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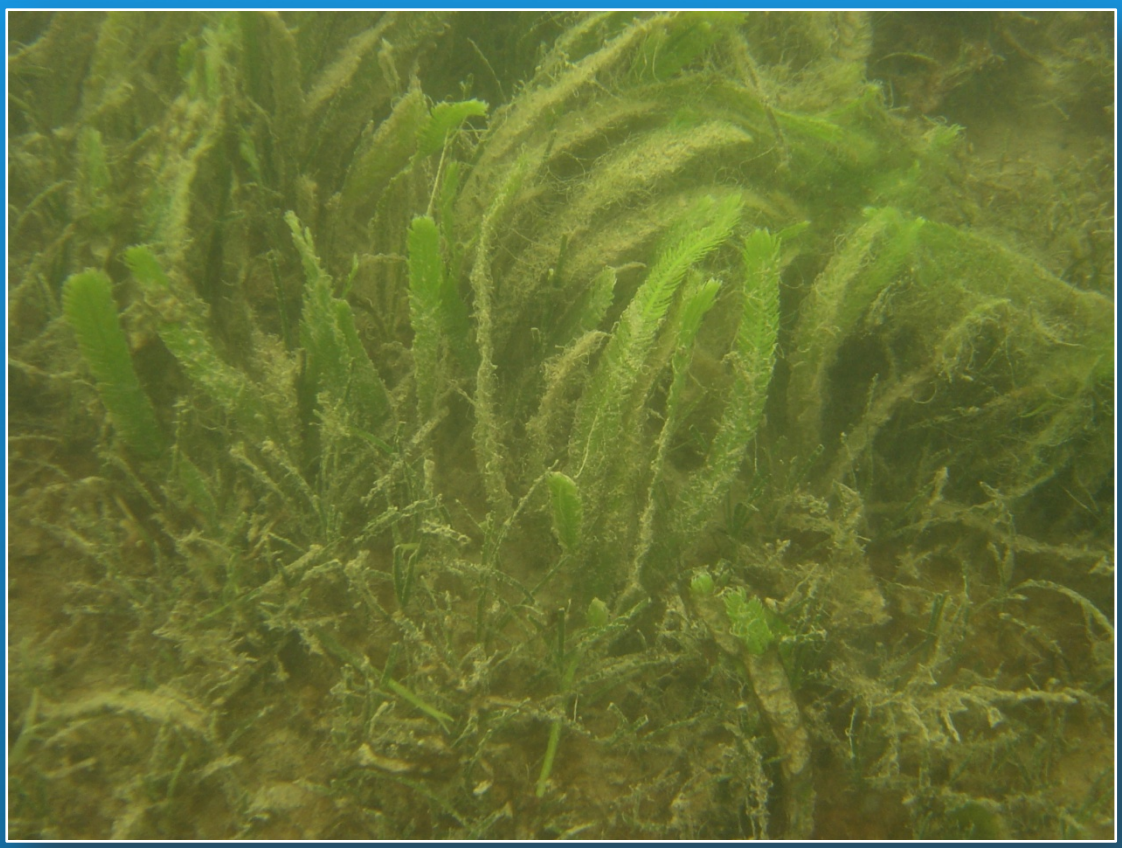
Caulerpa taxifolia – 2013 community monitoring in Barker Inlet and Port River



Kathryn Wiltshire and Marty Deveney

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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EXECUTIVE SUMMARY

The invasive alga *Caulerpa taxifolia* is established in the Port River-Barker Inlet system, and was surveyed annually by SARDI from 2003 to 2010. Community surveys were carried out in the Port River and Barker Inlet in 2013 by Reef Watch to determine if the distribution of *C. taxifolia* had changed since 2010, using methodology consistent with the previous SARDI surveys. In Barker Inlet, the range and density of the alga had increased slightly from that observed in 2009-2010, but abundance scores did not approach the very high values recorded in 2008. In the Port River, a lower density was found overall, but the transects were in shallower water than previous surveys and may have been inshore of the main area where *C. taxifolia* occurs. The continued presence of high densities of the alga in the Port River and at the Angas Inlet-Barker Inlet junction was confirmed.

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1. INTRODUCTION

The alga *Caulerpa taxifolia* (Vahl) C. Agardh has a circumtropical distribution and has formed invasive populations in numerous areas outside its native range, particularly in the Mediterranean (Meinesz *et al.* 2001; Cevik *et al.* 2007), with impacts on seagrass, macroalgae, fish and invertebrates reported (de Villèle and Verlaque 1995; Boudouresque *et al.* 1996; Ferrer *et al.* 1997; York *et al.* 2006; Gribben *et al.* 2009). In Australia, invasive populations have established in New South Wales (Creese *et al.* 2004; NSW DPI 2009) and South Australia (SA) (Cheshire *et al.* 2002; Rowling 2007).

The population of *C. taxifolia* in the Port River-Barker Inlet system, SA, cannot be eradicated with current technology (Manning and Deveney 2008; Westphalen 2008) and the approach to the invasion has shifted to one of management. To inform management, surveys of the *C. taxifolia* distribution in the Port River-Barker Inlet system were conducted annually from 2003-2010 (Wiltshire 2010), and a risk assessment performed to determine the areas most at risk from further outbreaks and the likely impacts of spread of the alga (Deveney *et al.* 2008). On 1 March 2011, a designated containment area for *C. taxifolia* was declared, including all waters of the Port River and Barker Inlet system (PIRSA 2013). Outside the containment area *C. taxifolia* will be managed aggressively, while it is regarded as established inside the containment area.

Analysis of the survey data from 2003-2010 allowed comparison of the *C. taxifolia* distribution between years, and identification of key sites where coverage scores correlated with overall extent (number of locations recording *C. taxifolia*) and abundance (total recorded score) of the alga (Wiltshire 2010). From 2003-2006 there were large increases in the abundance and extent of *C. taxifolia*, and while the general pattern of distribution was similar from 2006-2010, in 2008 there was a further increase in abundance and patches of the alga were found throughout Barker Inlet. In 2009 there was a decrease in abundance and extent of the alga, with further decreases occurring in 2010; in that year's survey *C. taxifolia* was found only at the southern end of Barker Inlet, and was absent from much of the North Arm, where it had previously been abundant. Dense patches were, however, still found in the Port River and at the Angas Inlet-Barker Inlet junction (Wiltshire 2010).

The SARDI surveys did not seek to determine factors that may be influencing *C. taxifolia* abundance, although an increased proportional cover of *Zostera* seagrass, and decreases of another *Caulerpa* (*C. racemosa* var. *cylindracea*) in Barker Inlet and the Port River may indicate that environmental conditions favoured seagrass rather than *Caulerpa* spp. from 2008-2010 (Wiltshire 2010). Many factors can, however, cause fluctuations in plant and algae population densities and abundances, and cyclical or chaotic patterns can occur (Hernández Plaza *et al.* 2012). Without knowledge of the causes of these previous changes, no prediction can be made about changes to the *C. taxifolia* distribution that may have occurred since 2010, and further surveys are needed to establish any spread or regression of the population.

Two of the key sites identified by the analysis of survey data were the main areas of accumulation of the alga at the northern edge of its distribution in the Port River, and near the junction of Angas Inlet and Barker Inlet. Located at the outer edges of the distribution, surveys of these areas facilitate rapid assessment of changes in the range of *C. taxifolia*. The density of the alga found in these areas in previous surveys correlated with overall abundance, suggesting that an increased density in these regions may also indicate an increase in the total biomass of *C. taxifolia* throughout its distribution. These correlations were, however, based on limited data and appeared to be driven by results from years with high abundance (2006, 2008), so a reduced density may not necessarily indicate an overall biomass decline (Wiltshire 2010). To assess changes in the range of *C. taxifolia* since 2010, community surveys were carried out in the Port River and Barker Inlet by Reef Watch. Survey methodology was consistent with the previous SARDI surveys but targeted only these two key sites, rather than aiming to cover the entire distribution. This report presents the findings of these community surveys and compares the range and abundances found in these key sites in 2013 to those of 2008-2010.

2. METHODS

Training of Reef Watch volunteers by SARDI personnel took place on the morning of the surveys and involved instruction in survey methodology and identification of species likely to be encountered, including *C. taxifolia.* An observer from SARDI was present aboard the vessel to provide guidance through the surveys. Two areas were surveyed on 14th April 2013 (Figure 1): Lipson reach of the Port River along the western side of Torrens Island (Lipson Reach), and the south-eastern corner of

Torrens Island along Barker Inlet from the junction with Angas Inlet (Barker Inlet). In both cases, the region targeted was from the edge of the area that recorded a high abundance in 2010 northwards for ~1 km, or as needed to establish the edges of the distribution. Contiguous 100 m transects were surveyed targeting the shallow subtidal zone (low tide water depth 0.5 to 2 m) by snorkelers. Two snorkelers separated by ~5 m swam each transect and recorded data separately. Coverage of *C. taxifolia* was estimated in terms of a modified Braun-Blanquet scale (Table 1). The start and end points of each transect were referenced using a GPS (Garmin GPS60) from the tender vessel. Points were mapped in ArcGIS 10.1.

There were also Braun-Blanquet estimates made of the cover of seagrasses (*Zostera* and *Posidonia* spp.), other *Caulerpa* species (notably *C. racemosa* var. *cylindracea*); and any visible marine pests (*Sabella spallanzanii*, *Ciona intestinalis*, etc) for future reference. These data are not considered here.

Table 1. Braun-Blanquet scale that was used to record coverage of *Caulerpa taxifolia* (and other major community types) per 100 m transect during the survey (based on a method developed in Mueller-Dombois and Ellenberg 1974).

Score	Percent Cover
0	Absent
1	< 5 %
2	5 – 25 %
3	26 – 50 %
4	51 – 75 %
5	76 – 95 %
6	> 95 %

The local abundance of *C. taxifolia* at each of the two sites was compared to that found in 2008-2010. Transects from 2008-2010 that lay within the area of the 2013 survey were selected, and average cover scores determined for each year.

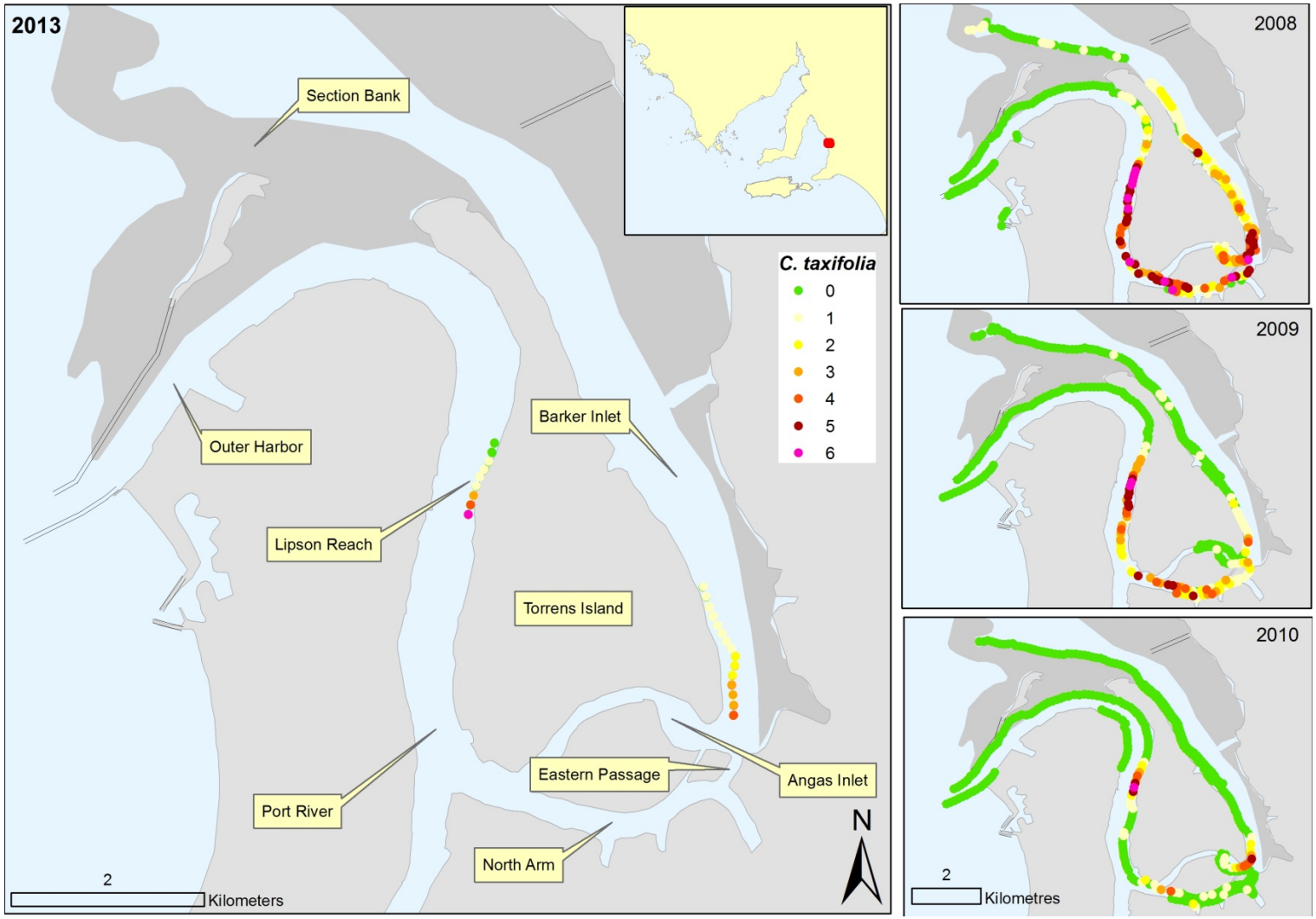

Figure 1. Map showing areas surveyed and scores for *C. taxifolia* from the current survey (2013) and 2008-2010.

3. RESULTS

In Barker Inlet, *C. taxifolia* was found in a dense mixed bed with *C. racemosa* at the Angas Inlet junction, with a maximum score of 4 (50-75% cover) (Figure 2). Patches of *C. taxifolia* (score=2, 5-25% cover) were found up to 600 m north of the main area of accumulation, beyond which, scores of 1 were recorded. Notes made by the snorkelers indicate these scores represented individual scattered plants, with the two most northern transects having only one plant present each over the 100 m. These plants were found up to 700 m further north than in 2010. Average abundance, although greater than that found in 2009-2010, was considerably less than that recorded in 2008 (Table 2). This area was surveyed around low tide.

The Lipson Reach area was surveyed around high tide, and surveys extended into an area that would be exposed at low tide. These transects are offset shoreward in comparison to the transects from 2008-2010 (Figure 3) and at the northern end were likely outside the zone in which the subtidal *C. taxifolia* occurs. Data from the two most northern transects for both snorkelers were therefore not included in the calculation of the average score. The SARDI observer noted that it was likely that water depth was unsuitable, being too deep to identify the area to be targeted. Volunteers were not, however, available to repeat the survey on a later low tide. The remaining transects in this area also appear to have been inshore of the main areas of *C. taxifolia* growth as surveyed in 2008-2010 and the average score for this area in 2013 was therefore lower than that recorded previously (Table 2), although it was confirmed that a dense patch (score = 6, >95% cover) persists (Figure 2).

Table 2. Average *C. taxifolia* abundance scores in the Lipson Reach and Barker Inlet areas 2008-2010 and current survey (2013).

Year	Lipson reach	Barker Inlet
2008	4.5	3.0
2009	3.3	1.3
2010	3.8	1.1
2013	**1.6**	**1.8**

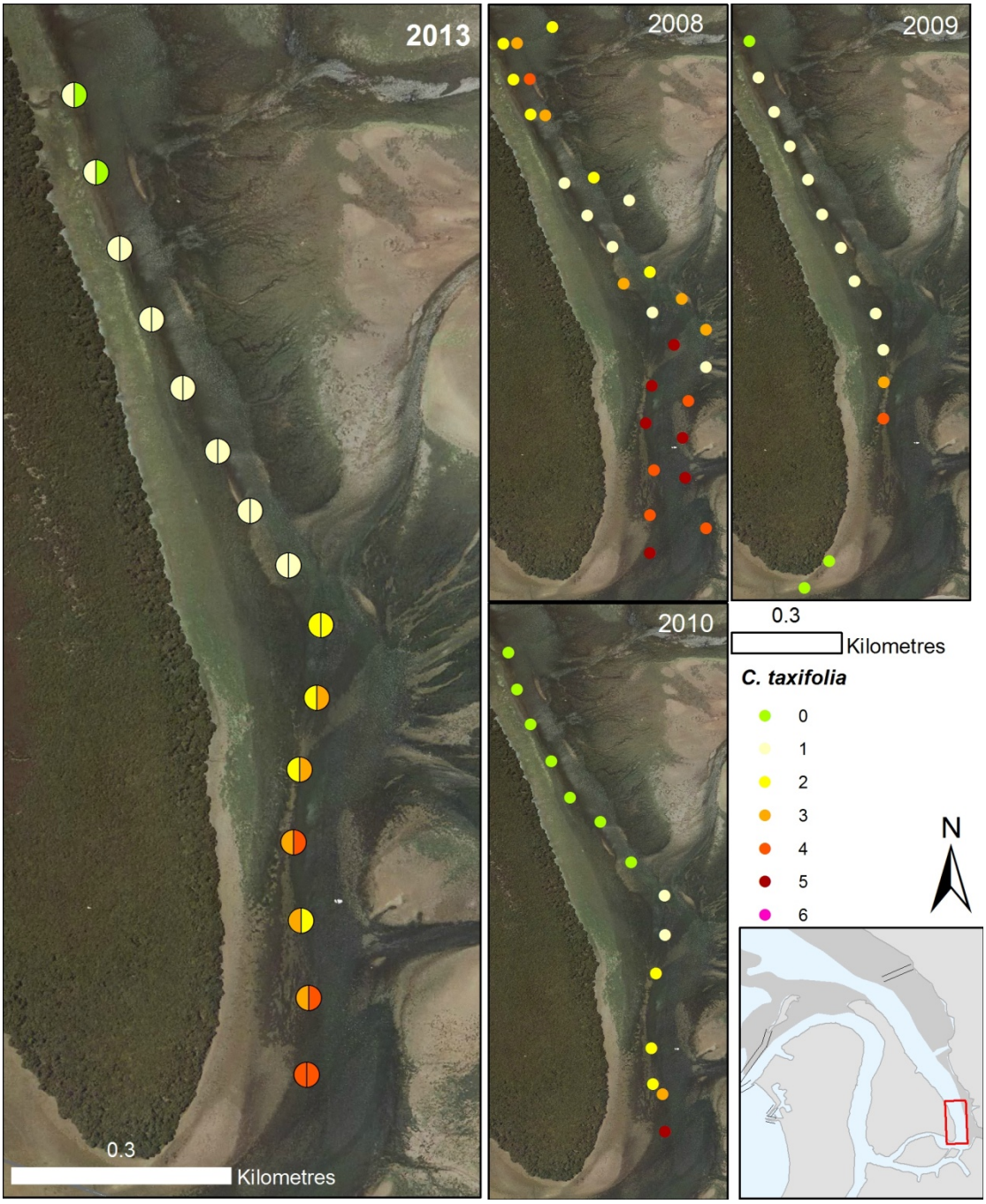

Figure 2. Map of *C. taxifolia* abundance scores from 2008-2010 and 2013 surveys in southern Barker Inlet. Symbols for the 2013 survey show the score for the more offshore snorkeler in the right half and more inshore snorkeler in the left.

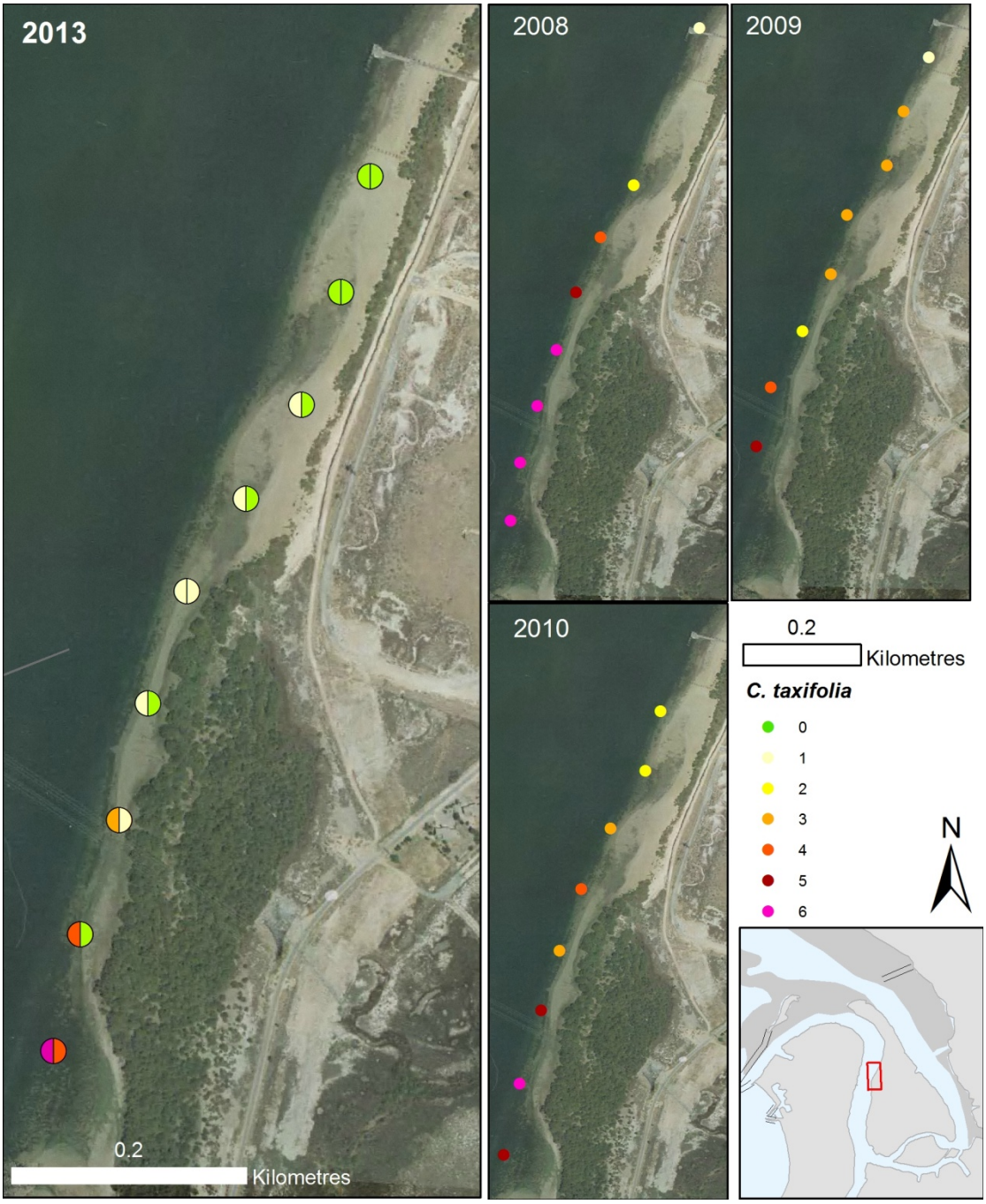

Figure 3. Map of *C. taxifolia* abundance scores from 2008-2010 and 2013 surveys in the Lipson Reach area of the Port River. Symbols for the 2013 survey show the score for the more offshore snorkeler in the left half and more inshore snorkeler in the right.

4. DISCUSSION

Caulerpa taxifolia persists in the Port River and Barker Inlet, with dense patches present along the western side of Torrens Island in the Lipson Reach, and at the junction of Barker Inlet and Angas Inlet where it continues to co-occur with *C. racemosa*. The population appears stable, with a slightly increased range and abundance in Barker Inlet since the 2010 survey, but much less than in 2008. Wiltshire (2010) found that abundance of *C. taxifolia* in this area was highly correlated with overall abundance and extent of the alga. This suggests that the population within the Port River-Barker Inlet system may have increased slightly since the 2010 survey, although there was only a small increase in range apparent. The current survey does not rule out the existence of patches of *C. taxifolia* occurring further north in Barker Inlet to Section Bank, but it appears unlikely that, if present, these would be significant. In the years where the alga was found throughout Barker Inlet (2006, 2008), scores of 2-3 were recorded further north than in this survey, and abundance in this area was considerably higher (Wiltshire 2010; SARDI unpublished data). Few conclusions can be drawn from the Lipson Reach area. The range of the alga in this area is unclear; it may have occurred further north than was recorded here, in deeper water than was surveyed, and with greater abundance. Previous expansions in the range of the alga in the Port River, however, were small (<1 km in range) compared to the spread into Barker Inlet (>5 km) (Wiltshire 2010), so it appears unlikely that significant expansion would have occurred in Lipson Reach given the minor change in Barker Inlet.

Wandersman (2003) described the characteristics of successful community science and outlined that sufficient education and monitoring of participants is required for rigor and quality of outcomes. In this survey the transects in Lipson Reach were not comparable with those from previous surveys because availability and time constraints required the surveys to be completed in one day. These transects were, by necessity, conducted at high tide and in unsuitable water depths. This problem was noted by the SARDI observer and was unlikely to be due to training or monitoring deficiencies; without this monitoring, the cause for the offset transects would not have been clear. The Barker Inlet survey, conducted around low tide, targeted a comparable area to that of the previous SARDI surveys, aided by guidance from the observer, and produced a robust estimate of *C. taxifolia* for 2013

there. Future community surveys should be organised to facilitate maximum quality of outcomes, including additional recruitment effort to overcome availability constraints among volunteers. Better volunteer availability would facilitate the area of interest being surveyed during optimal tidal phases and assist in managing fatigue associated with extended field work. Additional training could improve the community experience from the surveys and provide a trained base of support for future work.

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