

Gladstone Healthy Harbour Partnership 2024 Report Card Summary, ISP011: Seagrass

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Executive Summary

Gladstone Harbour seagrass meadows were in good overall condition in the 2024 reporting year after being in satisfactory condition in the 2023 report. The main drivers behind the condition upgrade were improvements in seagrass meadow biomass and area in Rodds Bay since the previous survey. At the zone level, seagrass in the Western Basin, the Narrows and South Trees Inlet continued to be in good condition, while seagrass in the Inner and Mid Harbour zones remained in poor condition.

Background

Seagrass monitoring in Port Curtis and Rodds Bay commenced in 2002 and has been conducted annually since 2004 as part of a long-term partnership between Gladstone Ports Corporation (GPC) and the Centre for Tropical Water and Aquatic Ecosystem Research (TropWATER) at James Cook University. Fourteen monitoring meadows representing the range of different seagrass community types in Port Curtis and Rodds Bay are assessed each October/November. Three indicators of seagrass condition are assessed: biomass, area and species composition. Each meadow is graded from A (very good) to E (very poor) relative to baseline conditions and scored on a 0–1 scale; allowing for average scores to be calculated (Table 1). The lowest of the three indicator scores dictates the overall meadow score and grade (Figure 2; Table 1). Where species composition is the lowest of the three indicator scores, it contributes 50% of the overall meadow score, with the remaining 50% coming from the lowest of either biomass or area scores (see Carter et al. 2023 for more details). Seagrass condition for the 2024 reporting year comes from data collected in October/November 2023. A detailed description of methods and approaches can be found in Reason et al. (2024 – go to <https://www.tropwater.com/reports-and-publications>) and is summarised for the Gladstone Healthy Harbour Partnership in this report.

Overall Seagrass Condition

Eight of the fourteen individual monitoring meadows were rated as being in good or very good condition for the 2024 reporting year (Table 1). In the Western Basin and the Narrows, four of the monitoring meadows remained in good or very good condition with the other three meadows remaining in satisfactory condition. Outside the Narrows and Western Basin, only the meadows at South Trees Inlet (Meadow 60) and those in Rodds Bay were in good condition. All three meadows in the reference area at Rodds Bay were in good condition for the first time since 2019 due to increases in biomass. Seagrass at Pelican Banks (Meadow 43) in the Mid Harbour continued to record low biomass and remained in poor condition. The meadow has been in poor or very poor condition for 8 of the last 9 years. The seagrass meadow at the Inner Harbour (Meadow 58) was in poor condition due to the absence of persistent seagrass *Zostera muelleri* in the meadow despite increases in biomass and area of other seagrass species.

Table 1. Grades and scores for seagrass sub-indicators (biomass, area and species composition), overall meadow, zone, and Gladstone Harbour scores for the GHHP 2024 reporting year (2023 survey). Scores are on 0 – 1 scale; cells are coloured according to grade, where dark green = very good, light green = good, yellow = satisfactory, orange = poor, red = very poor. Note, 2024 scores may differ slightly to those reported by Reason et al. (2024) due to bootstrapping used to calculate GHHP report card and scores.

Zone	Meadow	Biomass	Area	Species composition	Overall meadow	2024 (2023 survey)	2023 (2022 survey)	2022 (2021 survey)
1. The Narrows	21	0.89	0.96	0.97	0.89	0.89	0.93	0.94
3. Western Basin	4	0.88	0.97	0.86	0.87	0.70	0.72	0.82
	5	0.84	0.91	0.87	0.84			
	6	0.74	0.94	0.32	0.53			
	7	0.85	0.58	1.00	0.58			
	8	0.69	0.84	0.54	0.61			
	52–57	0.73	0.87	1.00	0.73			
5. Inner Harbour	58	0.87	0.87	0.00	0.43	0.43	0.10	0.39
8. Mid Harbour	43	0.45	0.86	0.83	0.45	0.49	0.57	0.67
	48	0.54	0.79	0.65	0.54			
9. South Trees Inlet	60	0.81	1.00	0.99	0.81	0.81	0.81	1.00
13. Rodds Bay	94	0.85	0.74	0.98	0.74	0.74	0.38	0.42
	96	0.78	1	0.85	0.78			
	104	0.71	0.93	0.84	0.71			
Harbour score						0.68	0.58	0.70

*Meadow 52-57 consists of a number of small meadows surrounding the Passage Islands in the Western Basin Zone (see Figure 1). These meadows are grouped for reporting purposes.

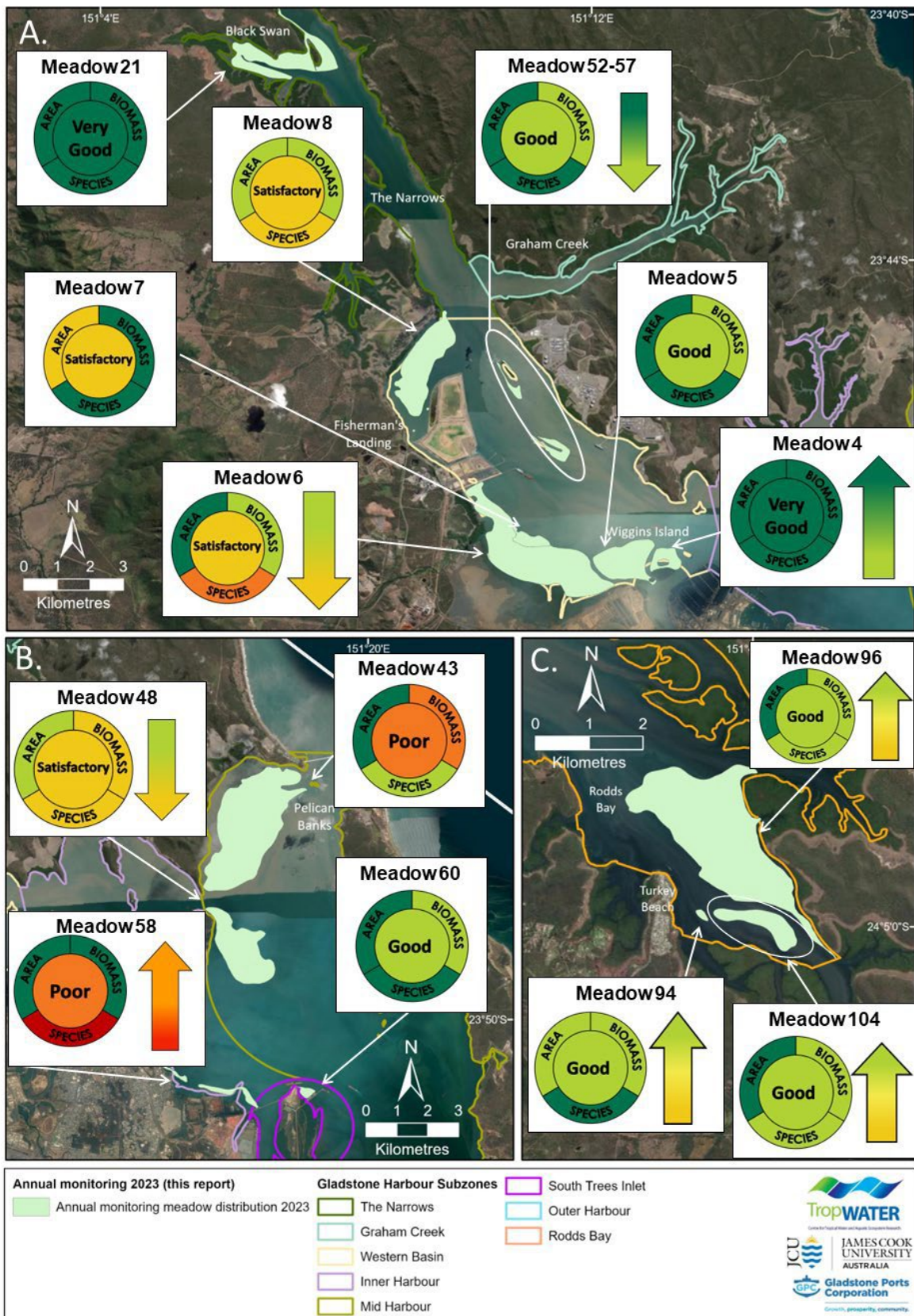


Figure 1. Seagrass distribution and meadow condition in the The Narrows and Western Basin Zones (A), Inner Harbour, Mid Harbour, and South Trees Inlet Zones (B) in Gladstone Harbour, and in Rodds Bay (C) in November 2023 (this report card). Arrows indicate an overall grade change from the previous year.

Drivers of Seagrass Condition

Local environmental conditions are a key factor in determining seagrass distribution, biomass and health in the Gladstone region. Seagrass has specific light requirements for photosynthesis and growth (Chartrand et al. 2016; 2018). Turbidity associated with rainfall and river outflow reduces benthic light conditions inhibiting seagrass growth and can ultimately lead to plant death whereas low rainfall and river flow generally lead to high benthic light and increases in seagrass growth. Long-term trends in seagrass condition over the past 20 years of annual monitoring reveal a strong relationship with river flow and rainfall in the region. In 2023, below average rainfall in Gladstone and below average river flow from the Calliope River were likely to have led to favourable seagrass growing conditions. If favourable conditions continue, seagrass biomass and condition may continue to increase and improve building their resilience and ability to resist and recover from future disturbances.

The largest seagrass meadow in Port Curtis, Pelican Banks (Meadow 43) is in poor condition for the second consecutive year. Pelican Banks is historically the largest, high-biomass seagrass meadow in Port Curtis. The main drivers behind the decline in condition over the previous years have been the reduction in biomass due to changes in species composition. This meadow has seen a change from the foundation species *Z. muelleri* toward smaller and less persistent *H. uninervis* and *H. ovalis*. *Zostera muelleri* has much greater biomass than the other species in the meadow (e.g. *H. uninervis*, *H. ovalis*) and the prevalence of each species ultimately affects meadow biomass and condition scores. The Pelican Banks meadow typically experiences the best water quality conditions for seagrass meadows in the region based on historical monitoring of benthic light (Chartrand et al. 2016) and therefore meadow condition would be expected to be more consistent or better than those elsewhere in Port Curtis. The Pelican Banks meadow is subject to high levels of herbivory from dugong and turtle that may be altering the species composition and restricting recovery. Research using herbivore exclusion cages found the impact of herbivores on both seagrass biomass and canopy height were greater at Pelican Banks than other meadows within Port Curtis and Rodds Bay (Scott et al. 2021). It has been suggested that megaherbivores target areas of high biomass which may explain high levels of herbivory in the past (Reason et al. 2024, Rasheed et al. 2017). Major meadow losses have occurred in other locations around the world as a direct result of turtle herbivory (Christianen et al. 2014). Despite these biomass changes the spatial footprint of the meadow has remained similar and *Z. muelleri* is still found throughout the meadow extent albeit at reduced biomass.

The three monitoring meadows in the out of port reference area in Rodds Bay all had improvements in biomass and area and were in good condition in the 2023 survey (2024 reporting year). Large declines were observed in the Rodds Bay meadows from 2009 to 2010 with a complete loss of seagrass in the monitoring meadows in 2011 to 2013. Biomass and area in the Rodds Bay meadows peaked in 2019-2020 and were considered very good after nine to 10 years of being in satisfactory to poor condition. The meadows declined to poor condition in 2022 and their recovery in the 2023 survey across all condition indicators is a likely reflection that climate conditions have been favourable for these meadows and has provided an opportunity to build on their resilience for another season.

Conclusion

The overall good condition of seagrasses (combined across all zones) in the 2024 reporting year indicates a healthy marine environment for Port Curtis and Rodds Bay. The seagrass dynamics observed in Port Curtis and Rodds Bay over the past year are consistent with the major climate drivers of seagrass change seen elsewhere in North Queensland and the continued use of the meadows by dugongs and green turtles are signs of a healthy functioning seagrass ecosystem. The improvements

in biomass and area and the maintenance of foundation species over the previous sampling years in most Port Curtis and Rodds Bay meadows likely provided some resilience to the less favourable conditions that occurred in 2022. Sustained periods of high biomass can lead to increased reproductive effort and replenish seed banks in the region, particularly for *Z. muelleri*. Larger seed banks further increase seagrass meadow resilience to impacts by increasing their capacity for recovery (Reason et al. 2017).

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