Seagrass resources in the vicinity of the proposed Urangan Boat Harbour dredge material disposal & rehandling area

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Disclaimer
Information contained in this publication is provided as general advice only. For application to specific circumstances, professional advice should be sought. Seagrass maps in this report are magnified so that small meadows can be illustrated. Estimates of mapping error (necessary for measuring changes in distribution) are not to be inferred from the scale of these hard-copy presentation maps. These can be obtained from the original GIS database maintained at the Northern Fisheries Centre, Cairns.

The Department of Primary Industries, Queensland has taken all reasonable steps to ensure the information contained in this publication is accurate at the time of the survey. Seagrass distribution and abundance can change seasonally and between years, and readers should ensure that they make appropriate enquires to determine whether new information is available on the particular subject matter.

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EXECUTIVE SUMMARY

1. 85.5 ±10.9 hectares of intertidal seagrass meadows were mapped on the mud/sand banks within the survey area adjacent to Urangan Boat Harbour in February 2002. This represents approximately 90 to 100% recovery since the total loss of seagrass meadows in the study locality in early 1999.
2. No subtidal seagrass meadows were found within the survey area as subtidal substrates were predominately highly mobile fine sands.
3. Approximately 55% of the seagrass meadows in the study area were aggregated or isolated patches of *Zostera capricorni* (plants generally of a small morphology with a canopy height <5cm). The remainder were continuous meadows of *Zostera capricorni* with *Halophia ovalis* which were generally located in close proximity to the boat harbour.
4. All intertidal seagrass meadows in the survey area were mostly light to moderate cover (10 to 50%) and dominated by *Zostera capricorni*. Seagrass abundance also appears to have recovered to near pre-flood levels
5. A GIS of the intertidal seagrass meadows was created in MapInfo® using the survey information. A CD Rom copy of the GIS with metadata was archived at QT Brisbane and the original archived with the custodians (DPI) at Northern Fisheries Centre.

INTRODUCTION

Queensland Transport (QT) has the role of making it safer, easier, environmentally-friendlier, and more cost effective to move people and goods across town, state and overseas. The department works closely with the community, industry and government agencies, to ensure a coordinated, consultative and integrated approach to addressing and resolving transport challenges. QT aims to create and manage a world-class transport system for all our communities and industries, to prosper locally and internationally and enhance the quality of transport for this and future generations. To this aim, it is necessary for QT to provide safe access to Urangan Boat Harbour, which requires regular maintenance dredging. In the past dredge material has been deposited in settling ponds upstream of Pulgul Creek (2km from the boat harbour).

Due to an identified need, QT are planning to begin construction of a dredge material disposal and rehandling area as an extension of the existing Urangan Boat Harbour in the near future. Prior to construction, QT contracted the Queensland Department of Primary Industries (QDPI) Northern Fisheries Centre (NFC) to conduct a survey of seagrass resources adjacent to the proposed development area.

This report presents the results of a survey conducted in February 2002. The objectives were:

- *To map the distribution and abundance of seagrass meadows in proximity to the Urangan boat harbour in February 2002 (an area defined as extending approximately 2 km south of the existing structure),*
- *To assess of changes in seagrass distribution and abundance since the December 1999 surveys, and*
- *Provide a CD-Rom containing the GIS of seagrass distribution.*

General Seagrass Ecology

The importance of seagrass meadows as structural components of coastal ecosystems is well recognised. These marine angiosperms are important for stabilising coastal sediments; providing food and shelter for diverse organisms; as a nursery ground for many prawn and fish of commercial importance; and for nutrient trapping and recycling. Seagrass meadows are also essential food for dugong, *Dugong dugon* (Miller) and green sea turtles, *Chelonia mydas* (Linnaeus). Intertidal seagrasses also provide important habitat for wading birds. Coastal seagrass meadows are therefore an important resource economically and ecologically.

Destruction or loss of seagrasses has been reported from most parts of the world, often from natural causes, eg "wasting disease", or high energy storms. More commonly destruction has resulted from human activities, eg. as a consequence of eutrophication, or land reclamation and changes in land use. Anthropogenic impacts on seagrass meadows are continuing to destroy or degrade coastal ecosystems and decrease their yield of natural resources.

Northern Great Sandy Strait seagrasses

Seagrass meadows are a major marine habitat of the Great Sandy Strait. A major population of dugong and green sea turtles are dependent on these meadows. The area and density of seagrass meadows in the strait also change seasonally and periodically (Conacher *et al.* 1999).

Seagrass distribution was first mapped in the Great Sandy Strait in July/December 1973 (Dredge *et al.* 1977). Seagrass was found south of the co-tidal line, which occurs at

Moonboom Islands (25°20’ S). No seagrass was found north of the co-tidal line, including Urangan.

In October-November 1992 an aerial photographic survey of the Strait was conducted and significant increases in seagrass distribution, relative to 1973 surveys, were reported in the northern section of the Strait, between River Heads and Urangan (Fisheries Research Consultants 1993).

In 1994, a broad scale survey of the Great Sandy Strait seagrass meadows was conducted (mainly by air) which reported an increase in distribution of meadows south of Urangan to River Heads compared with 1992 (Fisheries Research Consultants 1994a).

In June 1994, long-term monitoring transects were established throughout the Great Sandy Strait, including a transect at Pulgul Creek, adjacent to the Urangan Boat Harbour to determine any changes in seagrass presence and depth profiles. Resurveys were conducted in March 1995, November 1996, February 1998, September 1998 and February 1999. Large decreases in seagrass distribution were recorded in 1996 and recovery to February 1999 remained low (Conacher *et al.* 1999).

In December 1998 a detailed dive and aerial survey of the Great Sandy Strait was conducted which reported dense *Zostera capricorni* with *Halophila ovalis* (mud/sandy) meadows present on mud/sand banks close to the existing Urangan Boat Harbour development (McKenzie In Prep).

Flooding of the Mary River in February 1999 caused the complete loss of seagrass meadows in the northern Great Sandy Strait (McKenzie et al. 2000). Community seagrass monitoring from August 1999 showed initial re-colonisation of seagrasses in May 2000 and recovery of seagrass meadows to pre-flood levels occurred in August 2001. In addition to flooding, urban and coastal development threaten the environmental health of seagrass resources in the Great Sandy Strait region.

METHODOLOGY

Site Description

Urangan Boat Harbour is located in the very north of the Great Sandy Strait. The Great Sandy Strait is a sand passage estuary between the mainland and Fraser Island.

The Great Sandy Strait was listed as the 992nd Wetland of International Importance under the Ramsar agreement, in May 1999. The Strait includes the largest area of tidal swamps within the southeast Queensland bioregion, consisting of intertidal sand and mud flats, extended seagrass meadows, mangrove forests, salt flats/marshes, and often contiguous with freshwater *Melaleuca* wetlands and coastal wallum swamps. It is an exceptionally important feeding ground for migratory shorebirds and important for a wide range of other shorebirds, waterfowl and seabirds, marine fish, crustaceans, dugong, sea turtles and dolphin (Ramsar 1999).

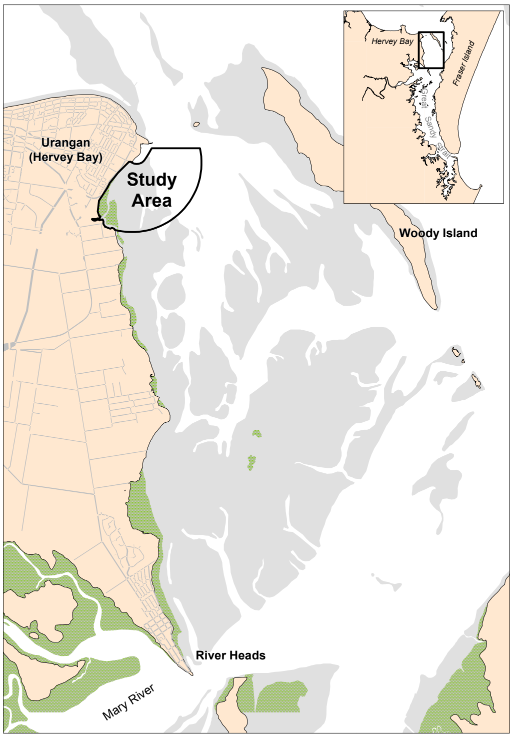


Figure 1. Location of study area – Great Sandy Strait Region.

The Mary River flows into the northern Great Sandy Strait before entering Hervey Bay from the south (Figure 1), and drains a catchment of 9600 km^2. Land use practices in this catchment have resulted in problems due to flooding, severe stream-bank erosion and land degradation (Queensland Department of Primary Industries 1993).

The major urban development in the immediate region is the City of Hervey Bay, in the northern Great Sandy Strait. Pollutants (nutrients, toxicants) from the urbanisation and stormwater runoff would be expected, but have not been analysed in this report.

Climate in the region is subtropical and coastal. Seasonal influences are derived from the tropical zone to the north, the temperate zone to the south and the thunderstorm breeding area to the south west (Dredge *et al*. 1977). Mean annual rainfall (from 127 years data) is 1166 mm for the region (Bureau of Meteorology 2000). Rainfall is greatest between December and March. Mean daily temperatures ranged from 15.2 to 26.9°C (87 years average), with January being the hottest month and July the coolest (Bureau of Meteorology 2000).

Survey Methods

Intertidal seagrass distribution was assessed using aerial photographs and helicopter surveys. An aerial survey of intertidal seagrasses was conducted on the 28th February 2002. During the flight, observers interpreted the distribution of seagrass onto survey charts and a digital video camera was used to store a visual record for future reference and to aid interpretation when mapping on the GIS. Ground truthing sites were haphazardly selected within the meadow. At these sites seagrass abundance and seagrass species composition was visually estimated.

Aerial photographs were sourced from the Queensland Department of Main Roads photographic flight runs taken in October 2001. These photos were taken at low tide when intertidal areas were exposed and were easily interpreted for presence or absence of seagrasses.

Data Collection

Seagrass habitat characteristics including above-ground seagrass biomass, species composition, % algae cover, sediment type, and geographic location were recorded at each ground truth site.

Above-ground seagrass biomass was determined by a “visual estimates of biomass” technique modified from Mellors (1991). At each intertidal site, observers recorded an estimated rank of seagrass biomass and species composition in three replicates of a 0.25 m^2 quadrat per site. On completion of the survey, each observer ranked ten harvested quadrats and the above-ground dry biomass (g DW m^{-2}) was measured for each quadrat. The regression curve representing the calibration of each observer’s ranks was used to calculate above-ground biomass from all their estimated ranks during the survey. All observers had significant linear regressions (r^2 >0.95) when calibrating above-ground biomass estimates against a set of harvested quadrats.

Field descriptions of sediment type 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).

Geographic location of sampling sites (±5 m) was accurately determined by a differential Global Positioning System (dGPS).

✍ Geographic Information Systems (GIS)

The GIS basemap of the study region including coastline, sandbanks, mangroves and islands was created by DPI (McKenzie In Prep), using rectified aerial photographs, the Digital Cadastral Database (DCDB courtesy DNR) and AusLig© database (digitised at 1:250,000 scale).

A GIS of the intertidal seagrass meadows was created in MapInfo® using the survey information. A CD Rom copy of the GIS with metadata was archived at QT Brisbane and the original archived with the custodians (DPI) at Northern Fisheries Centre.

Errors in GIS maps include those associated with digitising and rectifying basemaps and with Global Positioning System (GPS) fixes for survey sites.

Each seagrass meadow was assigned a qualitative mapping value, determined by the data sources and likely accuracy of mapping. Mapping quality was based on the range of mapping information available for each meadow and associated estimates of reliability (R) in mapping meadow boundaries. Estimates of mapping quality ranged from 7.5 to 75 m.

Data collected from the February 2002 survey was compared with the baseline survey undertaken in December 1998. Data recorded in the 1992/1993 seagrass surveys used percent cover of seagrass per quadrat and per site methodology and therefore cannot be used for direct comparisons to the present results where estimates of above-ground biomass techniques were used.

Intertidal seagrass distribution was determined from the GIS (incl. Error) polygons using MapInfo® and compared against the previous December 1998 GIS baseline.

Aerial photographs of the intertidal area of Urangan were scanned and rectified as a layer in the GIS and visually compared.

Biomass estimated from the ground truthed seagrass meadows examined in the helicopter flights over the intertidal seagrasses in the Great Sandy Strait were pooled for individual meadows. The Hi8 video of the helicopter flight was archived at the Northern Fisheries Centre, Cairns.

RESULTS

85.5 ±10.9 hectares of intertidal seagrass meadows were mapped on the mud/sand banks within the survey area adjacent to Urangan Boat Harbour in February 2002 (Map 1). No subtidal seagrass meadows were found within the survey area as subtidal substrates were predominately highly mobile fine sands.

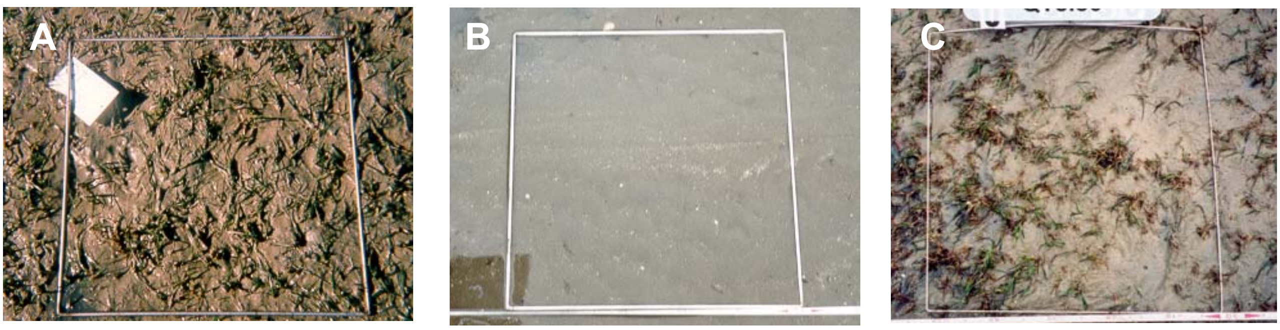
The intertidal seagrass meadows were dominated by *Zostera capricorni* (Aschers.) a strap like plant species. *Zostera capricorni* is a common species in southern Queensland across intertidal mud/sand banks. The plants were generally of a small morphology with a canopy height <5cm. The only other seagrass species present was *Halophila ovalis* ((BR.) D.J. Hook) a colonising species common in Queensland, however its distribution within the survey area was patchy.

Approximately 55% of the seagrass meadows in the study area were aggregated or isolated patches of *Zostera capricorni*. The remainder were continuous meadows of *Zostera capricorni* with *Halophia ovalis* which were generally located in close proximity to the boat harbour (Map 1).

All meadows in the survey area were light to moderate cover (greater than 1% and less than 50% percent cover) and above-ground biomass (mean = 14 g DW m^{-2}; range 4 to 27 g DW m^{-2}). Comparison of results from 2002 survey with previous surveys shows that seagrass meadows decreased from 104.4 ±15.9 hectares in December 1998 to 0 hectares in April 1999, and then subsequently increased to 85.48 ±10.9 hectares in February 2002 (Map 2). Since the total loss in early 1999 this represents approximately 90 to 100% recovery, when the measures of reliability are considered.

Similarly, seagrass abundance appears to have recovered to near pre-flood levels (Plate 1). Seagrass abundance however, could only be compared at the Seagrass-Watch monitoring site (UG2) (Map 1), as this was the only locality where sufficient data was available. At this location in March 1998, seagrass above-ground biomass was 13.9 ±1.2 g DW m^{-2} on average and ranged up to 51 g DW m^{-2}.

Plate 1. *Zostera capricorni* from Seagrass-Watch site UG2 at Urangan: (quadrat 0.25 m^{-2}) ***A***. 28 March 1998, above ground biomass 29.2 g DW m^{-2}; ***B***. 23 February 2000, nil seagrass; ***C***. 28 February 2002, above ground biomass 26.2 g DW m^{-2}.



The Seagrass-Watch long-term monitoring sites have provided the best record of recovery following the Mary River flood in February 1999. Seagrass recovery began after May 2000 (Figure 2). In July 2000 seedlings of *Zostera capricorni* germinated, and by May 2001 seagrass cover was 2-3%. In August 2001 (30 months post-flood) the abundance of *Z. capricorni* had increased to 5-8% at both UG1 and UG2 (Map 1). The canopy height of *Zostera capricorni* across the region increased to 4-5cm over the 2 year monitoring period. Dugong trails were found at Urangan after August 2001, coinciding with seagrass recovery.

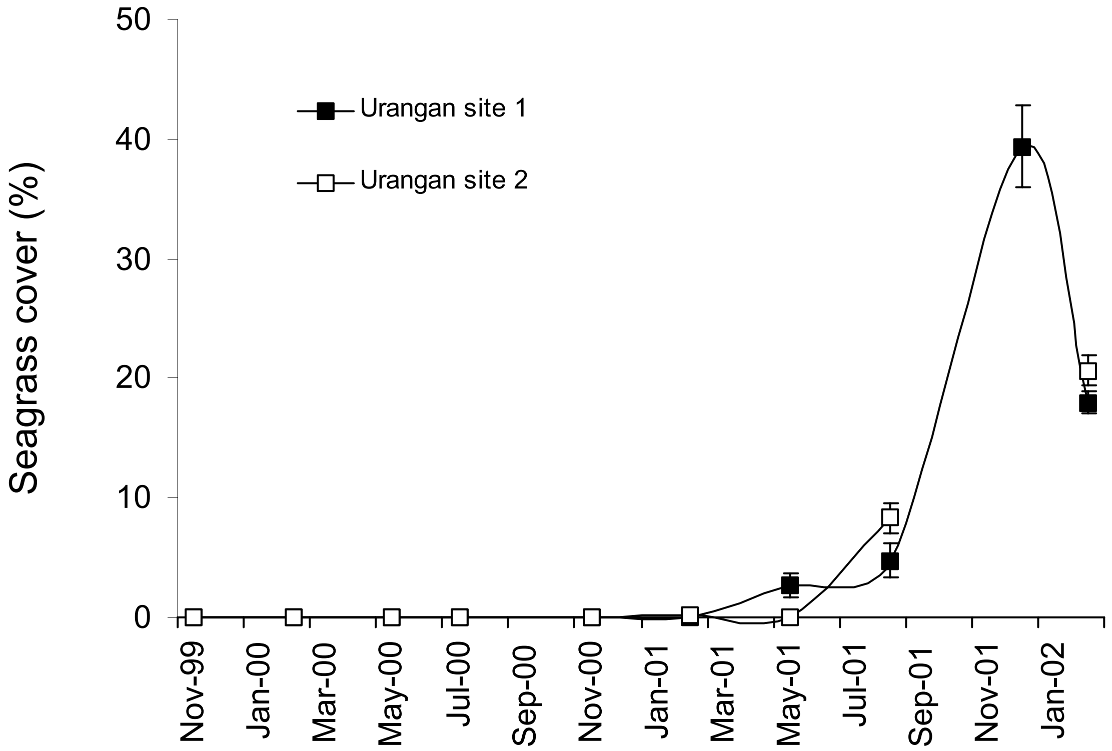


Figure 2. Seagrass abundance (% cover) at Seagrass-Watch long-term monitoring sites near the Urangan Boat Harbour.

MAP 1. Seagrass meadows and monitoring sites adjacent to Urangan Boat Harbour - February 2002.

LEGEND

Continuous cover of *moderate/dense Zostera capricorni*

Isolated & aggregated patches of moderate Zostera capricorni with Halophila ovalis

Seagrass-Watch monitoring site

Survey date: 27th February 2002

Funded by Queensland Transport.

Produced by the Marine Plant Ecology Group, QDPI, Northern Fisheries Centre, Cairns, 2002.

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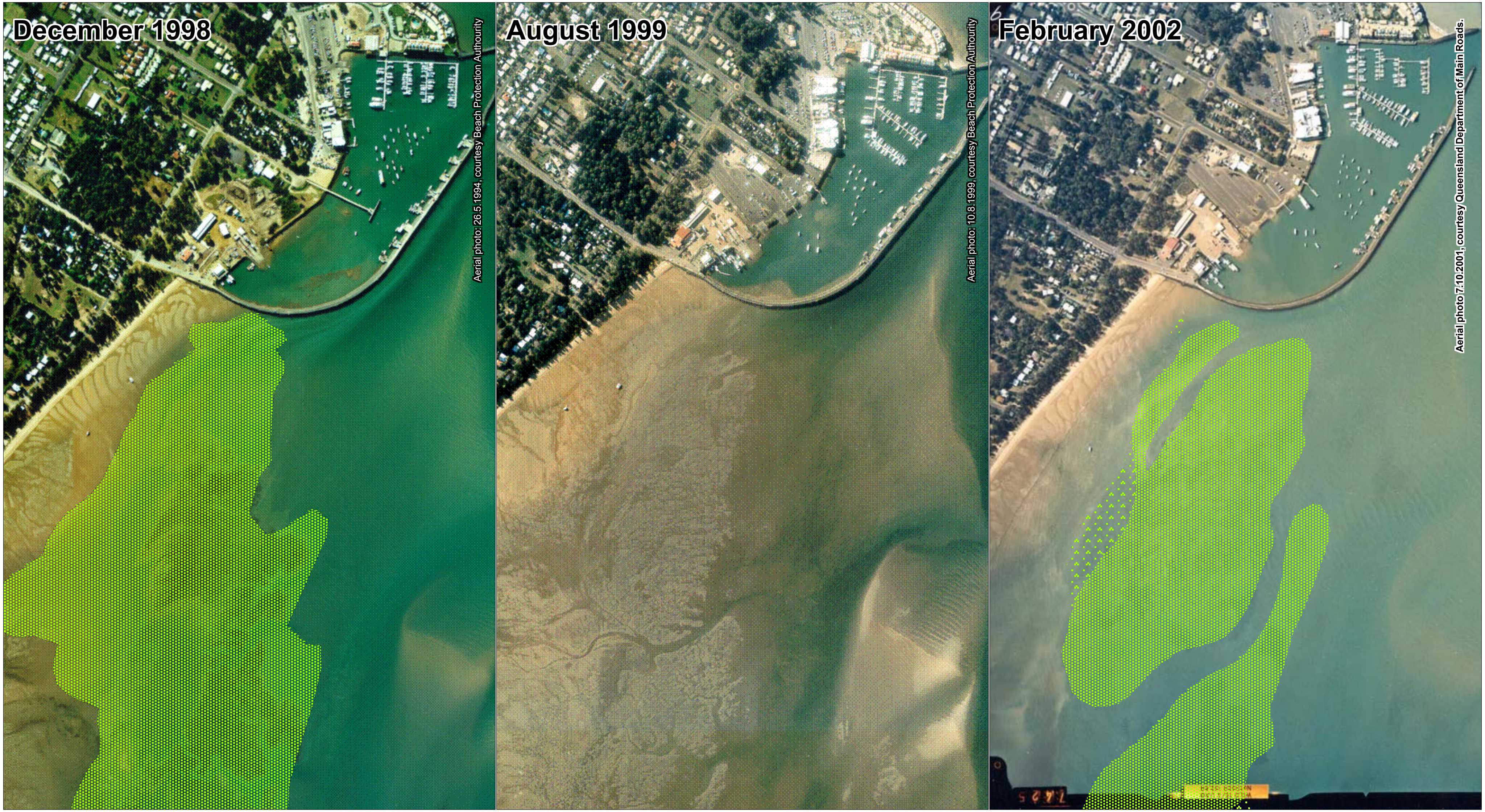
MAP 2. Seagrass meadows adjacent to Urangan Boat Harbour - December 1998 to February 2002.



LEGEND

- *Continuous cover of dense Zostera capricorni*
- *Isolated & aggregated patches of moderate Zostera capricorni with Halophila ovalis*

Survey dates: 12th December 1998 & 27th February 2002

Produced by the Marine Plant Ecology Group, QDPI, Northern Fisheries Centre, Cairns, 2002.

DISCUSSION

✎ Seagrass

Tropical and sub-tropical seagrasses are inherently resilient (McKenzie *et al.* 2000). In most areas where losses have occurred due to acute impacts, the seagrass resources have recovered within 3 to 5 years. While substantial areas of intertidal habitat were lost in 1999 from the northern section of the Great Sandy Strait, most of these meadows have recovered (Pers. Obs.).

Post-1992 flood studies in Hervey Bay found recovery did not begin until 1-2 years after the flooding event (Preen *et al.* 1995). They reported that seagrass recovery was primarily through seed germination as most of the seagrass plants had been completely lost from the region. Similarly, seagrass recovery in the vicinity of the Urangan Boat Harbour did not begin recovery until approximately 16 months after the flood and it was only through seed germination. With two catastrophic events within the last ten years, the capacity of these habitats to fully recover again is unknown.

Much of the seagrass in the intertidal regions on the northern Great Sandy Strait disappeared immediately or in the first few months after the flood impact. It has been speculated that immediate losses in marine angiosperms may also be a result of herbicides attached to sediment particles washed down in the flood waters. Whether this was the primary cause is unknown. Preen *et al.* (1995) suggested that the intertidal and shallow subtidal seagrass habitat probably would have survived the turbid waters of the flood plumes of the flood – cyclone – flood event in 1992 had it not been for the substrate disturbance associated with cyclonic seas.

Sediment deposition and disturbance associated with the flood may be the cause for the immediate seagrass loss at localities such as Urangan (McKenzie et al. 2000). Beneath a shallow layer of sand an abundant amount of roots and rhizomes persisted post-flood, providing a viable nutrient source for any resident seed bank. Seed germination may have been slowed however, as sediment deposition and disturbance associated with the flood, may have deeply buried the seeds, or they may have been damaged by the sediment movement. The potential for recovery (ie. seagrass seed availability within the local sediments) in these intertidal areas is poorly understood and we recommend that estimates of seagrass seed availability should be investigated.

✎ Dugong and turtle

These intertidal seagrasses in the survey area were frequented by dugongs, evident by the high number of dugong feeding trails observed during the survey. The seagrasses also displayed signs of turtle cropping.

Dugong Protection Areas essentially protect dugongs only from netting and other pressures that are related to fishing practices. To manage DPA's effectively, water quality-related problems which effect dugong health, the sources of which lie outside the DPA borders, need to be addressed. Pollutants (incl. Dioxins) have already been detected in high concentrations in dugongs in Great Sandy Strait (D Haynes, GBRMPA, Pers. Comm.).

Significant reductions in nutrient, sediments and pollutant inputs could be achieved by the adoption of industry codes of best practice by all farmers and by the implementation of the Intergrated Catchment Management program (ICM). ICM programs incorporate better land management methods, retention and rehabilitation of riparian zones and wetlands, vegetation management on grazing lands, better fertiliser application technology, and urban stormwater management.

There is no information regarding the affect of the February 1999 Mary River flood on the local turtle population. Green turtle population fluctuations are known to vary from year to year, and recent evidence suggests this may be linked to their food resources.

The loss of expansive areas of intertidal and shallow subtidal habitat, and the degeneration of deepwater seagrasses, in the Great Sandy Strait and Hervey Bay as a result of the February 1999 Mary River flood, is likely to have affected the feeding behaviour and ultimately the breeding cycle of local turtle populations. This may not be evident however, until the 2001 or 2002 nesting season (*results not released by EPA as yet*). Without adequate knowledge of the distribution or abundance of green turtles in the region before or after the flood, it is unclear to what extent this climatic event may have affected the regional population.

To identify and help manage destructive human activities in order to protect crucial fisheries, dugong and turtle habitats, a long term monitoring program for seagrasses has been established in the region - *Seagrass-Watch.* Community volunteers monitor seagrass abundance and composition at selected sites throughout Hervey Bay and the Great Sandy Strait. This is the most intensive seagrass monitoring program in the region and is currently supported by CRC Reef, Department of Primary Industries (Queensland) and Queensland Parks & Wildlife (EPA). Information from this program will be invaluable in monitoring the rate and extent of recovery of seagrass resources in the region.

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Notes: