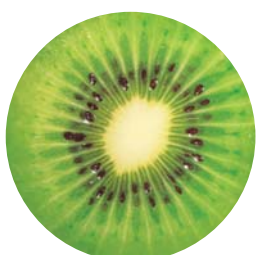


DISCOVERY

JUNE 2014 ISSUE 39



UNDERSTANDING
ECOSYSTEM SERVICES



Landcare Research
Manaaki Whenua

GUEST EDITORIAL

Ecosystem services are benefits obtained *by people from* ecosystems. That may seem to be a fancy name for what we used to call natural resource use, but there is more recognition of what resources are being used for, and that is for human well-being.

As such, consideration of ecosystem services promotes a broader view of all those services that contribute to human well-being, both individually and collectively. To clarify this broader perspective the Millennium Ecosystem Assessment (MEA) classified ecosystem services as either provisioning, regulating, supporting or cultural.

The MEA completed a global assessment of ecosystem services and found that over the last 50 years humans have changed ecosystems more rapidly and extensively than in any other comparable period in human history.

However, the assessment was carried out at a global scale while in New Zealand management of natural resources is usually undertaken at national and regional scale. If we are to expect improvement in natural resource management through a broader and more direct consideration of benefits then overview of ecosystem services should also be at these scales.

Recently I edited a book that leading scientists and academics came together to produce – the first national assessment of ecosystem services in New Zealand. More detailed information on the book and its findings is on page 4 but in effect it uses already published data to look at the conditions and trends of ecosystems and their services.

It's a broad topic and one that many New Zealanders know nothing, or very little about. Yet, for those working in local, regional and central government and other regulatory, planning and conservation organisations ecosystem services are well known and increasingly understood. It's on that basis that this issue of Discovery is presented; it covers a diverse range of articles starting with a 'beginners guide' to ecosystem services (page 3). We also briefly outline broad areas of work that Landcare Research undertakes – through science portfolios – that have relevance to ecosystem services.

And, we include new research investigating policy instruments that decision-makers can use when considering options and approaches to enhance, protect or maintain the suite of services provided by ecosystem services. (page 7)

This issue of Discovery provides an overview of ecosystem services, their importance to our livelihood, and the work being undertaken to understand them and protect them.

I hope you enjoy this issue of Discovery and welcome your questions, feedback and ideas on the topics we present here, or your own challenges with sustainable practice.

John Dymond
Principal Scientist

dymondj@landcaresearch.co.nz

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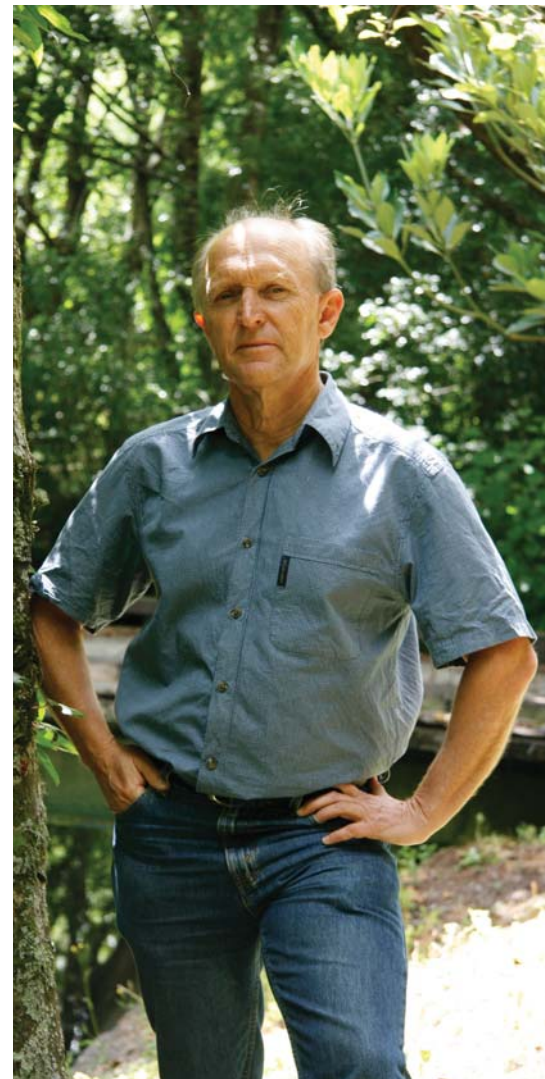
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A BEGINNER'S GUIDE TO ECOSYSTEM SERVICES

The phrases “ecosystem services” and “natural capital” are moving from the realm of policy and research into the language of business.

While scientists and environmentalists have discussed ecosystem services for decades, their definitions were only formalised by the United Nations 2005 Millennium Ecosystem Assessment (MEA), a four-year study involving more than 1,300 scientists worldwide. This grouped ecosystem services into four broad categories: provisioning, such as the production of food and water; regulating, such as the control of climate and disease; supporting, such as nutrient cycles and crop pollination; and cultural, such as spiritual and recreational benefits.

Provisioning services

These are ecosystem services that describe the material or energy outputs from ecosystems. They include food, water and other resources.

Food:

Ecosystems provide the conditions for growing food. Food comes principally from managed agro-ecosystems but marine and freshwater systems or forests also provide food for human consumption.

Raw materials:

Ecosystems provide a great diversity of materials for construction and fuel including wood, biofuels and plant oils that are directly derived from wild and cultivated plant species.

Fresh water:

Ecosystems play a vital role in the global hydrological cycle, as they regulate the flow and purification of water. Vegetation and forests influence the quantity of water available locally.

Medicinal resources:

Ecosystems and biodiversity provide many plants used as traditional medicines as well as providing the raw materials for the pharmaceutical industry. All ecosystems are a potential source of medicinal resources.

Regulating services

These are the services that ecosystems provide by acting as regulators – for example regulating the quality of air and soil or by providing flood and disease control.

Local climate and air quality:

Trees provide shade, while forests influence rainfall and water availability both locally and regionally. Trees or other plants also play an important role in regulating air quality by removing pollutants from the atmosphere.

Carbon sequestration and storage:

Ecosystems regulate the global climate by storing and sequestering greenhouse gases. As trees and plants grow, they remove carbon dioxide from the atmosphere and effectively lock it away in their tissues. In this way forest ecosystems are carbon stores. Biodiversity also plays an important role by improving the capacity of ecosystems to adapt to the effects of climate change.

Moderation of extreme events:

Ecosystems and living organisms create buffers against natural disasters, thereby preventing possible damage. For example, wetlands can soak up flood water, while trees can stabilise slopes. Coral reefs and mangroves help protect coastlines from storm damage.

Waste-water treatment:

Ecosystems such as wetlands filter both human and animal waste and act as a natural buffer to the surrounding environment. Through the biological activity of microorganisms in the soil, most waste is broken down. Thereby pathogens (disease-causing microbes) are eliminated, and the level of nutrients and pollution is reduced.



Erosion prevention and maintenance of soil fertility:

Soil erosion is a key factor in the process of land degradation and desertification. Vegetation cover provides a vital regulating service by preventing soil erosion. Soil fertility is essential for plant growth and agriculture, and well-functioning ecosystems supply the soil with nutrients required to support plant growth.

Pollination:

Insects and wind pollinate plants and trees, which is essential for the development of fruits, vegetables and seeds. Animal pollination is an ecosystem service mainly provided by insects but also by some birds and bats.

Biological control:

Ecosystems are important for regulating pests and vector-borne diseases that attack plants, animals and people. Ecosystems regulate pests and diseases through the activities of predators and parasites. Birds, bats, flies, wasps, frogs and fungi all act as natural controls.

Habitat or supporting services

Habitats for species:

Habitats provide everything that an individual plant or animal needs to survive: food; water; and shelter. Each ecosystem provides different habitats that can be essential for a species' lifecycle. Migratory species, including birds, fish, mammals and insects, all depend upon different ecosystems during their movements.

Maintenance of genetic diversity:

Genetic diversity is the variety of genes between and within species' populations. Genetic diversity distinguishes different breeds or races from each other thus providing the basis for locally well-adapted cultivars and a gene pool for further developing commercial crops and livestock. Some habitats have an exceptionally high number of species, which makes them more genetically diverse than others, and are known as 'biodiversity hotspots'.

Cultural services

Recreation and mental and physical health:

Walking and playing sports in green space are not only good forms of physical exercise but also let people relax. The role that green space plays in maintaining mental and physical health is increasingly being recognised, despite difficulties of measurement.

Tourism:

Ecosystems and biodiversity play an important role for many kinds of tourism, which in turn provides considerable economic benefits and is a vital source of income for many countries. In 2008 global earnings from tourism summed up to US\$944 billion. Cultural and eco-tourism can also educate people about the importance of biological diversity.

Aesthetic appreciation and inspiration for culture, art and design:

Language, knowledge and the natural environment have been intimately related throughout human history. Biodiversity, ecosystems and natural landscapes have been the source of inspiration for much of our art, culture and increasingly for science.

Spiritual experience and sense of place:

In many parts of the world natural features such as specific forests, caves or mountains are considered sacred or have a religious meaning. Nature is a common element of all major religions and traditional knowledge, and associated customs are important for creating a sense of belonging.



SO, WHERE ARE WE AT?

THE FIRST SUMMARY OF NZ ECOSYSTEM SERVICES

Dr John Dymond is the editor of the first comprehensive overview of the state of ecosystem services – the benefits people obtain from nature – in New Zealand.

New Zealand's leading scientists and academics have penned chapters for the new book, called *Ecosystem Services in New Zealand – Conditions and Trends*.

Dr Dymond says the book was produced to improve understanding of the functioning of New Zealand's ecosystems.

'It's important that our management of ecosystem services is based on sound knowledge.

'We didn't set out to create a scorecard but it's inevitable that people will look at a publication like this and ask "How are we doing?"

'When we consider that in the past 50 years, humans have transformed ecosystems more rapidly and extensively than in any other period in human history, I think that on the whole New Zealand's story is a reasonably balanced one.

'If we take a fairly simplistic, high-level view of the trending of indicators over the past 20 years, most have shown no net change, or both improvements and deterioration at different locations.'

However, Dr Dymond says the number of gains have been fairly evenly matched by losses.

'On the positive side, we are seeing improvements in pest management in cities and native forest, growth in indigenous forest and shrubland, and health and environmental benefits from less use of open fires and better home insulation.

'On the negative side, some examples are the decline in pollination services. We are losing

biodiversity, particularly rare species and in freshwater and wetland environments, and also water is being over-allocated in some catchments.

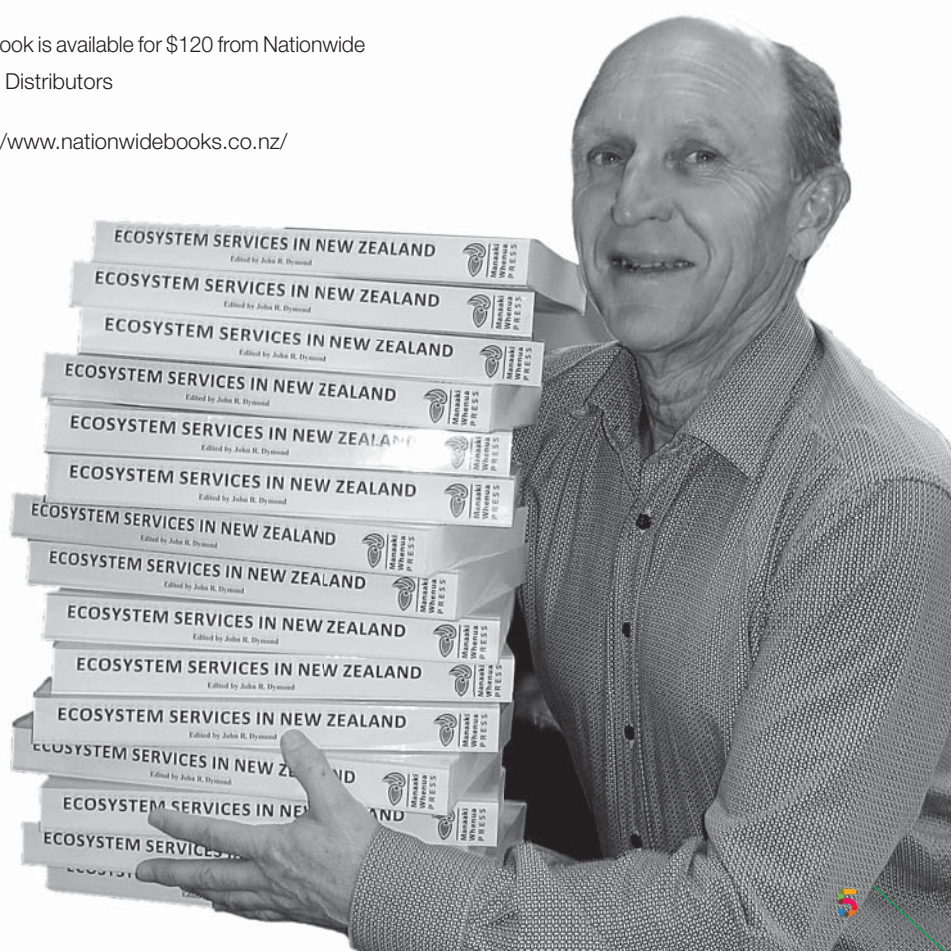
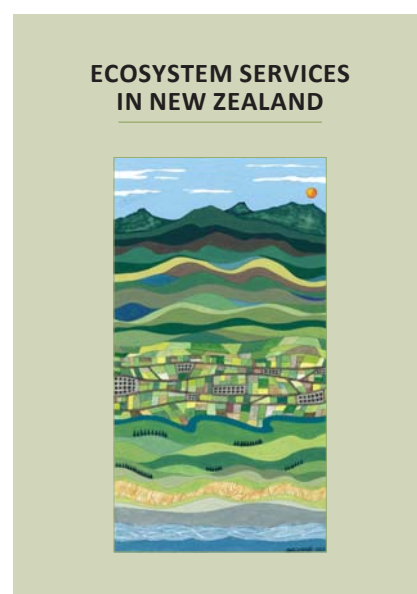
'There are no surprises there,' he says.

'In producing this book we haven't necessarily set out to unearth any new revelations. It was simply about synthesising information that has already been produced and making it more readily available.'

He notes that in New Zealand most of our natural resources are managed at regional or local scales. 'So we hope that this assessment of ecosystem services at these scales will benefit resource management decision-making across New Zealand.'

The book is available for \$120 from Nationwide Book Distributors

<http://www.nationwidebooks.co.nz/>



ECOSYSTEMS SCIENCE AT LANDCARE RESEARCH

Landcare Research has 10 research portfolios – clusters of research projects of common purpose that are aligned to users' needs – and three of these portfolios are directly related to the idea of ecosystem services.

Enhancing Policy Development

Effective policy, whether public or organisational, is an important component of resource management and planning as it provides the framework for sound decision-making. This portfolio complements Landcare Research's biophysical science by focusing on the social, cultural and economic processes and information needed to improve policy performance. (see page 7)

Development of effective policy entails designing, undertaking and evaluating engagement processes and strategies; understanding preferences, values and governance processes for natural asset management; assessing information to underpin choices and decisions; designing policy instruments and their implementation; and tracking policy performance to enable adaptive management.

Our research spans urban, rural and conservation landscapes and catchments, the full range of ecosystem services and natural resources, and a wide array of stakeholders – central and local government, industry, NGOs, community and Māori organisations.

CONTACT

SUZIE GREENHALGH
LANDCARE RESEARCH,
AUCKLAND
greenhalgh@landcareresearch.
co.nz

Supporting Trade

This portfolio supports trade by enabling business, production and tourism industries to understand and meet community expectations and market demands for environmental responsibility and sustainable practices. Our approach links the economic, social, cultural and environmental aspects of business performance. The ability of businesses to understand their own performance, manage and where appropriate to report it publicly is becoming increasingly important for market access and community license to operate. The integrity of responses to such challenges is widely seen as critical to the New Zealand brand.

The portfolio includes our important research on bovine TB control, which is a trade compliance issue for New Zealand's animal industry. Also included is work on trade policy impacts, market

developments in respect to sustainability and green growth, and our support to businesses implementing environmental management and reporting systems.

Research priority areas:

- TB freedom
- Production pests & environmental compensation
- Risk & environmental limits
- Export competitiveness

CONTACT

CAROLINE SAUNDERS
LANDCARE RESEARCH,
LINCOLN
saundersc@landcareresearch.co.nz



GRAHAM NUGENT

Possums are the main vectors of bovine tuberculosis in New Zealand.

Understanding Ecosystem Services

The role of this portfolio is to enable improved decision-making to sustain the life-supporting qualities of ecosystems. Nationally, there is an urgent need to develop evidence-based policy that takes ecosystem services and limits into account.

The scientific goal of this portfolio is to better understand the key pressures and drivers of ecosystem change, the consequences for ecosystem properties and processes, and ultimately ecosystem services (i.e. benefits such as carbon sequestration, water availability, and contaminant removal). Research will help policymakers understand what drives ecosystem change, and the spatial and temporal trade-offs in managing for different or multiple ecosystem services.

Some key upcoming projects include understanding the effects of irrigation on soil processes, understanding the benefits of more diverse pastures, quantifying emissions of carbon

dioxide, methane, and nitrous oxide and soil carbon changes in pasture and designing, implementing sampling and monitoring methods for evaluating invasive tree spread and the effectiveness of management, and finally, demonstrating links between soil quality and natural capital.

Research priority areas:

- Ecosystem services interactions & controls
- Ecosystem services pressures & limits
- Multiple pressures & ecosystem services
- Ecosystem services relevance & policy

CONTACT
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DUANE PELTZER
LANDCARE RESEARCH,
LINCOLN
peltzerd@landcareresearch.co.nz



NEW RESEARCH: POLICY INSTRUMENTS

To date there has been very little thought as to how policies might be better crafted to address multiple ecosystem services and minimise some of the trade-offs inherent in these decisions.

A policy guidance document produced by Landcare Research's Suzie Greenhalgh and colleague Mindy Selman, 'Review of Policy Instruments for Ecosystem Services', examines the types of policy instruments that decision-makers can use when considering options and approaches to enhance, protect or maintain the suite of services provided by ecosystems. They include instruments covering:

- Outreach and education—including public awareness, access to information, and environmental education. These

policies can take many forms and could be displayed on web portals, maps, interactive tools, awareness campaigns, or in regularly published documents. Messages need to easily understood.

- Regulatory approaches—including bans and restrictions, permits, environmental standards, and environmental limits and caps. These approaches operate on the premise that a penalty will be incurred if individual sources of ecosystem degradation fail to comply with prescribed levels of pollution, abatement, or ecosystem quality, or fail to adopt the prescribed means of reducing damage.
- Economic instruments—including price-based instruments like taxes, fees

and levies, subsidies, tax credits, and low-interest loans, and market-based instruments such as eco-labelling, environmental markets, and auctions and tenders. Economic instruments supplement or substitute for stand-alone regulatory approaches, providing entities with incentives (usually financial) to change their behaviour and thereby reduce their impact on the environment. Dr Greenhalgh's document outlines two categories of economic instruments: price-based and market-based (or rights-based) instruments.

- Ecosystem preservation and restoration—including protected areas, ecosystem restoration, land

purchases, and stewardship agreements. Ecosystem preservation and restoration policies protect or restore portions of the landscape to maintain or restore ecosystems and their services.

Dr Greenhalgh's research considers examples of where and how these policies have been applied, the strengths and weaknesses of the different policy approaches, and how these policies might be adapted to look more broadly at ecosystem services.

However, she says to support policies that are responsive to multiple ecosystem services and designed to minimise trade-offs, decision-makers must also reinforce and increase monitoring and modelling efforts to identify the most efficient policy instrument(s) but also to track policy performance.

In addition, policies cannot be effective without the appropriate institutions and authorities to effectively implement them.

Supporting implementation of policy instruments: research, monitoring and evaluation

Dr Greenhalgh says research, monitoring, and evaluation activities complement the implementation of any policy instrument by:

- providing information on the status, trend and condition of ecosystem services
- identifying the drivers of ecosystem service change
- providing information and tools to inform policy development, and
- establishing effective measures and monitoring programmes to track how policy and related processes impact and depend on various ecosystem services, and to adaptively manage the policies implemented.

Implementing policy: institutions and governance

Policies will be ineffective without the appropriate institutions and authorities to implement them. Decision-makers should consider whether appropriate institutions exist to administer the policies or implement the actions, whether there is institutional capacity and capability to enact and enforce the policies, and whether there is suitable transparency and accountability in existing institutions to ensure that policies are supported by the communities on which they impact. Missing or weak capacity issues should be addressed prior to implementing these policies.

Selecting appropriate policy instruments

It is unlikely that a single policy will provide the solution to complex environmental problems involving multiple ecosystem services. Rather, a mix of policy instruments is likely necessary. In many instances, the policy instruments currently in use have been designed to focus on individual ecosystem services. This silo approach can sometimes have unintended negative impacts on other ecosystem services. When choosing an instrument the wider impacts on ecosystem services should be determined and the subsequent design of policy should reflect these wider ecosystem services impacts.

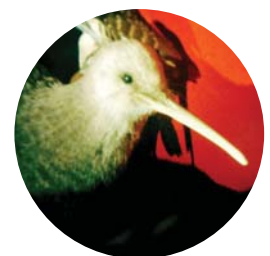
Conclusions

Environmental and ecosystem degradation and the decline of many of our ecosystem services are becoming increasingly recognised by governments, industry and the general public.

Dr Greenhalgh's document is useful for identifying the types of instruments a decision-maker may like to investigate and how these can be compared. The systematic assessment of how decisions impact on multiple ecosystem services and the wise choice and design of policy instruments will reduce the likelihood of unintended policy impacts, providing a solid platform from which to halt and reverse the decline of many of our ecosystem services.

CONTACT

SUZIE GREENHALGH
LANDCARE RESEARCH,
AUCKLAND
greenhalghg@landcareresearch.co.nz



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Landcare Research
Manaaki Whenua

Published by: Landcare Research - Manaaki Whenua
PO Box 40, Lincoln 7640, New Zealand
Ph + 64 3 321 9999
Fax + 64 3 321 9997

If you wish to be included on the mailing list for Discovery, contact Tom Fraser, Landcare Research, Lincoln (03) 321 9719 frasert@landcareresearch.co.nz

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