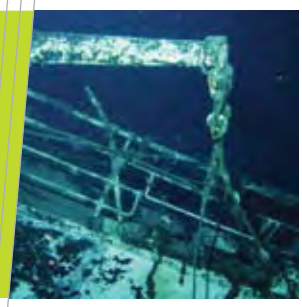
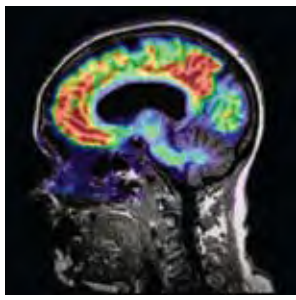
CSIRO

science: securing the future





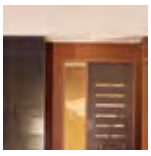
www.csiro.au

> a showcase of CSIRO activity **2009-2010**

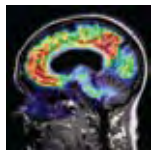
Australian Science, Australia's Future

Our purpose states:

By igniting the creative spirit of our people, we deliver great science and innovative solutions for industry, society and the environment.








© CSIRO 2010

This work is copyright. Apart from any use as permitted under the Copyright Act 1968, no part may be reproduced by any process without prior written permission from CSIRO. Requests and inquiries concerning reproduction and rights should be addressed to: CSIRO Communication General Manager, PO Box 225, Dickson ACT 2602

Printed on environmentally friendly paper.

Welcome

Looking back over the past year, I am extremely proud of the effort CSIRO has made to build on its remarkable track record of success and in doing so continues to make a positive impact on the social, environmental and economic wellbeing of Australia.

It is clear that the need for scientific knowledge and expertise is still incredibly strong and is necessary in understanding and providing tangible solutions to the global and national challenges we all continue to face. CSIRO continues to respond to this need, to anticipate future trends, challenges and opportunities, and focus our activity where it matters most to Australia and humanity. It is our duty and one we will not turn our back on.

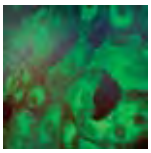
We are an organisation with goals and values that go beyond our science. We know we will be successful when our people always go home safely; our collaborators and partners realise lasting value from our science and involvement; our people share a sense of discovery, and we remain a trusted advisor to the people of Australia.

Our performance in 2009-10 has been strong. We have seen the value to our stakeholders and partners reflected in a record number of active licences for our innovations, a record level of external research services income and a record level of research activity. We have also responded quickly at home and around the globe to events such as biosecurity threats and food security issues.

Our world-class scientists have achieved great things again this year. Some of our achievements included the opening of Australia's first zero emissions house; our 'supergrain' BARLEYmax™ hit supermarket shelves in two new breakfast cereals; the Australian Square Kilometre Array Pathfinder telescope received its first radio signals; trainee surgeons are using our computer simulation technology to gain valuable experience in performing colonoscopies, and our fishery impact test has been adopted by many fishery managers around the world.

These are just some examples of our recent achievements and within these pages you will see further highlights across a number of key areas that are of major significance to Australia, and also the world. Many of our discoveries have been published in top scientific journals during 2009-10, or have resulted in licensing agreements, patents, and scientific breakthroughs. Each provides you with a reference for further information so you can discover more about the particular science and its outcomes.

I hope you enjoy reading about some of our recent achievements and view them, as we do, as important steps towards securing the future wellbeing and prosperity of Australia and indeed all humanity.




Dr Megan Clark
CSIRO Chief Executive

contents

Your CSIRO

CSIRO is Australia's national science agency and we are one of the largest and most diverse research organisations in the world.

We undertake world-class scientific research into practically all aspects of human activity and its interaction with natural and built environments. This scientific embrace includes our air and water, our diverse landscapes, oceans and climate, agriculture, energy, health, space technologies and exploration, manufacturing, materials science, minerals exploration and processing, information and communication technologies, and more.

We seek to make a difference with our research and generate impact for Australia now and in the future. We apply our knowledge to create jobs, national wealth, a healthy and sustainable environment and improved living standards for all Australians.

At CSIRO, people are the heart of our organisation and we pride ourselves on recruiting the best talent, where creativity and skill match enthusiasm for science and discovery. There is a real passion among our staff to make a difference, to explore new ideas and to play a part in something that is bigger than them alone. Today, we have over 6600 staff, located across 56 sites throughout Australia and overseas.

Our role in Australia's National Innovation System is unique, due to our size, our breadth and depth of capability, and our ability to conduct large-scale, multidisciplinary research focused on tackling the major challenges that matter to Australia's future. We respect this role and we take it on earnestly.

We address major challenges, and opportunities, largely through our National Research Flagships – one of the largest holistic scientific research programs ever undertaken in Australia that has become a well regarded model for delivering mission directed scientific research of national scale. We also understand the importance and value of partnering with the community, industry and other research agencies to collaborate with the best of the best around the world in order to deliver the impact required.

At CSIRO, we have a proud history of working for Australia. For more than 80 years we have been a trusted source of new and creative ideas that have contributed to Australia's nation-building, that have met some of our greatest technical challenges with practical technologies. These have generated enormous value, not only in the eyes of government and our partners, but also in the eyes of the Australian community. We have worked hard to build this trust and earn the community's confidence. We are proud of our record for science excellence and are committed to our role in sustaining Australia's prosperity and wellbeing.

Fast facts

> CSIRO stands for Commonwealth Scientific and Industrial Research Organisation.

> We are an independent statutory authority governed by the *Science and Industry Research Act 1949*.

> CSIRO ranks in the top one per cent of world scientific institutions in 14 of 22 research fields^.

> Our research delivers:
- integrated solutions to help address major national challenges
- technologies to transform or create new markets for Australian industry
- innovative technologies to improve the competitiveness of existing industries
- advice, information and research to meet specific community needs
- knowledge-based services to governments and businesses.

> We are a billion dollar enterprise. In 2009-10 we received Parliamentary appropriation funding of $704.9m and generated $459.2m in external revenue.

> Over 90 per cent of our total expenditure is directed towards Australia's National Research Priorities.

> We lead 10 National Research Flagships that bring focus and scale to research addressing some of Australia's most important and complex challenges and opportunities.

> We host three National Research Facilities and manage 10 national reference collections.

> The average citation rate for CSIRO's research publications is 13.83*. This is above the Australian average of 11.14 and the world average of 9.99.

> In the past year, our staff produced more than 4600 publications and 9800 client reports.

> In 2009-10 we reached 171 active licenses for our technologies and discoveries.

> Our staff provide a wide range of specialised technical and analytical services, ranging from analyses for air pollutants and satellite imaging to fire testing and diagnosis of exotic animal diseases.

> In 2009-10 we worked on over 4300 active research contracts serving small, medium and large businesses as well as the public sector.

> We undertook over 850 international activities under contract with partners in 50 countries.

> CSIRO is the single largest participant in the Cooperative Research Centre (CRC) Program, participating in 27 of the 53 centres as at May 2010.

> CSIRO is Australia's leading patenting enterprise, holding over 3900 granted or pending patents or other forms of intellectual property.

> More than 150 spin-off companies have been based on CSIRO generated intellectual property and expertise.

> Each year over 731,000 students, parents, teachers, and the public participate in a range of CSIRO education and visitor programs; plus we connect with over 3500 individuals through our Facebook and YouTube channels.

> At CSIRO, we value integrity of excellent science, trust and respect, initiative to explore, delivering on commitments, and safety and sustainability.

In brief – as at 1 July 2010

Organisation	
Total staff	6680
Research Divisions	15
Locations	56
National Research Flagships	10
Total budget 2009-10	$1164.1m

Research and outputs	
Total publications in 2009-10	4659
Total granted/pending patents	3900+

Partnerships and international	
Partners in National Research Flagship Program	400+
Research contracts	4366
International collaborative contracts	850

Education and outreach	
Supervised postgraduate students	840
Education program participants[1]	456,824
Enquiries received by CSIRO Enquiries[2]	33,619
Visitor Centre visitors[3]	274,289
Facebook fans and YouTube subscribers[4]	3527
CSIROpod / CSIROvod internet hits and YouTube downloads[5]	516,113+

1. Includes CSIRO Science Education Centres (386,500), Double Helix members (19,656), Science by Email subscribers (34,933), Maths by Email subscribers – began only in March 2010 (5461), CREST participants (8801), and Scientists in Schools partnerships (1473).
2. CSIRO Enquiries is CSIRO's central, single point-of-contact for external stakeholders including the general public and potential business partners both nationally and internationally.
3. Includes CSIRO Discovery Centre (94,365), Parkes Telescope Visitor Centre (112,342), and The Canberra Deep Space Communication Complex (67,582).
4. Facebook fans (3377), YouTube subscribers (150).
5. CSIROpod and CSIROvod provide the public with podcasts and vodcasts via the Internet. Figure consists of CSIROpod (362,665), CSIROvod (33,448), YouTube (120,000+).

^ Based on Thomson-Reuters/ISI Essential Science Indicators as at May 2010.

* Data updated as of 1 May 2010 to cover a ten-year + two-month period, 1 January 2000 to 28 February 2010.

Solving the energy puzzle

Powering the future is arguably the greatest environmental, economic and social challenge we have to resolve in the early decades of the 21st century.

CSIRO is tackling this challenge head on. Our $140 million per annum energy research portfolio is aimed at reducing greenhouse gas emissions, ensuring energy supply and maximising the country's wealth from our rich endowment of energy resources.

Our efforts to develop cleaner sources of energy like solar, geothermal and lower-emissions coal, as well as our research to improve our electricity networks and use energy more efficiently, are among the comprehensive range of activities we're undertaking. New technologies are also allowing us to exploit previously uneconomical and inaccessible oil and gas resources.

> Doors open on zero-emission house

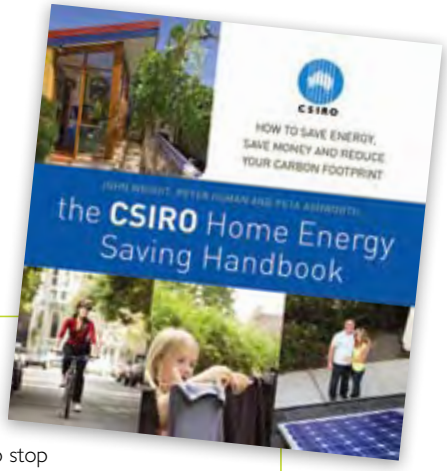
Australia's first Zero Emission House designed to fit the lifestyle, climate and budget of a typical middle income family, opened its doors in 2010 and may hold the answer to reducing energy use. Energy use in buildings is responsible for 26 per cent of Australia's greenhouse gas emissions – half of these emissions coming from people's homes. If all the new houses built in Australia between 2011 and 2020 were zero emission houses, 62 million tons of emissions would be saved.

> *More at www.csiro.au*

> The energy to save billions

A three-year study by CSIRO found that wide-scale adoption of distributed energy – technologies and systems that provide local generation of electrical power, energy efficiency and energy management – could reduce the cost of transitioning to a low-carbon future by as much as $130 billion by 2050. Distributed energy systems could include solar panels on a home for electricity generation, more efficient heating and cooling systems, or devices that can balance out energy demand and supply to reduce energy infrastructure costs.

> *Report: Intelligent Grid: A value proposition for wide scale distributed energy solutions in Australia, 2009*



> Energy book shows people the way

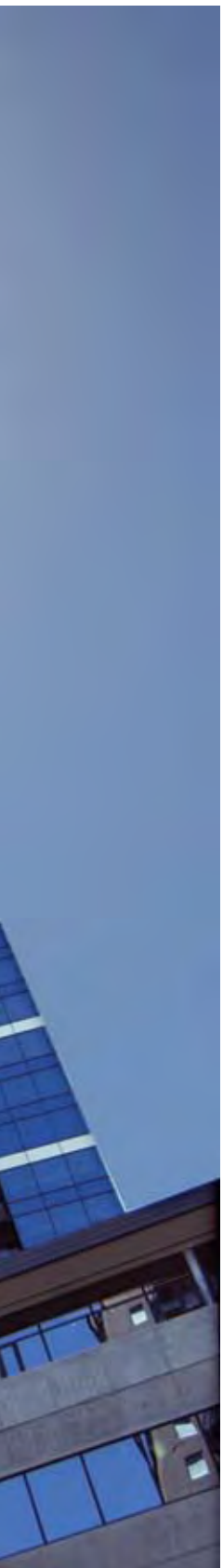
To give people the knowledge and tools to help stop climate change, *The CSIRO Home Energy Saving Handbook* hit the bookshops in September 2009. Authored by CSIRO energy experts, the handbook offers practical advice about reducing energy consumption, including tips on heating and cooling, shopping and transport and home renovations. The book has received significant interest from the public, media, industry and community groups, with over 13,000 copies already sold.

> *The CSIRO Home Energy Saving Handbook, 2009, published by Pan MacMillan*

> Worldwide reductions in energy for buildings

The worldwide commercialisation of CSIRO technology optiCOOL has helped building owners dramatically reduce their energy consumption and costs by up to 30 per cent. Under exclusive license to CSIRO start-up company BuildingIQ, optiCOOL intelligently alters the operation of a building's heating, ventilation and air-conditioning (HVAC) control system according to settings for cost savings, occupant comfort and energy efficiency. In Australia, over 60 per cent of energy use in commercial buildings comes from HVAC, so these technologies offer outstanding economic and environmental benefits.

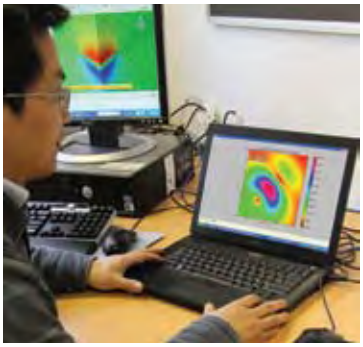
> *Licensed to BuildingIQ Pty Ltd*



> Advancing CO_2 capture technology efficiency

Marking an advance in reducing emissions from coal-fired power stations, CSIRO scientists have identified new solvents that are anticipated to be 30 per cent more efficient than current industry standards for post combustion capture solutions. The new solvents, which have an unusually high capacity for carbon dioxide (CO_2), were identified as part of a comprehensive screening study and are the subject of a patent application. The solvents are currently being trialled in one of CSIRO's post combustion capture pilot plants in Australia.

> *Patent No. WO2009121135-A1*



> Increasing the efficiency of stimulation

Hydraulic fracturing is a powerful stimulation technology used to precondition rock for caving in mining, and increase recovery rates of natural gas from coal seams. CSIRO scientists have developed a way to measure and analyse the orientation and volume of hydraulic fractures in real time. This information is critical to develop better methods of fracturing rock. This novel technique will enable advancements in hydraulic fracturing that could lead to increased production from coal seams and more productive mining conditions.

> *Patent No. US7677306B2*

CSIRO methods making more fuel

The ability to cost-effectively transform Australia's abundant natural gas resources into liquid transport fuels – a process known as Gas-to-Liquids or GTL – will contribute to the nation's fuel security and self sufficiency. Recognising this, CSIRO researchers have been working to produce efficient, lower-cost processes that can convert gas into liquid fuels such as diesel and gasoline. This research has resulted in a new process that uses energy generated during the GTL process for electricity generation. This approach could reduce GTL operating costs and the carbon footprint of the process.

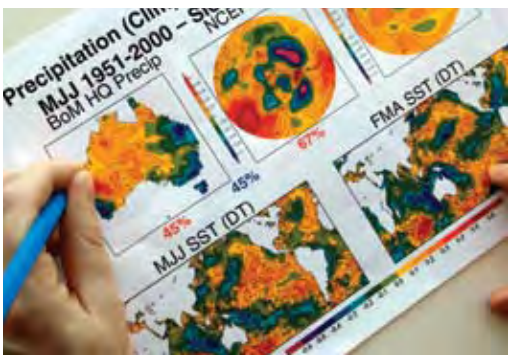
> *Patent No. WO2006066335-A1*

The science of climate change

Climate change is one of the most profound global challenges of our future.

For Australia, the climate change threat is urgent. We occupy the driest inhabited continent with a climate characterised by extremes of flood, fire and drought. Scientific research has a critical role in providing information and advice to support decisions on how Australia responds to the unavoidable impacts of climate change.

CSIRO is tackling this challenge and understands that a comprehensive response covering three spheres of action is needed: ongoing research to better understand the Earth's changing climate, adaptation to prepare for unavoidable impacts, and identifying ways to reduce greenhouse gas emissions.



> Collaboration sends clear message on climate change

More extremely hot days, fewer cold ones, wetter in the north and drier in the south: this is not a forecast for Australia's climate but a snapshot of our climate now. CSIRO and the Bureau of Meteorology released *State of the Climate* and with it a clear message to the Australian community that climate change is real. The snapshot provides Australians with an easily accessible update about how our climate has changed and what it means. It will help individuals to be better prepared to adapt to a changing climate and to take action to reduce the impacts of climate change.

> *Snapshot: State of the Climate, 2010*

> Weeds move on with climate change

Weeds are a major threat to Australia's biodiversity and agricultural areas, costing more than $4 billion a year in control and lost production. Using climate projections to 2080, CSIRO research has shown that in South Australia under a changing climate, increased temperatures will enable many weeds to invade new areas – landholders may have to deal with species where they have no past experience. However, the research also found that by heeding the early warning of projected climatic changes, managers may be able to reduce weeds in some areas as the climate becomes less suitable.

> *Report: Climate change and invasive plants in South Australia, 2010*

> Global carbon emissions rise despite GFC

Despite the economic effects of the global financial crisis, global carbon emissions are rising. Research involving CSIRO found that fossil fuel emissions increased by 29 per cent between 2000 and 2008, with a two per cent increase in 2008. Further, carbon dioxide (CO_2) emissions from human activities are at an all-time high of 1.3 tonnes of carbon per capita per year. Reducing climate change impacts requires the stabilisation of atmospheric CO_2 concentrations, which requires a global effort to accelerate reductions in emissions from human activity.

> *Nature Geoscience, 17 November 2009*

> Index solves south-west WA rainfall riddle

CSIRO scientists have developed a new climatic index to explain why rainfall in south-west Western Australia has been declining since the 1970s. The Southwest Australian Circulation Index (SWACI) assists in predicting annual patterns of wet season rainfall and long term drying trends. Using SWACI scientists have determined that a weakening circulation over the Indian Ocean is delivering more high pressure systems early in the winter wet season, explaining the rainfall decline. The WA Government is using SWACI to help forecast seasonal rainfall to assist farmers with agricultural management decisions.

> *Journal of Climate, March 2010*

> Victorian bushfires linked to ocean temperatures

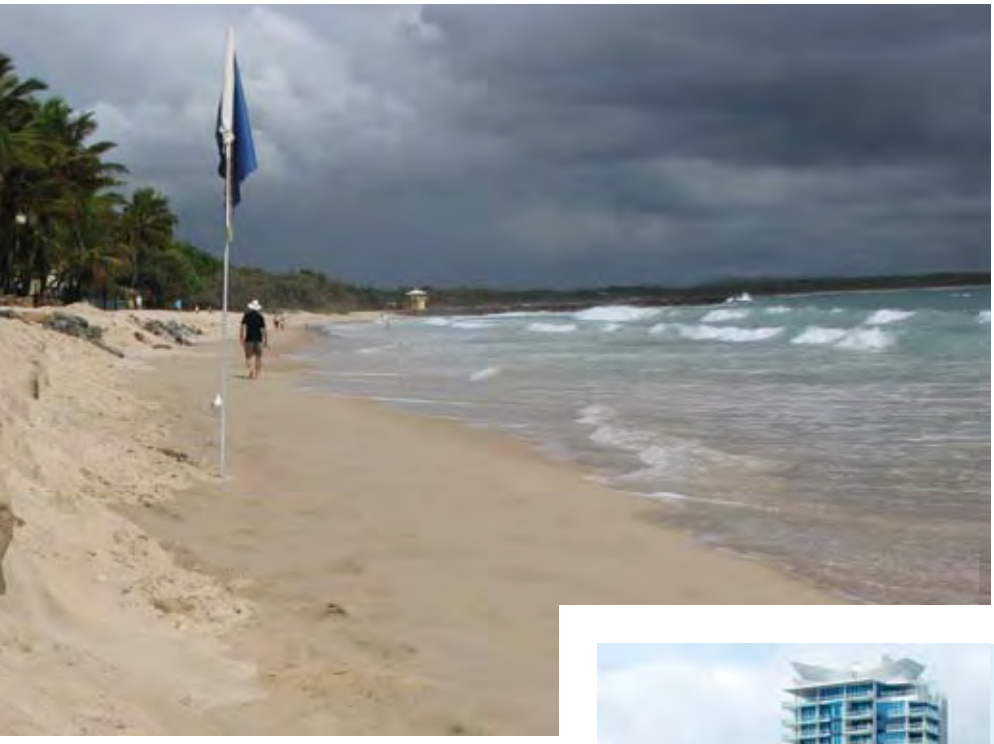
Weather conditions that led to Victoria's past two catastrophic bushfires – Ash Wednesday and Black Saturday – may be linked to lower than normal sea-surface temperatures in the eastern Indian Ocean. This type of occurrence is referred to by scientists as a 'positive' Indian Ocean Dipole. These conditions tend to induce lower than average rainfall and higher temperatures over south-eastern Australia. Research showed that of 16 such events since 1950, 11 were followed by major bushfires, and of the past 21 major bushfires, 11 were preceded by positive dipoles.

> *Geophysical Research Letters, 9 October 2009*

> Building with bushfires in mind

With research and industry partners, CSIRO is providing insight into affordable options for residential properties in bushfire prone areas. An experimental burnover house made almost entirely from steel, similar to a small family home, was flame-tested in a large bushfire flame front simulator to see how the structure withstands realistic bushfire conditions. The tests revealed valuable new information about building construction and materials under bushfire conditions that are now informing further research to support better housing design and inform building codes.

> *More at www.csiro.au*



> Cooperating to solve global environmental problems

Water crises, declining fisheries and increasing antibiotic resistance are some examples of today's environmental challenges. Finding solutions requires nations to cooperate for their collective good. This is the conclusion of a group of international scientists including CSIRO who advocate a new approach: effective cooperation facilitated by better-designed institutions. In this approach, nations gain by cooperating to address global-scale problems. The challenge though is to design international institutions that create incentives to reward cooperation and sanction violations.

> *Science, 11 September 2009*

> Healthy planet a delicate balance

A group of international scientists, including CSIRO, has developed a new approach to help safeguard the world from dangerous levels of climate change and other global environmental threats. Based on the concept of planetary boundaries, the group provides first estimates of the critical levels within which the world can operate sustainably and beyond which unacceptable changes and consequences to human and environmental wellbeing are likely to occur. Planetary boundaries are identified for nine key challenges including climate change, biological diversity and chemical pollution.

> *Nature, 24 September 2009*

> The costs of adapting now versus later

A CSIRO study shows considerable financial benefits from proactive, planned adaptation for built infrastructure in south-east Queensland. A preliminary assessment has investigated both costs and benefits of proactive adaptation by estimating the population and economic effects of a historical 1-in-100-year inundation event and exploring how these may change under different scenarios of settlement adaptation in 2030 and 2070. The findings provide a starting point for Australia's management of elevated coastal risks due to expected sea level rise and increased storm intensity in the context of a growing coastal population.

> *Report: Coastal inundation under climate change: a case study in South East Queensland, 2010*

Securing our water for future generations

Water is central to human life – biologically, environmentally, economically and socially. The sustainable management of water resources is therefore vital, and it is a challenge facing many around the world.

For Australia, as one of the driest continents, efficient and sustainable water use is critically important. As demand for water increases, the climate changes and options for new storage sites become economically or ecologically unviable, we must look to new strategies that reduce demand, increase efficiency of use, recycle wastewater and allow water to be traded.

CSIRO is doing the research to provide a better understanding of our environmental, production, supply, treatment, and reuse systems to secure the future sustainability of our valuable water resources. Our science is informing the decisions on where and how to best invest in these strategies and is providing enabling technologies.

> Where to water the Murray-Darling Basin

Knowing how much water is needed at different locations to provide a given level of environmental protection is incredibly important. CSIRO research is helping water managers to improve and justify delivery of environmental water to Murray-Darling Basin 'icon sites', and wetlands that are of international significance, such as the Macquarie Marshes, Gwydir Wetlands and Narran Lakes. A major outcome from the research is a model that for the first time provides a tool to predict the effect of flooding regimes on floodplain habitats, wetland connectivity and the health of vegetation, fish and other animals.

> *Report: Ecological Outcomes of Flow Regimes in the Murray-Darling Basin, 2010*

> Safeguarding Australia's water future

CSIRO has delivered crucial new water information fundamental to the sustainable management of water in Northern Australia, Tasmania and south-west Western Australia. The three projects, commissioned by the Council of Australian Governments, follow on from the highly successful Murray-Darling Basin Sustainable Yields project conducted by CSIRO in 2008. Together these projects have delivered the most comprehensive and complex water assessments ever undertaken for each of these regions, providing a consistent analytical framework for water policy decisions across the nation. This knowledge underpins sustainable water management for current and future developments and for a future affected by climate change.

> *All Sustainable Yields project reports are available at www.csiro.au*

> More than just hot air

CSIRO is working on a membrane process that could save industry millions of dollars and help protect the environment by separating and recovering steam from industrial vent gas. Currently, industry converts over 70 per cent of fuel purchased for energy into steam. After use, the steam is condensed into water or discharged into the atmosphere, resulting in energy losses and environmental issues. Pilot plant testing has shown that the new process can recover high-temperature industrial steam, allowing its reuse in industrial processes.

> *Patent No. PCT/AU2009/000386*

> National standard for water data exchange

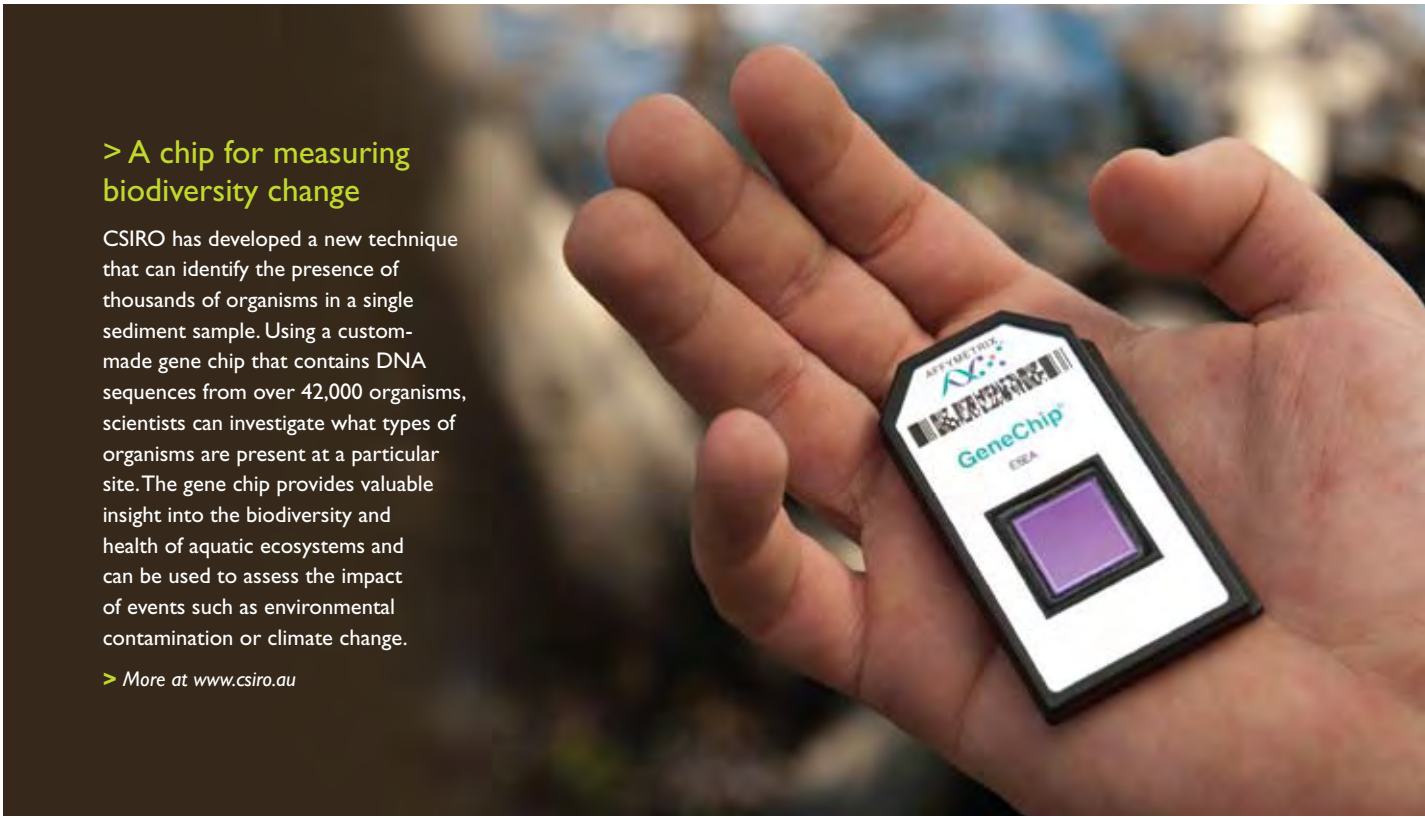
CSIRO and the Bureau of Meteorology have developed a new data transfer format which enables the Bureau to produce a clearer picture of Australia's water resources. The Water Data Transfer Format allows more than 200 data providers to efficiently provide millions of electronic data files to the Bureau annually. This research is helping to streamline the development of state-of-the-art water resources assessment and accounting systems.

> *More at www.csiro.au*

> A chip for measuring biodiversity change

CSIRO has developed a new technique that can identify the presence of thousands of organisms in a single sediment sample. Using a custom-made gene chip that contains DNA sequences from over 42,000 organisms, scientists can investigate what types of organisms are present at a particular site. The gene chip provides valuable insight into the biodiversity and health of aquatic ecosystems and can be used to assess the impact of events such as environmental contamination or climate change.

> *More at www.csiro.au*



> H_2O 4U – SMS saves precious water

CSIRO and the CRC for Irrigation Futures have developed a novel solution using satellite and mobile phone technology to deliver real water savings for irrigators at a low cost. IrriSatSMS combines remote sensed satellite crop imaging with weather data to calculate crop water use and sends farmers a daily SMS outlining the most efficient water schedule tailored for each farm and paddock. The success of IrriSatSMS in helping manage high security water in the Murrumbidgee Irrigation Area has seen its use extended to other irrigation areas across Australia.

> *More at www.csiro.au*

> Is there oil in that soil?

CSIRO and partner have developed a revolutionary technique for the rapid on-site detection and quantification of petroleum hydrocarbons (commonly derived from crude oil) in soil, silt, sediment, or rock. The technique removes the need to take samples or perform any kind of processing. It could be used for oil exploration purposes as well as for assessing and monitoring contaminated sites, such as coastal land following off-shore oil spills and industrial sites planned for urban redevelopment.

> *Patent No. PCT/AU2010/000804*

> Surfing beats digging for grain farmers

The available water capacity for plants for 600 soil types can now be found by surfing the web, thanks to information developed by CSIRO and partners. Available through Google Earth, it provides regionally specific soils information to primary producers and their consultants to enable better matching of scarce water resources for crop production to seasonal conditions, crop type and management inputs.

> *Crop & Pasture Science, Vol 60(11), 2009*

> Intelligent integrated sensor network

CSIRO and Seqwater have developed a cost-effective, fully integrated, accurate, scalable, and automated environmental monitoring system to remotely monitor water quality, event flows and greenhouse gas emissions in real-time. A proof-of-concept system is currently monitoring Lake Wivenhoe and its catchment – Brisbane's major source of drinking water. This integrated sensor network, dubbed iSnet, comprises 120 static nodes – some floating, some in the surrounding catchment – 30 mobile nodes attached to grazing cattle, and an autonomous robotic catamaran. iSnet is boding well to underpin the next generation of water quality monitoring systems.

> *Journal of the Australian Water Association, September 2009*

From farm to fork

Providing safe and nutritious food and agricultural products is central to our social and economic wellbeing. The big challenge for the 21st century is centred around food security – increasing agricultural productivity to meet the demands of a growing global population, whilst reducing greenhouse gas emissions per unit of food.

One of Australia's greatest natural advantages is its capacity to produce healthy, high quality and sustainable foods for local and international markets. The national challenge is to maintain and build on this ability.

CSIRO is enhancing Australia's food production systems through an integrated 'farm-to-fork' approach. We are delivering science to enable increased productivity and efficiencies at the farm level, improving the quality and yield of Australian crops, developing innovative food processing technologies, creating new value-added foods, and developing our livestock, aquaculture and fishery industries.

> New barley for better health

Developed by CSIRO, BARLEYmax™ is a natural wholegrain barley with enhanced nutritional benefits. Designed to improve health and wellbeing, this 'supergrain' contains twice the dietary fibre of regular grains, four times the resistant starch, has a low glycemic index and has a positive impact on indicators of bowel health. The first breakfast cereals made from *BARLEYmax* were launched in 2009 with exceptional sales to date. *BARLEYmax* is the first novel grain in an ongoing program delivering value added grains for farmers, food manufacturers and consumers.

> *Licensed to Popina Food Services • Read a full profile on page 44*

> Female only chickens

Scientists have solved the long-standing mystery of what determines sex development in chickens. New research by CSIRO scientists and collaborators has successfully manipulated chicken embryos to bring about male to female sex reversal. This discovery has major potential application in the poultry industry, particularly in the egg industry, whose lack of requirement for male chickens presents a challenge globally for animal welfare.

> *Nature, 26 August 2009*

> Better wheat for salty soils

In a major breakthrough for wheat farmers in salt-affected areas, CSIRO researchers have developed a salt tolerant durum wheat that yields 25 per cent more grain than the parent variety in saline soils. Salinity in soil often prevents farmers from growing durum wheat, but this breakthrough will enable wheat farmers to achieve higher yields of durum wheat in previously unsuitable areas. Although durum wheat is less salt tolerant than bread wheat, it attracts a premium price because of its superior pasta making qualities.

> *Functional Plant Biology, 25 February 2010*

> Is this the perfect prawn?

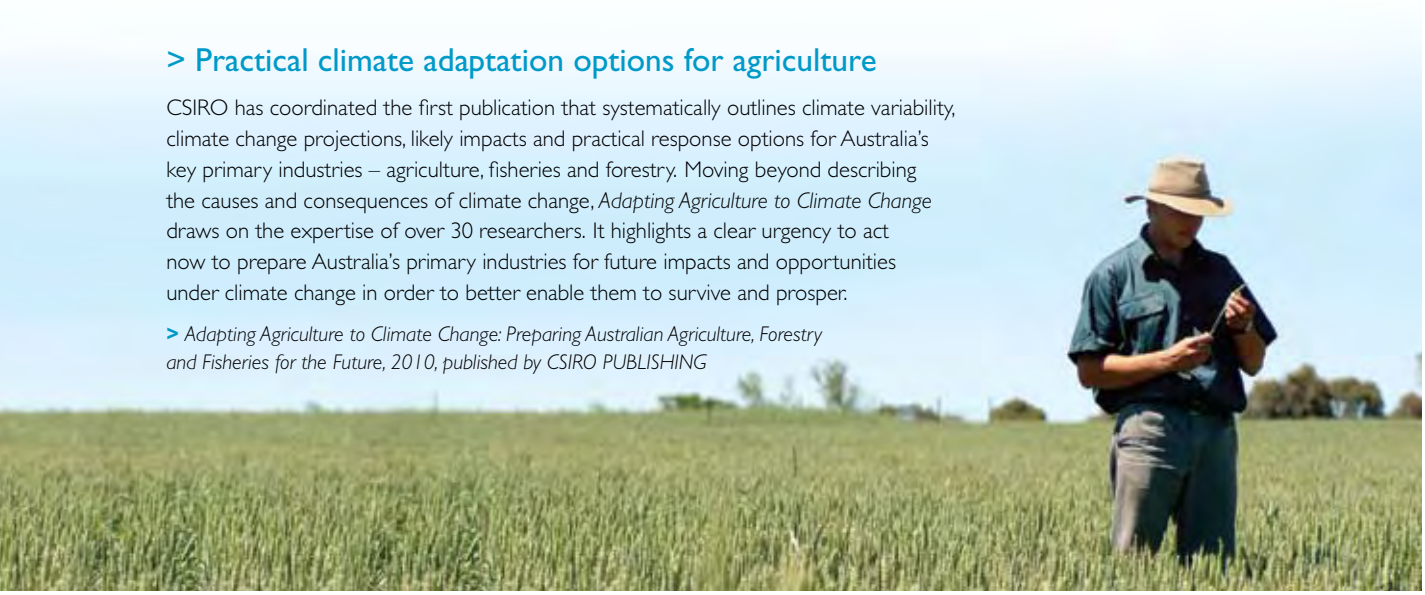
After 10 years of careful breeding and research, CSIRO scientists, in collaboration with the Australian prawn industry, have developed what could be the world's most perfect prawn. They have bred a 'domesticated' Black Tiger prawn that is producing record yields and further boosting the performance of local stocks each breeding season. With about 50 per cent of all prawns sold in Australia currently imported, developing an Australian prawn that sustainably breeds in captivity is a major gain for the local prawn industry and consumers wanting to buy Australian seafood.

> *Commercialised via partnerships with three of Australia's leading prawn farming companies*

> Practical climate adaptation options for agriculture

CSIRO has coordinated the first publication that systematically outlines climate variability, climate change projections, likely impacts and practical response options for Australia's key primary industries – agriculture, fisheries and forestry. Moving beyond describing the causes and consequences of climate change, *Adapting Agriculture to Climate Change* draws on the expertise of over 30 researchers. It highlights a clear urgency to act now to prepare Australia's primary industries for future impacts and opportunities under climate change in order to better enable them to survive and prosper.

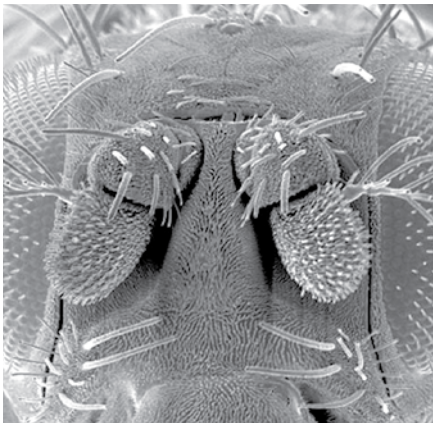
> *Adapting Agriculture to Climate Change: Preparing Australian Agriculture, Forestry and Fisheries for the Future, 2010, published by CSIRO PUBLISHING*



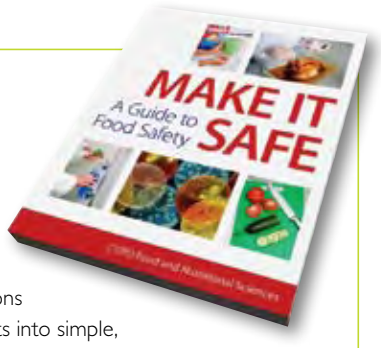
> Electronic nose verses the fly

CSIRO scientists have made a breakthrough in efforts to extend the sensory range of electronic noses – devices designed to detect odours and chemicals – by developing a system for comparing their performance against the much-superior nose of the vinegar fly. Although e-noses already have many uses – such as detecting spoilage in the food industry and monitoring air quality – current devices are not as discriminating as biological noses. CSIRO's new system enables comparison of technical sensors with biological sensors which is helping design better e-noses and improving our understanding of how biological systems work.

> *PLoS ONE, 29 July 2009*



> Safer food by the book



CSIRO has released *Make It Safe: A Guide to Food Safety*, which provides small-scale food manufacturers with a practical guide to controlling food safety hazards. The book translates sometimes complex descriptions of food safety practices and requirements into simple, easy to understand English. *Make It Safe* will help manufactures deliver even greater levels of food safety in Australia, reinforcing our position as a source of high quality food products.

> *Make It Safe: A Guide to Food Safety, 2010, published by CSIRO PUBLISHING*

> Faster, smarter measurement for cotton

The cotton industry is set to benefit from the production of 'Cottonscope' – a fully automated microscope that rapidly measures cotton fibre fineness and maturity directly and accurately in 25 seconds. The measurement can help determine when a crop is mature enough for harvest and thereby reduce the likelihood of potential 'textile consequences' to exist, which degrade overall yarn and fabric quality. Cottonscope's ability to monitor characteristics of various cotton breeds also helps select better cotton varieties and ultimately results in the production of higher quality fabric.

> *Licensed to start-up Australian company Cottonscope Pty Ltd*

> More food, less impact

In the context of global food security, Australian agriculture must achieve necessary productivity gains in an environment where land, water, nutrient, energy and labour resources are more constrained and competition for these resources more intense. CSIRO launched its Sustainable Agriculture National Research Flagship in February 2010 to focus on these challenges with Australian farmers, industry and government. The Flagship is also developing strong international research partnerships that are actively increasing production of major food and tree crops in countries like Africa, India and China.

> *More at www.csiro.au*

> Aphids teach scientists a thing or two

An international consortium has unravelled the genome of the pea aphid and taken a major step towards understanding how to better control this bane of farmers and gardeners around the world. CSIRO's researchers have revealed which genes control what function in the aphid, providing valuable insights into how information in the genome is passed from generation to generation without any change in the genome's basic building blocks. This sort of 'epigenetic' information is now known to be important in controlling diseases such as cancer and diabetes.

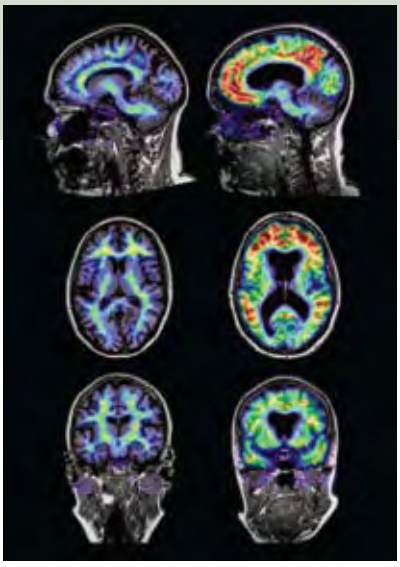
> *PLoS Biology, 23 February 2010*

Improving Australians' health and wellbeing

> Uncovering early stages in Alzheimer's disease

A study involving CSIRO scientists, and collaborators at a number of Australian universities and institutes, has provided new insights into the loss of structure in regions of the brain and its potential association with Alzheimer's disease. The study involved advanced techniques for analysing and comparing different types of brain scans. By helping to better understand the mechanisms involved in the progression of the disease, this study may guide the development of new strategies for early diagnosis.

> *Neurology, January 2010*



Chronic diseases have a growing impact on health and wellbeing and are increasingly costly for healthcare systems around the world. This, together with ageing populations, requires innovative healthcare solutions to prevent or delay such diseases, improve people's health and contain escalating healthcare costs.

For Australia, the protection and maintenance of public health is imperative for our prosperity in terms of social and economic wellbeing, workforce participation and increased productivity.

CSIRO is providing a positive impact on the health and wellbeing of Australians through research into prevention, early detection and better treatment of a range of diseases and debilitating degenerative conditions. Each year we invest more than $150 million in health-related research across fields such as nutrition, disease prevention, biomedical devices and implants, medical imaging and information processing.

> Investigating bioactives to protect against Alzheimer's disease

CSIRO has been researching how food components and small molecule agents known as bioactives may provide protection against Alzheimer's disease. Scientists are investigating whether bioactives can reduce the amount of a particular protein in the brain which has been linked to Alzheimer's disease. Through this work, the team has developed unique methods of extracting bioactives from food and plants, which CSIRO is now patenting. Once extracted, these bioactives can be incorporated into protective foods, neutraceuticals and supplements for the prevention or treatment of disease.

> *Provisional patent filed 2009903699, 2009903698, and 2009905525*

> Personal patient data improves surgery success

CSIRO statisticians have developed a new statistical model that predicts a patient's chances of success for aneurysm surgery and guides post-operative care. The simple spreadsheet, developed with a project partner, allows surgeons to input variables such as age, gender, aneurysm diameter and level of creatinine in the blood to determine how well a patient might respond to surgery. It also alerts the surgeon to any likely post-operative complications so they can assess whether surgery is in fact the best option. Over 250 Australian surgeons have already downloaded this free tool making aneurysm surgery safer for many Australians.

> *More at www.csiro.au*

> Low-fat better for mood than low-carb

A CSIRO study has shown that people who lost weight by following a low-calorie, low-fat diet maintained a more positive mood, while those who followed a low-carbohydrate diet had a more negative frame of mind, despite initially recording positive mood improvements. Researchers concluded that this outcome suggests some aspects of a low-carbohydrate diet may have detrimental effects on mood. This effect, over the term of one year, may negate any positive effects of weight loss.

> *Archives of Internal Medicine, 9 November 2009*

> Biobank to aid disease prediction and diagnosis

CSIRO and partners have launched a new collaborative research cluster to establish a Biobank of blood samples for advancing research into the prediction and early diagnosis of serious health conditions such as Alzheimer's disease and cancer. The blood samples will be collected from more than 10,000 healthy elderly Australians. As cases of disease emerge amongst the volunteers, researchers will use the blood samples to carry out case-control studies to help develop diagnostic tests for age-related disease and disability, and to investigate factors that may contribute to healthy ageing.

> *More at www.csiro.au*

> New books extend contribution to healthy communities

In 2009, CSIRO launched *The CSIRO Wellbeing Plan for Kids* book which contains practical evidence-based information to help parents positively influence their children's eating and activity habits. Seven months later, *The CSIRO Total Wellbeing Diet Recipe Book* was released with further recipes consistent with the wildly successful CSIRO Total Wellbeing Diet. These books along with *The CSIRO Healthy Heart Program* now form a trilogy of programs that aim to tackle some of the nation's biggest health challenges.

> *CSIRO Wellbeing Plan for Kids, 2009; CSIRO Total Wellbeing Diet Recipe Book, 2010, published by Penguin Group (Australia)*

Knowing our oceans – securing our future

Australia's territory is half ocean, giving us one of the largest marine estates in the world and a predominantly coastal population. Despite this, our oceans are poorly understood and relatively unappreciated.

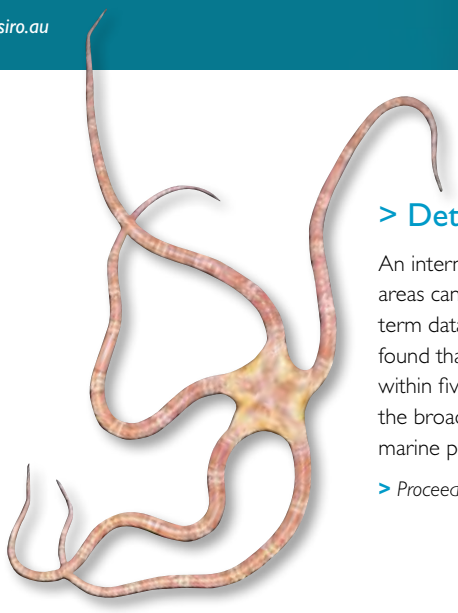
But this largely unexplored domain provides enormous opportunities for Australia to generate enduring social, environmental and economic wealth for today and tomorrow.

CSIRO research is providing leadership in understanding ocean systems, processes and technologies. We take a whole-of-system approach to marine science, focusing on national challenges where oceans play a central role. We deliver data, knowledge, tools and approaches that directly support sustainable ocean and coastal management and help Australia secure its future.

> BLUElink finds shipwrecks and tracks oil spills

BLUElink – a sophisticated ocean forecasting system developed by CSIRO, the Bureau of Meteorology and the Royal Australian Navy – helped the Australian and Queensland Governments successfully search for the Australian Hospital Ship *Centaur*, which was torpedoed in May 1943. To focus the search area, CSIRO provided information to expedition leader David Mearns, about the unusual ocean conditions when the ship was sunk, and BLUElink forecasts were used to help plan the search schedule. In 2010, BLUElink was also used to monitor the oil slick following the Montara well blowout and spill in the Timor Sea.

> *More at www.csiro.au*



> Detecting ecosystem impacts could take decades

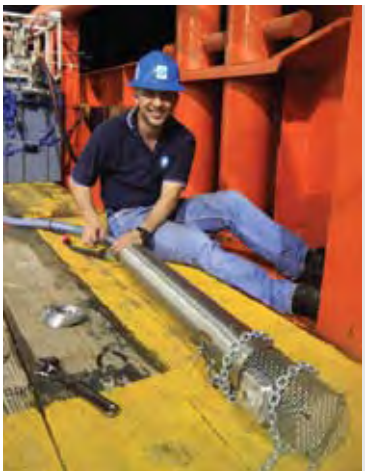
An international study led by CSIRO found that the effects of protecting marine areas can take decades to cascade through ecosystems. The team examined long-term data from New Zealand, Australia, California, the Philippines and Kenya. It found that the direct effects of protecting fished species are rapid, initially occurring within five years, but that it takes about 13 years to detect the indirect effects on the broader ecosystem. These findings will help with planning and monitoring of marine protected areas and ongoing conservation of our marine ecosystems.

> *Proceedings of the National Academy of Sciences, 23 February 2010*

> Benchmark for marine climate change impacts

The first Australian benchmark of climate change impacts on marine ecosystems and options for adaptation was launched in November 2009. The Marine Report Card summarises observations of impacts on 17 habitats and climate variables over recent decades, projecting forward to 2030 and 2100 with assessments of likely status. It suggests adaptation options for policymakers, industry and the community.

> *Global Change Biology, April 2010*



> Monitoring the Deepwater Horizon oil spill

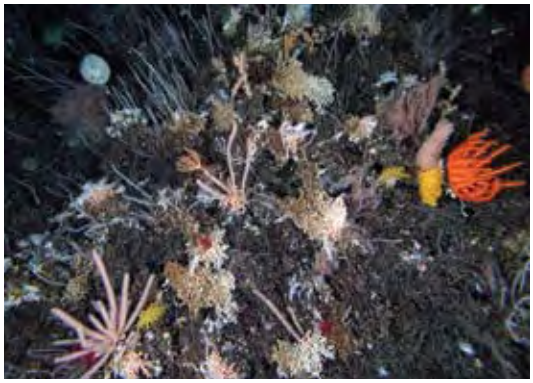
Since May 2010, CSIRO scientists have been deploying a system that detects the movement and location of oil released during the BP Deepwater Horizon oil spill. The hydrocarbon sensor array system, originally designed for use in petroleum exploration, can be used to detect various types of hydrocarbons – oil and natural gas – that may be present in the ocean. The data collected will help BP and US agencies to better understand the affected marine environment and aid in planning for future clean-up strategies.

> *More at www.csiro.au*

> Fishery assessment method catches on overseas

An Australian method, led by CSIRO research, for assessing the environmental impact of marine fisheries has been adopted in the United States, Canada, Ecuador and the Western and Central Pacific, and by the international eco-labelling organisation the Marine Stewardship Council. CSIRO's ecological risk assessment method considers intended and unintended captures; threatened, endangered and protected species; and marine communities and habitats. It contributes to the strategic assessment of fisheries and flags priorities for research, data collection, monitoring and management.

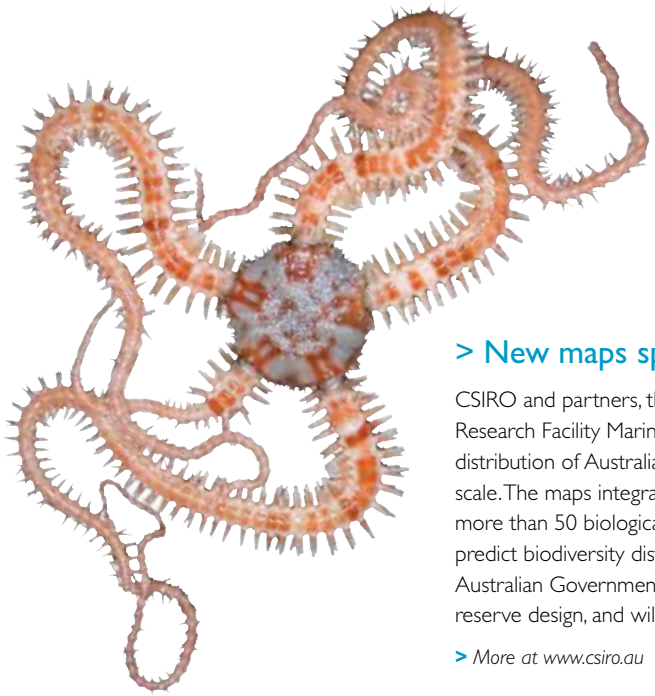
> *More at www.csiro.au*



> Atlantis finds the best in fisheries

CSIRO's marine ecosystem model Atlantis contributed to a groundbreaking study of the status and management of 31 fisheries worldwide. The international team of 19 researchers used Atlantis to examine trends in fish numbers and catches, and to highlight management approaches used to rebuild fish stocks. The study found that steps taken to curb overfishing were having success in five of the 10 large marine ecosystems examined, providing new hope for rebuilding troubled fisheries.

> *Science, 31 July 2009*



> New maps spotlight marine biodiversity

CSIRO and partners, through the Commonwealth Environment Research Facility Marine Biodiversity Hub, have mapped the predicted distribution of Australia's marine biodiversity at a one-square-kilometre scale. The maps integrate new national databases of 28 physical variables, more than 50 biological surveys, and new statistical approaches to predict biodiversity distribution. The maps are being used by the Australian Government to support bioregional planning and marine reserve design, and will contribute to the Atlas of Living Australia.

> *More at www.csiro.au*

> New ship reinforces marine science status

The Investigator, a new 85-metre research vessel, will significantly enhance Australia's ocean research capability and provide the opportunity for science to contribute to sustainable development and future management of ocean resources. With the capability to operate for 55 continuous days cruising at 12 knots over 10,000 nautical miles, the vessel will enable Australia to maintain its international position as a marine science nation. *The Investigator* is being designed, built and commissioned by CSIRO and will be completed in 2012.

> *More at www.csiro.au*

> Winds open window on the deep

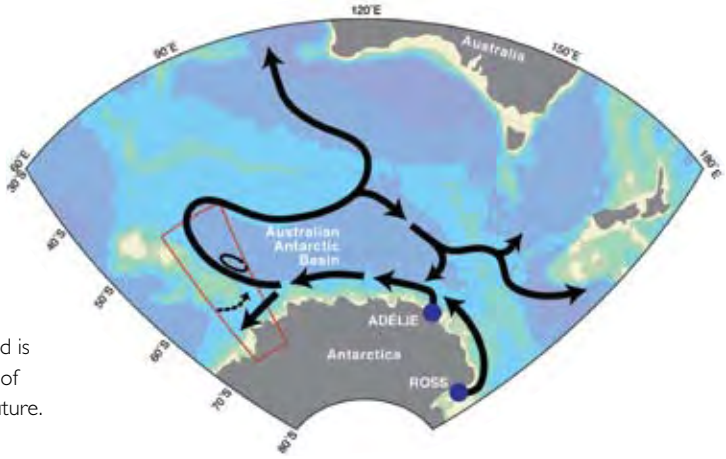
The ocean surface and what is called the mixed layer beneath provides a crucial channel between the atmosphere and the deeper layers of the ocean. Changes in the mixed layer regulate carbon and heat storage in the ocean and biological productivity. Scientists found that winds blowing on the Southern Ocean drive change in the depth of the surface layer, varying between oceans and with implications for the rate of climate change and biological production.

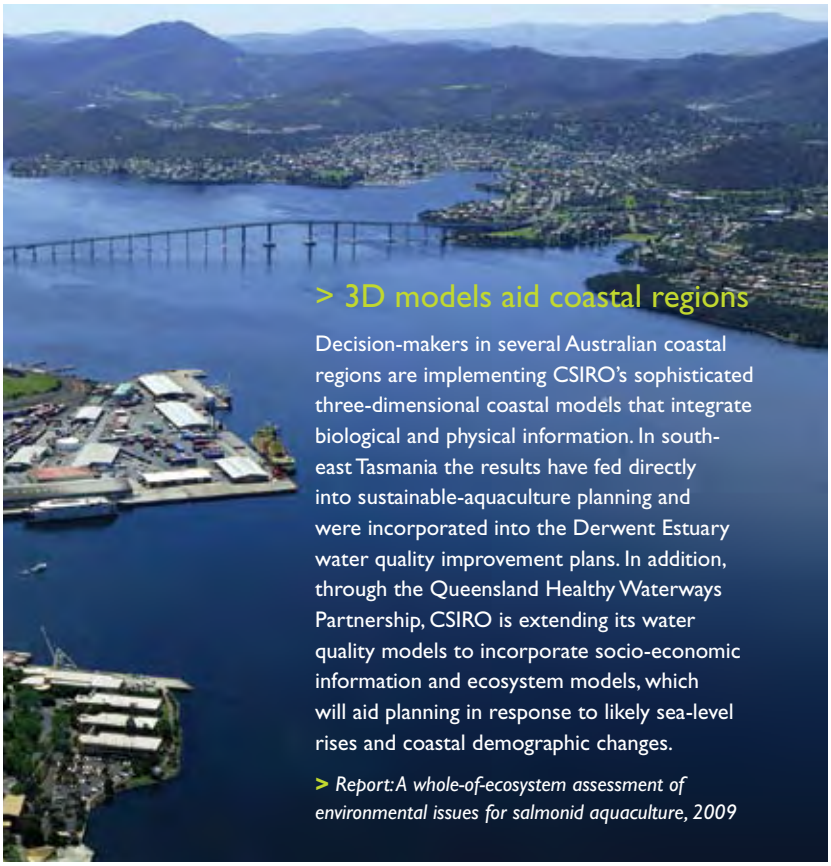
> *Nature Geoscience, 15 March 2010*

> Massive southern ocean current discovered

CSIRO and Australian and Japanese partners have discovered a deep ocean current with a volume equivalent to 40 Amazon Rivers. The current is near the Kerguelen plateau in Antarctica, about 4200 kilometres south-west of Perth. It is more than three kilometres below the surface and is an important pathway in understanding the global network of ocean currents that influence our climate, now and in the future.

> *Nature Geoscience, 26 April 2010*





> 3D models aid coastal regions

Decision-makers in several Australian coastal regions are implementing CSIRO's sophisticated three-dimensional coastal models that integrate biological and physical information. In south-east Tasmania the results have fed directly into sustainable-aquaculture planning and were incorporated into the Derwent Estuary water quality improvement plans. In addition, through the Queensland Healthy Waterways Partnership, CSIRO is extending its water quality models to incorporate socio-economic information and ecosystem models, which will aid planning in response to likely sea-level rises and coastal demographic changes.

> *Report: A whole-of-ecosystem assessment of environmental issues for salmonid aquaculture, 2009*

> Nine new species of disappearing handfish

Nine new species of handfish have been described by CSIRO bringing the family to 14 known species. Handfishes are small, often colourful fish that 'walk' on hand-like fins. Fifty million-years ago they walked the world's coastal seas, but now they exist only off south-eastern Australia where they are vulnerable to environmental change. Some shallow-water species are disappearing quickly. This improved knowledge of handfish enables a deeper understanding of how Australia's marine life evolved, and the effects of habitat alteration and rapid climate change.

> *Zootaxa, 8 October 2009*

> Discovering why the Yellow Sea turns green

CSIRO and the Chinese Academy of Science discovered that the massive algal bloom that occurred in the Yellow Sea in China during June 2008 was caused by a rapid expansion in coastal seaweed aquaculture. This discovery enabled the researchers to predict the 2009 bloom and will assist in managing what has since become an annual event. The 2008 bloom, the largest ever seen, almost derailed the Beijing Olympics sailing regatta and had a huge economic and environmental impact.

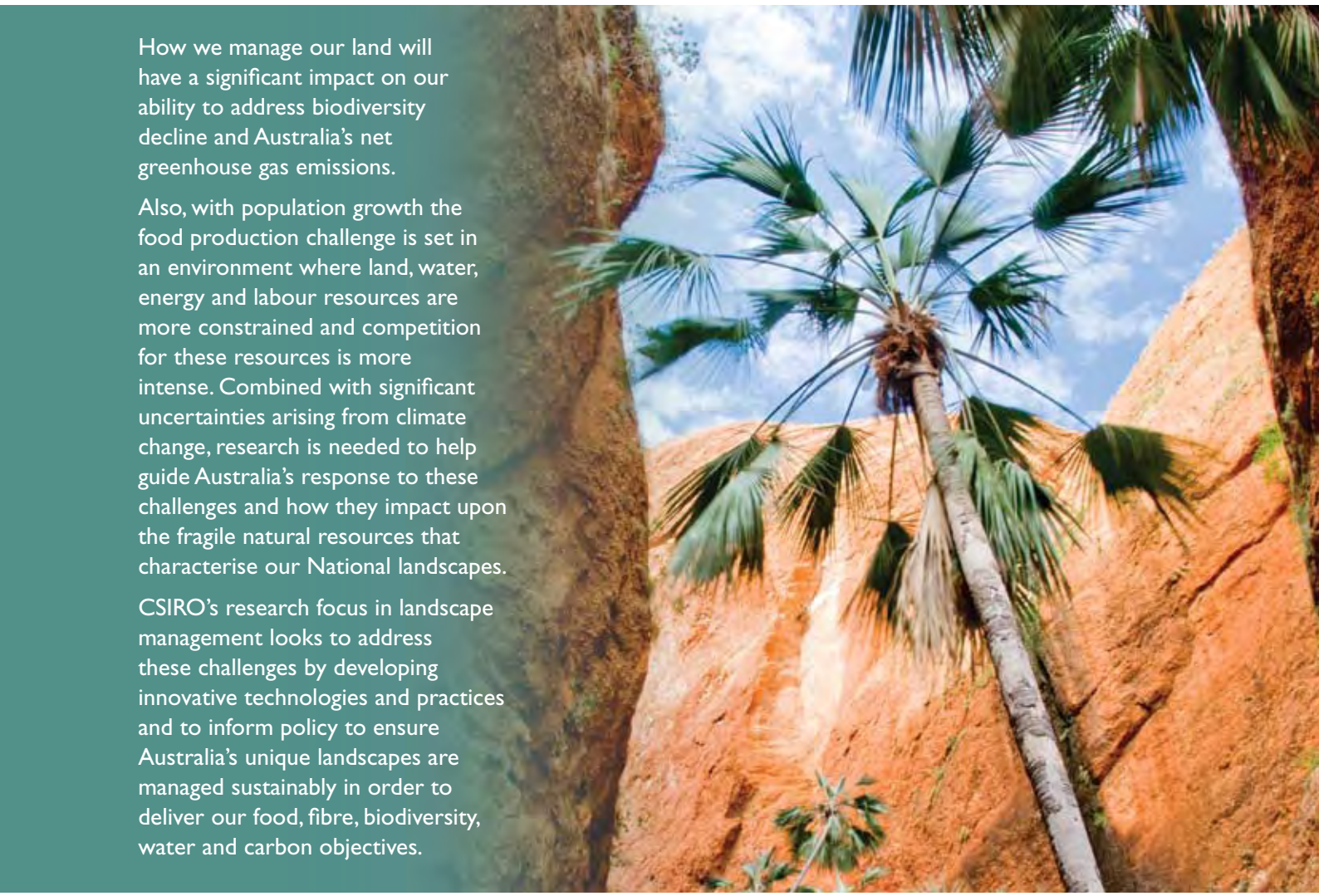
> *Marine Pollution Bulletin, June 2010 (in press)*

Managing Australia's landscapes for future generations

How we manage our land will have a significant impact on our ability to address biodiversity decline and Australia's net greenhouse gas emissions.

Also, with population growth the food production challenge is set in an environment where land, water, energy and labour resources are more constrained and competition for these resources is more intense. Combined with significant uncertainties arising from climate change, research is needed to help guide Australia's response to these challenges and how they impact upon the fragile natural resources that characterise our National landscapes.

CSIRO's research focus in landscape management looks to address these challenges by developing innovative technologies and practices and to inform policy to ensure Australia's unique landscapes are managed sustainably in order to deliver our food, fibre, biodiversity, water and carbon objectives.



> Conserving nature and dollars: delivering cost-effective biodiversity protection

Researchers have determined that a more flexible approach to the expansion of protected areas could ultimately see far greater protection of biodiversity without costing more money. The team, involving CSIRO, suggests that by identifying those areas that are the least cost-effective and reversing their protection status, the resulting capital can then be used to establish and manage new, more effective protected areas. This approach has the potential to dramatically improve the performance of protected area systems and thereby conservation activities.

> *Nature, 20 June 2010*

> Getting to the root of soil health

Root diseases cost the grains industry between A$100-200 million a year, depending on seasonal conditions. CSIRO and its partners have found crops such as cotton, cereals and canola, can alter root zone microbiology in different ways. The team is applying new molecular approaches to boost soil biological health and are developing crop specific beneficial micro-organisms which hold promise in lifting farm productivity and improving the efficiency of water and fertiliser use.

> *The Rovira Rhizosphere Symposium, 2010, published by The Crawford Fund*

> Rescuing Australia's native grasslands with genetics

Australia's temperate grasslands are at risk. Formerly widespread, it is believed that only one per cent of grasslands that existed before European settlement currently remain in moderate to good condition. This is not because of a lack of pollinators, poor flowering or drought, but because plants in small populations are related to each other and can't make enough seed for the population to survive. CSIRO scientists have used population simulation models to show that adding new genetic material to small grassland populations can rescue them from extinction.

> *Journal of Applied Ecology, June 2010*

> Scoping our potential for carbon capture

Australia has considerable potential to sequester, or store, carbon and mitigate greenhouse gases in agricultural production and land use systems. Recent CSIRO research suggests that forestry-related options have the greatest potential for sequestering carbon, making up about 75 per cent of that which is attainable through a determined effort. Australian cropping lands are, on average, still losing soil carbon but the adoption of 'carbon friendly' farming practices can mitigate soil carbon losses.

> *Report: An Analysis of Greenhouse Gas Mitigation and Carbon Biosequestration Opportunities from Rural Land Use, 2009*

> Coorong's future helped by new science

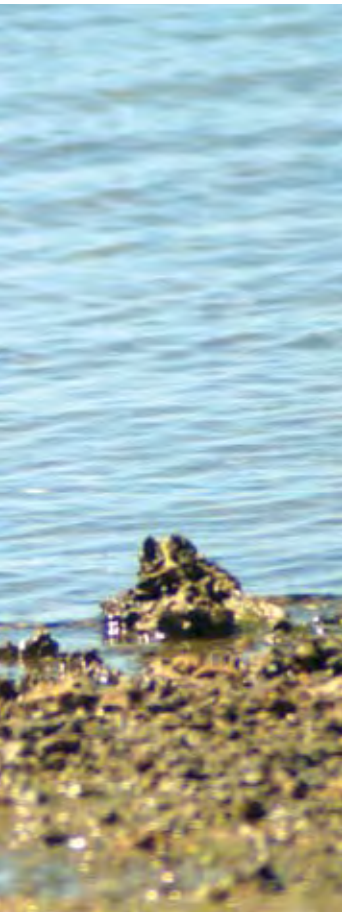
A research collaboration on the internationally recognised Coorong and Murray Mouth region has provided the first comprehensive understanding of the relationship between the estuary's organisms and environment, particularly in response to water level and salinity changes. Following a decade of low to no freshwater inflows, the estuary, which is one of Australia's most valued waterbird habitats, is degraded with significant declines in fish and bird numbers. This work provides a whole-of-system approach to help land and water managers make the most of environmental flows and evaluate potential management interventions to inform policy and support estuary management of the region.

> *Report: An Ecosystem Assessment Framework to Guide Management of the Coorong, 2009*

> New take on selective fishing

A selective approach to fishing may worsen rather than reduce the impact of fishing on marine fisheries and ecosystems. CSIRO research has found that reduced fishing effort, less selective fishing and better use of the catch would achieve higher sustainable overall yields while maintaining healthy marine ecosystems. Such 'balanced exploitation' could help meet the challenge of increasing global food demand. The implications of such changes to traditional practices will require careful consideration by fishmen, fishery managers and conservation agencies.

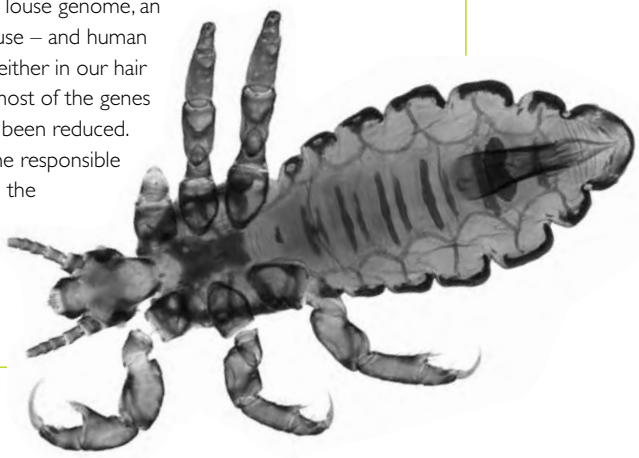
> *Proceedings of the National Academy of Sciences, 25 May 2010*



> Of lice and man

An international team has sequenced the body louse genome, an achievement that will yield new insights into louse – and human – biology and evolution. Lice have a simple life either in our hair or on our bodies with blood as their food, so most of the genes responsible for sensing their environment have been reduced. CSIRO research investigated one particular gene responsible for normal cell maintenance, which is missing in the body louse. This finding should give valuable insights into diseases and human ageing.

> *Proceedings of the National Academy of Sciences, 6 July 2010*



> Top End under the microscope

CSIRO researchers have examined a range of options for use of land and water in northern Australia and the likely consequences of those uses for communities, businesses and the environment in a changing world. It draws on the contributions of over 80 technical specialists and community and industry members, outlining the key limitations and enablers required for future development in the north. Insights from the research are now helping government and industry make planning and policy decisions.

> *Report: Northern Australia Land and Water Science Review 2009*

outer Teachings from space

Much can be learned from the universe – our past, our present, our future. Scientists around the world are utilising satellites, spacecraft and telescopes to explore outer space and better understand the intricacies of our solar system and beyond.

CSIRO extends our knowledge in these areas by providing technology and services for radio astronomy, spacecraft tracking and space sciences, as well as by undertaking research that is world leading. We also operate a world-class National Research Facility for radio astronomy, and manage one of three Deep Space Network stations used by NASA.

Over the next five years CSIRO will help contribute answers to key science questions of 21st century astrophysics and physics, as well as provide an improved understanding of the universe in which we live.

> Pathfinder telescope takes first steps

The first dish of CSIRO's Australian SKA Pathfinder (ASKAP) has been erected in Western Australia and has made its first scientific observations. ASKAP, a set of thirty-six 12-metre dishes, is an important precursor to the international Square Kilometre Array radio telescope, a $2.5 billion project, which Australia and New Zealand are bidding to host. The first six ASKAP antennas will be operational in 2011 with the full array planned for completion in 2013.

> *Proceedings of the IEEE, August 2009*

> CSIRO unveils monster galaxy

CSIRO astronomers have revealed the hidden face of an enormous galaxy called Centaurus A, which emits a radio glow covering an area 200 times bigger than the full Moon. The galaxy is so big and bright in radio waves that no other group in the world has attempted to make such a detailed image of the whole thing. By observing the galaxy for more than 1200 hours over several years, CSIRO scientists pieced together 406 smaller images, taking a further 10,000 hours to process and refine, to form a spectacular larger image.

> *More at www.csiro.au • Read a full profile on page 45*

> Telescopes join hands across the Tasman

Australia and New Zealand have taken another step in their bid to host the international Square Kilometre Array (SKA) radio telescope by linking six telescopes across the two countries to work as one giant instrument. Including four telescopes operated by CSIRO, this is the first such Australasian linkup spanning 5500 kilometres. The SKA will have several thousand antennas working together just like this. The six-linked telescope will be able to make images ten times more detailed than the Hubble Space Telescope.

> *More at www.csiro.au*

> Partners in space: CSIRO and NASA

February 2010 marked the 50th anniversary of CSIRO's partnership with NASA in solar system exploration. From man taking his first steps on the moon to missions to the edge of the solar system, CSIRO and NASA have been working at the forefront of space science. As part of this partnership, CSIRO manages and operates the Canberra Deep Space Communications Complex, one of three Deep Space Network stations around the world used for communicating with NASA's spacecraft.

> *More at www.csiro.au*

> Bursting bubbles spritz galaxy's surface

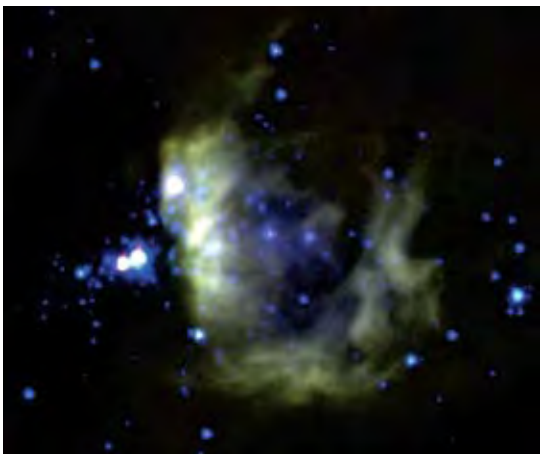
Like bubbles bursting on the surface of a glass of champagne, huge 'bubbles' in our galaxy burst and leave flecks of material in the form of clouds of hydrogen gas. This discovery was made by researchers using CSIRO's Parkes telescope, whose study explains for the first time the origin of these 'halo' clouds. Each cloud contains about 700 times the mass of the Sun in hydrogen gas and they are being studied to better understand their role in recycling gas within the galaxy.

> *Astrophysical Journal, 2010 (Accepted)*

> Rare nest for big stars found

Massive stars – those with ten or more times the mass of the Sun – are rare, only a few per cent of all stars, and it's been unclear whether or not they form the same way as smaller stars do. Now astronomers using CSIRO's Mopra telescope have found an unusually large cloud of gas and dust that is collapsing in on itself, and from which massive stars are likely to form. This discovery provides astronomers with valuable information in which to test theories on this massive star formation mystery.

> *Monthly Notices of the Royal Astronomical Society, February 2010*



> Star-birth myth busted

Like puppies, stars are born in litters – they form together in groups – and just like puppies in a litter, some stars in the group are born bigger than others. Since the 1950s, astronomers thought the ratio of big to little new-born stars in a group was the same, no matter which galaxy they were born in. But now, researchers using CSIRO's Parkes telescope have shown that's not the case. This finding has implications for other properties of galaxies that have also been puzzling astronomers.

> *More at www.csiro.au*

> Nullarbor fireball cameras find rare meteorite

Using cameras which capture fireballs streaking across the night sky and sophisticated mathematics, a worldwide team of scientists including CSIRO found not only a tiny meteorite on the vast Nullarbor Plain, but also its orbit and the asteroid it came from. Meteorites discovered with known orbits are incredibly rare so the achievement is a breakthrough in planetary science. The ability to track meteorites back to their asteroid home is an incredibly cheap way of sampling the asteroid, compared to conducting an expensive space mission.

> *Science, 18 September 2009*

safeguarding Australia

The world is characterised by the widespread and rapid movements of people, digitally coded data, goods and services, and exotic biological agents. With this has come increased risk to national security.

Australia is particularly vulnerable to such risks because of its linear infrastructure and vast coastline borders. In order to protect ourselves, we must be capable of anticipating and tackling critical threats to Australian society, the economy and the environment.

CSIRO is working towards a safer and more secure society through the development of world-first security technologies as well as national security technology partnerships. We are also the key national provider of science to help Australia reduce the impact of biological invaders and to manage the risk of emerging and future security threats.

> Biofuel crops will have biosecurity impacts

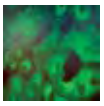
Important biosecurity issues are being ignored in the global push to develop new non-food crops for biofuels and industrial and pharmaceutical uses. Researchers have highlighted that the exponential growth in these crops could compromise conventional agriculture if issues such as invasiveness of new crops, abandoned plantings of trial crops, new pests and diseases and pest management are not thoroughly explored. In response, a CSIRO report makes a series of internationally relevant recommendations for the sustainable development of crop-based biofuels and bioindustries.

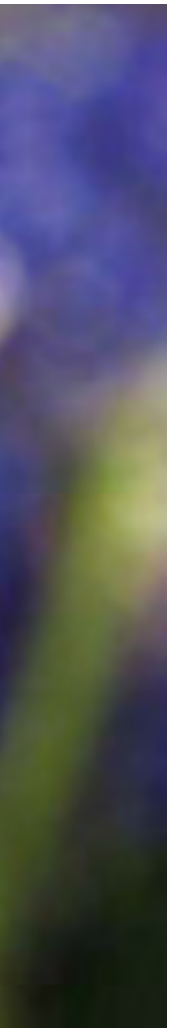
> *Report: Biosecurity in the new bioeconomy, 2009*

> Honeybee blues – another global threat

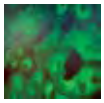
The European honeybee, *Apis mellifera*, is used for commercial honey production and utilised by a global pollination industry worth up to A$100 billion. But honeybees are under threat from many directions, including a deadly parasitic mite called *Varroa destructor*. Since switching from Asian honeybees 60 years ago, this mite has spread globally, except to Australia, and has decimated honeybee populations in its path. CSIRO, during an expedition to Papua New Guinea, discovered a new Varroa mite killing local honeybees, which sadly adds another threat to the world's honeybee population.

> *More at www.csiro.au*





> Lifesaving treatment for deadly Hendra Virus



A new treatment to combat the deadly Hendra virus is showing great potential to save the lives of infected people. In a world first, a scientific team from CSIRO and the United States has demonstrated that administering human monoclonal antibodies after exposure to the Nipah virus, which is closely related to Hendra virus, protected animals under experimental conditions. This suggests an effective treatment for Hendra virus infections in humans is possible, given the very strong cross-reactive activity this antibody has against Hendra virus.

> *PLoS Pathogens, October 2009*

> New bat viruses discovered

The role bats play as the natural host of several emerging viruses, some of which are deadly to humans, has gained widespread community interest. After two years of extensive research, CSIRO has had a major technical breakthrough in the international race to better understand virus-bat interactions. Researchers have developed a new scientific technique to isolate virus from bats. Using this technique they have discovered several new bat viruses.

> *PLoS One, December 2009*

> Pest risk maps for invasive alien species

CSIRO researchers have joined the call for improved pest risk mapping to better understand the impacts pests have on agriculture and international trade under climate change. These maps are powerful visual communication tools that describe where invasive alien species might arrive, establish, spread and cause harmful impacts. In studying the need for pest risk maps and comparing different mapping methods, the team recommended future research to improve the maps. They could then better inform pest management decisions such as potential restrictions on international trade or the design of pest surveys and domestic quarantines.

> *BioScience, May 2010*

Enabling industries through ICT

We live in an increasingly fast-paced and information rich world. Individuals and businesses want immediate and virtual access to information. The need to collect, manage and use information is unique to no one.

Almost all sectors of the Australian economy are underpinned by information and communication technologies (ICT) and more Australians work in services than any other sector of the economy. Each year, Australian businesses invest over a quarter of their research and development budget towards research related to ICT.

CSIRO is focused on providing enabling technologies that deliver innovative ICT solutions and enhanced services across industry sectors including health, the environment, energy, agriculture, security and mining. We are working in ICT, maths and related sciences to develop smarter ways to improve Australia's productivity and service delivery.

> Software for electronic health records

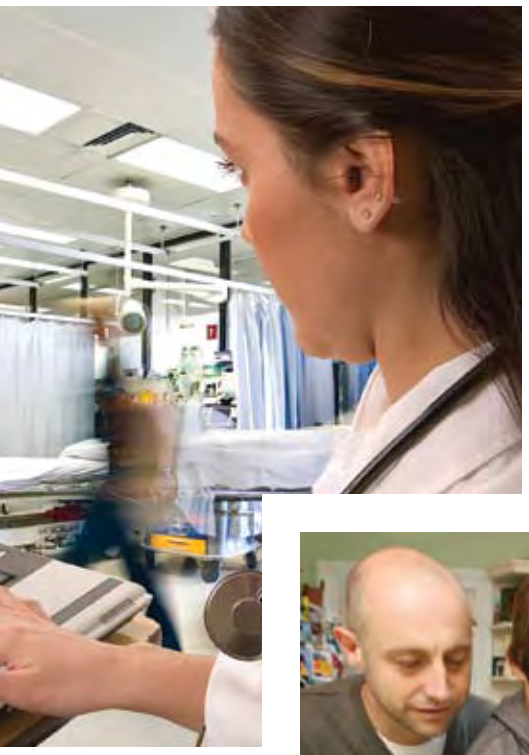
Inaccurate or missing data in patient records results in people being hospitalised unnecessarily and wastes an estimated 25 per cent of clinicians' time. To relieve this 'pain', an internationally agreed standard for the dictionary of clinical terms used in electronic health records software is being rolled out, called SNOMED CT. CSIRO software developed through the Australian e-Health Research Centre, is helping to translate terms used in the myriad of existing health information systems to terms which are in SNOMED CT.

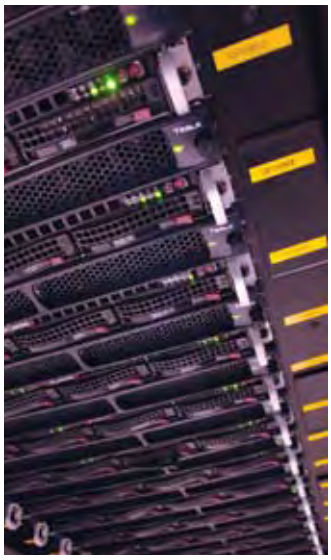
> *Australian provisional patent No. 2010902719*

> Opals shine with new grading technology

CSIRO and a consortium of Australian opal miners are restoring value to the opal industry with a world-first automated grading system. The Gemmological Digital Analyser™ uses automated vision technology developed by CSIRO to assess the gem's complex colour characteristics, and thus the grade of cut and polished opal. A major advancement for the opal industry, the system eliminates errors from human assessments, increases the reliability of opal prices for both miners and consumers and strengthens international export opportunities for Australian opal.

> *Patent No. WO2008119125-A1*





> Supercomputer speeding up science

CSIRO's latest supercomputer is Australia's first to combine central processing units with powerful graphics processing units (GPUs). The CSIRO GPU cluster is a world-class computational science facility providing scientists with a powerful resource to help them deal with vast volumes of complex data quickly. Scientists have observed applications running 10 to 100 times faster. In 2010, CSIRO become a member of one of the world's leading GPU developers' international network of high performance computing research centres, and is the only member in the southern hemisphere.

> *More at www.csiro.au*

> Electricity meters you can access remotely

CSIRO has developed a new web-based smart metering system that enables householders, small businesses and electricity retailers to remotely control energy use over a broadband Internet connection. Working with industry partners the system uses common broadband Internet connections to build and deploy a very cheap, real-time platform to deliver energy services to individual dwellings. It aggregates a large number of smaller users providing each with the flexibility to cut back their electricity use at times when it is needed elsewhere on the grid.

> *Australian patent application No. 2010902216*

> Computer gaming technology reduces risks to patients

Colonoscopy is a difficult medical procedure to master, with gastroenterologists requiring hundreds of supervised procedures to reach an expert level. CSIRO, with collaborators, has developed a colonoscopy simulator enabling trainee surgeons to interact with accurate computer-based simulations of the human colon. Better trained surgeons will reduce patient risk and improve the detection rate for colon cancer, which on average clams the lives of 90 Australians each week.

> *Licensed to Surgical Science AB Sweden; International Journal of Image and Graphics, April 2010*

Transforming Australia's minerals industry

The minerals industry has added hundreds of billions of dollars in export earnings to Australia's wealth in the last 25 years. But, despite this fast approaching $100 billion per year, the future of this industry is far from assured.

New deposits are not being found fast enough to replace those being extracted, and many have declining grades, with an associated increase in waste rock, tailings, greenhouse gas emissions, and water and energy consumption.

CSIRO is committed to sustaining Australia's competitive edge despite these hurdles through the development of new technologies and processes. We are integrating advanced technologies for next-generation tools and solutions to locate new mineral resources, and to deliver safer and more efficient mining, clean processing and value-added mineral products.

> How to design large open pits

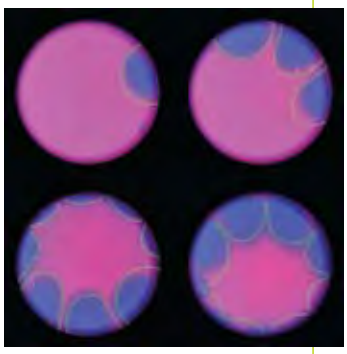
New guidelines for open pit slope design have been released for the first time in more than 30 years. Open pit mining is efficient, but if the slope is too shallow you move millions of additional tonnes of overburden that holds no value. Too steep and you risk collapse with subsequent risk to people and property. The guidelines link innovative mining research with best practice and address many of the uncertainties surrounding the development of large open pit mines.

> *Guidelines for Open Pit Slope Design, 2009, published by CSIRO PUBLISHING*

> Extracting gold without cyanide

Extracting gold without cyanide may be possible with a new thiosulfate leaching and recovery system being developed by CSIRO. In the process, gold is leached from its ore using the cyanide alternative – thiosulfate – and adsorbed onto a resin. A mixture of chloride and sulfite is used to 'strip' the gold thiosulfate complex from the resin and then the gold is recovered by electrowinning. This new process offers a non-toxic and biodegradable alternative to cyanide.

> *More at www.csiro.au*



> Something's stirring down under

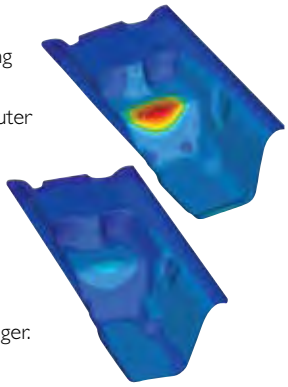
In-situ leaching is an ore extraction technique where solutions that dissolve minerals are injected directly into ore deposits without mining. The metal-rich liquid is then pumped out and valuable components extracted. However, the solution does not always penetrate fully throughout the ore deposit. CSIRO researchers have used chaos theory to design a carefully orchestrated switching on and off of the solution as an effective, patented way to 'stir' the solution underground. Computer modelling of the process predicts a marked rise in efficiency.

> *Philosophical Transactions of the Royal Society, 13 May 2010*

> Taking the heat out of ingot casting

Faced with a potential safety hazard, CSIRO researchers used sophisticated computer modelling to eliminate splashes of boiling coolant water in aluminium ingot production lines. Using the computer model, researchers re-designed the ingot mould to transfer heat more efficiently, eliminating the 'hot spot' which caused the boiling water hazard without affecting the finished ingot shape. The new, safer mould shape also speeds up ingot solidification, and as a bonus, the mould itself is stronger and more durable and therefore lasts longer.

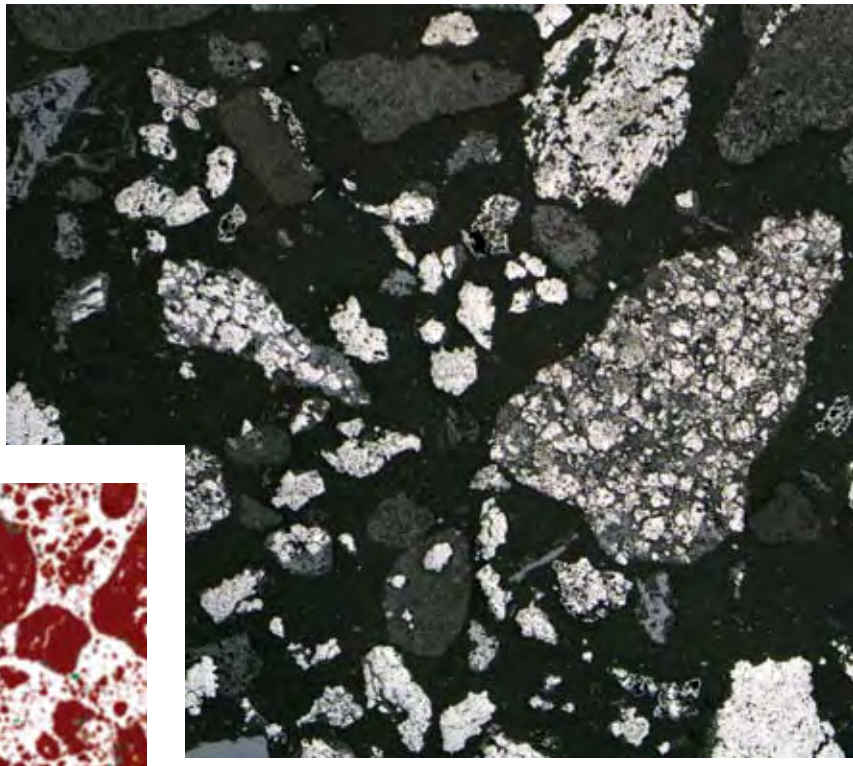
> *Materials Science Forum, October 2009*

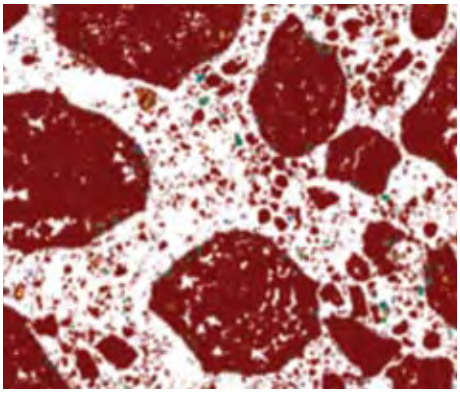


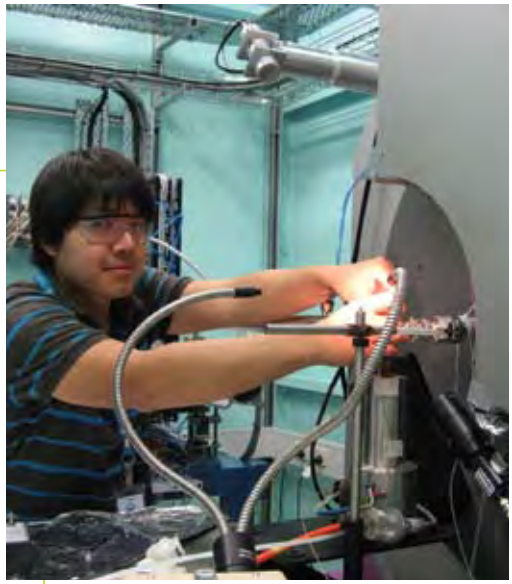
> Removing phosphorus from iron ore

As Australia's high-grade iron ore reserves decrease, we need to find ways to make lower value, high-phosphorus iron ores more attractive to steel producers. Currently, high-phosphorus ores are unacceptable as the higher percentage of phosphorus increases the brittleness of steel. CSIRO researchers are using electron microscopy techniques to understand how phosphorus is held within ore and are developing cost-effective processes to reduce phosphorus levels which could be worth billions of dollars to the Australian industry.

> *Patent No. PCT/AU2010/000302*



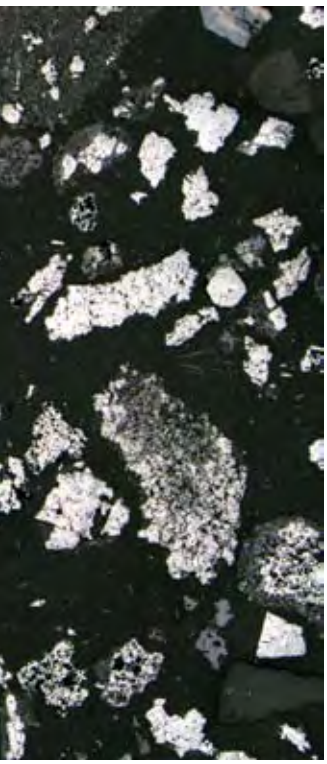


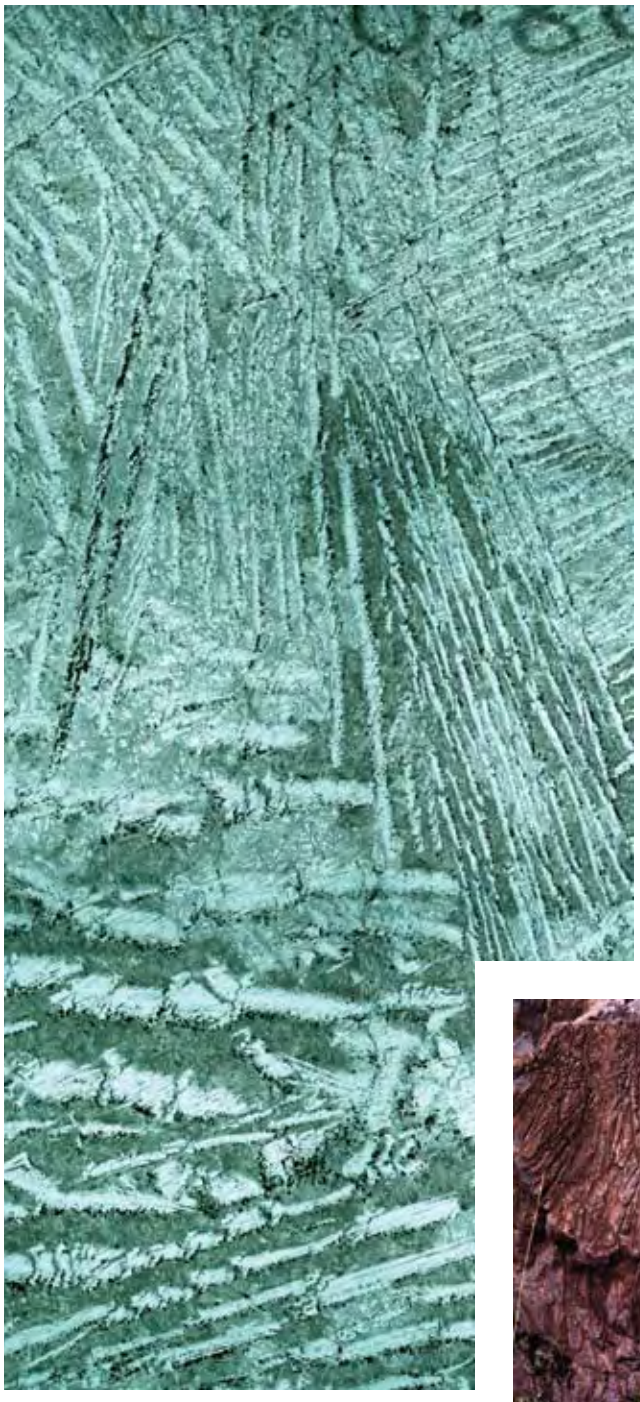


> Unravelling the double layer

Electrolyte solutions spontaneously organise into complicated structures at a solid surface. This electrical double layer (EDL) can hinder or help the electrodeposition process of extracting metals from solution. University and CSIRO scientists modelled the structure of the EDL in ionic liquids, providing vital knowledge for development of new processes for metal production. As ionic liquids have the capacity to significantly reduce the operating temperature of processes, these new processes offer greater energy cost savings and environmental benefits compared with current technologies.

> *Physical Review Letters, 10 September 2009*





> Extraterrestrial platinum stirred into the Earth

When the Earth's core formed it took all the available platinum with it, leaving the rest of the planet, the mantle and crust, with none. However, research involving CSIRO found that the platinum content of ancient lava flows increases with decreasing age. This platinum came from meteorites which hit the Earth four billion years ago. Plate tectonics 'stirred' this platinum down into the deep interior. CSIRO's research is the first to put a time scale on this process, about 1.5 billion years, and has implications for the study of mantle processes and the mechanisms that cause plate tectonics, earthquakes and volcanoes.

> *Nature, 30 July 2009*

Innovating materials & manufacturing

Manufacturing continues to be a significant part of Australia's economy, contributing around 10 per cent of GDP and employment. With natural materials becoming more scarce and increased international competition in the materials and manufacturing sectors, innovative science and technology are essential for ongoing economic sustainability.

CSIRO has a long history in these sectors and remains committed to being a catalyst to help secure their global competitiveness for Australia. We will do this by helping to transform existing industries and build future manufacturing opportunities, and by helping to develop new green technologies to support high value-adding, export-orientated market segments.

Such technology growth will support employment and deliver economic and social benefits by contributing to technical solutions across the energy, water, climate, health, security and environment sectors.

> Leaner, greener car parts

Steering wheels in some Australian-made cars are now stronger and less likely to fracture in a car accident due to CSIRO's high productivity ATM technology. ATM is a new system for delivering molten metal to a die, or mould, that is 'greener and leaner' than existing delivery systems for high pressure die casting. The ATM technology is highly effective using less metal to manufacture parts and producing fewer greenhouse gas emissions.

> *Licensed to Bridgestone Toyoda Gosei*

> Safer, cleaner rust inhibitor

CSIRO has developed a novel coating technology, Quench Coat, that protects galvanised products from white rust – the form of zinc oxide that tarnishes freshly galvanised coatings making them look dull. Quench Coat is a simple, water-based, drop-in replacement for the highly toxic chromium-based treatment currently used by Australian galvanisers to inhibit corrosion. It matches the performance of chromate but is more economical as it eliminates the costs associated with the disposal of hazardous chromium wastes.

> *Patent No. AU 2009202792*

> Biomass makes fantastic plastic

CSIRO scientists have developed a highly efficient process to convert biomass, a renewable energy source, from eucalypts into chemical compounds that can be used to manufacture plastics. The process is being used to produce durable industrial plastics that can act as a form of carbon sequestration. This is an important step to developing renewable alternatives to crude oil, natural gas and coal for industrial chemicals and plastics. Further, using indigenous eucalypts planted on land unsuitable for agricultural use, has additional positive environmental impacts.

> *Journal of Green Chemistry, January 2010*

> New lightweight concrete reduces greenhouse gases

CSIRO scientists have developed a lightweight, environmentally friendly geopolymer concrete material that will substantially reduce greenhouse gas emissions. For every 1000 kilograms of manufactured concrete, geopolymer concrete uses 27 per cent less embodied energy, produces 50 per cent less carbon emissions and lessens the impact on the environment by 22 per cent compared to an equivalent Portland cement product. Geopolymer products are lightweight, fire, blast and acid resistant, are extremely strong and can also be used as an effective adhesive.

> *Licensed to HySSIL™ Pty Ltd*

> Artificial bee silk a big step closer to reality

CSIRO scientists have achieved another important milestone in the international quest to artificially produce insect silk. They have hand-drawn fine threads of honeybee silk from a 'soup' of silk proteins that they had produced transgenically; these threads were as strong as threads drawn from the honeybee silk gland. This breakthrough will help to discover new protein materials with exceptional functional characteristics including extreme toughness and durability. Possible uses include tough, lightweight textiles and, because of their biocompatibility, medical applications, such as sutures, artificial tendons and ligaments.

> *Biomaterials, March 2010*

> Spinning a good yarn in China

Research to enhance China's capacity for processing Australian superfine wool has led to major productivity and quality improvements in Chinese textile mills that will prove of long-term benefit to the Australian wool industry through increased demand for superfine fibre. The research demonstrated that mills could dramatically reduce excessive processing and thereby improve productivity and final-product quality.

> *Report: Australia-China Agricultural Technical Cooperation Program, September 2009.*

Improving health with a new 'super' wholegrain

– The *BARLEYmax* story

The health benefits of wholegrains are well known and there is clear evidence that increased intake of particular foods can reduce our risk of chronic disease. Now, these health benefits are neatly packaged in a new 'super' wholegrain developed specifically to provide enhanced nutritional benefits to consumers.

In the 1990s, CSIRO scientists identified the physiological basis for the health effects of dietary fibre. They had also established that the Australian diet was deficient in an important, though largely unrecognised, fibre component called resistant starch.

Intakes were estimated to be less than 25 per cent of the optimal level, and there was evidence to suggest this contributed to the high rates of diet-related diseases such as colorectal cancer in Australia and globally.

Around the same time, CSIRO researchers developed a diverse collection of new barley variants in a project originally aimed at understanding the role of plant hormones involved in plant development.

The potential of this barley collection was recognised, along with CSIRO's expertise in researching the genetic pathways of starch biosynthesis, and a target group of barleys was identified with diverse starches and other dietary fibre components.

From this work came BARLEYmax™ – a natural wholegrain barley with high-levels of resistant starch with the potential to improve human health.

Scientists from across CSIRO were brought together to work on understanding and validating the specific nutritional properties of *BARLEYmax*. They found it had twice the dietary fibre and four times the resistant starch of other wholegrains.

A series of nutritional trials in animals, and then in human volunteers, confirmed the beneficial effects of *BARLEYmax* on bowel health biomarkers as well as glycemic index – two indicators of real public health potential.

Not only did *BARLEYmax* offer many potential health benefits by enhancing the positive nutritional attributes of a range of consumer foods, it also improved texture and enhanced flavour with a pleasant nutty taste that distinguished it from other barley grains.

This integrated and multidisciplinary research program concluded *BARLEYmax* could make a significant contribution to raising population-wide intakes of resistant starch.

With this knowledge, CSIRO formed a joint venture to breed new *BARLEYmax* varieties and began working with seed growers and food manufacturers to produce commercial quantities of the new grain and create products containing *BARLEYmax* for consumers.

A range of breakfast cereals containing *BARLEYmax* was launched nationally by an Australian food company in August 2009. Within two months, these cereals had achieved weekly sales 400 per cent greater than forecasted in the highly competitive ready-to-eat breakfast cereal category. Based on this success, a range of additional products is in the pipeline.

BARLEYmax is now creating a positive impact along the whole food value chain – providing speciality grains for farmers that command premium prices, generating new opportunities in food product manufacturing and delivering a potential health impact direct to consumers.

BARLEYmax has the potential to add significant value to the Australian economy, estimated to be well in excess of $100 million per annum.

* CSIRO and its joint venture partner, Australian Capital Ventures Limited, have commercialised *BARLEYmax* in Australia through Austgrains Pty Ltd and Popina Food Services.

* *BARLEYmax* grain has been patented in three countries (four more pending) and a trade mark for *BARLEYmax* has been secured in five major markets.

A giant on our doorstep

– Painting a portrait of the galaxy Centaurus A

Last century, astronomers were astonished to find that the universe was not at all as it had looked. Galaxies had seemed to be placid pools of stars; now some turn out to house massive black holes that both suck in matter and also hurl some out into space.

Glowing in radio waves, the matter exhaled from these black holes is ejected in jets that can stretch for millions of light-years, finally billowing out into lobes.

Galaxies like this are called *radio galaxies,* and remained hidden until astronomers acquired 'radio eyes' – or radio telescopes – for seeing them.

Sixty years of studying these radio galaxies has lessened their mystery, but only slightly. Astronomers still wrestle with basic questions such as, how do the filaments in the lobes stay powered up? How does a galaxy interact with the hot gas in space around it? Are these radio lobes a source of the high-energy cosmic rays that hit Earth?

To answer such questions astronomers have wanted to see a radio galaxy in detail, but due to their sheer size and rarity, there are few groups in the world that have the skills and facilities to undertake this activity. This challenge was taken on by CSIRO and in 2009 the world's most detailed image of one such radio galaxy was completed.

Centaurus A lies 12 million light-years away in the southern constellation Centaurus, and houses a monster black hole 50 million times the mass of the Sun. The radio glow emitted from this black hole covers an area 200 times bigger than the full moon.

Astronomers painstakingly 'mosaiced' 406 images taken with CSIRO's Australia Telescope Compact Array, with supplementary data from CSIRO's Parkes telescope, to build-up a single portrait that shows the galaxy in its entirety.

This massive challenge involved taking 1200 hours of observations over several years, and putting in a further 10,000 processing hours to combine the data, remove the effects of radio interference, and adjust the dynamic range.

The end result is a spectacular image that scientists can now use to better understand how black holes and radio jets interact with a galaxy's stars and dust, and how the Centaurus A galaxy has evolved over time. It will also provide insight into other radio galaxies and help determine the role black holes play in galaxy formation and growth.

Understanding and conserving Australia's biodiversity

– Our National Biological Collections

Biodiversity is the variety of life on Earth and is the result of four billion years of evolution. The state and abundance of an area's biodiversity is often used as a measure of the health and future prosperity of our biological systems.

Sadly, biodiversity in Australia and globally is in serious decline due to increasing pressures from habitat destruction, climate change, pollution, over-exploitation, and invasive species. This loss of biodiversity has significant negative effects on several aspects of human wellbeing, including health, food security, vulnerability to natural disasters, energy security and access to clean water and raw materials.

At CSIRO, we realise the importance and value of biological systems and the need to understand and vigorously protect them for present and future generations. In order to achieve this, good science and access to well-maintained and comprehensive scientific reference collections are vital.

To this end, CSIRO plays an important role on behalf of the Australian innovation system as the custodian of a number of internationally renowned scientific collections, including four National Biological Collections. Our scientists are taking the lead in contributing to the discovery, inventory, understanding and conservation of Australia's plant and animal biodiversity, and making this knowledge available to national and international parties. The scale of these collections is enormous and they continue to grow as scientists discover more new species.

The Australian National Herbarium has more than 1.4 million specimens, some of which were collected by Sir Joseph Banks on his voyage with Captain Cook in 1770. It is the largest herbarium in Australia and houses the largest collection of eucalypt specimens in the world.

Even bigger is the Australian National Insect Collection with more than 12 million specimens. This collection is growing by around 50,000 specimens each year and is the world's largest collection of Australian insects and related groups such as mites, spiders, worms and centipedes.

The Australian National Wildlife Collection contains almost 200,000 zoological specimens, covering 95 per cent of Australia's existing bird species, 75 per cent of its mammals, 30 per cent of its reptiles and 30 per cent of its amphibians.

Not to be outdone, the Australian National Fish Collection houses more than 150,000 specimens, representing approximately half of Australia's 5000 fish species and containing the world's largest collection of Indo-Pacific sharks and rays.

Together, these collections form a vast storehouse of information about Australia's biodiversity and they underpin a significant part of the country's taxonomic, genetic, agricultural and ecological research. They are recognised internationally for their quality and uniqueness and scientists come from all over the world to work with them.

These collections also make a significant contribution to the Atlas of Living Australia – a comprehensive online research tool designed to assist scientists, policymakers, planners and ordinary Australians with access to biodiversity information of unprecedented detail and scope.

By making over one billion dollars of collection and research resources available to the scientific and wider communities, CSIRO is providing valuable biodiversity data about Australia's wide ranging species of plants, animals and microorganisms to support research, education and decision making. This can only increase the future security and prosperity of Australia's treasured biodiversity.

Biodiversity on the world's stage

The United Nations declared 2010 the International Year of Biodiversity. People all over the world are working to safeguard this irreplaceable natural resource and reduce biodiversity loss.

Australia's top scientist

– Dr John O'Sullivan, Research Scientist

In October 2009, research scientist John O'Sullivan was honoured with the nation's highest science award – the Prime Minister's Prize for Science. The prize recognised his extraordinary contributions to Australian and international science across the fields of radio astronomy and wireless technology.

Almost every time you connect to a wireless network in the office or at home, you're using technology developed by John O'Sullivan and his colleagues.

In the early 1990s, when wireless networks were rare and slow, John and his team foresaw that people would one day want to use their computers no matter where they were. The team knew this would require a network capable of transmitting data at least ten times faster than any that existed at the time, but they also knew what prevented it – multipath interference. Radio waves bounce off surfaces creating reflections that mean the receiver in a laptop, for example, picks up many copies of the signal being sent. Because each signal arrives at a slightly different time, an echo like effect is created.

The solution to this problem came from John's earlier work in hunting for radio waves that were predicted to come from exploding black holes. While he didn't find those, his technique for cleaning up signals from space that had been distorted by the Earth's atmosphere turned out to be perfect for fixing the distortion created by multipath interference.

John and his multidisciplinary CSIRO team developed and patented this technology that now lies at the heart of most modern high-speed wireless communications systems and which is in close to one billion wireless devices around the world.

John began his CSIRO career in astronomy, and he's now back there again, this time working on an innovative radio camera known as a phased array feed for the Australian Square Kilometre Array Pathfinder radio telescope.

His work is crucial and has the potential to influence the design of the Square Kilometre Array, a huge international project to build a radio telescope so powerful it will be able to look back 13 billion years – almost to the Big Bang itself.

Science leader combines research with business knowhow

– Dr Cathy Foley, Deputy Chief – Science

She's smart, dynamic and a strong leader, and in 2009 she won the prestigious Nokia Business Innovation Award within the National Telstra Business Women's Awards.

Cathy Foley is renowned as one of the country's top applied physicists and her business savvy is now being acknowledged as well. Her success in taking out the Nokia Business Innovation Award was primarily for her invention of the method to make a highly sensitive magnetic field sensor using a high temperature superconductor. The sensor is the basis of the mineral exploration tool, LANDTEM™.

Mineral deposits such as nickel, gold and silver that are buried deep below the surface are often hard to find because they are too 'electrically conducting' or, in some cases in Australia, buried beneath ancient conducting soils, making them impossible to detect using conventional coil magnetic sensors.

LANDTEM™ is a portable exploration tool which uses highly sensitive magnetic sensors known as SQUIDs – Superconducting Quantum Interference Devices – to differentiate the ore from other conductive material.

Cathy led the initial development and commercialisation of LANDTEM™ in collaboration with BHP Billiton and the then Canadian mining company, Falconbridge.

LANDTEM™ has since been licensed to an Australian start-up company, Outer-Rim Development, and has ultimately helped to unearth around $6 billion of new mines worldwide.

At CSIRO, Cathy leads our work in materials physics, specifically in the areas of superconductivity and magnetism. She works tirelessly for the scientific community and is very active in promoting science and women in science, for which she achieved a Public Service Medal in the Australia Day Honors as well as a Eureka Prize.

Sharing her knowledge is a strong driver for Cathy. She speaks at national and international conferences and has been recognised as a 'distinguished speaker' at an international level. As an acknowledged expert in her field she also holds key roles in a variety of scientific societies – really, it is amazing that Cathy finds any time left in her day.

Changing the world one person at a time

– Ms Peta Ashworth, Research Group Leader

The past twelve months have been busy for Peta Ashworth – co-authoring *The CSIRO Home Energy Saving Handbook*, expanding the ever successful Energymark program and becoming the Chair of the International Energy Agency's Greenhouse Gas Research and Development Social Research Network.

How to deliver information to best effect, is the key challenge that drives Peta Ashworth in all her projects, whether it's climate change, low emission energy technologies, or carbon dioxide capture and storage – empowering and educating people with information is what Peta excels in.

As an internationally renowned social researcher, Peta manages projects that demystify complex issues including climate change and the link between energy use and greenhouse gas emissions.

As co-author of *The CSIRO Home Energy Saving Handbook*, Peta has already helped over 20,000 Australian households make a difference. The book helps demonstrate easy ways to tackle energy use to reduce emissions and mitigate the effects of climate change.

Peta and her team are also empowering Australians to take action on climate change at a local level with CSIRO's Energymark program. Already successful in Newcastle, the program expanded to South Australia, and is now being rolled out across New South Wales and south-east Queensland.

Energymark is a grassroots, 'kitchen table' approach where people volunteer to run small group meetings to share tips to reduce their carbon footprint and lower their household energy usage. It helps researchers understand some of the barriers to people accepting the range of low emission energy technologies and what impediments might exist to reducing energy use at home and at work. The results of this work and other research have been used to inform governments about public perceptions and attitudes to energy technologies.

Peta's perception and behaviour work is critical because although much of the effort to address climate change will be led by industry and government, energy users at the community level will play a pivotal role in technology acceptance and behaviour change. Peta believes it is important to educate and empower the community to engage with climate change and work towards environmental sustainability.

Award proves researcher's 'metal'

- Dr Roger Lumley, Research Scientist

Roger Lumley has converted a young man's fascination with cars into an outstanding career in the physical metallurgy of aluminium, which has seen him announced as an emerging innovation leader in 2009.

As a Research Scientist, Roger Lumley is applying his expertise to, among other things, cars where he has a deep understanding of metals and the way metal alloys behave when they are cast into car parts. This understanding has resulted in his developing a heat treatment process which makes cast aluminium components stronger, more fatigue-resistant, and better able to absorb energy under impact.

Roger's work won him the 2009 *Weekend Australian* award for emerging leadership in innovation. He is one of just ten Australians selected by a panel of prominent Australians as being in the forefront of their fields.

Roger's heat treatment process makes it possible to use high pressure die casting – the most widely used production method for automotive components – to rapidly mass produce aluminium alloy car parts which are as strong and safe as the wrought steel components car makers traditionally use, but in a more cost-effective way. As a bonus, substituting aluminium for steel makes cars lighter, more fuel efficient, and thus 'greener' – they produce less carbon dioxide per kilometre driven.

The treatment is easily implemented using existing production line facilities, providing the ability for car manufacturers to leverage this technology to redesign components with significantly lower weight and cost, leading to lighter cars that use less fuel.

More than 95 per cent of the aluminium used for high pressure die casting is recycled, so aluminium car components offer further environmental benefits beyond fuel efficiency.

Outside the automotive industry, high pressure die casting is used in aerospace and consumer goods industries, and Roger's process is just as easily applied to aircraft seat brackets and vacuum cleaner motor housings. In fact, Roger's early work with CSIRO focused on the development of alloys for the next generation of Concorde wing material.

Roger is now extending his work, developing a family of new formulations for aluminium alloys with high fracture resistance, which will benefit a large range of safety critical applications.

Honouring our science

– CSIRO medals and awards

At CSIRO, our staff are the organisation's heart and soul. Their talent, vision and commitment to solving problems and exploring opportunities are key to our success.

Foremost, it is our staff who are working every day to thread the importance of scientific endeavour into the fabric of Australian society. Each year we honour the tremendous efforts our people put into achieving this goal with the awarding of CSIRO medals and awards.

The CSIRO Chairman's Medal

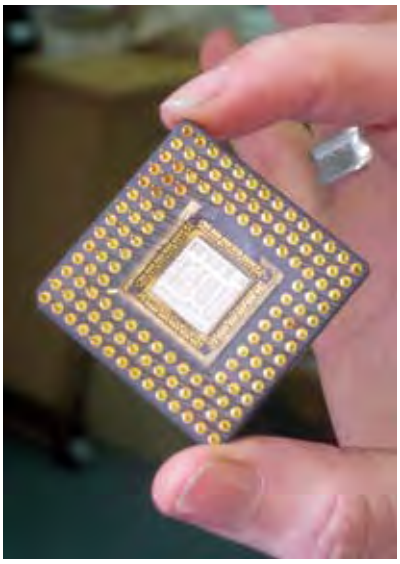
The Wireless LAN Team

For delivering major technical benefits to Australia and the world and substantial returns to CSIRO from wireless local area network (WLAN) technology now underpinning wireless communication systems in over one billion products worldwide.

The emergence of portable computers and wireless networking towards the end of the 1980s, presented an opportunity to harness CSIRO's unique skills in radio systems. The Wireless LAN Team foresaw that traffic would be so high that a new generation of wireless land area networks capable of transmitting data at 50 megabits per second would be needed. The team, with backgrounds mostly unrelated to computing, found a solution that eluded 22 major international research groups. Their technology and the associated patents enabled:

- a revolution in computer networking and the way we conduct our lives
- a successful spin-out company, Radiata
- the generation of significant returns to CSIRO and Australia from patent litigation settled in 2009.

This team demonstrates what can be achieved through the combination of scientific excellence with legal and commercial capability.



The Team: Dr John O'Sullivan, Mr Graham Daniels, Mr Diethelm Ostry, Mr Denis Redfern, Mr Terry Healy, Dr Jack Steele, Mr Nigel Poole, Dr Terence Percival, Mr John Deane, Dr Dennis Cooper, Ms Katrina O'Leary, Dr Hajime Suzuki, Ms Caitlin Westwood, Ms Julie Berwick, Ms Debbie Davis, Ms Julie Filazzola, Ms Sarah Spencer, Ms May Ling Goode.

The CSIRO Medal for Research Achievement

The Northern Prawn Fishery Bio-economic Team

For the development of a combined biological and economic model to guide the management of Australia's Northern Prawn Fishery in a way that ensures industry profitability and a vigorous fishery resource. The approach has won international acclaim as a global paragon of fishery management.

A bio-economic model developed by the Northern Prawn Fishery Bio-economic Team, in collaboration with industry, is now guiding the world-class management of Australia's Northern Prawn Fishery (NPF). The model defines harvest levels that achieve maximum economic yield (MEY) while sustaining the fishery resource.

After two years under the MEY target management system, the NPF has gained valuable efficiencies and annual fishery profits are expected to rise from an average of $8 million to more than $30 million a year by 2012.

This approach has focused attention on Australia as a world leader in fisheries management, and has been praised by the United Nations Food and Agriculture Organization.

The Team: Dr Catherine Dichmont, Mr Roy Deng, Dr André Punt, Dr Bill Venables, Dr Nick Ellis, Dr Shijie Zhou, Ms Janet Bishop, Prof Tom Kompas, Dr Sean Pascoe, Dr Nhu Che, Dr Yimin Ye, Dr Peter Gooday.

The Ophthalmic Biomaterials Team

For the development of two novel polymer technologies that have the potential to revolutionise vision correction using implantable devices.

The Ophthalmic Biomaterials Team used a multidisciplinary approach to develop novel polymer technologies with the potential to revolutionise vision correction. Working through vision-related CRCs, the Team designed and optimised two biocompatible polymer materials for implantable ocular devices – offering solutions for the correction of refractive errors and the eye's ability to near focus for the treatment of presbyopia and cataracts.

Both technologies target the growing demand for implantable ophthalmic devices and are currently being commercialised through Adventus Technologies Inc.

The Team: Dr Timothy Hughes, Dr Margaret Evans, Dr Keith McLean, Mr Graham Johnson, Dr Xiaojuan Hao, Dr Jack Steele, Dr Gordon Meijs, Dr Jason Watling, Dr Grace Chan, Prof Hans Griesser, Dr Hassan Chaouk, Dr Anthony Clayton, Dr Bronwyn Laycock, Dr Helmut Thissen, Ms Tam Le, Mrs Gail McFarland, Ms Justine Jeffery, Ms Xuan Nguyen, Mr Warren Knower, Mr John Wilkie, Ms Barbara Bojarski, Ms Danelle Beattie, Mr Jim Bates, Ms Malsha Wickramaratna, Mr Asitha Balachandra, Ms Eliana Pereeia, Dr Gerrit Beumer, Dr Helen Fitton, Ms Michelle Jenkins, Ms Tracey Woolford, Ms Janease Graham, Ms Lisa Hong, Dr Ann Dalton, Dr Thomas Gengenbach, Dr Roger Mulder, Mr John Ward, Mr Mark Greaves, Dr Mei Gao, Dr Richard Jarrett, Mrs Sarah Taylor, Ms Penny Bean, Ms Denise Lewy, Dr Lavinia Taliana, Vision CRC, LV Prasad Eye Institute, Bascom Palmer Eye Institute.

The CSIRO Medal for Business Excellence

The CSIRO-PETRONAS Engagement Team

For initiating and developing the CSIRO-PETRONAS Strategic Alliance and building trust between technical, legal and commercial teams across both organisations.

The CSIRO-PETRONAS Engagement Team identified and pursued strategic alignment opportunities between the two organisations in the areas of oil and gas exploration and production, advanced materials and renewable energy.

The mutually beneficial partnership is truly collaborative, with common priorities driving joint projects and workshops, secondments, co-publications, technology development and transfer and capability development in both organisations. It has also provided both organisations with an avenue for further testing and application of technologies.

The Team: Dr Edson Nakagawa, Mr Amir Aryana, Dr Beverley Ronalds, Dr Swee Mak, Dr Geoff Houston, Dr Stuart Bateman, Dr Russell Varley, Dr Herbert Volk, Dr Karen Kozielski, Dr Patrick Hartley, Dr Gerry Wilson, Mr Rajiv Cabraal, Mr Graeme Carlin, Dr Andrew Groth, C H H Wong, Dr Hamzah Abd Hamid, Dr Jaizan H M Jais, R A Karim, H S Hazri, Dr M I Abdul Mutalib, Dr Kok Hoong Leong.

The CSIRO Medal for Environmental Achievement

The CSIRO Property Services Queensland Water Management Team

For leading and implementing best practice water management plans to achieve significant and continued reduction in water usage at CSIRO's south-east Queensland research facilities, resulting in a massive reduction of 76 per cent over four years.

With diminishing water supplies in south-east Queensland, the CSIRO Property Services Queensland Water Management Team implemented strategies to reduce CSIRO's water usage by 25 per cent. In 2005-2007, this goal was significantly exceeded, with water consumption reduced by 55 per cent.

To further reduce water consumption, Water Efficiency Management Plans were developed and implemented. As a result, water usage across CSIRO's south-east Queensland facilities was significantly reduced from 59 million litres to 14.4 million litres – a massive reduction of 76 per cent.

The Team: Mr Rudy Van Kerckhof, Mr Bernie McDonough, Mr Michael Kath, Mr Colin Russell, Mr Andrew Shield, Mr David Sigmund, Mr Nathan Dolci, Mr Richard Butler, Mr Gary Bonney, Mr Neil Hoffmann.

The CSIRO Medal for Health & Safety Achievement

The Fieldwork Register Design and Implementation Team

For improving the safety of CSIRO staff undertaking fieldwork by developing and implementing Sustainable Ecosystems' online Fieldwork Register.

Sustainable Ecosystems (now Ecosystem Sciences) is CSIRO's most geographically spread business unit, whose staff frequently work in diverse, remote and difficult to access locations. Keeping track of where staff are working is critical to support safe field operations.

Recognising this, the Fieldwork Register Design and Implementation Team developed a web-based tool to better manage the risks involved with fieldwork and to improve both storage and retrieval of information. The team's tool is a centralised, highly accessible database of contact information, field sites, vehicle information and field trip plans that has led to a safer work environment for all staff.

The Team: Mr David Goff, Mr Stephen Henry, Ms Mandy Yialeloglou, Ms Karen Mobbs, Mr Justin Perry, Mr Adam McKeown, Mr Brett Cocks, Mr Matt Bradford)

The CSIRO Medal for Support Excellence

Ms Wendy Reid

For passionate, enthusiastic, one-CSIRO leadership in transforming Flagship financial management; innovation in organisational budgeting and common costing processes; consistent high-quality service provision, and readily embracing change in CSIRO's support systems.

Wendy Reid combines business acumen and advanced systems skills with exemplary agility in embracing change. Her achievements include a number of enterprise financial models and tools, which have delivered a consistent method for CSIRO-wide planning and introduced a pivotal transformation to organisational budgeting processes.

The CSIRO Medal for Lifetime Achievement

Dr Ezio Rizzardo

For seminal contributions to polymer science and pioneering work in controlled free radical polymerisation which has revolutionised the way polymers are made, leading to the development of new generations of polymeric materials in the field of electronics, healthcare and biotechnology.

Ezio Rizzardo has made seminal contributions to polymer science and is a pioneer in the area of controlled free radical polymerisation which has placed Australia and CSIRO at the forefront of polymer chemistry.

His pioneering work in the control of free radical polymerisation is enabling chemists worldwide to produce polymers with tailored chemical structures and defined properties. His work has revolutionised how polymers are made and has led the development of a new generation of polymeric materials.

Dr Warwick Wilson

For inspirational leadership spanning 27 years and ensuring consistent development and delivery of benchmark research instrumentation that has helped establish and maintain CSIRO's position as a world leader in the field of radio astronomy.

Warwick Wilson is one of the great enablers of science in both the Australian and international radio astronomy communities.

The benchmark quality of his and his teams' instrumentation, including receiver and signal processing systems, has enabled radio astronomy science to be performed at the highest level on an international scale.

The John Philip Award for the Promotion of Excellence in Young Scientists

Dr Ben Hoffmann

For research into the ecology and management of invasive ants, especially on Indigenous lands, which has resulted in internationally significant management outcomes.

Ben Hoffmann is recognised internationally as a leading invasive ant scientist. He has conducted innovative research on factors promoting invasion success, the ecological impacts of invasive ants, and on ecosystem recovery following eradication. His science-based approach to invasive ant management has led to internationally significant eradications of some of the world's worst ant pests from regions of outstanding ecological and cultural significance, including areas within Kakadu National Park, Arnhem Land and the Tiwi Islands.

Ben is highly respected in Aboriginal communities and organisations throughout the Top End, and has been influential in CSIRO's successful Indigenous engagement in the region.

*The above honours were awarded in 2009.

Image details

The following provides credit and caption details for the images used in this publication. Details begin from the top left corner of each page and move clockwise. Unless stated, images are credit CSIRO.

1: CSIRO Chief Executive, Dr Megan Clark.

4-5: Australia's first zero emission house.

Adoption of low-emission distributed energy could greatly reduce the cost of moving to a low-carbon future. Credit: iStockphoto.com.

The CSIRO Home Energy Saving Handbook. Credit: Pan MacMillan.

6-7: OptiCOOL is helping building owners reduce their energy consumption. Credit: iStockphoto.com.

New CSIRO solvents increase the efficiency of CO_2 capture from coal-fired power stations.

Real-time data analysis enables forward modelling of the geometry of hydraulic fractures.

CSIRO is working to create economical ways of converting natural gas to transport fuels. Credit: Nick Pitsas Productions.

Cross section of house (OptiCOOL).

8-9: Rainbow.

Climate change could prompt a period of 'weed change' in South Australia.

Global carbon emissions rose in 2000-2008 despite the global financial crisis.

SWACI helps predict annual patterns of wet season rainfall in south-west Western Australia.

Rainfall distribution across Australia has significantly changed over the past 50 years.

10-11: Lower sea surface temperatures in the eastern Indian Ocean can increase bushfire risk in south-eastern Australia.

Global scale environmental problems require global scale cooperation.

Coastal inundation will become more frequent as sea levels rise. Credit: Bruce Miller.

The experimental burnover house, before during and after the fire simulation.

12-13: Informing environmental watering in the Murray-Darling Basin.

Liffey Falls, Tasmania. Credit: DPIPWE, Tasmania.

CSIRO has developed a membrane that can recover and purify high-temperature industrial steam.

Conducting water quality monitoring in the Swan River, Western Australia. Credit: Damien Smith.

14-15: The gene chip can detect thousands of organisms. Credit: Tim Wheeler.

CSIRO scientist assessing soil for oil contamination. Credit: Ben Dearman, Ziltek Pty Ltd.

CSIRO's autonomous catamaran and one of the floating nodes. Credit: Deb Gale, Seqwater.

IrriSATSMS is helping irrigators save water.

16-17: BARLEYmax™ is the result of a 10-year research program.

Scientists have solved the mystery of what determines sex development in chickens.

Is this the perfect prawn?

CSIRO has developed a salt tolerant durum wheat.

18-19: Researchers have developed practical actions for primary industry to respond to climate change.

Technical Officer with the Cottonscope instrument.

A female pea aphid giving birth to live young. Credit: Shipher Wu, National Taiwan University.

CSIRO's Sustainable Agriculture Flagship was launched in 2010. Credit: CSIRO (under license).

Make It Safe: A Guide to Food Safety book.

Electron microscope picture of a fly's antenna.

20-21: Happy couple. Credit:iStockphoto.com

Our ERA model helps surgeons predict how patients will respond to surgery. Credit: iStockphoto.com.

The CSIRO Total Wellbeing Diet Recipe Book and *The CSIRO Wellbeing Plan for Kids*. Credit: Penguin.

New Biobank will aid disease predication and diagnosis.

Some aspects of a low-carb diet may have detrimental effects on mood.

CSIRO is investigating how bioactives may protect against Alzheimer's disease. Credit: iStockphoto.com.

In vivo imaging of a healthy elderly person (left) compared to Alzheimer's disease patient (right).

22-23: AHS *Centaur*. Credit: Australian and Queensland Governments.

CSIRO scientist working on part of the hydrocarbon sensor system.

Marine Climate Change Impacts and Adaptation Report Card for Australia.

Marine ecosystems are showing signs of recovery from overfishing.

The Torres Strait Tropical Rock Lobster Fishery was assessed for its environmental impact. Credit: Gary Bell.

The effects of protecting marine areas can take decades to cascade through ecosystems.

24-25: An unidentified species of Ophiactis.

The Indian Ocean sector of the Southern Ocean where the ocean current has been identified.

The endangered Spotted Handfish.

The Derwent Estuary.

When complete, *The Investigator* will enhance Australia's ocean research capability.

A wave breaks over the bow of the *Southern Surveyor* in the Southern Ocean.

26-27: Purnululu National Park. Credit: Glenn Walker.

New molecular approaches are boosting soil health.

Australia has a sizable potential to store carbon in land uses systems.

Australia's temperate grasslands are at risk.

28-29: Sharp-tailed Sandpipers found in the study area. Credit: Joel Allan, University of Adelaide.

Researchers sequence human body louse genome.

Kakadu National Park. Credit: iStockphoto.com.

A selective approach to fishing may worsen rather than reduce the impact of fishing on marine fisheries and ecosystems.

30-31: The first ASKAP antenna. Credit: Phil Dawson.

Centaurus A galaxy. Credit: CSIRO, R Morganti (ASTRON), N Junkes (MPIfR).

The new 12-metre dish near Warkworth, New Zealand. Credit: Tim Natusch, AUT.

32-33: An artist's conception of our Galaxy. Credit: NASA/JPL-Caltech.

Two galaxies showing their different proportions of very massive stars. Credit: NASA/JPL-Caltech/JHU.

The meteorite at the discovery site. Credit: Imperial College London.

Mid-infrared image from NASA's Spitzer Space Telescope. Credit: NASA/JPL-Caltech.

34-35: Bee collecting pollen.

CSIRO PhD student working with Hendra virus.

A Bridal Creeper infestation.

Bats are the natural host of several emerging viruses, some of which are deadly to humans.

36-37: CSIRO Snapper software helps medical computer systems speak the same language. Credit: iStockphoto.com.

CPUs and GPUs installed in CSIRO's GPU cluster.

Providing families with more control of their energy use. Credit: Roger Lovell.

Computer technology is being used to train surgeons and reduce the incidence of bowel cancer.

CSIRO Image Analyst with the Gemmological Digital Analyser. Credit: Chris Taylor.

38-39: Paddington open cut Gold Mine, Western Australia.

Sampling for gold thiosulfate recovered using the patented ion exchange resin. Credit: Darryl Peroni.

Experimental results (pink/blue) showing development of stirring the leaching. Green lines show what theory predicts, which matches well with the results.

Computer models showing hot spot in original mould (top), and the re-designed mould with no hot spot.

40-41: Microscopic analysis of iron ore.

Micrograph showing sheaves of parallel platy olivine crystals from a komatiite flow.

Outcrop of komatiite lava.

CSIRO researcher setting up an experiment for the modelling study at the Australian Synchrotron.

42-43: CSIRO engineer holding a steering wheel armature cast using ATM. Credit: Mark Fergus.

Turning eucalyptus oil into useful industry chemical products to manufacture plastics. Credit: Nick Pitsas Productions.

Geopolymer concrete will substantially reduce greenhouse gas emissions.

CSIRO scientists have artificially produced the silk honeybees produce naturally.

Researcher examining Quench coat treated surface.

44: BARLEYmax™.

45: Centaurus A galaxy set against the Australia Telescope Compact Array. Credit: CSIRO, R Morganti (ASTRON), N Junkes (MPIfR).

46: Imperial Fruit Sucking Moth.

Fish Collection's Gunard Specimen.

CSIRO researcher examines a daisy specimen.

Rainbow Lorikeets. Credit: John Manger.

47: Dr John O'Sullivan. Credit: Bearcat Productions.

Dr Cathy Foley.

48: Ms Peta Ashworth.

Dr Roger Lumley. Credit: Kym Smith, Courtesy *Weekend Australian*.

49: Wireless LAN technology.

50: The Northern Prawn Fishery Bio-economic Team won the 2009 CSIRO Medal for Research Achievement. Credit: Austral Fisheries.

The Ophthalmic Biomaterials Team won the 2009 CSIRO Medal for Research Achievement. Credit: iStockphoto.com.

The CSIRO-PETRONAS Engagement Team won the 2009 CSIRO Medal for Business Excellence. Credit: Concept developed from stock photography.

51: The CSIRO Property Services QLD Water Management Team won the 2009 CSIRO Medal for Environmental Achievement. Credit: iStockphoto.com.

The Fieldwork Register Design and Implementation Team won the CSIRO Medal for Health and Safety Achievement. Credit: iStockphoto.com.

Ms Wendy Reid. Credit: Wendy Reid.

52: Dr Ezio Rizzardo. Credit: Leo Farrell Photography.

Dr Warwick Wilson. Credit: Leo Farrell Photography.

Dr Ben Hoffmann. Credit: Leo Farrell Photography.

Contact Us

Phone: 1300 363 400
+61 3 9545 2176

Email: enquiries@csiro.au

Web: www.csiro.au

Your CSIRO

Australia is founding its future on science and innovation. Its national science agency, CSIRO, is a powerhouse of ideas, technologies and skills for building prosperity, growth, health and sustainability. It serves governments, industries, business and communities across the nation.