

Porirua Harbour

Intertidal Macroalgal Monitoring 2011/12



Prepared
for
**Greater
Wellington
Regional
Council**
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2012

Cover Photo: *Ulva* along the western side of the Onepoto Arm.



Sparse (1-5%) macroalgal cover on intertidal flats near the main channel in the lower Pauatahanui Arm.

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By

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Gracilaria on intertidal flats in the lower Pauatahanui Arm.



1. INTRODUCTION AND METHODS

INTRODUCTION



Macroalgae is an important feature of estuaries, contributing to their high productivity and biodiversity. However, when high nutrient inputs combine with suitable growing conditions, nuisance blooms of rapidly growing algae (e.g. *Ulva* (sea lettuce), *Gracilaria*) can occur. At nuisance levels such growths can deprive seagrass of light, causing its eventual decline, while decaying macroalgae can accumulate on shorelines causing localised depletion of sediment oxygen, and nuisance odours.

This brief report summarises the results of an annual survey of intertidal macroalgal cover in Porirua undertaken in February 2012. The report describes intertidal macroalgal cover - a broad scale indicator of estuary eutrophication - using a macroalgal coefficient (described below) developed for Wellington's estuaries to rate the condition of the estuary, and recommends monitoring and management actions. These actions need to be considered in conjunction with the fine scale monitoring presented in Robertson and Stevens (2008, 2009, 2010).

METHODS

Broad scale mapping of the percentage cover of macroalgae throughout all the intertidal habitat of Porirua Harbour was undertaken in February 2012 using a combination of aerial photography, ground-truthing, and ArcMap 9.3 GIS-based digital mapping. The procedure, originally described for use in NZ estuaries by Robertson et al. (2002), has subsequently been modified and successfully applied to various estuaries to develop a separate GIS macroalgal layer (e.g. Stevens and Robertson 2008, 2009, 2010).

Rectified aerial photographs of the estuary (2010 Greater Wellington Regional Council ~0.3 metre per pixel images) were used as base maps. Experienced coastal scientists then recorded the percentage cover of macroalgae directly onto laminated photos during field assessment of macroalgal cover. The field maps were then used to create a GIS layer from which the percentage cover information was subsequently calculated.

The report outputs are used to both identify and classify macroalgal cover, and to show changes in macroalgal cover over time by comparisons with previous surveys (annually if a problem estuary, or 5 yearly if not). The current report presents the 2012 percentage cover of macroalgae within the estuary as a GIS-based map (Figure 1), and a summary table of the dominant species and percentage cover classes (Table 1).

WELLINGTON ESTUARIES: MACROALGAE CONDITION RATING

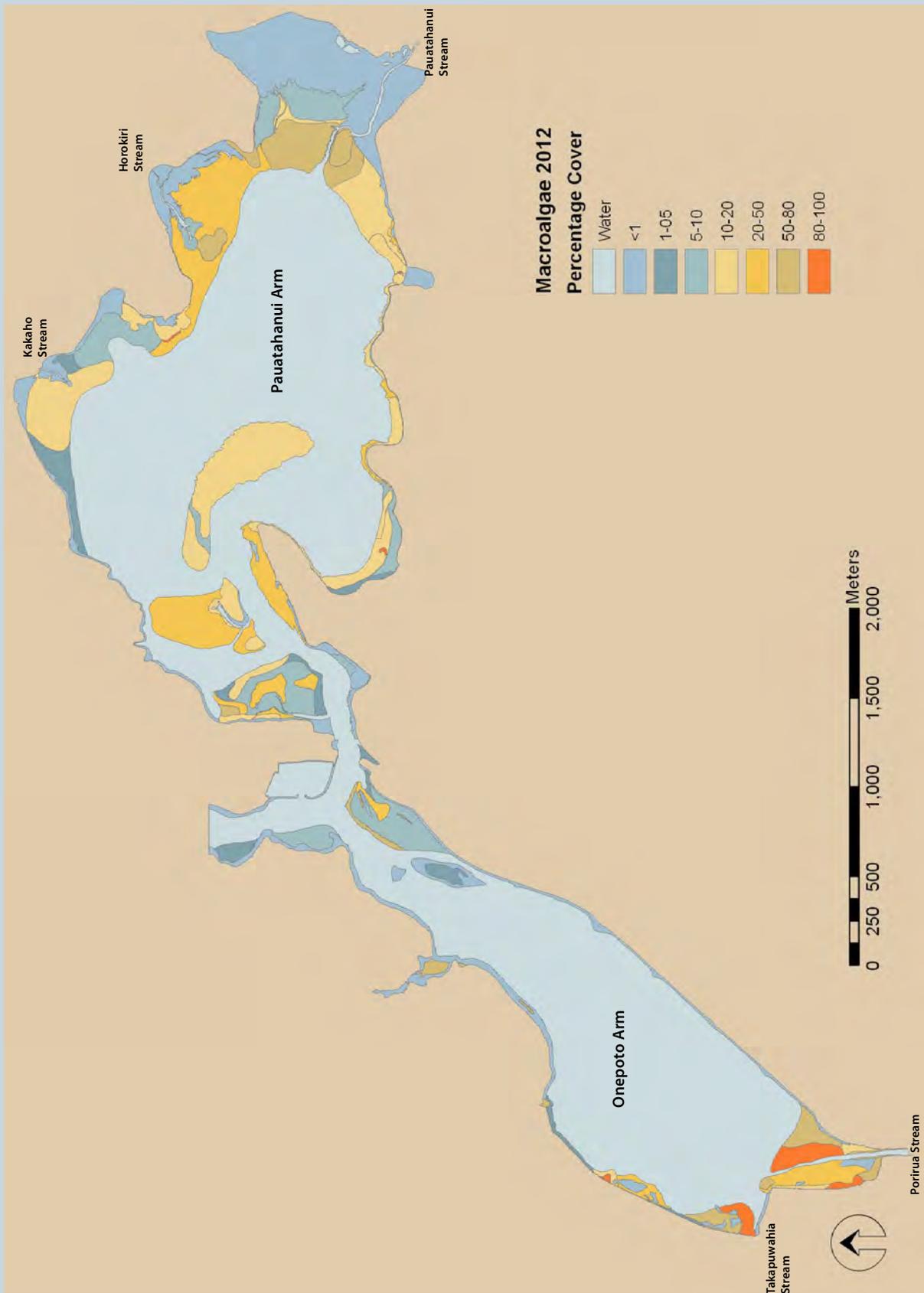


A continuous index (the macroalgae coefficient - MC) has been developed to rate macroalgal condition based on the percentage cover of macroalgae in defined categories using the following equation: $MC = ((0 \times \% \text{macroalgal cover} < 1\%) + (0.5 \times \% \text{cover } 1-5\%) + (1 \times \% \text{cover } 5-10\%) + (3 \times \% \text{cover } 10-20\%) + (4.5 \times \% \text{cover } 20-50\%) + (6 \times \% \text{cover } 50-80\%) + (7.5 \times \% \text{cover } > 80\%)) / 100$. Overriding the MC is the presence of either nuisance conditions within the estuary, or where >5% of the intertidal area has macroalgal cover >50%. In these situations the estuary is given a minimum rating of FAIR and should be monitored annually with an Evaluation & Response Plan initiated.

MACROALGAE CONDITION RATING

RATING	DEFINITION (+Macroalgae Coefficient)	RECOMMENDED RESPONSE
Over-riding rating: Fair	Nuisance conditions exist, or >50% cover over >5% of estuary	Monitor yearly. Initiate Evaluation & Response Plan
Very Good	Very Low (0.0 - 0.2)	Monitor at 5 year intervals after baseline established
Good	Low (0.2 - 0.8)	Monitor at 5 year intervals after baseline established
	Low Low-Moderate (0.8 - 1.5)	Monitor at 5 year intervals after baseline established
Fair	Low-Moderate (1.5 - 2.2)	Monitor yearly. Initiate Evaluation & Response Plan
	Moderate (2.2 - 4.5)	Monitor yearly. Initiate Evaluation & Response Plan
Poor	High (4.5 - 7.0)	Monitor yearly. Initiate Evaluation & Response Plan
	Very High (>7.0)	Monitor yearly. Initiate Evaluation & Response Plan
Early Warning Trigger	Trend of increasing Macroalgae Coefficient	Initiate Evaluation and Response Plan

FIGURE 1. MAP OF INTERTIDAL MACROALGAL COVER - PORIRUA HARBOUR, FEB. 2012



2. RESULTS, RATING AND MANAGEMENT

RESULTS

2012 MACROALGAL COVER CONDITION RATING

FAIR

Figure 1 and Table 1 summarise the results of intertidal macroalgal mapping within Porirua Harbour. The Macroalgae Coefficient (MC) for the harbour was 2.4, a condition rating of “fair”. This rating reflects that 186ha (65%) of the intertidal area within Porirua Harbour had cover exceeding 5%, a slight increase from 2011. This comprised 150ha (67%) of the Pauatahanui Arm, and 36ha (58%) of the Onepoto Arm. Localised nuisance conditions were present in both arms with 11% of the estuary exceeding 50% cover - 17.3ha (7.7%) in the Pauatahanui Arm, and 15.2ha (24.7%) in the Onepoto Arm. Cover was dominated by the red alga *Gracilaria*. The green alga *Ulva* sp. (sea lettuce) and *Ulva* (*Enteromorpha*) *intestinalis* were also common, but had a reduced subdominant cover compared to 2010 and 2011, particularly along the low tide channel margins where it was relatively sparse. A localised but relatively large (80m x 2m) intertidal accumulation of rotting *Ulva*, with associated surface sulphides and anoxic sediments, was observed opposite the railway overbridge in the lower Onepoto Arm (see lower sidebar photo).

Table 1. Summary of macroalgal cover results, 22-24 February 2012.

MACROALGAE 2011/12	Pauatahanui Arm			Porirua Arm			Entire Estuary	
Percentage Cover	Ha	%	Dominant species	Ha	%	Dominant species	Ha	%
Unvegetated	64.2	28.7	-	21.1	34.2	-	85.3	29.9
1-5%	9.3	4.2	<i>Gracilaria</i> , <i>Ulva</i> sp.	4.8	7.8	<i>Gracilaria</i> , <i>Ulva</i> sp.	14.1	4.9
5-10%	28.1	12.6	<i>Gracilaria</i> , <i>Ulva</i> sp., <i>U. intestinalis</i>	11.0	17.9	<i>Gracilaria</i> , <i>Ulva</i> sp.	39.1	13.7
10-20%	60.8	27.2	<i>Gracilaria</i> , <i>U. intestinalis</i> , <i>Ulva</i> sp.	1.8	2.9	<i>U. intestinalis</i> , <i>Gracilaria</i>	62.6	22.0
20-50%	43.9	19.6	<i>Gracilaria</i> , <i>U. intestinalis</i> , <i>Ulva</i> sp., <i>U. ramulosa</i>	7.7	12.5	<i>U. intestinalis</i> , <i>Gracilaria</i> , <i>Ulva</i> sp.	51.5	18.1
50-80%	16.9	7.6	<i>Gracilaria</i> , <i>U. intestinalis</i> , <i>Ulva</i> sp.	9.1	14.8	<i>Ulva</i> sp., <i>U. intestinalis</i> , <i>Gracilaria</i>	26.1	9.1
>80%	0.4	0.2	<i>Gracilaria</i> , <i>Ulva</i> sp., <i>U. intestinalis</i>	6.1	9.9	<i>U. intestinalis</i> , <i>Ulva</i> sp., <i>Gracilaria</i>	6.5	2.3
TOTAL	224	100		62	100		286	100



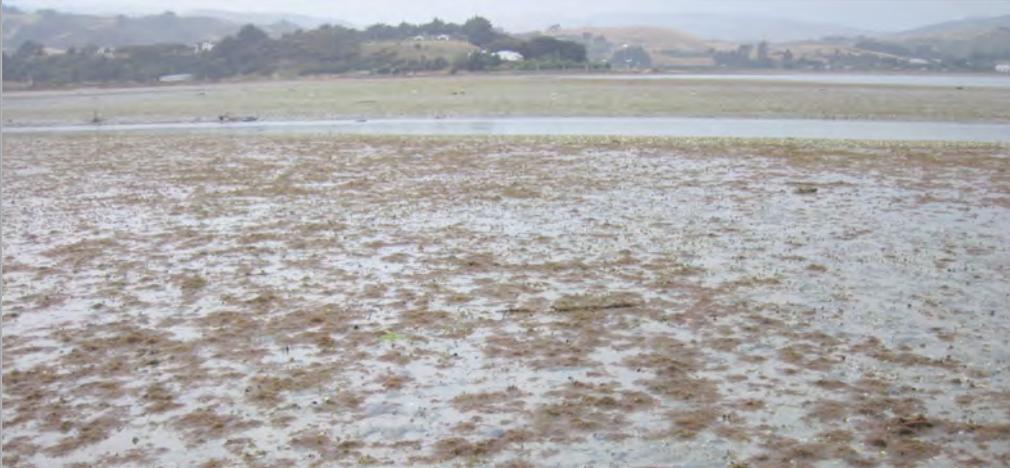
Table 2 summarises the Condition Rating and Macroalgal Coefficient (MC) results for the 2008-2012 period. The rating has remained constant across years (due to the extent of estuary with a >50% cover and the presence of nuisance conditions).

Around the Pauatahanui Stream mouth, nuisance conditions remained with a very shallow RPD depth indicating sediment oxygenation was poor, while rotting macroalgae was creating localised sulphide rich conditions. This was also the case in the upper reaches of the Onepoto Arm where dense mats of macroalgae (often wind blown accumulations) were present. Elsewhere in the harbour, there was a reduction in the cover of *Ulva* sp., but conditions have remained similar to those observed since 2008, changes essentially reflecting small scale local variations in macroalgal accumulation.

Table 2. Summary of condition rating and results, 2008-2012.

Year	Rating	MC	Result
2008	FAIR	2.2	High cover (50-80%) near Porirua Stream mouth in Onepoto Arm dominated by <i>Ulva</i> . 10-20% cover across most of Pauatahanui Arm, dominated by <i>Gracilaria</i> .
2009	FAIR	2.1	High cover (50-80%) near Porirua Stream mouth in Onepoto Arm dominated by <i>Ulva</i> . Large increase in growth near Pauatahanui Stream mouth (50-80% cover dominated by <i>U. intestinalis</i>). Increased growth by <i>Paremata</i> boathouses (20-50% cover).
2010	FAIR	2.4	High cover (50-80%) near Porirua Stream mouth in Onepoto Arm dominated by <i>Ulva</i> sp. Dominant cover near Pauatahanui Stream mouth changed from <i>U. intestinalis</i> to <i>Ulva</i> sp. Cover in northeast of Pauatahanui Arm increased from 1-5% to 20-50%.
2011	FAIR	2.3	High cover (50-100%) near Porirua Stream mouth in Onepoto Arm dominated by <i>Ulva</i> sp. High cover (50-80%) near Pauatahanui Stream mouth dominated by <i>Gracilaria</i> .
2012	FAIR	2.4	High cover (50-100%) near Porirua Stream mouth in Onepoto Arm dominated by <i>Ulva</i> sp. High cover (50-80%) near Pauatahanui Stream mouth dominated by <i>Gracilaria</i> .

2. Results, Rating and Management (Continued)

<p>CONCLUSION</p>	<p>Intertidal macroalgal monitoring since 2007 shows elevated macroalgal growth and localised nuisance conditions (rotting macroalgae and poorly oxygenated and sulphide rich sediments) in both the Onepoto and Pauatahanui Arms.</p> <p>While the estuary had an overall condition rating of “fair”, the concentration of growths and associated nuisance conditions near the major streams entering the estuary (e.g. Porirua, Takapuwahia, Pauatahanui, Horokiri, Kakaho Streams) suggest catchment nutrient inputs are a likely driver of the observed growths. Combined with increasing mud deposition in these same areas (Stevens and Robertson 2012), macroalgal growth and mud deposition remain continuing concerns within the estuary.</p>
<p>RECOMMENDED MONITORING AND MANAGEMENT</p>	<p>Based on the widespread cover of macroalgae and the presence of nuisance conditions, annual monitoring of macroalgal cover is recommended. The next monitoring in Porirua Harbour is therefore due in January/February 2013.</p> <p>The likely cause of macroalgal growths should also be further evaluated (e.g. catchment wide nutrient inputs or localised sources), and a management response plan initiated.</p>
<p>REFERENCES</p>	<p>Robertson, B.M., Gillespie, P.A., Asher, R.A., Frisk, S., Keeley, N.B., Hopkins, G.A., Thompson, S.J., Tuckey, B.J. 2002. <i>Estuarine Environmental Assessment and Monitoring: A National Protocol. Part A. Development, Part B. Appendices, and Part C. Application. Prepared for supporting Councils and the Ministry for the Environment, Sustainable Management Fund Contract No. 5096. Part A. 93p. Part B. 159p. Part C. 40p plus field sheets.</i></p> <p>Robertson, B.M. and Stevens, L. 2008. <i>Porirua Harbour: Fine Scale Monitoring 2007/08. Prepared for Greater Wellington Regional Council. 32p.</i></p> <p>Robertson, B.M. and Stevens, L. 2009. <i>Porirua Harbour: Fine Scale Monitoring 2008/09. Prepared for Greater Wellington Regional Council. 32p.</i></p> <p>Robertson, B.M. and Stevens, L. 2010. <i>Porirua Harbour: Fine Scale Monitoring 2009/10. Prepared for Greater Wellington Regional Council. 39p.</i></p> <p>Stevens, L. and Robertson, B.M. 2008. <i>Porirua Harbour: Broad Scale Habitat Mapping 2007/08. Prepared for Greater Wellington Regional Council. 29p.</i></p> <p>Stevens, L. and Robertson, B.M. 2009. <i>Porirua Harbour: Intertidal Macroalgal Monitoring 2008/09. Prepared for Greater Wellington Regional Council. 3p.</i></p> <p>Stevens, L. and Robertson, B.M. 2010. <i>Porirua Harbour: Intertidal Macroalgal Monitoring 2009/10. Prepared for Greater Wellington Regional Council. 3p.</i></p> <p>Stevens, L. and Robertson, B.M. 2011. <i>Porirua Harbour: Intertidal Macroalgal Monitoring 2010/11. Prepared for Greater Wellington Regional Council. 4p.</i></p> <p>Stevens, L. and Robertson, B.M. 2012. <i>Porirua Harbour: Intertidal Sediment Monitoring 2011/12. Prepared for Greater Wellington Regional Council. 8p.</i></p>
<p>ACKNOWLEDGEMENT</p>	<p>This report has been undertaken with the support of Greater Wellington Regional Council. The assistance and feedback of Juliet Milne and Megan Oliver is much appreciated.</p>  <p><i>Gracilaria</i> on intertidal flats near the Horokiri Stream mouth, Pauatahanui Arm.</p>