Implications of water resource development on migratory shorebird habitat in the Gulf of Carpentaria region

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Northern Australia Environmental Resources Hub

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World class research to support sustainable development in northern Australia

This research on the Flinders, Gilbert and Mitchell Rivers in the Gulf of Carpentaria is supporting water planning, through increasing our understanding of the links between river flows, estuaries and ecosystem assets such as migratory shorebirds, prawns and fish.

Key findings

- The aim of this research was to determine the relationship between freshwater flows and food supplies for migratory shorebirds in the estuaries of three rivers in the southern Gulf of Carpentaria earmarked for water resource development – the Flinders, Gilbert and Mitchell rivers (Burford et al. 2021).
- This intertidal habitat supports one of the highest numbers of migratory shorebirds in Australia. A reduction in flows from water resource extraction may impact food supplies for critically endangered migratory shorebirds and other species by affecting the estuarine food web.
- Intertidal flats of these southern Gulf estuaries and nearshore environments had high densities of macrobenthos (animals such as pipis, clams and worms that live in the sand and mud and are important food sources for shorebirds) compared with other Australian tropical coastal environments and explains the importance of this region for migratory shorebirds.
- The nutrients associated with freshwater flows are critical for fuelling the growth of algae – productivity that forms the base of the food web that nourishes macrobenthos and other animals (Burford and Faggotter, 2021). Reductions of these flows will impact the productivity of these estuaries, and that of important coastal fisheries (Burford et al. 2020).
- There were significant densities of shorebirds, including endangered and critically endangered species, at the mouths of all three estuaries. Some species appeared to use the estuaries and nearshore as staging sites for further migration north and south, while others were summer residents.
- It is vitally important to sustainably manage the water resources of the southern Gulf to maintain food supplies for migratory shorebirds and other important species.
- A companion hub project on the effect of water-resource development on fisheries species was undertaken at the same time as this study. It also identified the impact of flow alteration on the banana prawn and barramundi fisheries and quantified the catch implications and flow-on economic effects (Burford et al. 2020, McMahon et al. 2020, Smart et al. 2021).
- Knowledge gaps remain about the quantities, frequency and timing of flows that are required to maintain the estuarine productivity for the shorebirds. This includes the capacity to model long-term effects of water development where key 'tipping points' may be reached. As such, a precautionary approach to water-resource allocation should be taken.

The far eastern curlew is one of several critically endangered species that use the Gulf to feed and fatten up.

Implications/actions supported by the research

- This research has provided important new information to help manage habitat and conserve migratory shorebird species. The first on-ground surveys of the Gilbert and Mitchell estuaries found significant densities of shorebirds, including endangered and critically endangered species such as the great knot and eastern curlew. The Flinders estuary was found to be especially important for migratory shorebirds throughout the summer. The Gulf's extensive intertidal flats and significant food resources highlight this region as a critical site for migratory shorebirds. It is important to sustainably manage water resources to ensure productivity of the intertidal flats is maintained and Australia meets its international obligations to protect shorebirds.
- Maintenance of flows in low- and medium-flow years is critical for sustaining estuarine productivity, given the importance of nutrient inputs in fuelling algal growth. Additionally, first-flush flows at the start of the wet season are crucial for delivering nutrients which fuel productivity and ensure sufficient food for shorebirds for months to come. The Flinders estuary is likely the most vulnerable to loss of first-flush flows due to the longer period of no-flow each year compared with the Gilbert and Mitchell rivers.
- Water extraction in a year following multiple years of little or no flow will have major impacts on estuarine productivity. This scenario is not unusual, particularly for the Flinders River which has the highest interannual variability in flow of the three rivers and can have multiple consecutive years of no flow. The productivity of the system is likely to be further impacted if there is an increase in years of little or no flow from changing weather patterns due to climate change.
- The companion project on flows and fisheries also identified that fisheries species are likely to be impacted by water-resource development through a reduction in food availability (Burford et al. 2020). Barramundi will also be impacted by a lack of available floodplain habitat. The economic cost on both fisheries is likely to be significant (McMahon et al. 2020, Smart et al. 2021).
- This research provides an important step in identifying the links between migratory shorebirds and flow; however, quantitative data on long-term effects of changes in flow regime are needed. This is key information for water planning. Additionally, while the study provided some information about seasonal changes in shorebird use of habitats, it was limited and further surveys across seasons and years are needed.

Crabs and other animals of the mudflats and sandflats feed on algae in the sediment.

Context and background

The southern Gulf of Carpentaria estuaries and nearshore environments are a key Australian region for migratory shorebirds (Garnett, 1989; Driscoll, 1997, 2001, 2014). This includes sites of international and national significance for specific species, as well as sites with endangered and critically endangered species. There are several network sites of the East Asian–Australasian Flyway identified in the southern Gulf. Historically, shorebird surveys in the Gulf have focussed on the Norman/Flinders estuary area, providing a few snapshots in time, with other more remote areas of the Gulf under-represented.

The push for irrigated agricultural development in the southern Gulf has the potential to impact these important estuaries and the nearshore environments downstream. The White Paper on Developing Northern Australia (Commonwealth of Australia, 2015) identified the need for studies on the role of freshwater flows in supporting natural environments to inform decisions about sustainable water allocations. Three rivers in the Gulf of Carpentaria region in northern Australia

Endangered great knots in flight.

have been earmarked for water development – the Flinders, Gilbert and Mitchell rivers (DNRME, 2017; 2018a, b).

A resource assessment study of the Flinders and Gilbert rivers in the southern Gulf of Carpentaria, commissioned by the Australian Government, identified the need for further information on flow thresholds for river/coastal flood plume connectivity and associated ecosystem effects (Waltham et al., 2013). This includes species of high economic and ecological value associated with the river systems, including wetlands of national significance, important recreational and commercial fisheries, and migratory and threatened species. There is concern that these important ecological assets may be impacted by intensive land and water resource development.

Information on the water needs of estuarine ecosystems is needed to ensure that water allocation is ecologically sustainable, and that economic and social trade-offs between agriculture and the needs of the downstream environment are understood. The food supply for migratory shorebirds in the estuaries and nearshore environments is likely to be dependent on freshwater flows but the nature of this relationship has been unclear.

The Australian Government's Northern Australia Water Resource Assessment (NAWRA) and the Flinders and Gilbert Agricultural Resource Assessment (FGARA) projects undertaken by CSIRO synthesised available knowledge on marine ecosystems and species that may be impacted by water development. However, this study highlighted that key knowledge gaps remain, including the impact of reduced water flows on the productivity of the estuaries. Therefore, this project examined the links between freshwater flow and estuarine/coastal productivity to understand how changes in flow may impact the food supply for shorebirds in estuaries and adjacent coastal environments. Additionally, shorebird surveys were conducted to assess the importance of the Flinders, Gilbert and Mitchell estuaries and nearshore environments as feeding sites for birds.

Detail

This study showed that freshwater flows had a number of impacts on the productivity in the Flinders, Gilbert and Mitchell estuaries and nearshore environments. During wet-season flooding, the marine algae at the base of the food web are negatively impacted because they cannot tolerate the low salinity. However, this low-salinity water also contributes significant nutrient loads to estuaries and the nearshore. Experimental addition of nutrients stimulated algal growth on intertidal flats in all estuaries

at multiple sampling times, suggesting chronic nutrient limitation (Burford and Faggotter, 2020). Catchment nutrients are therefore critical to promoting algal growth across all three estuaries and adjacent nearshore. The Flinders estuary was the most productive of the three estuaries despite the high variability in flow, making the Flinders highly vulnerable to changes in the freshwater flow regime from water-resource development.

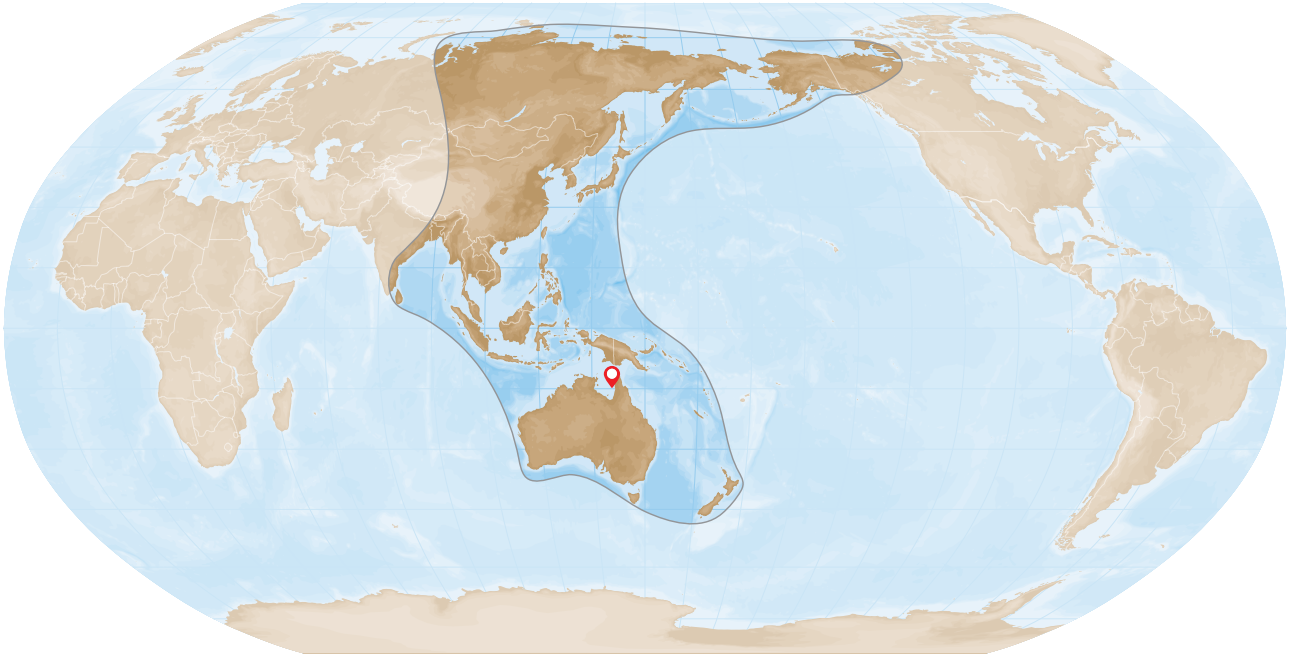
Macrobenthos are a suite of animals that live in the mud and sand, and feed on the algae growing in the estuaries and nearshore (Burford et al. 2021). They are an important food source for shorebirds. The abundance and types of macrobenthos were determined in all three estuaries. Polychaetes (marine worms) are an important food source for some shorebird species and dominated these environments. Consistent with the algae, macrobenthos densities decreased in the wet season when the salinity dropped. Abundances were higher in the late dry season and similar across all the estuaries. The abundance of macrobenthos in these Gulf systems was high when compared with many other northern Australian estuaries and nearshore environments. This combined with the extensive areas of intertidal habitat reinforce why estuaries and nearshore environments of southern Gulf rivers are so important for migratory shorebirds.

As part of the study, the Queensland Wader Study Group (QWSG; a non-government organisation) compared the shorebird numbers and species at and near the mouths of the three estuaries (see appendix in Burford et al. 2021). There were two low tide surveys – March and December 2019 – undertaken at the same time as algal and macrobenthos sampling. A key finding was that all three river mouths had significant numbers of shorebirds, including endangered and critically endangered species. This provides important new information for the management and protection of these species, particularly for the understudied Gilbert and Mitchell estuaries. The black-tailed godwit was present in the highest numbers (internationally significant) compared with other shorebird species in all three systems. Numbers of birds in the Flinders region in March 2019 were relatively low compared with other sampling occasions, possibly due to the major flood in the Flinders River system which washed away much of the food supply. In particular, numbers of great knots declined coincidentally with a major reduction of bivalves, their major food source.

Carpentaria Land Council Aboriginal Corporation (CLCAC) undertook a seasonal comparison of shorebirds in the Flinders system by surveying previously identified high-tide roost sites (see appendix in Burford et al. 2021). They found a predominance of great and red knots, and black-

Carpentaria Land Council Aboriginal Corporation

CLCAC rangers have been interested in shorebirds for a long time and have conducted surveys to count birds and understand how they’re using Gulf areas.



This research is supporting Australia's international commitments to protecting migratory shorebirds and their habitats and helping to support conservation in the East Asian–Australasian Flyway.

tailed godwits. A number of endangered and critically endangered species were present in significant numbers. There were high densities of great knots and black-tailed godwits in mid-summer (January), compared with August/September, suggesting that many birds are resident in the region over summer rather than staging here. Other species, e.g. red knot, had higher numbers in August/September, suggesting that these species use the Flinders region as a staging area before migrating south for the summer.

Knowledge gaps

- The project identified important shorebird sites but counts could only be performed twice in the Mitchell and Gilbert, and four times in the Flinders region. Further counting across time and space is needed to get more accurate data on shorebird counts and species in the southern Gulf.
- Although catchment nutrients were identified as critical to the food webs in estuaries, further research is needed to provide quantitative data about the volumes of water required to maintain the productivity of the estuaries, with flow-on effects to migratory shorebirds and fisheries species and estuarine food webs. This information is needed to improve understanding about the links between water extraction in the upper catchment and food webs hundreds of kilometres down in the estuaries, and guide water-resource planning and allocation decisions.

Consultation

Project development occurred in consultation with the Queensland Government, specifically the wetland group at the Department of Environment and Science, and water planning and policy staff at the Department of Natural Resources, Mines and Energy. The Wetlands Section of the Australian Government's Department of Agriculture, Water and the Environment was also consulted.

References

Burford, M.A., Faggotter, S.J., Kenyon R. 2020. Project 1.4: Contribution of rivers to the productivity of floodplains and coastal areas of the southern Gulf of Carpentaria – Component 1. Northern Australia Environmental Resources Hub final report.

Burford, M.A., Faggotter, S.J., Lowe, V., Venarsky, M., Frid, C., Ronan, M., Bush, R., Edwards, D. 2021. The vulnerability of food supplies for migratory shorebirds to altered flow in the southern Gulf of Carpentaria. NESP NAER project 3.6, Griffith University, Brisbane.

Burford, M.A., Faggotter, S.J. 2021. Comparing the importance of freshwater flows driving primary production in three tropical estuaries. Marine Pollution Bulletin 169, 112565.

Commonwealth of Australia 2015. Our north, our future: white paper on developing Northern Australia. Department of Infrastructure and Regional Development (Australia), Department of the Prime Minister and Cabinet (Australia)

DNRME [Department of Natural Resources, Mines and Energy]. 2017. Water Resource (Gulf) Plan, Sale of general reserve unallocated water: tender assessment report. Department of Natural Resources, Mines and Energy, Queensland Government, Brisbane, Australia.

DNRME [Department of Natural Resources, Mines and Energy]. 2018a. Minister's Performance Assessment Report, Water Plan (Gulf) 2007. Department of Natural Resources, Mines and Energy, Queensland Government, Brisbane, Australia.

DNRME [Department of Natural Resources, Mines and Energy]. 2018b. Minister's Performance Assessment Report, Water Plan (Mitchell) 2007. Department of Natural Resources, Mines and Energy, Queensland Government, Brisbane, Australia.

Driscoll, P. V. 1997. The distribution of shorebirds along the Queensland coastline. pp. 80-122. In Straw, P. (ed). Shorebird Conservation in the Asia-Pacific Region. Australasian shorebirds Studies Group of Birds Australia, Melbourne.

Driscoll, P.V. 2001. Gulf of Carpentaria Wader Surveys 1998-9 prepared on behalf of QWSG with assistance from AWSG for the Queensland Environmental Protection Agency, July 2001.

Driscoll, P.V. 2014. Shorebird surveys in the south east Gulf of Carpentaria. Report for Shorebirds 2020, Queensland and Australasian Wader Study Groups.

Garnett, S.T., 1989. Wading Bird Abundance and Distribution - South-eastern coast of the Gulf of Carpentaria. RAOU Report No. 58. Report to the Queensland National Parks and Wildlife Service.

McMahon, J.M., Smart, J.C.R. Robins, J., Burford, M., Stewart-Koster, B., Brown, C., Ndehedehe C. 2020. Project 1.4, The value of freshwater in northern Australia: Trade-offs between irrigated agriculture and fisheries in the Gulf of Carpentaria. Component 2. NESP Northern Australia Environmental Resources Hub final report.

Smart, J.C.R., McMahon J.M., Curwen, G. and Burford, M. 2021. Estimating the economic impact of potential extractions from Gulf rivers on the banana prawn fishery. Northern Australia Environmental Resources Hub final report.Griffith University, Brisbane.

Waltham N., Burrows, D., Butler, B., Wallace, J., Thomas, C., James, C., Brodie, J. 2013. Waterhole ecology in the Flinders and Gilbert. catchments. A technical report to the Australian Government from the CSIRO Flinders and Gilbert Agricultural Resource Assessment, part of the North Queensland Irrigated Agriculture Strategy. CSIRO Water for a Healthy Country and Sustainable Agriculture flagships, Australia.

Further information

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The project page and final report can be found on the Hub website.

This research was completed in September 2021.

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Queensland Government
QLD WADER STUDY GROUP
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