Big Trees, Small Moths: A Taxonomist's Rainforest Odyssey

Editor's Introduction | Gaden Robinson, a taxonomist in the entomology department of The Natural History Museum, shares his South East Asian rainforest odyssey. He introduces the big trees and small moths of West Malaysia and Brunei as he describes important expeditions that have both increased the Museum's collections and boosted the study of moth taxonomy in South East Asia through the production of the first field guide to moth biodiversity in the region. The collaborative effort of The Natural History Museum and the Malaysian Nature Society further highlights the key role of non-governmental organisations in developing countries working for rainforest care and conservation.

Beetles are arguably the most diverse insect order on Earth, but the Lepidoptera (moths and butterflies), with something like 140,000 named species, follows close behind. The term "microlepidoptera" has been coined for classification convenience, and a line has traditionally been drawn half way along the evolutionary tree, with butterflies and large moths situated on one side, and those that are predominantly small on the other. This division is an historical accident, maintained at The Natural History Museum simply because the collections are too large to store in one place. However, the division does make classificatory sense, with the more primitive super-families forming the microlepidoptera, and the more advanced species comprising the macrolepidoptera. An exception to the rule, in terms of size, are the ghost moths of Australia. They belong in the microlepidoptera, phylogenetically and biologically, but are extremely over-sized.

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Avicennia forest, Kuala Selangor, West Malaysia.

Museum scientists began work in the early 1980s in South East Asia, in order to fill both a gap in the Museum's collection, and to present a more accurate picture of tropical diversity. Inland from the coast of the Malay peninsula and Borneo lies a lowland dipterocarp forest. Right at the edge of the sea small bushes grow in the mud, the first mangrove forest colonisers-- Avicennia. Further in still, where more deposition of silt has occurred, there is almost a canopy, a scrub forest, but one which is technically a rainforest. The more mature, dense area around the spring high water mark is the Rhizophora forest. This is also mangrove, with enormous stilt roots protruding from the tree trunks around ten feet above the ground surface.

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Mangrove forest dominated by Rhizophora.

Four to five miles even further in, where the river winds towards the sea, the water is fresh and the soil no longer brackish. Although the river is tidal here, there is a true freshwater association of plants. The peat swamp forest in the Belait basin in Brunei is comprised almost entirely of one particular species of tree, and the canopy sizes are more regular. The dominant tree is known as *Shorea albida* and it is a member of the *Dipterocarpaceae*, the dominant family in the rainforests of South East Asia. Dipterocarps are an oriental speciality of enormous diversity, with extremely valuable timber. Inside the *Shorea albida* forest, the tree trunks are extremely tall. In Brunei, the species has never been seen to flower or fruit, despite thorough searches during the past seventy years. Regeneration is thus considered to be extremely rare, and logging has upset the natural balance.

Riverine forest dominated by Shorea albida, Belait River, Brunei.

Moving out of the flatlands and into the hills, a hill dipterocarp forest can be found. The terrain is steep, has tall trees and an irregular canopy, and hosts an incredible species diversity--in the Temburong valley in Brunei, around 231 species of tree were counted in one hectare alone. By contrast, there are fewer than twenty native tree species in Britain. Adjacent to the Temburong watershed, the Limbang salient of Sarawak has practically no trees because of severe logging practices and intensive agriculture. Many moths have caterpillars that are host-specific or that feed on a small range of closely related host plants, and the greater the tree diversity, the more moth species are to be found. Most of these species reproduce all year round and the generation time of microlepidoptera in the tropics may be as little as four weeks. Information about the life histories of most tropical moths is scanty, but work at The Natural History Museum suggests that life histories are known for only about ten percent of South East Asian species. Much of the reason lies in the difficulties experienced in locating the caterpillars that normally reside 150 feet up in the forest canopy. French research teams have experimented with a helium blimp to carry scientists up on a "raft" which rests gently on the forest canopy as samples are collected. However, once captured, it is extremely difficult to encourage caterpillars to feed, and therefore rearing them to adulthood away from their natural habitat is extremely problematic. Studies suggest that perhaps only one-third of the moth species living in South East Asia have been described and named.

Lowland hill forest dominated by Dipterocarpaceae, Brunei.

An important element of the tropical rainforest is the rapid breakdown of all material that hits the ground. Much of this breakdown is carried out by fungi, which are incredibly common and often luminous at night. Vertebrate animals are a rarity, for example the hornbill (which can be heard sweeping above the canopy like the sound of a helicopter, but is rarely seen) and the pangolin. The indigenous peoples of the West Malaysian forest are the orang asli (the original people), who were native to the area probably long before the mobile

Pangolin.

sea-going Malays colonised the peninsula together with much of the South East Asian archipelago.

The balance and diversity of the rainforests is constantly under threat from legal and illegal logging operations. One large dipterocarp can fetch up to $10,000, and with little enforcement against illegal activities, the practice is hard to control. In addition, housing and agricultural developments are cutting into mangrove and lowland forest in South East Asia. Logging operations have contributed to the steady erosion of *Shorea albida*, the peat swamp forest, which shows no sign of regenerating.

Pressure from agriculture is acute, with lowland dipterocarp rainforest replaced by several thousand square kilometres of oil palm on the Malay Peninsula. In addition, the hill forest has been cut and terraced to provide more space to grow fruit and vegetables. As the squeeze goes on, there is less and less habitat for creatures like the gibbon, which entirely relies on high canopy primary forest for survival. The implications for biological diversity are immense.

A delicious local fruit delicacy is the durian, its trade worth more than US $30m a year to the Malaysian economy. Most of the durians grown are clones, usually prefixed by a "D" number, the most popular being D23. This wild durian represents one of the last mixed wild populations, one of the two probable ancestors of *Durio zibethinus*. The image shows the rainforest as a cultural and an ecological asset, but also a monetary asset because it is the gene pool that supports the agricultural production and diversification of tropical fruit crops and many other kinds of crops including medicinal plants.

Taxonomists are keen to see biodiversity remain, and the possible extinction of many organisms is a serious cause for concern. The Malaysian Nature Society is leading the lobby for effective rainforest conservation, focusing on educating people about the wonder of the rainforest environment and about the ways and means to investigate its diversity. Taxonomists are useful people to work alongside the local people, and they have been able to provide identification manuals to assist with recognising the species that comprise the diversity of the landscape. Before 1980, there was little means to identify, for example, small moths in Malaysia or Borneo, and the programme headed by The Natural History Museum has been instrumental in providing the resources necessary for this education. Fieldwork began in South East Asia around this time, assisted in Brunei by soldiers from the Gurkha regiments.

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Helicopter to penetrate inaccessible areas of rainforest.

Sunset is the starting point for a lepidopterist. A mercury light is used to attract moths which will then settle on a white sheet strung between two poles. Individual specimens can thus be plucked from the sheet and preserved for later examination in small glass tubes. Specimens to be kept for later detailed examination are killed, pinned through the thorax for ease of handling and their wings are carefully spread. They are stored in plastic boxes with fungicide, and dried. Specimens are later sorted and labelled for the identification process to begin.

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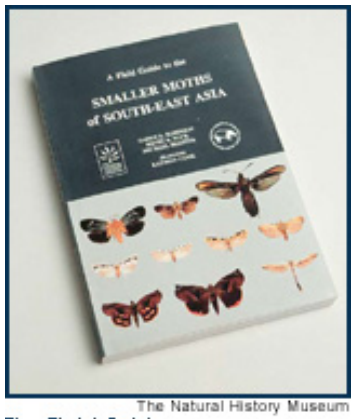
A mercury light is used to attract moths which them settle on a white sheet.

Once the research had begun, it soon became apparent that the scale of diversity of species was far more considerable than previously thought. Somewhere between 7,000 and 12,000 different species of moths had been identified over a ten-year period in South East Asia, and the task of researching the finer details was enormous for the naturalists involved. As a result, criteria had to be set, and specific moth types only were pursued: species that were common, conspicuous, and those classified as pests. The gaps could be filled later, to provide a picture of the major genera in the region--not the species. Seven-hundred species were then verified by dissection and the identities discovered. The final specimens were photographed and fine details were illustrated by a professional artist. Text was written to accompany the illustrations which, for many species, were to be the first pictures ever published.



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The Field Guide.

Before publication by the Malaysian Nature Society, a draft of the new guide was tested in the field to see how it could work in practice and how well it might be received. The test conveniently coincided with the Society's own expedition into a previously closed area and this expedition to Belum was to be a great opportunity for both taxonomy and collaboration. Two expeditions in fact resulted, the first, in August 1993, to northern Malaysia and the second, later, to an area further north, close to the Thai border.

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Studying small moths.

In 1978, the Temenggor Dam produced a lake of well over 100 square kilometres for this area, and the results were spectacular. The lake is crossed at its midpoint by the east/west highway that joins the coasts of Malaya. As the lake narrows, there is an island with a hotel and a landing stage, a bridge joining both sides. This was the alighting point in order to proceed down to the far end of the lake where the

Malaysian Nature Society had established its base camp.

Accommodation for the expedition was designed along the lines of a traditional Dayak long house, and the entire site was created to have absolute minimum impact on the environment. The ten or eleven hours of daylight provided excellent conditions for microscopic specimen analysis, and the specimens were then identified according to details and illustrations in the field guide. The results proved that simple taxonomical techniques, via the guide, could be used to assess a high diversity scenario in a practical and simple fashion.

Over the fifteen-year period of study, 20,000-30,000 specimens of small moths (including numerous new species) of the lepidoptera research group's involvement in South East Asia were returned to the Museum. A more complete collection has allowed for a greater understanding of the distribution and morphology of the lepidoptera in South East Asia, and will provide the raw material for many years of vital taxonomic research, mapping tropical biodiversity.

Malaysian Nature Society (www.mns.org.my/)

Books:

Title: Elsevier's Dictionary of Butterflies and Moths, in Latin, English, German, French, and Italian
Format: Hardcover
Author: Wrobel, Murray (Edt)
Date: 01-JUL-00
ISBN: 0444504338

Title: Hawkmoths of the World : An Annotated and Illustrated Revisionary Checklist (Lepidoptera: Sphingidae)
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Author: Kitching, Ian J./ Cadiou, Jean-Marie
Date: 01-MAY-00
ISBN: 0801437342

Title: Butterflies and Moths of the World
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Author: Eid, Alain; Viard, Michel
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ISBN: 0785808256

Title: The Lepidoptera: Form, Function and Diversity
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