coastalmanagement

New River Estuary

Macroalgal Monitoring 2008/09

Prepared for
Environment Southland
June 2009

Cover Photo: Extensive macroalgal growth in the northwestern arm of New River Estuary.

Gracilaria on intertidal flats by Bushy Point.

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By

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Small islands (2-6cm high) were being formed by sediment trapped within the *Gracilaria* (centre foreground).
No *Gracilaria* was present at this sediment plate site in 2007 or 2008.

All photos by Wriggle except where noted otherwise.

1. INTRODUCTION AND METHODS

INTRODUCTION

Developing an understanding of the condition and risks to estuarine habitats is critical to resource management in the Southland region. This brief report summarises the third year of macroalgal monitoring results for the New River Estuary, one of the key estuaries in the Environment Southland's long term estuary monitoring programme. The report describes the macroalgal cover of the estuary in February 2009, and applies the results to the macroalgae estuary condition rating (and recommended management responses) developed for Southland's estuaries. The next monitoring in the New River Estuary is due in February 2010.

METHODS

Broad scale mapping of the percentage cover of macroalgae throughout all the intertidal habitat of New River Estuary was undertaken in February 2009 using a combination of aerial photography, ground-truthing, and ArcMap 9.2 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. Robertson and Stevens 2007).

Environment Southland supplied rectified aerial photographs (~0.3 metre per pixel, scale 1:10,000) of the estuary, flown in February 2008. Experienced coastal scientists then recorded the percentage cover of macroalgae directly onto laminated photos during field assessment of macroalgal cover. The photographs also formed the GIS base layer onto which the percentage cover information was subsequently digitised.

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 2009 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). The report also rates macroalgal condition and provides recommended management actions based on the estuary condition rating (described below) and compares results to previous years (Table 2).

SOUTHLAND ESTUARIES: MACROALGAE CONDITION RATING

Certain types of macroalgae can grow to nuisance levels in nutrient-enriched estuaries causing sediment deterioration, oxygen depletion, bad odours and adverse impacts to biota.
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 x %macroalgal cover <1%)+(0.5 x %cover 1-5%)+(1 x %cover 5-10%)+(3 x %cover 10-20%)+(4.5 x %cover 20-50%)+(6 x %cover 50-80%)+(7.5 x %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. This index will continue to be refined as it is applied to estuary data from throughout NZ.

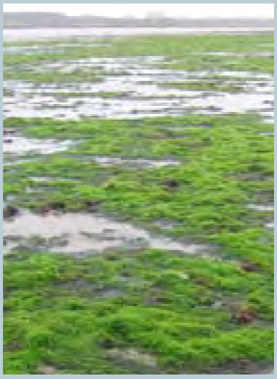
MACROALGAE CONDITION RATING

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

2. RESULTS, RATING AND MANAGEMENT

RESULTS

2009 MACROALGAL COVER CONDITION RATING
FAIR



The 2009 Macroalgae Coefficient for the estuary was 1.4, which equates to a condition rating of "fair". This rating was primarily driven by the portion of the estuary (12.5%, 337ha) with a high (>50%) macroalgae cover (Table 1), but also the significant increase in localised nuisance conditions of anoxic muds and sulphide odours associated with *Gracilaria* beds in the northwestern and western flats since 2007.

Figure 1 and Table 1 summarise the results of the 2009 macroalgal mapping and show that macroalgal cover was low across most of the well flushed lower estuary and central basin, as well as the northeastern flats. Pockets of high cover were present around the Oreti River mouth and in the relatively sheltered western flats, and along the margin of saltmarsh in the east on decaying *Spartina* roots. The most extensive growth was present on the northwestern flats and between Bushy Point and the Waihopai River channel. In these areas there were 130ha of *Gracilaria* dominated beds with an 80%-100% cover, and 81ha with 50%-80% cover.

The red alga *Gracilaria* was the dominant species in the estuary, followed by the green alga *Enteromorpha* (common along channel margins and on the root systems of sprayed *Spartina* beds), and *Ulva* (sea lettuce) growing on sandy flats.

Table 1. Summary of macroalgal cover results, February 2009.

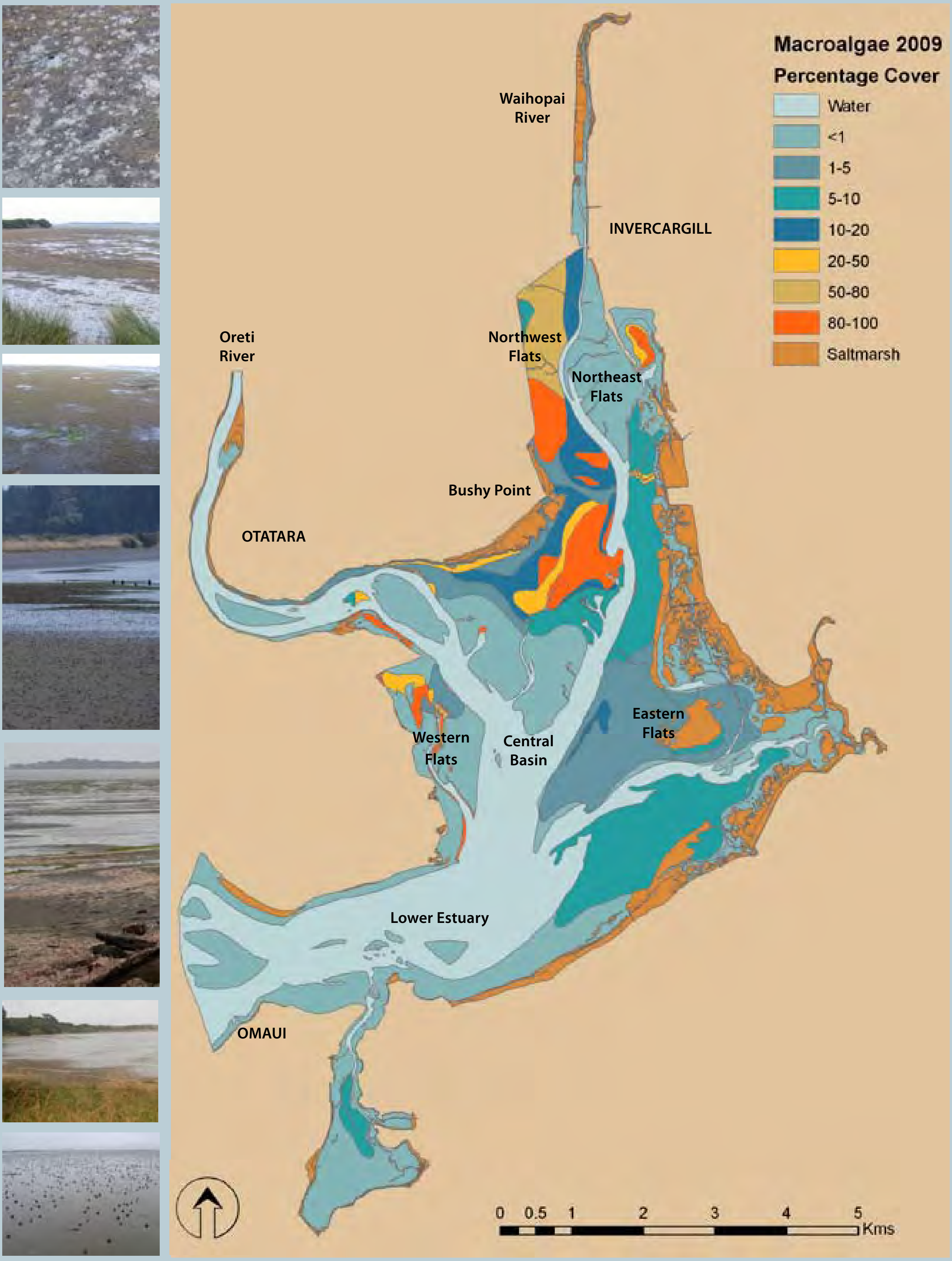
MACROALGAE	New River Estuary		
Percentage Cover	Ha	%	Dominant species
<1%	1,257	46.6	-
1-5%	406	15.0	*Gracilaria, Enteromorpha*
5-10%	475	17.6	*Gracilaria, Enteromorpha, Ulva*
10-20%	151	5.6	*Gracilaria, Enteromorpha, Ulva*
20-50%	73	2.7	*Gracilaria, Enteromorpha, Ulva*
50-80%	121	4.5	*Gracilaria, Enteromorpha*
>80%	216	8.0	*Gracilaria, Enteromorpha*
TOTAL	**2699**	**100.0**	

Table 2 summarises the Condition Rating and Macroalgal Coefficient (MC) results for the 2007-2009 period. Although the rating has remained constant across years (due to the extent of estuary with a >50% cover and the presence of nuisance conditions), there has been a dramatic increase in macroalgal cover in the northwestern flats of the estuary since 2007, and a steady increase in the MC.

Table 2. Summary of macroalgal cover results, 2007-2009.

Year	Rating	MC	Result
2007	FAIR	0.9	Low cover across most of estuary. Rating driven by patches of High cover near the Oreti River mouth and west of the Waihopai channel by Windy Point.
2008	FAIR	1.2	Low cover across most of the central and lower estuary. A large increase in cover and nuisance conditions on the west side of the northern arm from 2007.
2009	FAIR	1.4	A large increase in cover and nuisance conditions on the west side of the northern arm and Windy Point since 2008. Low cover across central and lower estuary.

FIGURE 1. MAP OF MACROALGAL COVER - NEW RIVER ESTUARY, FEBRUARY 2009



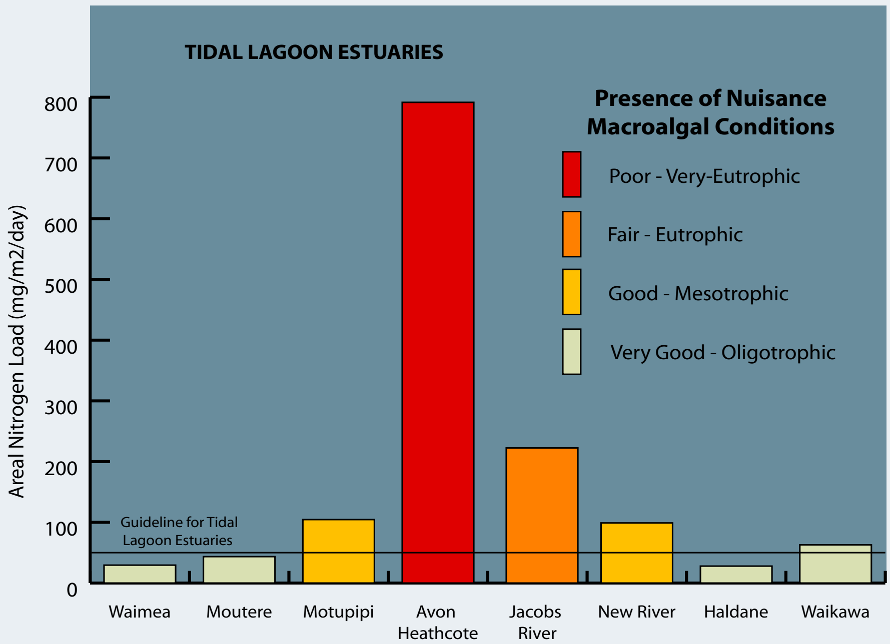
RESULTS

The increase in nuisance conditions in the northwestern flats of the estuary from 2007 to 2008, and a further increase in macroalgae and associated deterioration of sediment condition from 2008 to 2009, is a cause for concern.

The extensive *Gracilaria* beds that have established and expanded rapidly in the northwestern flats have significantly changed the habitat conditions present. This part of the estuary receives relatively high inputs of nutrients and sediment from the Waihopai River, and is a settling area for algae carried in with the tide and prevailing wind. The thick cover of *Gracilaria* currently appears to be trapping fine muds at a rapid rate, while also limiting their natural removal from the exposed flats by reducing the resuspension of sediment by wind generated waves. As a consequence, the sediments are becoming deeper and softer, sediment oxygenation is reducing, and there is likely to be a shift occurring where decaying macroalgae is creating anoxic conditions that are releasing nutrients previously bound in the sediments. These nutrients will predominantly be released in the form of ammonia which is much more readily available to fuel macroalgal growth, thereby creating a cycle of increasing habitat deterioration that, once established, will be difficult to reverse. As this area also contains the largest beds of high value seagrass (*Zostera*) in the estuary, there is a high likelihood that they will be adversely impacted by the changes occurring.

Figure 2 shows that the estimated nitrogen input to New River Estuary (as estuary areal load) is ~100 mg.m^2.day which is double the 50 mg.m^2.day upper limit suggested by Heggie (2006) for ensuring no eutrophication of temperate tidal lagoon estuaries. In addition, nitrogen concentrations in the estuary (0.8-1.5mg nitrogen/litre - ICC monitoring data) almost always exceed levels that limit sea lettuce growth (0.25 mg nitrogen/litre - Pederson and Borum 1997). Consequently, reducing nutrient inputs to the estuary is an obvious management need if macroalgal growth is to be limited.

Figure 2. Relationship between nitrogen inputs and nuisance macroalgal conditions in selected tidal lagoon estuaries.



2. Results, Rating and Management (Continued)

RESULTS	While Figure 2 shows that overall New River Estuary is in a mesotrophic state, parts of the estuary are eutrophic and quality is declining as localised macroalgal cover increases. In particular, the increase in decaying macroalgae is causing sediments to become anoxic, sulphide rich, and muddier in the northwestern and parts of the western flats. Management action is needed to address the changes in these locations.
CONCLUSION	2009 macroalgal cover had a condition rating of "fair" with nuisance conditions (rotting macroalgae and poorly oxygenated and sulphide rich sediments) concentrated in the northwestern flats, and in small sheltered areas in the western flats. Macroalgae is not causing problems in the well flushed central basin and lower estuary.
RECOMMENDED MONITORING AND MANAGEMENT	The increase in macroalgal cover from 2007, combined with the presence of nuisance conditions, means macroalgae should continue to be monitored annually. In addition, the following management is recommended: **Set Limits on Nutrient Inputs** • Because nutrient inputs to New River Estuary are high and strongly related to the eutrophication symptoms (Robertson and Stevens 2008), it is recommended that catchment nutrient inputs be reduced. A Total Daily Maximum Load to the New River Estuary of 2.0-2.5 tonnes N/day (as opposed to the current input of 3.6 tonnes/day) is suggested as a preliminary guide to maintain the mesotrophic state in the lower estuary and achieve less enriched conditions in the upper estuary areas near the Oreti and Waihopai River inputs. Further work is needed before a definitive limit can be set. **Identify and Manage Major Nutrient Sources** • The identification of nutrient sources to the estuary is seen as a priority given the very significant nature of both point and non-point discharges. Once identified, a plan should be developed to priortise and reduce the key inputs.

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