Goyder blue carbon research projects: synthesis report

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1 Introduction

Blue carbon refers to the carbon that is captured and stored in coastal vegetated ecosystems (Figure 1). This happens through two main pathways:

1) Carbon dioxide (CO_2) is taken up (sequestered) directly from the atmosphere by coastal vegetated ecosystems during photosynthesis and converted into above and below ground plant material
2) Organic matter is produced by plants and trapped and buried in the sediment/soil, where it can be stored for millennia (Lo Iacono et al. 2008).

Mangrove, tidal saltmarsh and seagrass ecosystems are very effective carbon stores because they constantly accrete sediment. This prevents carbon saturation, which means they have the capacity to continually sequester carbon from the environment. In addition, the sediment in these tidal systems is waterlogged and anoxic, which decreases the breakdown and release of carbon back to the environment (Mcleod et al. 2011).

Blue carbon ecosystems make a significant contribution to the global carbon cycle, with organic carbon (C_{org}) sequestration rates and storage periods orders of magnitude higher than in many terrestrial ecosystems (Mcleod et al. 2011). This makes them of significant interest for national and regional climate change mitigation strategies together with ongoing, high rates of global blue carbon ecosystem loss. Degradation and loss of blue carbon ecosystems decreases the carbon storage capacity of the coastal carbon sink and results in CO_2 emissions, while their conservation, restoration and creation have the potential to increase carbon capture and storage (Lovelock et al. 2017), mitigate climate change (Duarte et al. 2013), support carbon finance opportunities (Thomas 2014) and provide numerous other ecosystem services (also called co-benefits; Barbier et al. 2011).

Figure 1. The carbon cycle in blue carbon ecosystems.

Over the last two years, two collaborative Goyder Institute for Water Research funded research projects have been undertaken in South Australia investigating blue carbon: the *Coastal Carbon Opportunities* project led through the University of Adelaide and the *Salt-to-C* project led through Flinders University. The *Coastal Carbon Opportunities* project estimated baseline carbon stocks and carbon storage dynamics at case study sites within South Australian coastal carbon ecosystems and assessed the impact of degradation and restoration on blue carbon sequestration and stocks. The *Salt-to-C* project investigated whether tidal re-connection and restoration of the Dry Creek salt fields could provide a pathway towards realising blue carbon opportunities for South Australia.

A wealth of technical knowledge has been produced in both blue carbon research projects, filling some critical knowledge gaps around the sequestration of carbon and its long-term storage in South Australian coastal ecosystems. Knowledge synthesis and transfer are critical to making the most of these outputs and so this report synthesises key outcomes from both projects. The report outlines the distribution of blue carbon ecosystems in the state and estimates of carbon sequestration and stocks and will support the South Australian Government's strategic objectives related to blue carbon.

2 Blue carbon ecosystems in South Australia

Mangrove, saltmarsh and seagrass are distributed across South Australia's coastal regions from the west to the south-east, with the largest areas found in the two gulfs; Gulf St Vincent and Spencer Gulf (Figure 2). We estimate that the total area of blue carbon ecosystems in South Australia is 1.12 million hectares, based on the best spatial data currently available. Seagrass accounts for approximately 96.7% of this area. Mangroves and saltmarshes account for 1.5% and 1.8% respectively (Table 1). There are some significant areas of blue carbon ecosystems that are not adequately captured by the spatial data currently available. This is particularly the case for sub-tidal seagrass, which is inherently difficult to map using aerial imagery. One habitat that is noticeably absent from the seagrass maps are the *Ruppia* seagrass beds found throughout the Coorong region (Rogers and Paton 2009).

Table 1. Estimated area of each blue carbon ecosystem in South Australia, based on the best available spatial data sources as of June 2019.

ECOSYSTEM	ESTIMATED AREA (HA)	DATA SOURCE
Seagrass	1,080,738	DEW marine habitat mapping layers (state benthic, national benthic and estuary habitats)
Tidal saltmarsh	19,756	DEW Land Cover Dataset (cropped to 5 km from coastline to limit data to tidally-influenced marshes)
Mangrove	16,420	DEW Land Cover Dataset (cropped to 5 km from the coastline to limit incorrectly classified inland trees)
TOTAL	**1,116,914**	

There are estimated to be 15.2 million hectares of blue carbon habitat across all of Australia, with most of this area being seagrasses (83%) followed by tidal saltmarsh (10%) and then mangroves (7%) (Kelleway et al. 2017). Based on these national and state area estimates, South Australia has 8.6% of Australia's seagrass meadows, 1.8% of Australia's tidal saltmarshes and 1.1% of Australia's mangroves (with a total of 7.4% of the nation's blue carbon ecosystems).

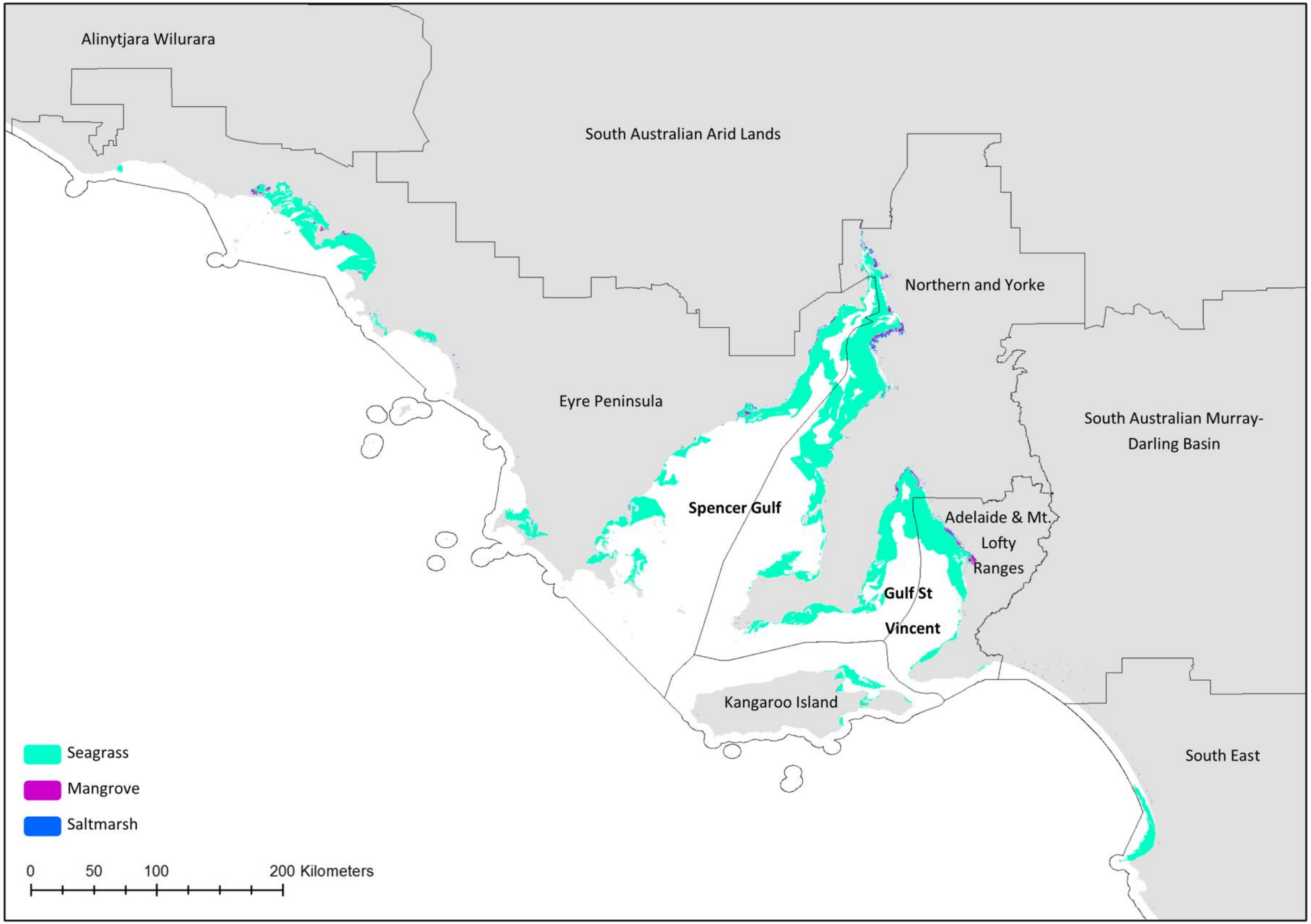

Figure 2. Map showing the documented distribution of blue carbon ecosystems (seagrass, mangrove and saltmarsh) throughout South Australia. Black lines show the borders of the South Australian natural resource management regions.

3 Blue carbon stocks and sequestration rates in South Australia

Figure 3. The role of South Australia's blue carbon ecosystems in mitigating climate change.

Carbon stock refers to the organic carbon (C_{org}) stored in a system (i.e. the carbon that has already been accumulated over previous years) – see Figure 3. Stocks are expressed as a mass of organic carbon, or the carbon dioxide equivalent (CO_2e) per unit area. Stocks can refer to the C_{org} stored in the sediment (sediment carbon pool) reported to a specified depth, or to the C_{org} stored in the vegetation biomass (biomass carbon pool). In this report we use tonnes (or megatonnes) of CO_2e per hectare (T CO_2e ha^{-1}) for both the biomass carbon pool and the sediment carbon pool (at 40 cm and 1 m depth horizons). We report over two different depth horizons because some sediment cores could only be taken to ~40 cm in length. After consideration and consultation with members of the broader project teams, we concluded that it was not valid to attempt to extrapolate the organic carbon in these cores to one metre as this would introduce considerable (and unmeasurable) uncertainty.

Carbon sequestration (accumulation) rate refers to the amount of organic carbon that is taken up by an ecosystem over a defined time period – see Figure 3. This metric is used to assess an ecosystem or area's carbon abatement potential. Sequestration rates are expressed as the mass of C_{org} (or the CO_2 equivalent) that is sequestered per unit area within a defined time period. In this report we use tonnes (or megatonnes) of CO_2e per hectare per year (T CO_2e ha^{-1} yr^{-1}).

3.1 Datasets

The sediment carbon results reported here are derived from a combined dataset of 53 sediment cores. These include 51 cores used to estimate sediment C_{org} stocks and 39 cores used to estimate sediment carbon sequestration rates (Table 2). The dataset for sediment carbon stock and accumulation rates is made up of core samples collected by both projects from unimpacted sites only (i.e. no cores collected at the degraded sites were included from the *Coastal Carbon Opportunities* project, nor from within the tidal trial pond sampled in the *Salt-to-C project*). This reduced the potential negative bias that including core samples from known degraded sites would introduce to the baseline stock and sequestration rate estimates. The stock and sequestration rates from the degraded or altered sites (and comparisons with reference sites) can be found in the final reports of the respective projects (Dittmann et al. 2019a, Lavery et al. 2019).

We assessed 24 samples for each of the root and vegetation biomass carbon pools of mangroves and saltmarshes (Table 2), which were collected exclusively for the *Salt-to-C* project. No data were collected as part of either project on the biomass carbon stocks for seagrass. The living biomass carbon pool has previously been shown to make up only a small fraction of the total C_{org} stock in seagrasses (Fourqurean et al. 2012). However, under certain conditions thick rhizome mats may be formed, so the significance of this carbon pool should not be completely discounted without further investigation (Fourqurean et al. 2012, Lo Iacono et al. 2008).

The sample location map (Figure 4) highlights significant spatial bias in terms of data availability. To date, all core and vegetation sampling has been carried out in the two South Australian gulfs, with no data from other regions of the state. This sampling bias must be considered when evaluating the state-wide estimates of stocks and sequestration rates presented in this report. Previous work has shown that blue carbon stocks and sequestration rates are related to coastal environmental setting and affected by the influence of rivers, tides, waves, and climate (Rogers et al. 2018, Twilley et al. 2018). In addition, carbon stocks and accumulation rates have been shown to vary considerably even within relatively similar environmental settings (refer to the confidence intervals on the data presented here and Lavery et al. 2013), as well as within the same site (Asanopoulos et al. In Review, Ewers Lewis et al. 2017). As such, extrapolated carbon stock and sequestration rate estimates (calculated by multiplying estimates from limited sampling locations by the total size of an ecosystem over a much broader area) are likely to have considerable uncertainty associated with them (Twilley et al. 2018); particularly if differences in coastal geomorphology, ecosystem condition, elevation and tidal inundation have not been accounted for (as is the case in this report). Please refer to the Blue Carbon Research Roadmap document produced as part of the knowledge synthesis project (Dittmann et al. 2019b) for advice on how best to reduce this uncertainty going forward.

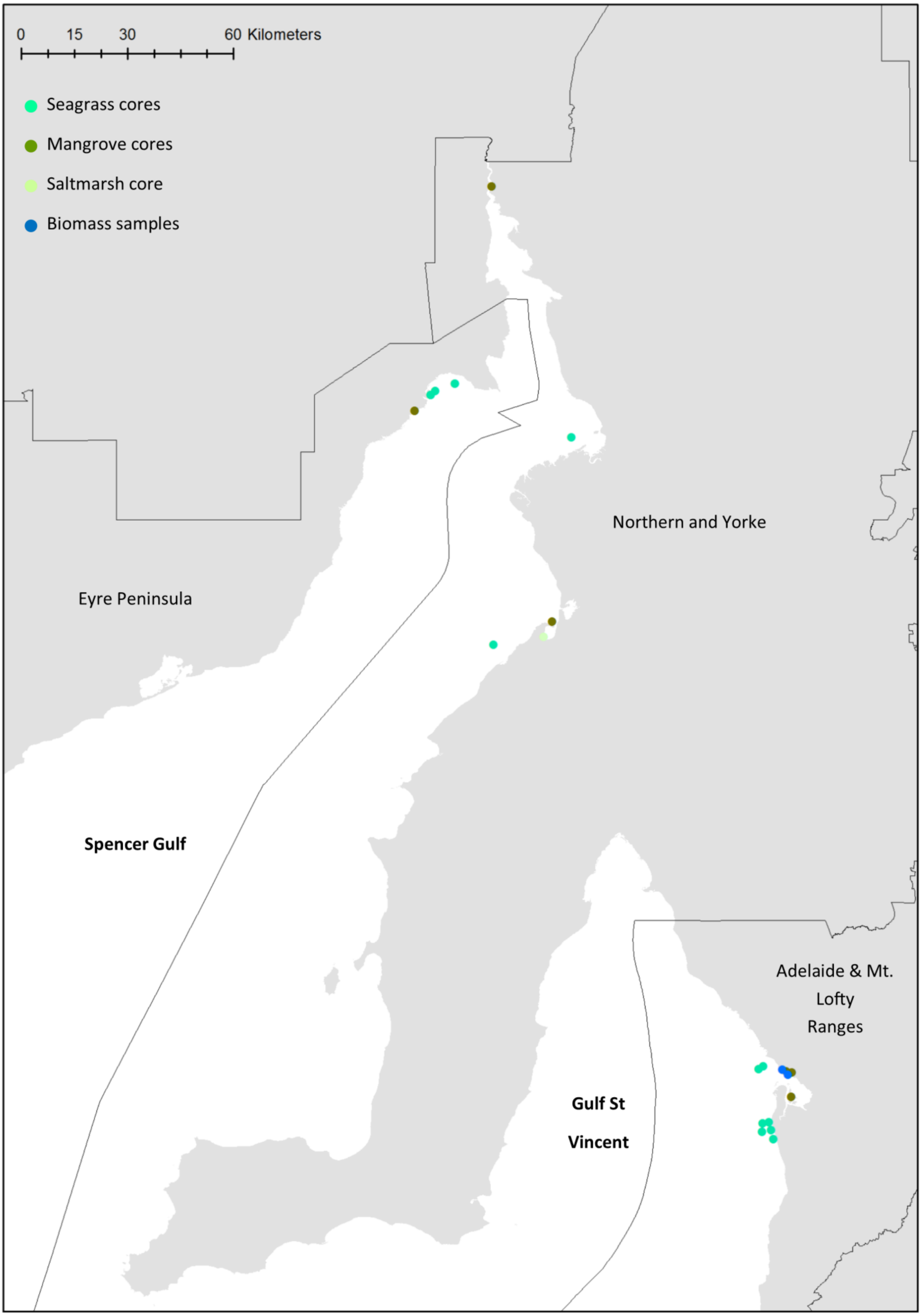

Figure 4. Map showing all sediment core and biomass sample locations. Note that all samples were collected in the gulf regions of South Australia. Multiple samples were collected at some locations.

Table 2. Summary of available data for sediment and biomass carbon stocks and sediment carbon sequestration rate estimates. Note that 1 m deep cores are a subset of 40 cm deep cores.

ECOSYSTEM	SEDIMENT CORG STOCKS (NUMBER OF CORES)		SEDIMENT CORG SEQUESTRATION RATES (NUMBER OF CORES)	BIOMASS STOCKS (NUMBER OF SAMPLES)	
	1 M DEEP	40 CM DEEP		ROOTS (BELOW GROUND BIOMASS)	VEGETATION (ABOVE GROUND BIOMASS)
Seagrass	30	30	24	0	0
Tidal saltmarsh	5	6	5	16	16
Mangrove	10	15	10	8	8
TOTAL	**45**	**51**	**39**	**24**	**24**

3.2 Estimated blue carbon stocks and accumulation rates in South Australia

3.2.1 STOCKS

Analysis of the carbon stock data from both projects showed that mangrove systems had the greatest sediment carbon stocks per hectare in South Australia, followed closely by tidal saltmarsh systems (this trend holds when looking at both the top metre and the top 40 cm of the sediment; see Figure 5). This is consistent with the findings of studies based on national and global averages (Kelleway et al. 2017). The overlapping error bars for the mangrove and saltmarsh soil carbon stock estimates (Figure 5) indicate that we cannot say with certainty that there is a difference between mangrove and saltmarsh soil stocks because of site-based variance. However, we can be more certain about the finding that seagrasses store and sequester lower amounts of carbon per hectare than either mangroves or saltmarshes (Table 3, Figure 5).

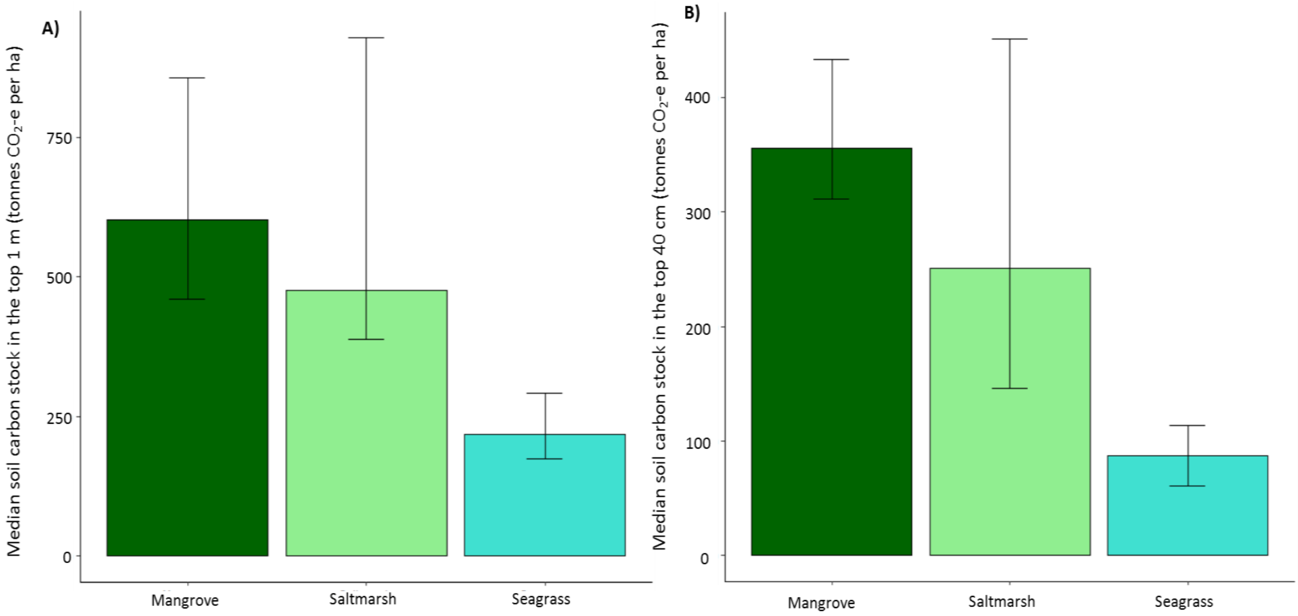

Figure 5. Median soil carbon stock estimates for A) the top 1 m of the sediment and B) the top 40 cm of the sediment for mangrove, tidal saltmarsh and seagrass ecosystems in South Australia (note different scale on y axes). Error bars show 95% confidence intervals around the median values and were estimated by simulation.

Table 3. Summary statistics for median carbon stocks and 95% confidence intervals for both soil and biomass carbon pools (provided in tonnes of CO_2e per hectare). National averages are provided for comparison and are sourced from Kelleway et al. (2017). NA = no data available.

ECOSYSTEM	CARBON POOL	SAMPLE SIZE	MEDIAN STOCK (T CO_2E HA^{-1})	95% CONFIDENCE INTERVAL (T CO_2E HA^{-1})	NATIONAL AVERAGE STOCK (T CO_2E HA^{-1})
Mangrove	Biomass (roots and vegetation)	8	Roots: 66.1 Veg: 480	353–710	458
	Soil (top 1 m)	10	602.1	460–856	919
	Soil (top 40 cm)	15	355	311–433	NA
Tidal saltmarsh	Biomass (roots and vegetation)	16	Roots: 12.7 Veg: 25.8	24–82	71
	Soil (top 1 m)	5	476.3	389–930	618
	Soil (top 40 cm)	6	250.8	146–451	NA
Seagrass	Biomass (roots and vegetation)	NA	NA	NA	7
	Soil (top 1 m)	30	218.18	174–292	412
	Soil (top 40 cm)	30	86.9	61–114	NA

The carbon stock in the above-ground mangrove biomass (vegetation) was considerably higher than that of saltmarsh per hectare (Table 3). This is not surprising given the stark difference between the size and growth forms of the two plant types. The root biomass carbon pool was greater for mangroves than for saltmarsh, but was generally lower in both ecosystems than their respective vegetation biomass stock (Figure 6).

Our estimates of mangrove biomass carbon stock were similar to the national average value reported by Kelleway et al. (2017), although the soil carbon stocks from our mangrove cores were considerably lower than their values (Table 3). Our median biomass and soil carbon stock estimates for saltmarsh and seagrass were all considerably lower than the national averages (Kelleway et al. 2017).

We scaled up our stock estimates to the entire area of the state's blue carbon ecosystems, using the upper and lower 95% confidence intervals around the median stocks to generate a range that accounts for uncertainty. The results show that although mangrove and saltmarsh have a greater stock than seagrass per hectare (Figure 5), their total stock in South Australia is far lower than that of seagrass (Table 4). This is because of the vast differences in the area of the three ecosystems across the state's coastal regions (see Section 2 and Figure 2). The estimated total blue carbon stock (in sediment and biomass) for South Australian coastal vegetated ecosystems is 121–255 MT CO_2e, which is equivalent to 5.5–11.5 times the state's annual emissions (based on the 2016–17 state emissions estimate of 22.1 MT CO_2e). Note that the stock estimate (and how it compares to state emissions) does not include the biomass carbon pool for seagrass, as this was not measured.

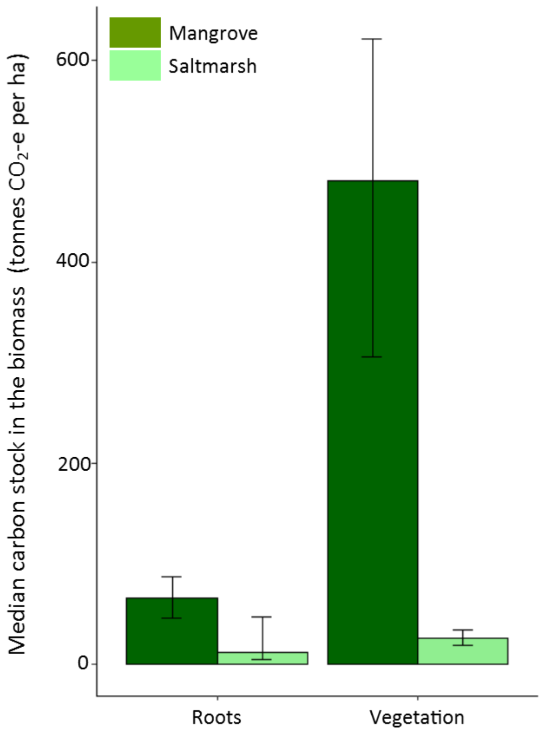

Figure 6. Median biomass carbon stock estimates for the roots (below ground biomass) and the vegetation (above ground biomass) of mangroves and tidal saltmarshes sampled near St. Kilda in South Australia. Error bars show 95% confidence intervals around the median values and were estimated by simulation.

Table 4. Estimates of blue carbon stocks in each ecosystem within South Australia based on best-available spatial data. Stock estimates for soil (top 1 m) and combined soil and biomass (for mangrove and saltmarsh only) are given. The ranges are based on the 95% confidence interval around our per hectare stock (see Table 3). Note that stocks are reported in megatonne (MT) of CO_2e. Red text indicates that seagrass values represent only the soil carbon pool and an asterisk (*) indicates that total stock estimates do not include the seagrass biomass carbon pool (as this was not measured).

ECOSYSTEM	AREA (HA)	COMBINED SEDIMENT (TOP 1 M) AND BIOMASS STOCKS (MT CO_2E)		SEDIMENT STOCKS IN THE TOP 1 M (MT CO_2E)	
		LOWER CONFIDENCE LIMIT	UPPER CONFIDENCE LIMIT	LOWER CONFIDENCE LIMIT	UPPER CONFIDENCE LIMIT
Mangrove	16420	13.0	25.7	7.2	14.1
Tidal saltmarsh	19756.2	8.2	20.0	7.7	18.4
Seagrass	1080737.5	99.4	209.7	99.4	209.7
TOTAL	**1116914.4**	**120.6 ***	**255.4 ***	**114.3**	**242.2**

3.2.2 CARBON SEQUESTRATION RATES

Carbon sequestration rates (T CO_2e ha^{-1} yr^{-1}) were estimated using 39 cores (Table 2). The results are similar to the pattern in the stocks in that mangrove has the greatest sequestration rate, but it is not significantly different to saltmarsh (see confidence intervals indicated by error bars on Figure 7). We can be confident that a hectare of mangroves in SA has a greater potential for carbon sequestration each year than a hectare of seagrass. However, the saltmarsh carbon sequestration rate estimate is very uncertain because of low sample size and large variance (Figure 7) and so we cannot say with certainty that saltmarshes sequester more carbon per hectare than seagrasses or less than mangroves. More carbon accumulation data from South Australian saltmarsh ecosystems would help to resolve this issue.

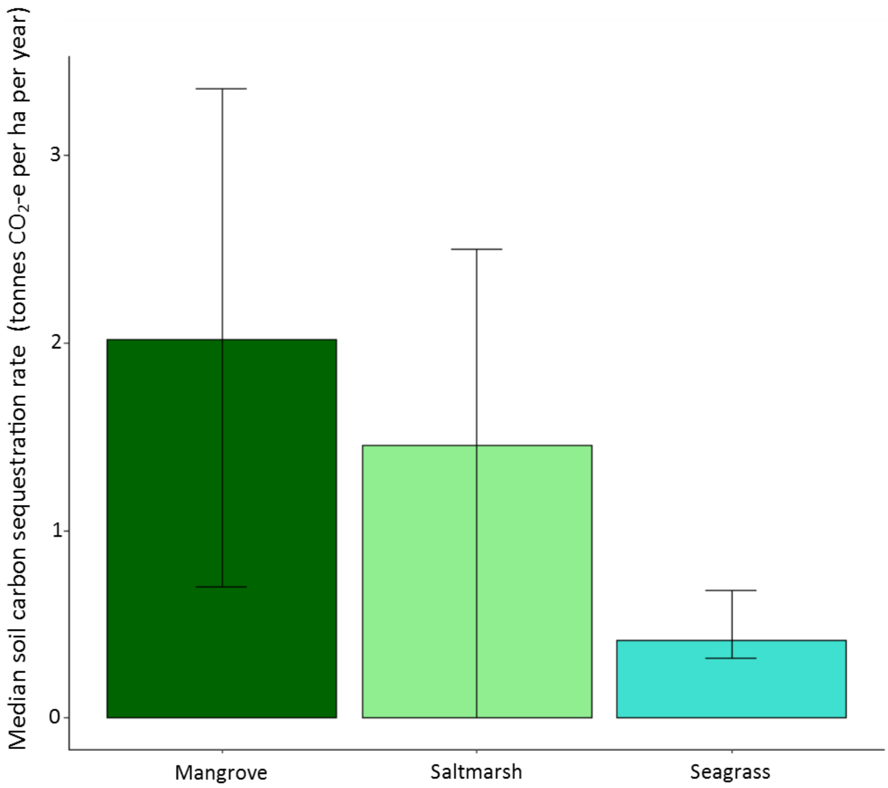

Figure 7. Median sediment carbon sequestration rates for mangrove, tidal saltmarsh and seagrass ecosystems in South Australia. Error bars show 95% confidence intervals around the median values and were estimated by simulation.

We scaled-up the per-hectare carbon sequestration values to estimate total annual sequestration rates for each ecosystem in South Australia using the area-based estimates and the total area of each ecosystem (Table 5). The results again highlight that seagrass accounts for the greatest proportion of carbon sequestration (as with the stocks, see Section 3.2.1), because it covers the largest area (Table 5). There are also areas of seagrass, including the *Ruppia* habitat in the Coorong, that are not captured by the spatial data at this time. Additional work to include areas such as this will enhance our understanding of the total reserves available across all blue carbon ecosystems. The total accumulation rate for all blue carbon ecosystems in South Australia was estimated to be between 0.36 and 0.83 MT $C0_2e$ per year (Table 5). This is equivalent to 1.8–3.6% of the state's annual GHG emissions (22.1 MT CO_2e in 2016–17; Commonwealth of Australia 2019), or the annual emissions from between 575 thousand and 1.3 million passenger vehicles.

Table 5. State estimates for blue carbon sediment sequestration rates for each ecosystem based on best available spatial data. The upper and lower confidence ranges are based on the 95% confidence interval around the median estimates.

ECOSYSTEM	AREA (HA)	SEDIMENT CARBON SEQUESTRATION RATE PER HECTARE PER YEAR (T CO_2E HA^{-1} YR^{-1})			STATE TOTAL ACCUMULATION PER YEAR (T CO_2E YR^{-1})	
		MEDIAN	LOWER CONFIDENCE LIMIT	UPPER CONFIDENCE LIMIT	LOWER CONFIDENCE LIMIT	UPPER CONFIDENCE LIMIT
Mangrove	16420	1.79	0.58	2.90	9518	47593
Tidal saltmarsh	19756	1.32	0	2.48	0	48960
Seagrass	1080738	0.41	0.32	0.68	346702	737676
TOTAL	**1116914**				**356220**	**834229**

3.3 Estimated blue carbon stocks and accumulation rates for Natural Resource Management regions

Almost 95% of the State's blue carbon ecosystems are found within three of the eight South Australian Natural Resource Management (NRM) regions: Northern and Yorke (47%), Eyre Peninsula (37%) and Adelaide and Mount Lofty Ranges (10.9%). However, there are small areas of at least one blue carbon ecosystem in all South Australian NRM regions (Table 6). The distribution of mangrove, saltmarsh and seagrass in the NRM regions are shown in Figure 8, Figure 9 and Figure 10. We have not included detailed maps of the Alinytjara Wilurara and South Australian Arid Lands NRM regions because they have such a small area of blue carbon ecosystems within them (refer to Table 6).

Table 6. Area estimates for all blue carbon ecosystems (seagrass, mangrove and tidal saltmarsh) in each of the eight Natural Resource Management regions of South Australia. Estimates are based on the best-available spatial data in June 2019 (see details in Table 1 and discussion in Section 2 relating to potential omissions and uncertainty in the spatial data).

NRM REGION	SEAGRASS AREA (HA)	TIDAL SALTMARSH AREA (HA)	MANGROVE AREA (HA)	TOTAL (HA)	PERCENTAGE OF TOTAL AREA
South Australian Arid Lands	1.0	19.5	0	21	0.002
Alinytjara Wilurara	0	22.5	0.2	23	0.002
South Australian Murray-Darling Basin	0	630	0.38	631	0.06
Northern & Yorke	506501	10530	7793	524824	47
Eyre Peninsula	402972	5476	5288	413736	37
Kangaroo Island	26014	470	93	26578	2.4
Adelaide & Mt Lofty Ranges	116172	2013	3229	121414	11
South East	29077	594	17	29689	3
TOTAL	**1080738**	**19756**	**16420**	**1116914**	**100**

We calculated best-estimates for the blue carbon stocks and sequestration rates for each ecosystem within each South Australian NRM region (Table 7). These estimates indicate that most of the carbon abatement through blue carbon occurs in the NRM regions of Northern & Yorke, Eyre Peninsula and Adelaide & Mount Lofty Ranges, driven by the distribution of blue carbon ecosystems (Table 6 and Figure 2).

It should be noted that there is significant spatial bias in the blue carbon sampling effort (Figure 4) and that previous studies, as well as the data from the two projects reported here, indicate significant spatial variability in carbon stocks and sequestration rates. This introduces large (and unmeasurable) uncertainty to the scaled-up, area-based stock and sequestration rate estimates. This is particularly the case for regions where no sampling has been undertaken and which are known to have different geomorphological settings and coastal exposures than the gulf regions (Alinytjara Wilurara, SA Arid Lands, western parts of Eyre Peninsula, Kangaroo Island, SA Murray Darling Basin and South East NRM areas). These estimates should be used (cautiously) as an indicator for potential blue carbon resources in each region and may help focus where to conduct future blue carbon research or demonstration projects. Until they can be validated with further sampling and analyses, they should not be used to make management, policy or investment decisions.

Table 7. Estimates of carbon stocks and sequestration rates for blue carbon ecosystems (mangrove, saltmarsh and seagrass) in each of the South Australian Natural Resource Management (NRM) regions. Estimates are based on the area of each ecosystem in each NRM region (see Table 6) multiplied by the stock or sequestration rate estimates. The upper and lower limits are based on the 95% confidence interval of median estimates of stocks and sequestration rates (generated through simulation). Value for stocks use the estimated total stock for top 1 m of the sediment and the biomass where available (the biomass estimates are not available for seagrass ecosystems).

NRM REGION	SEAGRASS STOCK (MT CO_2E)		SEAGRASS RATES (T CO_2E) PER YEAR		SALTMARSH STOCK (MT CO_2E)		SALTMARSH RATES (T CO_2E) PER YEAR		MANGROVE STOCK (MT CO_2E)		MANGROVE RATES (T CO_2E) PER YEAR	
	LOWER LIMIT	UPPER LIMIT	LOWER LIMIT	UPPER LIMIT	LOWER LIMIT	UPPER LIMIT	LOWER LIMIT	UPPER LIMIT	LOWER LIMIT	UPPER LIMIT	LOWER LIMIT	UPPER LIMIT
South Australian Arid Lands	0.0001	0.0002	0.3	0.7	0.01	0.02	0	48	0	0	0	0
Alinytjara Wilurara	0	0	0	0	0.01	0.02	0	56	0.0002	0.0003	0.1	0.6
SA Murray-Darling Basin	0	0	0	0	0.3	0.64	0	1562	0.0003	0.001	0.2	1
Northern & Yorke	47	98	162486	345721	4	11	0	26096	6	12	4517	22588
Eyre Peninsula	37	78	129274	275055	2	6	0	13571	4	8	3065	15327
Kangaroo Island	2	5	8345	17757	0.2	0.5	0	1166	0.1	0.2	54	270
Adelaide & Mt Lofty Ranges	11	23	37268	79295	0.8	2	0	4989	3	5	1872	9359
South East	3	6	9328	19847	0.3	0.6	0	1473	0.01	0.03	10	50
TOTAL	**99**	**210**	**346702**	**737676**	**8**	**20**	**0**	**48960**	**13**	**26**	**9518**	**47595**

4 Summary

Our collation and analysis of the two datasets generated by the Goyder Institute for Water Research blue carbon projects provides a critical summary of the most comprehensive data available for blue carbon in the South Australian setting. Blue carbon stock and sequestration rate estimates from our studies of South Australian coastal ecosystems are lower than national and global averages. This is likely due to the hotter and drier climate in South Australia (and associated reduction in suspended sediment supply to the coasts from river discharge) compared to the areas where most blue carbon research has previously been undertaken (for a summary of the national data see Kelleway et al. (2017)). This highlights the importance of generating SA-specific data to support state-based management and policy initiatives. However, there is some uncertainty around our findings due to the limited spatial coverage of our samples and potential negative bias in the results due to the selection of sample locations (Lavery et al. 2019). Nevertheless, similar results (lower carbon stocks and sequestration rates) have been found in other semi-arid and arid settings such as the western coast of the Arabian Gulf (Cusack et al. 2018), United Arab Emirates (Schile et al. 2017) and Red Sea coast (Almahasheer et al. 2017). We recommend further, strategic sampling in South Australia to build confidence in the results reported here. This sampling should ensure that the various environmental and geomorphological settings throughout the state are adequately represented and that the relationship between ecosystem condition and carbon accumulation and storage capacity is robustly assessed.

Our studies found that blue carbon ecosystems in South Australia hold the equivalent of more than five times the state's annual CO_2e emissions in their sediment and biomass and continue to abate SA's emissions by absorbing up to 3.6% of the greenhouse gases released in the state each year. Although there is some uncertainty around these estimates, they highlight the value of coastal vegetated ecosystems as nature-based solutions to mitigating climate change. These ecosystems are also vulnerable to anthropogenic impacts, from local scale disturbance to global sea level rise due to climate change. Many of these ecosystems have also experienced some previous degradation. Given they also provide a range of co-benefits (e.g. recreation, tourism, fishing), protection and restoration of these blue carbon ecosystems is an important priority for the South Australian government.

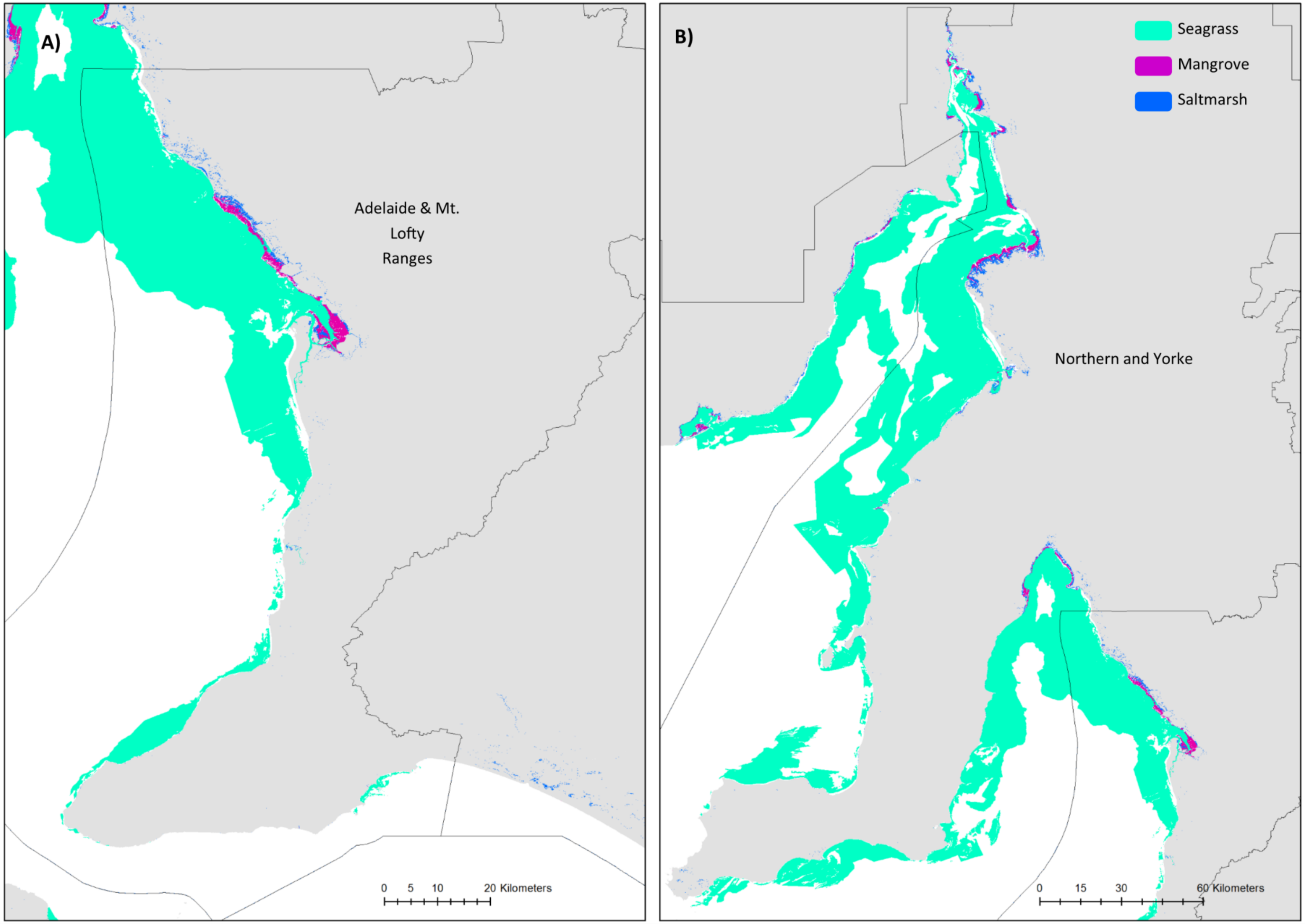

Figure 8. Maps showing the distribution of blue carbon ecosystems (seagrass, mangrove and saltmarsh) in the South Australian natural resource management regions of A) Adelaide & Mount Lofty Ranges and B) Northern & Yorke.

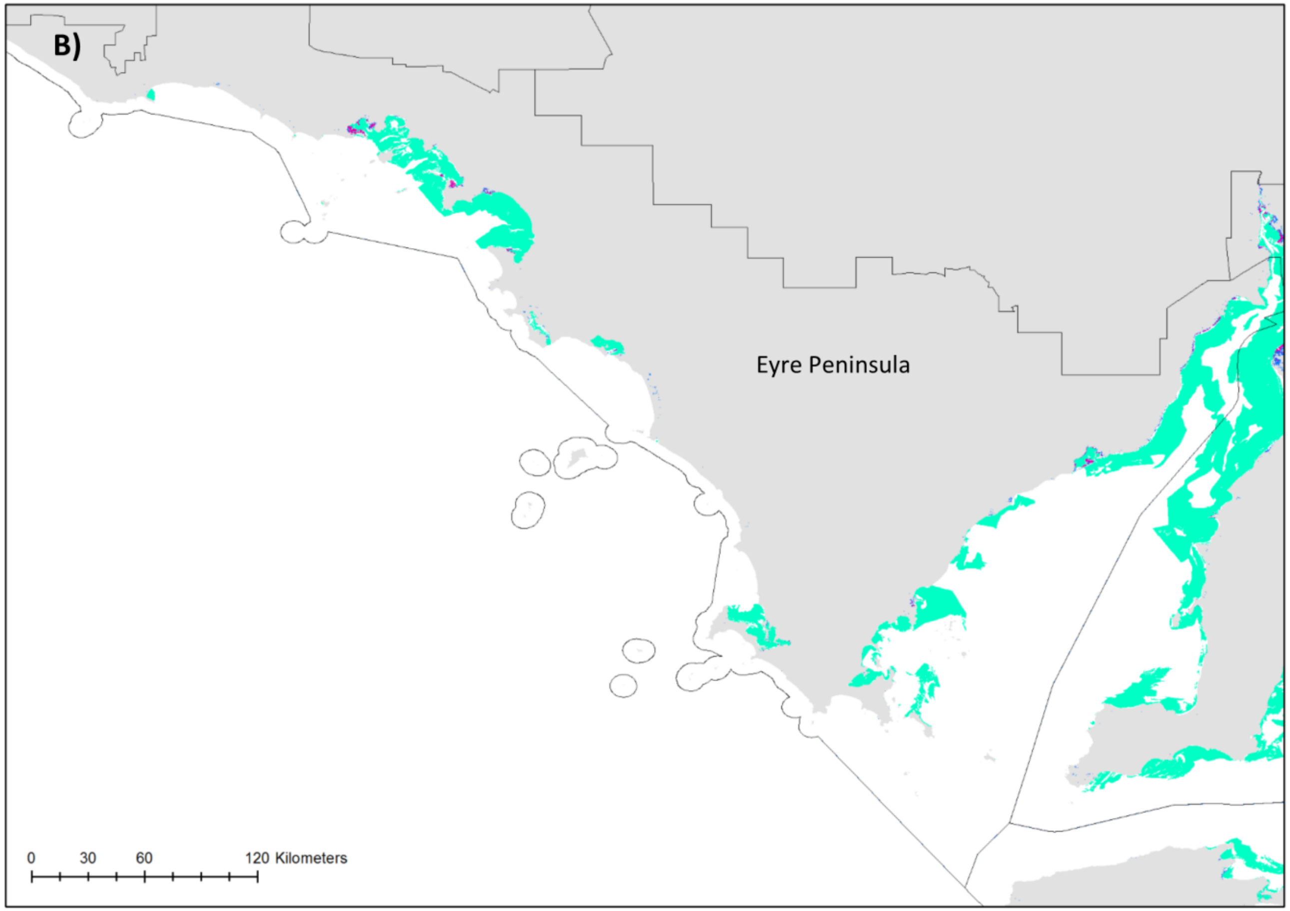

Figure 9. Maps showing the distribution of blue carbon ecosystems (seagrass, mangrove and saltmarsh) in the South Australian natural resource management regions of A) South East and B) Eyre Peninsula.

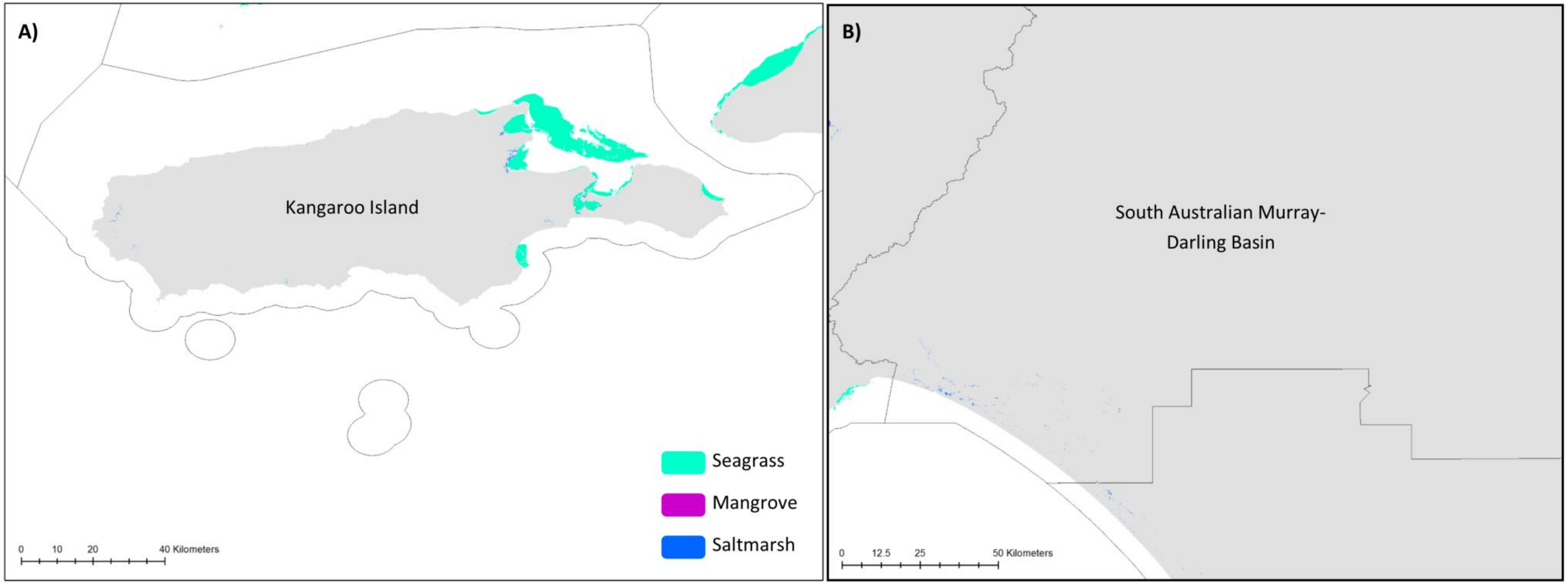

Figure 10. Maps showing the distribution of blue carbon ecosystems (seagrass, mangrove and saltmarsh) in the South Australian natural resource management regions of A) Kangaroo Island and B) South Australian Murray–Darling Basin.

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