

Waikanae Estuary

Intertidal Macroalgal Monitoring 2012/13



Prepared
for
**Greater
Wellington
Regional
Council**
March
2013

Cover Photo: Lower Waikanae River Estuary showing newly upgraded weir and fish pass.

Waikanae River Estuary

Intertidal Macroalgal Monitoring 2012/13

**Prepared for
Greater Wellington Regional Council**

By

Leigh Stevens and Barry Robertson

Contents

1. Introduction and Methods	1
2. Results, Rating and Management	4

Figures and Tables

Figure 1. Visual rating scale for percentage cover estimates of macroalgae	1
Figure 2. Map of macroalgal cover - Waikanae River Estuary, 14 January 2013	3
Table 1. Summary of macroalgal cover results, 14 January 2013.	4
Table 2. Summary of condition rating and results, 2010-13.	5

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 the fourth annual survey of intertidal macroalgal cover in Waikanae River Estuary, undertaken on 14 January 2013. 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 recommend monitoring and management actions. These actions need to be considered in conjunction with the fine scale monitoring presented in Robertson and Stevens (2010, 2011, 2012).

METHODS

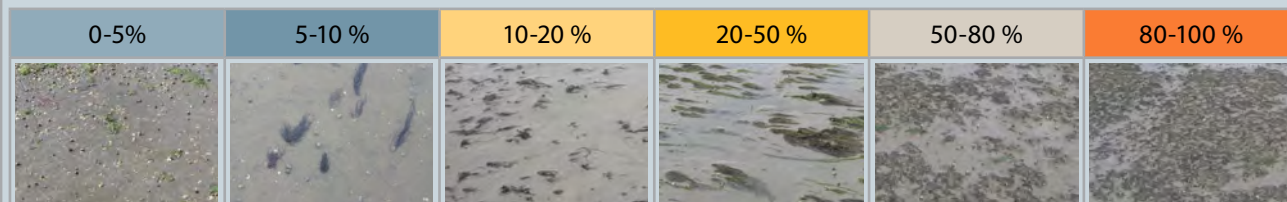
Broad scale mapping of the percentage cover of macroalgae throughout all the intertidal habitat of Waikanae River Estuary was undertaken in January 2013 using a combination of aerial photography, ground-truthing, and ArcMap 9.3 GIS-based digital mapping. The procedure, originally described for use in 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 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.

When present, macroalgae was mapped spatially using a 7 category percent cover rating scale (see Figure 1) to describe density.

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 2013 percentage cover of macroalgae within the estuary as a GIS-based map (Figure 2), and a summary table of the dominant species and percentage cover classes (Table 1).

Figure 1. Visual rating scale for percentage cover estimates of macroalgae.



Macroalgae growing on intertidal sediments in the lower Waikanae River Estuary, Jan. 2013.



1. Introduction and Methods (Cont.)

CONDITION RATINGS

A series of interim fine scale estuary “condition ratings” have been proposed based on ratings developed for Southland’s estuaries (e.g. Robertson & Stevens 2006) and subsequent extensions (e.g. Stevens and Robertson 2013). They are based on a review of NZ estuary monitoring data, guideline criteria, and expert opinion, and are designed to be used in combination with each other, and other important condition indices (particularly mud), when evaluating overall estuary condition and deciding on appropriate management.

Macroalgal ratings (see below) have been developed for both low and high density macroalgal cover, and temporal change. An “early warning trigger” highlights rapid or unexpected change, and each rating has a recommended monitoring and management response. In most cases initial management is to further assess an issue and consider what response actions may be appropriate (e.g. develop an Evaluation and Response Plan - ERP).

LOW DENSITY MACROALGAL COVER

A two part macroalgae condition rating has been developed: 1. for low density (<50%) macroalgal cover throughout the estuary, and 2. a warning indicator for hotspots of high density (>50%) cover (see following rating). Low density macroalgal condition is rated using a continuous index (the macroalgae coefficient - MC) based on the percentage cover of macroalgae in defined categories in the estuary where cover is <50%. The equation used is: $MC = ((0 \times \% \text{macroalgal cover} < 1\%) + (0.5 \times \% \text{cover } 1-5\%) + (1.5 \times \% \text{cover } 5-10\%) + (4.5 \times \% \text{cover } 10-20\%) + (7.5 \times \% \text{cover } 20-50\%)) / 100$.

LOW DENSITY MACROALGAL COVER CONDITION RATING			
CONDITION RATING	DEFINITION	MC	RECOMMENDED RESPONSE
Very Low	Very Low	0.0 - 0.2	Monitor at 5 year intervals after baseline established
Low	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
Moderate	Low-Moderate	1.5 - 2.2	Monitor yearly. Initiate ERP
	Moderate	2.2 - 4.5	Monitor yearly. Initiate ERP
High	High	4.5 - 7.0	Monitor yearly. Initiate ERP
	Very High	>7.0	Monitor yearly. Initiate ERP
Early Warning Trigger	Trend of increasing Macroalgae Coefficient		Initiate ERP (Evaluation and Response Plan)

HIGH DENSITY MACROALGAL COVER

The high density macroalgae condition rating targets areas of high density growth and is applied to the percentage of the estuary where the cover of intertidal macroalgal exceeds 50%. While this may not necessarily be combined with the presence of nuisance conditions, dense growths are an early warning of the estuary potentially exceeding its assimilative capacity and developing gross eutrophic conditions. A trend of an increasing dense macroalgal cover, or an increasing Macroalgal Coefficient for low density cover, provides an “early warning trigger” for initiating management action.

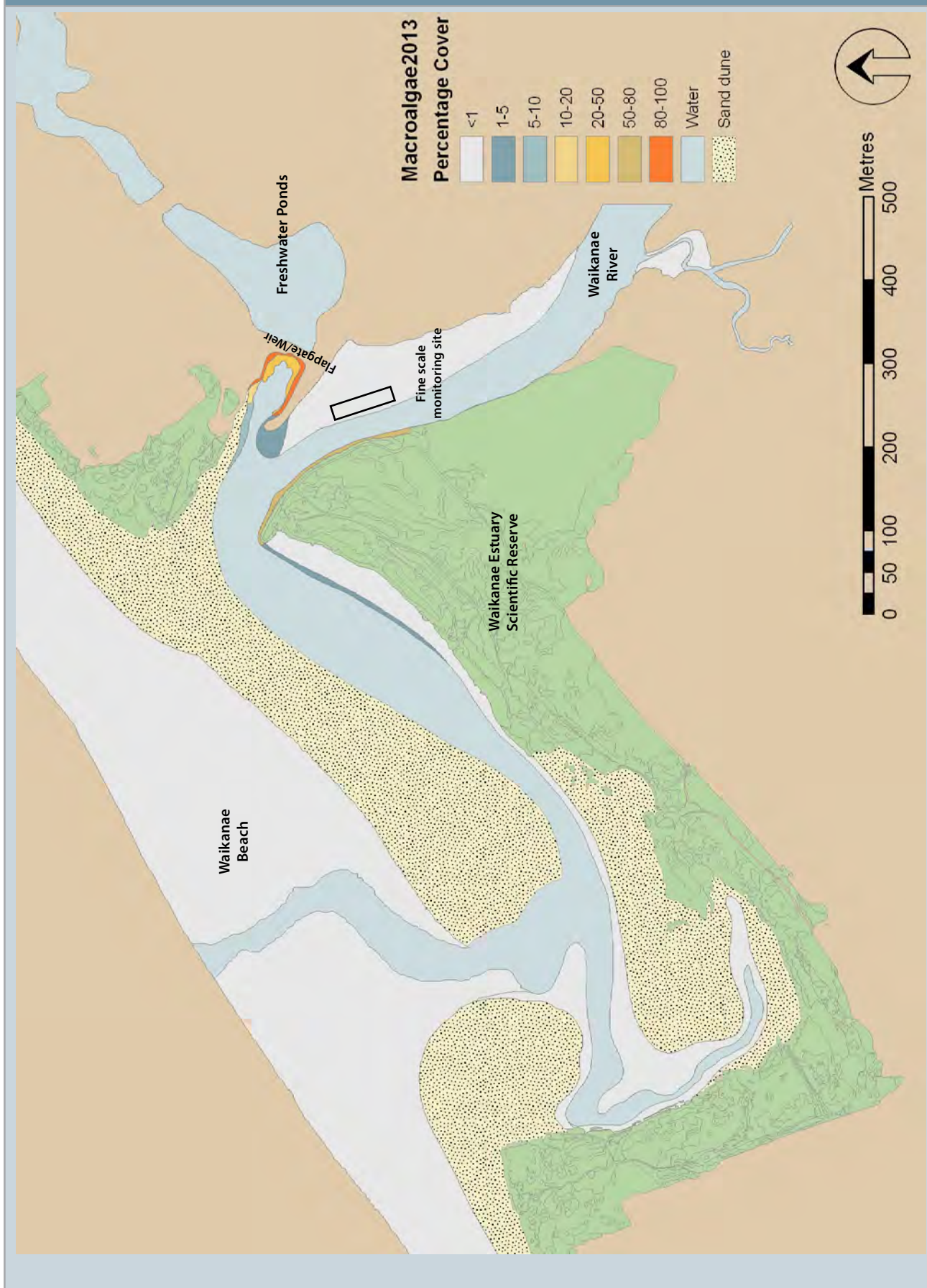
HIGH DENSITY MACROALGAL COVER CONDITION RATING		
CONDITION RATING	>50% MACROALGAL COVER OVER:	RECOMMENDED RESPONSE
Very Low	<1% of estuary	Monitor at 5 year intervals after baseline established
Low	1-5% of estuary	Post baseline, monitor 5 yearly. Initiate ERP
Moderate	6-10% of estuary	Monitor yearly. Initiate Evaluation & Response Plan
High	11-30% of estuary	Monitor yearly. Initiate Evaluation & Response Plan
Very High	>30% of estuary	Monitor yearly. Initiate Evaluation & Response Plan

HIGH DENSITY MACROALGAL COVER (CHANGE IN AREA)

Increases in the area of dense macroalgal cover indicate changes in catchment land use management are likely to be needed. Because extensive cover of dense macroalgae is commonly associated with gross eutrophic conditions that can be very difficult to reverse, even relatively small changes from baseline conditions should be evaluated as a priority.

HIGH DENSITY MACROALGAE AREA CHANGE RATING		
CHANGE RATING	DEFINITION	RECOMMENDED RESPONSE
No increase	Area of cover (ha) not increasing, or is decreasing	Monitor at 5 year intervals after baseline established
Small Increase	Increase in area of cover (ha) <5% from baseline	Post baseline, monitor 5 yearly. Initiate ERP
Moderate Increase	Increase in area of cover (ha) 5-15% from baseline	Post baseline, monitor annually. Initiate ERP
Large Increase	Increase in area of cover (ha) 16-50% from baseline	Post baseline, monitor annually. Initiate ERP
Very Large Increase	Increase in area of cover (ha) >50% from baseline	Post baseline, monitor annually. Initiate ERP

FIGURE 2. MAP OF INTERTIDAL MACROALGAL COVER - WAIKANAĒ ESTUARY, JAN. 2013



2. RESULTS, RATING AND MANAGEMENT

RESULTS

LOW DENSITY MACROALGAL CONDITION RATING

2013 VERY LOW

HIGH DENSITY MACROALGAL CONDITION RATING

2013 LOW

HIGH DENSITY COVER CHANGE RATING

2010-2013
VERY LARGE INCREASE



Lower estuary showing absence of macroalgal growth.



Macroalgal deposits in the flaggate embayment.

Figure 2 and Table 1 summarise the results of intertidal macroalgal mapping within Waikanae River Estuary. Overall, the vast majority of the intertidal area (91%) had no macroalgae growth (upper sidebar photo). *Ulva intestinalis* was present in patchy deposits in and around the embayment near the flaggate (bottom sidebar photo) where localised nuisance conditions (anoxic sediments, odours) were present due to rotting macroalgae. However, the extent of nuisance conditions had reduced from that observed in 2012. Although modifications have been made to the flaggate to allow fish passage and to better control water levels within the artificial freshwater ponds, it is unlikely that this has had any appreciable influence on the change in macroalgal cover observed.

Elsewhere, a sparse growth of *U. intestinalis* was present predominantly on boulders along the edges of the estuary with an increased cover along the true left bank evident in 2013.

Table 1. Summary of macroalgal cover results, 14 January 2013.

MACROALGAE Percentage Cover	Waikanae River Estuary		
	Ha	%	Dominant species
<1%	5.2	90.6	
1-5%	0.23	4.0	<i>Ulva intestinalis</i> *
5-10%	0.05	0.9	<i>Ulva intestinalis</i> *
10-20%	0.02	0.3	<i>Ulva intestinalis</i> *
20-50%	0.08	1.4	<i>Ulva intestinalis</i> *
50-80%	0.1	1.7	<i>Ulva intestinalis</i> *
>80%	0.06	1.0	<i>Ulva intestinalis</i> *
TOTAL	5.75	100	

* Note, *Ulva intestinalis* is synonymous with *Enteromorpha intestinalis* (reported as *Enteromorpha* in Stevens and Robertson 2010).

Macroalgal condition ratings were revised in 2013 and results from 2010-2013 have been reassessed and presented in Table 2. The 2013 Macroalgae Coefficient (MC) for low density (<50%) cover in the estuary was 0.16, a condition rating of "very low", and the percentage of the estuary with a high density (>50% cover) macroalgal cover (2.8%), a condition rating of "low".

The MC and area of dense cover had increased slightly from 2011 and 2012 (see Table 2), primarily due to increased cover on the true left bank (rockwall) of the lower Waikanae River. While the changes in macroalgal cover were minor, other indicators of increasing eutrophication of the estuary since 2010 have been evident. These, reported on in Robertson and Stevens (2012), were:

- A reduction in sediment oxygenation (RPD depth).
- Increased sediment nutrient concentrations (total nitrogen and phosphorus).
- Increased organic content (measured as total organic carbon).
- Dense microalgal mats growing on estuary sediments.
- A distinctive green tinge (chlorophyll a) in the estuary water, particularly in temperature/salinity stratified bottom waters.

In 2013, there was no obvious stratification of bottom water, attributed to recent rain and overtopping of the beach barrier by seawater increasing mixing and flushing in the estuary. Similarly, estuary waters did not have a strong green tinge (indicating high chlorophyll a), although water in the upper estuary was relatively turbid due to sediments being washed down from the catchment.

Based on the combined trend of an increasing MC, and the presence of eutrophication indicators, it is recommended that macroalgae again be quickly reassessed in conjunction with sediment rate monitoring scheduled for January/February 2014, and thereafter based on the condition ratings.

2. Results, Rating and Management (Cont...)

Table 2. Summary of condition rating and results, 2010-13.

Year	Low Density Rating	High Density Rating	Result
2010	0.01	VERY LOW	Macroalgae absent from the vast majority of the estuary. Very low cover of <i>Ulva intestinalis</i> along the lower true left bank. Dense macroalgal cover = <1%.
2011	0.01	LOW	Macroalgae absent from the vast majority of the estuary. Very low cover of <i>Ulva intestinalis</i> along the true left bank. Increase in nuisance conditions near flapgate. Dense macroalgal cover = 2.3%.
2012	0.04	LOW	Macroalgae absent from the vast majority of the estuary. Low cover of <i>Ulva intestinalis</i> along the lower true left bank. Increase in nuisance conditions near flapgate. Dense macroalgal cover = 2.8%.
2013	0.16	LOW	Macroalgae absent from the vast majority of the estuary. Increased cover of <i>Ulva intestinalis</i> along the lower true left bank. Minor nuisance conditions near flapgate. Dense macroalgal cover = 2.8%.

CONCLUSION

Low density macroalgal cover had a condition rating of “very low”, with only a small increase measured since 2010. High density macroalgal cover had a condition rating of “low” and was not a significant issue in the estuary. The high density macroalgal percentage change condition rating is rated as a “very large increase”, primarily because the baseline year recorded no dense macroalgae. The increase had resulted in minor localised nuisance conditions (rotting macroalgae, poorly oxygenated and sulphide rich sediments) in one small part of the estuary.

The results, combined with other indicators of eutrophication, show a decline in estuary quality over the past three years.

RECOMMENDED MONITORING AND MANAGEMENT

Quickly reassess macroalgal growth at the same time sedimentation monitoring is undertaken to ensure growths or nuisance conditions have not increased. The latest available aerial photographs from the estuary should be used where appropriate. The next monitoring in Waikanae River Estuary is therefore due in January/February 2014.

REFERENCES

- Robertson, B.M., Gillespie, P.A., Asher, R.A., Frisk, S., Keeley, N.B., Hopkins, G.A., Thompson, S.J., Tuckey, B.J. 2002. *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.*
- Robertson, B., and Stevens, L. 2006. *Southland Estuaries State of Environment Report 2001-2006. Prepared for Environment Southland.*
- Robertson, B.M. and Stevens, L. 2010. *Waikanae Estuary: Fine Scale Monitoring 2009/10. Prepared for Greater Wellington Regional Council. 19p.*
- Robertson, B.M. and Stevens, L. 2011. *Waikanae Estuary: Fine Scale Monitoring 2010/11. Prepared for Greater Wellington Regional Council. 21p.*
- Robertson, B.M. and Stevens, L. 2012. *Waikanae Estuary: Fine Scale Monitoring 2011/12. Prepared for Greater Wellington Regional Council. 22p.*
- Stevens, L. and Robertson, B.M. 2010. *Waikanae River Estuary: Intertidal Macroalgal Monitoring 2009/10. Prepared for Greater Wellington Regional Council. 3p.*
- Stevens, L. and Robertson, B.M. 2011. *Waikanae River Estuary: Intertidal Macroalgal Monitoring 2010/11. Prepared for Greater Wellington Regional Council. 3p.*
- Stevens, L. and Robertson, B.M. 2012. *Waikanae River Estuary: Intertidal Macroalgal Monitoring 2011/12. Prepared for Greater Wellington Regional Council. 4p.*
- Stevens, L., and Robertson, B.M. 2013. *Moutere Inlet broad scale habitat mapping 2012/2013. Prepared for Tasman District Council. 29p.*

ACKNOWLEDGEMENT

This survey and report was completed with the support of Greater Wellington Regional Council. The feedback of Megan Oliver is much appreciated.