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Hutt Estuary

Intertidal Macroalgal Monitoring 2013/14

Prepared for
Greater Wellington Regional Council
April 2014

Cover Photo: *Ulva intestinalis* growing at the mouth of Te Mome Stream, Hutt River Estuary.

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By

Leigh Stevens and Barry Robertson

Wriggle Limited, PO Box 1622, Nelson 7040, NZ. Ph 03 545 6315, 021 417 936; 0275 417 935, www.wriggle.co.nz

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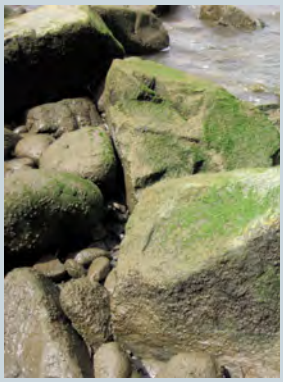
1. INTRODUCTION AND METHODS

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 fifth annual survey of intertidal macroalgal cover in Hutt River Estuary, undertaken on 22 January 2014. 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 2014 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).

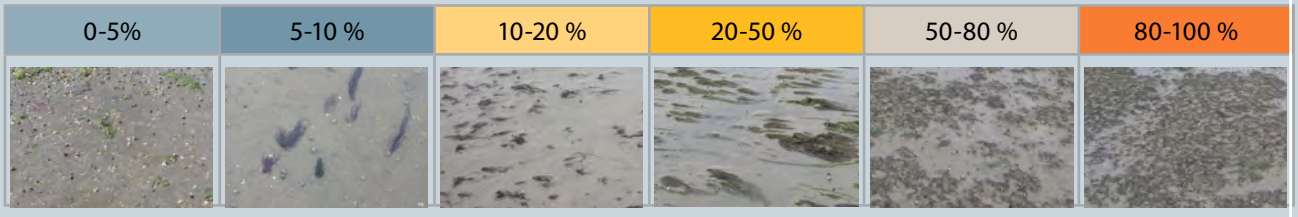
Rectified aerial photographs of the estuary (2010 Greater Wellington Regional Council ~0.3 metre per pixel images) were used as base maps. Experienced coastal scientists then recorded the percentage cover of macroalgae directly onto laminated photos during field assessment of macroalgal cover. The field 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 (e.g. annually if a problem estuary, or 5 yearly if not). The current report presents the 2014 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).

The methodology for assessing macroalgae is currently being updated following a review of international literature, and additions to the method (e.g. added measures of sediment entrained macroalgae and biomass) will be included in future monitoring.

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



Macroalgae growing on intertidal sediments in the lower Hutt River Estuary, Jan. 2014.

2. RISK INDICATOR RATINGS

The National Estuary Monitoring Protocol (NEMP, Robertson et al. 2002), and subsequent additions (e.g. Robertson and Stevens 2006, 2007, 2012a), recommend a defensible, cost-effective monitoring design for assessing the long term condition of shallow, intertidally-dominated, NZ estuarine systems. The design is based on the use of indicators that have a documented strong relationship with water or sediment quality. The approach is intended to help quickly identify the likely presence of the predominant issues affecting NZ estuaries (i.e. eutrophication, sedimentation, disease risk, toxicity and habitat change). In order to facilitate this process, "risk indicator ratings" have been proposed that assign a relative level of risk of adversely affecting estuary conditions (e.g. very low, low, moderate, high, very high) to each indicator (see examples below). Each risk indicator rating is designed to be used in combination with relevant information and other risk indicator ratings, and under expert guidance, to assess overall estuary condition in relation to key issues. When interpreting risk indicator results we emphasise:

- The importance of taking into account other relevant information and/or indicator results before making management decisions regarding the presence or significance of any estuary issue.
- That rating and ranking systems can easily mask or oversimplify results. For instance, large changes can occur within a risk category, but small changes near the edge of one risk category may shift the rating to the next risk level.
- Most issues will have a mix of primary and secondary ratings, primary ratings being given more weight in assessing the significance of indicator results.
- Ratings for most indicators have not been established using statistical measures, primarily because of the extensive additional work and cost this requires. In the absence of funding, professional judgment, based on our wide experience from monitoring >300 NZ estuaries, has been used in making initial interpretations. Our hope is that where a high level of risk is identified, the following steps are taken:
    1. Statistical measures be used to refine indicators and guide monitoring and management for priority issues.
    2. Issues identified as having a high likelihood of causing a significant change in ecological condition (either positive or negative), trigger intensive, targeted investigations to appropriately characterise the extent of the issue.
    3. The outputs stimulate discussion regarding what an acceptable level of risk is, and how it should best be managed.

The indicators and risk ratings relevant to the Hutt River Estuary macroalgal monitoring programme are presented in Table 1 below:

Table 1. Risk indicator ratings for opportunistic macroalgal cover.

MACROALGAL RISK INDICATOR RATING	LOW DENSITY (>50%) COVER COEFFICIENT[1]	EXTENT OF HIGH DENSITY (>50%) COVER[2]	CHANGE IN HIGH DENSITY (>50%) COVER[3]
Very Low	0.0 - 0.2	<1% of estuary	no increase (or decrease)
Low	>0.2 - 1.5	1-5% of estuary	<5% from baseline
Moderate	>1.5 - 4.5	6-10% of estuary	5-15% from baseline
High	>4.5 - 7.0	11-30% of estuary	16-50% from baseline
Very High	>7.0	>30% of estuary	>50% from baseline

NOTES:

Opportunistic macroalgae can grow to nuisance bloom proportions when nutrient levels are elevated and there is sufficient light to support growth. Opportunistic species generally survive well in conditions in which other species struggle to survive or compete and, consequently, they most commonly reach nuisance conditions in shallow estuaries, or the margins of deeper estuaries.

[1]**Low Density Macroalgal Cover**: This indicator is used as an "early warning" of increases in non-nuisance intertidal macroalgal growth. Low density (<50%) macroalgal cover is rated using a continuous index (the macroalgae coefficient - MC). It is based on the percentage cover of macroalgae in defined categories in the intertidal estuary (excluding saltmarsh) where macroalgal cover is <50%. The equation used is: ***MC=((0 x %macroalgal cover <1%)+(0.5 x %cover 1-5%)+(1.5 x %cover 5-10%)+(4.5 x %cover 10-20%)+(7.5 x %cover 20-50%))/100.***

[2]**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 is likely to correspond with worsening conditions in the estuary. Both the low and high density macroalgal cover ratings are currently being updated and expanded to provide a more robust metric of estuary condition, supported by narrative thresholds.

[3]**Change in High Density Macroalgal Cover:** This indicator is used as to assess change from baseline measures over time. Because an 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.

3. RESULTS, RATING, RECOMMENDATIONS

Figure 2 and Table 2 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.

The 2014 Macroalgae Coefficient (MC) for low density (<50%) cover in the estuary was 4.8, a risk indicator rating of "high". The percentage of the estuary with a high density (>50% cover) macroalgal cover was 52%, a risk indicator rating of "very high". Macroalgal cover was 24% above the baseline first established in 2010, a risk indicator rating of "high".

Table 2. Summary of macroalgal cover results, 22 January 2014.

MACROALGAE	Waikanae River Estuary		
Percentage Cover	Ha	%	Dominant species
<1%	0.0	0.0	-
1-5%	0.3	3.5	*U. Intestinalis*
5-10%	0.5	5.4	*U. Intestinalis*
10-20%	2.3	25.2	*U. Intestinalis, Ulva sp., Gracilaria*
20-50%	1.3	14.2	*U. Intestinalis, Gracilaria*
50-80%	2.2	24.9	*U. Intestinalis*
>80%	2.4	27.0	*U. Intestinalis*
TOTAL	**9.0**	**100**	

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

Results of annual monitoring since 2010 (Stevens and Robertson 2010, 2011, 2012, 2013) are summarised in Table 3. As in all previous years, an extensive cover of dense macroalgae grows on almost every available substrate in the lower estuary, with 8.7ha (96.5%) of the intertidal area supporting greater than 5% cover. This cover is a particularly dominant feature below the Waione Street bridge, and on the relatively sheltered intertidal flats near the Te Mome stream mouth. In both locations, 0.3-0.5m long growths of *Ulva intestinalis* were common in the shallow subtidal waters.

Table 3 shows that compared to 2013, there was a decrease in dense macroalgal cover in the estuary (down from 66% to 52%), the largest reduction occurring on the flats adjacent to the Waione Street bridge. The overall decrease in dense cover resulted in a corresponding increase in the low density macroalgal coefficient, (MC up from 4.2 to 4.8).

Despite the widespread and often dense growth of macroalgae throughout the estuary, 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 flood scouring of the river following rain, is likely to be limiting the length that nuisance macroalgae can grow to along the intertidal main channel margins, while also dislodging and washing macroalgae growing or deposited on the intertidal flats out to sea.

Based on these results, it is recommended that macroalgae again be reassessed in conjunction with sediment rate monitoring scheduled for January/February 2015. At that time a more comprehensive methodology for evaluating opportunistic macroalgae will be available for use in the estuary and will be used to derive an "ecological quality rating" based on a comprehensive multi-metric index that incorporates macroalgal cover, density, biomass, entrainment scored both within available intertidal habitat and areas affected by macroalgae.

3. Results, Rating and Recommendations (Cont...)

Figure 2. Map of Intertidal macroalgal cover - Hutt Estuary, 22 Jan. 2014.

3. Results, Rating and Recommendations (Cont...)

Table 3. Summary macroalgal risk indicator ratings and results, 2010-14.

Year	Low Density Coefficient	High Density % cover	Result
2010	Moderate (3.2)	Very High (42%)	High cover (80-100%) of *U. intestinalis* along rip-rap walls and near Moera Stream mouth. Moderate cover (20-80%) of *U. intestinalis* and *Ulva sp.* at Te Mome Stream mouth. Dense macroalgal cover = 42%.
2011	Moderate (3.9)	Very High (41%)	Increase in *U. intestinalis* at Te Mome Stream mouth and on true left bank downstream of Waione Street bridge compared to 2010. Dense macroalgal cover = 41%.
2012	Moderate (4.4)	Very High (60%)	Increase in *U. intestinalis* 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	Moderate (4.2)	Very High (66%)	Thick cover of *U. intestinalis* at Te Mome Stream mouth and on river banks downstream of the railway over-bridge. Luxuriant subtidal growths in shallows. Dense macroalgal cover = 66%.
2014	High (4.8)	Very High (52%)	Widespread cover of *U. intestinalis* at Te Mome Stream mouth and on river banks downstream of the railway over-bridge. Luxuriant subtidal growths in shallows. Dense macroalgal cover = 52%.

CONCLUSION

The extensive presence of macroalgae in Hutt River is reflected in a "high" risk indicator rating for low density macroalgal cover, a "very high" risk rating for high density macroalgal cover, and a "high" risk indicator rating the increase in high density macroalgal cover since the 2010 baseline (24% increase). Regular flushing of the estuary appears to currently restricti the presence of nuisance conditions (rotting macroalgae and poorly oxygenated and sulphide rich sediments) to localised areas on intertidal flats, and in subtidal areas near the Hutt River mouth.

RECOMMENDED MONITORING AND MANAGEMENT

The elevated risk indicator ratings support annual monitoring of macroalgal growth, with the next monitoring in Hutt River Estuary therefore recommended for January/ February 2015. At that time it is envisaged that a more comprehensive methodology for evaluating opportunistic macroalgal will be available for use.

In addition, it is recommended that the likely cause of macroalgal growths should 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 previously, 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.

Intertidal margins upstream of the Waione Street bridge, Jan. 2014.

3. Results, Rating and Recommendations (Cont...)

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Flood scoured *Ulva intestinalis* on intertidal margins in the lower Hutt Estuary (left) and Waiwhetu Estuary (right), Jan. 2014.