Habitat Distribution and Ectoparasites of Small Mammals in Sarawak

by

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Although tropical rainforest areas, such as those in Malaysia, are noted for their richness in species diversity (Harrison, 1962, Fleming, 1973), little quantitative data are available for numbers and relative abundance of mammals, including hosts of zoonotic pahogens or their vectors, in particular types of habitats. The primordial source of species which compose the overall diversity is presumably the primary rain forest. Yet, in addition there are species in Malaysia that are not commonly found in the primary forest, but are abundant in association with man and in habitats altered by the activities of man (Harrison and Quah, 1962).

The purpose of the present study was to compare various habitats which differed from the primary forest with the latter in terms of their mammalian species diversity and relative abundance. We wanted to find out, particularly, how habitats that had been altered by man and habitats flooded by the river differed from the primary forest in terms of their mammalian fauna. We also took note of the patterns of ectoparasite infestations, particularly vectors of zoonotic diseases, for comparative purposes. This information will aid to determine what species, in which habitats, may be suspect in terms of involvement in the transmission of zoonotic diseases.

METHODS AND MATERIALS

Mammals were collected with basket traps (Harrison, 1966) which were placed in pairs, one on the ground and the other 2 to 6 feet above ground on the vegetation. The habitats selected for comparisons were in the vicinity of the Niah Caves National Park, near Pangkalan Lobang, near Batu Niah, Miri District, Fourth Division, Sarawak (approximately 3° 53′ N, 113° 42′ E; elevation was nearly at sea level). Trapping was done under our supervision by local Malay and Iban collectors, but the trapping areas were selected by us.

Specimens which represent the primary forest were collected from an area of primary forest bordering the National Park, near Sungei Tangkap. The secondary forest sample was collected east of Niah

River, adjacent to the National Park, near Pangkalan Lobang. The swamp forest sample was collected on the west side of Niah River, north of Pangkalan Lobang. The edge habitat sample came mostly from the west side of Niah River near Pangkalan Lobang.

Animals were removed from the trap into cloth bags in which they were euthenized with chloroform. Thick and thin blood smears were prepared for examination of blood parasites (to be reported elsewhere). Serological samples were obtained for studies of scrub typhus (*Rickettsia tsutsugamushi*) prevalence (to be reported elsewhere). Fleas, lice, and mesostigmatid mites were brushed from the host. Ticks were removed from the ears and other parts of the body. Chiggers (larval Trombiculid mites) were dislodged from the ears and elsewhere on the body with a sharpened wooden applicator stick. All ectoparasites were placed in 70% alcohol for later identification and the cloth bags were washed between examinations. Although each specimen was examined for ectoparasites by the same person and equal time and effort was devoted to each, it is doubtful that every ectoparasite was recovered.

Females were examined for signs of lactation and their uteri were examined under a binocular dissecting miscroscope for the occurrence of embryos and placental scars (to be reported elsewhere).

This report includes all mammals trapped and those captured in nest cavities in trees in the habitats listed above, with the exception of bats (reported elsewhere: Lim, Chai and Muul, 1973).

DESCRIPTION OF TRAPPING AREAS

Primary forest:— According to the District Forestry Officer, this forest had not been opened for commercial timbering in the past. There were no signs of timbering on any scale in the area chosen for trapping. The canopy was from 80 to over 100 feet. Ground cover was sparse, consisting of palms and small trees.

Secondary forest:— According to the District Forestry Officer, this area has sustained some commercial timbering (however, tall trees were frequently encountered. The ground cover was denser than in the primary forest, with an abundance of small trees forming a lower canopy than in the primary forest.

Swamp forest:— This area had a high water table with exposed water abundant among the trees. The trees were not as tall as in the primary forest, but the canopy was complete.

Edge habitats:— This stage in regeneration of vegetation is known in Malaysia as *belukar*. It results from clear cutting. With the exception of occasional taller trees, the vegetation was up to about 30 feet tall, consisting mostly of fast growing species of trees which are characteristically primary invaders of such cut-over areas. These trees were intermixed with wild banana, wild ginger, vines, and herbaceous vegetation, forming a dense cover which was difficult to penetrate.

RESULTS

A total of 270 arboreal and 232 scansorial and terrestrial mammals were trapped. Additional arboreal species were captured in their nests in tree holes. Most of the terrestrial species (Figure 1) appear to be partly scansorial as they were trapped sometimes in vegetation above ground.

Callosciurus notatus was the predominantly caught arboreal species in all habitats and *Tupaia tana* was the terrestrial species most abundantly caught in all habitats except the swamp forest, where its dominance was replaced by *Rattus muelleri. Rattus rajah, R. exulans, R. whiteheadi, R. tiomanicus,* and *R. rattus* were captured only in the man-altered habitats and the swamp forest which was subject to periodic inundations of water from the river. Most of the species in the catch in each habitat were approximately in the same numerical proportion as those caught in the primary forest, although these species (primary forest component) comprised a smaller percentage of the total collection than in primary forest.

Figure 2. demonstrates the patterns of infestation of the mammalian hosts with ectoparasites. Only species which had 10 or more individuals examined are included. The canopy species tended to have a lower infestation rate with ticks than did the terrestrial species. The observed tick load varied from 1 to 4, with averages of 1 to 2 per individual among the canopy species. Terrestrial species varied from 5% to nearly 40% infested and tick loads varied from 1 to 40. The highest mean tick loads were in *Tupaia glis* 3.5, *Tupaia tana* 4, and *Rattus muelleri* 16.

Fleas were scarce among most of the canopy and terrestrial species (Fig. 2). The highest infestation rates were among the squirrels and terrestrial tree shrews. The mean flea loads were highest among the terrestrial tree shrews: *Tupia tana* 6 (one specimen with 65 fleas), *Tupaia glis* 3 (range 1-8); in the sqirrels the mean loads were less: *Callosciurus notatus* 1.6 (range 1-5), *C. prevostii* 2.5 (range 1-4).

No lice were found in three of the tree shrews and *Rattus tiomanicus* (Fig. 2). In the other species infestation rates varied from 18% (*R. sabanus*) to over 50% (*C. prevostii*). Mean louse loads varied from 6 (range 1-18) in *R. cremoriventer* to 17 (range 1-130) in *Callosciurus notatus.*

Most species had fairly high infestation rates with gamasoid (Mesostigmatid) mites, with the exception of the tree shrews. Rates varied from 10 percent (*Hylopetes lepidus*) to nearly 100 percent (*R. muelleri*) in mammals other than tree shrews. Gamasoid loads varied from 10 to 20 in *C. prevostii* to over 300 in *R. cremoriventer;* the highest mean loads were on *R. muelleri* (42) and *R. cremoriventer* (41). The mean loads in the squirrels were lower: *C. notatus* 10 (range 1-100), *C. prevostii* 17 (range 10-20).

Chigger infestation rates were highest among the squirrels, tree shrews and in *R. muelleri.* Individual chiggers were not counted so chigger loads were not determined.

DISCUSSION

Although the known mammalian fauna of Borneo is very diverse, only a fraction of the species known to occur there were obtained in the sample of over 500 mammals trapped in the few habitats under study. The trapped species were supplemented by those caught in arboreal nest cavities, but still many species were not caught. Of the 10 species of the lowland terrestrial forest rats known from Borneo (Harrison, 1964; Medway, 1965) only six were caught. None of the five tree rats were caught. Four of the six lowland commensal rats were trapped. Of the 7 lowland tree shrews, four were captured in addition to the related *Ptilocercus lowii.*

The squirrels were even less represented: one of the four species of lowland ground squirrels, five of the 11 species of lowland tree squirrels, and five of the 13 species of flying squirrels. Altogether, 44% of the rodent species within these groups known from the lowlands of Borneo were represented in our sample.

The absence of certain terrestrial forest rats and terrestrial squirrels may be owed to the limited number of habitats sampled. The commensal rats not caught were *Rattus norvegicus* and *Mus musculus* which seem to be restricted to coastal cities and *R. argentiventer* which seems to be confined to ricefields and grasslands (Harrison and Quah, 1962). The tree rats, tree squirrels, flying squirrels, and tree shrews may also be restricted to habitats other than the ones sampled by us.

In general, the arboreal animals in the man-altered habitats and the swamp forest which is periodically disturbed by floods were about the same as those in the primary forest. This seems to indicate that no specialized arboreal forms exist in these disturbed areas. *Callosciurus notatus* which was numerically dominant in the primary forest was even more prevalent in the edge habitats. For the first few days in the edge habitats it comprized nearly the entire catch and their capture had to be discontinued (the trappers were asked to release them after the 4th day of collections) in order to include sufficient numbers of other species in the sample which was originally to be limited to 200 specimens per habitat. In Peninsular Malaysia, *C. nigrovittatus* is the numerically dominant species in most primary forests and *C. notatus* is more abundant in secondary forests and edge habitats (Division of Medical Ecology, IMR, unpublished records).

The assortment of terrestrial species found in the primary forest seems to have been represented in approximately the same proportions in the disturbed habitats, with the exception of *R. muelleri* in swamp forest. This rat seems to be also more common in wet habitats, such as edges of streams, than in more dry areas in Peninsular Malaysia (Lim, 1970). In addition, the disturbed areas had an abundance of commensal rats, not represented in the primary forest sample (Fig. 1). This indicates that in this instance, the disturbed areas had a more diverse fauna, at least in terms of species which responded to our trapping efforts. The remaining 66% of the species not obtained by us probably do not enter traps readily or may be confined to specialized habitats, such as the taller growing rainforests found in the interior. In another study in Sabah (Muul and Lim, 1973), a much more diverse assortment of species was obtained in a forest with a canopy over 150 feet, with taller efergent trees, than in the forest near Pangkalan Lobang which had a canopy about 100 feet high.

In terms of ectoparasites, the arboreal species tended to have lower infestation rates with ticks and smaller tick loads than did the terrestrial species (Fig. 2). This was also the case in Sabah (Muul and Lim, 1973). It is interesting to note that fleas were not found on species which construct sub-terranean nests (infrequent or absent on such hosts also in Sabah). The elaborate grooming behavior of the tree shrews probably is responsible for the absence of lice in three of the four species examined and low numbers found on the fourth (three infested specimens with 1, 3 and 25 lice recovered from each). Gamasoid mites were few or absent in the tree shrews, again perhaps because of their grooming behavior. Larval Trombiculid mites (chiggers), on the other hand, were

abundant on tree shrews (in the ears) and squirrels. With the exception of *R. muelleri,* the rats were not frequently infested with chiggers.

These patterns of distribution of hosts and their parasites should be helpful in determining which species may be candidates for investigation in epidemiological studies of zoonotic pathogens in nature.

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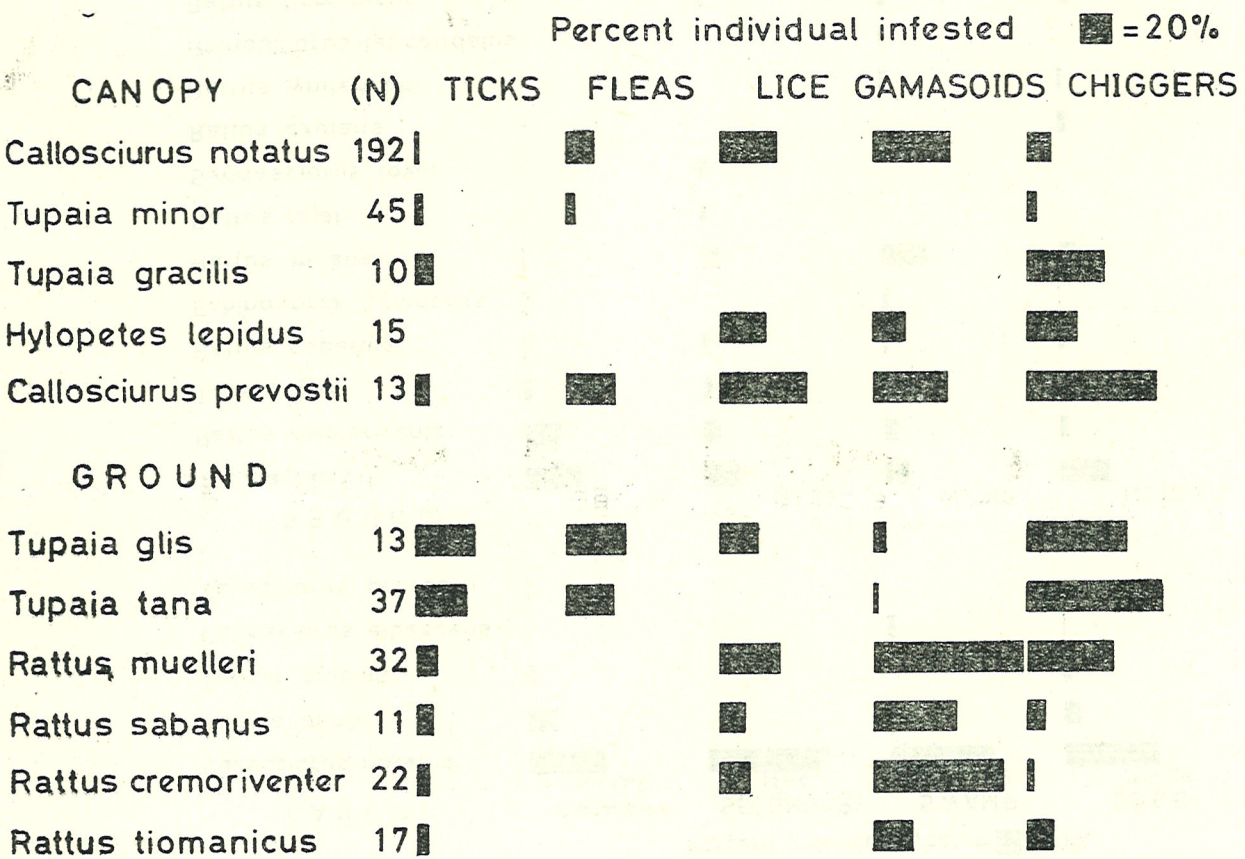
ECTOPARASITE PATTERNS IN MAMMALS COLLECTED IN SARAWAK



PATTERNS OF DISTRIBUTION OF MAMMALS TRAPPED IN FOUR HABITATS IN SARAWAK