Seagrass in the Kuuku Ya'u sea country: state of current knowledge, September 2019

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Abstract. Seagrass meadows in the Kuuku Ya'u 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 approximately 73.6 km^2 of seagrass in the Kuuku Ya'u sea country waters shallower than 15 m and at least an additional 22.3 km^2 of meadows in waters deeper than 15 m. Nine seagrass species are reported to occur within Kuuku Ya'u sea country, mostly in the sheltered areas of bays and on reef flats. Monitoring of seagrass condition was established at Piper Reef and Yum Yum Beach in 2012 as part of the Great Barrier Reef Marine Park Authorities' Marine Monitoring Program and Seagrass-Watch. Monitoring sites are on intertidal reef habitats and dominated by *Thalassia hemprichii* or *Cymodocea rotundata*/*Halodule uninervis* with varying amounts of *Cymodocea serrulata* and *Halophila ovalis*. No long-term (2012-2018) trend in seagrass abundance is apparent and seagrass condition at Piper Reef has fluctuated over the years and is currently in a Poor to Fair state (current state of seagrass at Yum Yum Beach is unknown).

Key words: seagrass; Kuuku Ya'u; monitoring; Seagrass-Watch; Marine Monitoring Program; Great Barrier Reef.

Introduction

Kuuku Ya'u Sea Country is the traditional lands of the Kungkay People. The Kuuku Ya'u Sea Country includes Forbes Island (Wuthara), Quoin Island (Mitirinchi), Restoration Island (Ma'alpiku), Rocky Island (Piinalalka), Pidgeon Island (Uuchuluku), the Piper Islands and all of the coastal country from Nyllichi River in the south to Olive River in the north. The region covers an area of marine waters approximately 1,970 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 Kuuku Ya'u 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. 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 Weymouth provides shelter to the norther inshore area of the region from the prevailing winds.

Seagrass meadows in the Kuuku Ya'u 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 world 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 meadows[10]. 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[11, 12].

Seagrass in the Kuuku Ya'u Sea Country was first mapped as part of broad scale surveys of the Queensland coast from Cape York to Cairns in November 1984 [13]. The survey however included only nearshore seagrass to a depth of approx 15m. Since the 1980s, the only mapping surveys occurred in waters deeper than 15m in November 1998[14] and January/February 2005[15]. It has been estimated from mapping surveys that there is approximately 73.6 km^2 of seagrass in the Kuuku Ya'u Sea Country waters shallower than 15 metres [14]. There is at least an additional 22.3 km^2 of meadows in the Kuuku Ya'u Sea Country waters deeper than 15 metres[16], [14, 17].

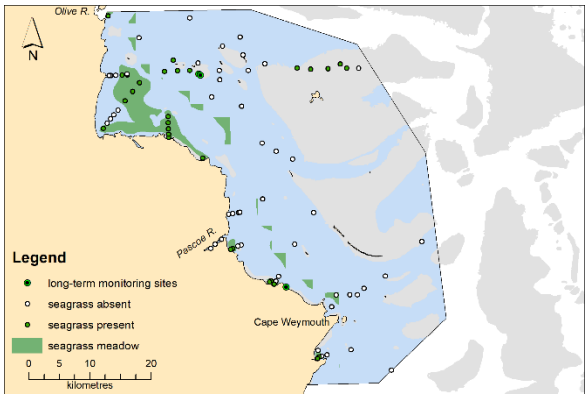

Figure 1: Seagrass distribution and location of field validation points within the Wuthathi Sea Country. Seagrass distribution is composite of all maps pooled. Sources [14-17].

Fifteen species of seagrass are reported in Queensland[18], nine are reported to occur within Kuuku Ya'u Sea Country [13-15, 19]: *Cymodocea rotundata, Cymodocea serrulata, Enhalus acoroides, Halodule uninervis, Halophila decipiens, Halophila ovalis, Halophila spinulosa, Syringodium isoetifolium* and *Thalassia hemprichii*. The highest seagrass species diversity in the Kuuku Ya'u Sea Country is found on the intertidal fringing reef at Yum Yum Beach and the shallow banks north to the Pascoe River. 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].

Seagrass meadows in the Kuuku Ya'u Sea Country occur mostly in the sheltered areas of the bays and on reef flats throughout the region. Seagrass can be found on sand or muddy intertidal flats, in reef lagoons, and on sandy and muddy bottoms down to approximately 20.5m below Mean Sea Level (MSL)[14]. The most extensive seagrass meadows occur in Temple Bay, particularly in subtidal habitats.

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 Kuuku Ya'u 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 Piper Reef and Yum Yum Beach as part of Seagrass-Watch and the Great Barrier Reef Marine Monitoring Program (MMP)[19]. The following summary is from published reports.

Piper Reef long-term monitoring site

Frequency: ongoing, biannual (established 2012)
Principal watchers: James Cook University, Seagrass-Watch HQ
Location: reef platform shared with Farmer and Fisher Islands, which form part of the Piper Islands National Park (CYPAL) (declared in 1989), jointly managed with Kuuku Ya'u Traditional Owners.
Site codes: FR1, FR2
FR1 position: S12º15.351 E143º14.020 (heading 0º)
FR2 position: S12º15.448 E143º14.185 (heading 0º)
Best tides: <0.7m (port Kay Reef 58655)

Long-term monitoring Results:

Environmental pressures 2017-18[19]:

- Environmental pressures affecting seagrass across the region include river discharge, wind, light availability and sea temperature.
- River discharge during the 2017–18 wet season from the Olive-Pascoe was slightly above the long-term median and wind were also above the long-term average following two previous years of windy conditions
- Offshore waters had predominantly 'green', phytoplankton rich water through the late wet season (February-April). Piper Island sites (FR1 and FR2) had highest exposure to fairly blue waters with some floodwater coloured dissolved organic matter influence, 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 significant long-term (2012-2018) trend (increase or decrease) is apparent (Fig. 2)

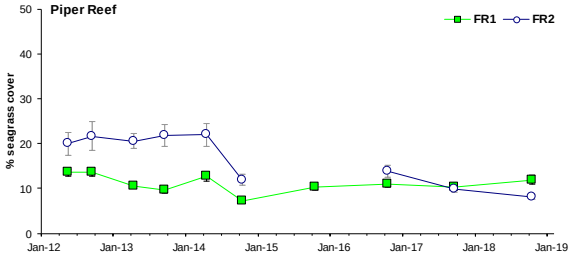

Figure 2: Changes in seagrass abundance (±SE) at each Piper Reef site for each sampling event since monitoring was established.

- Sites are dominated by *Thalassia hemprichii* (including minor amounts of *Cymodocea* spp. and *Halophila ovalis*), with little change between years (Fig. 3)

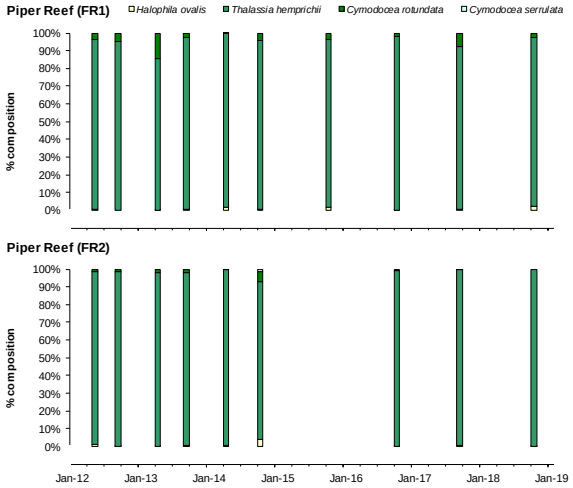

Figure 3: Seagrass species composition at each long-term monitoring site from 2012 to 2018.

- Seagrass canopy height (*Thalassia hemprichii* leaf length) is similar at both sites and correlated with abundance (Fig. 4)

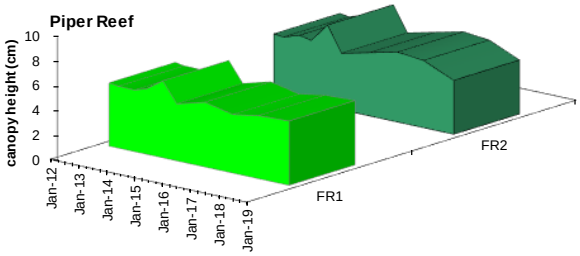

Figure 4: Average seagrass canopy height of the dominant strap-leaved species at each of the long-term monitoring sites (2012-2018).

- Macroalgal and epiphyte abundance is generally low, with little change between years (Fig. 5)

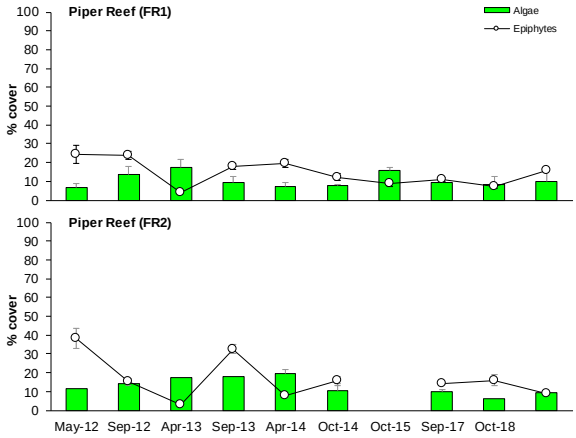

Figure 5: Mean abundance (% cover) (±Standard Error) of epiphytes and macro-algae at each long-term monitoring site (2012 - 2018).

Yum Yum Beach long-term monitoring site

Frequency: ongoing, ad hoc (established 2012)

Principal watchers: Northern Kuuku Ya'u Land and Sea Rangers, Seagrass-Watch HQ, and James Cook University

Location: on the intertidal fringing reef flat

Site codes: YY1

YY1 position: S12º34.260 E143º21.635 (heading 0º)

Best tides: <0.7m (port Portland Road 58660)

Seagrass Status (Oct14):

- The site has not been examined since 2014 but no long-term (2012-2014) trend (increase or decrease) was apparent (Fig. 6)

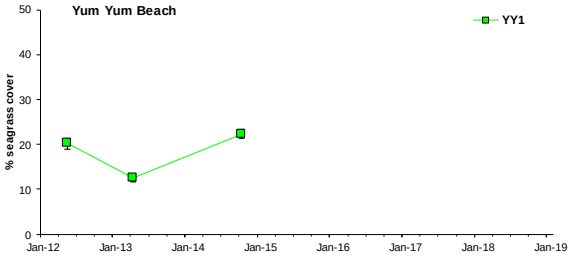

Figure 6: Changes in seagrass abundance (±SE) at each Piper Reef site for each sampling event since monitoring was established.

- Site dominated by *Cymodocea rotunda*ta and *Halodule uninervis*, with some *Thalassia hemprichii*, *Cymodocea serrulata* and *Halophila ovalis* (Fig. 7)
- Seagrass canopy height (leaf length) of the strap-leaved species is similar at both sites and correlated with overall abundance
- Macro-algae and epiphyte abundances are low, with little change between years (Fig. 8)

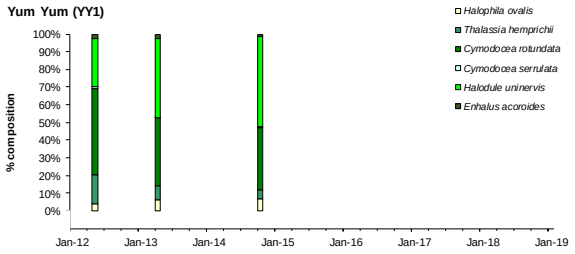

Figure 7: Seagrass species composition at long-term monitoring site from 2012 to 2018.

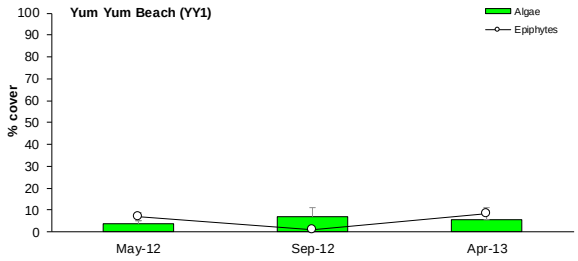

Figure 8: Mean abundance (% cover) (±Standard Error) of epiphytes and macro-algae at long-term monitoring site (2012 - 2018).

Report Card:

- using the reef habitat seagrass abundance guidelines values from Archer Point (the nearest similar long-term monitoring site from which abundance guidelines have been developed), seagrass state was determined for each monitoring event at each site by scoring the median abundance relative to the percentiles[22] (Fig. 9)
- seagrass abundance has fluctuated at both Piper Reef sites since monitoring was established. In October 2018, seagrass abundance at FR1 was in a **Fair** state, but FR2 was **Poor**.
- Yum Yum Beach was in a Good state in October 2014, however current status is **unknown**.

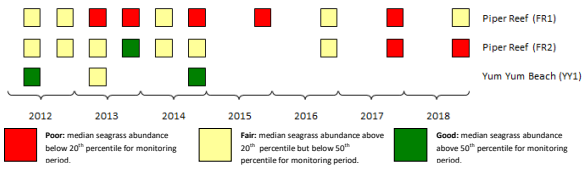

Figure 9: Seagrass abundance grade (good, fair or poor) at each site for each sampling event from May 2012 to October 2018.

Monitoring at Piper Reef is currently planned for the late dry season in 2019. 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. Waycott, M., L.J. McKenzie, J.E. Mellors, J.C. Ellison, M.T. Sheaves, C. Collier, A.-M. Schwarz, A. Webb, J. Johnson, and C.E. Payri, 2011, Vulnerability of mangroves, seagrasses and intertidal flats in the tropical Pacific to climate change. In: J.D. Bell, J.E. Johnson, and A.J. Hobday (Eds.), Vulnerability of fisheries and aquaculture in the Pacific to climate change. Secretariat of the Pacific Community, Noumea, New Caledonia, pp. 97-168.
11. 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
12. 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
13. 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.
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. 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.
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., 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.