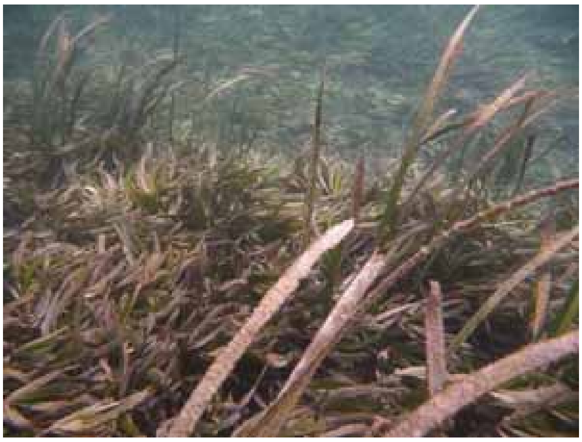
Department of Employment, Economic Development and Innovation

Badu Island Seagrass Baseline Survey

March 2010



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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 plans to be established in seven Torres Strait communities with Badu Island participating in the early stages of the program.

Very little information is known on the distribution and abundance of important subtidal seagrass habitat around Badu 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 Island and the Orman Reefs where an extensive coverage of highly diverse seagrasses were identified as one of the most important areas of seagrass habitat in the Torres Strait and Queensland for dugong (Rasheed *et al.* 2006; Chartrand *et al.* 2009). Additionally, the above ground productivity of Orman Reef seagrass meadows was high compared with other tropical seagrass communities, indicating that the habitat is of key importance to fisheries, dugong and turtle and carbon cycling in the central Torres Strait (Rasheed *et al.* 2007).

The Mura Badulgau (Badu) 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 Badu 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 also recently established at Badu Island. 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 on subtidal habitats around Badu Island and as a result our assessments were 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 Badu 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 11th-13th and 20th-22nd March 2010. Seagrasses are likely to be near their peak seasonable abundance at this time of year.

Sampling methods applied were based on existing knowledge of seagrass distribution by local rangers and Traditional Owners and physical characteristics of the area such as depth, visibility, logistical and safety constraints. 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 located approximately every 250-500m on 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) accurate to ± 5 m. 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 random placements of a 0.5m^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. 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 Badu Island assisted 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 Badu 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 Badu Island, 2010

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 Badu Island, 2010

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

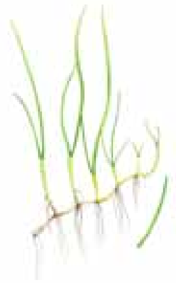
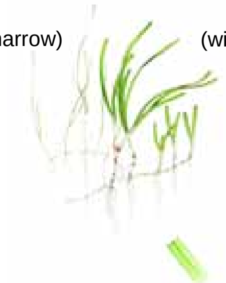
Each seagrass meadow was assigned a mapping precision estimate (±m) based on the mapping methodology utilised for that meadow as well as topographical changes in seafloor structure (i.e. reef tops versus deepwater channels) (Table 3). Mapping precision estimates ranged from 50m for isolated subtidal 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 basemaps and with GPS fixes for survey sites were embedded within the meadow reliability estimates.

Table 3 Mapping precision and methodology for seagrass meadows at Badu Island, 2010

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 2 families) were identified in the survey area in March 2010:

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

A total of 292 subtidal habitat characterisation sites were surveyed in March 2010. Seagrass was found at 51% of sites surveyed with most seagrass found associated with shallow reef tops and shallow sandy substratum's (Map 1). A combined area of 3,363 ± 834 ha of subtidal seagrass habitat was mapped in 11 seagrass meadows as a result of the baseline survey (Map 2). Meadow area ranged from 1.3 ha to 1,694.5 ha, with the largest meadow covering the majority of the western side of the island (Map 5). The densest seagrass meadows were located to the southeast of the survey area in the channel separating Badu and Moa Islands (Map 2). Most seagrass was found on substrates dominated by sand/shell, mud and reefy substrates. No seagrass was found in depths greater than 10.4m below Mean Sea Level, however there were areas in which seagrass may have grown deeper that were outside of the survey boundary.

Ten 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. *Cymodocea serrulata*
2. *Cymodocea serrulata* with mixed species
3. *Cymodocea serrulata/Halophila spinulosa*
4. *Cymodocea serrulata* with *Enhalus acoroides*
5. *Cymodocea serrulata* with *Thalassodendron ciliatum*
6. *Halodule uninervis* (wide) with mixed species
7. *Halophila ovalis*
8. *Halophila spinulosa* with *Cymodocea serrulata/Syringodium isoetifolium*
9. *Thalassia hemprichii* with mixed species
10. *Thalassodendron ciliatum* with *Enhalus acoroides/Cymodocea rotundata*

Seagrass meadows dominated by *Cymodocea serrulata* (with other species variants) were the most common type (55% of meadows), followed by *Halophila ovalis, Halophila spinulosa, Halodule uninervis* (wide)*, Thalassodendron ciliatum* and *Thalassia hemprichii* which dominated one meadow each (Table 4; Maps 2-6).

The majority of meadows were aggregated patches (64% of all meadows), followed by isolated patches (27% of all meadows). Only one meadow was found to have a continuous cover of seagrass.

Mean above-ground biomass of seagrass meadows ranged from 0.07 ± 0.07 in two small *Cymodocea serrulata* dominated meadows on the north-eastern and south-eastern points of the island, to 63.5 ± 1.9 g DW m^{-2} in the moderate *Thalassodendron ciliatum* meadow in the channel between Badu and Moa Islands (Table 4).

In addition to seagrass, other benthic taxa formed significant areas of habitat around Badu Island despite a large proportion of the substrate being open. Five structural distinct types of algae (erect macrophytes, erect calcareous, filamentous, turf mat and encrusting), hard coral, soft coral, and sponge formed areas of benthic habitat both on the reef tops and in the deeper channel areas.

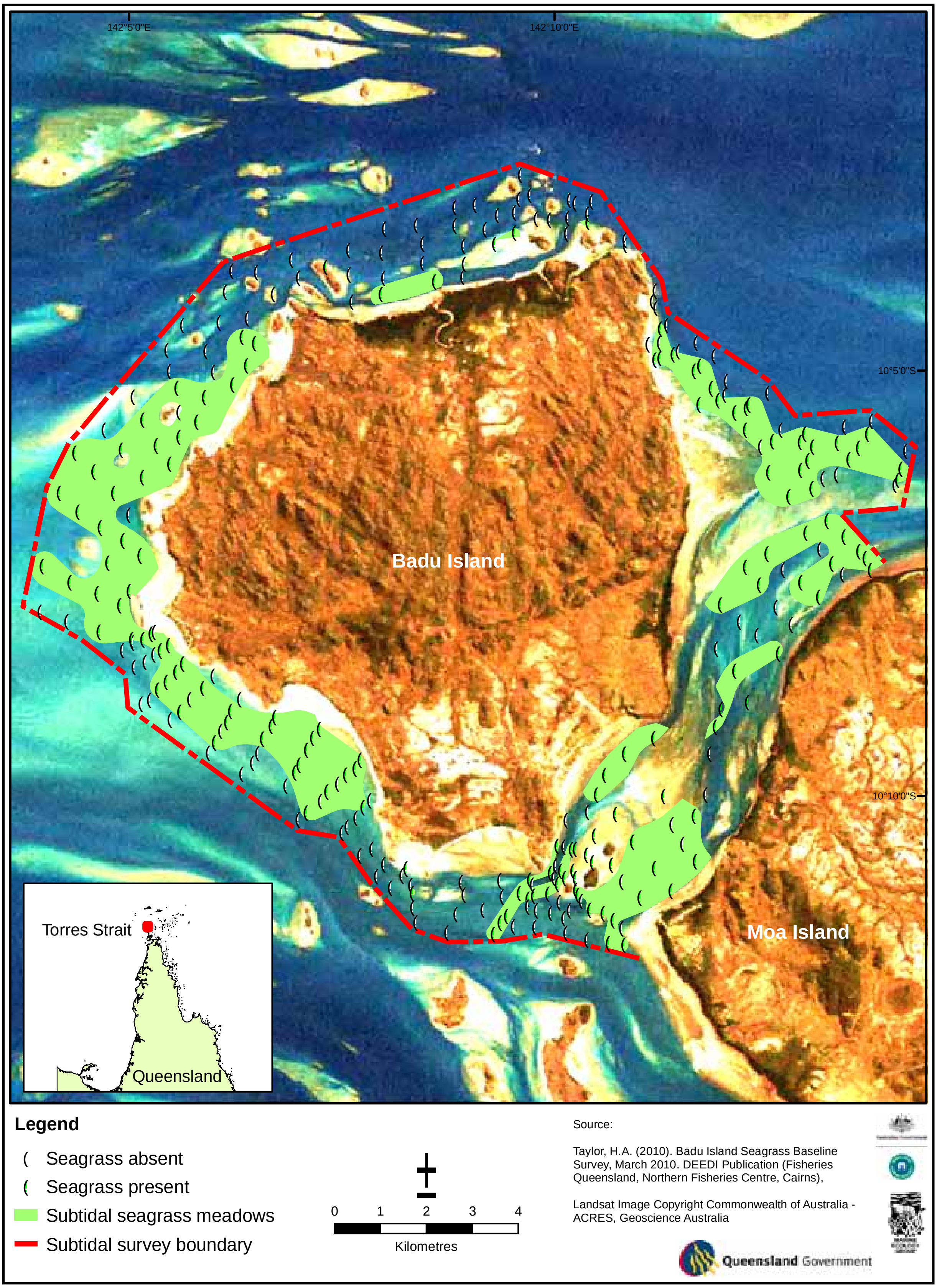
Extensive coverage of seagrass also extended onto intertidal banks but details are not discussed in this subtidal seagrass report (locations are indicated on Maps 2 - 5). Detailed information on these intertidal seagrasses can be found in the atlas of habitats at risk from shipping in the Moa to Mabuiag Island region of the Torres Strait (Taylor *et al.* 2010).

The most ideal location for a long term subtidal seagrass monitoring site is one that would have a good, consistent cover of seagrass year round, and that comprises the range of species that are found within the region. With this in mind, there are a few areas on the south and eastern side of the island that are appropriate, such as any of the meadows located in the channel between Badu and Moa Islands or the large *Halodule uninervis* (wide) meadow on the eastern side of the island (Table 1; Maps 2 & 3). Seagrass cover in these meadows is at its highest and biomass of the key species is dense. Fisheries Queensland and TSRA LSMU will be working with local rangers to develop a monitoring program.

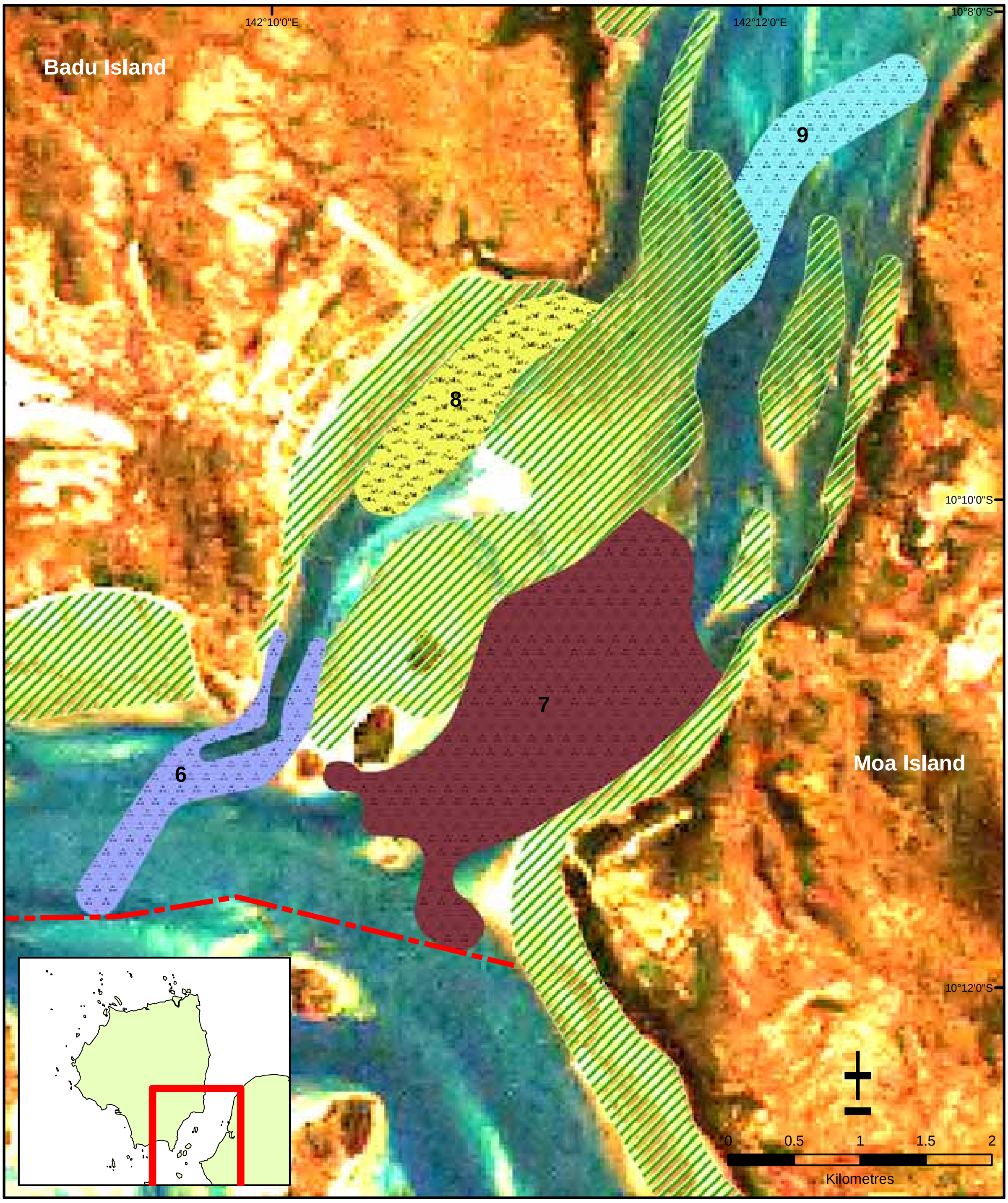
Table 4 Mean above-ground biomass, number of sampling sites and total meadow area for seagrass meadows, Badu Island 2010 (shaded meadows are those recommended for long term monitoring)

Meadow ID	Community type	Species present	Mean biomass ± SE g DW m-2	Number of sites	Meadow area ± R (ha)
1	Light *Cymodocea serrulata/Halophila spinulosa*	*C. serrulata, H. spinulosa*	0.07 ± 0.07	1	2.12 ± 4.25
2	Dense *Halophila ovalis*	*H. ovalis*	5.38 ± 0.17	1	6.02 ± 7.48
3	Light *Halophila spinulosa* with *Cymodocea serrulata/Syringodium isoetifolium*	*C. serrulata, S. isoetifolium, H. spinulosa*	0.18 ± 0.05	2	64.31 ± 19.38
4	Light *Cymodocea serrulata* with mixed species	*C. serrulata, H. spinulosa, T. hemprichii, H. uninervis (wide & narrow), H. ovalis, S. isoetifolium, E. acoroides*	4.68 ± 1.36	60	1695.35 ± 397.56
5	Light *Cymodocea serrulata*	*C. serrulata*	0.07 ± 0.07	1	1.34 ± 7.25
6	Moderate *Cymodocea serrulata* with mixed species	*C. serrulata, H. uninervis (wide & narrow), S. isoetifolium, T. ciliatum, E. acoroides, H. spinulosa, T. hemprichii*	23.87 ± 5.05	14	91.47 ± 44.37
7	Moderate *Cymodocea serrulata* with *Enhalus acoroides*	*C. serrulata, E. acoroides, S. isoetifolium, T. hemprichii, H. spinulosa, H. uninervis (wide), H. ovalis*	25.78 ± 6.67	8	397.02 ± 52.57
8	Light *Thalassodendron ciliatum* with *Enhalus acoroides/Cymodocea rotundata*	*T. ciliatum, E. acoroides, C. rotundata, C. serrulata, H. uninervis (wide), S. isoetifolium, T. hemprichii*	63.5 ± 1.9	3	108.22 ± 26.88
9	Moderate *Cymodocea serrulata* with *Thalassodendron ciliatum*	*C. serrulata, T. ciliatum, T. hemprichii, H. uninervis (wide), E. acoroides, H. spinulosa, H. ovalis*	28.08 ± 3.75	3	88.05 ± 63.07
10	Moderate *Thalassia hemprichii* with mixed species	*T. hemprichii, H. uninervis (wide), C. serrulata, C. rotundata, S. isoetifolium, H. spinulosa, H. ovalis, H. decipiens*	25.39 ± 1.87	5	360.16 ± 128.91
11	Light *Halodule uninervis* (wide) with mixed species	*H. uninervis (wide & narrow), C. serrulata, S. isoetifolium, H. ovalis, T. hemprichii, H. spinulosa, T. ciliatum, E. acoroides, H. decipiens*	9.11 ± 1.54	30	549.17 ± 82.71
Total all meadows				**128**	**3363.22 ± 834.41**

Map 1 Location of baseline 2010 seagrass assessment sites and seagrass meadows, Badu Island 2010



Map 2 Seagrass meadow location, cover type and composition, Badu Island 2010



Legend

- 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
- Intertidal seagrass meadows 2010
- Subtidal survey boundary
- Continuous cover
- Aggregated patches
- Isolated patches

Queensland Government

Source:
Taylor, H.A. & Rasheed, M.A. (2010). Badu Island Seagrass Baseline Survey, March 2010. DEEDI Publication (Fisheries Queensland, Northern Fisheries Centre, Cairns),

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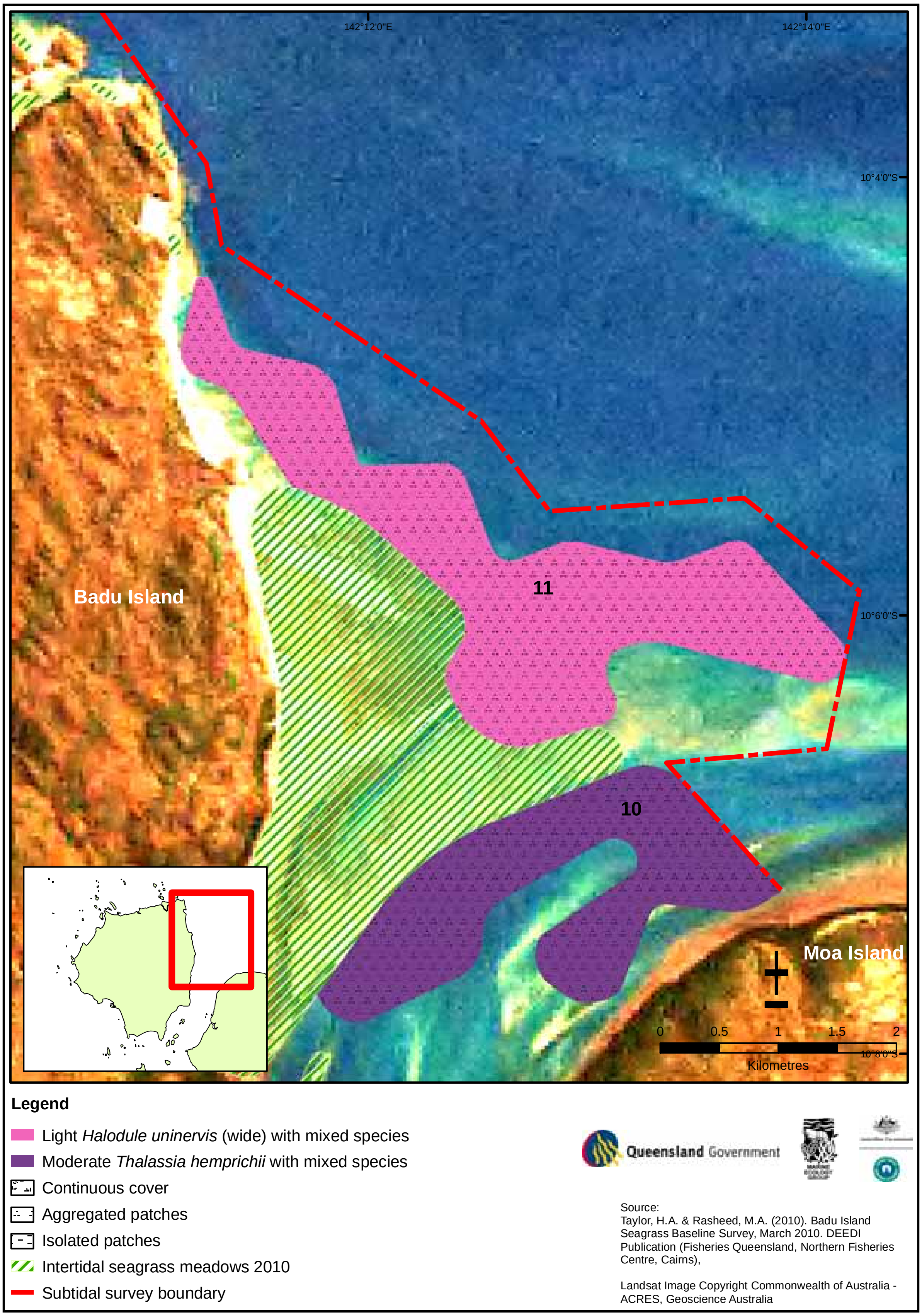
Map 3 Seagrass meadow location, cover type and composition, Badu Island 2010



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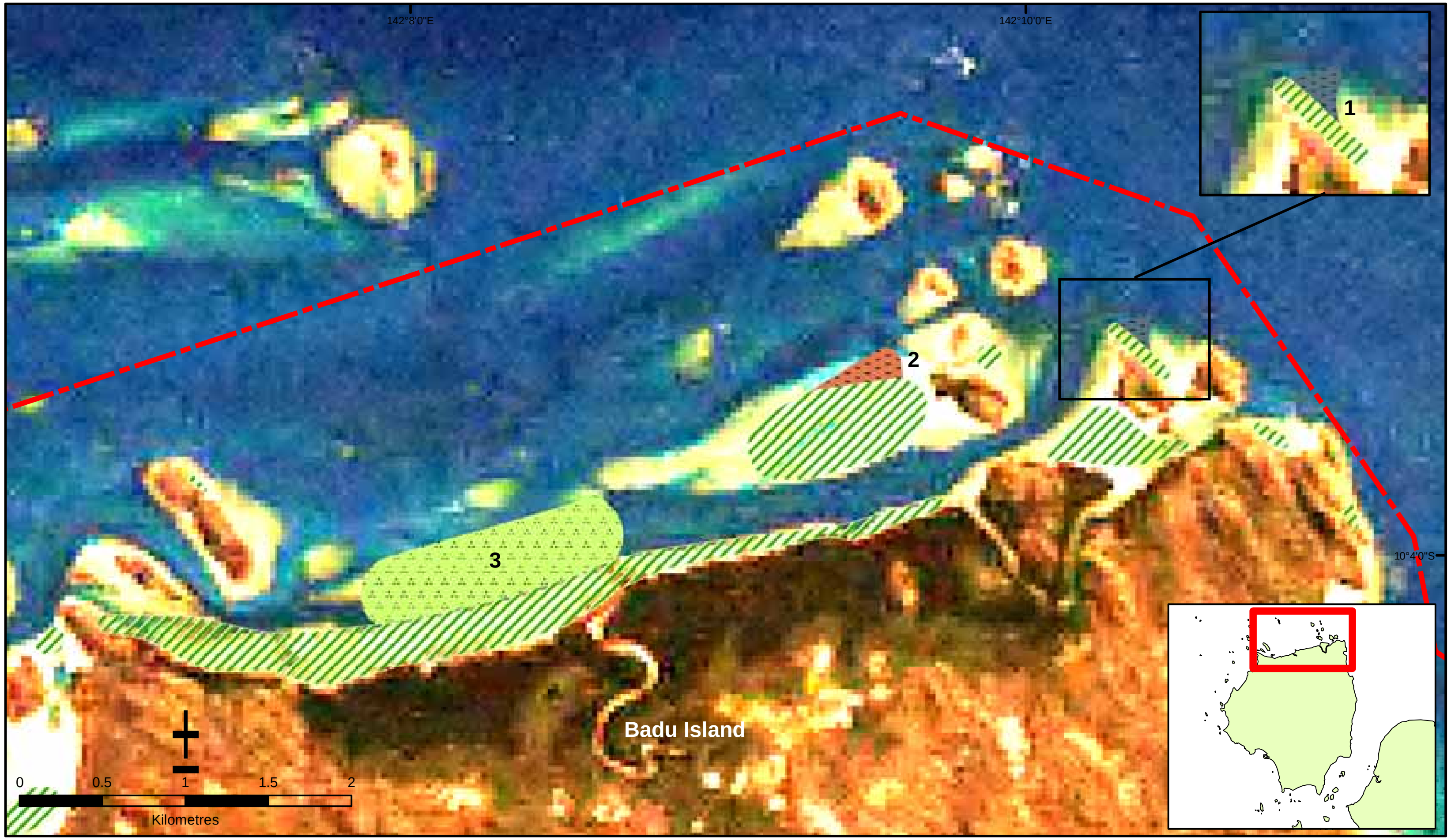
Map 4 Seagrass meadow location, cover type and composition, Badu Island 2010

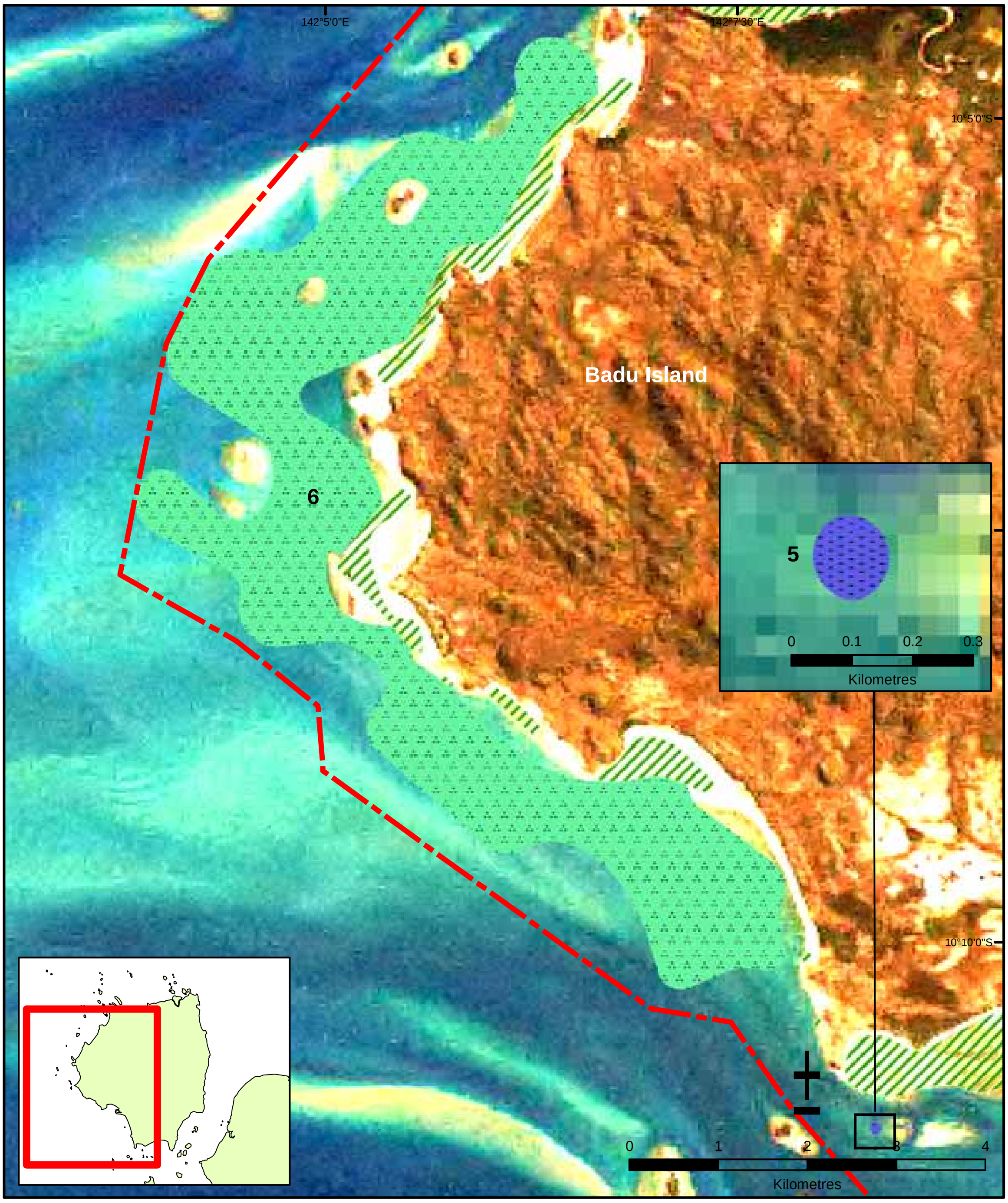


Legend

- Dense *Halophila ovalis*
- Light *Cymodocea serrulata/Halophila spinulosa*
- Light Halophila spinulosa with *Cymodocea serrulata* and *Syringodium isoetifolium*
- Intertidal seagrass meadows 2010
- Subtidal survey boundary
- Continuous cover
- Aggregated patches
- Isolated patches

Source:
Taylor, H.A. & Rasheed, M.A. (2010). Badu Island Seagrass Baseline Survey, March 2010. DEEDI Publication (Fisheries Queensland, Northern Fisheries Centre, Cairns),

Map 5 Seagrass meadow location, cover type and composition, Badu Island 2010



Legend

- Light *Cymodocea serrulata*
- Light *Cymodocea serrulata* with mixed species
- Continuous cover
- Aggregated patches
- Isolated patches
- Intertidal seagrass meadows 2010
- Subtidal survey boundary

Queensland Government

Source:
Taylor, H.A. & Rasheed, M.A. (2010). Badu Island Seagrass Baseline Survey, March 2010. DEEDI Publication (Fisheries Queensland, Northern Fisheries Centre, Cairns),

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