Seagrass in the Wuthathi Sea Country: state of current knowledge, September 2019

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Abstract. Seagrass meadows in the Wuthathi Sea Country play a vital role in supporting coastal marine communities and in maintaining diverse flora and fauna. It has been estimated from mapping surveys over the last three and a half decades that there is as much as 76.9 km^2 of seagrass in the Wuthathi sea country waters shallower than 15 m and at least an additional 33.6 km^2 of meadows in waters deeper than 15 m. Eight seagrass species are reported to occur within Wuthathi sea country, mostly in the sheltered areas of bays and on reef flats. Monitoring of seagrass condition was established in Shelburne Bay in 2012 as part of the Great Barrier Reef Marine Park Authorities' Marine Monitoring Program and Seagrass-Watch. Monitoring sites are dominated by *Halodule uninervis* and *Halophila ovalis*, with some *Thalassia hemprichii*. Macro-algae abundance is generally low at the sites and epiphyte abundance has remained very low since 2014. No long-term (2012-2018) trend in seagrass abundance is apparent and seagrass condition has remained stable in a Fair state over the last four years.

Key words: seagrass; Wuthathi; monitoring; Seagrass-Watch; Marine Monitoring Program; Great Barrier Reef.

Introduction

The Wuthathi people are the traditional custodians and owners of Wuthathi land and sea country surrounding Shelburne Bay on the north eastern coast of Cape York Peninsula. The sea country extends from Captain Billy Landing in the north to the Olive River in the south, and encompasses the adjacent lagoon and reefs of the Great Barrier Reef World Heritage Area, including Raine Island. The region covers an area of marine waters approximately 8,050 square km.

The majority of the land in Cape York Peninsula is relatively undeveloped and waters entering the GBR lagoon are perceived to be of a high quality. The tropical coast of the Wuthathi sea country is influenced by monsoonal rains and associated pulses of turbid waters draining from adjacent catchments. The region has a monsoonal climate with distinct wet and dry seasons with mean annual rainfall ranging to 2159 mm (Lockhart River airport, the closest weather station 100 km south). Most rain falls between December and April. The major catchment in the region is the Olive-Pascoe. Mean daily air temperatures in the area range from 19 – 32°C. The prevailing winds are from the south east and persist throughout the year[1]. Cape Grenville provides shelter to Shelburne and Margaret Bays from the prevailing winds.

Seagrass meadows in the Wuthathi Sea Country play a vital role in supporting coastal marine communities and in maintaining diverse flora and fauna. The meadows support dugong (*Dugong dugon*) and green sea turtles (*Chelonia mydas*), and economically valuable fish and prawns populations[2-4]. Seagrasses are critical to the survival of these animals. The meadows also provide a range of other important ecological services. Seagrass produce natural biocides and improve water quality by controlling pathogenic bacteria to the benefit of humans, fishes, and marine invertebrates such as coral[5]. Nutrient cycling in seagrass meadows makes them one of the most economically valuable ecosystems in the world6 and the retention of carbon within their sediments contributes significantly to Blue Carbon sequestration[6-9]. Much of the connectivity in reef ecosystems depends on intact and healthy non-reef habitats, such as seagrass meadows10. In addition, the incorporation of carbon within seagrass tissues can affect local pH and increase calcification of coral reefs, thereby mitigating the effects of ocean acidification[6, 7]. The ecosystem services provided by seagrass therefore makes them a high conservation priority[10, 11].

Seagrass in the Wuthathi sea country was first mapped as part of broad scale surveys of the Queensland coast from Cape York to Cairns in November 1984 [12]. The survey however included only nearshore seagrass to a depth of approx 15m. Since the 1980s, inshore mapping surveys occurred in August 2001[13] and waters deeper than 15m were examined in November 1998[14] and January/February 2005[15] (Fig. 1). It has been estimated from mapping surveys over the last three and a half decades that there is as much as 76.9 km^2 of seagrass in the Wuthathi sea country waters shallower than 15 metres [15]. There is at least an additional 33.6 km^2 of meadows in the

Wuthathi sea country waters deeper than 15 metres[16, 14, 17].

Fifteen species of seagrass are reported in Queensland[18], eight are reported to occur within Wuthathi sea country[12-14, 19]: *Cymodocea serrulata, Enhalus acoroides, Halodule uninervis, Halophila decipiens, Halophila ovalis, Halophila spinulosa, Syringodium isoetifolium and Thalassia hemprichii*. The highest species diversity of seagrass in the Wuthathi sea country is found in the waters of Margaret Bay[13]. Most species in the region are classified as colonising or opportunistic, capable of rapid recovery from losses due to fast asexual growth rates and capacity for generating large seed banks[20]. Only seagrass of the genus *Halophila* are found in waters deeper than 15m [14]. No species are listed as Endangered, Vulnerable, Near Threatened or Data Deficient under the IUCN Red List criteria[21].

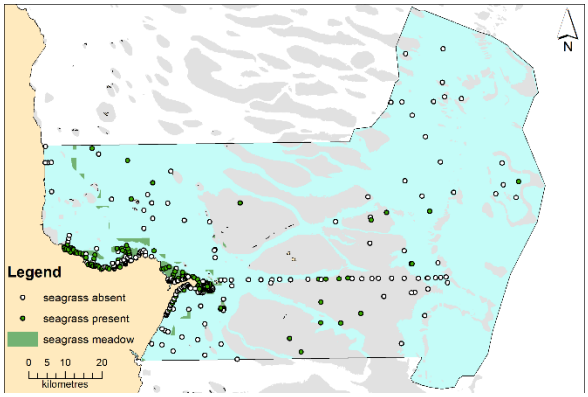

Figure 1: Seagrass distribution and location of field validation points within the Wuthathi Sea Country. Seagrass distribution is composite of all maps pooled. Sources [14-17].

Seagrass meadows in the Wuthathi sea country occur mostly in the sheltered areas of the bays and on reef flats: on intertidal sand banks throughout Shelburne, Margaret and Indian Bays, and on intertidal reef flats around the Home Islands and offshore around Haggerston and Cockburn Islands [19]. Seagrass in the region can be found on sand or muddy intertidal flats, in reef lagoons, and on sandy and muddy bottoms down to approximately 37m below Mean Sea Level (MSL) [14]. The Wuthathi sea country's seagrass ecosystems are a complex mosaic of different habitat types comprised of multiple seagrass species. Most extensive seagrass meadows occur in Margaret Bay, particularly in subtidal habitats. The majority of seagrass meadows in the region are low in seagrass cover (<10% cover) [13]. Coastal intertidal meadows in Shelburne, Margaret and Indian Bays are dominated by *Halodule uninervis* (narrow leaf form) and *Halophila ovalis*. Small isolated patches of *Enhalus acoroides* are scattered throughout the region in sheltered embayments and reef flats. Meadows of *Halophila spinulosa* with *Cymodocea serrulata / Halodule uninervis / Halophila ovalis* and *Halodule uninervis* with *Cymodocea serrulata*/mixed species dominate subtidal habitats[13].

Inshore meadows are influenced by coastal topography and shelter. All but the outer reef habitats are significantly influenced by seasonal and episodic pulses of sediment-laden, nutrient-rich river flows, resulting from high volume summer rainfall. Cyclones, severe storms, wind and waves as well as macro grazers (e.g. fish, dugongs and turtles) influence all habitats in this region to varying degrees. The result is a series of dynamic, spatially and temporally variable seagrass meadows.

Long-term seagrass monitoring in Wuthathi Sea Country

To understand the status of seagrass ecosystems in the Great Barrier Reef World Heritage Area and provide an early warning of change, long-term monitoring has been established at Shelburne Bay as part of Seagrass-Watch and the Great Barrier Reef Marine Monitoring Program (MMP) [22].

Shelburne Bay has a limited catchment with two main rivers being the Harmer and Macmillian Rivers and a number of other smaller creeks and tributaries. The catchment contains one of the least disturbed parabolic sand dunes areas in the world and is made up of seasonal wetlands and sand ridges. There was a pastoral lease issued in 1957 in Shelburne Bay which was not renewed in 1999. There are no current land use activities occurring in this catchment. The monitoring site at Shelburne Bay is approximately 5 km west of the mouth of the Harmer River.

Monitoring site details

Frequency: ongoing, biannual (established 2012)
Principal watchers: James Cook University / Seagrass-Watch HQ
Location: on the large naturally dynamic intertidal sand banks in the south of the bay
Site codes: SR1, SR2
SR1 position: S11.887 E142.9142167 (heading 0º)
SR2 position: S11.8873 E142.9156667 (heading 0º)
Best tides: <0.7m (port Round Pt 58601)
Comments: Extensive *Halophila ovalis / Halodule uninervis* dominated meadow. Dugong feeding trails common.

Long-term monitoring Results:

Environmental pressures 2017-18[22]:

- River discharge during the 2017–18 wet season was slightly above the long-term average and wind

were also above the long-term average following two previous years of windy conditions
- Inshore waters had predominantly 'green', phytoplankton rich water with some 'brown', sediment laden turbid water exposure through the wet season (December-April). Shelburne Bay sites had high exposure to turbid primary water, consistent with previous years.
- Daily incident light reaching the top of the seagrass canopy is generally very high
- 2017–18 was the sixth consecutive year intertidal within-canopy temperatures were above the long-term average and the second highest average annual temperatures since 2006
- daily tidal exposure (hours water has drained from the meadow) was below the long - term average for the second consecutive year, which may have provided some respite from the elevated temperatures.

Seagrass Status (Oct18):
- Seagrass abundance has remained stable over the last four years and no long-term (2012-2018) trend (increase or decrease) is apparent (Fig. 2)
- using the coastal seagrass abundance guidelines values from the Wet Tropics NRM region[23], seagrass state was determined for each monitoring event at each site by scoring the median values relative to the percentiles (Fig. 3)
- seagrass abundance declined temporarily at SR1 in early 2014, but has remained in a fair state since. In October 2018, seagrass abundance at Shelburne Bay was in a **Fair** state.

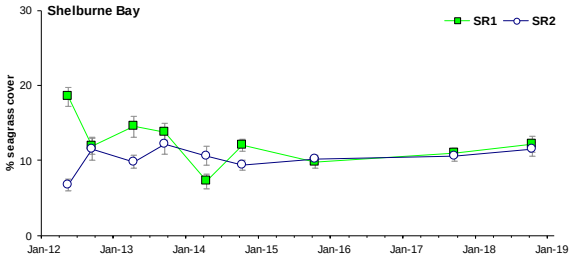

Figure 2: Changes in seagrass abundance (±SE) at each site for each sampling event since monitoring was established.

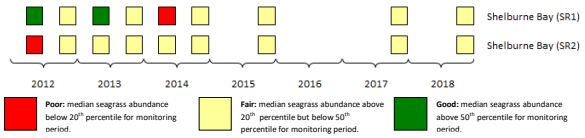

Figure 3: Seagrass abundance grade (good, fair or poor) at each site for each sampling event from May 2012 to October 2018.

- Sites are dominated by *Halodule uninervis* and *Halophila ovalis*, with some *Thalassia hemprichii*
- The colonising species *Halophila ovalis* fluctuates in composition between years, but is generally higher at SR1. The opportunistic foundational species *Halodule uninervis* dominates SR2 (Fig. 4)

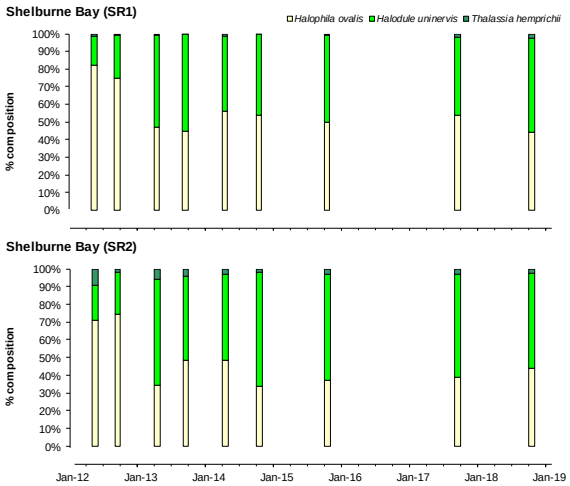

Figure 4: Seagrass species composition at each long-term monitoring site from 2012 to 2018.

- Seagrass canopy height (*Halodule uninervis* leaf length) is similar at both sites and correlated with abundance (Fig. 5)

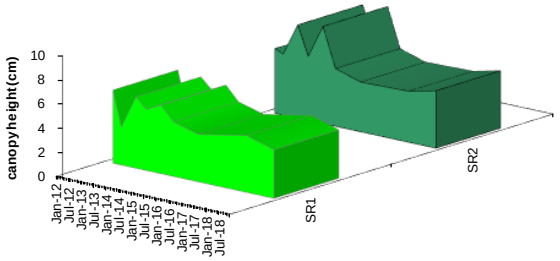

Figure 5: Average seagrass canopy height of the dominant strap-leaved species at each of the long-term monitoring sites (2012-2018).

- Macro-algae abundance is generally low at both sites, with significantly higher abundances in 2014
- Epiphyte abundance was higher from early 2013 to early 2014, but declined in late 2014 and has remained very low since

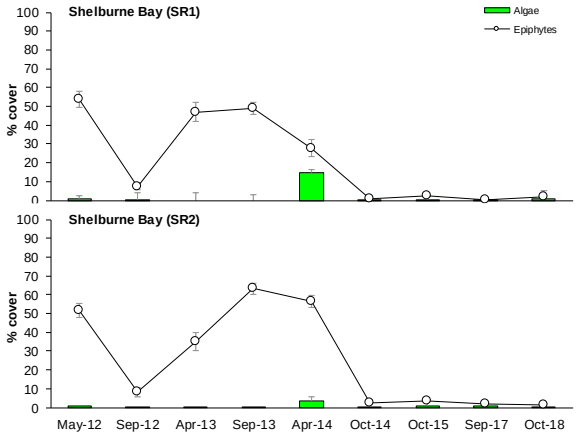

Figure 6: Mean abundance (% cover) (±Standard Error) of epiphytes and macro-algae at each long-term monitoring site (2012 - 2018).

Monitoring at Shelburne Bay is currently planned for the late dry season in 2019 and 2020. For more information, visit www.seagrasswatch.org

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References

1. Earth Tech, 2005, Cape York Peninsula Natural Resource Management Plan. Cape York Interim Advisory Group (February 2005).
2. Lee Long, W.J., J.E. Mellors, and R.G. Coles. 1993, Seagrasses between Cape York and Hervey Bay, Queensland, Australia. *Australian Journal of Marine and Freshwater Research, 44*, 19-32.
3. Read, M.A., and C.J. Limpus. 2002, The green turtle (*Chelonia mydas*) in Queensland: Feeding ecology of immature turtles in a temperate feeding area. *Memoirs of the Queensland Museum - Nature, 48*(1), 207-214.
4. Marsh, H., T.J. O'Shea, and J.E. Reynolds III, 2012, Ecology and conservation of the sirenia. Cambridge University Press, Cambridge.
5. Lamb, J.B., J.A.J.M. van de Water, D.G. Bourne, C. Altier, M.Y. Hein, E.A. Fiorenza, N. Abu, J. Jompa, and C.D. Harvell. 2017, Seagrass ecosystems reduce exposure to bacterial pathogens of humans, fishes, and invertebrates. *Science, 355*(6326), 731-733. doi: 10.1126/science.aal1956
6. Fourqurean, J.W., C.M. Duarte, H. Kennedy, N. Marba, M. Holmer, M.A. Mateo, E.T. Apostolaki, G.A. Kendrick, D. Krause-Jensen, K.J. McGlathery, and O. Serrano. 2012, Seagrass ecosystems as a globally significant carbon stock. *Nature Geoscience, 5*(7), 505-509. doi: 10.1038/ngeo1477
7. Unsworth, R.K., C.J. Collier, G.M. Henderson, and L.J. McKenzie. 2012, Tropical seagrass meadows modify seawater carbon chemistry: implications for coral reefs impacted by ocean acidification. *Environmental Research Letters, 7*(2), 024026.
8. Macreadie, P.I., O. Serrano, D.T. Maher, C.M. Duarte, and J. Beardall. 2017, Addressing calcium carbonate cycling in blue carbon accounting. *Limnology and Oceanography Letters, 2*(6), 195-201. doi: doi:10.1002/lol2.10052
9. Duarte, C.M., and D. Krause-Jensen. 2017, Export from Seagrass Meadows Contributes to Marine Carbon Sequestration. [Review]. *Frontiers in Marine Science, 4*(13). doi: 10.3389/fmars.2017.00013
10. Cullen-Unsworth, L., and R. Unsworth. 2013, Seagrass Meadows, Ecosystem Services, and Sustainability. *Environment: Science and Policy for Sustainable Development, 55*(3), 14-28. doi: 10.1080/00139157.2013.785864
11. Unsworth, R.K.F., L.J. McKenzie, C.J. Collier, L.C. Cullen-Unsworth, C.M. Duarte, J.S. Eklöf, J.C. Jarvis, B.L. Jones, and L.M. Nordlund. 2018, Global challenges for seagrass conservation. [journal article]. *Ambio*. doi: 10.1007/s13280-018-1115-y
12. Coles, R.G., W.J. Lee Long, and L.C. Squire, 1985, Seagrass beds and prawn nursery grounds between Cape York and Cairns. QDPI, Brisbane.
13. Sheppard, R., A.J. Roelofs, R. Garrett, and S.A. Helmke. 2002, Margaret Bay and surrounds: Assessment of fisheries resources August 2001. [DPI Information Series]. 94pp.
14. Coles, R., L.J. McKenzie, G. De'ath, A. Roelofs, and W.J. Lee Long. 2009, Spatial distribution of deepwater seagrass in the inter-reef lagoon of the Great Barrier Reef World Heritage Area. *Marine Ecology Progress Series, 392*, 57-68. doi: 10.3354/meps08197
15. Pitcher, R., P. Doherty, P. Arnold, J. Hooper, N. Gribble, C. Bartlett, M. Browne, N. Campbell, T. Cannard, M. Cappo, G. Carini, S. Chalmers, S. Cheers, D. Chetwynd, A. Colefax, R. Coles, S. Cook, P. Davie, G. De'ath, D. Devereux, B. Done, T. Donovan, B. Ehrke, N. Ellis, G. Ericson, I. Fellegara, K. Forcey, M. Furey, D. Gledhill, S. Gordon, M. Haywood, I. Jacobsen, J. Johnson, M. Jones, S. Kinninmoth, S. Kistle, P. Last, A. Leite, S. Marks, I. McLeod, S. Oczkowicz, C. Rose, D. Seabright, J. Sheils, M. Sherlock, P. Skelton, D. Smith, G. Smith, P. Speare, M. Stowar, C. Strickland, P. Sutcliffe, C. Van der Geest, B. Venables, C. Walsh, T. Wassenberg, A. Welna, and G. Yearsley, 2007, Seabed Biodiversity on the Continental Shelf of the Great Barrier Reef World Heritage Area. CRC Reef Research Task Final Report. CSIRO, Brisbane.
16. Carter, A.B., S.A. McKenna, M.A. Rasheed, L.J. McKenzie, and R.G. Coles, 2016, Seagrass mapping synthesis: A resource for coastal management in the Great Barrier Reef World Heritage Area. Report to the National Environmental Science Programme. Reef and Rainforest Research Centre Limited, Cairns.
17. McKenzie, L.J., R.L. Yoshida, A. Grech, and R. Coles. 2014, Composite of coastal seagrass meadows in Queensland, Australia - November 1984 to June 2010. . *PANGAEA*, http://doi.pangaea.de/10.1594/PANGAEA.826368.
18. Waycott, M., C. Collier, K. McMahon, P.J. Ralph, L.J. McKenzie, J.W. Udy, and A. Grech, 2007, Vulnerability of seagrasses in the Great Barrier Reef to climate change - Chapter 8: . In: J.E. Johnson and P.A. Marshall (Eds.), Climate Change and the Great Barrier Reef: A Vulnerability Assessment, Part II: Species and species groups. Great Barrier Reef Marine Park Authority Townsville, pp. 193-236.
19. Rasheed, M., R. Thomas, A. Roelofs, and S. McKenna, 2005, Critical marine habitats adjacent to the high risk Inner Shipping Route in the Shelburne, Margaret and Indian Bays Region, Far North Queensland, Australia - 2005 Atlas. QDPI&F Information Series QI04048. Northern Fisheries Centre, Cairns.
20. Kilminster, K., K. McMahon, M. Waycott, G.A. Kendrick, P. Scanes, L. McKenzie, K.R. O'Brien, M. Lyons, A. Ferguson, P. Maxwell, T. Glasby, and J. Udy. 2015, Unravelling complexity in seagrass systems for management: Australia as a microcosm. *Science of The Total Environment, 534*, 97-109. doi: http://dx.doi.org/10.1016/j.scitotenv.2015.04.061
21. Short, F.T., B. Polidoro, S.R. Livingstone, K.E. Carpenter, S. Bandeira, J.S. Bujang, H.P. Calumpong, T.J.B. Carruthers, R.G. Coles, W.C. Dennison, P.L.A. Erftemeijer, M.D. Fortes, A.S. Freeman, T.G. Jagtap, A.H.M. Kamal, G.A. Kendrick, W.J. Kenworthy, Y.A. La Nafie, I.M. Nasution, R.J. Orth, A. Prathep, J.C. Sanciangco, B. van Tussenbroek, S.G. Vergara, M. Waycott, and J.C. Zieman. 2011, Extinction risk assessment of the world's seagrass species. *Biological Conservation, 144*(7), 1961-1971. doi: 10.1016/j.biocon.2011.04.010
22. McKenzie, L.J., C.J. Collier, L.A. Langlois, R.L. Yoshida, J. Uusitalo, N. Smith, and M. Waycott, 2019, Marine Monitoring Program: Annual Report for Inshore Seagrass Monitoring 2017–18. Report for the Great Barrier Reef Marine Park Authority. Great Barrier Reef Marine Park Authority, Townsville.
23. McKenzie, L.J., 2009, Observing change in seagrass habitats of the GBR– Seagrass-Watch monitoring: Deriving seagrass abundance indicators for regional habitat guidelines,. In: L.J. McKenzie and M. Waycott (Eds.), Marine and Tropical Sciences Research Facility Milestone and Progress Report #3, 2008-2009 (ARP 3) Project 1.1.3 Report 3, 11th June 2000. http://rrrc.org.au/wp-content/uploads/2014/06/113-QDPIF-McKenzie-L-2009-June-Milestone-Report.pdf accessed 23 February 2017. RRRC, Cairns, pp. 7-1.