# Ecological monitoring summary

*Coorong and Lakes Alexandrina and Albert | July 2013 to June 2014*


Photo: David Palmer, EPA

Water quality monitoring, Coorong

## Lakes Alexandrina and Albert

From July to September 2013, **water levels** in Lake Alexandrina fluctuated between 0.6 and 0.82 m Australian Height Datum (AHD) due to variable tide and flow conditions. From September to mid November 2013, water levels were raised gradually from around 0.62 m AHD to a maximum of 0.80 m AHD. Water levels were dropped from mid November 2013 over several weeks, in order to push more water out of the barrages in an attempt to maintain Coorong water levels and target *Ruppia tuberosa* recruitment. Lake levels were then raised to nearly 0.80 m AHD in early January 2014 in preparation for a long period of low River Murray flows during which the Lake Victoria outlet regulator was upgraded. Lake levels were gradually reduced from mid-January 2014 until March 2014 in order to continue barrage releases through this dry period.

Generally the **water quality** in Lake Alexandrina and the Goolwa Channel has returned to pre-drought conditions, however this is still not the case for Lake Albert. Average **salinity** in Lake Alexandrina remained between 400 and 800 electrical conductivity (EC) units, with the exception of short-term salinity spikes at the barrages due to reverse head events in July and August 2013 and June 2014. Salinity in Lake Albert continued to improve, with the average salinity in Lake Albert at 3000 EC in June 2013 and rapidly reducing to 2700 EC in early July 2013.

From early July 2013 to mid-June 2014 salinity remained between 2700 and 2400 EC. These values still exceed pre-drought conditions, which typically averaged around 1500 EC.

Monitoring of surface water quality parameters (pH, alkalinity and acidity) indicated these remained stable and above all acidification trigger levels. However, after several years of post-drought conditions the shallow groundwater below lake margins still showed the presence of acidity and metals (including Aluminium, Manganese and Iron), which remain above Australian & New Zealand Environmental Conservation Council (ANZECC) guidelines. This groundwater is slowly recovering via natural remediation.

Monitoring has determined that if the Lakes' submerged **acid sulfate soils** (ASS) were to be exposed again they may oxidise more quickly, and reduced acid neutralising capacity in some sediments could also result in a larger impact on the water quality in many areas. The soil pH beneath surface sediments has not returned to pre-drought levels and the acidification and contaminant hazards remain high around many parts of the lakes. Acidity has not been lost from the Lower Lakes - it has just been recycled back into sulfide minerals.

An **ecotoxicological** assessment to better understand the environmental impacts of acidification events has also indicated that contaminants generated at ASS impacted sites, if bioavailable, could be severely toxic to aquatic organisms.

Government of South Australia

Australian Government

MURRAY–DARLING BASIN AUTHORITY

Photo: Scotte Wedderburn, The University of Adelaide

Aquatic vegetation, Dunn's Lagoon Clayton (*Myriophyllum sp.* and *Azolla filiculoides*)

Photo: Kate Mason, DEWNR Natural Resources SA MDB

Water rat

Although water quality had recovered in Lake Alexandrina and the Goolwa Channel, there was a lag in microalgae abundance returning to pre-drought levels, and since 2012/13 this lag has actually increased. Lake Albert has a bigger lag in the return to pre-drought abundances compared to Lake Alexandrina, which is strongly associated with salinity and oxidised nitrogen. There has been a decline in cyanobacteria in Lake Alexandrina since the return of flows in 2010, however it is still the dominant microalgal community.

The Lake Alexandrina and Goolwa Channel **zooplankton** communities were dominated by River Murray taxa, primarily rotifers and juvenile stages of copepods. Higher diversities in the Goolwa Channel reflect inputs from Currency Creek and the Finniss River. These tributaries supported discrete assemblages of riparian/epiphytic/epibenthic/littoral microfauna which appear in the zooplankton assemblages during high flows but which are not 'technically' planktonic. High and moderate salinity-tolerant zooplankton were present in Lake Albert. The rotifer *Filinia pejleri* had its greatest density in Lake Albert and the rotifer *Hexarthra brandorffi* was found only there.

No **benthic macroinvertebrate** recovery was detected in the sediments around the lakeshores with variable abundances and diversity recorded and no increase from previous years. No defined benthic macroinvertebrate communities were detected. Specifically, the sediments around the lakes continue to be inhabited by few macroinvertebrate species, with most recorded being larval stages of insects.

The submerged **aquatic vegetation** community was resilient and recovering, but differed in terms of cover and diversity from the community present prior to the drawdown of water levels. The community has shifted from being dominated by terrestrial taxa during the drought to submergent, emergent, floating and amphibious taxa. Around the shoreline of Lake Alexandrina there was an increase in the proportion of emergent and amphibious species between spring 2013 and autumn 2014, with *Calystegia sepium, Berula erecta, Mentha australis,* and *Typha domingensis* significant indicators of the autumn 2014 survey. *T. domingensis* and *Phragmites australis* continued to dominate the shorelines of Lake Albert and the plant community predominantly consisted of emergent species.

Monitoring of **frogs** between September 2013 and January 2014 involved a combination of call identification and active searching. A total of eight species was recorded including the painted frog (*Neobatrachus pictus*) which had not been detected in previous years. With the continued return of water to fringing wetland habitats and waterways, it had been expected that records for the *Environment Protection and Biodiversity Conservation (EPBC) Act* vulnerable-listed southern bell frog (*Litoria raniformis*) would match or exceed that gathered in previous years, but this was not the case. Records came from only two locations surveyed, both of which have been associated with recent or historical records of southern bell frog presence. Maintenance of water levels since 2010 has increased the area and complexity of habitats in many areas of Lakes Alexandrina and Albert. Being a species that is recognised to move significant distances, responsive to flooding, and known to readily occupy new areas, it is possible that dispersal and occupancy of new areas has made southern bell frog harder to detect.

An innovation for monitoring in 2013/14 was the trial of motion-sensor cameras to detect wetland mammals during April and May. Cameras were beneficial in recording nocturnal species, particularly the presence of **water rats** (*Hydromys chrysogaster*) and **swamp rats** (*Rattus lutreolus*). Water rats were identified at four camera trapping sites and swamp rats at one of the camera trapping site within days of camera installation. The outcomes of the trial show this approach to assessing the distribution of water rats in the region is worth pursuing further in 2014/15.

Photo: Kate Mason DEWNR Waterbirds at Narrung wetland

The monitoring of **threatened small-bodied fishes** in the Lower Lakes recorded the four species that were part of the reintroduction process undertaken between 2011 and 2013. They were captured in very low numbers, even though habitat and water quality were apparently suitable. A total of 255 Murray hardyhead (*Craterocephalus fluviatilis*) were captured across eight sites (in November 2013 and March 2014). Murray hardyhead was the only threatened species to show substantial levels of recruitment in the Lower Lakes, naturally re-colonising two areas (Goolwa Channel and Dog Lake). By comparison, only six southern purple-spotted gudgeon (*Mogurnda adspersa*) were captured at one site, 15 southern pygmy perch (*Nannoperca australis*) at two sites, and two Yarra pygmy perch (*N. obscura*) at one site. There was evidence of localised recruitment for a precarious southern pygmy perch population on Mundoo Island, which represents some success of the reintroduction project. There was, however, no evidence of recruitment for Yarra pygmy perch. Unmeasured factors, such as starvation or predation by the introduced redfin perch (*Perca fluviatilis*), may have contributed to the limited recruitment in both species of pygmy perch. Populations are yet to return to pre-drought abundances.

Nearly 79,000 **waterbirds** from 58 species were recorded in the Lower Lakes in January 2014, which equates to only 25 per cent of the total number of waterbirds recorded throughout the whole site in this year. The most abundant species were the Australian Shelduck (*Tadorna tadornoides*) and Great Cormorant (*Phalacrocorax carbo*). High and stable water levels generally reduce productivity and are not ideal conditions for many waterbirds, especially migratory waders.

Photo: Scotte Wedderburn, The University of Adelaide Fyke netting for fish, Lake Alexandrina

**Cryptic waterbird** surveys indicated that the distribution, abundance and species were comparable between 2012 and 2013, with only the Little Bittern (*Ixobrychus minutus*) missing in 2013 from species recorded in 2012. While the total number of individuals recorded was lower in 2013 than 2012 for many species, the overall the pattern of distribution and abundance for cryptic waterbirds in the region did not change significantly across the two surveys. Numbers of **colonial nesting waterbirds** (Australian white ibis *Threskiornis moluccus* and straw-necked ibis *Threskiornis spinicollis*) were higher in 2013/14 than 2012/13.

## Coorong and Murray Mouth

Average Coorong South Lagoon **water levels** peaked at around 0.95 m AHD in September 2013, and dropped to a minimum of around -0.30 m AHD in March 2014. There was a rapid reduction in water levels from late October – November 2013. Average Coorong South Lagoon **salinity** ranged from approximately 55 parts per thousand (ppt) in October 2013 to a maximum of 96 ppt in March 2014, thus remaining below the target 100 ppt threshold for the year. The Murray Mouth remained open without the need to dredge for the entire year, and barrage releases were maintained throughout 2013/14. Approximately 1,300 GL of water was released from the barrages during 2013/14, consisting of unregulated flow and environmental water.

Photo: David Paton,
The University of Adelaide

Black swans, Coorong

(provided by The Living Murray and Commonwealth Environmental Water Office). Flows were prioritised at fishways and in barrage bays adjacent to fishways to provide attractant flow.

**Microalgae** communities along the Coorong showed major differences, with Parnka Point and Villa de Yumpa in the South Lagoon and Long Point in the North Lagoon particularly different from other sites. For the water quality parameters, barrage discharge, turbidity and salinity were primary determinants of the differences seen in microalgae communities between sites, while Total Nitrogen was the second determinant of change.

In the southern Coorong South Lagoon there were high salinity tolerant **zooplankton** assemblages, comprising estuarine or inshore marine species similar to the salt lakes in the South East. The zooplankton in the southern end of the North Lagoon contained a mix of freshwater, high and moderate salinity tolerant species. The freshwater zooplankton species in the North Lagoon are thought to be from the lakes due to barrage flows.

Among **macroinvertebrates** in Coorong mudflats, signs of recovery were based on higher numbers of species and increased abundances of individuals at sites throughout the Murray Mouth and into the northern South Lagoon. Most species maintained a distribution consistent with that from the previous year's monitoring survey. Encouragingly, increased species numbers were found around Hells Gate where the South and North Lagoon meet and in the North Lagoon, although these species were in relatively low numbers. For example, the small bivalve *Arthritica helmsi,* which was very abundant before the drought, continued to recolonise the mudflats. The vertical distribution of macroinvertebrates also improved, with more species and high abundances in the deeper sediment layers at several sites. Based

Photo: Benjamin Hamilton, EPA

Zooplankton monitoring, Coorong

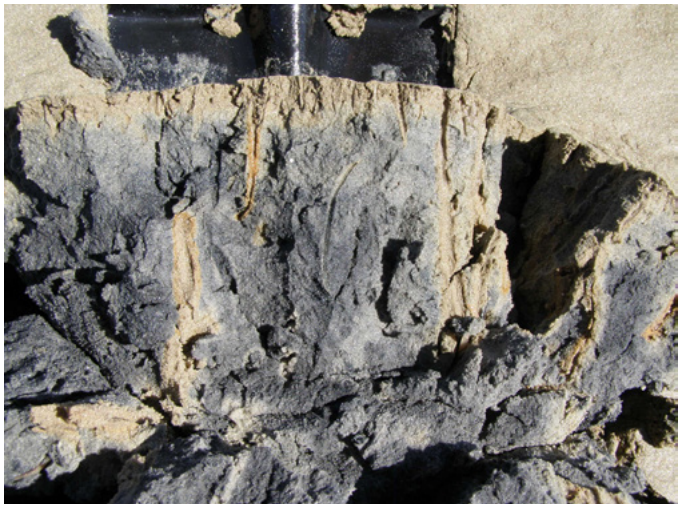

Photo: Sabine Dittmann,
Flinders University

Worm casings in
Coorong sediments

on abundance and biomass data, food availability for shorebirds in the Coorong was one of the highest in 2013/14 since this monitoring began in 2004.

Over 230,000 **waterbirds** from 70 species were recorded in January 2014 in the Coorong during the annual waterbird census (an increase from the 187,000 recorded at the same time the previous year). Food resources (including *Ruppia tuberosa,* smallmouthed hardyhead, sandy sprat and benthic invertebrates) in the Coorong were maintained or increased compared to previous years. Fairy tern *(Sternula nereis)* numbers remained relatively stable, with individuals prominent at the southern end

Photo: Sabine Dittmann, Flinders University

Sharp-tailed Sandpipers at Coorong mudflats

Photo: Qifeng Ye, SARDI Aquatic Sciences

Juvenile black bream

of the North Lagoon and in the mid-section of the South Lagoon. Red-necked Stint *(Calidris ruficollis)* and Sharp-tailed sandpiper *(calidris acuminate)* numbers increased in the Coorong in 2013/14. Appropriate water levels were present in the Coorong over summer for migratory waders. Many species of shorebird found at the Coorong are not found at other wetlands in the Murray-Darling Basin. Numbers of **Colonial nesting waterbirds** in the Coorong (Australian Pelican *Pelecanus conspicillatus* and crested tern *Thalasseus bergii*) were slightly lower in 2013/14 than 2012/13.

**Estuarine fish** at the barrage fishways were sampled over spring and summer 2013/14. The fish assemblage was diverse, and similar to that sampled in 2011/12. However, abundances of catadromous congolli *(Pseudaphritis urvillii)* and common galaxias *(Galaxias maculatus)* were the highest sampled since the monitoring program began in 2006, with the majority being

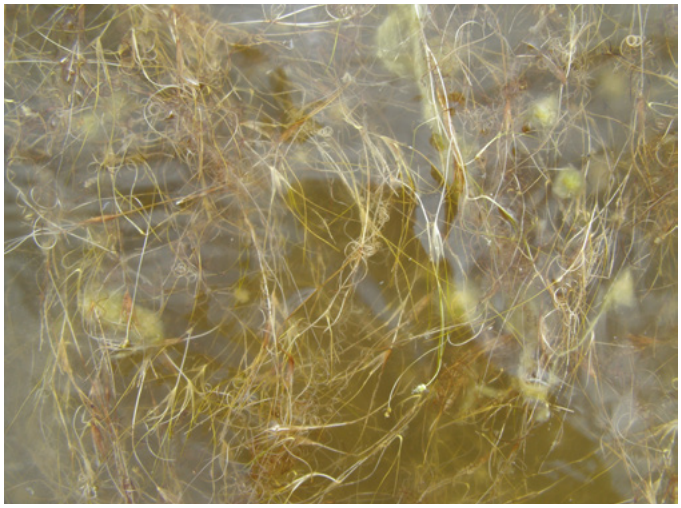

Photo: Sabine Dittmann, Flinders University

*Ruppia tuberosa,* Coorong South Lagoon

young-of-year individuals, attempting to move upstream. In general, the fish community trended towards a diverse and variable assemblage characteristic of a dynamic estuarine environment. The importance of providing freshwater releases through the barrages and consecutive years of continuous barrage releases are highlighted by the strong recruitment in catadromous species.

Recruitment of **large-bodied fish** was generally maintained in the Coorong despite some spatial variations in new recruit abundance. These included estuarine species: yelloweye mullet (*Aldrichetta forsteri)*, greenback flounder *(Rhombosolea tapirina)* and mulloway *(Argyrosomus japonicus)*. Several small-bodied fish, including sandy sprat *(Hyperlophus vittatus)*, smallmouthed hardyhead *(Atherinasoma microstoma)* and Tamar goby *(Afurcagobius tamarensis)* showed a general increase in abundance particularly in the estuary region. These species are important prey for piscivorous fish and birds. For the iconic estuarine fish, black bream *(Acanthopagrus bucheri)*, the level of recruitment and population abundance remained low in 2013/14 although this species has been more broadly distributed in the Coorong since 2010/11 due to increased flow releases and reduced salinity. A number of species continued to be present in the South Lagoon, including smallmouthed hardyhead, black bream, yelloweye mullet, congolli and bony herring *(Nematolosa erebi)* during 2013/14.

The submerged aquatic plant ***Ruppia tuberosa*** continued to increase in distribution and cover in the Coorong South Lagoon. This is likely due to two factors: the delivery of environmental water through the barrages in November and early December 2013; and the *Ruppia* translocation project in which sediment (including *Ruppia tuberosa* seed) from Lake Cantara in the South East of South Australia was introduced to a number of sites along the Coorong South Lagoon. Despite these interventions, and widespread flowering in November and early December

2013, little increase in the net seedbank of this species was recorded in January 2014. However, a much higher proportion of seed collected was viable compared to previous years. Maintaining suitable water levels in the Coorong South Lagoon through November and early December (to allow sufficient inundation of plants so they can complete their lifecycle) is still considered the most important factor in promoting successful recruitment, however rapid changes in salinity and the presence of filamentous green algae can also disrupt reproduction.

## Environmental and Cultural Health

The **Ngarrindjeri Regional Authority (NRA)** support a range of actions in the Coorong and Lakes Alexandrina and Albert, to remediate and build resilience at the site. Freshwater flows down the Murray-Darling system are seen by the Ngarrindjeri as the life blood of the living body of the River Murray, Lower Lakes and Coorong. Maintaining connectivity between parts of the living body is a Ngarrindjeri cultural priority. In 2009 the South Australian Government and the Ngarrindjeri people entered into a **Kungun Ngarrindjeri Yunnan Agreement** (KNYA). Through the partnership formed by the KNYA, there has been significant work jointly undertaken by the NRA and DEWNR in monitoring and research programs funded through the CLLMM Recovery and TLM initiatives. These programs recognise Ngarrindjeri values and incorporate Ngarrindjeri expertise and capacity.

All monitoring programs in the region are assessed from a cultural heritage perspective by the NRA and monitoring contractors are required to undertake cultural heritage training before working on country. The NRA have also provided field assistance for several fish monitoring programs, were a major delivery partner in the ***Ruppia* translocation project** and provided advice and guidance on annual environmental watering priorities through the Yarluwar-Ruwe (sea country) program. Formal statements of commitment have been developed to guide engagement and implementation for the *Ruppia* translocation, Ecological Character Description and State Water Planning processes. Ngarrindjeri support the aims of ensuring a diversity of healthy wetland habitats and restoring and maintaining connectivity between habitats. The fundamental connection between the health of this system and Ngarrindjeri culture is informing the management responses.

## Conclusion

The process of ecological recovery following drought has continued in 2013/14 for the Coorong and Lakes Alexandrina and Albert. Monitoring has revealed that while the water quality in Lake Alexandrina and the Goolwa Channel has returned to pre-drought levels, this is generally not the case for Lake Albert. Monitoring has also shown that soil pH levels in several previously exposed areas around the lakes have not returned to normal levels and the acidification hazard remains high in many areas.

Monitoring of the key biota of the region has also determined varying rates of recovery for different species. While some fish such as the diadromous congolli and common galaxias have shown a positive and immediate response to the return of flows, other species such as southern bell frog, pygmy perch, black bream and *Ruppia tuberosa,* have still not recovered in terms of abundance and distribution recorded prior to the drought. The water levels in the Coorong through spring and summer provided appropriate feeding habitat for migratory waders, however the relatively high and stable levels in Lakes Alexandrina and Albert have limited productivity in the fringing lake edge and wetland habitats. More variable water levels in future may provide improved habitat for waterbirds, threatened fish and frogs.

Continued recovery is dependent on future freshwater flows to the site. In addition to continuous flows through the fishways throughout the year to support connectivity, substantial barrage flows are required over spring and summer to facilitate appropriate water quality and water level conditions in the Coorong. These flows also allow for seasonal water level changes in the lakes, and extra inundation of fringing wetlands. Barrage flows are also required throughout the year to minimise sand accumulation in the Murray Mouth.

Other management interventions may also help to achieve ecological outcomes. These include: water level manipulation in managed wetlands of the Lower Lakes (i.e. Narrung, Waltowa, Tolderol and Jenny's Lagoon); a continuation of the *Ruppia* translocation project; barrage release management (i.e. Boundary Creek trickle flow); and the construction of new barrage fishways.

Continuing the meetings and provision of advice from the Lower Lakes, Coorong and Murray Mouth Scientific Advisory Panel / Group (SAP) and the Coorong, Lower Lakes and Murray Mouth Community Advisory Panel (CAP), as well as working with the NRA, will assist DEWNR to continue to make informed decisions about the best use of environmental water and barrage operations to deliver effective environmental outcomes.

## Monitoring Staff and Organisations

| Category | Organisation | Lead Scientists |
|---|---|---|
| **Aquatic vegetation (Lower Lakes)** | SARDI Aquatic Sciences | Jason Nicol<br>Susan Gehrig |
| **Small-bodied threatened fish (Lower Lakes)** | The University of Adelaide<br>SARDI Aquatic Sciences<br>Nature Glenelg Trust/Aquasave | Scotte Wedderburn / Tom Barnes<br>Chris Bice<br>Nick Whiterod |
| **Waterbirds** | The University of Adelaide<br>Coorong Nature Tours | David Paton / Colin Bailey<br>David Dadd |
| **Barrage fishway movement and recruitment** | SARDI Aquatic Sciences | Brenton Zampatti<br>Chris Bice |
| **Ruppia tuberosa (Coorong)** | The University of Adelaide | David Paton<br>Colin Bailey |
| **Benthic invertebrates and mudflats** | Flinders University | Sabine Dittmann |
| **Coorong fish** | SARDI Aquatic Sciences | Qifeng Ye<br>Luciana Bucater<br>David Short |
| **Frogs and nocturnal mammals (Lower Lakes)** | DEWNR Natural Resources SA MDB | Kate Mason |
| **Cryptic waterbirds (Lower Lakes) and colonial nesting waterbirds** | DEWNR | Jody O'Connor<br>Dan Rogers |
| **Surface and shallow groundwater water quality (including nutrients & microalgae)** | EPA<br>Analysed by CSIRO | David Palmer<br>Rod Oliver |
| **Acid sulfate soils** | CSIRO | Andrew Baker<br>Paul Shand |
| **Zooplankton** | Collected by the EPA<br>Identified by The University of Adelaide<br>Analysed by CSIRO | David Palmer<br>Russ Shiel<br>Rod Oliver |
| **Acid sulfate soil ecotoxicology** | CSIRO | Anu Kumar |

**Acronyms**

CSIRO Commonwealth Scientific and Industrial Research Organisation

DEWNR Department of Environment, Water and Natural Resources

EPA Environment Protection Agency

SA MDB South Australian Murray-Darling Basin

SARDI South Australian Research and Development Institute

**Definitions**

Diadromous: Fish which travel between salt water and freshwater.

Catadromous: Fish which are born in saltwater, then migrate into freshwater as juveniles where they grow into adults before migrating back into the ocean to spawn.

## Useful Links

**DEWNR TLM and CLLMM recovery program**

**Commonwealth Environmental Water Office**

**The Living Murray**

CLLMM Recovery scientific reports on the **Monitoring river health**

The Coorong, Lower Lakes and Murray Mouth (CLLMM) Recovery Project is a key component of South Australia's $610 million Murray Futures program, funded by the Australian Government's Water for the Future initiative. It is being delivered in collaboration with the community and Ngarrindjeri, the areas traditional owners.

The Living Murray is a joint initiative funded by the New South Wales, Victorian, South Australian, Australian Capital Territory and the Commonwealth governments, coordinated by the Murray–Darling Basin Authority.

## Futher information

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**www.environment.sa.gov.au**
**www.naturalresources.sa.gov.au/samurraydarlingbasin**

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