Winning back the wh

What must change?

Earth is inhabited by 5.4 billion people. This is expected to reach 8.6 billion by 2025. *Nature Conservation 3 : The Reconstruction of Fragmented Ecosystems – Global and Regional Perspectives*, explains that the current food supply could (in theory) feed the present population, given equitable distribution systems and a predominantly vegetarian diet. Meeting these two provisos, however, would require major changes in the attitudes of most people.

Many people believe that humans exist apart from other organisms. A different view of nature is needed: one which acknowledges that humans are part of ecological processes and that there are limits to the changes natural systems can tolerate. The book's editors say this process of education is the responsibility of everyone with a basic understanding of ecology.

Most ecologists and conservation biologists are not involved in the management of natural resources. As a result, much reconstruction is designed by engineers and landscape architects. This must change. Ecologists should commit at least 10% of their time to communicating and working with communities involved in restoration.

Universities should encourage their ecology and biology faculties to research problems central to improving Earth's habitability, the editors say in the book's final chapter. More emphasis should be placed on immediate world problems and their solutions.

Ecologists must also educate politicians about ecological issues and the need for restoration. Ecologists, economists and politicians need to develop integrated views of the future combining ecological and economic principles.

Nature Conservation 3: The Reconstruction of Fragmented Ecosystems: Global and Regional Perspectives *is available from Surrey Beatty & Sons Pty Ltd, 43 Rickard Road, Chipping Norton, 2170 NSW, (02) 602 3888, fax (02) 821 1253. The book costs $78 plus postage.*

Wayne Deeker and Bryony Bennett

Scientists in Western Australia are helping communities to halt land degradation and loss of species in the wheatbelt. They're adopting a management approach in which the goals of conservation and agriculture need not be in conflict.

In 1896, soon after a railway was laid from Northam to Southern Cross, surveyors began drawing squares across the woodland, heath, shrub and mallee country now known as Western Australia's central wheatbelt.

Gold had been discovered at Southern Cross eight years earlier and the government of the day was keen to encourage permanent settlement. Through new legislation the government permitted itself to re-buy, subdivide and sell land within 32 kilometres of a railway. Pastoral leases were terminated and the area cut into farm-sized blocks for cropping: agriculture had begun to take hold.

Nearly 100 years later, scientists at CSIRO's Division of Wildlife and Ecology at Perth are working with landholders and community groups in the wheatbelt to redraw the boundaries of agricultural landscapes. They are developing farm-management techniques designed to sustain yields in the long term and to conserve and enhance remnants of native vegetation as habitats for threatened plants and animals.

This is a research problem common to many parts of the world where clearing for agriculture has fragmented the landscape. On a global scale, we have less than a decade available to halt and reverse the loss of biological diversity and the damage to ecosystems, according to renowned ecologists Paul and Anne Ehrlich. They say a world-wide effort will be needed just to halt the trend of degradation, let alone reverse it and increase productivity in the face of rising human pressures and other global changes.

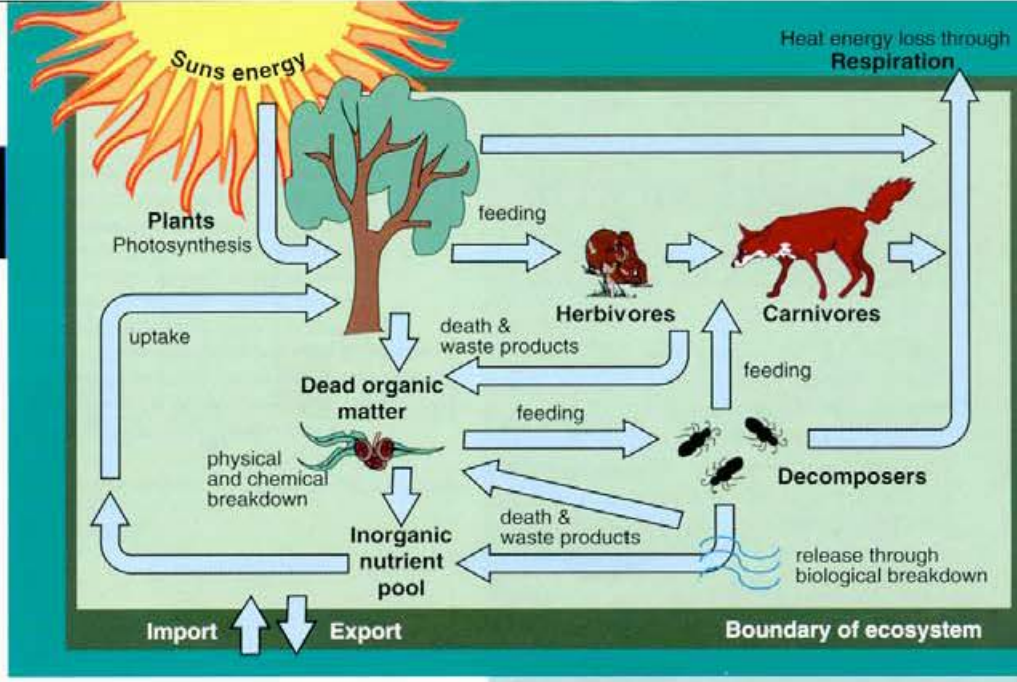
In a new book called *Nature Conservation 3: The Reconstruction of Fragmented Ecosystems – Global and Regional Perspectives*, Anne and Paul Ehrlich outline the dual role of restoration ecologists and conservation biologists in the next decade. They say these scientists may be all that stands between humanity and a biotically-devastated world by the middle of the 21st century.

Paul Ehrlich is Bing professor of population studies and professor of biological sciences at Stanford University, California. He co-edited *Nature Conservation 3* with Dr Denis Saunders and Dr Richard Hobbs of CSIRO's Division of Wildlife and Ecology at Perth. The book contains the papers presented at a workshop held two years ago as part of research begun by the division in 1984 to examine the ecology of remnant native vegetation in cleared agricultural areas. *Nature Conservation 3* builds on material presented at two previous workshops from which came the publications *Nature Conservation: the Role of Remnants of Native Vegetation* and *Nature Conservation 2: the Role of Corridors*.

Ecologists from Australasia, Canada, Finland, Norway, Sweden, the United Kingdom and the United States attended the third workshop. It was held at Tammin, an hour and a half's drive east of Perth in Western Australia's central wheatbelt, an area with severe landscape degradation and an urgent need to revegetate. Tammin has an active Land Conservation District Committee which Saunders says has a 'positive attitude to landscape reconstruction'. The committee helped to organise the workshop and designed a tour of the district. Two local farmers also presented papers.

The choice of venue reflected the workshop's major theme: that scientists must take an active stance on restoration, globally and locally, by interpreting their work to assist

eatbelt



Ecosystem degradation affects the land's ability to support plants and animals. ***(Reproduced with permission from Surrey Beatty Pty Ltd.)***

restoration projects, and by working towards changing people's attitudes to human population growth and resource use.

New practices needed

Agricultural areas were chosen as the focus for the nature conservation workshops for three reasons.

- Agriculture provides the food base for the world's growing population, yet destroys native vegetation and reduces biodiversity.
- Intensive agriculture is a primary reason for land degradation.
- Humans have a bleak future unless agricultural practices that do not degrade the soil can be developed.

There are few areas on Earth where agriculture is practised on a sustainable basis. Energy efficiency, nutrient cycling and soil stability are usually surrendered for short-term gain. To redress this damage, ecologists and conservation biologists need to help design self-sustaining landscapes in which biodiversity and agricultural productivity can be maintained.

It is unrealistic to expect that landscapes can be restored to incorporate all their original elements and functions. The goal should be to create healthy, self-regulating systems that integrate with surrounding landscapes and have structures and functions similar to those of the pre-disturbance system. They will also need to support the human communities dependent on them.

The goals of restoration will dictate the approach to be taken. If the aim is to preserve biodiversity, it will be necessary to preserve and restore the original biota. In many areas this is not possible because of the degree of change from the original state. If restoration is to reverse the processes leading to the degradation of landscapes, the aim will be to preserve and restore ecological functions and processes, as in the restoration of the hydrological balance to prevent further salination of soils in Australian agricultural landscapes. Ideally, restoration should encompass the two aims by preserving the remaining biodiversity and using these species in revegetation programs to restore ecosystem functions.

Restoring the wheatbelt

Human settlement has had a devastating effect on the biological diversity of WA's agricultural landscape. The wheatbelt, which occupies 14 million hectares, has had 93% of its original vegetation removed in the past 100 years. As a result, 24 plant species and 13 native mammals (excluding bats) have disappeared and 38 species of birds have decreased in range and abundance.

There have also been major changes in the hydrological balance and other ecosystem processes. It is estimated that more than 15% of agricultural land in the wheatbelt may become affected by salinity within the next 30 years.

Integrated landscape management, including the development of corridors, is seen by many as the best hope for conserving fragmented habitats and their species.

Integrated landscape management challenges our traditional understanding of conservation. Many of us probably relate the concept of conservation to images of national parks. But in the WA wheatbelt, only 20% of the remaining native vegetation is protected, the rest is on privately-owned land. Many species are not represented in conservation reserves at all. Conservation management can no longer afford to concern only the

Restoring ecosystems

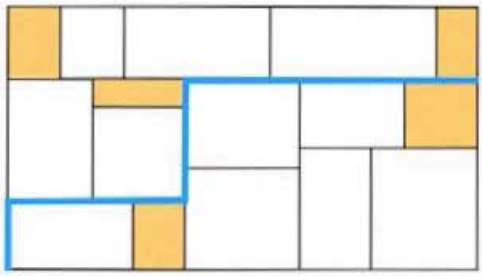
An intact ecosystem contains plants, animals and decomposer organisms which keep the processes of nutrient, energy and water transfers working efficiently.

All life depends on the continued ability of ecosystems to capture and transfer energy from the sun and nutrients from the soil and atmosphere, and the cycling of water. Degradation of the ecosystem leads to the loss of important components and a breakdown of these essential processes. This in turn leads to loss of the ability of the land to produce crops or other products and a lower ability to retain the region's plants and animals.

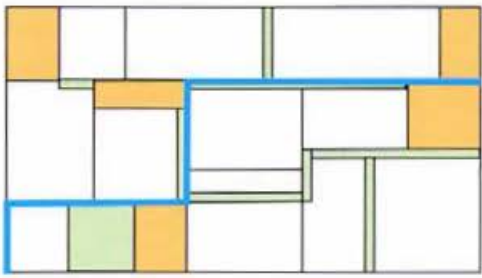
Restoration involves replacing some of the vital components and a breakdown of these essential processes. Revegetation is only a part of restoration. Replacement of plants alone may not result in the redevelopment of a working ecosystem if other parts are not reinstated or do not colonise subsequently.

The goal of restoration is to create healthy, self-regulating systems; some that are as similar as possible to the original system to create habitat for native species; and others with characteristics which allow sustainable production. The ultimate test is to restore degraded areas in such a way that these two types of system can co-exist with the remnants of the original ecosystem to their mutual benefit.

Expanding habitats



(a)



(b)

Corridors are strips of native vegetation that link at least two formerly-joined vegetation remnants, effectively increasing reserve sizes. They are believed to have a number of ecological functions such as facilitating movement of biota — mainly animals — between remnants. This allows fauna populations in a remnant-network to function as a single large population, called a metapopulation.

Movement among patches enhances gene flow, which helps prevent the genetic consequences of isolation. In general, the greater the degree of connectiveness, the greater a metapopulation's chance of survival.

Mammal populations need freedom to move for other reasons too. If local extinction occurs in one habitat remnant, connection with other remnants has been shown to enable recolonisation. Also, many mammals and birds require at different times a diversity of habitats that a single reserve may not contain.

A corridor network exists in WA, but it is not extensive enough, and much of it is in poor condition. Corridors are even more subject to habitat degradation than remnants because their narrowness makes them prone to edge effects and to physical degradation.

To cater for the needs of many species, corridors that are several hundred metres wide may be required, much wider than most are now. Nevertheless, there is an urgent need for active management to prevent the inevitable degradation of existing corridors and remnants. If they degrade too far, or disappear through clearing, they will take most species with them.

Corridors facilitate the movement of animals between vegetation remnants.

landscape patches set aside for conservation.

On-farm conservation is likely to be met with enthusiasm by land owners only if sympathetic with production goals. This means developing methods that maintain sustainable production but at the same time enhance the conservation network of an area.

Integrated management

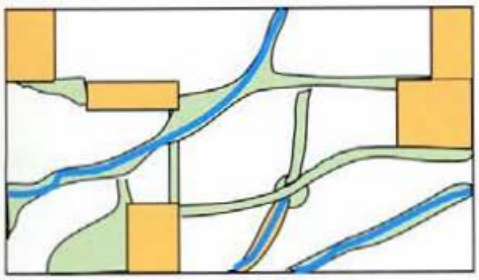
Saunders and Hobbs say it is pointless to manage vegetation remnants in isolation from each other or from the surrounding agricultural land. It cannot be assumed that problems stop at reserve borders. Given that no large reserves will be declared in future, and that the existing ones are too small, a network of reserves, connected by corridors (see box story), is the only way to ensure the long-term viability of habitat fragments. Networks can support more species than any single reserve just because of their total area, and because they represent more habitats than any single reserve.

At present, agricultural land and remnants are managed separately, and they are both degrading simultaneously, while different managers pursue different goals. Saunders and Hobbs say the goals of conservation and agricultural management can be complementary, but adequate management of both systems requires managers to work together, setting common goals. Conservation management must be firmly linked with agricultural management which seeks to reduce or reverse landscape degradation.

Solutions to agricultural problems can help to alleviate the problems of habitat and species loss. Revegetation is important in controlling waterlogging, salinity and wind and water erosion, each of which causes production losses in the WA wheatbelt. With adequate planning and complementary management techniques it should be possible to carry out revegetation which controls land degradation and also serves ecological functions.

For example, revegetation can be sited closer to existing vegetation to serve at least as a buffer zone between the remnant and the surrounding agricultual land. Use of native species in revegetation will also increase the conservation benefit. Windbreaks can be designed so that they can link isolated remnant areas and allow faunal movement. **Figure 2b** shows the sort of enhancement of the conservation network that is possible using these methods. **Figure 2c** goes further in an attempt to return the landscape to a subdivision based on natural features.

Implementing these procedures will help to make agriculture and nature conservation sustainable, but it will



(c)

Current and potential nature conservation networks in the wheatbelt: (a) current network consisting of a nature reserve, remnants on private land and a road verge; (b) potential network after revegetation for salinity and erosion control, based on existing rectangular grid; (c) potential network after revegetation based on natural landscape features such as soil types and drainage lines. *(Reproduced with permission from Elsevier Editorial Services.)*

Existing remnant vegetation

Revegetation

Drainage channels

require co-operation between different managers and owners, some of whom will have conflicting goals. Also, many problems have to be tackled at a regional or catchment scale, but be implemented on individual farms.

To be successful, integrated management depends on communication between managers and a method for developing mutually-acceptable compromises. On a small scale, this is often possible through adequate discussions. At a wider level, a more structured approach may be required, involving conflict resolution using land-use planning models and decision-support systems such as LUPIS (see page 28).

In the WA wheatbelt it is likely that workable solutions can be found. This is mainly because of the development of a strong land care movement and the formation of Landcare groups. With expert advice, these groups can develop solutions to local problems, taking a landscape-level approach. Ownership of the problems and solutions at a local scale is the key to success.

Unless action is taken soon, a large number of species will become extinct because their habitats will degrade. These events are preventable, Saunders believes, provided that the financial and other resources to upgrade Australia's remnant network become available.

The costs of restoration will be considerable. Saunders and Hobbs believe the whole community should bear these, and adequate resources and incentives need to be made available. The costs of not restoring will be much higher, and so far those costs have been deferred to future generations.

Achieving conservation

Foremost among management issues is the need for more information. Management decisions are presently made with little scientific basis. The first thing to do, Saunders says, is to develop regional inventories so that the location and condition of corridors and remnants can be assessed.

Saunders and Hobbs have also highlighted a need for basic ecological information about corridors and remnants. Which species are using the corridors, and which demographic groups? What is the exact extent of habitat degradation in vegetation remnants? Which invertebrates are present in the corridors?

When this information is gathered, it can be used to assess the conservation value of remnants, a first step in developing detailed management plans, and to identify the minimum conservation requirements. But such studies will take time, and long before the evidence is available, the habitat remnants will have degraded further.

Saunders says there is insufficient time to wait for such studies to be completed. He calls for the immediate protection of all habitats of potential conservation significance, saying that it is far better to conserve something without knowing exactly how it works than to lose it and discover that it was vital.

See Ecos 77 *for Wayne Decker's first article on habitat fragmentation.*

Scientists are developing farm-management techniques to help rural communities restore their degraded landscapes.

Birds in the bush

Little is known about the distribution and abundance of Western Australia's native biota, or about the basic biology of many species. But this information is crucial to the future management of the region's fragmented landscapes.

In 1987, residents of the central wheatbelt were given their chance to help. A community bird atlassing scheme was set up by the Division of Wildlife and Ecology in which 187 people recorded the presence of birds in their area. This information was compared with historical records to examine the changes in species distribution and abundance, and to establish the effects of changing land-use on native birds.

The results indicated a dramatic reduction in the range and/or abundance of a large proportion of the birds of the wheatbelt. Scheme organiser, Dr Denis Saunders, was not surprised by the gloomy findings considering the extensive clearing of native vegetation that has taken place.

'As research biologists we need to do more than just catalogue the demise of our biota. We need to get out into the community and convince the populace that they have a conservation problem that requires attention now,' Saunders says.

'By involving people in collecting data on the birds in their area they are made aware of their biota and of what they stand to lose if the degrading processes operating at present are not controlled.'

When land was released for agriculture, it was classed on the basis of the vegetation associations, with woodland being indicative of good agricultural soil. As a result, woodland areas have been selectively cleared and those species dependent on woodland for nest sites and food have suffered a major decline. The purple-crowned lorikeet, rufous tree-creeper and yellow-plumed honeyeater are examples. The yellow-plumed honeyeater was once the most abundant honeyeater in the wheatbelt. It has undergone a catastrophic decline in the past 50 years.