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JAMES COOK UNIVERSITY AUSTRALIA

Green Island Jetty Repairs Seagrass Monitoring Final Report - Sixteen Month Post-Disturbance, October 2021

Report 22/01

Smith TM, McKenna SM, York PH, Rasheed MA

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Key Findings

As part of works for the Green Island Jetty repairs, utilization of an area for a contractors work barge was subject of agency approval for potential impacts to marine plants. As works progressed an area of seagrass was impacted by the barge sitting on the bottom and associated mooring blocks adjacent to the jetty during works. A monitoring program that incorporated pre-disturbance baseline and reference areas of undisturbed seagrass was established to assess impacts and recovery of seagrasses in the impacted area.

This report details results of the fourth and final post-disturbance survey conducted 16 months after the works barge was removed. Key findings from this survey were:

1. In October 2021, sixteen months after removal of the works barge, seagrass within the barge footprint area had fully recovered.

2. Seagrass biomass within the barge footprint had returned to the same levels as the undisturbed reference areas and the pre-disturbance baseline.

3. The area of seagrass impacted by the barge had largely recovered after 12 months and this recovery was sustained with no visible impact of the barge footprint 16 months following the disturbance.

4. Seagrass biomass was lower across all sites in October 2021 (disturbed and undisturbed reference areas) compared to May 2021 and November 2019 (pre-barge impact), but biomass was similar to September 2020, with changes likely reflective of natural seagrass seasonality.

5. As seagrass had fully recovered with no signs of ongoing impact of the jetty works, no further monitoring of seagrass is required for the project.

1. Background & Scope

The Green Island jetty is located approximately 27km from the Port of Cairns and Ports North maintains the jetty on behalf of the Department of Transport and Main Roads. As part of maintenance on the jetty, Ports North removed and reinstated approximately 380m^2 of defective concrete; approximately 45 concrete piles were repaired ranging from minor crack repairs to significant structural repairs. As part of the construction works a barge was moored alongside the jetty that sat on the bottom during spring low tide disturbing the benthic seagrass habitat.

The area surrounding Green Island falls within the Great Barrier Reef Marine Park (GBRMP) and supports a diverse range of habitats including significant seagrass meadows and reefs that begin in the tidal zone. The extensive seagrass meadows that surround Green Island provide key habitat and food for a diverse range of fish species and large herbivores such as green turtles (Rasheed 2004, Scott et al. 2020). Ten species of seagrass have been identified in the waters surrounding Green Island (Mellors 1993; Rasheed 2000; 2004). An initial pre-disturbance seagrass survey at the inshore barge location and surrounding seagrass was conducted in November 2019. The meadow was mostly subtidal and dominated by *Halodule uninervis* and *Cymodocea rotundata* with *Syringodium isoetifolium*, *Cymodocea serrulata*, *Thalassia hemprichii* and *Halophila ovalis* also present. Seagrass biomass was relatively dense and consistent across the baseline survey area. In June 2020 a follow up survey was conducted immediately after the barge was removed from the area to determine the initial impacts of the barge on seagrass and found significant localised seagrass decline in the barge footprint. The area of seagrass decline was approximately 10.0 x 5.5m and consisted predominately of sand with some sparse, low biomass seagrass still present. The impacted area and reference blocks were monitored in September 2020 and May 2021, three and twelve months after the barge was removed to assess the recovery and any lasting impacts from the barge. After three months the seagrass had begun to recolonise the impacted area and after twelve months the seagrass had recolonised all the impacted area returning to pre-impact levels. The aim of this study was to:

- Conduct a sixteen-month post-disturbance survey of seagrass impacted by the barge and adjacent reference areas.
- Confirm that seagrass has fully recovered and there is no ongoing impact of the jetty works.
- Compare the survey results to the results of the baseline and initial post disturbance surveys

2. Seagrass Sampling Approach and Methods

The survey design followed those previously used to monitor seagrass at Green Island before (November 2019) and after (June and September 2020, May 2021) jetty repair works. Survey's focused on three monitoring blocks (one area of impact and two reference areas) situated within the initial pre-disturbance survey extent (Figure 1). The disturbance impact block, extending across the barge impact area, and two reference blocks were monitored to assess the impact of the barge on the seagrass meadow and subsequent recovery (Figure 1).

Figure 1. Seagrass survey sites within disturbance and reference blocks three months post-disturbance and areas impacted by the barge and moorings.

Within the survey blocks, seagrass assessment sites were located at sufficient density to adequately describe the seagrass characteristics (Figure 1). Sampling methods followed those used in the established state-wide seagrass assessment and monitoring program including within Ports North's other ports (see Rasheed et al. 2019; Bryant et al. 2019 for recent reports). These standard methods are based on the JCU TropWATER seagrass program for baseline assessment and monitoring for other areas of Queensland including Cairns, Townsville, Weipa, Gladstone, Abbot Point, Karumba, Mourilyan, Mackay, Clairview and Thursday Island.

At each survey site a snorkeler collected data on seagrass and other benthic habitats present in three replicate placements of a 50cm x 50cm quadrat (Figure 2).

Figure 2. Seagrass habitat assessments.

At each survey site information on benthic habitats including seagrass, algae and other major benthos and benthic macro-invertebrates (BMI) was collected and included;

- **Seagrass biomass, species composition**; Seagrass biomass was determined using a "visual estimate of biomass" technique (see Kirkman 1978; Mellors 1991). A 0.25 m^{-2} quadrat was placed randomly three times at each site. For each quadrat, an observer assigned a biomass rank made in reference to a series of quadrat photographs of similar seagrass habitats for which the above-ground biomass had previously been measured. The relative proportion of the above-ground biomass (i.e. percentage) of each seagrass species within each quadrat was also recorded. At the completion of ranking, the observer also ranked a series of photos of calibration quadrats that represented the range of seagrass observed during the survey. These calibration quadrats had previously been harvested and the actual biomass determined in the laboratory. A separate regression of ranks and biomass from the calibration quadrats was generated for each observer and applied to the biomass ranks given in the field. Field biomass ranks were converted into above-ground biomass in grams dry weight per square metre (g DW m^{-2}).

- **Algae type** (categorised into functional groups) and percent cover;
- **Benthos type** (categorised into functional groups) and percent cover;
- **Sediment type**; visual assessment of broad sediment grain size categories (e.g. sand, mud);
- **Time and position** (latitude/longitude)

All survey data was entered into a Geographic Information System (GIS) database for presentation. From this survey two GIS layers were created in ArcGIS to describe the seagrass habitat in the survey area;

- **Seagrass habitat characterisation survey sites** – site (point) data containing seagrass above-ground biomass (for each species), sediment type (based on visual estimates), time, latitude and longitude, sampling method and comments.
- **Seagrass biomass interpolation layer** - Information from the site layer was used to construct a subsequent polygon layer for seagrass biomass within the seagrass survey extent using spatial interpolation tools within the spatial analyst package of ArcGIS.

3. Survey Results & Discussion

A total of 72 seagrass habitat assessment sites were sampled within the three survey blocks at the Green Island jetty repair site in October 2021 (Figures 1, 3). A total of four seagrass species were identified; *Cymodocea rotundata, Halodule uninervis, Syringodium isoetifolium* and *Thalassia hemprichii.* Two species, *Halophila ovalis* and *C. serrulata,* have been recorded in previous surveys but were not recorded in this monitoring survey in any of the survey blocks. *Cymodocea rotundata* was the dominant species while *T. hemprichii* was the least common (Figure 3). The composition and biomass of seagrass in the survey area was similar to that of previous surveys of the larger seagrass meadow (Mellors et al. 1993, Rasheed 2000; 2004).

Figure 3. Seagrass species composition at each site within each monitoring block (% of total biomass per species) at the Green Island jetty repair site.

The area of seagrass impacted by the barge during the jetty repairs was indistinguishable from the surrounding meadow 16 months after the initial impact (Figure 4, 5). There was no difference in biomass within the impacted area relative to the reference blocks or visible impacts of the barge in this survey (Figure 4, 5). Immediately after the barge removal (June 2020) there was a distinct 10.0 x 5.5m (50 m^2) footprint of absent or very low seagrass cover. Seagrass had begun to re-colonise the area three months after the barge had been removed (September 2020) and the area of absent or very low seagrass biomass had retracted to 29m^2 (Figure 4, 5, 6). After 12 months (May 2021) there was no visible impact of the barge or the denuded seagrass area as biomass in the impacted area returned to reference and pre-impact levels indicating the seagrass had recovered (Figure 4, 5, 6). Maintenance of similar seagrass biomass across impacted and reference blocks in this survey show that the seagrass has fully recovered and there are no lingering effects of the seagrass loss caused by the barge during the jetty works.

Seagrass biomass across all monitoring blocks was lowest in this survey (October 2021, 16 months post-impact) compared to the previous surveys (Figure 4, 5). Biomass in the reference blocks also declined in September 2020 (three months post impact) relative to the first two surveys. These declines maybe related to broad scale seasonal variations in seagrass growth and condition. On Green Island, seagrass biomass peaks in December-January and is lowest in June-August as a function of changing light and temperature conditions (Mellors et al. 1993, Rasheed 2004). Biomass is generally lowest in August and begins to increase in September and October until peaking later in summer (Mellors et al. 1993, Rasheed 2004). Low biomass recorded in September/October in this survey is consistent with these seasonal changes. Grazing from turtle and other marine herbivores can also regulate seagrass biomass on Green Island causing localised seagrass declines (Scott et al. 2020). Evidence of seagrass herbivory was recorded during this survey (Figure 6D) and could be contributing to lower biomass across the survey blocks during the final survey.

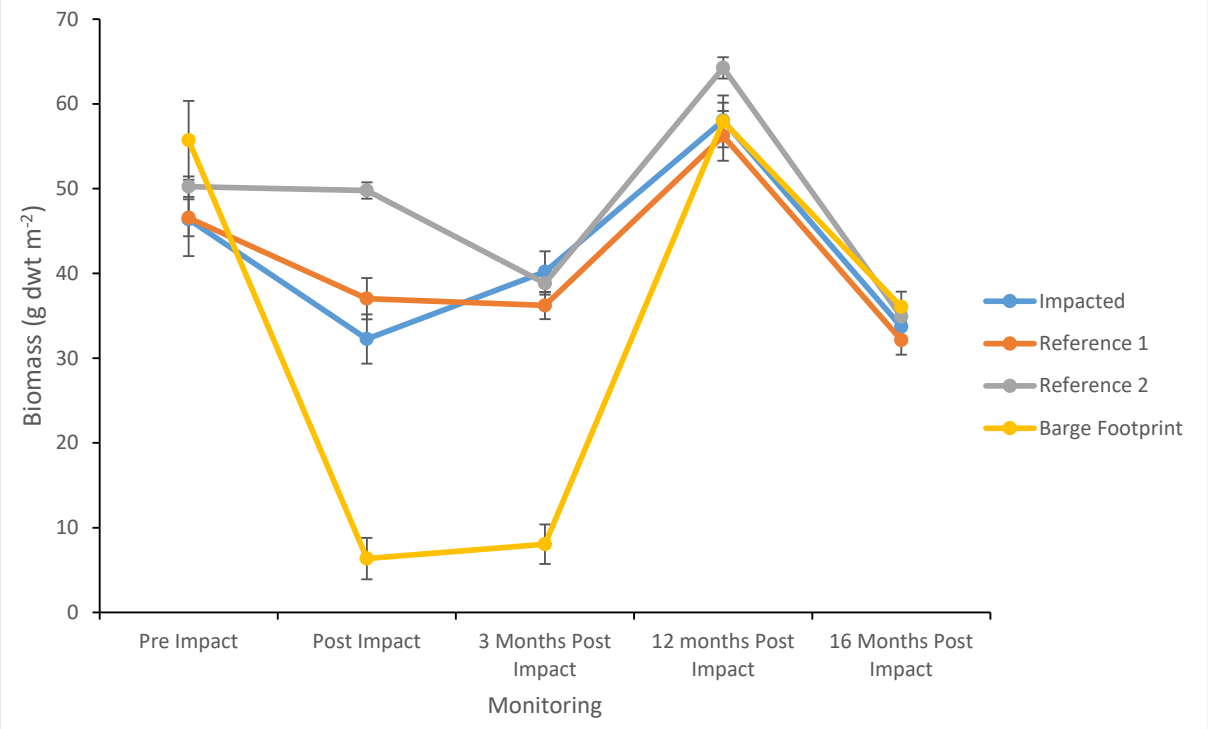

Figure 4. Seagrass biomass (mean ±SE) at each monitoring area and within the barge footprint during each monitoring survey.

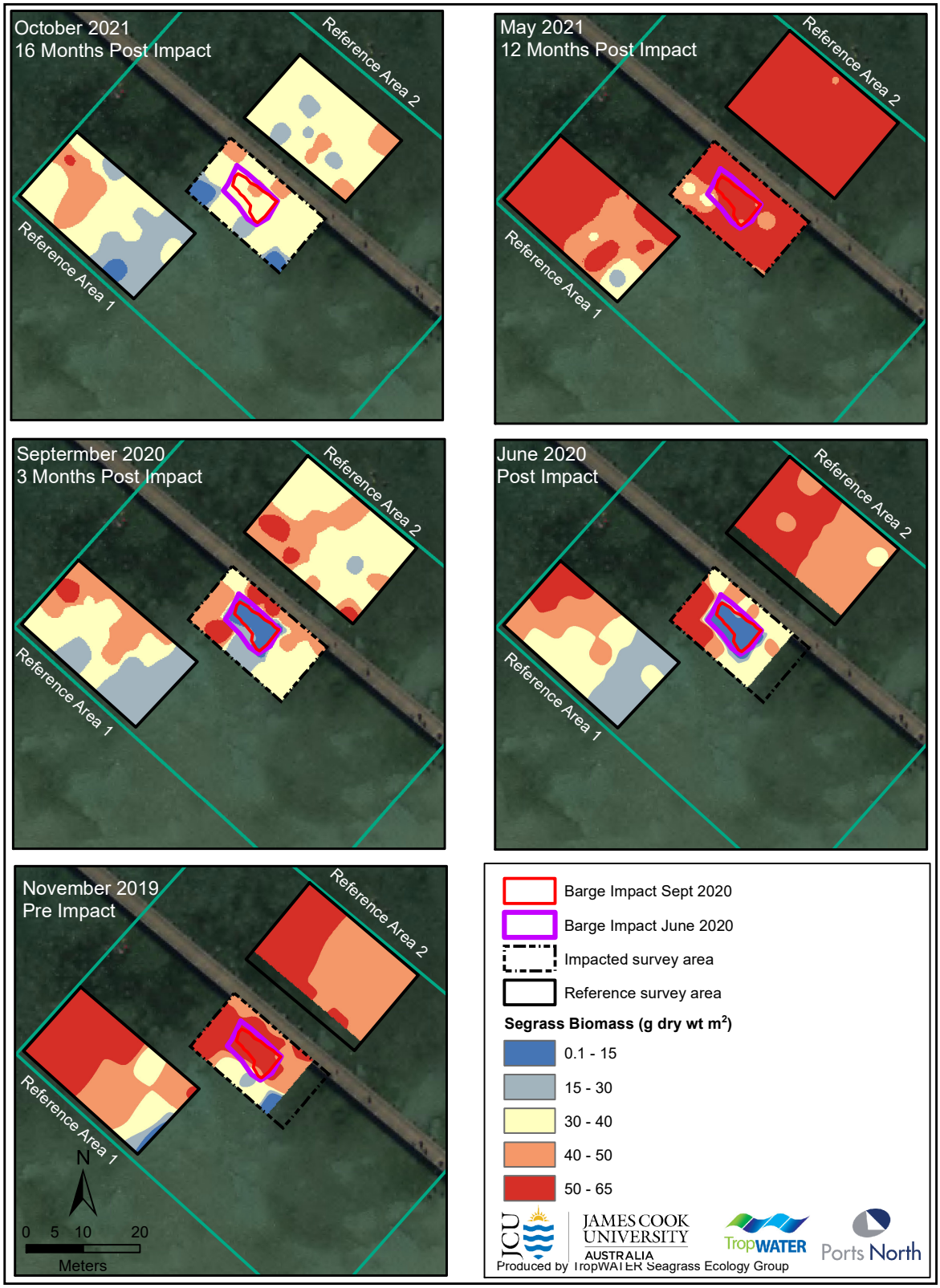

Figure 5. Seagrass biomass in the impact area and reference area in each of the survey periods from November 2019 before the barge impact until October 2021 16 months post barge impacts.

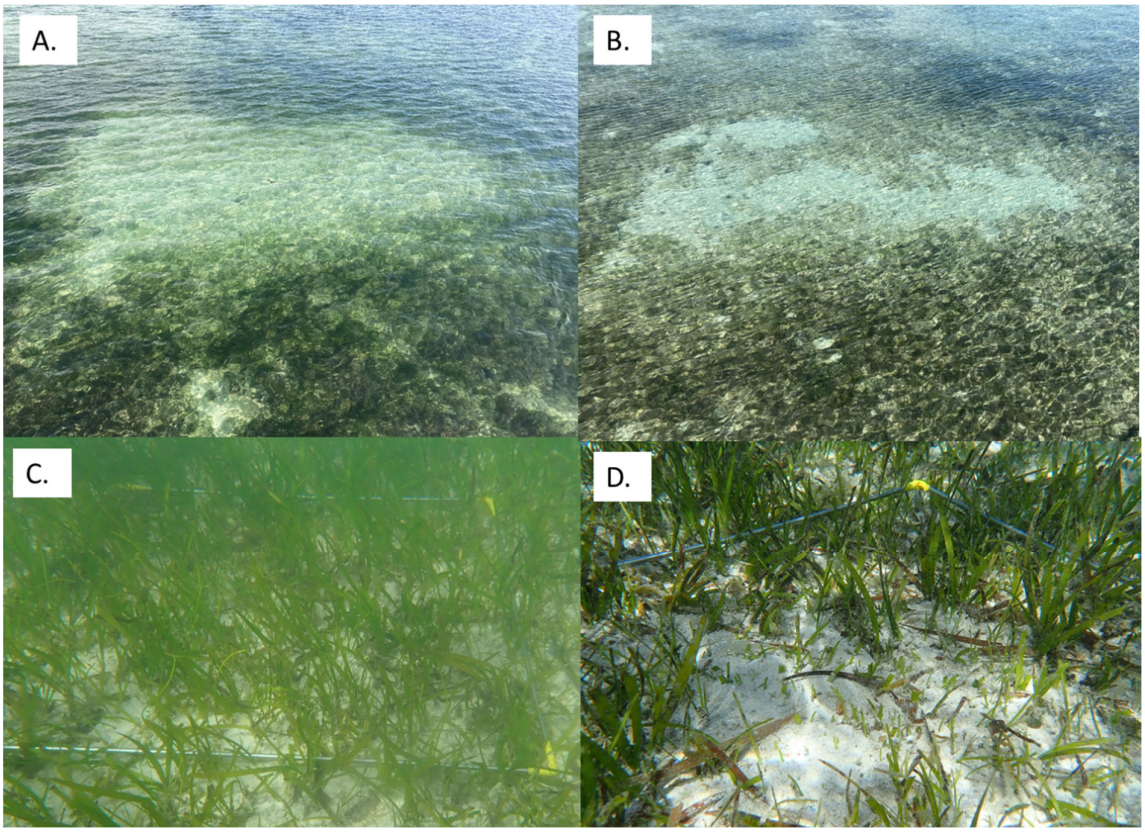

Figure 6. The area of seagrass disturbed by the barge immediately after barge removal (A), three months after barge removal (B), and seagrass quadrats from within the impacted area 12 (C) and 16 months after impact (D). Note the seagrass cropping from turtle herbivory in the seagrass 16 months after impact (D)

Seagrass loss from the moored barge during jetty repair works has recovered after 12 months and there have been no obvious legacy effects of the barge impacts after 16 months. Disturbed seagrass can take months to years to recover to pre-disturbance conditions depending on the size and type of disturbance (Rasheed 2000, 2004). Loss of above ground biomass can recover quickly via shoot regeneration or rhizome extension into disturbed habitats but may take extended periods (years) to recover if rhizomes have been removed or sediment conditions altered (Rasheed 2004, Smith et al. 2016). Rhizome extension from the surrounding meadow is the most likely method of recovery for the disturbed site. The perimeter of the damaged area was the first to be recolonised after three months and continued rhizome extension and growth allowed the seagrass to fully recover within 12 months (Smith et al. 2020).

Seagrass has not only recolonised the denuded area via rhizome extension but has recovered biomass and species composition to the same levels as the reference blocks. The return of seagrass to reference biomass and species compositions over multiple monitoring periods demonstrates an absence of any ongoing or residual effect from the disturbance from the barge. No further monitoring is recommended as the seagrass has now recovered within the period initially predicted. Consistent monitoring of the impacted area has provided an insight into seagrass recovery dynamics on Green Island and demonstrated the ability of seagrass to recover unassisted from small scale disturbances within meadows with the timeframe consistent with previous small scale disturbance experiments conducted in the Green Island seagrass meadow (Rasheed 2004).

4. References

Bryant, CV, Wells, JN & Rasheed, MA 2019, 'Port of Townsville Annual Seagrass Monitoring Survey: October 2018,' James Cook University Publication, Centre for Tropical Water & Aquatic Ecosystem Research (TropWATER), Cairns, 47 pp.

Kirkman, H. 1978. Decline of seagrass in northern areas of Moreton Bay, Queensland. Aquatic Botany, 5: 63-76.

Mellors, J E 1991. An evaluation of a rapid visual technique for estimating seagrass biomass. Aquatic Botany, 42: 67-73

Mellors, JE, Marsh, H and Coles, RG, 1993. Intra-annual changes in seagrass standing crop, Green Island, northern Queensland. Marine and Freshwater Research, 44(1), pp.33-41.

Rasheed, MA. 2000. Recovery and succession in north Queensland tropical seagrass communities. PhD thesis, James Cook University of North Queensland, Townsville.

Rasheed, MA. 2004. Recovery and succession in a multi-species tropical seagrass meadow following experimental disturbance: the role of sexual and asexual reproduction. Journal of Experimental Marine Biology and Ecology, 310: 13-45

Rasheed MA, Reason CL & Wells JN. 2019. Seagrass habitat of Cairns Harbour and Trinity Inlet: Annual Monitoring Report 2018. JCU Publication, Centre for Tropical Water & Aquatic Ecosystem Research Publication 19/13, Cairns, 50 pp.

Scott, AL, York, PH, Rasheed, MA. (2020). Green turtle (Chelonia mydas) grazing plot formation creates structural changes in a multi-species Great Barrier Reef seagrass meadow. Marine Environmental Research, 105183.

Smith, TM, York, PH, Macreadie, PI, Keough, MJ, Ross, DJ and Sherman, CDH. 2016. Recovery pathways from small-scale disturbance in a temperate Australian seagrass. Marine Ecology Progress Series 542: 97-108.

Smith TM, van de Wetering C, York PH, Rasheed MA (2020) Green Island jetty repairs seagrass monitoring – Three months post-disturbance, September 2020, JCU Centre for Tropical Water and Ecosystem Research, Cairns, Report 20/38