Measuring and Monitoring Biodiversity in Tropical and Temperate Forests

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Quiz time! Faced with the loss of perhaps 30–50% of Earth's plant and animal species over the next 50 years, would you: a) measure genetic variation within a single species of commercial timber tree; b) count beetle species in the canopy of a tropical forest or c) combine the latest computer technology and satellite imagery to map disappearing wildlife habitats more accurately than has hitherto been possible? If you selected any of these, you would not have felt out of place at the international symposium on Measuring and Monitoring Biodiversity in Tropical and Temperate Forests, organized by the International Union of Forest Research Organizations and the Royal Forest Department.

Biodiversity—the variety of life, from DNA to ecosystems—became a buzzword in the 80s, as concern grew over the rate at which plant and animal species were being wiped out. That concern received global recognition at the Rio Earth Summit, with the drafting of a global convention on biodiversity, but the convention still has to be implemented and debate continues as to exactly how biodiversity can be defined, quantified and above all conserved. Consequently, the subject has become well-established on the international conference circuit.

The Chiang Mai symposium consisted of 54 spoken papers, about 30 posters, discussion sessions plus demonstrations of several computer packages.

Standard mathematical indices of diversity featured prominently in many papers, but several speakers questioned their value. As R.L. Kitching put it, "everyone agrees that data on the abundance and distribution of species are seriously lacking, so when such data *are* collected, why boil them down to a single index?". E.C. Pielou also criticized use of indices of what she termed old-style diversity, since they fail to take into consideration differences in the conservation value of different species. "Numerical measures of diversity are useless without considering species lists", she said.

But how can species lists be compiled, if species cannot be accurately named, due to lack of taxonomists? K.D. Hyde said that, in Australia, there are only 5 full time taxonomic mycologists working on an estimated 250,000 species of fungi. On the other hand, 25 taxonomists work on *Eucalyptus,* a single genus of timber tree, which contains only 600 species. The vertebrates and vascular plants are fairly well covered, but they represent only a very small fraction of the world's biodiversity. According to R. Kitching, "biodiversity *is* arthropods", in particular, beetles, which comprise a quarter of the world's known species. N. Stork neatly summed up the problem: "undescribed species have a greater probability of going extinct than being described".

The most impressive attempt to tackle this problem, is InBio's biodiversity survey and research program in Costa Rica, which trains local villagers, who may not even have finished high schools, as "parataxonomists". They work out of 26 simple field stations, in or near national parks, covering all habitats in Costa Rica. After 6 months' intensive training, parataxonomists collect specimens, sort them to order or family and preserve them in the field stations. They also spend 20% of their time educating school children about biodiversity conservation. Some have gone on to become internationally respected specialists in particular taxa. Many participants were inspired by J. Jiminez's presentation on InBio and thought that this project is a model that many developing countries could follow.

Counting the numbers of species in different habitats is such a daunting task, it isn't surprising that scientists look for short cuts, such as predicting total biodiversity from the species richness of easily identified taxonomic groups; so-called indicator species. But which groups.....lichens, epiphytes, trees, birds, butterflies? All were mentioned in passing, but participants could not agree on which worked best. The majority view on indicator species seemed to be that we are still looking for them.

Another approach is to dispense with counting species altogether. Two papers described rapid, simple and practical forest survey methods to assess the degree to which forest ecosystems had been disturbed, the idea being that disturbance causes loss of species. H. Koop likened himself to an ecosystem doctor. "You don't have to dissect a patient to diagnose a disease, just learn to recognize the symptoms". His method was to look for early successional stages which indicate disturbance, including structural features (e.g. number of canopy layers) and plants which indicate light (e.g. grasses) and moisture (e.g. mosses growing on leaves). A. Gillison proposed a similar approach, using plants' morphological characteristics, especially leaf shape, the vascular system and above-ground roots. To demonstrate just how rapid his method was, he used it during the symposium field trip to Doi Inthanon and presented the results the next day. Some taxonomists took a dim view of such rough and ready methods, but they have a vested interest in promoting species as the units of biodiversity.

Several speakers thought that simply measuring biodiversity was not enough. We need to understand the processes that create and destroy it. There is no shortage of theories as to what factors cause some communities to be more diverse than others, but few of these theories have been tested. A. Young thought that data collection should be organized in such a way as to test these hypotheses.

But how does all this theorizing actually help conserve biodiversity? Too few papers provided practical advice to help forest managers and politicians make sensible decisions about how to conserve the world's diminishing species. One exception was L.M. Tsai's lecture on how to log a forest without destroying the trees' genetic diversity. Conventional logging removes the fittest genotypes. Tsai described how to design a logging system which maintains the population density of trees high enough to prevent genetic erosion.

Another practical concept described at the meeting was "complementarity", which helps planners decide where to establish protected areas and which areas should receive priority funding. Complementarity means that protected areas systems are formed by adding sites which contain the most species not already represented within the system.

This concept is one of the central features of WORLDMAP, a computer program which helps planners decide on where to put protected areas. I. Kitching demonstrated the program's latest features, such as the ability of the user to specity the minimum number of protected areas needed to adequately conserve each species. The demonstration used surveys of British birds, probably the largest data set of its kind in the world. However, in tropical countries, most species are undescribed and their distributions and taxonomic relatedness unknown. This rather begs the question: why develop sophisticated, data–hungry computer models, if the data to feed them are lacking?

However, two excellent presentations showed just how such data are being collected in the tropics to feed complementarity models. M.J.B. Green described an extensive transect survey, recording plants and animals in all remaining forests in Sri Lanka. Using a computerized geographical information system, species complementarity was combined with the importance of sites as water catchment areas to determine the optimum protected areas system. P. Howard used a similar approach in Uganda where the 713 existing forest reserves were intensively surveyed for all species in five indicator groups (woody plants, mammals, butterflies, moths and birds). Sites were then scored according to the rarity of the species present and the degree to which each site contributed towards the full compliment of species found in Uganda. Thus an optimum protected areas system was arrived at.

Presentations on the final morning concentrated on international institutions and funding opportunities for biodiversity research. The emphasis was on large projects, linking institutes in developed and developing countries, but are such projects the best way to measure biodiversity?

K. Beese's description of how to apply for funding from the European Union left most participants' heads spinning. Projects must involve at least two institutes from developing countries and two from Europe. Once those links are formed, applications must pass through layer after layer of bureaucracy and committees. Many of the audience laughed out loud when Beese, explaining how he had simplified his diagram of the application procedure, displayed probably the most complex flowchart of the symposium. No wonder the EU has failed to disperse all its funds available for forestry research!

The need for institutes in developing countries to form links with those in developed countries, simply to gain access to funds, kills many projects. And are the huge sums spent flying foreign experts around the world really cost–effective, when so much biodiversity research involves simple tasks like measuring trees or trapping insects? Salaries and overheads in institutes in developed countries are extraordinarily high, often consuming a large part of grants for collaborative projects. In this way, money earmarked for foreign aid finds its way back to already well-funded museums and universities in the donor countries. Why cannot institutes in developing countries apply directly for funds from the European Union or Britain's Darwin Initiative?

Biodiversity projects are mostly simple and, if local people are employed or used as volunteers, cheap. Often they require only small grants which are readily accessible with a minimum of form-filling. The message I took away from the symposium was that international agencies offer no hope of such funding. Until they do, sponsorship from local companies and small foundations dedicated to conservation will continue to fill the gap.

It amazes me that, even with modern technological advances such as computer graphics and laser printers (not to mention thick colour pens), audiences at international symposia still have to suffer eye strain from squinting at overlays densely crammed with incomprehensible data tables. Too many speakers opened with that immortal refrain, "you probably won't be able to see this at the back..." and left me reaching for the eye drops and aspirin.

Notable exceptions were R.L. Kitching's presentation on arthropods in Australia—

"conservation of biodiversity is just as much an economic use of the forest as chopping it down and flogging the timber"—and K.D. Hyde's entertaining talk on fungi: "mycologists are fun guys" (geddit?). His infectious enthusiasm made me regret that I was not devoting my life to the study of mouldy bits of wood. However, if there was a prize for presentation, it would have to go to G. Lund for his colourful and humorous review of the latest technogadgets used to map vegetation from airplanes and satellites—"good planets are hard to find".

The posters were nearly all well-presented. A host of fascinating facts awaited those who found time to browse around the exhibition. Did you know that Doi Inthanon has the most species of springtails (wingless insects) (Deharveng *et al.* found 211 species in 367 soil samples, 169 of which were new to science); or that 82.4% of New Caledonia's vascular plants are found nowhere else, including the only parasitic gymnosperm known to science (*Parasiticus ustus* (Podocarpaceae), a relative of pine trees)?

By covering biodiversity at all levels of organization, from genes to landscapes, the meeting attracted a large and diverse audience, including geographers, molecular biologists, ecologists, statisticians, etc. Exchange of ideas between such diverse groups must surely be beneficial, but the diverse nature of the audience resulted in the symposium lacking a clear direction.

It became clear in the final discussion session that the symposium had not helped participants identify key issues and focus on them. One expectation from the meeting was that standard methods to measure biodiversity might be decided upon, so that data from studies all over the world become comparable. However, even this simple goal did not receive universal support. P. Kanowski, for example, felt that standardized methods would be too restricting and that methods must be adaptable to variable local conditions. Even a representative of IUFRO admitted that the meeting had not generated any information that would persuade development agencies to become more involved in biodiversity. A list of recommendations was drafted, but discussion of it petered out in disarray, as participants questioned the necessity of such a list.

However, the main value of such a symposium lies not in a list of recommendations, but in the personal contacts made between participants, which hatch new projects. Personally, I came away with lots of new ideas about how to improve my own research on biodiversity. I therefore have no doubt that this symposium will continue to generate benefits far into the future and that because of it, some of the world's millions of unknown species now have a slightly better chance of being described.

Anyone interested in receiving a copy of the symposium proceedings should contact Dr. Tim Boyle, CIFOR, P.O. Box 6596, JKPWB Jakarta 10065, Indonesia, FAX: +62 (251) 32-6433, E-MAIL: cifor @cgnet.com

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