What can we learn from ins

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New techniques for monitoring biodiversity are being put to test by CSIRO entomologists.

Improved methods of estimating biological diversity are being developed as part of CSIRO Division of Entomology's Biodiversity and Conservation program.

The program is headed by taxonomist Dr Peter Cranston and operated by post-doctoral researcher John Trueman. They have been funded by the Biodiversity Unit of the Department of the Environment, Sport and Territories to trial a variety of biodiversity assessment techniques.

'The Rio Convention on Biological Diversity requires assessment and monitoring of each nation's biodiversity,' Cranston says. 'Invertebrates comprise a huge proportion of global diversity, with many millions of insect species. If scientists and politicians are to meet their international obligations, more must be learned about this largely unknown component.

'The attractions of rapid biodiversity assessment (RBA) are obvious. Time scales of human-induced habitat destruction and political processes are short and, with current resources, traditional methods of biodiversity assessment are argued to be too slow.'

Traditionally, biodiversity surveys are restricted to the conspicuous organisms in the environment such as mammals, birds and flowering plants. But these groups make up only about 15% or less of the species present in most environments. Apart from microbes, it is the invertebrates, especially insects and their relatives, that contribute most to biodiversity.

Invertebrates are ideal to use as environmental indicators because they are abundant, diverse, easy to sample and rapid to respond to environmental variation. They also facilitate many ecosystem functions, from nutrient cycling in soils and processing leaf litter, to the regulation of other populations.

Cranston has tested the application of RBA techniques in aquatic ecosystems, assaying freshwater organisms to understand how aquatic biodiversity relates to ecosystem health, water quality for human use and environmental management (see 'Midges as Bio-indicators', *Ecos* 75).

In these situations, rapid biodiversity assessment of selected invertebrate species may give an indication of the health of the environment. However, Cranston is cautious about how much we can expect to be able to apply such RBA techniques to predict biodiversity levels.

To test whether such techniques can be applied to biodiversity estimation, Cranston's team has established five sites along a 40-kilometre transect in north-eastern Tasmania, between low rainfall coastal heath, wet and dry eucalypt forests and temperate rainforest. A variety of techniques are being used to look at patterns of diversity.

The study is concentrating on ants, springtails, carabid beetles, spiders, centipedes and millipedes from the terrestrial environment, and midges, dragonflies and damselflies from the aquatic environment. Vegetation surveys of the area are also being carried out to seek correlations with invertebrate diversity.

With the data eventually acquired from four seasons of sampling in one year, Cranston's team aims to discover whether:

- diversity measures derived from any single group predict the diversity of other groups at the same site;
- the diversity derived from one sampling technique predicts the diversity derived from other methods;
- diversity measured at one site predicts diversity at other sites and
- whether any one group provides the same biodiversity prediction at different times of year.

Early results indicate that variability within each site and between seasons is high, and that the ranking of sites

Identifying beetles with CD-ROM

More than a third of Australia's estimated 225 000 insects and invertebrates have yet to come under the microscope. Scientists estimate that 30% of these species are undocumented, and a further 30% are known, but not named.

Researchers at the Division of Entomology, together with the Division of Plant Industry, are working to redress this lack of knowledge, particularly through cooperative research into plant, invertebrate and soil interactions.

Australia's National Insect Collection is housed at the Division of Entomology's Canberra headquarters. Dr Ebbe Nielsen is in charge of a collection of almost 11 million Australian specimens which he says are central to identifying and monitoring biological diversity.

Nielsen recently compiled a CD-ROM titled *Beetle Larvae of The World*. a world first interactive identification guide.

Beetle Larvae of The World consists of a compact disk (available in an MS-DOS format, with Windows and Macintosh versions on the way) and a 52-page manual that allows the identification of 385 beetle groups in their larval stages. The package will benefit taxonomists, agricultural, veterinary and medical researchers, quarantine officers and conservationists.

The system uses DELTA, a descriptive database, combined with an interactive program called INTKEY, which allows the user to 'talk' to the database. In future it will be expanded to include adult beetles too.

The CD-ROM package Beetle Larvae of the World *costs $240 plus $24 postage. Contact: CSIRO Bookshop, PO Box 89, East Melbourne, Vic. 3002, (03) 418 7217, fax (03) 419 0459.*

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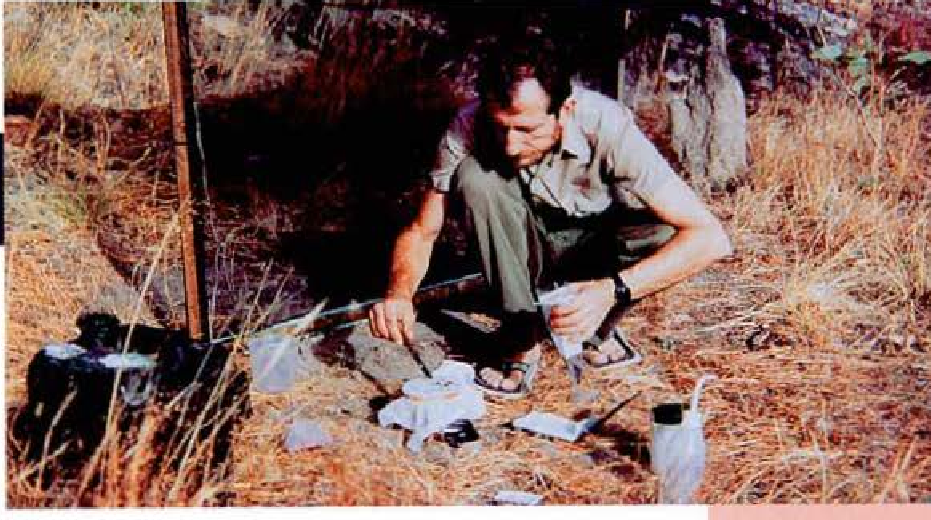

Entomologists from CSIRO are surveying the insect populations of Cape York. Their findings will aid the development of a land-use strategy for the region.

according to the relative diversities of different invertebrate groups varies according to the group.

'A difficulty with the concept of selected 'indicator groups' of biodiversity lies in avoiding judgments based on easy or arbitrary criteria (such as easily identifiable groups, 'charismatic' organisms or groups that can be surveyed cheaply),' Cranston says.

'Another complication lies in what we mean by 'indication'. The concept of indicator groups as it applies to biological monitoring — meaning the use of selected organisms as indicators of environmental health — has been transferred to biodiversity studies without proper consideration of whether such a concept works.

'We need to identify groups that show correlations in their diversity with other groups; groups such as beetles or ants, whose diversity may correlate with plants, human disturbance and environmental heterogeneity; 'predictor sets' of organisms that indicate more than their own diversity.'

Mapping the wilderness

Dr Ian Naumann, also a taxonomist at the division, is another scientist involved in the search for information about insect species. Naumann and his colleagues work with botanists and zoologists to help establish what is called 'baseline data'. To baseline map an area, they record what is present in which locations and under what conditions.

Many institutions have joined together to carry out this work. CSIRO is running studies with the Queensland Museum, the Queensland Department of Primary Industry and the Tasmanian Department of Parks, Wildlife and Heritage.

One of the first baseline studies involving the division took place in Tasmania. It was called the Wilderness Ecosystems Baseline Study and finished in 1991. Scientists found wingless moths, flies that don't fly and a flightless sawfly — all new to science. They also found links to Gondwana, the ancient land mass from which the continents of Australia, South America and Africa originated. Moths, wasps, beetles and gnats similar to those found in South America were documented.

The study also revealed insects that could be used as monitors for climate change.

'We discovered that some insects are adapted to the cold conditions near the top of Tasmania's highest mountain, Mt Ossa,' Naumann says. 'If our climate starts to become warmer, they will vanish. If we want early warnings of climate change we should be keeping our eyes on the insects living on mountain tops, not just sticking thermometers in the ocean.'

Now the scientists are searching Cape York Peninsula as part of the Cape York Land Use Strategy. This project is a joint effort between the Queensland and Federal governments to prepare a land-use strategy for the cape. It involves a comprehensive data collection and interpretation exercise and will provide a decision-making framework to aid sustainable development in Cape York.

The CSIRO component is an insect survey. Entomologists are looking for dragonflies, termites, grasshoppers, lacewings, beetles, wasps and moths and plotting their locations. This data will be combined with what is known of the cape's animals and plants, and mapped to show distribution patterns.

'If we want to develop an area we can refer to these maps and see what will be affected,' Naumann says. 'If endangered fauna lives in that area, this will give us the information to help prevent their destruction.'

Key role for herbarium

Nearly a million specimens of native plants, including the world's largest collection of eucalypts, are housed at the Australian National Herbarium, part of CSIRO's Division of Plant Industry in Canberra. The herbarium also maintains a specialist rainforest collection at the Tropical Forest Research Centre at Atherton, south-west of Cairns.

Head of the herbarium, Dr Judy West, says herbaria facilitate plant classification and identification, and assist research into vegetation distribution and patterns of variation in species. They can also help biologists to determine whether a species is rare or endangered, to identify historical changes in species distribution and to assess a plant's economic value.

National and international access to Australian plant collections is being simplified with the establishment of a continent-wide eucalypt database. This will link information on species including phytogeography, habitats and landscapes, analysis of surveys and rare and threatened plants.

As well, Dr West oversees the production of references such as *Rare or Threatened Australian Plants* (by John Briggs and Dr John Leigh) and an innovative key to eucalypts that employs leaf-vein patterns and other poorly used but important features to assist identification.

The national herbarium forms the core of the newly established Cooperative Centre for Plant Biodiversity Research, a joint venture between the Division of Plant Industry and the Australian National Botanic Gardens.

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