# Notes and Abstracts

## RAINFOREST

### 1.8

**Land clearing and forest rehabilitation in the Wet Tropics of north Queensland, Australia.** Peter D. Erskine (Rainforest Cooperative Research Centre, Department of Botany, University of Queensland, St. Lucia, Qld 4072, Australia. Email: p.erskine@botany.uq.edu.au)
[Peer reviewed]

Key words: *forest regrowth, forest rehabilitation, land clearing, world heritage.*

**Introduction.** Queensland has accounted for more than 60% of the land clearing in Australia over the last 30 years and there is continuing evidence that the rate of land clearing in Queensland is increasing (Queensland Department of Natural Resources 2000). State legislation (Vegetation Management Act 1999 and Vegetation Management Regulation 2000) and federal legislation (Environment Protection and Biodiversity Conservation Act 1999) may limit the destruction of endangered vegetation types, habitats and species in Queensland. However, a number of issues surrounding compensation and enforcement of this legislation continue to be debated by different levels of government and it is still unclear how effective it will be in the short term. Indeed, this uncertainty appears to be one of the driving forces behind Queensland's ever increasing land-clearing rates. Against this background it appears an appropriate time to review the land clearing situation in one of Australia's most biologically rich regions, the Wet Tropics of north Queensland.

**The Wet Tropics.** The wet tropical biogeographic region is extremely diverse, containing around 3000 plant species, 50% of Australia's bird species, a large proportion of Australia's invertebrate species and numerous endemic vertebrate animal taxa (Goosem *et al.* 1999). Approximately one-quarter of the bioregion was cleared during the 20th century, and most of the accessible forests were logged (Winter *et al.* 1987).

To protect the remaining biodiversity and in recognition of the region's global significance, the Wet Tropics World Heritage Area (WTWHA) was declared in December 1988. A common public perception was that this declaration, extending over a large area of Australia's Wet Tropics, has protected the region's ecosystems for perpetuity. However, about 40% of the remaining forests in the bioregion are not under formal conservation protection and 41 of the 105 recognized regional ecosystems are still considered threatened, having been reduced to less than one-third their original area (Winter et al. 1987; Goosem *et al.* 1999). Goosem *et al.* (1999) state that continued land clearing is one of the main threats to the ecosystems and species in this region.

**Rates of land clearing, regrowth and forest change in the Wet Tropics.** Recent assessments by the Statewide Landcover and Trees Study (SLATS) indicate that, in contrast to Queensland generally, clearing rates in the Wet Tropics have decreased by more than 60% over the past decade; from nearly 3600 ha/year in the early 1990s to less than 1300 ha/year in 1999 (Queensland Department of Natural Resources 1999a, 1999b, 2000). Most of this clearing has occurred for crop production outside of the World Heritage Area, however 90 ha has been cleared inside the WTWHA (Wet Tropics Management Authority 1999). The overall loss in forest cover was almost 20 500 ha between 1991 and 1999.

In contrast to this clearing, some forest regrowth has also occurred on previously cleared land. New forest regrowth accounts for approximately 15% of the area that was cleared and average rates of new regrowth were around 400 ha/year between 1991 and 1999 (Queensland Department of Natural Resources 1999a, 1999b, 2000).

**Forest regrowth versus rehabilitation in the Wet Tropics.** Working in the opposite direction to land clearing, and alongside natural forest regeneration, are forest rehabilitation efforts by humans. Forest rehabilitation in the Wet Tropics has been carried out by several organizations including the Wet Tropics Tree Planting Scheme (WTTPS), the Community Rainforest Reforestation Program (CRRP), NQ Afforestation Association (NQAA) and the Centre for Tropical Rehabilitation (CTR) in cooperation with a local community-based tree planting organization, Trees for the Evelyn & Atherton Tablelands (TREAT). A survey of these organizations indicates that works aimed at revegetating more than 3100 ha of cleared land have been conducted since 1991 (Table 1). As the satellite imagery used by SLATS cannot distinguish between natural forest regeneration and small-scale reforestation works (T. Danaher, pers. comm., 2001); much of what some may interpret as 'regrowth' occurring in the region since 1991 might be attributable to forest rehabilitation works rather than natural regrowth.

**Success and costs of rehabilitation.** Short-term survival rates for trees planted by the CRRP were estimated to be 85% (Vize & Creighton 2000) and over 90% for CTR (N. Tucker, pers. comm., 2001). The CRRP sites generally have much lower tree planting density (400–1700 stems/ha) than the

**Table 1.** Types, areas and costs of forest rehabilitation conducted in the Wet Tropics from 1991 to 2001

| Style of rehabilitation | Organization | Area planted (ha) | Approximate cost |
|---|---|---|---|
| Farm forestry (mixed species cabinet timber) | CRRP | 2000 | \$5000–10 000 per ha |
| Habitat restoration | WTTPS/NQAA | 1000 | \$15 000–25 000 per ha |
| | CTR/TREAT | 120 | \$15 000–25 000 per ha |
| Total | | 3120 | \$27 000–48 000 000 |

Sources: Vize & Creighton 2000, S. Vize, pers. comm., 2001, N. Tucker pers. comm., 2001.

restoration type plantings of the other organizations (2500–4000 stems/ha). Therefore, the CRRP may have rehabilitated the largest area in the Wet Tropics (Table 1) but the sites generally have an open canopy and retain a grassy understorey for many years. Initial biodiversity surveys suggest that the habitat restoration plantings have greater biodiversity benefits than the CRRP plantings (C. Catterall, pers. comm., 2001). However, there has been no systematic assessment of the long-term success or otherwise of most rehabilitated areas, although there are published accounts and ongoing monitoring of a few restoration sites by the CTR (e.g. Tucker & Murphy 1997; Tucker 2000). In addition, the satellite imagery used in SLATS cannot determine the quality of the natural forest regeneration that has occurred, nor estimate the coverage of exotic woody weeds that may impede successful rainforest recovery. Success criteria for rehabilitated sites and regrowth sites should therefore become a priority area of research in the near future to demonstrate whether rehabilitation efforts have effectively reconstructed forests or enhanced remnant rainforests.

Tropical forest reconstruction costs between \$5000 and \$25 000 per ha (Table 1). Cost variations are the result of different site preparation treatments, seedling propagation, species chosen, planting densities, weed removal and long-term maintenance of a site. On this basis, the area that has already been rehabilitated in the Wet Tropics has probably cost more than \$27 000 000 (Table 1). The cost of natural forest regrowth in the region has not been estimated but it would be relatively small in comparison.

**Discussion.** The data presented here indicate that clearing rates in the Wet Tropics have decreased during the 1990s, although rates of clearing still far exceed rates of reforestation and regrowth. The new state and federal legislation and the precision of satellite images will make it more difficult for people to continue to actively clear threatened ecosystems, although the majority of ecosystem types in the region can continue to be cleared under the present legislation. To maintain the viability of many ecosystems and species in the Wet Tropics it is likely that forest rehabilitation will have to occur on a much larger scale to improve the forest cover in over-cleared catchments, and to connect and enhance remnant forests.

Currently, there appears to be more land in need of rehabilitation than there is money for rehabilitation works (S. Vize, NQ Afforestation Association, pers. comm., August 2001) and most of the funding for rehabilitation efforts currently comes from government sources. The Natural Heritage Trust has provided much of the funding for tree planting since 1997 but it is unlikely to last over the long term. This raises two obvious questions: (i) to what extent should replanting, rather than simply assisting natural forest regrowth, be used to rehabilitate degraded land, and (ii) who should fund the rehabilitation needed throughout the Wet Tropics (e.g. should the industries that have gained financially from land clearing pay for the increased need for forest rehabilitation?)?

Regrowth occurs naturally in areas protected from disturbance across the Wet Tropics and the costs for this type of rehabilitation are generally small. Promotion of this is desirable, but at the same time, planting programs are necessary as many areas are heavily weed infested with species such as guinea grass (*Panicum maximum*) resulting in a state of 'arrested succession' whereby native tree species are unable to become established. Other areas are too remote from seed sources to become reforested through natural processes. Areas such as these that have been identified by planning studies as a priority for rehabilitation (i.e. because they could become important corridors for endangered native animal species), will require tree planting and weed treatment to ensure that suitable habitat becomes established.

To pay for the reinstatement of forest in priority areas — by both fostering regrowth and replanting — the implementation of a green tax on Australian industries that have cleared forest could be one solution. A small tax on sales from the sugar, banana and dairy industries would raise a considerable amount of capital to implement on-ground rehabilitation efforts in the Wet Tropics. On the other hand, much of the freehold land for rehabilitation is only available because landholders are supportive of such efforts. The willingness of farmers to invest their land, time and money in rehabilitation efforts may be compromised by an additional tax on their industry. Furthermore, most of the clearing in the Wet Tropics was actively encouraged by the government of the day and the broader community has presumably gained financially from these industries. Perhaps the rehabilitation costs should be borne by the broader community either through increased incentives for landholders to rehabilitate land or through more direct funding of community-based organisations? Further demonstration of the success or otherwise of tree planting activities and the pursuit of cheaper methods, such as assisted natural regrowth, need to be addressed by these organizations to ensure that the limited funds available for rehabilitation are effectively used.

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## 1.9

**Trial of shelter poles to aid the dispersal of tree-kangaroos on the Atherton Tablelands, north Queensland.** J. Kanowski[1] and N. I. J. Tucker[2] ([1]Rainforest Cooperative Research Centre, Environmental Studies, Griffith University, Nathan, Queensland 4111, Australia; [2]Queensland Parks and Wildlife Service, Centre for Tropical Restoration, P.O. Box 21, Yungaburra, Queensland 4872 Australia) [Peer reviewed]

Key words: *arboreal mammals, artificial shelters, rainforest.*

Artificial habitat structures, such as poles, platforms and nest-boxes, have long been part of the management of captive animals. Only in the last few decades have these structures been widely used in the conservation of wild populations, to provide habitat features that are not easily or rapidly restored to a site by natural processes. For example, nest-boxes may allow reforested sites to be colonized by hollow-dependent fauna, which otherwise would have to wait decades or centuries before suitable hollows formed in senescent trees (Menkhorst 1984). Artificial structures can also restore certain ecological functions to sites where revegetation is impractical. For example, tunnels, overhead bridges and other structures are increasingly used to facilitate the safe dispersal of wildlife across roads (Goosem *et al.* 2001).

Lumholtz's tree-kangaroo (*Dendrolagus lumholtzi*) is a distinctive arboreal marsupial endemic to the rainforests of north Queensland. The species is listed as rare under state legislation. Much of its prime habitat — upland rainforests on fertile soils — has been cleared for agriculture over the past century, although the species is still relatively common within remnant patches of rainforest on the Atherton Tablelands (Kanowski *et al.* 2001). However, population sizes in most remnants are small. The majority of remnants on the tablelands are less than 5 ha in size (Collins 1994) and population densities are unlikely to exceed one to two individuals per ha (Newell 1999). Assuming that small populations are at high risk of local extinction (e.g. from in-breeding or catastrophe), the long-term persistence of tree-kangaroos in remnant forests on the Atherton Tablelands will depend on the continued dispersal of animals across the agricultural landscape.

Tree-kangaroos are capable of traversing long distances across grassland, but they are vulnerable to predation by dogs in open country (Newell 1999). For this reason, the dispersal of tree-kangaroos between remnants is probably assisted by corridors of vegetation (Laurance & Laurance 1999). While considerable effort has been put into planting rainforest corridors between remnants on the Atherton Tablelands, much of the revegetation effort has targeted steep creek banks and other unproductive areas on farms (Tucker 2000). Because landholders are less willing to revegetate productive land, a number of remnants on the tablelands are likely to remain isolated from other areas of rainforest for the forseeable future. In such cases, it has been proposed that artificial trees, or 'shelter poles', might aid the dispersal of tree-kangaroos between remnants (Schmidt *et al.* 2000). Shelter poles would provide refuge from dogs and, when installed in a row, would help channel dispersing animals between remnants.

In December 2001, a trial of shelter poles was established as part of the Anderson Road Landscape Linkage project, near Malanda (Fig. 1). This project aims to re-establish a corridor of native vegetation along a creek which runs for 2 km between forest remnants at Peeramon Scrub and the North Johnstone River. While much of the riparian area has reverted to regrowth or has been revegetated under the project, several hundred metres of relatively flat riparian land remains under pasture on the lower reaches of the creek. This break in the corridor was chosen to trial the shelter poles. Four poles were erected at 30–40 m intervals adjacent to the creek, providing a disperal

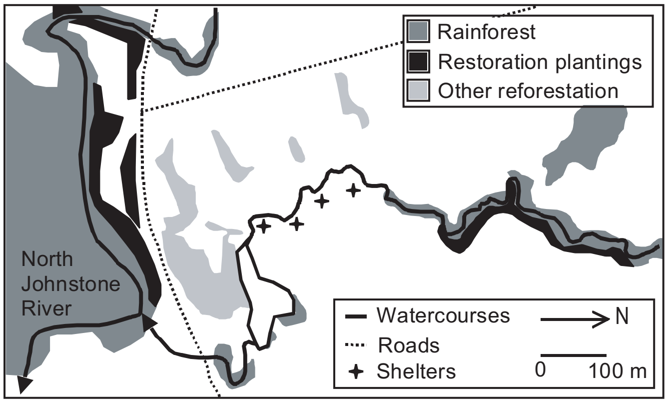


**Figure 1.** **Location of shelter poles in relation to remnant rainforest and restoration plantings undertaken by the Anderson Road Landscape Linkage project and Wet Tropics Tree Planting scheme.**

route between regrowth vegetation on the creek and a row of exotic pines that lead to riparian vegetation on the North Johnstone River.

The shelters were made from old electricity poles (Fig. 2). Cross-bars were bolted to the poles 5 m above ground level for tree-kangaroos to rest on, above the reach of dogs. The shelters were covered with mesh to provide shade for animals stranded in the poles during the day. The design of the shelters was based on the known preferences of Lumholtz's tree-kangaroo for climbing and resting substrates (Procter-Gray 1985). The dimension of the poles (30–40 cm diameter) was at the upper end of the size class of stems climbed by tree-kangaroos in the wild. To assist climbing, the lower section of each pole was roughened with a chainsaw while a length of large-diameter rope — an artificial vine — was draped over the top section.

The project was completed in 1 week and cost $600, although some of the materials, all labour, tools and specialist equipment were donated to the project. Each shelter took two workers nearly a day to complete. If all inputs were charged at current rates, the cost of each shelter would be in the order of $200–300 in materials and a similar amount in labour.

**Figure 2.** **A shelter pole designed to provide safe and shaded resting points for tree-kangaroos crossing open paddocks.**

The trial will be monitored to determine whether the shelters are used by tree-kangaroos. At best, use is likely to be episodic, as dispersal among tree-kangaroos is largely restricted to the period when sub-adults leave their mothers to establish a territory (Procter-Gray 1985; Newell 1999). However, even occasional use of the shelters by tree-kangaroos should be detectable from their distinctive scats and scratches. If the trial is successful, shelter poles could be used more widely on the Atherton Tablelands to aid the dispersal of tree-kangaroos in areas where landholders do not wish to plant trees, or to provide temporary refuge in young restoration plantings.

The major problem with the shelter-poles is likely to be their limited lifespan, perhaps 5–10 years. A more permanent solution to the problem of assisting tree-kangaroos to disperse across the agricultural landscape in places where corridors are unacceptable, would be to plant individual trees or rows of trees in paddocks. This is already a widespread practice among landholders on the Tablelands, many of whom have planted rows of hoop pine (*Araucaria cunninghamii*) as windbreaks.

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## WETLAND

### 3.9

**Floodplain wetlands of the Gellibrand estuary: What type of invertebrate community?** Belinda J. Robson, John Sherwood, Shanaugh F. Mckay and Lauren M. Kelly. (School of Ecology & Environment, Deakin University, PO Box 423, Warrnambool, Vic 3280. Email: brobson@deakin.edu.au) [Peer reviewed]

Key words: *bar-built estuaries, floodplain, macroinvertebrates, wetlands.*

**Introduction.** Along the south coast of Australia, wetlands on the floodplains of lowland rivers and estuaries have been severely altered by agriculture and urbanization. Efforts to restore or rehabilitate these wetlands are hampered by insufficient knowledge of the original condition of these wetlands, or their variability in time and space. This research describes the macroinvertebrate community of wetlands on the floodplain of the Gellibrand River and estuary, which has suffered comparatively few human impacts. The aim of the research was to describe the variability of macroinvertebrate communities as a baseline for the future management of these wetlands, and to contribute to the general understanding of estuary-floodplain wetlands, thereby improving the basis for their management.

The Gellibrand River has a catchment area of approximately 1200 $km^2$ draining the western slopes of the Otway Ranges, and entering the Southern Ocean at Princetown. From a mean annual flow of 315 000 mL, 25 000 mL are removed per annum for agricultural and domestic use (O'May & Wallace 2001), and flows are closer to natural regimes than most other Western Victorian rivers. The estuary is a bar-built, salt-wedge estuary that becomes completely blocked by the sand bar in most years, during summer and autumn. Over past decades, the estuary mouth has been opened artificially in most years, to prevent flooding of agricultural land and roads adjacent to the wetlands. At its maximum, the salt-wedge penetrates approximately 10 km upstream from the river mouth, but the estuary may also be completely fresh during high winter discharge (Mckay 2000).

The wetlands surrounding Princetown cover 119 ha and are listed as nationally important (Environment Australia 2001). This listing regards the wetlands as an important habitat for animals at vulnerable stages of their life cycle and a refuge from adverse conditions, such as drought. They are a good example of coastal brackish and freshwater marshes, with an important ecological and hydrological role as part of a large wetland complex.

**Methods.** Four locations within the wetlands were sampled: in the wildlife refuge and adjacent to the Princetown football oval (approximately 2 km upstream from mouth), on the floodplain of LaTrobe Creek (tributary of Gellibrand approximately 1 km from mouth) and on the northern floodplain of the river (approximately 9 km from the estuary mouth). All locations were partially covered by submerged or emergent vegetation but samples were located randomly regardless of the presence or absence of vegetation. Six samples were taken from each location in September and December of 1999 and February, May and August of 2000, except for the upstream site, which was dry in February and May. Samples were taken by sweep netting for a distance of 5 m over 30 s (mesh size 250 μm) and were preserved in 70% ethanol. In the laboratory, samples were sieved into >1 mm and 0.25–1.0 mm fractions and all invertebrates counted and identified to the lowest taxonomic level possible (polychaetes, oligochaetes and Cladocera were not identified further, copepods were identified to Order). The 0.5 mm fraction was often sub-sampled volumetrically, with at least 10% of the sample processed. Salinity was also measured at each location during sampling.

The level of similarity of macroinvertebrate communities between locations and months was calculated (Bray-Curtis similarity and non-metric MDS ordination (Clarke & Warwick 1994)) and the significance of differences in the composition of these communities between locations and months was determined (two-way crossed ANOSIM on data set minus the upstream wetland; 20 000 permutations per randomization test). The taxa responsible for these differences were identified (SIMPER routine, Clarke & Warwick 1994).

**Results.** The Latrobe Creek wetland was the most saline location, ranging from 17 to 21 p.p.t. in September–February and 3.3 to 10 p.p.t. in May and August. The wildlife refuge and football oval locations were fresher, ranging from 7 to 10 and 6.5 to 8 p.p.t. respectively in September–February and 2.7 to 3.3 and 4.2 to 5 p.p.t. in May and August. The upstream floodplain wetland was dry in February and May, but was fresh in both September–December (0.5–1 p.p.t.) and August (0.6 p.p.t.).

The macroinvertebrate fauna of the Gellibrand wetlands is predominantly a freshwater wetland fauna, characterized by insects (73% of taxa) and crustaceans. Sixty-seven distinguishable taxa, from 39 families were collected. The most abundant taxa across all sites were amphipods, hemipterans, calanoid copepods, chironomid larvae and ostracods (three genera). More than 20 species of aquatic beetles (Coleoptera) were found and seven species of dragonfly nymphs (Odonata). Water mites, various dipterans, aquatic moth larvae and the shrimp *Paratya australiensis* were also relatively common. The pond snail *Potamopyrgus antipodarum* was also very abundant and the only feral species found. Polychaetes were only found at the Latrobe Creek wetland.

Considerable location-to-location and month-to-month variation was observed in the Gellibrand wetlands. The invertebrate community differed between all locations (ANOSIM $R = 0.823$; $P < 0.001$) and months ($R = 0.745$; $P < 0.001$). The upstream floodplain wetland showed the most within-location variation and the most month-to-month variation of all the sampling locations (Fig. 1), and was also the only site to dry out. The invertebrate community differed as much between September and

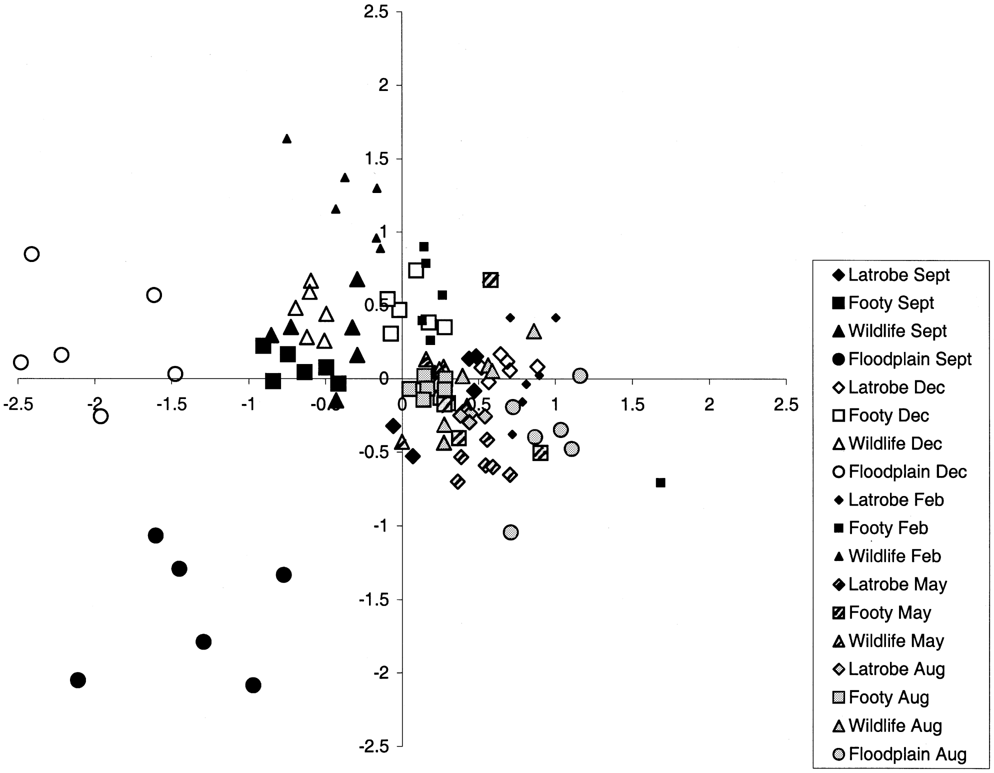


**Figure 1.** MDS ordination of macroinvertebrate samples for each location and month sampled. Stress = 0.19. Samples close together on the graph have more similar macroinvertebrate communities than those placed further apart.

December as it did from the other sampling locations. This wetland in September and December also differed the most from the other wetlands because it had fewer calanoid copepods, ostracods and amphipods (Eusiridae) than the other locations, which were dominated by these taxa.

The Latrobe Creek wetland differed from the others in all months but August and May. This location had more *P. antipodarum,* calanoid copepods and amphipods (Eusiridae) and fewer chironomid larvae, cladocerans, *Megaporus* larvae (Coleoptera) and *Sigara* sp. (Hemiptera) than the other locations in September, December and February. Some month-to-month variation was observed in the wetland in the wildlife refuge and next to the oval, but these communities were similar in all months except August.

In August, all wetlands were similar, and they were also similar to the Latrobe Creek community at all other sampling times. SIMPER analysis showed that the August samples had fewer cladocerans, *Megaporus* larvae, *Paranisops* sp. and *Sigara* sp. than samples from the other months. There were also more calanoid copepods, amphipods (Eusiridae), chironomid larvae, Lestidae sp. 2 larvae (Odonata) and *P. antipodarum* in August.

**Discussion.** The predominantly freshwater character of the macroinvertebrate fauna of these wetlands was not an expected result. Locations close to the river mouth were expected to have an estuarine fauna. The salinity measurements show that all locations except the floodplain wetland were brackish, and Latrobe Creek was quite saline over summer (but still much lower than seawater 35 p.p.t.). The vegetation of the wetlands also indicated that Latrobe Creek was the most saline site, containing *Sarcocornia quinqueflora* (beaded glasswort) which is a typical saltmarsh plant. Vegetation at the wildlife reserve and football oval locations were dominated by *Chara* sp., *Triglochin* sp, and *Phragmites australis*. The upstream floodplain location was dominated by *Triglochin* sp. several *Cyperus* species and flooded pasture grasses (Kelly 2000).

The Gellibrand wetlands contained more taxa than a seasonally flooded marsh habitat in California (67 *vs* 29: de Szalay & Resh 2000) although salinities were similar. In both cases, the fauna was dominated by insects, but the Californian marsh had large numbers of Diptera, followed by Hemiptera and Coleoptera. Crustacea were uncommon but this may have been an artefact of the sampling (de Szalay & Resh 2000). de Szalay and Resh (2000) suggested that these results may have been influenced by the seasonal hydrology, warm summers or brackish water. The different results from the Gellibrand wetlands, which also show all these attributes, suggest that this is not the case.

The fauna of the Gellibrand wetlands has much more in common with the fauna of other Australian temperate coastal wetlands (with salinities <3 p.p.t.). For example, the coastal wetlands studied by Balla and Davis (1995) had between 80 and 110 taxa collected over a similar time period, but with more intensive sampling. Those wetlands were also numerically dominated by calanoid copepods, amphipods (Ceinidae), ostracods and cladocera and the most diverse group was also the Coleoptera. Hemiptera and Odonata were also species-rich groups.

The similarity between the Gellibrand floodplain wetlands and other freshwater wetlands may be, in part, related to the pattern of stratification in the estuary. The estuary has a deep (4 m on average) rectangular channel, separated from the wetlands by a levee bank. It stratifies by salinity both when the mouth is open and when it is closed, with a freshwater layer (1–2 m deep) at the surface (Mckay 2000; Kelly 2000). It is this freshwater layer that spreads into the wetlands throughout the year. Nevertheless, the salinities in these wetlands are higher than would be expected for a freshwater fauna.

The seasonal variation observed in the macroinvertebrate fauna of the Gellibrand wetlands is typical of wetlands with marked hydrological fluctuations (Balla & Davis 1995; Bechara 1996; Quinn *et al.* 2000). In this case, there appears to be a group of animals (characterized by calanoid copepods, amphipods and *P. antipodarum*) indicative of all locations in August and the Latrobe Creek wetland in all months sampled. August is a period of high river flows, lower salinities and cold weather, which may reduce the abundances of other macroinvertebrate taxa. High water levels in other freshwater floodplain lakes have been shown to increase the similarity between wetlands (Bechara 1996), and also to remove the differences between permanent and temporary wetlands (Quinn *et al.* 2000).

These results suggest that in the process of restoring or rehabilitating coastal river or estuary floodplain wetlands, the hydrological regime of the wetlands should be taken into account. Such wetlands may have more characteristics of freshwater than of saltmarshes, depending on the extent of river and tidal flows, and wetland morphology. Rehabilitation efforts will need to be tailored to either salt or freshwater marshes, and the relative success of these efforts will need to be examined using different standards for ecosystem health, if based on macroinvertebrate communities.

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## 3.10

### Salinity risk management for a rare wetland (Western Australia).

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Key words: *groundwater, surface water salinity, threatened ecological community, wetland.*

In this paper, we present information on a threatened wetland which is only one of two known examples of its type. Information presented relates to its ecological value, methods used to identify threatening processes, as well as some of the actions being taken (through a partnership between landholders, government conservation agencies and community groups), to attempt to protect the wetland from degradation.

Seasonal freshwater wetlands dominated by extensive stands of Swamp Sheoak (*Casuarina obesa*) and Swamp Paperbark (*Melaleuca strobophylla*) were once widespread in the Western Australian agricultural zone. Until recently there was only one known extant example (Toolibin Lake, 420 ha) owing to the degradation of the rest by secondary salinity and/or water-logging (Froend *et al.* 1987). A recovery team was established in 1993, and a full recovery plan completed and endorsed in 1994. Implementation of the plan has continued since that date. Partly as a consequence of the publicity of actions on Toolibin Lake, another occurrence of this wetland type was located on one privately owned agricultural property in 1996, 200 km to the north.

This small perched wetland (20 ha) as yet unnamed, occurs adjacent to a tributary of a creek that has become saline (total dissolved salts ranging from 400 to 760 mS/m) from a major breakout of surface salinity approximately 16 km upstream. This creek flows into a lake that has become saline in recent decades. Although this process is now under control in the creek, there are other areas of surface salinity in the creek catchment.

**Threatening processes identified.** Three major threatening processes were therefore identified for the second wetland by the landholders and the WA Department of Conservation and Land Management's Threatened Species and Communities Unit (WATSCU). These were the input of saline surface water as well as increased salinity and waterlogging potentially resulting from rising groundwater. While the wetland appears to be as yet unaffected by salinity and waterlogging, the presence of early warning indicators (i.e. tree deaths, lack of recruitment, invasion by exotics and colonization by chenopod species) are being closely monitored. WATSCU, in consultation with the landholders, has written an interim recovery plan for the wetland with the main objective of reducing its rate of degradation by clarifying the operation of the threatening processes, quantifying the impacts, and developing and implementing solutions.

Three hydrological pathways capable of bringing salt into the wetland were identified. These are discussed below, along with actions to address each of them.

*Overland flow from the creek line.* Annual rainfall for the area is 365 mm, with 270 mm of this occurring in the half year from May to October inclusive. The first rains after a sustained dry spell pick up salt from breakouts of surface salinity upstream and wash it into the creek, making its water saline. This potential threat was foreseen by the landholders who erected a low earthen diversion barrier that diverted water back to the main creek. However, in heavy rainfall events, the barrier was breached. At the same time, the earthen barrier causes very long periods between inundation and the wetland does not fill sufficiently for the health and adequate regeneration of the lakebed community. An adjustable diversion barrier (designed by one of us (CDW) and erected at the landholders' expense), coupled with a low deflection bank and channel, will now allow the management of the saline creek water even during storm events and the capacity to direct fresh water into the lake.

*Throughflow from the creek line.* Throughflow is the sideways movement of groundwater in a profile. In the low gradient sections of the creek, recharge of groundwater into the profile will occur during flood conditions. Where this occurs near the wetland, it would create a pressure gradient in groundwater towards the wetland.

Shallow monitoring bores have been installed that provide a means of investigating the magnitude of the throughflow process. Two bores have been installed to 4.5 m depth, with a 2 m length of slotted (permeable) casing at the lower end. These were installed in the halophyte chenopod shrub zone, on the fringe of the wetland, and at different distances from the creek. If monitoring of these two bores shows a consistent gradient in their waterlevel, with the gradient falling away from the creekline, a throughflow problem could be anticipated. This might be capable of being ameliorated by planting deep-rooted vegetation, for example.

*Development of groundwater pressure beneath the wetland.* The wetland and creekline are located over a larger geological feature known as a paleochannel. This is the depositional plain of a larger river system. This river system has become a string of lakes as climate has become more arid and in-fill of its valley has proceeded. The depositional process varies over time with water transport sorting materials on particle size and other properties. Occasional hardened and less water-permeable layers can develop as flat beds. Coarser materials are deposited from a mobile dune entering the water course or a section of rapid river flow suspending much of the fine materials. When these coarse materials remain deposited in the profile they tend to constitute somewhat serpentine or 'shoe-string' aquifers.

Other lakes in the region that are already saline have shown upward groundwater pressure in piezometer nests installed adjacent to them. This indicates that 'shoe-string' aquifers of coarse alluvial deposits buried in the paleochannel are remaining conductive to brines. Confining layers over these of lower permeability are necessary for them to display a pressurized condition. Such layers were observed in the monitoring bores installed in the lake fringes in the exercise described above, at depths of 1.8–2.0 m and again at 3.5 m.

A set of three pairs of piezometers were installed to investigate whether the 'shoe-string' aquifers at the wetland are pressurized. These were again on the margins of the wetland, both near the creekline and to either side of the wetland. The piezometer is a water-pressure measuring tube, with no slotting, open only at its lower end to a specific depth, with a sealing collar of bentonite clay used to isolate the hole to the depth in the formation to which the casing has been installed. The appropriate depths to which pairs of piezometers should be installed need to be interpreted from the nature of the formation during installation. The three piezometer pairs installed in the present study can be generally described as monitoring for a vertical water pressure gradient across the layer at approximately 3.5 m below ground.

After installation, initial observations indicated that recent rains (August 2001) were increasing water pressure in the superficial groundwater above the confining layer, as water levels were higher in the shallower piezometers. However, one of the piezometer pairs was equipped with floats with indicator staffs protruding through their caps. This facilitated prompt observation of the development of a riskier situation of greater water pressure in the deeper piezometer, which could prompt a round of observations on other locations.

**Take home message.** By monitoring water quality and pressure gradients in piezometer nests and water levels and quality in monitoring bores, managers of the wetland can learn of situations where the groundwater pressure gradients would move salt into the wetland. This can be addressed by using the new adjustable diversion barrier to divert fresh surface storm water into this wetland. This would simply be used to counterbalance the underground pressure. A similar, but much larger device, augmented by pumping, is used at Toolibin Lake.

At the same time, members of the catchment group and other community group members have been actively attempting to correlate vegetation health with groundwater and surface water processes. They have been measuring factors such as tree height and diameter and, using a Crown Assessment Procedure devised by Murdoch University, Western Australia, evaluating the proportion of dead branches, crown density and epicormic growth. Particular attention was paid to the trees near the shallow monitoring bores measuring throughflow from the creekline as mentioned previously. The trees will be monitored on a yearly basis.

Quadrats (10 m × 10 m) have been placed around the wetland to monitor the presence of exotics and colonization of chenopods and any subsequent recruitment of understorey species. The community groups are committed to monitor this every year.

We recognize that these engineering projects are short- to middle-term solutions; however community activity in the catchment will hopefully provide a long-term solution to restoring hydrological balance.

**Acknowledgements.** The Natural Heritage Trust, BankWest Landscope Conservation Visa Card grant and the State Salinity Strategy provided funds for different portions of this project.

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## INTEGRATING ECOSYSTEMS & PRODUCTION

### 13.10.1

**Threatened and potentially threatened freshwater fishes of coastal New South Wales and the Murray Darling Basin.** (2000) S. A. Morris, D.A. Pollard, P. C. Gehrke and J. J. Pogonoski. World Wide Fund for Nature Australia, Sydney.

This report identifies 29 fish biodiversity hotspots in coastal New South Wales and the Murray Darling Basin and presents a map for strategic management of the ailing native fish populations. Of 30 species examined in the report; two are recommended for listing as Critically Endangered, two as Endangered, three as Vulnerable, two as Lower Risk (near threatened), with insufficient data being available for 11 to be classified. The report is the first known comprehensive investigation of areas of critical conservation value in the region and will be of interest to people trying to incorporate freshwater biodiversity elements into catchment management across the Basin and coastal NSW. Management options are suggested for regions including the Paroo River, Balranald Weir, the Bega River, Moruya River, the Upper Murrumbidgee River and Broadwater National Park. The report details information on the opportunities to address conservation through threatened species legislation, community action and engineering solutions. The report also provides conservation synopses on each of the 30 fish examined, includes a summary of each species' biology, ecology, distribution, current conservation status and management options and provides coloured line drawings to aid identification. CD-Rom copies of the report are available for $16.50 (incl. GST and postage). Order by phoning Noeleen Crispo at WWF on 03 9281 5515 or emailing ncrispo@wwf.org.au.

### 13.10.2

**Warnings from the Bush: The impact of climate Change on the Nature of Australia.** (2002) Anne Reynolds, Climate Action Network Australia.

This report reviews current and predicted impacts of global warming on animals, plants, and environments in Australia and, while sometimes a little emotive, includes useful information compiled from published research about and how climatic conditions are predicted to change in northern and southern Australia over the next 70 years. 'Warnings from the bush' includes reference to predictions of significant damage in four of Australia's World Heritage Areas (Kakadu, Wet Tropics, Great Barrier Reef and Blue Mountains) and impacts to 90 Australian animals, including mammals, birds, reptiles, frogs, fish and invertebrates from all Australian States and Territories. Many of Australia's remaining native forests are predicted to change or be damaged, including Australia's wet tropical mountain rainforests which are predicted to decrease by 50% with only a 1°C rise in the global temperature. The report claims that most of these changes will occur within our lifetimes and will be difficult to stop if greenhouse gas emissions continue to accumulate in the atmosphere at higher and higher levels. <http://swiftek.modwest.com/cana/bush/default.htm >

### 13.10.3

**Implications of Salinity for Biodiversity Conservation and Management.** (2001) Australian and New Zealand Environment and Conservation Council (ANZECC).

Prepared by a Salinity and Biodiversity Taskforce established under ANZECC's Standing Committee on Conservation, this report provides an overview of current knowledge on the causes, impacts, and extent of salinity. It makes recommendations for on-ground actions and institutional change and identifies key research needs. The report aims to raise awareness and demonstrate how, if appropriately designed, actions to mitigate salinity can result in benefits to biodiversity conservation. The report is a readable resource for students, teachers and community members seeking reliable information and a perspective to guide individual, community and government action. <http://www.environment.sa.gov.au/biodiversity/pub.html salinity>

## CULTURAL & SOCIO-ECONOMIC ISSUES/SOLUTIONS

### 14.15

**The ecosystem services project: Exploring the importance of ecosystems to people.** S. J. Cork,[1] W. Proctor,[1] D. Shelton,[1] N. Abel[1] and C. Binning[2] ([1]CSIRO Sustainable Ecosystems, GPO Box 284, Canberra, ACT 2602, [2]Greening Australia). [Peer reviewed]

Key words: *ecosystem services, economic valuation, environmental valuation.*

**Introduction.** Concern has been growing over the last half century as evidence of decline in the world's ecosystems grows and ecologists, economists and other social scientists debate the underlying socioeconomic causes. Most explanations involve complex interactions among (i) people's understanding of the benefits and tolerances of ecosystems; (ii) the limitations of markets (market failure); and, (iii) inadequacy of other institutional arrangements (institutional failure) (Bingham *et al*. 1995; Daily 1997).

Sometimes scientific knowledge is inadequate to allow a full assessment of the costs and benefits of converting ecosystems from one state to another or substituting ecosystem processes with technological alternatives, but in other cases the information is not communicated in ways that allow decision makers to understand and use it. In cases like the salinity problem in Australia, it is argued that much of the information exists but the steps required to reap their economic benefits from ecosystems require greater community and political will than is currently in evidence (Pannell 2000).

Because markets do not readily develop around goods and services that are publicly rather than privately owned (as is the case for many components of ecosystems under current regimes of property rights), there are limited economic signals to warn of declines in ecosystem function. More broadly, informal and formal institutional arrangements, social norms and beliefs among communities and organizational cultures often lead to poor recognition of the values of ecosystems and inability to take action at speeds and scales needed to maintain those values (Berkes and Folke 1997).

In 1999, The Myer Foundation and CSIRO started a process to bring together researchers and stakeholders from various institutions and communities around Australia to explore the use of the concept of ecosystem services to address some of the issues discussed above. The 'Ecosystem Services Project' is now a multi-partner initiative that draws on theory from ecology, the physical sciences, economics, political, policy and other social sciences.

**The concept of ecosystem services.** The concept of ecosystem services has been developing gradually for over a century as a way to recognize the dependence of human societies on nature-based systems (Daily 1997). Daily (1997) defined ecosystem services as '. . . the conditions and processes by which natural ecosystems, and the species that make them up, sustain and fulfil human life'. In the Ecosystem Services Project we see a focus on 'services' as a way to put scientific and economic research into the language and concepts of everyday life for people without specialist training in these disciplines. Just as services provided by businesses need to be described and marketed in language that consumers understand and identify with, so ecosystem services need to be expressed in relation to the perceptions of the general public if that public is to value the services. This means that the ecosystem services identified by stakeholders often do not match precisely the way ecologists would describe ecosystem processes. The challenge for the scientists in this project, then, is to establish the bridge between the public perceptions of services and values and the theory underpinning the disciplinary approaches to ecosystem analysis.

Various authors in Daily (1997) give examples of ecosystem services. These include not only life support services like maintaining air and water quality, flood protection, pollination and control of pests, but also life-fulfilling services like provision of cultural, spiritual and intellectual stimulation and maintenance of other species for their existence value. Cork and Shelton (2000) cite some studies on Australian systems.

**The Ecosystem Services Project.** The aims of the Project include: increasing awareness and understanding of ecosystem services among members of society; exploring the value of ecosystem services (in economic and other terms) to people in relation to real decisions and challenges; and, investigating new mechanisms and institutional arrangements for recognizing and making better use of these values. Currently more than eight case studies around Australia are cooperating in the initiative (Cork *et al*. 2001; www.ecosystemservicesproject.org).

We have developed a framework for analysis of ecosystem services at a range of scales in partnership with stakeholders. The approach has the following elements:

- a semi-quantitative inventory of what ecosystem services are present, how they are being used, and what is happening to them under current land use regimes;
- identification of major decision scenarios for the future;
- quantitative and qualitative economic, social and ecological assessments of decisions and exploration of new options;
- analysis of institutional arrangements and exploration of new mechanisms for gaining greater value from ecosystem services.

In the following section, we report progress on the inventory phase of the most advanced case study, in the Goulburn Broken catchment of Victoria, and briefly outline plans for the later phases. More details of this approach and the other case studies are reported in Binning *et al*. (2001), Cork *et al*. (2001), Shelton *et al*. (2001) and at www.ecosystemservicesproject.org.

**Progress to date.** *Inventory of ecosystem services in the Goulburn Broken Catchment.* An economic, social and biophysical profile for the catchment was derived from data from the Australian Bureau of Statistics and an input–output analysis of the catchment. Qualitative assessments of interactions between ecosystem services and land uses were derived as expert judgements using staff from CSIRO, other research institutions, government land management agencies, industries, and other stakeholders (Binning *et al*. 2001; Shelton *et al*. 2001). Participants were asked to identify what goods and services of value come from the catchment's ecosystems and to judge the impacts of marginal changes in the ecosystem services or land uses. Interactions between services and land uses were judged to be high priority for future investigation if either: (i) a marginal change in the service is likely to have a substantial impact on delivery of valued products from the land use, or, (ii) a marginal change in the land use is likely to negatively impact on the ecosystem service. This was essentially a process to engage a wide range of stakeholders in thinking about the catchment's values and challenges and to identify where we should focus more detailed quantitative analyses. We documented the reasoning of the participants to provide hypotheses that could be assessed by readers and tested experimentally if necessary. We also commissioned a set of issues papers from experts in various fields of ecology to link existing knowledge and theory with the set of ecosystem services identified by stakeholders and with the reasoning behind the assessments (Binning *et al*. 2001; www.ecosystemservicesproject.org).

Twelve major ecosystem services were identified and assessed against 12 groupings of land-uses and industries (Fig. 1). Some ecosystem services (e.g. pollination) are very

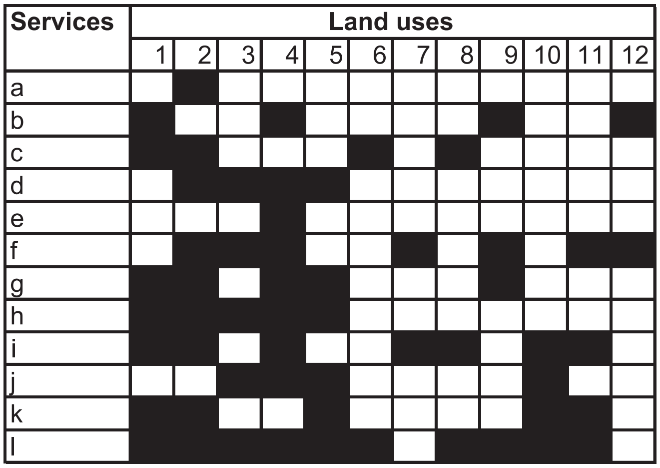


**Figure 1.** High-priority interactions between ecosystem services (rows) and land uses (columns) in the Goulburn Broken Catchment as judged by expert opinion. Key to column headings: 1, dairying, on farm; 2, fruit and grapes; 3, vegetables; 4, grazing; 5, crops; 6, intensive animals; 7, forestry; 8, food processing; 9, housing; 10, water production; 11, recreation; 12, areas of cultural/future options. Key to row headings: a, pollination; b, life fulfilment; c, regulation of climate; d, pest control; e, provision of genetic resources; f, maintenance of habitat; g, provision of shade and shelter; h, maintenance of soil health; i, maintenance of healthy waterways; j, water filtration and erosion control; k, regulation of rivers and groundwater; l, waste absorption and breakdown.

important to a wide range of land uses but only appear to be of high priority as defined above for one or a few. Other services, like waste absorption and maintenance of soil health, appear to be at high priority points for most land uses.

*Decisions, scenarios and economic–ecological–social analyses.* The inventory process also identified decisions and issues facing the catchment in the next 10–50 years and beyond. These included:

- re-establishing part of the floodplain of the lower Goulburn River by removing levee banks;
- alternative strategies for managing vegetation across the catchment;
- options for enhancing cultural values and growing the tourism and recreation industries in the upper catchment;
- intensification of some industries with possible offsets on other land uses;
- management of combinations of land uses to enhance value to communities at a catchment scale.

The research challenges that the above issues pose include: exploring the costs and benefits of ecosystem services (such as water filtration, flood control, maintenance of soil fertility, and natural pest control) compared with technological alternatives (such as water filtration facilities, levee banks and application of fertilizers and pesticides); assessing non-market values (e.g. aesthetic, cultural and biodiversity values); assessing economic returns from public investment in land use change under current institutional arrangements (compared with possible improvements like development of markets for some ecosystem services); and, exploring ways to consider whole ecological–social systems and interactions among ecosystem services and land-use options.

For all services investigated, we will attempt to predict changes and their possible ecological and social implications. Economic valuation techniques will be used for services that are amendable (including input–output analysis, traditional benefit–cost analysis, and various approaches to assessing non-market values). A multi-criteria decision framework is being used to organize the economic and other assessments (Proctor 2001), but we are being cautious about the controversial weighting of criteria. We are exploring other processes, like citizen's juries and deliberative polls, that allow stakeholders and decision makers to come together with technical experts to consider existing knowledge and uncertainties before making value judgements (Proctor 2001; www.ecosystemservicesproject.org).

To focus our use of quantitative ecosystem modelling, we are putting considerable effort into defining the issues that need to be resolved by stakeholders, to define the research questions and avoid the need to build all-purpose models that rarely answer specific questions adequately.

**Implications for management and theory.** The ecosystem services approach is one way that some of the key issues behind decline in ecosystems and associated human welfare may be addressed. The key feature of the approach is its use to engage a broad segment of society in understanding and debating the benefits and costs of decisions that affect natural ecosystems. We are suggesting this approach as a complement rather than an alternative to more traditional approaches to decision making based on economics and policy or political sciences. We are mindful of the need to link the use of ecosystem services with these approaches so that the engagement with stakeholders produces outputs relevant and useful to policy makers and other decision makers. It is for this reason that we have engaged key decision makers throughout the project and we are regularly reviewing our approach as we learn together with them.

Our experience over the past 2 years has been that farmers, other land managers and the general public who are concerned about environmental issues find this framework useful for working towards practical solutions that recognize a wide range of values. It is being used already as a component of the Goulburn Broken Catchment Management Authority's approach to equitable sharing of the costs and benefits of environmental management. It is an important challenge for us to develop a body of theory around the concept of ecosystem services that is consistent with theory in ecology, economics and political, policy and other social sciences.

**Acknowledgements.** We thank The Myer Foundation, CSIRO, Land and Water Australia, the Goulburn Broken Catchment Management Authority, and the Rainforest and Cotton Cooperative Research Centres for their support; and our other partners for their contribution to defining the framework and research agenda. Information on partners, other details of the project, and copies of most of the references below can be found at www.ecosystemservicesproject.org.

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## 14.16

**Conservation covenants: A national survey of landholders' views.** S. Stephens,[1] J. Lambert,[2] J. Elix,[2] C. Morrison[3] and M. Kennedy[4] ([1]Bush for Wildlife National Coordinator, 11 Finn St, O'Connor, ACT 2602 (Email: sally@bushforwildlife.com.au); [2]Community Solutions, 179 Sydney Rd, Fairlight, NSW 2094, [3]14–15/17 Ralston St, Lane Cove, NSW 2066, and [4]Humane Society International (Aust), PO Box 439, Avalon NSW 2107, Australia.) [Peer reviewed]

Key words: *conservation covenants, landholders, national survey, needs and expectations.*

Conservation management beyond National Parks and other dedicated reserves is increasingly recognized as crucial to the conservation of Australia's biodiversity. As about two-thirds of the landmass is managed by private landholders, their role in conservation is critical. However, debate continues as to how best to secure and support conservation management on private land.

More than 2000 private landholders across Australia have established permanent conservation covenants on their properties, under various State-based schemes. Such covenants go by different names, but all involve agreements to protect and encourage conservation management in perpetuity on all or sections of a parcel of land. They are registered on title deeds, are binding on subsequent owners, and are supported by legislation.

These privately owned conservation areas range from less than 1 ha to many thousands of hectares, adding significantly to our total 'conservation estate'. Landholders with conservation covenants, or considering them, need support and encouragement, as they contribute not only land but levels of management far beyond the capacity of government agencies.

This note reports on a national survey of conservation covenant holders, as landholders with conservation covenants on their properties are best placed to provide advice on what makes a covenant work well for them, what kinds of support they value, and what might encourage other landholders to move into conservation management as a serious land use.

**Survey approach.** The survey sought information on a range of issues relating to conservation covenants, including the types of support and assistance provided, and their relative importance to the respondents (survey details are in the full report provided to the covenant providers noted in the Acknowledgments).

Agencies and organizations providing conservation covenants in each State distributed the survey forms to their covenant holders. Responses were anonymous. Every landholder with a conservation covenant was approached in all States except South Australia, where one-third (every third person from each regional list) of the 1200 landholders with Heritage Agreements were included. Covenant holders in some small local government schemes were not covered.

Of a total of 1141 survey forms sent out in August 2001, 466 (41%) from across all States were returned by the response date. Responses were entered into an SPSS statistical program database and analyzed using basic statistical and other functions, including various cross-correlations.

**Overall responses.** Surveys were returned from properties of sizes: 0–49 ha (39.6%), 50–499 ha (31.4%) and larger than 500 ha (29%). The area subject to a conservation covenant varied widely (mean area 209 ha, median 34 ha), as did the proportion of each property subject to the covenant, ranging from 0.01% of the property, to the whole property (18% of respondents).

Nearly 75% of respondents indicated they had entered into a conservation covenant to ensure the permanent conservation of the vegetation on their property. Only 9.5% of respondents had entered into a covenant to gain financial compensation as a result of State agencies rejecting clearing applications. Eighteen per cent of respondents had inherited their conservation covenant from a previous owner.

Almost two-thirds of all respondents (61%) indicated that 30% or less of their income comes from their property, with the proportion of off-property income and percentage of property covered by conservation covenants being strongly correlated (Pearson coefficient $R = 0.614$, $P < 0.01$). While not definitive, this finding suggests that many who have entered into conservation covenants are lifestyle landholders. However, a further 30.2% of respondents stated that between 60 and 100% of their income derives from their property. On average, this latter group had conservation covenants over 18% of their property, although 10% of this group had covenants over more than half their property and two respondents in this group had covenants over their whole property. Clearly, the needs of both groups must be considered when planning conservation covenants and their management.

Perhaps not surprisingly (given the growing awareness and promotion of covenanting), the majority of covenants have been in place for a relatively short period (19.3% for 0–1 year, 43% for 1–5 years). Three-quarters (75%) of all respondents were members of organizations providing support for nature conservation on private land (such as *Land for Wildlife,* Greening Australia, Landcare groups, 'Friends of' groups and networks).

**Responses to types of assistance.** The major focus of this note is on responses relating to the types of assistance, and their relative values to landholders.

Asked if they would recommend that other landholders apply for a conservation covenant with the same agency, 87.9% of respondents replied positively, suggesting some level of satisfaction with their relationship with the agency. The average time taken from application to covenant establishment was 14.4 months. However, this value is skewed by a few covenants that took a long time, as reflected in the range 1–120 months, with a median of 12 months. Although the majority (67.4%) responded that the time taken was reasonable, 32.1% felt that it was too long, with under-staffing and under-resourcing of the relevant department, slowness in reaching an agreement on financial assistance, and the impacts of 'red tape' or 'bureaucracy' being the most frequently cited problems.

Although most respondents were generally satisfied with the covenanting process, there were discrepancies (Table 1) between what landholders identify as being 'important' in establishing and maintaining a conservation covenant, and the support currently provided by the agencies administering these covenants.

Financial support in its various forms was considered important by more than 90% of all respondents, although fewer than 50% generally received such support. Fifty per cent of respondents had the costs (legal etc.) associated with establishing their conservation covenant covered; 47.8% had received financial assistance for fencing and related activities during the establishment of their covenant; and, only 35.3% received this during ongoing management. Thirty-two per cent had received some rate rebates or exemptions.

Provision of labour to assist with on-ground works such as fencing or weed control was considered to be important both during the establishment phase (78% of respondents) and during ongoing management (87.7%). However, a much lower

**Table 1.** Support received, and landholder needs in establishing and managing conservation covenants

| Assistance/support | % of respondents receiving this support | % of respondents identifying as 'Most important' | % of respondents identifying as 'Important'[a] |
|---|---|---|---|
| While establishing covenant | | | |
| Assessment of remnant vegetation and/or wildlife habitat | 74.4 | 56.0 | 95.4 |
| Funding assistance (for fencing etc.) | 47.8 | 64.2 | 94.8 |
| Property visit | 86.4 | 61.4 | 92.6 |
| Advice on funding sources | 36.4 | 47.4 | 92.3 |
| Costs covered (e.g. legal fees etc.) | 50.0 | 60.3 | 92.1 |
| Advice on value of vegetation to conservation | 45.7 | 40.8 | 92.0 |
| Advice on quality of remnant | 54.5 | 36.6 | 91.0 |
| Flora and/or fauna survey | 53.7 | 49.1 | 90.8 |
| Technical advice on management etc. | 34.1 | 47.2 | 90.6 |
| Property and/or vegetation mapping | 35.3 | 32.8 | 84.6 |
| Advice on value of vegetation to landholder | 25.4 | 36.8 | 84.2 |
| Advice on non-financial assistance | 16.4 | 26.0 | 80.4 |
| Labour for on-ground works | 15.1 | 32.5 | 78.0 |
| Ongoing, once covenant established | | | |
| Rate rebates/exemptions | 32.3 | 57.1 | 93.0 |
| Financial assistance (for fencing etc.) | 35.3 | 60.0 | 90.7 |
| Access to technical experts for advice | 27.2 | 38.3 | 89.5 |
| Labour for on-ground works | 17.5 | 46.0 | 87.7 |
| Field days | 25.2 | 13.9 | 85.2 |
| Property visits | 51.9 | 28.0 | 78.1 |
| Technical notes/publications | 25.9 | 21.4 | 77.7 |
| Signs and/or other recognition | 37.7 | 29.3 | 74.2 |
| Newsletters | 49.8 | 15.0 | 73.0 |
| Access to technical computer database information (e.g. on wildlife or vegetation) | 8.0 | 19.6 | 69.6 |
| Links with other covenant holders | 19.6 | 14.7 | 66.7 |
| Regular phone contact from providers | 19.2 | 12.7 | 59.7 |

[a]Rated 'Important' by respondents if scored 5 (most important), 4 (quite important) or 3 (important).

percentage (15.1% and 17.5%, respectively) received such support. While some expressed this need because they are older and find the work physically demanding, others stated that they simply did not have the time to do the work required.

Participating landholders also expressed a much greater desire for technical advice and support than is currently being received. More than 90% of respondents saw technical advice as important during the establishment phase, yet only 34% received it. This discrepancy was even more pronounced during ongoing management, with 70% or more of respondents rating various forms of technical advice and assistance as important, yet only 8–27% receiving it. The reasons for this deficiency in information flow warrant further attention.

Participants viewed follow-up property visits (78.1%) and/or regular phone contact (59.7%) as important. About half (51.9%) received such follow-up visits and 19.2% received follow-up phone calls. While landholders were establishing a conservation covenant, most received a property visit (86.4%) and/or a site assessment (74.4%), with other support services going to only half or fewer of the respondents.

Two-thirds (66.7%) of all respondents see links with other conservation covenant holders as important, and comments on the need for such links were frequent in open-ended questions. Conservation Management Networks of the type proposed by Prober *et al.* (2001) offer one mechanism for addressing these needs.

**Conclusions.** The aim of the survey was to learn from the experiences of landholders participating in conservation covenant schemes, to enable relevant agencies to improve the quality of those schemes and to encourage other landholders to participate.

Most respondents were reasonably satisfied with their experiences, although satisfaction was higher if the agency contact people were enthusiastic and provided the required level of assistance. This common view was encapsulated in one landholder's response that 'the agreement is only as good as the person you have to deal with'.

The data show that financial assistance is consistently important to the substantial majority of respondents, supporting previous findings of Young *et al.* (1966) and Binning and Young (1997). Ongoing contact, access to technical expertise and labour assistance were also highly valued. However, discrepancies between the perceived importance of these services and their current delivery suggest that the covenanting process could be substantially improved.

Providing appropriate follow-up is likely to be cost/personnel intensive and may well be beyond the current capacity of gencies providing conservation covenants. If this is so, then exploring other mechanisms such as the introduction of tax deductions for commercial sponsors of individual conservation covenants; the involvement of part-time landholder 'extension officers'; and increased access to electronic services and on-ground management networks (Prober *et al.* 2001) may provide effective alternatives — especially given that landholders also often expressed a desire to link up with other conservation covenant holders, to learn from each other and to benefit from each other's experiences.

**Acknowledgments.** This survey would not have been possible without the assistance of agencies and organizations who provide conservation covenants in each State. The assistance of the following is gratefully acknowledged: Michael Looker and Natalie Woodward (Trust for Nature, Victoria); Joanne Millar and Greg Sullivan (Queensland Parks and Wildlife Service); Neil Collins and Elspeth Young (Department of Environment and Heritage, SA); Steven Smith, Sharon Moore and Felicity Britten (Department of Primary Industry, Water and Environment, Tas); Ken Atkins (Department of Conservation and Land Management, WA), Mark Holland (AgWest), Lesley Thomas (National Trust WA); Rochelle Callaghan (NSW National Parks and Wildlife Service) and Bruce Thompson (Department of Land and Water Conservation, NSW).

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## 14.17

### Filling a niche: Woodland Watch in Western Australia.

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Key words: *agricultural land, community involvement, extension, landscape pattern and design*.

In the 18 months since its inception, World Wide Fund for Nature (WWF) Australia's Woodland Watch project in Western Australia has had a significant impact on the uptake of conservation options by owners and managers of rural bush in the Central Wheatbelt. The project has targeted land-holders with good quality tall eucalypt woodlands, particularly those containing woodlands grossly under-represented in the conservation estate. These include Salmon Gum *(Eucalyptus salmonophloia),* Gimlet *(E. salubris),* Red Morrel *(E. longicornis)* and York Gum *(E. loxophleba)* woodlands. It has also led to the protection of thousands of hectares of bushland through conservation agreements and management support programs.

**Objectives.** WWF established Woodland Watch to enhance the conservation of tall eucalypt woodlands on private and local government land in the WA Wheatbelt through the negotiation and implementation of a range of conservation strategies. These strategies include conservation covenants, revolving funds, local shire rebates, Land for Wildlife and voluntary management agreements. Management agreements are facilitated through a process of community consultation; community involvement; and, identification and surveying of woodlands.

The core assumptions underlying the project are that:

- eucalypt woodland communities have been extensively cleared (approximately 3% of their original range remains in the western and Central Wheatbelt) and are poorly represented in existing conservation reserves;
- there is insufficient data about the different woodland types, their floristic composition and their distribution, particularly on private land; and,
- a suite of options for management and conservation on private land, as well as increased representation in the National Reserve System, will be necessary to protect these ecosystems for the future.

Our project has emerged from the recogition that there are still good quality patches of bush under private and shire ownership/management in the WA Wheatbelt — but that, despite the availability of various schemes to help bush owners/managers achieve long-term conservation, the connections are not necessarily being made between the landholders and the conservation management schemes. We observed a need for a new project to help link owners of land with important remnants with conservation opportunities, effectively acting as a broker for landholders.

**On-ground role.** One of the keys to the rapid returns of the Woodland Watch program has been the effectiveness of the on-ground role of the program's field extension staff. Acting as 'cultural translators' by making conservation science readily accessible to rural landowners, Woodland Watch staff work face-to-face with landholders. Landholders with good quality woodlands are sought-out through GIS surveys and field-reconnaisance tours, through referrals from field extension staff such as Community Landcare Coordinators, and through articles placed in local community newspapers. Staff provide to landholders an independent assessment of the importance of their remnant vegetation and assist with their queries about bush management and conservation. Staff are also in a position to dispel misconceptions landholders may have about the implications of entering into conservation agreements.

In addition to encouraging or brokering conservation agreement options, we encourage the landholders to adopt a range of best practice management strategies that offer wider farm benefits. We also encourage them to learn more about their patch of bush and its role in whole farm management through further communication with field extension officers and the use of data in such publications as the Land For Wildlife magazine 'Western Wildlife'.

Among the conservation options brokered to landholders are:

- non-binding, voluntary conservation schemes — such as Land for Wildlife and WWF's Woodland Watch Conservation Agreement;
- conservation covenants — such as those offered by the Department of Agriculture (DOA), the Department of Conservation and Land Management (CALM) and the National Trust of Australia, Western Australia (NTWA); and
- selling the land to private conservation-minded buyers (e.g. through Bush Bank, Bush Brokers, Australian Bush Heritage Fund) or to the Government for inclusion in the national reserve system.

**Bottom-up Approach.** Woodland Watch uses a 'bottom-up' approach to facilitate bush conservation. Landholders who have suitable woodlands on their properties are identified and engaged through the direct and indirect approaches outlined above. Those who are not already involved in conservation schemes or do not have conservation agreements protecting their woodlands are targeted for participation in the project.

Through initial discussions, Woodland Watch field officers assess landholders' attitudes towards bush management and conservation and make efforts, wherever necessary, to raise landholder awareness of the benefits of retaining healthy bush. They encourage the landholders to make use of the conservation programs most likely to suit their level of willingness; the brokering phase of the project. Given the long-term management and conservation objectives of the project, low-impact, less-secure options are considered as entry points and participating landholders are encouraged to upgrade to more secure agreements when they are ready.

The Project's early phases involve one-to-one meetings with landholders, aimed at raising their level of awareness of the benefits of better management of remnant vegetation. This is achieved through informal discussions, often during casual walks through the landholder's patch of bush. A survey, providing a floristic snapshot of the woodland, is subsequently carried out in each patch of bush — the results of which, together with a woodland condition assessment report, are passed back to the landholder. The survey is conducted by a botanist from the Western Australian Herbarium, which ensures the flora information is taxonomically accurate and consistent with State Herbarium standards. This feedback not only provides data on the woodland's floristic composition, health, threats and ecology, but also an opportunity to promote 'best-practice' woodland management and the development of management plans and programs that help the landholder achieve long-term conservation outcomes. By the time the landholders receive the survey results, the Woodland Watch field officer will have visited the property on up to four occasions.

The desired outcome of this close collaboration is that the bush managers/owners become more informed about the nature and value of their patch of bush, best-practice management strategies, support mechanisms and conservation options (where necessary, financial assistance is sought to address primary management issues such as fencing).

**Outcomes.** The outputs of the project are listed in Box 1. As a result of the enthusiastic response from landholders, Woodland Watch has confirmed the key principles upon which the project was founded, namely:

- that there are huge benefits to be gained from field officers brokering a variety of conservation options to suit the needs/attitudes of individual landholders;
- that there are not nearly enough extension officers operating

in the field — either to promote conservation outcomes, or to work face-to-face with landholders;

- that there are still significant amounts of good quality remnant vegetation in the vastly cleared agricultural zone without conservation management and/or protection; and
- that there are many landholders, communities and local authorities who are willing to embrace bush conservation strategies — including conservation covenants — but who require more accurate information, capacity-building or direct assistance to do so.

By the end of 2001, about 18 months after the project was initiated, more than 60 private landholders and 10 local authorities were working with Woodland Watch project staff. Their level of prior awareness of and commitment to rural bush conservation varied from very low to high.

Through their brokering role, Woodland Watch field staff have been field representatives of not only WWF Australia; but also Land for Wildlife (CALM), the organizations offering conservation covenants (DAWA, CALM, NTWA) and other options being brokered in the Woodland Watch 'toolkit', such as BushBank, Bush Brokers and Australian Bush Heritage Fund. In brokering a spectrum of conservation options — from low impact, introductory levels to more engaged levels with more securely binding conservation outcomes — it appears that Woodland Watch has been welcomed by the full spectrum of bush owners/managers (see box below).

**The future.** WWF is currently planning to expand the Woodland Watch project both geographically and thematically — predominantly in response to demands from landholders, Community Landcare Coordinators, local authorities and regional groups. The project is oversubscribed with interested landholders and local authorities; creating an obvious demand for more field officers. In addition, many of the landholders expressing an interest in the project are from outside the current project area; and are owners of patches of bush which contain not only woodlands, but other types of remnants (granite outcrops, mallee and heath). While the project has experienced significant success to date, there are still a considerable number of woodlands and other patches of bush in the Wheatbelt that are either unmanaged or not protected by conservation agreements and it is early days in terms of the persistence of results. It is hoped that the early, encouraging results lead to ongoing, persistent growth in conservation outcomes and encouragement not only for Woodland Watch, but also for other similar programs elsewhere around the nation.

**Acknowledgements.** Woodland Watch is supported by Alcoa and the Natural Heritage Trust.

## OUTCOMES TO DATE.

More than 150 patches of bush have been investigated with the following outcomes:

1. Flora surveys have been conducted in 62 woodlands.
2. Approximately 2500 plant specimens have been collected, and lodged at the WA Herbarium resulting in:
   - the discovery of several new undescribed species, as well as several new locations of rare or priority flora;
   - the discovery of a significant number of range extensions; and
   - other valuable data additions to the WA Herbarium database.

These discoveries are being made in rural shires with as little as 5% remaining uncleared vegetation. Much of the landscape has been cleared, yet new species and populations are still being discovered — demonstrating the urgency of projects aimed at conserving every patch of bush.

3. Species lists derived from the 41 Spring 2000 flora surveys have been returned to all of the participating landholders. The lists contained the following information:
   - a site report (location, site data, threats, management issues, recommendations, etc);
   - a list of species recorded at the site — scientific and common names;
   - a list of known bush tucker/medicine species from the species list; and
   - a list of known revegetation species from the species list.

These data, without site identification features, are being made available to local authorities, community Landcare facilitators and other extension staff, researchers, and interested landholders for revegetation projects, to help build-up a regional remnant vegetation 'pictures', and to provide baseline data for further monitoring and evaluation purposes.

4. A significant number of landowners involved in the project have been encouraged to implement conservation measures — with the following significant outcomes:
   - More than 3000 hectares of remnant vegetation are either under secure conservation covenants and/or voluntary management agreements, or in the process of covenant preparation, with most of the participating landholders involved in one or more of the variety of promoted schemes.

The success of the brokering approach being recognized by other conservation schemes — whose staff have, at times, approached Woodland Watch to initiate talks with landholders in the knowledge of the project's success in engaging landholders.

## 14.18

**FROM: Environment Australia/Land & Water Resources Research & Development Corporation. National Research and Development Program on Rehabilitation, Management and Conservation of Remnant Vegetation: Report Series 1999.** (Available from Land and Water Australia, GPO Box 2182, Canberra ACT 2601, Australia).

### 14.18.1

**Beyond Roads, Rates & Rubbish: Opportunities for local government to conserve native vegetation.** Carl Binning, Mike Young and Emily Cripps. Environment Australia/Land and Water Resources Research and Development Corporation. Research report 1/99

This is one of a series of reports (see below) undertaken by CSIRO Wildlife and Ecology which identifies opportunities for Local government to use incentives to foster the conservation of remnant vegetation. This report evaluates the key policy and financial opportunities and impediments to local governments playing an active role in native vegetation management. It provides strategies and a 'toolkit' for councils to enhance their contributions to conservation through (i) the development consent process, (ii) direct management of public lands and (iii) facilitation of community involvement in public and private land management. This report is presented well and puts forward policy guidelines for all levels of government.

### 14.18.2

**Opportunity Denied: Review of the legislative ability of local governments to conserve native vegetation.** Emily Cripps, Carl Binning and Mike Young. Environment Australia/Land and Water Resources Research and Development Corporation. Research report 2/99

This report reviews the legislative framework within which local government in each State of Australia operates, and considers the legal capacity and potential for local governments to offer a range of innovative policy tools (including revenue raising tools such as environmental levies, and incentives such as grants to community groups, rate rebates, revolving funds and management agreements) for sustainable vegetation management. The report concludes that a range of opportunities to manage native vegetation are being denied to local governments by the legislative framework within which they operate.

### 14.18.3

**Conservation Hindered: The impact of local government rates and State land taxes on the conservation of native vegetation.** Carl Binning and Mike Young. Environment Australia/Land and Water Resources Research and Development Corporation. Research report 3/99

This report evaluates the impact of property-based local government rates and State-based land taxes on the ability of landholders to conserve native vegetation. It does so with the objective of understanding how private investment in private land conservation can be more effectively promoted in Australia. The report concludes that conservation is being hindered by rate and land tax structures. It identifies important policy opportunities for all spheres of government that could be directed at correcting the price signal provided to landholders to conserve areas of high conservation value. A national program of rate and land tax concessions is proposed to complement other conservation programs.

### 14.18.4

**Talking to the Taxman: Proposals for the introduction of tax incentives for the protection of high conservation value native vegetation.** Emily Cripps, Carl Binning and Mike Young. Environment Australia/Land and Water Resources Research and Development Corporation. Research report 4/99

This report identifies that there are considerably tax incentives available for conservation on land where a *bona fide* business is being carried out but no tax incentives for people who manage land solely for nature conservation. This imbalance functions as an incentive to use, rather than to protect, lands of high and often unique conservation value under pressure from development. This report, then, wrestles with the problem of how to increase the incentive for people to make significant contributions to conservation on private land and puts forward proposals to address this situation.

## 14.19

**Encouraging Conservation through Valuation. Volumes 1 and 2.** (2000) R. Skitch. QLD Department of Natural Resources and Mines, Brisbane.

This is a report on the feasibility of encouraging conservation and ecologically sustainable management of private land by incentives offered through the statutory valuation systems. This report examines how statutory property valuation and/or property taxes could be used as tools to encourage natural heritage conservation and the sustainable management of productive land, in non-urban areas. Key findings in the report include that landholdings should be rated on present use rather than development potential. Several previous reports on statutory valuation over more than three decades have highlighted the deficiencies of the unimproved value approach used in Queensland. More recently, there have been specific claims that the property valuation system unfairly discriminates against conservation and sustainable farming practice. This report has outlined a workable and better alternative system.

A 'green accreditation' scheme within the valuation system could be used to reward sustainable 'good practice' on rural properties. A non-government body could operate this accreditation.

Available from QLD Department of Natural Resources and Mines. Tel: 07 3224 2338 or online at: http://www.dnr.qld.gov.au/resourcenet/land/landplan/ectv/index.html

## 14.20

**Incentives for Sustainable Land Management: Community cost sharing to conserve biodiversity on private lands. A guide for local government. Revised edition.** (2001) Bateson, P. Environment Australia, Canberra and Environs Australia, Melbourne.

This guide is designed to help local government to work with local communities and landholders to develop, implement and monitor the success of financial incentive schemes that encourage private landholders to become partners in conserving biodiversity. It provides successful case studies and a step-by-step approach for councils to develop and implement local financial incentive programs and to encourage people who are interested in making a real difference to conserve biodiversity on their land. For each State, the type of package offered may depend upon the legislative arrangements that are in place. Where the legislation allows, rate rebates and grants are the recommended preferred option, but a combination of incentives can also be linked to property management plans and management agreements under local planning schemes. There is a strong need to amend State legislation to remove impediments so that local government can more readily and effectively apply a full range of instruments and mechanisms. All spheres of government are encouraged to work together in partnership to build a national coalition of support for cost-sharing arrangements across all States to conserve biodiversity. <http://www.environs.org.au/bio_cons/index.html>

## 14.21

**Making Farm Forestry Pay — Markets for Ecosystem Services. A scoping study to set future research directions.** (2002) Carl Binning, Brendan Baker, Seona Meharg, Steve Cork and Allen Kearns. Rural Industries Research and Development Organisation. RIRDC publication number 02/005

In recent years researchers and policy makers have consistently highlighted the potential role farm forestry and agroforestry could play as drivers of landscape rehabilitation. The uptake of agroforestry has, however, been patchy for a range of reasons including soils, rainfall and access to markets. This 74-page report addresses the challenge of how to make farm forestry pay by identifying key issues connected with providing incentives and commercializing the environmental and social values associated with agroforestry. It introduces the role of markets for ecosystems services in delivering ecological products to investors. It does so with reference to the role of both the government and non-government sectors. The full report and a summary are available at <http://www.rirdc.gov.au/reports/AFT/02-005.pdf>

## 14.22

**Repairing the Country: Leveraging Private Investment.** (2001) Allen Consulting Group, Australian Conservation Foundation (ACF), Melbourne.

This report arose from collaboration between the ACF, CSIRO and leading businesses to identify how Australia may be able to mobilize the private sector's capacity for significant, long-term commercial investment in the repair and ecologically sustainable management of rural landscapes. What public policies and programs need to be designed to implement and provide leverage for such investments? The study found that AUD$12.7 billion in new private investment in environmental projects could be generated over 10 years through a mix of policy and tax measures; investment which would cost taxpayers less than AUD$3.6 billion over the same period. The report recommends a package which includes improved access to private capital through tax-preferred investment vehicles; tax concessions; and, the establishment of a land repair fund to administer programs. Available on line at <http://www.acfonline.org.au/docs/publications/rpt0006.pdf> with a very readable summary on <http://www.acfonline.org.au/docs/publications/rpt0005.pdf>

## 14.23

**Cost Sharing for Biodiversity Conservation: A Conceptual Framework.** (2001) Aretino, B. Holland, P., Matysek, A. and Peterson, D. Productivity Commission: Canberra.

This very interesting and readable discussion paper discusses the principles for sharing the costs of conservation between individuals, groups and the general community. It illustrates situations in which the different cost sharing principles (e.g. 'impacter pays' or 'beneficiary pays') may be relevant and highlights some issues surrounding property rights and responsibilities and who should pay for biodiversity conservation. Available for $9.00 from the AusInfo Tel: 13 24 47 or on-line at: <http://www.pc.gov.au/research/staffres/csbc/csbc.pdf>

# WEB SITES AND LISTSERVERS

## 25.1

**ENVIROWEEDS is a moderated email discussion group** (with over 600 contributors, mainly from Australia and New Zealand) dealing with a range of topics relating to environmental weeds. The volume of messages on this listserver is high and most of this is relevant and of good quality. Its greatest strengths are the breadth of expertise (covering taxonomy, distribution, prevention, control, legislation and safety) available to the group and the practical nature of the information shared (although summaries of replies received directly by recipients could be posted back to the group more frequently). Philosophic discussions are few, although when they occur, they are often of high quality. Enquiries about subscribing to the list should be directed to Kate.Blood@nre.vic.gov.au

## 25.2

**GRASSECOL is an email discussion group moderated by Ian Lunt from Charles Sturt University.** It is open to all interested members of the public. The volume of messages is of a medium level, with occasional bursts of traffic in response to 'hot' issues. The emphasis is on grassland management and restoration, although the flow of ecological information is also high. Some excellent discussions have been had in the past on such topics as the role of disturbance on grassland daisy recruitment, natural versus derived grasslands, fire, grazing, soil seed persistence, faunal habitats, and restoration techniques. The system does not allow attachments to be sent and, unfortunately, messages are not archived. The list is a reliable way of receiving information on workshops and publications relevant to grassland management and restoration. To subscribe email: majordomo@life.csu.edu.au, with the following text in your email message: subscribe grassecol your@email.address (e.g. subscribe grassecol bsmith@hotdot.com.au), or send a message to the list manager, ilunt@csu.edu.au.

## 25.3

**The website of Environs Australia: the Local Government Environment Network** (www.environs.org.au) is worth a visit by anyone involved in improved ecosystem management, particularly at local government level. The website has a number of sections, including one on biodiversity conservation, which contains over 50 'good examples' of local and regional initiatives to improve public and private natural resource management in Australia. Case studies include examples of incentive schemes, innovative planning projects, sustainable enterprises and practical on-ground biodiversity conservation works. Environs also hosts the bushremnants network email discussion group, the message volume of which is currently low to medium but is likely to increase with higher subscription. To subscribe to the list server discussion group send a blank message (no subject) to bushremnants_network-subscribe@yahoogroups.com and follow the prompts.