



Wetlands Australia

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ANNUAL UPDATE FOR AUSTRALIA'S WETLAND COMMUNITY



Australian Government

Department of the Environment,
Water, Heritage and the Arts

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Ministers' Foreword



Australia's natural environment, our biodiversity and the ecological services it provides, underpin our quality of life, our economy and much of our national identity. We are one of the world's 17 mega-diverse countries, with more endemic animal species than any other country. However, places such as the Great Barrier Reef and Kakadu National Park, which are ecosystems of international significance as well as part of our national identity, are at risk from climate change.

Climate change is one of the greatest economic, social, and environmental challenges of our time, but the Government is meeting that challenge. We are getting on with the job of preparing for a future with less water. A drying climate and rising demand for water means added pressure on Australia's rivers and wetlands. A high proportion of species – about 85 per cent of terrestrial mammals, 91 per cent of flowering plants and 90 per cent of reptiles and frogs found only in Australia – are also potentially at risk due to climate change.

This edition of *Wetlands Australia* focuses on "wetlands, biodiversity and climate change", in keeping with the theme for World Wetlands Day 2010. It also coincides with the United Nations designation of 2010 as the International Year of Biodiversity. Climate change is a permanent fixture in the media and understood at least at some level by many people, so now is the time to focus on wetland ecosystems and their biodiversity, the impact of climate change and importantly, what we can do about it.

In response to climate change, the Australian Government has developed *Water for the Future*, an initiative that provides national leadership in water reform for all Australians. This long-term \$12.9 billion package aims to secure our water supplies, use water wisely, take action on climate change and support healthy rivers. A key priority under *Water for the Future* concerns the future of the many communities, rivers and wetlands of the Murray-Darling Basin.

Senator the Hon Penny Wong
Minister for Climate Change and Water

In the Murray-Darling Basin, the challenges of climate change and extended drought have been compounded by decades of mismanagement. No government can make it rain, but this government is enacting a three-point plan to put the Murray-Darling Basin back onto a sustainable footing: 1) We have taken over Basin-wide planning and for the first time will place a scientifically-based cap on Basin water use. 2) We are investing in irrigation infrastructure to help our farmers and Basin communities and to protect food security. 3) We are buying back water to help restore health to the Basin's rivers and wetlands.

To protect our biodiversity and use Australia's natural resources wisely, *Caring for our Country*, the Australian Government's environmental management initiative, targets clear national priorities and measurable outcomes. This includes recognising aquatic ecosystems as significant environmental assets that provide a wide range of services which are fundamentally important to the Australian lifestyle and economy. These national priorities are designed to make a real on-ground difference to wetland health, and ensure that funding goes to those areas and projects across the nation that best meet the ecological challenges we face.

Wetlands are a critical part of our natural environment. They protect our shores from wave action, reduce the impacts of floods, absorb pollutants and improve water quality. They provide habitat for animals and plants and many contain a wide diversity of life, supporting plants and animals that are found nowhere else. It is vital that these critical ecosystems and their biodiversity are maintained, protected and given resilience to meet the challenges of climate change.

The Australian Government takes the challenge of climate change seriously and is already acting to protect our environment. We are doing this on every front, including by looking at the effectiveness of our national environmental legislation, significantly expanding our investments in the National Reserve System and providing communities and landowners with the tools and capacities they need to safeguard our natural resources over the long term.

The projects featured in this edition demonstrate the nationwide, on-ground battle against climate change to protect wetlands. These actions made today will have consequences for decades. Whether you are monitoring water quality in a local stream or helping to revive internationally-significant wetlands, every single action makes a difference and the Australian Government acknowledges each individual effort.

The Hon Peter Garrett AM MP
Minister for the Environment, Heritage and the Arts



Cobourg Peninsula, Northern Territory, the world's first Ramsar-listed site. Photo: Michelle McAulay and DEWHA.

RAMSAR SECRETARY GENERAL VISITS AUSTRALIA

Simon Godschalx, Department of the Environment, Water, Heritage and the Arts

Anada Tiéga, the Secretary General of the Ramsar Convention, visited Australia in October 2009 to attend a conference in Cairns and see first-hand the work Australia is doing to protect its wetlands and implement the Ramsar Convention. Mr Tiéga visited a number of Ramsar wetlands and met with site managers and other key stakeholders to discuss the opportunities and challenges facing Australia in managing our wetlands.

A citizen of Niger, Mr Tiéga has many years' experience in working with wetland conservation and sustainable use both at local level and internationally. He served for some years in the environmental administration of Niger, following which he became Niger's country representative for The World Conservation Union (IUCN). In the mid-1990s, he served as IUCN's regional coordinator for West Africa.

Mr Tiéga's site visits started at the Boondall Wetlands Environment Centre, part of the Moreton Bay Ramsar site in south-east Queensland, where he met representatives from the Brisbane City Council, Wetlands International-Oceania, Queensland Wader Study Group and Australian and Queensland government officials.

Discussions covered the educational work of the Boondall Wetlands Environment Centre; the Queensland Wetlands Program (a joint program of the Australian and Queensland governments); the March 2009 Moreton Bay oil spill; the recently released *Healthy Waterways Report Card*; links to international wetlands work including the Australia East Asia Flyway program; and migratory shorebird counts and community educational activities of the Queensland Wader Study Group.

Mr Tiéga commented on the national (and 'international') applicability of the work undertaken through the Queensland Wetlands Program on wetland mapping, indicators and inventory as well as the high level of cooperation between governments and non-government agencies on wetland management in Queensland.

Mr Tiéga's next site visit was to the Coorong and Lakes Alexandrina and Albert, South Australia. Mr Tiéga saw the difficult situation facing the site and met with site managers, traditional owners and community members to discuss management issues. This provided him with an understanding of the short and longer-term planning and actions being implemented or considered, to ensure an enduring outcome for these internationally-important wetlands.

Mr Tiéga also visited the Macquarie Marshes in New South Wales, a site for which an Article 3.2 notification (of 'likely' human induced adverse change to the ecological character of the site) has been recently made. He had the opportunity to see a wetland that was partially inundated with water and a flush of green. This picturesque phase of the marshes was a product of an ongoing NSW environmental water flow and to a lesser extent, recent rainfall in the area. Like the Coorong, the marshes are suffering from reduced flows.

Mr Tiéga met with former and current managers of the privately-owned part of the Ramsar site ('Wilgara'), as well as Australian and New South Wales government officers and was provided with an update on the development of a response strategy to address the Article 3.2 notification.

The final site visit by Mr Tiéga was to the Towra Point Nature Reserve Ramsar site at Kurnell in Sydney. Towra Point is situated in the highly-urbanised and industrialised Georges River and Botany Bay Catchments.

Mr Tiéga visited an area on the site where management actions such as dredging and beach nourishment have been



undertaken to protect breeding habitat of the endangered little tern. Site managers also provided an overview of the monitoring program in place to evaluate this work.

While in Canberra, Mr Tiéga met the Minister for the Environment, Heritage and the Arts, the Hon Peter Garrett, AM, MP, international organisational partners including World Wildlife Fund Australia, Wetland International Oceania, Birds Australia, the Australian Committee for IUCN; as well as the Australian Wetlands Alliance to discuss Australia's implementation of the Ramsar Convention.

Mr Tiéga also addressed an event at the Department of the Environment, Water, Heritage and the Arts to celebrate the 35th anniversary of the listing of Cobourg Peninsula as the world's first Wetland of International Importance.

Kenny Wauchope, traditional owner and chair of the Cobourg Peninsula Sanctuary and Marine Park Board, and Peter Fitzgerald, senior district ranger of the Garig Gunak Barlu National Park, attended the celebration.

Cobourg Peninsula is managed jointly by the Northern Territory Government and the Cobourg traditional owners through the Cobourg Peninsula Sanctuary and Marine Park Board. Cobourg Peninsula is a good illustration of community involvement and participation in management decision-making for Ramsar-listed wetlands. Under the Ramsar Convention, the role of Indigenous communities in managing local wetlands is well recognised. The advantages of participatory management provide a blend of local environmental knowledge with scientific understanding for more effective wetland management.

Mr Tiéga also officially launched the updated Australian Wetlands Database Ramsar site information pages, a key tool for the Ramsar Convention's Communication, Education, Participation and Awareness program in Australia.

The enhanced database promotes the wise use of wetlands and provides easily accessible information about Australia's wetlands, including all of Australia's 65 Ramsar sites. The database features a virtual tour of Cobourg Peninsula Ramsar site.

The database will be a valuable resource for wetland site managers, other key stakeholders and the public in general. The department welcomes feedback on the database and inquiries can be made at wetlandsmail@environment.gov.au

Information: www.environment.gov.au/wetlands



Secretary General of the Ramsar Convention, AnadaTiéga.
Photo: Imaging Services Section DEWHA.



NSW WETLAND RECOVERY PROGRAM DRAWS TO A CLOSE

Macquarie Marshes, New South Wales. Photo: Renee Shepherd.

*Renee Shepherd, NSW Wetland Recovery Program,
Department of Environment, Climate Change and Water*

Investment in the Gwydir Wetlands and Macquarie Marshes through the NSW Wetland Recovery Program has paid dividends. This four-year program concludes in June 2010 and has supported 26 projects to restore wetland resilience.

To date, the program has seen the purchase of 5890 megalitres (ML) and 2190 ML of general security access water entitlement in the Macquarie and Gwydir Valleys respectively, and 1302 ML supplementary access in the Macquarie Valley, to be used for environmental outcomes.

A total of 70 kilometres of the Macquarie River has been cleared of willows and re-planted with native species, and the removal of a weir has improved fish passage. The coverage of water hyacinth in the Gingham Channel has been reduced from 60 per cent to less than 10 per cent, through installing eight trap fences and five containment booms, regular spraying, mechanical harvesting, establishment of weevil nurseries for biological control and construction of an all-terrain spray vehicle.

Research has been carried out into the biological control of lippia, which has resulted in the identification of 37 natural enemies. Six of these pathogens have the potential for control and are being further investigated. The selection of biological control agents for lippia is made difficult by the existence of a closely-related native species, *Phyla nodiflora*. A successful biological control agent would need to be able to target lippia without impacting on the native *Phyla nodiflora*.

Gradgery Lane has been updated to allow larger daily flows to the Macquarie Marshes without restricting road access for landholders. This will increase the flexibility of managing environmental flows to key ecological assets. Grazing guidelines have also been developed to provide information on wetlands and stock management. Information on 41 plant species, including feed quality, is included in the new *Glovebox guide to plants of the Gwydir Wetlands and Macquarie Marshes*.

Investigation has been carried out into 119 structures that may have been affecting water flows in the Macquarie

Marshes. Twenty eight structures required further action, including the removal of five structures. A total of 45 km of fencing has been installed to better manage grazing practices in the Gwydir Wetlands, including the subsequent establishment of sustainable grazing agreements over 1150 hectares. Finally, the construction of the Gwydir Wetlands Education Centre on private property allows the wetlands to be more accessible to the public.

Construction of a pipeline in the Gwydir Wetlands will replace the current open channel delivery system of stock and domestic water along the Gingham Channel. Nearly 1000 ML of system savings will be delivered to the environment, allowing for rehabilitation of wetland values through a more appropriate wetting regime.

Key documents developed for the Gwydir Wetlands and Macquarie Marshes are Adaptive Environmental Management Plans (AEMPs). The plans guide the actions required to restore and maintain critical ecological functions and habitats in the wetlands. The information in the plans is intended to stimulate discussion and allow all interested stakeholders to be involved in determining the future management of the wetlands. Consultation on the Macquarie Marshes AEMP was undertaken during the second half of 2009.

A clear outcome of the program was that enacting change in the landscape is most successful when the people in that landscape are involved in change. Local Indigenous people have been involved with AEMPs and identified ways to be more closely involved in natural resource management.

Already this issue has been addressed through the inclusion of Indigenous community representation on the Environmental Water Advisory Groups for the two valleys. Landholders have been involved in project steering committees, providing historical insights and valuable experience. Participation in surveys has provided benchmarking information. The use of private land for research and information days has allowed access to various wetland assets and provided an insight into the numerous management practices that occur.

The NSW Wetland Recovery Program is jointly funded by the New South Wales Government and the Australian Government's *Water for the Future* initiative and is delivered by the Department of Environment, Climate Change and Water, Office of Water, Industry and Investment NSW, and the Border Rivers-Gwydir and Central West Catchment Management Authorities.

Information: www.wetlandrecovery.nsw.gov.au



REVIVING THE MURRAY-DARLING BASIN

Markaranka Wetlands, Waikerie, South Australia, before and after environmental watering in autumn '09. Photos: Mark Mohell and DEWHA.

Jon Thiele, Department of the Environment, Water, Heritage and the Arts

All across the vast Murray-Darling Basin, rivers, wetlands and floodplains are under significant stress. According to the Murray-Darling Basin Sustainable Rivers Audit just one of the basin's 23 catchments – the Paroo in Queensland – is in good condition*. Elsewhere, a century of irrigated farming and the expansion of cities and towns has taken its toll. This year is forecast to be the 17th driest year in 118 years of records for the River Murray. Even the northern Basin has been particularly dry and in late 2008 the Darling River stopped flowing. The CSIRO's Sustainable Yields report has forecast less water and higher temperatures in the next two decades as a result of climate change.

Many of the Basin's wetlands of international significance and national importance, and the species they support, are at risk from a warmer and drier future. Work is underway, however, to revive the ecological health of the Basin and give it the best chance of survival. The Australian Government has developed a plan to restore the balance between water for human use and water for the environment by acquiring water entitlements to return water to the environment. This rebalancing of water use is part of a wider reform to ensure that future consumptive use is sustainable in the long term, so that ecosystems have sufficient water to perform key ecological functions.

A total of \$3.1 billion has been set aside to purchase water entitlements under the Australian Government's 10-year *Water for the Future* framework. *Water for the Future* provides a further \$5.8 billion for infrastructure and other improvements to provide water savings, a share of which will be returned to the environment. As at 31 October 2009, the government had secured the purchase of 638 billion litres of water worth \$996 million. These entitlements are expected to deliver on average 414 billion litres per year for the environment.

Australian Government entitlements are being managed by the Commonwealth Environmental Water Holder (CEWH), an independent statutory position established under the *Water Act 2007*, as part of broader reform of the way we manage water resources in the Basin. In making decisions on use of the Commonwealth's environmental water holdings, the CEWH considers input from Basin state governments and local site managers as well as advice from an independent scientific advisory committee. Proposed watering actions are assessed against a set of published criteria: the ecological significance of the asset; the expected ecological outcomes from the proposed watering action; potential risks of the proposed watering action at the

site and at connected locations; the long-term sustainability of the asset(s) including management arrangements; and the cost effectiveness and feasibility of undertaking the watering.

Continuing low inflows to the Basin have meant low allocations for all entitlement holders. Even so, about 27 billion litres of Commonwealth water was returned to the environment in 2009; 11 billion of it in autumn and the balance in spring and early summer. Some 25 sites have benefited, including the Ramsar-listed wetlands of Hattah Lakes, Macquarie Marshes and Chowilla Floodplain (Riverland Ramsar site).

In dry conditions, such as those currently being experienced in large parts of the Basin, environmental watering is aimed at avoiding damage to aquatic ecosystems and giving them the best chance of recovery when natural flows increase. To date, watering by the CEWH will help maintain river red gums, coolabahs, black box and other native vegetation, including breeding areas for the endangered southern bell frog. In wetter conditions, the CEWH will look to maintain and improve the health of rivers and wetlands in the Basin. Watering actions to support large-scale breeding events for birds, fish, frogs and vegetation will become possible, as will the ability to provide ecologically-important flows between floodplains and river channels.

Collaboration is critical to the success of the environmental watering program. The CEWH is working with delivery partners and environmental site managers such as state agencies and catchment management authorities to deliver environmental water and monitor the outcomes. The government has also established the Water Recovery and Environmental Use Stakeholder Reference Panel, which is comprised of farming, environment and Indigenous representatives and the general community.

To support the CEWH, a framework is being developed to prioritise watering actions so that the Commonwealth's water entitlements can be put to the most effective use in the long term. The *Water Act 2007* requires the Murray-Darling Basin Authority to prepare and oversee a Basin Plan, a legally-enforceable document that provides for the integrated management of all Basin water resources. Its central legal requirement is to set environmentally-sustainable limits on the amount of water that can be taken from the Basin's water resources. Another central element is an environmental watering plan to restore and sustain the wetlands and other environmental assets of the Basin and to protect biodiversity dependent on the Basin. In the future, Commonwealth water holdings will be managed in accordance with relevant environmental water plans, including the Murray-Darling Basin Environmental Watering Plan being developed by the Murray-Darling Basin Authority, due for completion by 2011.

*First Sustainable Rivers Audit (2004-2007)

www.environment.gov.au/water/policy-programs/cewh



An extensive survey of the rivers of the Lake Eyre Basin covered 1500 kilometres of river systems and revealed the importance of the region for waterbirds.
Photo: Damien Farine.

FREE-FLOWING RIVERS OF THE CHANNEL COUNTRY

Conservation implications of the 2009 Georgina-Diamantina flood

Roger Jaensch, Wetlands International, Julian Reid, Australian National University and Richard Kingsford, University of New South Wales

Unlike many Australian rivers, the rivers of the Lake Eyre Basin remain largely unmodified and free-flowing. With pastoral grazing the dominant land-use in this arid zone, both landholders and wildlife benefit from river floods. This scenario presents a great opportunity for conservation outcomes coupled with sustainable use of natural resources.

Within the Basin's Channel Country region, the three rivers that flow toward Lake Eyre – the Georgina, Diamantina and Cooper – provide millions of hectares of habitat for wetland-dependent plants and animals. Every two to three years, two or more of these rivers experience a major flood but this tends to remain unheralded except when floodwaters reach Lake Eyre itself.

In January-February 2009, exceptional monsoonal rainfall in headwaters near Mount Isa generated major flooding in the Georgina-Diamantina system, which was large enough to partly fill Lake Eyre in April-May. As the waters rose, collaborating scientists from three organisations – Wetlands International, Australian National University and

University of New South Wales – secured funding from the Australian, South Australian and Queensland governments to expand knowledge of the ecology and importance of the Channel Country wetlands, particularly for waterbirds. This knowledge will underpin natural resource management planning for the region and for other river basins.

Ground and aerial surveys in April and May traversed more than 1500 kilometres of river system and a dozen lakes. These included more than 150 transects and plots that were used to estimate total numbers of birds and breeding. Managers of pastoral leases cooperated in providing information on access and conditions.

As anticipated, huge numbers of waterbirds arrived in the Channel Country, many seizing the opportunity to bolster their declining numbers by breeding. Two and almost certainly three sectors of swampy Georgina-Diamantina floodplain were estimated to each support in excess of 500 000 waterbirds and overall numbers exceeded 2.0 million in April at maximum extent of water and also in May when much of the floodplain country had dried back. These numbers are impressive by any measure though perhaps not as high as occurred in 2000 and 2001 when flooding was more widespread in the region. Relatively few of these birds were on Lake Eyre, because insufficient freshwater had entered to counter the hypersaline conditions.

Seven species of migratory shorebird were recorded in the drying floodplains and shallow lakes. Most individuals were sharp-tailed sandpipers and little curlews and numbers of the latter exceeded 1 per cent of the East Asian Australasian Migratory Flyway population size. Flocks of aerial-feeding,

white-winged black tern, another migrant, were estimated to total nearly 20 000 individuals. Just how important the Channel Country is for migrating waterbirds has been recognised only in the past decade.

Undoubtedly the most significant aspect of Channel Country flooding is the breeding opportunities it affords waterbirds, both the colonial and dispersed nesters. In 2009, at least 30 colonies were active, accounting for approximately 120 000 breeding pairs. Most were in the Georgina-Eyre Creek wetlands and there were several colonies of more than 1000 pairs. Some colonies had not been documented previously.

The well-publicised breeding colony of Australian pelicans (more than 30 000 nests) on Lake Machattie, on the Eyre Creek system, is now estimated to have involved 135 000 nests collectively from five breeding events over the past decade, thereby apparently being the largest contributor to maintaining the overall population. The single, largest mixed-species colony of ibises, night-herons, spoonbills, egrets and cormorants in the basin, situated in shrubby swamp on the Diamantina system, has made a similar decadal contribution: 40 000 nests of those species were active in 2009.

Numbers of black-tailed native-hen, hardhead and pink-eared duck nests or family broods were estimated in the tens of thousands, dispersed in shrubby swamps with lush understorey. For the first time, substantial numbers of blue-billed duck were documented breeding in the Channel Country, perhaps a response to reduced breeding habitat in south-east Australia.

As the Channel Country wetlands inevitably dry out again, these birds – the adults that bred and their surviving progeny – have to disperse out of the region.

The 2009 surveys confirmed and further quantified an emerging understanding of the role of Channel Country wetlands in sustaining waterbirds in Australia and in the flyway. These wetlands continue to provide extensive feeding and breeding opportunities sufficient to make a significant contribution to whole populations of many waterbird species. Without these wetlands, over the past decade there could have been catastrophic declines due to greatly reduced wetland habitat and drought, particularly in the Murray-Darling Basin. For a suite of waterbirds including freckled duck, glossy ibis and black-tailed native-hen, the Channel Country seems to be of paramount importance.

These findings demonstrate the importance of widespread networks of inland wetlands, comprising complementary wetland types across multiple river systems. The role played by flood events in intermittently connecting these widely-spaced and diverse arrays of important wetlands is a significant part of these critical ecosystems.



Ibis breeding colony site, Channel Country. Photo: Roger Jaensch.



Cooper Creek floodplains near Windorah, Queensland. Photos: John Porter.

FIRST NATIONAL WATERBIRD SURVEY

John Porter, Richard Kingsford and Stuart Halse, Australian Wetlands and Rivers Centre School of Biological, Earth and Environmental Sciences, University of New South Wales

One of the world's largest and most ambitious wildlife surveys, completed in October and November 2008, sampled the entire Australian continent for waterbirds. The National Waterbird Survey covered thousands of wetlands over an area of 7.6 million km², making it the largest aerial survey of wildlife in the world, the next most extensive waterbird aerial survey in the world being the American Breeding Waterfowl survey with a sampling extent of 3.6 million km².

The survey attracted collaboration and support from state and federal conservation agencies and non-government organisations and dispatched aerial and ground survey teams to sample thousands of wetlands across the continent, from Australia's highest lake near Mt Kosciuszko to the floodplains of Kakadu and the spectacular coastlines of the Kimberleys. The project broke new ground in the scope of its coverage and as one of the first to sample an entire continent in such detail. An unprecedented amount of new data on waterbird populations and wetland health was amassed and is currently being processed, much more than was originally envisaged.

The three-year project was funded by the National Water Commission and faced some unenviable challenges in planning and logistics for such a complex undertaking, including unpredictable distributions of flooding and waterbirds, limited availability of experienced pilots and suitable aircraft, lack of refuelling options, fluctuating fuel costs, breakdowns, as well as database programming and data entry and validation complications.

Despite these difficulties the project is entering its final phases of data processing, analyses and reporting, and has successfully delivered valuable aquatic biodiversity data that will provide a significant boost to our ability to evaluate, monitor and manage Australia's most significant river and wetland resources and waterbird populations.

The National Waterbird database contains the results of the National Waterbird Survey. Other large aerial survey data sets using the same methodology including the Eastern Australian Waterbird Survey database (72 524 records from 1983-2008), and Murray Icon Surveys (4157 records 2007 and 2008) have also been incorporated into this dataset, enhancing the temporal and spatial extent of data and making it a unique resource for anyone interested in quantitative, spatially-explicit information on the distribution and abundance of Australian waterbirds and the health of their wetland and river habitats. At the time of writing, some small sections of aerial and ground survey counts were still being validated and so were not available for inclusion in this report. The results presented here are therefore preliminary although we do not expect any major changes when the final results are processed.

An enormous volume of biodiversity data was collected during the survey and handling the count data was a highly labour-intensive process. For each wetland surveyed, waterbird data were firstly recorded as audio counts during the survey (in total 4812 minutes or more than 80 hours), then stored in an audio archive, before being transcribed by hand on to data sheets. This was followed by initial validation (cross-checking of both observer counts), then entry and merging to spreadsheet software, followed by further cross-checks before import into the database. In total there were almost 27 000 lines of spreadsheet containing about 940 000 data points.

After this came the most time-consuming single step: spatial and temporal validation using maps, aircraft GPS track

logs and GIS software. This step was critically important to ensure that the waterbird data was correctly recorded and attributed to a uniquely identified wetland area. At present there is no nationally-consistent mapping coverage of wetlands. Because of these gaps in base wetland mapping quality and consistency and the massive volume of data acquired, this step was time-consuming.

More than 3.8 million waterbirds from 106 species over 4940 wetlands were surveyed. The surveys covered more than 1.7 million hectares of wetlands. Waterbird abundance was highest in the Northern Territory (1.7 million) and Western Australia (1 million) followed by Queensland (366 000), New South Wales and Victoria (combined total 213 000), South Australia (139 000) and Tasmania (21 000). The Northern Territory supported 49 per cent of total waterbird abundance, and Western Australia 29 per cent.

Although widespread throughout the continent, most waterbirds were strongly clustered on a relatively small number of the wetlands surveyed. In some areas, such as central Western Australia and western South Australia, there were relatively few wetlands that supported waterbirds or held water. The largest concentrations of waterbirds occurred in the north (Northern Territory and Queensland), the north-west of Western Australia, central Queensland and western New South Wales and the Coorong and Lakes Alexandrina and Albert.

Maggie geese were the most abundant species, accounting for 23 per cent of total waterbirds surveyed. Other abundant species included small waders, plumed whistling-duck, grey teal, banded stilt, wandering whistling-duck and egret. The 10 most abundant species accounted for more than 75 per cent of total waterbird abundance, with the other 96 species making up the remainder.

The most important wetlands surveyed in terms of total waterbird abundance include the East Alligator River floodplains and South Alligator River floodplains, Northern Territory. In Western Australia, Lake Argyle and Lake Macleod supported the largest numbers. The Coorong and

Lower Lakes at the mouth of the Murray River supported the largest numbers of waterbirds in South Australia. In Queensland, Lake Galilee was important and in New South Wales the Paroo Overflow and Cuttaburra Creek system supported large numbers. While in Victoria, the Werribee sewage ponds supported the most waterbirds, and in Tasmania, Moulting Lagoon was important.

Surveyed wetland area was highest in Western Australia followed by Queensland and the Northern Territory. More than a third of all wetlands surveyed supported no waterbirds, and 16 per cent of wetlands surveyed were dry. The most commonly encountered wetland size ranged from 10-200 hectares.

Further analyses of waterbird communities, river flows and rainfall is still underway. We are also looking at foraging guilds (functional groups) so that we can infer differences among groups of other organisms (for example, piscivores and fish species) and the ecosystem itself. This will improve understanding of the potential impacts of river regulation on a suite of organisms in wetlands with relevance to river management.

The project has demonstrated that aerial surveys of waterbirds on a continental scale are achievable and can provide rigorous, quantitative data on waterbird populations as well as the ecological health of wetlands and rivers. Such data can inform management authorities about the potential effectiveness of rehabilitation policies or demonstrate where there may be significant impacts of degradation on entire wetland communities. When a repeat survey or monitoring is done (for example, Eastern Australian Waterbird Survey program) the data can provide greater understanding of significant environmental threats and problems for wetlands in Australia.

Information: www.wetrivers.unsw.edu.au



Blue Lake near Mt Kosciuszko, New South Wales.



A BLEACHED OUTLOOK

Coral reef fish such as the clown fish (*Amphiprion percula*), above, are vulnerable to climate change. Photo: Simon Foale. Below, *Acanthochromis* fish. Photo: Joao Krajewski.

Heat is on for the coral reef fish of Australia's Great Barrier Reef

Morgan Pratchett and Philip Munday, ARC Centre of Excellence for Coral Reef Studies, James Cook University

Coral reef ecosystems are extremely vulnerable to sustained and ongoing environmental changes caused by global climate change. This is because reef-building corals live very close to their upper thermal limits and any significant increases in ocean temperatures cause corals to bleach and die. The link between coral bleaching and global climate change is incontrovertible and highlights the threat that climate change poses to Australia's Great Barrier Reef.

Scientists at the ARC Centre of Excellence for Coral Reef Studies have also revealed that climate change poses a real and significant threat to coral reef fish. There are approximately 2000 fish species that live on and around coral reefs, and many of these (up to 65 per cent) depend on corals for their survival. When corals bleach and die, coral reef fish are left without food or shelter. Like a rainforest with no trees, coral reefs without coral cannot support the exceptional diversity of species that is characteristic of these environments.

Fish are also affected by the environmental changes that are causing coral bleaching in the first instance. Shallow marine environments will become ever warmer and also more acidic as a consequence of climate change. These changes in environmental conditions have been shown to affect the growth, behaviour and survival of fish, especially among very young and very small fish.

For *Acanthochromis polyacanthus*, a common damselfish from the Great Barrier Reef, maximum growth occurs at water temperatures between 28-30°C, which corresponds with the typical maximum temperatures experienced in the central reef. For every degree increase in temperature above 30°C the rate of growth for these fish kept in aquaria declined by approximately 10 per cent.

There is reason to suspect similar effects would occur for many coral reef fish, including commercial fisheries species such as coral trout. Current climate predictions suggest that temperatures in shallow marine environments may increase by as much as 4°C by 2100, and unless fish can adapt to these altered temperature regimes, this may lead to fewer and smaller fish.

Changes in ocean acidification, resulting from increasing absorption of atmospheric carbon dioxide in surface waters of tropical oceans, will also have significant, but altogether different effects on coral reef fish. The current pH of tropical oceans is approximately 8.1, but is expected to decline to 7.8 by 2100 if carbon dioxide emissions are not substantially curtailed. Reductions in pH of this magnitude have been found to play havoc with the sensory abilities of larval clownfish (*Amphiprion percula*), such that ocean acidification may prevent fish from finding coral reefs on which to settle following their early development in the open ocean.

Like many coral reef fish, clownfish are swept away from reefs into the open ocean as babies and use acute senses of smell and hearing to find their way back. Recent research has shown that these fish can distinguish between different smells in the water, and key in on certain smells to navigate towards reefs. However, fish that were raised in water with a pH of 7.8 became confused and were strongly attracted to scents that they would normally avoid. For example, these fish were attracted towards the smell of predators, where fishes raised in normal (8.1 pH) water would strongly avoid potential predators, for good reason.

The combination of habitat degradation, increasing temperatures, and ocean acidification appears distinctly bad for coral reef fish. While there is potential that some fish may be able to adapt, and indeed benefit, from potential changes in coral reef environments, at least some species are expected to disappear, thereby reducing biodiversity on coral reefs.





CITIZEN SCIENTISTS

Reef Check Australia's volunteer recreational divers collect vital information on the Great Barrier Reef. Photos: Reef Check Australia.

Volunteer divers carry out underwater surveys across the Great Barrier Reef

Gemma Routledge, Reef Check Australia

According to the *Status of Coral Reefs of the World 2008*, Wilkinson, 2008, 20 per cent of reefs are under threat of loss within 40 years, without even considering the potential effects of climate change. Coral reefs may be in decline but through the efforts of recreational divers, like those volunteering with Reef Check Australia, help is at hand.

Reef Check Australia is a not-for profit organisation based in Townsville, Queensland, and for the past nine years, its highly-trained community volunteers have dedicated their weekends to coral reef health surveys across the length and breadth of the Great Barrier Reef. Although Australia's reefs are among the best managed in the world, they are not immune to the damaging impacts of fertiliser (nutrient) pollution, sedimentation, over fishing, destructive fishing and, most importantly, global climate change.

Volunteer divers from Reef Check Australia collect vital information on coral health. This data is useful to marine park managers in planning the sustainable use of the reef by everyone, divers and fishers alike. The underwater surveys, conducted between depths of 3 metres and 12 metres, record percentage substrate cover within 25 categories (for example, coral, sponge and rock), incidences of coral damage such as *Drupella* and crown of thorns starfish (*Acanthaster planci*) scars, bleaching and disease, plus counts of key fish and invertebrate species sighted. Photographs are also taken at the sites during surveys. These include the research site landscape, any damaging impacts and important new species discovered.

Now with more than 150 qualified survey volunteers, Reef Check Australia is leading the way in 'citizen science', with a solid baseline data set collected annually on more than 25 sites across the Great Barrier Reef. In 2009, a new regional office was established in Brisbane to cover the south-east Queensland area, where some surveys have taken place since 2007. Teams have also begun to use the established monitoring protocol to survey the Moreton Bay Ramsar wetland, including two survey sites at Peel Island. This long-term monitoring aims to supplement the existing government

programs conducted by professional researchers and provides a means for community divers to help preserve their local reefs.

By adapting the United Nations recognised international monitoring protocol, Reef Check Australia is able to survey many popular dive sites on a more cost-effective basis than other monitoring programs. This allows each site to be surveyed annually, rather than biennially, as in many cases of state-commissioned monitoring.

Through generous donations of in-kind berth space from dive operator partners, the organisation is able to access arguably some of the most important sites on the reef. These include the sites most important for tourism (the reef generates more than \$6 billion for the Australian economy annually), and those sites more at risk from land-based human impacts. Many research sites are important for specific species, for example the green turtle (*Chelonia mydas*), which can often be found enjoying the reefs at the Low Isles off Port Douglas. Grey nurse sharks (*Carcharias taurus*) are also an important endangered species encountered at Flat Rock in the Moreton Bay Marine Park.

Reef Check Australia also has an educational program to raise awareness of environmental concerns facing coral reefs and what individuals can do to help. Called Reef IQ, the program is curriculum-based for use in schools, targeting seven to 14-year-olds. All materials have been made available for free download.

Alongside other public awareness campaigns, the program aims to show that simple things can make a difference. For example, reducing the use of products that pollute the sea such as fertilisers and household cleaning products, eating seafood only caught from a sustainable fishery, and using less fossil fuel by cycling to work or school. Hopefully future generations will be more environmentally aware.

Information:
www.reefcheckaustralia.org





A female southern corroboree frog (*Pseudophryne corroboree*), above and opposite page. Photos: Aimee Silla.

ARTIFICIAL REPRODUCTIVE TECHNOLOGIES FOR THE SOUTHERN CORROBOREE FROG

Dr Phillip Byrne, Monash University and Aimee Silla, University of Western Australia

Amphibian decline is a serious global phenomenon with nearly one-third of the world's frogs, toads and salamanders now listed as threatened. Explanations for the observed declines are numerous, with habitat destruction, climate change, increased UV-B radiation, introduced species, infectious disease (including Chytrid fungus), pollutants, and their synergistic interactions the most commonly documented.

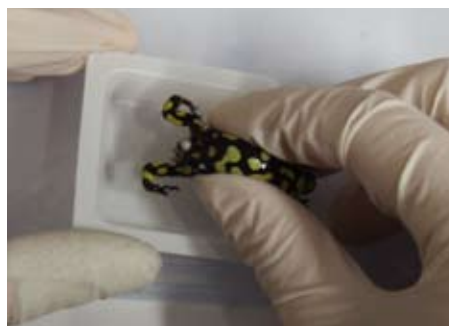
Australia is among the countries most affected by amphibian decline, with serious declines occurring in at least 48 species. The southern corroboree frog (*Pseudophryne corroboree*) is one of Australia's most endangered frog species, having experienced an estimated 95 per cent decline in population size over the past two decades. According to environmental scientist David Hunter, there are fewer than 200 individuals remaining in the wild, indicating that these strikingly coloured terrestrial frogs are clearly on the brink of extinction.

Due to the alarming disappearance of the southern corroboree frog, management plans for preserving the species are focusing on captive breeding programs. To date, however, successful recruitment in captivity has been limited, largely due to the fact that it is inherently difficult to simulate the combinations of environmental factors

that trigger frogs to breed. One strategy to overcome this hurdle, and maintain the genetic integrity of this endangered amphibian, is the use of artificial reproductive technologies (ART).

Recently the New South Wales Department of Environment, Climate Change and Water provided funding to initiate an ART research program headed by scientists Dr Phillip Byrne (Monash University) and Aimee Silla (University of Western Australia). This research program, which commenced in early 2009 at Monash University, is currently using captive reared frogs from colonies maintained by Gerry Marintelli at the Amphibian Research Centre in Melbourne and by Dr Peter Harlow and Michael McFadden at Sydney's Taronga Zoo. It is anticipated that the project will ultimately involve large-scale quantitative breeding and reintroduction programs, but initial research will focus on the development of effective and practical gamete collection and *In-vitro*

Fertilisation (IVF) procedures.



Non-invasive removal of eggs. Photo: Phillip Byrne.

IVF is an integral component of assisted reproduction and first requires the induction of sperm and egg release (spermiation and ovulation) and the subsequent collection of fresh gametes (eggs and sperm). The procedure

involves injecting synthetic hormones subcutaneously into the dorsal lymph sac of male and female frogs. Sperm are collected from the males by gently inserting the end of a smoothed cannula into the cloaca and stimulating urination. Once sperm have been obtained, eggs are then obtained from females by applying pressure to the abdomen in a massaging motion that simulates the natural mating

embrace (amplexus). Once fresh gametes are obtained, the sperm are activated in a mildly saline medium and transferred to the eggs. The mix is then agitated to enhance the probability of gamete union and fertilisation.

Exogenous hormones have been used to induce ovulation and spermiation in a number of amphibian species with varying success. Given the diversity of reproductive strategies exhibited by frogs, it is not surprising that their physiological responses to hormone administration are correspondingly diverse. The variable response of amphibians to administration of synthetic hormones may also be a consequence of numerous factors, including the amphibian's sex, age, condition and species, which in turn effects their basal androgen levels. Consequently, there is a need to develop dose-dependent protocols on a species by species basis, and also to control for a range of intrinsic variables. All of these factors create a fresh set of challenges when devising ART for any given species.

Although in its infancy, the research started by Dr Byrne and Aimee Silla in 2009 has already generated encouraging results, providing the foundations for establishing ART as a viable tool for managing captive populations of corroboree frogs.

This will be a major advance in the race to bolster rapidly declining captive-insurance colonies of Australia's critically endangered frogs.

Specifically, administration of synthetic hormones was found to successfully stimulate the release of viable gametes, and IVF trials resulted in successful fertilisations. Despite these advances, however, the techniques are not yet ready to be routinely implemented due to highly variable male and female responses, and sub-optimal levels of fertilisation and embryo survival. Research scheduled for 2010 aims to address these issues by: identifying optimal hormone doses, improving responses to hormone treatment, and identifying optimal fertilisation mediums and embryo incubation conditions.

Devising practical ART protocols for corroboree frogs is not only expected to assist with the conservation of this species, but also to aid the preservation of other endangered frogs. This will be a major advance in the race to bolster rapidly declining captive-insurance colonies of Australia's critically endangered frogs.



The development of frog ART in Australia is part of a multi-pronged recovery program for the southern corroboree frog.

The recovery team includes experts from the NSW Department of Environment, Climate Change and Water (Dr David Hunter and Rod Pietsch), the Amphibian Research Centre (Gerry Marintelli), Taronga Zoo (Dr Peter Harlow and Michael McFadden), Tidbinbilla Nature Reserve (Murray Evans), Healesville Sanctuary (Kristy Penrose) Melbourne Zoo (Raelene Hobbs), the University of Western Australia (Aimee Silla) and Monash University (Dr Phillip Byrne).



Mutton Hole Wetlands, Normanton, Queensland. Photo: Jenni Metcalfe.

GROUND-BREAKING STUDY INTO AQUATIC FOOD WEB OF OUR TROPICAL RIVER SYSTEMS

Jenni Metcalfe, consultant to Tropical Rivers and Coastal Knowledge research hub

Leading environmental researchers from the Tropical Rivers and Coastal Knowledge (TRaCK) research hub are carrying out the largest study ever conducted on food webs: finding out who eats what across northern Australian river catchments. Research includes studying how these food webs change down a river, across a river and over time.

TRaCK researcher Dr Danielle Warfe, from Charles Darwin University, says the water connections up and down a river system, from its head waters to the floodplain and estuary, are likely to be very important for supporting the animals and plants relying on the rivers.

“Food webs in tropical river systems are tied to cycles of wet and dry seasons and can shift with the movement of water, organic matter and animals between rivers, waterholes, floodplains and estuaries,” Dr Warfe says.

Given the Daly River boasts some of the biggest barramundi ever caught, and is home to the annual Northern Territory Barra Classic and Barra Nationals fishing tournaments, it is of interest to recreational fishers to maintain this sort of productivity. The rivers, streams, waterholes and estuaries are also important to local Indigenous communities. The sooty grunter or black bream are highly sought-after by

Indigenous people living along the Daly River. And these fish are typical of the fish found in northern rivers in that their diet, habitat and reproduction depends on being able to move up and down rivers at different times of the year. But rivers like the Daly are under increasing development pressure from activities such as agriculture and mining.

“We need to know how these rivers function so that water managers can make sure that animal populations like the barramundi and sooty grunter are not negatively impacted,” Dr Warfe says.

To work out what is moving around the Daly River, and when, TRaCK researchers are collecting samples at different times of the year to see how the numbers of plants and animals vary with the seasons both down a waterway and across it. Researchers estimate how many primary producers (algae, leaf litter and larger aquatic plants) are present.

They also find out how many invertebrates (invertebrates larvae living on the bottom and those emerging from the water, as well as land invertebrates that fall into the waterway) are present. Researchers also sample the fish, turtle and larger animal populations with nets that capture animals as they move up and downstream.

But the researchers are not just interested in the numbers, they also want to know what eats what to understand the aquatic food web. This will provide more knowledge to water managers about the effects of changing a river. If one part of the food chain is taken away, it could dramatically affect another part. For example, fish living in isolated waterholes in the dry season could rely on food from insects, fruit, flowers and leaves falling from the overhanging trees. If these are removed, it could affect their population.

To obtain this knowledge, TRaCK researchers are collecting plant and animal samples from 70 sites along small streams, main channels waterholes and floodplains over three large northern catchments: the Daly River, the Mitchell River in Queensland and the Fitzroy in Western Australia. Researchers take samples of the animals and plants to determine their carbon and nitrogen 'signatures', with a method known as 'stable isotopes analysis', which provides a ratio of isotopes of carbon ($^{12}\text{C}/^{13}\text{C}$) and nitrogen ($^{14}\text{N}/^{15}\text{N}$). If fish have the same carbon ratio in them as the local algae, we can assume the fish have got their main source of food from the algae. If the fish have higher nitrogen ratios it is likely that they are further up the food chain and eating other fish that eat insects that eat the algae.

Dr Neil Pettit from the University of Western Australia believes this research may further highlight the connections along the freshwater rivers and into the ocean. "As fish move upstream at certain times of the year, they may be bringing the carbon from the floodplains or ocean with them," he says.


And this may just be the case, as early results have found that Daly River fish, unlike the fish in the Mitchell and Fitzroy river systems, may not be getting all their carbon from the local algae or other animals that feed on the algae. Dr Tim Jardine from Griffith University says it is not known "where the carbon in Daly River fish is coming from, it could be coming from the floodplains. Fish may feed on tiny algae and other plants and animals of the floodplains during the wet and then bring the carbon from this food back upstream during the dry."

Researchers do not have the answers yet but when they do, it will be crucial knowledge for the future management of these rivers. "The river system is highly inter-connected, everything is using another animal or plant for food or habitat," Dr Warfe says. "It's important to know the consequences of losing any of these connections."

Information: www.track.gov.au



TRaCK researchers check nets for fish and other animals swimming downstream at Edith River, Northern Territory. Top: insects and plants form an important part of the food web in northern rivers. Photos: Jenni Metcalfe



UNDERSTANDING AQUATIC BIODIVERSITY IN THE LOWER GWYDIR AND THE FLOW PATTERNS NECESSARY FOR ITS SURVIVAL

Above, Gingham watercourse floodplain. Photo: Peter Berney. Opposite, cracked mud and juvenile Murray cod. Photos: Glenn Wilson.

Dr Glenn Wilson, School of Environmental and Rural Science, University of New England

The Lower Gwydir Wetlands in north-west New South Wales are one of the Murray-Darling Basin's key wetland areas, comprising a delta system of channels at the end of the Gwydir River and an extensive low-lying floodplain. Its conservation value is recognised by the number of privately-managed Ramsar sites at the end of the Gingham Watercourse and Lower Gwydir River. With the development of agriculture on the Lower Gwydir floodplain, and pressures from ongoing drought, it is critical to understand the distribution of aquatic biodiversity in this ecosystem, and the flow patterns necessary to maintain such species and populations.

Sound scientific information is vital for the conservation of any ecosystem. The most recent water-sharing plan for the Gwydir valley includes an environmental contingency allowance (ECA) in Copeton Dam for downstream environmental purposes. However, integrated analyses of the effectiveness of these releases are also necessary both for adaptively managing the use of such water and to demonstrate its benefits to the community. In 2006, a team from the University of New England (Glenn Wilson, Peter Berney, Tobias Bickel and Julia Sisson) commenced such a study to guide managers of ECA releases in the Lower Gwydir. It examined responses of water chemistry, fish, aquatic invertebrates and wetland plants to an ECA and other flow events up until February 2009.

Although core wetland areas in the Lower Gwydir have diminished considerably in recent decades, they still contain highly diverse plant communities, including some of the last known stands of the marsh club-rush (*Bolboschoenus fluviatilis*), considered to be threatened. We first examined

responses of wetland vegetation to flooding alongside the effects of herbivore grazing, using data collected from May 1994 to March 2008. Inundation had the greater influence on the dynamics of the wetland plant communities. Grazing was found to affect plant communities in different ways depending on the dominant plant species and antecedent soil-moisture conditions.

In the marsh club-rush communities, grazing resulted in a break-down of the dense canopy formed by this tall species, allowing more light to reach the ground and the growth of a range of other native species such as swamp buttercup and knotweeds. Conversely, grazing in water-couch communities helped to maintain the dominance of this species by removing taller herbaceous species that shade the water-couch.

Responses of vegetation to flooding from an individual ECA varied according to the seasonal timing of the release. Responses were far higher in summer when native wetland plants are growing most actively. Native species appeared to successfully compete with the invasive weed lippia, leading to a reduction in lippia cover following the flow. However, following an autumn ECA flow, the initial growth of key species such as water-couch appeared to be halted by winter frosts, and few benefits of the release were evident at the beginning of the following spring.

Lower Gwydir fish assemblages are also reasonably diverse for lowland Murray-Darling Basin river systems, including at least nine native and three exotic species. Interestingly, despite the common upstream water source (Gwydir River), each study channel was dominated by different native species: bony bream in the Lower Gwydir River, spangled perch in the Gingham Watercourse, carp gudgeon in the Mehi River. In each channel, fish assemblages upstream

contained the highest number of species and were often dominated by rarer species absent elsewhere, such as hardyheads.

In contrast, ubiquitous lowland species like bony bream and spangled perch dominated downstream reaches. Reasons for these patterns might include differences in structural habitat availability between channels (for example bed or sediment structure, woody debris and aquatic plants), the way in which such structures alter flow conditions between channels, and reductions in flow conditions downstream. Either way, certain parts of these channels appear to be critical refugia to many of the rarer species.

The capacity for ECA releases to enhance spawning activity and recruitment may be one of their most important functions for fish populations. Significant recruitment was observed in spangled perch, bony bream, carp gudgeon and carp, while smaller numbers of juvenile smelt, hardyhead and goldfish were also observed.

However, pulsed flow events (including ECA releases) did not appear to produce consistent spawning patterns in the more abundant species, which varied between channels and seasons. This suggests that factors other than recent flow conditions are also influencing spawning or recruitment in Lower Gwydir waterways. At the end of the day, these are complex and variable systems to unravel and a longer-term view may be necessary before we have an adequate understanding of their flow requirements.

The importance of identifying key refugia was also apparent in turtle populations. Although these were highly abundant in the few large shallow waterholes (both in-stream and on the floodplain), they were otherwise sparsely distributed throughout most of the aquatic environment and only one of the three species, the long-necked turtle (*Chelodina longicollis*), appeared to possess extensive populations. No clear responses to flow events were detected, although waterholes contained fewer turtles as they were drying out.

Similar to fish, the larger crustacean species such as freshwater prawns (*Macrobrachium*) and yabbies (*Cherax destructor*) reflected differing patterns between channels. For example, while prawns were more abundant upstream than downstream in the Gingham Watercourse and yabbies were more abundant downstream in the Mehi River, both species were evenly distributed between sites in the other channels. Neither showed a clear response to ECA releases.

The findings of this study provide a baseline understanding of the distribution of aquatic species in this ecosystem, responses to flow variability and recent ECA releases, and resilience to altered flow regimes. They particularly show how variable the ecology of such aquatic systems can be, and how important a broad monitoring program is to identify its flow requirements. Recommendations of the study include continuing to build long-term data sets on the Lower Gwydir flow ecology, which establish how aquatic species fluctuate in response to hydrological and structural habitat factors. A rigorous event-based monitoring program would facilitate this, and should include fish, water chemistry and wetland vegetation parameters.

It must be recognised that ecological responses to ECA and other flows will likely differ seasonally and although significant Lower Gwydir floods have occurred in winter, the region has a summer-dominant rainfall pattern and the timing of future ECA events should match this whenever possible. Furthermore, future ECA releases may be best timed to 'piggy back' natural flow events or large managed releases such as bulk irrigation transfers. This would help to maximise the height and duration of ECA events, and enhance the ecological outcomes from any environmental water used for these high-value wetlands.





NATIONAL SHOREBIRD SURVEY STRIVES FOR RELIABLE POPULATION TRENDS

Black-winged stilts in flight. Photo: Dean Ingwersen.

Joanne Oldland, *Birds Australia*

Shorebird populations in Australia continue to decline on north-west Western Australia, Queensland, and the Coorong in South Australia according to reports released in 2009 by the Australasian and Queensland Wader Studies Group's Monitoring Yellow Sea Migrants in Australia Project and Queensland University.

In southern Australia, shorebird numbers at non-coastal wetlands have also decreased by nearly 80 per cent since the 1980s. Similarly, reports of habitat loss throughout the East Asian-Australasian Flyway have continued, and a recent review by Birds Australia has found evidence that 21 shorebird species are decreasing in at least one area in Australia, with curlew sandpiper, eastern curlew, great knot and bar-tailed godwit species showing strong evidence of national population declines.

In order to conserve shorebirds it is critical to increase the confidence in reporting national population changes, and to further identify what factors are driving those changes. The Shorebirds 2020 program, an initiative of Birds Australia and the Australasian Wader Studies Group, aims to achieve this through a coordinated national monitoring program that relies on hundreds of dedicated volunteer counters around Australia. While national shorebird monitoring began in 1981, Shorebirds 2020 was launched in 2007 to reinvigorate the program, with funding from the Australian Government's *Caring for our Country* initiative and WWF-Australia.

Over the summer of 2008-2009 about 500 to 1000 volunteers conducted shorebird counts at 155 known shorebird areas and an additional 225 other areas, with the best coverage ever achieved in some areas. Recent analysis of 2009 data suggests refining the list of areas to be surveyed to 113 nationally (down from the 150 recommended after year one). Surveying 113 areas should enable the detection nationally of 25-52 per cent change in five years for 19 shorebird species, and 50-80 per cent change for seven species in 10 years (no national trend is likely to be detected for 18 shorebird species, for which we have insufficient data).

The significant amounts of both new and historic data being collated under the program is enabling the Shorebirds 2020 team to report on some of the obvious large declines in shorebird numbers in Australia. A recent analysis that looked at 49 sites nationally, comparing average numbers between 1981-1987 and 2004-2009, found that: red-necked stint populations have declined by about 30 000, curlew sandpiper by approximately less than 60 000 and sharp-tailed sandpiper by 27 000.

These declines represent 10-30 per cent of the known flyway populations of these species. It is not certain how accurate these estimates are, as the Shorebirds 2020 program is designed to report such findings with confidence in five years. However, in the meantime, bringing datasets together is improving understanding of how widespread and large these declines might be.

Resources were also developed over the past year, which will increase the program's ability to involve and train more volunteers, communicate with the large expansion in the numbers of people involved, and accurately manage increasing volumes of data. Newsletters, a brochure, learning materials on shorebirds, the new *Shorebird Conservation in Australia* publication, online data entry and a new website have increased the quality of information available.

Over the next two summers 25 shorebird identification and counting workshops will be run nationally to recruit and train more shorebird counters, and fund local groups to better support counting efforts nationally. About 315 community volunteers took part in the first seven workshops and feedback has been excellent.

The identification and mapping of important shorebird areas in Australia, and sites to include in the national monitoring program within a national GIS, has been ongoing. The mapping of fixed count areas is seen as a critical step in ensuring future counts cover consistent areas on the ground. Nationally, 241 shorebird areas, 1450 areas of feeding and roosting habitat, and 2019 count areas have been mapped.

There are a number of challenges to face over the next year in order to obtain reliable population trends for shorebirds in Australia. Challenges include: continuing to significantly grow the base of volunteers involved and trained in shorebird monitoring to ensure sustainable participation levels; and improving consistency of counting methods used each year at many areas to ensure population trends can be identified.

Information: 03 9347 0757 www.shorebirds.org.au
shorebirds@birdsaustralia.com.au

GLOBAL MONITORING PROGRAM PROVIDES EARLY WARNING OF COASTAL ECOLOGICAL DECLINE

Len McKenzie, Seagrass-Watch HQ, Northern Fisheries Centre

A massive 56 000 square kilometres of seagrass is present around Australia, most in Western Australia and Queensland, equating to nearly 32 per cent of the world's seagrass. Disturbingly, over the past few decades, seagrasses globally have been declining at a rate of 110 square kilometers a year or the equivalent to two football fields an hour. These figures are alarming and place seagrass meadows among the most threatened ecosystems on Earth.

Multiple stressors are the cause of this decline, in particular the negative impacts accruing from the billion or more people who live within 50 kilometres of seagrass meadows. Climate change is likely to add to these pressures.

These flowering marine plants, found mainly in clear shallow inshore areas of bays, estuaries and coastal waters, provide an estimated \$2.1 trillion per year globally in the form of nutrient cycling, sediment stabilisation, sequestration of carbon, habitat for fish, bird, and invertebrate species, food for dugong and endangered green turtles, and commercial and subsistence fisheries. Seagrass also supports important linkages between mangrove and coral reef habitats.

Of the world's 72 seagrass species, 40 are found in Australian waters. Information on the status of seagrass resources both locally and globally is solely dependent on monitoring efforts. This is the important role that the global seagrass monitoring program, Seagrass-Watch, plays. Developed in 1998, Seagrass-Watch provides an early warning of coastal ecological decline. It focuses on long-term monitoring and education, awareness and capacity building. Monitoring is a valuable tool for improving management practices by allowing resource managers to know whether resource status and condition is stable, improving or declining.

Participants in the program range in ages from 18 to 72 and represent a diverse cross-section of the community, including trades people, engineers, Indigenous communities, school teachers, fishers, divers, retirees, university students, biologists and ecologists. Many are involved with local environmental groups and have a keen interest in conservation and environmental issues.

Established in Queensland as an initiative of Primary Industries and Fisheries, the program has expanded to 17 regions in Queensland, as well as across New South Wales, Victoria, Western Australia and the Northern Territory. More

than 25 countries participate in the program globally and monitoring is occurring at more than 270 sites. Information collected can be used in local decision-making on habitat management practices and protection.

Seagrass-Watch methods were developed to be rigorous, yet relatively simple and easy to use. After six to nine hours of training, participants can produce reliable data. Training includes both formal and informal approaches. Technical issues concerning quality control of data are important, especially when the collection of data can be done by those not previously educated in scientific methodologies. Seagrass-Watch has an accepted Quality Assurance-Quality Control program in place to ensure that the program is producing data of high quality, and that time and resources are not wasted. Quality data reassures the data users (for example coastal management agencies) that they can use the data to make informed decisions with confidence.

Early detection of change allows coastal management agencies to adjust their management practices and/or take remedial action sooner. The program has provided information about the health of seagrass ecosystems for local management agencies and developed benchmarks where performance and effectiveness can be measured. Ongoing monitoring has detected loss and subsequent recovery of seagrasses in relation to climatic events including flooding.

Seagrass-Watch has also provided an early alert system exposing coastal environmental problems before they became intractable. This has been used to track the possible consequences of global climate change. The findings from the program have contributed to Ramsar and World Heritage Area assessments, regional and local management plans and reporting on the health of the Great Barrier Reef to determine the effectiveness of management practices applied as part of the Australian Government's *Reef Rescue* initiative.

By working with both scientists and local stakeholders, it is hoped that the impacts on seagrass meadows can be avoided. To protect the valuable seagrass meadows along our coasts, everyone must work together.

Information: www.seagrasswatch.org



Seagrass-Watch volunteers in Nhulunbuy, Northern Territory.
Photo: Len McKenzie.



A seagrass status and trend report for the coastline within the Great Barrier Reef area has just been compiled. Photo: Rob Coles.

PROTECTING QUEENSLAND'S SEAGRASS MEADOWS

Rob Coles, Queensland Primary Industries and Fisheries

Seagrass meadows found in estuaries and shallow coastal waters in Queensland form important wetland ecosystems. They are habitats for many marine species and birds and are the primary producers that form the base of a dynamic food chain in shallow waters. They are also recognised as key habitats for many larval, juvenile fish and crustacean species that contribute to commercial, recreational and Indigenous fisheries. For this reason Queensland Primary Industries and Fisheries (QPIF) has implemented policies and legislation to keep seagrass safe and protected.

Seagrasses in Queensland are protected under fisheries legislation; *Queensland Fisheries Act 1994*; and associated regulations and policies. This legislation protects all types of marine plants and all parts of the plant, leaves, roots and rhizomes. Dead seagrasses are also protected as it is recognised that the dead material breaks down to provide nutrients that support the base of the food chain. Seagrasses can only be damaged in Queensland waters when an assessment of some form or a permit has been obtained from QPIF.

This general protection is supported by a program of identifying key locations of high fisheries values and in these locations providing a higher level of protection in declared Fisheries Habitat Areas. These are areas where the integrity of the entire structure of the coastal ecosystem is recognised as important and protected by legislation. There are more than 70 Fish Habitat Areas covering about 880 000 hectares of coastal wetlands including more than 20 000 hectares of coastal seagrass.

It is the policy of QPIF to maintain the distribution of seagrasses statewide to at least 90 per cent of their

distributions in 1990. To assist with protecting seagrasses and meeting the policy targets, QPIF maintain a program of monitoring and assessing the health and trends within the meadows. This is an enormous challenge with the length of the Queensland coastline and it is met by several different approaches.

One approach is the participatory monitoring program, Seagrass-Watch, which complements a research and monitoring program aimed at habitats in ports and development areas considered at high-risk of damage and loss.

Another approach is a research program in conjunction with James Cook University using sophisticated modeling techniques to identify potential areas of seagrass meadows that are exposed to high levels of composite risk. A mapping program has also compiled maps of seagrass and seagrass species for almost the entire Queensland coast.

Many of the major coastal seagrass meadows in Queensland are found in bays and estuaries. These are also locations that are ideal for ports and urban development. Places such as Gladstone Harbour, Townsville and Cairns on the east coast are typical. This adds to the challenge of maintaining the health and viability of the meadows. Fortunately in Queensland, vast areas in the north of the state, Torres Strait and the Gulf of Carpentaria have low population densities and little coastal development and the seagrasses in these areas are not threatened by developments.

QPIF recently compiled a seagrass status and trend report for the coastline within the Great Barrier Reef World Heritage Area. This report compiled nearly 22 years of mapping, research modeling, and monitoring data. It showed that on large scales the seagrass meadows were not changing although at some locations, on a smaller scale, seagrass is affected by local impacts.

Information: www.seagrasswatch.org/publications



Mimosa green seed. Photo: Joye Maddison.

MIMOSA ON THE MARCH

Collaborative approach to a Weed of National Significance in the Top End

Caroline Biggs, Natural Resource Management Board Northern Territory

Anson Bay and its associated coastal floodplains sprawl over 3480 square kilometres in the Northern Territory, 130 kilometres south west of Darwin. One of its greatest threats is invasion by the weed mimosa (*Mimosa pigra*), which threatens the habitat of large numbers of waterbirds and at least 10 threatened species. These include the critically-endangered northern quoll and the vulnerable yellow-spotted monitor, water mouse and flatback turtle. The site also hosts Indigenous and pastoral operations, fisheries, wild harvest and tourism activities, which are impacted by the weed.

A partnership is underway with the Natural Resource Management (NRM) Board (Northern Territory), Indigenous and non-Indigenous land managers to tackle mimosa infestations over 16 500 hectares on the floodplains forming part of the Anson Bay site within the Daly and Moyle catchments. The project is funded with \$1.4 million from the Australian Government's *Caring for our Country* initiative and \$2.5 million in-kind contributions.

The project will adopt a 'best practice' land management approach consistent with the Mimosa Strategy developed by the National Mimosa Management Committee and the Mimosa Weeds of National Significance National Strategy. Activities will include survey and mapping, chemical, biological and mechanical control and native revegetation to provide competition against mimosa regrowth.

With four Indigenous ranger groups, a Landcare group, a tourist operation, several pastoral stations, the Northern Territory Government Weeds Branch, the Northern Land Council and the NRM Board working together, this project is strongly committed to landscape-scale management and the sharing of resources and knowledge to achieve the best possible outcome.

While protecting native floodplain habitat, the project also aims to improve land productivity, restore access and re-establish connections to culturally-significant sites and reduce bush tucker harvesting pressure on limited non-infested waterholes. In the short-term, benefits will include improved knowledge and understanding of the issues associated with mimosa, development of skills, increased local employment and the development of a strategic control and management plan for mimosa within the catchments. The longer-term benefits will be the contained spread of this species through capacity building and collaboration so as to reclaim infested areas of the floodplain.

The Anson Bay site is listed as a wetland of national significance in the *Directory of Important Wetlands in Australia* (Daly Reynolds Floodplain-Estuary System) and has been nominated as both a site of conservation significance by the Northern Territory Government and a High Conservation Value Aquatic Ecosystem by the Australian Government.

At present, mimosa is restricted in Australia to the Northern Territory and one dam in central Queensland but it threatens to spread across the entire wetlands, coastal plains and river systems of northern Australia.

Information: info@nrmbnt.org.au



Mangroves and saltmarshes are amongst the most endangered marine wetland habitats worldwide.
Above: Yellow mangroves near Cairns. Photos: Norm Duke.

PIONEERING MANGROVE MONITORING PROGRAM PARTNERS EXPERTS WITH THE COMMUNITY

Dr Norm Duke and Jock Mackenzie, Centre for Marine Studies, University of Queensland

Australia's first community 'watch' program for mangroves that addresses both scientific and environmental management needs is underway. Such a monitoring system has never before been conducted by a partnership between community members and scientists.

Mangroves and tidal saltmarshes are amongst the most endangered marine wetland habitats worldwide. This is despite a wealth of benefits, ranging from fish habitat supporting commercial and recreational fisheries, to shoreline defence protecting valuable coastal real estate. These wetlands also act as filters of coastal waters, but they are disappearing around the world at up to 2 per cent a year on average. As a consequence, there has been a dramatic loss of ecosystem services from mangroves with vast losses in area and function as remnant patches progressively deteriorate.

Despite this, Australia's mangrove habitats are considered the healthiest in the world and Australians can boast having the world's third, or arguably second largest area for this wetland type. The extent of Australia's mangrove habitats is about 12 000 square kilometres, and the area of tidal wetlands is easily twice that figure.

Australia's global status is enhanced further, with the diversity of mangrove species representing more than half of those found elsewhere in the world. At least one species, *Avicennia integra*, is found in 16 estuaries in the Northern Territory, but is found nowhere else in the world. However, the bulk of Australia's once isolated tidal wetlands are coming under threat from our growing population.

Until recently, many of Australia's mangrove communities had largely escaped the ravages of shoreline development and rapid expansion of coastal populations. However, this situation is changing fast and threats are exacerbated by climate change. In south-east Queensland's Moreton Bay, recent surveys carried out by the University of Queensland's Centre for Marine Studies have quantified massive losses in

functional mangrove habitat resulting from drought stress and human impact. Where mangrove forests die back in mid to high intertidal areas they have strangely subsided to form shallow sterile ponds. The area lost to sinking ponds in 2008 was about 2600 hectares (about 15 per cent of the bay's tidal wetlands) and this loss is expanding.

Protecting threatened areas within marine parks and reserves is only part of the solution. The number of 'watch' programs demonstrate the enthusiasm and competence of community volunteers for monitoring seagrass, corals, wetlands and coasts. Unfortunately, this community enthusiasm has, until recently, been impeded for mangroves by the lack of an effective monitoring methodology.

Lessons of past programs show that people quickly become disheartened with pointless sampling of no value to scientists or managers. People also need effective feedback on results that directly relate to their efforts. For tidal wetlands, there has been no suitable assessment methodology that managers can readily use. So these valuable wetland ecosystems have largely been neglected by managing agencies and monitoring programs – a factor that arguably may have contributed to some declines.

However, MangroveWatch is rectifying the situation. Since its launch in May 2009, enthusiastic volunteers are joining this new Community Coastcare initiative implemented by the University of Queensland in the Burnett-Mary Natural Resource Management (NRM) Region. The region extends from Eurimbula Creek in the north to Tin Can Bay in the

south, including Hervey Bay, Fraser Island and the Great Sandy Straits. The program is a pilot while methods and strategies are tested and developed over 12 months.

Disturbance to mangrove habitat is recorded by digital imagery and observations include tree removal, habitat replacement with coastal development projects, changes in hydrology and erosion, storm damage, mangrove dieback during recent drought, excess herbicides in runoff, pollution, rising sea levels and climate change. The first step towards protecting such threatened tidal wetlands is to identify and describe each disturbance, along with factors causing them. Student volunteers and assistants at the University of Queensland then assess image data received, noting details such as species, tree height, stand density, condition of plants, condition of banks and erosion.

Our preparedness for change depends on the ready availability and reliability of baseline information and monitoring data. A basic tenant of MangroveWatch is that a properly informed and well-resourced community will be key contributors to the future survival of natural resources, such as mangroves and saltmarsh. So far, about 60 people are involved covering about 16 river estuaries across the region.

Simon Rowe, of Ocean Watch Australia, wants MangroveWatch groups to coordinate with restoration projects conducted by Ocean Watch groups around the country. There is also great interest with like-minded people in Singapore and elsewhere in the world.

With the 2009-2010 pilot program, the University of Queensland has the support of regional stakeholder groups including: the Burnett-Mary Regional NRM Region, Butchella Traditional Land custodians, Cooloola Wild Dog Control, Cooloola Coastcare, Southern Sandy Straits Marine Environment Group, Xavier College, Chanel

College, Burnett Heads Progress Association, Friends of the Burrum River, Ocean Watch Australia, Port of Bundaberg, Queensland Department of Primary Industries and Fisheries, and the Australian Centre for Tropical Freshwater Research at James Cook University.

A key feature of MangroveWatch is its close partnership between community volunteers and scientists from the University of Queensland's Centre for Marine Studies. Together they have been systematically recording basic data as video and still imagery for assessments of estuarine habitat health. Armed with expert support, training and advice, MangroveWatch volunteers in the Burnett Mary Region are actively contributing to the monitoring of a significant number of local estuaries. An important goal is to produce a public document describing key issues affecting local estuaries and mangroves, and their overall health.

Were the program to continue beyond May 2010, this would become part of an annual report card for the condition of estuaries and tidal wetlands in the region. If the program were to expand to other regions around Australia, such reports would form part of a national wetland audit. In every case, the popularity and respect for this vulnerable wetland habitat is set to increase through MangroveWatch as communities learn more about these fascinating wetland ecosystems.

**Information: 07 3365 2729 mangrovetwatch@gmail.com
www.mangrovetwatch.org.au**



Mangroves and tidal saltmarshes are disappearing around the world at up to 2 per cent a year on average.



The oil spill that occurred off Cape Moreton in 2009 affected many areas within the Moreton Bay Ramsar site such as Spitfire Creek (above). Photo: Myles Waller.

AFTERMATH OF PACIFIC ADVENTURER OIL SPILL AND ITS EFFECTS ON MORETON ISLAND'S WETLANDS

Dave Rissik, Queensland Department of Environment and Resource Management and Samantha Lloyd, SEQ Catchments

On 11 March 2009, a 185 metre container ship, the Pacific Adventurer, lost 31 shipping containers along with a large quantity of heavy fuel oil, about seven nautical miles east of Cape Moreton, near Brisbane. The incident happened while the ship was trying to enter Moreton Bay to shelter from the effects of Cyclone Hamish, a Category 5 cyclone. Damage to the ship caused by the falling containers resulted in the loss of oil into the ocean.

The resultant oil slick affected sandy beaches, rocky reefs and two coastal wetlands on the northern end of Moreton Island and beaches and mangrove wetlands along the Sunshine Coast. Many of the affected areas were located within the Moreton Bay Marine Park and the Moreton Bay Ramsar site.

The two wetlands on Moreton Island, Spitfire and Eagers Creek, were probably the most sensitive ecosystems affected by the oil spill. The strong winds and associated large waves and rough seas resulted in oil being carried over the beach and into the predominantly freshwater wetlands. The oil affected large expanses of estuarine vegetation and a significant amount of oil sank to the bottom of the wetland channel.

Spitfire and Eagers Creek wetlands have important cultural value to the Indigenous owners of Moreton Island, the Quandamookan people. They also provide habitat for a number of threatened flora and fauna. Early recognition of the sensitivity and importance of these wetlands ensured cleanup activities were carefully managed to reduce the potential for a major impact to occur from the cleanup process.

Initially, Department of Environment and Resource Management (DERM) scientists inspected the wetlands, mapped the extent of the oil and associated damage, collected samples of oil and water for analysis, assessed the vegetation communities and collected data on water flow rates. This information was used to develop a cleanup plan for each wetland.

To ensure that the cleanup of the wetlands was conducted with the utmost care and consideration for environmental and cultural values, a team of Indigenous trainee rangers was formed by the Quandamookan Traditional Owners, to implement the cleanup plan in collaboration with DERM scientists and operation staff.

Several methods of cleanup were trialled at Eagers Creek and once this wetland had been cleaned effectively, work began on Spitfire Creek. All cleanup work was supported logistically by Marine Services Queensland staff. Although Moreton Island is not far from Brisbane, it is effectively very remote and removing oil for disposal was logistically intensive.

Once the cleanup began, it was apparent that Spitfire Creek was severely affected with large quantities of oil located in the deep channels. Much of this oil had not been obvious during initial inspections because of poor visibility through

the tannin-stained water. The need to keep the footprint of the oil cleanup as small as possible meant that only a small team of people could enter the wetland and consideration also had to be given to minimising impacts on the wetland edges.

Vegetation was cut to just below water levels and oil was carefully scraped from the base of exposed vegetation. It was not possible to remove all of the oil, as this would have resulted in most root matter being removed, resulting in reduced bank structure and inhibited vegetation regrowth. However, these wetlands have high levels of detritus (organic matter) and therefore, it was considered that natural bacteria living in the wetland would be able to break down the remaining oil, once the dense areas of oil had been removed.

The biggest challenge was the oil in the channels. Dredges could not be brought in as this would have removed the impervious detritus layer at the bottom of the wetland, which is critical in preventing water from seeping out of the wetland through the sand layer below.

In May 2009, Moreton Island was subjected to a major rainfall event (approximately a one in fifty-year event), which increased the flow of water from the wetland from about 75 litres per second to more than 5,500 litres per second. These large flows reworked the extent of the oil considerably. Unfortunately, this period coincided with uncharacteristically high tides that transported oil into areas of the wetland that had not previously been affected. However, the increased flows from the wetland made it easier to cut oiled vegetation and remove oil from affected areas. In the few weeks preceding this rainfall, it was possible to remove most of the oiled vegetation and clumps of oil that remained in the channel. Once this had occurred, the wetland was ready to be rehabilitated.

Strong winds and associated large waves and rough seas resulted in oil being carried over the beach and into the predominantly freshwater wetlands.

The Australian Government allocated \$2 million from its *Caring for our Country* initiative towards rehabilitation and recovery from the Moreton Bay Oil Spill. This funding was provided to South East Queensland Catchments (SEQC), the regional natural resource management body for south-east Queensland. SEQC then devolved this funding through the Moreton Bay Oil Spill Restoration Program and competitive Expression of Interest process. The Program received tremendous enthusiasm from the community and five project applications were developed through this process.

The successful projects involve recovery works such as revegetation, weed removal, dune stabilisation, pest management, erosion control, monitoring of flora and fauna species and traditional knowledge recording. The projects are being coordinated by a variety of organisations including collaborations between Traditional Owner groups, local government and volunteer community groups. Total funding approved for the five projects is approximately \$1.3 million, with an estimated total value (including in-kind contributions) of approximately \$3.5 million. Further funds were devolved through a targeted funding round in November and December 2009.

One of the five projects, the rehabilitation of Spitfire and Eagers Creek wetlands, is being carried out through a collaborative project between the Traditional Owners of Moreton Island, Quandamookan Lands Council, and DERM. This project will integrate Indigenous knowledge and contemporary scientific information and support stronger relationships and knowledge sharing between Indigenous elders, trainee rangers and scientific staff. DERM will prepare a rehabilitation plan and help to manage the rehabilitation works. The Department will also regularly assess water quality and the effects of the oil and impacts on fauna and flora to ensure an adaptive management approach.

A second project is being run by the Sunshine Coast Regional Council (SCRC), which involves rehabilitation works for areas impacted by the oil spill between Caloundra and Coolumb on the Sunshine Coast. SCRC will collaborate with up to 32 community groups and research institutions to achieve on-ground outcomes, support community monitoring programs and build ecological resilience in coastal communities.

A third project, managed by the Moreton Island Protection Committee, will focus on revegetation, weed removal, rubbish removal and cane toad detection surveys on Moreton Island. The South-east Queensland Traditional Owners Alliance is managing a fourth project that involves recording the cultural and ecological knowledge of traditional owners on Moreton Island and the Sunshine Coast. The fifth project, managed by Birds Australia Southern Queensland, will monitor the shore, dune and coastal birds on Moreton and Bribie Islands.

Outcomes from the Program will include meaningful environmental and ecosystem recovery, rigorous monitoring of key species, and new and enhanced community partnerships and capacity. The success of projects will also be used to inform coastal management planning, which will help build greater resilience in coastal ecosystems.



Chenopod-dominated saltmarsh with mangroves. Photo: Doug Frood.

VICTORIAN STUDY GROUP SEEKS TO REDRESS LACK OF KNOWLEDGE OF COASTAL SALTMARSH

Professor Paul I. Boon, Victoria University

Coastal saltmarsh makes up approximately 13 500 hectares of Australia's coastline and yet has not received the same attention as other coastal ecosystems. Coastal saltmarsh is land that experiences regular low-energy inundation by seawater and is vegetated by low-growing (< 1.5 m) vascular plants such as succulent chenopods and salt-tolerant monocots.

The two major types of plant communities on the seaward side of coastal saltmarsh, seagrass beds and mangrove swamps, have been subject to intensive study in Australia over the past 30 years. There are even separate entries for seagrasses and mangroves – but not for coastal saltmarsh – in the introductory volume *Flora of Australia* (Orchard 1999). In contrast, Australian coastal saltmarshes have not benefited from a comparable investment in inventory work and research and development investigations.

Saltmarsh is found along many parts of the Victorian coast, although it is most extensive along the western coast of Port

Phillip Bay, northern parts of Westernport, in the Corner Inlet-Nooramunga complex and behind the sand dunes that line Ninety Mile Beach in Gippsland, especially in Lake Reeve. There are few estimates of the area of saltmarsh in Victoria but available data ranges from less than 60 km² to more than 130 km².

While many saltmarshes in the Northern Hemisphere are dominated exclusively by grasses and/or herbs, coastal saltmarsh in Victoria can be structurally far more complex. Succulent shrubs such as shrubby glasswort (*Tecticornia*) form one structural type; large tussocky monocots, for example prickly spear-grass (*Austrostipa stipoides*) and chaffy saw-sedge (*Gahnia filum*) form another type, and low rhizomatous grasses such as Australian salt grass (*Distichlis distichophylla*) and salt couch (*Sporobolus virginicus*) a third.

A fourth structural type is represented by succulent herbs such as beaded and thick-head glassworts (*Sarcocornia*), trailing hemichroa (*Hemichroa pentandra*) and rounded noonflower (*Disphyma clavellatum*), and a fifth by prostrate shrubs such as southern sea-heath (*Frankenia pauciflora*) and silky wilsonia (*Wilsonia humilis*). Local patches dominated by annuals may constitute a sixth variation and, if we include the aquatic plants found in the shallow pools of low-lying depressions another type. In the system used to classify vegetation in Victoria, however, coastal saltmarsh is listed under one Ecological Vegetation Class – EVC 9 Coastal Saltmarsh.

Although Australia has the fourth highest species diversity of mangrove taxa of any country, after the Philippines, Indonesia and Papua New Guinea, only one species of mangrove, *Avicennia marina* var. *australasica*, extends as far south as Victoria. Nevertheless, mangroves are particularly well developed around Western Port, including on French Island, and in the Corner Inlet-Nooramunga area of south Gippsland. The most southerly known occurrence of mangroves in Australia - and indeed, the world - is near Corner Inlet, where *Avicennia marina* occurs to a latitude of 38° 45'S.

Mangroves and coastal saltmarsh are subject to an incredibly wide range of threats. Large areas have been drained for industrial, port and urban developments and the areas that remain are particularly susceptible to oil and heavy-metal pollution. Many coastal saltmarshes are subject to habitat disturbance from grazing or altered hydrology, for example road construction.

Coastal saltmarsh is also highly susceptible to weed infestations. The most landward areas, for example, are commonly invaded by a much larger suite of weeds, often agricultural or garden escapees. In Victoria the most problematic weed species in upper saltmarsh include tall wheat-grass (*Lophopyrum ponticum*), coast barb-grass (*Parapholis incurve*), sea barley-grass (*Hordeum maritimum*) and spiny rush (*Juncus acutus*). The lower levels of coastal saltmarsh, as well as mangroves, can be invaded by *Spartina anglica* and/or *Spartina x townsendii*.

The Victorian Saltmarsh Study Group 2010, funded by the Australian Government, is seeking to redress the lack of knowledge of coastal saltmarsh, at least for coastal saltmarsh in Victoria. The project aims to conduct a thorough literature review of the published and grey-literature information on coastal saltmarsh and mangroves, and revise the current typology for classifying coastal saltmarsh in Victoria so that it acknowledges the floristic and structural diversity in vegetation.

The project also aims to map the distribution of mangroves and the various types of coastal saltmarsh at a scale of 1:10 000 and undertake extensive ground-truthing to confirm the aerial photographic interpretation, and map the likely pre-European and likely post-climate-change (2050) distributions. Social-marketing studies will also be carried out to better understand the attitude of the public



Frankenia pauciflora in flower. Photo: Geoff Carr.

to mangroves and coastal saltmarsh, and a management template will be prepared to assist in the future management of coastal saltmarsh in Victoria. Full versions of the report should be publicly available in early-mid 2010.

Victorian Saltmarsh Study Group 2010:

Paul Boon (project manager), Tim Allen (*Caring for our Country* Facilitator, Coasts and Marine), Geoff Carr, Steve Mathews and Andrew McMahon (Ecology Australia), Doug Frood (Pathways Bushland & Environment), Chris Harty (Chris Harty Environmental Consulting), Jasmine Hoye and Jennifer Brook (Ipsos Eureka), Neville Rosengren (Environmental GeoSurveys), Steve Sinclair and Matt White (Arthur Rylah Institute, Department of Sustainability and Environment), and Jeff Yugovic (Biosis Research).



Estimates of the area of saltmarsh in Victoria range from less than 60 km² to more than 130 km². Photo: Steve Sinclair.

NEW WETLAND TYPOLOGY DEVELOPED TO DISTINGUISH EACH UNIQUE TYPE

*Lana Heydon, Maria Vandergragt, Mike Ronan, Department
of Environment and Resource Management*

To manage wetlands it is essential to know where your wetlands are and what kinds of wetlands you have. Queensland has more than 140 000 wetlands covering more than 6.6 million hectares, or 3.8 per cent of the state. Of this, lakes (lacustrine) and swamp (palustrine) wetlands cover almost 3.7 million hectares.

Like most natural systems, no two wetlands are the same. As a result, distinguishing wetlands as meaningful, discrete types can be challenging. Nonetheless, the characterisation of wetlands into ecologically relevant groups is useful for understanding and managing these systems. For example, classifications can be useful for assessing the representativeness or uniqueness of wetlands within an area, identifying appropriate condition or risk indicators and having a context to understand the results of monitoring.

The Queensland Wetlands Program, a joint program of the Australian and Queensland governments, has developed a typology based on characteristics or attributes which, when combined, help to define the nature of a specific wetland and what it is that distinguishes it from others. Developing and applying a wetland typology to these lakes and swamps has been an important step in describing them and provides a framework for ongoing wetlands management.

There are numerous wetland classification systems and typologies. This suggests it is difficult to establish a definitive classification system and shows the potential for different frameworks to address different purposes and scales. Regardless of their specific purpose, wetland classifications based on descriptive attributes that can be measured provide the greatest degree of objectivity and usefulness.

In considering the need for a typology for Queensland's lakes and swamps, several commonly-used wetland classifications were considered. At the Australian level, an accepted wetland classification based on broad wetland ecosystems comprises:

- marine (coastal wetlands including rocky shore)
- estuarine (deltas, tidal marshes and mangrove swamps)
- riverine (wetlands along rivers and streams)
- lacustrine (wetlands associated with lakes)
- palustrine (marshes, swamps and bogs)
- reservoirs (water storage areas, excavations, wastewater ponds, irrigation channels, rice fields, canals)
- subterranean (inland subterranean wetlands).

Using this system-level classification, the Queensland Wetlands Program developed the Wetland Description Tool, which provides a framework with more detailed resolution beyond the broad system level. It also identifies and groups key ecological and physical processes within wetlands of each climatic zone.

This framework identifies the attributes of wetland characteristics at increasingly specific scales (continental, ecosystem, landscape and local) and is the basis for



Photos: Lana Heydon.

determining different wetland types. Using this approach, different wetland habitat types can be identified using desktop techniques such as remote sensing, data trawling and GIS.

The attributes were not used to form a hierarchy, they can be used as a series of tools to characterise wetlands when and if they are useful in a particular wetland system and climatic zone combination. The use of the typology and the defined wetland types established for coastal and sub-coastal swamps can be viewed in the Science and Research section at www.epa.qld.gov.au/wetlandinfo

Twenty wetland habitat types have been identified for Queensland. The classification provides both a base for conceptual modelling of the processes and components of wetland habitat types. It also allows for more detail at the local level when focusing on specific attributes such as vegetation types, soil, water regime or even salinity.

The classification system is now being used in New South Wales and South Australia, demonstrating that it can be applied at different levels of resolution and can be adapted for use at any scale depending on the attribute information available.



Coastal non-floodplain heath swamp on Fraser Island. Photo: Lana Heydon



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Jocks Lagoon Ramsar site, Tasmania. Photo: Michelle McAulay and DEWHA.

ROLLING REVIEW OF AUSTRALIA'S RAMSAR SITES

Gayle Partridge, Department of the Environment, Water, Heritage and the Arts

Under the Ramsar Convention, Australia has obligations to maintain the ecological character of our Ramsar sites. The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) regulates actions that will have or are likely to have an impact on the ecological character of Ramsar sites.

To meet our obligations under the convention and the EPBC Act, we need to know: when ecological character is changing, how best to manage Ramsar sites and how to prioritise funding to meet these needs.

Australia does not have a systematic reporting process to facilitate an overarching picture of the status of Ramsar sites across the country. Australia has 65 Ramsar sites located across a range of land tenures and managed by government and private land holders.

The Rolling Review of Australian Ramsar sites is being developed to rectify the gap in reporting. It will provide targeted information based on ecological character descriptions, including the assessment of threats and impacts, to assess the ecological character of Australia's 65 Ramsar sites. This will allow investments to be targeted to imminent threats, provide benchmark and ongoing data to support site management, monitoring and evaluation, help fulfil Australia's Ramsar obligations, and support effective implementation of the EPBC Act.

Consultants have been commissioned to develop site-specific site status forms and pilot the Rolling Review at 15 to 20 sites. This also includes the development of site-specific threat conceptual models to identify suitable indicators to include in the site status forms.

The Rolling Review is intended to help Ramsar site managers by collecting useful data to facilitate monitoring and evaluation of site status, in particular changes in

ecological character. The review will also help to identify threats and prioritise resource allocation (including protection, rehabilitation, data collection requirements etc).

To date, the design and pilot of the Rolling Review has commenced and is due to be completed by May 2010. So far workshops for site managers have been conducted across the country; a draft generic site status form has been developed and is being refined following the consultation workshops; and conceptual models and threat indicators for all pilot sites are being identified.

Information: www.environment.gov.au/wetlands



Queensland's declared Fish Habitat Area Network, now 40 years old, includes Hinchinbrook Channel.
Photo: Queensland Primary Industries and Fisheries.

QUEENSLAND'S MARINE PROTECTED AREAS, 40 YEARS ON

Marine Habitat Unit, Queensland Primary Industries and Fisheries

Queensland's declared Fish Habitat Area (FHA) Network has just celebrated its 40-year anniversary. The network was set in motion by a former Queensland Primary Industries (QPIF) employee, Frank Olsen, now aged 90. The former public servant and his colleagues' research resulted in the protection of large areas of critical mangrove, seagrass and other fish habitats. The survey approach they developed is the basis for the current comprehensive assessment and selection process for declared FHAs.

Following a submission by the Treasury, the Queensland Government decided to establish the first seven declared FHAs, then known as 'Fisheries Habitat Reserves', in Moreton Bay near Brisbane on 14 January 1969. The involvement of the Treasury recognised the importance of fish habitats in supporting the state's fisheries and its contribution to Queensland's economy.

The justification for this early type of marine protected area, according to state government records, was "the productivity of the mangrove and adjacent marine grass flats in terms of organic food production ... can be as much as 10 times greater than that of the best farm land and it may be safe to predict that if the mangroves are halved the fish stocks are also halved, and that reclamation and development may destroy a local fishery."

Today, 70 declared FHAs protect 880 000 hectares of fish habitats from the growing impacts of development. These are the critical habitats on which Queensland's important recreational, Indigenous and commercial fisheries rely. The areas protect fish feeding, spawning and nursery grounds, while still allowing legal fishing.

Dugong, marine turtles, and wader birds also benefit from the habitat protection that declared FHAs afford. It is estimated that declared FHAs contribute \$40 billion per year in ecosystem services to the Queensland economy.

QPIF has prepared the Declared Fish Habitat Area Network Strategy, which reflects on the long history of declared FHAs and guides the future of the network. The strategy addresses how best to consolidate, reinforce and strengthen declared FHA management. Effective communications, enforcement tools, incorporation into external planning processes, and on-ground management are key issues the strategy addresses.



Queensland's Bowling Green Bay Fish Habitat Area protects mangroves and saltmarshes such as those adjacent to Barramundi Creek. Photo: Mary Lawrence.

MANAGING IMPACTS OF INSTREAM STRUCTURES ON QUEENSLAND'S RAMSAR WETLANDS

Mary Lawrence, Queensland Primary Industries and Fisheries

Queensland boasts five Ramsar-listed wetlands, two of which are located in the spectacular Great Barrier Reef catchment. Unfortunately, many wetlands, including Ramsar sites, are facing pressure as the demands for agriculture, recreation, tourism and industrial and urban development along the coastal zone increases.

To help reduce the impact of land-use activities, Queensland Primary Industries and Fisheries (QPIF) is developing an inventory of instream structures and their impacts on Bowling Green Bay Ramsar site near Townsville, Shoalwater and Corio Bays Ramsar site near Rockhampton and declared Fish Habitat Areas.

The project, funded by the Australian Government through the Queensland Wetlands Program, will implement fish habitat guidelines and a decision support system, which was developed by QPIF in a pilot project in 2009.

Bowling Green Bay provides major nursery habitat for barramundi and other finfish. It is also an important dugong and loggerhead turtle habitat that encompasses extensive areas of saltmarsh and mangrove wetlands that support many species important to the food chain of the offshore billfish fishery. Corio Bay contains extensive saltmarsh areas and seagrass beds and provides habitat for barramundi, blue salmon and mangrove jack as well as supporting the recreationally-important banana prawn fishery.

The presence of instream structures in these areas can modify flow regimes or cause physical disturbances that result in a direct loss of fish habitats. In addition, structures forming complete or partial barriers may prevent or severely limit important migrations and movements of fish and other aquatic species through wetlands. This leads to population declines, reduced distributions of species and degraded habitats, with further detrimental effects on recreational, Indigenous and commercial fisheries.

The guidelines implemented by QPIF allow for the mapping and prioritisation of these structures to identify priority 'problem' structures that negatively impact on fish habitats. Workshops were held with local stakeholders in Townsville, Ayr and Rockhampton to discuss potential management options in regard to high priority structures. Participants included NQ Dry Tropics, Fitzroy Basin Association, traditional owners, the Department of Environment and Resource Management, the Great Barrier Reef Marine Park Authority and local councils.

The project data compiled will add to the Queensland Wetlands Program's wetlands inventory database and ecological character descriptions being developed for Ramsar wetlands.

Information: Queensland Primary Industries and Fisheries, 13 25 23 www.dpi.qld.gov.au

AUSTRALIAN SCIENTISTS AT WORK ON THE INTERNATIONAL STAGE

*Margrit Beemster, Institute for Land, Water and Society,
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Australian experts hold key roles in the Ramsar Convention on Wetlands, assessing how they can be better managed to mitigate the effects of climate change and the importance of wetlands for human health.

Four Australians are currently members of the Scientific and Technical Review Panel, a subsidiary body of the convention made up of 17 appointed members and 24 invited observer organisations. Panel members include six regional experts and eight thematic experts, who each lead priority work areas as identified at the convention's triennial conference.

The four Australians are: wetland ecologist professor Max Finlayson, director of NSW's Charles Sturt University's Institute for Land, Water and Society, working on Wetlands and Climate Change; Dr Pierre Horwitz, an aquatic ecologist from Western Australia's Edith Cowan University, working on Wetlands and Human Health; George Lukacs, an ecologist with Queensland's James Cook University, working on Wetlands and Agriculture; and Christine Prietto, manager of the education program at NSW's Hunter Wetlands Centre Australia, working on Communication, Education, Participation and Awareness.

The Wetlands and Climate Change theme is looking at adaptation mechanisms for how to cope with change in wetlands for biodiversity outcomes and whether or not wetlands can be used to help mitigate the effects of climate change by storing carbon. Dr Nick Davidson, Deputy Secretary General of the Ramsar Convention and one of the scientists working on this theme, says "the climate change community has so far focused almost exclusively on forests as a means of storing carbon".

"However, it is becoming very clear from the work of our scientific panel that a number of different types of wetlands [peatlands, mangroves and salt marshes] store a significant amount of carbon," Dr Davidson says. "While it is difficult to find out how much of the carbon is stored underground in the soils, we are looking at a number of initiatives to encourage exploring the importance of maintaining existing wetlands."

Professor Finlayson, the panel's longest serving member, is looking at linking the work being done on this theme in Australia with the water resources and biodiversity network of Griffith University's National Climate Change Adaptation Research Facility. A research project on land use and climate change impacts on Australian peat wetlands is also starting at Charles Sturt University in 2010.

The Wetlands and Human Health theme analyses the interactions between human health and wetlands, looking at both the positives and the negatives. This will be followed by the preparation of guidelines, with the assistance of the World Health Organisation, for wetland managers worldwide on managing wetland issues for human health.

Wetlands provide food, fibre, fresh water, help regulate floods and can buffer storms helping to protect lives. But they can also carry water-borne diseases and harbour mosquitoes, which can carry life-threatening diseases such as malaria. Professor Finlayson says the team is looking at "what is a healthy wetland ecosystem and what health benefits will it bring people". The theme's second focus familiarises health authorities with the benefits of wetlands and wetland management issues. Many projects are underway in Australia that explicitly address the relationship between wetland ecosystem services and human health.

For example, wetlands on the Swan Coastal Plain in Western Australia are drying and exposed sediments are producing acidic and metal-rich groundwater plumes. If these catch alight they produce toxic smoke for months. In both instances people in neighbouring residential communities can be exposed. Preventing the wetlands from drying and maintaining the ecosystem services provided by saturated sediments becomes a human health agenda. The framework being developed by the Ramsar Scientific and Technical Review Panel will help identify pathways for action.

The Wetlands and Agriculture theme assesses the extent of agriculture in wetlands on a global basis using case studies from different countries. The purpose is to look at the trade-offs between using wetlands for food and the eco-system services they provide. Professor Finlayson estimates that 80 per cent of wetlands, globally, have some sort of agricultural activity. While the figures for Australia aren't yet available, it is expected to be 60-80 per cent.

Other activities include a review of the biodiversity value of rice fields including those in Australia. This will build on work already completed by the Institute for Land, Water and Society looking at how birds and frogs utilise rice fields. A project is currently investigating the biodiversity value of rice fields in southern and northern Australia.

"Even though they are artificial, rice fields are an important wetland type but in many places people are not fully aware of their biodiversity value," Professor Finlayson says.

The technical findings of all scientists on the Scientific and Technical Review Panel need to be translated into every-day language so that they can be understood by policy makers and the general public. The Communication, Education, Participation and Awareness theme cuts across all panel activities both in Australia and overseas.



The Hunter Wetlands Centre, New South Wales, the site of the 2009 Wetland Link International Oceania conference. Photo: Sarah Stuart-Smith and DEWHA.

Christine Prietto, Hunter Wetlands Centre and Sarah Stuart-Smith, Department of the Environment, Water, Heritage and the Arts

Climate change, agriculture and human health are emerging as some of the greatest issues associated with wetlands in the Australia, New Zealand and the Pacific Islands (Oceania) region. During 28-30 October 2009, the Hunter Wetlands Centre hosted the 2009 Wetland Link International Oceania conference to discuss these issues and create links between government and non-government organisations, wetland centre staff and volunteers.

The conference committee included government and non-government professionals from Australia, New Zealand and the South Pacific Islands and brought together people involved in wetland education, policy, research and conservation from across the Oceania region. Guest speakers included Sandra Hails from the Ramsar Convention, Professor Max Finlayson from Charles Sturt University, George Lukas from James Cook University, Pierre Horwitz from Edith Cowan University and Chris Rostron from Wetland Link International.

During the conference the role of the Ramsar Convention's Communication, Education, Participation and Awareness (CEPA) program was outlined, highlighting the value of developing CEPA Action plans for regions and wetland centres in order to facilitate strategic and targeted education programs. Wetland Link International showcased potential resources and networks for wetland education organisations.

World Wetlands Day was highlighted as a key event for wetland education centres and community groups to link together to provide a focused message on the value of wetlands, their wise use, biodiversity and climate change.

The conference strongly encouraged participants to share experiences of wetland communication techniques and

showcase projects on engaging local communities, schools and visitors in the underlying efforts of wetland conservation. Key points from the event included:

- Climate change, agriculture and human health are emerging as some of the greatest issues associated with wetlands in the Oceania region and wider awareness needs to be raised amongst communities
- communication and education are critical in informing new audiences and preparing target audiences for responding to current and future impacts
- wetland education activities can be more effective through collaboration and support from other government, non-government organisations, wetland centre staff and volunteers across the Oceania region
- Wetland Link International offers an excellent resource for networking and evaluating wetland communication techniques
- development of CEPA Action Plans and integration of wetland education activities into management plans and other relevant environmental plans allows an organisation to have a targeted, strategic direction to their communication activities
- World Wetlands Day is an opportunity for wetland organisations to collaborate on activities to provide a clear message on wetland values and wise use.

Participants also provided ideas for collaboration across the region, including enhanced communication among wetland centres, future collaboration on messages for World Wetlands Day 2011, the 40th Anniversary of the Ramsar Convention, and greater promotion of the Ecosystems Services Framework - how ecosystem services can be used more extensively to underpin communication and education for wetlands.

Information: www.wetlands.org.au



Western District Lakes Ramsar site, Victoria. Photo: Ammie Jackson.

Rehabilitating waterbird habitat on the Victorian Volcanic Plains

Ammie Jackson, Greening Australia

The lunette lakes of the Western District Lakes Ramsar site in Victoria, shaped by volcanic activity, provide the perfect habitat for migratory birds and waders. Situated on the Victorian Volcanic Plains 150 kilometres south west of Melbourne and covering about 180 000 hectares, the site contains nine lakes, including Lake Corangamite, the largest permanent saline lake in Australia.

The lakes vary in salinity from brackish to hyper-saline. The value of this site to water birds and to Indigenous cultural heritage is reflected in the title of a conservation project: “borrell-a-kandelop” or “resting place for water birds”. This project, a partnership between Greening Australia (Victoria), the Corangamite Catchment Management Authority and Parks Victoria, works with landholders to protect the lake values and vegetation types such as saltmarsh, grasslands and grassy woodlands, sedgy wetlands and stony rises woodlands.

A number of threatened flora and fauna species occur in the area and borrell-a-kandelop staff are working in conjunction with Department of Sustainability and Environment threatened species officers to protect and enhance habitat for the striped legless lizard and the critically endangered Corangamite water skink, as well as helping to map existing populations and report new populations of spiny pepper-cress and salt-lake tussock grass.

The education and awareness-raising aspect of the project involves annual adult education field days and workshops. Past events have included wetland ecology training and identification of wetland plants, grassland plants, weeds, frogs and birds.

The school program centres on threatened species such as the sharp-tailed sandpiper. Four local primary schools learn about the species throughout the year and are involved with activities around this species such as writing poems, stories, illustrations and banner design. Students then come together for a planting event and barbecue to celebrate National Threatened Species Day.

Project achievements so far include working with more than 100 landholders to fence about 130 kilometres of lake frontages and waterways feeding into the lakes, and planting more than 172 000 indigenous plants.

Over the years, up to eight schools have been involved in project activities, Green Corps teams have been engaged in revegetation and rubbish clearing activities, international students have helped with revegetation and local volunteers have provided their time.

During its eight years the project has faced many changes and challenges including the permanent lakes drying out as a result of the drought. Working through a detailed Conservation Action Planning process, with input from key stakeholders, has allowed the project to evolve. Through this planning process, specific objectives have been identified.

In 2010 the project will continue with fencing, vegetation enhancement and revegetation works adjoining the lakes, but will also focus on controlling invasive weeds and pest animals. Work has commenced to form a Brolga Action Group consisting of landholders who regularly have brolgas visit and nest in their wetlands and who are passionate to protect this species. The borrell-a-kandelop project will assist landholders with fox control, wetland enhancement and grazing advice in an attempt to successfully fledge brolga chicks and protect brolga populations.



Yanga National Park, New South Wales. Photos from left: Megan Graham, Sascha Healy and Paul Coates. Opposite: Megan Graham.

RESTORING THE LOWER MURRUMBIDGEE FLOODPLAIN

Megan Graham, Rivers Environmental Restoration Program, Department of Environment, Climate Change and Water

The wetlands and rivers of the New South Wales Murray-Darling Basin have been under serious pressure in recent decades, with reduced water inflows, drought and land clearing all taking their toll. The Lower Murrumbidgee River floodplain (Lowbidgee) in south-west New South Wales is no exception.

To support the Lowbidgee floodplain a range of projects is being supported through the \$173 million Rivers Environmental Restoration Program, including RiverBank environmental water purchases. The program, jointly funded by the New South Wales Government and the Australian Government's *Water for the Future* initiative, aims to arrest the decline of wetlands through water recovery, effective management of environmental water and sustainable wetland management.

This is being done through water infrastructure efficiency works, water purchase from willing sellers, research, monitoring, the control of wetland weeds, partnerships with landholders and the Indigenous community and the purchase of high conservation-value wetland properties.

The Lowbidgee floodplain and adjacent Great Cumbung wetland of the Lachlan River is one of the most important wetlands in New South Wales. Historically, the Murrumbidgee River flooded every year across this floodplain, creating a mosaic of wetland types. Floodplain features include one of the most extensive areas of river red gum in New South Wales, large open lakes, reed bed

swamps, vast areas of spike rush, black box/lignum swamps and chenopod scrub surrounding the wetlands.

The diversity of wetlands within the Lowbidgee system provides habitat for a range of flora and fauna. In particular, the Lowbidgee is important habitat for significant populations of water birds, including colonial nesting water birds such as egrets and ibis and migratory species.

Yanga National Park, which opened to the public in 2009, contains a significant amount of the Lowbidgee wetlands and river red gum forests, and has a strong cultural history with Indigenous people and pastoral settlement. Yanga holds a diversity of wetlands that have in the past supported some of the largest breeding colonies of waterbirds in Australia. With 150 kilometres of Murrumbidgee River frontage the conservation of Yanga and its wetlands is vital.

Through the Rivers Environmental Restoration Program, more than \$1.5 million will be spent upgrading Yanga's aged water infrastructure system for more efficient and effective use of water for ecological outcomes. The recently completed Two Bridges Regulators have already been successfully used to direct environmental water, in some cases to areas that have not been inundated since 2005.

Some environmental water is available for the Lowbidgee and other Murrumbidgee wetland assets under the Murrumbidgee Water Sharing Plan. Additionally, the New South Wales and Australian governments are working to recover environmental water from the Murrumbidgee water market, and the New South Wales Government has now purchased about 13 500 megalitres of general security water entitlement.

The allocation that is accrued to this entitlement can be provided to the Lowbidgee and other Murrumbidgee

wetlands. By increasing the volume and frequency of water delivered from environmental water accessed under the water-sharing plan, water purchases will help support the long-term viability of these critical systems.

Since 2007, a limited amount of environmental water has been made available for watering wetlands that are key habitat areas for southern bell frogs. Fortunately, this watering has resulted in some success in maintaining existing populations of these frogs. Hopefully, environmental watering will continue into the future.

In 2009, 34 300 ML of environmental water was delivered to the Lowbidgee wetland environment. This is the most environmental water delivered since 2005. The water was delivered to three private properties with significant wetlands, to Maude lagoon and Yanga National Park.

'Narwie' was one property that received water. Property owner and manager Paul Connellan says 'receiving the water meant that drought-stressed red gum trees will start to recover, reed beds that have disappeared will re-shoot from the soil, some wetland birds are nesting, and the health of drought-affected soil will begin to improve. We will keep stock off for now and expect that the animals will do well on the growth expected as the water recedes.'



Narwie received water because of the known bird rookeries and the ability of current vegetation to recover. This was supported by Paul's commitment to exclude livestock from the area while it remains inundated. Bordering Paul's property is 'Wynburn', owned and managed by Sue and Craig Williams.

Wynburn has a red gum/spike rush dominated wetland known locally as Steam Engine Swamp. This wetland was

also watered in 2009 because of its wetland values and well-documented egret rookery. Craig says the water has the swans and ducks breeding, and pied stilts, white faced and white necked herons have moved into the wetland areas.' The Williams have also committed to keeping stock out of the wetlands until the flooding cycle is complete.

During the past four years, the Department of Environment, Climate Change and Water (DECCW) has been refining its techniques for selecting wetlands for watering. DECCW senior wetlands and rivers conservation officer, James Maguire, says 'in 2009, an independent expert panel was convened to deliberate on the options and needs for water delivery.'

'The panel made watering recommendations to DECCW based upon the volume of available water, wetland type, ease of delivery, time of year, time period since last watering, presence of threatened species, presence of assets such as bird rookeries, vegetation type and condition and the landholder's commitment to wetland management.'

Each watering event is accompanied by a range of monitoring activities to assess the effectiveness of environmental flows. Researchers monitor a number of attributes including response of vegetation, bird and frog species. This data is then used by DECCW and an independent panel to help with future decisions about watering priorities.

Information: www.environment.nsw.gov.au/environmentalwater/index.htm



LONG-TERM RESCUE PLAN TO BUILD RESILIENCE IN THE COORONG WETLANDS

David Heath, SA Department for Environment and Heritage

South Australia's Coorong, Lower Lakes and Murray Mouth region - recognised as an internationally-important wetland - is facing an unprecedented environmental crisis. Record low inflows caused by prolonged drought in the Murray-Darling catchment and decades of over-allocation of water resources are having a significant impact.

This poses a serious threat to its ecosystem, which supports many species of migratory birds, fish and native plants. It also threatens the heart of the local economy and the life and culture of the Ngarrindjeri people, who to this day continue to live on their traditional lands.

Unsustainably low water levels in the Lower Lakes are exposing serious management issues including acid sulfate soils, while the lack of water flowing through the system has prevented the flushing of salt and pollutants. Lakes Alexandrina and Albert are in danger of becoming acidic, while the Coorong has lost much of its productivity. The picture is bleak but there is hope.

The South Australian Government, working with local communities, industries and the Ngarrindjeri people, have been formulating a long-term plan to build resilience in the system and deliver a healthy and sustainable future for the region.

With funding of up to \$200 million from the Australian Government, the long-term plan aims to ensure the Coorong, Lower Lakes and Murray Mouth remain an internationally-important wetland, as well as setting the framework for the region's long-term ecological, social, economic and cultural future.

With extensive community consultation, the long-term plan will propose a range of management activities, including bioremediation and revegetation using limestone to treat acidification, pumping hyper-saline water out of the Coorong's South Lagoon and protecting critical native fish refuges throughout the system. To support and inform these significant projects, a comprehensive program of investigations, modelling and monitoring will also be undertaken.

While work on the long-term plan has been progressing, immediate action has also been taken to tackle the critical impacts of record low inflows into the Lower Lakes. The best way to manage the threat of acidification is to keep acid sulfate soils submerged, so two temporary flow regulators have been constructed in the Goolwa Channel near Clayton and at the mouth of the Currency Creek to allow water levels to be raised. This enables the acid sulfate soils to remain submerged thus preventing oxidation acid formation. The temporary regulators will be removed once conditions in the region improve.

At the same time, the South Australian Government launched a major project to vegetate large areas of exposed

lakebeds at Lake Alexandrina and Lake Albert. This initiative is part of the Lower Lakes Bioremediation and Revegetation Project, funded by the Australian Government and coordinated through the South Australian Department for Environment and Heritage. As part of this project, thousands of hectares of lakebed have already been seeded, with the aim of stabilising the soil, reducing erosion and returning carbon to the lake bed soils.

The bioremediation project, targeting urgent works to address urgent environmental issues such as acidification and soil erosion, has also involved local communities, with much of the growing and planting work to be undertaken by local organisations, businesses and the Ngarrindjeri community.

Early results of the seeding have been positive, in what is considered to be an important first step for broader bioremediation and revegetation works in the Lower Lakes region. The \$10 million project is also delivering other benefits for the Lower Lakes recovery effort, including weed management and fencing, ecological monitoring and reporting, the development of local action plans, workshops and training for local communities, and funding for the Ngarrindjeri community for bioremediation projects.

A management plan has also been developed specifically for Lake Albert, which is facing a serious threat of acidification. The clay soils at the centre of the lake pose a particularly serious acidification problem, with some fast-drying (sandy) shore areas also having been identified as high-risk acid sulfate soil 'hot spots'.

Last year, water was pumped from Lake Alexandrina into Lake Albert as a temporary measure to prevent acidification in Lake Albert. The aim was to keep Lake Albert's water level above the threshold at which acidification was likely to occur. The pumping operation ceased on June 30, 2009, after it was determined there wasn't enough freshwater available to maintain water levels and prevent acidification in both Lake Alexandrina and Lake Albert.

The new plan for Lake Albert will see bioremediation and revegetation work carried out in conjunction with local communities. Limestone treatment will also help to neutralise acid released from soils and into the water. In addition, renewed pumping from Lake Alexandrina into Lake Albert is likely to begin in early 2010, to maintain the lake's level at above one metre below sea level for another year. This would keep the high-risk clay soil at the centre of Lake Albert submerged, covering about 55 per cent of the lake bed.

The overall goal is to build resilience in the system and ensure the Coorong, Lower Lakes and Murray Mouth region has a healthy and productive future, and continues to be one of Australia's most important wetland areas.

Information: www.murrayfutures.sa.gov.au/lower.php



Newly-planted seedlings on the shores of Lake Albert. Left: Barrages between the Coorong lagoon and Lake Alexandrina. Photos: David Heath.

CONSERVATION VOLUNTEERS AUSTRALIA AND BHP BILLITON CELEBRATE 10-YEAR PARTNERSHIP OF WETLAND RESTORATION

Sarah Brittle, Revive our Wetlands Coordinator, Conservation Volunteers Australia

One of the most significant, corporate-community partnerships in Australia, Revive our Wetlands, is celebrating a decade of nationwide wetland restoration work. Its inception in 2000 stemmed from a shared concern about the state of Australia's wetlands by Conservation Volunteers Australia (CVA) and BHP Billiton. Combining skills, expertise and financial resources, CVA and BHP developed a \$6 million partnership that has generated public awareness and interest in wetlands, resulting in unprecedented community action, minimised ecological impacts and a long-term conservation legacy.

Over the past 10 years Revive our Wetlands has delivered more than 50 700 volunteer days to declining wetlands across the country, engaging more than 120 schools in developing 'mini wetlands' and conducting 366 flora and fauna surveys. A total of 822 915 trees have been planted, 1728 kg of seed collected and 53 336 plants propagated. In addition, 4362 hectares of weed has been removed, 41 929 kg of rubbish cleared and 220 km of fencing built or maintained.

A key element to the partnership's success is that every three years the partners stop to reflect on the achievements and short-comings of the program, prior to entering a new term. This reflection, combined with assessments of community and environmental needs and changes in government policy, has ensured the program remains relevant and returns tangible outcomes for time and money invested.

The aim of the first term (2000-2003) was to 'halt, and where possible, reverse the loss of Australia's wetlands by building the capacity of local communities to rehabilitate and conserve 100 of their wetlands'. A ground-swell of public enthusiasm began to build with more than 17 000 volunteer days spent at 100 threatened sites. Some of these sites included Queensland's Alexandra Bay in the Daintree and the MacKay Wetland System, Coomaditchie Lagoon in the Illawarra, New South Wales, Brown's Bore/Deering River Floodout in central Australia, Big Swamp Wetland in Western Australia and Moulting Lagoon in Tasmania.

The second term (2004-2006) took a more targeted approach, concentrated on fewer (10) but more significant wetlands. These wetlands included Eagleby Wetlands and Townsville Town Common in Queensland, Lindsay and Walpolla Islands, Little Lake Wallawalla and Cheetham

Wetlands in Victoria, Cattai Wetlands, Darawakh/Frogalla wetland and Newhaven Reserve, Coomonderry, Werri Lagoon, Tom Thumb and Lake Conjola in New South Wales, and Beeliar Regional Park in Western Australia.

Financial resources and time allocation were directed to these sites for on-ground works, making a greater impact that enabled the community to carry on the wetland management long after Revive our Wetlands' involvement. More than 19 000 volunteer days were spent reviving these 10 wetlands and for every \$3 invested by BHP Billiton, an additional \$2 was secured from third parties. Over 10 years, third party contributions have totalled more than \$2 million. An online monitoring system was also established to track progress against annual plans at each site.

In its most recent term (2007-2010) Revive our Wetlands introduced a community and school education component and continued to address the loss of five focus wetland sites: Beeliar Regional Park in Perth, Cheetham Wetlands in Melbourne, Townsville Town Common in Queensland, Telowie Beach and Winninowie in the Upper Spencer Gulf, South Australia, and Coomonderry, Werri Creek, Minnamurra Swamp and Tom Thumb Lagoon in Wollongong, New South Wales.

Revive our Wetlands now delivers 50 days of volunteer assistance per year to help schools develop living classroom 'mini wetlands' in or near their schools. Schools that are located close to the five focus wetland sites are involved in site visits and hands-on conservation projects. In 2009, 3500 days of volunteer assistance was delivered to focus wetland sites and 100 'outreach' days to other wetlands across Australia.

The financial and professional support provided by BHP Billiton, the volunteer management and expertise of CVA and the thousands of volunteers have delivered the on-ground results. Project partners have ensured that the teams work under the guidance of a management plan, and have provided in-kind or financial support in addition to expertise and support from regional bodies and organisations.

Information: www.reviveourwetlands.net



Volunteers removing African boxthorn at Cheetham Wetlands, Melbourne. Photo: BHP Billiton.

REGENERATING HABITAT FOR GIANT BARRED FROG, BARKING OWL AND BUSH STONE CURLEW

Simone Haigh, WetlandCare Australia

Giant barred frog (*Mixophyes iterates*) populations in Queensland have undergone dramatic declines, as has the bush stone curlew (*Burhinus grallarius*) and barking owl (*Ninox connivens*) in New South Wales. WetlandCare Australia is working on multiple projects to restore critical habitat and reduce the impact of feral animals on these endangered species. The overall objective is to reverse localised population declines by increasing connectivity of habitats and populations, enhancing breeding success and supporting community and landowner engagement.

There are an estimated 5000 to 10 000 adult giant barred frogs remaining, making them a critically endangered species. Threats include reduced water quality, weed invasion, the spraying of herbicides close to streams and the clearing of native vegetation. This, along with other factors such as unnatural fire regimes, has resulted in reduced leaf litter and fallen log debris that forms critical habitat for the frogs.

The Giant Barred Frog Habitat Enhancement and Restoration Project began in early 2009 with a grant from the Threatened Species Network. WetlandCare Australia, in partnership with Permaforest Pty Ltd and Gold Coast City Council, has been working in Queensland's Numinbah Valley along the creek line of the Nerang River, to restore habitat for this species. Weed control works began during winter, outside of the frogs breeding season, to ensure minimal disturbance. One of the many weeds removed was the giant reed, *Donax arundo*, which impacts heavily on waterways, consuming up to 2000 litres water/m²/day.

Replanting of native species along the riparian zone has followed, with 1560 rainforest species, 1000 sedges and water species and 300 trees planted over five hectares. This project will ultimately improve existing habitat as well as increase the area of habitat suitable for the giant barred frog. It will also build on the conservation efforts already undertaken and assist connectivity with neighbouring populations, thereby increasing population resilience and sustainability.

Weed invasion also presents a problem for the barking owl. This species likes to live near rivers, swamps or creek beds, and is dependant on old-growth riparian vegetation for nesting and roosting. The introduced South American vine, cat's claw creeper (*Macfadyena unguis-cati*), threatens old-growth riparian vegetation because it grows prolifically, latching on to the trunk with its three distinctive 'claws' to

reach the canopy, which it eventually completely smothers and kills its host.

To conserve the barking owl's habitat, WetlandCare Australia, with funding from the Northern Rivers Catchment Management Authority (CMA), has helped landowners to control this invasive vine through best management practice conservation guidelines and pots of the recently developed biocontrol agent, the cat's claw creeper tingid *Carvalhotingis visenda*. While good progress has been made, cat's claw creeper is a tenacious weed and will require at least two more years of follow-up work to ensure success.

For the bush stone curlew, work is underway to protect it from predators. Being very difficult to see is a strategy that they have employed to avoid predation by raptor species, which hunt by sight. This has served them well and they were once widely distributed across Australia and commonly found in large flocks of 50 to 100 birds. Unfortunately, when faced with an introduced predator such as a fox, which hunts by smell, they are literally 'sitting ducks' and this, combined with other factors such as habitat loss, has resulted in a severe decline in their numbers.

WetlandCare Australia, with funding from the Northern Rivers CMA, has commenced a broad-scale fox control program around the Glenugie/Pillar Valley area of northern NSW, an area where there are still known breeding pairs of birds and a community of sympathetic landowners. This will give the birds the best chance of a successful breeding season.

These actions have a synergistic effect and do not benefit single species in isolation. Restoring habitat for the giant barred frog will also benefit the stony-creek frog, emerald-spotted tree frog and endangered species such as fleays barred frog and the cascade tree frog.

Fox control will enhance the breeding success of bush stone curlews but will also benefit the barking owl because they are a direct competitor for prey and directly benefit other small to medium-size mammals such as the rufous bettong.

Community engagement and education is an ongoing component of these projects. WetlandCare Australia has been very fortunate to work with groups of committed landowners who are keen to protect these threatened species. Ultimately, the success of most threatened species conservation projects depends on improved and thoughtful land management practices.

Information: www.wetlandcare.com.au



Flock of great knots in flight. Photo: Roger Jaensch.

SURVEY UNVEILS ONE OF THE LARGEST GATHERINGS ON AUSTRALIA'S EAST COAST OF THE GREAT KNOT

Jody McDonald, Fitzroy Basin Association

A comprehensive shorebird survey in Central Queensland has bridged the knowledge gap of coastal biodiversity, discovering several thousand migratory birds that stop over in the region, including internationally-significant species.

The survey was conducted by Wetlands International on the Broad Sound coast near St Lawrence, funded by the Fitzroy Basin Association Incorporated (FBA) under the Australian Government's *Caring for our Country* initiative. The survey stemmed from an earlier landscape condition assessment of the Broad Sound region, carried out by Wetlands International.

FBA biodiversity coordinator Graham Lightbody says that during the first assessment, a number of shorebird roosts were discovered on the salt flats of Broad Sound, and it became clear there was a knowledge gap regarding coastal biodiversity in the area.

"FBA needs to understand local ecosystems in order to help manage them effectively, so this survey was an important follow-up to enable the investigation of six high-tide roosts previously unknown to ornithologists," Graham says.

"The survey showed Broad Sound supported internationally important levels of red-necked stints, sharp-tailed sandpipers and marsh sandpipers. In addition, the area supports one of the largest gatherings on Australia's east coast of the great knot, a species recently impacted by loss of habitat in north-east Asia.

"Migratory shorebirds are a natural asset and many are threatened by coastal development of wetlands in the northern parts of their migration in Asia. We wanted to know more about the composition of birds in our region to ensure we could prioritise future conservation and management efforts."

The shorebird survey was carried out across four field surveys from late 2008 to early 2009, and was led by Roger Jaensch from Wetlands International with a small team of volunteers to count bird numbers including members of Birds Australia's Capricornia group.

Roger says that Broad Sound wetlands were both a stop-over point and end-destination for migrating shorebirds that travel thousands of kilometres each year from north-east Asian and Alaskan breeding grounds. Some birds, such as the red knot, travel on from Broad Sound to Victoria and New Zealand.

"The surveys were sometimes hampered by weather but the collective coverage of roosts enabled a reasonable baseline knowledge of use of Broad Sound wetlands by migratory shorebirds to be established," Roger says. "Broad Sound is comparable to nearby Shoalwater Bay in terms of species richness for migratory shorebirds and counts of some species, but overall supports smaller numbers."

Local conservation group, the Capricorn Conservation Council, is ensuring knowledge of the Broad Sound wetlands continues to expand by funding more surveys. Surveys will be conducted by volunteers at critical times of the year in the shorebird migration cycle, September and March, to determine which species are using the roosts, and how many. This will provide more detailed and reliable data about bird populations that can be used to plot trends, set priorities for protection of shorebird sites, promote awareness of waterbirds and their management, and build volunteer capacity.

Information: www.fba.org.au



Landholder Rob Webb and his rehabilitated wetland on the Backwater Cowal, near Narromine, New South Wales. Photo: Central West Catchment Management Authority.

NSW FARMERS ENHANCE WETLANDS AND PRODUCTION FOR THE LONG TERM

Libby McIntyre and Rodney Price, Aquatic Habitat Rehabilitation Unit, Industry and Investment NSW

A massive 96 per cent of New South Wales wetlands are located inland, west of the Great Dividing Range, and most are on privately-owned farming land. Since 2007, the Wetlands on Farms project, funded by the Australian and NSW governments, has formulated management plans for 84 680 hectares of the state's wetlands, collaborating with 52 separate landholders across eight inland catchments.

Staff from the Conservation Action Unit of Industry and Investment NSW, have helped landholders to develop Wetland Management Plans, which are designed to increase the landholder's knowledge and enhance the conservation of their wetlands. Each plan contains information about the catchment, regional and local hydrology, flora and fauna found on the property, property infrastructure and tenure, threats to the wetland and finally, actions and goal setting. Information on addressing each threat is provided to allow the landholder to approach funding bodies with an easily identifiable amount of finance required to address the threat and achieve the associated goal.

During the project, it was found that many landholders thought a wetland had to be wet all the time, when in fact only a very small proportion of wetlands west of the Great Dividing Range hold water permanently. Inland NSW wetlands encompass a wide range of habitats, including permanent and intermittent lakes, marshes and swamps, boggy areas in paddocks, freshwater springs, clay pans and lignum and canegrass swamps. So to better protect their wetlands, many farmers wanted to find out what actually constituted a wetland and how to protect and enhance them.

To begin the planning process, current wetland condition was assessed to determine the health of the wetland and to identify any immediate threats. Through a series of questions, a workbook was completed on farm with the landholder giving information about the physical environment, farming practises, known hydrology, history and biology of the wetland.

The workbook then enabled each identified threat to be rated and to then discuss the options for management with the landholder. The management plan content and timeframe is finalised based on the outcomes from the workbook and what the landholder feels they can implement while maintaining or improving farm productivity.

Upon completion of each plan, landholders received a wetland management plan with self-determined actions and high-resolution maps of their property. An assessment report of the wetland condition for future monitoring and evaluation purposes is also provided and extension information to assist them to make better informed management decisions in the future.

As each wetland plan was specifically tailored to suit the wetland and property, management actions generally ranged from development of alternative stock watering points away from the wetland, weed and pest animal control, fencing for periodic stock exclusion, management of invasive native scrub and environmental watering plans. Associated estimates of cost, time and responsibility for each action is also documented.

Funds for the Wetlands on Farms pilot program were originally obtained from the Australian Government *Caring for our Country* initiative for 24 plans for wetlands in the Border Rivers Gwydir, Central West, Lachlan, Lower Murray-Darling, Murray, Murrumbidgee, Namoi and Western Catchments. Further funding was provided by Central West, Lachlan and Western Catchment Management Authorities for 26 more plans. The NSW Department of Environment, Climate Change and Water funded an additional two plans in the Macquarie Marshes.

Response to the project has been extremely positive from landholders and key stakeholders. Landholders have reported that they found the experience rewarding and informative and would recommend it to other landholders. Direct face-to-face facilitation was critical in ensuring the project's success. Facilitators provided a bridge between technical and scientific knowledge and the practical resolution and management of specific issues. Individual wetland management plans offered a documented resource for the landholder and a formal way of keeping track of their management progress long term.



Artificial wetlands are being built in Queensland's Burdekin region. Photo: Steve J Miller.

SUGAR CANE MAKES WAY FOR WETLAND WILDLIFE IN QUEENSLAND'S BURDEKIN

Kathy Cogo, North Queensland (NQ) Dry Tropics

Drive through the Burdekin area in north Queensland and you'll see sugarcane lining the roadside. With 650 growers, it is the country's largest sugar-growing region. However, fish and other wildlife are battling to share the area because creeks have been turned into irrigation channels and wetlands have yielded to cane.

Landowners Vince and Rita Papale have decided to give some land back to nature. "It was getting far more difficult to manage that area of land. In a flood event this year we lost 10 to 15 acres of cane in 2009. We tried to pump the water clear of the paddocks and lose the crop anyway," Vince says.

The Papales applied for Australian Government *Reef Rescue* funding from their local land and water management group, North Queensland (NQ) Dry Tropics, to build a wetland. The constructed wetland will cover three hectares of their farm, the lagoon itself will cover half of this area. The deepest part of the lagoon is four-and-a-half metres. Aquifers lie three metres under much of the Burdekin but the wetland will be lined with clay to stop its water from influencing the quality and quantity of the watertable.

Planning, mapping and excavation costs exceeded \$100 000 - 30 per cent more than originally budgeted. This is mostly due to the discovery of mild acid sulfate soils in the area. The design needed to be re-done and the soil remediated with lime. The costs have been footed by NQ

Dry Tropics through *Reef Rescue* and the landholder. The local water board is providing machinery at a subsidised rate.

Wetlands have been built in other cane farming regions, however, this is the first artificial wetland in the Burdekin. While crocodiles and fish are not expected to take long to move in, it is expected to take three years before the lagoon reaches its full potential, complete with native plants such as melaleucas, lomandras and water lillies.

In the middle of the harvest season, Vince and Rita were working 14-hour days to build the wetland and plant a cane crop. Vince says they considered a recycling pit, which is what some farmers use to catch the water that runs off paddocks and redistribute it back to the land, to avoid run-off into the adjacent Great Barrier Reef. However, Vince says he wanted something more environmentally friendly.

"Recycling pits are a hole in the ground but there's a whole lot more we can do," he says. "If you imagine the pressure we're under from environmental lobby groups and you think 'I can do something that proves we can co-exist with everything around us'. It's a site you can bring people to and show them the cane's there and there's the wetland."

Bob Frazer, NQ Dry Tropics chief executive officer, says the constructed wetland is a great move forward for cane growers in the region. "We hope that this example will encourage other growers to follow suit."

Information: www.nqdrytropics.com.au

TRADITIONAL OWNERS REGENERATE CABBAGE TREE ISLAND

Adam Gosling, WetlandCare Australia

Cabbage Tree Island, situated in the Richmond River in Bundjalung country on the north coast of New South Wales, is rich in biodiversity values and is of immense cultural significance to local Indigenous people. First settled in the 1880s by the local Indigenous community, Cabbage Tree Island has seen a number of transformations: from the original self-sufficient and sustainable community to an Aboriginal Reserve and then later as a designated Aboriginal Station.

Ownership was returned to the traditional owners in 1984 with the Jali Local Aboriginal Land Council obtaining the land title. Today, Cabbage Tree Island is a hub for the local Indigenous community, and a focus for traditional cultural heritage knowledge of the area. Elders' stories of life on Cabbage Tree Island tell of the abundance of wild food provided by the rivers, the freshwater and estuarine wetlands and sand dune environments. As with many of Australia's coastal wetland environments, these areas have become either completely lost through agriculture and urban development, or severely degraded by human impacts.

The local Cabbage Tree Island community has taken significant steps to arrest the decline of the biodiversity values of the island and surrounding lands. WetlandCare Australia has partnered with the Cabbage Tree Island community on conservation projects that have improved bush regeneration and other natural resource management skills amongst the community, and consequently improved biodiversity values of the island's wetlands. As a result, the community has the knowledge and skills to better manage their land as well as a range of employment opportunities.

One of the major successes of these projects has been the construction of a wetland educational boardwalk adjacent to the Cabbage Tree Island Public School. The boardwalk site was previously an illegal dumping site, a degraded estuarine area heavily infested by exotic weeds. To prepare the site, the riparian banks underwent extensive weed control and all rubbish was removed.

The boardwalk, funded by the NSW Government's Environmental Trust, the Australian Government and the Northern Rivers Catchment Management Authority, runs parallel to the mangrove forest. It has two outdoor teaching bays extending into the mangrove forest where students can closely observe the estuarine wetland's flora and fauna.

The area surrounding the boardwalk was revegetated with more than 6000 local vegetation species, with an emphasis on culturally-significant plants for bush tucker or traditional medicine. The revegetation and boardwalk now connect the



A boardwalk constructed during the regeneration of the Indigenous-owned Cabbage Tree Island wetlands, New South Wales. Photo: Adam Gosling.

school to a littoral rainforest and mangrove forest. A series of interpretive signs explain the ecological values of the flora and fauna, the traditional uses of the species and cultural heritage.

The local school has ownership over the boardwalk with students adopting a post along the boardwalk and decorating it with traditional paintings, handprints and names. This is a source of great pride for students and their families. Further education is provided to students through an interactive website based on the boardwalk, with information on the flora and fauna of the Richmond River estuary, traditional uses of these species, types of estuarine wetlands found on Cabbage Tree Island and threats facing these wetlands.

Success at Cabbage Tree Island is the result of strong partnerships, which not only include funding bodies but also in-kind support from the Cabbage Tree Island Public School and its principal, Dyonne Anderson, Jali LALC, Bunjum Aboriginal Cooperative, Ashley Moran from Department of Environment, Climate Change and Water and Danny Morton and staff at Wollongbar TAFE.

Although WetlandCare Australia has been working closely with the Cabbage Tree Island community on these projects, the success lies with the local community, particularly Marcus Ferguson and the Mibinj bush regeneration crew.

Without their drive and desire to see an improved environment, and the harnessing of community ownership of these projects, these projects would not have been as successful. This work has had tangible and intangible benefits including improved biodiversity conservation, information dissemination on the value of wetlands and the pressures that they face, the sharing of traditional knowledge and stories, and momentum towards continuing the natural resource management work on traditional land by Traditional Owners.

MURRUMBIDGEE INSPIRES A PARTNERSHIP FROM BOTH SIDES OF THE RIVERBANK

Tanya Rucosky-Noakes, Upper Murrumbidgee Waterwatch

The Upper Murrumbidgee Demonstration Reach (UMDR), which runs 70 kilometres from the Monaro Plains and Snowy Mountains of New South Wales into the heart of Canberra, has formed a unique partnership with Upper Murrumbidgee Waterwatch to engage urban and rural stakeholders to rehabilitate the river to benefit native fish, fauna and flora.

The Murrumbidgee River is highly valued by residents in the Australian Capital Territory and New South Wales for recreational activities. Consequently, Upper Murrumbidgee Waterwatch has been involving landholders, Parkcare and Landcare groups in monitoring for more than a decade. The keen interest from the Canberra community and riparian landholders in the river's health and its dependent species has made the establishment of UMDR a natural progression for the community to further engage in their waterway.



Bumbalong Valley, part of the Upper Murrumbidgee Demonstration Reach, New South Wales. Photo Luke Johnston.

The UMDR consists of both degraded and good quality sections of river habitat. It highlights the concerns facing many Australian rivers, as well as the promise of community, government and corporate partnerships in delivering aquatic ecosystem health. Project coordinator Luke Johnston says 'the UMDR is affected by a range of impacts including reduction in flow levels caused by water harvesting and drought, high levels of sedimentation, reduction in available fish habitat caused by an eroding catchment, previous clearing or floodplains, recent fire, as well as other impacts associated with being so close to Australia's largest inland city.'

'With the community so firmly on board, the UMDR will address threats for which there is no defined or preferred management approach,' Luke says. 'Our aim is to reinstate a stable and diverse in-stream habitat to increase the ability of native species to survive and respond to future threats.'

Upper Murrumbidgee Waterwatch facilitator, Tanya Noakes, says the area is dealing with 'the troubles that beset all our rivers, including water scarcity and even climate change.'

'We are, person by person, landholder by landholder taking back the responsibility and caring for our river,' Tanya says. 'We benefit from the local knowledge of the community about how this river used to be and how it should be. In return, we will help the community to reconnect to a place that we all can call our own and nurture. Since Waterwatch has been in the region working with the community for the past decade, we have been able to help the UMDR get off to a roaring start with a strong network of committed contacts and education materials.'

Luke says the reach possesses almost 30 years of long-term monitoring data for fish and more than a decade of community water quality monitoring data.

'This is a situation that is probably unique in Australia and one that provides a robust benchmark of condition against which to measure signs of recovery,' he says. 'We really know where we are and by taking this approach we are already, in our first year, deeply entrenched in the community.'



Clockwise: Saltmarsh in the Clarence River estuary, New South Wales, beaded glasswort, mudflat crab hole. Photos: Alan Cibilic.

REGENERATING BARE WHEEL RUTS PUTS SALTMARSH DEGREDAATION IN REVERSE

Alan Cibilic, WetlandCare Australia

Micalo Island, one of about 40 significant islands in the Clarence River Estuary, lies at the mouth of the river, between Coffs Harbour and Byron Bay, northern New South Wales. About 240 hectares of known saltmarsh remains in the estuary and this particular site comprises 6 per cent of the total. Wheel ruts found in this endangered saltmarsh wetland provide evidence that people, in ignorance, had been driving all over it, following tracks no doubt made by others.

Coastal saltmarsh is delicate, comprised of easily-disturbed, shallow-rooted grasses and herbs adapted to waterlogged soils. Yet these plants are survivors that cope with an environment of extremes: wet or dry, freshwater or hypersaline, cool or hot, terrestrial or estuarine and acidic or alkaline.

Coastal saltmarsh may appear desolate. Yet about 200 different plants colonise saltmarsh, while many sites in northern NSW are dominated by one or two species such as marine couch (*Sporobolus virginicus*), saltwater couch (*Paspalum vaginatum*) and glasswort samphire (*Sarcocornia quinqueflora*), along with other species such as streaked arrowgrass (*Triglochin striata*), creeping bushweed (*Samolus repens*), jointed rush (*Juncus kraussii*) and seablite (*Suaeda australis*).

Saltmarsh often forms a mosaic, interspersed with estuarine mudflats and mangroves at lower elevations, and floodplain forests at higher elevations. The saltmarsh vascular plant species frequently colonise areas in response to micro-elevation and soil salinity. There is often a tug-of-war at the terrestrial margins as the saltmarsh advances landward

in the dry season, and retreats during the wet season as terrestrial species take advantage of the reduced salt level from freshwater inputs. The fauna of saltmarsh is often hidden below ground (crabs, worms), or transient, coming with the tides (fish) or foraging for food from the terrestrial margins (spiders, birds).

Coastal saltmarsh is an endangered ecological community in northern NSW, highly valued as aquatic and terrestrial habitat and for the support it provides for fish and crustacea. Saltmarsh is also surprisingly productive, storing higher levels of carbon in the waterlogged (anaerobic) soils than most other vegetation communities. Algae and phytoplankton add to this by increasing their mass during the monthly cycle of highest tides and dying back during the low tide cycle. Some saltmarsh species such as glasswort actively shed outer leaf segments in which they store salt, as a means of reducing their overall salt load.

In 2006, the saltmarsh at northern Micalo Island was managed by the NSW Land and Property Management Authority, and with assistance from WetlandCare Australia installed a vehicle control fence. Saltmarsh regeneration in the wheel ruts was rapid and after two years there are few signs of the original tracks.

In 2009, WetlandCare Australia with *Community Coastcare* funding, carried out the most comprehensive site assessments to date of coastal saltmarsh in the Clarence catchment. The Micalo Island site stands out for its healthy condition, the diversity provided by the mosaic structure, and the potential, in the short to medium term, for migration of the saltmarsh as sea level rises.

From these field assessments, knowledge is being shared with the community and NSW Land and Property Management Authority is supporting proposals for weed control in the adjoining floodplain swamp oak forest patches, which are also an endangered ecological community in northern NSW.



A black-neck stork (*Ephippiorhynchus asiaticus*) at Cattana Wetlands near Cairns, Queensland. Photos: Ruth Hickey.

LOCAL WETLANDS USED BY UNIVERSITY STUDENTS AS PRACTICAL SESSION IN ENVIRONMENTAL EDUCATION

Ruth Hickey, James Cook University

A Cairns coastal plain wetland constructed from three old sand mining pits, surrounded by urban development and sugar cane fields, serves as a practical learning centre for tomorrow's teachers. The Cattana Wetlands are being used by James Cook University students enrolled in a Graduate Diploma of Education course just three kilometres away, to promote community awareness of the wetlands through the development and use of environmental educational materials.

The project, Cattana Wetlands Environmental Education for Sustainability, is a partnership between James Cook University, Cairns Regional Council and Terrain Natural Resources Management, with funding from the Australian Government's *Caring for our Country* initiative and the Queensland Government.

Fifteen student teams have identified topics for community awareness events and then researched, sourced and developed educational materials. Key products are information brochures that form the core of the education events. Because of the close proximity of the wetlands to the university, tertiary students undertake regular field activities as part of their studies.

Students are keen to engage in these activities because they recognise that community education work is highly regarded by the Queensland teacher registration body. It is also a way they can make a contribution to environmental education for sustainability. Teachers can have a strong

impact on the values, beliefs and practices of children and the local community.

Project materials are organised into themes. For the 'catchments' theme, students produced tree-planting guides for use at National Tree Planting days. Two student teams focused on water quality (hydrology and inflow pollutants) and distributed brochures at their local Smithfield community markets and one team conducted a session at a community meeting about the value of wetlands to preserve remnant feather palm forests, and the threats to wetlands from imported fauna such as tilapia (*Oreochromis mossambicus*).

A second theme focused on the richness and vulnerability of the catchment's flora and fauna, which was promoted at educational events, university open days and community markets. One team prepared material about the 150 species of birds that rely on the wetlands and are successfully establishing themselves in urban areas, and gave a talk to a local bird observers club. Another used information from a mosquito researcher at James Cook University to run a session for teachers at a nearby school.

The final theme highlights the people who provide links to the wetlands through work, beliefs or values. These people include a consultant from a natural resource management group, an environmental consultant, an Indigenous elder and his connection to the Yirriganydji country, and a water quality scientist, who all provided information for community events about the Cattana Wetlands.

All educational materials developed by the students are publicly available on a website provided by Terrain NRM. The project is innovative as web users can 'meet' virtual experts through video streaming or download. Community groups, schools and tertiary students can get online to hear about bush tucker from Indigenous author, George Skeene, understand the council's role in revegetation and asset management; learn about the lifecycle of the Ulysses butterfly from a butterfly sanctuary manager; learn how

to preserve their region's biodiversity by listening to an environmental consultant; how to recognise acid-sulfate soils from a CSIRO scientist; and appreciate 'desirable local' plants and distinguish them from invasive weeds.

Web users can also take a 'virtual tour' of the Cattana Wetlands, driving with the Cairns Regional Council's project manager through the construction site, pointing out flood mitigation works, revegetation for roadside stability, bird hides, barbecues and walking tracks. This video is useful for schools as an orientation to the site prior to a visit, and to compare how the site has developed since mid-2009.

An important part of education students' development is to position themselves as educators of influence in their own community, who are not restricted to a classroom. Building human capacity, at the local level, has significant impact on sustainable practices, conservation of existing wetlands, resistance to loss of biodiversity and a sense of belonging.

The community awareness-raising events conducted in 2009 were part of a research project to identify cost-effective, high-impact events. Students gathered feedback from participants about what they had learned about the value of wetlands, the threats to wetlands, what was the most important thing they learned, and then rated the event.

Participant feedback from 15 events, which are informal (for example community markets), formal (special interest group meetings) and school-based (talks to year-groups), will be correlated to the topics (water quality, flora, fauna, biodiversity, etc.). This impact assessment will compare short (immediately after the event) and long-term effects (six months later) on participants. It will identify which aspects are most clearly recalled, or which stimulated changes in participants' views of the value of wetlands, and the ability to recall practices that limit negative impacts.



Monitoring the progress of a *Papilio ulysses* on a host tree.

This data will contribute to research that monitors the extent, direction and persistence of changes in participants' knowledge, skills, understandings and values about wetlands (as an identified place) and sustainable practices (as a broader concept).

Initial findings suggest that community members are strongly in favour of education students taking on this role of community awareness-raising in the area of environmental education, sustainability and conservation. They recognise the potential for teachers to be leaders in public education and to develop community values, beliefs and practices. The Cattana Wetlands materials will be embedded in James Cook University education courses as they align with the university's goal of education for sustainability, and they instill a sense of place in students.

Information: www.nqit.net/cattana/main.html



Cattana Wetlands are constructed from mining pits and bordered by urban development.



VINEYARD ON THE RIVER MURRAY CARES FOR ITS RAMSAR SITE AS MUCH AS ITS SHIRAZ

Banrock Station wetlands, South Australia, were rehabilitated using a wet and dry regime. Photo: Ernie Murray.

Kate Thorn, Banrock Station Conservation and Wetland Manager

Banrock Station is a former grazing property situated on the banks of the River Murray, about three hours' drive north-east of Adelaide, South Australia. It was purchased in 1995 at a time when it was suffering from significant overgrazing.

Today, the property combines conservation and ecotourism with new vineyard development, wine grape production, land preservation and environmental watering. The 1800 hectare site includes 250 hectares of vines, internationally-recognised wetlands, floodplain and protected mallee ecosystem. It also includes a wetland that for 70 years had been permanently flooded with a largely stable water level due to the adjacent Lock and Weir 3 on the River Murray.

When the region was hit with severe drought, the site managers decided to reinstate a more natural ephemeral hydrological regime and voluntarily dried the wetland and instigated an ongoing wet and dry regime to rehabilitate the area. Managing a Ramsar-listed site in a time of drought proved a major challenge, however tailoring a wet and dry cycle to the limited water available has had results.

Rehabilitation of the site commenced in the mid-'90s with partial winter draw-downs. Regenerating young red gum forest and fringing vegetation are evidence of this strategy's success. The ultimate goal was to reinstate a complete dry during summer-autumn achieved in 2007. In the context of limited water availability, the planned six-month dry turned into 18 months, resulting in stress to both young and mature red gums and the development of areas of acid sulfate soil. Finally, a seven-month watering (the first managed filling after the complete dry) was achieved from June 2008 to January 2009 through a combination of environmental water from The Living Murray program, and water purchased by Banrock Station's owners.

With a world-class eco-tourism destination built around the boardwalk and wetland experience, visitors needed some assistance to appreciate the apparent oxymoron - a dry wetland. Managers devised a new walking route

with interpretative signage where visitors are encouraged to investigate the signs of life that may not be evident from a distance: mussel shells, yabby holes, red gum seedlings and tiny floodplain flowers.

The results of the watering in 2008-2009 exceeded expectations, with 44 species of waterbird recorded, including 10 duck species. Notable sightings included freckled duck, pink-eared duck, Latham's snipe, Australian spotted and spotless crakes, royal spoonbill and sharp-tailed sandpiper. Five species of duck plus black swans bred successfully, albeit in small numbers.

In addition, an estimated 90 per cent of stressed red gums in the immediate wetland area responded to watering, with new growth first detected four months after refilling. The health of these trees continued to improve throughout the summer and was sustained well into 2009. However, there was little response in ground water or floodplain plants beyond the margins of the wetland.

After the prolonged dry, concern was held for the site's population of threatened southern bell frogs, however these returned along with four other frog species (eastern sign-bearing froglet, spotted marsh frog, eastern banjo frog and Peron's tree frog) and completed a breeding cycle before the wetland was dry again.

Perhaps the most pleasing result for a wetland in the lower Murray region was the water clarity achieved in the absence of carp. Carp were excluded at the wetland's inlet and outlet channels as part of a trial of new carp separation cages for wetlands by the South Australian Research and Development Institute. During the latter part of the refill phase, the water cleared dramatically, despite flow rates and salinity remaining fairly constant. Submerged plant growth was also impressive, with about 90 per cent cover of milfoil and ribbonweed on the wetland bed by early summer.

Reduced water allocations and lack of overbank flooding for the past 13 years are still major concerns for the Ramsar site, which includes nearly 1000 hectares of floodplain in addition to the 200 hectare main wetland. Lignum, red gum and river box communities across this area are under severe stress and many mature trees have already been lost.

However, the success of the wetland rehabilitation efforts on Banrock Station demonstrates that even after decades of degradation, it is possible to restore a wetland to a healthy, functioning system in a relatively short timeframe.

Information: www.banrockstation.com.au



Paiwalla near Mannum, South Australia. Photo: Dr Tumi Bjornsson.

RIVERINE RECOVERY PROJECT: SECURING A RESILIENT RIVER SYSTEM IN SOUTH AUSTRALIA

Dr Tumi Bjornsson and Whendee Moore, Department of Water, Land and Biodiversity Conservation

The South Australian Riverine Recovery Project is a 10-year, \$100 million project to secure a resilient River Murray system that can function during times of reduced water availability. It will be based on functional ecosystem principles with a focus on improved environmental water management, including the reinstatement of wetting and drying cycles.

The project is one of five under the South Australian Government's Murray Futures program, and receives 90 per cent of its funding through the Australian Government's *Water for the Future* initiative.

The Riverine Recovery Project is bringing together the extensive investigation, planning and research that have occurred along the river over the past three decades. New analyses will also add value to this existing knowledge to inform the management priorities for the floodplains, wetlands and backwaters between Wellington and the Victorian Border. The primary objective of the Riverine Recovery Project is to deliver a functional ecosystem.

Ecological, economic and social values will be important considerations when assessing the functional requirements of the riverine ecosystem under a range of environmental flow scenarios. These assessments will direct where Murray Futures funding is invested.

The project is being progressed with the development of several key plans. These plans cover goal setting, operations, infrastructure and monitoring and management. The goal-setting plan is developing a benchmark matrix to define an attainable healthy river system for the Riverine Recovery Project, and to monitor the ongoing health of the ecosystem. This matrix will also define at different scales (local to regional) what aquatic ecosystems are expected in the region and sub-regions and the condition indicators for these ecosystems.

The operations plan will assess methods to maintain or reinstate the ecosystems required to attain the healthy river system. Using a functional-based approach the analysis of management options for these systems will principally be based on the hydrological requirements. This will be addressed through the development of scenarios for management, based on future inflow scenarios including the impacts of climate change. The scenarios will be a starting point in understanding how to maintain or improve management to rehabilitate ecosystems (including infrastructure investments) and drive investment options.

The monitoring and management plan will use the benchmark matrix indicators as a key basis for the monitoring framework. The framework will define what needs to be monitored to effectively assess the impacts of regional management at the different scales (local to regional). This plan will also establish an adaptive management cycle.

The critical elements of the project's planning stage are currently being developed. This will lead to a 10-year investment and ongoing adaptive management plan for the River Murray between Wellington and the Victorian border.

Information: www.murrayfutures.sa.gov.au/riverine



Migratory waders, red-necked stilts, at Tasmania's Pitt Water-Orielton Lagoon. Photos: Alan Fletcher.

RESCUING TASMANIA'S PITT WATER-ORIELTON LAGOON

Stewart Blackhall, Tasmanian Department of Primary Industries, Parks Water and Environment

The importance of Tasmania's greater Derwent River estuary and its bays and saltmarshes has long been known to local birdwatchers. Members of Birds Tasmania, a state branch of Birds Australia, have been surveying there since the 1970s. It was this information and a vegetation survey by Jamie Kirkpatrick and Chris Harwood of the University of Tasmania in 1979 that contributed to the nomination of the Pitt Water-Orielton Lagoon area in 1983 as a Ramsar site.

The area is also the southern-most site for migratory waders in Australia, supporting many local bird species. There is a high diversity of plant life including several threatened species and abundant marine life including a rare sea star (*Parvulastra vivipara*), one of only three species in the world that gives birth to live young. The Pitt Water saltmarshes are the most diverse and extensive of Tasmanian saltmarshes, with high flora and fauna values, some recognised internationally while some remain unstudied.

Land use impacts and climate change are impacting these wetlands. A recent study for a Master's thesis (Vishnu Prahalad UTAS 2009) found that areas of the saltmarsh are dying from eutrophication, being eroded by higher sea level, tidal inundation and increased wave activity, and are being lost to land reclamation. While some area of saltmarsh has been gained through accretion and landward transgression, it is less than a quarter of the saltmarsh area lost. Results for vegetation change show that low marsh plants, which are more adapted to waterlogging, have replaced long-lived, high marsh plants as the dominant vegetation community of the saltmarshes.

The area has had a long history of human activity, being one of the first areas of Tasmania to be settled by Europeans. The area was cleared for agriculture and coal was mined there to support the fledgling colony of Hobart in the early 1800s. A railway was built in 1868 to carry produce that involved building causeways across the open water of the estuary and nearly cutting off the upper parts of Pitt Water and the head of an adjoining bay that later became known as Orielton Lagoon. With the decline of the rail service, the causeways were used as a base for a highway and upgrades over the years resulted in the isolation of Orielton Lagoon from the rest of the estuary. It was suggested that the waterbody could be made fresh and that trout could be released there. However, there was insufficient freshwater flow to maintain this and high evaporation caused extreme seasonal fluctuations in salinity.

The growth of the towns of Midway Point and Sorell led to increased sewage flow into the waters and severe eutrophication that culminated in an outbreak of toxic blue-green algae. Consulting engineers, who were engaged to recommend ways to alleviate these problems, suggested improving the tidal flushing of the lagoon by increasing the number and size of the culverts under the roadway. This work was done in 1995 and the water quality has improved as a result. There have been no further algal blooms and the saltmarsh that was killed by the freshwater inundation is recovering. The sewage treatment plant that was discharging into the lagoon has also been upgraded and the effluent diverted to an onshore disposal scheme.

Some threats remain however, with population growth continuing and housing developments spreading along the shoreline. In addition, the main river feeding into the estuary, the Coal, was dammed in 1987 to provide irrigation water for the river valley. The agricultural area has expanded greatly over the years with resultant nutrient and chemical run-off. The river channel is used to deliver water to the farmers and this has reversed the flow patterns in the river reducing flood flows in winter and providing a near constant flow in

summer. Consequently, nutrient and sediment flow into the estuary have been greatly modified.

To address these problems, cross-tenure management of the Ramsar wetland, surrounding saltmarsh communities and coastal environment has engaged government, community groups, landholders and industry.

Sorell Council, which services the townships of Midway Point and Sorell, is undertaking a stormwater remediation and mitigation program including designing a best-practice chain of mini-wetlands to treat the major stormwater drainage outfalls from the catchment that flows through Miena Park into the lagoon.

The South East Coastal Management Strategy Steering Committee in partnership with Natural Resource Management South has built cross-tenure collaboration to undertake priority foreshore rehabilitation activities (including weed mapping and management, revegetation, installation of fencing and pedestrian access gates and interpretation signage). Surveys of threatened species and resident and migratory shorebirds, and assessments of foreshore values and condition and Indigenous heritage have also been undertaken for the lagoon.

Community involvement has also been galvanised through the work of Conservation Volunteers Australia, Sorell Council, the Parks and Wildlife Service and local care groups under the Revive our Wetlands program at Pitt Water-Orielton Lagoon and neighbouring southern beaches. Activities include a two-year program relocating the endangered seastar to protect the population, while work was carried out to widen the causeway and replace one of the main bridges.

Stock access, land clearing and reclamation have contributed to poor water quality, severe riverbank erosion and saltmarsh degradation in the lower catchment of Pitt Water-Orielton Lagoon and associated waterways. The Coal River Products Association has a long history of engaging landholders in landcare programs and has been working in the lower catchment and on the fringes of Pitt Water-Orielton Lagoon to manage weeds, install fencing and undertake revegetation.

Land adjoining the lagoon and adjacent waterways also supports diverse local industries including oyster production, golf links, plant nursery and light industry. The local Parks and Wildlife Service has commenced industry engagement and is working with the Tasmanian Golf Club (at Pitt Water) to address environmental management and rehabilitation works.

The need for ongoing strategic planning and management across land tenures is vital for the future conservation and management of this important Ramsar wetland and coastal ecosystem, particularly in this time of major climate change.



Resident shorebirds of Tasmania's Pitt Water-Orielton Lagoon, bar-tailed godwits.



If you would like to tell your story in the next edition of *Wetlands Australia*, or have any feedback on this edition, please contact the Wetlands Section of the Department of the Environment, Water, Heritage and the Arts on 02 6274 1111 or email: wetlandsmail@environment.gov.au

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