Benthic marine habitat of the Skardon River mouth, May 2010

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# TABLE OF CONTENTS

EXECUTIVE SUMMARY .................................................................................................................1

INTRODUCTION .............................................................................................................................2

METHODS .......................................................................................................................................3

Survey Approach..................................................................................................................3

Habitat Characterisation....................................................................................................... 4

Habitat Mapping and Geographic Information System.........................................................5

RESULTS ........................................................................................................................................7

Seagrass Species, Distribution and Abundance .................................................................7

Algae and BMI Species, Distribution and Abundance..........................................................8

DISCUSSION..................................................................................................................................10

REFERENCES ...............................................................................................................................11
EXECUTIVE SUMMARY

This report details the findings of the 2010 survey for seagrass habitat in and around the mouth of the Skardon River. The survey included assessment of approximately 30km² of intertidal and shallow subtidal substrate. One seagrass species was identified that formed only a small community within the survey area. Other small seagrass meadows are known from previous surveys to exist further upstream within the Skardon River system. These meadows are all likely to be regionally important and also highly variable between both years and seasons. No significant algae or benthic macro-invertebrate communities were identified in the 2010 survey area.

The presence of seagrass communities in intertidal areas adjacent to port facilities and infrastructure in Skardon River has implications for port management. The fact that seagrass meadows exist within the port indicates that these important habitats can co-exist with well managed port activities and development. However, seagrass that was located in proximity to the river mouth may be vulnerable to the effects of turbidity associated with proposed channel development works. While these seagrasses are likely adapted to natural pulsed turbidity events, further increases associated with channel development works could potentially push communities beyond their tolerance. Effective planning to mitigate these potential impacts would be an important consideration. Factors such as the length of works windows, type of equipment and timing in which work occurs (i.e. state of tide) could potentially be manipulated to avoid significant impacts.

The information collected in this survey will feed directly into the formulation of impact assessment on marine flora and habitat forming benthos and can be used in the formation of appropriate mitigation strategies when planning for the proposed channel developments and long term viability of the shipping channel and capital works in the Skardon River port area.
INTRODUCTION

Far North Queensland Ports Corporation Ltd (Ports North) is investigating options for expanding existing port facilities in Skardon River to enhance service for a proposed mining operation north of Weipa. As part of the preliminary investigations for the project, a requirement to deepen the channel at the mouth of the Skardon River to facilitate shipping access has been identified. Prior to the commencement of any works for channel deepening, Ports North commissioned studies to identify and assess any significant marine habitats within the proposed works area to inform port management and project approval process. Previous surveys conducted by Fisheries Queensland further upstream and adjacent to the port facilities in Skardon River have identified significant areas of benthic habitat including seagrass and algae (Roelofs et al. 2002).

Other significant areas of seagrass and benthic habitat have also been previously identified nearby within both Port Musgrave (30km south) (Chartrand & Rasheed 2010) and the Port of Weipa (100km south) (Chartrand & Rasheed 2009). These types of habitat provide feeding grounds for dugong and turtle and are also important nursery grounds for juvenile commercial fisheries species. Benthic marine habitats, especially seagrass meadows, have the potential to be impacted by many of the activities associated with port development, including establishing new infrastructure such as a defined shipping channel. Despite this potential there are several examples on the Queensland coast where well managed port activities and productive seagrass communities can co-exist.

The Marine Ecology Group, a working group of Fisheries Queensland, was engaged by Ports North to conduct a survey of seagrass and habitat forming benthic macro-invertebrates (BMI) on the intertidal banks and subtidal channel area adjacent the mouth of the Skardon River in May 2010. The sampling approach was based on a need to establish baseline data on seagrass communities and other significant habitat forming BMI communities.
METHODS

Survey Approach

Sampling and mapping techniques applied were standard methodologies developed by the Fisheries Queensland Marine Ecology Group for assessing seagrass and benthic marine habitats in tropical environments. Techniques take into account the spatial variability and patchiness common for many tropical benthic communities as well as logistical issues associated with naturally high water turbidity and the presence of dangerous marine creatures including saltwater crocodiles. The mapping and monitoring approach developed by Fisheries Queensland has been highlighted as an example of world best practice for assessing seagrasses in dredging programs (Erftemeijer & Lewis 2006). The methods are also used as part of baseline and long term monitoring programs throughout Queensland including Karumba, Thursday Island, Cairns, Townsville, Weipa, Mourilyan Harbour Port Musgrave and Gladstone (see (Rasheed et al. 2001); (Rasheed et al. 2002); (Campbell et al. 2003); (Rasheed & Taylor 2007); (Chartrand & Rasheed 2009); (Sankey et al. 2009); (Chartrand & Rasheed 2010); (Thomas et al. 2010)). This enables direct comparisons of the results from Skardon River with other Queensland locations.

The survey area encompassed approximately 30km² of intertidal and shallow subtidal areas in and around the mouth of the Skardon River. This level of coverage was deemed sufficient to provide an accurate description of any significant benthic habitats likely to be impacted by a proposed channel development program. More intense sampling was conducted within the specific 1.5km² footprint proposed for works. This survey focused on identifying benthic marine flora and fauna habitats and did not attempt to characterise the mangrove fringe found at the edges of the survey extent, or any reef habitats located outside of the survey area at the mouth of the Skardon River.

Two mapping and sampling techniques were used to collect marine habitat data:

1. **Helicopter aerial surveys**

   Intertidal habitat boundaries and characteristics were determined using a helicopter around spring low tides when habitats were exposed. Habitat boundaries were flown directly over at low speed at a height between 10m and 100m while the position of the meadow edge was fixed using a Global Positioning System (GPS). Habitat characteristics and composition were determined by observers in a helicopter hovering over the habitat at a height of <2m while the position was fixed using a GPS, accurate to ±5m. The position of submerged areas likely to contain seagrass and other benthic communities was also noted to help focus efforts during subtidal surveys. Habitat characteristics were determined at sites located approximately 50m to 500m apart. A higher density of sites was used in areas of high habitat complexity to ensure accurate community characterisation and to determine habitat area boundaries.

2. **Subtidal underwater camera surveys**

   In shallow subtidal areas unable to be surveyed by helicopter, an underwater CCTV camera system was used to assess habitat characteristics. The camera was deployed to the seabed and provided real-time footage to a monitor observed on the vessel. A Van Veen grab (grab area 0.0625m²) was used at sites to confirm seagrass and benthic species and surface sediment characteristics. Habitat characterisation sites were spaced throughout the survey area and were located from 50m to 750m apart. A high density of sites was used throughout deeper parts of the survey area to ensure accurate identification of any subtidal habitat communities. When habitats were identified, characterisation sites were located on either side of a site where a particular community type was present (e.g. seagrass). This technique ensures sites are identified just outside of a habitat boundary as well as inside to define subtidal habitat boundaries more precisely.
Habitat Characterisation

Habitat characterisation sites assessed as part of the helicopter and subtidal camera surveys encompassed a circular area of the substratum of approximately 10m$^2$. The position of each site was recorded using GPS (accurate to ±5.0m). Survey details including time, depth below mean sea level (MSL; boat-based surveys only), the observer and sediment type were recorded at each site. While methods of observing habitat characterisation sites varied (i.e. helicopter or observer/camera), information collected at each site was consistent. The site was characterised by assessments of three random deployments of a 0.25m$^2$ quadrat.

Seagrass

At sites where seagrass was present the seagrass species composition, seagrass above ground biomass, and percent cover were recorded. Seagrass above ground biomass was determined using a modified "visual estimates of biomass" technique (Mellors 1991); (Rasheed 1999); (Rasheed 2004); (Rasheed et al. 2008). This technique involves an observer ranking seagrass biomass in the field in three random placements of a 0.25m$^2$ quadrat at each site. Ranks were made in reference to a series of quadrat photographs of similar seagrass habitats for which the above ground biomass has previously been measured. The relative proportion of the above ground biomass (percentage) of each seagrass species within each survey quadrat was also recorded. Field biomass ranks were then converted into above ground biomass estimates in grams dry weight per square metre (g DW m$^{-2}$). At the completion of sampling, the observer ranked a series of photo calibration quadrats that represented the range of seagrass biomass in the survey area. The photographs of calibration quadrats were previously harvested and the actual biomass determined in the laboratory. A regression of ranks and biomass from these calibration quadrats was generated for the observer and applied to the field survey data to determine above ground biomass estimates.

The presence or absence of seagrass at each site was defined by the above ground biomass. Survey sites with no seagrass can be found within meadows because seagrass cover within meadows is not always uniform and may be patchy and contain bare gaps or scars. In addition, a visual estimate was made of the overall percent cover of seagrass at each site.

Algae

At sites where macro-algae were present, they were identified into the following five functional groups:

- Erect macrophytes - Macrophytic algae with an erect growth form and high level of cellular differentiation e.g. *Sargassum*, *Caulerpa* and *Galaxaura* species
- Erect calcareous - Algae with erect growth form and high level of cellular differentiation containing calcified segments e.g. *Halimeda* species
- Filamentous - Thin thread-like algae with little cellular differentiation
- Encrusting - Algae growing in sheet like form attached to substrate or benthos e.g. coralline algae
- Turf Mat - Algae that forms a dense mat or "turf" on the substrate

At each site, a visual estimate was made of the overall percent cover of algae as well as the relative proportion of the total cover made up of each of the five algal functional groups. All sites within a mapped algae region were grouped to provide a mean percent cover of algae for that region.
Benthic macro-invertebrates (BMI)

At sites where habitat forming BMI were present, they were identified into the following four broad taxonomic groups:

- Hard corals - All massive, branching, tabular, digitate and mushroom scleractinian corals
- Soft corals - All alcyonarian corals i.e. corals lacking a hard limestone skeleton
- Sponges - All sponges were grouped together
- Other BMI - Any other BMI identified e.g. oysters, ascidians, bivalves, gastropods and holothurians

At each site, a visual estimate was made of the overall percent cover of each of the BMI broad taxonomic groups.

Habitat Mapping and Geographic Information System

Spatial data from the field surveys were incorporated into the DEEDI Geographic Information System (GIS) database. Three GIS layers were created:

1. Habitat characterisation sites
   Site data containing above ground biomass, depth below mean sea level (MSL) (for subtidal sites), sediment type, time, Global Positioning System (GPS) fixes and sampling technique.

2. Seagrass meadow characteristics
   Area data for seagrass meadows with summary information on meadow characteristics. Seagrass community types were determined according to species composition from nomenclature developed for seagrass meadows of the Queensland region (Table 1). Abundance categories (light, moderate, dense) were assigned to community types according to above ground biomass of the dominant species (Table 2).

3. Seagrass landscape category
   Area data showing the seagrass landscape category determined for each meadow:

   - **Isolated seagrass patches**
     The majority of area within the meadows consisted of unvegetated sediment interspersed with isolated patches of seagrass

   - **Aggregated seagrass patches**
     Meadows are comprised of numerous seagrass patches but still feature substantial gaps of unvegetated sediment within the meadow boundaries

   - **Continuous seagrass cover**
     The majority of area within the meadows comprised of continuous seagrass cover interspersed with a few gaps of unvegetated sediment
Table 1  Nomenclature for the seagrass community type in Skardon River mouth, May 2010

<table>
<thead>
<tr>
<th>Community type</th>
<th>Species composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species A</td>
<td>Species A is 90-100% of composition</td>
</tr>
<tr>
<td>Species A with mixed species</td>
<td>Species A is 50-90% of composition</td>
</tr>
<tr>
<td>Species A/Species B</td>
<td>Species A is 40-60% of composition</td>
</tr>
</tbody>
</table>

Table 2  Abundance categories and mean above ground biomass ranges used in determining seagrass community density in Skardon River mouth, May 2010

<table>
<thead>
<tr>
<th>Abundance</th>
<th>Mean above ground biomass (g DW m⁻²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>Halodule uninervis</em> (narrow)</td>
</tr>
<tr>
<td>Light</td>
<td>&lt; 1.0</td>
</tr>
<tr>
<td>Moderate</td>
<td>1.0 – 4.0</td>
</tr>
<tr>
<td>Dense</td>
<td>&gt; 4.0</td>
</tr>
</tbody>
</table>

Meadows were also assigned a mapping precision estimate (in metres) based on mapping methodology utilised for that meadow (Table 3). The mapping precision for the intertidal seagrass meadow in Skardon River mouth was ±5m. The mapping precision estimate was used to calculate a range of meadow area for that meadow and was expressed as a meadow reliability estimate (R) in hectares. Additional sources of mapping error associated with digitising and rectifying aerial photographs onto base maps and with GPS fixes for survey sites were embedded within the meadow reliability estimate.

Table 3  Mapping precision and methodology for the seagrass meadow in Skardon River mouth, May 2010

<table>
<thead>
<tr>
<th>Mapping precision</th>
<th>Mapping methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤5m</td>
<td>Meadow boundaries mapped in detail by GPS from helicopter</td>
</tr>
<tr>
<td></td>
<td>Intertidal meadows completely exposed or visible at low tide</td>
</tr>
<tr>
<td></td>
<td>Relatively high density of mapping and survey sites</td>
</tr>
<tr>
<td></td>
<td>Recent aerial photography aided in mapping</td>
</tr>
</tbody>
</table>
RESULTS

Seagrass Species, Distribution and Abundance

Seagrass habitat surveys of the Skardon River mouth were conducted between April 30th and May 2nd, 2010. One seagrass species was identified within the Skardon River mouth survey area (Figure 1).

Family CYMODOCEACEAE Taylor:

*Halodule uninervis* (narrow leaf morphology) (Forsk.) Aschers. in Boissier

![Halodule uninervis (narrow) and wide leaf](image)

Figure 1  *Halodule uninervis* (narrow) identified in Skardon River mouth, May 2010

A total of 230 seagrass habitat characterisation sites were surveyed within the Skardon River mouth survey area (Map 1). The majority of these sites were comprised of open substrate on sediments dominated by sand or sand and shell. Only one isolated seagrass community type was identified at the north eastern extremity of the survey area that covered an area of 1.0 ± 0.3 ha (Map 1; Table 4). This intertidal seagrass community was comprised entirely of *Halodule uninervis* (narrow leaf morphology) and occurred on sediment dominated by mud and sand.

Mean above ground biomass for the intertidal *Halodule uninervis* (narrow) meadow was dense at 11.10 ± 7.00 g DW m⁻². Although only occurring as an isolated community, cover for this seagrass meadow was continuous along the section of intertidal bank it occupied. No dugong feeding activity was observed on this meadow despite this species being a preferred food source for dugong.
Table 4  Seagrass community type, mean above ground biomass and area in Skardon River mouth, May 2010

<table>
<thead>
<tr>
<th>Meadow ID</th>
<th>Community type</th>
<th>Species present</th>
<th>Mean meadow biomass (g DW m(^{-2})) ± SE</th>
<th>Area ± R (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dense <em>Halodule uninervis</em> (narrow)</td>
<td><em>Halodule uninervis</em> (narrow)</td>
<td>11.10 ± 7.00</td>
<td>1.0 ± 0.3</td>
</tr>
</tbody>
</table>

Algae and BMI Species, Distribution and Abundance

Algae formed a very low percent coverage (≤1%) of the benthos in both intertidal and subtidal areas throughout the Skardon River mouth survey area. The only functional groups present were filamentous, turf and a minor percentage of erect macrophytic algae. Filamentous algae beds formed a thin film at several sites on the intertidal sand banks but did not represent a significant habitat or community group to be mapped and considered in further analysis. No significant BMI groups were identified within the survey area.
Map 1. Location of coastal seagrass habitat characterisation sites and seagrass meadows in the Skardon River survey area, May 2010

DISCUSSION

Halodule uninervis (narrow) was the only seagrass species identified within the Skardon River mouth survey area and formed only a minor community on one section of intertidal river bank. Other areas of seagrass meadows dominated by Halodule uninervis (narrow) have previously been identified on intertidal banks further upstream in Skardon River (Roelofs et al. 2002); (Coles et al. in prep.). There are also potentially seagrass meadows much closer to the proposed works area at the river mouth as the subtidal areas of the river between the current survey area and the immediate area around the barge landing (4 km upstream) have not been surveyed and may well contain seagrass meadows. The confirmed presence of seagrass meadows throughout the Skardon River system suggests seagrass distribution in this system is variable between years and perhaps seasons. Halodule uninervis meadows have been found to be variable in other locations on western Cape York, such as the Love and Kirke Rivers (Rasheed 2000). Long term monitoring over several years of Halodule uninervis (narrow) meadows at Weipa have also indicated high variability in cover and biomass between years and seasons. More recently, baseline surveys of seagrass meadows in nearby Port Musgrave have indicated seasonal variations in biomass for intertidal Halodule uninervis (narrow) meadows (Chartrand & Rasheed 2010). These meadows appear to be susceptible to impact following high rainfall events that commonly occur in the region. Halodule uninervis is capable of producing long-lived seeds that can lay dormant in the sediments (McMillan 1981). This “seed bank” may allow recovery of these meadows during favourable conditions for seagrass growth. It is likely that parts of the Skardon River may contain a viable seed bank.

Seagrass meadows form a valuable component of the marine ecosystems in regions of the western Cape York area including Skardon River and nearby Weipa and Port Musgrave. These seagrass meadows contain species important as a food resource for dugong and turtle as well as meadows known to support commercial fisheries species. Although no evidence of dugong feeding activity was identified on the seagrass meadow in the Skardon River survey area, dugongs are known to utilise the Skardon River and have previously been observed well upstream adjacent the Skardon River port facilities (Roelofs et al. 2002).

Seagrasses can be impacted by a range of port activities including the effects of channel development. Development of deep channels can impact seagrasses by: 1) direct removal; 2) burial by spoil material; and 3) increased turbidity as a result of re-suspended sediments and ship movements (Cabaço et al. 2008), (Erftemeijer & Lewis 2006). The severity of impacts on seagrasses is affected by the intensity and duration of the activity, as well as the natural physical and environmental conditions of the area (Carruthers et al. 2002). While seagrasses were not found in the direct footprint of the potential Skardon River shipping channel, seagrasses further upstream are potentially at risk from increased turbidity associated with proposed works. Turbid plumes can negatively impact on seagrasses (due to low light levels) when the turbidity levels are significantly greater and more prolonged than natural variation (Erftemeijer & Lewis 2006), (Orpin et al. 2004). Effective ways to mitigate the intensity and length of seabed disturbance related turbidity could be employed to protect seagrasses. Mitigation options may include but are not limited to shortening the campaign window and working during an ebbing spring tide to flush re-suspended sediments from the area. Seagrasses in the Skardon River area are likely to be subjected to periods of naturally high turbidity associated with high wind and wave action as well as pulses of high turbidity from wet season flooding. It is probable then, that seagrasses in the area are adapted to pulsed high turbidity events and would have a reasonable resilience to turbidity associated with channel development works, particularly if effective mitigation strategies for the proposed works are employed.
REFERENCES


