Securing the ecological character of the southern Coorong

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Preamble

This paper provides a brief background and a potential solution to a major issue in the southern Coorong – inadequate water levels through spring preventing the recovery of the aquatic plant *Ruppia tuberosa*. *Ruppia tuberosa* is a key ecological component of the southern Coorong, providing resources (both food and habitat) for other biota, including the small-mouth hardyhead *Atherinosoma microstoma,* the salt-dwelling chironomid *Tanytarsus barbitarsis* and a wide variety of waterbirds, including migratory shorebirds, endemic shorebirds and waterfowl. The paper is based on relevant parts of presentations given at a forum in Goolwa in June 2016 and in a presentation to the Murray Darling Basin Authority in Canberra in March 2017. It featured as a news item on ABC TV on 22 January 2017 (www.abc.net.au/news/2017-01-23/coorong-weir-proposal-to-stop-water-dropping/8202310).

Background

Ruppia tuberosa was widespread throughout the southern lagoon of the Coorong since at least the 1960s (Paton 2010). *Ruppia tuberosa* is essentially an annual plant that grows on the ephemeral mudflats around the margins of the Coorong. Historically, these ephemeral mudflats were covered with water through winter, spring and into summer, but the mudflats were dry and exposed for parts of autumn. Water levels vary seasonally in the southern Coorong by about 1m and, depending on the topography, provide several hundred metres of ephemeral mudflat suitable for *Ruppia tuberosa* along both the eastern and western shorelines of the southern Coorong. The life cycle of the plant is such that seeds germinate and turions sprout in late autumn once water has returned to the ephemeral mudflats. Turions are asexually-produced perenniating organs, essentially small swellings with stored carbohydrate that are produced by the plant along stolons and leaf axils, particularly during summer. Turions are relatively short lived, while seeds remain viable for a number of years. Only a proportion of the seeds that are viable germinate in any year and so the seed bank provides this annual plant with resilience, a capacity to cope with one or more years of poor flowering. The plant grows and establishes over winter and spring with the plants typically producing flowers and setting seeds through late spring and early summer (October-December).

During the millennium drought (2002-2010), *Ruppia tuberosa* disappeared from the southern Coorong because extremely low water levels through spring left the beds of *Ruppia tuberosa* exposed, such that the plants could not complete their flowering and so did not set seeds. The accumulated seed bank eroded during this time. Towards the end of the drought, the salinities (even in winter), were such that they were too high for the few seeds that remained to germinate. When substantial flows (~1000 GL/month) of water exist over the barrages through spring and into summer, then water remains over most of the ephemeral mudflats and *Ruppia tuberosa* can complete its reproductive cycle and produce turions. Flows of water over the barrages, however, are not required to lift water levels to re-inundate the ephemeral mudflats in late autumn or winter. This is because winter sea levels are slightly higher and storm events and associated strong NW to W winds push water into the Coorong, resulting in the reinundation of the ephemeral mudflats each year, even in the absence of flows over the barrages. Reduced evaporation and increased precipitation during this winter period also contribute to the higher levels.

As a consequence of extracting water for human uses from the Murray Darling Basin, the quantities of water reaching the end of the river are now insufficient to maintain the water levels in the southern Coorong through spring; consequently, the beds of *Ruppia tuberosa* fail to be covered with water long enough for this annual plant to complete its annual cycle. The critical hydrological issue needed to recover and then secure healthy and resilient populations of *Ruppia tuberosa* is maintaining adequate water levels in the southern Coorong through spring to allow *Ruppia tuberosa* to complete its reproductive cycle. The plant has been declining since the mid-1980s at least. The millennium drought simply brought these declines into sharp focus. In the mid-1980s, the seed banks were substantial, approaching 20,000 seeds/m^2 in some areas. This compares with current seed banks of around 200 seeds/m^2, even 5-6 years after the end of the millennium drought. The on-going failure for *Ruppia tuberosa* to complete its reproductive cycle since the millennium drought is linked to falling water levels in the southern Coorong during spring (Figure 1). Water levels in the southern Coorong need to remain on or above 0.2m AHD through spring and into early summer to allow plants from most of the beds of *Ruppia tuberosa* to flower and set seeds. As shown in Figure 1, water levels have dropped below this level for at least a few weeks (sufficient to expose and desiccate the plants) in the springs of 2010, 2011, 2012, 2013, 2014 and 2015. The only year in which water levels were sustained through spring was 2016, when there was an unregulated flow (but water levels still dropped rapidly once the barrage gates were closed in January 2017). In 2016, *Ruppia tuberosa* growth was substantial and plants flowered along the Coorong, but the flowering resulted in little seed production because of interference from filamentous algae (*Ulva* spp). Significant interference from algae is a recent occurrence, with the filamentous algae becoming prominent in the southern Coorong after releases of substantial volumes of fresh water from the South East of South Australia into the southern Coorong at Salt Creek in 2013. Algal interference is a separate issue and also needs to be addressed but is not part of this paper.

Recent modelling indicates that, in most years, the quantity of water reaching the end of the river is inadequate to sustain suitable water levels for *Ruppia tuberosa* in the southern Coorong through spring. This holds even with the added water expected to reach the end of the river once the current MDB Plan is implemented. Thus, an alternative solution is needed or we manage the Coorong as an entirely different system and renege on our international obligations under the Ramsar Convention, various international migratory bird agreements, and contravene Australia's EPBC Act. One potential engineering solution is to put a barrier across the Coorong, midway along its length, to prop up the water levels in spring and provide conditions that are more conducive to *Ruppia tuberosa* completing its life cycle.

Barrier Proposal

In developing the following proposal, an understanding of the following is required:

(1) *Ruppia tuberosa* extends throughout the south lagoon of the Coorong and into the southern end of the north lagoon for about 10 km. Thus, to maximize the benefit of any structure, the structure should be placed across the north lagoon as close to the 10km point as possible.
(2) As a barrier can interfere with movements of other biota (such as fish), any barrier that is built should have capacity to be transparent or allow passage of biota for at least part of the year.
(3) There are likely to be significant cultural sensitivities with placing a structure across the width of the Coorong for the traditional owners, the Ngarrindjeri, and those sensitivities need to be considered and solved to their satisfaction.
(4) Any barrier that is built should have the capacity to be removed if the barrier fails to deliver the benefits sought, and/or is no longer needed.

There are potentially a range of structure options but most have issues about maintaining their functional integrity in the exposed conditions (e.g., fluid-filled tubes) and still have the capacity to be removed without trace if required. The best of the solutions to date seems to be interlocking plastic piles, made of recycled plastic that have comparable lifespans to concrete. These plastic piles are about 10 cm x 10 cm in cross section and several metres in length (e.g. Figure 2). They are simply pushed into the sediment 1-2 m, leaving a portion of the post above the sediment and set at the desired water level. Each post in turn is punched into the sediment from a barge or lightweight tractor, depending on water levels and the compaction of the sediment. If these had to be removed, then they are simply pulled out of the sediment in turn. In the Coorong, any depression in the sediment that might be left after removal of a pile is quickly infilled. Thus, there would be no trace of the structure if removed, unlike a structure built with concrete that would be hard to remove in any case. These interlocking plastic piles have been used successfully in other wetlands within the Murray-Darling Basin. There are also opportunities to have one-way valves or areas that can be opened along the length of the structure providing some additional flexibility in managing water levels.

In terms of positioning the structure across the Coorong, the logical place is near the Needles near the southern end of the North Lagoon (ca 6 km from the junction of the two lagoons; Figure 3).This captures the greatest amount of key *Ruppia tuberosa* mudflats. A structure placed 6 or so kilometres south of this, near Parnka Point, would exclude significant areas of *Ruppia tuberosa*. Although Parnka Point is often promoted as a logical place because the span across the Coorong is less than 100 m, the nature of the sediments is such that the use of plastic piles would not be feasible. If the structure was placed as shown in Figure 3, the preferred ecological location, then about 1.2 km of plastic pile barrier would be required.

If keeping the water levels in the southern Coorong on or above 0.2 m AHD into early summer is the key deliverable being sought, then a barrier that has a sill set at 0.4 m or 0.3 m AHD, would secure an extra 4-8 weeks with water levels above the threshold (given evaporative water losses of about 0.1 m per month). Higher barriers would provide a longer period with higher water levels but a higher barrier delays the return of water to the southern Coorong in late autumn, so there are trade-offs at other times of the year. Importantly, with a 0.6 m AHD sill, the two lagoons are disconnected for much of the year, so there are some ecological benefits of setting the sill height at a lower level (0.3-0.4 m AHD). First, water levels return to the southern Coorong a little earlier in autumn (which mirrors natural patterns better). Second, for much of the year, the barrier is underwater, providing for unimpeded movement of aquatic biota over the barrier. Third, the barrier is out of sight for this period (see Figure 4). Finally and importantly, the structure would not need to go all the way across the Coorong because the margins of the ephemeral mudflats in the southern Coorong are above 0.3-0.4 m AHD. This may make such a structure more acceptable to the traditional owners, the Ngarrindjeri. The trade-off however would be that there would be some years in which, even with such a barrier in place, the beds of *Ruppia tuberosa* would be exposed prematurely, restricting the plants ability to complete their reproductive cycle. At present, securing water levels for *Ruppia tuberosa* only seem possible in those years with unregulated flows and in recent decades that has occurred about once every 10 years, which provides no opportunity for *Ruppia tuberosa* to recover from its current low base. A structure that extends the period of higher water levels for 1-2 months in spring in 50% of the other years provides greater opportunity for the plant to recover.

Only recently has any modelling of water levels for the southern Coorong with or without a barrier been conducted. Some initial detailed modelling of such a structure shows a benefit, like that outlined above, could accrue in some years. In other less detailed modelling, the outputs have been equivocal. Models, however, are approximations and simplifications of reality, and the predictions they produce often depend on assumptions that may not hold. For example, a structure across a narrow part of the Coorong restricts the rate at which water can flow back into the southern Coorong in autumn more so than a wider barrier set at the same sill height. Using the same argument, a wider barrier near the Needles is better able to top up the southern Coorong in spring, if water levels are getting close to the critical level, than a narrower one further south. Modelling does not currently consider those differences. An alternative to modelling, would be to build an experimental structure across the Coorong and actually observe what happens. Sufficient merit and urgency exists (given the parlous state of *Ruppia tuberosa*) to pursue such a structure as a solution for the frequent occurrence of inadequate water levels for *Ruppia tuberosa* in the southern Coorong. To do this requires the government agencies responsible for managing the Coorong (and its Ramsar-listed qualities) to be willing to invest in innovation to trial a potential solution. To do this in a timely fashion would be to communicate and engage with the Ngarridjeri and local communities, undertake geophysical assessment of the sediments to confirm the feasibility of building such a structure and establish baseline monitoring programs so we can measure outcomes if and when a structure is built. Indicative costs for consultation, feasibility, monitoring and implementation, including a contingency to remove the structure, is likely to be of the order of $20 million. This is a very cheap potential solution relative to what the costs would be to provide even further water from the Murray—Darling Basin. In the process, we will learn what is and is not feasible and be better informed for managing the region in the face of other perturbations.

References

Paton, D.C. 2010. *At the End of the River: The Coorong and Lower Lakes.* ATF, Adelaide

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August 2017

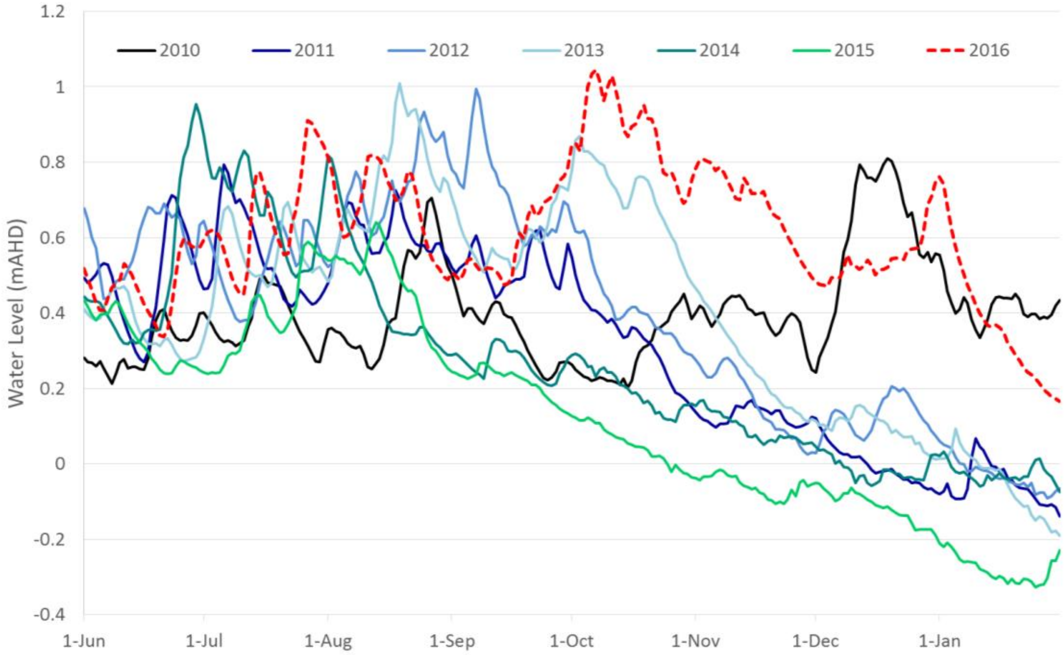

Figure 1: Changes in average water levels (m AHD) for the South Lagoon for 2010 to 2016 for the period June 1st to January 31st of the following year.

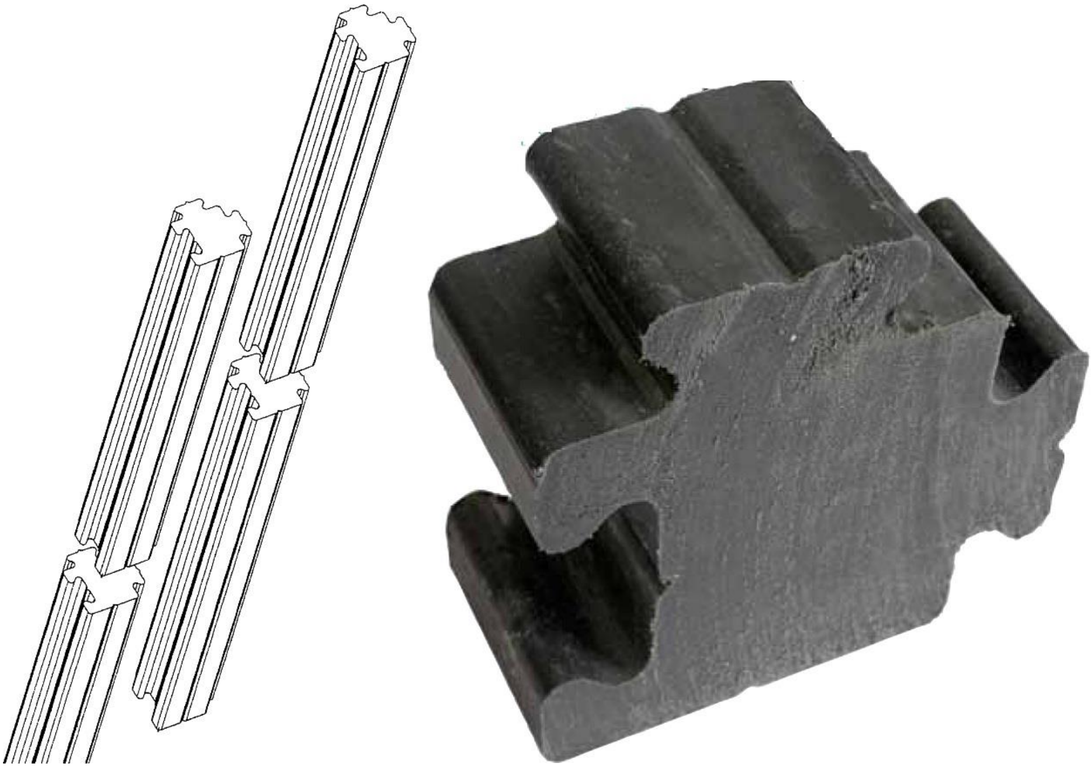

Figure2: Drawing of a plastic pile (left) and close up image of a cross-section of a portion of a two-dimensional interlocking plastic pile (right), as might be used to construct a barrier across the Coorong. These plastic piles are made from recycled plastic. For more details on this system and their use in constructing barriers visit: http://www.vonmac.com.au

Figure 3: Aerial view showing the approximate location of a barrier (red) in the southern end of the North Lagoon near the Needles. The Island in the middle of the Coorong, where the barrier would likely go, is known as Needle Island. (Note that the Coorong lagoon runs across the image from left (southern) to right (northern). Parnka Point at the junction of the two lagoons is shown on the left-hand side of the image.

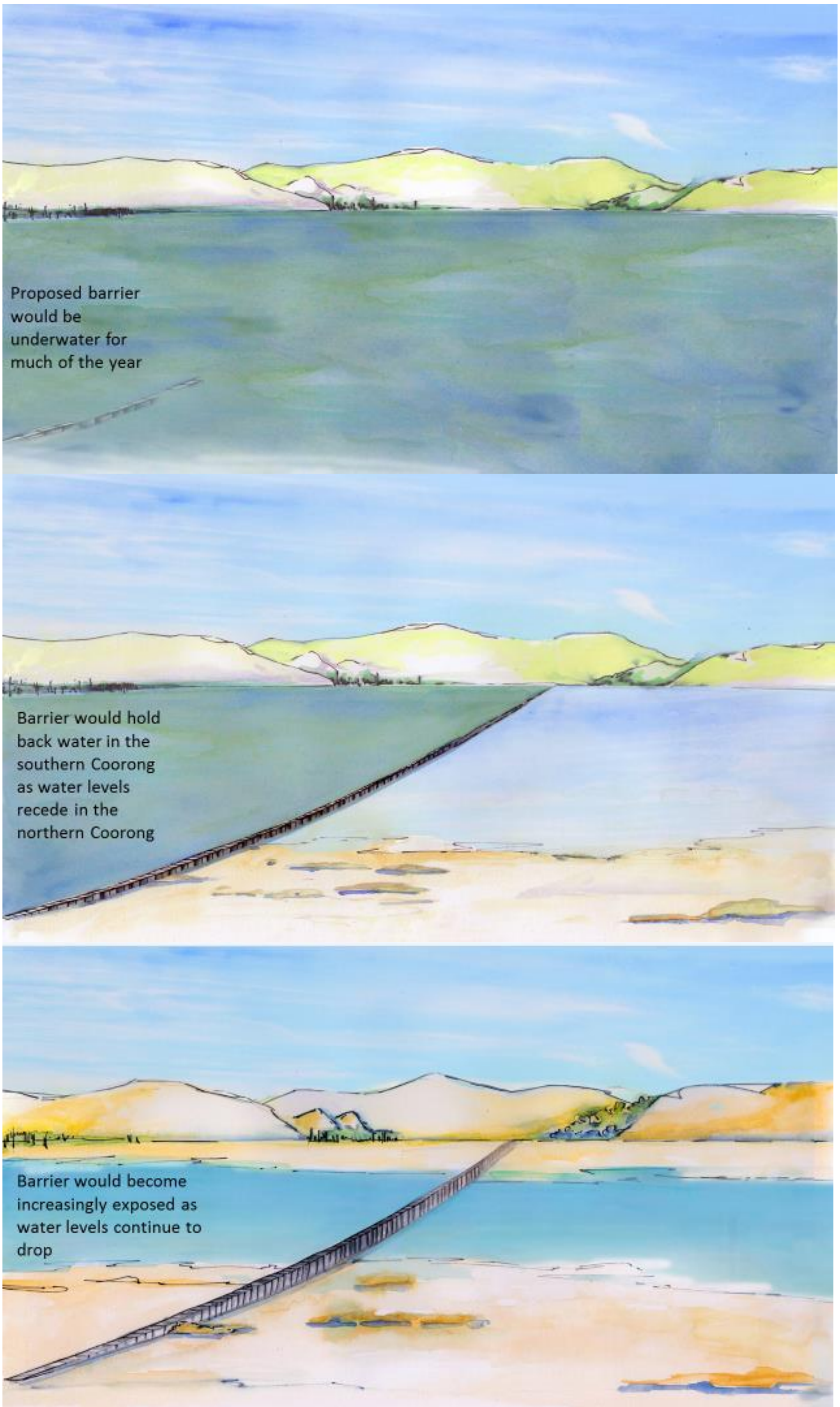

Figure 4: An artist's impression of the barrier underwater and out of sight, as it would be for much of the year and then increasingly exposed as water levels dropped