
Preface to Changes and disturbance in tropical rainforest in South –East Asia. A Discussion Meeting held at the Royal Society on 20 and 21 January 1999

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Preface

Views on the dynamics of tropical forests are changing rapidly with the recognition that their environment is variable on the decadal to century scale. It is becoming clearer from recent research (some of which is reported in this issue) that fluctuating climatic conditions do partly determine tropical forest structure, species composition and dynamics. Further, it is widely recognized by ecologists today that tropical communities are highly contingent in space and time with respect to site, climatic and historical factors. Tropical forests have most likely experienced this disturbance regime to some degree in the past, and at the local scale species are probably largely adapted to it. However, climatologists are now predicting that increasingly frequent extreme events are to be expected in the future and the combination of continuing deforestation and land-use conversion of anthropogenic origin plus an increasingly variable environment means an exacerbated situation that could be difficult to manage.

The role of stochasticity is gaining appreciation in the study of complex systems in fields such as climatology, ecology and economics. Simple deterministic equilibrium models rarely reflect nature and are of limited use in understanding the dynamics of species-rich communities such as tropical forests. The present impasse of poor predictability could be greatly improved if physical disturbance was measured reliably and community change was correspondingly quantified. With what probability, for instance, does a volcanic eruption, a strong drought, a fire, or a huge storm, occur with a given magnitude in x years at a particular site or within a given region? For climatologists and ecologists this is becoming the science of extreme events. Long-term data sets are essential in tackling this problem.

Much tropical research has centred on questions about the maintenance of high biodiversity in tropical communities. The factors involved are multifarious and vary in relative importance from site to site. However, a general driving factor in all vegetation systems is the extent, frequency and mode of disturbance. For the tropical forest perhaps the most recent, far reaching and unique source of disturbance is man's activity. This must be placed in the context of other 'natural' disturbances, with recognition that deforestation may also feed back on regional climate. It is of interest to ask in what ways and to what extent do the dynamics of certain groups of species change when disturbed and what contribution does this make to the overall loss, or gain, in biodiversity. Particularly well documented are biological interactions determining biodiversity, yet these too are subject to the effects of disturbance and climatic events.

This issue reports on recent research completed under the Royal Society's South-East Asia Rain Forest Research (SEARFR) Programme. An earlier Discussion Meeting (*Phil. Trans. R. Soc. B* 1992 **335**, 323–457) towards the end of the first two quinquennia (1985–1994) had the theme *Recovery of tropical forest after disturbance*. The current third quinquennium (1995–1999) has been focused on the *Restoration of tropical ecosystems*, and it is leading to the fourth one (2000–2004) on *Extreme events and sustainability of tropical forests in a changing world*. Over this period there has been a noticeable shift in thinking which began with a concentration on disturbance processes internal to the forest moving now to the development of ideas about disturbance processes which are externally driving the ecosystem. A strong interest in understanding how the primary rainforest functions has remained throughout, as has an equally strong commitment to understanding the processes controlling the recovery of secondary forests.

A large part of the Programme's work has been concentrated at the Danum Valley Field Station in Sabah, Malaysia (north-eastern Borneo, 60 km inland) but with important contributions from other sites in South-East Asia. Danum is located in an excellent class 1 protected reserve of 438 km² of lowland dipterocarp rainforest and it is adjacent to a large area of forest lands which have been managed over the last 40 years for their timber and then largely left to recover naturally. In close collaboration with several Sabah institutions, notably the Sabah Foundation, Universiti Malaysia Sabah and the Sabah Forest Department, this area has provided the required conditions for research, combined with an exceptionally interesting flora and fauna of world conservation and biodiversity value. It has also turned out to be a very suitable location for studying climate variability. The station, founded and constructed by the Foundation, is directed by the Danum Valley Management Committee: the Society has contributed significantly through its Programme to running, equipment, travel and personnel costs.

Although the majority of the contributions here concern Danum, it was important to include cross-links to other South-East Asian sites and place the Programme's work in an international framework by inviting two contributions from another tropical region. The papers concern hydrology and erosion in managed forests at Danum with an overview by Douglas, a study of chance storm flooding by Douglas *et al.* and modelling hydrological processes by Chappell *et al.* The role of recurrent drought as a disturbance factor in the Danum area is evaluated in terms of forest dynamics by Newbery *et al.* and from the climatological standpoint by Walsh & Newbery. This last topic is complemented by a paper by Condit *et al.* comparing the dynamics of Central American and West Malaysian forests. From Indonesia, on a larger extreme-event scale, Whittaker *et al.* update ideas on stand dynamics still evident after the Krakatau eruption; and long-term processes of peat formation in swamp forest in Sarawak are considered by Page *et al.* Following an overview of insect dynamics in the tropics by Godfray *et al.*, the effects of forest disturbance from timber harvesting on termites by Eggleton *et al.*, and on moths by Willott, are presented. Similar considerations are given to fishes by Martin-Smith *et al.* The roles of light in forest regeneration at Danum, and nutrients in tree growth at Barito

Ulu (Kalimantan), are taken up by Brown *et al.* and Mirmanto *et al.*, respectively. Disturbance and ecological change are the principal ideas throughout.

The current Programme has shown that understanding reactions and responses to disturbance is achievable but requires a long-term commitment. Major events of different magnitude may occur perhaps once every ten to 100 years and trees live typically for 100–350 years. Animal populations are highly dependent on the existence of this forest structure. Furthermore, the dynamics at the community-ecosystem level is complex due to spatial variation in species and age-class composition, intrinsic time-lags and feedback processes. Scaling up from the plot to the region is not yet possible but it seems that by testing predictions at other sites and having longer runs of data from established ones like Danum a more comprehensive picture could emerge in the next few years. Continuity of measurement and preparedness for the next events are important. In the coming years more attention is needed to canopy-level processes and forest water balance.

The work supported by the SEARFR Programme, would not have been possible without the generous and sustained cooperation of our tropical-country colleagues and on behalf of the Society's committee and the many visiting scientists we should like to thank them warmly. In Malaysia particularly we acknowledge the important guiding role of the Danum Valley Management Committee (DVMC) and especially thank its chairman Tengku D. Z. Adlin for his constant encouragement and support. Dr S. Sutton played a crucial role in coordinating the scientific work in both UK and South-East Asia and to him we are all greatly indebted. To the Royal Society we record our thanks for providing the forum and sponsoring a stimulating and rewarding Discussion Meeting, with our gratitude to N. Boross-Toby for his excellent coordination. The Meeting was well attended and we appreciate the many interesting contributions to the discussions. Finally, our thanks go to the many reviewers of the contributions, and to J. Clifford, A. Gibbins and their colleagues E. Carter and H. Winser in the Society's *Phil. Trans. B* office for so ably seeing the issue through to press.

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