The Whistler **13 (2019)**: 62-68

Changes in wetland use by shorebirds following mangrove removal, Area E, Ash Island, New South Wales

Philip Reid

1/41 Swan Street, Cooks Hill, NSW 2300, Australia preid@ncig.com.au

Received 2 May 2019, accepted 26 August 2019, published on-line 3 October 2019

Hydrological controls, such as flood and tidal gates, have been used historically in Australian estuarine environments to make tidal environments more arable. The removal of flood gates such as these from Fish Fry Flats and Wader Creek on Ash Island in the Hunter Estuary in the mid-1990s led to the proliferation of grey mangroves *Avicennia marina* in both wetlands. Subsequently, shorebird usage of the wetlands declined substantially.

As part of work to offset biodiversity impacts of the third coal export terminal in the Port of Newcastle, mangroves were removed from both wetlands to restore migratory shorebird habitat. There was a positive response in shorebird usage of Fish Fry Flats and Wader Creek following the mangrove removal. Shorebird species richness and abundance have increased since 2016, including both migratory and endemic species. Notably, there have been relatively high counts of small sandpiper and plover species, including Sharp-tailed Sandpiper *Calidris acuminata*, Red-capped Plover *Charadrius ruficapillus*, Red-kneed Dotterel *Erythrogonys cinctus* and Red-necked Stint *Calidris ruficollis*. Currently, Fish Fry Flats/Wader Creek appears to be the preferred habitat in the Hunter Estuary for Red-capped Plover.

INTRODUCTION

Fish Fry Flats (32º 52'S, 151º 43'E) is a tidal wetland at the southern extent of Ash Island, in the Hunter Estuary (see **Figure 1**). The wetland is connected to the South Arm of the Hunter River via Fish Fry Creek, opposite the Newcastle suburb of Sandgate. Wader Creek is a tidal creek proximal to Fish Fry Flats, although the two wetlands are not directly connected, with the exception of some high tide and flood events throughout the year (Rodríguez & Sandi Rojas 2014). There is some indirect connection of the waterbodies through Swan Pond. These wetlands constitute a portion of a wetland system, known as 'Area E'. Area E, defined as the wetlands east of the Hunter River South Arm, south of the Jemena gas pipeline and west of the Kooragang Island main rail line, is subject to a complex set of tidal and freshwater influences and includes other water bodies known as Wader Pond and Northwest Pond (Avifauna Research & Services 2016).

Fish Fry Flats has historically been considered important shorebird habitat in the Hunter Estuary (Herbert 2007). Until 1995, Fish Fry Creek was tidally restricted, which resulted in a tidal wetland dominated by saltmarsh species and mudflats with minimal mangrove growth (Hunter-Central Rivers Catchment Management Authority 2011). Following the removal of hydrological controls at Fish Fry Creek, Grey Mangrove *Avicennia marina* were observed to have proliferated over a 20-year period, eventually occupying the majority of Fish Fry Flats (see **Figure 2**). Based on aerial photographs, Wader Creek was also observed to have transformed from a saltmarsh/mudflat wetland to a mangrove-dominated wetland over a similar period. While the causes of this are less understood than at Fish Fry Flats, it is likely these developed through similar processes.

Habitat restoration

As part of work to offset biodiversity impacts of the third coal export terminal in the Port of Newcastle (Newcastle Coal Infrastructure Group (NCIG), Kooragang Island), a decision was made to attempt to restore migratory shorebird habitat at Area E. This was specifically the removal of mangroves from within the Fish Fry compartment (Fish Fry Creek and Fish Fry Flats) and an ongoing commitment to keeping the tidal wetland free from mangrove regrowth. This was intended to facilitate the re-establishment of saltmarsh vegetation communities and, to some extent, open tidal mudflats. The project was approved by the NSW State Government in 2013 (NCIG 2013) and mangroves were progressively removed from May 2016 to September 2016.

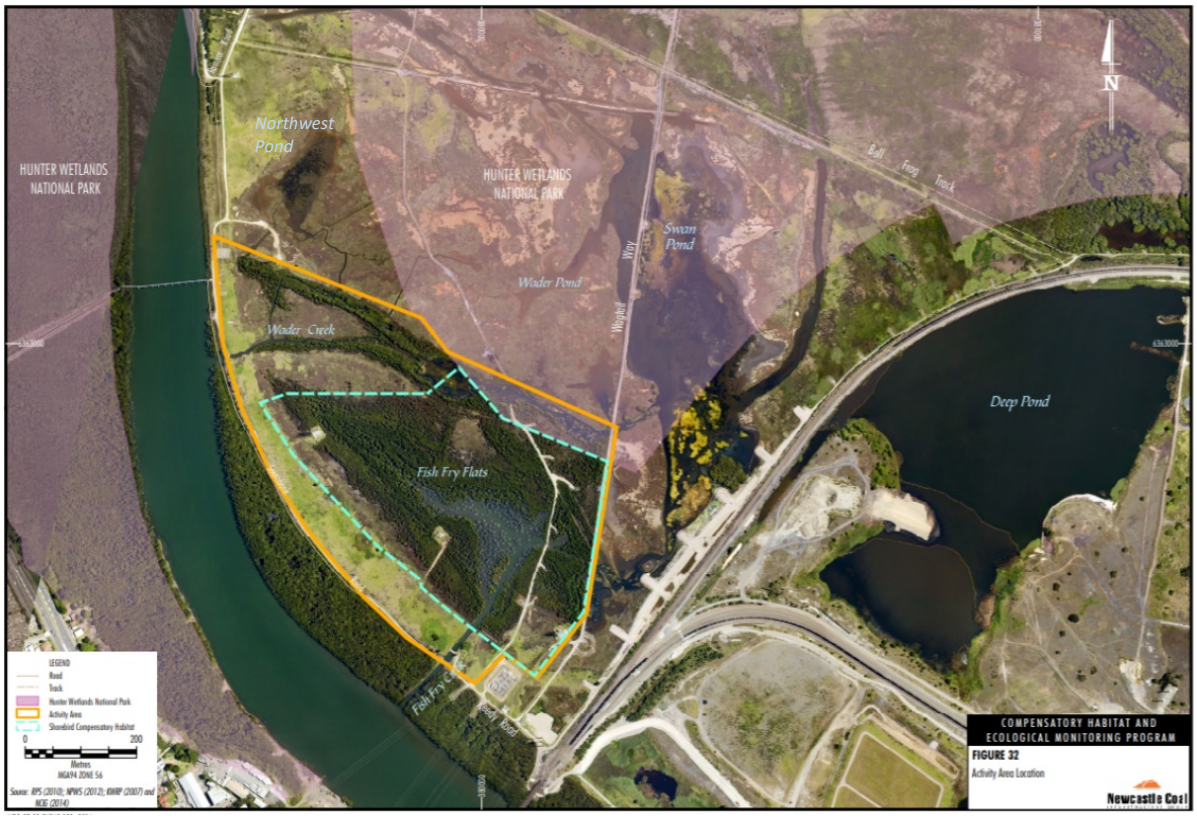

Figure 1 - NCIG Migratory Shorebird Compensatory Habitat Area, Area E, Ash Island (NCIG 2013).
Note: Shorebird Compensatory Habitat outlined by dashed light blue line; Activity Area outlined by solid orange line.

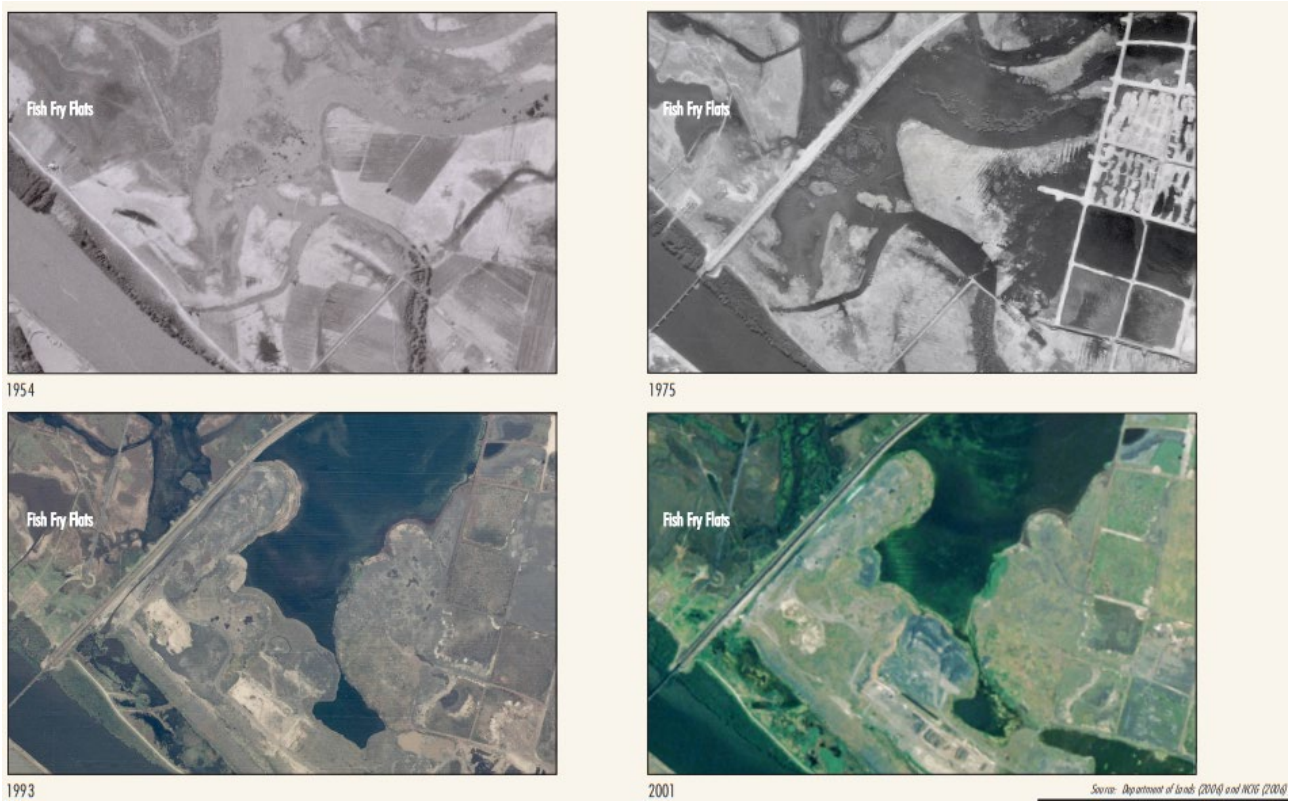

Figure 2 – Historical photographs, Fish Fry Flats and Wader Creek (1954, 1975, 1993, 2001) (NCIG 2013)

As part of the project, the proponent, Newcastle Coal Infrastructure Group, in consultation with Avifauna Consulting and National Parks and Wildlife Service, decided to also remove mangroves from Wader Creek, directly adjacent to Fish Fry Flats. That was because retaining the mature mangroves in that area would be a potential deterrent for shorebirds and would also be an ongoing source of new mangrove progeny in the Area E system, which would lead to extensive and continuous effort to keep the remaining area free of mangrove regrowth. To assist in maintaining ideal hydrological conditions within Fish Fry Flats and to limit the ingress of mangrove propagules from the South Arm of the Hunter River, an automated tidal gate and 20 mm stainless-steel mesh screen were fixed to an existing culvert in Fish Fry Creek. To further mitigate mangrove re-establishment, a finer mesh net was fixed further upstream within Fish Fry Creek and a small 20 mm stainless-steel mesh screen was installed in the existing Wader Creek tidal connection to the river.

In total, 17 hectares of mangroves were removed from Fish Fry Flats and Wader Creek. The area is effectively free of mangrove regrowth, with follow-up removal efforts conducted in December 2017 and November 2018. Removal has mostly been new mangrove progeny from seeds remaining from the original removal effort.

The purpose of this article is to document shorebird and other waterbird species records prior to and after tidal connectivity and mangrove removal and discuss the reasons for the observed changes.

METHODS

Baseline measurement

For the purposes of baseline comparison, the study has considered bird presence/absence data from two temporal periods – historical data (1994-2003) and pre-mangrove removal (Feb 2015-Mar 2016). The historical data has been obtained from three separate data sets, namely a report prepared for NSW National Parks and Wildlife Service (Kingsford 1995), continuous data collected by the Hunter Bird Observers Club (Stuart 1999-2003) and survey data collected by Birds Australia in 2002 (Hutchinson & Morris 2003).

Studying the change

During and following removal of the mangroves (Kleinfelder 2017; General Flora & Fauna 2018), regular bird surveys were conducted at Fish Fry Flats and Wader Creek. Since removal of the mangroves, this has been combined with data collected from Swan Pond (north and south), Wader Pond and North West Pond. This monitoring has been conducted in parallel with monitoring of other biotic and abiotic parameters such as vegetation surveys, benthic fauna surveys (Rankin 2018), surface water/groundwater chemistry, water levels and 6-monthly topographical surveys, which do not form part of the analysis of this report.

The avian data studied included records of migratory and endemic shorebirds and other waterbirds.

Changes have been recorded in vegetation communities since the initial mangrove removal. There has been proliferation of saltmarsh species within the intertidal zone, specifically Seablite *Suaeda australis*, Samphire *Sarcocornia quinqueflora* and Saltwater Couch *Sporobolus virginicus* (Rankin 2018). There have also been apparent changes in benthic fauna assemblages and surface topography (Rankin 2018).

RESULTS

The temporal changes revealed by the study are presented in a number of Excel line and bar charts. Counts of migratory shorebirds from 1995 to 2003 following tidal reconnection are presented in **Figure 3** and counts of endemic shorebirds from the same period are presented in **Figure 4**. Migratory shorebird and endemic shorebird counts prior to, during and following mangrove removal are presented in **Figure 5**, while **Figure 6** presents species richness (shorebirds plus other waterbirds) for the same three periods. The average number of shorebirds and waterbirds recorded on Fish Fry Flats and other wetlands in Area E since mangrove removal in 2016 are presented in **Figure 7** while **Figure 8** presents the total number of shorebirds and waterbirds over the same period. **Figure 9** presents Red-capped Plover *Charadrius ruficapillus* counts for Stockton Sandspit and Fish Fry Flats from 20014 to 2018. Counts of Sharp-tailed Sandpiper *Calidris acuminata* on Fish Fry Flats and Wader Pond since mangrove removal in September 2016 are presented in **Figure 10**.

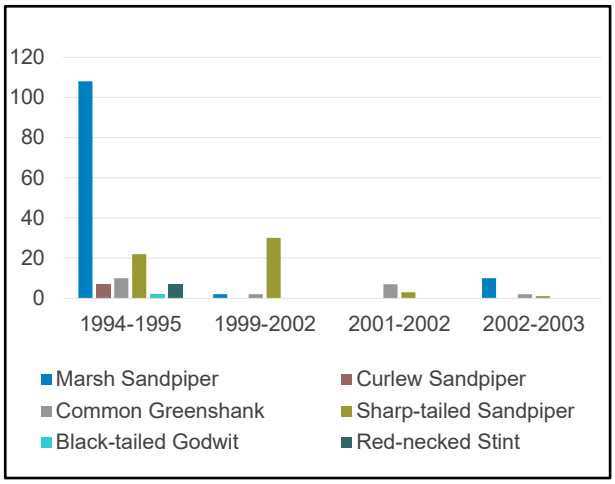

Figure 3 - Maximum migratory shorebird count by species, Fish Fry Flats during the period of mangrove growth following tidal connection in 1995 (based on three separate datasets)

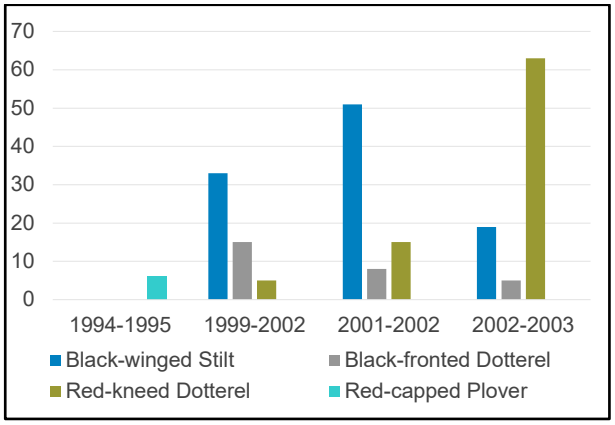

Figure 4 - Maximum endemic shorebird count by species, Fish Fry Flats during the period of mangrove growth (based on three separate datasets)

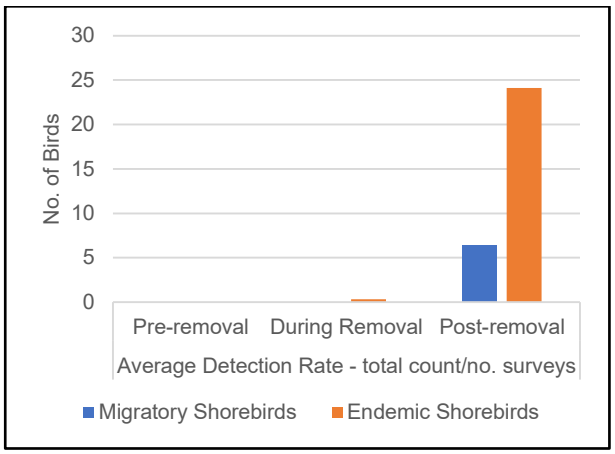

Figure 5 - Average detection rate - Fish Fry Flats/Wader Creek

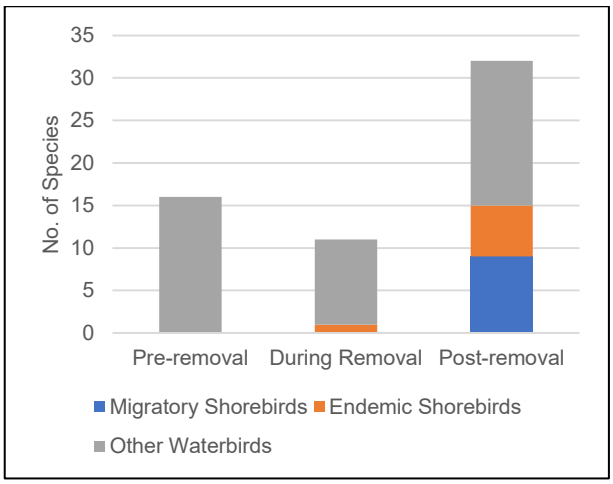

Figure 6 - Species richness - Fish Fry Flats/Wader Creek

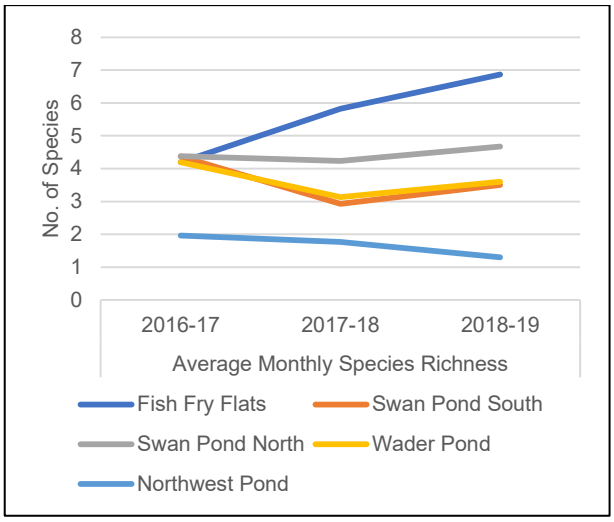

Figure 7 - Average monthly shorebird and other waterbird species richness, Area E, Ash Island

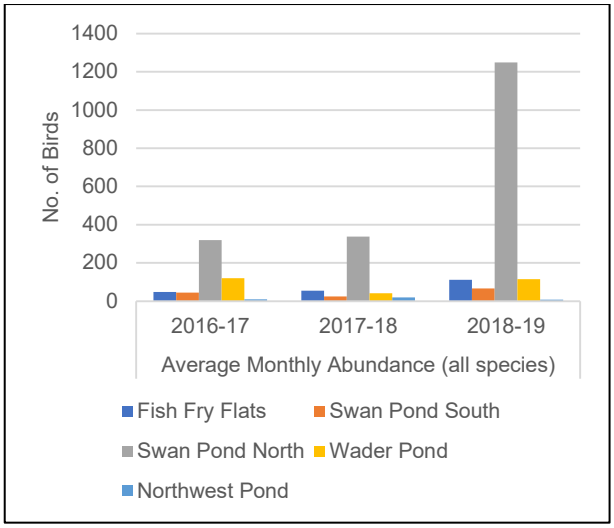

Figure 8 - Average Monthly Shorebird and other Waterbird Abundance, Area E, Ash Island

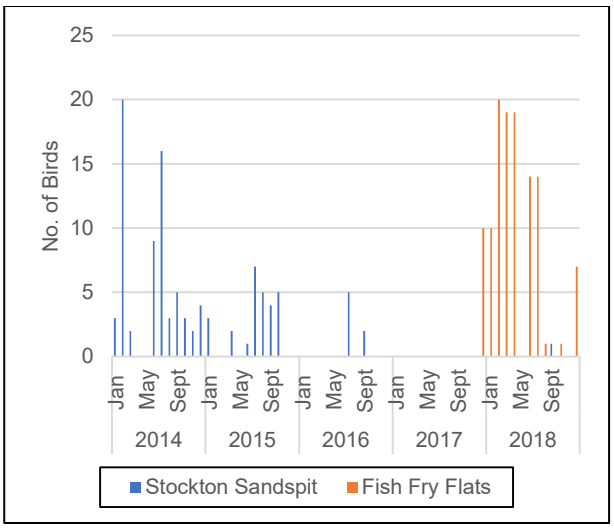

Figure 9 - Monthly Red-capped Plover counts, Fish Fry Flats and Stockton Sandspit

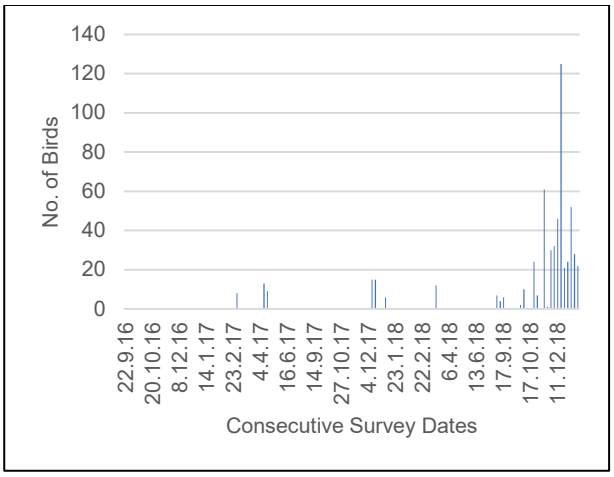

Figure 10 - Sharp-tailed Sandpiper counts, Fish Fry Flats/Wader Creek - consecutive surveys since mangrove removal

DISCUSSION

Changes in shorebird utilisation as mangrove proliferation occurred

The resultant impact of the change in tidal connectivity on wader occupation can be seen in the monitoring records. Between 1995 and 2003, a number of migratory wader species that historically used Fish Fry Flats were either no longer observed or were present in much lower numbers (**Figure 3**). These include Marsh Sandpiper *Tringa stagnatilis*, Curlew Sandpiper *Calidris ferruginea*, Black-tailed Godwit *Limosa limosa* and Red-necked Stint *Calidris ruficollis*, although a general decline in migratory shorebird numbers may also be attributed to overall population declines in the East Asian-Australasian Flyway (Hansen *et al*. 2016). Trends were different amongst endemic shorebird species (**Figure 4**). Red-capped Plover *Charadrius ruficapillus* and Red-necked Avocet *Recurvirostra novaehollandiae* were no longer recorded after 1995 (Note – Red-necked Avocet is not shown in **Figure 4** due to scale. The total observations during the 1994/1995 season were 677 individuals). Species such as Pied Stilt *Himantopus leucocephalus* and Black-fronted Dotterel *Elseyornis melanops* were relatively unchanged across the period, while Red-kneed Dotterel *Erythrogonys cinctus* increased between 1994 and 2003.

Figures 3 and **4** were developed from three data sets: Kingsford (1995); Hunter Bird Observers Club (1999-2003); and Hutchinson & Morris (2003). The data from the Hunter Bird Observers Club have been presented across two separate time periods (1999-2002 and 2002-2003).

This general downward trend in shorebird usage was confirmed through additional monitoring conducted more recently by Avifauna Consulting from 2015 to 2016, with no migratory shorebird or endemic shorebird species recorded in Fish Fry Flats (Avifauna Research & Services 2016). Consistent usage by other waterbirds was observed across all datasets with Australian White Ibis *Threskiornis moluccus*, White-faced Heron *Egretta novaehollandiae* and Chestnut Teal *Anas castanea* recording the highest maximum counts of birds which were observed in all datasets (Avifauna Research & Services 2016).

Shorebirds present during and after mangrove removal

Figures 6-8 summarise the changes that occurred during and after removal of the mangroves. The overall species richness (**Figure 6**) declined slightly while mangroves were actively being removed but increased subsequently, to more than double the pre-removal levels. That result is reflected in the monthly average species richness levels from the surveys (**Figure 7**). There was little or no change in species richness at the adjoining water bodies (Swan Pond, Wader Pond, Northwest Pond) but at Fish Fry Flats / Wader Creek the average number of species per survey increased from 4.2 species per survey to 6.9 species per survey.

There has been a distinct change in bird usage observed in the Fish Fry / Wader Creek

compartment. Since removal of the mangroves, there has been an immediate response in shorebird usage of the habitat. This can be seen in **Figure 5**, with the average number of shorebirds per routine survey count at Fish Fry Flats/Wader Creek changing from zero prior to mangrove removal to an average of 6.4 birds following mangrove removal. The average number of endemic shorebirds changed from 0.32 to 24.1 after mangrove removal. The species with the highest counts were Masked Lapwing *Vanellus miles*, Sharp-tailed Sandpiper *Calidris acuminata*, Red-kneed Dotterel, Red-capped Plover, Pied Stilt and Red-necked Stint. Across all waterbird species, there was also a distinct increase in species richness observed at Fish Fry Creek after mangrove removal (**Figure 6**).

To date, there have been nine different species of migratory shorebirds recorded at Fish Fry Flats/Wader Creek. Some species, such as Whimbrel *Numenius phaeopus*, Bar-tailed Godwit *Limosa lapponica*, Common Greenshank *Tringa nebularia* and Curlew Sandpiper, were present only fleetingly after the initial mangrove removal (Kleinfelder 2017; General Flora & Fauna 2018). Other species have been recorded more consistently since the 2016/17 season, including Eastern Curlew *Numenius madagascariensis*, Double-banded Plover *Charadrius bicinctus*, Pacific Golden Plover *Pluvialis fulva*, Sharp-tailed Sandpiper and Red-necked Stint (General Flora & Fauna 2018).

In comparison to neighbouring wetlands in Area E, such as Swan Pond, Wader Pond and Northwest Pond, Fish Fry Flats/Wader Creek has experienced a steady increase in average species richness (total number of shorebird and waterbird species observed) since removal of the mangroves (see **Figure 7**). Despite this high species richness, Swan Pond North remains the most important wetland in Area E for shorebirds and waterbirds with an average monthly count far greater than all other wetlands (**Figure 8**). During the 2018/19 season there was an increase in average monthly counts across all wetlands with the exception of Northwest Pond. The cause of this is unknown although it may have been a result of wetting/drying cycles or broader shorebird and waterbird trends in the estuary and elsewhere across the Australian eastern seaboard.

Changing Red-capped Plover usage patterns

While the purpose of restoring saltmarsh and mudflat habitat to Fish Fry Flats and Wader Creek was intended to provide habitat for all shorebird species, particularly migratory shorebirds, there has been a trend of increases in the number of small sandpiper and plover species using the water bodies. Red-capped Plover have been recorded during monthly Hunter Bird Observers Club (HBOC) surveys with counts of up to 20 birds, while NCIG-commissioned surveys recorded up to 22 individuals (General Flora & Fauna 2018). **Figure 9** represents the two most consistent locations in the estuary for Red-capped Plover observations over the past 5 years – Stockton Sandspit and Fish Fry Flats. Traditionally these birds have been observed predominantly at Stockton Sandspit. More recently the predominant location in the estuary[1] for this species is Fish Fry Flats/Wader Creek. Note – there was one significantly high count of Red-capped Plover at Tomago Wetlands, Samphire Flats in August 2018 (155 individuals) (A. Stuart pers. comm.).

Red-capped Plover have also been recorded as breeding at Fish Fry Flats. Chicks were observed twice during HBOC monthly wader surveys in the 2017/18 season, while a chick and a nest containing two eggs were recorded in the 2018/19 season (A. Stuart pers. comm.).

Sharp-tailed Sandpiper increase

Sharp-tailed Sandpiper have also been observed in increasingly large numbers at Fish Fry Flats/Wader Creek. Since post-mangrove-removal monitoring commenced in September 2016, regular surveys have been conducted by the ecological consultancy General Flora and Fauna Consulting. The surveys were conducted fortnightly in the period from September to April and monthly in the period from May to August. Fortnightly monitoring has involved low- and high-tide surveys, as well as nocturnal surveys, while monthly monitoring has involved low- and high-tide surveys only. **Figure 10** shows occasional usage of Fish Fry Flats and Wader Creek by Sharp-tailed Sandpiper in the 2016/17 and 2017/18 seasons with a substantial increase in the numbers present since October 2018.

[1] The Hunter Estuary, for the purpose of this article, excludes Worimi Conservation Lands

While it is unclear as to the reason for the increase in Sharp-tailed Sandpiper numbers, there does not appear to be a correlation between total summer records at Fish Fry Flats and total summer records in the broader estuary (2016/17 season - 3173 birds recorded; 2017/18 season - 15,956 birds recorded; 2018/19 season (to Dec 2018) – 9002 birds recorded) (Stuart 2014-2018). It is also noted that the majority of Sharp-tailed Sandpiper using Fish Fry Flats and Wader Creek were foraging rather than roosting.

CONCLUSION

The removal of mangroves at Fish Fry Flats and Wader Creek on Ash Island has promoted the presence of shorebird species utilising the habitat. Species abundance and richness have both increased for migratory and endemic shorebirds. Since the removal of mangroves, average shorebird and other waterbird species richness has steadily increased at Fish Fry Flats/Wader Creek in comparison to neighbouring wetlands. However, overall abundance remains highest at neighbouring Swan Pond (north).

The restored habitat at Fish Fry Flats and Wader Creek has become the preferred habitat for Red-capped Plover in the Hunter Estuary, while Sharp-tailed Sandpiper are increasingly using the habitat for feeding. More work is required to better understand the value of Fish Fry Flats and Wader Creek to wader species, particularly as feeding habitat. This should include analysis of bird usage patterns, vegetation coverage and benthic infauna assemblages, as well as further analysis of biotic and abiotic factors.

ACKNOWLEDGEMENTS

I would like to thank the efforts of the ecologists, consultants and volunteers in collating the important data that supports this work, including Phil Straw (Avifauna Research & Services), Greg Little (General Flora and Fauna), Dan O'Brien (Kleinfelder) and Alan Stuart (Hunter Bird Observers Club). Ann Lindsey has been very helpful in generating estuary-wide data for comparison with specific data from the project site. I would also like to thank all club members and volunteers from the Hunter Bird Observers Club who have been involved in the NCIG Biodiversity Offset to date, as well as researchers from the University of New South Wales and University of Newcastle who are conducting research on the project site more broadly. Finally, a thank you to my colleagues, Nathan Juchau and Hayley Ardagh, as well as NCIG management for committing the substantial time and resources to the habitat restoration project.

REFERENCES

Avifauna Research & Services (2016). NCIG Shorebird Compensatory Habitat Monitoring, Pre-construction Period January-March 2016. (Unpublished report prepared for Newcastle Coal Infrastructure Group).

General Flora and Fauna (2018). 2017-18 Survey Data, NCIG Area E. (Unpublished report prepared for Newcastle Coal Infrastructure Group).

Hansen, B.D., Fuller, R.A., Watkins, D., Rogers, D.I., Clemens, R.S., Newman, M., Woehler, E.J. and Weller, D.R. (2016). Revision of the East Asian-Australasian Flyway Population Estimates for 37 listed Migratory Shorebird Species. (Unpublished report for the Department of the Environment. BirdLife Australia: Melbourne.)

Herbert, C. (2007). Distribution, Abundance and Status of Birds in the Hunter Estuary. (Hunter Bird Observers Club Special Report No. 4. Prepared for Newcastle City Council.)

Hunter Bird Observers Club (1999-2003). Monthly Hunter Estuary Wader Surveys, 1999-2003.

Hunter-Central Rivers Catchment Management Authority (2011). Managing Hydrodynamics for Shorebird Habitat in Area E, Ash Island, Hunter Estuary. (Prepared by Dr Pia Laegdsgard for the Kooragang Wetlands Rehabilitation Project.)

Hutchinson, A. and Morris, A.K. (2003). Rehabilitation of Waterbird Habitat on Ash Island. Final Report. Grant No. 1998/RR/G001. (Prepared for the Environmental Trust, Environment Protection Authority by Birds Australia.)

Kingsford, R.T. (1995). Rehabilitating estuarine habitat on Kooragang Island for waterbirds, including migratory wading birds - Stage 1 of the Kooragang Wetland Rehabilitation Project. (Prepared for NSW National Parks and Wildlife Service: Hurstville, NSW.)

Kleinfelder Consulting (2017). Shorebird Monitoring Final Report. (Unpublished report prepared for Newcastle Coal Infrastructure Group).

NCIG (2013). Compensatory Habitat and Ecological Monitoring Program. (Unpublished report prepared by Newcastle Coal Infrastructure Group.)

Rankin, C. (2018). Fish Fry Flats Vegetation and Infauna Report Methods and Preliminary Results. (Unpublished report prepared for Newcastle Coal Infrastructure Group.)

Rodríguez, J. and Sandi Rojas, S. (2014). Shorebird Compensatory Habitat Area Hydrological-Hydraulic Modelling. Newcastle Innovation. (Unpublished report prepared for Newcastle Coal Infrastructure Group.)

Stuart, A. (2014-2018). Hunter Region New South Wales Annual Bird Report Numbers 23, 24, 25 and 26. (Hunter Bird Observers Club Inc.: New Lambton, NSW.)