

RESEARCH ON TROPICAL FORESTS IN SARAWAK, MALAYSIA: TOWARD UNDERSTANDING THE ECOSYSTEMS AND SOCIAL-ECOLOGICAL SYSTEMS

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The mixed dipterocarp forest in Sarawak, Borneo may be characterized by four dimensions of ecosystem complexity. The first is species richness; The forest is one of the richest tropical rain forests in the world, in particular with quite a high species diversity of trees. The second is attributed to complex interaction networks among these species. For example, most flowering plants depend on animals for pollination. Although majority of the plant-pollinator interactions are diffuse, some plants have evolved very tight relationships with a particular group of pollinators. The third and forth are heterogeneity in space and time. The forest canopy of 20-40 m with emergents reaching up to 70 m creates various microenvironments and habitats, which support different flora and fauna. For temporal heterogeneity, irregular fluctuation of precipitation plays an important role. For example, a dry period of about 40 days is known to trigger general flowering at irregular intervals of 3-10 years. During general flowering, most dipterocarp species, together with species of other families, come heavily into flower, while flowering is rarely observed in non-general flowering periods.

We have studied the ecosystem complexity in Lambir Hills National Park, Sarawak, Malaysia since 1992. Monitoring of forest dynamics and reproductive phenology for 20 years have revealed drastic changes in mortality and regeneration of the forest under relatively aseasonal climate. Facilities such as tree towers, areal walkways and canopy crane have greatly enhanced our researches in the canopy, and our understanding of spatial heterogeneity of the forest. In the former half of the talk, I will introduce some of the results of the studies.

In the latter half of the talk, I will focus on the studies about the cause and consequences of recent rapid decline of the forest conducted as part of the RIHN project “Collapse and restoration of ecosystem networks with human activity”. In Sarawak, human activities have changed ecosystems dramatically in the last 50 years; land use has shifted from small-scale agriculture in the forests by indigenous people to logging in natural forests by enterprises as a source of timber for export, and then to the development of oil-palm plantations.

The decrease and degradation of forests due to human activities inevitably result in considerable loss of forest organisms and biodiversity. Our studies demonstrated that a major proportion of species were only found in primary forests, while a lower level of biodiversity can be maintained in secondary forests after swidden cultivation. In comparison, species loss is much greater when forests are converted to oil palm plantations. In addition, the effects of loss of primary forests are

not always simple. The effects are strongly depending on the group of the organisms, and they sometimes have repercussions on biodiversity in the surrounding area. The changes in the species composition and forest structure alter biological interactions and ecosystem functions. These observations suggest that loss of biodiversity and ecosystem services following reduction of forest area do not proceed linearly but show abrupt decline a certain point (“tipping point”). Once a majority of the forests are lost or become degraded on a large scale, and re-colonization of the organisms becomes difficult, recovery of the forests may be impossible.

Drastic changes in land cover are considered responsible for many negative changes in the lives and society of indigenous peoples. To investigate the effects of such changes quantitatively, we conducted interview surveys in the Baram and Rajang river basins. We also collected data on aspects of their environments; forest cover was evaluated based on the land cover maps based on the satellite data, and available infrastructures of the villages were recorded based on the interview to the village leaders. The data indicate that loss of forests is one of the major factors explaining a decline in the use of various non-timber forest products and swidden agriculture. Such changes in the livelihood may also affect social capital of the villages.