

Science's role in balancing people and planet

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This month, ECOS moves to a new home, but its 41-year archive will continue to be freely accessible online. That archive tells the story of how sustainability science evolved in Australia. So where did it all begin?



Credit: Bill Anders/NASA

When ECOS was launched in 1974, CSIRO kicked off a national conversation about the role of science in characterising, monitoring and managing the environment. It came just two years after the Club of Rome's *Limits to Growth* explored what unchecked population and economic growth would do to the Earth's natural resources. Over the following 40-odd years, environmental science has become part of broader discourse that embraces not just ecology, but also economics, society, culture and policy.

Now, we talk about 'sustainability science' based on the ideal of sustainable development – 'development that [meets the needs of the present without compromising the ability of future generations to meet their own needs](#).

In truth, sustainability science is a bit like the theory of everything. It's humanity's attempt to understand the interconnected 'whole' of planetary, human and biological systems, through different scales of time and space. It's about 'circles within circles' – how carbon, water and energy interact with each other; and how the global economy is increasingly viewed as a subsystem of both human society and the biosphere with its 'free' ecosystem services like clean water and air, temperature regulation, genetic material for food crops, and so on.

The ECOS archive mirrors the evolution of sustainability science from the 1970s. Here are a few highlights:

1974

1. [Monitoring carbon dioxide](#)

Yes, more than 40 years ago, scientists were warning us about the danger of atmospheric warming from CO₂ emissions caused by burning fossil fuels!

2. The ozone layer and UV radiation

The 1987 Montreal Protocol on substances that deplete the ozone layer is regarded as one of the most successful global agreements on protecting the environment, but in 1974 scientists were still building the case against CFCs.

3. Getting away from pesticides

CSIRO's entomologists focus their efforts in the '70s on pesticide-free 'biocontrol' methods, using insects and other organisms to fight against insect pests. This included the use of [insect sex hormones or pheromones](#).

1975

1. Re-using sewage water and aquifer storage

Every day, billions of litres of water flow from Australia's sewers into the sea. In 1975, scientists ask can we make sewage water clean enough to allow re-use? And if so, could we store it in naturally occurring aquifers underground?

2. Understanding the East Australian Current

This is the fast-moving, southerly ocean superhighway off our east coast that carries Great Barrier Reef marine life to Sydney Harbour and beyond, made famous in the 2003 film *Finding Nemo*.

3. Finding land's potential: CSIRO Land Survey

slice of post-war Australia...in 1946, CSIRO scientists began a decades-long survey of 2 million square kilometres of northern Australia and Papua New Guinea, culminating in a series of 39 reports that provide the [first 'baseline' assessments of these remote landscapes](#).

1976

1. Petrichor: rain's piquant perfume

What's the evocative fragrance released when rain first breaks onto parched soil? CSIRO discovers it comes from a yellowish oil, petrichor, trapped in the rocks and soil.

2. Phosphorus and feeding the world

Forget peak oil, scientists warn us in 1976 that future food production could be constrained by 'peak phosphorus' as the world's population balloons.

1977

1. Solar air-conditioning

With more than 1000 watts per square metre pouring down from Australia's clear blue skies, ECOS talks to scientists about the feasibility of solar cooling and air conditioning – work that later contributes to [solar cooling solutions for rural villages in India](#).

2. New deserts, thanks to humans

Human-caused 'desertification' precipitated the 1974 famine in Ethiopia and laid waste to other areas of subsistence agriculture bordering the Sahara. Identifying the problem has since enabled affected regions to devise solutions. In China, reforestation has [transformed the Loess Plateau](#) from barren brown to fertile green.

1978

1. Next year's weather — the largest experiment ever

While today we take weather and climate predictions for granted, in 1978 meteorologists were seeking to understand the unknown through an ambitious Global Weather Experiment: at the time, the largest scientific experiment ever undertaken.

2. [Photovoltaic cells: turning sunshine into electricity](#)

Another thing we take for granted today – photovoltaic (PV) solar panels on suburban rooftops. In 1978, CSIRO was part of a global research effort to develop applications for the then-emerging technology of photovoltaics.

1979

1. [Solar house checked out](#)

Scientists fit out the first energy-efficient house with sensors and automated appliances to determine how features like solar hot water, thermal-mass floors, insulation and passive solar design can save energy use and power bills. This research contributes to the development of later energy star-rating schemes for new houses, such as NatHERS (National House Energy Rating Scheme).

2. [A high-country perspective](#)

Early investigation into cattle grazing in alpine national parks – still a contentious issue for graziers and ecologists.

1980

1. [Praying mantis preys on birds and frogs](#)

A scientist's gruesome account of carnivory in the insect world.

2. [The world's deadliest snake](#)

When a Queensland resident sent some snake venom samples for analysis, researchers discovered that the snake – Queensland's inland taipan – had the most potent venom, mL for mL, of any snake in the world.

3. [Wombats from space](#)

The Great Wall of China isn't the only built structure visible from outer space. Satellite images of mysterious white patches on the southern fringes of the Nullarbor Plain proved to be colonies excavated by the hairy-nosed wombat, *Lasiorninus latifrons*.

1983

1. [Drought and the El Nino phenomenon](#)

A crucial link is made between periodic warming of the western Pacific ocean, and drought in southeastern Australia.

1984

1. [How bushfires set houses alight: lessons from Ash Wednesday](#)

Until the 2009 Black Saturday fires, Victoria's most devastating bushfire was the one that occurred on Wednesday 16 February 1983. Within a day of that disaster, CSIRO researchers began a detailed study of the effects of fires on buildings. Why did one house burn while the one next door survived? After Black Saturday, we have [even more insight into this issue](#).

2. [Buffalo in the Top End](#)

In 1984, there were around 250,000 Asian water buffalo trampling the coastal floodplains of the Northern

Territory. The extent of the devastation was enormous.

1987

1. [Prepare now for climate change, scientists warn](#)

‘Scientists have been talking for years about the possibility of global climate change from the warming effects of extra carbon dioxide....Now, however, a general warming trend has been firmly established, and laboratories around the world have become more confident about their predictions.’

1991

1. [How high could the seas rise?](#)

With growing awareness of climate change came predictions of sea-level rise that ranged from the very small to catastrophic. CSIRO oceanographers develop a model that takes into account the complexities of the systems that contribute to sea level rise.

1994–95

1. [Car sharing could halve vehicle use](#)

Well before the advent of Uber and today’s car-sharing schemes, researchers help a Melbourne company develop Easy Share, an ‘instant’ carpooling system based on computer scheduling and deployment systems used in the freight sector.

2. [Ant antics](#)

Dr Alan Andersen identifies ants as reliable indicators of environmental change, enabling his team to cost-effectively assess the environmental impact of mining.

3. [Exposing the private lives of emus](#)

A study of emus near Canberra find they may be the most promiscuous birds in the world.

4. [The case of the disappearing frogs](#)

When Queensland’s tropical frog populations start disappearing, scientists begin to suspect a virus is involved. We now know it was not a virus but the chytrid fungus, which has since decimated frog populations around the world. CSIRO scientists were part of a global team that eventually identified chytrid fungal disease.

5. [Irrigation at the crossroads](#)

Experts discuss the new era of irrigation that we know today, built on water pricing, tradeable water rights and allocations for environmental flows.

6. [Seed saviours](#)

A botanist works with Aboriginal communities to collect seed from 30 acacia species traditionally used as food plants in central Australia – one of many collaborations over the years between scientists and indigenous communities on indigenous health, culturally encoded ecological knowledge, bush tucker and working on country.

7. [Scientists rat on beastly names](#)

Four researchers advocate using the indigenous names of native rodents...to engender more public support for these creatures!

1997

1. Sharks: looking beyond the bite

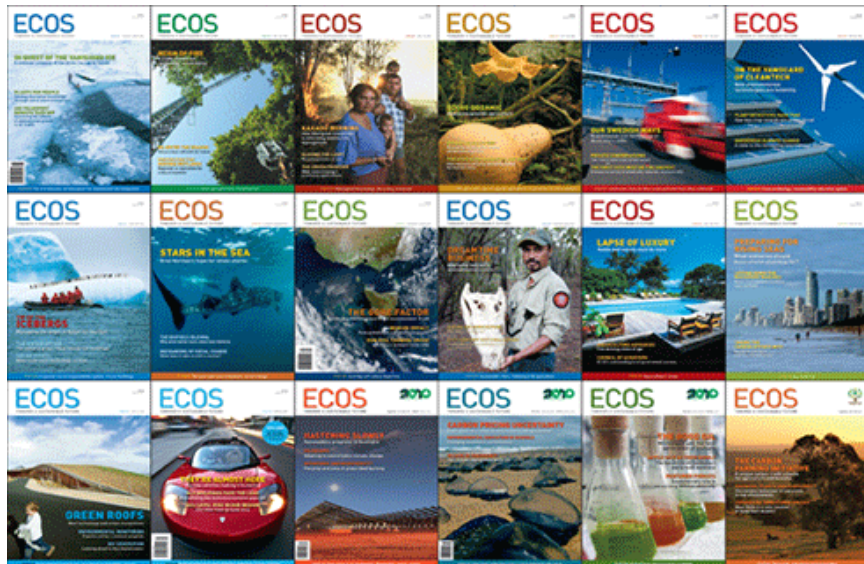
It's still a vexed issue – but in 1997, CSIRO was already working with the fishing community and other scientists to better understand the role played by sharks in ecosystems.

2. Can quolls be our companions?

Some scientists say keeping native animals as pets may be a good way to conserve them and boost their public image – what more likely creature than the native cat?

3. Taming wild limes

Six varieties of native citrus – adapted to low rainfall and poor soils – are evaluated for their commercial potential at CSIRO's former regional lab in the Sunraysia town of Merbein, Victoria.



Credit: CSIRO Publishing

2001

1. Breath-testing the savanna

Through a project called (OzFACE, the Australian Free Air Carbon Dioxide Enrichment Study) Australia's tropical savannas become the focus of world-first research into the effects of rising carbon dioxide levels on a natural tropical ecosystem.

2. Thinking urged on the Free Trade Agreement's environmental impact

There's another side to free trade agreements apart from economic benefits: the impact on the sustainability of Australia's natural resources. Experts note a need for formal environmental impact assessments, including associated legal and policy issues.

2004

1. Costing Mother Nature's service

Australia was leading the world in assessing and valuing the 'free' ecosystem services provided by Nature: the production of food and water; the control of climate and disease; the provision of nutrient cycles and crop pollination; and the spiritual and recreational benefits.

2. Meat diets drive water consumption

A person's diet, not how long they spend in the shower, is the main determining factor in per capita water consumption, with meat requiring vastly more water to produce than most other food.

3. [Returning the lifeblood to rivers](#)

The emerging science of environmental flows is providing overwhelming evidence of the damage inflicted on Australian rivers and estuaries, and is now developing solutions to restore river environments.

2006

1. [Shower with air to save water](#)

Researchers at CSIRO's Manufacturing and Materials Technology develop a showerhead that saves up to 20,000 litres of water per year per household.

2. [Stars in the sea](#)

Driven by a love of the sea and its largest fish, the elusive whale shark, Australian naturalist Brad Norman creates a worldwide photo-identification system that enables fishers and divers to assist in its conservation.

2007

1. [Outflanking the Laotian rice thieves](#)

Research on mouse plagues in the Australian wheat belt helps farmers in Asia reduce rice losses and other damage from local rodents.

2. [Sea rangers close in on Gulf's killer nets](#)

Along Australia's remote northern coastline, indigenous sea rangers have been working with government and nongovernment organisations to clean up a deadly threat to marine life.

2008

1. [Supermodelling the Murray–Darling](#)

How does the Murray–Darling's complex water system work, how do we measure its capacity under increasing demands, and how do we understand the implications for local communities? The Murray–Darling basin Sustainable Yields Project – at the time, the most ambitious resource inventory attempted anywhere in the world – met that challenge.

2. [Population: the lost priority](#)

Australian authorities on population growth warn that the fundamental priority of the Earth's real limits to growth are being perilously overlooked.

3. In the same year, ECOS looked at the [rise of the green city in China](#) and the threat of [acid oceans](#).

2009

1. [Guardians of the electric reef](#)

In Bali's idyllic north-west corner, a community-driven project uses electricity to rapidly regrow damaged coral reef and restore local livelihoods. It delivers safe, low voltage electrical currents to submerged metal structures causing dissolved minerals to crystallise out as white limestone and accelerating the formation and growth of corals. The structures are colonised by fish, crabs, clams, octopus, lobster, sea urchins and other reef life.

2010

1. [Learning from the locals](#)

Why does a Tammar wallaby produce less methane, a potent greenhouse gas, than a cow? The answer lies in the microbiome of the macropod's special foregut and could lead to innovations such as enzymes for more efficient processing of plant biomass in ethanol production, or probiotic additives for livestock feed.

2011

1. [Moving on: Relocating species in response to climate change](#)

Global warming is not just threatening biodiversity – it's challenging the way scientists think about conservation. How can a species be saved in place if its habitat disappears under climate change? Managed relocation may preserve some species for the future, but its success will rely on good science.

2. [Green roofs and walls are growing up](#)

Environmental roof and wall installations take off as architects, engineers, landscape gardeners, horticulturalists and ecologists collaborate on a new urban technology.

3. [Meeting challenges at the energy–water–carbon interface](#)

The linkages between energy, water and carbon emissions run deep, and call for new ways of thinking about people and their environment: desalination plants guzzle energy, for example, and forests planted to sequester carbon reduce river flows. 'Energy, water and carbon are literally the cradle of life,' writes Dr Michael Raupach. 'About three-and-a-half billion years ago, on an Earth very different from the one we now inhabit, carbon-based molecules in a water environment started using energy to become organised and reproduce.'

4. [Is feeding wild birds OK?](#)

Ecologist Dr Darryl Jones looks at the pros, cons and precedents for feeding birds in your backyard.

5. [Adelaide a focus for the 'barcode of life'](#)

The world may contain up to 50 million species of plants and animals. But after 250 years of taxonomic research, less than two million have been named. How can we ever hope to get the job done? The solution may lie in a visionary plan to digitally barcode every species using 'bits' of DNA.

2012

1. [Macquarie Island is back in bloom](#)

Scientists are astounded at the rapid recovery of native vegetation on Australia's sub-Antarctic Macquarie Island after a massive effort to eradicate introduced rats, mice and rabbits.

2. [Secure social licence calls for 'big picture' thinking](#)

'Social licence to operate' has become central to the current debate between the mining and extractive industries and the community over activities such as coal seam gas (CSG) extraction in Queensland. But what does the term actually mean, and how is such a licence secured?

3. [Improving road safety for Australia's high-flyers](#)

Roads pose many risks to wildlife and could lead to the local extinction of many species. Given the number of major roads being built or enlarged as we try to accommodate ever-increasing volumes of traffic, we need to provide more structures to help wildlife cross the road.

4. [Do environmental assessments protect the environment?](#)

Are environmental impact assessments doing the job of protecting Australia's diverse environments and their inhabitants for future generations?

2013

1. [Some snakes are lovers, others are fighters](#)

Renowned Sydney University biologist, Professor Rick Shine, marks the Chinese Year of the Snake by sharing some insights into their world, including the fact the way males of some species entwine as a form of ritualised combat – what looks like mating is in fact the opposite.

2. [Indigenous intellectual property and desert knowledge](#)

CSIRO researcher Dr Jocelyn Davies discusses ethical and other issues involved in engaging with other cultures, and how Australia's desert heart might shape the nation's future.

3. [In search of evolution's footprint](#)

What kinds of wildlife do we have on this continent? Where are these species found? How have they evolved? How are they related to wildlife in other parts of the world? How can we conserve this natural heritage for future generations...all questions that drive the work of Leo Joseph, Director of the Australian National Wildlife Collection (ANWC).

2014

1. [How much suffering is OK when it comes to pest control?](#)

Dr Clive Marks – who was once involved with testing lethal chemical baits for pest animals – asks why animal welfare remains largely sidelined in the pest control debate.

2. [Birds on the edge: species at risk from climate change](#)

2002 was a dry year in the rainforests of Cape York and proved tough for local bird species, particularly the delightful white-faced robin. Of those that were tagged, only 25 per cent survived that year writes Professor Stephen Garnett, co-editor of the landmark [Climate Adaptation Plan for Australian Birds](#).

3. [Why collect?](#)

CSIRO is the custodian of many large biological collections – of insects, fish, seeds, plants, wildlife and algae – that contribute to national and international scientific knowledge. Why are specimen collections so important? Dr Jeff Leis, from the Australian Museum, explains.

4. [From the ground up, there is wealth in waste](#)

From 2009–10, Australia threw away 21.6 million tonnes of household and industrial waste. From repair cafes to research clusters, keeping resources out of landfill is better for the environment and economy.

5. [Off-grid megashift increasingly likely](#)

Mass grid defection by domestic and low-use electricity consumers in Australia is imminent. In 2013 CSIRO's Future Grid Forum saw industry players coming together to model energy futures. They projected that by the late 2030s, under business as usual conditions, disconnection could become a mainstream option.

6. [Hot and bothered](#)

What will happen to population health under climate change? What good, for example, would a painkiller be in the face of a prolonged heatwave? Or an anti-viral drug against dengue fever, if carrier-mosquitoes were to spread down Australia's the east coast?

7. [Bitterns boom in rice bays](#)

The largest population of Australasian Bitterns ever recorded has been found in Riverina rice crops, highlighting the potential role of rice growing – an industry often under fire for high water use – in waterbird conservation.

8. [Shifting lands: how international trade is transforming global biodiversity](#)

Global trade has led to an increase in the distance between where a product is produced and where it is consumed. Land displacement occurs when the resources consumed by people in one nation or region are produced on land in another.

9. [Pause for hope: de-carbonisation could halve CO2 emissions and enhance prosperity by 2050](#)

Researchers and economists say humanity can halve its carbon emissions by mid-century, using known technologies, and without compromising prosperity. The Deep Decarbonisation Pathways project involves researchers from Australia and other countries with high emission levels. The aim is to show how we can limit global warming to 2°C to avoid the worst climate change impacts by cutting emissions within each country, not trading offsets created offshore.

10. [Listening to the land](#)

Believe it or not, different vegetation communities have different soundscapes. Over the past decade, ecologists have begun using acoustic profiling to monitor changes in biodiversity wrought by human activity.

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