

DISTRIBUTION AND ABUNDANCE OF PRIMATES
AFTER THE FOREST FIRE IN THE LOWLAND FOREST OF
EAST KALIMANTAN 1983-1986

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I. INTRODUCTION

Vast stretches of lowland tropical rainforest of East Kalimantan was swept over by forest fire in early 1983. Most of the forest where logging was done were burnt. Apparently networks of forest road and conditions produced by the local people in the forest, favoured the outbreak and spread of the fire after 8 months of no rain spells. In the interior of the Kutai National Park (Taman nasional Kutai: abbreviated as Kutai NP or KNP) a few stretches of forest are found to remain intact from the fire (Wirawan et al 1983, Suzuki 1987).

The former Kutai Game Reserve (Suaka Margasatwa Kutai) was promoted in grade of protection and is declared as National Park after the fire by the Government of Indonesia, in 1985. Large scale forest fire of the tropical rain forest is a rare ecological event. In the present research project which intends to document the ecological effect of fire and to monitor the early stages of succession in the process of recovery of the forest, I took a part of the survey of primates and other arboreal mammals.

This project apparently attempts to tackle with the problem of ecosystem succession. In recent years, with the progress of the studies of life history of tropical forest trees, and ecology of primates and birds of the tropical forest, role played by animals in the pollination and seed dispersal of the tropical forest trees is gradually called to attention. As one of the parameters which may influence the later course and speed of succession, the present distribution and abundance of primates are surveyed. Since the study areas in KNP did not cover major variety of habitat, survey of additional areas outside of the Park was also made in two areas to the south and west of KNP.

II. SOURCE OF DATA AND STUDY AREA

The primate fauna within the Kutai National Park was studied by Rodman (1973, 1978 a,b,) around the Mentoko Camp, in the upstream of the Sengatta River, and at 10Km downstream from there by Lindburg and others (Fittinghoff et al 1980, Kurland 1973, Wheatley 1980).

For the rest of the Kutai Reserve and its neighbouring areas nothing was known as to the conditions of primate fauna before the forest fire.

After the forest fire of 1983, the study of orang-utan at Mentoko was taken up by Suzuki with largely extending the study area (Suzuki 1988 in this volume). In 1983, distribution and abundance of primates was studied at two plots south of the KNP boundary. These were around 10 and 35Km inland (north) of Sebulu, on the northern bank of the Mahakam River (Azuma et al 1985).

Reconnaissance into the interior of the KNP was done several times by N.Wirawan and PPA Staffs in order to evaluate the conditions of the forest affected by the forest fire. His sighting records of animals during the period shortly after the fire is very valuable, although they are limited in cases.

In 1986, field work was done from 16th., August to 10th., September along the Kayu Mas Forest Road from Teluk Kaba going into the interior of the KNP. Survey was made around the camps set up at 45Km, 37Km N, 24Km and 9Km. Supplementary survey was done at 9Km and at Teluk Kaba from 6th., to 15th., October. Replicate census was made from 19th., to 28th., September around 7-14Km and 30-40Km of Sebulu forest Road, the same areas studied in 1983.

Survey by boat along R. Mahakam and its tributary Kedang Rantau up to Sudulang and Puhun Cepak, was made from 28th., September to 1st, October, 1986.

III. CENSUS METHOD

Sighting record along the Forest Road: The Kayu Mas forest road (originating) from Teluk Kaba to Km 45, and route branching from Km 35 to former Kayu Mas Camp at 2Km to the North (abbreviated as 37Km N) were covered by research members, and PPHA guards and local porters on their route between camps and Teluk Kaba. Records

of their encounter with animals were gathered. The chances of encounter or chances of noticing the presence of animals on the route, is obviously not high ; in most cases, they are laden with heavy luggages and part of the route is covered during later hours of the morning and at high noon when the activity of animals are remarkably reduced. Travel between 5:00-8:00 and 17:00-21:00 or later yielded by far the abundant records of encounter even for primates as well as for cats and ungulates (Doi, in this volume). But these cases are limited. The second disadvantage concerns with the nature of the route taken. It is invariably along the forest road. Originally, the road was opened through the forested area, with a width of 6-15m. At the time of forest fire the road functioned as a corridor for the spread of the fire with concentration of easily inflammable material accumulated along it. Therefore, destruction of the vegetation on both sides of the road was usually greater. Even before that, logging was done starting from the road in most part of the area.

Transect Census: In normal rain forest habitat this is the method most commonly adopted for censusing the primates (Wilson and Wilson 1975). During the present survey, transect census was done at Km 45, Km 37 N and Km 9. The lengths of transects made in the forest were, 2200m, 1800m and 4400m, respectively.

Some species of primates may be sensitive to the practice of cutting the transect. In the present survey, although some consideration for this was paid, census had to be done shortly after the cutline was made. I do not claim it was enough.

Grid Census: In the present survey, owing to the limited period of field study and to limited availability of man-power for the cutting of transects and grids, this was possible only for the study plot at km 9.

Vocalization Census: Some of the primates utter territorial and other calls, that carry a long distance. The gibbons, leaf monkeys and Orang-utans are among these species. Owing to their reduced density, terrestrial call (long distance call) of leaf monkey species were heard only on two occasions during the period of this study. Bornean gibbons uttered their morning calls. Orang-utans gave out their loud calls or murmured when dead trees fell down. Calls of orang-utans were rather frequent perhaps be-

cause the survey was done during their mating season.

Direction and time of these calls were recorded. If these data are measured from two different points by two persons, the location of the source of the sound can be determined by triangulation. The baseline between the two points was traverse surveyed with 25m measuring tape and a Blanton Compass. Stadia survey was sometimes used to know the distance across the river at the fallen bridges with instantly made measuring pole and Spiegel RELA SKOP.

During the early part of the field study, owing to unavailability of the assistants trained for the purposes, vocalization census was done by the author alone, at either end of the baseline on alternate days (single observation). Simultaneous recording from the two points were possible twice at 9Km and 3 times at Sebulu (paired observation).

In the case of paired observation, a Blanton Compass and a SUNTO compass (made in Finland) were used. Since the latter was easy for reading the direction, it was used by the assistants.

For the survey, along the River Mahakam (between Sugihan and Muara Kaman) and its tributary Kedang Rantau, small local boat 15m long, with inboard Diesel engine was chartered. Observation was done sitting on its roof top, cruising at a speed of 6 to 8Km/hr.

RESULTS

9 species of primates were found along the localities surveyed in 1983, and 8 species in 1986. Besides, two species of prosimians were sighted. Table 1 summarizes the primate species found in the localities surveyed.

1. Western tarsier (*Tarsius bancanus* Horsfield) and slow loris (*Nycticebus coucang* Boddaert) were not confirmed of their presence during repeated night surveys at Km 45 (2 nights) Km 37 N (3 nights) and Km 9 (3 nights) of the Kayu Mas Road, and around Km 34 north of Sebulu (3 nights). (At Km 45 night search was done together with Mr. Harie of PHPA who had some experience with these animals at Selawesi.) I suspect these nocturnal small primates are gone or extremely reduced in number around these areas at the time of our survey in 1986.

Slow loris was sighted near PPA camp Mentoko in 1984 (by a PPA guard) and tarsier somewhere between 37 and 24Km of Kayu Mas

Road by N. Wirawan in June, 1983.

These two are only informations available after the fire. At Sebulu, workers at the logging camp have not sighted nor heard them. Perhaps they don't discriminate these animals, although they know the word 'Binatang hantu'.

Bekara[K],

2. Proboscis monkey (*Nasalis larvatus* van Wurmb) Bekantan[I]

This species is commonly considered to live in fair density in the mangrove forest. Records were obtained from lower delta of the Mahakam, estuary of Sengatta River and coastal forest of Teluk Kaba. These places are typical of these vegetation. They are also found in the upper reaches of the river. The density of troops found per length of the river in Kedang Rantau was 0.26 group/Km. The actual density would be higher, since some groups could have been passed unnoticed.

On the banks of main stream of the Mahakam River, their distribution is extremely fragmental and discontinuous.

On the left bank of R.Mahakam at 3Km and 3.8Km downstream of Teratak two sightings were made of small group(s) on different days. The first was composed of 4 animals and the second 2 or 3. The latter sighting was just a casual observation on the edge of a small plantation of banana and kapok about 30m from a small stand of good secondary forest.

On the right bank of Mahakam 1Km downstream of Bunua Puhun, a group of 11 animals were found in an isolated forest of 30m wide x 100m long in 1983. This group was not to be found in 1986. The patch of forest remained fairly intact except that the adjoining hill forest downstream was opened for slash and burn farming.

Along the banks of the main stream surveyed, most of the land is turned into cultivation, either permanent or shifting, settlements and rubber plantation.

While silvered leaf monkeys and long tailed monkeys were found also in the native rubber plantations, proboscis monkeys were mostly confined to natural secondary riparian forest which in most cases contain some number of *Sonneratia* trees.

3. Leaf monkeys (*Presbytis* spp.)

Silvered leaf monkey (*P. cristatus* Raffles) was found in several types of vegetation along the river - seasonally inondated forest patches (along the banks of Kedang Rantau), native rub-

ber plantation mixed with other native trees, and Nippa-hardwood mixed forest on the alluvial on the delta. Their distribution seem to be discontinuous, rather more so in comparison with other species.

Along the Kayu Mas Road which extends through the inland hilly regions, no records were obtained indicating the presence of this species. Foot prints of several colobid primates found near the junction of the path to the mangrove area at 1Km point might possibly be of this species.

P.hosei, *rubicundus* and *frontatus* were found in the forest even away from the banks of big rivers. They were found in small groups but groups were seldom found in continuous distribution. Groups were found ranging close together only in 3 instances - 3 groups near the Sebulu Camp, more than 3 groups around 8-10Km north of Sebulu in 1983 and those (perhaps two groups) at 36Km north of Sebulu found in 1986. In all other areas, the sightings were each done once for all and only one individual was seen.

They uttered vocalization very infrequently. Dense growth of scrubs and broken canopies produced by forest fire make these animals extremely difficult to find. There would have been more groups of leaf monkeys than were found. *P.frontatus* were found in two locations in 1983; at Km 31 Sebulu Road and in a small un-burnt forest patch on the hill of Sugihan village on the River Mahakam. From both these places no monkeys were found when revisited in 1986.

In localities surveyed in 1986 *P.frontatus* were not encountered. Local loggers told me, monkeys with white patches on their foreheads (apparently *frontatus*) are found only in the Hutan lepas - wild (natural) forest, presumably - such as was found around Km 30-40 of the Sebulu Forest Road. The white-fronted leaf monkey seems to be more limited in distribution than gray and maroon leaf monkeys in the present fire affected forest. Judging from the limited cases of finding them, they survive in the remnant patches of the lowland forest, which were originally the best developed, and tallest part of the high forest in the original pre-fire conditions.

The burnt forest on top of the ridges were clad with green leaves at the time of the present survey, the *frontatus* group may well have expanded or shifted their range into (their original home range of) the interior. Otherwise they have perished during the three years. To determine between these two possibilities,

further intensive study would be necessary.

In the back country of Sebulu carrying inland up to 40Km, the *Presbytis* species found and confirmed were all *rubicundus* (12 groups were seen).

In the interior of KNP, 3 sightings of *Presbytis* were obtained and foot-prints of Colobid monkeys were found at 2 places (Fig.2).

Two of the sightings, one in burnt forest of Km 47 and the other in unburnt logged forest of Km 37 were made in the adverse light condition of the evening. Hue of the coat colour which is discriminative of the two forms was hard to tell. The third animal sighted, in the unburnt natural forest of Km 45 by a field assistant at high noon, had grayish coat characteristic of *hosei*. In each of these cases only one animal were sighted.

Foot prints were marked on the soft soil around the water-holes on the road passing near top of the ridges, at 14Km by the burnt forest and at 38Km by the unburned logged forest. Both places had unburned forest patches in the headwater of valleys near by.

In 1983, Suzuki saw *hosei* to the north of the Kayu Mas Camp at Km 37N. If *rubicundus* is present somewhere along the Kayu Mas Road is yet open to question. Rodman (1973,1978) reported both *rubicundus* and *hosei* from Mentoko study area, but he wrote 'my observation on *rubicundus* is rare....'.

In September and October 1983, about 6 months after the fire, the *Presbytis* spp. were hardly encountered in Mentoko Study Area (Suzuki and Yayat pers comm.). Chances of sighting gradually increased. In 1985 and 1986, *hosei* is found in the Study Area that is on the right bank of Sengatta River. *P.rubicundus* is found only on the left bank of the same River. Although a solitary *P.frontatus* was encountered, group of this leaf monkey was not seen.

4. Pig-tailed Monkey (*Macaca nemestrina* Linnaeus)

Along the Kayu Mas Road there were four sighting records: at 24Km a solitary male (A) and a group (B), at 38 Km two sightings each of a group (C,D).

Partial troop composition was obtained in (D). Although a few animals may have failed to be counted, it was evidently a small group (Adult ♀), Adult ♀, J, J, Adult ♂, J, J = 6-7 animals. Pig-tails were seen around 10Km and 20Km Sebulu Forest

Road (Azuma et al 1984). All these records are from the inland hill forest and no records were available from the riparian forest habitat.

This species is considered as dwellers of tropical high forest.

5. Long-tailed monkey (*Macaca fascicularis* Raffles) Kera[K&I]

In the KNP, troops of this macaques was found twice between Km 24 and 26, and once at Km 0.5 Teluk Kaba. The species is usually found in riparian forest secondary scrubs and in mangrove habitat. A conspicuous ecological segregation between *M.nemestrina* is found, the latter favouring the hill forest habitat, (Fittinghoff et al 1980, Wilson and Wilson 1980, Roaman 1978, Caldecott 1986, Oi in prep.). That they were not found in the Km 45 study area is hardly believable, and problematical as well as apparently low density of *Presbytis spp.*. Habitat around Km 24 is severely burnt forest. How do this troop live in such an environment? Conditions at Km 26 is much better. Gently sloping headstream of several small streams, is scattered with tall trees remaining alive. The sighting was a group feeding on a tall fruiting (*Dillenia*?) tree. In the coastal mangrove forest of Teluk Kaba, at least two groups seem to live. They also wander into the *Accasia* scrub bordering the salty marsh.

6. Gibbons and Orang-utans

Both the apes were fairly common around the Kayu Mas Road. Nests of orang utans and calls of gibbons were good indicators of their presence. They were visually encountered (sighted) fairly frequently along the Kayu Mas Road (Fig.2).

Orang-utans: Km 45 (0), Km 37N (2), Km 24 (0), Km 9 (4),
Km 9-24 (2+?), Km 35-40 (4+)

Gibbons: Km 45 (4), Km 37 (2), Km 24 (0), Km 9 (3),
Km 37-45 (2), Km 37-24 (0), Km 24-9 (1),
Km 9-Teluk Kaba (1)

The number in the parentheses shows number of encounters.

6.1 Orang-utan (*Pongo pygmaeus* Linnaeus)

Orang-utans were encountered in the unburnt natural forest (Km 45), unburnt logged forest (Km 37N - Km 38N) and also in the

burnt and unburnt logged forest mosaics (Km 9 - Km 12). No signs of them were found in the large tract of intensively burnt forest.

Sometimes even in the moderately burnt forest, nests and feeding scars of orang utans are found (9-24 Km) and one sighting is recorded. It may be that female orang utans are strongly terrestrial and they tend to remain in their original home ranges even if they are deteriorated in quality.

Around the study plot at Km 9 call or murmur of Orang-utans were heard; they were often heard during the morning auditory censuses, and also at another hours of the day and night. They were encountered on 3 occasions. Small nests of juvenile(s) are found near the adult's nest and independently. Judging from these, at least 6 individuals (1-2 large adult (males?), 1-2 young adult male(s), 2-3 adult or young adult females and at least 1 juvenile) seemed to be present in the area. The total population may be about 10. From Km 7 to Km 12, a habitable space of Orang-utans continues. The population living in whole this area would amount to 20 animals.

Nest counts were made in the KNP at Km 45, Km 37N and Km 9. At Sebulu along several transects between Km 40 and 30 and between km 9-14. These data are not included in the presnet paper.

6.2 Bornean Gibbon (*Hylobates muelleri* Martin)

The number of calls audible during the early mornings from the observation points near the camps are given in Fig.4. The distance categories near/middle/far/very far were subjectively judged by the sound intensity of a series of calls from each group (source of call) and direction was measured.

Observation hours correspond with the beginning and end of the 'morning chorus'. The chorus began later and did not last long on mornings of fog or drizzle. Excluding these cases number and direction of calls were found more or less stable from day to day for each observation points: 11-15 at 45N, (9-)11 at Km 45S, 20-24 at Km 37, 4-6 at Km 24, 19-26 (maximum:36-39) at Km 9, and 20 from Teluk Kaba. The calls seldom carry by soft breeze (of Grade 1 of Beaufort) from the lee of the wind. They are attenuated to next class in distance category. By wind of Grade 2 of Beaufort the calls audible are only those from the wind-ward.

The area that can be scanned by auditory (vocalization) census is primarily determined by the topography. Within the area

topographically exposed to auditory observation, the gibbon calls were invariably from the area where tall trees are remaining alive in a continuous forest, in a smaller patch (stand) or in a grove of a few trees. For instance, the directions of source of calls at Km 24 is limited to the groves that remain in scattered spots along the narrow slopes bordering a small river. Around the Camp 24, forests are intensively burnt and taken over by dense scrub of pioneer trees.

By paired observation of calls at 9 km made on 11th, October 37 (N_1) and 39 (N_2) different directions were obtained from the both ends of the baseline. The baseline was 275m long. From these, locations of 18 groups were fixed by triangulation (Fig.7).

For fixing the location of a group, following criteria were used: i) proximity in timing of the calls (within 2 or 3 minutes difference) ii) directions from observation points intersect with each other and iii) distance to the located point of the group is within the range of relative distance category recorded. If any one of the 3 criteria is not met, that location is disqualified and not adopted.

Fig.6 shows the relation between absolute distance and relative distance category for the fixes obtained. (Where these distances do not fit very well, question marks are put to the Name of the groups.)

Now, maximum estimate of the number of groups N_{max} is given by

$$N_{max} = F + (N_1 - F) + (N_2 - F) = N_1 + N_2 - F.$$

where F is the number of successful fixes. Hence,

$$N_{max} = 37 + 39 - 18 = 58 \text{ groups.}$$

Looking for the more conservative minimum estimate (N_{min}); Out of the rest of the directions, which failed to be fixed, that is $[N - F]$,

(1) combinations of directions which meet only geometrically are sorted out, and number of these are counted (G). This is done allowing for the possibility that calls of a group may be logged by two observers at different times.

(2) the rest of the directions $[N - (F + G)]$ is a set of 'odd pairs' that are logged by either of the observers alone and that have no possibility of intersection. (\bar{G})

$$\begin{aligned} N_{min} &= F + G + \bar{G}_1 + \bar{G}_2 = F + G + (N_1 - F - G) + (N_2 - F - G) \\ &= N_1 + N_2 - (F + G) \end{aligned}$$

$$N \text{ min} = 18 + 9 + 7 + 10 = 44$$

Actual number of groups (source of calls) (N) is given by

$$N \text{ max} \geq N \geq N \text{ min}$$

So, N is somewhere between 58 and 44.

The largest distance obtained between the source of call and the observation points was 1370m (to the South) and 1260m to the north. These and some other points fell on the crest of ridges bordering the area. The calls from beyond these seem to be sheltered. (On the other hand, those calls uttered near the top of the ridges could carry a long distance.)

This suggests a possibility of delineating the "area exposed to auditory scann" (AEAS) if enough number of fixes are available. At Km 9 it is effectively bound by low ridges of say 20 and 40m high to the east and the north.

In order to assess the density, AEAS should be estimated. Instead of drawing it empirically from many fixes, this could be approximated by reading a good, contoured topographical map. If this is done, data obtained by (single observations) can also be converted to density estimates.

DISCUSSION

1. On the census method

Some species are easy to find and others are not. This depends on the behaviour patterns of the species and experience with habit of the animal on the side of the observer. To make a census, or just to confirm if the species is present in an area, parameter of species' proneness to sighting, trapping etc, should be checked and incorporated into the procedure of estimation.

Transect census commonly used for the estimation of density of forest primates is done assuming that probability for the animal to be sighted is almost equal with any species (Wilson and Wilson 1975). And this would be approximately true in most cases in the situation of the high forest. When animals are in the foliage, their flight distance (Hediger 1964) is largely covered by the bole height of the trees.

However, in the post-forest-fire situation this is not always the case. Implicitly presupposed requisite for the transect census would no more hold good. In fact the results obtained by the transect census survey were very poor.

2. Less conspicuous or low density species

For 3 species of leaf monkeys, white-fronted, maroon and gray (*P.frontatus*, *rubicundus* and *hosei*) and pigtailed monkeys no sightings were obtained nor their feeding and other scars found during the transect censuses at Km 45, Km 37N and Km 9. It was almost surprising, and disappointing, that even at Km 9 where transect census was done in a fairly satisfactory condition, none of these monkeys were found. Since there are a few casual encounters they are not completely wiped out by the forest fire. I suggest the situation is that a small number of groups of these monkeys are surviving in sectors very much restricted in distribution. Low frequency of vocalization is either because ; 1) the species found there is *P.hosei* and this species somehow or other gives out calls rather infrequently or 2) number of groups is reduced so much that their chances of uttering territorial calls are reduced to minimum. In the case of frugivorous pigtailed monkeys, they might be ranging over a very wide area. In any case, overall density may well be very low. In a 3 sq. kilometer area of Mentoko, Rodman (1973) found 7 groups of *P. aygula* (= *P.hosei*). Their Density was calculated at 2.6 groups/sq.Km.

In the study area 10-15Km downstream, orang utans, gibbons and Sunda Island leaf monkeys (=grey leaf monkey) were seen frequently, but pigtailed monkeys only occasionally (Fittinghoff et al 1980).

Between the present way of distribution of these monkeys in the hill forest and the former abundance in Mentoko, discrepancy is so great. What produced the very low present density of *Presbytis* spp. *Macaca* spp. and *Prosimians*?

3. Effect of the fire

Riparian forest on the bank of Sengatta River and hill forest of the interior Kutai NP may not have been the same in their original condition before the forest fire. Although it is most probably so, is it really a new situation created by the events associated by forest fire? What happened to them in relation to their habitat condition would be as follows,

- 1) unfavourable survival conditions during the long drought
- 2) direct mortality caused by forest fire
- 3) unfavourable survival conditions after the fire

Proceeding the fire selective logging alone would not have given severely detrimental effect to the primate population, so long as it was done deliberately. (Wilson and Wilson 1975)

In my impression, the poorly represented prosimian and forest leaf monkey and macaque fauna may be due to the effect of the fire and drought. If the poor fauna seen at Km 45 is really typical of the present conditions of the unburnt natural forest, it would follow that drought alone could severely reduce the population. For smaller, less agile animals, 2) would have been most critical but 1) and 3) also could be detrimental.

To determine the effect of fire, data is yet poor. Present survey was after all a preliminary survey. The points on which further research work is necessary were understood and some of them were referred to in this report.

One approach which is definitely possible is to monitor the way the remnant population of primate species builds up and disperse into the area that now appears vacant. In the different types of fire affected forest, the population process is expected to differ. If a saturation density is observed or become predictable and if it is higher than the present density level, then we can assume either that the present density is the product of fire and drought or that the species is a seral species. Although it is easy to refer to a seemingly abnormal phenomena found in the burnt over areas as the effect of fire, it may or may not be so. Crucial point in our discussion has been how inference toward the reconstruction is possible concerning the pre-fire, original condition of the Biotop of the interior of the Kutai NP.

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"Kyoto University Overseas Research Report of Studies on Asian Non-human Primates. Primate Research Institute, Kyoto University, Inuyama" is abbreviated as KUORR Asia.

Table 1. Primate fauna in and around the Kutai National Park, 1983-1986

	Kutai National Park										Mahakam R.				
	Sangatta R.		Kayu Mas Forest Rd.							Sebulu			Tributaries		Delta
	1) Upper	Lower	km 45	km 37	km 24	km 9	km 9	km 30-40	km 9-14	km 9-14	River bank	Suduran Sabintul.	Puhuncapak		
			km 45	km 37	km 24	km 9	km 9	km 30-40	km 9-14	River bank	Suduran Sabintul.	Puhuncapak			
Orang utan <i>Pongo pygmaeus</i>	++	±	+	++	+	++	+	++	+	+	+	±	seasonal	+	±
Bornean gibbon <i>Hylobates muelleri</i>	+	-	++	+	+	++	++	++	+	+	+	+	(±)	±	
Maroon leaf monkey <i>Presbytis rubicundus</i>	+ 1)	-	-	-	-	-	-	-	-	-	+	-	-	+	
Gray l.m. <i>Presbytis hosei</i>	+	-	+	+	-	-	-	-	-	-	-	-	-	-	
White-fronted l.m. <i>Presbytis frontatus</i>	±	(-)	-	-	-	(-)	(-)	(-)	(-)	(-)	+	+	+	+	
Silvered l.m. <i>Presbytis cristatus</i>	±	+	(-)	(-)	(-)	(-)	(-)	(-)	+	+	+	+	+	+	+
Proboscis monkey <i>Nasalis larvatus</i>	+	++	--	--	--	--	--	--	++	++	+	+	++	++	++
Pigtailed macaque <i>Macaca nemestrina</i>	+ 2)	-	-	-	-	+	-	-	+	+	+	+	+	+	
Longtailed macaque <i>Macaca fascicularis</i>	+	+	--	(-)	+	-	-	-	++	++	-	++	++	+	++
Slow loris <i>Nycticebus coucang</i>	+ 2)	-	--	-	-	-	-	-	-	-	-	-	-	-	
Western Tarsier <i>Tarsius bancanus</i>				(+)							+				

Note: ++:abundant, ±:rare, -:not found, certainly non-existent, -:not found, yet to be confirmed by further studies.
 (-):not found, possibly non-existent, judging from habitat types. + with indication of sources. + in the previous reports (for Sangatta before 1982, and for Sebulu in 1983) but 0 ± in later studies. (See text)
 Source: Upper basin of Sangatta River: 1) Suzuki, A. 1984. 2) Kodman 1973, 1978, Fittinghoff and Lindburg 1980.
 Sebulu(1983) : 3) Azuma, Suzaki, Yayat 1984. Sebulu(1986) and other localities(1986) by present study.

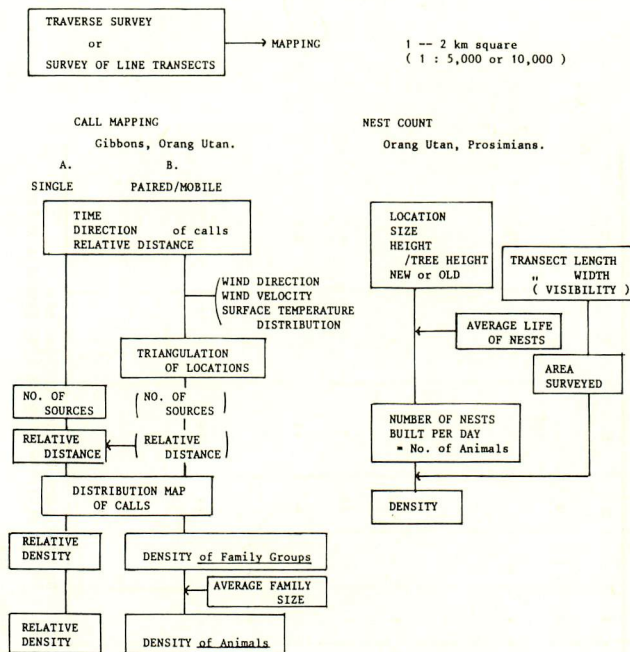


Fig. 1. Diagram of census procedures and parameters (Nest count and vocalization census)

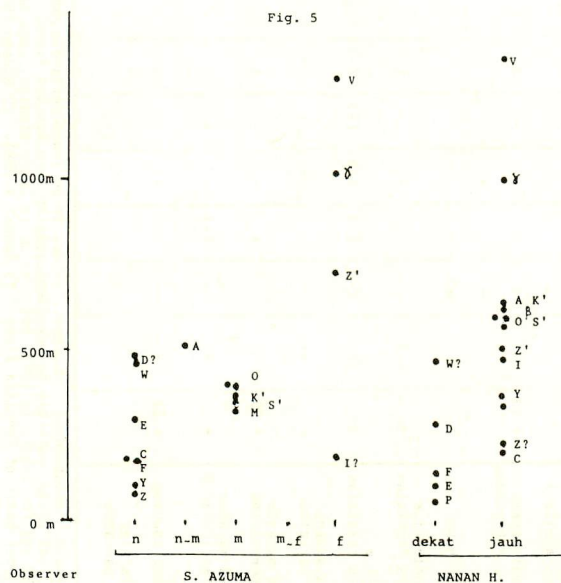


Fig. 5. Correlation between the Relative Distance Categories and Absolute Distance. Absolute Distance was estimated by fixing the location of source of vocalization by triangulation

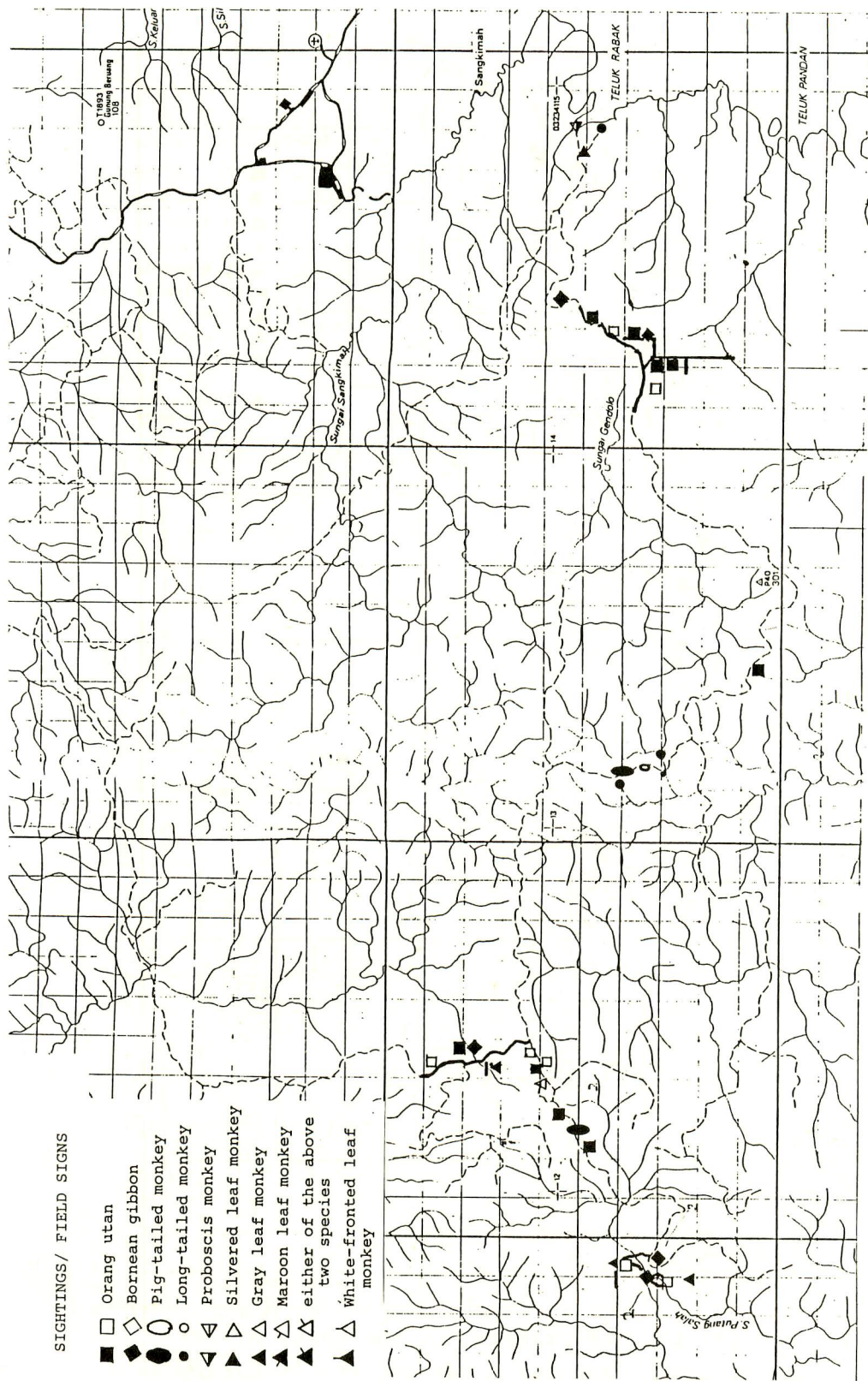


Fig. 2. Distribution of primates along the Kayu Mas Forest Road in the Kutai National Park, 1986

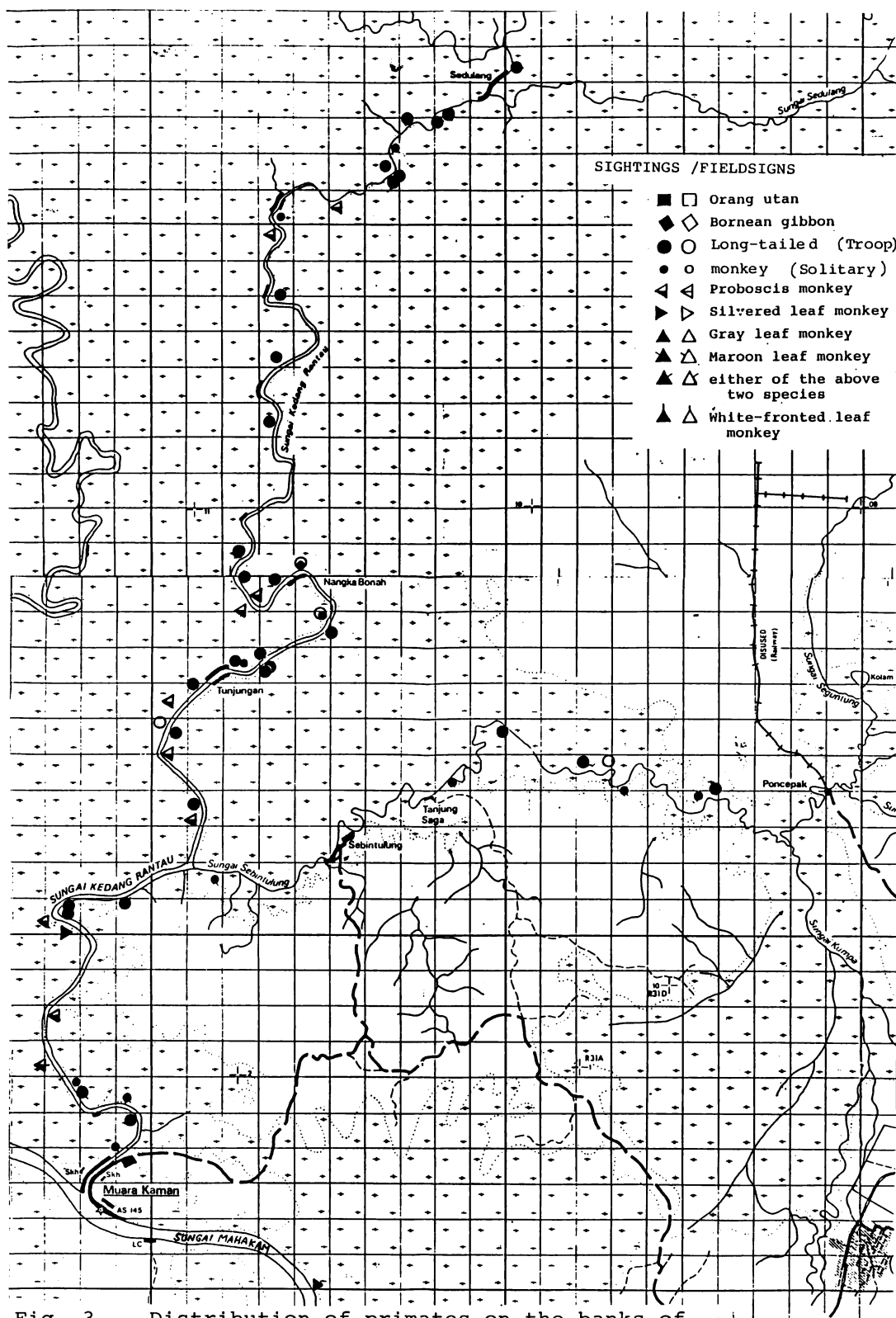


Fig. 3. Distribution of primates on the banks of Midstream of Mahakam River and its tributary Kedang Rantau.

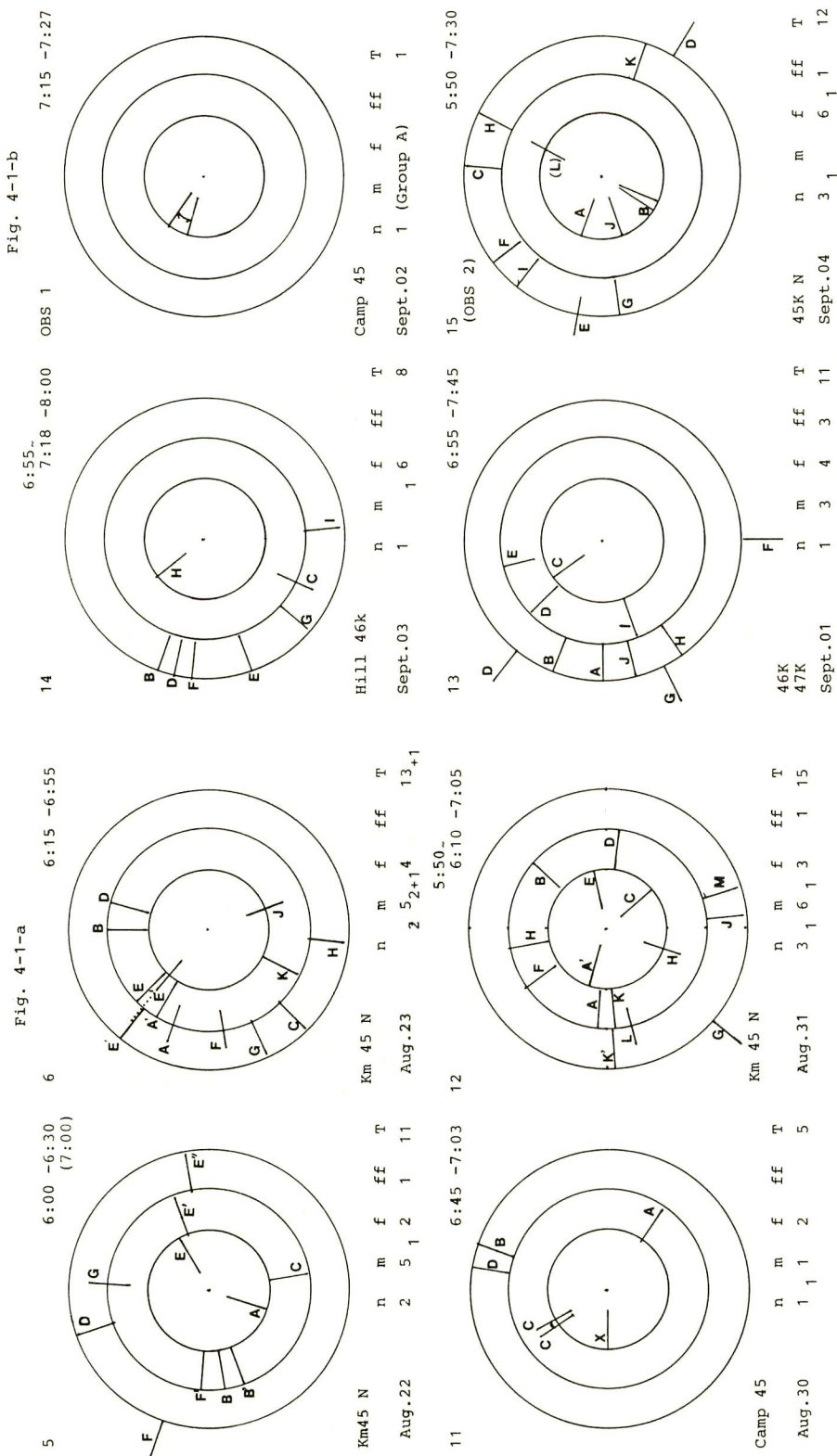


Fig. 4.-1-a

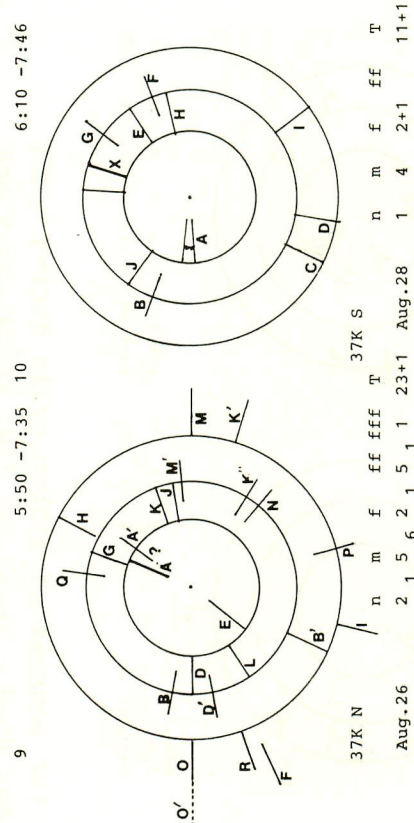


Fig. 4.-1-b

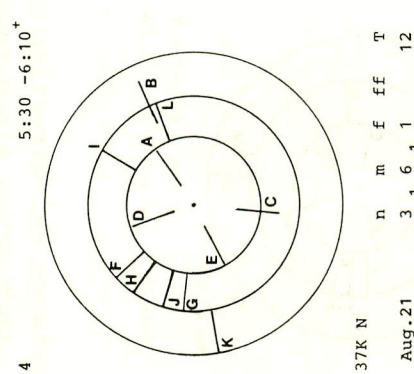


Fig. 4.-1-c

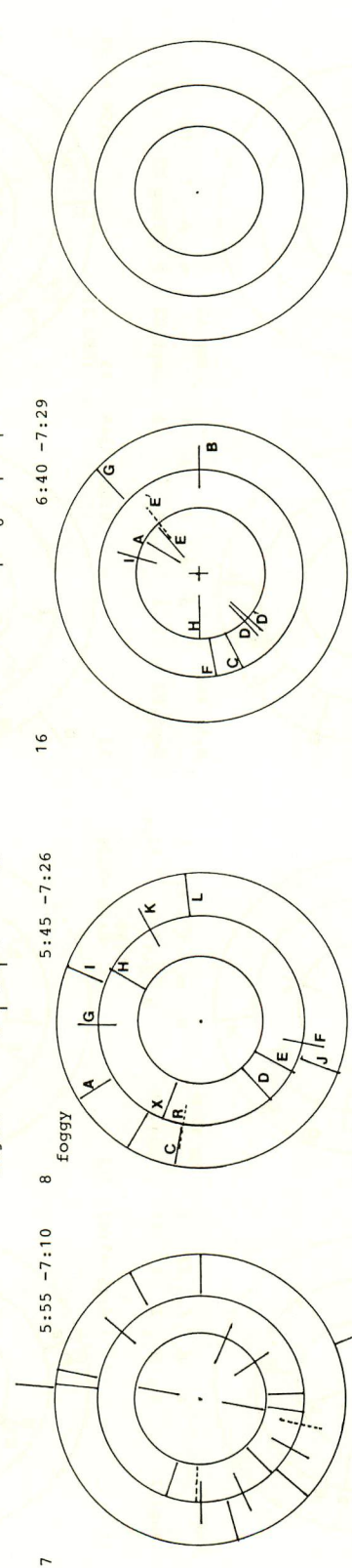
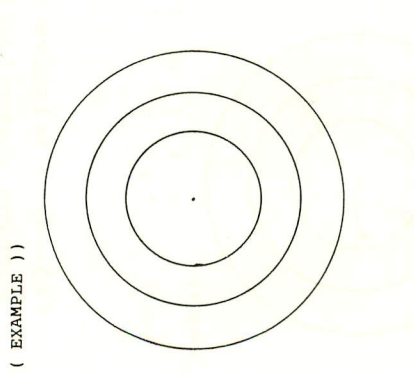
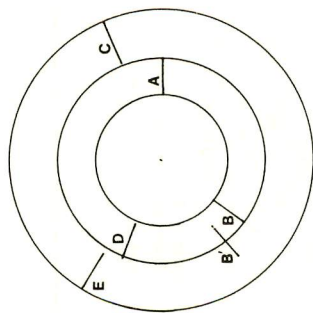


Fig. 4.-2-a

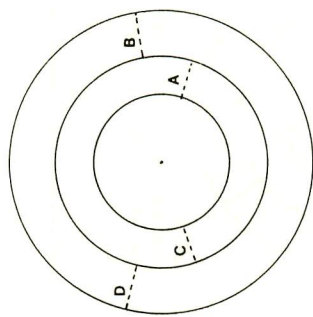
6:00 -6:55

2,



Camp 24
Aug. 18
n m f ff T
3 1 2 6

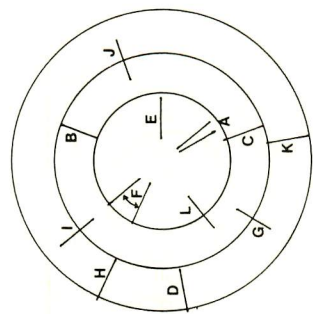
6:30 -7:20



Camp 24
Aug. 19
n m f ff T
2 2 4 6

5:05 -7:30

1

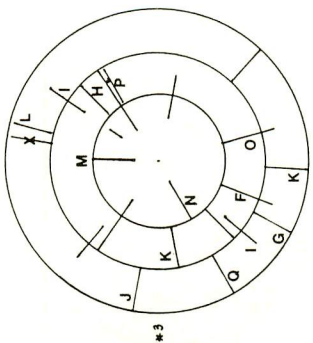


Camp 9
Aug. 17
n m f ff T
3+1 2 3 3+1 13+3
21 5:30 -7:00

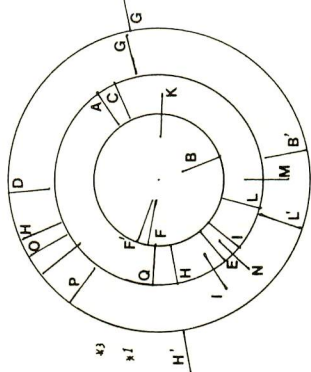
Fig. 4.-2-b

18

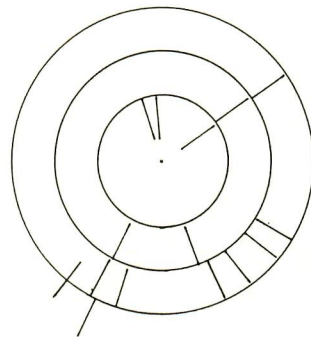
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Camp 9
Sept. 09
n m f ff T
3 4 6 4 7 24
4:15 -6:40

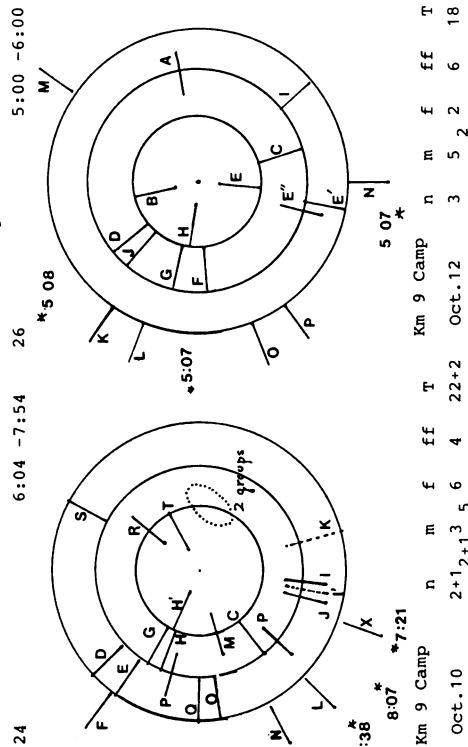


Camp 9
Oct. 08
n m f ff T
3 1 7 3 8 2 22

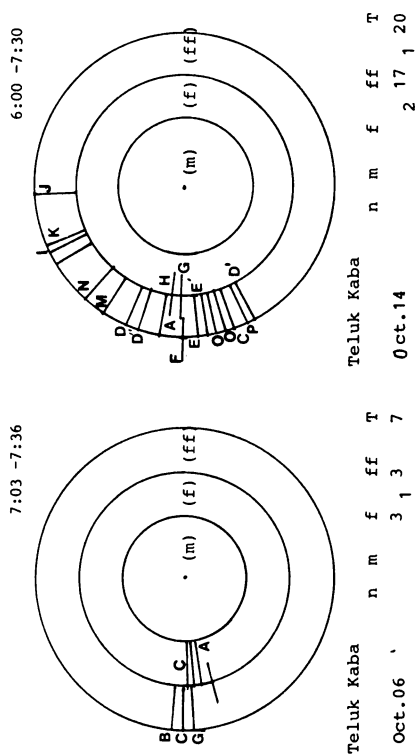


Camp 9
Oct. 07
n m f ff T
3 3 7 1 2 16

Fig. 4.-2-d1



7:03 -7:36



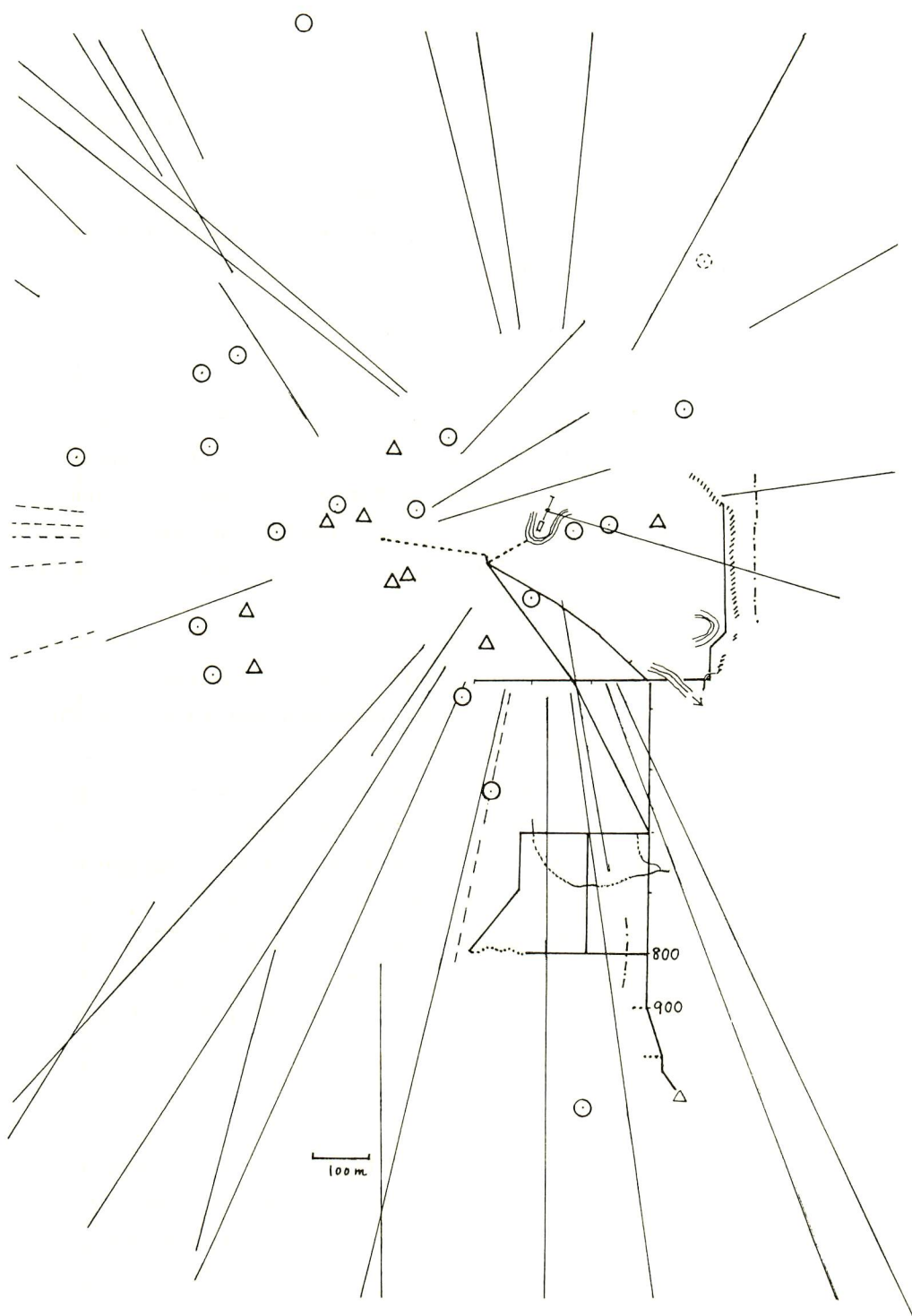


Fig. 6. Distribution of Bornean gibbon groups in Km 9 study area. ● location by fix, - probable range of location of the groups (sources of call), on 11th, October, 1986. ▲ location by fix on 9th, October, 1986.