Malayan Forest Records. No. 23. 1 v.

APPENDIX 1

The scientific names, location, and relative distribution of the plants eaten by the Kuala Tahan seladang.¹

Scientific Name	Malay Name	Locality	Distribution	Remarks
<u>Gramineae</u> (Grasses)				
<u>Paspalum conjugatum</u>	Rumput chenkenit	Abandoned fields and clearings	Common-abundant	One of the most preferred and important food plants
<u>Paspalum scrobiculatum</u>	Peher belalang	Abandoned fields and clearings	Common in old padi fields-scattered	
<u>Panicum pilipes</u>		Most clearings	Common-scattered	
<u>Panicum trigonum</u>		Clearings in shady places	Common-scattered	
<u>Panicum brevifolium</u>		Clearings in shady places	Common-abundant in some fields	Heavily grazed on occasion
<u>Panicum amplexicaule</u>	Kumpai	Wet places	Rare-in one padi field	
<u>Panicum sarmentosum</u>	Telebong	Forest edges	Common-scattered	
<u>Ottochloa nodosa</u>	Rumput dawai	Most clearings	Common-abundant in some fields	Heavily grazed on occasion
<u>Eleusine indica</u>	Sambal	Abandoned fields and clearings	Common-abundant in one padi field	

APPENDIX 1 (cont'd.)

Scientific Name	Malay Name	Locality	Distribution	Remarks
Gramineae				
<u>Themeda villosa</u>	Perimping	River edges	Common-abundant in places	Coarse grass often 10 feet tall-leaf tips occasionally eaten
<u>Brachiaria brizantha</u>		Introduced in the experimental clearing		
<u>Imperata cylindrica</u>	Lalang	Abandoned fields and clearings	Common-abundant in airstrip	Fire tolerant species grazed when young
<u>Coelorachis glandulosa</u>		Clearings and river edges	Rare	Heavily grazed when encountered
<u>Axonopus compressus</u>		Clearings	Common-abundant in places	
<u>Phragmites communis</u>	Rumput gedabong	River edges	Common-abundant in places	Reed sometimes 12 feet tall-leaves and stems occasionally grazed
<u>Oplismenus compositus</u>		Clearings in shady places	Common-scattered	
<u>Centotheca lappacea</u>		Abandoned fields clearings	Common-abundant in places	
<u>Setaria palmifolia</u>		Clearings in wet places	Rare	

APPENDIX 1 (cont'd.)

Scientific Name	Malay Name	Locality	Distribution	Remarks
Gramineae				
<u>Digitaria marginata</u>		Abandoned fields and clearings	Common-scattered	
<u>Digitaria</u> spp.		Abandoned fields and clearings	Rare	
<u>Sporobolus indicus</u>	Telor belalang	Abandoned fields	Common-abundant in one field	
<u>Chrysopogon aciculatus</u>		Abandoned fields and clearings	Common-scattered	
<u>Andropogon brevifolius</u>		Clearings	Common-scattered	
<u>Cyrtococcum</u> spp.	Padi pipit	Clearings	Rare	
<u>Bambusia</u> spp.	Buloh	River edges and old clearings	Common-scattered	Bamboo shoots are occasionally browsed
<u>Oryza sativa</u>	Padi	Cultivated crop		Young plants sometimes eaten
Cyperaceae (Sedges)				
<u>Cyperus cyperoides</u>		Abandoned fields and clearings	Common-scattered	
<u>Cyperus cyperinus</u>	Pepara	Abandoned fields and clearings	Rare	

APPENDIX 1 (cont'd.)

Scientific Name	Malay Name	Locality	Distribution	Remarks
Cyperaceae				
<u>Cyperus aromaticus</u>		Abandoned fields and clearings	Common-scattered	
<u>Cyperus diffusus</u>	Para-para	Abandoned fields and clearings	Common-scattered	
<u>Cyperus compactus</u>		Clearings in wet places	Common-abundant in one field	Coarse sedge often grazed
<u>Cyperus distans</u>	Rumput wangi	Clearings	Common-scattered	
<u>Cyperus kyllingia</u>		Clearings	Common-scattered	
<u>Scleria multifoliata</u>		Clearings	Common-scattered	Leaf tips sometimes eaten
<u>Scleria lithosperma</u>	Sasink	Clearings in shady places	Common-scattered	
<u>Gahnia baniensis</u>		Clearings	Common-scattered	Only rarely sampled
<u>Fimbristylis globulosa</u>	Rumput sandang	Clearings in wet places	Common-abundant in one field	Heavily grazed on occasion
<u>Rhynchospora aurea</u>	Kumboh	Clearings in wet places	Common-scattered in one field	

APPENDIX 1 (cont'd.)

Scientific Name (Forbs)	Malay Name	Locality	Distribution	Remarks
Compositae				
<u>Eupatorium odoratum</u>	Kelambu harimau	Abandoned fields and clearings	Common-abundant	Colonizer forming dense thickets 5-10 feet tall-plant tips occasionally eaten
<u>Synedrella nodiflora</u>	Rumput babi	Abandoned fields and clearings	Common-scattered	Occasionally browsed
Labiatae				
<u>Hyptis brevipes</u>	Butan baju	Common only near Jenut Belau salt lick	Rare	Plant tips browsed
Tiliaceae				
<u>Triumfetta bartramia</u>		Abandoned fields	Common-abundant in one field	Leaves and young shoots browsed
<u>Corchorus aestuans</u>	Kapas hantu	Common only near Jenut Belau salt lick	Rare	Occasionally browsed
Musaceae				
<u>Musa spp.</u>	Pisang	Cultivated and wild species in clearings	Common-abundant gregarious along river edges	Both leaves and young bannanas eaten

APPENDIX 1 (cont'd.)

Scientific Name (Ferns)	Malay Name	Locality	Distribution	Remarks
<u>Dennstaedtiaceae</u>				
<u>Athyrium esculentum</u>	Paku	Clearings and river edges	Common-scattered	Leaf tips occasionally eaten
<u>Stenochlaena palustris</u>	Paku	Brushy fields and early secondary forest	Common-scattered	Leaf tips occasionally eaten
<u>Nephrolepis biserrata</u>	Paku	Brushy fields and early secondary forest	Rare	
(Herbaceous vines) <u>Convolvulaceae</u>				
<u>Merremia umbellata</u>	Ulan minyak	Abandoned fields and clearings	Common-abundant in most fields	Important food plant-leaves and stem eaten
<u>Merremia tridentata</u>		Clearings and river edges	Rare	
<u>Merremia hederaceae</u>	Ulan susu	Abandoned fields and grassy places	Common-abundant in recently abandoned fields	Important food plant-leaves and stem eaten
<u>Merremia vitifolia</u>	Ulan buloh	Clearings and open secondary forest	Common-scattered	

APPENDIX 1 (cont'd.)

Scientific Name	Malay Name	Locality	Distribution	Remarks
Compositae				
<u>Mikania cordata</u>	Selaput tunggal	Abandoned fields, clearings, and early secondary forest	Common-abundant	One of the most preferred and important food plants
Passifloraceae				
<u>Passiflora foetida</u>	Timun pandang	Abandoned fields and clearings	Common-abundant in a few fields	Occasionally browsed
Menispermaceae				
<u>Pericampylus glaucus</u>	Akar gasing puteh	Abandoned fields and clearings	Common-scattered	
Leguminosae				
<u>Vigna parviflora</u>		Clearings	Rare	Leaves browsed when encountered
<u>Canavalia microcarpa</u>		Abandoned fields and clearings	Rare	
<u>Desmodium</u> spp.		Open brushy fields	Rare	
(Woody vines) Rubiaceae				
<u>Uncaria cordata</u>		Brushy fields and secondary forest	Common-scattered	Leaves browsed when encountered

APPENDIX 1 (cont'd.)

Scientific Name	Malay Name	Locality	Distribution	Remarks
<u>Ampelidaceae</u>				
<u>Vitis</u> spp.	Asam papan	Secondary forest	Common-scattered	Leaves and young shoots browsed
<u>Oleaceae</u>				
<u>Jasminum</u> spp.	Chandas	Secondary forest	Common-scattered	Leaves browsed
<u>Palmaaceae</u>				
<u>Calanus</u> spp.	Rotan	Secondary and primary forest	Common-scattered	Leaves browsed
(Shrubs) <u>Verbenaceae</u>				
<u>Clerodendron serratum</u>	Tamin tasek	Abandoned fields and clearings	Common-abundant in places	Leaves and twigs often heavily browsed
<u>Euphorbiaceae</u>				
<u>Flueggea virosa</u>	Bebeti	River edges	Common-scattered	Leaves occasionally eaten
<u>Oleaceae</u>				
<u>Jasminum bifarium</u>		Clearings and river edges	Common-scattered	Leaves browsed

APPENDIX 1 (cont'd.)

Scientific Name	Malay Name	Locality	Distribution	Remarks
Malvaceae				
<u>Sida cordifolia</u>	Berpelut	Abandoned fields and clearings	Common-scattered	Leaves are often heavily browsed
Zingiberaceae				
<u>Costus speciosa</u>	Kaki rusa	Clearings and forest edges	Common-abundant near river	Rarely browsed
Rubiaceae				
<u>Uncaria</u> spp.		Clearings and brushy fields	Rare	Heavily browsed when encountered
Urticaceae				
<u>Ficus</u> spp.		Clearings and brushy fields	Common-scattered	Heavily browsed when encountered
Ampelidaceae				
<u>Leea indica</u>	Batang mali	Secondary and primary forest	Common-scattered	Leaves and shoots browsed
Leguminosae				
<u>Flemingia macrophylla</u>		Clearings and brushy fields	Rare	Heavily browsed when encountered

APPENDIX 1 (cont'd.)

Scientific Name	Malay Name	Locality	Distribution	Remarks
(Trees)				
Loganiaceae				
<u>Fagraea racemosa</u>	Sepuleh	Secondary forest	Rare	Leaves and twigs of saplings browsed
Leguminosae				
<u>Parkia javanica</u>	Kerayong	Primary forest	Rare	Seed pods relished-the hard seeds deposited intact with dung
<u>Pithecellobium angulatum</u>	Saga	Secondary forest	Common-scattered	Leaves and young shoots eaten
Urticaceae				
<u>Trema orientalis</u>	Mengkirai	Abandoned fields and clearings	Common-abundant in recently abandoned fields	Colonizer-leaves and shoots often heavily browsed
<u>Ficus glomerata</u>	Ara	River edges	Common-abundant in places	Leaves and young shoots occasionally browsed-the fruits were never known to be eaten
<u>Ficus obpyramidata</u>	Ara	River edges	Common-scattered	Fruits occasionally eaten
Euphorbiaceae				
<u>Bridelia stipularis</u>	Kenidai	Brushy fields	Common-scattered	Leaves and twigs browsed

APPENDIX 1 (cont'd.)

Scientific Name	Malay Name	Locality	Distribution	Remarks
Euphorbiaceae				
<u>Macaranga puncticulata</u>	Mahang	Secondary forest	Common-abundant	Colonizer-leaves of saplings occasionally browsed
.....	Buah keras malam	Secondary forest	Common-scattered	Leaves of saplings occasionally browsed
<u>Croton</u> spp.	Pedai babi	Secondary forest	Common-scattered	Leaves occasionally browsed
<u>Glochidion obscurum</u>	Tembangau	River edges	Common-scattered	Leaves occasionally browsed
<u>Hevea brasiliensis</u>	Pokok getah	Cultivated tree		The rubber tree is the main source of income for many Malays-seladang relish leaves and shoots
Araliaceae				
<u>Trevesia cheirantha</u>	Pokok itek	Secondary forest	Rare	Leaves and young shoots relished
Verbenaceae				
<u>Callicarpa tomentosa</u>	Derdap dapur	Secondary and primary forest	Common-scattered	Leaves and young shoots occasionally eaten
Myrtaceae				
<u>Eugenia jambos</u>	Jambu	Cultivated	Rare	Leaves and shoots occasionally eaten

APPENDIX 1 (cont'd.)

Scientific Name	Malay Name	Location	Distribution	Remarks
<u>Myrtaceae</u>				
<u>Eugenia aquea</u>	Jambu ayer	Cultivated	Rare	Leaves and shoots occasionally browsed
<u>Dilleniaceae</u>				
<u>Dillenia ovata</u>	Simpoh	Secondary forest	Common-abundant in places	Fruit is very rarely sampled
<u>Hypericaceae</u>				
<u>Cratoxylon formosum</u>	Mempat	Secondary and primary forest	Common-scattered	Leaves and shoots of saplings browsed
<u>Rhizophoraceae</u>				
<u>Gynotroches axillaris</u>	Mata keli	Secondary forest	Common-scattered	New leaves and sucker shoots browsed

¹Scientific names taken from Henderson, M. R. Malayan wild flowers. 2 v. Monocotyledons. 357 pp. 1954. Dicotyledons. 478 pp. 1959. Caxton Press Ltd., Kuala Lumpur. Dr. P. R. Wytcherly, head of Botanical Division, Pusat Penyelidikan Getah Tanah Melayu and Dr. E. Soepadmo, botanist at University of Malaya helped with plant identification.

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