

Riparian ecosystem services



What are ecosystem services?

Ecosystem services are the benefits to humans that come from plants, animals and micro-organisms in nature interacting together as an ecological system, or 'ecosystem'. The functioning of natural ecosystems provides 'services' that are essential for human health and survival. Examples of the kinds of services we receive from nature include water filtration, maintenance of soil fertility, pollination, pest control, and cultural and spiritual fulfilment. Despite receiving these benefits, however, many of the ecosystems that deliver them in Australia are in decline. Growing salinity problems, worsening water quality, continuing tree clearing and increasing greenhouse gas emissions are showing us that many of our ecosystems are under threat.

This Fact Sheet is the twelfth in a series dealing with the management of rivers and riparian land.

River Landscapes



The concept of ecosystem services has been developing around the world since the 1950s, as people have tried to think more broadly about human dependence on ecosystems and how to fairly share both the costs and benefits of maintaining those services. At present, there are major initiatives on identifying, valuing, and managing ecosystem services on every continent of the globe (although sometimes they go under different names like “Multifunctional Landscapes”, which is the term used in Europe). These initiatives are responses to new knowledge that emerged late last century. For example, there has been increasing evidence from national and international studies that the world’s ecosystems are changing dramatically under pressure from growing human populations and high levels of consumption of natural resources. The World Resources Institute in Washington DC concluded in 2000 that “If current trends continue, humanity will dramatically alter or destroy virtually all of the Earth’s natural ecosystems within a few decades.”

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These studies have shown that declining ecosystems are affecting people in terms of their supplies of good food and clean water, living conditions, and physical and mental health, as well as threatening many of the others species that we feel responsibility for. There has been gradual recognition that these declines are being encouraged by a lack of understanding, at all levels of decision making, of the benefits and value of well functioning ecosystems. This lack of recognition is coupled with the fact that most of the services from ecosystems do not pass through markets and, as a result, do not automatically get a clear financial value placed on them.

The concept of ‘service’ is familiar to all people and the table opposite shows one way of categorising the huge complexity of ecosystems into 15 services that most people can understand and appreciate.



Photo LWA



Production of goods

Food: Terrestrial animal and plant products, forage, seafood, spice

Pharmaceuticals: Medicines, precursors to synthetic drugs

Durable materials: Natural fibre, timber

Energy: Biomass fuels, low-sediment water for hydropower

Industrial products: Waxes, oils, fragrances, dyes, latex, rubber, precursors to many synthetic products

Genetic resources: The basis for the production of other goods

Regeneration services

Cycling and filtration services: Detoxification and decomposition of wastes, renewal of soil fertility, purification of air and water

Translocation services: Dispersal of seeds necessary for revegetation, pollination of crops and native vegetation

Stabilising services

Coastal and river channel stability, compensation and substitution of one species for another when environments vary, control of the majority of potential pest species, moderation of weather extremes (such as temperature and wind), partial stabilisation of climate, regulation of the hydrological cycle (mitigation of floods, droughts, salinity)

Life-fulfilling services

Aesthetic beauty, cultural, intellectual, and spiritual inspiration, existence value, scientific discovery, serenity

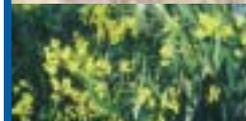
Preservation of options

Maintenance of ecological components and systems needed for the future, supply of goods and services awaiting discovery

Source: Daily, G.C. 1999, 'Developing a scientific basis for managing Earth's life support systems', *Conservation Ecology*, 3:14



Ian Prosser



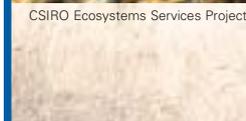
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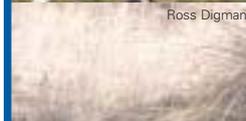
Canegrowers



CSIRO Ecosystems Services Project



Ross Digman



Aridflo project



Hans Wapstra



CSIRO Ecosystems Services Project



Why are ecosystem services important for land and water managers?

When we look at this list it is clear that the protection, maintenance and rehabilitation of ecosystems is what underpins land and water management so that humans can continue to enjoy and benefit from this huge range of natural services. The action of bacteria, fungi, earthworms and other organisms in soil maintain its fertility. The vast majority of potential pests are controlled by other species in natural ecosystems. Crops and pasture plants come from natural varieties that are provided through the services of maintaining genetic diversity. The quantity and quality of water in rivers are regulated by vegetation systems that filter the water, even out flow peaks, stabilise streambanks and provide shade for in-stream habitat.

In theory, these services are worth money to land and water managers, because without nature providing them technological alternatives would have to be used. Unfortunately, the value is often only noticed when the ecosystems become dysfunctional, and replacements like fertilisers, pesticides and engineering works are required. We have now recognised that research to provide better advice on how these ecosystem services function, is required

so that land and water managers can make informed decisions about what ecosystem services they need, and what value they might get from them compared with the costs of technological alternatives.

Valuing ecosystem services

When we have a range of services that benefit all of society, but only a small part of society is aware of the services and even fewer (land and water managers) have responsibility for maintaining them, there is potential for unfair and inefficient sharing of costs and benefits. This is made worse because the regulations and beliefs that govern every day activity were developed at a time when benefits from ecosystems were poorly understood and it was assumed that nature was endlessly renewable.

Rural land managers know of many ecosystem services by other names, though they often don't have the information available to manage them optimally or estimate what they might be worth economically. Scientists have researched many aspects of ecosystem function but have not put the pieces together in a way that answers questions like 'what is the overall benefit to society of keeping a healthy functioning ecosystem versus using technological alternatives to provide services to humans?'. The rest of society is largely unaware that these services even exist, let alone how important they might be.



Photo LMA.



In response to this situation, there is now a lot of interest in placing an economic value on ecosystem services. Economic value is determined by what people are prepared to pay. For example, soil fertilisation by bacteria and fungi are not worth anything if people never have to pay to maintain or replace it or have to accept the cost of its loss. While ecosystems keep renewing themselves, there is no need for these payments, but when they start to degrade the costs have to be paid by someone. The question is who? This question is made more complex to answer because:

- most people do not know what services are provided by ecosystems;
- most ecosystem services do not pass through markets and so do not have a price;
- there is confusion about whether ecosystem services are owned by individuals or all of society;
- often the information is not available to tell land and water managers ahead of time how close their ecosystems are to losing the ability to provide services;
- subsidies and incentives can mask the costs incurred by loss of ecosystem services; and
- laws and regulations do a poor job of spreading responsibilities for maintaining ecosystem services across all beneficiaries in society.

Riparian areas, which are the focus of this Fact Sheet, are where land and water meet in landscapes. They are particularly important producers of ecosystem services because the diversity of ecological processes that characterise riparian areas support a wide range of human activities. Ten years ago the word ‘riparian’ was not commonly used in land and water management. Over the past decade, however, considerable research has focused on the processes that occur in riparian areas and the services that these parts of the landscape provide.

Riparian land is any land that adjoins or directly influences a body of water. It includes:

- the land immediately alongside small creeks and rivers, including the river bank itself;
- gullies and dips that sometimes run with water;
- areas surrounding lakes; and
- wetlands and river floodplains which interact with the river in time of flood.

Photo Siwan Lovett.



riparian land

The table below describes some of the ecosystem services provided by riparian areas.

Decreased erosion Well vegetated riparian areas stabilise riverbanks and protect them in times of flood. If riparian land is not well-vegetated with deep-rooted plants, then flood-outs, stripping of topsoil from the floodplain, and accelerated bank erosion can occur — all of these can lead to the loss of valuable agricultural land and infrastructure such as roads, bridges, and buildings.



A wetland provides refuge for wildlife amidst the cane fields, as well as providing sediment filtering for surrounding crop land.

Photo Canegrowers.

Improved water quality Good management of riparian land can decrease the amount of soil and nutrients moving from cultivated fields upslope of the riparian land into the stream. By trapping soil and nutrients, water quality is improved and the loss of in-stream habitat through siltation is prevented.

Healthy ecosystems Good management of riparian land can prevent or minimise damage to both land-based and river ecosystems. Such damage can upset important biological balances and lead to the deterioration or even destruction of interdependent environmental systems, for example resulting in poor water quality or blooms of toxic algae.

Maintaining biodiversity Riparian land also plays an important role in the lifecycle of many native animals and plants, including some that cannot live in other areas. Riparian areas provide wildlife corridors as well as being a refuge for animals in times of drought or fire. Riparian lands also act as corridors of natural vegetation, preventing species becoming isolated and dying out.



Riparian areas are sites of high biodiversity.

Photo Ross Digman.

Riparian zone restoration needs to be considered at the catchment scale, so that projects such as connected wildlife corridors can be undertaken.

Photo CSIRO Ecosystems Services Project.



Maintaining river courses

Healthy riparian vegetation protects riverbanks and channels and reduces the risk of erosion. When riverbanks are cleared, increased flow can cause rivers to change their course and form new meanders or flood channels.

Part of the Cooper Creek floodplain, an area that needs to be protected in its unregulated state.

Photo Aridflo Project.



Decrease in insect pests

Healthy vegetated riparian land provides habitat for insect-eating birds and insect parasites that can help to protect pastures and crops from damage. It has been shown that losing even a small number of birds can allow significantly more below-ground pasture grubs to survive and become adults.

Decreased algal growth

Riparian vegetation helps to reduce light and temperature levels of stream ecosystems. It has been shown that this controls the growth of nuisance plants and algae, even when nutrient levels in the stream water have increased.

Nuisance algae, one result of increased nutrient levels.

Photo MDABC.





In undisturbed rivers there is often a large amount of large woody debris present on streambanks. This provides important fish habitat. Campaspe River, Victoria. Photo Ian Rutherford.

Maintaining fish stocks

Healthy riparian vegetation helps maintain good habitat for aquatic animals, including insects and the fish that feed on them. Riparian vegetation provides important food sources including leaves, fruit and stems that fall into the stream. The roots of vegetation provide essential habitat for fish by protecting overhanging banks, while large branches or trunks that fall into the water also provide shelter from predators and a diversity of flow speeds. This service is vital for both freshwater and some in-shore marine fish species.



Large woody debris is important in creating different habitat for plants and animals, Tumut River, NSW. Photo Chris Gippel.

Increase in capital values

Anecdotal evidence from real estate agents suggests that well managed riparian frontage can add up to 10% of the market value of a rural property.

Shelter effects

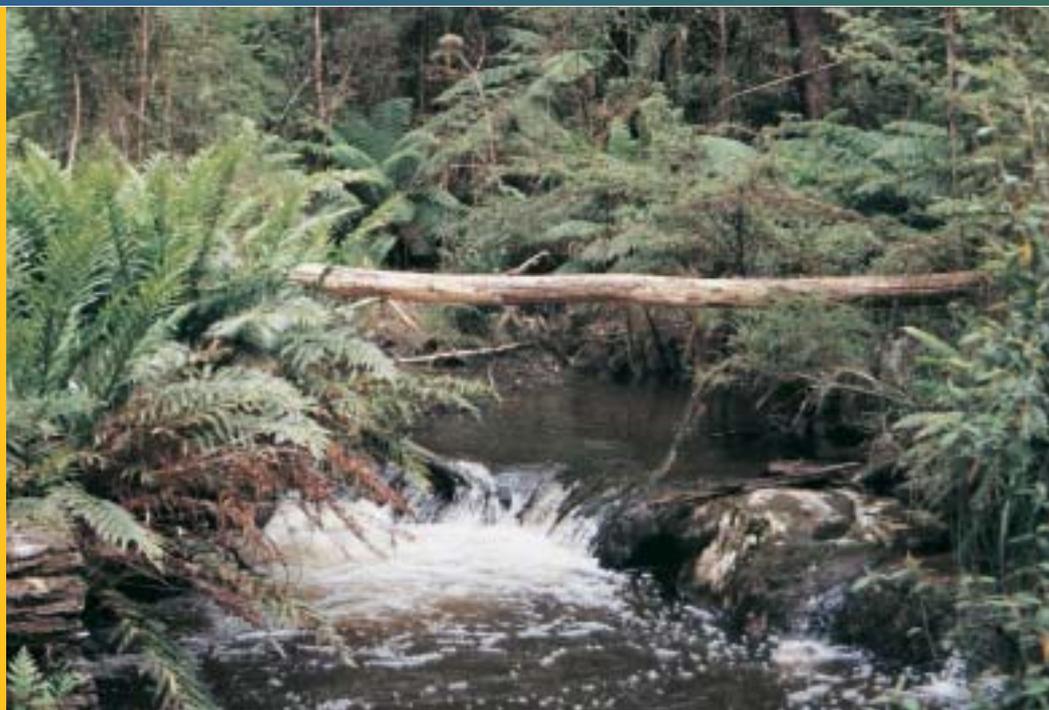
The shelter and microclimate that riparian vegetation creates can help to reduce death in newborn or newly shorn sheep, and lead to improved growth and productivity through reduction of heat or cold stress in animals. Vegetated riparian areas reduce wind speeds and this can assist growth and production of crops and pastures, as well as reduce wind damage to valuable horticultural produce.



Intact riparian vegetation, protected by fences. WhiteKanga, south-east Tasmania. Photo Peter Davies.

Intact riparian area. Upper Latrobe River, Victoria.

Photo Ian Rutherford.



Retention of nutrients

In addition to preventing erosion and improving water quality, riparian vegetation can absorb and use natural or added nutrients that might otherwise be washed in streams, resulting in the growth of nuisance plants and algae within rivers.

Lowered water tables

Deep-rooted riparian vegetation may, in some circumstances, act to lower water tables along riverbanks, reducing the movement of salt and nutrients into streams from sub-surface flows, and helping to further stabilise the bank.

Denitrification

Recent studies have shown that riparian land plays an important role in reducing the amount of nitrate moving into waterways through sub-surface flow. This can help protect downstream aquatic ecosystems and lessen the risk of problems such as algal blooms occurring.

Opportunities for diversification

Some landholders have combined riparian management with agroforestry production. Others have used riparian land for producing hay or other stored forage, or for growing firewood or specialist crops. These farmers have increased the sustainability of their property while, at the same time, protecting its most valuable land.

High pruned spotted gums over pasture in western Victoria. The stand still provides grazing opportunities.

Photo RIRDC – Joint Venture Agroforestry Program.





The many values of the Murray frontage. Access management is an integral component of the Mallee Catchment Management Authority.

Photo Arron Wood.

Recreation

Riparian areas provide people with access to rivers that are an important recreational resource for fishing, canoeing, swimming or simply relaxing.



Protecting riparian areas is important for past, present and future generations.

Photo John Koehn.

Cultural and spiritual fulfilment

Rivers and riparian areas are important to people for spiritual, cultural and historical reasons. They provide people with connection to the environment, their past, present and future.

Ecotourism

Ecotourism is becoming a major source of income for rural regions, as shown by the resources being used to establish good bird watching habitat, canoe racing, walking trails and other activities compatible with rivers and their adjoining lands.



Riparian areas are beautiful parts of the landscape and important sites for ecotourism.

Photo LVVA.

It is only in recent times that we have begun to recognise the range of ecosystem services provided by riparian areas and to develop strategies to protect and maintain these parts of the landscape. One of the ways to highlight the importance of these ecosystem services is to place a monetary value on them in order to convince people that protecting and conserving these areas makes good economic sense. By quantifying the value of natural goods and services put at risk by unsustainable development, we would be much better able to consider the costs and benefits of different land uses and management practices. To date, there are few studies that have estimated the nature, value and extent of natural ecosystem services — or the costs to the economy if they should fail.

Land & Water Australia, through independent studies of return on investment from its R&D programs and projects, has developed estimates of the potential value of some of the benefits listed below that are derived from riparian ecosystem services.

Categories of benefits derived from riparian ecosystem services

Benefit	Economic	Environmental	Social
Biodiversity improvement		✓	✓
Reduced sediment and nutrient export and improved water quality (e.g. lowered risk of algal outbreaks with environmental and recreational implications)	✓	✓	✓
Retention of nutrients on the farm that can be reutilised	✓		
Aesthetic improvements			✓
Reduced need for and expenditure on remedial works downstream (e.g. erosion)	✓	✓	
Improved livestock management and performance (e.g. lower costs)	✓		
Less breakouts from creeks and lower maintenance of creek crossings	✓	✓	
Other benefits to the agricultural system, such as pollination services	✓		
Carbon sequestration	✓	✓	

An attempt was made to place financial values on some of these benefits. For example, from the Victorian Bushtender scheme, it could be concluded that the public value of maintaining and improving biodiversity on riparian land is \$125 to \$250 per hectare. Reduced nutrient and sediment exports into rivers could be worth around \$145 million per year nationally in the form of less remedial works and treatment for water quality. General riparian restoration could be worth \$56,000 for each kilometre of river returned to a 'fishable' condition (based on a household willingness-to-pay survey), or \$84 over 15 years per kilometre restored (based on the value of public funding for this activity). The Prime Minister's Science, Engineering and Innovation Council reports the value of pollination to agriculture has been calculated as \$1.2 billion per annum, and riparian land would provide a significant contribution to this as a site of high biodiversity and refuge for insects, birds and other organisms

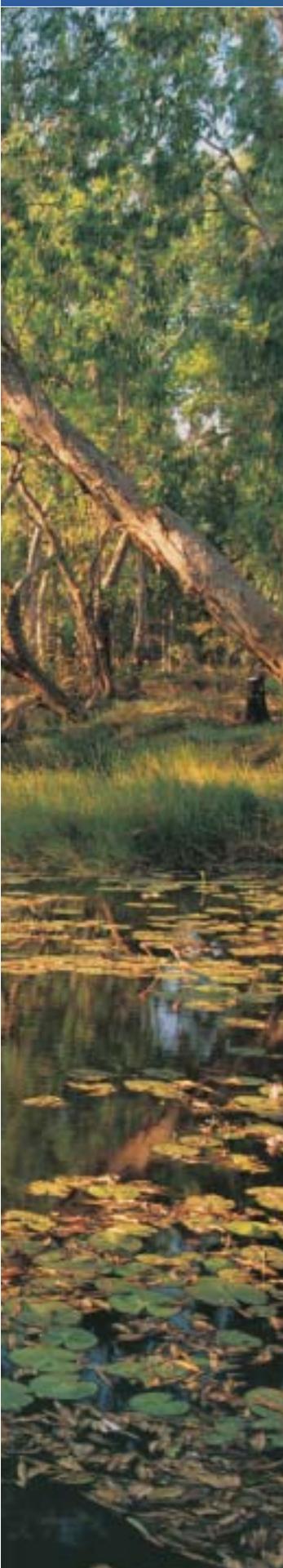
Each of these estimates include a set of assumptions that are unlikely to apply in every case or in every riparian area, and there is a large 'scarcity effect', in which values may change according to how much riparian land in excellent condition there is in a given area. However, they do show that the value of riparian ecosystem services can be significant in comparison with adjacent land uses, although the type and value

of the services vary widely between different situations. It is therefore clear, that continued or increased provision of ecosystem services should be factored into all decision-making about riparian management, whether by private or public land and water managers, and whether at the scale of catchment plans or on-ground management by farmers. As noted earlier, the benefits of ecosystem services may not be captured on-site, so there is a need for fair and efficient cost-sharing arrangements.

A scheme launched in the Gwydir Catchment of New South Wales in 2002 is one example of how this might be achieved. The overall aim of the scheme is to identify the ecosystem services provided by changed land use activities to enable them to be valued by the community. Eventually, the goal is to create a market for trading these environmental services. The scheme focuses on identifying, measuring and monitoring the costs and benefits to farm business of six ecosystem services:

1. carbon sequestration — related to greenhouse gases and air quality;
2. terrestrial biodiversity benefits — related to improvements in the value of vegetation as habitat for other life-forms;
3. salinity benefits — related to improvements in stream water salinity;



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4. soil benefits — related to retention of soil on the property;
 5. water quality — related to retention of nutrients on the property; and
 6. acid sulfate soil benefits — related to reduction in the production and export of acid products from acid sulfate soil regions.

For more information on this project you can visit the website at: <http://www.ecoman.une.edu.au/gesp/index.html>

In summary

The aim of this Fact Sheet has been to alert land and water managers to the existence of important ecosystem services provided by riparian lands, and to encourage incorporation of this knowledge into planning and decisions about land use and management within riparian areas. More work is needed to better value these services, so that trade-offs can be assessed between alternate or competing land uses. There is no excuse for continuing to neglect their existence.

Other Fact Sheets in this series provide detailed information about some of the principles and methods that can be used to achieve particular management objectives within riparian lands.

Riparian lands are highly productive and provide a range of habitat components for wildlife.

Photo Peter Walton Photography.

For more information

CSIRO Sustainable Ecosystems is managing a project focusing on ecosystem services in Australia, you can find out more from the website www.ecosystemsproject.org

The Gwydir Ecosystem Services Project <http://www.ecoman.une.edu.au/gesp/index.html>

RipRap, Edition 21, 'What are Ecosystem Services' available in hard copy from CanPrint Communications 1800 776 616 or on the website www.rivers.gov.au.

References

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- Daily, G.C. 1999, 'Developing a scientific basis for managing Earth's life support systems', *Conservation Ecology*, 3:14
- Prime Minister's Science, Engineering and Innovation Council, 2002, *Sustaining Our Natural Systems and Biodiversity*, Department of Education, Science and Training, Canberra.

These **Fact Sheets** are grouped according to whether they deal with riparian land, in-stream issues, river contaminants or other matters. They aim to set out the general principles and practices for sound management. Other information that focuses on local conditions and management issues is available from state government agencies, local governments, catchment management authorities, rural industry bodies and community organisations. Together, this information should assist users to understand the key issues in river and riparian management, and enable them to adapt general management principles to their particular situation, and to know where to go for advice specific to local conditions.

Other relevant Fact Sheets

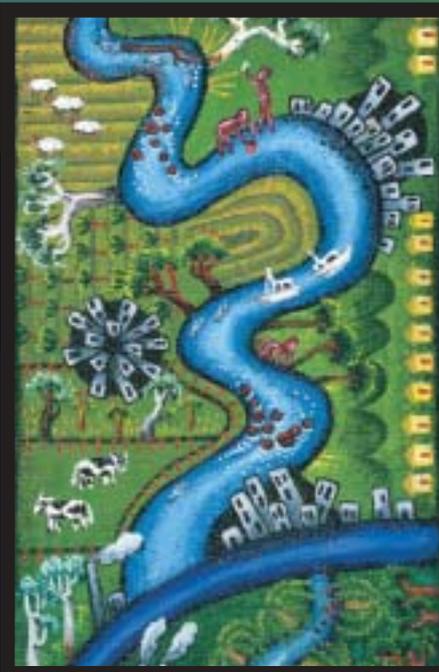
- 1 Managing riparian land
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Further information on river and riparian management can also be found at the Land & Water Australia 'River Landscapes' website.

www.rivers.gov.au

This website provides access to projects, fact sheets, guidelines and other information designed to assist people to better manage river and riparian areas across Australia.

River Landscapes



Written by Siwan Lovett, Phil Price and Steven Cork and produced by Land & Water Australia's National Riparian Lands R&D Program.



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