Coastal Seagrass Habitats at Risk from Human Activity in the Great Barrier Reef World Heritage Area

Review of areas to be targeted for monitoring

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Acronyms Used In This Report

AIMS	Australian Institute of Marine Science
DEH/DEW	Commonwealth Department of the Environment and Heritage / Commonwealth Department of the Environment and Water Resources (now Commonwealth Department of the Environment, Water, Heritage and the Arts)
EPBC	*Environmental Protection and Biodiversity Conservation Act* (Queensland)
GBR	Great Barrier Reef
GBRMPA	Great Barrier Reef Marine Park Authority
GBRWHA	Great Barrier Reef World Heritage Area
GIS	Geographic Information System
JCU	James Cook University
LTM	Long-term Monitoring
MPA	Marine Protected Area
MTSRF	Marine and Tropical Sciences Research Facility
QDPI&F	Queensland Department of Primary Industries and Fisheries
QEPA	Queensland Environmental Protection Agency
QT	Queensland Transport
Reef Plan MMP	Reef Plan Marine Monitoring Program (of the RWQPP)
RRRC	Reef and Rainforest Research Centre Limited
RWQPP	Reef Water Quality Protection Plan

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1. Introduction

The MTSRF Seagrass Status and Trends Program

Seagrass meadows form a key component of the coastal marine habitats of the Great Barrier Reef Word Heritage Area (GBRWHA). In recognition of their importance the Australian Government's Marine and Tropical Sciences Research Facility (MTSRF) has developed a seagrass status and trends research program (Project 1.1.3) with the Queensland Department of Primary Industries and Fisheries (QDPI&F). The program is designed to deliver cost effective monitoring and assessment of the status of coastal seagrasses in the GBRWHA. The project is based on a strategy of using community, industry resources and co-investment to enhance and broaden the scope of the monitoring and assessment program. There are three major components which together deliver the program:

1. **Broad scale mapping**
   Fills information gaps in the GBRWHA seagrass baseline information
   The broad scale mapping covers large regions of the coast at relatively low resolution and provides much of the baseline information for planning processes such as setting up Marine Protected Areas (MPAs) including Fish Habitat and Dugong Protection Areas and input into marine park zoning. However the broad resolution of this mapping is not suited for monitoring changes to seagrass at a local level.

2. **Fine-scale assessment and monitoring in key risk areas**
   Detailed intensive monitoring focusing on seagrass areas at risk
   The fine-scale assessment component conducts detailed regular annual monitoring of intertidal and subtidal seagrass meadows at key sites where there is a high risk of impacts from human activity. The intensive nature of these monitoring surveys means that they can only be conducted at a few key sites within the region. These monitoring surveys produce detailed information on changes to the area, composition, and biomass of seagrass meadows and relate them to natural and anthropogenic influences within the area. Generally these monitoring programs are reliant on partnerships with industry for funding.

3. **Seagrass-Watch (community) monitoring**
   Supervised monitoring at intertidal sites (including sites monitored for the Reef Plan Marine Monitoring Program)
   *T*he Seagrass-Watch program uses a standard monitoring protocol at permanent sites that can easily be conducted by community volunteers after training from the QDPI&F researchers (see www.seagrasswatch.org). This program provides information on a range of seagrass variables at a large number of locations throughout the GBRWHA that would not be logistically feasible to collect in the fine-scale monitoring program. As Seagrass-Watch relies on methods that can easily be conducted by community volunteers it does not collect information on subtidal meadows or changes to seagrass meadow area and biomass in the same manner as the fine-scale monitoring conducted by the QDPI&F researchers. However the methods' simplicity and relatively low cost allows for sampling to occur more frequently and across a large range of locations, completing a regional picture of trends in seagrass change.

Assessing Seagrasses at Risk

Increasing human populations and associated impacts such as port expansions, industrial developments, urban expansion, agriculture and aquaculture along the Queensland coastal strip have focused attention on the risks these activities pose to our estuaries and coasts. In coastal areas of the GBRWHA seagrass habitats provide for much of the recreational and commercial fisheries activity through provision of nursery habitat and sources of primary productivity as well as food for threatened species such as dugong and turtle. These seagrass habitats are susceptible to the risks posed by global events such as climate change as well as being potentially impacted by coastal development decisions, and at the same time are washed by the nutrients, herbicides and pesticides that flow down the coastal rivers. Much of the valuable coastal seagrass habitat in the GBRWHA lies in sheltered coastal bays and estuaries that are also the centres of urban, port and coastal development. While seagrasses are vulnerable to changes in water quality from non-point sources their location in these coastal areas of direct anthropogenic activity and development means they are also under significant threats from direct local impacts.

A key goal of the seagrass status and trends program is to ensure that monitoring focuses on seagrass areas that are most "at risk" from the various direct and non-point source threats that face seagrasses in the GBRWHA. We have recognised that there may be shortfalls of information in some locations due to the Project 1.1.3 monitoring strategy of using community volunteers and industry funds to enable GBRWHA wide seagrass monitoring. A workshop of regional seagrass experts and end users of the monitoring information was conducted on 5 March 2007 at James Cook University to address this issue. The goal of the workshop was to identify the extent to which the current program addresses at risk seagrass meadows and prioritise locations for future monitoring. The workshop:

- Reviewed our current knowledge of seagrass areas in the GBRWHA;
- Assessed the ecological and fisheries values of seagrass meadows;
- Identified the threats faced by seagrass areas; and
- Developed a matrix to prioritise "high risk" seagrass areas for monitoring.

This report details the results of that workshop, identifies the key coastal seagrass risk areas in the GBRWHA and examines how well the current program addresses information needs in these areas. The report provides recommendations for developing the seagrass status and trends program in the future.

2. GBRWHA Seagrass Assessment

Workshop Methodology

Coastal seagrass locations in the GBRWHA were initially separated into geographic units (regions) according to Lee Long *et al.* (1993), with some further additional areas separated where more recent seagrass information was available (Map 1). A Geographic Information System (GIS) was used during the workshop to display the known seagrass information. Where available other data that could assist in assessing seagrass value and threats was either overlayed or discussed around the table by the workshop participants including:

- Major river inputs;
- Urban centres;
- Dugong numbers / Protection Areas;

- Marine Park boundaries; and
- Fish Habitat Areas.

Areas of the GBRWHA coast where seagrasses were absent were not assessed. Full details of the workshop agenda and minutes can be found in Appendices 1-3.

Seagrass Assessment Matrix

A seagrass assessment matrix was developed prior to the workshop to categorise seagrasses within each region. At the beginning of the workshop the matrix was further refined to incorporate suggestions of the participants. The final matrix contained the following fields:

- **Threats:** An assessment of the range of threats faced by seagrasses including the major acute and chronic threats such as:
  - Agricultural runoff;
  - Urban runoff;
  - Coastal development including reclamations and marina developments;
  - Industrial pollution and discharges;
  - Localised small scale disturbances such as anchoring and propeller scarring;
  - Risk of oil spills and pollution due to proximity to high risk areas of shipping lanes (as identified in the report by Queensland Transport and the GBRMPA (2000)) or port operations; and
  - Commercial port activities such as regular maintenance dredging capital dredging and expansion of port facilities
- **Value:** An assessment of the value of the seagrass meadows including:
  - Value to dugong and turtle;
  - Importance to fisheries (nursery habitat / primary production);
  - Size of meadows and regional significance;
  - Quality of seagrass habitats; and
  - Presence of rare seagrass species.
- **Capture:** If seagrass monitoring was to occur, to what extent is there capacity for intervention and use to management. Are there management structures in place? Are there activities and processes within the region that could be changed by management actions that would benefit seagrass and coastal ecosystems?
- **Status and Trend:** To what extent is the seagrass information from the particular region meeting needs of management and the MTSRF program to assist in determining status and trend of seagrasses in the GBRWHA? Are the seagrass meadows representatives of a particular habitat type or represent the only seagrass communities within a large area of the GBRWHA coast (regardless of the level of capture)?
- **Other Data:** Will seagrass monitoring in the region integrate with other biophysical data sets being collected as part of MTSRF or other research programs such as coral, water quality, fisheries, dugong and turtle monitoring? Is there existing seagrass data collected in the area that would assist in determining seagrass change such as long term monitoring or reliable baseline information?
- **Feasibility:** How feasible is it to work in the region? What are the major logistical constraints such as remoteness and access? Are seagrasses predominantly intertidal or subtidal? Proximity to airports, suitable vessels, etc.

For each seagrass region a value between 1 and 10 (1, 2.5, 5, 7.5 or 10) was assigned for each of the matrix categories by the workshop participants (Tables 1 and 2). The value was arrived at by consensus of the group after consideration of the issues for each region. Not all regions were able to be assessed within the timeframe of the workshop. For regions not addressed within the workshop the QDPI&F team drafted a set of values and distributed those to the workshop participants for comment and reassessment before finalisation (Appendix 3 outlines the regions that were assessed during the workshop).

Table 1: Description of the matrix category scores for the extremes of the score range (1 and 10).

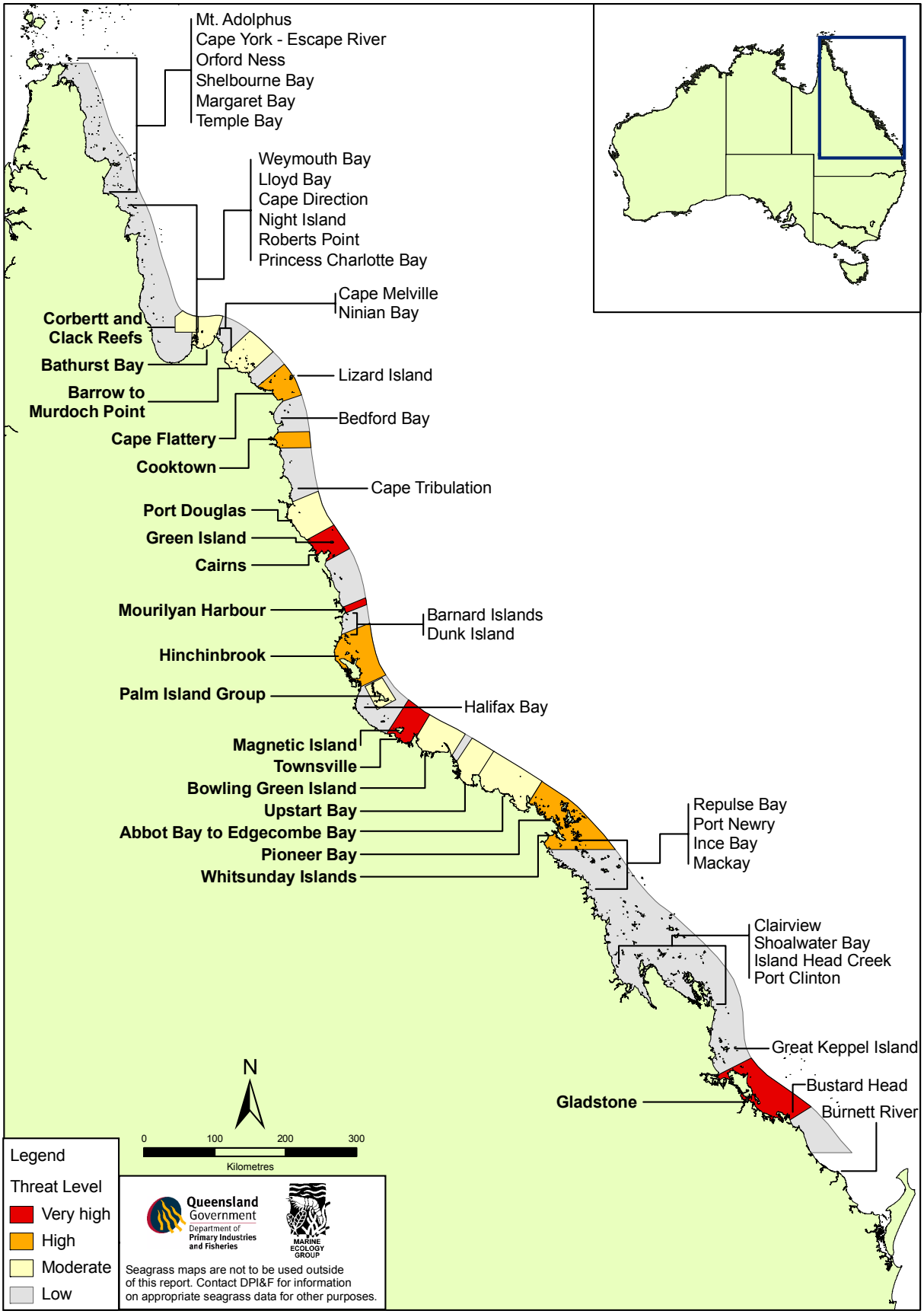
Matrix category	Score of 1	Score of 10
Threats	• Very low threat level from any source.	• Very high threat level from any one source. • High to medium threat from a number of different sources.
Value	• Small area of common seagrass habitats with low value to fisheries or endangered species.	• Seagrass particularly important in any one value category, e.g. key fisheries nursery habitat or critical dugong feeding area. • Seagrass considered important across a number of value categories.
Capture	• Very low ability to make meaningful management changes that will effect seagrasses.	Management tools and processes in place or easily implemented. Activities in the area with potential to impact on seagrass can be modified through management processes such as: • Dredge management plans; • MPA zoning; • Fisheries management plans; • Changes to agricultural practices; and • Controls to point source discharges.
Status and Trend	• Does not add significantly to information on seagrass status and trend.	Is of key importance to understanding the status and trend of GBRWHA seagrasses including: • Meadows highly representative of a particular habitat type. • Existing seagrass information is old or at very coarse resolution.
Other Data	• No other biophysical monitoring programs in the area. • No existing seagrass monitoring in place.	• Extensive biophysical data available, e.g. water quality monitoring.
Feasibility	• Logistically difficult or highly expensive, e.g. subtidal seagrass area in remote region of Cape York.	• Region easy to access near existing boat ramp and research facilities and available vessels. • Seagrasses intertidal and within two hours' flight from a helicopter base.

Table 2: Completed seagrass assessment matrix for seagrass regions within the GBRWHA.

Region (see Map 1) (adapted from Lee Long *et al.* 1993)	**Threats**	**Value**	**Capture**	**Status and Trend**	**Other data**	**Feasibility**	**TOTAL**
Cairns (Double Island – Cape Grafton)	10	10	10	7.5	10	10	**57.5**
Townsville (Cape Pallarenda – Cleveland Bay)	10	10	10	7.5	10	10	**57.5**
Gladstone (Narrows – Rodds Bay)	10	10	10	10	10	10	**60**
Mourilyan Harbour	10	5	10	10	7.5	10	**52.5**
Burnett River	10	2.5	10	1	7.5	10	**41**
Hinchinbrook (Family Islands – Lucinda)	7.5	10	10	5	7.5	10	**50**
Pioneer Bay	7.5	10	7.5	5	7.5	10	**47.5**
Whitsunday Islands (including mainland coast)	7.5	10	10	7.5	7.5	10	**52.5**
Cape Flattery (Starke River – Cape Flattery)	7.5	7.5	7.5	5	5	5	**37.5**
Margaret Bay	7.5	7.5	5	2.5	5	1	**28.5**
Abbot Bay - Edgecombe Bay	7.5	5	5	5	5	5	**32.5**
Cooktown	7.5	5	7.5	5	5	7.5	**37.5**
Mackay	7.5	5	7.5	2.5	7.5	7.5	**37.5**
Port Douglas (Daintree - Double Island)	5	5	10	7.5	5	10	**42.5**
Dunk Island	5	7.5	7.5	5	2.5	10	**37.5**
Barrow-Murdoch Point	5	10	5	5	5	5	**35**
Bathurst Bay	5	10	7.5	10	5	5	**42.5**
Corbett Reef/Clack Reef	5	10	7.5	10	5	7.5	**45**
Princess Charlotte Bay	5	10	7.5	10	5	2.5	**40**
Upstart Bay	5	10	5	7.5	5	7.5	**40**
Bowling Green Bay	5	7.5	7.5	10	7.5	10	**47.5**
Ninian Bay	5	7.5	5	2.5	2.5	5	**27.5**
Cape Melville	5	5	5	2.5	2.5	5	**25**
Temple Bay	5	5	2.5	2.5	1	1	**17**
Weymouth Bay	5	5	2.5	2.5	1	5	**21**
Barnard Islands	5	2.5	5	2.5	2.5	7.5	**25**
Shoalwater Bay	5	10	7.5	7.5	2.5	7.5	**40**
Green Island	5	7.5	10	7.5	10	10	**50**
Palm Island Group	5	7.5	5	5	5	7.5	**35**
Repulse Bay	5	5	2.5	1	2.5	5	**21**
Halifax Bay	5	2.5	7.5	5	5	7.5	**32.5**
Clairview	2.5	7.5	5	1	2.5	5	**23.5**
Ince Bay	2.5	7.5	5	1	2.5	5	**23.5**
Port Newry	2.5	7.5	5	1	2.5	5	**23.5**
Roberts Point	2.5	7.5	5	2.5	2.5	5	**25**
Shelbourne Bay	2.5	7.5	5	1	1	1	**18**
Bedford Bay	2.5	5	5	5	2.5	5	**25**
Bustard Head	2.5	5	5	1	1	5	**19.5**

Region (see Map 1) (adapted from Lee Long *et al.* 1993)	**Threats**	**Value**	**Capture**	**Status and Trend**	**Other data**	**Feasibility**	**TOTAL**
Night Island	2.5	5	2.5	2.5	2.5	5	**20**
Cape Direction	2.5	2.5	1	1	1	5	**13**
Cape Tribulation	2.5	2.5	2.5	2.5	2.5	7.5	**20**
Lloyd Bay	2.5	2.5	2.5	2.5	1	5	**16**
Mt Adolphus	2.5	2.5	2.5	1	1	2.5	**12**
Island Head Creek	1	10	7.5	5	2.5	5	**31**
Port Clinton	1	10	7.5	5	2.5	5	**31**
Orford Ness	1	7.5	1	1	1	1	**12.5**
Cape York – Escape River	1	5	5	2.5	1	2.5	**17**
Lizard Island	1	5	5	5	7.5	7.5	**31**
Great Keppel Island	1	2.5	2.5	5	2.5	5	**18.5**

Map 1: Coastal seagrass regions within the Great Barrier Reef World Heritage Area (GBRWHA) (after Lee Long *et al*. 1993), and location of highly threatened regions.



Selection of Priority Monitoring Areas

To determine the priority risk regions to target for seagrass monitoring a hierarchical selection process was applied to the completed risk matrix table. Matrix categories for each region were considered in the following order:

1. Threat;
2. Value;
3. Capture;
4. Status and Trend;
5. Other Data; and
6. Feasibility.

The selection process considered each one of these matrix categories in sequential order from 1 to 6. For a region to be selected as a priority monitoring area it had to firstly have a score of 5 or better for *threat* to be considered for the next step in the selection process. Regions selected for *threat* were then assessed for *value* and had to have a *value* score of 5 or better to remain in consideration and so on through the six matrix categories.

For example in the table below, the Burnett River and Weymouth Bay regions were not selected as priority monitoring targets despite having a *threat* value of 5 or better. The Burnett River area was eliminated due to the low *value* score for seagrasses in the region. The Weymouth Bay region had a seagrass *value* of 5 or better but was eliminated due to the low capture score. In the examples below The Whitsunday Islands region would be selected as a monitoring priority target area as it achieved a score of 5 or better across all of the matrix categories.

Region	Threats	Value	Capture	Status and Trend	Other data	Feasibility	TOTAL
Burnett River	10	2.5	10	1	7.5	10	**41**
Weymouth Bay	5	5	2.5	2.5	1	5	**21**
Whitsunday Islands (including mainland coast)	7.5	10	10	7.5	7.5	10	52.5

This process resulted in the selection of nineteen “risk regions” in the GBRWHA (Table 3; Maps 1-18). These nineteen regions were further distinguished into three “threat level” categories – *very high* (four regions), *high* (six regions) and *moderate* (nine regions) (Table 3). The QDPI&F project team developed a breakdown of the principal threats that contributed to the overall threat score for each of the selected regions following the workshop (Table 4).

Table 3: Identified high risk seagrass regions to target for priority monitoring in the GBRWHA.

Threat Level	Location (See Map 1)	Threats	Value	Capture	Status and Trend	Other data	Feasibility	TOTAL
Very High	Gladstone (Narrows – Rodds Bay)	10	10	10	10	10	10	**60**
	Cairns (Double Island – Cape Grafton)	10	10	10	7.5	10	10	**57.5**
	Townsville (Cape Pallarenda – Cleveland Bay)	10	10	10	7.5	10	10	**57.5**
	Mourilyan Harbour	10	5	10	10	7.5	10	**52.5**
High	Whitsunday Islands (including mainland coast)	7.5	10	10	7.5	7.5	10	**52.5**
	Hinchinbrook (Family Islands – Lucinda)	7.5	10	10	5	7.5	10	**50**
	Pioneer Bay	7.5	10	7.5	5	7.5	10	**47.5**
	Cape Flattery (Starke River – Cape Flattery)	7.5	7.5	7.5	5	5	5	**37.5**
	Cooktown (Indian Head – Walker Bay)	7.5	5	7.5	5	5	7.5	**37.5**
	Abbot Bay – Edgecombe Bay	7.5	5	5	5	5	5	**32.5**
Moderate	Corbett Reef / Clack Reef	5	10	7.5	10	5	7.5	**45**
	Bathurst Bay	5	10	7.5	10	5	5	**42.5**
	Barrow-Murdoch Point	5	10	5	5	5	5	**35**
	Upstart Bay	5	10	5	7.5	5	7.5	**40**
	Green Island	5	7.5	10	7.5	10	10	**50**
	Bowling Green Bay	5	7.5	7.5	10	7.5	10	**47.5**
	Palm Island Group	5	7.5	5	5	5	7.5	**35**
	Magnetic Island	5	5	7.5	7.5	7.5	10	**42.5**
	Port Douglas (Daintree – Double Island)	5	5	10	7.5	5	10	**42.5**

Table 4: Categories of threats and threat level for identified high risk seagrass target regions in the GBRWHA. L = Low Level; M = Medium Level; H = High Level. Red shading indicates the key threats for a location.

Location (See Map 1)	**Threat category**						
	Threat Score	**Coastal development** (e.g. marinas, boat ramps, reclamations, aquaculture)	**Port Activities** (e.g. dredging)	**Urban and Industrial runoff**	**Agricultural Runoff** (includes river/ flood inputs)	**Oil/ chemical spills** (proximity to high risk areas of shipping lanes)	**Localised physical disturbances** (e.g. anchoring)
Gladstone (Narrows – Rodds Bay)	10	H	H	H	H	H	L
Cairns (Double Island – Cape Grafton)	10	H	H	H	H/M	H/M	L/M
Townsville (Cape Pallarenda – Cleveland Bay)	10	H	H	H	M/L	H	L
Mourilyan Harbour	10	H	H	L	H	M	L
Whitsunday Islands (including mainland coast)	7.5	H	L	M	L	H	H
Hinchinbrook (Family Islands – Lucinda)	7.5	L	L	L	H	L/M	L
Pioneer Bay	7.5	H	-	M/H	L	M	L/M
Cape Flattery (Starke River – Cape Flattery)	7.5	L	M	M	L	H	L
Cooktown (Indian Head – Walker Bay)	7.5	M	M	L/M	L	L	L
Abbot Bay - Edgecombe Bay	7.5	M	M	M	L	M/H	L
Corbett Reef / Clack Reef	5	L	-	L	L/M	H	L
Bathurst Bay	5	L	-	L	L/M	H	L
Barrow-Murdoch Point	5	L	-	L	L	H	L
Upstart Bay	5	L	L	L	H	L	M
Green Island	5	L	M	L	M	L	M/H
Bowling Green Bay	5	L	-	L	H	L	L
Palm Island Group	5	M	L	L	M	L	L/M
Magnetic Island	5	H	L	L	M/L	L	L
Port Douglas (Daintree – Double Island)	5	H	M	L	M/L	L/M	L

Very High Threat

Very High Threat Level Regions

Gladstone (The Narrows to Rodds Bay)

The Gladstone region (Map 2) contains significant areas of high value seagrass including extensive meadows of species important for dugong as well as high fisheries value nursery meadows (Rasheed *et al.* 2003). The region contains a Dugong Protection Area and is known to support significant populations of dugong and turtle (Marsh and Lawler 2001). Seagrasses in the Gladstone area face significant threats from a range of sources. Gladstone contains substantial port and industrial infrastructure including existing and proposed reclamations, capital dredging, industrial and urban discharges, regular maintenance dredging and port and marine facility expansion. In 2006, an oil spill in the port area highlighted the potential risk from shipping accidents to marine plants in the area (Taylor *et al.* 2006). Two rivers, the Boyne and Calliope, also discharge into the region with potential non point source pollution from catchment use a threat to seagrasses (Apte *et al.* 2005; Taylor *et al.* 2007).


Seagrass meadow, Gladstone port


Reclamation, Gladstone

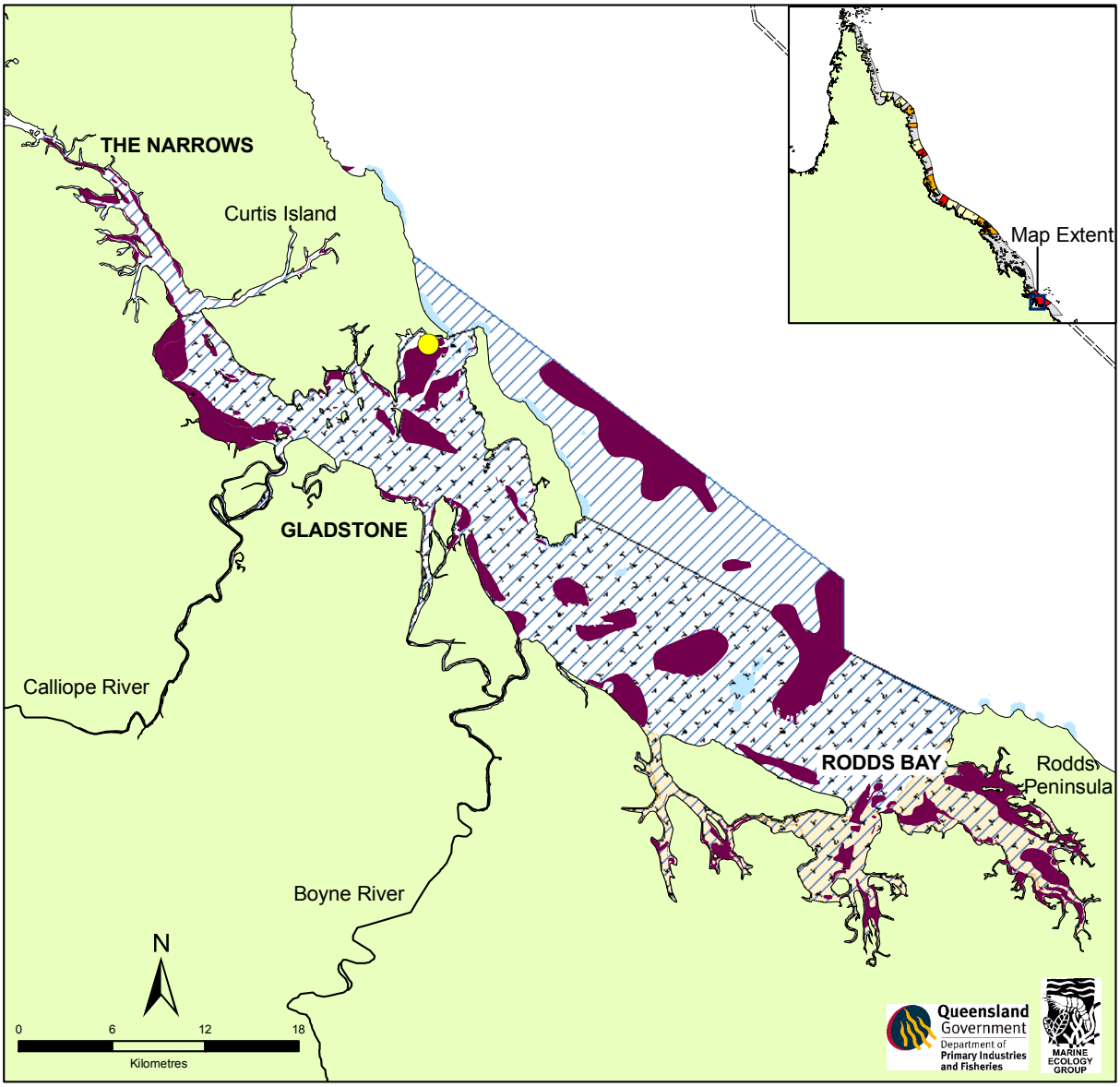

Seagrass meadow, Curtis Island

Capture in the existing program – ***High***

The Gladstone area is well represented in the current status and trend monitoring program containing two Seagrass-Watch sites as well as annual fine-scale monitoring in Port Curtis and Rodds Bay conducted in partnership with the Central Queensland Ports Authority and the Port Curtis Integrated Monitoring Program (Map 2). There is good capture of status and trend information for the range of both subtidal and intertidal meadow types that occur in the region.

Very High Threat

Map 2: Gladstone (The Narrows to Rodds Bay) target area.



Legend

- Seagrass meadows
- Reef
- Seagrass-Watch location
- Established finescale high risk monitoring area
- Dugong Protection Area
- Fish Habitat Area
- == Shipping Route

Seagrass maps are not to be used outside of this report. Seagrass meadows are a composite of survey data collected from 1984 - 2007, and may not represent current distribution. Contact DPI&F for information on appropriate seagrass data for other purposes.

Very High Threat

Cairns (Double Island to Cape Grafton)

The Cairns region (Map 3) contains significant areas of high value seagrass. Dense *Zostera capricorni* meadows in the region are recognised as being of key importance as a tiger prawn nursery habitat (Watson *et al.* 1993). There are also substantial meadows of *Halodule uninervis* (narrow leaf) *and Halophila* species important for dugong feeding (Campbell *et al.* 2002a). Seagrasses occur in both intertidal and shallow subtidal areas with the largest meadows located in Cairns Harbour and Missionary Bay. The importance of marine plants including seagrasses in the region has been recognised through the declaration of a Fish Habitat Area (FHA). Seagrasses in the Cairns area face threats from a range of sources including regular dredging in Trinity Inlet and Cairns Harbour, coastal and urban development and runoff from the Barron River and point source discharges (Campbell *et al.* 2002a; State of Trinity Inlet Report and Ecological Review 1997; Devlin & Brodie 2005; Erftemeijer & Robin Lewis 2006).

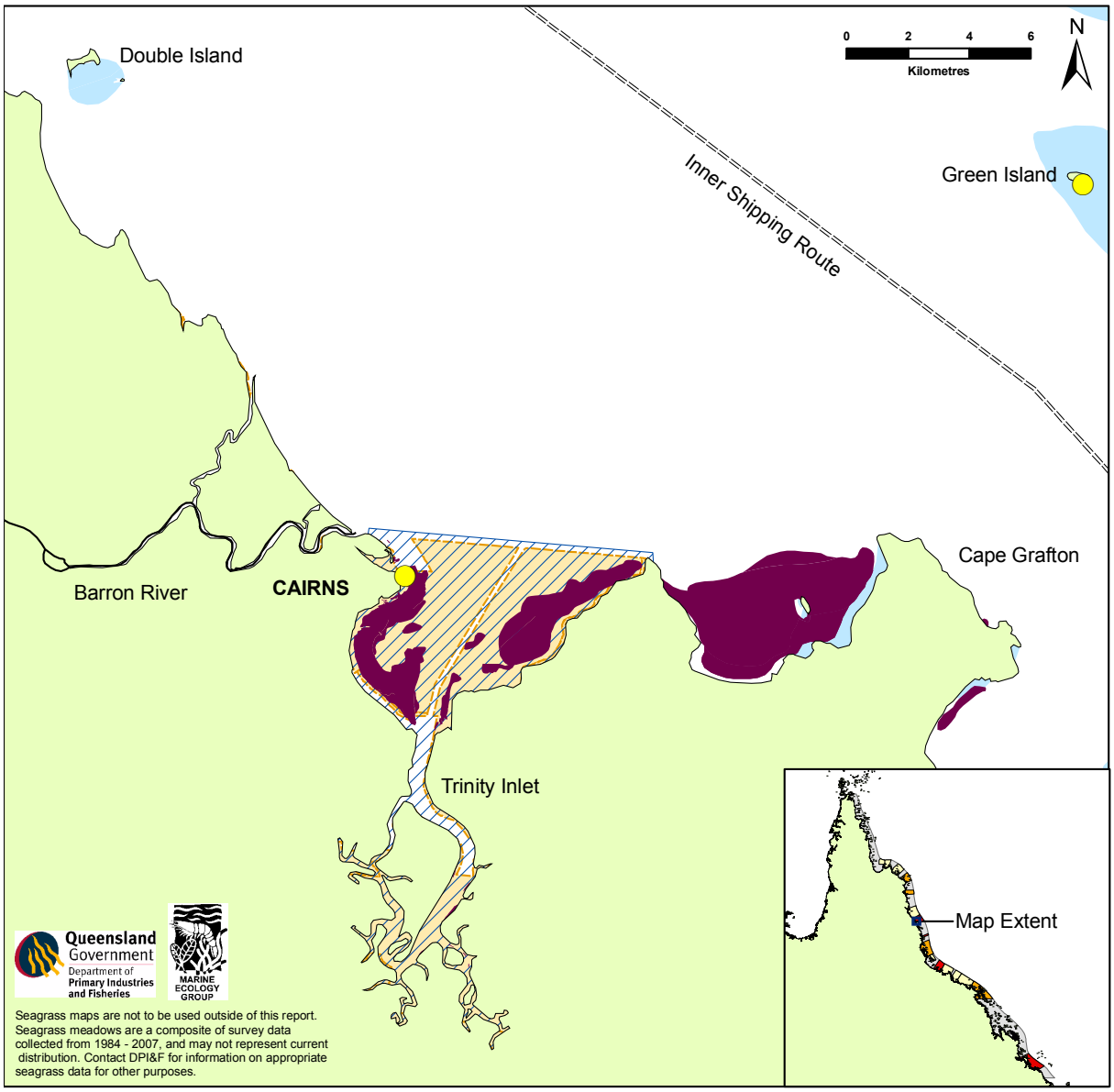
Capture in the existing program – ***High***

The Cairns area is well represented in the current status and trend monitoring program containing two Seagrass-Watch locations as well as annual fine-scale monitoring in Cairns Harbour and Trinity Inlet conducted in partnership with Cairns Port Authority (Map 2) that has been running since 2001.

***Zostera capricorni*, Cairns**

Intertidal seagrass, Cairns

Map 3: Cairns (Double Island to Cape Grafton) target area.



Legend

- Seagrass meadows
- Reef
- Seagrass-Watch location
- == Shipping Route
- Fish Habitat Area
- Established finescale high risk monitoring area

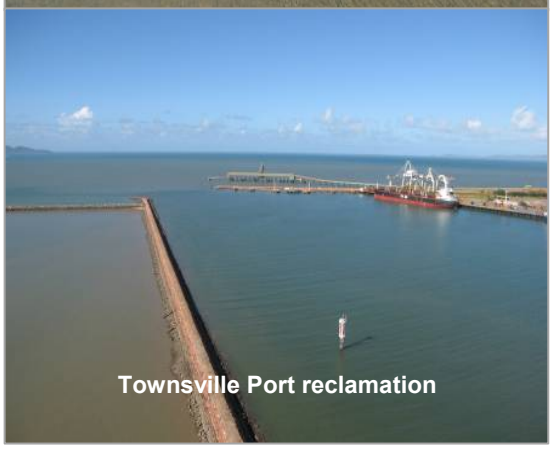
Very High Threat

Very High Threat

Townsville (Cape Pallarenda to Cleveland Bay)

The Townsville region (Map 4) has substantial cover of both intertidal and subtidal seagrass meadows along much of the coastal fringe. One of the largest *Zostera capricorni* meadows in north Queensland occurs in the eastern half of Cleveland Bay. As with the Cairns region, seagrasses in Townsville face threats from a range of sources including regular dredging, coastal and urban development, and port reclamations. The region is influenced by runoff and flood discharges from the Burdekin River (Devlin & Brodie 2005).

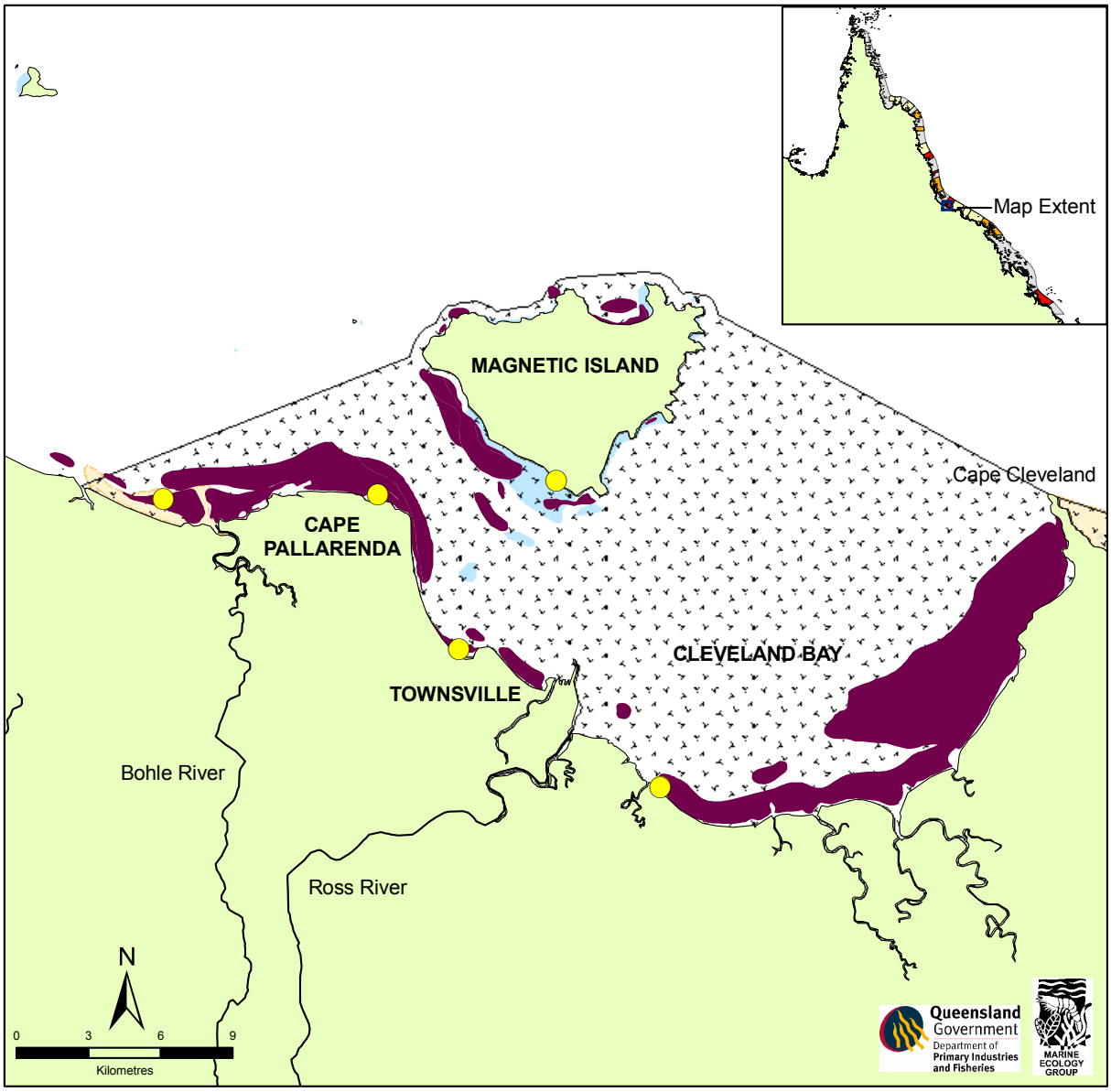

Seagrass meadow, Cape Pallarenda


Townsville Port reclamation

Capture in the existing program – ***Moderate***

The Townsville area has a good coverage of Seagrass-Watch sites (five locations) that provide information on intertidal seagrass changes. Baseline mapping that included subtidal areas was conducted in 1996 (Lee Long *et al.* 1998) but there is currently no regular seagrass monitoring that assesses the status of subtidal seagrasses or fine-scale monitoring of changes to seagrass meadow area or abundance. Intertidal seagrass distribution has recently been resurveyed (March 2007) as part of a broadscale seagrass survey from Hinchinbrook to Cape Bowling Green.

Map 4: Townsville (Cape Pallarenda to Cleveland Bay) and Magnetic Island target areas.



Very High Threat

Very High Threat

Mourilyan Harbour

Mourilyan Harbour is a relatively small region (Map 5) but contains some of the only substantial estuarine seagrass meadows between Cairns and Hinchinbrook Island. The area also contains one of the southernmost occurrences of the species *Enhalus acoroides* and has dense *Zostera capricorni* meadows known to support juvenile commercial prawn species (McKenzie *et al.* 1996). The seagrasses in Mourilyan Harbour are within a relatively enclosed estuary and are highly susceptible to runoff from the Moresby River catchment. A substantial proportion of the catchment is dedicated to intensive cropping such as sugar cane with associated non point source inputs of nutrients, sediments and herbicides a high threat to seagrasses. The area also contains an active commercial port that is undergoing expansion and has six aquaculture facilities that discharge water into the catchment.


Mourilyan Harbour entrance

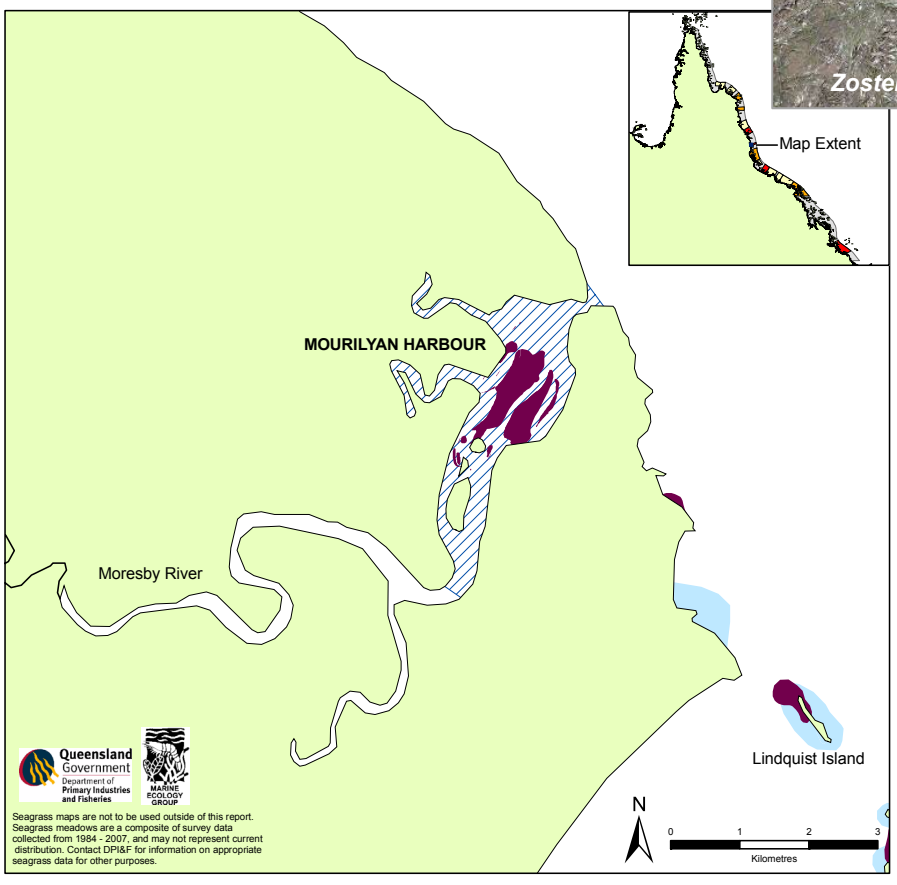

Aquaculture facility, Mourilyan


Zostera capricorni, Mourilyan

Capture in the existing program – ***High***

The Mourilyan Harbour area has an established annual fine-scale seagrass monitoring program conducted in partnership with the Ports Corporation of Queensland. The program covers both intertidal and subtidal seagrasses and has been running since 1994.

Map 5: Mourilyan Harbour target area.



High Threat Level Regions

Whitsunday Islands (including mainland coast)

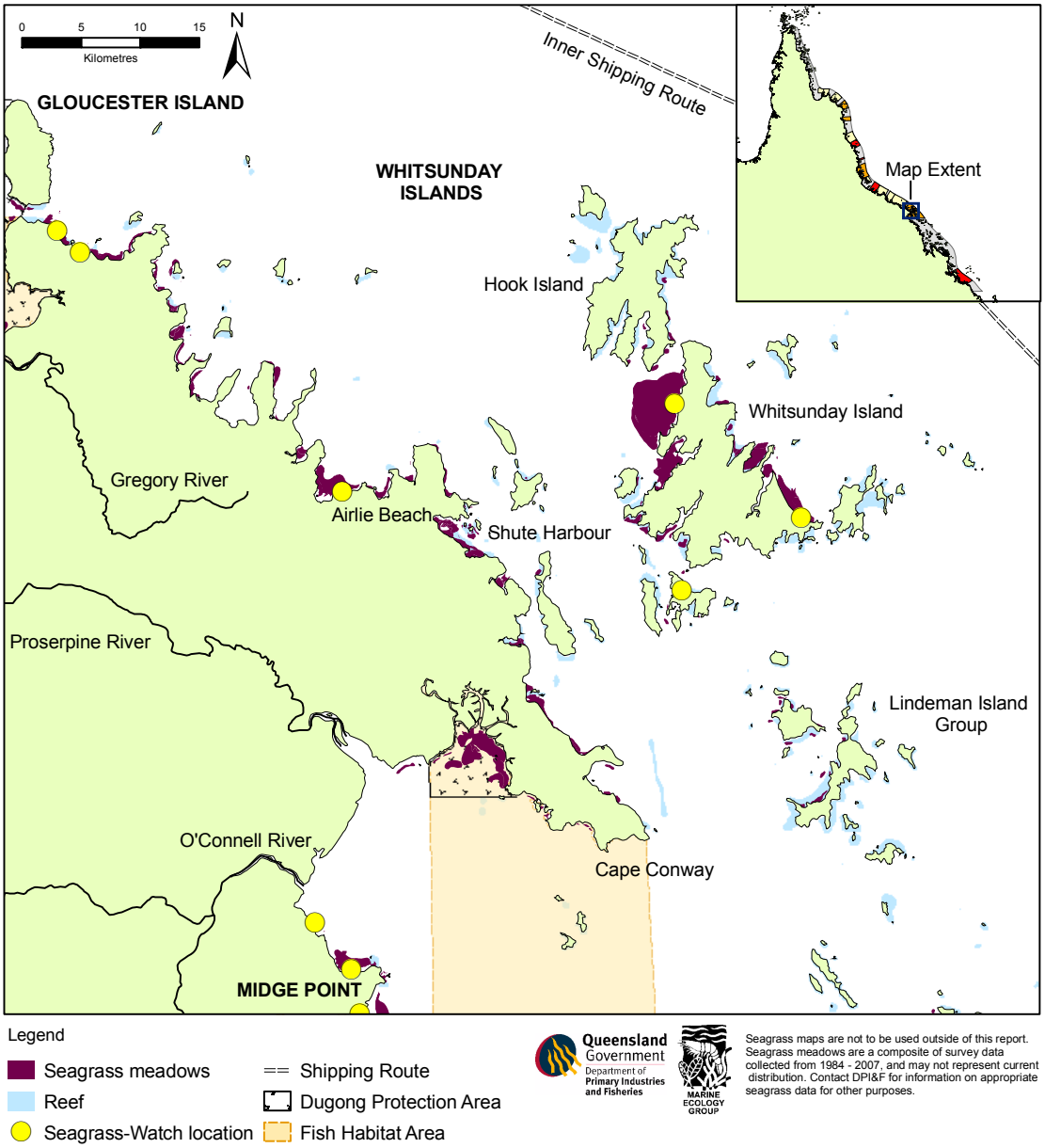
Main Threats: Coastal developments including marinas; small scale disturbances from anchoring; increasing urban development.


Seagrass-Watch volunteers, Whitsunday region

Capture in current program – ***Moderate***

The Whitsunday region has a good coverage of Seagrass-Watch monitoring locations (Map 6) with information collected on intertidal seagrass meadows and relatively recent (1999/2000) baseline information on overall seagrass distribution (Campbell *et al.* 2002b). There is no regular long term monitoring of subtidal seagrasses in the region or fine-scale monitoring of changes to meadow area and biomass.

Map 6: Whitsunday Islands (Gloucester Island to Midge Point, including mainland coast) target area.



High Threat

Hinchinbrook (Family Islands to Lucinda)

Main Threats: Agricultural runoff from the Herbert River; fuel/oil spills and shipping accidents in commercial port area of Lucinda.

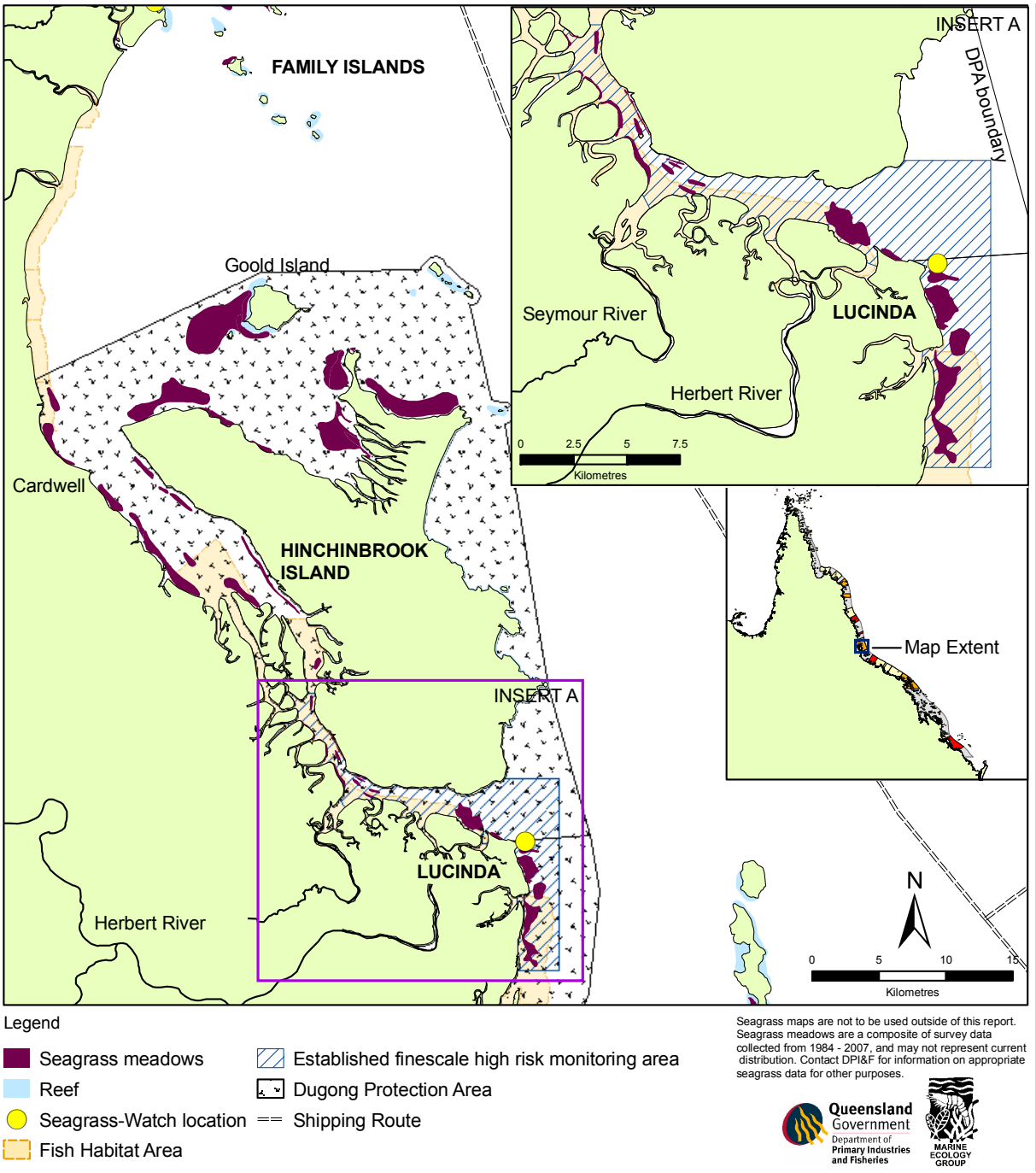
Capture in current program – ***Moderate***

The Hinchinbrook region has one Seagrass-Watch monitoring location in the south near Lucinda (Map 7). Baseline seagrass mapping for the entire region was last conducted in 1996 (Lee Long *et al.* 1998). More recently a detailed baseline survey to establish a fine-scale monitoring program was completed in March 2007 for the southern Hinchinbrook/ Lucinda area in the vicinity of the Herbert River mouth (Map 7). An annual fine-scale monitoring program could be developed from the results of this baseline. No seagrass monitoring is conducted in the northern section of this region.

Turbid plume, Herbert River mouth

Dugong feeding trails, Lucinda

Map 7: Hinchinbrook (Family Islands to Lucinda) target area.



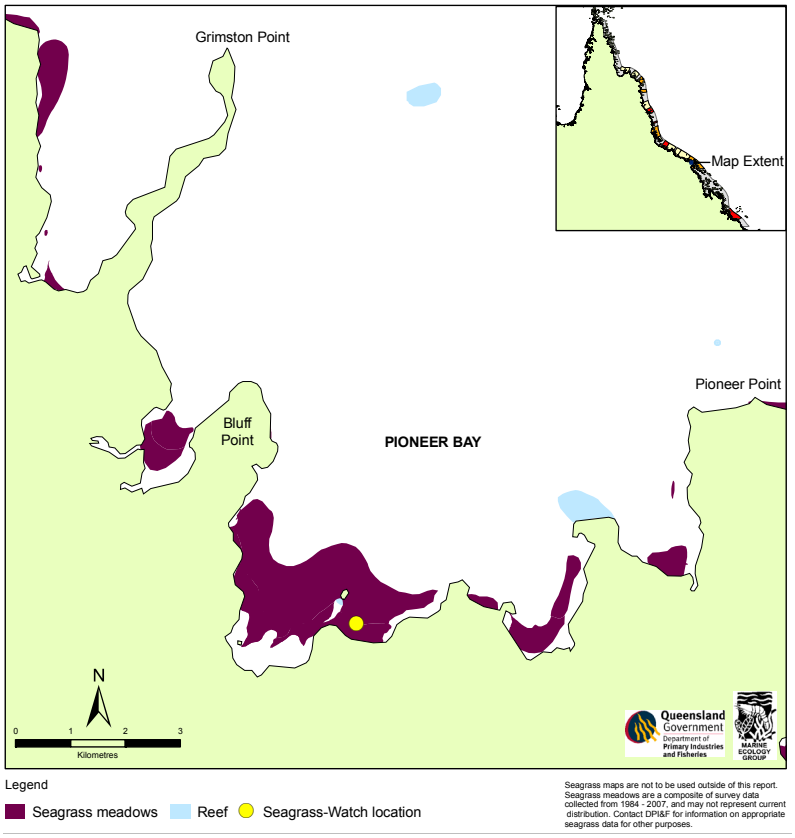
High Threat

Pioneer Bay

Main Threats: Coastal, urban and marina development.

Capture in current program – ***Moderate***

Four Seagrass-Watch sites are actively monitored at one location in this bay (Map 8) which forms part of the greater Whitsunday Island (coastal) region (Map 6). As with the greater region no information on subtidal seagrasses is being collected.



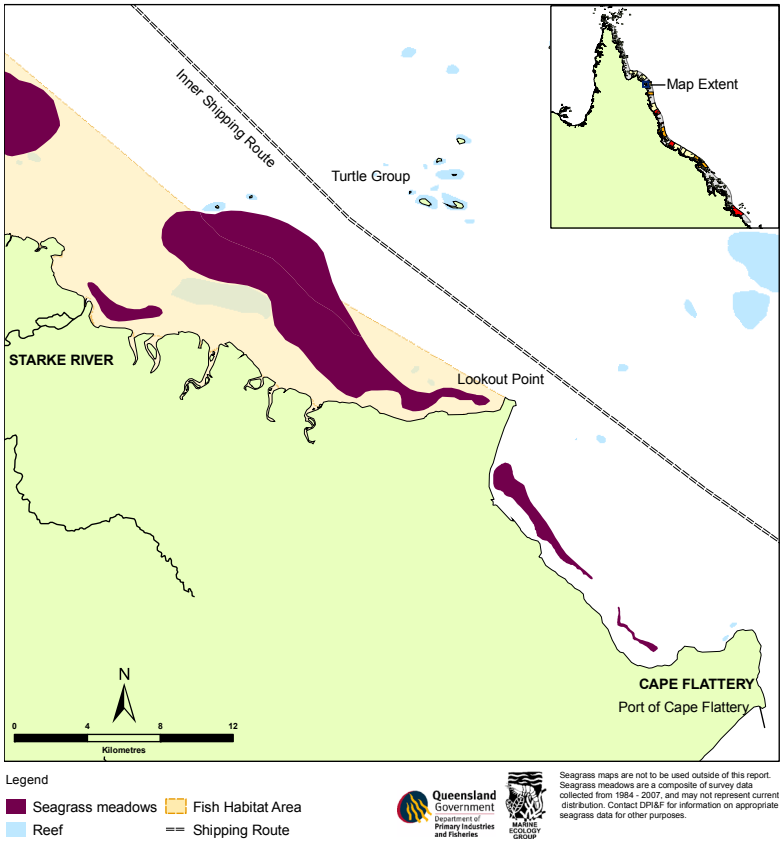
Map 8: Pioneer Bay target area.

Cape Flattery (Starke River to Cape Flattery)

Main Threats: fuel/ chemical/ oil spills and shipping accidents in commercial port area of Cape Flattery; shipping accidents and oil spills from high risk section of inner GBR shipping route

Capture in current program – ***None***

There are no current seagrass monitoring programs in this region. The area to the north of Lookout Point was mapped at broadscale level in 1984 (Coles *et al.* 1992) (Map 9). A more detailed baseline survey within the Cape Flattery port limits (Lookout Point to south of Cape Flattery) was conducted in 1996 (Ayling *et al.* 1997).



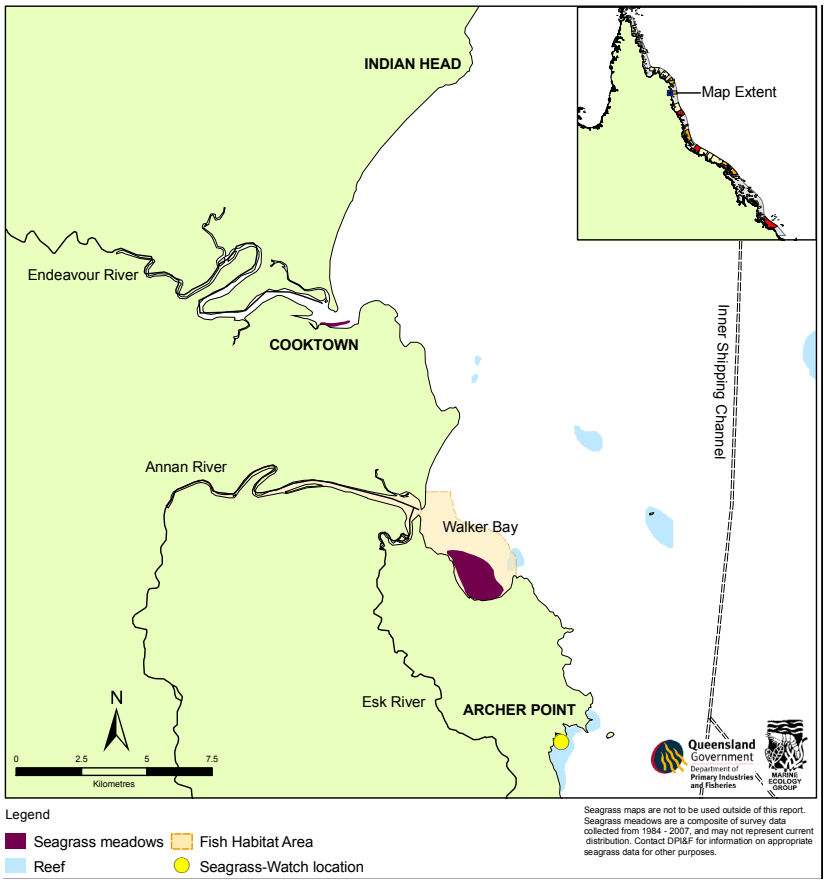
Map 9: Cape Flattery (Starke River to Cape Flattery) target area.

Cooktown (Indian Head to Archer Point)

Main Threats: Maintenance dredging of Cooktown access channel (threat to Endeavour River seagrass); coastal and urban development in Cooktown area

Capture in current program – ***Low***

There is an active Seagrass-Watch location south of Cooktown at Archer Point (Map 10). The area was mapped at a broadscale level in 1984 (Coles *et al.* 1985).



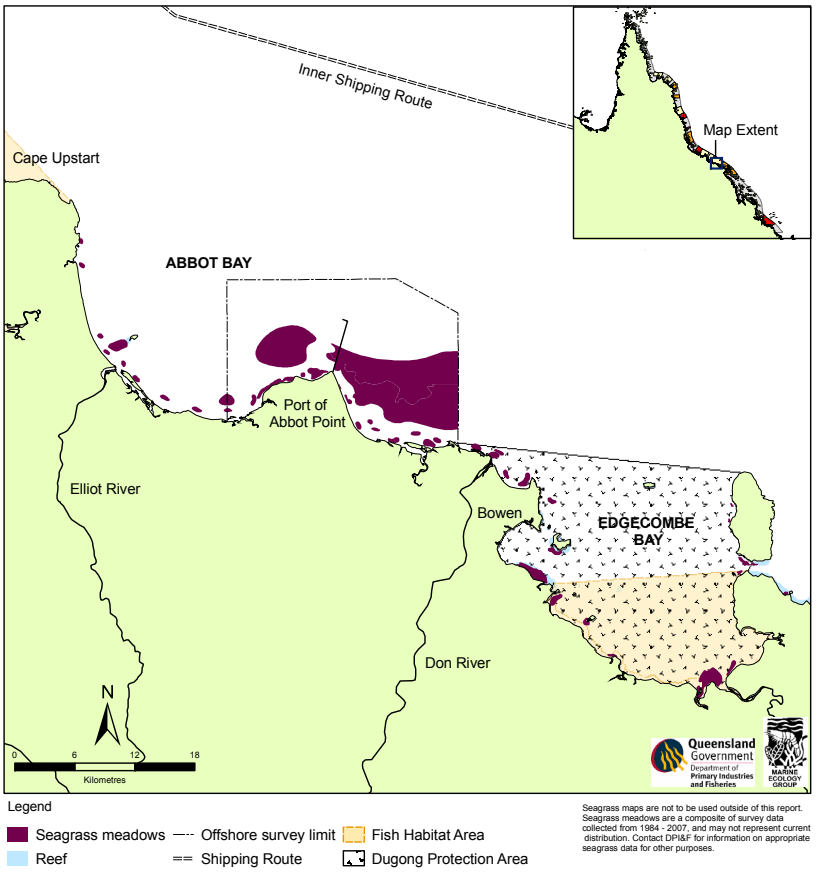
Map 10: Cooktown (Indian Head to Archer Point) target area.

Abbot Bay to Edgecombe Bay

Main Threats: Main Threats: Port expansion at Abbot Point; coastal development and urban runoff in Bowen area; aquaculture facilities and development

Capture in current program – ***Low***

A Seagrass-Watch site has recently been established at Bowen. The entire region was mapped at a broadscale level in 1987 (Coles *et al.*1992). A more detailed baseline survey within the Abbot Point port limits was conducted in 2005 (Map 11) (Rasheed *et al.* 2005).



Map 11: Abbot Bay to Edgecombe Bay target area.

Moderate Threat

Moderate Level Threat Regions

Corbett Reef / Clack Reef

Main Threats: Shipping accidents; oil spills from high risk section of inner GBR shipping route

Capture in current program – ***None***

There are no current seagrass monitoring programs in this region (Map 12). No detailed baseline mapping of seagrasses has been undertaken for the region. Extensive seagrasses meadows on the reef tops and back reef lagoons are known to occur (Coles *et al.* 1996) and are important feeding grounds for dugong (Marsh & Lawler 2002).

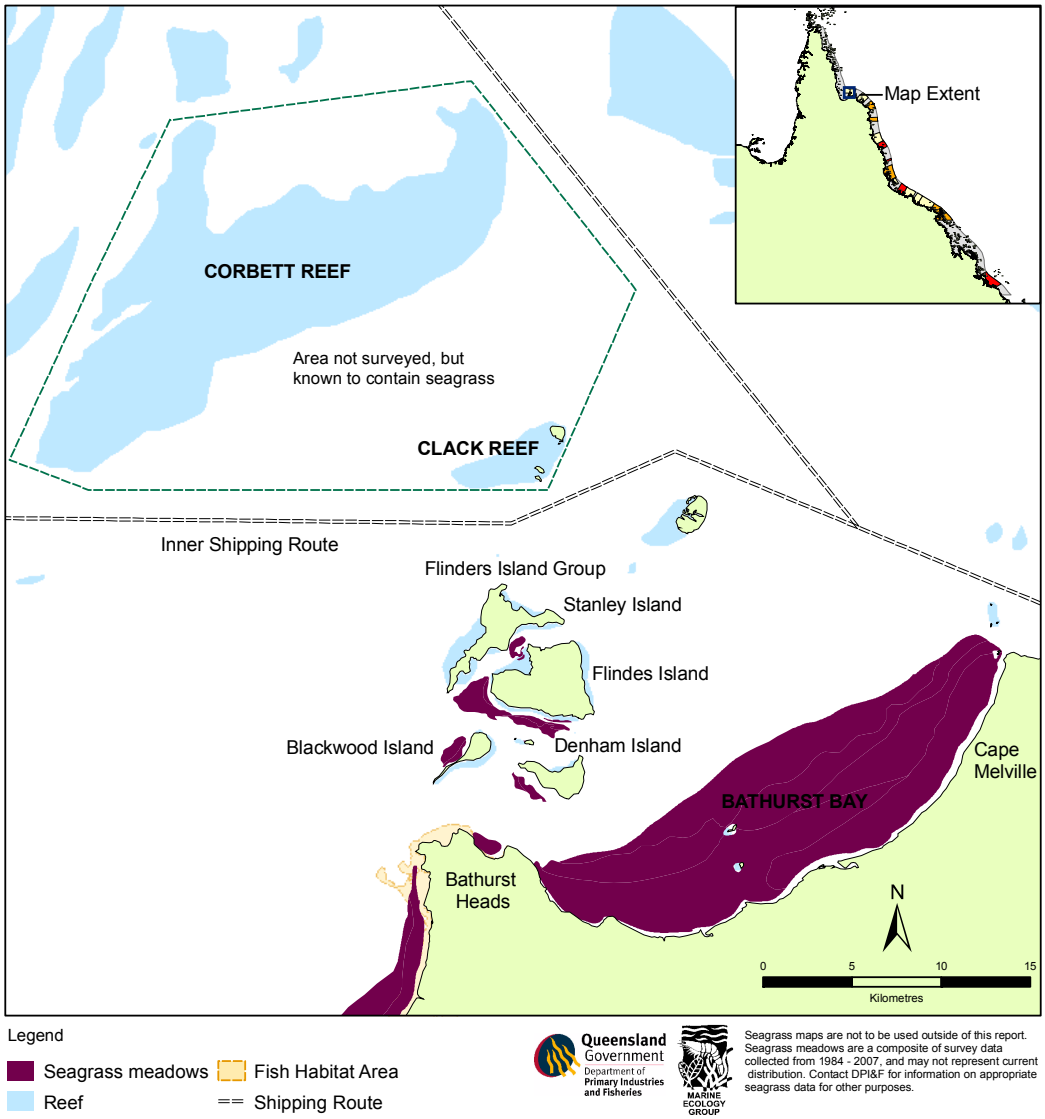
Bathurst Bay

Main Threats: Shipping accidents; oil spills from high risk section of inner GBR shipping route

Capture in current program – ***None***

There are no current seagrass monitoring programs in this region (Map 12). The coastal region was mapped at a broadscale level in 1984 (Coles *et al.* 1985).

Map 12: Bathurst Bay and Corbett and Clack Reef target areas.



Moderate Threat

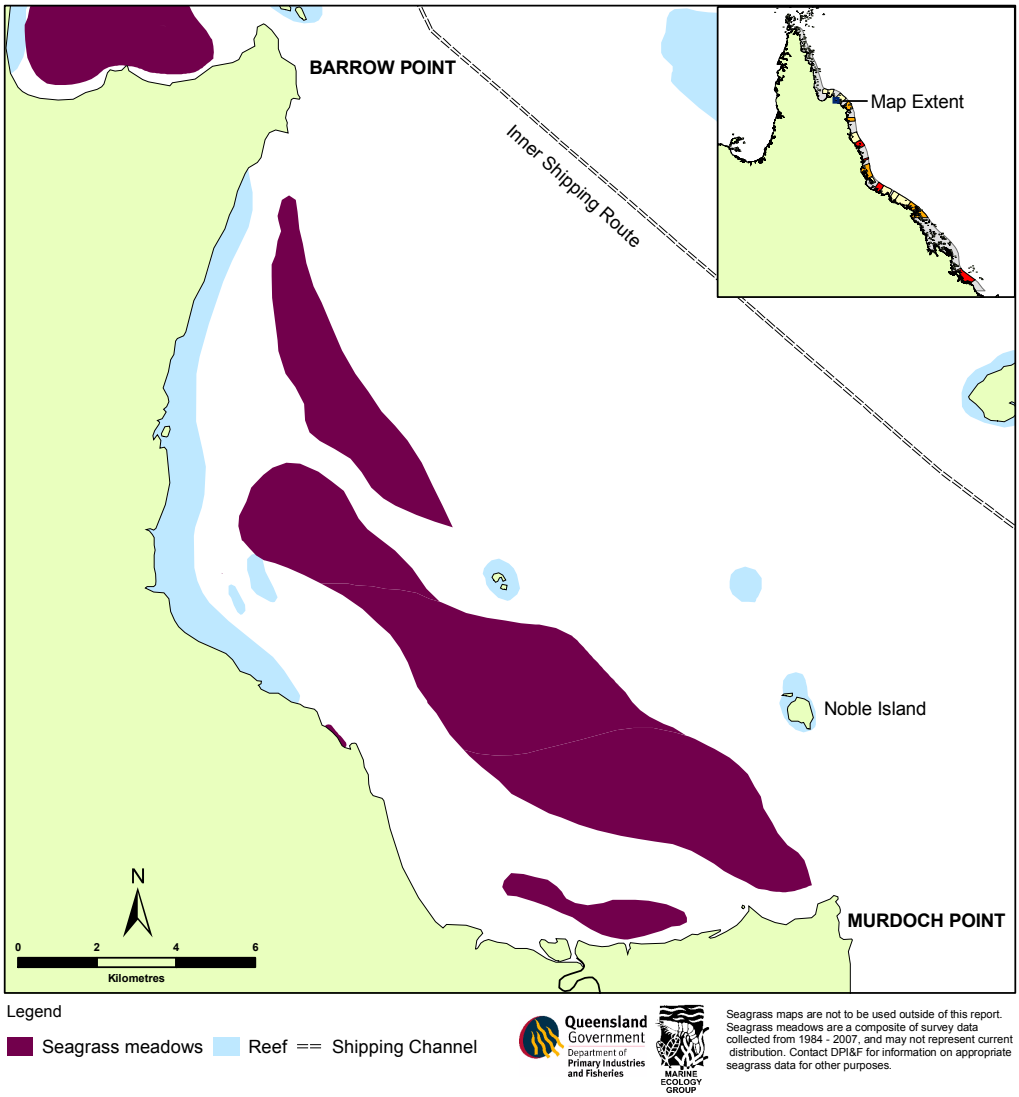
Barrow Point to Murdoch Point

Main Threats: Shipping accidents; oil spills from high risk section of inner GBR shipping route (Queensland Transport 2000)

Capture in current program – ***None***

There are no current seagrass monitoring programs in this region (Map 13). The region was mapped at a broadscale level in 1984 (Coles *et al.* 1985).

Map 13: Barrow Point to Murdoch Point target area.



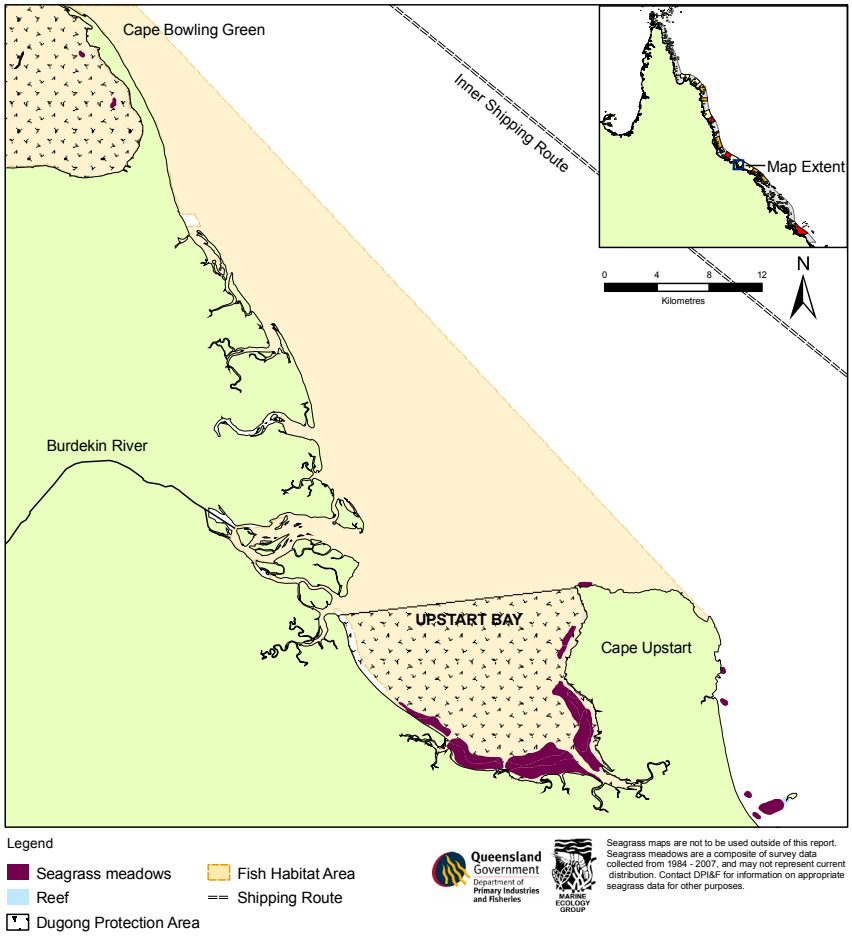
Moderate Threat

Upstart Bay

Main Threats: Runoff from flood discharges of Burdekin River; aquaculture discharges, small scale disturbances from boating; dredging of Molongle Creek boat channel.

Capture in current program – ***None***

There are no current seagrass monitoring programs in this region (Map 14). Detailed baseline surveys were conducted within the Upstart Bay Dugong Protection Area in 1999 (Coles *et al.* 2001).The region was mapped at a broadscale level in 1987 (Coles *et al.*1992).



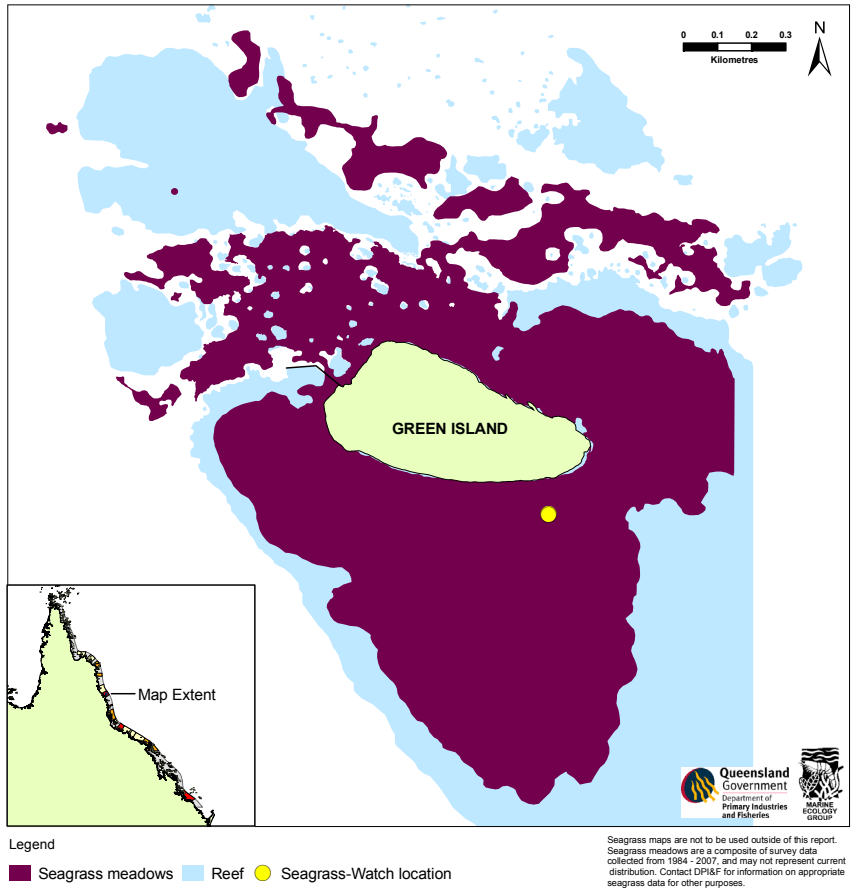
Map 14: Upstart Bay target area.

Green Island

Threats: Runoff from flood discharges of Barron River; small scale disturbances from anchoring in lagoon area; changing nutrient status from sewage treatment; scouring from commercial vessels departing wharf.

Capture in current program – ***Moderate***

There is an active intertidal Seagrass-Watch location at Green Island (Map 15). Several detailed seagrass monitoring surveys collecting information on seagrass biomass and area changes have been conducted (1992, 1993, 1994, 1997, and 2003). There are no additional monitoring surveys currently planned.



Map 15: Green Island target area.

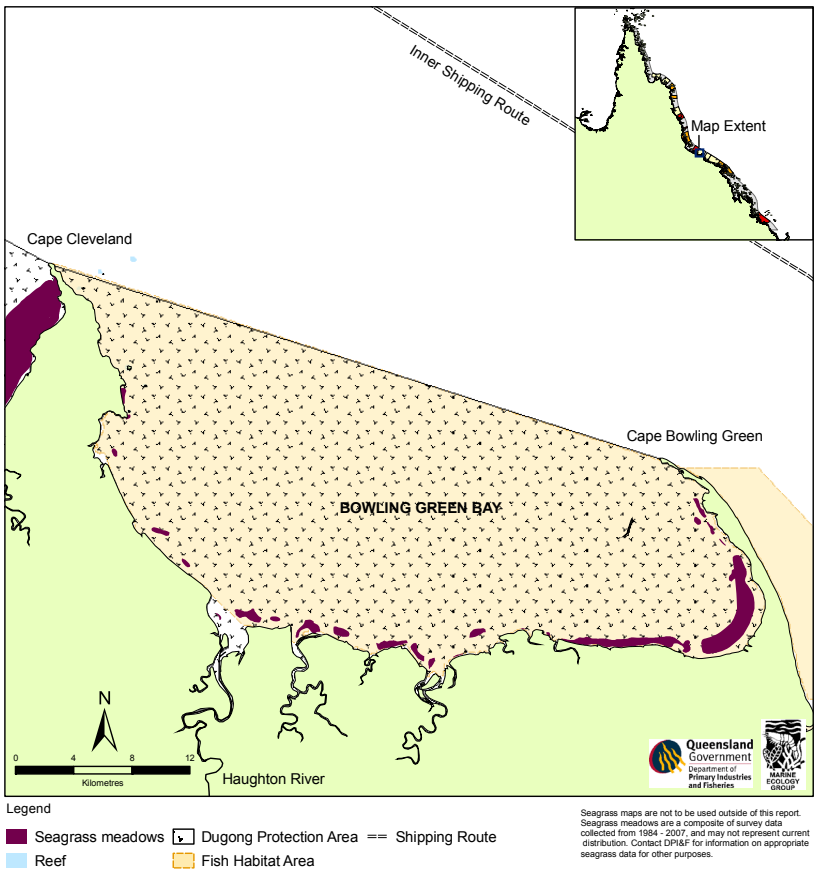
Bowling Green Bay

Main Threats: Flood runoff of the Burdekin River.

Capture in current program – ***Low***

There are no current seagrass monitoring programs in this region (Map 16). A broadscale mapping survey of intertidal and subtidal seagrasses was conducted within the region in 1987 (Coles *et al.*1992). A more detailed survey of intertidal seagrasses was conducted by the QDPI&F team in March 2007 as part of the first year of MTSRF activities.

Map 16: Bowling Green Bay target area.



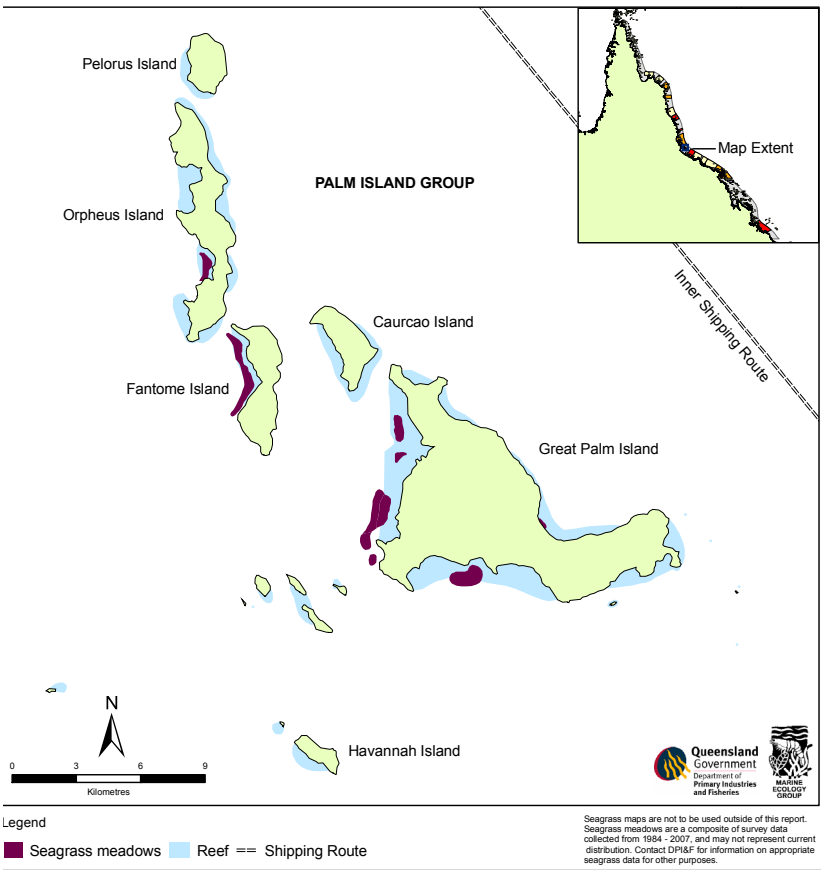
Palm Island Group

Main Threats: Small scale disturbances; coastal developments including aquaculture and new marine infrastructure.

Capture in current program – ***None***

There are no current seagrass monitoring programs in this region (Map 17). A baseline survey of intertidal and shallow subtidal seagrasses in the region was conducted in 1996 (Lee Long *et al.*1998).

Map 17: Palm Island Group target area.



Moderate Threat

Magnetic Island

Main Threats: Coastal and urban development and runoff; region is affected by flood runoff from the Burdekin River.

Capture in current program – ***Low***

There are two active intertidal Seagrass-Watch sites at a fringing reef location on Magnetic Island (see Townsville region Map 4). There is currently no regular seagrass monitoring that assesses the status of subtidal seagrasses or fine-scale monitoring of changes to seagrass meadow area or abundance. A baseline survey of seagrasses around Magnetic Island was conducted in 1996 (Lee Long *et al.* 1998).

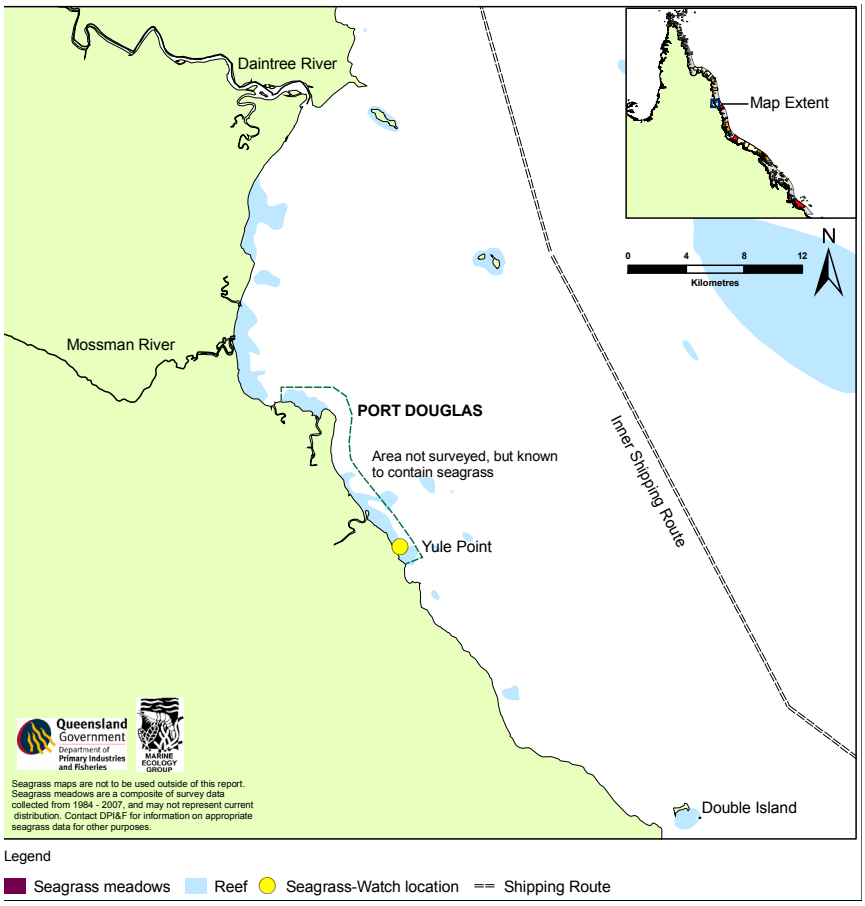
Port Douglas (Daintree to Double Island)

Main Threats: Coastal and Urban development; port maintenance dredging; agricultural and flood runoff.

Capture in current program – ***Low***

There is an active intertidal seagrass watch location at Yule Point south of Port Douglas (Map 18). There is currently no regular seagrass monitoring that assesses the status of subtidal seagrasses or fine-scale monitoring of changes to seagrass meadow area or abundance. Seagrasses in this region have not been formally mapped but are known to occur (e.g. Yule Point monitoring site and aerial reconnaissance of coastal region by authors).

Map 18: Port Douglas (Daintree to Double Island) target area.



3. Conclusions

The workshop and subsequent review identified nineteen of forty-nine regions of the GBRWHA coast where seagrasses are at heightened risk. The established MTSRF seagrass status and trend program addresses many of these risk areas well, particularly areas that are in the highest threat category. However, there are several areas where information is lacking or could be improved.

Of the four regions identified as facing a “very high” threat level, three have excellent capture in the current program (Cairns, Gladstone and Mourilyan). The detailed information on status and trends collected in these regions has been made possible through partnership programs with the port authorities that operate within these areas (Ports Corporation of Queensland; Cairns Port Authority; Central Queensland Ports Authority) and some local community volunteers. Some expansion of monitoring activities in the Townsville region may be warranted; at present only intertidal information from Seagrass-Watch sites is regularly collected. Currently no information on subtidal seagrass or fine-scale assessments of changes to seagrass meadow area and abundance are regularly collected in this “very high” threat region.

Outside of the four highest threat regions no regular monitoring or assessment of subtidal seagrasses is being conducted. While some regions have detailed baseline information collected on subtidal seagrass, regular monitoring is only conducted as part of Seagrass-Watch, which operates in intertidal areas. The Whitsunday region, for example, has good coverage of information on intertidal seagrass changes but little information is available on subtidal seagrass meadows that make up an important component of the overall seagrass resources. Subtidal seagrass meadows are particularly important to monitor as often they are the first regions to be affected by changes to water quality such as increased turbidity resulting in a reduction of light.

To strengthen our monitoring of seagrass areas at risk the MTSRF program has established a fine-scale baseline survey for southern Hinchinbrook (Herbert River area) in Year 1 of its research programme (March 2007). Preliminary results of the baseline survey have identified suitable intertidal and subtidal seagrass meadows to develop a fine-scale annual monitoring program for the area.

There is an obvious gap in the status and trends program for seagrasses north of Port Douglas, with monitoring in the area from Cape York to Port Douglas confined to only one Seagrass-Watch location (Archer Point). Many of the regions within this area have only broadscale seagrass information that was collected more than twenty years ago, or they have not been mapped or surveyed at all. While the majority of this area does not face particularly high threat levels, several regions do have threats that would warrant some level of monitoring, particularly key dugong feeding areas such as the seagrass meadows in the Corbett and Clack Reef region for which there is currently no information.

While this review has focused on high risk areas to target for monitoring in the GBRWHA there is merit in monitoring some seagrass areas that do not face high levels of anthropogenic threat. Monitoring in these areas would provide ‘reference regions’ to put changes observed in highly threatened areas into context. Some seagrass areas may also be worthy of monitoring due to their high value such as Dugong Protection Areas despite facing low anthropogenic threat. The existing status and trend program does examine some of these areas, for example Rodds Bay south of Gladstone. Collecting more information on other key representative seagrass areas in the GBRWHA at low risk would also be desirable.

The expansion of the seagrass status and trends program into new “risk” areas identified in this review is contingent on finding additional funding support for fine-scale monitoring or identifying new community groups with an interest in seagrass monitoring to establish Seagrass-Watch sites. This presents a significant challenge for many regions with a low capture in the current program, particularly regions in the Cape York area that are remote with few local communities or industries to support seagrass monitoring activities.

While the established program goes a long way towards assessing the status and trends of seagrasses at highest risk from human activity in the GBRWHA we would suggest the following actions to improve the program:

1. Maintain the existing fine-scale high risk seagrass monitoring locations;
2. Expand the fine-scale monitoring program to the Townsville region to capture changes in subtidal seagrasses and changes to seagrass meadow area;
3. Establish monitoring of subtidal seagrasses in the Whitsunday region (beyond the limited Seagrass-Watch coverage);
4. Investigate funding options to continue fine-scale monitoring of seagrasses in the southern Hinchinbrook (Herbert River mouth) area;
5. Support and encourage the expansion of Seagrass-Watch to Cape York communities;
6. Establish baseline information and a monitoring program for seagrasses in the Corbett/ Clack Reef area (Princess Charlotte Bay); and
7. Investigate opportunities to fill gaps in our seagrass baseline information in the Cape York region (north of Port Douglas).

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Appendix 1: Workshop Agenda

QDPI&F/MTSRF Seagrass Monitoring and Assessment Workshop

"Assessing Seagrass Habitats at High Risk"

Date: Monday, 5 March 2007
09:30hrs – 16:00hrs

Venue: Australian Centre for Tropical Freshwater Research
Room 117, Second Floor, Kevin Stark Research Building
James Cook University, Townsville Campus

Agenda:

1. **Welcome and introductions** (Rob Coles, 10 mins)
2. **Agency / participants' expectations** from the meeting (All, 10 mins)
3. **Overview of MTSRF Program 1.1.3** *Condition, trend and risk in coastal habitats: Seagrass indicators, distribution and thresholds of potential concern* (Rob Coles, 20 mins):
   - Developing a cost-effective strategy;
   - How the components work together;
   - Project output.
4. **Seagrasses at risk – the existing program** (Michael Rasheed, 20 mins)
   - Current locations;
   - Strategy and design;
   - Risks faced;
   - Incorporating management response.
5. **Threats and risks faced by coastal seagrasses in the GBRWHA** (15 mins)

Break: 10:45hrs (15 mins)

6. **Review of coastal seagrasses in the GBRWHA** (90 mins) – Workshop to **evaluate current knowledge, identify areas of high risk, information needs** and identifying gaps:
   - Regional review of seagrasses from Cape York to Bundaberg;
   - Current seagrass knowledge;
   - Value / importance of seagrass meadows;
   - Risks and levels of risks faced;
   - Degree of capture in current program;
   - Areas where more information is needed;
   - Funding sources for current activities.

Lunch: 12:30hrs – 13:30hrs

7. **Review of identified gaps and priorities** (60 mins)
   Summary of actions (30 mins)

Appendix 2: Workshop Working Paper

Rob Coles and Michael Rasheed

The Marine and Tropical Sciences Research Facility (MTSRF) seagrass status and trends project aims to deliver cost effective monitoring and assessment of the region's seagrasses, including assessment of the threats from human impacts and improving knowledge of distribution and status of seagrass habitats. The project is based on a strategy of using community and industry resources and co-investment to enhance and broaden the scope of the monitoring and assessment program. The overall results from the project contribute to the development of the Integrated Report Card for the Great Barrier Reef.

Queensland is in the unique situation of having almost its entire eastern sea coast adjacent to a marine world heritage area and a multi use marine park. Increasing human populations, port expansions, industrial developments, agriculture and aquaculture, along the coastal strip have focused attention on the high environmental and biodiversity values of our estuaries coasts and their fisheries. Seagrass habitats which provide for much of the recreational and commercial fisheries activity in these centres of productivity as well as food for threatened species such as dugong and turtle, are being stressed by global events such as climate change, damaged by coastal development decisions, and at the same time are washed by the nutrients, herbicides and pesticides that flow down the coastal rivers. The inshore coastal waters and estuaries are vast mixing areas, which if functioning properly will protect the coral reef system and marine park from damage caused by coastal influences. There are worrying signs. Thousands of square kilometres of seagrass were lost in the mid 1990s in the south due to turbid storm waters from catchment run off resulting in the deaths of many dugong and a reduction in fisheries productivity.

The MTSRF program has recognised these issues and the seagrass status and trend project was developed to address them. The project builds on and integrates existing long term data sets collected by the QDPI&F research team over the last decade as well as addressing gaps and areas where data is out of date or at inappropriate spatial resolution. Continuing long term data sets also enables historic comparisons including those relevant for observations of climate change.

Due to the strategy of using community and industry funds to enable region wide seagrass monitoring there are likely to be shortfalls of information in some locations.

The goal of the workshop is to assess the program and identify any of these shortfalls, particularly in areas where seagrass may be at high risk.

This workshop will:

- Outline the current strategy adopted by the group to deliver on the project;
- Identify areas of seagrass at high risk in coastal areas of the GBRWHA and assess how well the current program covers them;
- Review the program to assess if the major information needs of agencies are being adequately addressed; and
- Identify any gaps in the program and strategies to address them.

Issues to consider:

- There are currently three major components of the program which together provide the information required for assessing GBRWHA seagrass status:
  1. Community based monitoring;
  2. Detailed monitoring by QDPI&F (focused on high risk areas); and
  3. Mapping areas where there are information gaps.
- The review will look at all three of the assessment components, how they are presently addressing risk areas, and which tool is most appropriate in a particular location.
- Each of the components collects complimentary information that combined provides the overall picture of seagrass status and trend. For example the monitoring currently conducted by QDPI&F in high risk areas (2) is the only component of the program where changes in area of entire seagrasses meadows, biomass and sub-tidal seagrasses meadows are monitored but this only occurs at a limited number of sites and times in a year. Logistic constraints and the reliance on volunteers for data collection restricts the type and scope of the community based monitoring (1) but the design of this collection program allows for more sampling times and locations to be assessed during the year. The two techniques together give a more complete picture of the overall seagrass health and trends.
- To include additional monitoring sites and time additional sources of funding will need to be found.

Prior to the meeting:

Prior to the meeting we would like you to:

- Consider the issues and questions on seagrasses discussed above from the context of your organisations needs and the region;
- Consider the potential information gaps on seagrasses in the GBRWHA that you feel are most important;
- Consider potential avenues for supplementary funding for additional areas that are identified from the workshop; and
- Locate and bring any ARC GIS data sets you feel may contribute

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Appendix 3: Workshop Minutes

QDPI&F/MTSRF Seagrass Monitoring and Assessment Workshop

"Assessing Seagrass Habitats at High Risk"

Monday, 5 March 2007

Attendees

Rob Coles – QDPI&F (Chair)
Michael Rasheed – QDPI&F
Jane Mellors – QDPI&F
Helen Taylor – QDPI&F
Peter Doherty – AIMS
Kerry Neil – RRRC
Michelle Waycott – JCU
Alana Grech – JCU (GIS Services)
Catherine Collier – GBRMPA
David Haynes – GBRMPA
James Monkivitch – GBRMPA
Fergus Molloy – GBRMPA
Joelle Prange – GBRMPA
Sarah Salmon - GBRMPA

Apologies

Len McKenzie – QDPI&F

Welcome and Introductions

Rob Coles (RC) chaired the meeting and commenced by welcoming everyone.

Agency / Participants' Expectations

RC stated that QDPI&F's expectations from the meeting were centred on a need to deliver a cost effective seagrass monitoring strategy, which would address areas of assessment and monitoring required satisfying the Seagrass Status and Trends report as per MTSRF contract. This research and monitoring strategy would include the range of methodologies currently used by the group. The focus is on the monitoring that is conducted in areas of high risk to seagrass and the program of mapping areas where we have poor information on seagrass distribution.

David Haynes (DH) stated that GBRMPA has a number of key seagrass issues that it would like addressed. In order of priority they are:

1. Drivers of seagrass population change – why do they come and go?
2. Climate change – how this will effect natural change?
3. Water quality.

DH agreed that mapping / monitoring seagrasses over time would help in distinguishing natural changes from climate change. DH stated that to assess drivers, we need to look at water temperature loggers, light meters. DH would like to see the community involvement continue, whether this be through direct involvement (data collection) or indirect through education. DH stressed that data needs to be combined across groups / agencies for a comprehensive view of seagrass habitat. Michael Rasheed (MR) replied that this was part of what the Seagrass Status and Trend report the major deliverable from Project 1.1.3 was designed to do.

James Monkivitch (JM) stated that he was interested in trigger levels and whether it was possible to set triggers over seagrass meadows during projects to do with water quality and seagrass loss. Currently, turbidity is used as a trigger for corals. JM explained that GBRMPA uses any baseline information on seagrass distribution for the area, and looks at turbidity and water quality. JM would like QDPI&F to look at establishing acceptable levels of change to background parameters that would not kill seagrass.

Discussion surrounded feasibility of this and the result was that all agreed that not all seagrasses are the same so setting a single value would not work. We may need to look at stratifying seagrass and setting different trigger levels for different groups, i.e. inshore, offshore, turbid environments, clear environments, different species, etc.

Note
Post meeting, Len McKenzie noted that there is a separate MTSRF Project 3.7.1 Marine and estuarine indicators and thresholds of concern *(Katharina Fabricius) in which there is a seagrass program addressing some threshold concerns. In Year 2, this project will be addressing some of these issues and it may be worthwhile exploring the expansion / refinement of this work to facilitate some of the additional experimental work discussed in the workshop.*

Michelle Waycott (MW) indicated that the 'Vulnerability of seagrasses in the Great Barrier Reef to climate change[1]' paper had discussed some of these issues, and had assessed historical data to look at developing triggers. Very little information was available. MW stated that linking mapping of distribution and change and the causes of change is very hard and there was a great need for collaborative work to help develop stronger links.

MR agreed that it is difficult to link change with cause but the current seagrass risk program and Seagrass-Watch program have made significant progress toward this goal. The seagrass risk monitoring programs examine the major physical drivers of seagrass change such as temperature, tidal exposure, river flows, solar irradiance, and place observed seagrass changes in the context of the prevailing environmental conditions. Generally the major seagrass changes have been shown to link with changes to these climate variables.

There was general agreement that collaborative experimental work was desirable to enhance the seagrass assessment and monitoring conducted in Project 1.1.3. Some experimental work may assist to better identify some causes of change.

Jane Mellors (JMS) asked if any post-project monitoring has been/is currently conducted by QDPI&F, as this seems like an "experiment" on a big scale. RC and MR both stated that this has had limited success in the past, often because funding is not extended beyond the end

[1] *Vulnerability of seagrasses in the Great Barrier Reef to climate change*, Michelle Waycott, Catherine Collier, Kathryn McMahon, Peter Ralph, Len McKenzie, James Udy and Alana Grech. In: J. Johnson and P. Marshall (Eds.) *Assessing Climate Change Vulnerability of the Great Barrier Reef* (in press). Great Barrier Reef Marine Park Authority, Townsville. This paper will be released in May. MW to distribute to those interested.

of the development projects conducted. An exception is the current Hay Point monitoring project, but the lack of seagrass present immediately prior to and during the project has limited the outcomes.

MR noted that a separate workshop could be organised to look at experimental work, as this is not the goal of this workshop. This workshop is focused on identifying high risk areas for seagrass status and trend.

Peter Doherty (PD) expressed that AIMS does limited work on seagrass and he was at the workshop principally as the program leader for status and trends.

Discussion followed regarding the reporting process to the RRRC. Kerry Neil (KN) stated that QDPI&F needs to deliver seagrass status and trend information for the overall Status and Trends report card. The RRRC will actually compile and synthesise all information, including seagrass, corals, fish, etc., into one document. MR asked whether there was a set template or particular format for QDPI&F's seagrass information to be presented in, and KN replied that it can be set out however QDPI&F feels it needs to be. The information for seagrass does not necessarily need to be set out the same as corals. RC requested guidance from RRRC so that the report we provide is easily integrated into their final report. The Status and Trends report will be reporting on the first year of projects within the MTSRF. PD noted that this would be a status of research, rather than status of the ecosystem. KN stated that the information gathered needs to end up affecting management actions. RC stated that from QDPI&F's point of view, the information is being collected as part of a partnership between QDPI&F and MTSRF and therefore has a strong relationship to fisheries values, plus impacts on dugong and turtles. The seagrass program is a partnership program and feeds into QDPI&F, MTSRF and GBRMPA.

MR highlighted that there were key stakeholders not represented at the meeting including:

- QEPA – frequently request information;
- DEH / DEW – for EPBC assessments of major developments (e.g. Dredging); and
- Industry representatives (e.g. Port Authorities).

Note
Results of the seagrass risk assessment and meeting will be provided to other key stakeholders for comment, including ports corporations ***(Action MR)****.*

PD summarised the needs of each group as follows:

- QEPA / Industry – Needs surround coastal development;
- MTSRF / RRRC – Looking at overview and integration of knowledge;
- QDPI&F – Fisheries perspective, habitat and water quality; and
- GBRMPA / DEH – Conservation issues.

Overview of MTSRF Project 1.1.3 Seagrass Status and Trends

RC gave a presentation on the MTSRF Project 1.1.3 and how this developed from the old CRC Reef project. A copy of the presentation is provided in Appendix 4.

Key Points

- The program is an integrated set of projects that work together to deliver status and trend of seagrasses in the GBRWHA;
- The program has used a strategy of incorporating community assessments (Seagrass-Watch) and industry partnerships (seagrass at risk program) to deliver monitoring for seagrass status and trend;
- Combined with these "monitoring" tasks is a mapping task in the project which is designed to fill information gaps on seagrass distribution where we have out of date or insufficient information; and
- The goals of this workshop are to:
  1. Examine coastal seagrasses in the GBRWHA assess their risk and value to come up with priority high risk areas of seagrass to target for monitoring in the program for Years 2-4 of MTSRF;
  2. Use the information to assess the suitability of the current high risk monitoring locations in the program; and
  3. Identify areas where basic knowledge of coastal seagrass distribution is poor and that may require baseline mapping in Years 2-4 of MTSRF

Discussion following the presentation on the history of the seagrass program. RC stated that in the MTSRF program QDPI&F has moved away from the old Ports and Shipping program from the CRC and is focussing on areas of high risk. There is a concern that the program potentially may miss information in areas of risk where there are no ports or major urban centres e.g. North of Cairns, the Herbert River area. As a result, the new program will focus on Habitats at Risk. RC said that this project receives minimal operational funding from QDPI&F or MTSRF. This, plus much of the salaries of staff involved is funded by other groups.

The approximate 2006/2007 split of MTSRF funds for tasks in Project 1.1.3 Assessing the status and trend of GBR seagrasses (Total MTSRF budget $197k):

Task	Task from ARP1	#Approx MTSRF funding split
Seagrass-Watch	a1	$100,000
Fine-scale monitoring of seagrasses at risk	a3	$20,000
Baseline assessment of for Herbert River mouth/ southern Hinchinbrook	a3	$36,000
Improved spatial knowledge (mapping information gaps)	a4	$36,000
Long term changes in deepwater seagrasses	a5	$5,000

All tasks include a funding component for developing data for the overall seagrass status and trend report.

Townsville was flagged as a potential high risk high value seagrass area in which there is missing information on seagrass. The last full survey of the area was in 1998, and MW indicated that a recent look at seagrass distribution in the area by a JCU PhD showed that the distribution is dramatically different to 1998. Drought conditions have allowed seagrasses to move into deeper waters. There has also been reduced dugong mortality (other than boat strike) recorded in the last three years. RC highlighted the fact that studies that had been

done did not look at the variability of the seagrasses there. Seagrass-Watch regularly surveys intertidal regions around Townsville, however JMS pointed out that it was too hard to get community to do subtidal work.

Note
Post meeting Sarah Salmon (SS) supplied following information on dugong: In the Townsville Region (latitude 19'), according to the EPA Annual Stranding and Mortality Reports, the number of dugong strandings has not reduced over the last three years. Strandings reported in 2005=4; 2004=3; 2003=4.

Slide from overview talk listing Project 1.1.3 components.

Points 1-3 were identified as monitoring strategies, whereas four was a once-off type strategy. Joelle Prange (JP) asked about how QDPI&F chooses when to monitor. RC replied that it is based on known information about seagrass growth. Generally, this occurs in October to December when growth is at its maxima. This is also supported by Seagrass-Watch data, which is collected year round. It was highlighted that QDPI&F does have a good handle on the "big" drivers of change, such as seasonality. Points 1-3 were also highlighted by MR to be contributing to understanding processes through collection of water temperature data, tidal exposure rates, river flows and other climate data. RC highlighted that points 1-5 need to integrate with b). Funding was noted as an issue, other funding sources are needed to support the project.

PD asked how many gaps in the coast were left. RC replied that most areas had been surveyed at some stage, however for many areas the data was collected in the 1980s when technology and methodologies were different and inferior. RC highlighted particular areas including many offshore islands, such as the Keppels, Bowling Green Bay, Port Douglas, Clack / Corbett Reef and other reef tops.

There was discussion about Seagrass-Watch. A gap in its data collection was noted north of Cooktown. JMS highlighted this was related to issues with indigenous involvement and politics and the lack of large population centres. Seagrass-Watch uses three permanent fixed transects and surveys these four times a year. JMS and MW are currently trying to assess

feasibility of working on inshore islands. It was highlighted that all RWQPP sites are Seagrass-Watch sites. KN indicated for the record that MTSRF is only interested in East Coast (GBR) sites.

Seagrasses at Risk – The Existing Program

MR gave a presentation on the existing seagrass program. A copy of the presentation is provided in Appendix 4.

Key Points

- There are three components of the program which may address elements of seagrasses at risk:
  1. Community Monitoring (Seagrass-Watch and RWQPP monitoring);
  2. **Detailed monitoring conducted by QDPI&F; and**
  3. Mapping program.
- While focus is on the detailed monitoring of seagrass habitats at risk conducted by QDPI&F (1.1.3 a(3)) Any of the three or a combination of the techniques may be appropriate depending on level of information required.
- The risk program is focused on areas of high urban, coastal and industrial development where seagrass is present.
- Major areas of coastal seagrass in the GBRWHA tend to be in sheltered coastal bays and inlets which also coincide with urban and coastal developments, ports harbours and marinas, etc.
- Many of these areas are also subject to non-point source impacts from river inputs.
- Industry partners are sought to fund the detailed monitoring and assessment.
- Changes to seagrasses detected in the program are measured against baselines and placed in context with the range of natural changes recorded previously in the monitoring program and with similar meadows monitored in other Queensland locations.
- Seagrass changes are also assessed in the context of the prevailing environmental conditions that have the potential to impact on seagrasses such as temperature river flows solar irradiance tidal exposure, etc.
- Management trigger levels for changes to seagrass meadow biomass, area and species composition are set based on power analysis of baseline and monitoring data.
- Results are fed directly to management and have led to management responses to better protect seagrasses.

JM asked about the trigger levels that were set in the program and whether they were the same for different locations. MR replied that the trigger levels for change were very much dependant on location and type of seagrass meadow. The level of natural variability of different seagrass species was taken into account when determining management triggers. Also meadows of the same species under different ambient environmental conditions and in different geographic locations can vary dramatically. That is why the trigger levels are set based on the characteristics of the individual meadow and made in reference to baseline information and the range of natural changes previously recorded. The longer the program has been running the more powerful it is at determining changes that are outside of what could be considered “natural”.

Discussion surrounded why QDPI&F was surveying around the Herbert River area this year as part of the expansion of the seagrass habitats at risk program. JP indicated that there were other places where there was a greater input into rivers from land uses (i.e. Tully River,

Johnston River). KN indicated that surveying this site would tie in with other terrestrial projects in the area.

Review of Coastal Seagrasses in the GBRWHA

RC & MR introduced the risk matrix spreadsheet (Attachment 3). Discussion ensued about the categories and how best to rate each one.

Categories used in the matrix were:

- **Threats:** Includes acute and chronic threats such as pollution/shipping/coastal development and incorporates resilience of seagrasses;
- **Value:** Value of seagrass meadows including to dugong and turtle/ fisheries/ size/ quality/ rare seagrass species;
- **Capture:** Capacity for intervention and use to management;
- **Status and Trend:** Meets needs of management and program to assist in determining status and trend of seagrasses in the GBRWHA;
- **Other Data:** Integration with other long term data sets (seagrass) and coral and water quality monitoring; and
- **Feasibility:** Logistics and costs of working in each location.

A ranking system out of ten for each category was discussed for each.

Note
A report detailing the risk assessment process employed in the workshop and results will be produced and distributed to participants.

Examples of locations completed during the meeting:

Cairns Harbour

- Threat factor – 10 – active coastal development, port, Wet Tropics catchment (Barron River), agricultural, urban development, high tourism use, heavily used airport;
- Value – 10 – very high conservation, fisheries value, dugong and turtles, tourism, large area of Zostera key fish habitat. Important indigenous uses of the area;
- Capture – 10 – very high, fish habitat area, Cairns plan of management, port authority, technical advisory boards, lots of permits;
- Status and trend – 7.5 – monitoring requirements for key area of high density seagrass in the region, key fisheries habitat, indigenous value;
- Other data – 10 – very high, water quality data, excellent seagrass baseline data for comparisons; and
- Feasibility – 10 – local, easy access relatively cheap.

*** Potential for external funding through legislative tools.

Mount Adolphus

- Threat – 2.5 – high risk from shipping accidents due to proximity of shipping channel but other impacts low. Consensus was there was some risk, note MR thought that 2.5 was lower risk than he would suggest due to shipping accident risk is very high as per the GBRMPA / MSQ risk assessment. Agreed that the frequency of impact from shipping accidents was likely to very low compared to other more chronic threats;
- Value – 2.5 – low amount of seagrass some dugong grazing but not significant;
- Capture – 2.5 – low capacity but some;
- Status and Trend – 1 – very low, wouldn't add significantly to overall status and trend;
- Other data – 1 – very little other work done in the area; and
- Feasibility – 2.5 – can get there but very remote and need boat access as some subtidal seagrass.

Comments
Note the risk influence of climate change, and a general feeling from the meeting that the north of the GBR is more at risk from climate change than the south.

Other areas addressed during the workshop were:

- Cape York to Escape River;
- Orford Ness;
- Shelbourne Bay;
- Margaret Bay;
- Townsville (including Cape Pallarenda and Cleveland Bay);
- Hinchinbrook;
- Mourilyan;
- Bowling Green;
- The Whitsundays;
- Princess Charlotte Bay; and
- Corbett /Clack Reefs.

Time ran out to finish the remaining locations within the meeting. All agreed that RC and MR would complete the table and pass around for comment **(Action MR and QDPI&F group to draft values for rest of the areas and circulate to participants for comment) (Completed).**

Comments
Baseline data for Cleveland Bay is of poor quality and needs to be revised.
Princess Charlotte Bay different feasibility depending on the location within the system.
Area around Missionary Bay (Hinchinbrook) is one of the largest dugong habitats so that influences its importance which will be in the context of the whole Hinchinbrook system.

There may be a need for reference locations that are not at risk.

Discussion revolved around what would then be done with the matrix. The matrix results would be prioritised and locations identified that should be sampled. This may include areas which are currently not being sampled, and in this case we would need to determine what

tools / methods would be used at those locations identified – funding permitting. MR noted that not all locations will necessarily be suitable for long term monitoring.

Issues to do with funding will be addressed at the next operational meeting, which is taking place this month. ARP2 is due soon. MW put forward that a collaborative proposal for research into the drivers of change for seagrass should be given to PD within the next week and a half.

Discussion was had about budgets and where money was / will be coming from – MTSRF, GBRMPA, and in particular, which projects were likely to be supported. PD suggested that we look at what we want MTSRF to fund, and prioritise projects and provide supporting evidence for each. MW brought up the topic of finding funding for more research. Len McKenzie (post meeting) noted that this could be another area that may be supported by the Katharina Fabricius' program.

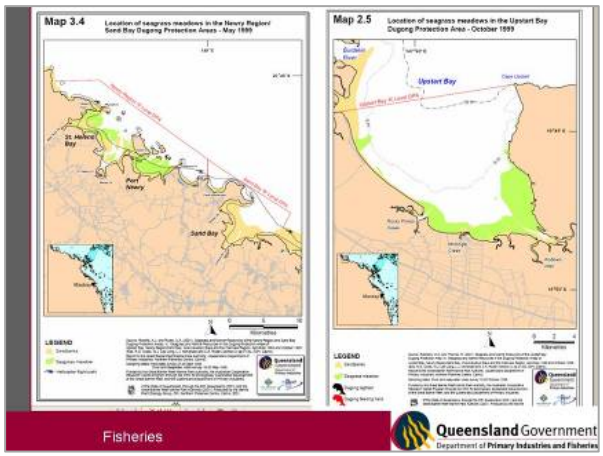
There was a brief discussion about the value of monitoring Corbett/Clack Reefs and Shoalwater Bay as north and south reference sites against which to measure any trends in coastal seagrass meadows in the risk areas and as reference sites for climate change.

Actions

- MR/RC – Complete Risk Matrix table and send for comment (completed)
- MW – Complete 2 pager proposal for PD (completed);
- MW – Send Climate change paper to interested people when finished;
- DPI&F – Complete report on workshop by 28th May (completed);
- HT – Complete minutes and forward to participants for comment (completed); and
- MR - Send minutes and matrix out to port industry stakeholders (completed).

Appendix 4: Workshop Presentations

Presentation by Rob Coles



Marine Ecology Group – LTM Habitat

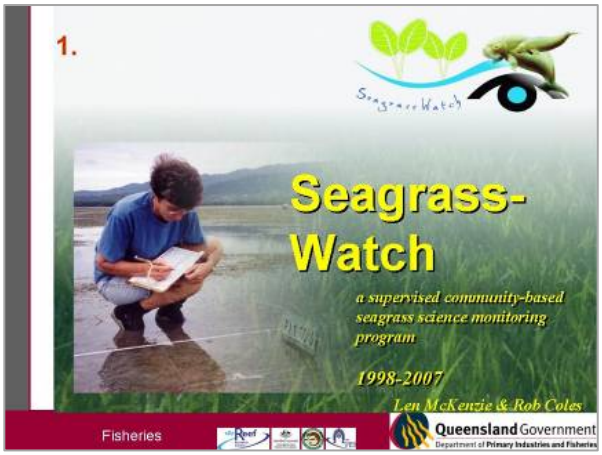
1.1.3 Condition trend and risk in coastal habitats: Seagrass indicators, distribution and thresholds of potential concern

a) Assessing the status and trend of GBR seagrasses

1. Seagrass-Watch (community seagrass assessment & monitoring)
2. GBRWQPP monitoring of seagrass meadows
3. Fine scale monitoring & mapping in coastal areas at risk.
4. Improved spatial knowledge of key intertidal and shallow subtidal seagrasses
5. Long-term changes in deep seagrasses and algae

b) Assessments of GBR habitats at high risk from direct impacts from human activity. (To be conducted in years 2-4 of MTSRF.)

Fisheries
Queensland Government



Seagrass-Watch

Vision

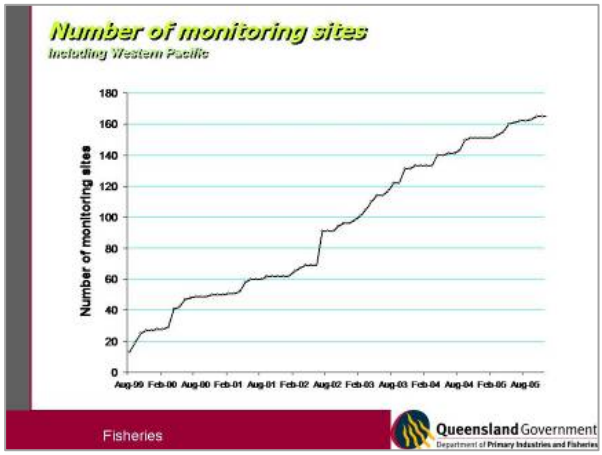
- Education, awareness and capacity building
- Community participation and ownership
- Governments, NGO's working with communities
- Standardised scientific methodology
- Long-term monitoring
- Early warning of ecological decline

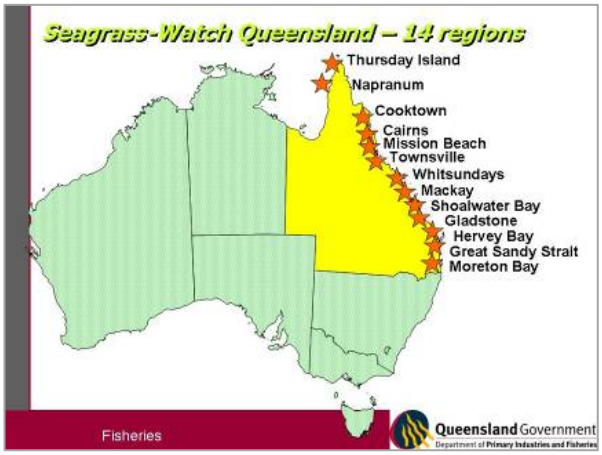
Fisheries
Queensland Government

Seagrass-Watch

- Started May 1998
- Long-term monitoring started August 1999
- 165 sites currently established across 12 countries (>40,000 quadrats have been examined)
- Data remains property of group (principal) who collected it - Seagrass-Watch HQ (DPI&F) is custodian.
- Data submitted under condition it can be used by Seagrass-Watch HQ for condition and trend reporting

Fisheries
Queensland Government






Education & Awareness
·Classroom
·Field
·Laboratory
Fisheries
Queensland Government


Fisheries
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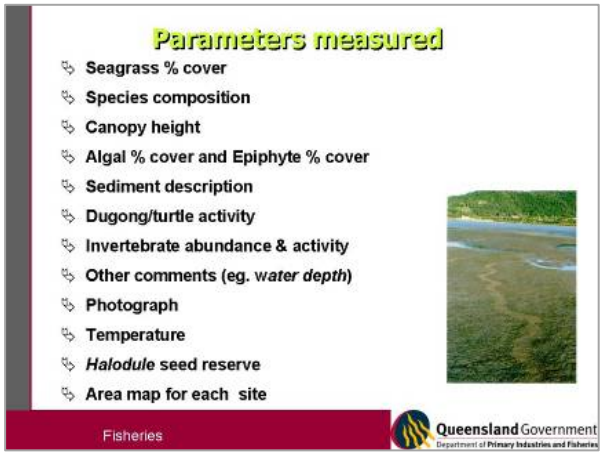
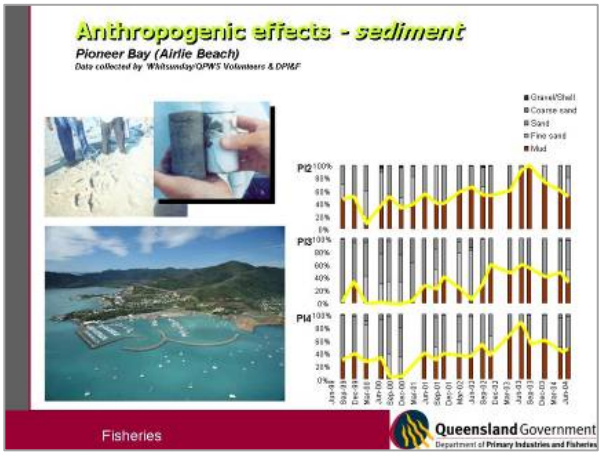
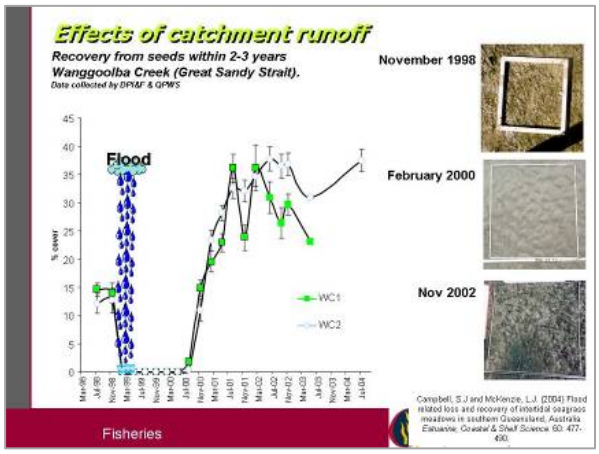

Parameters measured
Seagrass % cover
Species composition
Canopy height
Algal % cover and Epiphyte % cover
Sediment description
Dugong/turtle activity
Invertebrate abundance & activity
Other comments (eg. water depth)
Photograph
Temperature
Halodule seed reserve
Area map for each site
Fisheries
Queensland Government


Anthropogenic effects - sediment
Pioneer Bay (Airlie Beach)
Data collected by Whitsunday/QPWS Volunteers & DPI&F
Gravel/Shell
Coarse sand
Sand
Fine sand
Mud
P12
P13
P14
Fisheries
Queensland Government


Effects of catchment runoff
Recovery from seeds within 2-3 years
Wanggoolba Creek (Great Sandy Strait).
Data collected by DPI&F & QPWS
Flood
% cover
WC1
WC2
November 1998
February 2000
Nov 2002
Campbell, S.J and McKenzie, L.J. (2004) Flood related loss and recovery of intertidal seagrass meadows in southern Queensland, Australia. Estuarine, Coastal & Shelf Science 60: 477-490.
Fisheries


Welcome to Seagrass Watch
Fisheries
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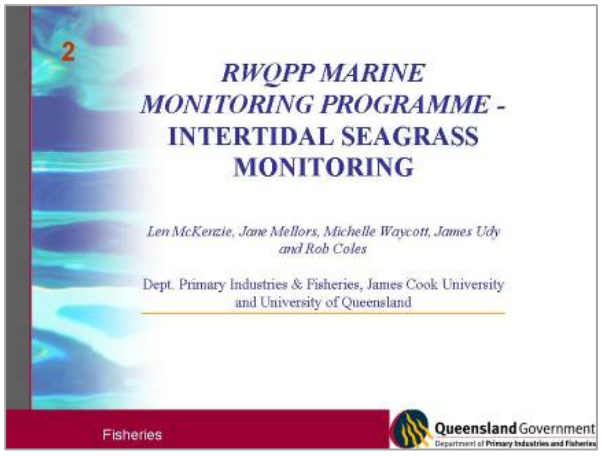
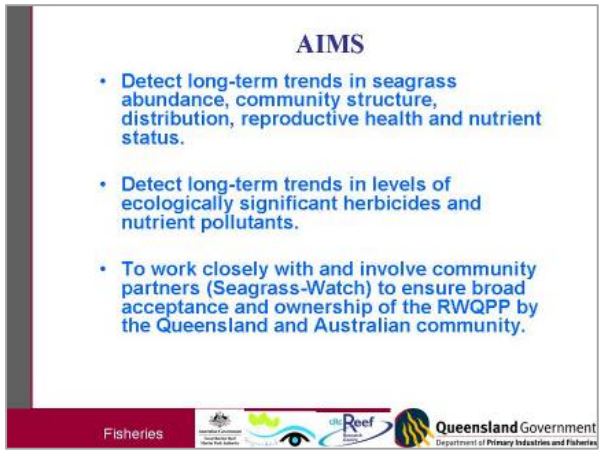

2
RWQPP MARINE MONITORING PROGRAMME - INTERTIDAL SEAGRASS MONITORING
Len McKenzie, Jane Mellors, Michelle Waycott, James Udy and Rob Coles
Dept. Primary Industries & Fisheries, James Cook University and University of Queensland
Fisheries
Queensland Government


AIMS
Detect long-term trends in seagrass abundance, community structure, distribution, reproductive health and nutrient status.
Detect long-term trends in levels of ecologically significant herbicides and nutrient pollutants.
To work closely with and involve community partners (Seagrass-Watch) to ensure broad acceptance and ownership of the RWQPP by the Queensland and Australian community.
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Intertidal seagrass monitoring locations

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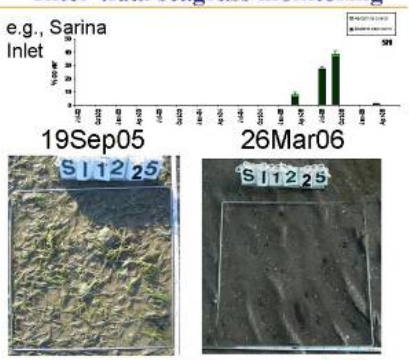
Inter-tidal seagrass monitoring

- e.g., Sarina Inlet



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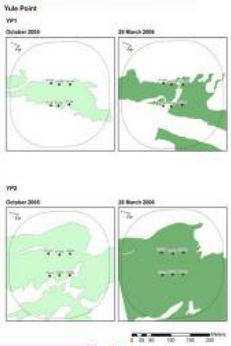
Edge mapping

- Mapping edge of monitoring meadow with area of 100m around site.
- Changes in meadow edge varies between location
- Southern sites meadow absent in March/April 2006 (Hervey Bay & Gladstone)



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Reproductive health

- Samples collected in October 2005 and April 2006
- Total samples = 330
- Processing completed 23 May 2006.

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Sediment herbicides –Apr/May05

- Concentrations low (Diuron ~10 µg kg^{-1} inhibit seagrass photosynthesis, aquatic half life ~120 days)

Sector	Region	Catchment	Monitoring location		Atrazine (ng/kg)	Diuron (ng/kg)	Tebuthiuron (ng/kg)
Far Northern	Cape York	Endeavour	Cooktown	AP1	<0.1	<0.1	<0.5
				AP2	<0.1	<0.1	<0.5
Northern	Wet Tropics	Daintree	N4				
		Russell / Mulgrave Johnstone	Green Island	GI1	<0.1	<0.1	<0.5
				GI2	<0.1	<0.1	<0.5
			Cairns	YP1	<0.1	<0.1	<0.5
				YP2	<0.1	<0.1	<0.5
		Tully	Mission Beach	LB1	<0.1	<0.1	<0.5
		Herbert	*Champ Pt		<0.1	0.33±0.03	<0.5
			N4				
Central	Burdekin	Burdekin	Magnetic Island	MI1	<0.1	<0.1	<0.5
				MI2	<0.1	<0.1	<0.5
			Townsville	SB1	<0.1	<0.1	<0.5
				BB1	<0.1	<0.1	<0.5
	Mackay / Whitsunday	Proserpine	Whitsundays	PI2	<0.1	0.27±0.03	<0.5
				PI5	<0.1	0.27±0.03	<0.5
		Pioneer	Mackay	SI1	<0.1	0.17±0.03	<0.5
				SI2	NA	NA	NA
Southern	Fitzroy	Fitzroy	Shoalwater Bay	RC			
				WI1			
	Burnett-Mary	Burnett	Gladstone	GH1	NA	NA	NA
				GH2	NA	NA	NA
		Mary	Hervey Bay	UG1			
				UG2			

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Sediment nutrients

- NH_4^+ levels ranged from 77.58 µmols L^{sed-1} at YP2 to 1106.04 µmols L^{sed-1} at UG1.
- UG1 again recorded the highest variability. Closer examination of outliers is required to explain this variability.
- Nitrogen oxides were also analysed however the majority of samples were below detectable limits.

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Marine Ecology Group – LTM Habitat

1.1.3 Condition trend and risk in coastal habitats: Seagrass indicators, distribution and thresholds of potential concern

a) Assessing the status and trend of GBR seagrasses

3. Fine scale monitoring & mapping in coastal areas at risk.
4. Improved spatial knowledge of key intertidal and shallow subtidal seagrasses

b) Assessments of GBR habitats at high risk from direct impacts from human activity. (To be conducted in years 2-4 of MTSRF.)

Total operating for 3 = 12K, Total operating for 4 =30K and b= 0k)

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Coastal Habitats at Risk

Products:

1. Advice to management
2. Shipping lane surveys -atlases and GIS products- 4
3. Baseline environment mapping of Ports – 10
4. Long term monitoring sites – 6
5. Research – climate/resilience
6. Development of survey methods
7. Marine pest surveys and methods
8. Publications

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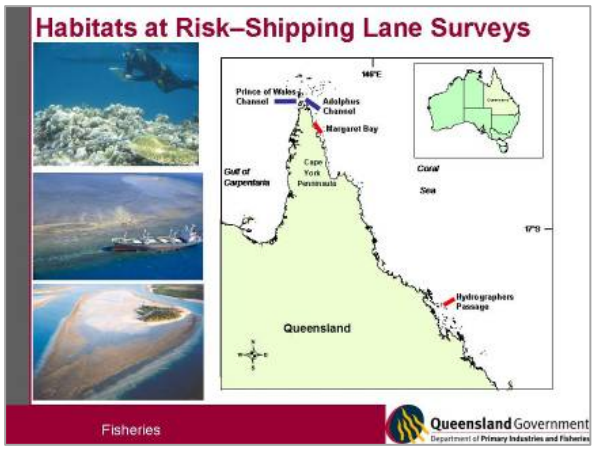
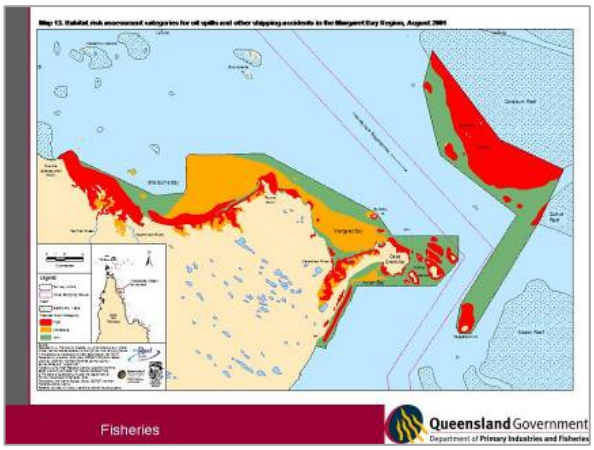

Habitats at Risk–Shipping Lane Surveys
Prince of Wales Channel
Adolphus Channel
Margaret Bay
Gulf of Carpentaria
Cape York Peninsula
Coral Sea
Hydrographers Passage
Queensland
Fisheries
Queensland Government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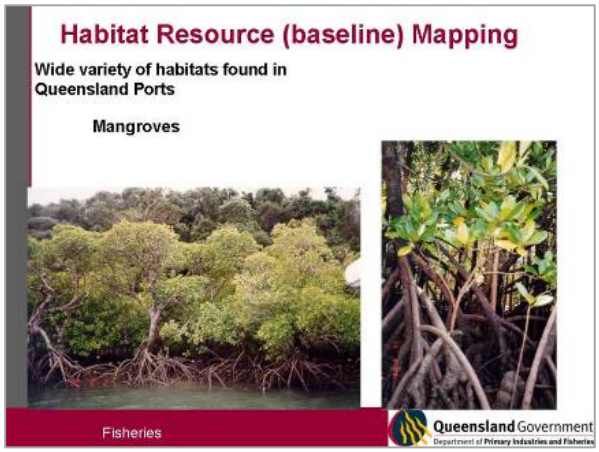
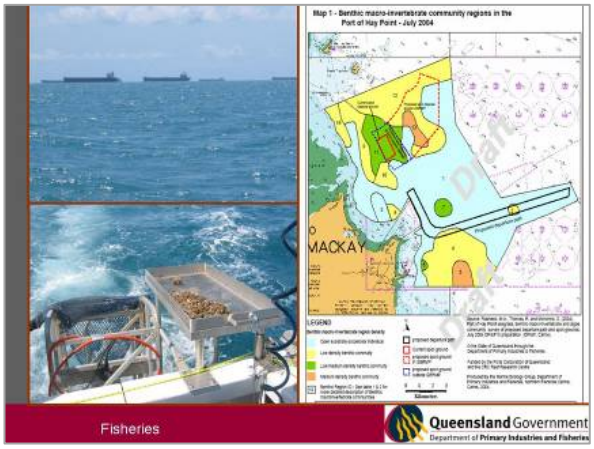
Habitat Resource (baseline) Mapping
Thursday Island
Skardon River
Weipa
Gulf of Carpentaria
Cape York Peninsula
Coral Sea
Cairns
Mourilyan
Abbot Point
Mackay
Hay Point
Gladstone
Queensland
Fisheries
Queensland Government


Habitat Resource (baseline) Mapping
Wide variety of habitats found in Queensland Ports
Mangroves
Fisheries
Queensland Government


Habitat Resource (baseline) Mapping
Wide variety of habitats found in Queensland estuaries
Seagrass
Algae
Fisheries
Queensland Government


MACKAY
Fisheries
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Fishermans Landing Wharves
Fish Habitats with Observed Oil Spill Affects 28/02/06
Oil Affected Mangroves
Mud
Seagrass
Saltmarsh
Mangrove
Site of Oil Spill 24/01/06
Coal Loading Facility
Gladstone
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Long-term Monitoring of Seagrass in Queensland habitats at risk
Seagrass found in the majority of Queensland bays
Dominant habitat feature
Fisheries
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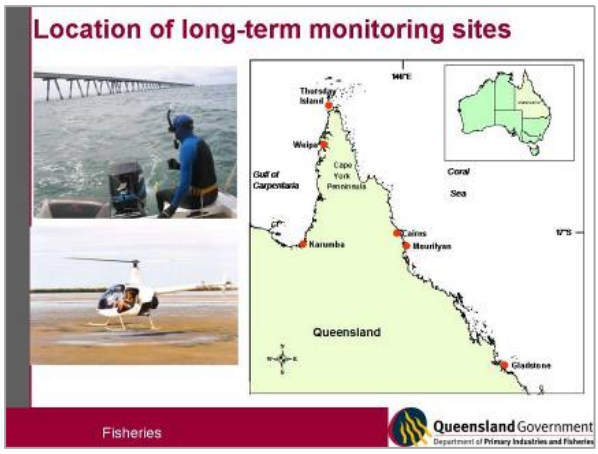
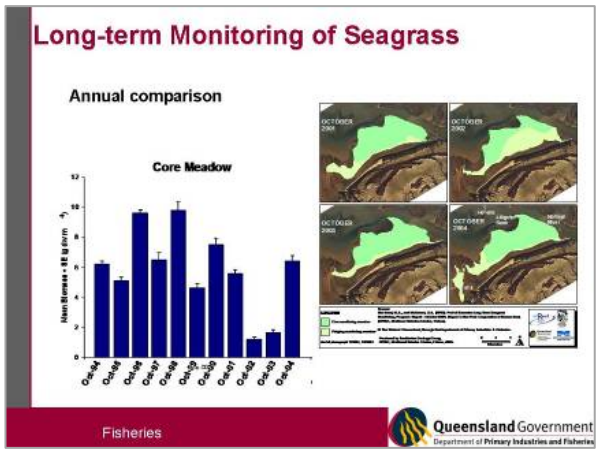
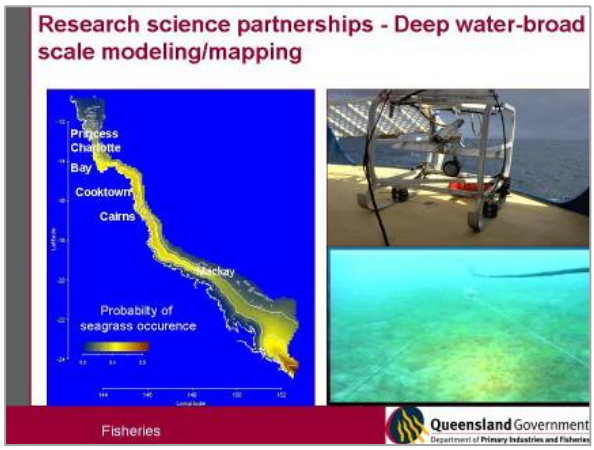
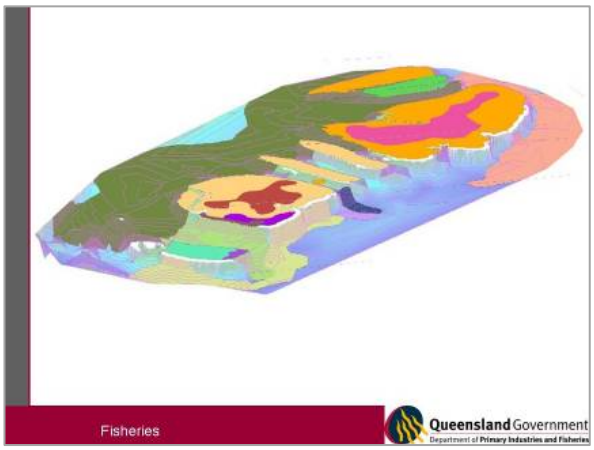

Location of long-term monitoring sites
Thursday Island
Weipa
Cape York Peninsula
Gulf of Carpentaria
Coral Sea
Cairns
Karumba
Mourilyan
Queensland
Gladstone
Fisheries
Queensland Government


Long-term Monitoring of Seagrass
Annual comparison
Core Meadow
Fisheries
Queensland Government


Research science partnerships - Deep water-broad scale modeling/mapping
Princess Charlotte Bay
Cooktown
Cairns
Mackay
Probability of seagrass occurence
Fisheries
Queensland Government


Fisheries
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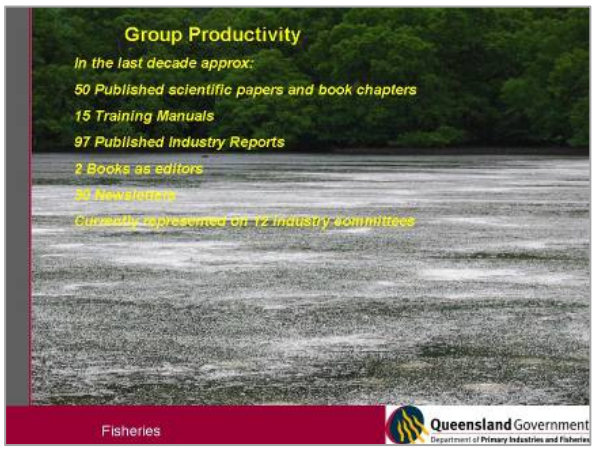
Group Productivity
In the last decade approx:
50 Published scientific papers and book chapters
15 Training Manuals
97 Published Industry Reports
2 Books as editors
30 Newsletters
Currently represented on 12 industry committees
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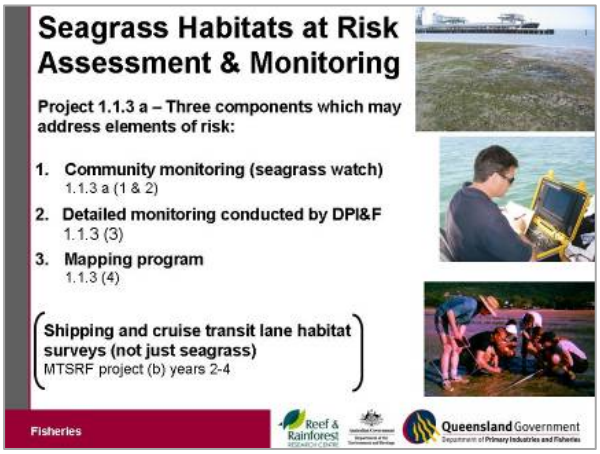
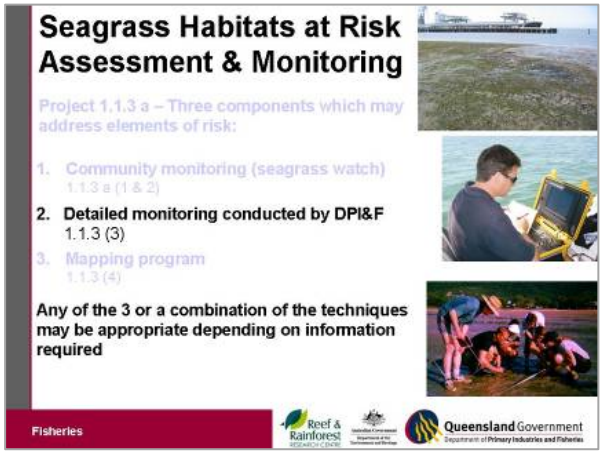
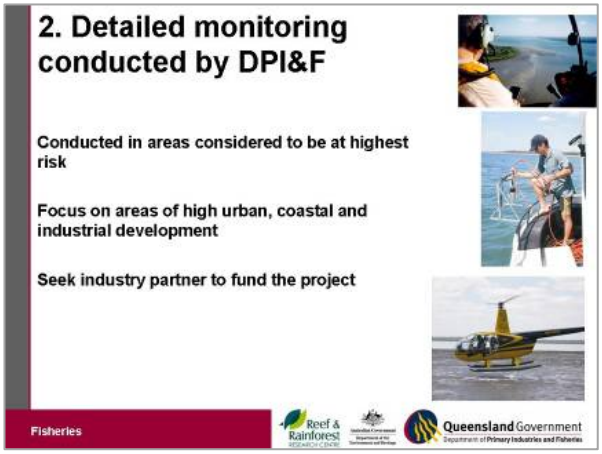
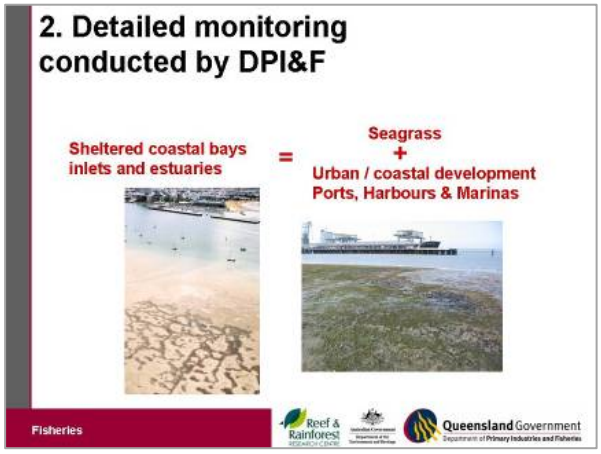
Developing a cost effective strategy
How the components work together
Project output
Fisheries
Queensland Government

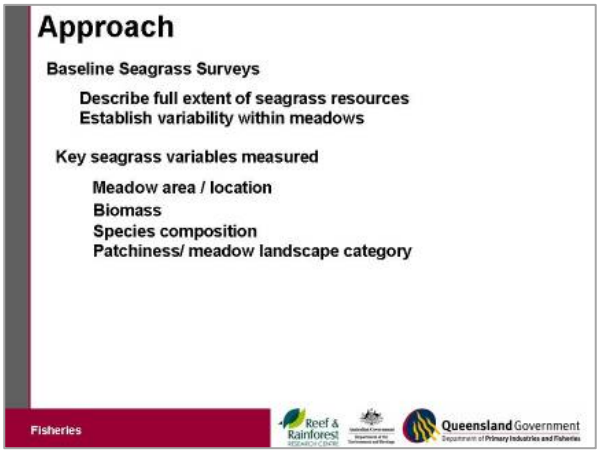
Presentation by Michael Rasheed











Baseline Assessments

Fisheries

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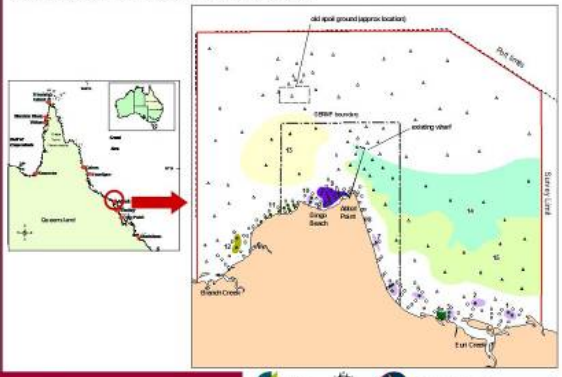
Baseline Assessments



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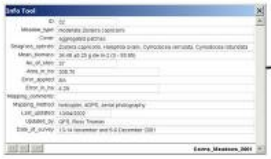
Monitoring Approach

Establish GIS



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Monitoring Approach

Select representative meadows

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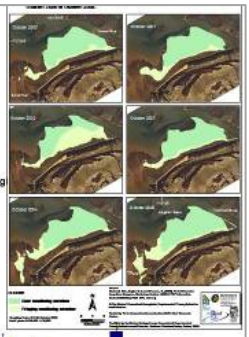
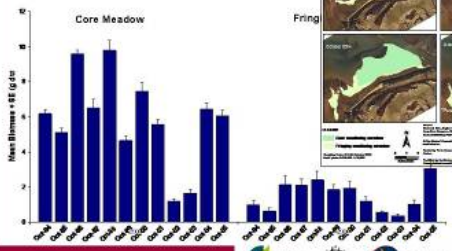
Monitoring Approach

Annual comparison





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Monitoring Approach

Key seagrass variables measured:

- Meadow area / location
- Biomass
- Species composition
- Patchiness/ meadow landscape category
- Seed Bank status
- Depth

Use baseline to determine number of sites with desired power

Set management triggers:

- 30% change in biomass
- 3 consecutive changes in the same direction (regardless of significance)
- change in species composition

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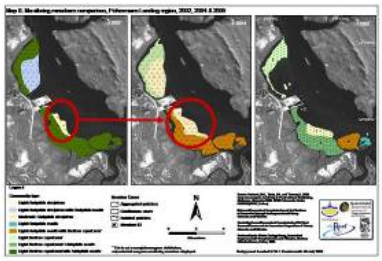
Monitoring Approach

Measure change compared with baseline/previous monitoring



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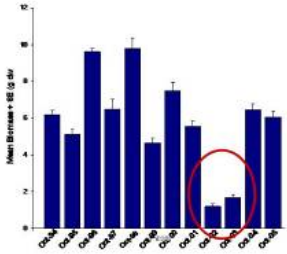
Monitoring Approach

Compared with "normal" range of values for the location



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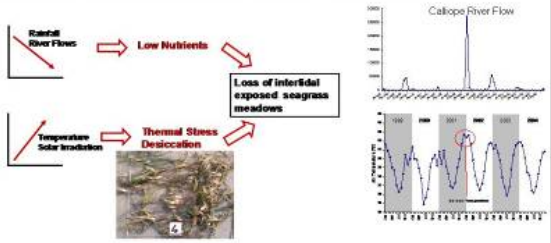
Monitoring Approach

Changes assessed in relation to regional and local climate



Fisheries

Monitoring Approach

Compared with similar seagrass meadows throughout Queensland

Fisheries

Monitoring Approach

Feed directly to management
- DPI&F
- EPA
- DEH
- GBRMPA
- Port Authorities

Technical advisory committees
Data requests for developments
Direct input into planning
Developing partnerships

Management responses
- Additional monitoring
- Altering dredging operations
- Changing development plans
- Use in emergency response

Fisheries

Location of long-term monitoring sites

Fisheries

Cairns Harbour

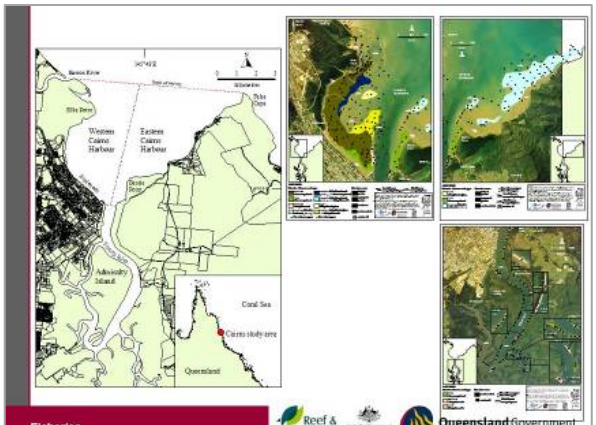
Baseline 2001
Annual monitoring 2002 -

Large area of seagrass (1000ha)
High value to fisheries
dugong and turtle

Annual dredging
Oil and fuel spills
Coastal development
Sewage storm water discharge
Large Urban expansion

Baron River flood plumes and inputs

Fisheries



Fisheries

Gladstone – Rodds Bay

Baseline 2002
Annual monitoring 2004 -

Large area of coastal seagrass 7,200 ha

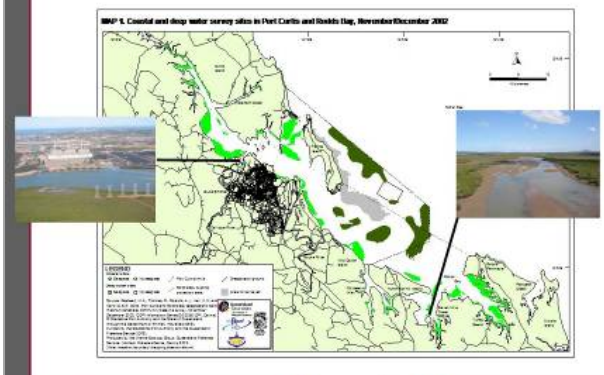
Important for dugong and turtle and a declared dugong protection area

Dense meadows regionally important for fisheries production

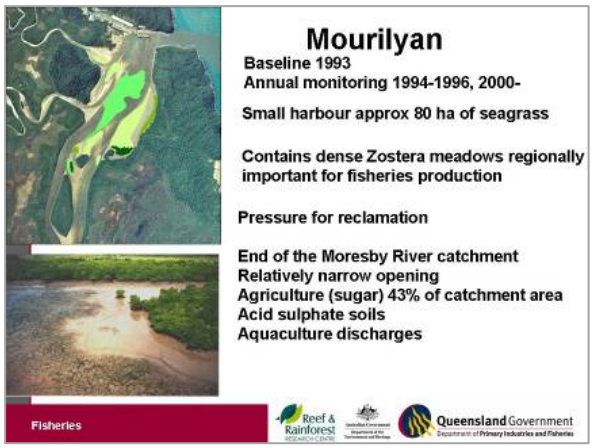
Massive port development
maintenance and capital dredging
reclamations
Oil and chemical spills
industrial discharges……

2 major rivers and catchments – Calliope and Boyne

Fisheries



Fisheries


Mourilyan
Baseline 1993
Annual monitoring 1994-1996, 2000-
Small harbour approx 80 ha of seagrass
Contains dense Zostera meadows regionally important for fisheries production
Pressure for reclamation
End of the Moresby River catchment
Relatively narrow opening
Agriculture (sugar) 43% of catchment area
Acid sulphate soils
Aquaculture discharges
Fisheries
Reef & Rainforest
Queensland Government


Threats & Risks to Coastal Seagrasses
Remove your "coral hats"
Similar factors but different importance
Unlike majority of GBRWHA corals, seagrasses most abundant in coastal bays estuaries and inlets
Direct human impact a significant threat
Fisheries
Reef & Rainforest
Queensland Government