HEALTHY WATERWAYS

Assessing the seagrass depth range data to determine historical changes in *Caulerpa taxifolia* distribution in Moreton Bay

Submitted by

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To

Healthy Waterways

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December 2012

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For Bibliographic purposes, this document can be cited as: Burfeind, D. (2012). Assessing the seagrass depth range data to determine historical changes in *Caulerpa taxifolia* distribution in Moreton Bay: Healthy Waterways, Brisbane Australia. 11pp.

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Summary

The objective of this project was to evaluate the usability and quality of existing data collected through Seagrass Watch and the seagrass depth range (SDR) component of EHMP, for the purposes of determining changes in *Caulerpa taxifolia* prevalence within Moreton Bay. Seagrass Watch does not currently collect sufficient data to quantify potential changes in *C. taxifolia* occurrence. Seagrass Watch data are collected predominantly from intertidal meadows, and therefore are largely from survey areas where *C. taxifolia* does not normally occur. Seagrass depth range data quality was analyzed by determining the reliability in recording of *C. taxifolia* presence or absence within a transect and at the end of the transect. Specifically, the data we are interested in examining are not as much from the seagrass transect, but rather the substrate or vegetation occurring at the end of the *Zostera* transect. I found that the quality of data recording was generally high and similar before 2005 and after 2005. Furthermore, in many of the locations where the recording of *C. taxifolia* occurrence was absent, *C. taxifolia* had never been recorded (as a part on any monitoring program). Therefore, even though data were not provided, it is unlikely to influence quantitative measures of *C. taxifolia* occurrence since it has never been reported within that area. I conclude that the data from the SDR are of sufficient quality to use to quantify changes in *C. taxifolia* occurrence from 1998 to the present. Furthermore, it is critical to examine these data in conjunction with existing mapping data to better understand the dynamics of an increasing *C. taxifolia* population as they relate to changes in environmental conditions, particularly under drought and flood conditions.

Background

Caulerpa taxifolia is a benthic green macroalga that is native to Moreton Bay. Globally, it is best known as an invasive species and even though it is native to Moreton Bay there is concern that it is spreading. It has been suggested that *C. taxifolia* increase is at the expense of native seagrasses; however, in Moreton Bay water quality appears to regulate the balance between seagrass and *C. taxifolia*, with *C. taxifolia* opportunistically colonizing areas where seagrasses have been lost from decreases in water quality (Burfeind 2009, Burfeind and Udy 2009).

A preliminary analysis of seagrass depth range data in 2005 indicated that *C. taxifolia* distribution was expanding in Moreton Bay (Burfeind 2009). This increase was further supported by surveys conducted in 1998, 2003, and 2005, which indicated an increase in *C. taxifolia* distribution (Thomas 2003, Burfeind 2009, Burfeind and Udy 2009). Additionally, we identified that there is a pattern of seagrass loss, resulting in unvegetated substrate, which was subsequently colonized by *C. taxifolia*. Even though it does not appear that *C. taxifolia* is directly displacing seagrass in Moreton

Bay, we never identified an instance were an area once colonized by *C. taxifolia* returned to a seagrass bed (Burfeind 2009). Therefore, while *C. taxifolia* does not displace seagrass it may limit the potential for seagrass to recolonize. Alternatively, the change in water quality that promoted the shift from seagrasss to *C. taxifolia* may represent a physical niche shift whereby areas once colonized by seagrasses are no longer suitable habitats, regardless of the presence or absence of C. taxifolia.

There are several implications of increased *C. taxifolia* coverage within Moreton Bay. We have conducted several studies comparing the habitat value (e.g. food availability, predation avoidance) of seagrass (specifically *Zostera muelleri*) versus *C. taxifolia*. A broad comparison of faunal density indicates that *Z. muelleri* and *C. taxifolia* have similar fauna densities; however, pipefish and seahorses are absent from *C. taxifolia* beds (Burfeind 2009). Functionally, seagrasses provide protection from predation and food resources for associated fauna. *C. taxifolia* provides a structurally complex habitat for fish (Burfeind et al. 2009) and decreases predation rates on some taxa when compared to unvegetated substrate (Burfeind et al. unpublished data). However, *C. taxifolia* does not provide the same food resources as a seagrass bed (Street 2007), and therefore may not provide the same net benefits as a seagrass bed. Additionally, *C. taxifolia* growth and survival is largely influenced by environmental conditions (Burfeind et al. in press), and therefore large disturbances (such as floods) may have a dramatic influence on the distribution of *C. taxifolia* within Moreton Bay (Burfeind et al. in prep). Therefore, organisms relying on *C. taxifolia* may be influenced by the dramatic loss of habitat resulting in from sudden losses in *C. taxifolia*.

The initial analysis of seagrass depth range data was carried out on data from 1998 to 2005, a period over which *C. taxifolia* increased in distribution. There were no large rainfall events during this time period and we observed a steady increase in *C. taxifolia* distribution through time. However, since 2005 there have been several large flood events, which likely had large-scale influences on *C. taxifolia* distribution and therefore may have resulted in significant changes in the benthic community composition over the last 7 years. The seagrass depth range data proved a potentially valuable source of data on the presence/absence of *C. taxifolia* throughout Moreton Bay collected over more regular intervals than existing mapping data. Therefore, these data may prove invaluable in understanding *C. taxifolia* dynamics in Moreton Bay.

Seagrass watch data

Objective: To determine if existing seagrass watch data have sufficient data on *C. taxifolia* distribution to analyze changes in *C. taxifolia* occurrence and distribution within Moreton Bay.

Type of data collected: Seagrass watch collects data on seagrass species and percent cover in mostly intertidal and some shallow subtidal seagrass beds. Their survey sites provide an extensive monitoring network across Moreton Bay and therefore have a high potential for the detection of *C. taxifolia* in new locations.

Evaluation of data: *C. taxifolia* only occurs subtidally. Therefore, as most of the seagrass watch sites were intertidal, there were no records of *C. taxifolia* occurrence at the majority of the locations. *C. taxifolia* was recorded at the deep (subtidal) edge of some locations; however, data collection was infrequent to be useful for quantifying distributional changes. Two locations (Fishermans Islands and Victoria Point) had quantifiably useful amounts of *C. taxifolia* presence data; however, these locations were paired with existing seagrass depth ranges sites. Therefore, these data were only useful for supporting SDR trends rather than providing independent data on distributional range. Furthermore, several of the data sheets reported the presence of "macroalgae" but did not report which species occurred. At some of the points along the transect there were photographs taken of the quadrats, however, the quality of the photographs did not allow for the identification of species. The program has now switched to digital cameras, which is likely to alleviate this problem. Searches of the database for "*Caulerpa*" did not retrieve all of the data on *Caulerpa* as detected by manual search of the spreadsheet, which may be due to inconsistency in the formatting of "*Caulerpa*" within the file.

Suggestions for changes in data collection to optimize *C. taxifolia* detection: The seagrass watch program provides a valuable large-scale monitoring program in Moreton Bay. The current data collection strategy could be altered somewhat to increase the usability of these data for determining changes in *C. taxifolia* occurrence within the bay. I recommend that where possible the volunteers look past the end of their transect (in about 50cm water at low tide) for the presence of *C. taxifolia*. I also recommend to provide training and identification cards of *C. taxifolia* and other macroalgal species to the volunteers to ensure that there is reliable identification of common macroalgal species.

Seagrass depth range data

Objective: To determine the quality and reliability of *C. taxifolia* reporting within the existing seagrass depth range data and the potential to use these data to analyze long-term changes in *C. taxifolia* distribution within Moreton Bay.

Methods: Data were extracted from seagrass depth range data sheets provided by DERM. An initial summary of these data were conducted in 2005 by Nicola Udy and this report verified these data and added additional data up to the most recent data available (second half of 2011). We identified three places in the data where *C. taxifolia* could be recorded: mid transect (mixed in with *Z. muelleri*), end of the transect (up to 2m after the end of the *Z. muelleri* patch), and in the notes or narrative comment section of the data collection. Analysis of *C. taxifolia* reporting was split into two categories: 1995 to 2005 and 2006 to present. This distinction was made because the staff collecting the field data changed at the end of 2005, and therefore it was necessary to determine if there was reliability in the collection of data between different teams in the field.

Summary of *C. taxifolia* reporting

C. taxifolia has a lower light requirement than *Z. muelleri* therefore, the most valuable data from the seagrass depth range are the data for which species occur at the end of the *Z. muelleri* transect. Overall, these data were reported in 78% of the seagrass depth range monitoring records. Furthermore, the recording rate is similar, if not better from 2006 to present (Table 1). I also looked further into which locations did not report a species at the end of the *Z. muelleri* transect. The locations with the highest non-report incidence were: Godwin's beach, south Deception Bay, and Fisherman's Islands 2. There are no reports of *C. taxifolia* occurring at these locations within any of the other records at any of the other times, therefore, it is likely that *C. taxifolia* has never occurred at these locations. Therefore, the absence of reporting in these locations is unlikely to influence the reliability of any analysis of *C. taxifolia* occurrence data within Moreton Bay. Overall, the quality of the data are very good and will prove to be both reliable and useful in determining changes in *C. taxifolia* occurrence in Moreton Bay.

Table 1. Summary of *C. taxifolia* records and end of transect reporting for seagrass depth range data from October 1995 to November 2011 (lower percentage indicates higher level of reporting).

Site	First Data	Last Data	# Measures	Ct mid transect	Ct end of transect	End no record (2005 and earlier)	End no record (2006 and later)	Reported in notes
Fish 1	31-Oct-95	24-Jun-11	31	6	20	0.00%	0.00%	3
Fish 2	10-Apr-03	24-Jun-11	14	0	0	100.00%	75.00%	0
Wynnum	18-Aug-95	21-Sep-11	35	0	17	4.00%	20.00%	2
Birkdale	21-Aug-98	22-Sep-11	27	0	0	11.76%	40.00%	0
Crab Is	09-Sep-98	21-Oct-11	23	0	0	41.67%	27.27%	0
Pelican	08-Jul-98	23-Jun-11	25	0	4	6.67%	20.00%	5
N.Pumicestone	29-Jan-03	22-Nov-11	15	0	1	0.00%	0.00%	1
Gallagher’s	26-Nov-98	22-Nov-11	21	1	14	0.00%	0.00%	11
Sth Deception	22-Feb-00	27-Jul-05	5	0	0	100.00%	n/a	4
Godwin	30-Nov-01	6-Sep-11	17	0	0	100.00%	20.00%	0
Peel	15-Mar-99	23-Jun-11	16	0	0	37.50%	0.00%	0
Victoria Pt	17-Aug-98	6-Oct-11	25	18	8	23.08%	10.00%	3
Bedrooms	18-Jul-98	12-May-11	23	5	12	0.00%	0.00%	12
Broadwater2	6-Jun-02	29-Jul-11	16	4	0	0.00%	12.50%	4
Pannikin	27-Mar-03	22-Jun-11	16	0	2	0.00%	11.11%	2
Long Is	29-Oct-98	22-Jun-11	24	1	2	21.43%	10.00%	3
					Averages	**27.88%**	**16.39%**	

Note: South Deception site was discontinued after 2005.

General comments on data quality

I identified several concerns with the data as entered into Excel. Generally there were several inconsistencies in reporting style and data that were missing from original field data sheets. In particular, I have noted the following concerns:

- Data files from before 1998 are locked and in a format that I cannot access. It would be ideal to have consentient file saving formatting.
- There was only one sampling event recorded for 2008. It is unclear to me if these data are missing or were never collected.
- The abbreviations used to report different species were inconsistent (eg. *Halophila ovalis* was reported as Hov, Ho, ovalis, H. ovalis). While it is possible to decipher these notes, it makes sorting files or doing a quick search for these data impossible.
- There were several places where field notes were not transcribed into the electronic data sheets. There were notes in several places indication that field notes would be transcribed later "comments to be entered later" and this clearly was not done in many instances.
- There were also a few locations where it was mentioned that there was something wrong with the data and that it would be corrected at a later date and it is unclear from the data sheets if this correction ever occurred.
- The field notes/comments sections were missing on several of the data sheets.

Recommendations changes in monitoring

I have the following recommendations for changes in monitoring and reporting of data:

- Develop a standard ID card and reporting abbreviations for seagrasses and common macroalgal species
- Create a formal category within the seagrass depth range sampling for the reporting of *C. taxifolia* occurrence. This will provide a more uniform reporting of *C. taxifolia* occurrence within the monitoring locations.
- Conduct all of the sampling twice a year at the same time for all locations. The current model spreads the monitoring across the calendar year and therefore, makes it difficult to identify any potential seasonal variability across locations. This seasonal variability is especially critical in the identification of potential changes *C. taxifolia* occurrence. *C. taxifolia* growth and biomass change dramatically with water temperature, with the greatest biomasses occurring in early Autumn and the lowest in early spring (Burfeind et al. in press). Therefore, with the current sampling strategy, we are likely under reporting changes in *C. taxifolia* occurrence.

Proposed further analysis

The SDR data provide a good indication of the occurrence of *C. taxifolia* through time in Moreton Bay. These data will be highly valuable if used in further analysis to determine long-term trends in *C. taxifolia* dynamics. Specifically, if these data were added to the existing mapping efforts (1998, 2003, 2005, 2007, 2011) and then paired with water quality and rainfall data we could better understand how environmental conditions are driving potentially large-scale changes in benthic community composition in Moreton Bay.

Preliminary graphical analysis of results (examples of output that can be determined for all sites with additional resources). The data presented are the species occurring at the end of the *Zostera* transect. Please note the data included in this report are until mid 2011. Data from the latter half of 2011 and 2012 will be critical in providing information on impacts from the floods in January 2011.

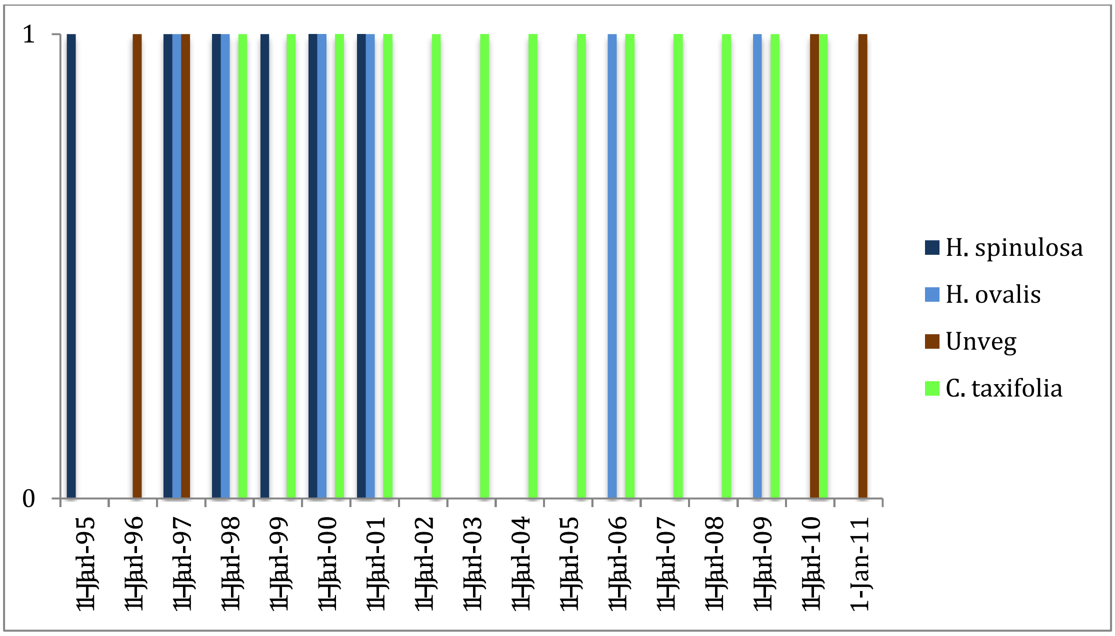

Figure 1. Presence-absence data (1 represents "Present") for two seagrass species, *C. taxifolia*, and unvegetated substrate at location Fisherman's Islands 1.

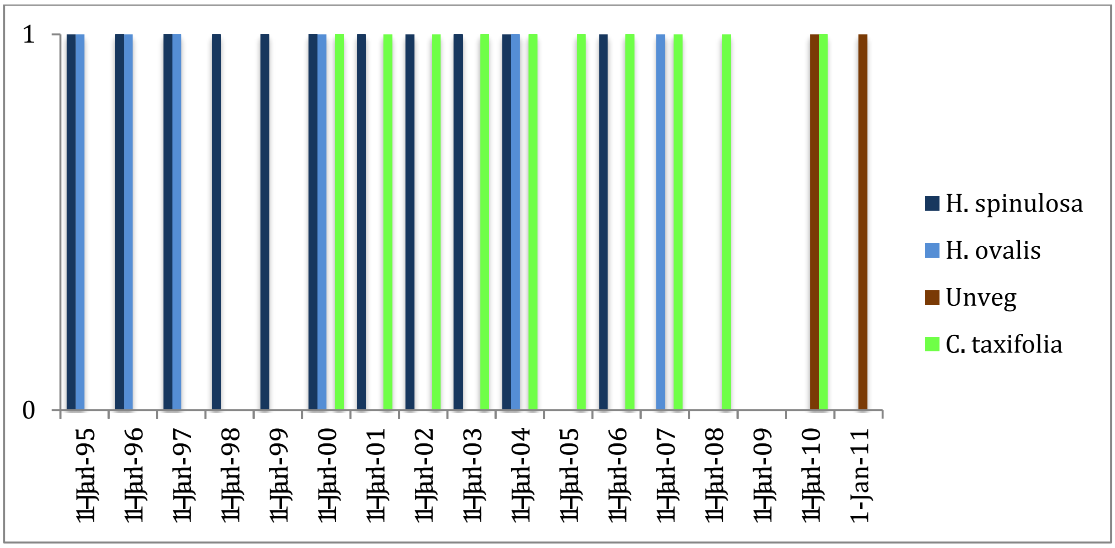

Figure 2. Presence-absence data for two seagrass species, *C. taxifolia*, and unvegetated substrate at Wynnum.

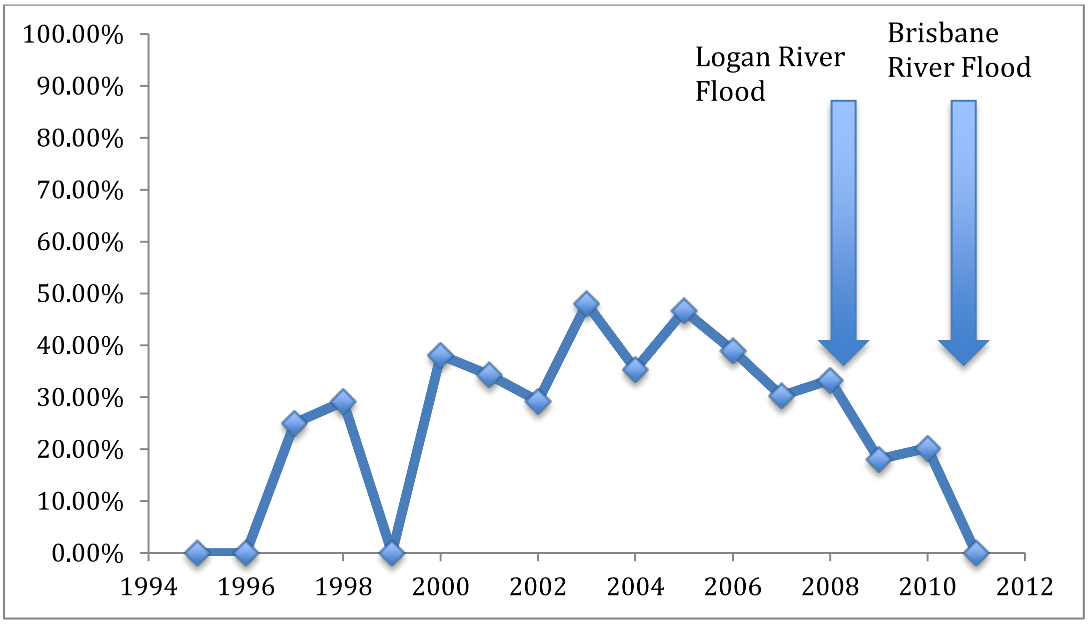

Figure 3. Percentage of sites with *C. taxifolia* (all stites).

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