coastalmanagement

Jacobs River Estuary

Macroalgal Monitoring 2009/10

Prepared for
Environment Southland
April 2010

Cover Photo: Macroalgae beds in the central basin, Jacobs River Estuary.

Enteromorpha growth on the edge of the Aparima River channel.

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By

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Contents

List of Figures

List of Tables

Gracilaria and *Enteromorpha* growing on the southern flats.

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*, *Enteromorpha*, 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 report summarises the fourth year of macroalgal monitoring in the Jacobs River Estuary, one of the key estuaries in the Environment Southland's long term estuary monitoring programme. The report describes the intertidal macroalgal cover of the estuary in February 2010, and uses a macroalgal coefficient (described below) developed for Southland's estuaries to rate the condition of the estuary, and recommend monitoring and management actions. The next scheduled monitoring in Jacobs River Estuary is in February 2011.

METHODS

Broad scale mapping of the percentage cover of macroalgae throughout all the intertidal habitat of Jacobs River Estuary was undertaken in February 2010. Using a combination of aerial photography and ground-truthing, ArcMap 9.3 GIS-based digital maps were produced. 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 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. A summary table of the dominant species and classes of percentage cover is also produced, and management recommended.

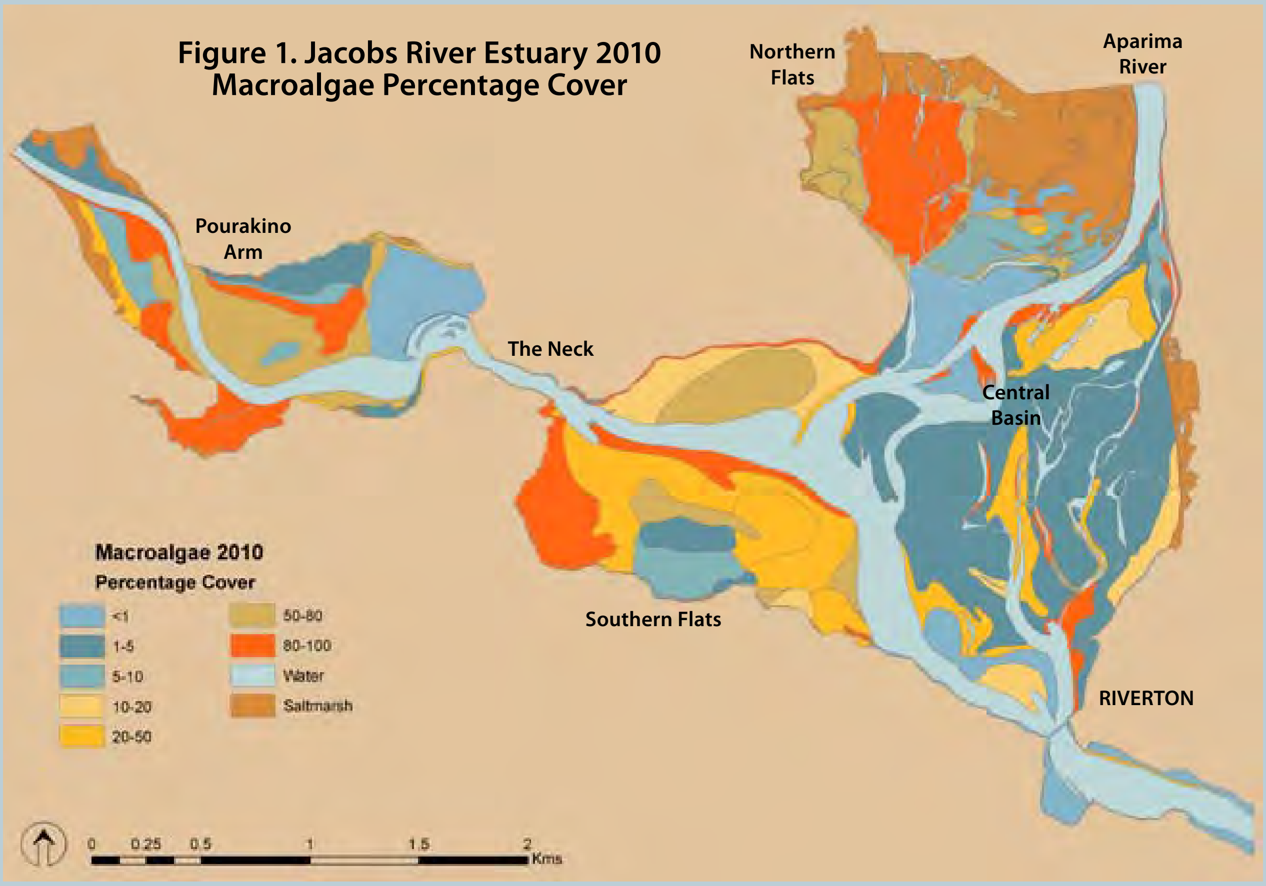
SOUTHLAND ESTUARIES: MACROALGAE CONDITION RATING

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 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.

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

2010 MACROALGAL COVER CONDITION RATING

FAIR

Figure 1 and Table 1 summarise the results of the 2010 macroalgal mapping of Jacobs River Estuary. Relative to the rest of the estuary, the well flushed Central Basin had the lowest cover of macroalgae, while the highest densities were found in the more sheltered embayments (where the red alga *Gracilaria* was dominant), and along channel margins (where the green alga *Enteromorpha* was dominant). *Ulva* (sea lettuce) was present throughout the lower estuary, but at low densities.

Table 1. Summary of macroalgal cover results, February 2010.

MACROALGAE	Jacobs River Estuary		
Percentage Cover	Ha	%	Dominant species
<1%	58.4	11.7	-
1-5%	131.9	26.5	*Enteromorpha, Gracilaria, Ulva*
5-10%	32.3	6.5	*Gracilaria, Enteromorpha*
10-20%	33.4	6.7	*Enteromorpha, Gracilaria*
20-50%	77.3	15.5	*Gracilaria, Enteromorpha, Ulva*
50-80%	74.3	14.9	*Gracilaria, Enteromorpha, Ulva*
>80%	91.0	18.3	*Gracilaria, Enteromorpha*
TOTAL	**499**	**100**	

2. Results, Rating and Management (Continued)

RESULTS

As in 2007, 2008, and 2009, the areas of highest percentage cover (>50% cover) in 2010 were on the soft muds of the Pourakino Arm, and on the Southern and Northern Flats of the estuary (Figure 1). These areas support extensive growths of *Gracilaria* and act as settling areas for algae carried in from around the estuary by the tide and prevailing wind. They also receive drainage from agricultural lands bordering their margin, along with sediment and nutrients from wider afield, including marine sources.

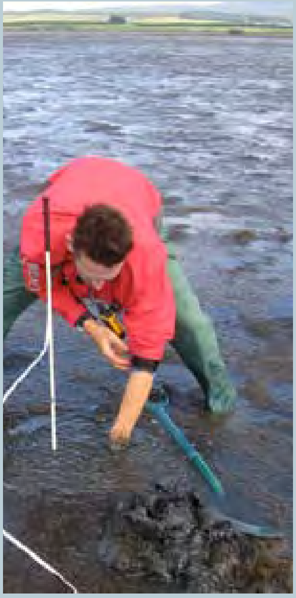
The extensive and often smothering cover of growing and decaying macroalgae in these areas (see top sidebar photo) was reducing sediment dissolved oxygen and causing sulphide rich sediments and nuisance odours. Macroalgae was also trapping fine muds, and limiting the natural removal of it, by reducing the re-suspension of sediment by wind generated waves. As a consequence, sediments are expected to become deeper, softer, and muddier over time, while oxygen levels will further reduce. This will see ongoing displacement of the existing biological communities and a continuing decline in the health of the estuary. To address the potential for ongoing sedimentation within the estuary, and to measure its magnitude, 12 sediment plates were deployed at three sites in 2010 (see Appendix 1 for site locations).

Table 2, which summarises the Condition Rating and Macroalgal Coefficient (MC) results for the 2007-2010 period, shows a continuing increase in macroalgal growth since 2007. The most recent increase is due largely to macroalgae growing and accumulating along the northern shoreline of the estuary either side of The Neck (see photo below). Much of this algae is likely to have come from estuary channels where macroalgae grows rapidly wherever substrate allows, and where it regularly breaks off and gets deposited by wind, wave and currents around the estuary margins.

The increase in growth, and the presence of nuisance conditions of anoxic muds and sulphide odours is evidence that the nutrient supply to the estuary is currently too high and that large areas of Jacobs River Estuary are eutrophic and support excessive macroalgal growth.

Table 2. Summary of condition rating and results, 2007-2010.

Year	Rating	MC	Result
2007	FAIR	1.2	Low-Moderate cover across most of estuary. Isolated patches of high cover in sheltered arms and by Aparima River.
2008	FAIR	3.3	Relatively extensive areas of high cover in sheltered arms, by Aparima River, and in lower Central Basin.
2009	FAIR	3.3	Relatively extensive areas of high cover in sheltered arms and by Aparima River. Predominantly low cover in Central Basin.
2010	FAIR	3.4	Increase in extensive areas of high cover in sheltered arms and by Aparima River. Predominantly low cover in Central Basin.



100% cover of *Gracilaria* growing in anoxic muds in the Pourakino Arm.

Enteromorpha growing by the Pourakino River channel.

Extensive accumulations of windblown algae along the northern shore by The Neck.

2. Results, Rating and Management (Continued)

Recent monitoring has shown a sharp increase in nuisance conditions since 2007, while the estimated estuary areal nitrogen load (200-250 mg.m^2.day) is well above the 50 mg.m^2.day upper limit suggested by Heggie (2006) for ensuring no eutrophication of temperate tidal lagoon estuaries. Consequently, Jacobs River Estuary falls well within the range where nuisance macroalgal conditions are expected in tidal lagoon estuaries. This, combined with the current monitoring results, highlight a clear need for targeted management actions to reduce nutrient inputs.

CONCLUSION

2010 macroalgal cover had a condition rating of "fair". Nuisance conditions of rotting macroalgae and poorly oxygenated and sulphide rich sediments were present in many parts of the estuary, particularly sheltered areas receiving limited flushing.

RECOMMENDED MONITORING AND MANAGEMENT

The large increase in macroalgal cover from 2007 (see Stevens and Robertson 2007, 2008, 2009), combined with the ongoing 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 Jacobs 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 Jacobs River Estuary of about 0.7 tonnes N/day (as opposed to the current input of 1.6 tonnes/day) is suggested as a preliminary guideline to achieve a more moderately enriched estuary.

Identify and Implement Catchment BMPs

- Catchment runoff is one of the major stressors in estuaries. Likely ecological responses are lowered biodiversity, aesthetic and recreational values. To prevent avoidable inputs, best management practices (BMPs) should be identified and implemented to reduce nutrient, sediment, and pathogen runoff from catchment "hotspots".

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APPENDIX 1. SEDIMENT PLATE LOCATIONS

Site	Plate	NZGD2000 NZTM East	NZGD2000 NZTM North	NZMG 260 East	NZMG 260 North	2010 height/ depth (mm)*
JRE A	Peg 1	1216362	4855928	2126170	5417975	150
	Peg 2	1216360	4855924	2126169	5417970	150
	Peg 3	1216359	4855919	2126167	5417966	150
	Plate 1	1216361	4855927	2126170	5417973	175
	Plate 2	1216361	4855925	2126169	5417971	216
	Plate 3	1216360	4855923	2126168	5417969	190
	Plate 4	1216359	4855920	2126168	5417966	215
JRE B	Peg 1	1214906	4855311	2124715	5417361	190
	Peg 2	1214910	4855308	2124719	5417358	190
	Peg 3	1214914	4855304	2124723	5417355	190
	Plate 1	1214908	4855309	2124717	5417360	210
	Plate 2	1214909	4855308	2124718	5417359	198
	Plate 3	1214912	4855306	2124721	5417357	202
	Plate 4	1214913	4855305	2124722	5417356	215
JRE C	Peg 1	1212947	4856458	2122761	5418511	~150
	Peg 2	1212942	4856458	2122757	5418512	~150
	Peg 3	1212936	4856458	2122751	5418512	~150
	Plate 1	1212945	4856458	2122759	5418511	215
	Plate 2	1212943	4856458	2122757	5418511	198
	Plate 3	1212941	4856458	2122756	5418512	207
	Plate 4	1212939	4856458	2122754	5418512	229

*Note: Sediment currently settling over plates installed in February 2010. Baseline to be measured from February 2011.