

F-1 Effects of Deforestation on Wildlife Community Structure

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Abstract To analyze the effects of forest destruction and fragmentation, vegetation habitat size, food abundance, etc. on the community structure, we have studied the species diversity and dynamics of dung beetle, birds, bats, squirrels, and ground dweller mammals in several different types of habitats in Malay Peninsula. Dung beetle community was variable in relation to the distance from the forest edge. Avian community was different in composition in two habitats with different degree of perturbation. The size and habitat use of 4 squirrels species were estimated by using radio-tracking. Bat community was studied by mist-nets. Two species of megachiropteran bats with different ecological traits were detected. Mammal community was studied in relation to frugivory by using automatic cameras.

Key Words Deforestation, Wildlife Community, Habitat Destruction

1. Dung beetle community structure in the Pasoh Forest Reserve

Eight permanent sites were chosen beside a main trail from the edge to the core area in the Pasoh Forest Reserve. Arranged from the edge to the core area of the forest, these sites are referred to as Site 1 to 8. As the loggings in 1950's were avoided at swampy area, the distribution of primary and secondary forest areas is slightly complicated. Site 1, 2, 3 and 7 are settled in the secondary forest and other sites in the primary forest. Each site was 200 meters apart from one to another. Three baited traps (with cattle dung) were used at all the sites except for Site 2 that had ten traps. Trappings were carried out once a month at all sites and collections were made two days later after the traps had been placed. At Site 1 and from Site 3 to 6 trappings were carried out since October 1991 whereas at Site 2, and at Site 7 and 8 trappings began since July 1991 and February 1992 respectively.

The collection of dung beetles in Pasoh Forest Reserve between July 1991 and January 1994 consists of 5,020 individuals of 37 species. This figure is slightly smaller than other forests in tropical areas such as Africa or South America. This may be partly due to that Pasoh Forest Reserve is a small natural forest (about 2000 ha) left in a lowland of Malay

Peninsula, and lacking large mammals such as elephants or tigers. For α -, β - and γ -diversities the Shannon-Weaver function is used. α -, β - and γ -diversities refer to local diversity, turnover between habitats and total species richness, respectively. Most of variation in g-diversity was found to be explained by the variation of a-diversity, and b-diversity was independent of g-diversity. Site dependency of each species was analyzed for six most abundant species. One of these species (*Sisyphus thoracicus*) was found to be more abundant at primary forest than at secondary forest site. While, one species (*O. pacificus*) was more abundant at secondary forest. Two other species (*Onthophagus rutilans* and *O. vulpes*) increased in number at the central parts of the forest. On the other hand, the abundance of *O. sp.1* was low both at the edge and the center of the forest. This may be due to the species difference in resource requirement or competition for resource among species, however, this is a subject for future research.

Similarity in species composition among sampling sites was analyzed using Cl index proposed by Morisita (1959). The results indicate that most of sites are similar in their species composition, but Site 1 and 7 were slightly different from others. This suggests that vegetation type influences a lot in the species composition of dung beetles. There was a clear seasonal change in the number of individuals in major six species. Most of them have two population peaks a year and was parallel to the rain fall periodicity in long term meteorology records.

2. On the effect of forest disturbance on avian community structure at two lowland rainforests in Peninsular Malaysia.

Approximately 370 bird species inhabit rainforest and forest fringe in Peninsula Malaysia. Avian community structure generally is closely related with vegetation structure, because foraging technique of birds might evolve closely in relation to habitat structure. Mist-netting was conducted monthly at Pasoh Forest Reserve and Ulu Gombak Forest Reserve between August, 1992 and July, 1995. Though virgin forest is remaining in Pasoh, it is isolated forest island surrounded by oil palm plantation. Ulu Gombak forest is lowland forest continuing to hill forest though it is disturbed lowland forest. Standard mist-netting method was established and adopted in the study sites. Five to twenty nets were set in lines along trail or in the understory during three or four consecutive days. Five hundred and thirteen birds belonging to 73 species were captured at Pasoh forest, while 1332 individuals belonging to 90 species were captured at Ulu Gombak. The netting efficiency, which was defined as the slope of linear regression between netting effort and number of birds captured and meant relative density of understory birds, was 0.47 birds/net/day at Pasoh and 0.86 birds/net/day at Gombak respectively. The abundance of understory birds at Pasoh was clearly less than that at Gombak. The estimated number of species is only sixty-three, though eighty-one understory species were recorded in early 1980's at Pasoh. Some species may extinct from Pasoh because of

small area and forest isolation. Though the number of species captured at Ulu Gombak was more than those at Pasoh, the species diversity was almost equal at both sites.

Fourteen species of Timaliidae were captured in Pasoh, and occupied 32% of species of understory birds. On the other hand, only 8 species of Timaliidae were captured and they had narrower niche width in Ulu Gombak compared to Pasoh. More species of babblers seemed to be packed in understory in virgin forest than in disturbed secondary forest, and niche width was also compressed in Gombak. Only 9 species of bulbuls, however, were recorded in Pasoh and 20 species of them were recorded in Gombak. Contrary to Timaliidae, more species of bulbuls were packed and had wider niche width in Ulu Gombak than in Pasoh. Large babblers were found mainly at Pasoh and were lacking at Ulu Gombak. This suggested that habitat perturbation has an adverse effect on large babblers. They would need a large undisturbed area and have a smaller population as compared to the smaller species. Thus, large species would be particularly vulnerable to habitat destruction. Frugivores such as bulbuls and sunbirds formed a "mobile link" and normally abundant at the forest edge and/or in gaps. We tried to divide the bulbuls into several group by means of principal component analysis (PCA). Each species in the mixed foraging flock cannot be separated clearly by foraging techniques but especially by foraging height. Human activity has created many forest edges along the road or forest gaps after selective logging. Since those disturbed habitats were suitable for bulbuls, disturbed area would provided superabundant food resources and could support more number of species and individuals of bulbuls without clear niche segregation. Babblers and bulbuls are suitable groups for evaluating the degree of habitat perturbation.

3. Bat community was studied for about two years in the secondary forest in Ulu Gombak, West Malaysia.

Netting with mist nets, banding, radio-tracking and recording with bat detector were conducted to document community structure, food habits, movement patterns, echolocation calls, and reproductive cycles of these bats. Results indicated that in total, there were 926 captures comprising 24 species, of which 754(81%) captures of 9(38%) species were megachiropterans, while the remainders were microchiropterans. *Cynopterus brachyotis* and *C. horsfieldi* were captured almost every month and predominant, comprising 87% of the megachiropterans. In *C. brachyotis*, estimated density was 39 individuals per ha. In insectivorous bats, *Tylonycteris robustula* and *T. pachypus* were predominant, comprising 48% of the microchiropterans. Interspecific temporal difference in nocturnal activity existed among megachiropterans. The initial peak of activity of *C. brachyotis* after sunset was earlier than that of *C. horsfieldi* by 1-2 hours, and activity levels were higher in *C. brachyotis* than in *C. horsfieldi* during the night. As for nectarivorous bats, The major peak of activity after sunset in *Macroglossus sobrinus* was earlier than that in *Eonycteris spelaea*. Microchiropterans were most active in a few hours after sunset. In three *Hipposideros* and two

Rhinolophus species, constant frequency portions of the echolocation calls were species-specific. This may be a consequence of acoustic resource partitioning with respect to prey type. The day roosts of *C. brachyotis* were abundant, and most were in various trees, while those of *C. horsfieldi* were sparse and mainly in palms. Males *C. brachyotis* changed their roosts almost every day. Mean movement distance of *C. horsfieldi* was longer than that of *C. brachyotis*. Home ranges of individuals of both species largely overlapped respectively, and home range size in *C. horsfieldi* was larger than that in *C. brachyotis*. *C. brachyotis* ate fruit, flowers and leaves, but *C. horsfieldi* ate only *Ficus* fruits almost every season. The wet weight of figs carried by *C. brachyotis* averaged 7.9g, and that carried by *C. horsfieldi* averaged 17.8g. The average distances between the feeding roosts and *F. variegata* trees bearing ripe fruit were 50-78m. *Cynopterus* may be the most important dispersal agent for fig seeds in the study area. *C. brachyotis* was reproductive throughout the year with three peaks of lactation or pregnancy. Timing of peaks of pregnancy and lactation varied somewhat from year to year. Most of the females probably breed three times a year. On the other hand, female *C. horsfieldi* may breed twice a year. It is probable that *C. brachyotis* and *C. horsfieldi* can coexist in the same habitat through differences in roost site selection, temporal segregation of activity, and partitioning of food resources in relation to their different body size. Especially, *C. brachyotis* was abundant and the home range size was very small in the study area. Such a high density might be associated with the distribution of their various roosts and food resources, and their reproduction of three litters per year.

4. Space use by sympatric tree squirrels in Malaysian tropical forests.

Space use patterns, interspecific interactions, anti-predator vocalizations, and social structures were compared among three species of tree squirrels (*Callosciurus caniceps*, *C. notatus*, and *C. nigrovittatus*) in lowland forests of West Malaysia. These sympatric species had each different space demands in respect of tree height and forest structure, and interspecific interactions were infrequent. Therefore, they were able to coexist in the tropical forests that consist of tall trees and have complex habitat structures. Anti-predator vocalizations and social structures differed among the three species, and this may be correlated to the habitat structure of each species: *C. caniceps* predominated in a bushy area and more subtly used auditory communication in predator avoidance than did the other two species.

5. Frugivory of mammals and effects of deforestation on mammalian community structure.

To identify the animal species which visits fallen seed for eating or taking out, we placed automatic camera system under the tree which had been falling its fruits or seeds in Pasoh Forest Reserve. Of 2,738 pictures obtained which were photographed successfully visitors, 93.3% were mammals consisting of 25 species and others were birds (8 species) and