

Hutt Estuary

Intertidal Macroalgal Monitoring 2012/13



Prepared
for
**Greater
Wellington
Regional
Council**
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Cover Photo: *Ulva intestinalis* growing at the mouth of Te Mome Stream, Hutt River Estuary.

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By

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Extensive growths of *Ulva intestinalis* along the intertidal margins of Hutt River Estuary.



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 Hutt River Estuary, undertaken on 15 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 results presented in Robertson and Stevens (2010, 2011, 2012).

METHODS

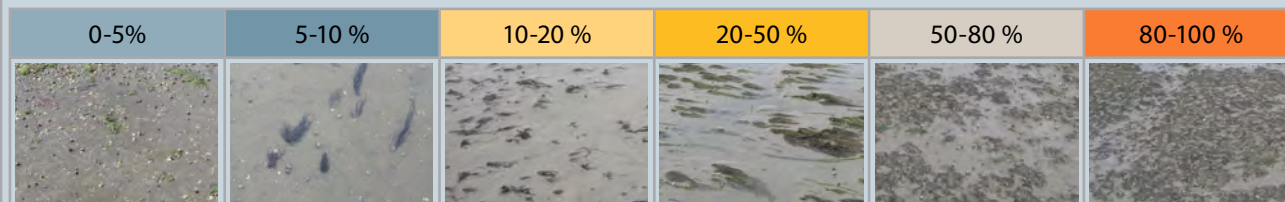
Broad scale mapping of the percentage cover of macroalgae throughout all the intertidal habitat of Hutt River Estuary was undertaken in January 2013 using a combination of aerial photography, ground-truthing, and ArcMap 9.3 GIS-based digital mapping. The procedure, originally described for use in NZ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



2. RESULTS, RATING AND MANAGEMENT

RESULTS

LOW DENSITY MACROALGAL
CONDITION RATING

2013 MODERATE

HIGH DENSITY MACROALGAL
CONDITION RATING

2013 VERY HIGH

HIGH DENSITY COVER
CHANGE RATING

2010-13
VERY LARGE INCREASE



Figure 2 and Table 1 summarise the results of intertidal macroalgal mapping within Hutt River Estuary. As the highly modified estuary is confined within extensive floodbanks, the intertidal area is restricted to narrow bands along steep rip-rap rock walls and small areas of mudflat habitat present at the mouths of the Te Mome and Moera Streams. *Ulva intestinalis* is by far the most dominant species and is continuing to grow on almost every part of the intertidal habitat, with an extensive cover extending from the railway overbridge to the Hutt River mouth. Similar conditions are present throughout the linked Waiwhetu Estuary that has its mouth in the lower reaches of the Hutt River. *Gracilaria* and the green alga *Ulva lactuca* (sea lettuce) were present but much less conspicuous than *Ulva intestinalis* and confined largely to the lower intertidal reaches and in subtidal areas near the Hutt River mouth.

Table 1. Summary of macroalgal cover results, 15 January 2013.

MACROALGAE Percentage Cover	Hutt River Estuary		
	Ha	%	Dominant species
<1%	0	0.0	-
1-5%	0.2	2.3	<i>U. Intestinalis</i>
5-10%	0.5	5.8	<i>U. Intestinalis</i>
10-20%	1.7	19.8	<i>U. Intestinalis, Ulva sp., Gracilaria</i>
20-50%	0.5	5.8	<i>U. Intestinalis, Gracilaria</i>
50-80%	3.1	36.0	<i>U. Intestinalis</i>
>80%	2.6	30.2	<i>U. Intestinalis</i>
TOTAL	8.6	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 4.2, a condition rating of “moderate”, and the percentage of the estuary with a high density (>50% cover) macroalgal cover (66%) a condition rating of “very high”. This reflects increasing low density cover from 2010 - see Table 2, Stevens and Robertson 2010, 2011 2012), and the extensive and increased cover of dense macroalgae in the lower estuary, mostly below the Waione Street bridge, and on the relatively sheltered intertidal flats near the Te Mome stream mouth. Here, 0.3-0.5m long growths of *Ulva intestinalis* were common.

Overall, macroalgae is present over the vast majority of the intertidal area within Hutt River Estuary - 8.3ha (97.7%) with greater than 5% cover. Despite the high cover, nuisance conditions (e.g. rotting macroalgae and poorly oxygenated and sulphide rich sediments) were present in only a relatively few intertidal areas, and in subtidal areas near the mouth which is currently muddy, poorly oxygenated, and sulphide rich.

The primary factor preventing widespread nuisance conditions appears to be the regular flushing of macroalgae from the estuary. This flushing, and particularly freshes in the river following rain, is likely to be limiting the length that nuisance macroalgae can grow to along the intertidal main channel margins.

The marked increase in macroalgal growth evident since 2010 means the potential for nuisance conditions and associated adverse impacts in the lower estuary has increased considerably over the past three years. In particular, the estuary is likely to be susceptible to rapid degradation under low flows and in areas where fine sediments are regularly smothered by macroalgal growths.

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	3.2	VERY HIGH	High cover (80-100%) of <i>U. intestinalis</i> along rip-rap walls and near Moera Stream mouth. Moderate cover (20-80%) of <i>U. intestinalis</i> and <i>Ulva sp.</i> at Te Mome Stream mouth. Dense macroalgal cover = 42%.
2011	3.9	VERY HIGH	Increase in <i>U. intestinalis</i> at Te Mome Stream mouth and on true left bank downstream of Waione Street bridge compared to 2010. Dense macroalgal cover = 41%.
2012	4.4	VERY HIGH	Increase in <i>U. intestinalis</i> at Te Mome Stream mouth and on true left bank downstream of Waione Street bridge compared to 2011. Luxuriant subtidal growths in shallows. Dense macroalgal cover = 60%.
2013	4.2	VERY HIGH	Thick cover of <i>U. intestinalis</i> at Te Mome Stream mouth and on river banks downstream of the railway over-bridge. Luxuriant subtidal growths in shallows. Dense macroalgal cover = 66%.

CONCLUSION

High density macroalgal cover had a condition rating of “very high”, with extensive growth throughout the estuary. The increase in high density macroalgal cover since 2010 had a condition rating of “very large increase”. Low density macroalgal cover had a condition rating of “moderate”, with a warning trigger of increasing macroalgal coefficient since 2010. Despite this, nuisance conditions (rotting macroalgae and poorly oxygenated and sulphide rich sediments) were only present in localised areas on intertidal flats, but do exist in subtidal areas near the Hutt River mouth.

RECOMMENDED MONITORING AND MANAGEMENT

The condition rating triggers annual monitoring. The next monitoring in Hutt River Estuary is therefore due in January/February 2014.

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. In particular, it is recommended that management actions be taken to reduce nuisance macroalgal growth to non-nuisance levels. As recommended in 2011 and 2012, this should include deriving a guideline limit for nutrient (likely to be nitrogen) inputs as the first step, followed by identification of major sources and their subsequent reduction to meet the guideline.

GWRC is currently investigating the sources of nutrients in the Hutt River catchment with a focus on nitrogen. Although these investigations are currently centered around the occurrence of cyanobacteria blooms in the Hutt River, the information will also be relevant to macroalgal blooms in the estuary. A summary of these investigations will be available by the end of May 2013.

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