Australian Government

Wetlands Australia

NATIONAL WETLANDS UPDATE 2008

ANNUAL UPDATE FOR AUSTRALIA'S WETLAND COMMUNITY

REHABILITATION OF SPRINGS ON SANTA TERESA ABORIGINAL LAND TRUST

Patrick Dupont, formerly Alice Springs Regional Land Management Officer, Central Land Council

The **Rehabilitation of Springs on Santa Teresa Aboriginal Land Trust** project was developed at the request of traditional owners for Santa Teresa Aboriginal Land Trust. Traditional owners and local community members worked with staff of the Land Management section of the Central Land Council (CLC) and Greening Australia to fence Hayes Springs, Salt Springs and Keringke Rock Hole in late 2006 and 2007. Open wells at Salt Springs and Marion Springs were also covered with mesh to prevent animals from becoming trapped.

A Community Water Grant provided $34 155 to fund the works, with in-kind and additional financial support provided by CLC and Greening Australia. NT Parks and Wildlife scientists assisted with water quality monitoring at Salt and Hayes springs.

Tangentyere Landcare facilitated involvement of local school students and teachers in the fencing and monitoring activities.

Hayes Springs (Mparntwenge)

Hayes Springs is three permanent water-filled rock holes in a shady gorge in the Allambaringe Range. The site includes engravings (petroglyphs) and a rock shelter with sleeping area and hearths that are still used today. Large numbers of stone flakes, grindstones and tools indicate that Mparntwenge was an important camping place for Arrernte people for many generations before the Santa Teresa Mission. Bobby Hayes remembers camping here when he was young.

Continued on page 4

Fence crew at Hayes Springs (Mparntwenge): (L to R) Justin Hayes, Richard Furber, Dion Alice, Derek Hayes, Lawrence Hayes, Patrick Dupont (CLC), Bobby Hayes, Gerard Davis (squatting). Photo: Patrick Dupont (CLC)

CONTENTS

Produced by the Australian Government Department of the Environment, Water, Heritage and the Arts.

ISSN 1446–4845

Cover photograph inset: Egret chicks in the Gwydir Wetlands, NSW. (Photo: Tara Schalk)—see page 20

Back cover photograph inset: Mussell shell found on the floodplain at Back Lake, in the Narran ecosystem. (Photo: Arthur Mostead)—see page 46

Editorial, artwork and project management: Wilton Hanford Hanover

Printed by Pirion

2008: MINISTERS' FOREWORD

Welcome to the 2008 edition of *Wetlands Australia*—an annual publication bringing together information and resources from across Australia relating to wetlands conservation, management and education.

Wetlands are a vital part of our environment and are increasingly recognised for playing a unique role in managing and conserving the flow of water through both the rural and urban environments.

In Australia, drought has had a devastating effect on some of our wetlands.

Climate change also means the droughts and floods that have always characterised Australia's climate are likely to be even more severe into the future.

With this in mind, it has never been more important that we protect our wetlands and manage them wisely.

Despite the prevailing drought, 2007 saw a number of significant achievements in the area of wetlands management. After many years of discussion and negotiation, the Paroo River Wetlands was listed as a wetland of international importance under the Ramsar Convention.

Australia now has sixty-five wetlands listed under the Ramsar Convention, covering approximately 7.5 million hectares.

This year will mark the 10th Conference of the Contracting Parties to the Ramsar Convention. The conference will be held in the Republic of Korea towards the end of 2008 and we look forward to seeing Australia's experts play a vital role in the conference.

This edition of *Wetlands Australia* comprised over thirty articles with contributions from all states and territories.

We commend the efforts of the many people working to effectively manage our wetlands across the country and hope this edition inspires you to continue with your hard work.

Senator the Hon Penny Wong
Minister for Climate Change and Water

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

Continued from page 1

'My grandfather and grandmother used to camp here before mission days. They was naked—nothing, no clothes. This fencing work here is good. Bullocks and camels have been messing up the springs. Maybe once they are all cleaned out people will be able to drink the water again. That would be good. Then traditional owners and young fellas should keep them clean.'—Bobby Hayes, fifty-six years old

Veronica Dobson also remembers camping there with her family when she was young. They used to work on nearby cattle stations and return to camp and hunt kangaroos and euros (a subspecies of the Common Wallaroo), and collect seeds for flour and wild oranges, bush bananas, bush tomatoes, bush onions and yams in the area.

At the start of our project, Mparntwenge was being visited daily by many horses, cattle and camels and the main rock hole had filled up with large volumes of dung. Water quality was poor.

We built two strong feral animal-proof fences at both ends of the gorge and cleaned out the main rock hole. After the rock hole was cleaned out, clean water began seeping in from fractures in the surrounding rocks.

After the fences were completed, heavy summer rains washed much of the rest of the dung away and refilled the rock holes with cleaner water. Monitoring before and after the rain showed that life was coming back to the springs.

The springs are home to frogs, lizards, snakes, bats and many insects and water bugs. They are important watering places for native animals including euros.

Salt Springs (Irlkertye)

Salt Springs is a chain of permanent springs located in a wide-open gorge in the Allambarinja range. This area was a traditional camping place for Arrernte people going back many generations before missionaries came and settled Santa Teresa.

Water quality varies widely from pool to pool. The saltiest water is saltier than the sea and the good water is as good as rainwater.

At Salt Springs, we built two strong fences to block off the western and eastern ends of the gorge, including up one side of the gorge where animals (mainly cattle and horses) were getting through. Heavy rain can produce huge flows of water through the gorge so we needed a strong fence.

Works involved hand digging holes for fence poles, concreting poles, building a gate, oxy-torching holes in posts, welding stays and straining up cables.

We removed a tree growing in the mission-built well and covered the well over with mesh to stop animals from falling in and getting stuck.

While camping we saw many lizards, snakes and spiders that live at Salt Springs.

Keringke Rock Hole—fence and gate

Keringke Rock Hole is a culturally important non-permanent rock hole just outside the Aboriginal Land Trust on Allambi Station. It is registered as a sacred site with the Aboriginal Areas Protection Authority. The area has many rock carvings (petroglyphs) in a number of styles and a large

Waterhole cleaning at Hayes Springs (Mparntwenge): (L to R) unknown, Derek Hayes, Tristan Hayes, Bobby Hayes, Gerard Davis, Lawrence Hayes, Adrian Hayes, Dion Alice. Photo: Patrick Dupont (CLC)

camping area with stone tool scatters and grindstones. The rock hole is in a narrow rocky gorge and custodians were concerned that it was under threat from cattle and horses.

Because the fence site was a rocky 500-metre scramble from our campsite, we were unable to carry the big generator that powered the welder to the site. This meant all welding had to be done at the campsite, so the location was carefully measured and the gate built at the campsite. After completion it was carried the 500 metres for installation—and it fitted perfectly! No welder at the fence site meant that tensioned cables were used to strain the eighteen-metre fence in place of welded stays. The gate was placed slightly up the side of the gorge to avoid high water flows in the main channel of the gorge.

Keringke Rock Hole—cleaning it out

When we arrived at Keringke to build the fence we discovered that the rock hole was completely dry. Custodian Bobby Hayes said this was a good time to clean it out, so young men removed built-up dirt (and centipedes!) from the rock hole with buckets and shovels in a couple of hours.

When the rock hole fills with the next rains the water will be much cleaner—hopefully good enough to drink.

Marion Springs—covering the well

Marion Springs is a traditional soakage next to a rock face in a wide river valley. The site has ochre paintings. When missionaries settled Santa Teresa they ran cattle in the area and dug a well to get water. The well has little water in it now and, at more than two metres deep, is a danger to animals, who can fall in and get stuck and eventually pollute the water.

We covered the open well with mesh supported by lengths of pipe and bolted down with dyna-bolts. We cut a hole in the cover large enough to allow birds and small mammals continued access to water when it is available, but small enough to exclude larger animals like kangaroos and euros.

Waterhole monitoring—Hayes and Salt springs

Waterhole monitoring was carried out at Hayes and Salt springs both before and after fences were built to keep out feral animals. The collection of basic data by traditional owners was supervised by Greening Australia, and detailed measurements, including night sampling, were taken with NT Parks and Wildlife scientists.

Santa Teresa secondary school students were involved in the monitoring, facilitated by Tangentyere Landcare, and a separate report was produced by Tangentyere detailing this work.

Strainer post at Hayes Springs (Mparntwenge): (clockwise) Peter Barker (Greening Australia) (front), Justin Hayes, Derek Hayes, Richard Furber, Gerard Davis, Bobby Hayes, Lawrence Hayes. Photo: Patrick Dupont (CLC)

Scientists and traditional owners looked at:

- width and depth of waterholes
- bacteria levels
- temperature, salinity and dissolved oxygen
- which plants were there and how many
- how much trampling by feral animals had occurred
- which water bugs were living in the water.

They also took photographs of the springs.

Preliminary monitoring results indicate that the springs most heavily used by feral animals contained fewer kinds of aquatic animals, possibly because of poor water quality from trampling and animal dung. This suggests that fencing to keep out feral animals will have a positive effect on water quality at these sites.

What next?

- Continue water quality and vegetation monitoring with Greening Australia and NT Parks and Wildlife
- Check fences after rain events and remove debris to prevent damage
- Check for any weed outbreaks now that camels, horses and cattle are excluded from fenced areas
- CLC will assist traditional owners with fence repairs and any weed control as required.

For more information, please contact the Central Land Council at email: media@clc.org.au or on tel: (08) 8951 6211.

FIGHTING TOXIC SOILS AND NOXIOUS FISH IN TASMANIA'S WETLANDS

Coping with coastal acid sulfate soils

Imogen Birley, Australian Government NRM Water Facilitator for Tasmania

Coastal acid sulfate soils (CASS) are an emerging issue in Tasmania, and efforts are now under way to improve knowledge and management of the problem. This will also assist with better management and protection of Tasmania's many diverse and significant wetlands, as acid sulfate soils and wetlands often coincide in the same coastal lowland areas. The traditional agricultural practice of draining wetlands, bogs and swamps in such areas often exposes previously water-logged soils rich in iron sulfides to the surface, where oxygen in the air reacts with the iron in the soil to produce sulfuric acid. This acid can spread through soils, surface water and groundwater, damaging habitat and, in severe cases, causing fish kills. All these impacts spell bad news for wetlands.

Two initiatives in Tasmania are working to raise understanding of the problem of CASS and provide tools to help land managers to identify potential risk areas. A project funded by the Australian Government and the Tasmanian Government is developing a set of Tasmania-specific guidelines for the management of CASS. The project will also identify the further information needs of land managers from sectors such as local government, aquaculture, agriculture, forestry and public lands, and recommend the best methods for providing information resources. It is hoped that further funding in 2008 will enable some of the identified information needs to be met.

Meanwhile, a series of forums combined with field visits held in early 2007 has provided Tasmanian land managers with practical advice and exposure to local examples of CASS around the state. The forums, jointly organised by federal, state and local government staff along with CASS experts from CSIRO, explained the impacts CASS can have on the environment and looked at interstate examples of how CASS has been tackled through research, policy and site remediation. One of the field trips as part of the forums was to the Tamar Island Wetlands Conservation Area, a wetland of national significance, where a large acid sulfate scald due to the disturbance of acidification of the soil was clearly visible (see photo).

The workshops were an overwhelming success, providing valuable insight to Tasmanian managers about the importance of proactively managing coastal acid sulfate soils.

For more information on CASS projects in Tasmania, contact Nicole Middleton, Australian Government NRM Coastal and Marine Facilitator for Tasmania at email: nicole.middleton@nht.tas.gov.au or on tel: (03) 6233 3849.

Tamar wetland, clearly showing the loss of vegetation due to a large acid scald. Photo: Nicole Middleton

Working to eradicate *Gambusia holbrooki*

The Tamar wetlands were also the focus of a concerted effort in 2007 to eradicate the noxious pest fish species *Gambusia holbrooki*. Originally introduced to Australia on the erroneous belief that the species eats mosquito larvae, *Gambusia* is now present through most of the Australian mainland and is an aggressive predator. They are known to attack, kill and eat small native fish, water bugs, frog eggs and tadpoles and they compete with native fish for food. Where present, *Gambusia* has had a significant impact on the aquatic biodiversity of wetlands and waterways.

Fortunately for Tasmania, the pest fish has so far become established in only a very small number of relatively isolated locations, and there is a very real prospect of eradicating it. To this end, regional body NRM North and Tamar NRM, with Australian Government funding, have undertaken considerable work at the Tamar wetlands and in several local dams where *Gambusia* has been found. This has resulted in successful eradication of *Gambusia* from the dam locations, and, in the Tamar Island Wetlands Conservation Area, both a significant reduction in their numbers and a restriction of their population to three sites. Plans are under way to construct screens along levee banks to effectively isolate the remaining *Gambusia* in the wetland, and regular netting and trialling of new techniques to trap the fish are being carried out.

There has also been a tremendous amount of work done to raise public awareness about *Gambusia* in order to help prevent any further introductions or an increase in the number of infected sites. If *Gambusia* can be eradicated from Tasmania, the aquatic health and biodiversity of the state's wetlands will be saved from a significant threat.

For more information on the Tamar *Gambusia* control and eradication project, contact Imogen Birley, Australian Government NRM Water Facilitator for Tasmania at email: imogen.birley@nht.tas.gov.au or on tel: (03) 6233 3401.

SPHAGNUM BOGS IN THE AUSTRALIAN ALPS: RECOVERY AND REHABILITATION FOLLOWING THE 2003 FIRES

Amanda Carey, Ranger, West District, Parks Conservation and Lands, ACT

Trish Macdonald, Research and Monitoring, Parks Conservation and Lands, ACT

Sphagnum cristatum bogs are found in the higher altitudes (300 to 1500 metres) of the Australian Alps and Tasmania. They form a highly specialised habitat that makes up only a small fraction of the landscape of south-eastern Australia. Namadgi National Park in the Australian Capital Territory supports substantial areas of *Sphagnum* bog that, until 2003, were in almost pristine condition and among the finest examples of this community in the Australian Alps, including the Ginini Wetlands Ramsar site. Elsewhere in the Alps, *Sphagnum* bogs have been significantly impacted by past cattle grazing and the increased fire frequency of the nineteenth century.

Sphagnum bogs form in areas not normally subject to drought, with relatively high rainfall and low evaporation. In alpine and subalpine areas where plant growth only occurs for a short period, bog and peat development is very slow. In simple functional terms, a *Sphagnum* bog can be likened to a filtering sponge. It intercepts and stores water, releasing it slowly into waterways as well as removing sediments and nutrients. Maintaining their integrity is vital to the ACT's water supply.

The Namadgi bogs also support a diverse assemblage of flora and fauna restricted to this type of wetland, some of which are endangered species such as the Northern Corroboree Frog (*Pseudophryne pengilleyi*). The bogs are important in maintaining the genetic and ecological diversity of a number of endemic and restricted species found in subalpine wet heaths and bogs.

Impacts of the January 2003 fires

In January 2003, an electrical storm caused several hundred lightning strikes and fires throughout the Australian Alps. More than two million hectares were burnt and seventy per cent of the entire ACT was burnt.

Almost all *Sphagnum* bogs in the ACT were affected by the fires. Post-fire assessment revealed that between fifty-five per cent and one hundred per cent of the areas of individual bogs were severely burnt. The fires' impact on the bogs varied, reflecting differences in fire severity. Most bogs retained some intact areas or living hummocks of shrub bog, while elsewhere vegetation was reduced to ash or charred remnants. Peat soils did not burn except in isolated patches, so the fibrous root mat mostly survived.

Implications for the ecology and hydrology of *Sphagnum* bog communities

Areas of bogs that were not severely affected were expected to slowly recover. Severely affected areas, where the loss of all vegetation cover exposed the underlying peat to drying, were likely to experience further deterioration. Peat, once dry, cannot be rehydrated, and subsequent erosion of the dry, friable peat can lead to the collapse of the entire bog. Without intervention, any surviving patches of *Sphagnum* would die through lack of water and exposure to ultraviolet light. Increased run-off during rain events would likely result in stream incision, stream bank collapse and channelling of groundwater flows. The end result would be loss of the bogs as a water storage and filtration mechanism.

Cotter Source bog in Namadgi National Park after the 2003 fires. Rehabilitation has prevented stream entrenchment and bog collapse. Photo: A. Carey

Living *Sphagnum* protected from ultraviolet exposure and wind desiccation with 70/30 shade cloth. Photo: A. Carey

In view of these implications, a management program, funded by the Australian Government and the ACT Government, commenced in October 2003 to enhance the ecological and hydrological processes of the bogs and assist these important and highly specialised communities to return to their pre-fire state.

Post-fire bog restoration is taking place across the Australian Alps, and this project has been one of cross-border cooperation from its inception. In 2004 and 2005, the Australian Alps Cooperative Management Program held forums for those involved directly in bog restoration and research from the ACT, New South Wales and Victoria. Cross-jurisdictional liaison and cooperation has continued.

Aims of the Namadgi *Sphagnum* bog project

The overall aim of the project is to re-establish functionality to the ACT's damaged *Sphagnum* bogs by slowing and spreading water run-off to allow recharging of water in subsurface peat and prevent stream incision of bogs.

A subsidiary aim was to take advantage of the opportunity the project provided to inform and educate the community about the values and significance of *Sphagnum* bogs.

Rehabilitation techniques

Retaining, pooling and spreading water within the bog systems

Using weed-free straw bales, prefabricated erosion control coir logs and locally sourced materials such as logs, rocks and divots of *Empodisma*:

- dams were constructed across drainage lines to retain and spread water
- existing pools were reinforced and new ones created
- water was diverted onto areas of burnt *Sphagnum*.

Preventing stream incision by dispersing water across the bogs

- On incising streams, erosion points were blocked from above at intervals determined by the natural fall of the bog. The barriers help to slow and disperse channel flow.
- Below nick points, the watertable was raised and the hydraulic gradient causing stream wall slumping was reduced. This was achieved by placing a wall of straw bales with a downstream dissipative slope to create a pond and spread water.
- Subterranean holes and drains were blocked where possible to prevent rapid flow and loss of groundwater through the bog.

Enhancing *Sphagnum* moss recovery

- *Sphagnum* has been found to grow more quickly under shade, which protects it from ultraviolet exposure and dehydration. Lack of shade enables other plants to outcompete the moss. Key *Sphagnum* areas were covered with 70/30 shade cloth, extended at least 1.5 metres beyond the surviving margin to protect them from solar radiation.
- Transplants of *Sphagnum* were placed in suitable moist, shaded locations at the edges of hummocks.
- Fertiliser (slow release and low in phosphorus) was used experimentally to assess whether it would assist in promoting moss growth.

Minimising further peat loss

- Water was diverted into areas of burnt peat and revegetated with transplants of *Carex*, *Empodisma* and *Poa* to help minimise loss of peat soil in areas where rehabilitation with *Sphagnum* was not possible.

Results

All bogs are slowly regenerating and no major bogs have lost their hydrological function.

Despite the ongoing drought, there is evidence of good recovery in the bogs where there has been restoration.

- In all rehabilitation sites, stream incision has been halted, flow is much slower and there is more ponding of water.
- Drainage lines that previously contained *Sphagnum* hummocks and have had remediation works are starting to be covered by vegetation, with an increase in the area of living *Sphagnum* as well as new moss appearing.
- *Sphagnum* transplants have been successful.
- Shaded moss has survived and expanded.
- At all sites shrubs are resprouting and new seedlings are appearing.

On-ground works and monitoring have continued for the past five years. Maintenance and long-term monitoring will need to continue for up to ten more years.

For further information, contact Trish Macdonald, Research and Monitoring, Parks Conservation and Lands at email: Trish.Macdonald@act.gov.au.

Acknowledgments

This article draws heavily from the work of park ranger Amanda Carey, who was the officer in charge of this project until her death. The success of this work is directly attributable to her enthusiasm, leadership and persistence. The survival of these bogs is a testament to the love Amanda had for the Australian mountains.

Acknowledgment is made of the advice and support of alpine ecologist Roger Good, Professor Geoff Hope of the Australian National University, and Dr Jenny Whinam of the Tasmanian Department of Primary Industries, and of the contribution made by staff of Parks Conservation and Lands and the volunteers who embraced the project so enthusiastically and carried out the restoration work.

LOSING EDEN: THE DECLINE OF THE MACQUARIE MARSHES 1996–2007

NSW Ramsar Managers' Network

A confronting visual documentary of the decline of one of Australia's most significant wetlands opened in Sydney in October 2007 before preparing to travel around rural New South Wales.

'Losing Eden—The Decline of the Macquarie Marshes 1996–2007' is a graphic depiction of the devastating impact of a decade of drought and up to fifty years of reduced flows—largely a result of human activity—on the iconic Macquarie Marshes.

Renowned Australian landscape photographer Grenville Turner's images capture the heart and soul of this distinctive landscape over a decade of unprecedented decline of what was once a pristine environment.

The exhibition has been organised by the NSW Ramsar Managers' Network (RMN)—a group of private and government wetland managers who support private landholders managing wetlands in New South Wales that have been listed under the Ramsar Convention. The RMN was established to address increasing concerns from private managers of Ramsar-listed wetlands that the importance of these wetlands was not being adequately recognised by government or community, particularly with regard to access to flows for the benefit of the environment.

Former Network Chair, Eric Fisher, believes the exhibition is a unique opportunity to highlight the plight, and value, of this and other NSW wetlands:

The Macquarie Marshes are semi-arid wetlands where agriculture and the environment have been managed for nearly 150 years, to the extent that the major number of colonies of nesting waterbirds are still on private land.

The stark contrast between the images of the wetlands in full flood, teeming with plant and animal life, and those depicting the desolate expanse that is the wetland today, provides an unforgettable graphic depiction of the plight of this iconic inland wetland that so many have never seen.

The Macquarie Marshes first formed around 6000 to 8000 years ago when the waterway now known as the Macquarie River began to undergo a slow but fundamental change about 250 kilometres north-west of present-day Dubbo. Where it reached a vast, semi-arid lowland plain, the strong, sand-banked river gradually began to break down into hundreds of tiny channels, forming a vast swampland.

The Marshes include extensive areas of reed swamp, River Red Gum woodlands and Water Couch grasslands and are habitat for many species of waterbirds and other wildlife.

Grenville Turner has worked behind the camera for more than thirty years and is regarded as one of Australia's leading landscape and documentary photographers and imaging specialists. His work has been exhibited throughout Australia, Europe and the United States.

The natural world has been a constant source of inspiration for me as a photographer. Wetlands are a particularly important type of habitat—not just for their natural beauty but because they are essential to many different species of birds for breeding. Water is our most precious resource—without water there can be no wetlands, which in turn leads to local extinctions of wildlife. I believe we have a duty of care, a responsibility to maintain a healthy natural world. True wilderness is increasingly difficult to find. Continued degradation of the environment is my main concern as a photographer.

The exhibition is available to tour to appropriate educational sites.

For more information, please contact the NSW Ramsar Managers' Network chair, Mike Schultz, on mobile: 0427 535 914 or at email: trust@fivebough.org.au, or Grenville Turner on mobile: 0407 207 228.

PICK SWAMP: PASTURE TO MARSH—JUST ADD WATER

Steve Clarke, Wetland Restoration Ecologist, SA Department for Environment and Heritage

Two thousand Whiskered Terns fly relentlessly two metres above the still open water of Pick Swamp, harvesting a bountiful supply of insects on the wing and occasionally diving into the fresh water for other tasty morsels. Below the terns lie 1.5 square kilometres of open water supporting rafts of newly emergent aquatic plants—every single one of them indigenous to this restored swamp. Ducks nestle on the plants, taking a rest after a day's feasting and only rising to the air when the occasional Swamp Harrier flies overhead. The ducks at the moment vastly outnumber the Black Swans, Grebes, Eurasian Coots, Great Cormorants, Black-winged Stilts, Sharp-tailed Sandpipers, Ibis, Egrets, Herons and the odd Brolga and Magpie Goose. The scene is idyllic as another day ends at the swamp. The backdrop of coastal dunes to the south and primeval Silky Tea-tree swamp to the north frames the sedge-bordered water, with only the plaintive calls of the swans as dusk settles.

Pick Swamp is a restoration success story. Located thirty kilometres south-east of Mount Gambier, South Australia, the property was purchased by the South Australian Government in 2005. The aim was not only to restore the property but also to buffer the neighbouring Piccaninnie Ponds Conservation Park and thereby join up what had become two fragmented bits of the original twelve square kilometres of wetland. Over the past fifty years, the 230-hectare grazing property was drained, denuded of 180 hectares of its original vegetation and planted with exotic pasture grasses. The grazing stretched even to the thirty hectares of coastal dunes on its southern edge. But Pick Swamp, though reduced in its original beauty, biodiversity and complexity, still harboured a rare gem: thirty hectares of pristine primeval Silky Tea-tree forest.

Crescent Pond. Photo: Steve Clarke

At the centre of this forest is Crescent Pond, a karst-rising spring that will express enough water through the year to maintain the sixty hectares of open water on Pick Swamp as well as the many associated sedge and bog areas. The Silky Tea-tree (*Leptospermum lanigerum*) owes its very existence to the spring. It was here a thousand years ago, growing on

Pick swamp. Photo: Steve Clarke

the deep peat watered by the spring. The forest remains here today only because the quantities of water flowing from the ground made it impossible for farmers to clear the tea-tree.

The springs that rise into Pick Swamp and the rest of the Piccaninnie wetland system flow from deep ancient limestone seabeds. The water is collected over thousands of square kilometres and wells up from ponds, some as deep as ninety metres, to flow into shallow swamps and peat fens. This water, for the past fifty years, has been directed by efficient drains to flow from Pick Swamp to the sea. But since May 2007, much of this water has been allowed to lie where the first surveyors recorded it in 1896. This has been achieved by blocking drains and building levees to retain water at optimum depths.

The results of this inundation have been spectacular. Even though the water depth rarely exceeds forty centimetres (and much of it is only ten to twenty centimetres in depth), the waterfowl have literally 'flocked' to Pick Swamp, and local experts were predicting an influx of migratory species such as Common Greenshank, Marsh Sandpiper and Latham's Snipe in November and December 2007. Occasionally the water depth reaches 1.2 metres and this favours the diving birds such as the Great Cormorants and Grebes.

Other results of the restoration have been the amazing return of the aquatic vegetation. Plants such as Common Spike Rush (*Eleocharis acuta*), Swamp Crassula (*Crassula helmsii*) and River Buttercup (*Ranunculus inundatus*) occupy the shallower reaches while Water-ribbons (*Triglochin procerum*), Milfoil (*Myriophyllum sp.*) and Pondweed (*Potamogeton sp.*) are found in the deeper water. Many of these species have been absent for as much as forty years but have almost miraculously reappeared since the water permanently returned. These plants are adding to the Piccaninnie system's impressive list of species—a list that contains nearly fifty state and national threatened flora and fauna species. It is hoped that the recognition of the area as an internationally significant wetland under the Ramsar Convention will soon become a reality.

The water teems with aquatic life. The frog calls at times reach such a crescendo as to make normal conversation difficult. All those amorous calls have resulted in a tadpole boom, and the water bug life seems to be in direct competition. Although the fish population is yet to be quantified, a number of species have been recorded in Pick Swamp: Southern Pygmy Perch (*Nannoperca australis*), Common Galaxia (*Galaxias maculata*), Dwarf Galaxia (*Galaxiella pusilla*) and Yarra Pygmy Perch (*Nannoperca obscura*). These species have also been recorded in Piccaninnie Ponds, which hosts a number of other species as well: Congolli (*Pseudaphritis urvillei*), Short-finned Eel (*Anguilla australis*), Small-mouthed Hardyhead (*Atherinosoma microstoma*), Pouched Lamprey (*Geotris australis*) and Spotted Galaxia (*Galaxias truttaceus*).

The rehabilitation works still have a long way to go to breathe complete life back into the swamp. Weed control, direct seeding and cell stock planting will help realise long-term replacement of original habitat, and the removal of ten kilometres of fence line and other farm infrastructure has had an immediate visual impact. And some days, if you turn your head to one side, and squint a little, you can see the ancient wetland system again. It's only a matter of time.

For more information, contact Steve Clarke at email: Clarke.Steve@saugov.sa.gov.au.

Waterfowl now literally flock to Pick Swamp. Photo: Steve Clarke

Friends group on planting day. Photo: L. Green

PAROO RIVER WETLANDS RECEIVES RAMSAR LISTING

Alison Curtin, Water Policy, NSW Department of Environment and Climate Change

In September 2007, after nearly ten years of discussion and negotiation, the Paroo River Wetlands was listed as a wetland of international importance under the Ramsar Convention.

The Paroo River Wetlands are located in far north-west New South Wales. The area listed includes the Nocoleche Nature Reserve and a portion of Paroo-Darling National Park (see map). Both areas are managed by the NSW Department of Environment and Climate Change.

The Paroo River is the last remaining free-flowing (unaltered) river in the Murray-Darling Basin in Australia. The climate in the Paroo catchment ranges from arid to semi-arid and the river has one of the most variable flow regimes of any river in the world.

The Paroo River Wetlands meets six of the nine criteria for Ramsar listing. Wetland types within the Ramsar site include large overflow lakes, floodplains, claypans, tree-lined creeks and waterholes, lignum and cane grass swamps, and artesian mound springs (Kingsford & Porter 1999). It is one of the most important wetland systems for waterbirds in eastern Australia (Kingsford & Porter 1999) and supports a number of threatened plant and animal species as well as significant native fish communities. The artesian mound springs at Peery Lake are the largest active complex in New South Wales and among the rarest landforms in Australia.

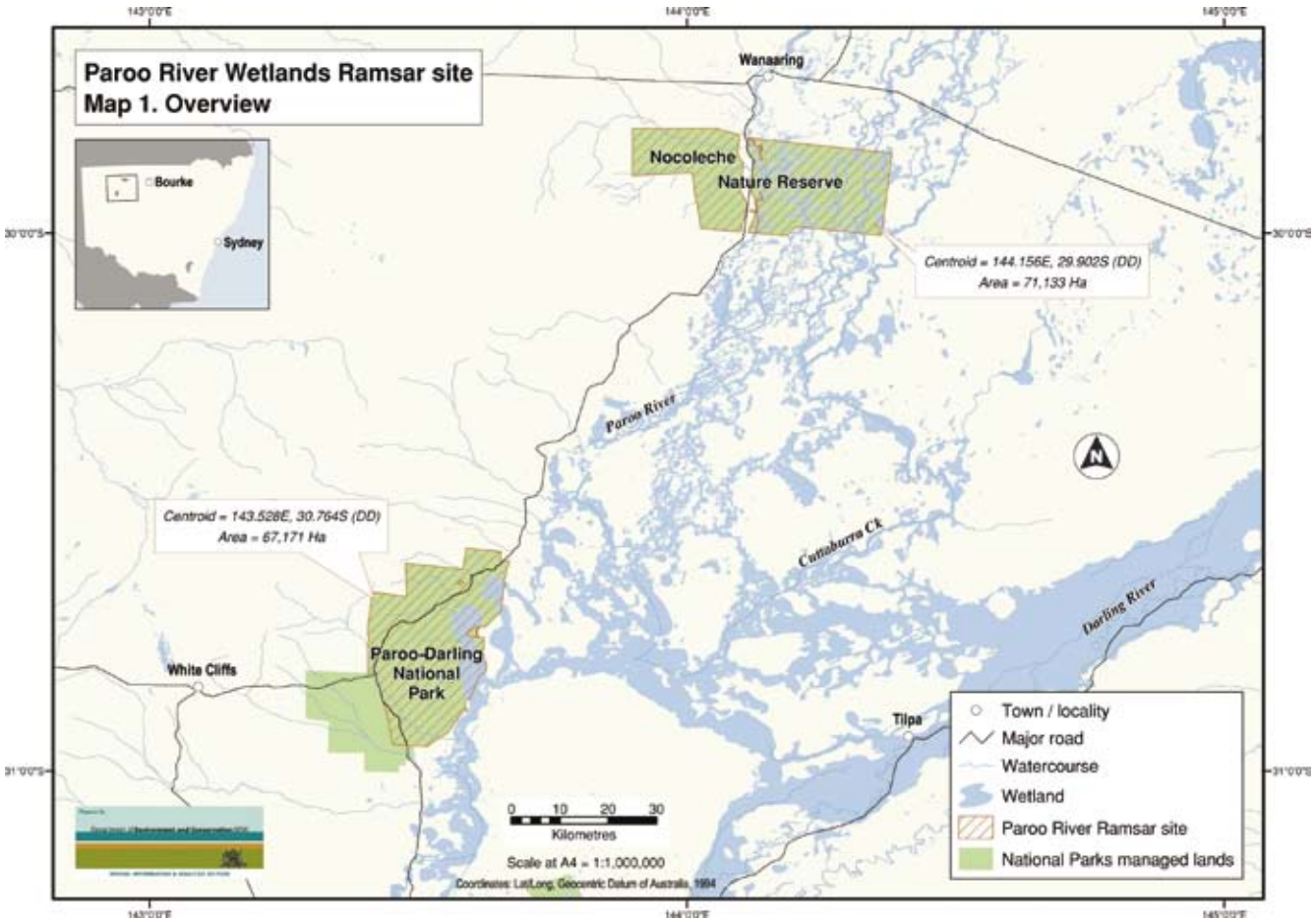
The Paroo River Wetlands have natural, cultural and spiritual significance to the traditional owners of the Paroo River country, the Baakandji and Budjiti people.

Aboriginal people living on the Paroo traditionally moved up and down the river and between rivers, with the seasons, for ceremonies and seeking resources. Following European settlement on the Paroo, many Aboriginal people were displaced into more permanent camps and towns, some were moved by the government to other parts of Australia and others were fortunate enough to find work on properties on the Paroo, which allowed them some continued access to their country.

Consultation with Aboriginal communities about the proposed Paroo River Wetlands Ramsar site began in 2001.

The traditional owners are concerned about the health of the river and recognise that action is needed to help protect it for the future. In 2004, a joint meeting was held at Nocoleche Nature Reserve that was attended by about fifty Baakandji and Budjiti people. Participants came to the consensus that if Ramsar listing would help to protect the river, then it should be pursued.

A cultural mapping study to report on the Aboriginal values of the Paroo River was undertaken as part of the Ramsar nomination. Two community members were trained in oral



history collection and a community booklet and video were produced. The values identified in the project included:

- *traditional*—stories, beliefs, living and cultural practice (e.g. ceremonies, births and burials)
- *historical*—employment, conflict, refuge and survival
- *identity*—meeting, teaching, management, recreation and relationships.

Representatives from the Baakandji and Budjiti people were nominated to take part in a Paroo River Wetlands steering group so that they could be consulted and involved in the Ramsar nomination. Three of them attended the ninth meeting of the Contracting Parties to the Ramsar Convention in 2005 to explain the Aboriginal values for wetlands and inform discussion about the importance of recognising Indigenous values of wetlands.

The Paroo River Wetlands Ramsar nomination was also supported by reserve neighbours, the Western Catchment Management Authority and the Paroo River Association.

The signing of the Paroo River Agreement by New South Wales and Queensland in July 2003 was a significant milestone for protecting the Paroo River and its wetlands. Ramsar listing will ensure protection under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* for this important system.

The NSW Department of Environment and Climate Change, which includes the NSW National Parks and Wildlife Service, will continue to manage the Ramsar site as a nature reserve and national park in partnership with the Baakandji and Budjiti people.

For further information, contact Alison Curtin at email: Alison.Curtin@environment.nsw.gov.au or on tel: (02) 9995 6062.

Reference

Kingsford and Porter 1999, Wetlands and waterbirds of the Paroo and Warrego rivers, In *A free-flowing river: the ecology of the Paroo River*, R.T. Kingsford (ed.), NSW National Parks and Wildlife Service.

'NUTRIENTS, CATCHMENTS AND REEFS— A GUIDE TO NUTRIENTS IN YOUR LANDSCAPE'

Concerns for declining water quality in Great Barrier Reef (GBR) catchments and near-shore habitats has prompted the Catchment to Reef Program (Rainforest CRC and CRC Reef) to produce a colourful booklet describing the role of nutrients in the tropical landscape.

The 16-page A4 booklet *Nutrients, catchments and reefs* has been produced by a team of scientists and science communicators. Designed for landholders, land managers and senior students, the booklet uses plain language and engaging graphics to introduce the role and behaviour of nutrients in the tropical environment.

Key nutrient cycles are explained in terms of the latest scientific understanding of the effects of increased nutrients in GBR catchments—and what is being done about it in the Natural Resource Management Regions.

This Catchment to Reef publication has been supported by DEWHA, CSIRO WFHC Flagship, NAP, BDTNRM and Terrain NRM Ltd. Released in February 2007, the free booklet is being distributed through these organisations.

A PDF copy of the booklet can be downloaded at: www.catchmenttoreef.com.au.

Character-driven storytelling takes the reader on a journey through the wet and dry catchments that feed into the Great Barrier Reef lagoon. The booklet illustrates the nutrient processes at work in our waterways and the impacts human activities have on the environment and downstream communities.

THE WETLANDS, BIODIVERSITY AND SALT PROJECT

Project Team: Michael Smith (project leader), Keely Ough, Michele Kohout, Changhao Jin, Ruth Lennie, Belinda Cant, and Derek Turnbull

Wetlands, Biodiversity and Salt Project, Arthur Rylah Institute for Environmental Research, Victorian Department of Sustainability and Environment

Non-riverine wetlands are predominantly filled by groundwater and/or rainwater. They are often a major—at times, the only—source of surface water in many Australian landscapes and have important economic, social and cultural values. Importantly, non-riverine wetlands are also 'hotspots' for biodiversity. They are becoming increasingly endangered with the pressures of urbanisation and agriculture, and yet the processes that degrade—or, alternatively, maintain—their condition are still poorly understood.

A natural and relatively unaltered wetland with high levels of biodiversity. Photo: Michael Smith

Secondary salinisation, or human-induced changes to salinity regimes, is a major threat to non-riverine wetlands. In Victoria, as in other parts of Australia, secondary salinisation is increasingly affecting vast areas of land and water. Non-riverine wetlands, which are typically low points in the landscape, are often first to reflect such broader landscape processes. Since European settlement, more than forty per cent of temporary wetland area has been lost in Victoria. Understanding how this threat will affect the remaining wetlands and their biodiversity will help us to manage these ecosystems.

A highly modified and secondary salinised wetland with low levels of biodiversity. Photo: Michael Smith

The Wetlands, Biodiversity and Salt Project Team has been studying the effects of secondary salinisation on non-riverine wetlands and their biodiversity, resulting in a significant new knowledge base that will directly influence the management and conservation of these important ecosystems. We have created predictive models to help conceptualise the relationship between biodiversity and salinity.

We studied a wide range of wetland taxa—including microscopic zooplankton, larger aquatic plants (macrophytes), riparian vegetation, frogs and birds—to better understand the impacts of secondary salinisation of non-riverine wetland biodiversity and to identify salinity thresholds and possible indicator species.

Brown Tree Frog (*Litoria ewingii*), a common inhabitant of Victoria's wetlands. Photo: Michael Smith

Villarsia reniformis. Photo: Michele Kohout

We have made some important determinations regarding the spatial aspect of salinisation of non-riverine wetlands, including the finding that these ecosystems should be viewed and managed as part of a broader landscape. The interconnectedness of wetland systems should also be considered, as well as the varying ability of our biodiversity to move around the landscape. For example, many wetland bird species can readily move from one wetland to another, whereas species like amphibians and crustaceans may be more limited in their dispersal opportunities. Additionally, many aquatic plants and invertebrates depend upon egg and seed banks to persist in wetlands and may rely upon more passive means of moving around the landscape.

The Project Team has successfully enlisted considerable community and agency interest, input and support. Community perceptions of wetland management are critical because the majority of non-riverine wetlands are on private property. Bearing this in mind, we also investigated some of the social aspects of the secondary salinisation of non-riverine wetlands, since combining social and natural sciences will optimise wetland stewardship.

In addition to disseminating our findings to wetland owners and Natural Resource Managers, we are currently publishing our results in leading scientific journals. We have also produced a CD with many of the project outputs which can be obtained by contacting Michael Smith (Michael.smith@dse.vic.gov.au). Wetlands, Biodiversity and Salt Project, Arthur Rylah Institute for Environmental Research, Department of Sustainability and Environment, 123 Brown Street, Heidelberg, Victoria 3084.

QUEENSLAND WETLANDS PROGRAMME

Angela Reed, Communications Manager, Queensland Wetlands Programme

What a dynamic team!

The Queensland Wetlands Programme is an example of a successful partnership producing outstanding results. The $23 million program is a joint initiative of the Australian Government and the Queensland Government to deliver resources and decision-making tools to help people protect and conserve wetlands.

The program was established in 2003 in response to concerns about the decline of wetlands in Queensland, particularly in the Great Barrier Reef catchment. The state's wetlands are renowned for their beauty and environmental importance, and are valued for the role they play in supporting industry and agriculture. They are also critical in maintaining the health of the Great Barrier Reef by filtering sediment and nutrients that would otherwise flow into the reef lagoon and by providing habitat for fish and other species.

The program's objective is to support projects and activities that result in long-term benefits to the sustainable use, management, conservation and protection of these wetlands. The program has carefully identified knowledge gaps in wetland management and is developing tools and information to assist in these areas. For example, there will be guidelines and information support tools for issues such as using buffer areas, selecting assessment methods, and identifying and understanding wetlands boundaries. There will also be tools for guidance on monitoring and rehabilitating wetlands, and on sound land use and development near wetlands. The program will develop and implement new planning and new assessment arrangements to protect wetlands and provide tools to access the range of existing wetland-related legislation and policy provisions. Funding through the Queensland Wetlands Programme will allow delivery of these products.

Pilot program

The pilot was a $2.2 million on-ground wetland management project involving landholders at twenty-two sites in the Great Barrier Reef catchment. Funded by the Australian Government through the Queensland Great Barrier Reef Coastal Wetlands Programme, the pilot program examined weed control, revegetation, fuel load control, strategic grazing techniques, and the reinstatement of hydrology through flow regime management. It also developed more sensitive planning provisions with local government and industry to better define wetland areas and their values, threats and management needs, and to increase community awareness.

Information about this project is available through the Queensland Wetlands Programme.

One of the keys to the program's success has been its collaboration with the government and the community. In north Queensland, the program is funding work with farmers to improve the quality of water entering the reef lagoon. Cairns-based Terrain Natural Resource Management is developing a management plan template for local governments to use for managing wetlands in coastal reserves. Government and non-government agencies have also contributed to the mapping and classification of wetlands in the Great Barrier Reef catchment, south-east Queensland and Cape York.

A pilot project under way at Proserpine Goorganga Plains, north Queensland. Photo: C. Peterson

Queensland Government staff examine crustaceans and shells in an ephemeral wetland near Longreach. Photo: Queensland Environmental Protection Agency

The development of Wetland*Info*, a website containing a comprehensive collection of wetland management resources and information, involved consultation with more than 300 stakeholders across Queensland.

Wetland*Info*

Wetland*Info* is a comprehensive, easy-to-use information website for anyone interested in managing, protecting, conserving, learning about or studying wetlands in Queensland.

Historically, wetland information and resource materials have been scattered among agencies and other organisations across Queensland, which has made it difficult to access useful information for wetland management decision making. Recognising that this was a major impediment to effective management and protection of wetlands, the Queensland Wetlands Programme began developing a new information system and related website, Wetland*Info*—a 'one-stop shop' for wetland information and resources in Queensland.

Key sections in Wetland*Info* include:

- an explanation of what wetlands are, including their value and the important role they play in Queensland's natural environment
- maps that show where wetlands are, and inventories of their physical, chemical and biological attributes
- a range of materials and tools to support wetlands assessment, management, rehabilitation and monitoring
- the most current wetlands science and research in a range of formats to support managers and researchers in making decisions
- educational tools for students, teachers, volunteers and landholders created by people with experience in sustainable wetland management
- tools to help decision makers access and make sense of legislation that covers development and land use in and around wetlands.

Find Wetland*Info* at www.epa.qld.gov.au.

Working with the Great Barrier Reef Marine Park Authority, the program has produced a range of products. These include comprehensive wetlands school curriculum units; the *Exploring Wetlands* virtual learning tool; a vibrant wetlands exhibit at the Townsville-based headquarters of the Great Barrier Reef Marine Park Authority and its ReefHQ Aquarium; an interactive learning software tool, *Wetlands Interactive Online*; eleven wetlands interactive kiosks across Queensland; and the wetlands *ReefBeat* poster and activity book series.

The program currently supports more than thirty projects, a number of which are due to finish in June 2008. The dedicated management of wetlands today, enabled by the comprehensive suite of tools, resources and information products delivered by the program, will help secure our natural resources and safeguard our environment for future generations.

Wetlands curriculum

The Queensland Wetlands Programme has developed a curriculum with Townsville Central State School that literally immerses students in wetlands—the intensive ten-week course culminates with a two-day canoe trip along one of the region's wetlands. The students learn about a range of wetland issues as well as practising field assessment. The course helps the students understand the part they can play in maintaining and conserving wetlands—and how much fun wetlands can be!

For more information about the Queensland Wetlands Programme, visit www.environment.gov.au/water/environmental/wetlands/programs/qwp.html. For management tools, visit Wetland*Info* at www.epa.qld.gov.au.

Students put their knowledge to the test.
Photo: Kane Constantine

KATFISH REACH: A MURRAY-DARLING BASIN DEMONSTRATION REACH FOR NATIVE FISH PROJECT

Mike Harper, Project Manager, SA Department for Environment and Heritage

The Katfish Reach project is an integrated fish recovery project working for a healthier and more productive aquatic and floodplain ecosystem that everyone can enjoy.

The project is centred on the Katarapko and Eckerts Creek floodplain, located on the River Murray in South Australia between the towns of Berri and Loxton. The project covers an area of 8920 hectares that includes permanent waterways extending some thirty-eight kilometres, nineteen temporary wetlands ranging from 0.1 to 41 hectares in size, and two irrigation saline water disposal basins. Most of the site is within the River Murray National Park (Katarapko section) with the remainder consisting of land held by the Gerard Reserve for Aborigines, three private landowners and Berri Barmera District Council in addition to areas of crown land.

Electrofishing survey of fish. Photo: Department of Water, Land and Biodiversity Conservation, South Australia

The Murray-Darling Basin Native Fish Strategy provides for demonstration reaches, described as 'large-scale river reaches or wetlands where a number of management interventions are applied to showcase the cumulative benefits of river rehabilitation on native fish populations'. Accordingly, the Katfish Reach project, established in 2007, addresses issues relating not only to native fish but also to habitat and water, with the aim of improving the health of a substantial stretch of river.

The initial focus of the project has been on collecting data. A baseline fish survey of the project area and reference site has been undertaken by the South Australian Research and Development Institution, along with a fish habitat assessment carried out by Conservation Volunteers Australia. Wetland monitoring (waterbirds and water quality) is in progress, together with bush bird surveys relative to habitat being conducted by the Friends of Riverland Parks.

Looking ahead, the Katfish Reach project will also include improving native fish passage, restoring floodplain inundation, improved wetland management, use of saline irrigation drainage water for the nationally threatened Murray Hardyhead and waterbirds habitat, management of introduced species and community participation.

Stakeholders responsible for the development and management of this project include the South Australian Department for Environment and Heritage (project sponsor); the Murray-Darling Basin Commission; the South Australian Department of Water, Land and Biodiversity Conservation; the South Australian Murray-Darling Basin Natural Resources Management Board; Rural Solutions SA; Friends of Parks Inc.; and Banrock Station Wines. The project's steering group, chaired by a community member through Friends of Riverland Parks, will be responsible for assisting in the development of the Project Management Plan and implementation of the plan, promoting community awareness and involvement in the project, and supporting stakeholder consultation.

For further information, visit www.katfish.org.au or contact Mike Harper, Project Manager at email: harper.michael@saugov.sa.gov.au or on tel: (08) 8595 2041.

MAPPING WETLANDS IN THE WHEATBELT OF WESTERN AUSTRALIA

John Lizamore, Project Coordinator, WA Department of Environment and Conservation

The wheatbelt of Western Australia is considered by some to be the breadbasket of Australia. This productivity, however, has not come without a cost. As a result of the vast clearing of land for agricultural production, extreme alteration in the hydrological regime is evident. The watertable in some areas of the wheatbelt has risen to within a few centimetres of the surface, and serious salinisation of the soil has resulted.

The rising watertable has also had a major impact on the natural wetlands in the wheatbelt. Many of the existing wetland systems, although naturally saline, have become hypersaline. Many 'new' wetlands have started to form as saline water seeps up through the rising watertable and leaves once productive agricultural land with a salt crust and diminishing productivity.

The Western Australian Government in partnership with the Australian Government and the Avon Catchment NRM Council has initiated a number of measures to battle this growing problem. One of these is the Wheatbelt Wetlands Assessment Project. The project is managed by the WA Department of Environment and Conservation and aims to map and classify the wetlands in the wheatbelt. This project is part of a larger program, the Wheatbelt Drainage Evaluation—Framework for Implementation, managed by the WA Department of Water and funded by the Australian Government and the Western Australian Government.

Mapping of the wetland boundaries is at a scale of 1:10 000 with an intended operation scale of 1:100 000. The project has mapped more than sixty-five per cent of the wheatbelt

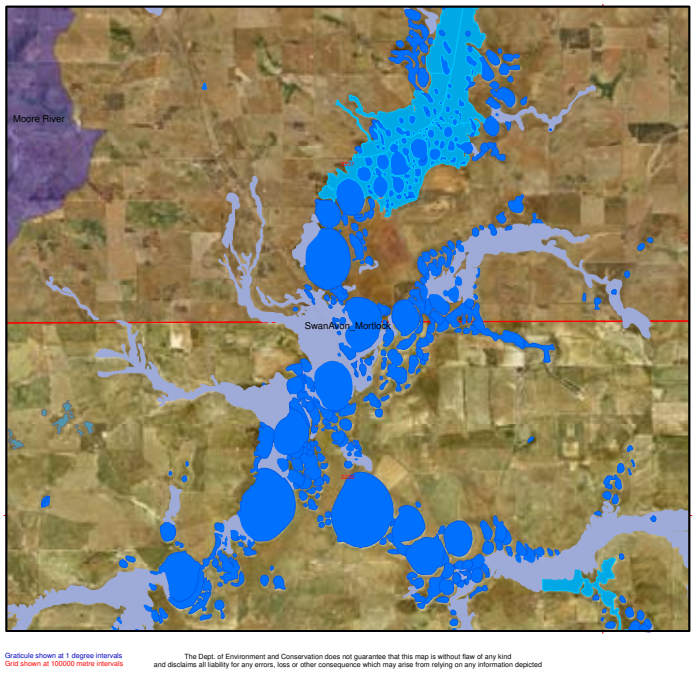
area thus far, and work on evaluating condition and classifying wetlands is well under way.

The mapping of the wheatbelt uses a combined process of remote-sensing techniques, individual assessment and field verification. The mapping captures not only the area and coordinates of the wetlands but also their geomorphic classification, the extent of vegetation cover, their hydrologic placement in the catchment and connectivity in the landscape, the extent of natural buffer surrounding them, and other features that impact on wetland integrity and function.

Figure 1 indicates the area being mapped, while Figure 2 presents an example of how the mapping layer is presented.

It is anticipated that the final wetland mapping product will be available to the general public and government institutions in the second half of 2008 on the NatureBase website of the Western Australian Department of Environment and Conservation: http://www.naturebase.net/content/view/813/861.

More information, as well as copies of the project inception report and mapping protocol, can be obtained from: Coordinator, Wetland Conservation, WA Department of Environment and Conservation on tel: (08) 9334 0442.



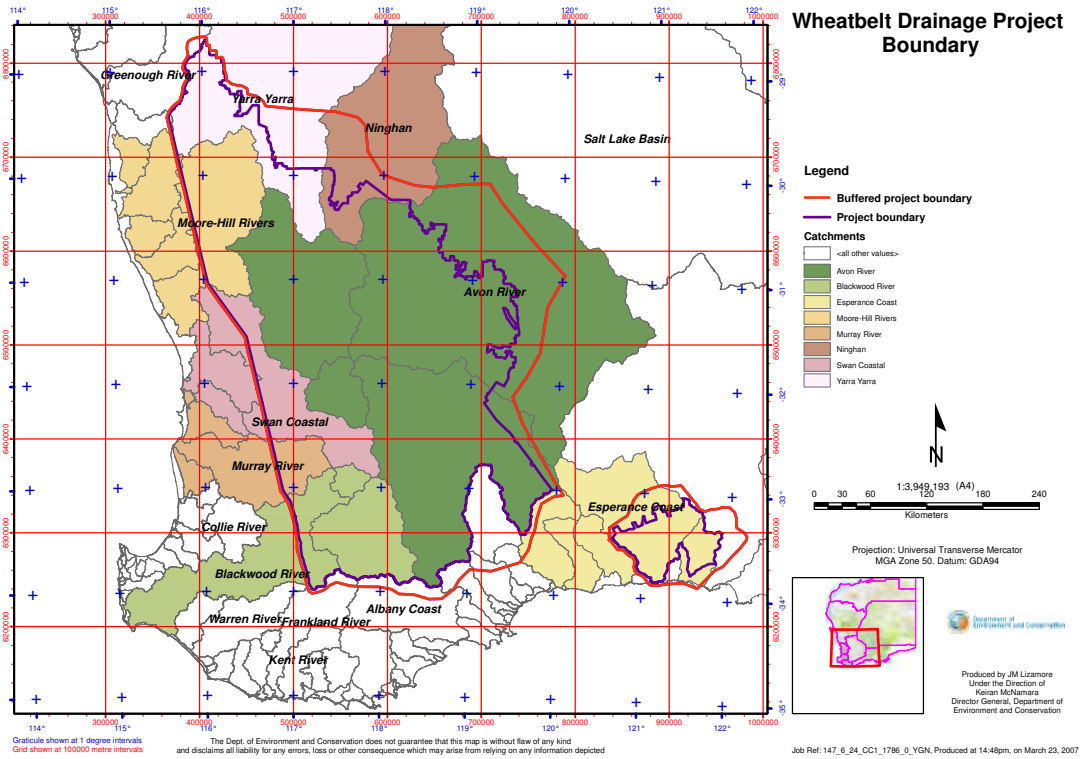


Figure 1. Wetland mapping of the Swan-Avon—Mortlock catchment. Figure 2. Wheatbelt Wetlands Assessment Project

WETLANDS ON FARMS PILOT PROJECT

Libby McIntyre and Steffan Holmes, NSW Department of Primary Industries

Responsibility for the management of wetlands—including those listed as nationally and internationally important—invariably falls to private landholders as the largest owners of wetland area in New South Wales. In inland New South Wales, the Wetlands on Farms pilot project is encouraging landholders to be more involved in the sustainable management of wetlands on their properties. Its overall aim is to ensure wetland management is integrated with primary production management in a way that may improve the benefits of primary production to landholders whilst assisting in minimising the potential negative impacts of production on healthy wetland function.

The Wetlands on Farms team is working with private landholders (individuals as well as groups of neighbouring landholders) and catchment management authorities (CMAs) to improve wetland management west of the Dividing Range in New South Wales. The CMAs participating in the program include the Border Rivers—Gwydir, Central West, Lachlan, Lower Murray-Darling, Murray, Murrumbidgee, Namoi, and Western.

The project is helping private landholders to develop wetland management plans suited to their production systems, their land use needs and the type of wetlands located on their land. The project is using a wetland planning tool (including a mapping component) that builds on landholders' local knowledge to produce information specific to individual properties. Landowners end up with high-resolution, up-to-date maps of their properties as well as a property-specific wetland plan detailing self-determined management actions.

The Wetlands on Farms pilot project will be producing *Management guidelines for wetlands in inland New South Wales* as a reference tool based on current best management practice for wetlands, including in western New South Wales.

Since the Wetlands on Farms pilot project commenced in January 2007, thirty private landowners with wetlands have been involved and wetland plans have commenced. In some instances, an individual landholder is the sole manager of a wetland; in others, groups of neighbouring landholders co-manage a single wetland and participate as a group in the planning process. The wetland sites range from large ephemeral wetland complexes in the Mulga Lands bioregion around Bourke to smaller semi-permanent wetlands near Narrabri and a terminal drainage swamp on the floodplain of the Lachlan River in the Riverina bioregion.

The program is managed by the NSW Department of Primary Industries' Conservation Action Unit and funded by the Australian Government. The project is scheduled for completion in June 2008.

For further information, please contact Libby McIntyre, Conservation Manager at email: libby.mcintyre@dpi.nsw.gov.au or on tel: (02) 6881 1233 or Steffan Holmes, Conservation Management Officer on tel: (02) 6881 1216.

Wildlife enjoying a wetland near Trangie in western New South Wales, a site where the 'Wetlands on Farms' planning tool has been trialled. Photo: NSW Department of Primary Industries

RECOVERING NEW SOUTH WALES WETLANDS

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

The NSW Wetland Recovery Program consists of a variety of projects that aim to contribute to the recovery of the Gwydir Wetlands and Macquarie Marshes. These wetlands, parts of which are listed under the Ramsar Convention, will benefit from water efficiency projects, water purchase from willing sellers, research into and removal of wetland weeds, and improvements to wetland management.

The program was implemented to respond to the decline of the wetlands due to pressure from both drought and land and water management practices.

The initial allocation of $13.4 million in funding made by the NSW Government in June 2005 was matched by the Australian Government's Water Smart Australia program. Total funding for the program stands at $26.8 million.

Because the entire Gwydir Wetlands and most of the Macquarie Marshes are on private land, a key feature of the Program is recognition of the important role that local landholders and the community play in wetland conservation. Because they are the principal custodians, it is important to engage landholders in the active management of the places where they live and work.

The program will help private landholders to continue to balance wetland conservation with productive use of the land.

Progress to date

The four-year program, which will conclude in June 2009, has already made substantial progress. An important component of the program is a series of scientific research projects that are investigating the ecology of the Gwydir Wetlands and Macquarie Marshes. The information gained is being used to develop environmental management plans, which will provide a comprehensive guide to the most appropriate land and water management strategies for the wetlands.

Progress to date on key projects to inform the plans includes:

- draft vegetation maps for both wetlands completed
- a survey of terrestrial and aquatic fauna to assess biodiversity completed
- water quality sampling completed
- data to develop a detailed elevation model of the two wetlands collected
- preliminary consultation with Aboriginal communities as the basis for increased Aboriginal involvement in management planning commenced.

To date, water licences for a total of 5571 megalitres have been purchased in the Macquarie valley, and licences for

Egret chicks in the Gwydir Wetlands, NSW.
Photo: Tara Schalk

246 megalitres have been purchased in the Gwydir valley. These licences will be managed as adaptive environmental water for the benefit of the wetlands' identified ecological assets.

Anticipated project outcomes for 2008

The next year of the program is expected to deliver practical outcomes that will collectively assist in the recovery of the wetlands. Among many others, the following products are scheduled for completion:

- maps outlining the change in vegetation extent and condition in both wetlands
- a report on the effects of grazing in the wetlands
- maps outlining the frequency of flooding in both wetlands
- maps outlining the distribution of Lippia within the wetlands
- designs for fishways for the Marebone Weir in the Macquarie River to address the current high rates of fish mortality.

In addition to these project-level achievements, extensive community consultation will be undertaken for the environmental management plans for both the Gwydir Wetlands and Macquarie Marshes. The input received from the broad range of stakeholders will be used to ensure that the plans are robust and allow for the most effective management of the wetlands well into the future.

The NSW Wetland Recovery Program is delivered by the NSW Department of Environment and Climate Change, in partnership with the NSW Department of Water and Energy, NSW Department of Primary Industries and the Border Rivers—Gwydir and Central West Catchment Management Authorities.

Further information on the NSW Wetland Recovery Program can be found at www.wetlandrecovery.nsw.gov.au.

The Program Coordinator, Renee Shepherd, can be contacted at email: renee.shepherd@dnr.nsw.gov.au or on tel: (02) 6883 3047.

LONG TIME WET… LONG TIME DRY…

Justine Watt, Wetlands Officer, Wimmera Catchment Management Authority

When Major Thomas Mitchell first stood atop the towering Mt Arapiles in June 1836—the first European to do so—he counted twenty-seven lakes, swamps and wetlands as the sun set. 'This is certainly a remarkable portion of the earth's surface', he said.

The Wimmera region in western Victoria boasts more than 3200 wetlands, accounting for twenty-five per cent of Victoria's wetlands. Of these 3200 wetlands, eighty-five per cent are temporary freshwater wetlands isolated from stream systems.

The region's wetlands are grouped in three geomorphic areas—the Douglas depression, the Millicent Coast Basin and the Western Limestone region—each of which is home to unique wetland systems. They are all under growing pressure, particularly from increased land use and development.

Wimmera Catchment Management Authority is responsible for the strategic management of the region's wetlands. With more than ninety per cent of shallow freshwater wetlands found on private property, the success of its projects depends heavily on the strength of the organisation's relationship with the community.

Wimmera CMA has celebrated World Wetlands Day since 2003, with an aim of increasing wetland awareness and education. Tours and talks were the traditional format for the day, but for the 2007 celebration it was felt that a more accessible program, recognising the community's love of wetlands and connection with the land, would attract a greater number of people.

When early settlers arrived in Natimuk, they asked the local Indigenous people about the weather. 'Sometimes long time wet, sometimes long time dry', they were told. It was this authentic and enduring statement that gave the title to Wimmera CMA's 2007 World Wetlands Day show. The live multimedia production told the story of the floods and droughts of the Wimmera wetlands, drawing on anecdotes and memories, referencing local film and photos, and taking the viewer on a poignant and often funny journey through the swamplands in both wet and dry times.

Wimmera CMA's 2007 World Wetlands Day show, live-action shadow puppetry depicting wetland values. Photo: David Fletcher

Artist Jill McLeod's piece *Chain of Lakes*, which reflects the changing landscape of the Wimmera wetlands and the effects of the drought. Freshwater lakes have long since evaporated, salt is encroaching onto the land, and habitat for wildlife and birds is being lost. Although it could really be anywhere in the Natimuk-Douglas wetlands system, the painting is based loosely on Pine Hut Swamp near Miga Lake, as seen from a bird's perspective. Photo: Wimmera Catchment Management Authority

The show also featured live-action shadow puppetry performed by students from four Wimmera schools.

Not all tales were told through words. Wimmera CMA also held an exhibition of twenty-five local artists' work inspired by the *long time wet… long time dry…Wimmera wetlands story* theme. The exhibition was held before the showing of the film *long time wet… long time dry…Wimmera wetlands story* on World Wetlands Day.

The popularity of the live *long time wet… long time dry… Wimmera wetlands story* show prompted the creation of a small book featuring images collected during the process. *Chain of Lakes* by Natimuk artist Jill McLeod was selected as the cover image and the original painting hangs in the Wimmera CMA office in Horsham.

Projects such *long time wet… long time dry…Wimmera wetlands story* demonstrate the importance of community collaboration, which is essential to the success of wetland protection and conservation efforts. Wimmera CMA will continue to engage the community through exciting and inspiring wetland education and awareness-raising activities with the aim of increasing support for the protection of our precious wetlands.

Wimmera Catchment Management Authority would like to thank the Australian Government for its investment in this project.

For more information, please contact Justine Watt at email: wattj@wcma.vic.gov.au or on tel: (03) 5382 1544.

MAPPING AND MONITORING WETLANDS IN THE SOUTH-WEST OF WESTERN AUSTRALIA

Mia Podesta, Wetlands Program, Species and Community Branch, WA Department of Environment and Conservation

Western Australia features a high diversity of wetlands, many of which contain significant environmental and social values. Sadly, a large number of wetlands in the south-west of Western Australia have been degraded or are under threat by human activities—land clearing, farming, mining, water abstraction and urban and industrial development. In order to manage them wisely and ensure that their important values are maintained in the long term, it is imperative that we increase our understanding of wetlands.

Working to this end is the Mapping, Classification and Evaluation of Wetlands, South West Western Australia project. By providing information on the location, values and characteristics of wetlands in the south-west, the project will assist with regional decision making and priority setting for activities affecting wetlands and lead to better wetland management and protection.

The project is being undertaken by the WA Department of Environment and Conservation and is funded by the Australian Government. These are joint initiatives of the state and federal governments; for this project, they are administered by the South West Catchments Council (SWCC). The project is a continuation of activities undertaken in a previous SWCC project, W5-01, Wetlands Mapping, Classification and Evaluation Program for South West, WA 2006–07 (see Issue 15 of *Wetlands Australia*, 'Putting wetlands on the map' by Alison Beard).

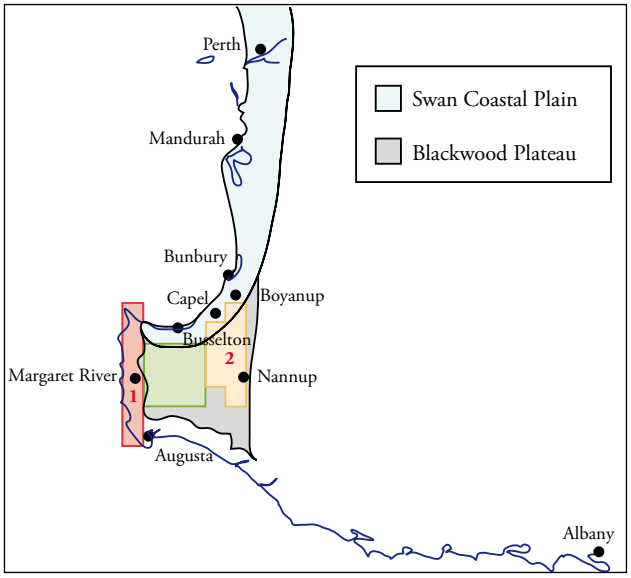
Volunteers helping with wetland monitoring at Lake Hayward, Peel-Harvey Inlet, Mandurah. Photo: Mia Podesta

The first component of the project is to provide mapping, classification and evaluation of wetlands within high-priority areas for which little or no digitised data is available. After regional consultation, two study areas were chosen, covering approximately 200 000 hectares (see map).

The Leeuwin Naturaliste Ridge (Area 1) was chosen because of the threat arising from increasing pressure from residential development and visitation and the presence of significant environmental values (wetland-associated tufa, cave threatened ecological communities, and critically endangered snail species).

The Swan Coastal Plain wetlands (Area 2) have the potential to be affected by current water extraction.

The green area indicates the area mapped under the previous project.



The mapping will add data to natural resource management processes, outline the wetland assets of the study areas, provide information on individual wetland values, and provide baseline mapping against which loss, degradation and rehabilitation can be measured.

The second component of the project is a monitoring program that aims to establish a baseline condition for wetlands throughout the region. In all, forty sites will be monitored. Monitoring will continue on thirteen already established monitoring sites on the Swan Coastal Plain. In addition, initial data collection has begun on twenty-seven wetland sites in an area east of Margaret River (an area mapped in the previous project).

Sites have been monitored in early spring and late spring 2007 and will be monitored once in autumn 2008. The parameters monitored include depth, pH, dissolved oxygen, conductivity, salinity, temperature, colour, nutrients, transparency, phytoplankton, macroinvertebrates and vegetation. Vertebrate fauna, physical form and process, catchment disturbance and hydrological disturbance are also noted. If continued, the program will eventually allow for detection of changes in condition.

For more information, contact Mia Podesta at email: Mia.Podesta@dec.wa.gov.au or on tel: (08) 9219 8756.

CARING FOR WETLANDS IN PARTNERSHIP

Alan Cibilic, CEO, WetlandCare Australia

In northern New South Wales, six Aboriginal communities are developing local responses to wetland degradation.

In partnership with WetlandCare Australia (WCA) and with assistance from other organisations (see box on page 24), the six communities have undertaken a range of actions: wetland planning, site assessments, riparian management, weed control, restricting unauthorised vehicles, rubbish removal, stock control fencing, interpretive signage, and construction of an educational boardwalk. An added bonus has been further skills gained in bush regeneration, project management, and developing new projects.

WetlandCare Australia is a not-for-profit organisation with the mission of supporting the community to protect and restore Australian wetlands. The partnerships with each Aboriginal community have developed from 2004, through the exchange of ideas relating to environmental land management. The approach taken has reflected the needs of each Aboriginal community partner and place.

Bellinger River community—The Kelly family of the Gumbayngirr people purchased the site of the old Yellow Rock Aboriginal mission near Urunga in the 1940s. It continues to be privately owned by the family, and the Bellinger River elders continue to reside there. The first stage of the Yellow Rock Road project involved weed control and bush regeneration with WCA's Tatiana Velasco. Tatiana's connection with the family, access to local Gumbayngirr history, and thorough background research all proved invaluable in developing a comprehensive management plan. Challenges remain in efforts to reinstate more natural hydrology of the estuarine wetland, which has been impacted by roadworks, drainage, and flood control works—all difficult to mitigate.

Controlling lantana on Sleeper Island, NSW. Photo: Janet Purcell

Fox Laurie accepts a certificate from Alan Cibilic (WCA) and Judy Henderson (Chairperson, Northern Rivers CMA) in appreciation of Birrigan Gargle's site work at Oyster Channel, Yamba. Photo: Janet Purcell

Birrigan Gargle Local Aboriginal Land Council (LALC)—Wooloweyah Lagoon and Oyster Channel and their surrounds in the Clarence River estuary are important for their habitat, cultural significance, and wetland values. Yamba area's Birrigan Gargle LALC has prioritised these areas for rehabilitation works and, with assistance from WCA, has developed staged site plans. The NSW Department of Lands and Clarence Valley Council have helped with weed control, rubbish removal and blocking of access by unauthorised vehicles. More than thirty hectares of salt marsh and coastal wetlands have benefited as a result.

Bogal LALC—Bogal LALC at Coraki on the Richmond River has recently partnered with WCA. A good working relationship has developed, and the community has agreed on plans for bush tucker regeneration and nearby wetlands site works. Weed control and setting up equipment and resources have been the first steps, and many positive actions are in the pipeline.

Jali LALC—Based around Ballina and Cabbage Tree Island, Jali LALC and WCA developed the first project partnership in 2004. Working with WCA project officer Tatiana Velasco, a bush regeneration team was established. The team completed TAFE training in conservation land management and put its training to use on riparian weed control and regeneration (including significant salt marsh and mangrove fish nurseries). In partnership with Jali LALC and the Cabbage Tree Island School, the second stage of a major educational boardwalk, including interpretive materials, has been completed. These projects were designed in close consultation with the community, and this has led to a strong partnership and very positive results.

Tweed Aboriginal Cooperative (TAC)—The TAC manages land adjacent to Minjungbal Centre on the river at South Tweed Heads, in the Tweed River estuary. TAC leases land from NSW National Parks Service and has previously constructed a boardwalk and interpretive centre. Working with WCA, the group has employed a bush regeneration team, trained in conservation land management, to complete weed control of the wetland area.

Yaegl LALC—From its base in Maclean, Yaegl LALC has been managing weeds and restricting cattle access to Sleeper Island; it has also developed a work plan for neighbouring Thorny Island in the nationally significant wetland of the Clarence River estuary. WCA was able to assist with planning and resources; Yaegl LALC organised a boat to transport its bush regeneration team to the islands. Plans for the future include removal of an unauthorised earthen causeway from a channel running between Sleeper Island and neighbouring Palmers Island that is restricting fish passage, altering hydrology and providing the means of access for cattle. Both islands support NSW-listed endangered ecological communities of swamp oak floodplain forest and salt marsh as well as protected mangroves.

Partnerships for wetlands

Wetland rehabilitation and conservation projects—in fact, all natural resource management—benefit from strong partnerships. The Aboriginal communities have formed good links with WCA to deal with local issues in ways relevant to the local area and their communities. As always, much remains to be done, but the seeds are sown, the relationships are growing, and the environment benefits.

None of these projects would have succeeded without the help of other groups too numerous to mention here by name. Significant help was received from each of the communities, and from funding bodies:

- NSW Natural Resources Advisory Council—for significant seed funding from the insightful Forging Partnerships program
- Northern Rivers Catchment Management Authority—for assistance with on-ground works funded by the Australian Government
- NSW Environmental Trust—for effective Working on Country funds and other assistance provided to Jali LALC
- Banrock Station—for timely on-ground works funds through the Oyster Channel project at Yamba
- Australian Government—for recent funding for on-ground works and earlier funding from the *Sustainable Regions* program that first brought WCA and Aboriginal communities together in environmental projects.

Sustainable partnerships and long-term commitment, for enduring and effective natural resource management: Australia's wetlands need more of that.

For more information, contact Tatiana Velasco at email: ballina@wetlandcare.com.au or on tel: (02) 6681 6169.

WETLANDS.EDU GOES NATIONAL—YOUR OPPORTUNITY TO GET ON BOARD

Dr Bill Phillips, Coordinator, Wetlands.edu training program

Wetlands.edu is a national wetland management capacity-building program funded by the Australian Government. It is part of Wetland Management Solutions, which also includes a project being undertaken by Wetlands International (see page 25). The 2007 issue of *Wetlands Australia* reported on both of these components.

Wetlands.edu is being developed and delivered by a consortium comprising the Hunter Wetlands Centre Australia, the Wetland Education and Training program of the Sydney Olympic Park Authority, Banrock Station Wine and Wetland Centre, Dr Bill Phillips (Main Stream Environmental Consulting), Dr Rhonda Butcher (Water's Edge Consulting) and Jennifer Hale Consulting.

The program's principal aim is to offer train-the-trainer capacity building for those working in regional natural resource management and catchment bodies, state government agencies, Landcare and river management groups, and local governments. Funding to help establish Wetlands.edu ends in mid-2008.

To date, Wetlands.edu has delivered thirteen two-day training sessions in five states, with a further six courses anticipated by mid-2008. To date, 206 people have participated in our training. Wetlands.edu is unique in delivering training across the country through established wetland education centres and in key regional towns and cities, and in offering a particular emphasis on training to address regional issues. Training is intended to be very practical and hands on, with all training modules including a field component.

By early 2008, Wetlands.edu will have developed seventeen training modules. They have been peer reviewed and are undergoing national accreditation, meaning that participants in Wetlands.edu courses will be able to gain credit for this training against a range of related tertiary courses.

From the outset, the Wetlands.edu consortium wanted to ensure it was not a 'flash in the pan' initiative, and set the goal of seeing the program become self-sufficient by the time the Australian Government investment ended. It is hoped this can be achieved through a combination of user-pays and support from both the government and private sectors.

Wetlands.edu sees itself as an information broker, keeping on top of the latest advances in wetland management and delivering training on these issues in a ready-to-use format for practitioners. At the end of the day, the goal is to see wetlands managed better by helping those in key roles to make well-informed decisions.

For further information, including advice on upcoming training opportunities, go to www.wetlandsedu.org.au or contact the coordinator, Dr Bill Phillips.

ROVING WORK FOR REMOTE WETLANDS

Roger Jaensch, Wetlands International—Oceania, Brisbane

Protecting and managing wetlands is a challenging task in Australia's remote, sparsely populated rangeland regions. Regional organisations dedicated to natural resource management (NRM) take on this challenge but their staff face the tyrannies of great distance and a small pool of community volunteers. Locally based wetland experts are rare. Issues critical to successful management of remote wetlands—such as control of weeds and feral animals—are present at enormous scales. To be successful in the outback, NRM needs tailored solutions.

Two years ago, Australian Government funding started Wetland Management Solutions. The initiative includes a component to support NRM regional bodies across the rangelands of northern and inland Australia. (Other components of Wetland Management Solutions include the development of a national training program for wetland management, centred on formal training courses provided by Wetlands.edu—see page 24.)

As implementer of the remote wetlands component of Wetland Management Solutions, Wetlands International has been providing expertise to boost the capacity of remote NRM regions to undertake investments in wetland management. Its approach has been to meet regional needs on site, through a roving wetland specialist working one-on-one with NRM technical officers and other wetland managers. To date, eleven regions have become engaged in the project, from the semi-arid and arid subregions of the Northern Territory and South Australia to rangeland regions of central Queensland and western Cape York.

With such a large slice of Australia and its wetland estate to address, a realistic focus was needed. Accordingly,

A nationally important wetland on the Cooper floodplain, Desert Channels Queensland region: site of a waterbird breeding colony. Photo: R. Jaensch, Wetlands International

Habitat for critically endangered Capricorn Yellow Chat at Broad Sound nationally important wetland, Fitzroy Basin region, Queensland. Photo: R. Jaensch, Wetlands International

Wetlands International concentrated on nationally important wetlands—those listed in the *Directory of Important Wetlands in Australia*, Ramsar sites and internationally important sites for shorebirds—to raise the profile of wetlands in general, in the remote regions (see table). Recognition by landholders and NRM staff of the existence of these places—and the assets that make them important—is a necessary prelude to planning for asset protection and management of any threats.

Nationally important wetlands in selected remote regions	
Northern Gulf	9
Southern Gulf	16
Desert Channels	26
South West Queensland	16
South Australian Arid Lands	7
Northern Territory	45

At the forefront of the roving work were skills transfer activities in remote regions: by late 2007, around twenty had been conducted, with individuals or with small groups of NRM staff. This required many hours in the air and on outback roads, from Darwin to the desert, Cairns to Karumba, Brisbane to Bedourie.

Typically, this work started with the provision of information tools to participants. These tools comprised existing resources—most notably the wetland management profiles produced by the Queensland Wetlands Programme (see Wetland*Info* on page 16)—as well as tailor-made presentations on local needs such as the recognition and management of palustrine (swamp) wetlands in a grazing land-use context.

Examples of skills transfer activities

- *Barkly subregion, Northern Territory*: drawing attention of graziers to the locations and importance of waterbird breeding colonies on their properties
- *South West region, Queensland*: assisting Indigenous landowners to conduct inventory of their wetlands and prioritise investments for management
- *Southern Gulf region, Queensland*: helping new NRM technical staff appreciate the scale and context of nationally important coastal wetlands through aerial reconnaissance

The advice and information provided by periodic visitation is more effective if backed up by regular communication; this has been achieved through monthly information updates to a network of regional NRM contacts.

Additionally, the Wetlands International team has provided over 500 hours of technical advice on wetlands, wetland species and wetland management, through email and other forms of communication, from its base in Brisbane, to participating NRM staff and to others who requested information. Advice has included review of regional planning documents, draft conservation designations for wetlands and proposals for ecotourism development in wetlands. Guidance has addressed management of fire in swamp shrublands, saline intrusion in coastal wetlands, and fencing of wetlands sensitive to disturbance by cattle.

Examples of advice provided on management of waterbirds

- Advising managers on thresholds for identifying internationally important wetlands in terms of numbers of individual birds that use the wetland
- Helping community organisations to plan surveys of threatened waterbird species such as the Australasian Bittern and to understand habitat requirements

Australian rice, Birrindudu nationally important wetland, Northern Territory: reporting to landholders on proliferation of native wetland plants achieved by fencing to exclude cattle seasonally. Photo: R. Jaensch, Wetlands International

The project has deliberately aimed at a large number of regions in order to trial its methods in wide-ranging situations. If funding becomes available beyond mid-2008, Wetlands International will consider further roving work, to deliver the most demanded aspects of this project in selected remote regions.

For more information:
Roger Jaensch
Senior Program Officer
Wetlands International—Oceania
Brisbane
Email: roger.jaensch@wetlands-oceania.org
Mobile: 0427 884 979
Post: c/o Queensland Herbarium, Mt Coot-tha Road, Toowong Qld 4066
Tel: (07) 3406 6047 Fax: (07) 3896 9624
www.wetlands.org/Oceania/EN

Southern Gulf region, Queensland: advice has been provided to landholders on selection of swamps for fencing to manage cattle access. Photo: R. Jaensch, Wetlands International

REVIVE OUR WETLANDS 2007: FROM AWARENESS TO ACTION

A new focus on wetland education

Sarah Brittle, Revive our Wetlands Project Manager, Conservation Volunteers Australia

At a critical time of worsening drought, dwindling water resources and debate and action about climate change, Conservation Volunteers Australia (CVA) and BHP Billiton are proud to report that their Revive our Wetlands partnership is continuing for three more years through to 2009.

In July 2007, the Revive our Wetlands program won the prestigious Banksia Environmental Award in the water category for outstanding achievement in protecting, conserving or enhancing Australia's water resources including freshwater and marine environments. This award recognises the contributions the partnership has made to Australia's wetlands since its inception in 2001. Some of the achievements in numbers:

- 298 880—volunteer hours logged
- 500 000—stems planted
- 4000—hectares of weeds removed
- 200—kilometres of fencing installed to improve stock control
- 196—flora and fauna surveys carried out.

Education initiative

As part of Revive's commitment to wetland education in the broader community, the program has initiated an exciting new focus on education. A three-pronged approach will provide theoretical and hands-on learning to students, utilising wetlands as an outdoor classroom and inspiring students to go beyond awareness to action. These educational activities are aligned with the principles established by the United Nations' Decade of Education for Sustainable Development (2005–14) and have a whole-of-community approach, reaching out to all ages.

Revive our Wetlands aims to engage over a hundred schools in three ways:

School presentations—Presentations are made to students on the values of and threats to wetlands. The interactive presentations aim to complement existing school curriculum, encourage students to increase their understanding of and interest in wetlands regionally and nationally, and move them to action.

School excursions—Schools have been invited to visit wetlands in their local region to participate in an educational tour or undertake a wetland conservation project such as wetland rehabilitation, frog watch or water watch. Students have found these visits highly educational and they have been encouraged to get involved in wetland conservation outside their school curriculum.

Revive Schools Project—Each year, schools are encouraged to apply for assistance through our Revive Schools Project to establish 'outdoor wetland education spaces' on school grounds. In 2007, over fifty schools around Australia applied for assistance, and grants were made to twenty-two schools. Projects include repairing and upgrading frog ponds and improving habitat through weed removal, plantings and fencing around wetlands. Schools are enthusiastically participating in this program.

Case study: Hands on at Tom Thumb

Forty-eight Year 1 and 2 students from Coniston Primary School, Wollongong, visited the Tom Thumb Lagoon Wetland. They spent a number of hours on site involved in a variety of educational activities conducted by CVA staff as part of the Revive program.

- Red-fingered Marsh Crabs activity—students learnt about crabs (what they eat, where they live, how they reproduce) and learnt to identify parts of a crab, with a live specimen
- Tree planting—students planted four trees each
- Refuse, reuse, reduce, recycle
- Rainbow game—students chose from a selection of differently coloured blocks and then had to match them to the vegetation around the wetland.

The aim of these activities is to engender a sense of understanding and interest in wetlands in the local region and encourage students to increase their involvement in wetland conservation through other Revive initiatives.

'Thanks for the opportunity for our students to attend Tom Thumb last week. We really appreciated the professional way in which it was handled, and can confirm they all really enjoyed the time spent with you at the wetland.'—Teacher, Coniston Primary School

Case study: Primary school pairs up with its wetland

Fifty students from the Port Germein Primary School, South Australia have recently taken on the challenge of assisting in the rehabilitation of the Telowie Beach wetlands. They showed great enthusiasm when approached to become involved in the Revive program and have since gained funding from a number of sources to assist with the program.

The students have started collecting seed that will be propagated at their school grounds, with the tube stock to be planted back on site next year. They have received funding from the Northern and Yorke NRM Board to assist with setting up a small 'nursery'. The students are excited and motivated when on site and are keen to take responsibility for their adopted wetlands. Next year, they plan to make regular trips to Telowie Beach to continue the rehabilitation of this unique wetland.

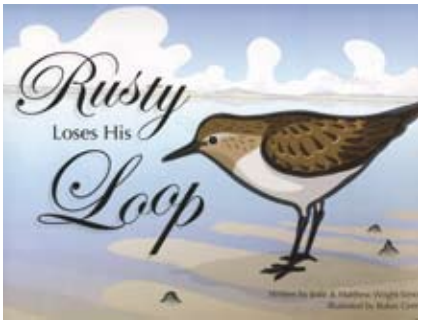
Ultimately, the aims of these projects are to encourage and support students and schools to eventually adopt a local Revive wetland and contribute to ongoing restoration and, critically, to engender future champions of wetlands in the local community.

Revive our Wetlands continues to engage thousands of volunteers at over twenty Revive wetland sites across Australia and is delighted to be extending the program to educating students and encouraging them to translate awareness into action.

For more information on the Revive our Wetlands program, please go to www.reviveourwetlands.net or contact Sarah Brittle on tel: (02) 6247 7770 or mobile: 0447 526 884.

RUSTY LOSES HIS LOOP

Matthew and Josie Wright-Simon, River Murray Urban Users Committee Inc.



Rusty loses his loop is a tale for children based on the real-life predicaments faced by Red-necked Stints at the Coorong, one of Australia's most important wetlands. The story is based on the lack of food caused by increased salinity: 'Rusty' loses his energy and hence his 'loop'. Only weeks after they hatch in Siberia, these tiny migratory birds fly more than 12 000 kilometres south for the winter. Along with many other species of migratory birds, Red-necked Stints make the lagoon and estuary mudflats of South Australia's Coorong their second home. Red-necked Stints habitually return to the same place every year; during their lifetime, they can cover a distance equivalent to that between the Earth and the Moon!

The Coorong is made up of ocean beach, freshwater lakes, dry ephemeral salt lakes, ephemeral carbonate lakes, estuaries and a long, narrow lagoon that runs parallel with the coastal dunes for 140 kilometres. It is also where, during normal flows, the waters of the Murray-Darling River system flow out to the southern sea near Goolwa, South Australia.

The lack of 'environmental flows' of fresh water in the River Murray system has had a negative effect on the ecology of the Coorong. Salinity levels have risen to many times that of sea water. This has had serious effects on the species represented by the characters in *Rusty loses his loop*.

The main character, 'Rusty', is a Red-necked Stint who returns to the Coorong each year to find that the water is getting saltier due to reduced flows. The central theme of the book concerns the overallocation of our water resources and the impact this has on the natural environment of the Coorong and the bird life that relies on the health of this fragile ecosystem. The book aims to serve as a springboard for discussing how we can help Rusty and his friends.

Rusty is an environmental education book designed for children aged four to eight. The book has a companion activity booklet for teachers and parents, available online free of charge. The booklet provides background information and suggestions for many fun, educational activities to help children (and grown-ups) to learn more about Red-necked Stints and what we can do to help restore the health of Australia's rivers and wetlands.

The book was written and illustrated by the Ecocreative team in close consultation with teachers, the SA Department of Education and Children's Services, early childhood educators and the River Murray Urban Users Committee Inc. It lends itself particularly well to use in teaching a module on water conservation in the society and environment curriculum. The activities are multidisciplinary, with a particular focus on numeracy and English. *Rusty* will fill a gap in early childhood education identified in professional development sessions with teachers.

To order a copy of the book and to download a copy of the free activity booklet, visit www.murraycare.com.au/rusty. A box of seventy books is available at wholesale price for community groups wishing to use *Rusty* as a fundraiser. For further information, contact Carl Charter at the SA MurrayCare office at email: rusty@murrayusers.sa.gov.au or on tel: (08) 8204 9100.

A bit about names

Polychaete (pronounced 'polly-keet') worms are Rusty's favourite food. Polychaete means 'many bristles'. These marine worms belong to the same family as earthworms and leeches. Ngori, Rusty's best friend, is an Australian Pelican (*Pelecanus conspicillatus*). Pelicans are very well known at the Coorong and have long had a special significance to the region's Indigenous people, the Ngarrindjeri. 'Ngori', when correctly pronounced, sounds a lot like one of the noises pelicans make. The book's publishers thank the Ngarrindjeri Heritage Committee Inc. for permission to use this word.

HISTORY INFORMS THE FUTURE

Using historical aerial photographs to map the invasion of an exotic plant at the Townsville Town Common Conservation Park

Justin Perry and Tony Grice, Commonwealth Scientific and Industrial Research Organisation, Sustainable Ecosystems, Townsville

A project initiated in 2005 used historical aerial photographs to map an invasion by Para Grass (*Urochloa mutica*) at the Townsville Town Common Conservation Park (TTC), a large coastal wetland in northern Queensland. The project was conceived to complement an in-depth field study of how fire and grazing can be used to manage Para Grass.

Up to the 1970s, the TTC was globally renowned for its abundant bird life. In particular, the area was a favoured breeding ground for Brolga and Magpie Geese. These iconic north Australian wetland breeders congregated in the open floodplain in their thousands to feed on the abundant array of water plants, in particular the bulbs of Bulkuru sedge and the seeds of wild rice.

In the 1970s, the TTC was declared a conservation park under Queensland legislation and was progressively de-stocked until the last cattle were removed in the early 1980s. Since that time, Para Grass has dramatically altered the structure and composition of the wetland and is now the dominant plant (Figure 1). The infestation of Para Grass and the consequent displacement of Bulkuru and wild rice are thought to be the catalyst for dramatic declines in the numbers of Brolga and Magpie Geese on the TTC.

The northern wetland restoration project was initiated in response to the decline in waterbirds and obvious degradation of the conservation values of the park. The project has been investigating the impacts of fire and grazing on Para Grass and the associated impacts on the wetland flora and fauna. One element of this work has been to map the invasion by Para Grass to help determine some of the factors that constrain it.

Historical aerial photographs taken between 1952 and 2004 were sourced from the Townsville City Council. The photographs were scanned and georectified against known points such as fence lines and roads and added to a computer mapping program. The Para Grass was mapped by drawing polygons around the observed Para Grass boundaries on each image.

At the same time, another area that straddled the boundary between the TTC and Townsville Airport was mapped. The Townsville Airport boundary was an excellent comparison point as the Airport side was ungrazed from 1952 to the present day. These comparative images were used to illustrate the impacts of grazing on Para Grass expansion.

In addition, low-altitude photographs were taken from a helicopter in 2005 and 2006 and stretched, then georectified to the boundaries of the six-hectare experimental plots, which were clearly visible on the images. The latter images show how the paddock structure changed in response to the various treatments imposed on the experimental plots.

We are planning further aerial photography to complete an up-to-date history of the Para Grass invasion. When the final image is included we will have a record of the long-term invasion history of Para Grass to compare with the observed impacts of fire and grazing imposed during the on-ground study. When all the data are combined we will have an informative model of Para Grass invasion, including the impact of fire and grazing as constraining factors.

This project was funded by Burdekin Dry Tropics Natural Resource Management Inc. The northern wetland restoration project is a joint venture involving CSIRO Sustainable Ecosystems, Queensland Parks and Wildlife Service and James Cook University.

The mapping project will be used to inform the next phase of the Townsville Town Common work. This will involve using what we have learned to plan and implement management regimes at the site. It is hoped that the invasion model will guide managers on how to best spend scarce economic and personnel resources. In addition, we now have a base dataset to aid in ongoing monitoring of the effectiveness of future management regimes.

For more information about the project, please contact the project leader, Dr Tony Grice, at email: tony.grice@csiro.au or Justin Perry at email: justin.perry@csiro.au.

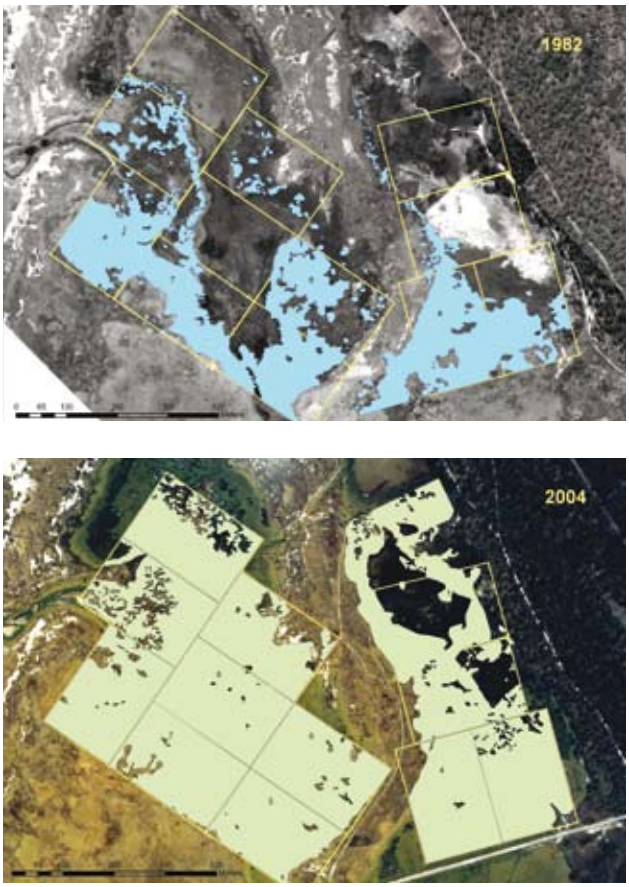


Figure 1. The images above illustrate the rapid invasion of Para Grass (in green polygons) at the Townsville Town Common between 1982 and 2004.

HUNTER REGION LEADING THE WAY IN WETLANDS COMMUNICATION

Tess Hilleard, Hunter Wetlands Centre Australia

The Hunter region of New South Wales is securing a reputation as a leader in wetlands communication, education and public awareness (CEPA), with a range of innovative program and projects unfolding across the region.

The Hunter Wetlands Centre Australia (HWCA) is a forty-five hectare community-owned wetland education, conservation and ecotourism facility located on the outskirts of Newcastle in the NSW Hunter Valley. Over the past twelve months, HWCA has initiated and built on a number of valuable CEPA projects in the region. The projects have involved a range of project partners including the local catchment management authority (CMA); federal, state and local governments; corporate sponsors; and community groups working on wetland projects.

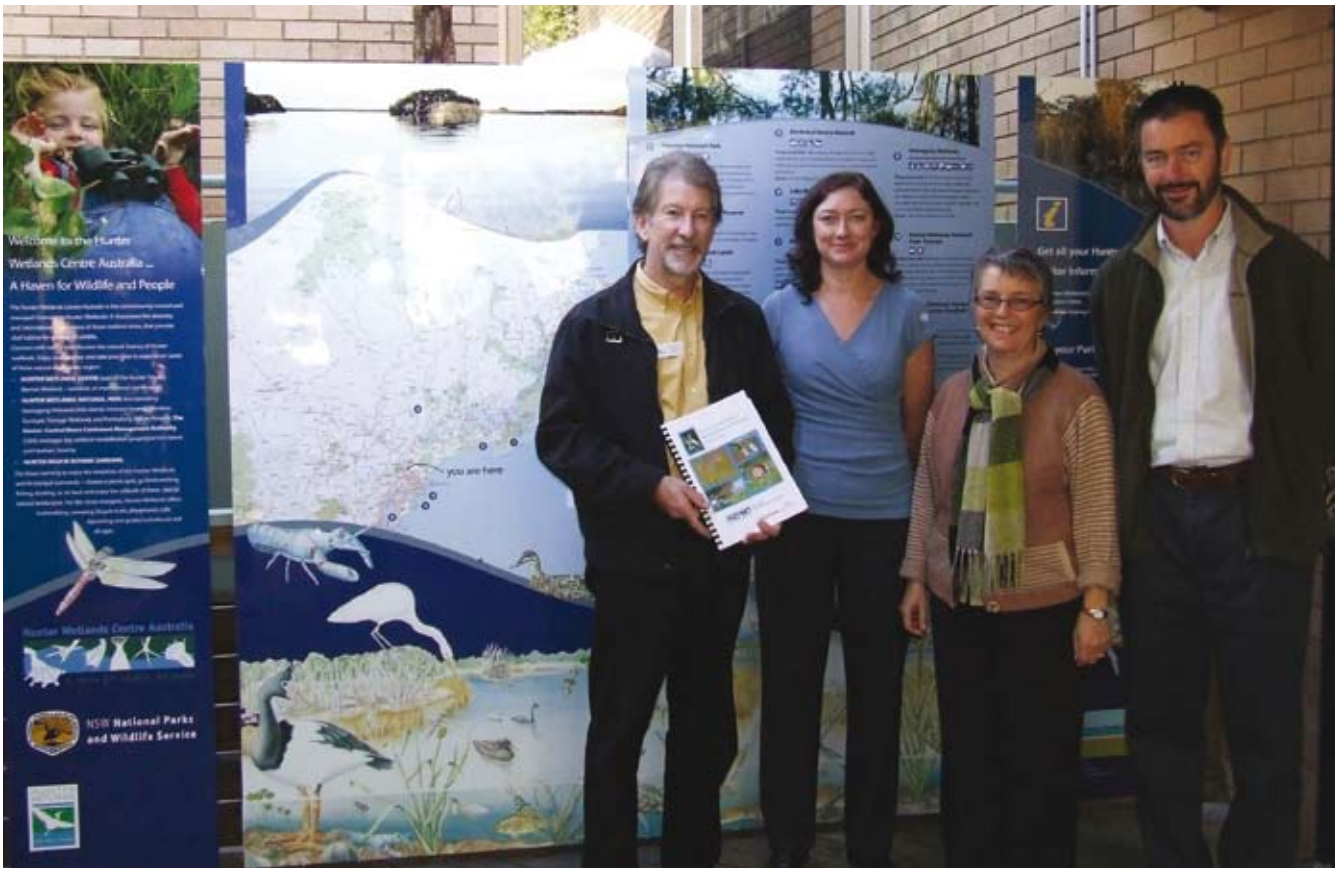
Hunter Wetlands gateway project

Initiated by HWCA in 2005, this important regional project has promoted the Hunter region as a nature tourism destination—*'Hunter Wetlands: your key to nature'*—with HWCA positioned as the 'gateway' to this experience. Participating in the Hunter Wetlands promotion are HWCA; the new Hunter Wetlands National Park (incorporating Blue Gum Hills Regional Park, Kooragang Wetlands, Tomago Wetlands and Stockton Sandspit); and Hunter Region Botanic Gardens.

The gateway project aims to market Hunter Wetlands as a key nature tourism experience, facilitating an increase in visits to wetland areas, and building community awareness and understanding about the value of wetlands. We have been pleased at the increase in visits that has already resulted from this project.

The project has involved research, branding, marketing and product development phases, culminating in the launch of the Hunter Wetlands 'brand' in August 2007. Significant upgrades to visitor facilities and the range of experiences offered at HWCA have been part of the project.

Project stakeholders include: NSW National Parks and Wildlife Service; Hunter Botanic Gardens; Hunter-Central Rivers CMA and its Kooragang Wetlands Rehabilitation Project; Hunter Tourism; University of Newcastle; Newcastle City Council and Newcastle Tourism; and Port Stephens Council. The project was funded by the Australian Government's *Regional Partnerships* program, in collaboration with the Hunter Area Consultative Committee and NSW Department of State and Regional Development.



Launching the Hunter Wetlands gateway project (L to R): Hunter-Central Rivers CMA General Manager Glenn Evans; HWCA CEO Tara O'Connell; HWCA Chairman Christine Prietto; and NSW National Parks and Wildlife Service Regional Manager Robert Quirk. Photo: HWCA

Hunter-Central Rivers Wetlands education strategy (2007–10)

A unique regional wetlands education strategy has been developed by HWCA in partnership with the Hunter-Central Rivers CMA. The strategy aims to achieve effective and integrated regional wetland education that builds the capacity of the people of the region to be informed and active participants advocating the wise use and sustainability of wetlands.

The strategy is relevant to those in the region whose work involves making decisions about our wetlands, including those working in environmental management, policy, education, communications, training, community involvement and research, whether in industry, educational institutions, government or community organisations. The strategy is being used by the CMA and other key partners to guide wetland education activities in the region.

HWCA had previously developed the Hunter Region Ramsar wetlands communication strategy as well as the NSW Ramsar wetlands communication strategy.

2007 Wetlands innovation series forum

This national event, hosted by HWCA on 17 and 18 October 2007, provided fifty wetland educators and managers from across Australia with a unique opportunity to discuss new approaches to wetland communication, education and participation, and to network and develop partnerships among government, community and industry representatives. The forum was supported by the Australian Government through the then Department of Environment and Water Resources.

Keynote speakers included the International Coordinator of Wetland Link International from the London Wetland Centre, Malcolm Whitehead; the Director of the London Wetland Centre, Malcolm Spray; the National Waterwatch Facilitator, Dr Don Thomson; and the Manager of Wetlands International–Oceania, Doug Watkins.

VICTORIAN INDEX OF WETLAND CONDITION ENTERS SECOND PHASE

Phil Papas, Arthur Rylah Institute for Environmental Research, Victorian Department of Sustainability and Environment

Janet Holmes, Victorian Department of Sustainability and Environment

Shanaugh McKay, Arthur Rylah Institute for Environmental Research, Victorian Department of Sustainability and Environment

The need to meet wetland monitoring requirements at international, national and state levels has been the driving force behind the development of a standard method for assessing wetland conditions in Victoria. These requirements include condition monitoring and evaluation under the international Ramsar Convention; reporting under various Australian Government water quality and wetland management programs; and State of the Environment and catchment condition reporting at the state level.

In response to these requirements, a rapid assessment method for assessing the condition of naturally occurring, non-marine-influenced wetlands in Victoria—the Index of Wetland Condition (IWC)—was developed in 2005 by the Biodiversity and Ecosystems Services Division of the Victorian Department of Sustainability and Environment. Funding assistance was provided by the Australian Government. The method was developed with the support and expertise of natural resource managers in Victoria as well as wetland ecologists from around Australia.

The IWC is comprised of six subindices reflecting key wetland characteristics, with measures of wetland components within each subindex. The IWC measures some wetland components directly and others indirectly by assessing threats. The IWC was developed primarily for use by natural resource managers, including catchment management authorities (CMAs) and water authorities as well as state agencies such as the Victorian Department of Primary Industries and Victorian Department of Sustainability and Environment. The IWC aims to assist Victoria's CMAs to establish condition targets for wetlands and to monitor and evaluate management effectiveness.

Stage two of the project, which involves provisional use and testing of the IWC, got under way in late 2006. It has included training in the use of the IWC, design of information management protocols and databases,

Phil Papas trains a group of consultants and Catchment Management Authority staff in the IWC method near Colac, Victoria. Photo: Shanaugh McKay

Training NRM practitioners and consultants in the use and application of the IWC will help assess the quality of wetland vegetation across Victoria. Photo: Shaunnagh McKay

and testing. Four training sessions have provided over one hundred NRM practitioners and consultants with experience in the use and application of the IWC. Further training is planned for CMAs. Thus far, approximately 400 wetlands across the state have been provisionally assessed using this method. A number of information management tools have been developed to assist IWC wetland assessors and to manage data collected from IWC assessments. Stage two will also incorporate scoping protocols for mapping wetland vegetation and extent.

Testing of the IWC is under way. Four hypotheses underpin the testing program: 1) the IWC measures condition consistently across a condition gradient; 2) the IWC measures condition consistently in two hydrological phases (filling and drying) at individual wetlands; 3) the IWC measures condition consistently in different wetland types; and 4) the IWC measures condition consistently between assessors. Approaches adopted for the testing include the development of a method for estimating condition *a priori* from spatial data, analysis of quantitative wetland datasets, and an 'expert opinion' assessment of wetland datasets by wetland ecologists.

Testing will be complete by early 2008, after which the IWC method will be revised to reflect the outcomes of the testing program. The revision will also take account of the national framework in development on wetland indicators.

Implementation of the IWC at a statewide scale will be scoped, and the results of the IWC implementation and testing will be published in 2008.

For more information on the method, including downloadable documents, visit the Victorian Department of Sustainability and Environment's wetlands website at www.dse.vic.gov.au/wetlands or contact Phil Papas at email: phil.papas@dse.vic.gov.au or Janet Holmes at email: janet.holmes@dse.vic.gov.au.

Pugging by livestock is an impact included in the soils sub-index of the Index of Wetland Condition. Photo: Phil Papas

INVESTING IN PRIORITY WETLANDS

Nicola Sheard and Brooke Turner, WetlandCare Australia

WetlandCare Australia (WCA) is delivering on-ground outcomes in wetlands with high conservation values, known as priority wetlands, through two related initiatives, both funded by the Australian Government through catchment management authorities.

The Sustainable Wetlands on NSW Coastal Landscapes project is a wetland mapping, prioritisation and on-ground rehabilitation project spread across the coastal Northern Rivers CMA (NRCMA) and Hunter-Central Rivers CMA (HCRCMA), and inland across the Hunter-Central Rivers region. This three-year project began in 2005, and is funded by the Australian Government through the HCRCMA with support from the NRCMA.

The Priority Wetlands project builds on the outcomes of the Sustainable Wetlands project, by using the priority wetlands identified through the Sustainable Wetlands project to target on-ground investment in wetland rehabilitation. This project began in June 2006, and is funded through the Northern Rivers CMA.

Wetland mapping

The Sustainable Wetlands project has compiled wetland mapping for the Hunter-Central Rivers and Northern Rivers CMA regions of New South Wales. WCA mapped more than 260 000 hectares of wetlands using existing spatial data, from Tweed Heads (on the New South Wales–Queensland border) to Gosford (central New South Wales). The mapped wetlands have also been classified using the classes in the *Directory of Important Wetlands in Australia* to provide consistency of wetland types across the project area.

WCA grouped individual wetlands into larger, workable management units known as 'wetland complexes'—wetlands that are connected or contiguous and form part of an entire wetland ecosystem. Figure 1 on page 34 shows Brisbane Waters (priority wetland complex number 134). The project team used additional spatial data relating to threats such as land use, and to conservation values such as threatened species, to determine wetland attributes. WCA used a specially designed decision support database to assess and prioritise wetlands for environmental investment. The database produces a number of useful reports and lists valuable for prioritising wetlands for various purposes and regions.

Standing new fence, Maria River. Photo: Ann Biasol (landholder)

Swans nesting, Maria River. Photo: Ann Biasol (landholder)

WCA is also currently undertaking a similar mapping, classification and prioritisation project for the Central West Catchment Management Authority (CWCMA). Information about this project will be available from WCA or the CMA from February 2008. This project is also funded by the Australian Government, through the CWCMA.

On-ground works

Going a step beyond the identification of priority wetlands, the Sustainable Wetlands and Priority Wetlands projects also aim to conserve, protect or improve the condition of wetlands across the HCRCMA and NRCMA regions.

Sustainable Wetlands

Since June 2006, the Sustainable Wetlands project has invested more than $530 000 in on-ground wetland rehabilitation works of more than 10 000 hectares of priority wetlands, with twenty-seven projects under way across twenty priority wetland complexes in the HCRCMA and NRCMA regions.

Private landholders, non-government organisations and local government agencies participating in the project are delivering on-ground projects, expected to be completed by early 2008, including fencing to exclude stock from wetlands; weed control and revegetation; replacement of floodgates to improve fish passage; installation of stormwater pits to improve water quality; and drain infilling to remediate acid sulfate scalds.

Priority Wetlands

For its part, during its first year of operation, Priority Wetlands has secured three property vegetation plans and three landholder management agreements covering a total of 266 hectares of wetlands for an investment of $80 000 in on-ground works, in accordance with these plans.

Landholders' wetland protection and rehabilitation works included fencing of wetlands and waterways; weed control; revegetation; stock exclusion; and engineering works.

The Priority Wetlands project builds upon the outcomes of the Sustainable Wetlands project by targeting additional investment from the NRCMA at identified priority wetlands in the region. During the first year (2006–07), the project targeted four priority wetland complexes:

- Maria River (Macleay catchment)
- Limeburners Creek (Hastings catchment)
- Arakoon (Macleay catchment)
- Wooli Wooli River (Clarence catchment).

WCA developed concept plans for each of the priority wetland complexes that examined wetland threats, values and management options. The project team used the conservation values and potential threats derived from the decision support database to select specific on-ground actions for each site. In this way, WCA was able to 'drill down' and assess the conservation and threat data for smaller wetlands within the complexes. The NRCMA provided funding for on-ground works in this project through incentive conservation agreements such as property vegetation plans and landholder management agreements. Under these agreements landholders agree to carry out on-ground wetland management actions for a set number of years in return for funding.

In the second year of operation (to June 2008), funding will again be provided to landholders in the Year 1 priority wetland complexes listed above, and also to landholders in three new wetland complexes:

- Goolawah (Macleay catchment)
- Tuckean (Richmond catchment)
- Cudgen (Tweed catchment).

Where to from here?

The Sustainable Wetlands and Priority Wetlands projects have allowed WCA to communicate the conservation value of wetlands and the value of prioritising wetland investment to a broad audience. Many more landholders and other wetland managers are now taking a keen interest in protecting and rehabilitating their wetlands.

Thirty-three priority wetland sites across the HCRCMA and NRCMA regions have received targeted investment. However, many wetlands of high conservation value are still under threat. Continued investment in on-ground wetland rehabilitation is important from an environmental as well as an educational standpoint.

Further information

The *Sustainable Wetlands interactive CD*—an interactive CD containing the decision support database and wetland maps—is available from WetlandCare Australia. For further information on the Sustainable Wetlands on NSW Coastal Landscapes project, please contact Nicola Sheard or Cassie Burns on tel: (02) 6681 6169 or at email: nicolasheard@wetlandcare.com.au. For further information on the Priority Wetlands project, please contact Brooke Turner on tel: (02) 6652 5589 or at email: brooketurner@wetlandcare.com.au. Or please visit our website: www.wetlandcare.com.au.

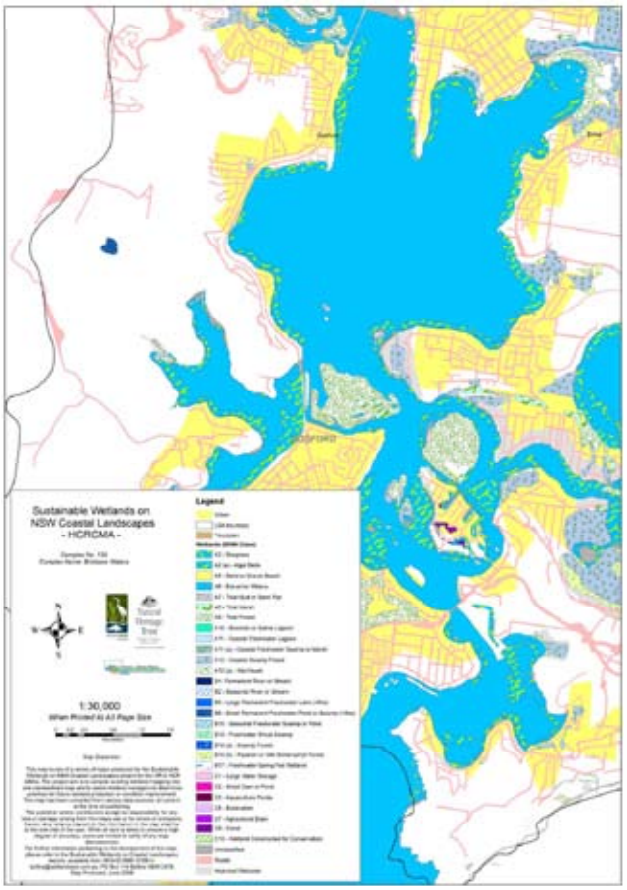


Figure 1. Wetland Complex No. 134 Brisbane Waters

RIVERBANK: MAKING UP THE DIFFERENCE

Mike Maher, Wetlands and Rivers Conservation Officer, Environmental Water and RiverBank, NSW Department of Environment and Climate Change

RiverBank is an innovative initiative of the NSW Government, overseen by the NSW Environmental Trust and administered by its Department of Environment and Climate Change. It is based on a relatively simple concept—purchase water entitlements (water access licences) from willing sellers and use them for the environment—and responds to the recently observed and widespread deterioration in wetland condition across the NSW portion of the Murray-Darling Basin.

Murrumbidgil Swamp after seven years with no flooding. Photo: M. Maher, DECC

Environmental flows that were previously negotiated in statutory water-sharing plans prepared under the NSW *Water Management Act 2000* are unlikely to provide all the water that healthy wetlands need under current climatic conditions. The RiverBank program is an equitable solution that seeks to make up the difference. It commenced operating in July 2006 and is now poised to use up to 20 000 megalitres of water entitlement in wetlands in four target river valleys (Gwydir, Macquarie, Lachlan and Murrumbidgee) once the rains fall and allocations again become available under each water access licence.

The NSW Government's initial $101.5 million investment in RiverBank has been significantly boosted by $71.77 million in funding from the Australian Government's Water Smart Australia fund. This combined investment is known as the NSW Rivers Environmental Restoration Programme (RERP). Under this program, funds will be used not only to purchase water entitlements ($147.37 million) through RiverBank but also to enable the better management of environmental flows through investment in scientific research and decision support tools, improvements in river and wetland infrastructure, and further partnerships with landholders to extend environmental gains for wetlands ($25.9 million).

Purchasing water and obtaining allocations

Purchasing water involves traversing numerous steps and hurdles. The first step is to purchase a water access licence. These licences are acquired through annual expressions of interest and direct sales through brokers within an indicative price range based on independent advice and taking account of market trends. RiverBank's acquisition planning is guided by wetland priorities in each valley and influenced in the short term by the opportunities arising. Prices on offer vary from valley to valley, reflecting both reliability of water supply and returns from agricultural enterprises.

That step achieved, a major hurdle must be confronted—receiving an allocation. Most of the water purchased by RiverBank is in a category called 'general security'. In New South Wales, this means that allocations become available only after sufficient water is stored to meet town, stock, domestic and high-security needs for a period equivalent to the worst inflow sequence recorded in a particular water source. However, because many NSW valleys are experiencing new lows, allocations for general security purposes are currently zero. The NSW Department of Water and Energy is responsible for setting allocations.

Murrumbidgil Swamp, a target wetland for RiverBank water, being filled by Lachlan River floodwaters in June 1978. Photo: M. Maher, DECC

Burrawang West Lagoon, a target wetland for RiverBank water in the mid-Lachlan River. Photo: M. Maher, DECC

Applying water

Purchasing entitlements and receiving allocations are critical components of the RiverBank program; additional steps, however, are required before the water can be used. The water access licences that RiverBank purchases are issued subject to certain conditions. They are considered to be adaptive environmental water licences that require an accompanying water use plan approved by the NSW Department of Water and Energy. If new structures or pumps are needed to apply the water, works approvals will also be required. All of these conditions are then linked to the relevant licence.

So which wetlands should get RiverBank water? The RiverBank Business Plan (see www.environment.nsw.gov.au/resources/2006442riverbankbp.pdf) establishes the initial priorities. Licences have been purchased in all target valleys except the Condamine–Balonne, which feeds Narran Lake. Some administrative matters relating to cross-border trade between Queensland and New South Wales need to be finalised before RiverBank can be confident of the product it purchases in this valley. It is also likely that additional wetlands will be added to the target list as experience is gained and opportunities arise.

For large wetland complexes such as the Macquarie Marshes and Gwydir Wetlands, RiverBank partners with existing flow advisory groups to maximise opportunities arising from a variety of sources of environmental water. For smaller wetlands where RiverBank water alone may be sufficient for the wetlands' needs, RiverBank works with the relevant landholders and catchment management authority to maximise environmental gains. Additional partners may also be involved, as is the case with NSW Department of Primary Industries (Fisheries) in some mid-Lachlan wetlands.

NSW State Water Corporation is a key partner for RiverBank. It is responsible for receiving and delivering orders for water and has experienced staff who understand travel times, flow paths for delivery of water and the delivery constraints that may apply at a given time. In some cases, this experience can make the difference between success and failure to achieve the desired outcome.

Breeding colony of Australian pelican on Narran Lake, the terminal wetland of the Narran River and a long-term target for RiverBank water. Photo: M. Maher, DECC

Monitoring outcomes

RiverBank is committed to improving the management of environmental water and demonstrating the effectiveness of its use over time. There are few examples of effective wetland monitoring programs, so RiverBank has developed benchmarking assessments and sought expert advice on the choice of features to measure over the long term.

Approaches to monitoring developed under The Living Murray Initiative are applied by RiverBank where appropriate to allow comparisons between the programs. Monitoring under the RiverBank program will therefore address compliance, surveillance and response: compliance to ensure RiverBank water gets to where it should; surveillance to provide a general picture of the environment's reaction when water is added; and response to test our conceptual understanding of the links between environmental flows and the health of specific organisms.

Funding, governance and administration

From the total investment of $173.27 million under the NSW RERP, RiverBank now manages funding for water purchase totalling $147.37 million ($101.50 million from RiverBank and $45.87 million from Water Smart Australia), including the administrative costs associated with holding and using water access licences. The remaining $25.9 million in funding from Water Smart Australia is for ensuring that the benefits of the water acquired are secured, maximised and demonstrated.

RiverBank reports biannually to a subcommittee of the NSW Environmental Trust. The subcommittee comprises representatives of key agencies as well as four independent members chosen on the basis of their expertise in the ecological, economic and practical components of environmental water management.

The RiverBank journey has just begun. It has already made a difference through its acquisition of water access licences in the Gwydir, Macquarie, Lachlan and Murrumbidgee river valleys and it is poised to make up the difference between the amount of water currently available to support key wetlands and what is needed.

For further information, contact Mike Maher at email: mike.maher@environment.nsw.gov.au or on tel: (02) 6298 0305.

ONKAPARINGA PARK, WETLAND #1

Tony Bainbridge, Friends of Onkaparinga Park

I have been involved with the Friends of Onkaparinga Park (FOOP) for a decade or so, most of that time spent on the executive committee. My special interest is the birds of our park. I have compiled the bird list from many sources (even finding a few myself); it contains 198 species. The 199th—a breeding record of White-winged Chough—is awaiting confirmation.

I'm proud to have been involved in the ongoing improvements that our group has achieved so I'd like to share with other wetland lovers just what can be done by a relatively small group of passionate, committed volunteers.

In the late 1980s, a group of concerned citizens decided to try to improve the Onkaparinga River estuary water quality. Ironically, the prime culprit was SA Water's sludge treatment lagoons along River Road, which is south of Adelaide approximately halfway between Port Noarlunga on the coast and Old Noarlunga to the east, abutting main South Road. Another issue was—and still is—stormwater run-off from new local housing estates. Through the efforts of environmental groups, the 'lagoons' are to be de-commisioned and converted into a wetland bird sanctuary. Some $2 million has been allocated for this, and I am very fortunate to be working closely with the contracted consultant on the design work from the viewpoint of a 'birdo'.

The community really got behind the Wetland #1 project, raising a few million dollars from the state, federal and local governments. In 1990, a wetland was built, complete with rock mat overflows. These mats are engineered to be at the highest level of the water in the wetland, i.e. full to the brim. The area is partially excavated to form a neck for run-off and the neck is lined with rocks in assorted sizes, all bound together with strong wire meshing. This prevents erosion occurring in a run-off event.

Swans bred there in the first year! However, our initial excitement was followed by great disappointment as the wetland dried out in summer. We discussed lining the wetland with clay from the new expressway but it was far too expensive.

Also, the water levels never reached the rock mats, which meant no 'good water' was being fed into the river.

Volunteers created bird perches which are used by pelicans, cormorants, ducks and other birds during the wet.
Photo: Andrew McKinnon

However, it did not deter waterbirds from streaming into the wetland in winter. Our bird list soon included Freckled Duck, Painted and Latham's Snipe, breeding of Blue-billed Duck and Buff Banded Rail—and even, one year, chicks from Lewin's Rail. Brown Bittern, Spotted and Spotless Crake and Baillon's Crake also have bred, with a recent record of a covey or so of Brown Quail.

A large boardwalk was built through the wetland by a supervised group of community offenders. We understand they still keep an eye out for vandalism on their own time—good to see a bit of pride!

A few years later, with some guidance from our group and the help of our Park Ranger, we managed to raise $6000, built a largish island at the eastern end in the dry season—and waited with anticipation to see what would happen when the wet came.

We were all amazed at its success. The spoil removed for the island extended the margins out by about a third—and, best of all, the water now goes over the rock mat spillways into the river as it was originally designed to do. To date, we have only had one year, 2006, when no water came at all.

Another project was to put up bird perches. One of the FOOPers managed to borrow a tipper truck from his work. We went to the far end of the park to retrieve broken-off, wind-blown, gum tree branches, then we organised teams with post-hole diggers and 'planted' our salvaged trees upright in the summer-dry wetland. These perches fill me with delight every year when the wet comes as they are laden with cormorants, pelicans, ducks and, sometimes, some of our rarer visitors such as the Pacific or White-necked Heron and Darters as well.

For further information, visit the FOOP website at www.communitywebs.org/~FOOP/pdf_files/birdlist.pdf.

Improvements to the wetlands have resulted in a greater number and variety of birds at Onkaparinga Park. Photo: Andrew McKinnon

ALPINE MOSSBEDS: DOWN BUT NOT OUT

Arn Tolsma, Senior Scientist, Arthur Rylah Institute for Environmental Research, Victorian Department of Sustainability and Environment

Alpine mossbeds, also known as peatlands or the rather delightful 'bogs', cover just over ten per cent of Australia's treeless high country. Many people have never heard of them, let alone seen them, yet they play an important role in storing, regulating and filtering water in south-east Australia's mountain catchments. Located at the headwaters of north-east Victoria's and south-east New South Wales' major rivers, they help our mountain streams keep running in summer, and reduce flash flooding after heavy rainfall. In fact, despite their relative size, most of the water that falls on the peaks and high plains flows through a mossbed at some stage before descending into the surrounding valleys. Mossbeds are also important for their biodiversity values, and are home to many rare and threatened plants and animals.

Like most Australian ecosystems, alpine mossbeds can handle the occasional fire and will recover, albeit very slowly. But burn them too often, or subject them to 150 years of grazing, and they don't fare well. Scientists estimate that we have now lost around half the area of alpine mossbeds that we once had, and the ones that are left are often in poor condition. Many of the mossbeds were burnt in the 2003 alpine fires, and more again were burnt during Victoria's late 2006 to early 2007 fires, some for the second time. Some on Mt Buffalo have now been burnt four times since 1972. And there is a serious new threat to mossbeds in some areas: thousands of Grey Sallow willow seedlings have become established in the moist, bare peat soils exposed by the fires. With their deep roots and high water use, willows have the potential to profoundly alter the structure and hydrological functions of mossbeds, which simply don't have the ability to cope with this novel threat.

Even without further disturbance, damaged mossbeds will take many decades to recover. However, with global temperatures rising and an increasing risk of bushfires,

Mossbeds in good condition, such as this one north of Heathy Spur, Bogong High Plains, can cover several hectares with a thick, wet mat of *Sphagnum* moss. Photo: Arn Tolsma, Arthur Rylah Institute

Cattle grazing prior to and shortly after the 2003 fires caused severe damage to this mossbed overlooking Pretty Valley, Bogong High Plains. Extensive rehabilitation work has now been undertaken to stabilise the slope and keep it wet, and hundreds of seedlings have been planted. In the absence of further disturbance, there is a good chance of restoration success. Photo: Arn Tolsma, Arthur Rylah Institute

the alpine area can be expected to suffer more, not less, disturbance. If mossbeds can't be buffered against further damage, and if willows can't be controlled, then many mossbeds will be lost forever.

Fortunately, Victorian land managers have recognised the very real threat to these valuable ecosystems. Since 2004, Parks Victoria and the Victorian Department of Sustainability and Environment have been involved in an extensive project to assess and restore badly damaged mossbeds, with the help of the Bogong High Plains Restoration Alliance and many other volunteer groups. This ongoing project, funded by the Victorian Government's statewide bushfire recovery and high country initiative programs and the North East Catchment Management Authority, involves a substantial degree of work, because many of the damaged or willow-infested mossbeds are in steep, remote areas and are difficult to access.

Restoration is complex—not just a matter of putting in a few plants—and requires expertise in mossbed hydrology, plant ecology, soils and restoration ecology. Barriers in the form of small weirs are installed to slow and spread out the flow of water, saturating the peat and raising the watertable. The weirs also trap silt and nutrients behind them to encourage plant growth. Revegetation can involve both tube stock and seeds, and mulch or matting may be used to reduce drying and erosion. Most importantly, we are working hard to control willows, both in the mossbeds and at their source in the surrounding valleys.

Now that cattle have been removed from the Alpine National Park there is a strong chance of restoration success, provided the high plains can be protected from another fire in the coming decades. However, in some remote areas of the Alps and in lower-altitude subalpine to montane areas, deer and feral horses remain a threat to mossbed condition. Thus, there are other matters yet to be addressed.

For further information, contact Dr Arn Tolsma, Arthur Rylah Institute for Environmental Research at email: arn.tolsma@dse.vic.gov.au, or Charlie Pascoe, Parks Victoria at email: cpascoe@parks.vic.gov.au.

AWARD-WINNING WETLAND PROJECT FITS ALTERNATIVE WATER RESOURCE VISION TO A TEE

Carol Hannaford, Adelaide and Mount Lofty Ranges Natural Resources Management Board

In Adelaide, start talking about sustainable water use and the conversation inevitably turns to finding alternative ways of reducing the city's reliance on its traditional sources of water: groundwater, and water from the Adelaide Hills watershed reservoirs (and their supplementary supplies from the ailing River Murray).

One alternative, much talked about, is to make better use of stormwater run-off. The Adelaide metropolitan area generates, on average, around eighty-six gigalitres per year of stormwater run-off. Most of this is discharged directly out to the Gulf St Vincent—less than ten per cent is currently being reused.

The Adelaide and Mount Lofty Ranges (AMLR) Natural Resources Management (NRM) Board is not just talking about using urban stormwater as a viable alternative water source, it's doing something about it, with a wetland and aquifer storage and recovery (ASR) scheme at a local golf club.

Planning an ASR scheme in Adelaide, however, is a task not without its hazards—namely, pollution of stormwater run-off from the city's highly urbanised catchments, and the fact that stormwater flows mainly during winter and in large volumes over short periods. Key requirements to effectively capture this stormwater include sufficient open space for large constructed wetlands, where the stormwater from rainfall events can be collected and filtered; and a suitable aquifer, where the water can be stored for later distribution and use.

In the north-western suburbs of Adelaide, a particular site fitted all these requirements to a tee: The Grange Golf Club at Seaton. The club was an ideal candidate for a wetland and ASR scheme: it had the open space necessary for wetland construction; a need for large volumes of water for irrigation during summer; major stormwater infrastructure systems nearby; and a suitable aquifer underground.

Around five years after discussions between the Board and the club first began, The Grange Golf Club Wetland and Stormwater Reuse Scheme was launched—most appropriately—on World Wetlands Day in February 2007. The scheme is now a beacon in the achievement of NRM outcomes in the built urban environment.

A water hazard of a different kind for golfers taking their shots from the fifth tee of the club's east course: the scheme's final cleansing wetland pond. Photo: Randy Larcombe

Ingredients for success

The Grange Golf Club Wetland and Stormwater Reuse Scheme:

- 500 hectares—size of two local upstream catchments to supply stormwater to the scheme
- 300 megalitres—urban stormwater likely to be harvested annually
- 24 000 square metres—series of wetland 'cells' to treat and cleanse the water to a standard suitable for injection into the underlying aquifer, and store it for summer extraction and sustainable irrigation use
- two internationally rated eighteen-hole golf courses—to reduce dependency on groundwater use from the locally stressed aquifer
- 5 years—consultation, feasibility studies, planning and construction
- $2.8 million—joint private and public funding (The Grange Golf Club: about thirty per cent of the total project; government funding: about seventy per cent of the total project)
- partnerships—private (the club); federal (Water Smart Australia program); state (Stormwater Management Fund, administered by the SA Department for Transport, Energy and Infrastructure; AMLR NRM Board); local (City of Charles Sturt, a keen project supporter).

Harvesting the benefits

The scheme has the potential for delivery of triple bottom line outcomes—environmental, economic and social—for the club, the community and the environment—for many years to come.

As the single largest groundwater user in the region, the implementation of this scheme effectively makes The Grange Golf Club self-sufficient on renewable stormwater resources.

The benefits, however, will be felt way beyond the golf course:

- immediate improvement in groundwater pressure in the local aquifer
- contribution to long-term salinity reduction in the local aquifer
- increase in local biodiversity of native aquatic habitats and recreation
- reduction in polluted stormwater inflows to the receiving waters of the Gulf St Vincent
- demonstration of best practice in environmental protection and water conservation
- a facility that can be used by local schools and the community to increase awareness of water conservation and ecological issues.

Paving the way

With the very limited open space available in the developed catchments of urban Adelaide, the completion of the scheme sends a strong message to all large landholders with irrigation requirements that they have a responsibility for the sustainable use of water resources and the use of their land for the greater good of the wider community.

Urban stormwater in Adelaide is a viable and plentiful water source, and a project such as this demonstrates

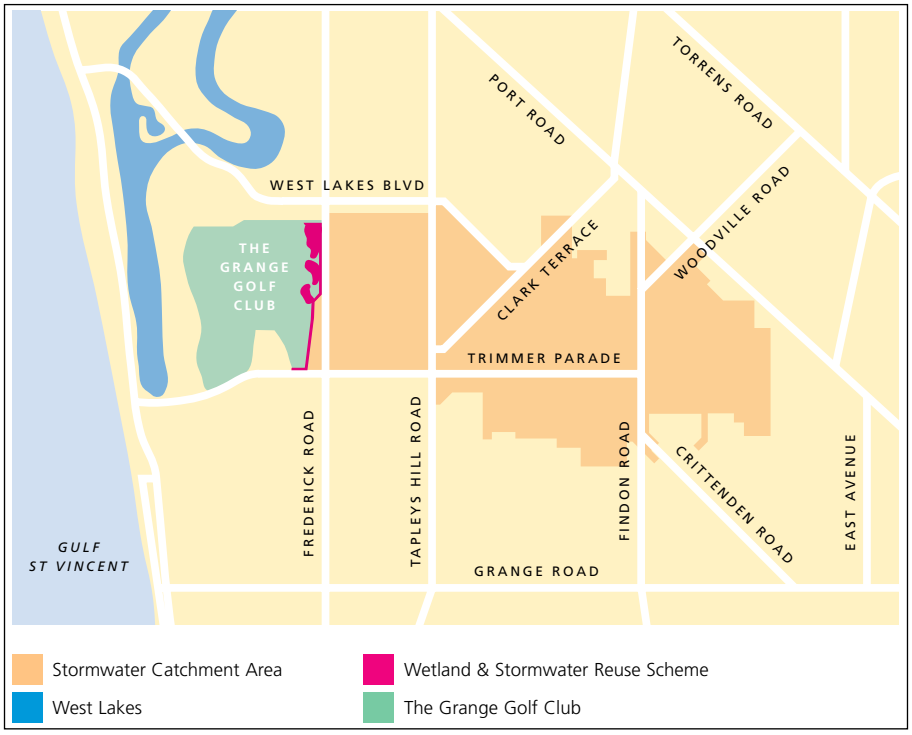
Birds and frogs are already enjoying the improvements in local biodiversity and recreation of native aquatic habitats. Photo: Randy Larcombe

the very real opportunities that exist to reuse millions of litres of stormwater each year. It demonstrates, too, what is achievable when organisations share a vision and work together in the spirit of true partnership to achieve environmental, social and economic outcomes.

The project has now paved the way for even more local investment in protecting the water resources of the Adelaide Plains: similar schemes are teeing off at both Glenelg and Royal Adelaide golf clubs.

The accolades have been many, with the project partners recently winning a 2007 South Australian Water Award (water projects category) from the Australian Water Association.

For further information, please contact Carol Hannaford, Senior Communications Consultant, Adelaide and Mount Lofty Ranges Natural Resources Management Board, on tel: (08) 8273 9100 or visit www.amlrnrm.sa.gov.au.



NSW MURRAY WETLANDS WORKING GROUP

Margrit Beemster, Margrit Beemster Media Services

Winner of the National Thiess River*prize* for 2007

The winner of the prestigious $100 000 National Thiess River*prize* for 2007 is the NSW Murray Wetlands Working Group. The community-based wetlands rehabilitation group, established in 1992, puts its success down to three factors—community involvement, investing in science, and informed management practices.

Much of its work focuses on rehabilitating private wetlands that are largely overlooked, yet are of vital importance to wetland diversity and landscape management. The group averages forty projects a year.

Since 2000, it has also managed environmental water on behalf of the NSW Government in the Murray and Lower Murray-Darling catchments. It has delivered over 75 000 megalitres of environmental water to more than 200 wetlands, covering 71 000 hectares across two catchments.

It is the culmination of the huge amount of work we have done and the support we have had over the years. The real key to it all is that we are able to work with community, whether it is industry, landholders or local government, and get a collaborative result that educates people about what we are trying to do.—Howard Jones, Chair, NSW Murray Wetlands Working Group

Community involvement: Upper Murray Wetlands project

While the importance of protecting large wetlands along the Murray River is recognised, the smaller wetlands in the Upper Murray are also important and contribute to water quality, river health and biodiversity.

The NSW Murray Wetlands Working Group is providing $30 000 over five years to the Hume Rural Land Protection Board to protect and rehabilitate two wetlands—Karara Reserve and Appleton's Reserve—located on travelling stock reserves in the Upper Murray. Although degraded because of grazing, the wetlands are still significant and contain many indigenous species. The new funding is for weed and stock control, fencing materials and biological monitoring of the sites. Previous funding was for fencing and revegetation. The group has been involved in restoring the site since it was first proposed in 2000, providing technical assistance and some initial funds.

The benefits of fencing off and tree planting at Karara Reserve are obvious. Photo: Margrit Beemster

Karara Reserve—The current project builds on earlier work done by the Murray Catchment Management Authority and the local Landcare group. Seven years ago, the reserve's ten-hectare wetland was fenced off, and the regeneration since then is striking. The wetland now boasts good stands of *Phragmates australis* and other wetland plants.

Appleton's Reserve—The project funding aims to alter the management of Appleton's Reserve by helping to cover the loss of income to the Board as a result of both reserves not being grazed; scientific monitoring; weed and pest animal control; preventing unauthorised grazing; photographic monitoring of changes; and repairs to fences (as the reserves border the river, fences are prone to flood damage).

The fact we have been able to attract funding to help us with environmental management is a real bonus. Everything above the Hume Weir seems to have been forgotten politically. But if you parallel it with weed control, where the advice is to work from your least infested areas to your most infested, to my mind rehabilitating a waterway also starts with working on your least degraded section to your most degraded. If we can do what we can on the upper reaches of the Murray, that will help water quality further downstream.—Neale Whitsed, Ranger, Hume Rural Lands Protection Board

Appleton's Reserve in the Upper Murray. Photo: Margrit Beemster

Neale Whitsed and Allan Scammell on the banks of the wetlands at Appleton's Reserve. Photo: Margrit Beemster

Bottle Bend Lagoon near Mildura has been devastated by the effects of sulfidic sediments. Photo: Margrit Beemster

Investing in science: sulfidic sediments project

Understanding how wetlands work—and, when necessary, funding scientific research projects and looking for funding partners—is a key focus of the NSW Murray Wetlands Working Group.

When we have challenging issues, we don't walk away. We engage with the research community to find solutions.—Howard Jones, Chair, NSW Murray Wetlands Working Group

Sulfidic sediments, which are potential acidic sulfate soils, are an emerging and potentially major environmental problem in Australia's inland wetlands. The group first became aware of sulfidic sediments after a drying phase at Bottle Bend lagoon, in the Gol Gol State Forest near Mildura, resulted in massive kills of fish and vegetation in 2002. It commissioned the Murray-Darling Freshwater Research Centre (MDFRC) to survey wetlands for sulfidic sediments along the Murray from Albury to the South Australian border. Further surveys of more wetlands were funded by the NSW Environment Trust.

The results, to date, suggest the problem is more widespread than was first suspected: twenty per cent of eighty-one wetlands throughout the NSW section of the Murray-Darling Basin show evidence of sulfidic sediments, as do twenty out of twenty-eight wetlands in South Australia's Riverland.

In 2007, the group received over $500 000 through the Australian Government Water Fund for a joint project with MDFRC; the group is also contributing $100 000. The project will develop tools and guidelines for environmental water managers to enable them to best manage inland waters to prevent the devastating effects caused by a build-up of sulfidic sediments. It is hoped the project will also give managers advice on how to remediate affected systems.

Sulfidic sediments in themselves are not necessarily a problem unless the management regime of wetlands is changed. And that's what is happening now, with the call to dry out wetlands for water recovery. While drying out wetlands can be good for rehabilitation purposes where wetlands are too wet or unseasonably wet, the problem now is if you start to do that and it produces sulfidic sediments, we don't know exactly what the long-term impacts are on the wetlands and the river. In some instances, you might get acid pulses … and you get lots of fish kill and lots of dead vegetation. It happened at Bottle Bend and we suspect it will happen at other places.—Howard Jones, Chair, NSW Murray Wetlands Working Group

The NSW Environment Trust is providing funding for communication and workshops to train implementation officers within the catchment management authorities and for an educational CD-ROM that has been widely distributed across New South Wales.

Informed management: *River Murray wetlands database atlas*

Although the River Murray wetlands have been mapped before, information about commence-to-flow levels for individual wetlands has now been collated for the first time. A new atlas produced by the NSW Murray Wetlands Working Group will take the guesswork out of knowing what height the Murray River needs to be in order for wetlands to receive water.

The *River Murray wetlands database atlas*, launched in October 2007 by Wendy Craik, Chief Executive of the Murray-Darling Basin Commission (MDBC), is a valuable new tool for river managers and others involved in wetland rehabilitation.

It contains details on over 4000 wetlands along the Murray River from the Hume Dam to the South Australian border, with maps, summaries, aerial photographs and photographs of wetland vegetation. The atlas is a hard-copy version of the group's spatial database, a geographic information system based on the MDBC's *River Murray mapping*. Information for the database comes from a variety of sources—interviews with landholders, field assessments at a range of river flow levels, satellite image analysis and previous studies. The atlas has a protective glaze on all pages, making it practical for use in the field.

The $500 000 project has been funded by the MDBC, the Australian Government, the former Department of Natural Resources (NSW) and the group.

To purchase a copy of the atlas or for more information on individual wetlands, please contact the group's executive officer, Deb Nias, at email: deb.nias@cma.nsw.gov.au or on tel: (02) 6051 2223.

PROTECTING ESTUARINE WETLANDS: GREAT LAKES COASTAL CATCHMENTS INITIATIVE

Peter Scanes, Head, Coastal Waters Science, NSW Department of Environment and Climate Change

Jocelyn Dela-Cruz, Geoff Coade, Jaimie Potts, Brendan Haine and Max Carpenter

A few years ago the former chief of CSIRO Land and Water, Dr Graham Harris, was invited to advise Great Lakes Council on how best to manage Wallis Lake, on the NSW lower North Coast. The story (perhaps apocryphal) goes that he was standing and looking at the lake when he remarked, 'If you are looking at the lake and wondering how to manage it, then you have your back to the real problem'. He was, of course, saying that most of the environmental problems affecting coastal wetlands have their root cause in the lands that surround the wetland: you don't manage estuarine wetlands, you manage their catchments.

This is the philosophy adopted by the Great Lakes Coastal Catchments Initiative. The GL CCI is part of the national Coastal Catchments Initiative funded by the Australian Government. It seeks to deliver significant reductions in the discharge of pollutants from coastal water quality 'hot spots'. More specifically, the GL CCI is based on the concept that land uses within the catchment have the potential to alter the loads of nutrients and sediments entering the creeks and rivers, which in turn have the potential to substantially affect the ecological values of the lakes. Our brief was to develop models for catchment run-off and estuary function for a decision support system that will be used to produce plans to improve water quality. The modelling approach was based on two well-founded theories:

- Reduced light penetration through the water (e.g. due to sediment run-off) will lead to death of plants attached to the lake floor. There is a strong positive relationship between seagrass survival and secchi depth, which is a measure of the clarity of surface waters. Sea grass does not survive past a secchi depth of four metres.
- Excessive nutrients will result in the development of algal blooms. The growth of algae occurs in two phases. Initially, there is a very high-level response (bloom) when nutrients are exported from the catchment following rain. The bloom rapidly consumes all the available nutrients in the water and slowly dies and reduces in intensity. As it dies, the algal cells with their absorbed nutrients fall to the lake floor and are broken down by microbes in the lake sediments. Over time, the store of added nutrients in the lake sediments increases and is released back to the water column to sustain a level of algae that is relatively high (but lower than during the bloom) between rainfall events.

Here we present three case studies to illustrate how these theories are in operation in Wallis Lake. The first two case studies show how actions in developed catchments are degrading the lake, and the third shows the condition of a largely pristine portion of the lake.

Table 1: Wallis Lake, modelled loads of nutrients and sediments from catchment of case study areas (kilograms per square kilometre per year)

	Total nitrogen	Total phosphorus	Total suspended solids
Pipers Creek and Bay	762	73	270
Coomba Bay	113	5	2
Pacific Palms	78	4	10

Case study 1: Coomba Bay

Coomba Bay includes much of the western shore of Wallis Lake basin. The catchment is mainly forested, but there is about 1600 hectares of cleared agricultural land fringing the lake in the central and northern parts of the bay. A small number of creeks and drainage lines cross the agricultural land and enter the bay. Current estimates indicate that the amounts of nutrient and sediment input from the main part of the catchment are relatively small (Table 1). Considering these estimates, it was surprising that recent aerial photography showed the absence of seagrass and an area of turbid water in the central portion of Coomba Bay (Figure 1). The area devoid of seagrass is immediately adjacent to the site of a large erosion gully that developed during the early 2000s but was remediated by the Great Lakes Council in 2005. The gully was up to 300 metres long and estimated to be three to four metres wide and two metres deep. Given these dimensions, and assuming that the density of sediment is 1.2 tonnes per cubic metre, we estimated that the gully would have delivered 2100 tonnes of sediment. This is in stark contrast to current estimates of 0.004 tonnes/year for the rest of Coomba Bay.

Despite remediation, it appears that the ecosystem is still being affected by the sediment from the gully erosion. Certainly our current surveys show an area (2.5 hectares) near the lake shore covered by a layer of fine sediment of up to 200 millimetres thick. The sediment is similar to the surrounding soils and very different from the normal black lake-bottom sediment. We found no living seagrass in areas where the sediment had deposited; we also found that the waters were very turbid (15 to 20 nephelometric turbidity units, compared with an expected value of 0 to 2 nephelometric turbidity units). Video transects showed living seagrass beyond the zone where the sediment had deposited, out to a depth of two metres. This compares with the average seagrass survival depth for the lake of 3.5 metres. Water quality sampling showed chlorophyll concentrations (a measure of algal biomass) of 3.1 micrograms per litre in Coomba Bay (indicative of a moderate level of excess algal growth) in comparison with less than 1.6 micrograms per litre in other parts of Wallis Lake.

Figure 1. Coomba Bay, 7 June 2007, showing turbid (dirty) water and absence of seagrass. Only a narrow band of seagrass has managed to survive between the smothered area and depths where the turbid water prevents sufficient light from reaching the lake bed. Photo: Brendan Haine

Case study 2: Pipers Creek and Pipers Bay

Pipers Creek and Bay receive all the runoff water from medium-density urban and light industrial development on the eastern side of the Wallis Lake complex. The amounts of nutrients produced by the catchment are quite large (Table 1). As a consequence, large blooms of macroalgae are obvious on seagrass beds in the lower estuary (Figure 2). Our studies indicated that while turbidity values were moderate (4–6 nephelometric turbidity units), chlorophyll concentrations in Pipers Creek were among the highest measured anywhere in the system, averaging 8.6 micrograms per litre and peaking at 12 micrograms per litre. The average value is five to six times greater than expected values and represents a significantly degraded ecosystem.

The ecological indicators for Pipers Creek show that it is one of the most degraded parts of the Wallis Lake system. The large amounts of algae, both as chlorophyll and attached macroalgae, suggest that nutrient enrichment is the greatest problem in Pipers Creek, with turbidity from catchment soil loss a secondary issue.

Figure 2. Excessive growth of macroalgae over seagrass beds in Pipers Creek. Photo: Peter Scanes

Case study 3: Pacific Palms and the southern bays

The southern bays of Wallis Lake, in contrast, are in near pristine condition. They support a wide variety of seagrass, healthy algae and brackish water plant communities to a water depth in excess of three metres. These benthic plant communities are dependent on clear, clean water with very low nutrient loads. Current water quality measurements for the southern bays revealed chlorophyll concentrations less than 1 micrograms per litre, turbidity below 2 nephelometric turbidity units and secchi depths in excess of three metres. These near pristine conditions have allowed the continued survival of the ecologically important macrophyte communities, with their associated biodiversity, including the rare and diverse estuarine sponges (Figure 3), in the southern parts of Wallis. The sponge communities of Wallis Lake are the most diverse and rare in New South Wales. The hydrological separation of southern Wallis and the relatively small surrounding catchment with largely intact natural vegetation means that only very low amounts of nutrients and sediments ever reach these bays. Modelled estimates from the surrounding catchment (Table 1) indicate loads are small. The slightly higher loss of sediments is a result of the catchment being very steep and containing highly erodible soils. This makes the catchment very vulnerable to disturbance and likely to produce extremely large amounts of nutrients and sediments if land use changes inappropriately.

If conditions are allowed to deteriorate—in particular, if there are increased loads of sediments and nutrients entering these bays—all the symptoms of poor health that have been described for Coomba and Pipers bays (high chlorophyll levels, turbid water, poor light penetration, loss of benthic plants) will begin to occur and a locally unique ecosystem will be lost.

Figure 3. Healthy clear-water ecosystems with estuarine sponges and perennial algae in Pacific Palms. Photo: Max Carpenter

What can we learn from this?

The Wallis Lakes case studies show clearly that the impacts of catchments on estuarine wetlands exist not only in theory but are occurring right now. Here, there are obvious contrasts among parts of the lake—Pacific Palms, with its very small catchment-related inputs, where healthy and biologically diverse ecological communities flourish to the maximum depths possible in clear, low-nutrient water; Pipers Bay, with algal blooms resulting from large inputs of catchment nutrients; and Coomba Bay, which is experiencing the loss of its seagrass, killed off by a large input of sediments, with continual long-term turbidity in the waters of the bay as a result.

Unless catchments are protected from inappropriate changes to land use, the environmental and social values of the lake will continue to be degraded. The Water Quality Improvement Plan being developed through the Coastal Catchments Initiative process will provide the basis for prediction of potential environmental harm from changes to land use in catchments and will support decision making to help protect the environmental values of the Great Lakes.

If you would like more information about the case studies, please contact Dr Peter Scanes at email: peter.scanes@environment.nsw.gov.au.

Useful web links

www.environment.gov.au/coasts/pollution/cci/index.html

www.greatlakes.local-e.nsw.gov.au/environment/9292.html

Acknowledgments

The GL CCI receives the majority of its funding from the Australian Government through the Department of the Environment, Water, Heritage and the Arts and is co-funded by Great Lakes Council and NSW Department of Environment and Climate Change.

THE NARRAN ECOSYSTEM PROJECT: ANIMAL COMMUNITIES AND EPHEMERAL WETLANDS

Martin Thoms, Environmental Science, University of Canberra

Large floodplain wetlands are a characteristic feature of Australia's inland river systems. These ecosystems are centres of high biodiversity that play an important role as feeding and breeding sites for many migratory waterbirds, fish and other animals. They are 'oases' in an otherwise dry landscape. While many dry out during extended periods of no rainfall and stream flow, their refilling acts like a magnet for a great variety of animals, both large and small.

The Narran ecosystem is an important system in north-west New South Wales. In June 1999, it was listed under the Ramsar Convention as a wetland of international importance, being an excellent example of a relatively undisturbed terminal floodplain lake system. It is a significant site for many animals, both nationally and internationally, because it provides habitat for some species that are recognised as being of conservation concern at a regional, state or national level. Some of the animals that utilise the Narran ecosystem are described below.

The Narran ecosystem provides important habitat for a large number of migratory birds. In 1983, 400 000 waterbirds were recorded in the Narran ecosystem. In total, sixty-five species of waterbirds have been recorded in the Narran ecosystem; of these, five are listed under the NSW *Threatened Species Act 1995*, at least eight are of conservation concern in western New South Wales, and eight wader species are listed under international agreements for migratory waders. Colonial waterbirds—those that nest in colonies—are particularly important in the Narran ecosystem, and these include the Australian Pelican, Little Egret, Glossy Ibis, Intermediate Egret, Straw-necked Ibis, Pied Cormorant, Pacific Heron, Great Cormorant and Royal Spoonbill.

Waterbirds including ibis and black swans are found in the Narran Lakes. Photo: Arthur Mostead

Floodplain wetlands like Narran are also important to fish communities because they provide excellent habitat for feeding and breeding. During the 2004 flood event, 31 955 fish from eight families and eight species (native: eight and exotic: three) were caught. These were Spangled Perch, Bony Bream, the common Carp, Hyrttl's tandan, Yellow belly, Goldfish, Mosquito fish, Silver perch, Murray cod, Western carp gudgeon and Australian smelt. During this flood, three species dominated the fish found in the system, accounting for ninety-nine per cent of the total catch: Spangled perch (forty-eight per cent), Carp (twenty-seven per cent) and Bony bream (twenty-four per cent). Spangled perch and Bony bream were more abundant during the early stages of the flood but their numbers dwindled as the water receded. Carp were virtually absent early in the flood event; however, they dominated by the end.

At a very small scale, zooplankton—microscopic animals (usually less than one millimetre long) that drift or swim in water—are an important part of floodplain wetland foodwebs. These tiny animals are well adapted to variations in flow and their eggs can remain viable in dry soils for years. Once the dry soil becomes wet, these minute creatures emerge from the soil. Important groups found in the Narran ecosystem include rotifers (wheel animals), cladocerans (water fleas) and copepods (minute crustaceans related to shrimps and crabs). During the 2004 flood event, the numbers collected ranged from ten animals per litre to four thousand animals per litre. Overall, copepods and cladocerans (both juvenile and adult) were less abundant, although they did increase in number during drying of the floodplain wetland.

The Narran Ecosystem Project was a four-year project funded by the Murray-Darling Basin Commission and managed by eWater Cooperative Research Centre and the Riverine Landscapes Research Laboratory, University of Canberra. Contact Professor Martin Thoms for further details at Martin.Thoms@canberra.edu.au.

Aerial view of the Narran ecosystem, featuring a view north towards Clear Lake in the distance. Photo: Arthur Mostead

Mussell shell found on the floodplain at Back Lake, in the Narran ecosystem. Photo: Arthur Mostead

Glossary

adaptive environmental water. Water committed under an access licence for specified environmental purposes, either generally or at specified times or in specified circumstances.

bioregion. A relatively large area of land or water that contains a geographically distinct assemblage of natural communities.

karst. A region composed of limestone or dolomite and characterised by underground drainage systems, sinkholes and gorges.

midden. A mound of shells of edible molluscs and other refuse, indicating prehistoric human habitation.

montane. Mountain top ecology.

Ramsar. The Convention on Wetlands of International Importance, especially as Waterfowl Habitat (the Ramsar Convention), agreed in Ramsar, Iran in 1971. It aims to achieve 'the conservation and wise use of wetlands by national action and international cooperation as a means to achieving sustainable development throughout the world'.

tufa (calctufa). A sedimentary rock (limestone or silica) deposited in or around springs, lakes and rivers.

wetland. The Ramsar Convention definition of 'wetland' includes areas of marsh, fen, peatland or water—whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt—including areas of marine water that does not exceed six metres at low tide. A wetland may also incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands.

Shorebirds, Robbins Island. Photo: Fiona Spruzen

The Australian Government facilitator network

The Australian Government funds a network of facilitators to support the regional delivery of natural resource management.

The primary purpose of the Australian Government NRM facilitators is to support and communicate Australian Government policies, programs and priorities. These facilitators also engage relevant government, industry and community stakeholders in relation to one of four broad natural resource management themes:

- biodiversity
- coasts and marine
- sustainable resource use
- water.

The thirty Australian Government facilitators located across the country foster activities that fall within the Bushcare, Landcare, Coastcare, and Rivercare themes. The Rivercare facilitators have an extensive understanding of river and wetland issues. Their contact details are:

	Name	Email	Phone	Mobile
Queensland	Brad Lewis	brad.lewis@csiro.au	(07) 3214 2369	0438 201 246
New South Wales	Sally Hunt	sally.hunt@environment.gov.au	(02) 4388 2163	0428 874 846
Australian Capital Territory	Michael Schultz	michael.s.schultz@environment.gov.au	(02) 6272 3305	0438 093 798
Victoria	Pam Robinson	pam.robinson@dse.vic.gov.au	(03) 9637 8979	0438 089 231
Tasmania	Imogen Birley	Imogen.Birley@nht.tas.gov.au	(03) 6233 3401	0439 410 040
South Australia	Paul Francis	paul.francis@csiro.au	(08) 8203 8102	0439 411 431
Western Australia	Felicity Bunny	felicity.bunny@csiro.au	(08) 9333 6706	0438 218 162
Northern Territory	Russell Willing	russell.willing@nt.gov.au	(08) 8999 4507	0438 089 281

For more information about the Australian Government NRM facilitator network please refer to the Natural Resource Management website at www.nrm.gov.au/do/facilitator.html.

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 Australian Government Department of the Environment, Water, Heritage and the Arts on (02) 6274 1111 or via email: wetlandsmail@environment.gov.au.

www.environment.gov.au/water/environmental/wetlands