3.7 Rehabilitation and reconstruction of estuarine habitats for shorebirds

Phil Straw
Avifauna Research & Services
Australia

Abstract

Shorebird habitat is under serious threat across Australia as well as along the East Asian Australasian Flyway. Some projects and research is underway to restore or reconstruct estuarine habitats for birds, in particular migratory shorebirds. Some lessons have been learned and shining examples of management of waterbird habitat with appropriate input by expert ecologists and engineers by Melbourne Water are highlighted.

Introduction

As their name suggests, shorebirds spend most of their lives along the shores of estuaries or foraging on intertidal mud or sand flats in estuaries, on the muddy margins and shallows of lakes, or along ocean beaches.

Shorebirds have a range of different styles of bill suited to a variety of substrates and prey varying from soft mud and deep burrowing polycheates or crustaceans to firm sandy substrate with invertebrates on or close to the surface. Others such as stilts and avocets take their prey from the water column or visible on the muddy substrate (such as Chironomids).

Shorebirds use a variety of foraging techniques to capture prey. Some use visual cues; for example, plovers with smaller beaks are able to feed on harder surfaces, chasing prey on land or shallow water. Species using visual cues have been found to forage more intensely nocturnally in urban areas, taking advantage of incidental light from nearby built up areas. Many species of sandpipers have long beaks, using tactile cues to deeply probe soft mud for prey in shallow water. Godwits insert their bills and continue probing until detecting prey and Eastern Curlews insert their bill often for burrowing shrimp (Colwell 2010). Interestingly, both Godwits and Eastern Curlews also use visual cues, sometimes seen chasing and picking up crabs from the surface.

Two species of oystercatchers are found in coastal areas across Australia. Pied Oystercatchers gather in estuaries, feeding on worms and bivalve molluscs, while the Sooty Oystercatcher is found along rocky shores, feeding on dark rocky areas where well camouflaged (Hayman *et al*. 1986). Oystercatchers use their specialised bill to prise open or stab at molluscs, crustaceans, worms and small fish. Turnstones are also found along rocky shores, using their bill to find prey items by lifting rocks.

Shorebirds generally follow the falling tide when feeding on intertidal mudflats while polycheate worms, shellfish and crustaceans are still feeding actively in the shallows of receding waters and are easily accessible. Once the tidal flats are covered by the high tide the birds are forced to move to suitable roost sites to rest until the tide once again recedes to expose the tidal flats.

Shorebirds prefer to have a clear view of their surroundings so that they can see the approach of potential predators enabling them to take avoidance action and take flight at any approach of danger. This appears to be more important when flocked together at a roost site than when moving about on the tidal flats. Lawler (1996) found that shorebirds avoided areas close to tall vegetation or structures that obscured their view as shown in Figure 3.7.1.

The presence of predators can result in shorebirds abandoning their roost site as long at the threat is present. Field observations have been made of shorebirds remaining in flight for several hours until they were able commence feeding on the expanse of mudflats rather than roost close to birds of prey such as Peregrines of Merlin perched in nearby trees (pers. obs.).

During daylight hours at high tide shorebirds roost at a variety of locations such as open sand spits, beaches, sea walls etc. However research has shown that such locations are abandoned at the approach of nightfall in preference for areas of sheltered shallow water where the shorebirds can stand in the shallow water, presumably to better observe the approach of terrestrial predators such as foxes, cats or dingoes that could otherwise sneak up on them along a beach or sandspit under the cover of darkness (unpublished data).

Australia is regularly visited by 36 migratory shorebirds (Table 3.7.1), in addition to 16 resident species (Table 3.7.2) that stay in Australia all year

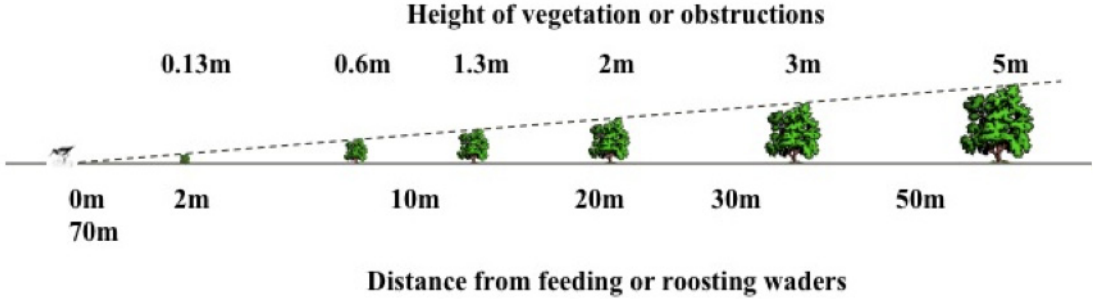

Figure 3.7.1. Shorebirds avoid tall vegetation when feeding but more particularly when roosting at high tide (after Lawler 1996).

round. Even migratory species spend six to seven months each year in Australia. They spend about two months or more on migration or at staging areas where they replace the fat reserves they have used during long migratory flights. The remaining three months is spent on the breeding grounds during the brief breeding season establishing territories, laying and incubating eggs and rearing chicks. This is made possible due to the 24 hours of daylight which enables young birds to feed continuously and put on fat reserves for a return flight of up to 11,000 km back to Australia from the Arctic.

Table 3.7.1. The migratory shorebird species listed under the EPBC Act.

#	Scientific name	Common name
	Scolopacidae	*Sandpipers*
1.	*Gallinago hardwickii*	Latham's Snipe
2.	*Gallinago stenura*	Pin-tailed Snipe
3.	*Gallinago megala*	Swinhoe's Snipe
4.	*Limosa limosa*	Black-tailed Godwit
5.	*Limosa lapponica*	Bar-tailed Godwit
6.	*Numenius minutus*	Little Curlew
7.	*Numenius phaeopus*	Whimbrel
8.	*Numenius madagascariensis*	Eastern Curlew
9.	*Tringa totanus*	Common Redshank
10.	*Tringa stagnatilis*	Marsh Sandpiper
11.	*Tringa nebularia*	Common Greenshank
12.	*Tringa glareola*	Wood Sandpiper
13.	*Xenus cinereus*	Terek Sandpiper
14.	*Actitis hypoleucos*	Common Sandpiper
15.	*Heteroscelus brevipes*	Grey-tailed Tattler
16.	*Heteroscelus incanus*	Wandering Tattler
17.	*Arenaria interpres*	Ruddy Turnstone
18.	*Limnodromus semipalmatus*	Asian Dowitcher
19.	*Calidris tenuirostris*	Great Knot
20.	*Calidris canutus*	Red Knot
21.	*Calidris alba*	Sanderling
22.	*Calidris ruficollis*	Red-necked Stint
23.	*Calidris subminuta*	Long-toed Stint
24.	*Calidris melanotos*	Pectoral Sandpiper
25.	*Calidris acuminata*	Sharp-tailed Sandpiper
26.	*Calidris ferruginea*	Curlew Sandpiper
27.	*Limicola falcinellus*	Broad-billed Sandpiper
28.	*Philomachus pugnax*	Ruff
29.	*Phalaropus lobatus*	Red-necked Phalarope

Table 3.7.1. (cont.) The migratory shorebird species listed under the EPBC Act.

#	Scientific name	Common name
	Charadriidae	*Plovers and lapwings*
30.	*Pluvialis fulva*	Golden Plover
31.	*Pluvialis squatarola*	Grey Plover
32.	*Charadrius bicinctus*	Double-banded Plover
33.	*Charadrius mongolus*	Lesser Sand Plover
34.	*Charadrius leschenaultii*	Greater Sand Plover
35.	*Charadrius veredus*	Oriental Plover
	Glareolidae	*Pratincoles*
36.	*Glareola maldivarum*	Oriental Pratincole

Table 3.7.2. Resident Shorebirds.

#	Scientific name	Common name
	Haematopodidae	*Oystercatchers*
1.	*Haematopus longirostris*	Australian Pied Oystercatcher
2.	*Haematopus fuliginosus*	Sooty Oystercatcher
	Recurvirostridae	
3.	*Himantopus himantopus*	Black-winged Stilt
4.	*Recurvirostra novaehollandiae*	Red-necked Avocet
5.	*Cladorhynchus leucocephalus*	Banded Stilt
	Charadriidae	*Plovers and lapwings*
6.	*Charadrius ruficapillus*	Red-capped Plover
7.	*Charadrius australis*	Inland Dotterel
8.	*Elseyornis melanops*	Black-fronted Dotterel
9.	*Thinornis rubricollis*	Hooded Plover
10.	*Erythrogonys cinctus*	Red-kneed Dotterel
11.	*Vanellus tricolor*	Banded Lapwing
12.	*Vanellus miles*	Masked Lapwing
	Burhinidae	*Thick-knees*
13.	*Burhinus grallarius*	Bush Stone-curlew
14.	*Esacus magnirostris*	Beach Stone-curlew
	Rostratulidae	*Painted Snipes*
15.	*Rostratula australis*	Australian Painted Snipe
	Glareolidae	*Pratincoles*
16.	*Stiltia isabella*	Australian Pratincole

High quality shorebird habitat is becoming increasingly more important due to threats in other parts of the flyway in order to put on sufficient fat reserves prior to an arduous northern migration and to recover from a non-stop flight back from the Arctic. Any habitat losses or disturbances while the birds are in Australia is likely to have an impact on long term survival.

The Australasian Wader Studies Group (AWSG) has been carrying out surveys at a number of key shorebird areas in Australia since the early 1980s. Recent analysis of population monitoring in south-east Australia by the AWSG (Gosbell and Clemens 2006) revealed long term declines in four species, the Bar-tailed Godwit, Curlew Sandpiper, Eastern Curlew and Sharp-tailed Sandpiper (Figure 3.7.2). A significant declining trend was found for the Curlew

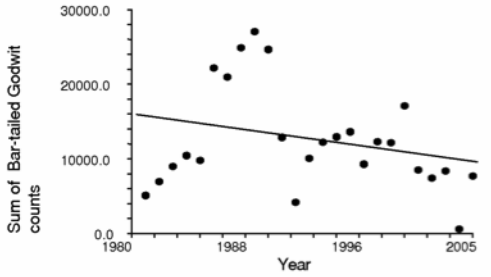

FIGURE 2a. Bar-tailed Godwit population trend SE Australia.

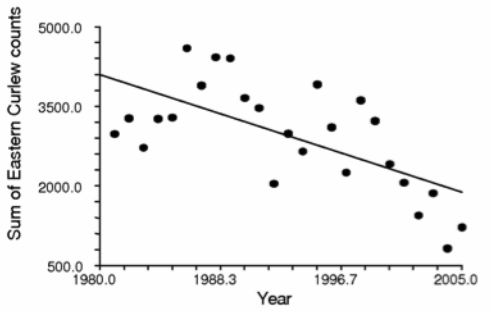

Figure 2c. Eastern Curlew population trend SE Australia.

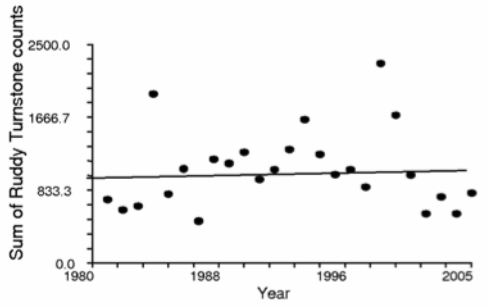

Figure 2e. Ruddy Turnstone population trend SE Australia.

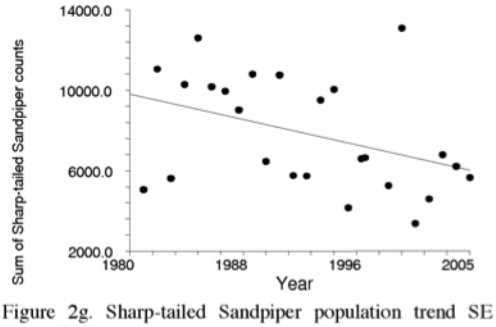

Figure 2g. Sharp-tailed Sandpiper population trend SE Australia.

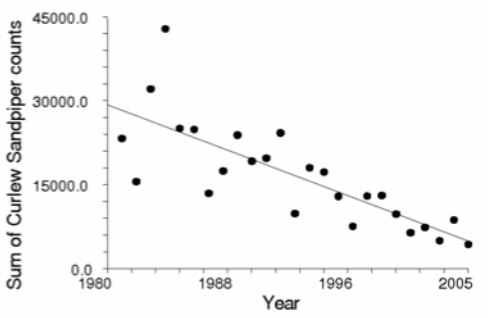

Figure 2b. Curlew Sandpiper population trend SE Australia.

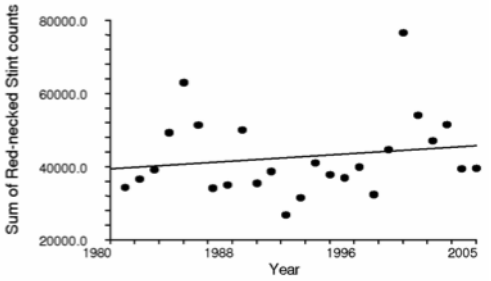

Figure 2d. Red-necked Stint population trend SE Australia.

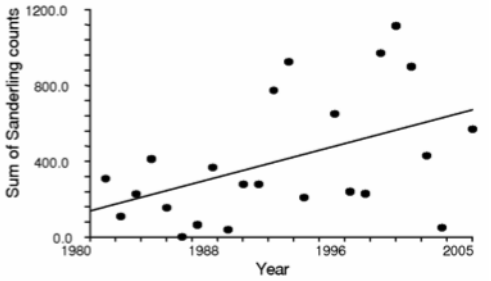

Figure 2f. Sanderling population trend SE Australia.

Figure 3.7.2. Least square regression trends for selected species using maximum summer counts summed across 7 shorebird areas in south-east Australia (Gosbell and Clemens 2006).

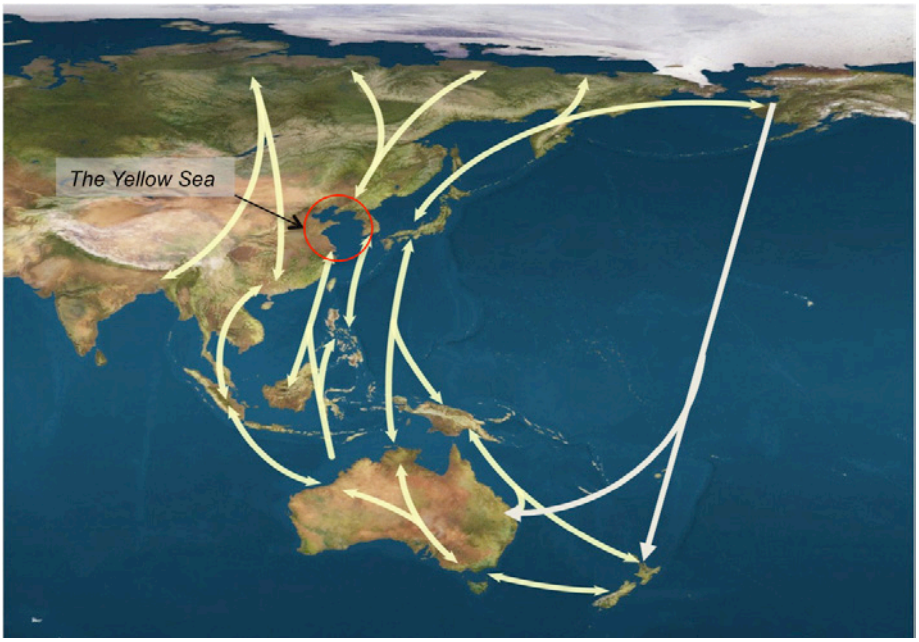

Figure 3.7.3. Migratory birds east Asia Australasia pathway. (Source: Google Earth.)

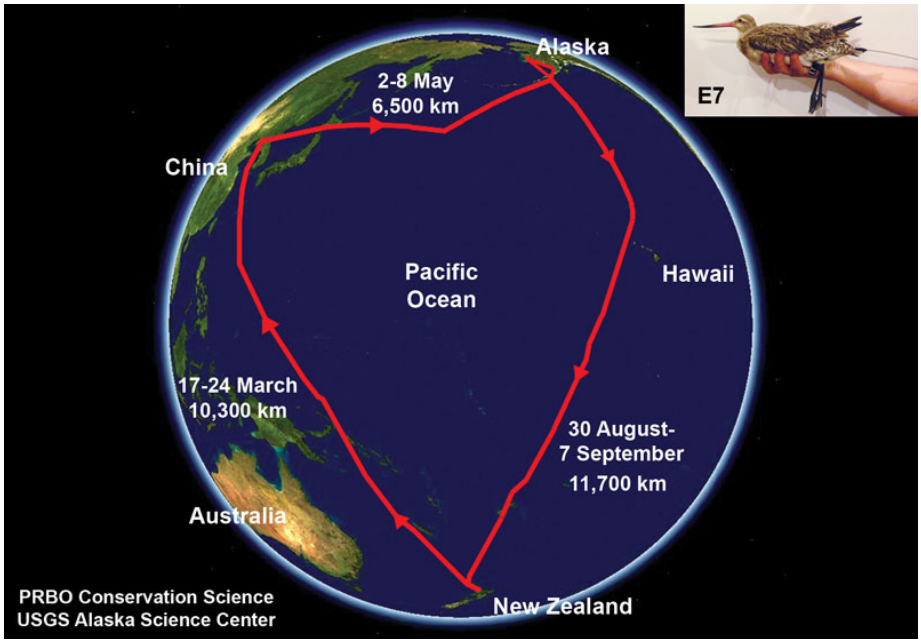

Figure 3.7.4. Godwit flight path. (Source: Google Earth.)

Sandpiper (3% per year) and Eastern Curlew (2% per year). The declining trend of the Curlew Sandpiper is widespread in the rest of Australia, with a long term decline reported in north-east Tasmania (Cooper *et al.* 2012) and an 82% decline over a 30 year period at Corner Inlet, Victoria (Minton *et al.* 2012). A slight increase was found for the Sanderling and no changing trend was found for the Red-necked Stint and Ruddy Turnstone, however, the tendency of these species to be found scattered along much larger stretches of the coast puts doubt on the results, with more thorough counts conducted recently at some sites.

Recent analysis of the Queensland Wader Study Group (QWSG) database found nine species of shorebirds occur in internationally or nationally significant numbers across south-east QLD, the Bar-tailed Godwit, Whimbrel, Eastern Curlew, Common Greenshank, Terek Sandpiper, Grey-tailed Tattler, Pied Oystercatcher, Pacific Golden Plover and Lesser Sand Plover (Milton and Driscoll 2006).

The East Asian-Australasian Flyway (Figure 3.7.3 and 3.7.4) is the pathway for an estimated 5 million migratory shorebirds, of which 2 million shorebirds migrate from their far northern breeding grounds in Russia and Alaska to spend the non-breeding season in Australia. During migration, shorebirds depend on a network of stopover sites to rest and build up fat reserves for the onward flight. Shorebirds using this flyway are under increasing threat from habitat modification and loss due to land reclamation, pollution and climate change.

Protective legislation

Estuarine habitats in Australia provide a pivotal role in ensuring the survival of the 36 international migratory shorebird species that regularly visit Australia each year. These species are listed as migratory under the Government Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Listed migratory species are a 'matter of national environmental significance'.

Migratory shorebirds are protected under international bilateral agreements between the Government of Australia and the Governments of Japan (JAMBA), China (CAMBA) and South Korea (ROKAMBA) as well as the protection of some site under the Ramsar Convention on Wetlands of International Importance.

Each state and territory also has conservation acts that cover some shorebird species, including the Threatened Species Conservation Act of NSW.

Rehabilitation and reconstruction of estuarine habitat

There have been quite a few restoration and reconstruction attempts taken in NSW and elsewhere in Australia. There have been mixed results in terms of attaining the targets but a few of these are briefly illustrated in the following case study examples.

Case Study 1: Hunter River estuary

The Hunter River estuary is the most important area for migratory shorebirds in NSW despite the fact the area has degraded as non-breeding habitat for thousands of shorebirds.

According to records there has been a decrease of over 80% of saltmarsh and floodplain forest, 13% of open water, 50% of shoreline length and 50% of shorebird numbers in the Hunter River estuary over the past 200 years. Numbers of deltaic islands in the estuary have been reduced from 20 to 4. Hydrological regimes have been significantly altered resulting in reduced tidal flushing reduced and fragmented habitat.

Most of these losses have been the result of clearing, draining, filling and dredging have extensively modified the Hunter estuary. Structures affecting hydrology have increased from 0 in 1801 to the construction of 112 culverts, bridges and floodgates, and 77km of drains and levees by 1994 (Williams *et al*. 2000).

Between 1954 and 1994, there was a loss of over 1400 ha of saltmarsh and 340 ha of open water as well as an increase of 400 ha of mangroves. This resulted in a net loss of over 1300ha of fisheries habitat and over 1400ha of shorebird habitat (Williams *et al*. 2000). The number of migratory shorebirds has declined by at least half since the 1970s and fish species dependent on sea grass have dropped out of the commercial catch (Kingsford and Levy 1995).

The loss of habitat continues as industrial development continues within an area designated industrial development.

However recent efforts to restore shorebird habitat in the lower reaches of the Hunter River have been attempted as part of the Kooragang Wetlands Rehabilitation Project (KWRP) and several projects initiated to offset the loss of habitat as a result industrial development. The larger of these remediation sites includes the proposed construction of large tidal lagoons flushed on a daily basis from the north arm of the Hunter River via a large constructed channel.

Some progress has been made in restoring semi-tidal habitat for some species of migratory shorebirds. However, planned large-scale restoration projects are at the whim of global demand for mineral resources and the availability large funding allocations to claw back some of the habitat losses over past years.

Threats to the viability of the wetland as habitat for shorebirds, in particular migratory species are:

- Continued encroachment of saltmarsh and shorebird feeding habitat by mangroves
- Continued loss of shorebird habitat as a result of industrial development.

Requires:

Funding commitment and a coordinated approach by government and industry to restore or create habitat to offset past and current losses of shorebird habitat.

Case Study 2: Botany Bay

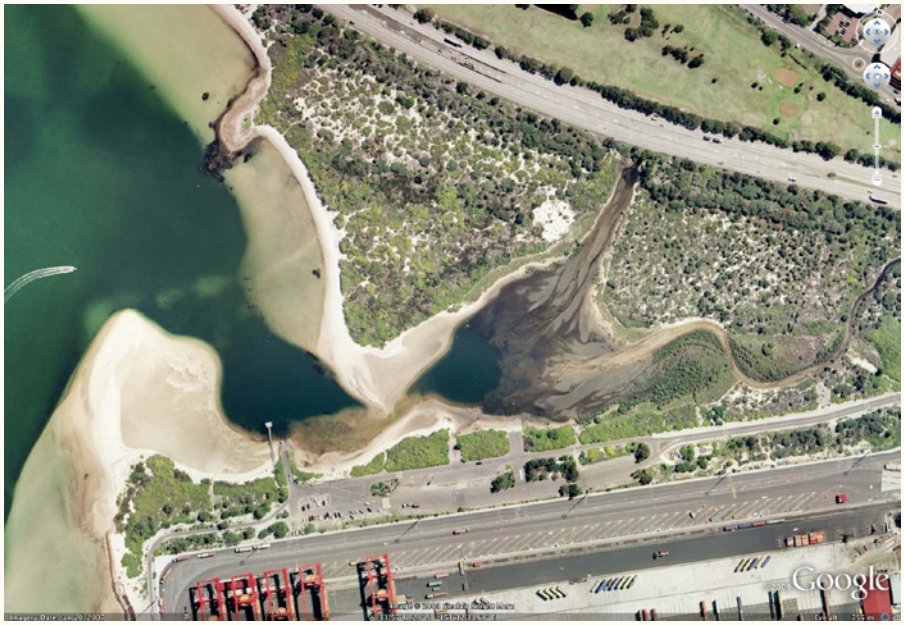

Figure 1. Penrhyn Peninsula (before).

The sight of large flocks of shorebirds in the wetlands around Botany Bay was common place a little over 60 years ago. Sydney's ornithologists of the 1940s and 50s reported thousands of shorebirds of ten to eleven species along the northern shores of Botany Bay including the mouth of the Cooks River before it was diverted to make way for the expansion of Sydney Airport (Straw 2003). Species lost to Sydney have been the smaller sandpipers and plovers that frequented the northern part of the Bay with more than 90% loss of Red-necked Stint, Curlew Sandpiper, Pacific Golden Plover and Lesser Sand Plover.

- The loss of shorebirds and their habitats in Botany Bay has been as a result of:
- Large scale development of the northern portion of Botany Bay including, the reclamation of large areas of tidal flats;
- The loss of the Cooks River estuary; and
- Large scale dredging to source material for runways as well as ports and oil terminal development.

The recent expansion of Port Botany by Sydney Ports Corporation had the potential to effect the only remaining fragment of shorebird habitat on the north side of Botany Bay at the Penrhyn Estuary created during previous port development in the 1970s (Figure 1). The identification of the potential loss resulted in the Penrhyn Estuary Habitat Enhancement Project being instigated by Sydney Ports Corporation. This project greatly enlarged the estuary of about three hectares of shorebird habitat to a total area of about 26 hectares including saltmarsh and tidal flats (Figure 2). The project also created high tide roosting islands as well as nocturnal roosting habitat. The project has also included a 12+ year monitoring/management program to ensure the success of the project.

The results have so far shown an increase in the use of the estuary, especially by shorebirds feeding at the site at night, and the use of a secure nocturnal roost site for shorebirds using Botany Bay. The aim is to have a net gain in the numbers of each species of shorebird using the site prior to the commencement of the port expansion by the end of the project in 2018.

Threats to the viability of the wetland as habitat for shorebirds, in particular migratory species are:

None imminently apparent.

Requires:

Continued government commitment for ongoing management of the site including fox abatement, weed control and monitoring.

Figure 2. Penrhyn Estuary (after).

Case Study 3: Mason Park

The Mason Park wetland is a remnant of the once extensive wetland system bordering the Parramatta River. It is a small saltmarsh and mudflat that alternates from a dry condition during neap tides and low rainfall to a shallow lagoon during spring tides or periods of high rainfall. The site was used as a roost site by comparatively large numbers of shorebirds due to the open aspect of the site giving them a clear view of the approach of potential predators (Figure 1).

It is part of the remaining network of wetlands in Homebush Bay that includes Bicentennial Park and Sydney Olympic Park at Newington. Despite its small size, Mason Park remains a very important wetland site for waterbirds, especially migratory waders. A large number of waterbirds have been associated with this tiny wetland, which has been described as “one of the best places in Sydney for waterbirds”. Deterioration of the site in recent years and disturbance of the birds by people, domestic animals and foxes threaten the future of this valuable site.

A plan of management was produced for the site in 1994 that included recommendations of restoring an existing weir and establishing a second weir to allow tidal flushing and the control of mangrove propagules by having a one-way tidal flow between these weirs.

Other issues relating to the management of the site were also covered in the management plan including the need to manage tall trees that threatened to enclose the wetland and consequently potentially effect the viability of the site as habitat for migratory shorebird habitat.

Unfortunately these recommendations were not initiated due to the lack of resources. Until 2013 the wetland was subject to aggressive mangrove colonization and loss of core habitat values (Figure 2).

Returning Mason Park to a productive habitat for waders and other birdlife is dependent on adequate tidal flushing, providing soil conditions conducive to invertebrate production and the establishment of suitable native vegetation in and around the wetland.

Threats to the viability of the wetland as habitat for shorebirds, in particular migratory species are:

Encroachment of saltmarsh and mudflats by mangroves and propagules entering via a sluice gate/weir.

Trees previously planted, or becoming established, around the wetland resulting in reduced value as shorebird habitat.

Lack of resources to manage water levels to prevent drying during neap tides/low rainfall periods.

Requires:

Resources for site management including expert advice on management for core values as saltmarsh and migratory shorebird habitat.

Figure 1. Mason Park before changes.

Figure 2. Mason Park after changes.

Case Study 4: The Waterbird Refuge, Bicentennial Park

The area known as the Waterbird Refuge at Sydney Olympic Park was created as the result of a reclamation project of the Parramatta River in the 1960s. A bund wall was constructed and dredged mud was used to partially fill the area behind the bund. Fortunately the project was abandoned leaving an area of useful shallow water habitat for waterbirds and migratory shorebirds (Figure 1).

The site, though largely isolated from tidal movements, received an exchange of water that percolated through crevices in the bund wall allowing partial fluctuation of tide levels that provided useful habitat for migratory shorebirds until the mid 1980s. Although contaminated by runoff from adjacent industrial sites including the nearby abattoirs the site attracted large numbers of migratory shorebirds and waterbirds (Kelso data).

With the management of the Bicentennial Parklands in the early 1990s the bund surrounding the Waterbird Refuge became impermeable to tidal waters. This resulted in the wetland becoming stagnant with a large amount of floating algae accumulating over time. Benthic invertebrates at this time were largely restricted to Chironomids with very few burrowing polycheates or other benthic prey for migratory shorebirds, which mainly probe the mud for food.

A small pipe installed through the bund in the early 1990s to allow some tidal exchange made little difference to the condition of the wetland and it was not until a 2m wide automated sluice gate and weir was installed more recently that the wetland dramatically changed for the better. Additional management actions to improve shorebird habitat included the removal of mangroves that were becoming established around the shorelines of the wetland, which were effecting the open aspect of the wetland shores that is so important for shorebirds (Figure 2). These actions saw a substantial improvement in shorebird habitat including an increase in the number of benthic invertebrates providing an increase in the abundance of prey for migratory shorebirds and improved conditions for other waterbirds.

Conditions also improved as a roosting area for shorebirds both diurnal and nocturnal at a time when alternative roost sites free from disturbance in the Parramatta River estuary were becoming scarce and almost none existent during spring high tides.

Threats to the viability of the wetland as habitat for shorebirds, in particular migratory species are:

Changing conditions in the vicinity of the Waterbird Refuge are presenting significant impacts on the wetland as habitat for shorebirds. This is due to incompatible management of vegetation surrounding the wetlands including the ever-increasing height and density of trees planted on three sides of the wetland. These are closing the open aspect of the site present in the early stages of development, with a risk of reducing the value of the site to migratory shorebirds.

Requires:

Long term management plan for the site including monitoring and coordinated management of adjacent land use. These conflicts need careful consideration in order the retain the value of thiswetland.

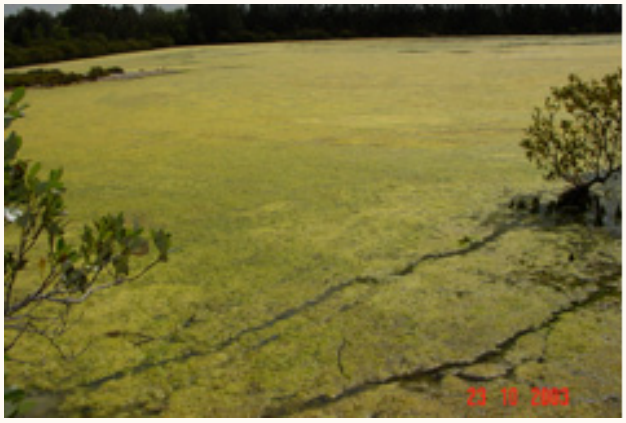

Figure 1. Waterbird Refuge before restoration.

Figure 2. Waterbird Refuge after tidal restoration.

Artificial wetlands managed to advantage migratory shorebirds

A variety of artificial wetlands provide important habitat for waterbirds and to some extent make up for wetland habitats lost due to urban development and farming practices. These include sewage treatment works, saltworks as well as farm dams and reservoirs.

Werribee Sewage Treatment Works

There must be few birdwatchers in Melbourne who have not, at some stage, visited the 'Werribee Sewage Farm' or, more correctly, Melbourne Water's Western Treatment Plant, near Werribee - to enjoy its great diversity of birdlife, and the sheer numbers of birds to be found there.

In addition to the treatment of some 420 million litres of raw sewage and industrial wastewater arrive at the site each day the authority has an

environmental responsibility for managing for thousands of shorebirds, other waterbirds and aquatic fauna.

"The authority runs its operations in a manner that is sympathetic to wildlife providing high biodiversity values, particularly for waterbirds. In addition, some areas of the farm are now set aside and managed specifically as habitat to protect threatened species and to provide 'compensatory habitat' for any future potential loss of wildlife habitat that might arise from the expansion of operations or treatment upgrades". A Wildlife Consultative Committee of experts and stakeholders was formed in 1986 as the Western Treatment Plant Biodiversity Conservation Advisory Committee. This Committee provides specialist advice to Melbourne Water, and also fulfills a community liaison function by linking relevant community groups such as BirdLife Australia as well as local conservation groups to those responsible for conservation management at the Western Treatment Plant.

Conservation ponds on site are all constructed wetlands and so are essentially artificial habitat. There are 46 ponds within three large decommissioned sewage treatment lagoons together with 13 separate ponds within the Sewage Treatment Precinct, that are remnants of former treatment lagoons no longer required for sewage treatment.

Most of the ponds are shallow and of varying sizes and shapes. Some have sludge deposits while others have sandy bottoms. Management are slowly learning the important characteristics of each pond through watching what wildlife are attracted at different times of the year and at different water depths. For example Curlew Sandpipers seem to prefer one pond with a sandy bottom that is largely ignored by many other species of shorebird. Based on these observations every year ponds are allocated to one of three management regimes:

"Shorebird ponds are mostly intended to provide foraging habitat over summer for migratory shorebirds and so most of these ponds are flooded over winter to control vegetation growth. Then, in spring, the ponds are slowly drawn down to provide shallow water (less than 10 cm) and exposed muddy margins where the shorebirds can forage. The ponds are particularly useful for the shorebirds since they provide foraging habitat at high tide and during bad weather, when the intertidal mudflats where the shorebirds usually feed are under water or too exposed to the elements. The rate at which these ponds draw down varies with local when drawn down, the ponds will have bare muddy bottoms".

"They now plan to have a new pond management regime: Shorebird breeding habitat. So, hopefully, within a few years we will see some ponds managed specifically to support breeding shorebirds" (Steele 2009).

Current Research

Essential information about the flight paths of migratory shorebirds, their important stopover sites (to rest and feed between long flights) and breeding grounds has been gathered over the past 30 years, initially as a result of numbered leg bands returned by hunters or recorded when the birds are caught be researchers. In more recent times (since 1991) coloured bands shaped with a protruding tab or 'flag' has meant the birdwatchers are able to identify the original banding site as a result of colour combinations or alpha numeric engravings visible in the field using binoculars or spotting scopes.

The main limitations using bands and flags are that they must be caught by hunters or seen in the field and show where hunters or birdwatchers are present to observe the birds. Huge expanses of the migratory flyways and important staging areas have remained unknown until very recently. The use of satellite transmitters provide accurate patterns of movement of shorebirds in flight from their non-breeding areas in Australia and New Zealand to their breeding grounds and previously unknown important staging areas in between. While this technology provides hitherto unknown essential information to direct conservation efforts to the most threatened links in shorebird migration routes smaller species are unable to carry the relatively heavy satellite transmitters. An interim measure has been the use of tiny geolocators weighing 0.6 gram which measure light and time, the essential information for working out longitude and latitude. These devices can be attached to a leg flag of a shorebird but must be removed, by re-trapping the bird to enable data to be downloaded using a computer.

The race is on to solve the mysteries of shorebird population declines before it is too late to take appropriate action to save species from even more serious declines or extinction.

Summary

Thirty-six species of migratory shorebirds and 16 species resident to Australia utilise a wide variety of wetland habitats, none more threatened than estuaries, especially those on the east and south east coasts of Australia close to centres of high human population.

Research carried by the Australasian Wader Studies Group of BirdLife Australia and some universities have found alarming declines in many shorebird populations, in particularly migratory species the use the East Asian Australasian Flyway to migrate between their Arctic breeding grounds and Australia where they spend their non-breeding season and the first year or so of their lives as juveniles before returning to their northern breeding grounds each breeding season.

A few examples of sites under threat include the Hunter River estuary and Botany Bay in NSW where large scale habitat destruction has taken place, as well as a couple of examples of small wetlands but with great importance to shorebirds are examined. Restoration projects are becoming more critically important to help protect shorebirds, in particular migratory species. The only good side of large scale development is that with today's environmental legislation millions of dollars can be made available to create or restore essential habitat, as is the case at Port Botany in NSW.

A good example of effective management is illustrated by Melbourne Water at the Werribee Sewage Treatment Works where managers meet on a regular basis to discuss management strategies of wetlands for migratory shorebirds as well as other waterbirds and aquatic fauna.

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Useful Resources

EAAF Partnership Newsletter. Available at http://www.eaaflyway.net/newsletter.php.

Stilt (Journal of the AWSG). Available at http://www.awsg.org.au/stilt.php.

Tattler (Newsletter for the Asia Pacific Flyways). Available at http://www.awsg.org.au/tattler.php.