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Moa Island Seagrass Baseline Survey

February 2011



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Background

Local island communities in the Torres Strait are deeply connected to their sea country through their culture, economy, spirituality and social way of life. The health of their marine resources has been, and continues to be, vital to Torres Strait Islanders from a subsistence and cultural point of view. The Torres Strait Regional Authority Land and Sea Management Unit (TSRA LSMU) is focused on addressing environmental priorities through the establishment of an Indigenous Land and Sea Ranger Program. The program aims to engage rangers in delivering land and sea management initiatives in their region. The ranger program has been established in seven Torres Strait communities, with Moa Island (Kubin and St Pauls) joining in 2011.

The importance of seagrasses as structural components of coastal ecosystems is well recognised (Hemminga and Duarte 2000). Seagrass/algae meadows have been rated the third most valuable ecosystem globally (on a per hectare basis) for ecosystem services, preceded only by estuaries and swamps/flood plains (Costanza et al. 1997). Within Queensland, these meadows have been found to have a high value as nursery habitat for juvenile prawns and commercial fish (Coles et al. 1993; Watson et al. 1993), whilst providing critical food sources for endangered turtle and dugong populations.

Very little information is known on the distribution and abundance of important subtidal seagrass habitat around Moa Island, despite the value of these habitats as an important food source for culturally significant dugong and turtle. Subtidal seagrasses have been studied at nearby Mabuiag and Badu Islands and the Orman Reefs, where extensive coverage of highly diverse seagrasses were identified as some of the most important areas of seagrass habitat in the Torres Strait and Queensland for dugong (Rasheed et al. 2006; 2008; Chartrand et al. 2009; Taylor & Rasheed 2010). Additionally, the above-ground productivity of Orman Reef seagrass meadows was high compared with other tropical seagrass communities, indicating this habitat is of key importance to fisheries, dugong and turtle, and carbon cycling in the central Torres Strait (Rasheed et al. 2008).

The Moa Rangers and the TSRA LSMU has recognised the importance of seagrasses and have made establishing long-term subtidal seagrass monitoring a key priority of the local ranger program. To establish the program locally, good baseline information on the subtidal seagrass habitat around the island was required. A baseline survey provides important information on overall habitat diversity, areas considered of high environmental value and areas best suited for long-term monitoring by rangers.

The Fisheries Queensland Marine Ecology Group (MEG) in collaboration with the TSRA launched a program to deliver the baseline information on the marine habitat around Moa Island with a focus on subtidal seagrass communities. This information compliments mapping of the intertidal seagrasses that has been conducted by MEG/TSRA and the long-term ranger intertidal “Seagrass-Watch” program recently established at Kubin. Seagrasses are important in supporting local dugong and turtle populations in addition to being habitat and nursery grounds for a number of locally fished prawn and crayfish species. Little information is known regarding subtidal habitats around Moa Island and as a result our assessments focused on describing these areas.

The specific objectives of the present study were to:

1. Conduct a baseline survey of subtidal seagrass distribution and abundance around Moa Island; and
2. Identify a suitable area in which to establish a community long-term monitoring site.

Methods

The baseline survey was conducted between the 26th February and 2nd March 2011. Seagrasses are likely to be near their peak seasonal abundance at this time of year.

Sampling methods were designed based on the existing knowledge of seagrass distribution by local rangers and Traditional Owners. Physical characteristics of the area such as depth, visibility, logistical and safety constraints also influenced the methods chosen. Two sampling techniques were used:

1. Subtidal diver habitat characterisation
2. Subtidal underwater camera habitat characterisation

1. Subtidal diver habitat characterisation

In shallow areas (<10m) where the risk from dangerous marine animals was low, sites were examined by free diving observers swimming to the bottom. Seagrass habitat characteristics were determined at sites spaced 250-500m apart within transects. Transects were spaced from 1 to 3 km apart with a higher density of transects in areas of high habitat complexity. Additional sites were sampled between transects to check for seagrass habitat continuity.

2. Subtidal underwater camera habitat characterisation

In subtidal areas where water was too deep for effective sampling by free divers (>10m), or the risk from dangerous marine animals was high, an underwater CCTV camera system was used to assess seagrass habitat characteristics. The camera was deployed to the seabed and provided real-time footage to an observer on the boat. A Van Veen grab (grab area 0.0625 m^2) was used at sites to confirm seagrass species and sediment characteristics. Seagrass habitat characterisation sites were located on transects and between transects in the same manner as the shallow subtidal diver sites.

Habitat Characterisation Sites

Seagrass habitat characterisation sites encompassed a circular area of the substratum of approximately $10m^2$. The position of each site was recorded using a Global Positioning System (GPS) with a stated accuracy of ± 5m. While methods of observing habitat characterisation sites varied (diver/camera), information collected at each site was consistent. This included seagrass species composition, seagrass above-ground biomass, depth below mean sea level (MSL) and sediment type. Additional information on other habitat forming benthos was also recorded at all sites (algae cover, hard coral, soft coral, sponge and other benthic macro-invertebrates).

Seagrass above-ground biomass was determined using a modified “visual estimates of biomass” technique described by Mellors (1991). This technique involves an observer ranking seagrass biomass in the field in three $0.5m^2$ quadrats placed randomly 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. Three separate biomass ranges were used: low biomass, high biomass and an *Enhalus* range for sites dominated by the two largest species, *Enhalus acoroides* and *Thalassodendron ciliatum*. 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 each observer ranked a series of calibration quadrats that represented the range of seagrass biomass in the survey for each of the three biomass ranges. After ranking, seagrass in these quadrats was harvested and the actual biomass determined in the laboratory. A separate regression of ranks and biomass from these calibration quadrats was generated for each observer and applied to the field survey data to determine above-ground biomass estimates.

Seagrass Habitat Mapping and Geographic Information System

All survey data were entered into a Geographic Information System (GIS) for presentation of seagrass distribution and abundance. Rectified satellite images of Moa Island were used to assist with mapping. Other information including depth below mean sea level (dbMSL), substrate type, and the shape of existing geographical features such as reefs and channels was also interpreted and used in determining habitat boundaries.

Three types of GIS layers were created in ArcGIS® to describe Moa Island seagrasses:

- **Habitat characterisation sites** – point data containing percent cover of seagrass, above-ground biomass (for each species), algae and benthic macro-invertebrate percent cover and proportion of functional group, dbMSL, sediment type, time, latitude and longitude from GPS fixes, sampling method and any comments.
- **Seagrass meadow biomass and community types** – 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 Queensland (Table 1). Abundance categories (light, moderate, dense) were assigned to community types according to above-ground biomass of the dominant species (Table 2).
- **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 community types at Moa Island, 2011

Community type	Species composition
Species A	Species A is 90-100% of composition
Species A with Species B	Species A is 60-90% of composition
Species A with Species B/Species C	Species A is 50% of composition
Species A/Species B	Species A is 40-60% of composition

Table 2 Density categories and mean above-ground biomass ranges for each species used in determining seagrass community density at Moa Island, 2011

Density	Mean above-ground biomass (g DW m^{-2})				
	***H. uninervis* (narrow)**	***H. ovalis*, *H. decipiens***	***H. uninervis* (wide), *C. serrulata*, *C. rotundata*, *S. isoetifolium*, *T. hemprichii***	***H. spinulosa***	***E. acoroides*, *T. ciliatum***
Light	< 1	< 1	< 5	< 15	< 40
Moderate	1 - 4	1 - 5	5 – 25	15 - 35	40 - 100
Dense	> 4	> 5	> 25	> 35	> 100

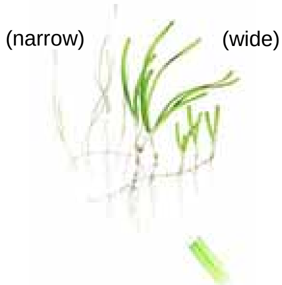
Each seagrass meadow was assigned a mapping precision estimate (±m) based on the mapping methodology utilised for that meadow as well as topographical changes in seafloor structure (i.e. reef tops versus deepwater channels) (Table 3). Mapping precision estimates ranged from 50m for isolated subtidal seagrass meadows to 100m for larger subtidal meadows. The mapping precision estimate was used to calculate a range of meadow area for each meadow and was expressed as a meadow reliability estimate (R) in hectares. Additional sources of mapping error associated with digitising aerial photographs onto base maps and with GPS fixes for survey sites were embedded within the meadow reliability estimates.

Table 3 Mapping precision and methodology for seagrass meadows at Moa Island, 2011

Mapping precision	Mapping methodology
50m	Meadow boundary interpreted from diver or camera/grab surveys; All meadows partially subtidal/adjoining intertidal seagrass meadows; Relatively high density of survey sites; Satellite imagery aided in mapping.
100m	Subtidal meadow boundaries determined from camera/grab surveys only; All meadows subtidal; Moderate density of survey sites; Satellite imagery aided in mapping.

Results & Discussion

A total of ten seagrass species (from two families) were identified in the survey area in February 2011:

Family	Species			
CYMODOCEACEAE Taylor	*Cymodocea serrulata* (R.Br.) Aschers and Magnus		*Cymodocea rotundata* Ehrenb. Et Hempr. Ex Aschers	
	Syringodium isoetifolium (Ashcers.) Dandy		*Halodule uninervis* (wide and narrow leaf morphology) (Forsk.) Aschers. in Boissier	
	Thalassodendron ciliatum (Forsk.) den Hartog		HYDROCHARITACEAE Jussieu: *Enhalus acoroides* (L.F.) Royle	
HYDROCHARITACEAE Jussieu	*Halophila decipiens* Ostenfield		*Halophila ovalis* (R. Br.) Hook. F.	
	Halophila spinulosa (R. Br.) Aschers. in Neumayer		*Thalassia hemprichii* (Ehrenb.) Aschers. in Petermann	

Two hundred and fifty three subtidal habitat characterisation sites were surveyed in February 2011. Seagrass was found at 42% of sites surveyed with most seagrass associated with shallow reef tops and shallow sandy substrata (Map 1). A combined area of 2910 ± 877 ha of subtidal seagrass habitat was mapped in 13 seagrass meadows as a result of the baseline survey (Map 1). This excludes seagrass meadows that had previously been identified by Taylor and Rasheed (2010) between Moa and Badu Islands. Meadow area ranged from 17.4 ha to 1076.3 ha, with the largest meadow covering the majority of the northern side of the island (Map 2). The densest seagrass meadows were located to the south and west of the survey area near the community of Kubin (Map 4). Most seagrass was found on substrates dominated by sand/shell, mud and reef substrates. No seagrass was found in depths greater than 16.4m dbMSL, however there were areas in which seagrass may have grown deeper that were outside of the survey boundary.

Six mixed species meadow types (of varying density) were identified in the survey limits (Maps 2-5). These were categorised according to each meadow's dominant species:

1. *Halophila spinulosa*
2. *Halophila spinulosa* with mixed species
3. *Halophila spinulosa*/*Halophila ovalis*
4. *Halophila ovalis*
5. *Thalassia ciliatum* with mixed species
6. *Cymodocea serrulata* with mixed species

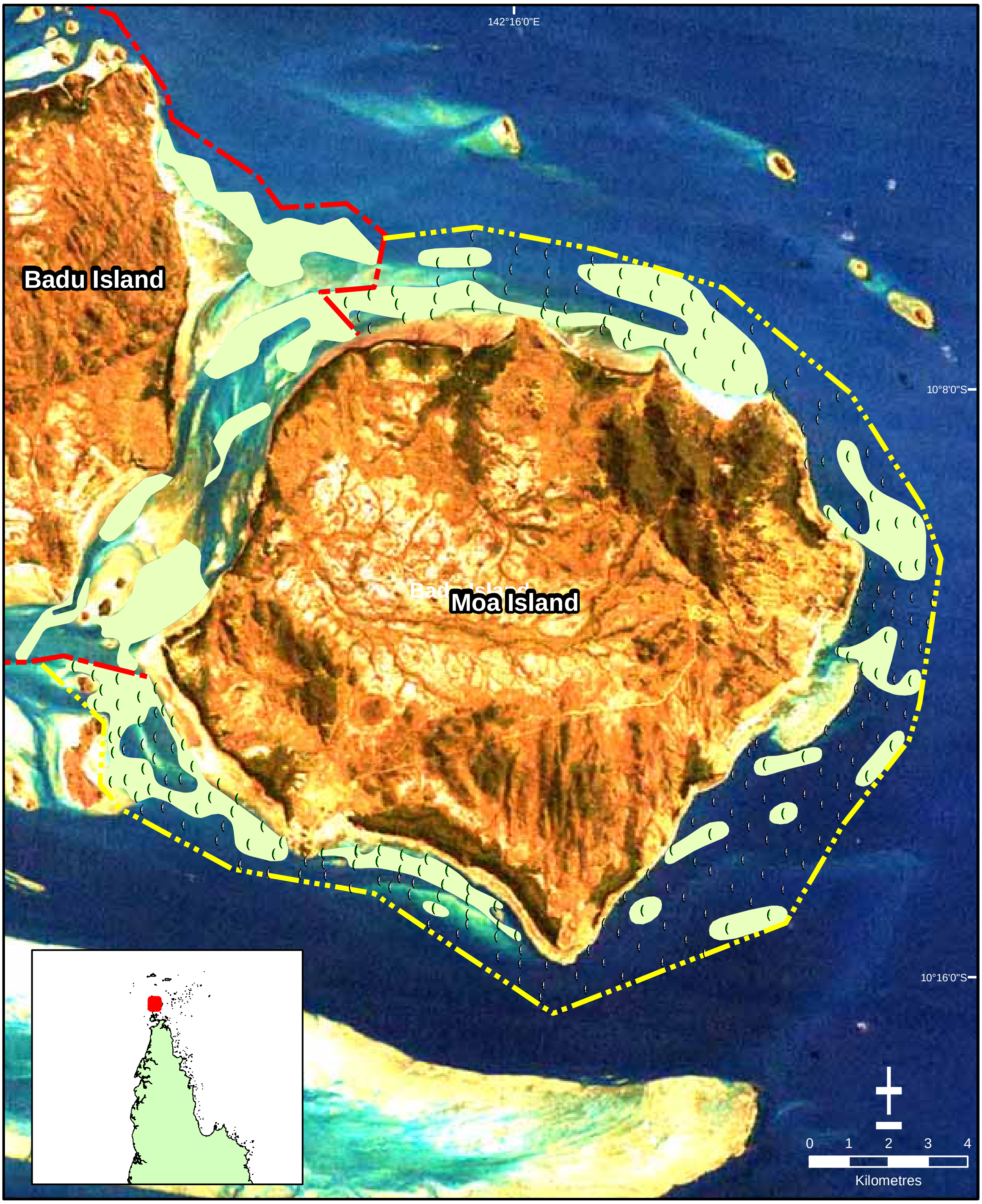
Seagrass meadows dominated by *Halophila spinulosa* and/or *Halophila ovalis* (with other species variants) were the most common type (87% of meadows) followed by *Thalassodendron ciliatum* and *Cymodocea serrulata* which dominated one meadow each (Table 4; Maps 2-5). The majority of meadows were isolated patches (80% of all meadows), followed by aggregated patches (20% of all meadows). No meadows had a continuous cover of seagrass. Mean above-ground biomass of seagrass meadows ranged from 0.03 ± 0.02 g DW m^{-2} in a small *Halophila ovalis* dominated meadow on the eastern side of the island near St Paul's community (Map 3, Table 4), to 23.25 ± 4.92 g DW m^{-2} in the moderate *Halophila spinulosa* meadow on the southern side of the island near Kubin community (Map 4, Table 4).

Other benthic taxa formed significant areas of habitat around Badu Island despite a large proportion of the substrate being open (i.e. bare sandy patches). Five structurally distinct types of algae (erect macrophytes, erect calcareous, filamentous, turf mat and encrusting), hard coral, soft coral, and sponge formed areas of benthic habitat on reef tops and in deeper channel areas.

Extensive coverage of seagrass also extended onto intertidal banks but details are not discussed in this subtidal seagrass report (locations are indicated on Maps 2-5). Detailed information on these intertidal seagrasses is in the atlas of habitats at risk from shipping in the Moa to Mabuiag Island region of the Torres Strait (Taylor et al*.* 2010) and No. 2 Reef to Mabuiag Reef region (Taylor et al. In prep).

The ideal location for a long-term subtidal seagrass monitoring site should have a good, consistent cover of seagrass year round, and include the range of species found within the region. With this in mind, there are two meadows on the south-western side of the island that are ideal, one of which is dominated by *Halophila spinulosa* and the other by *Thalassodendron ciliatum* (see highlighted meadows in Table 4; Map 4). Seagrass cover in these meadows is at its highest and biomass of the key species is dense. Close proximity to the island and the Kubin community makes these meadows especially appealing. Fisheries Queensland and TSRA LSMU will be working with local rangers to develop a monitoring program.

Map 1 Location of baseline 2011 seagrass assessment sites and seagrass meadows, Moa Island 2011



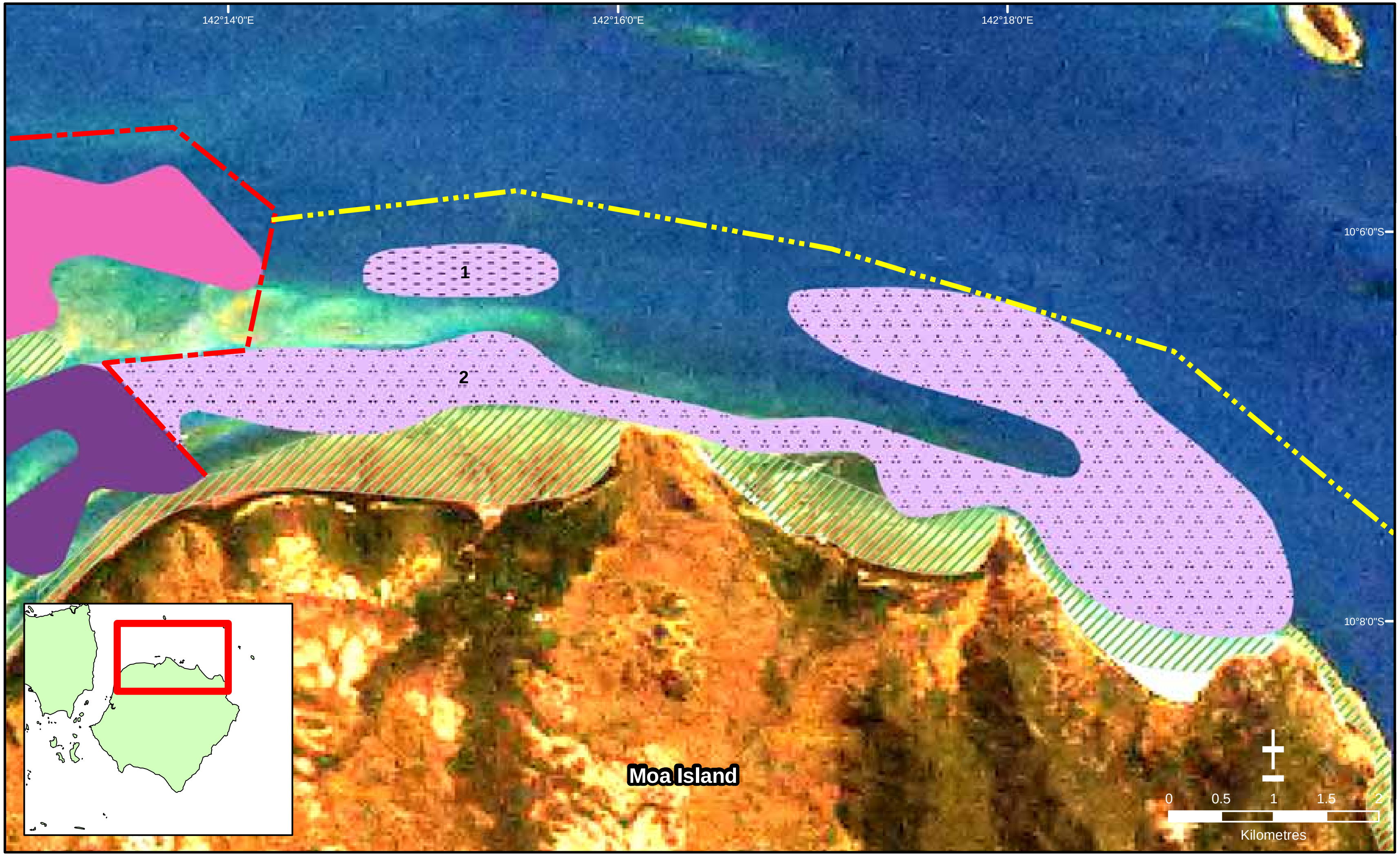
Legend

- Seagrass absent
- Seagrass present
- Subtidal seagrass meadows
- Moa Is subtidal survey boundary 2011
- Badu Is subtidal survey boundary 2010

Source:

Taylor, H.A. (2011). Moa Island Seagrass Baseline Survey, February 2011. DEEDI Publication (FisheriesQueensland, Northern Fisheries Centre, Cairns),

Map 2 Seagrass meadow location, cover type and composition, northern side of Moa Island 2011



Legend

- Aggregated patches
- Isolated patches
- Light *Halodule uninervis* (wide) with mixed species
- Moderate *Thalassia hemprichii* with mixed species
- Light *Halophila spinulosa* with mixed species
- Intertidal seagrass meadows 2010 and 2011
- Moa Is subtidal survey boundary 2011
- Badu Is subtidal survey boundary 2010

Source:

Taylor, H.A. (2011). Moa Island Seagrass Baseline Survey, February 2011. DEEDI Publication (FisheriesQueensland, Northern Fisheries Centre, Cairns),

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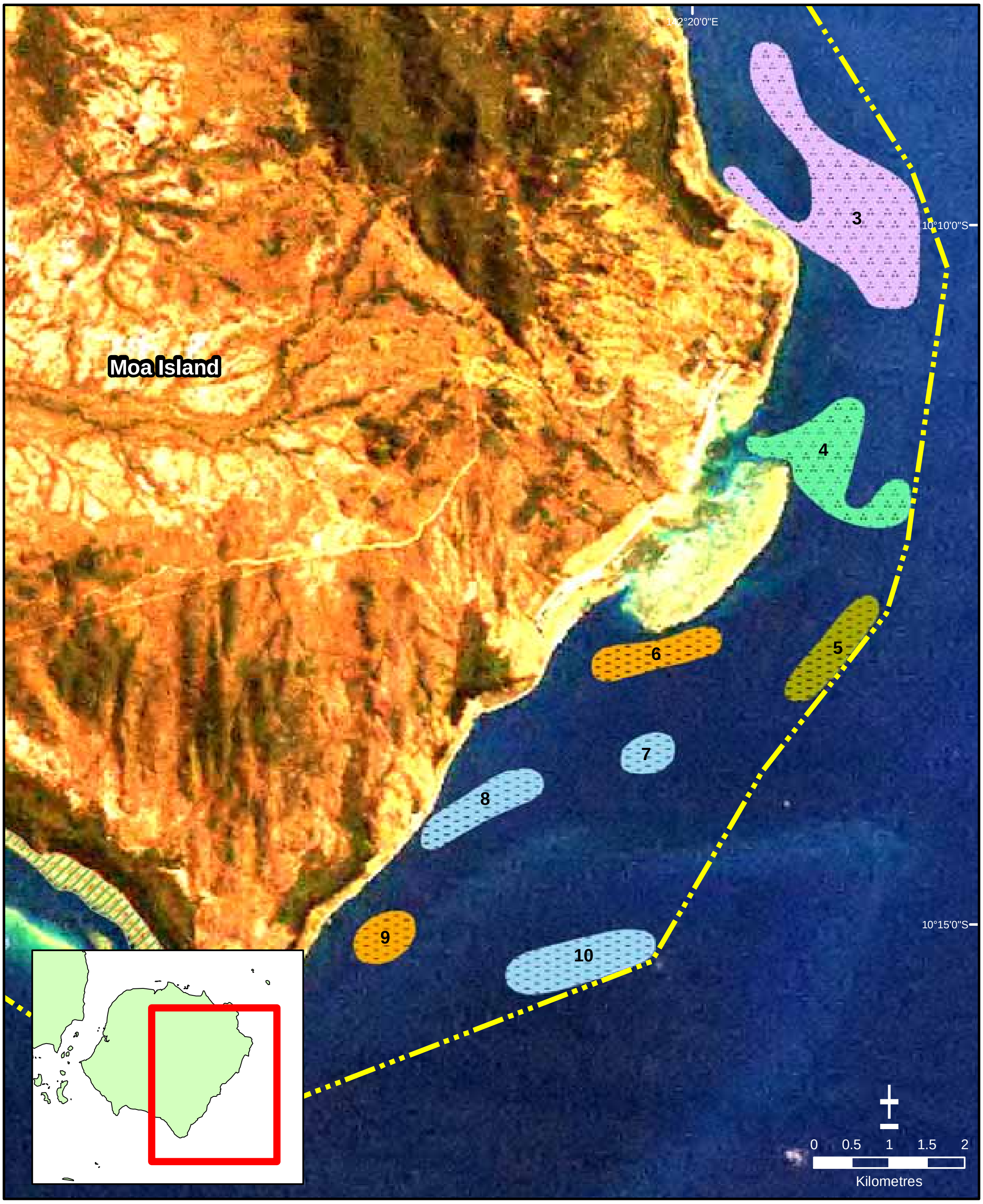
Map 3 Seagrass meadow location, cover type and composition, south-eastern side of Moa Island 2011



Legend

Aggregated patches

Isolated patches

Light *Cymodocea serrulata* with mixed species

Light *Halophila ovalis*

Light *Halophila spinulosa*

Light *Halophila spinulosa* with mixed species

Light *Halophila spinulosa/Halophila ovalis*

Intertidal seagrass meadows 2010 and 2011

Moa Is subtidal survey boundary 2011

Source:
Taylor, H.A. (2011). Moa Island Seagrass Baseline Survey, February 2011. DEEDI Publication (FisheriesQueensland, Northern Fisheries Centre, Cairns),

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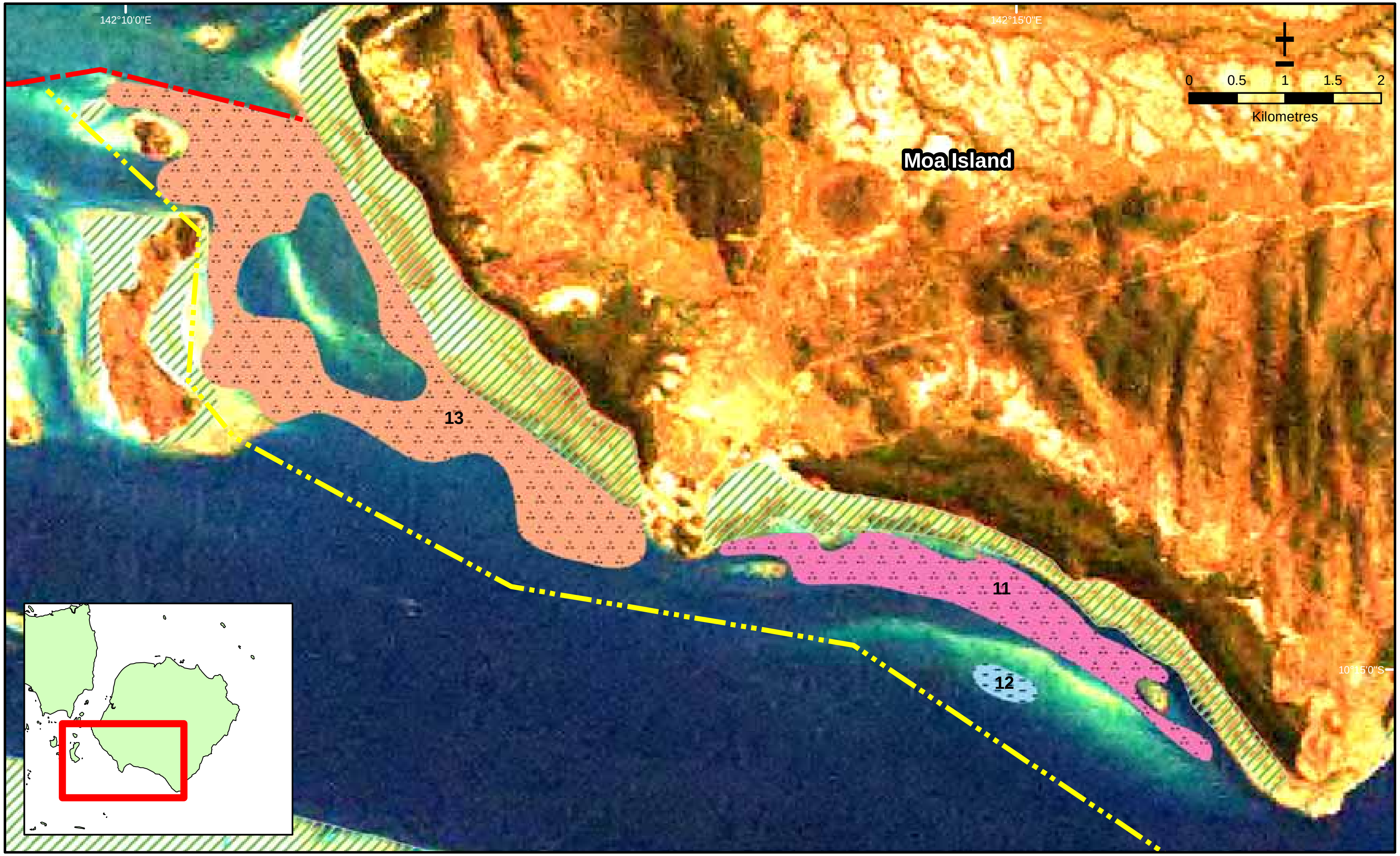
Map 4 Seagrass meadow location, cover type and composition, south-western side of Moa Island 2011



Legend

- Aggregated patches
- Isolated patches
- Light *Halophila spinulosa/Halophila ovalis*
- Light *Thalassodendron ciliatum* with mixed species
- Moderate *Halophila spinulosa* with mixed species
- Intertidal seagrass meadows 2010 and 2011
- Moa Is subtidal survey boundary 2011
- Badu Is subtidal survey boundary 2010

Source:

Taylor, H.A. (2011). Moa Island Seagrass Baseline Survey, February 2011. DEEDI Publication (FisheriesQueensland, Northern Fisheries Centre, Cairns),

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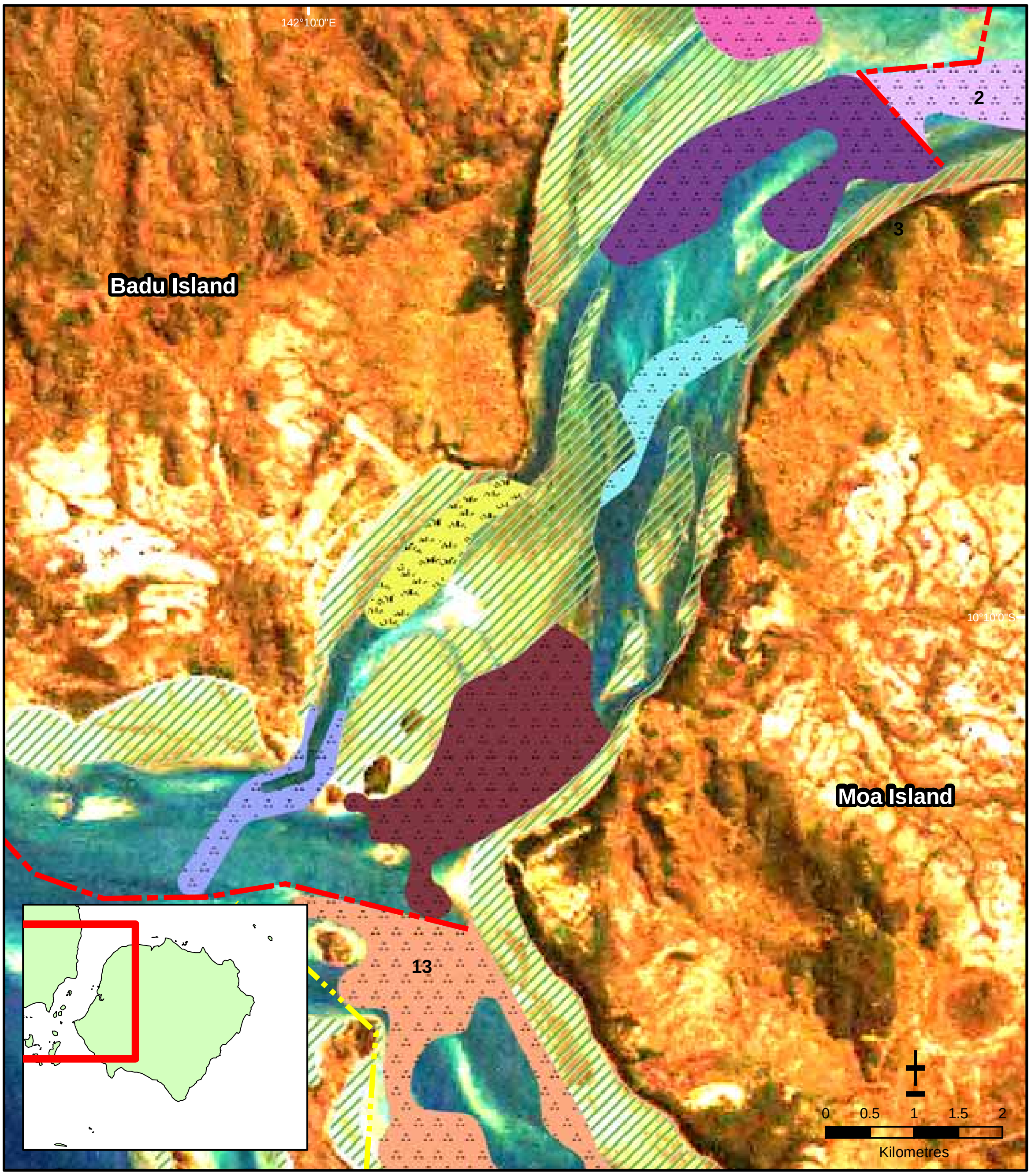
Map 5 Seagrass meadow location, cover type and composition, north-western side of Moa Island 2011



Legend

- Aggregated patches
- Continuous cover
- Isolated patches
- Light *Halophila spinulosa* with mixed species
- Light *Thalassodendron ciliatum* with mixed species
- Light *Halodule uninervis* (wide) with mixed species
- Light *Thalassodendron ciliatum* with *Enhalus acoroides/Cymodocea rotundata*
- Moderate *Cymodocea serrulata* with *Enhalus acoroides*
- Moderate *Cymodocea serrulata* with *Thalassodendron ciliatum*
- Moderate *Cymodocea serrulata* with mixed species
- Moderate *Thalassia hemprichii* with mixed species
- Intertidal seagrass meadows 2010 and 2011
- Moa Is subtidal survey boundary 2011
- Badu Is subtidal survey boundary 2010

Source:
Taylor, H.A. (2011). Moa Island Seagrass Baseline Survey, February 2011. DEEDI Publication (FisheriesQueensland, Northern Fisheries Centre, Cairns),

Table 4 Community type, species present, mean above-ground meadow biomass, total meadow area and number of sampling sites for 13 seagrass meadows surveyed at Moa Island in 2011. Shaded meadows are those recommended for long term monitoring.

Meadow ID	Community type	Species present	Mean meadow biomass (g DW m^{-2} ± SE)	Area ± R (ha)	No. of sites
1	Light *Halophila spinulosa* with mixed species	*C. serrulata, H. uninervis* (thin), *H. uninervis* (wide), *H. ovalis, H. spinulosa*	3.29 ± 2.93	81.54 ± 21.65	2
2	Light *Halophila spinulosa* with mixed species	*T. hemprichii, C. rotundata, C. serrulata, H. uninervis* (thin), *H. uninervis* (wide), *S. isoetifolium, H. ovalis, H. spinulosa*	8.79 ± 1.92	1076.27 ± 329.17	31
3	Light *Halophila spinulosa* with mixed species	*C. serrulata, H. ovalis, H. spinulosa*	1.40 ± 0.81	341.11 ± 59.72	9
4	Light *Cymodocea serrulata* with mixed species	*C. serrulata, H. uninervis* (thin), *H. ovalis, H. spinulosa*	4.27 ± 2.90	154.54 ± 36.97	6
5	Light *Halophila spinulosa*	*H. spinulosa*	0.45 ± 0.39	68.57 ± 20.24	2
6	Light *Halophila ovalis*	*H. ovalis*	0.03 ± 0.02	66.73 ± 20.68	2
7	Light *Halophila spinulosa/ Halophila ovalis*	*H. ovalis, H. spinulosa*	0.05 ± 0	30.81 ± 10.96	1
8	Light *Halophila spinulosa/ Halophila ovalis*	*H. ovalis, H. spinulosa*	0.04 ± 0.03	72.87 ± 21.14	2
9	Light *Halophila ovalis*	*H. ovalis*	0.04 ± 0	42.57 ± 12.75	1
10	Light *Halophila spinulosa/ Halophila ovalis*	*H. ovalis, H. spinulosa*	0.05 ± 0.02	104.87 ± 23.74	2
11	Moderate *Halophila spinulosa* with mixed species	*E. acoroides, C. rotundata, C. serrulata, H. uninervis* (wide), *T. ciliatum, S. isoetifolium, H. ovalis, H. spinulosa*	23.25 ± 4.92	222.82 ± 64.03	17
12	Light *Halophila spinulosa/ Halophila ovalis*	*H. ovalis, H. spinulosa*	2.11 ± 0	17.44 ± 9.15	1
13	Light *Thalassodendron ciliatum* with mixed species	*E. acoroides, T. hemprichii, C. rotundata, C. serrulata, H. uninervis* (thin), *H. uninervis* (wide), *T. ciliatum, S. isoetifolium, H. ovalis, H. spinulosa, H. decipiens*	20.32 ± 3.13	630.08 ± 247.01	28
TOTAL				**2910.22 ± 877.21**	**104**

Conclusion

The baseline survey of subtidal seagrasses around Moa Island was the most comprehensive assessment of seagrass distribution and abundance that has been conducted for the area. Moa Island's healthy, productive subtidal seagrasses are important as they exist in a relatively pristine environment and are likely to support significant dugong and turtle populations. The large areas of dense seagrass meadows are also likely to be an important source of primary production for the marine ecosystem. The baseline survey presented here will provide a reference point to establish a Ranger long-term monitoring program in future years to assess changes to seagrasses. This information will allow an assessment of natural and anthropogenic causes of seagrass change, and will be incorporated into local dugong and turtle management plans to assist in development of effective management options to protect this valuable ecosystem.

References

Chartrand KM, Taylor HA, Rasheed MA (2009). Mabuiag Island seagrass baseline survey, March/May 2009. DEEDI Publication (QPIF, Northern Fisheries Centre, Cairns), 10pp.

Coles RG, Lee-Long WJ, Watson RA, Derbyshire KJ (1993). Distribution of seagrasses, and their fish and penaid prawn communities, in Cairns Harbour, a tropical estuary, Northern Queensland, Australia. Australian Journal of Marine and Freshwater Research **44**: 193-210.

Costanza R, d'Arge R, de Groot R, Farber S, Grasso M, Hannon B, Limburg K, Naeem S, O'Neil RV, Paruelo J, Raskin RG, Sutton P, van der Belt M (1997). The value of the world's ecosystem services and natural capital. Nature **387**: 253-260.

Hemminga MA, Duarte CM (2000). Seagrass Ecology. Cambridge University Press.

Mellors JE (1991). An evaluation of a rapid visual technique for estimating seagrass biomass. *Aquatic Botany* **42:** 67-73.

Rasheed MA, Dew KR, Kerville SP, McKenzie LJ, Coles RG (2006). Seagrass distribution, community structure and productivity for Orman Reefs, Torres Strait – March and November 2004. DPI Information Series QI06088. (DPI, Cairns), 38pp.

Rasheed MA, Dew KR, McKenzie LJ, Coles RG, Kerville SP, Campbell SJ (2008). Productivity, carbon assimilation and intra-annual change in tropical reef platform seagrass communities of the Torres Strait, north-eastern Australia. Continental Shelf Research **28**: 2292-2303.

Taylor HA, Rasheed MA (2010). Badu Island Baseline Seagrass Survey, March 2010. DEEDI Publication (Fisheries Queensland, Northern Fisheries Centre, Cairns), 13pp.

Taylor HA, McCormack CV, Rasheed MA (2010). Critical marine habitats in high risk areas, Torres Strait – Moa to Mabuiag Islands. 2010 Atlas. DEEDI Publication (Fisheries Queensland, Northern Fisheries Centre, Cairns), 53pp.

Taylor HA et al. (In prep). Critical marine habitats in high risk areas, Torres Strait – Moa to Hammond Island. 2011 Atlas. DEEDI Publication (Fisheries Queensland, Northern Fisheries Centre, Cairns).

Watson RA, Coles RG, Lee Long WJ (1993) Simulation estimates of annual yield and landed value for commercial penaeid prawns from a tropical seagrass habitat, northern Queensland, Australia. Australian Journal of Marine and Freshwater Research **44**: 211-220.