Seagrass and algal abundance in the Whitsundays region.

Status Report

March 2001

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1. Background

Seagrass-Watch is a collaborative program between DPI, QPWS, Coasts and Clean Seas and community groups that are collecting scientific data on the condition and trend of seagrass meadows in Queensland. The program provides an early warning mechanism for detecting potential threats and damage to seagrass resources throughout Queensland.

Coastal seagrass meadows in the Whitsundays, particularly those adjacent to mangrove habitats, are similar to habitats elsewhere along the Queensland coast that support very productive fish and prawn populations of commercial and recreational fisheries value. Seagrass meadows also provide food for dugong and green sea turtles. From broad-scale surveys conducted in January 1999 and 2000, extensive areas of seagrass habitat exist in the Whitsunday region, from Cape Gloucester to Midge Point. Mapping is yet to be finalised and at this stage total area coverage of seagrasses is unknown (DPI unpublished data).

Anthropogenic threats to Whitsunday region seagrasses include: sewage effluent in Pioneer Bay (coastal) and vessel use (anchoring) at Whitehaven Beach (Whitsunday Island). Urban development at Hydeaway and Dingo Beach may present impacts of sediment run-off and septic ground-water flows onto near-shore seagrasses. Chronic impacts on water quality and seagrasses along the Whitsunday coast from adjacent agricultural catchments are poorly understood.

Eight locations have been selected for long-term monitoring of seagrasses within the *Seagrass-Watch* Program. These include intertidal sites at Hydeaway Bay, Dingo Beach, Pioneer Bay, Laguna Quays, Midge Point, and Midgeton, and sub-tidal sites at Whitehaven Beach and Cid Harbour (Map 1).

This report presents seagrass and algal abundance data from an impacted intertidal site (Pioneer Bay = PI), an impacted subtidal site (Whitehaven Beach = WB) and a relatively non-impacted (reference) site (Midge Point = MP). Detailed maps of seagrasses and *Seagrass-Watch* site locations at Pioneer Bay, Whitehaven Beach and Midge Point are shown in Maps 2, 3 and 4 respectively.

The objectives of *Seagrass-Watch* are to monitor the condition and trend of seagrass meadows and to increase community awareness of the importance of seagrass meadows throughout Queensland.

2. Methods

The methods employed follow *Seagrass-Watch* protocols (McKenzie *et al.* 2001). Three 50m (100m for subtidal sites) transects are laid parallel across the seagrass meadow, spaced 25 m apart. Along each transect line 50x50cm quadrats are placed at each 5m (10 m for subtidal sites) interval. Within each quadrat estimates of percentage seagrass cover, species composition, canopy height, epiphyte cover and algal cover are estimated using standard photo-calibration sheets. Percentage cover estimates are derived in the following manner:

- Seagrass cover (%) by estimating the percentage of the 50x50cm quadrat overed by seagrass.

- Epiphyte cover (%) by estimating the percentage of seagrass blades covered by epiphytes within a quadrat.

- Non-attached algae (%) by estimating the percentage of the 50x50cm quadrat covered by non-attached algae.

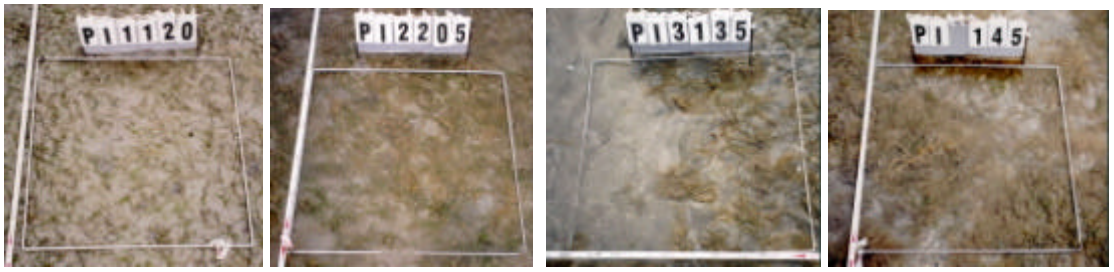
Sites are marked permanently (fixed) and monitoring is carried out 4 times per year at 3 monthly intervals. At Pioneer Bay, 4 sites (Map 2) have been monitored from September 1999 to March 2001. At Whitehaven Beach 2 sites (Map 3) have been monitored from September 1999 to March 2001. At Midge Point 2 sites have been monitored since April 2000.

Standard photo-calibration sheets ensure that observers' estimates are consistent between both sites and times (visits).

3. Results and Discussion

i. Impacted Intertidal site (Pioneer Bay)

Figures 1 and 2 show characteristic seagrass and algal abundance at the sites monitored in Pioneer Bay.



PI1 PI2 PI3 PI4

Figure 1. Seagrass and algal cover at all Pioneer Bay sites in December 2000. Sites PI1 and PI2 have high seagrass cover. Sites PI2, PI3 and PI4 have high epiphyte/algal cover.

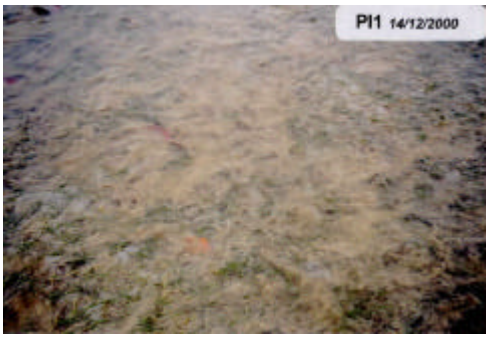


Figure 2. *Hincksia* sp. bloom at site PI1 in the intertidal region of Pioneer Bay, 14/12/00.

At the 4 Pioneer Bay sites trends in seagrass abundance exhibit characteristic seasonal responses as reported from other tropical Queensland localities (McKenzie 1984, Mellors 1991). This was represented by low percentage cover of seagrass in winter (July) and an

increase in seagrass cover from spring through to summer (September to January) (Fig 3a).

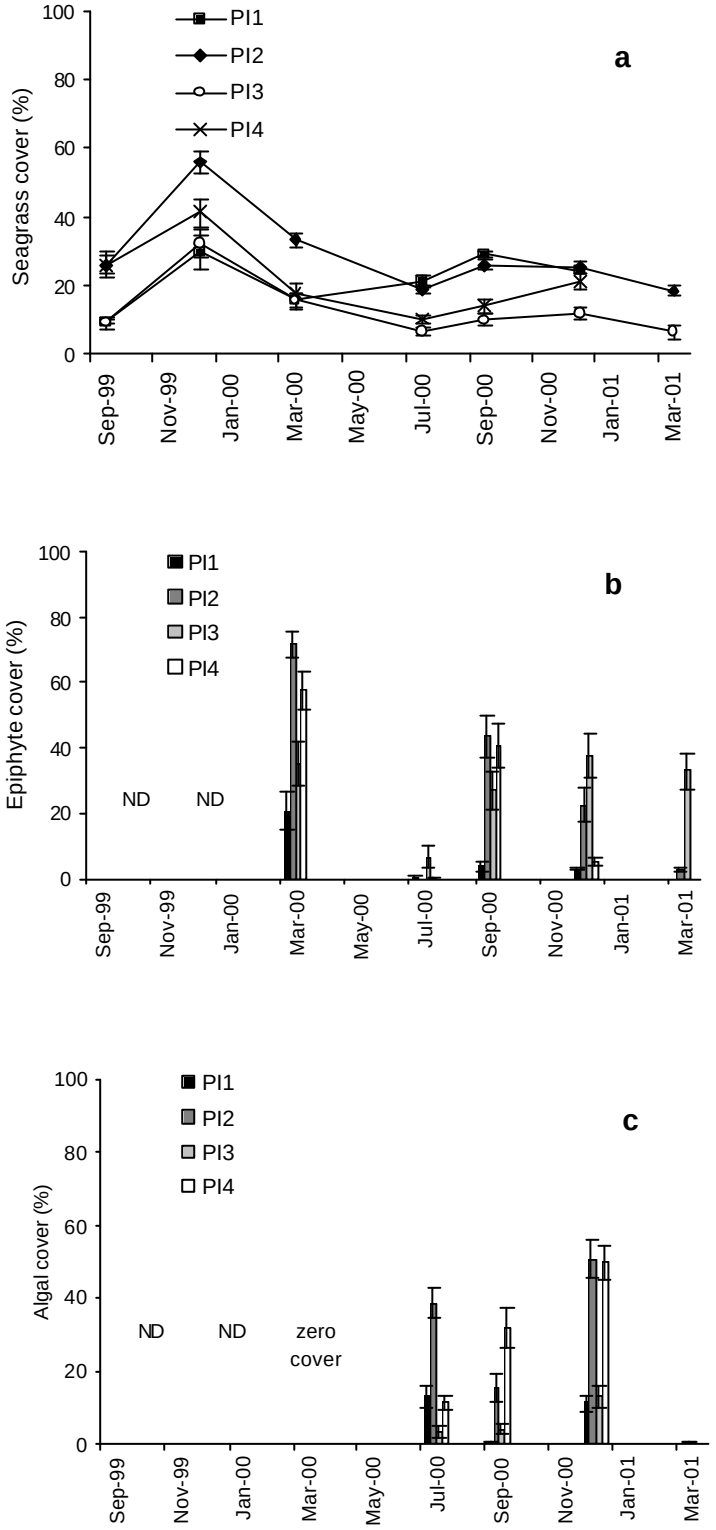
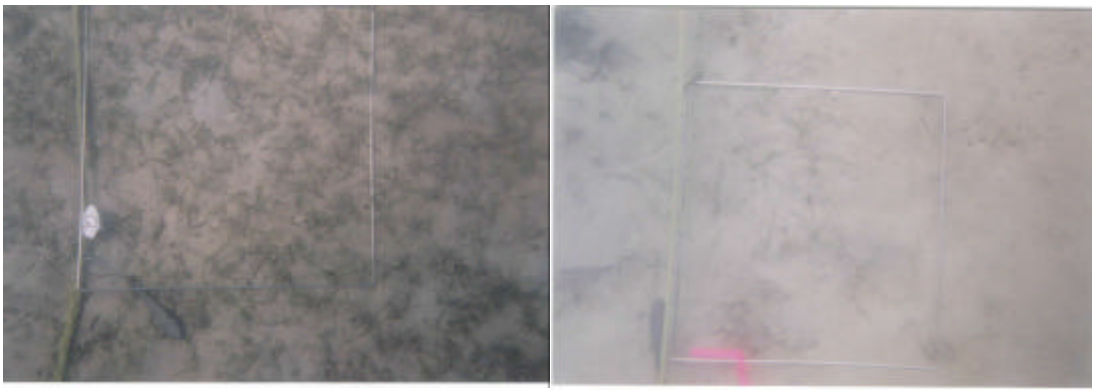


Figure 3. Mean (±s.e.), (a) seagrass cover (%), (b) epiphyte cover (%) and (c) algal cover (%) at Pioneer Bay intertidal sites (PI1-4) from September 1999 to March 2001. (ND denotes no data collected).

Epiphyte (attached algae) and non-attached algae ranged from 20-80% cover at all sites in Pioneer Bay (Fig 3b and c). The abundance (% cover) of filamentous epiphytic and non-attached algae differs between sites in Pioneer Bay with higher cover at sites PI2, PI3 and PI4 compared with site PI1 (Fig. 3c). The epiphytic algal flora consists mainly of diatoms and filamentous brown algal species *Ectocarpus* sp. and *Hincksia* sp. (S. Campbell). Non-attached or free floating algal species present at Pioneer Bay sites have been identified to be the brown algae *Ectocarpus* sp. and *Hincksia* sp. (S. Campbell) and the blue green alga *Lyngbya majuscula* (A. Watkinson, University of Queensland, 16 March 2001 pers. comm.*)*. Brown (epiphytic and non-attached) filamentous algae dominated the algal flora in March and December 2000 monitoring events, whilst the blue-green alga (non-attached) *Lyngbya majuscula* was dominant during July and September 2000 monitoring events.

ii Impacted subtidal site (Whitehaven Beach)

Figure 4 shows characteristic seagrass abundance at the sites monitored at Whitehaven Beach. A significant difference in seagrass abundance occurred between site WB2 (Fig 4a) where boat anchoring was minimal (1-2 boats per day) and site WB3 (Fig 4b) where frequent boat anchoring occurs (6-15 boats anchored per day) (Fig.4).



a) WB2 **b) WB3**

Figure 4. Seagrasses (mixed *Halodule uninervis*, *Cymodocea serrulata*, *Halophila ovalis*) at, a) WB2 and b) WB3 in March 2000. The abundance of epiphytic algae and non-attached algae was low.

Peaks in seagrass abundance were observed during spring and summer at both Whitehaven Beach sites (Fig 5a). Seagrass cover (%) was highest at the "low anchor impact" site throughout the monitoring period (Fig. 5a).

Epiphyte and algal cover was low (< 20% cover) throughout most of the sampling events but a high abundance of epiphytic and non-attached algae (>20% cover) was found in March 2001 (Figs 5b-c). The algae was identified as the blue-green alga *Lyngbya majuscula* (A. Watkinson, University of Queensland, 16 March 2001 pers. comm.*)* and dominated the subtidal region at depths of 4-6m (Fig. 6). During the *Lyngbya* bloom at Whitehaven Beach epiphytic and non-attached algal abundance was comparable (ie 20-70% cover) to Pioneer Bay sites.

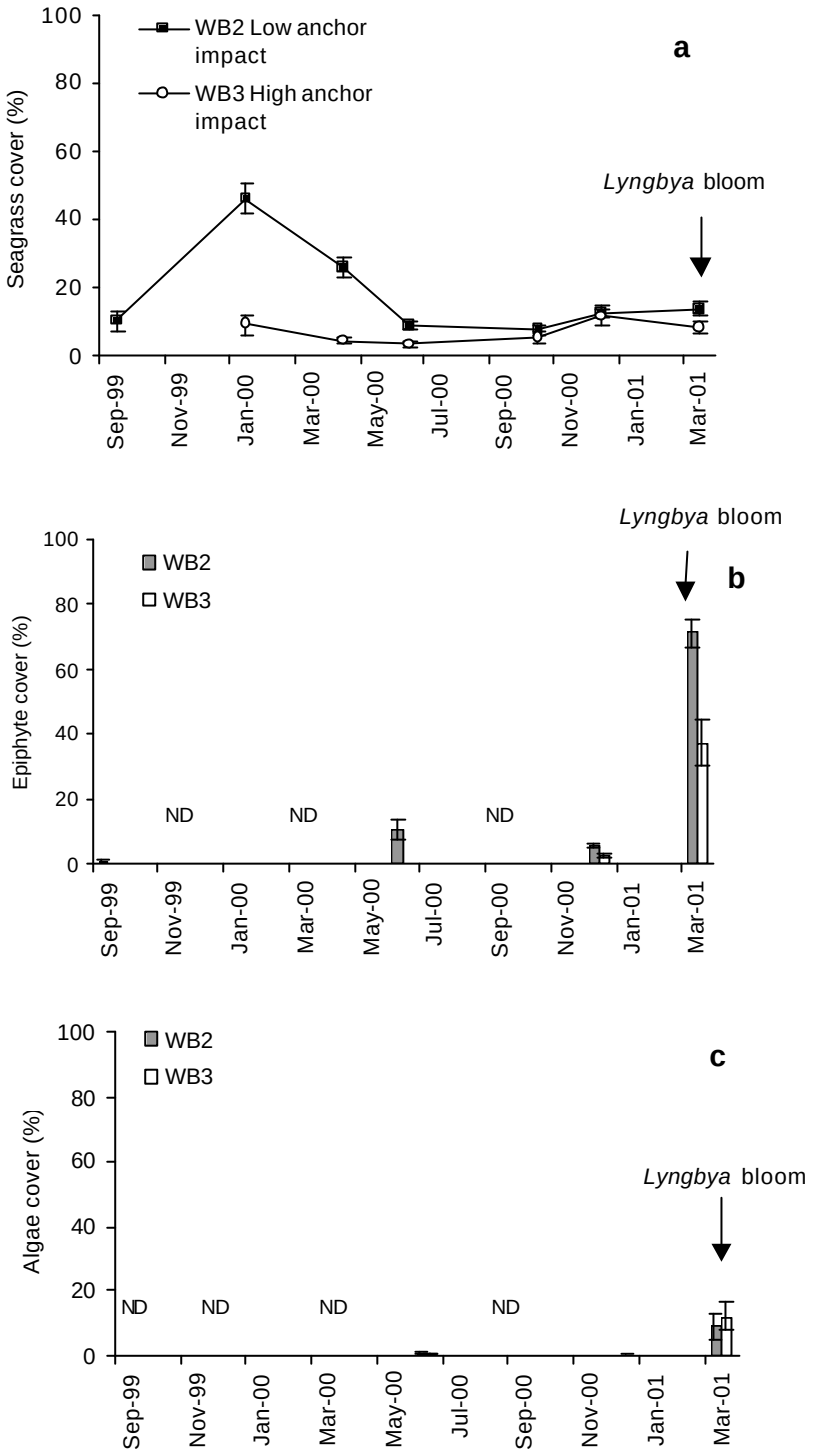


Figure 5. Mean (± s.e) (a) seagrass cover (%), (b) epiphyte cover (%) and (c) non-attached algal cover (%) at Whitehaven Beach subtidal sites from September 1999 to March 2001 (ND denotes no data collected).

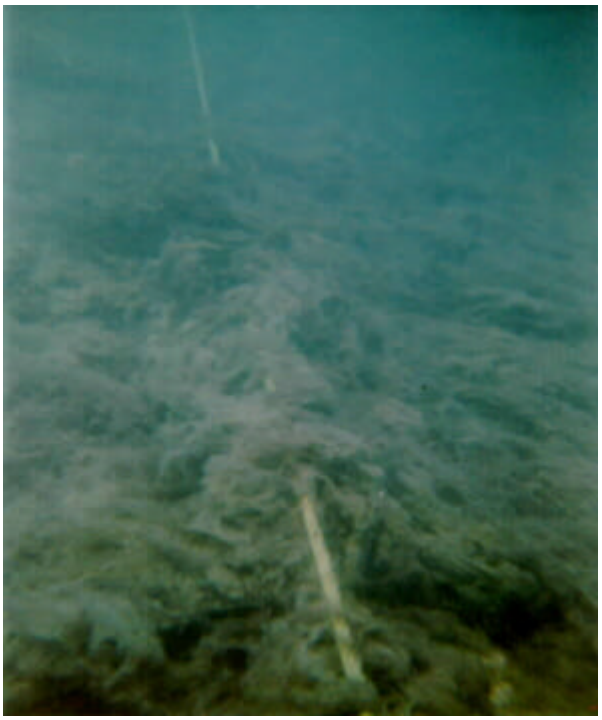
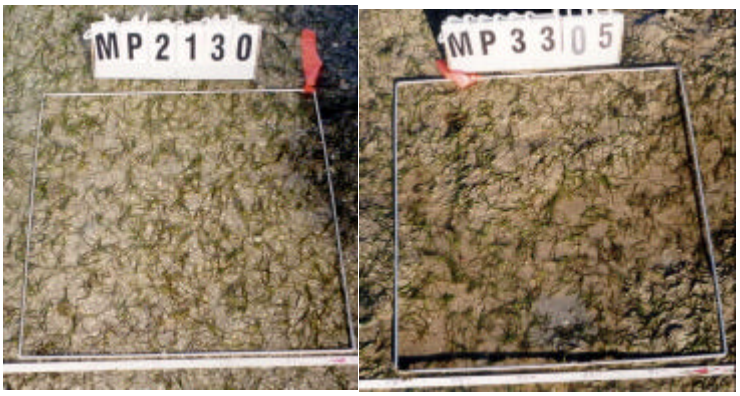


Figure 6. *Lyngbya majuscula* bloom at site WB2 (4m depth) at Whitehaven Beach, 12/03/01.

iii. Unimpacted intertidal sites (Midge Point)

Sites at Midge Point are comparable with respect to species and sediment composition to sites at Pioneer Bay (i.e. muddy, tidal influenced seagrass meadows consisting of *Z. capricornii, H. ovalis* and *H. uninervis*) (Fig. 7). Midge Point sites are less influenced by urban development than Pioneer Bay sites. Seagrass cover (%) at Midge Point sites was comparable to that found at Pioneer Bay sites PI1 and PI2, but higher than seagrass cover found at sites PI3 and PI4. The percentage cover of epiphytic and non-attached filamentous algae at Midge Point intertidal sites was up to 50 times lower than that found at Pioneer Bay (Fig. 8).



a) MP2 **b) MP3**

Figure 7. Seagrasses (mixed *Zostera capricornii* and *Halodule uninervis*) at, a) MP2 and b) MP3 in March 2001. The abundance of epiphytic algae and non-attached algae was low.

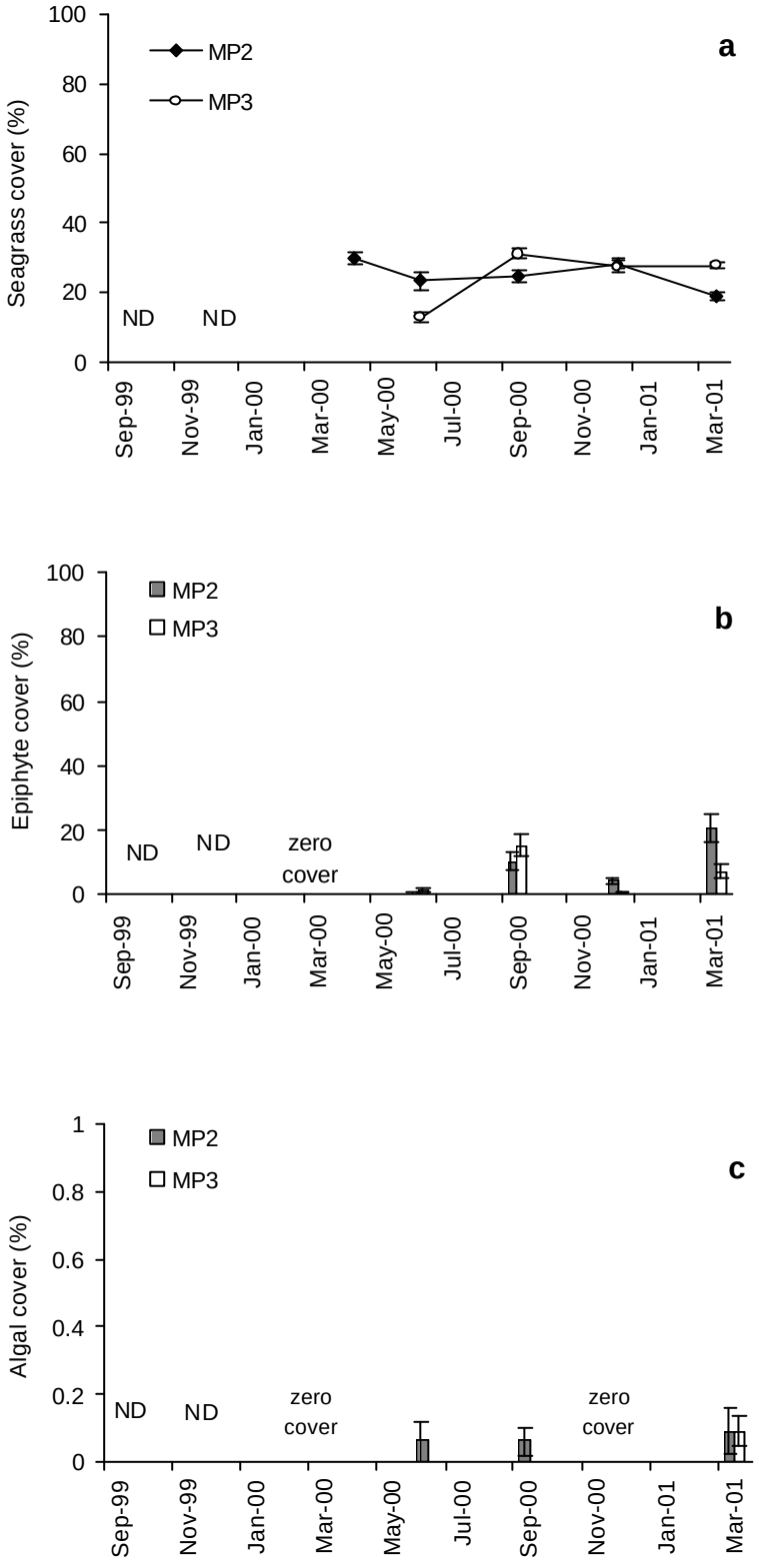


Figure 8. Mean (± s.e) (a) seagrass cover (%), (b) epiphyte cover (%) and (c) non-attached algal cover (%) at Midge Point intertidal sites from September 1999 to December 2000. (ND denotes no data collected).

ii. General

The contribution of nutrient sources in the local region to the growth of filamentous algae have been examined in a number of investigations conducted on behalf of the Whitsunday Shire Council. The reports have concluded that "filamentous epiphyte growth is very high within the intertidal and has clearly influenced the density and well being of seagrasses it covers" (FRC November 1998, p15). In a subsequent report they further conclude that "nutrient enrichment, which may be reasonably linked to the discharge of treated effluent, has clearly affected the health of seagrasses within the shallow waters of Pioneer Bay and to a lesser extent Boat Haven Bay" (FRC May 1999, p34).

Seagrasses in the area do not appear to be utilising sewage derived nitrogen (FRC November 1999, June 2000). On the other hand, filamentous algae growing over the seagrass within Pioneer Bay have been shown to have a higher $\delta^{15}N$ value (2.69-3.16) than seagrasses, suggesting that they are using sewage derived nitrogen as a nutrient source. This may not be the only source of nitrogen used by these algae (FRC November 1999, June 2000). A more detailed sampling program that samples epiphytes/algae at a number of subtidal and intertidal sites representative of Pioneer Bay is required. Conclusions made about the contribution of nutrient sources to persistent algal growth in the region can then be based on informed scientific data from an adequately designed monitoring program. Inferences based on the sampling of epiphytes for $\delta^{15}N$ analysis from a single subtidal site are inconclusive.

There has been limited examination of other factors that influence the growth of these algae, including the potentially toxic *Lyngbya majuscula*. This species is harmful to seagrasses as it can directly smother and cause localised seagrass die-off. *Lyngbya majuscula* can cause significant localised inputs of bio-available nitrogen through nitrogen fixation followed by release of organic and inorganic nitrogen through decay. In addition, this species of algae can be toxic to humans causing severe contact dermatitis to the extent that skin can blister and peel off (Dennison et al. 1999).

5. Conclusion

The persistence and frequent abundance of filamentous algae in the Whitsundays region is cause for concern as these algae place at risk important productive seagrass meadows used for feeding by dugong and turtle populations. The excessive abundance of filamentous algae in Pioneer Bay appears to be detrimentally impacting the density of seagrasses in the region. Sewage derived nitrogen has been implicated in the growth of filamentous algae in Pioneer Bay, although other sources of nutrients are likely to contributing to their growth. No specific cause of these algal blooms have been identified and such causes may differ dependant on the species being examined. There are, however, many factors that can lead to filamentous algal blooms and these include nutrient (Fe, N, P) enrichment, organic enrichment and favourable light and temperature conditions.

6. Recommendation

Investigations be undertaken to assess the influence and contribution of localised sources of nutrients and other potential factors to filamentous algal growth at intertidal and subtidal sites in Pioneer Bay and other sites in the Whitsundays.

7. References

Dennison, W.C., Oneil, J.M., Duffy, E.J., Oliver, P.E. and Shaw G.R. (1999). Blooms of the cyanobacterium *Lyngbya majuscula* in coastal waters of Queensland, Australia. *Bulletin de l'Institut océanographique, Monaco* **19**: 501-506.

FRC Coastal Resource and Environmental (1998). Pioneer Bay Environmental Monitoring Program. Second Monitoring Event, November 1998, 37pp.

FRC Coastal Resource and Environmental (1999). Pioneer Bay Environmental Monitoring Program. Third Monitoring Event, May 1999, 37pp.

FRC Coastal Resource and Environmental (1999). Pioneer Bay Environmental Monitoring Program. Fourth Monitoring Event, November 1999, 38pp.

FRC Coastal Resource and Environmental (1999). Pioneer Bay Environmental Monitoring Program. Fifth Monitoring Event, June 2000.

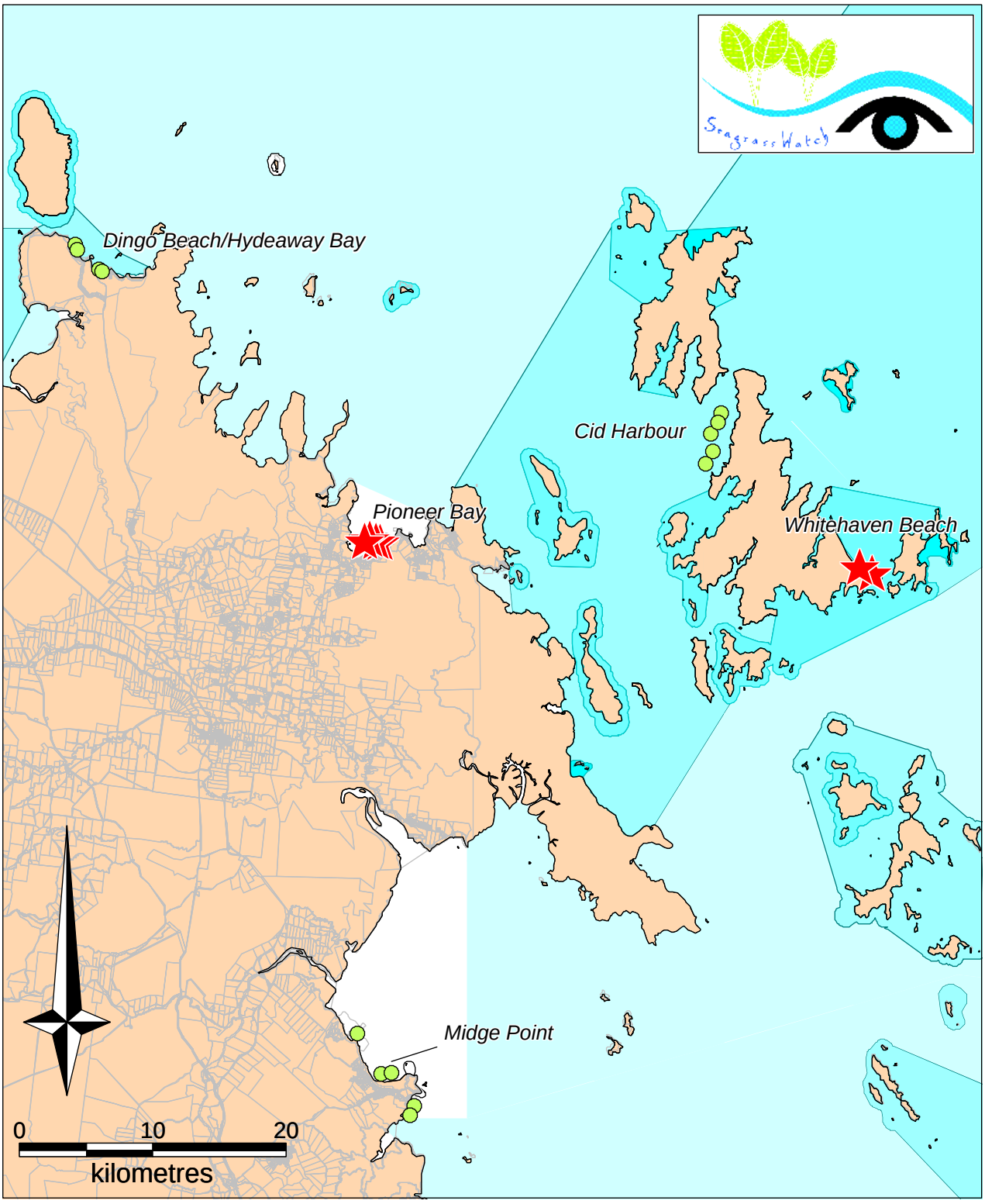
McKenzie, L.J. (1994). Seasonal changes in biomass and shoot characteristics of a *Zostera capricorni* Aschers. dominant meadow in Cairns harbour, northern Queensland. *Australian Journal of Marine and Freshwater Research* **45**: 1337-52

McKenzie et al. (2001). Seagrass-Watch: Manual for Mapping and Monitoring Seagrass Resources- A practical guide for detecting change at local and regional scales. (In Prep).

Mellors, M, Marsh, H. and Coles, R.G. (1993). Intra-annual changes in seagrss standing crop, Green Island, Northern. *Australian Journal of Freshwater Research* **44**: 33-41.

Map 1

Location of Seagrass-Watch long-term monitoring sites in Whitsundays.



LEGEND

- Seagrass-Watch monitoring site
- Seagrass-watch monitoring sites with Lyngbya present
- Marine Park - General Use A
- Marine Park - General Use B
- Marine National Park A
- Marine National Park B

Map 2

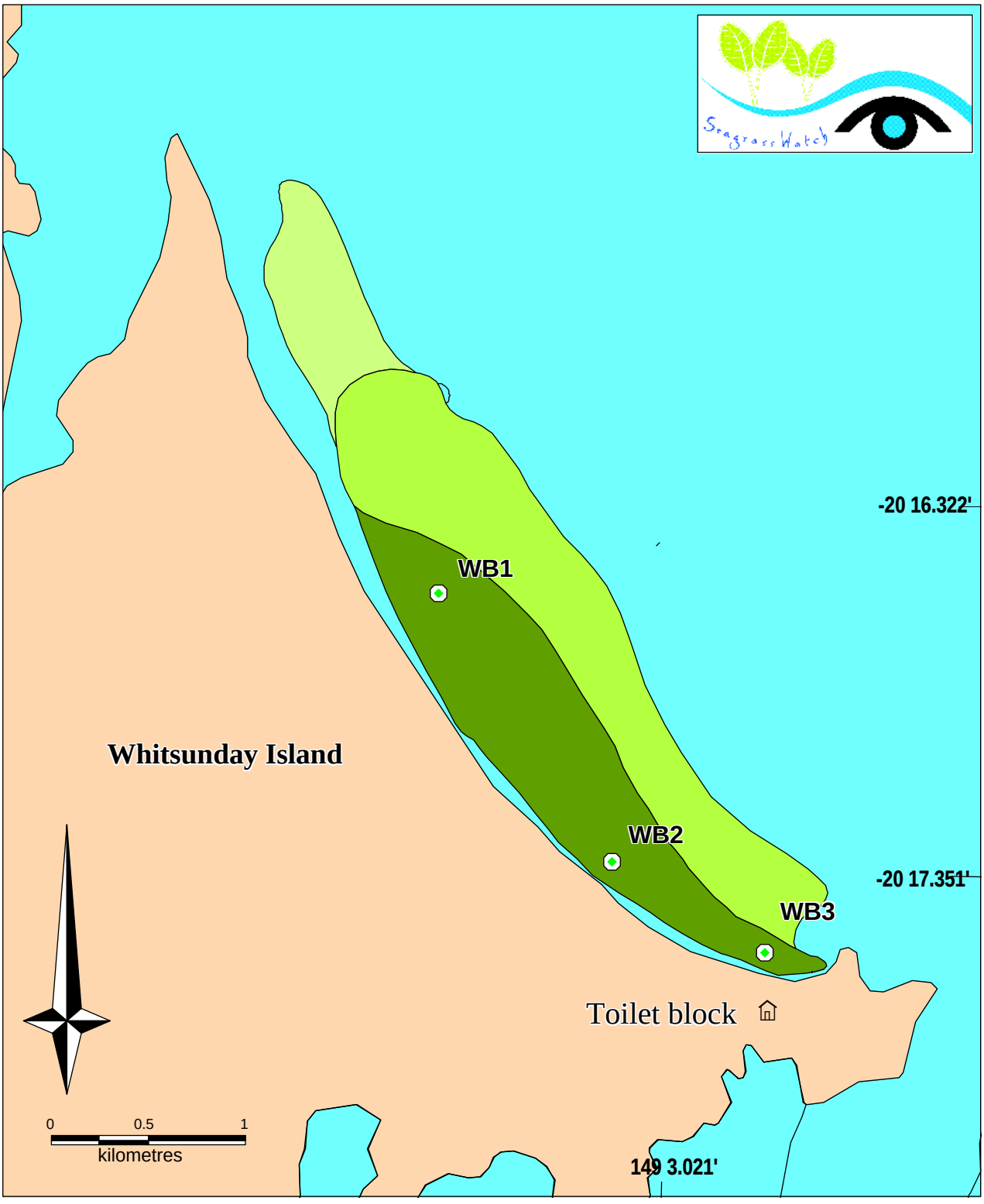
Location of Seagrass-Watch long-term monitoring sites in Pioneer Bay

LEGEND

- Seagrass-Watch monitoring site

Map 3

Location of Seagrass-Watch long-term monitoring sites at Whitehaven Beach.



LEGEND

- Seagrass-Watch monitoring site
- *Halodule uninervis (narrow)*
- *Halophila spinulosa/ Syringodium isoetifolium/ Halophila ovalis*
- *Halodule uninervis (wide)/ Cymodocea serrulata/ Halophila spinulosa/ Thalassia hemprichii*
- Marine National Park A

Map 4

Location of Seagrass-Watch long-term monitoring sites at Midge Point.

LEGEND

- Seagrass-Watch monitoring site