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CRC REEF RESEARCH

TECHNICAL REPORT

Distribution of Seagrasses in the Lizard Island Group- a reconnaissance survey, October 1995

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CRC Reef Research Centre

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Executive Summary

Key Results

1. 292 ±78 ha of seagrass habitat was mapped in the survey of intertidal and sub-tidal areas surrounding the Lizard Island Group in October 1995.

2. Seven seagrass species (1 previously undescribed) from two Families, were recorded in the survey area. *Thalassia hemprichii* was the most commonly encountered species (38 % of seagrass sites), although it was restricted to the shallow reef-tops. *Halophila ovalis* was the second most commonly encountered species (36 % of seagrass sites) and was found in both intertidal and subtidal areas. Other species found in the survey area included *Halodule uninervis, Halophila spinulosa, Syringodium isoetifolium, Cymodocea serrulata* and *Halophila* sp

3. *Halophila ovalis* had the widest depth distribution and occurred at both the shallowest (0.4 m below MSL) and the deepest (4.4 m below MSL) sites where seagrass was found. Mean depths of occurrence for individuals species were mostly <15 m below mean sea level.

4. A previously undescribed seagrass species, *Halophila* sp., was found in the survey area near Watson's Bay in depths >10 m below MSL. This species was similar to *Halophila capricorni* although several differences were noted. Advice is being sought to help clarify its identification.

5. Seagrass communities included Halophila ovalis and Thalassia meadows in the shallow sandy areas of the reef-flat and Halophila species dominated meadows in deep-water. Shallow (<3m) parts of Watson's Bay contained medium dense meadows of Halodule uninervis and Halophila ovalis.

Key Issues

1. The inventory of seagrass species from the Lizard Island Group, including the present survey, now totals 8, which is high for a Great Barrier Reef locality.

2. Anchor damage (scars) was observed in the seagrass meadows of Watson's Bay. Shallow-water (<10 m) scars showed evidence of recolonisation/recovery, however deep-water (>10 m) scars appeared recent, as there was little evidence of seagrass recovery. It is unknown whether recovery occurs at a faster rate in shallow-waters compared to deep-water meadows and further research is necessary.

3. We recommend that permanent moorings be considered for large passenger vessels using the Watson's Bay National Park Zone, if use of the site continues to increase and if the deep-water seagrass habitats are to be protected.

4. Indications from this seagrass survey are that the Watsons Bay seagrasses are already affected by vessel anchoring. Seasonally and year to year changes in seagrass distribution, abundance and species composition make assessment of such impacts difficult. Anthropogenic impacts may not manifest in the seagrasses until 6 to 12 months after the impacting event. Large scale changes may only be detected over a period of years as loss can be gradual. Investigations over long terms therefore need to be designed to detect gradual change.

↳Introduction & General Seagrass Ecology

Seagrass meadows in northern Queensland play a critical ecological role as nursery grounds for commercial species of penaeid prawns and fish (Coles and Lee Long 1985; Coles *et al.* 1993; Watson *et al.* 1993). Seagrasses are also essential food for dugong, *Dugong dugon* (Miller), and green sea turtles, *Chelonia mydas* (Linnaeus) (Lanyon *et al.* 1989).

The growth of seagrasses depends on several factors including the availability of light (Dennison 1987; Williams and Dennison 1990), nutrients (Orth 1977; Erftemeijer 1994) and water temperature (Bulthuis 1987). Activities that lead to a change in these factors such as turbidity from dredging, and runoff from agriculture, could potentially have a negative impact on seagrass growth and distribution. Seagrasses show measurable growth responses to changes in ambient water quality and can therefore be used as effective ecological indicators of environmental impact (Dennison *et al*. 1993).

Tropical seagrass meadows vary seasonally and between years (Mellors *et al*. 1993; McKenzie 1994). The potential for widespread seagrass loss has been well documented. Causes may include natural occurrences such as cyclones and floods (Poiner *et al.* 1989) or result from human influences such as dredging (Pringle 1989), agricultural runoff (Preen *et al*. 1995), industrial runoff (Shepherd *et al*. 1989) and oil spills (Jackson *et al.* 1989). Smaller scale losses occur as a result of propeller (Zieman 1976) and anchor damage or dugong feeding activity.

The Lizard Island group is adjacent to the Starke River region, an area recognised for its sizeable dugong populations and associated seagrasses. Little is known of the seagrasses in the Lizard Island Group. Price *et al.* (1976) reported only 2 species of seagrass (*Cymodocea rotundata* and *Halophila ovata*) from the Lizard Island group in their checklist of marine benthic plants. The only other previously reported species for the group is *Thalassia hemprichii* (Nichols and Johns, 1985; Boon, 1986). Seagrasses have also been reported from inter-reef waters in the vicinity of the Lizard Island group during a deep-water survey of seagrasses (Lee Long *et al.* 1989;Coles *et al*. 1995).

The Lizard Island group is currently zoned within the Cairns Section of the Great Barrier Reef Marine Park (GBRMPA ID No 14-116) and includes a National Park Zone, Buffer, Conservation Park Zone and No Structure Subzone. Lizard Island provides one of the most protected boat anchorages near the outer-reef in the northern section of the GBR. The anchorage is especially popular in the latter months of the year during the billfish (marlin) fishing season. The island group is also popular for tourists as it is situated close to favoured SCUBA diving sites (eg. Cod Hole) and it includes a national park and a resort (Lizard Island Lodge).

This report presents the results of a reconnaissance survey conducted in October 1995. The objectives of the survey were:

❶ *to map the seagrass distribution of the Lizard Island group and*

❷ *describe the seagrass communities present.*

↳Materials & Methods

Site description

The Lizard Island group is located within the Great Barrier Reef lagoon approximately mid-way between the mainland coast and outer barrier reefs (145° 29.8'E, 14° 40'S) (Figure 1). The Lizard Island group refers to the 3 continental islands of Lizard (the largest), Palfrey and South Islands and associated reefs. The present seagrass reconnaissance survey was conducted on the southern (blue lagoon) and western sides of Lizard Island from Lizard Head to North Point and to a depth of 21 m below MSL (Figure 2).

Survey Methods

Seagrass distribution was surveyed between the 6 - 9 October 1995. Estimates of above-ground seagrass biomass (3 replicates of a 0.25 m^2), seagrass species composition, % seagrass area cover, % cover of algae and sediment characteristics were recorded by divers at each survey site.

Above-ground biomass was determined by a "visual estimates of biomass" technique described by Mellors (1991). The technique requires each diver to rank seagrass biomass in the field. These ranks are then calibrated for each diver against a set of harvested quadrats to calculate above-ground biomass estimates in grams dry weight per square metre of substrate (g DW. m^{-2}).

Seagrass species were identified according to Kuo and McComb (1989). Voucher specimens of each seagrass species were collected (GBRMPA Permit # G95/487) for later verification if necessary. Sediment characteristics were described using visual estimates of grain size: shell grit, rock gravel (>2000μm), coarse sand (>500 μm), sand (>250 μm), fine sand (>63 μm) and mud (<63 μm). A global positioning system (GPS) was used to locate each survey site. A depth gauge was used to measure water depth and these depths were converted to depths below mean sea level (MSL) by reference to tide tables.

Geographic Information System

All data was entered onto a Geographic Information System (GIS). A new base-map for the Lizard Island group was created from a rectified 1:30,000 aerial photograph (23 November 1995, height 4580 m) and control points (courtesy QDoE). All maps and GIS outputs were produced using Australian Map Grid (AMG) Zone 55 projection.

Boundaries of seagrass meadows were determined based on the positions of survey sites, depth contours (courtesy Sunmap), and on information from aerial photograph interpretation. Errors which should be considered when interpreting GIS maps include those associated with digitising and rectifying the aerial photograph onto the basemap and GPS fixes for survey sites. The error from the position of diver relative to the GPS receiver was assumed to be embedded within this range.

Each seagrass meadow was assigned a meadow boundary quality value based on the type and range of mapping information available for each area and determined by the distance between survey sites and GPS position fixing error (Table 1). These meadow boundary "error" values were used to estimate the likely range of area for each meadow mapped.

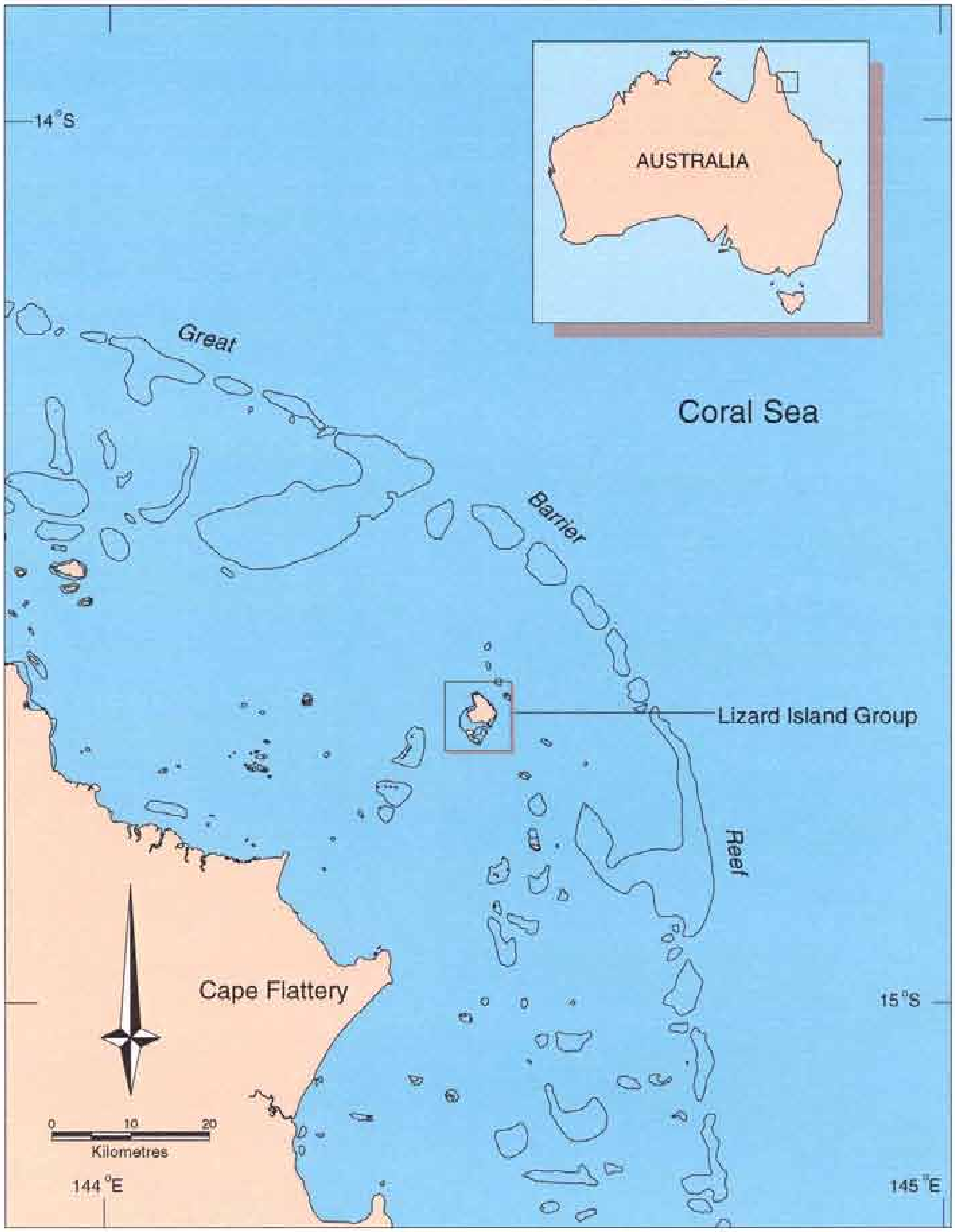

Figure 1. Location of Lizard Island Group.

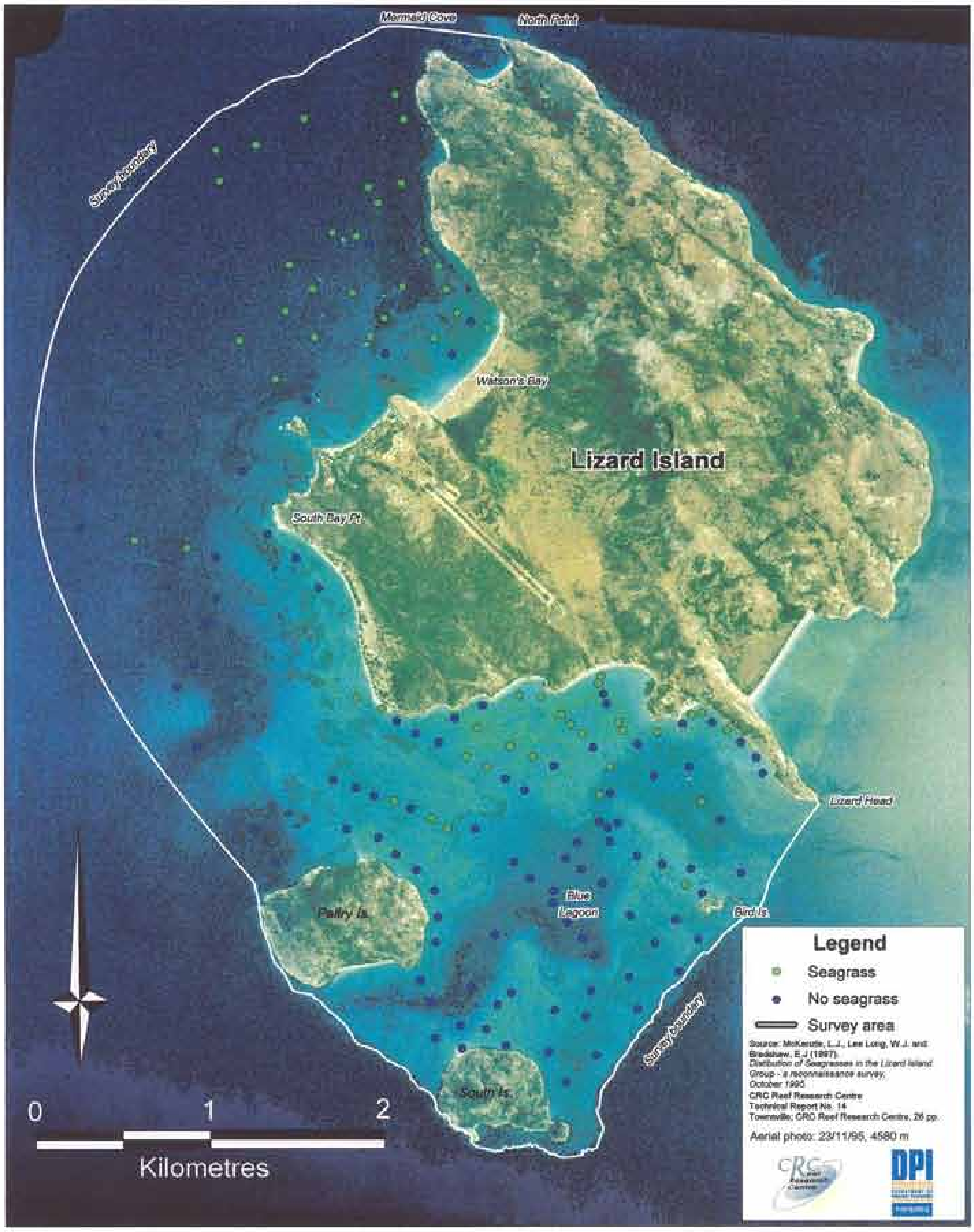

Figure 2. Location of survey sites (seagrass present & absent) in the Lizard Island Group survey area - October 1995.

Table 1. Mapping quality for seagrass meadow boundaries mapped in the Lizard Island Group survey area - October 1995.

Mapping Quality	Data Sets	Comments
±25m	Rectified aerial photo & dive survey.	Detailed checking of meadow boundary during dive surveys. Aerial photo of high resolution.
±30m	Rectified aerial photo & dive survey.	Some meadow boundaries checked during dive survey. Aerial photo of low resolution.
±100m	Dive survey only.	Subtidal meadows not visible in remote-sensing images. Data density generally low and reliant solely on dive surveys.

Results

Seagrass species, communities and distribution

Seven species of seagrasses (from 2 families) were found in the Lizard Island Group survey area (see Appendix 1):

Family CYMODOCEACEAE Taylor
Cymodocea serrulata (R. Br.) Aschers. & Magnus
Halodule uninervis (wide) (Forsk.) Aschers.
Syringodium isoetifolium (Aschers.) Dandy

Family HYDROCHARITACEAE Jussieu
Halophila ovalis (Br.) D.J. Hook.
Halophila spinulosa (R. Br.) Aschers. in Neumayer
Thalassia hemprichii (Ehrenb.) Aschers. in Petermann
Halophila sp. (*cf. Halophila capricorni* Larkum)

Seagrass was present at 56 (36 %) of the 157 sites surveyed (Figure 2), and of these sites 85 % were on sandy substrates. Seagrass habitats within the Lizard Island Group survey area covered 292 ±78 ha (Figure 3, Table 2). The major areas of seagrass habitat on both the reef-flat and subtidal habitat were dominated by *Halophila* species (70% of total area) (Plates 1 & 2).

Plate 1. *Halophila* habitat with blue-green filamentous algae on reef flat, Lizard Island (October 1995).

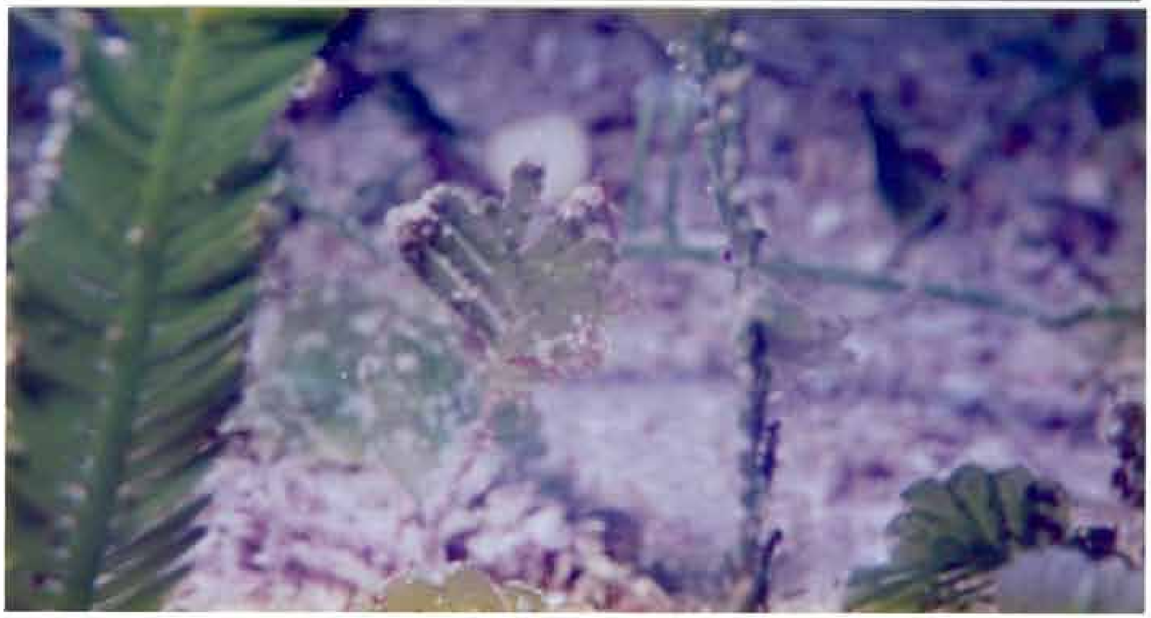

Plate 2. Subtidal Halophila habitat (*H. ovalis, H. spinulosa* with the algae *Caulerpa mexicana*) at 20 m depth, Lizard Island - October 1995.

22 seagrass meadows, of 9 habitat types, were identified in the survey area (Table 2) (Figure 3). The most widely distributed seagrass habitats were dominated by *Halophila spinulosa*, which were found in subtidal areas adjacent to Watson's Bay (Figure 3). The seagrass habitat of greatest biomass was *Halophila uninervis/Halophila* mixed (Table 2), located mainly in Watson's Bay (Figure 3 & 4a). Seagrass meadows on the reef flat were mainly low in biomass and dominated by *Thalassia hemprichii* (Figure 4b).

Table 2. Description of seagrass habitats in the Lizard Island survey area - October 1995
Ranges in brackets.

Seagrass habitat	Distribution (ha)	# of meadows	mean biomass (g DW m^{-2})	% cover seagrass	% cover Algae
Halophila (mixed spp)	22.3 *(8.3-42.6)*	1	6.08 ±1.41 *(1.94-8.23)*	30	35 *(0-70)*
Halophila sp.	30.7 *(6.7-49.7)*	1	4.00 ±1.03 *(0.89-8.14)*	15 (10-20)	3.5 *(5-40)*
Halophila ovalis	1.22 *(1.3-4.3)*	4	3.94 ±0.63 *(0-6.40)*	20.25 *(1-40)*	30 *(5-90)*
H. ovalis/ Thalassia hemprichii	0.44 *(0.4-1.5)*	1	3.26 ±0.36 *(1.81-4.10)*	5	7.5 (5-10)
Halophila spinulosa	145.51 *(75.6-214.1)*	1	6.41 ±0.91 *(0-21.60)*	20.6 *(1-70)*	14.6 *(0-40)*
Halodule uninervis	0.32 *(0.3-0.32)*	2	2.87 ±0.85 *(0.89-5.56)*	5.5 *(1-10)*	40 *(0-80)*
H. uninervis/ Halophila mixed	69.07 *(46.1-93.8)*	3	10.39 ±1.08 *(0-26.16)*	37.5 *(0-90)*	23.2 *(0-70)*
H. uninervis/ T. Hemprichii	4.86 *(1.0-10.9)*	2	4.85 ±0.91 *(0-9.68)*	26.8 *(2-50)*	11.3 *(0-40)*
T. hemprichii	18.06 *(7.3-32.6)*	7	3.52 ±0.43 *(0-13.29)*	17.5 *(1-60)*	35 *(10-80)*

All seagrass species when present had mean biomasses below 6 g DW m^{-2} (Figure 5). The seagrass species of greatest mean biomass was *Halodule uninervis* and the lowest mean biomass was *Halophila ovalis* (Figure 5).

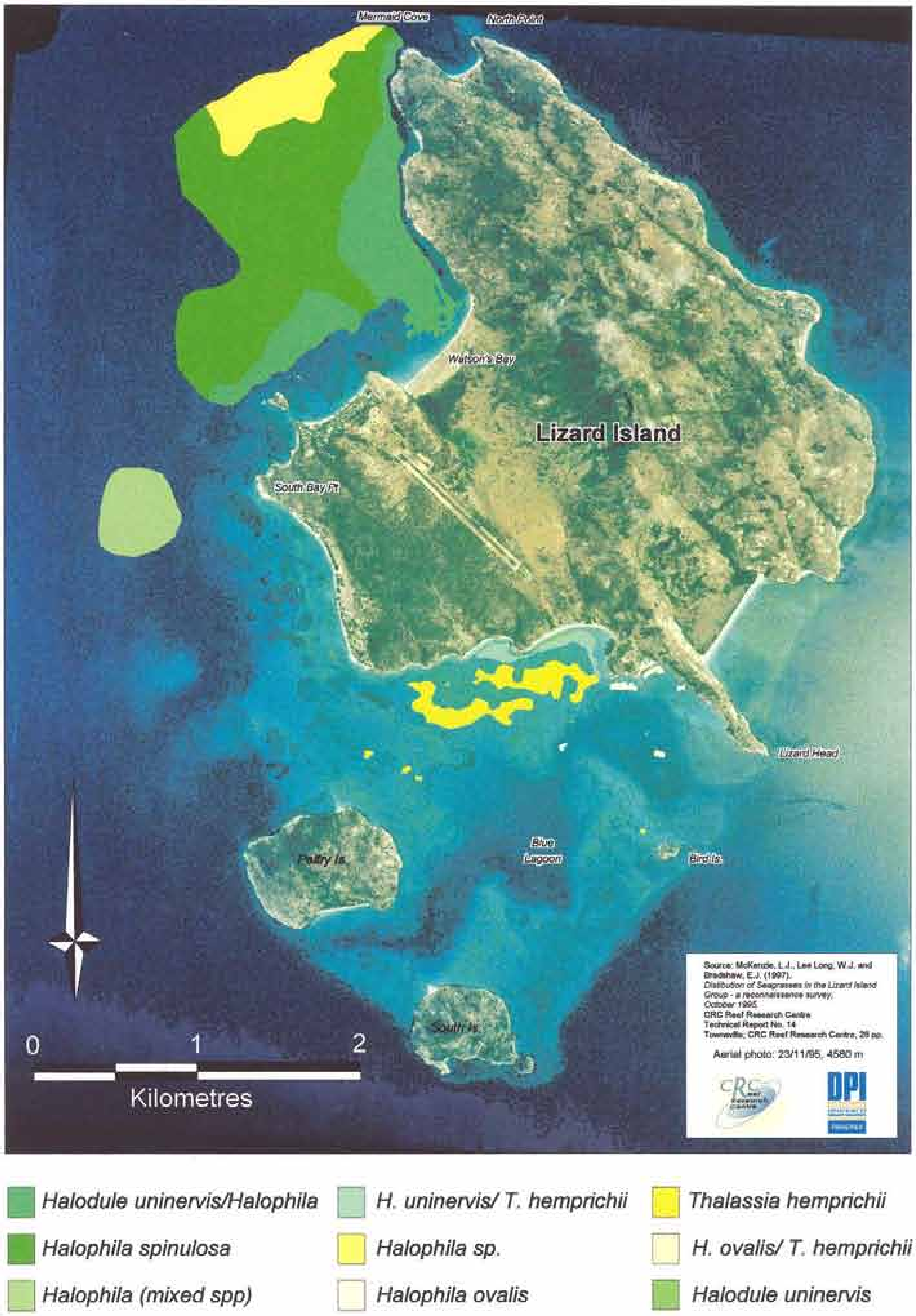

Figure 3. Distribution of seagrass meadows in the Lizard Island Group survey area - October 1995.

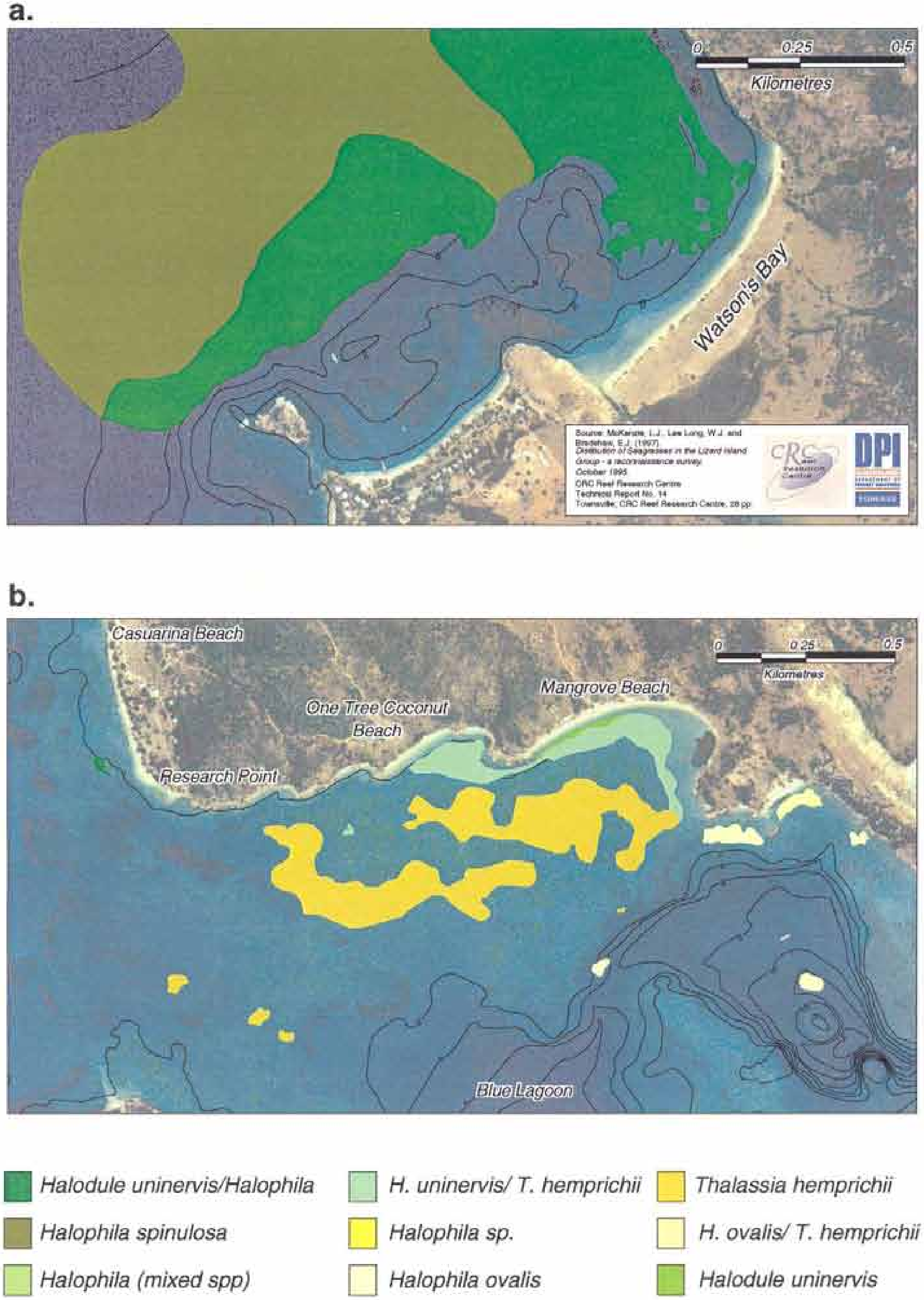

Figure 4. Distribution of seagrass meadows in a. Watsons Bay and b. the reef flat of the Lizard Island Group survey area - October 1995.

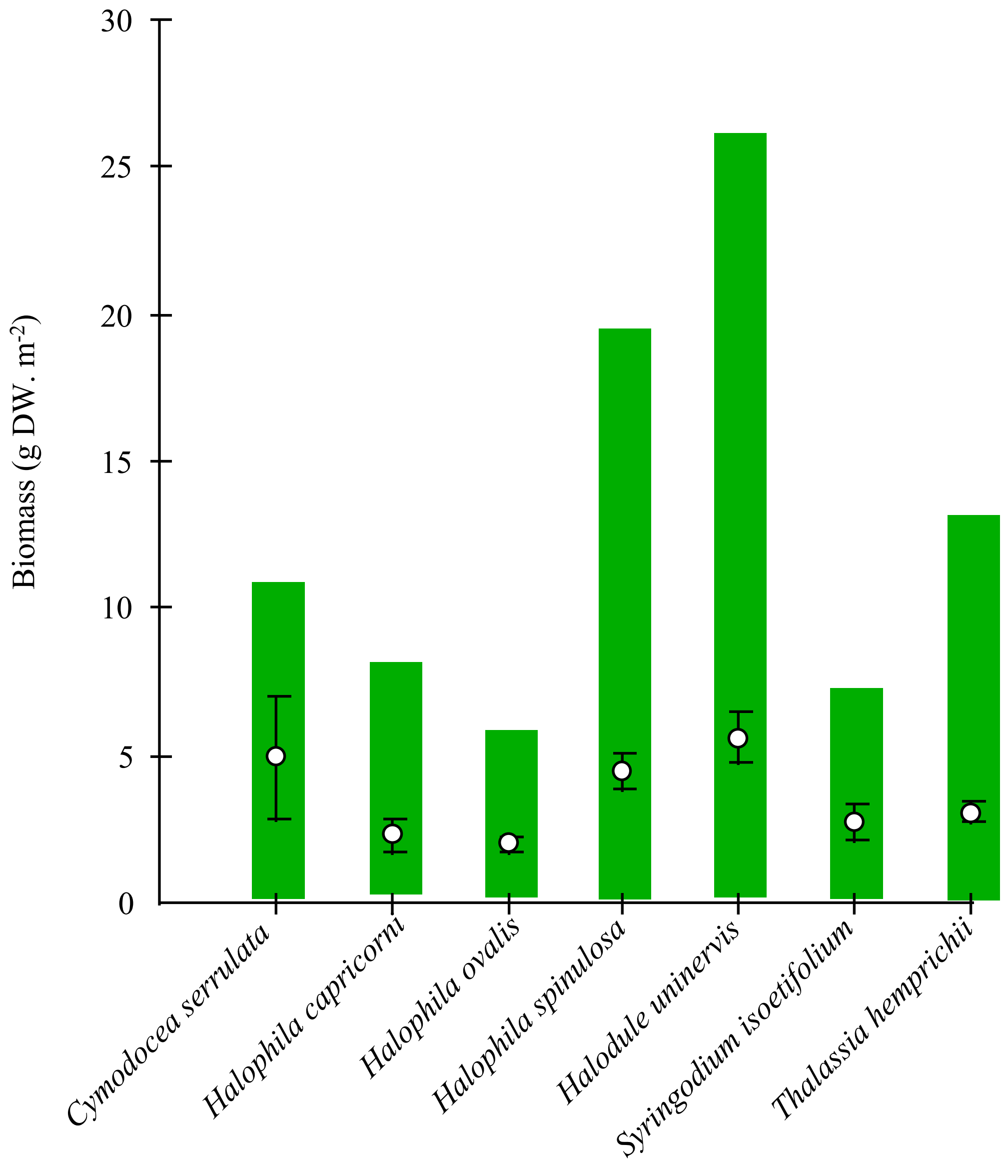

Figure 5. Biomass for each species of seagrass surveyed in the Lizard Island Group survey area - October 1995.

Both male and female flowers were collected from *Halophila* sp plants (Plates 3, 4 & 5), although male and female reproductive structures were not found on the same plant. Flowers and fruits were also found on plants of *Halophila ovalis* and *Syringodium isoetifolium.*

Plate 3. Hairs on adaxial side of *Halophila* sp.

Plate 4. Female flowers of *Halophila* sp.

Plate 5. Male flowers of *Halophila* sp releasing pollen.

Seagrass depth distribution

Halophila ovalis occupied almost all depths to 21 m. Most other species appeared restricted to separate depth zones (Figure 6). *Halophila spinulosa* had the second widest depth distribution (7 to 21 m). *Cymodocea serrulata*, *Halodule uninervis*, *Syringodium isoetifolium* and *Thalassia hemprichii* were all found at depths <11 m. *Halophila capricorni* was found at depths >11 m. *Cymodocea serrulata* and *Thalassia hemprichii* had the smallest depth distributions (<2 m range).

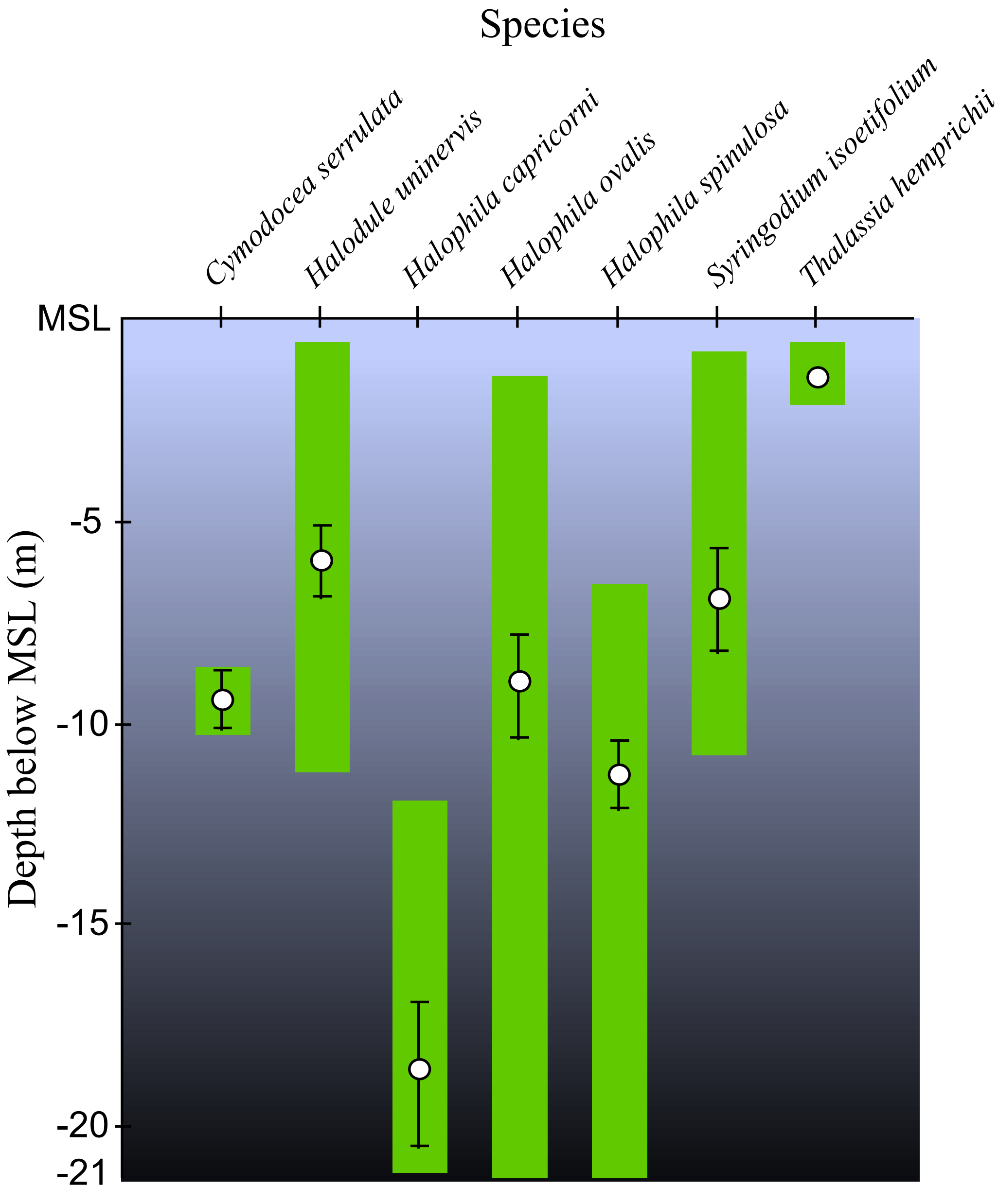

Figure 6. Means, standard errors and ranges of recorded depth (below MSL) of occurrence for seagrasses in waters <21 m in the Lizard Island Group survey area

Algae

Algae were present at 135 sites (86 % of total) in the survey area and at all depths examined. 7 groups of algae were identified during the survey (Table 3). The most common group of algae were the blue-green filamentous (77 % of sites with algae) with a mean cover of 26 % when present (Plate 6).

Table 3. Algal groups present in Lizard Island survey area.
Range in brackets

Algal group	# sites present	# sites with seagrass	Mean % cover
Blue-green filamentous	104	29	26 (5-70)
Blue-green turf	22	2	41 (0-90)
Brown macro-algae	10	10	45 (15-70)
Caulerpa mexicana	4	1	6 (5-10)
Caulerpa spp.	3	2	24 (1-40)
Halimeda spp.	7	4	10 (5-15)
Udotea spp.	6	5	16 (1-40)

Plate 6. Habitat of blue-green filamentous algae on the reef-flat of the Lizard Island Group.

Dugongs

The only dugongs sighted during the survey were a pair of animals out from Casuarina Beach, although evidence of feeding (feeding trails) was observed at Mangrove Beach (Figure 7) (Plate 7). The trails were observed only in a narrow (3 m width) meadow of *Halodule uninervis*, with sandy substrate, at Mangrove Beach.

Figure 7. Location of dugong and dugong feeding trails sighted in the Lizard Island Group survey area - October 1995.

Plate 7. Dugong feeding trails at Mangrove Beach, Lizard Island.

↳Discussion

Seagrass distribution & taxonomy

The present survey is the first time the distribution of seagrasses in the Lizard Island Group have been mapped. It is also the most extensive inventory of seagrasses from the Lizard Island Group to date. Only 1 of the species collected in the present survey has been reported from the Lizard Island Group in the past; Boon (1986) sampled interstitial pore-water in sediments of a *Thalassia hemprichii* meadow on the reef-flat adjacent to One Tree Coconut beach in 1983 and reported no other species from the site. The seagrass plants identified by Price *et al*. (1976) as *Halophila ovata,* lodged in the James Cook University herbarium, were re-identified in 1981 by Dr Ian Price as *Halophila minor* and verified by Ms Jane Mellors (QDPI & TESAG, JCU) at request of the present authors. The *Cymodocea rotundata* voucher specimens identified by Price *et al.* (1976) could not be verified, as the specimens are currently listed as missing from the JCU herbarium. The seagrass species diversity for the Lizard Island Group after the present study totals 8.

Halophila sp. collected in the present survey was similar to the recently described *Halophila capricorni* (Larkum 1996), but exhibited different characteristics to the type specimen, suggesting a possible new or undescribed species. These different characteristics include:

- no male or female flowers were found on the same plant
- stiff hairs completely cover the adaxial side of leaves (Plate 3) (*H. capricorni* is described from plants with stiff hairs confined to the centre of the adaxial).
- plants have only been found in mid- to outer-shelf areas of the northern GBR (Coles *et al*. 1995)

Voucher specimens have been sent to a taxonomist, Professor John Kuo (University of Western Australia), for further consideration.

This survey was conducted at the time of year when most seagrasses in northern Queensland are near their greatest abundance, so that the species list and distribution pattern would be expected to be potentially complete. Seasonal and inter-annual variation in seagrass distribution and abundance are likely to affect the results of this and other surveys of the area.

Seagrass destruction & management implications

Human impacts on the seagrasses in Watson’s Bay could include anchor damage, introductions of new species transported on anchors lifted at other seagrass localities, and effluent from vessels and/or tourist facilities on the island. Increases in boat use (especially mooring) in Watson’s Bay is currently an issue of concern for marine park managers and anchor damage is of particular concern.

Anchor damage was observed in the seagrass meadows of Watson’s Bay where several small pleasure craft and a large passenger vessel were moored during the present survey. In the 5-10 m depth range, “anchor scars” were evident throughout the meadow where anchors had dragged along the seabed for several metres. Larger scars (approximately 15-20 m in length, covering an arc of approximately 15-20 degrees) were found in the 10-15 m depth range. Habitats in this depth range were also unusual due to the high number of large echinoderms and scleractinian solitary corals associated with them.

The shallow-water (<10 m) scars showed evidence of recolonisation/recovery, however deeper-water (>10 m) scars appeared recent, as there was little evidence of seagrass recovery. It is unknown whether recovery occurs at a faster rate in shallow-waters compared to deep-water meadows and further research on this issue is necessary.

The Great Barrier Reef Marine Park Authority has established a policy and strategy for permanent moorings to protect corals of the Great Barrier Reef from impacts of boat anchors and chains. Little consideration however has been given to other habitats, including seagrasses. Moorings are preferable as they are considered safer and less destructive than anchoring. The Marine Park Authority and Queensland Department of Environment currently require commercial tourist operators that use a site more than twice a week to install environmentally acceptable moorings, approved by a marine architect in specified locations and at the operators cost. We recommend that permanent mooring for larger vessels be considered in the Watson's Bay National Park Zone to help protect the deep water seagrass habitats.

The high number of vessels moored in Watson's Bay suggests that the area may be impacted, but to a lesser extent than areas with a continually high tourist load such as Green Island. For example, Boon (1986) measured the interstitial pore waters in seagrass sediments on the reef-flat near blue-lagoon and reported 6-48 μmol L^{-1} ammonium and 1.5-2.5 μmol L^{-1} phosphorus. McKenzie and Lee Long (1997) however, measured the interstitial pore waters in similar seagrass sediments on the reef-flat of Green Island and reported 2.1-84.8 μmol L^{-1} ammonium and 0.5-5.5 μmol L^{-1} phosphorus. Acute (low levels) of impact may not present ecological problems, however chronic (continual) and increased impact/damage should be of concern to managers of the Lizard Island Group.

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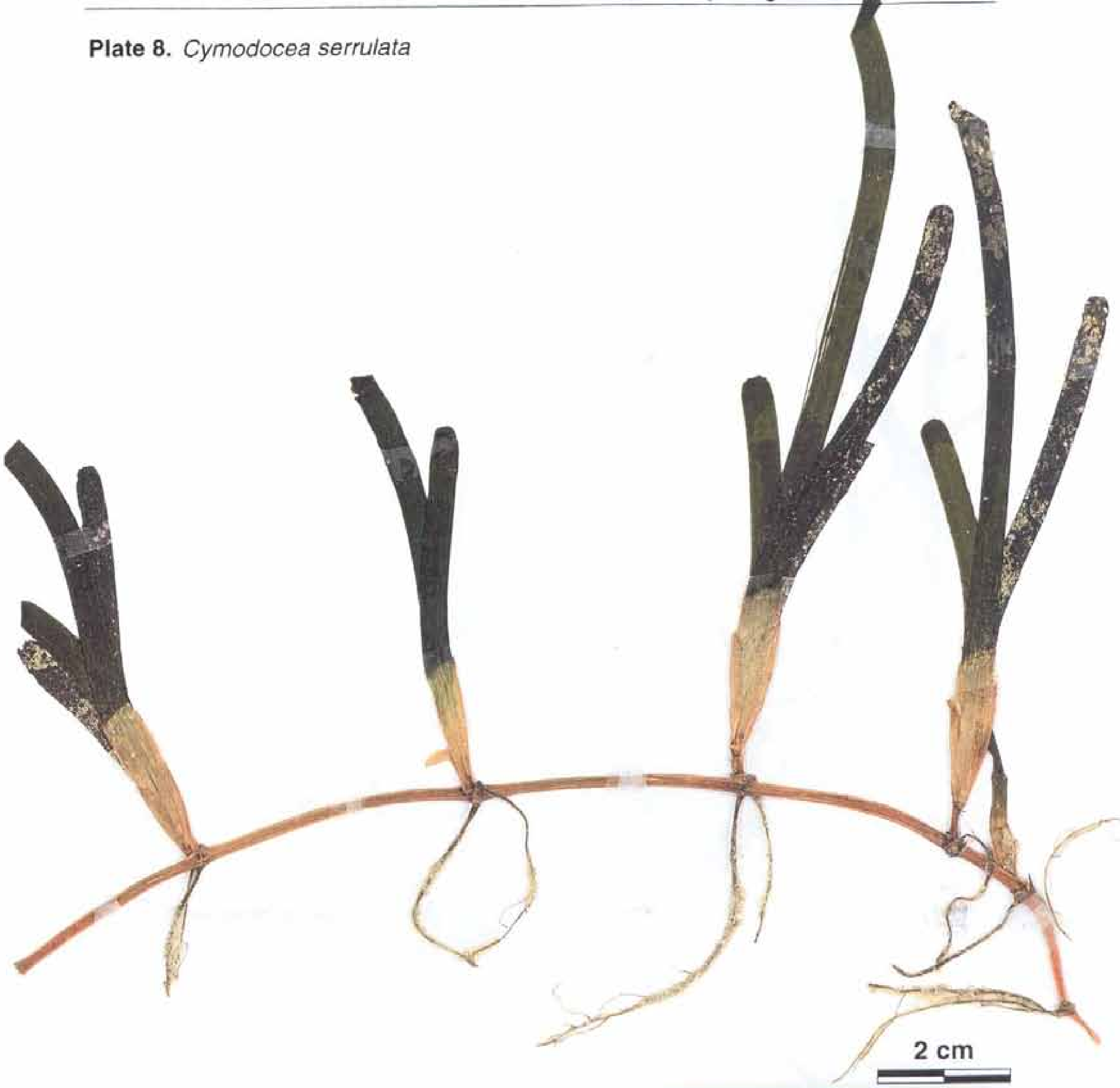
➯Appendix 1

Plates 8 - 15

The following seagrass species were collected from sites at Lizard Island in October 1995 (voucher specimens are preserved in the NFC herbarium for future reference)

Plate 8.	*Cymodocea serrulata*	NFC/36
Plate 9.	*Halodule uninervis*	NFC/37, NFC/39
Plate 10.	*Halophila ovalis* (shallow)	NFC/41
Plate 11.	*Halophila ovalis* (deep)	NFC/43
Plate 12.	*Halophila* sp *(cf Halophila capricorni)*	NFC/44
Plate 13.	*Halophila spinulosa*	NFC/42
Plate 14.	*Syringodium isoetifolium*	NFC/40
Plate 15.	*Thalassia hemprichii*	NFC/38

Plate 8. *Cymodocea serrulata*



● *Cymodocea serrulata*

Source: McKenzie, L.J., Lee Long, W.J. and Bradshaw, E.J (1997).
Distibution of Seagrasses in the Lizard Island Group - a reconnaissance survey, October 1995.
CRC Reef Research Centre
Technical Report No. 14
Townsville; CRC Reef Research Centre, 26 pp.

Plate 9. *Halodule uninervis*

● *Halodule uninervis*

Source: McKenzie, L.J., Lee Long, W.J. and Bradshaw, E.J (1997).
Distibution of Seagrasses in the Lizard Island Group - a reconnaissance survey, October 1995.
CRC Reef Research Centre
Technical Report No. 14
Townsville; CRC Reef Research Centre, 26 pp.

Plate 10. *Halophila ovalis (shallow sites)*

● ***Halophila ovalis (shallow sites)***

Source: McKenzie, L.J., Lee Long, W.J. and Bradshaw, E.J (1997).
Distibution of Seagrasses in the Lizard Island Group - a reconnaissance survey, October 1995.
CRC Reef Research Centre
Technical Report No. 14
Townsville; CRC Reef Research Centre, 26 pp.

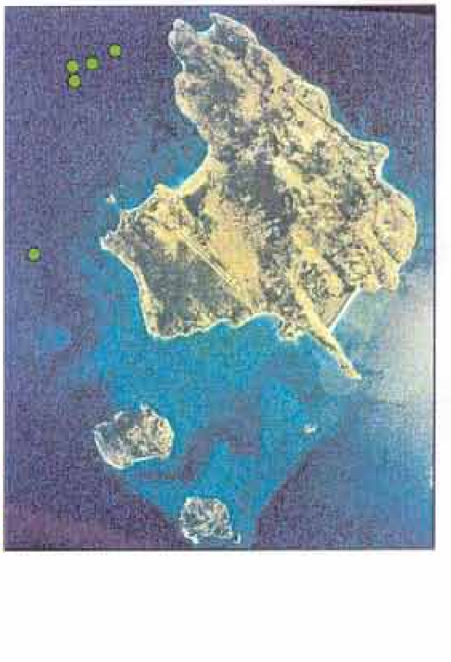
Plate 11. *Halophila ovalis (deep sites)*

2 cm

● ***Halophila ovalis (deep sites)***

Source: McKenzie, L.J., Lee Long, W.J. and Bradshaw, E.J (1997).
Distibution of Seagrasses in the Lizard Island Group - a reconnaissance survey, October 1995.
CRC Reef Research Centre
Technical Report No. 14
Townsville; CRC Reef Research Centre, 26 pp.

Plate 12. *Halophila sp.*



● ***Halophila sp.***

Source: McKenzie, L.J., Lee Long, W.J. and Bradshaw, E.J (1997).
Distibution of Seagrasses in the Lizard Island Group - a reconnaissance survey, October 1995.
CRC Reef Research Centre
Technical Report No. 14
Townsville; CRC Reef Research Centre, 26 pp.

Plate 13. *Halophila spinulosa*

● *Halophila spinulosa*

Source: McKenzie, L.J., Lee Long, W.J. and Bradshaw, E.J (1997).
Distibution of Seagrasses in the Lizard Island Group - a reconnaissance survey. October 1995.
CRC Reef Research Centre
Technical Report No. 14
Townsville; CRC Reef Research Centre, 26 pp.

Plate 14. *Syringodium isoetifolium*

● ***Syringodium isoetifolium***

Source: McKenzie, L.J., Lee Long, W.J. and Bradshaw, E.J (1997).
Distibution of Seagrasses in the Lizard Island Group - a reconnaissance survey. October 1995.
CRC Reef Research Centre
Technical Report No. 14
Townsville; CRC Reef Research Centre, 26 pp.

Plate 15. *Thalassia hemprichii*

● *Thalassia hemprichii*

Source: McKenzie, L.J., Lee Long, W.J. and Bradshaw, E.J (1997).
Distibution of Seagrasses in the Lizard Island Group - a reconnaissance survey, October 1995.
CRC Reef Research Centre
Technical Report No. 14
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