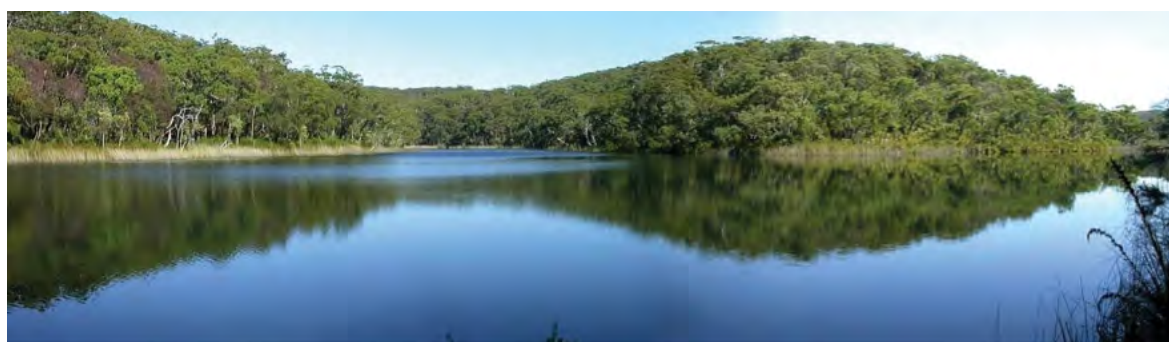


# Wetlands research

# Wetland palaeo-insights: revealing the past to manage the future

Cameron Barr and John Tibby (University of Adelaide), and Jonathan Marshall and Glenn McGregor (Queensland Department of Science, Information Technology and Innovation)

Understanding how wetlands have reacted to past climate fluctuations provides insights for appropriate management to lessen future impacts and conserve habitat for endangered species.



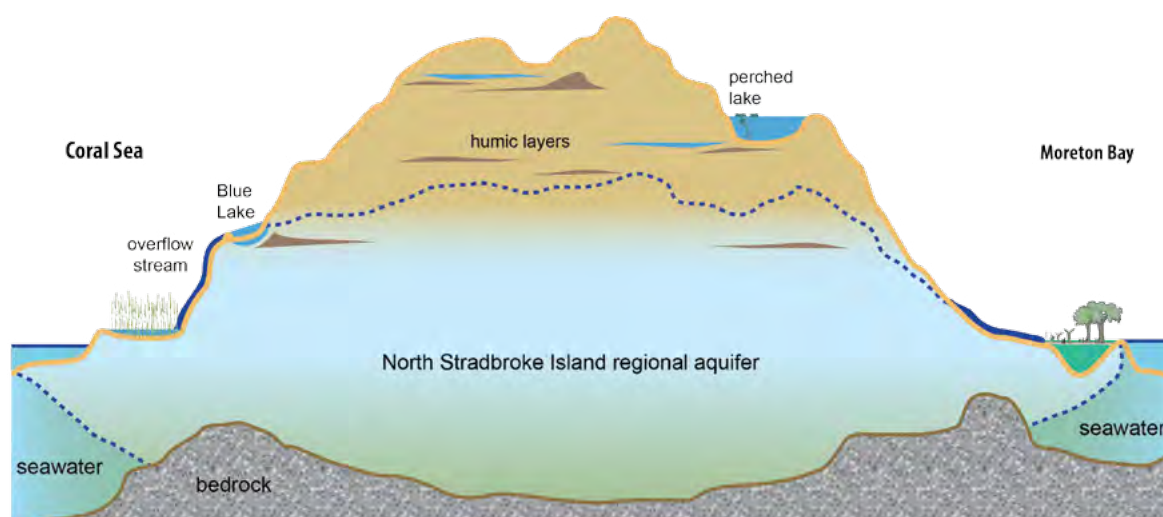
However, management decisions are often undertaken without such knowledge because even long-term ecosystem monitoring does not fully encapsulate the range of natural climatic variability. Palaeoenvironmental reconstructions provide windows into wetland responses to past climate perturbations using sequential information preserved in sediments over millennia.

North Stradbroke Island, in south-east Queensland, lies just offshore from one of the largest and fastest growing population centres in Australia. The island has over 75 wetlands including lakes, swamps and creeks, most of which are dependent on groundwater. These wetlands, some of which are included in the Moreton Bay Ramsar site, are significant in terms of their impressive biodiversity (Marshall *et al.*, 2011), as community and cultural assets and as recorders of past environmental change.

Blue Lake (Figure 1), part of the Moreton Bay Ramsar site, supports significant biodiversity including the endemic water plant *Eleocharis difformis*, which grows at depths of over 8 metres due to the lake's clear water, and a genetically unique population of the endangered pygmy perch (*Nanoperca oxleyana*). Our recent study (Barr *et al.*, 2013) examined the response of Blue Lake to climate variability over the last 7500 years using several indicators preserved in the lake sediments, including fossil algae and pollen. There was clear evidence of catchment change in response to continental drying from around 4000 years ago (Donders *et al.*, 2007). In stark contrast, the lake ecosystem remained stable, indicating a remarkable degree of resistance to large climatic changes. This may be unique in Australia.

This disconnect between climate and the lake ecosystem is explained by the lake's location in the landscape in relation to the large regional aquifer contained within the sand mass of North Stradbroke Island (Leach, 2011) (Figure 2). Blue Lake is a 'window' into this aquifer and, as such, receives constant inflow of chemically stable groundwater. The lake discharges through an outflow swamp, which acts as a natural weir that regulates lake depth (Figure 3). The entire lake volume is replenished approximately every 30 days. This combination of factors maintains a constant lake environment on seasonal to millennial timescales.

Resistance to the full range of climate variability over millennia, including significant continental aridification, highlights the importance of Blue Lake as a freshwater refuge from future climate change. However, this stability depends on continual connectivity with groundwater. Increased extraction of groundwater would risk breaking this connection with unprecedented impacts on lake ecology, biodiversity and dependent threatened species.



*Figure 2: Schematic cross section of North Stradbroke Island, showing the location of Blue Lake as a surface expression of the regional aquifer* (© Copyright, Glenn McGregor)

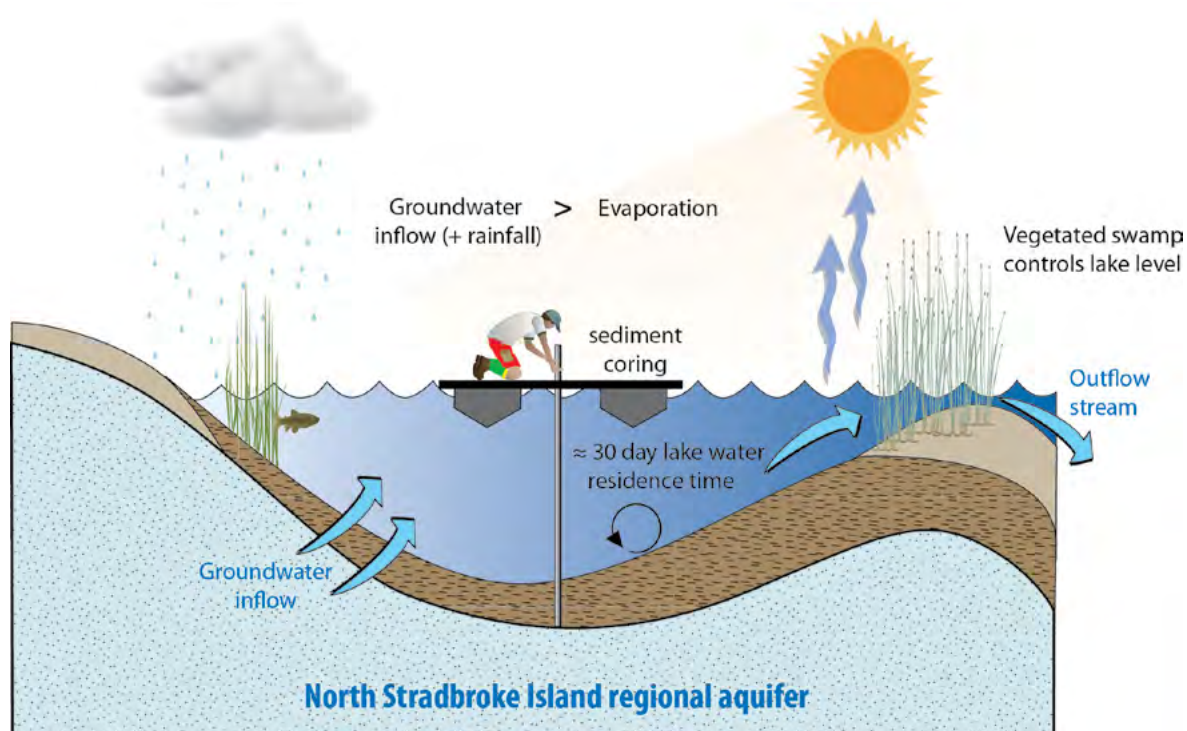


Figure 3: Conceptual model of Blue Lake. High water clarity and short lake residence time are dependent upon a constant throughflow of groundwater. Lake depth is determined by the height of the outflow swamp and can only fall below this height if net water loss is greater than inputs. Our data indicate this is unlikely to have occurred in the last 7500 years (© Copyright, Glenn McGregor)

## References

Barr, C., Tibby, J., Marshall, J.C., McGregor, G.B., *et al.* (2013) "Combining monitoring, models and palaeolimnology to assess ecosystem response to environmental change at monthly to millennial timescales: the stability of Blue Lake, North Stradbroke Island, Australia." *Freshwater Biology*, 58:1614-1630

Donders, T.H., *et al.* (2007) "Pollen evidence for the transition of the Eastern Australian climate system from the post-glacial to the present-day ENSO mode." *Quaternary Science Reviews*, 26:1621-1637

Leach, L.M. (2011) "Hydrological and physical setting of North Stradbroke Island." *Proceedings of the Royal Society of Queensland*, 117:21-46

Marshall, J.C., *et al.* (2011) "Distributions of the freshwater fish and aquatic macroinvertebrates of North Stradbroke Island are differentially influenced by landscape history, marine connectivity and habitat preference." *Proceedings of the Royal Society of Queensland*, 117:239-260

# Mapping intertidal habitats and their protection in Australia

Kiran Dhanjal-Adams (University of Queensland), Nicholas Murray (University of New South Wales) and Richard Fuller (University of Queensland)

Around Australia, intertidal habitats such as mudflats and sandflats provide a wide range of ecosystem services including protection from storm and sea level rise.

In addition, they are valuable habitats for marine species such as clams and fish, and are a critical habitat for Australia's five million internationally migrating shorebirds. However, we know very little about how much intertidal habitat there is in Australia, let alone where most of it is.

The reason for this is simple. Intertidal habitats are remarkably difficult to map, particularly at continental scales. Only now, with the advent of novel satellite remote sensing techniques, has it become possible. By using freely available satellite images across all of Australia's 35 876 kilometres of coastline, a team of researchers from the University of Queensland have produced the first map of Australia's intertidal habitats. They discovered large swathes in Western Australia, Queensland and South Australia, particularly along embayed coastlines and river mouths. Surprisingly, the amount of intertidal habitat within protected areas was quite different between states, ranging from 80 per cent

in Victoria to 6 per cent in the Northern Territory. Even more interesting, some states mainly protect intertidal habitats as part of marine protected areas, and others as part of terrestrial protected areas. In fact, in some cases, intertidal habitats were protected by both!

It is undeniable that marine and terrestrial protected area managers need to continue coordinating their efforts to ensure intertidal habitats are managed properly. What is more, protected areas boundaries need to align more sensibly with intertidal habitats if we are to benefit from their ecosystem services for years to come, and protect the threatened species such as shorebirds which rely on them.

Want to find out more? Visit the Fuller Lab website at [www.fullerlab.org](http://www.fullerlab.org)





*Between land and sea – Internationally migrating  
bar-tailed godwits (Limosa lapponica) roosting on  
valuable intertidal habitat in Moreton Bay, Queensland*

(© Copyright, Kiran Dhanjal-Adams)



# Coastal wetlands in south-east Queensland are home to the mighty water mouse

Nina J. Kaluza, University of Queensland

Surveys of the vulnerable water mouse (*Xeromys myoides*) along the Maroochy River in Queensland will help to improve our understanding of their ecological role within coastal wetlands.

Between 2011 and 2014, coastal wetlands along the Maroochy River system of south-east Queensland were surveyed for the nocturnal water mouse (Figure 1). Water mice are small carnivorous rodents (weighing approximately 40 grams) that occupy and build elaborate mud nests along intertidal zones dominated by mangrove (*Avicennia marina* var.) and saltmarsh (*Sporobolus virginicus*) communities (Figure 2). Within these sites this tiny mouse will cover vast distances to forage for food upon the receding tide. As water mice are not known to interact with human activity, their only home is within wetland habitat. They are rare, protected and listed as vulnerable under the federal *Environment Protection and Biodiversity Conservation Act* (1999), and are supported by a National Recovery Plan.

The survey covered 765.34 hectares and located 180 nests with the aim of understanding the ecological role of this native mammal. As one of the few native terrestrial mammals occupying these wetlands, they are likely to be important predators of crustaceans, mollusc and flatworms. They are prey for nocturnal raptors and reptiles whilst potentially providing ecosystem services for other interacting species within these tidal areas.

The project provided an opportunity to collect baseline data on nest characteristics (0.22 active nests per hectare), water mouse behavior (more than 10 000 photos were collected), species interaction and potential risk factors for water mice along the Maroochy River. This significant milestone was only achieved through the collaborative efforts of

WetlandCare Australia, Queensland Parks & Wildlife Service (QPWS), Environment Heritage Protection and Queensland Museum based on funding provided by the Australian Government.

To promote awareness, data was distributed to community groups such as Bunya Bunya Aboriginal Corporation, Landcare Australia, non-government organisations, regional councils, state government schools and HQ Forestry Plantation. Educational packages of these findings were delivered within community forums using digital representation and field workshops to enhance society stewardship of wetlands.

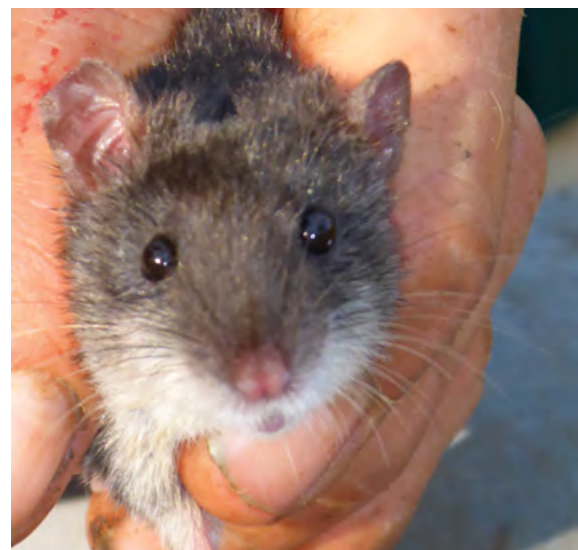


Figure 1: Water mouse (*Xeromys myoides*) captured along the Maroochy River using a size A Elliot Trap in June 2014  
(© Copyright, Nina Kaluza)

Currently, I am completing a Research Higher Degree at the University of Queensland and working with the Burnett Mary Regional Group, linking regional and local knowledge of nest distribution for the Great Sandy Strait-15 years after Mark Burnham of QPWS completed the last survey. By connecting research areas for this mighty mouse we may be able to determine

critical points in the relationship between terrestrial and marine ecosystems. The presence of this one mammal may be useful as an indicator of the health of coastal wetlands.

For information on this research, please email Nina Kaluza: [1mightywatermouse@gmail.com](mailto:1mightywatermouse@gmail.com)



*Figure 2: Camera observations as part of a four-year study on water mouse (*Xeromys myoides*) behaviour and tidal inundation* (© Copyright, Nina Kaluza acknowledgements Les Donald QPWS)



# Protecting wetland connectivity for endangered freshwater fish in northern Australia

Dr Nathan Waltham, TropWATER, Centre for Tropical Water and Aquatic Ecosystem Research, James Cook University

River systems of northern Australia are extremely seasonal, with most of the total annual flow occurring during the wet season between November and April.

This wet season flow is important in the longitudinal, lateral and vertical connection of rivers, especially wetland floodplains, which provide critical spawning and feeding areas for fish and wildlife.

An assessment of the feasibility of agricultural development in the Flinders and Gilbert River catchments in northern Queensland was completed in 2013 ([www.csiro.au/Organisation-Structure/Flagships/Water-for-a-Healthy-Country-Flagship/Sustainable-Yields-Projects/Flinders-and-Gilbert-Agricultural-Resource-Assessment-overview.aspx](http://www.csiro.au/Organisation-Structure/Flagships/Water-for-a-Healthy-Country-Flagship/Sustainable-Yields-Projects/Flinders-and-Gilbert-Agricultural-Resource-Assessment-overview.aspx)).

In the assessment, a range of environmental factors were considered in determining suitable locations for dams to service the agricultural operations proposed. Published literature, museum records and expert local knowledge revealed that 50 freshwater fish species exist in the Flinders catchment, with 42 species in the Gilbert catchment, with most species wide spread across both catchments.

Undoubtedly, the most impressive fish species present in both catchments are freshwater sawfish (*Pristis pristis*; listed as vulnerable under Commonwealth legislation and endangered on the 2000 IUCN Red List of Threatened Species), and the giant freshwater whiplay (*Himantura dalyensis*; listed as probably vulnerable on the IUCN Red List, though data is

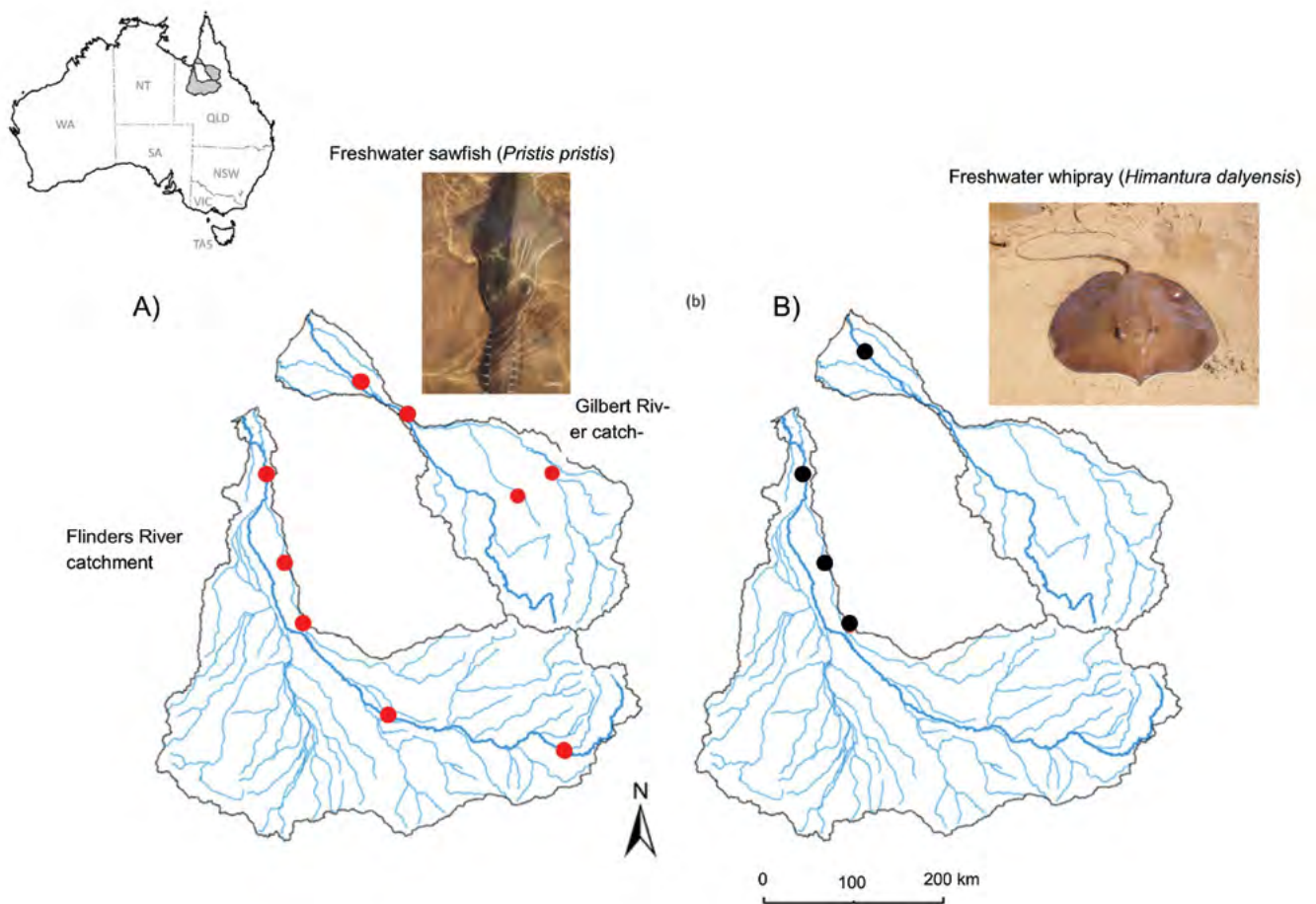
limited). Both species are large (freshwater sawfish grow up to two metres and the giant freshwater whiplay can grow up to one metre in disc width and weigh up to 120 kilograms) and travel long distances across river wetlands to access upstream areas for feeding and breeding. This large scale movement highlights the importance of maintaining river and wetland system connection, which is particularly important when considering water resource development and flow alterations in seasonal rivers of northern Australia.

Given their size (and the saw-shaped rostrum on the sawfish) upstream migration for both species would be hindered by migration barriers. While fish passage engineering is available to assist migration of fish, it is unlikely that these two species would be able to negotiate current designs.

The spatial distribution maps generated in this assessment revealed the recorded locations of both species. While the freshwater sawfish has migrated to more locations in both catchments, the full distribution of both species is probably much broader than represented here as both species are caught only with specialised survey techniques (such as gill nets).

The prospects of agricultural development in the Flinders and Gilbert River benefited greatly from these spatial maps, as a starting point for assessing water resource development options. This mapping approach could help other water development investigations and lead to more effective protection of these high conservation, charismatic species that need connection to wetlands and river channel catchments.

To find out more, contact Dr Nathan Waltham on [nathan.waltham@jcu.edu.au](mailto:nathan.waltham@jcu.edu.au) or 07 4781 4191, TropWATER, Centre for Tropical Water and Aquatic Ecosystem Research, James Cook University.



Captures or sightings in the Flinders and Gilbert catchments: (a) freshwater sawfish (*Pristis pristis*)

(© Copyright, Dr Brendan Ebner) and (b) freshwater whipray (*Himantura dalyensis*) (© Copyright, Prof Bradley Pusey)



*Seasonally flowing Einasleigh River, Gilbert River catchment, Queensland* (© Copyright, Dr Nathan Waltham)



*Drying waterhole in Flinders River, Queensland* (© Copyright, Dr Nathan Waltham)



# The unusual saltmarsh of Lake Wollumboola

Joy M Pegler

Coastal saltmarsh at Lake Wollumboola on the Shoalhaven Coast of New South Wales provides habitat for a number of threatened species.

Lake Wollumboola is known for supporting a number of waterbirds (Pegler, 2016) and the saltmarsh community plays an important role. At low water levels, approximately 16 hectares of saltmarsh emerges at the southwest end of the lake. Coastal saltmarsh is listed as an Endangered Ecological Community in NSW and supports a variety of threatened species,

including the white-fronted chat (*Epthianura albifrons*), the round-leaved wilsonia (*Wilsonia rotundifolia*) and potentially the green and gold bell frog (*Litoria aurea*) (NSW Office of Environment and Heritage, 2015).



*Sarcocornia quinqueflora* and *Wilsonia rotundifolia* at Lake Wollumboola in April 2007, seven months after the lake opened and two months after it closed (© Copyright, Joy Pegler)



*White-fronted chat (Epthianura albifrons) foraging area amid Sarcocornia quinqueflora and Atriplex australasica. Coonemia Creek is to the right* (© Copyright, Joy Pegler)

The saltmarsh at Lake Wollumboola operates in a system of irregular inundation. A high saltmarsh species, the sea rush (*Juncus kraussii*) grows above 1.1 metres AHD which is the mean water height of the Lake. When the entrance to the Lake closes, the water fluctuates above and below this level depending upon the competing influences of surface and groundwater inflows versus evaporation. When the entrance breaches and the water level drops to 0.4 metres AHD, extensive substrate is exposed and within two months low saltmarsh vegetation, primarily beaded glasswort (*Sarcocornia quinqueflora*), but also the *Wilsonia*, sprouts through stranded algae and macrophytes. This low saltmarsh emerges even after periods of up to five years of submersion.

Most of the saltmarsh substrate is mud of clay and silt, with some sand at the Coonemia Creek delta. Here native orache (*Atriplex australasica*) overlays *Sarcocornia*. The white-fronted chats specifically forage at this delta and only retreat to feed on the shoreline under dead *Atriplex* when *Sarcocornia* completely covers the substrate.

The use of the saltmarsh and the Lake by threatened species demonstrates how important it is to protect such a diverse ecosystem.

## References

- Pegler, J M (2015), Lake Wollumboola, New South Wales: A special lake for birds. *Wetlands Australia*, February 2015. pp 90-91.
- NSW Office of Environment & Heritage (2015), Species found in the Saltmarshes class.