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Distribution of Seagrasses at Oyster Point, Cardwell September 1994

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Abstract

There was 393 ha of seagrass habitat at Oyster Pt and adjacent to Cardwell (Hinchinbrook Channel) found in a reconnaissance survey of 1150 ha of intertidal and sub-tidal areas conducted in September 1994. Five seagrass species were recorded in the survey area. *Halophila ovalis* was the most commonly encountered species and occurred over 24% of the surveyed area (70% of seagrass habitat). The total mean cover of the overall seagrass habitat was approximately 55%. The majority of seagrass habitat was intertidal on the mud or sand banks on the perimeter of Hinchinbrook Channel. There was no seagrass outside the mouth of Stony Creek.

Seagrasses at Oyster Pt and adjacent to Cardwell were restricted to shallow depths, probably because of high turbidities and attenuation of photosynthetically active light. *Halodule pinifolia* had the shallowest distribution (to 0.60 m below MSL) and *Halophila decipiens* the deepest (to 3.44 m below MSL). Mean depths of occurrence for individuals species were mostly between 1.03 m and 2.75 m below mean sea level.

Introduction & General Seagrass Ecology

Seagrass meadows in northern Queensland play a critical ecological role as a support 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). Coastal seagrasses are also important nutrient and sediment sinks (Short 1987), and play important roles in maintaining sediment stability and water clarity.

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 conditions and can therefore be used as effective ecological indicators of environmental impact (Dennison *et al.* 1993).

Tropical seagrass meadows are subject to temporal changes, varying seasonally and between years (Mellors *et al.* 1993; McKenzie 1994). The potential for widespread seagrass loss has been well documented and the causes of loss can be natural such as cyclones and floods (Poiner *et al.* 1989), or due to human influences such as dredging (Pringle 1989), agricultural runoff (Preen *et al.* 1995), industrial runoff (Shepherd *et al.* 1989), oil spills (Jackson *et al.* 1989).

In 1987 Coles *et al.* (1992) surveyed seagrass meadows in the Hinchinbrook Channel reporting substantial meadows, and identifying 6 different species. Seagrass meadows in the channel (Lucinda Pt - George Pt in the south. to Meunga Creek - Hectare Pt in the north) were estimated to cover 1457 ha (Lee Long *et al.* 1993) and found to support high densities of juvenile penaeid prawns and were considered important in sustaining fisheries stocks in the area (Coles *et al.* 1992).

In 1993 an aerial survey (altitude 400 ft) was conducted between Mission Beach and Bowen (including Hinchinbrook Channel) by Jane Mellors (Department of Tropical Environmental Studies and Geography, James Cook University) to determine the presence and extent of seagrass meadows in the region. Mellors (pers. comm.) reported extensive meadows along the banks of Cardwell and Hinchinbrook Channel. She reported extensive feeding by dugongs. The survey also provided an index of the relative importance of intertidal meadows as dugong feeding grounds, with Cardwell - Hinchinbrook rating as the most important in the region, based on density of feeding trails.

On the 11 of March 1994, Tony Preen (Department of Tropical Environmental Studies and Geography, James Cook University, pers.comm.) surveyed 9 transects (a total of 23 sites) in Hinchinbrook Channel. Transects were perpendicular to Oyster Point, Cardwell and Meunga Creek, and were approximately 200 to 300 m in length. Preen reported that seagrass covered approximately two thirds of the transects, and that *Halophila ovalis* was the dominant species.

The present seagrass reconnaissance survey was conducted along approximately 6 km of shore centred on Stony Creek, on the 27 to the 29 of September 1994.

Site Description

Hinchinbrook Channel is between Hinchinbrook Island and the mainland coast within the Murray River basin and has a coastline which runs from Tully River in the north to Lucinda in the south. Hinchinbrook Channel is approximately 4 km wide and up to 20 m deep in the Oyster Pt vicinity (Fig. 1). Mangrove wetlands and dry sclerophyll woodlands form a major part of the landward margin of the channel. Annual rainfall for the area is 2129 mm, of which 1450 mm falls from January to March (Director of Survey, Department of Defence, Canberra).

The Herbert River catchment drains a vast agricultural (predominantly sugar cane and pasture) area in the southern Hinchinbrook Channel. The dominant currents are tidal, semi-diurnal and are due to two nearly identical tidal waves entering the channel at its northern and southern openings and meeting in the middle. There is an almost negligible net flow to the north through the channel. The residence time of water is about 2 months (Wolanski *et al.* 1990).

The only urban coastal development on this coastline is Cardwell. There is a prawn farm (>20 ha) and a barramundi farm operating within 3 km south of Oyster Pt, and other aquaculture developments are planned for, further south in the Channel. A resort complex (Port Hinchinbrook) to accommodate 1500 people plus day visitors, with development involving construction of a marina, access channel, canal, breakwaters and associated dredging is proposed for Oyster Pt. The Port Hinchinbrook project proposes to excavate an entrance channel approximately 37000 m^2, along a stable slope of 1 in 4, with rock walls extending no more than 100 m out from Oyster Pt.

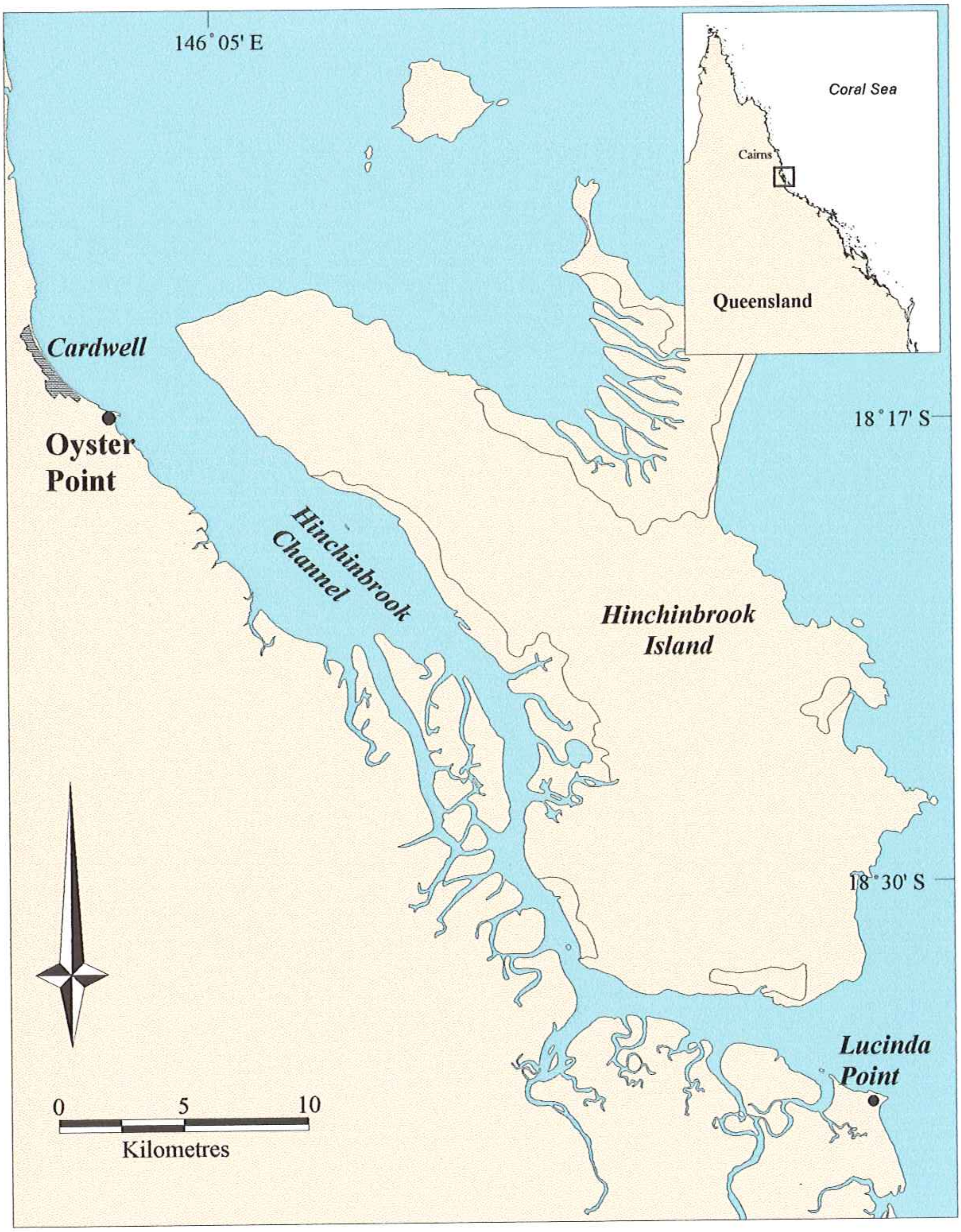

Figure 1. Location of Oyster Point study area

Methods

Survey Methods

Seagrass distribution was surveyed from the 27 to the 29 of September 1994. A total of 198 survey sites were selected, including 20 transects and numerous point sites (Fig. 2). Estimates of % seagrass species cover within 0.25 m^2 quadrats, % cover of algae and sediment characteristics were recorded by divers at each survey location. Seagrass species were identified according to Kuo and McComb (1989). Sediment characteristics were described using visual estimates of grain size: shell grit, rock gravel (>2000µm), coarse sand (>500µm), sand (>250µm), fine sand (>63µm) and mud (<63µm). A differential global positioning system (GPS) was used to accurately locate each survey point (mean quality = 3.59 ±0.07m) and record universal time. A depth sounder 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 from the survey were entered onto a Geographic Information System (GIS). A new base map for the area was created from aerial photographs and control points. Seagrass meadows were plotted on Mapinfo 3.0 using site data and aerial photographs. All maps and GIS outputs were produced using Australian Map Grid (AMG) zone 55 projection. Errors which should be considered when interpreting GIS maps include digitising and rectifying aerial photographs onto basemaps and Global Positioning System (GPS) fixes for survey sites (± 3.59 m, expressed as "quality" in the database).

Results

Seagrass habitats within the area surveyed at Oyster Point and adjacent to Cardwell cover an area of 393 ha (Fig. 2). Five species of seagrasses were found in the survey area:

Halodule pinifolia (Miki) den Hartog
Halodule uninervis (wide) (Forsk.) Aschers in Boissier
Halophila decipiens Ostenfeld
Halophila ovalis (R. Br.) Hook.*f*.
Halophila tricostata Greenway

Of the 198 sites surveyed, 109 contained seagrass (Fig. 2). The majority of seagrass habitat was located on wide, shallow mud banks lining the perimeter of Hinchinbrook Channel. The major areas of seagrass habitat were those dominated by *Halophila ovalis* (approximately 276 ha) (Fig. 6). Mean seagrass % cover for the vegetated sites was 54.48 ±2.89, and mean algae % cover was 8.75 ±2.39 (4 sites only). *Halodule pinifolia* had the highest percent seagrass cover on average and *Halophila decipiens* the least (Table 1, Fig 8). *Halophila ovalis* was the most commonly recorded species followed by *Halodule* uninervis and *Halodule pinifolia* (Table 1). The highest diversity of seagrass species occurred in the survey area south of Oyster Pt.

Table 1. Mean percent cover of seagrass at each site.

Species	# sites present	Mean % cover	Area covered (ha)	see Figure #
Halodule pinifolia	8	72.50 ±13.98	18.7	3
Halodule uninervis	26	40.39 ±4.77	46.5	4
Halophila decipiens	19	11.42 ±2.56	90.5	5
Halophila ovalis	78	44.05 ±2.94	275.6	6
Halophila tricostata	12	54.58 ±7.77	40.7	7

Seagrass species along the perimeter of the channel were distributed into distinct depth zones with some species overlap (Fig. 9). Narrow bands (approximately 100 m wide) of predominantly *Halodule uninervis/Haludule pinifolia* were located high on the intertidal mud banks (Figs 3 & 4). Immediately below this was a wide (500 - 600 m on the north side of Oyster Pt and 300 - 400 m on the south) zone of *Halophila ovalis,* followed by *Halophila decipiens* (Figs 5 & 6). *Halophila tricostata* occupied the deepest sites and occurred only south of Oyster Pt (Fig 7). Most seagrass occurred in fine-mud or mud/sand/shell substrates.

No seagrass was found at depths greater than 3.5 m. Adjacent to and seaward of the seagrass, in deeper water, was a zone of sea-pens and alcyonarians. Beyond this zone the benthos was bare mud/coarse sand with shell.

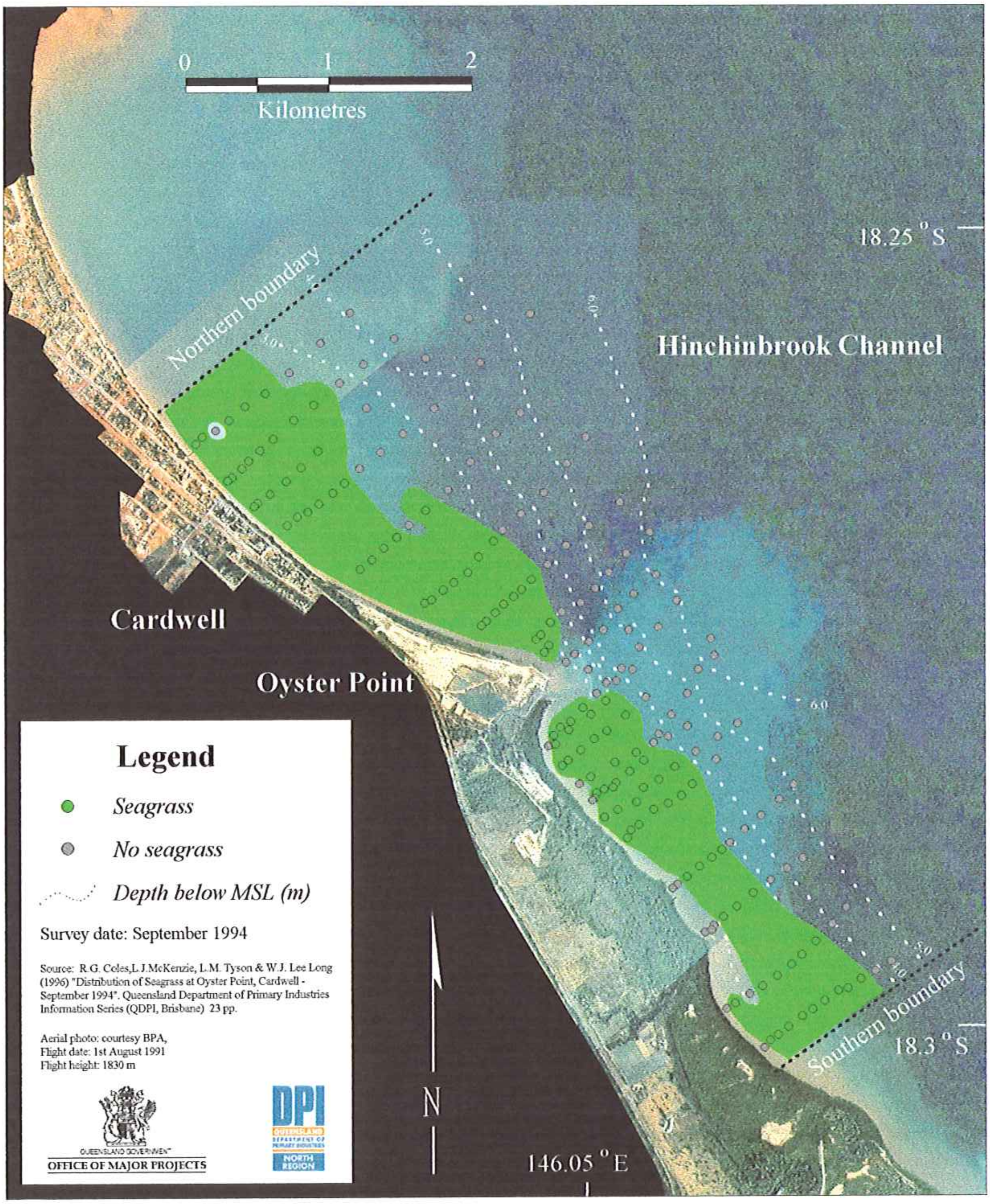

Figure 2. Location of survey area at Oyster Pt and adjacent to Cardwell, showing position of sampling sites and distribution of seagrass.

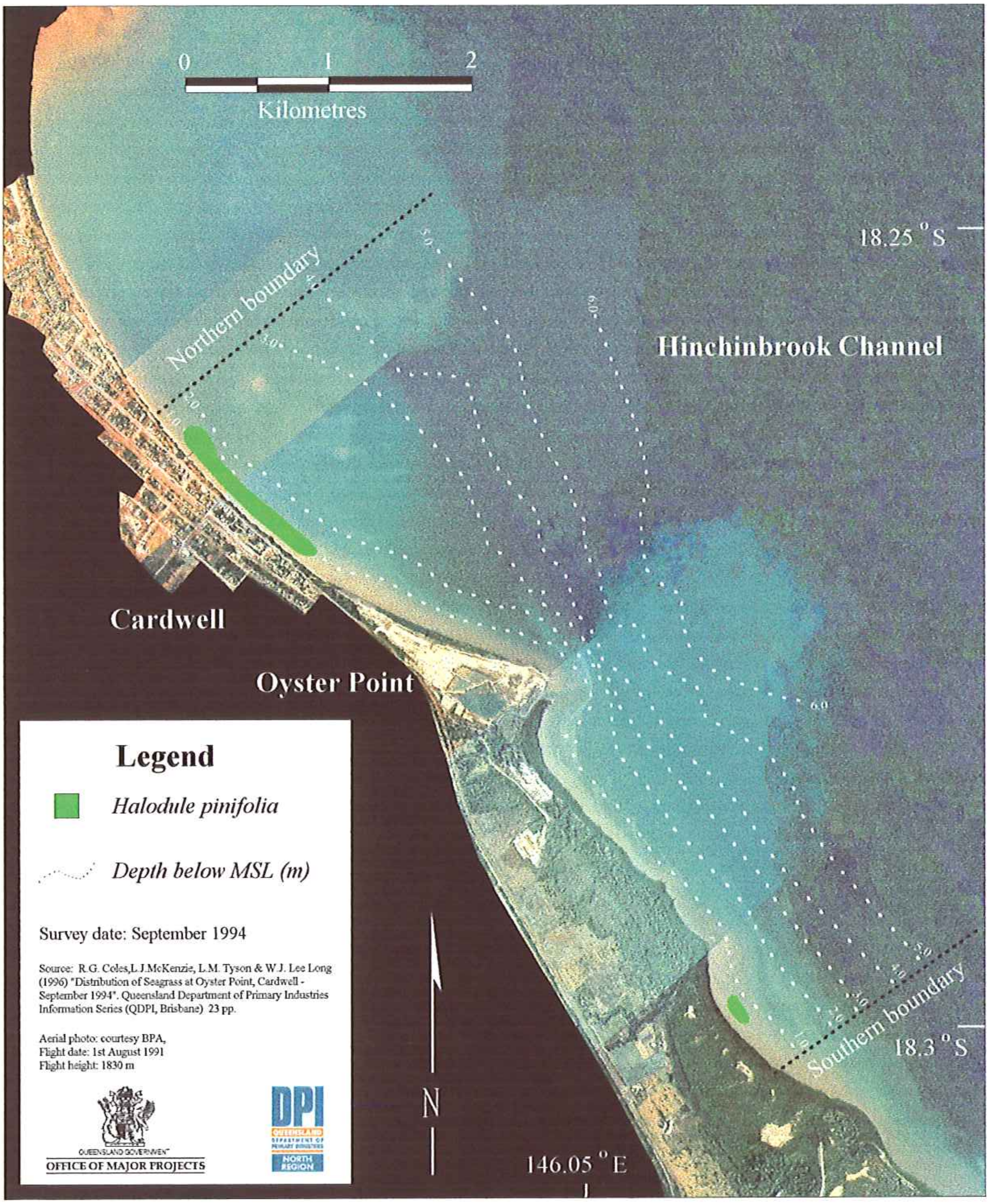

Figure 3. Distribution of *Halodule pinifolia* within the survey area at Oyster Pt - September 1994.

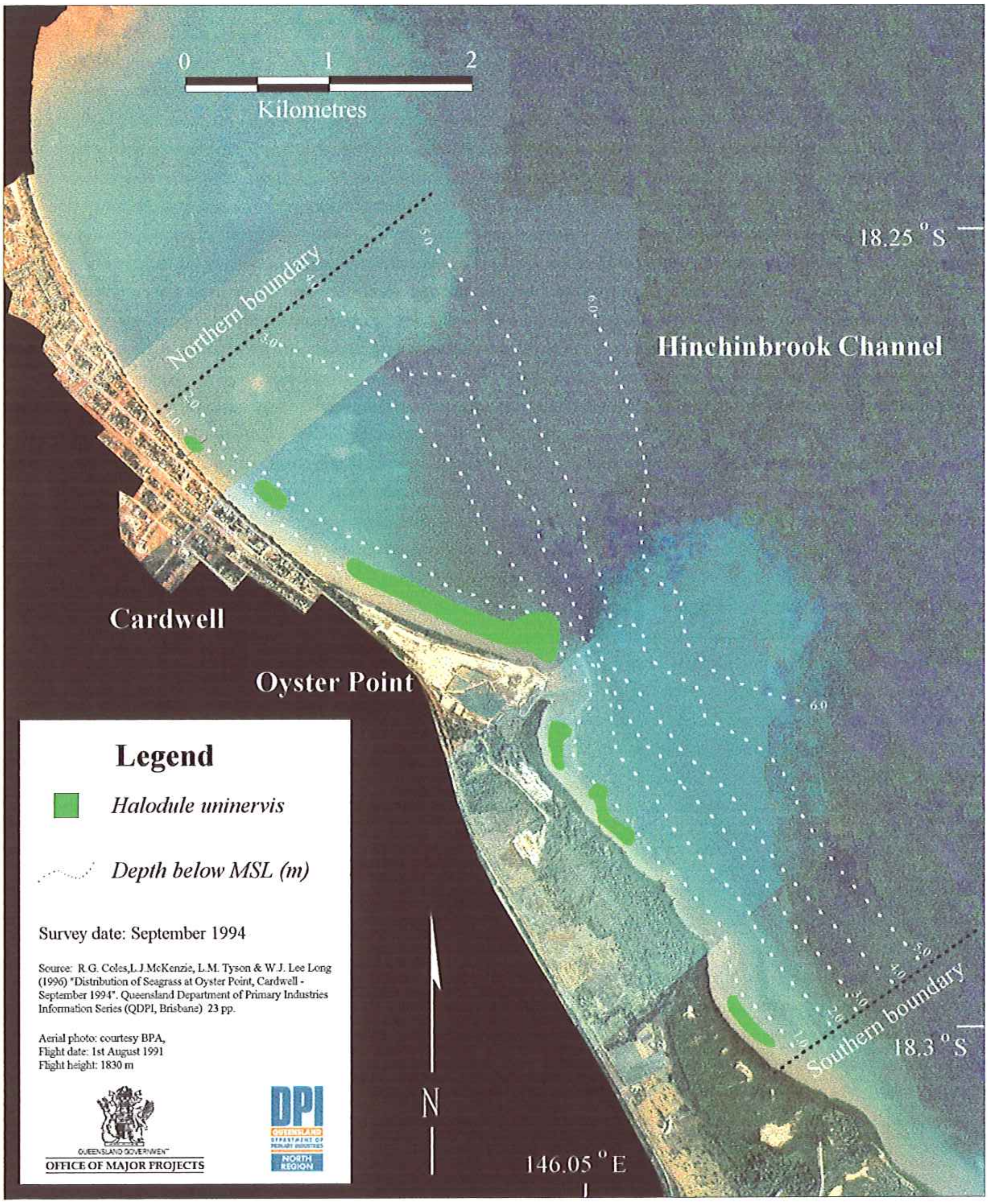

Figure 4. Distribution of *Halodule uninervis* within the survey area at Oyster Pt - September 1994.

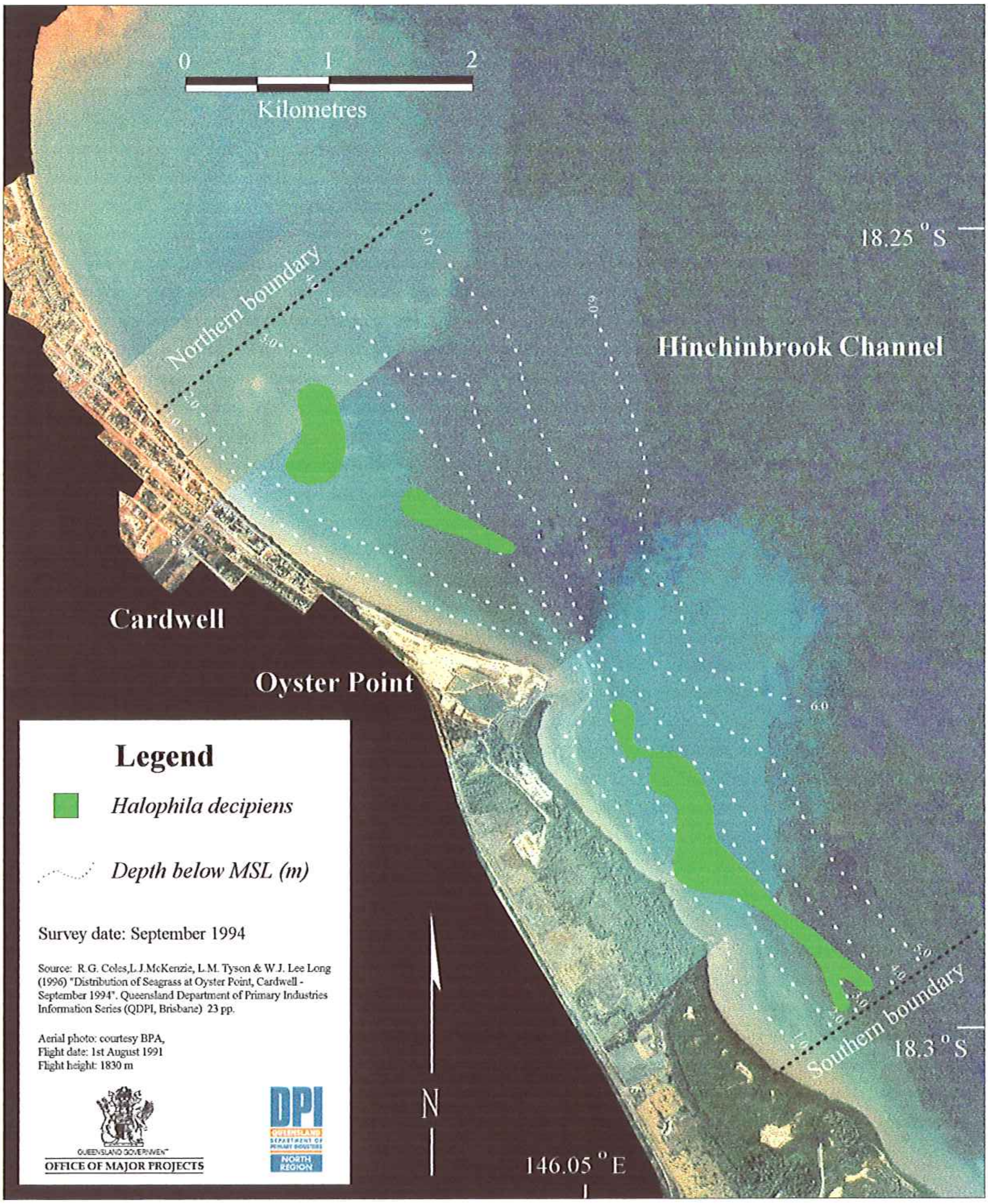

Figure 5. Distribution of *Halophila decipiens* within the survey area at Oyster Pt - September 1994.

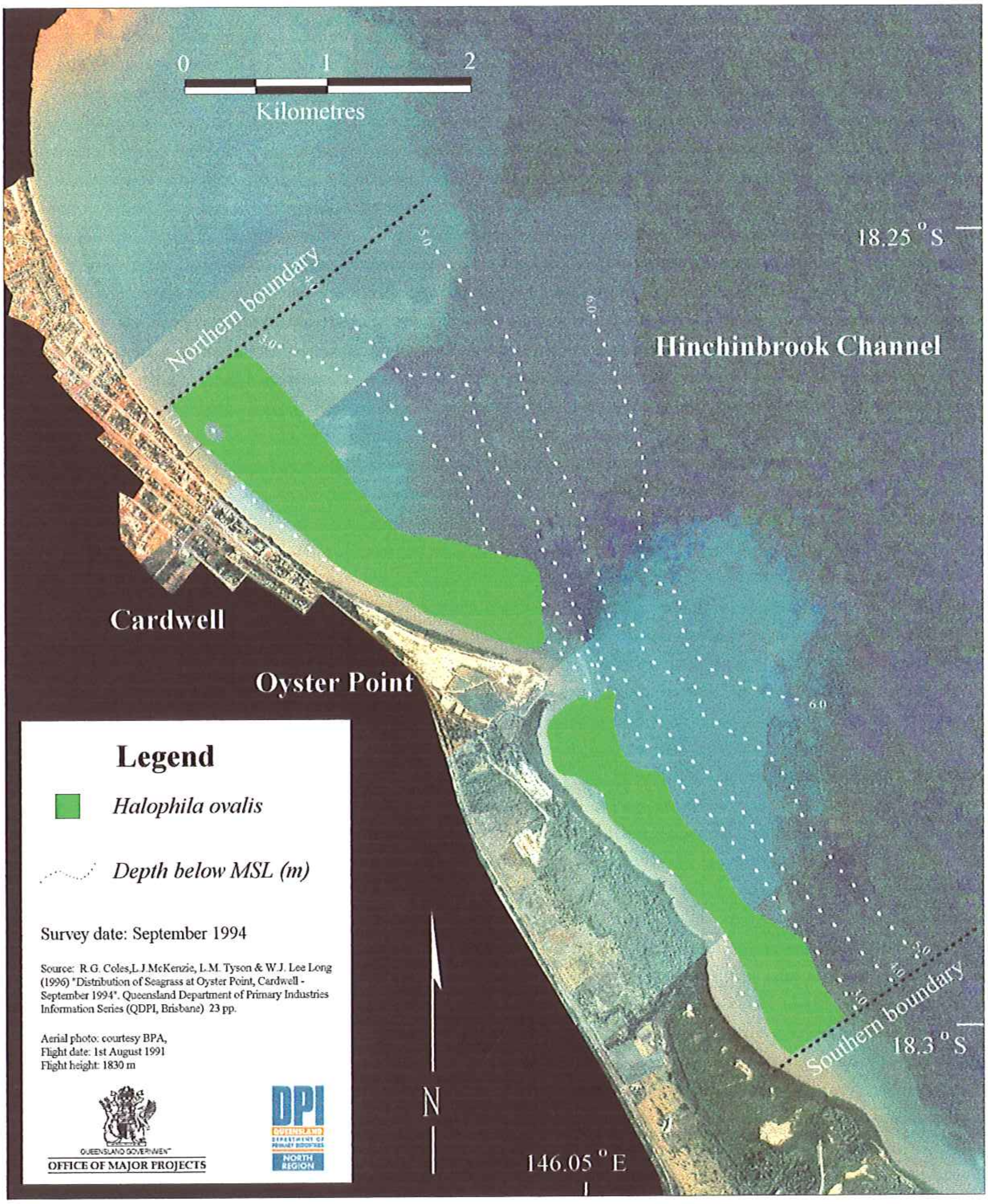

Figure 6. Distribution of *Halophila ovalis* within the survey area at Oyster Pt - September 1994.

Figure 7. Distribution of *Halophila tricostata* within the survey area at Oyster Pt - September 1994.

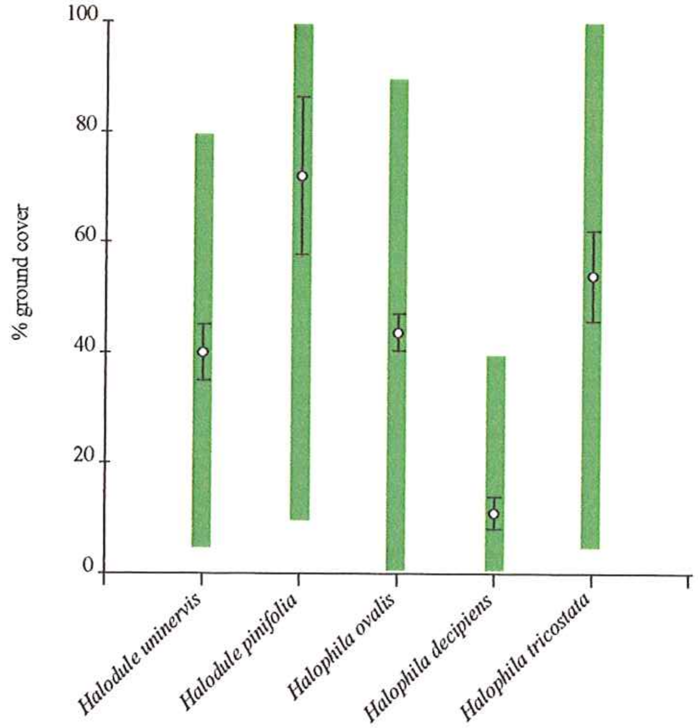

Figure 8. Mean, standard error and range of percent ground cover for each seagrass species found at Oyster Pt and adjacent to Cardwell.

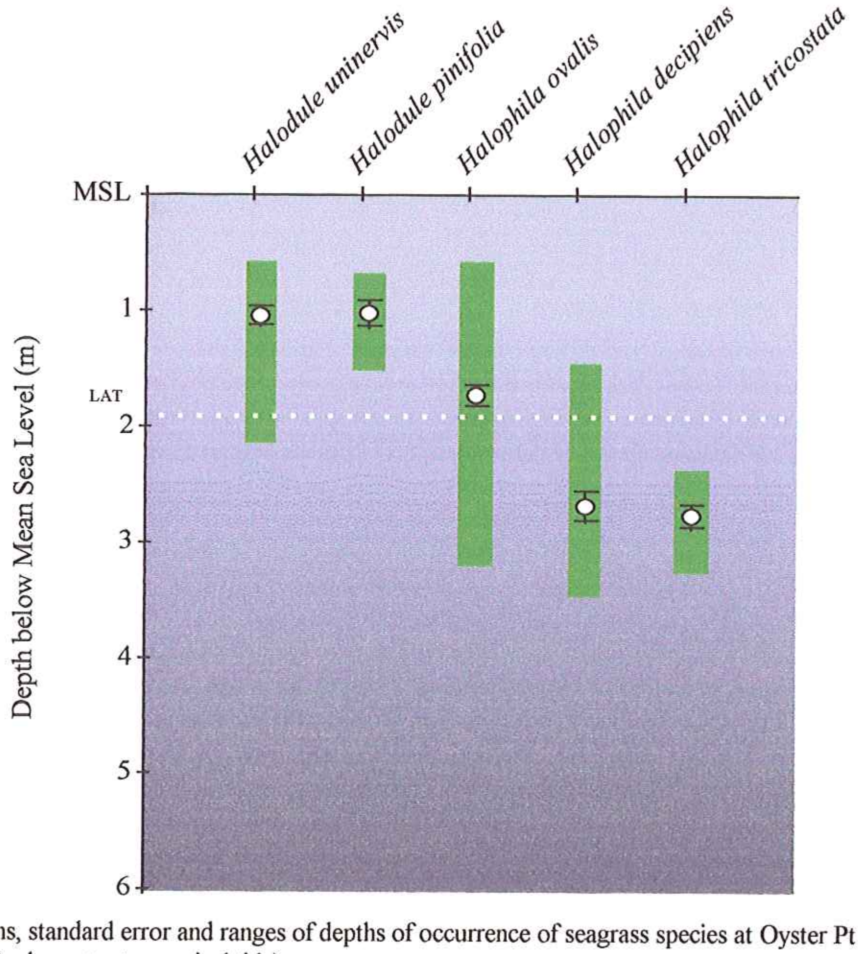

Figure 9. Means, standard error and ranges of depths of occurrence of seagrass species at Oyster Pt and adjacent to Cardwell (LAT = lowest astronomical tide).

Discussion

Distribution and abundance of Oyster Point Seagrasses

Seagrasses occurred only in shallow water depths. The upper depth limit is most likely controlled by exposure and drying at low tides. High water turbidity and light attenuation most likely affect the lower depth limit of seagrasses in Hinchinbrook Channel. Seagrasses, like all plants, require sunlight for photosynthesis and growth. Increased periods of high turbidity in the channel may reduce the light available to seagrasses. This will limit the depth range in which seagrass can survive and therefore reduce the total amount of seagrass.

No seagrasses were found immediately outside the mouth of Stony Creek. The sediment here is mainly rock, coarse-sand or shell with very little mud. Such sediments are not favourable for seagrasses growth. The area is probably also scoured by tidal flow and freshwater runoff from the creek. The natural sediment plume generated from Stony Creek would further reduce the light available for photosynthesis.

Significance of Oyster Point Seagrasses

It is our opinion, based on the best information presently available, that the seagrasses at Oyster Pt and adjacent to Cardwell represent a regionally important resource. The seagrass habitat surveyed is approximately 27 % of the total seagrass habitat estimated for Hinchinbrook Channel (from the seagrass distribution maps for the entire channel in 1987 (Coles *et al.* 1992)). There is only approximately 20,700 ha of coastal seagrass habitat recorded between Cairns and Townsville (Lee Long *et al.* 1993). Almost all of this is in sheltered areas which are also desirable for port and marina development, and so are under some threat.

Halophila tricostata is a little-studied species which is found only in Queensland, currently recorded from locations between latitudes 14°11'S and 23°45'S. Until recently, very little was known of the species' distribution and reproductive biology. First described from sledge samples near Lizard Island (Greenway 1979), its distribution has since been established in surveys in the late 1980's (Coles *et al.* 1987a, 1987b, 1992; Lee Long *et al.* 1989). It is a dioecious (male and female flowers on separate plants) species known to occur between 1.4 and 30 m depth in habitats which include shallow coastal areas near mangrove-lined estuaries (Kuo *et al.* 1993). Approximately 41 ha of *Halophila tricostata* was recorded in the present study (Preen's survey in March of 1994 did not record any plants).

Halophila tricostata is an ephemeral seagrass. It is an annual, most abundant from September to January (Kuo *et al.* 1993). Halophila tricostata germinates from seed, grows and produces flowers and fruits all within these few months of the year. After January, seeds lie dormant in the sediments. The mean percent cover recorded for this species in the present survey was very high when compared to the Fitzroy Island site studied by Kuo *et al.* (1993).

The plants observed during this study were also not a morphological type (growth form) typical of the species. *Halophila tricostata* is generally a species which does not stand very high off the sediment. Plants found in the present study were tall (6-8 nodes visible above the sediment) and therefore unusual. It is unknown whether the morphological type observed is due to the plant responding to the surrounding environmental conditions, or is a new and much rarer species which may deserve increased protection. Research on this is continuing by taxonomist, Professor John Kuo (Centre for Microscopy and Microanalysis, University of Western Australia).

Halophila ovalis, Halodule uninervis, Halodule pinifolia and *Halophila decipiens* on the other hand are relatively common seagrasses and are a major source of food for dugongs and sea turtles. Mr Lem Aragones (Department of Tropical Environmental Studies and Geography, James Cook University) has recorded dugong feeding scars on the meadows to the north of the survey area where he currently conducts research into seagrass regrowth. Two green sea turtles and a dugong were also sighted at Oyster Pt during our seagrass survey.

Seagrass meadows, such as reported in the present study, are important nursery habitat for juveniles of commercially important prawn species. Coles *et al*. (1992) collected commercial species of prawns (*Penaeus esculentus* and *Metapenaeus endeavouri*) in beam trawls on the opposite side of the channel to Oyster Point in their survey between Cairns and Bowen. They commented that the importance of these particular meadows to the commercial prawn fisheries should be taken in account in the management of coastal systems. Nearshore seagrass meadows of approximately 900 ha in Cairns harbour, contributed an estimated $1.2M per year to commercial prawn fisheries, and also supported approximately 9,000 fish per hectare (Coles *et al.* 1993).

On the 16th of June 1994, Northern Fisheries Centre staff conducted a preliminary study (unpublished data) of Mary Creek (at the southern boundary of the present survey area) to examine the health of the creek. In beam trawl samples from the seagrass meadow near Mary Creek (at the southern boundary of the present studies survey area). 68% of the prawns collected were of commercial importance to the north-eastern prawn fishery, of which endeavour prawns (*Metapenaeus endeavouri*) were the most abundant (46% of total prawns). The remaining taxa collected were typical of fauna associated with seagrasses along mangrove-lined estuaries of the region.

Based on this information, we would expect the seagrasses mapped in the present study to be significant to fisheries production of the channel and the region.

Human impacts & monitoring

Oyster Point seagrasses may also be susceptible to human impacts such as dredging, land runoff from farming, forestry and urban areas. Sediment and nutrient loads from these areas also affect water quality conditions and availability of light and nutrients to the seagrasses. Hydrocarbons and other chemical pollutants may have further negative impacts and increase the susceptibility of seagrasses to disease. These inputs must also be considered in assessing total human impacts on the Hinchinbrook Channel seagrasses.

Results of this reconnaissance survey establish the present distribution of seagrasses, but do not provide the detailed quantitative baseline measures of seagrass abundance required for assessing future changes. Management of the seagrass resources in Hinchinbrook Channel will require a program which identifies changes, causes of change, acceptable ranges of change and critical levels of the impacting agents.

Conclusions

Nearshore seagrass habitats such as those at Oyster Point and adjacent to Cardwell, are important to the marine ecology, particularly dugong and turtle populations and the commercial prawn fishery. These habitats are only a small part of the total coastal zone, and any losses need to be avoided.

Human population growth in the Cardwell and Hinchinbrook area, and increases in use of the Hinchinbrook Channel, are likely to increase the threats to seagrasses in the area. Prolonged periods of poor water quality (light and nutrients) may threaten the health of these seagrasses and further impacts on water quality should be a concern for the maintenance of some rarer species. In Hinchinbrook Channel water turbidity is already preventing growth of seagrasses in depths greater than 3.5 m.

The present survey does not provide the detailed information on seagrass abundance necessary for measuring future changes, but it does provide a foundation GIS from which baseline and monitoring programs can be developed. A monitoring program should ideally be designed to identify causes of change, acceptable ranges of change and critical levels of the impacting agents. Developing management policies to minimise negative impacts on Hinchinbrook Channel and Oyster Point seagrasses require more information on natural variability of seagrass abundance, annual trends and impacts.

Research on the causes and mechanisms of change (loss and recovery) in these seagrasses and community education programs are recommended in developing the necessary widespread support to protect these valuable habitats.

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