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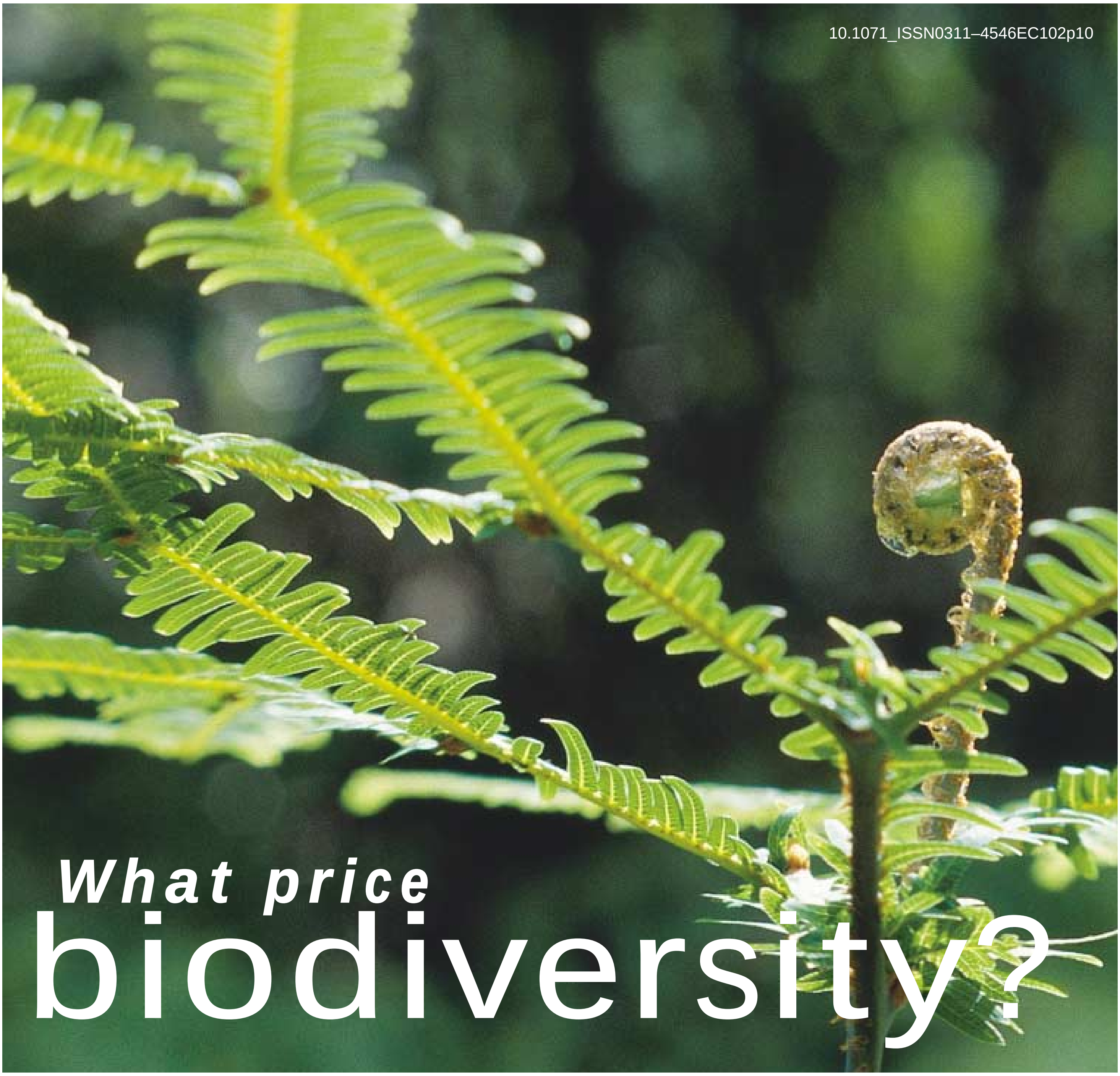


What price biodiversity?

How do we value something that is rarely traded for its true worth, yet sustains life on Earth? **Steve Davidson** outlines a collaborative beginning.

Putting an economic value on biodiversity is a complex challenge involving both scientific and economic tools. Yet it is clearly a worthwhile task, and a pressing one.

According to Dr Denis Saunders of CSIRO Wildlife and Ecology, some 192 species go extinct in the world every day. That's 70 000 species lost each year.

To the sceptic who argues that extinction is a normal process, Saunders says the above rate of loss is many times greater than the 'background' rate of extinction, that is, without human interference. Extinction rates today are 100 to 1000 times greater than those in the fossil record. Furthermore, the rate of detrimental change – at the level of genes, species and ecosystems – is increasing, not slowing.

Aware that biodiversity is a dwindling and often unappreciated resource, a group of scientists led by Dr Brian Walker and Dr Steve Cork, of CSIRO Wildlife and Ecology is developing principles and methods for objectively valuing biodiversity. The ambitious program is being funded by both CSIRO and the Myer Foundation and involves scientists and economists from some six CSIRO divisions in partnership with state and federal agencies and other organisations. They intend to report their findings regularly between 2000 and 2003.

The systems we too often take for granted.

Left: Plant productivity underpins life on Earth.

Below: Fungi and other decomposers break down organic matter, releasing nutrients that would otherwise remain unavailable to plants.

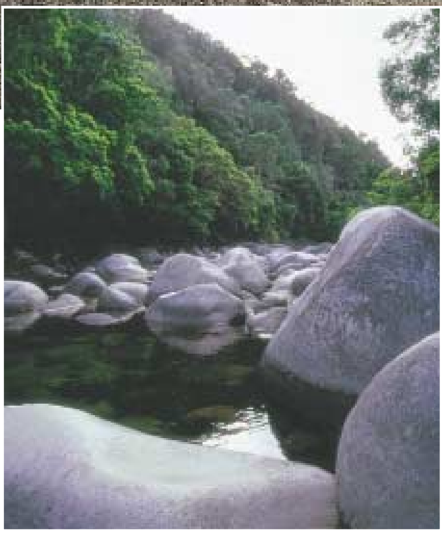
Bottom: A multitude of unpaid predators, such as this robber fly, controls insect pests for farmers and gardeners.

Steve Davidson

Ecosystems at your service

Cork says the project is focussing on ecosystem services – the conditions and processes by which natural ecosystems sustain and fulfil human life – and which we too often take for granted. These include such services as flood and erosion control, purification of air and water, pest control, nutrient cycling, climate regulation, pollination, and waste disposal.

'People are well aware of the intrinsic aesthetic, cultural and physical values of ecosystems such as forests and of ecosystem goods such as timber,' Cork says. 'But we need to raise awareness of ecosystem services, which are very poorly understood.'



Top: Remnant vegetation in the Western Australian wheatbelt. Remnant vegetation has economic value for various reasons, including control of water tables, provision of habitat for enemies of pests, and neutralising effects on acid soils.

Above: A forested catchment may have greater economic value as a provider of pure water than as a source of timber.

He cites the example of clean water. A recent study in the United States showed that the provision of clean water to New York City by nearby forests was equivalent to a capital investment of US$6-8 billion, plus an annual $1-2 billion operating cost for plant. The city decided to maintain water quality by means of ecosystem services instead of the costly technological fix. It bought some parcels of land, applied certain covenants on fertiliser use in the catchment and made a one-off investment of only $1 billion to upgrade local sewerage plants.

An Australian example can be found in the Thomson River catchment which supplies much of Melbourne's water and is logged on an 80-year rotation. An independent economic study of the catchment reached the perhaps surprising conclusion that 'an increase in rotation length or a cessation of logging would increase substantially the value of catchment outputs'. In other words, the value of additional water in streams in the catchment would exceed the value of timber foregone if management of the forest was altered.

Productivity to pollination

Before they can 'value the nature' the researchers need to determine the nature of ecosystem services. They are conducting a vigorous assessment of the kinds, magnitudes, consumption and, finally, economic values of services in a selection of Australian ecosystems. The aim is to produce information of use to policy writers and decision-makers.

The four case studies will be in Australia's agricultural heartland (the farming zone), the rangelands (a grazed ecosystem), the Atherton tableland (tropical agriculture and forestry), and a southern forested catchment (water and timber).

'In each case, we first intend to sit down with the experts – local landholders, conservation groups, land management agencies, state and local governments, industry people, federal agencies, economists, lawyers – and devise a list of goods and services provided by the catchment,' Cork says.

'We then need to identify the main services and underlying ecological processes that will be affected by management practices and concentrate on these in the economic analyses. We are developing a framework for assessing the economic services delivered to society by Australian nature.'

Some likely key services are those provided by remnant vegetation, crop pollinators, soil-dwelling organisms and forests in water-supply catchments. Perhaps the most enigmatic service is that provided by minor grass species in rangelands (see boxed story on page 13).

Pollination of crops by insects and birds was last estimated (a decade ago) to be worth between $600 million and $1.2 billion per year in Australia – and we are fortunate in this country that some of this unpaid work is performed by native insects that fly in from nearby bushland.

Soil fungi associated with plant roots (mycorrhiza) can effectively increase the surface area of roots by some 2000 times, providing a huge boost to plant productivity. Then there are the other gifts from soil organisms: soil formation, delivery of water and nutrients, maintenance of soil structure and pores, physical support and so on.

Replacement values

So the dollar-values of such services to society can be astronomically high. One study reported a few years ago in *Nature* put the aggregate value of the world's ecosystem services at US$16-54 trillion per year. One could argue that even this is a conservative estimate considering that humans depend on nature's services for their existence.

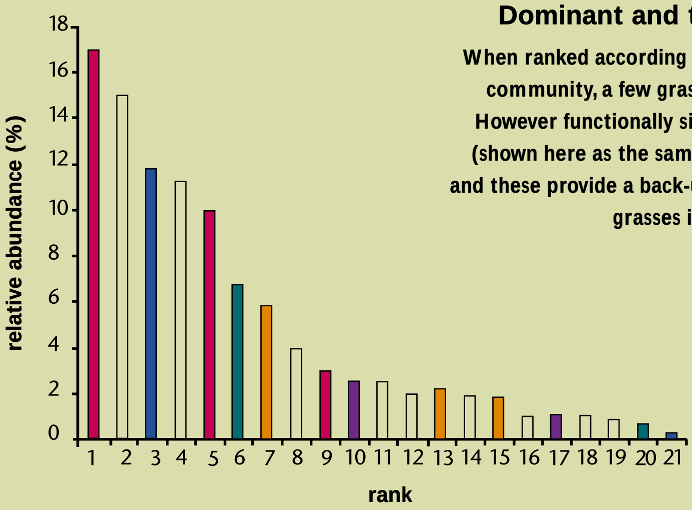
In illustrating this, one commentator pointed out the failure of the three-acre enclosed micro-world known as Biosphere II. It was built in Arizona, in 1991, to re-create nature's life-support services for just eight intrepid residents or 'bionauts'. Despite a price tag of more than $200 million, it was a dismal failure.

'The challenge for us is to price ecosystem services at a meaningful catchment or regional scale, and to work out, for instance, the partial replacement costs of such services due to gradual or marginal loss or change,' Cork says, 'What, say, are the costs and benefits if 50, 70 or 90% of a landscape is cleared of vegetation?'

The team will tap into existing databases and ecological models and explore the use of economic methods such as shadow pricing, contingent valuation and choice modelling.

Cork says once the services are valued and the beneficiaries identified, the research will raise awareness of the links between ecological processes and the economy and, hopefully, have a positive impact on policy and legislation.

Research in rangelands has shown that minor grass species provide insurance for these ecosystems when conditions change. Species diversity confers resilience.



Dominant and tail-end species

When ranked according to abundance in the community, a few grass species dominate. However functionally similar minor species (shown here as the same colour) also occur and these provide a back-up for the dominant grasses if conditions change.

A reservoir of resilience

WHEN Dr Brian Walker and his colleagues in CSIRO Wildlife and Ecology asked themselves why a healthy rangeland has perhaps 20–30 grass species in it – when surely fewer would suffice – they came up with an intriguing hypothesis.

Noticing that most species in a rangeland ecosystem occur in low abundance, while just a few species dominate, they wondered whether the minor species were acting as an insurance policy for the ecosystem. That is, they surmised that the apparently superfluous minor species may act as a back-up for the dominant species.

Their research supports this idea. A handful of abundant grass species in the grazed savanna rangeland communities they investigated make different contributions to the functioning of the ecosystem. It emerged that many of the less abundant minor species are 'functional analogues' of the dominants. That is, one or more of them perform a similar function to a dominant grass species, but respond differently to environmental change or disturbance such as fire, drought or, in this case, grazing. So the minor species can step in for a similar dominant species that may be eliminated or disadvantaged by disturbance, thus ensuring persistence or resilience of the rangeland under different conditions.

In fact, most ecological communities are like our rangelands in having a distribution of species abundance in which a few species make up the bulk of the biomass, with a long tail of relatively scarce minor species. It could be a general rule, say the scientists, that the tail-end species provide a vital 'reservoir of resilience' that assures on-going performance of communities: one of the less obvious benefits of biodiversity.