From salt to C: carbon sequestration through ecological restoration at the Dry Creek Salt Field

This research found that tidal reconnection and restoration of salt fields could be a pathway towards realising blue carbon opportunities for South Australia. It is the first study to investigate the impact of salt pond tidal reconnection on carbon stocks.

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Project partners:

Flinders University ADELAIDE • AUSTRALIA

THE UNIVERSITY of ADELAIDE

Government of South Australia, Department for Environment and Water

University of South Australia

Blue carbon refers to carbon captured and stored in coastal vegetated ecosystems including saltmarsh, mangrove, and seagrass beds. These ecosystems store and sequester more carbon per unit area than any other vegetated habitat. The Dry Creek Salt Field, located to the north of Adelaide, was used to see if restoration through tidal reconnection could contribute to South Australia achieving carbon neutrality and net zero emissions.

KEY FINDINGS

- Opening a salt pond to tidal flow can lead to restoration of coastal wetlands without adverse effects
- The reconnected pond was naturally revegetated by saltmarsh, had increased soil organic carbon content, and had negligible greenhouse gas (GHG) emissions after just 1.5 years
- Short-term vegetation development within the pond was strongly influenced by the vegetation immediately adjacent to the pond inlet
- Modelling indicated potential net gains for carbon stocks (soil and biomass) above the business-as-usual baseline of hypothetically reconnected further sections of the salt field
- Ecosystem services, including social and cultural values, would be enhanced with coastal wetland restoration

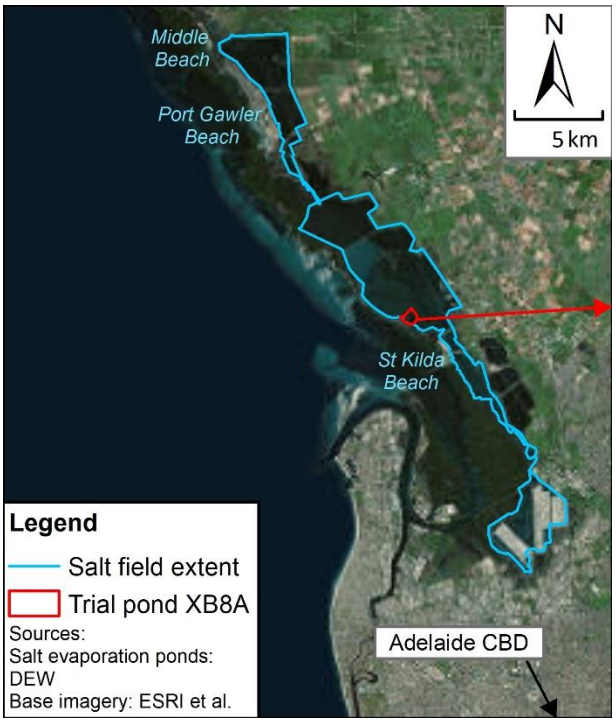
The research project has addressed a number of important knowledge gaps and informed policy development in South Australia. It has collected data and knowledge on carbon stocks and sequestration rates for coastal wetland soils, mangrove and saltmarsh, and identified processes which enable restoration of coastal wetlands through tidal reconnection. It has demonstrated the potential for carbon offsets from coastal environments and expanded the databases used in national inventory reporting and for improving values for blue carbon at a regionally specific level. It has also clarified the need for greater knowledge around sediment accumulation rates.

IMPACT

The 'Salt to C' project has gained state and nation-wide interest as the first pilot study which can provide a proof of concept for blue carbon benefits from tidal reconnection and salt field restoration. The knowledge gained from the project will inform decision making on coastal restoration in South Australia and nationally, which can enhance ecosystem functions and services, adaptation to climate change, mitigation of GHG emissions and the development of blue carbon methods under the ERF.

TIDAL RECONNECTION OF THE DRY CREEK SALT FIELD

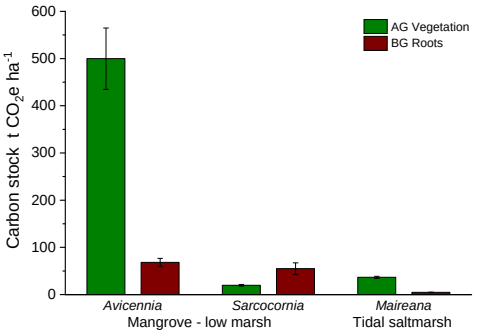
Eighty years after operating as a salt field, the pond was reconnected to the Gulf of St Vincent on 28 July 2017. Over 1.5 years post reconnection we carried out field investigations and experiments, comprehensive analyses, workshops, a social survey and modelling to investigate its blue carbon potential and the co-benefits of tidal reconnection.



Location of the Dry Creek salt field north of Adelaide, South Australia, where solar evaporation ponds extend for ca. 30 km along the Gulf St Vincent coastline from Middle Beach in the north to Port Adelaide in the south. The trial pond, XB8A, is encircled in red and shown in an aerial photo after reconnection (photo DEW).

CARBON SEQUESTRATION IN SOILS AND VEGETATION AND GREENHOUSE GAS FLUXES

The carbon dynamics in soils and vegetation were assessed, along with GHG fluxes, during the early (ca. 1.5 years) stages of tidal reconnection and compared to reference areas. There was a net gain of soil organic carbon stock following tidal reconnection, which was partly attributed to influx of seagrass wrack. Methane gas fluxes from the highly saline soils were negligible and could be excluded from further carbon pool assessments. Sediment accumulation rates were highly variable across the strata and between the trial pond and reference areas.



Carbon stocks (CO_2 equivalents) of above-ground (AG) vegetation and belowground (BG) roots

TOTAL ESTIMATES OF CARBON STOCK

		Carbon stock					
		t C ha^{-1}			t CO_2e ha^{-1}		
STRATA	CARBON POOL	MEAN	±	SD		±	SD
Mangrove-low marsh	Biomass	175	±	67.3	643	±	246.8
	Soil	93	±	42.7	341	±	156.6
	Sum	274	±	122	1006	±	447.3
Tidal saltmarsh	Biomass	32	±	12.7	116	±	46.6
	Soil	127	±	90.2	465	±	330.7
	Sum	158	±	103	581	±	377.7
Supra-tidal saltmarsh	Biomass	32	±	12.7	116	±	46.6
	Soil	36	±	1.3	132	±	4.8
	Sum	68	±	14	248	±	51.3

REVEGETATION DYNAMICS

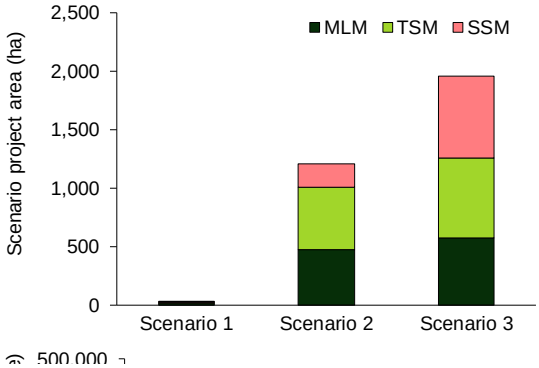
We surveyed the natural saltmarsh vegetation close to the trial pond and found 28 different species across eight vegetation types. Revegetation of saltmarsh and mangrove depends on seed or propagule availability from the local seed bank, dispersal, and suitable hydro- and morpho-dynamic conditions. Our seed traps revealed that colonization relied initially on influx of seeds from saltmarsh vegetation outside the pond, which rapidly colonised the pond following tidal reconnection. Pioneer species *Suaeda australis* and *Sarcocornia quinqueflora* dominated and grew quickly to mature stages inside the trial pond and provided a local seed supply.

ECOSYSTEM SERVICES

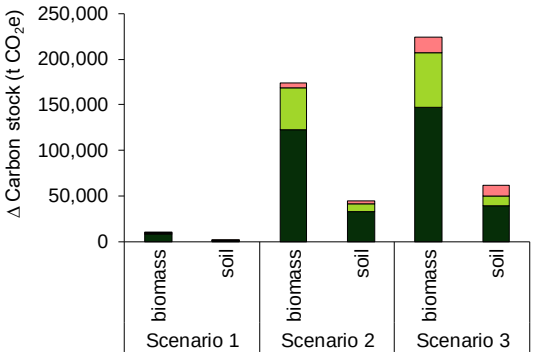
Carbon sequestration from tidal reconnection is just one of the benefits that comes from salt pond restoration. The restored saltmarsh and mangrove habitat will enhance ecosystem services and provide co-benefits like nursery habitat for fishes which can enhance commercial and recreational fishing. Saltmarsh and mangrove habitats can provide food, fibre and shelter, and help to maintain water and air quality as well as reduce coastal erosion. Blue Carbon ecosystems are highly productive and biodiverse. Recreation and ecotourism are examples for cultural ecosystem services. A social survey revealed strong cultural ecosystem values associated with the coastal wetland region north of Adelaide. Visitation and activities undertaken by people had a positive influence on the importance of cultural values assigned to places. The survey further revealed that people highly valued the naturalness of the coastal region.

UPSCALING TIDAL RECONNECTION – THE CARBON STOCK BENEFITS

The net project benefits were estimated at the scale of the trial pond, and for scenarios that hypothetically reconnected additional salt field ponds. The offset potential will increase with the size of the reconnected area. Rates of carbon gains associated with biomass are initially expected to be rapid as saltmarsh plants spread and become established. Further gains are associated with mature mangrove growth. We estimated that in 30 years, the net gains for change in carbon stocks (soil and biomass) under project scenarios above the business-as-usual baseline (Scenario 1), could be over 218,000 t CO_2e for 1210 hectares of reconnected low-lying ponds (Scenario 2), and over 250,000 t CO_2e if an area of 1963 hectares of low to higher elevation would be reconnected (Scenario 3).



Project area for each scenario considered, and breakdown of the area for each stratum; MLM = 'Mangrove-low marsh', TSM = 'Tidal saltmarsh', SSM = 'Supra-tidal saltmarsh'



Estimated net project benefit from the change in carbon stock as t CO2e for the respective area of each scenario, based on a 30-year timeframe without sea level rise

POTENTIAL FOR CARBON OFFSETS FROM COASTAL ENVIRONMENTS

There is currently no method for blue carbon offsets under the Emissions Reduction Fund (ERF). Registering the tidal reconnection trial under the Human-Induced Regeneration of a Permanent Even-Aged Native Forest (HIR) ERF method was not possible as FullCAM (Full Carbon Accounting Model) is not able to model mangroves. While the trial pond project could not be an eligible carbon offsets project with the Clean Energy Regulator (CER), it has become a pilot project for the introduction of tidal flow as an activity under a potential new blue carbon ERF method in development. Once a method for blue carbon is available through the ERF, carbon offset credits can be gained for introducing tidal flow to further ponds of the salt field.

NEXT STEPS

Tidal re-connection is considered to be a top priority activity recommended by a national blue carbon working group for establishing a methodology under the ERF for blue carbon. Blue carbon has been identified as a key carbon offset opportunity for South Australia and tidal reconnection is one of the most lucrative activities. The South Australian Government has developed a blue carbon strategy which will include pathways to achieve carbon credits for blue carbon projects.

MORE INFORMATION

The following technical reports associated with the research program are located at www.goyderinstitute.org/publications/technical-reports/:

- Dittmann, S., Mosley, L., Beaumont, K., Clarke, B., Bestland, E., Guan, H., Sandhu, H., Clanahan, M., Baring, R., Quinn, J., Seaman, R., Sutton, P., Min Thomson, S., Costanza, R., Shepherd, G., Whalen, M., Stangoulis, J., Marschner, P., Townsend, M. (2019) From salt to C; carbon sequestration through ecological restoration at the Dry Creek Salt Field. Goyder Institute for Water Research Technical Report Series No. 19/28.
- Dittmann, S., Mosley, L., Clanahan, M., Quinn, J., Crooks, S., Emmer, I., Min Thomson, S. and Seaman, R. (2019) Proof of concept for tidal re-connection as a blue carbon offset project. Goyder Institute for Water Research Technical Report Series No. 19/29, Adelaide, South Australia.

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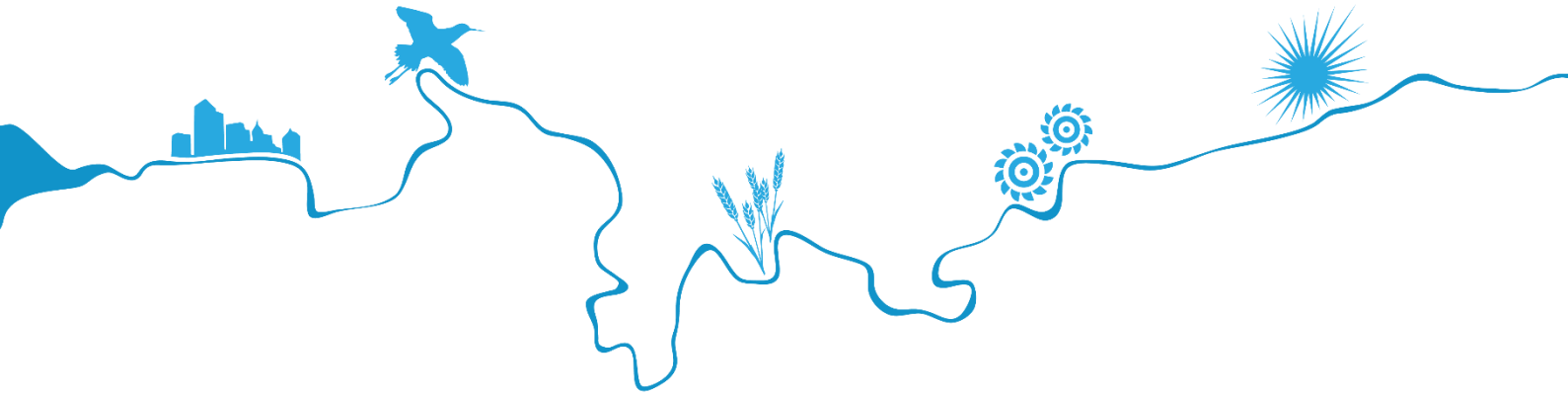

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