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Fortrose (Toetoes) Estuary

Macroalgal Monitoring 2011/12

Prepared for
Environment Southland
July 2012

Cover Photo: *Ulva* growing in an intertidal flow channel on the Eastern Flats of Fortrose (Toetoes) Estuary, Jan 2012.

Fortrose (Toetoes) Estuary entrance showing sandy sediments with no macroalgal growth.

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By

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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. When high macroalgal cover coincides with soft muddy sediments, conditions for animal life in the sediments are generally very poor due to toxic sulphides, elevated nutrients, and depleted oxygen.

This brief report summarises the fourth year of macroalgal monitoring in Fortrose Estuary, one of the key estuaries in the Environment Southland's long term estuary monitoring programme. The report describes intertidal macroalgal cover - a broad scale indicator of estuary eutrophication - using a macroalgal coefficient (described below) developed for Southland's estuaries to rate the condition of the estuary, and recommends monitoring and management actions. These actions need to be considered in conjunction with the fine scale monitoring results - see Robertson and Stevens (2009).

METHODS

Broad scale mapping of the percentage cover of macroalgae throughout all the intertidal habitat of Fortrose Estuary was undertaken in January 2012 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 2007, 08, 09, 10, 11).

Rectified aerial photographs (~0.3 metre per pixel, scale 1:10,000) of the estuary, flown in February 2008 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.

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, 5 yearly if not). The current report presents the 2012 percentage cover of macroalgae within the estuary, and a summary of the dominant species and percentage cover classes (Table 1).

SOUTHLAND ESTUARIES: MACROALGAE CONDITION RATING

The primary fine scale indicators of eutrophication are grain size, RPD boundary, sediment organic matter, nitrogen and phosphorus concentrations, and the community structure of certain sediment-dwelling animals. The broad scale indicators are the percentages of the estuary covered by macroalgae and soft muds. For short residence time estuaries like Fortrose, highly eutrophic conditions only occur when sediments from large ares of the estuary exhibit all of the following symptoms; high macroalgal growth (>50% cover), are soft and muddy, have a shallow RPD, elevated nutrient and TOC concentrations, and very high invertebrate organic enrichment tolerance ratings.

A two part macroalgae condition rating has been developed: 1. for the whole estuary, and 2. for hotspots within the estuary. Whole estuary macroalgal condition is rated using a continuous index (the macroalgae coefficient - MC) based on the percentage cover of macroalgae in defined categories throughout the estuary. The equation used is: ***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.*** The hotspot rating targets areas of heavy growth and is applied where EITHER the percentage cover of intertidal macroalgal exceeds 50%, OR if nuisance conditions are judged as being significantly adverse. The highest rating calculated is applied to determine recommended responses.

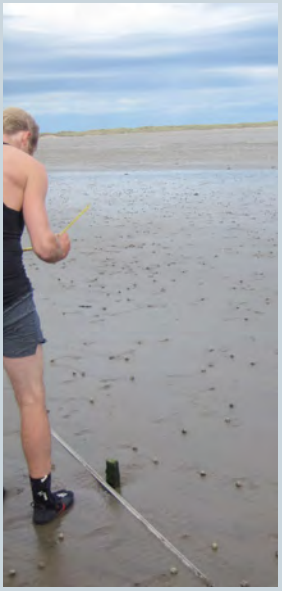
MACROALGAE CONDITION RATING

ESTUARY RATING	DEFINITION	MC	RECOMMENDED RESPONSE
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
HOTSPOT RATING	**>50% COVER OVER:**	**NUISANCE CONDITIONS**	**RECOMMENDED RESPONSE**
Good	<5% of estuary	Low	Monitor at 5 year intervals after baseline established
Fair	5-10% of estuary	Moderate	Monitor yearly. Initiate Evaluation & Response Plan
Poor	10-30% of estuary	High	Monitor yearly. Initiate Evaluation & Response Plan
Very Poor	>30% of estuary	Very High	Monitor yearly. Initiate Evaluation & Response Plan

2. RESULTS, RATING AND MANAGEMENT

RESULTS

Ulva on the eastern flats of Fortrose Estuary.



<1% cover on the northern flats of Fortrose Estuary.

2012 MACROALGAL COVER CONDITION RATING

GOOD

Figure 1 and Table 1 summarise the results of the 2012 macroalgal mapping of Fortrose Estuary. Across the vast majority of the estuary (206Ha, 96%), macroalgal cover was below 50%, with the highest densities of macroalgae growing predominantly in the well flushed lower intertidal reaches of the Central Basin and Eastern Flats. Nuisance conditions of anoxic muds and sulphide odours were uncommon and largely restricted to localised areas in the estuary where wind and current-deposited macroalgae accumulates (predominantly along the eastern shoreline). Broad scale mapping (Robertson et al. 2003) reported only 3% of the estuary was dominated by soft mud, with no significant macroalgal growth observed in these areas in 2012. Consequently, there were no areas exhibiting gross nuisance conditions.

In 2011, a reduction in the cover of the dominant green alga *Ulva (Enteromorpha) intestinalis* was noted compared to 2009 and 2010 surveys. In 2012, the cover had generally returned to levels similar to those seen in 2009 and 2010, but it remained sparse on the northern flats. The most extensive macroalgal growths remained located in subtidal areas and tidal channels wherever substrate allowed macroalgae to gain a foothold. *Ulva* in particular was most common intertidally along the edge of the river channel margins.

Table 1. Summary of macroalgal percentage cover results, 31 January 2012.

MACROALGAE	Fortrose (Toetoes) Estuary		
Percentage Cover	Ha	%	Dominant species
<1%	53.8	25.1	-
1-5%	127.2	59.4	*Ulva intestinalis, Gracilaria*
5-10%	16.9	7.9	*Ulva intestinalis, Gracilaria*
10-20%	5.9	2.8	*Ulva intestinalis, Gracilaria*
20-50%	2.1	1.0	*Ulva intestinalis, Gracilaria*
50-80%	6.5	3.0	*Gracilaria, Ulva intestinalis*
>80%	1.9	0.9	*Ulva intestinalis, Gracilaria*
TOTAL	**214**	**100**	

* Note, *Ulva intestinalis* is synonymous with *Enteromorpha intestinalis* (reported as *Enteromorpha* in Stevens & Robertson 2009, 10) .

Table 2. Summary of macroalgal condition rating and results, 2009-2012.

Year	MC Rating	Hotspot Rating	Result
2009	1.8	FAIR	Widespread growth in central basin and eastern side of estuary. Little growth in the west and across lower estuary, but localised concentrations of windblown algae.
2010	1.2	FAIR	Most macroalgal growth and localised concentrations of windblown algae located on the Eastern Flats. Little growth across the north, west or lower estuary flats.
2011	0.9	FAIR	Most extensive as windblown deposits on the Eastern Flats. Little growth across the north, west or lower estuary flats. Reduced cover in central basin.
2012	0.8	GOOD	Little growth across the north, west or lower estuary flats. Low cover in central basin. Most extensive growths near river channel margins.

Table 2 summarises the Condition Rating and Macroalgal Coefficient (MC) results for the 2009-2012 period. The Condition Rating was revised in 2011 following a review of the extensive data set compiled for Southland since 2007. Macroalgal cover has continued to decrease in the Central Basin and in the lower intertidal sections of the Northern and Eastern Flats and has seen the MC reduce due to less of the estuary having >80% cover, as well as an increase in areas with <5% cover. The condition rating in 2012 was "GOOD" due to a reduction in "hotspot" accumulations on the eastern shoreline that appeared to have been flushed from the estuary.

2. Results, Rating and Management (Continued)

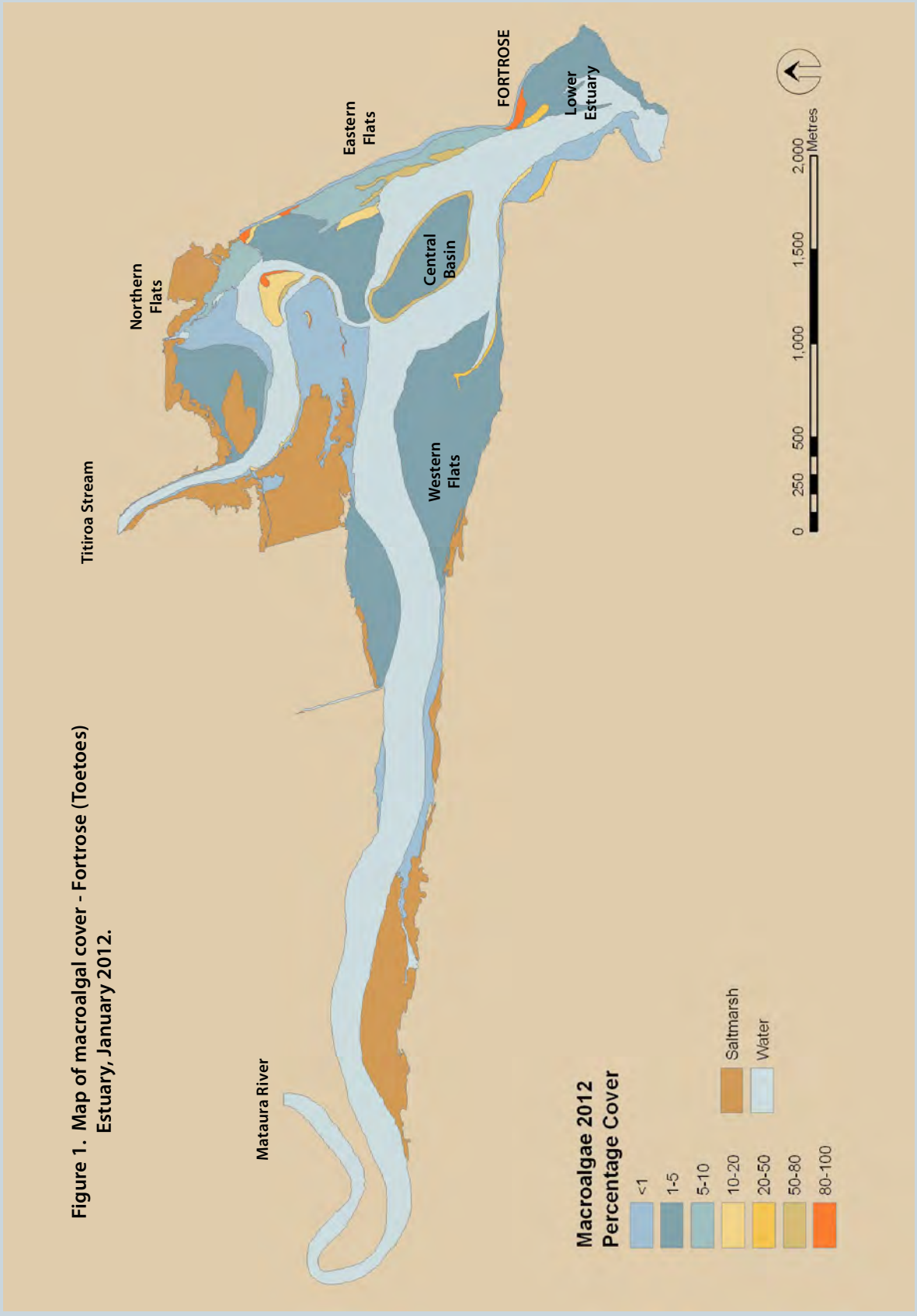


Figure 1. Map of macroalgal cover - Fortrose (Toetoes) Estuary, January 2012.

2. Results, Rating and Management (Continued)

RESULTS	The continued decrease in the unusually high macroalgal growth observed in Fortrose Estuary during summer 2008/09, and the general absence of nuisance conditions in 2011 and 2012 is a positive sign. However, extensive growths of macroalgae in subtidal areas, which contribute to localised impacts where shoreline accumulations occur, require monitoring and management action. This extensive subtidal growth present in the estuary is driven by the high nutrient loads entering the estuary (estimated N load 2,450 tonnes N $year^{-1}$ based on NIWA's CLUES model). Because the estuary is relatively small in comparison to the very large freshwater inflow (mean flow 76$m^3.s^{-1}$), most of the N inflow is rapidly flushed out to sea. However, the high N inputs support excessive growths of nuisance macroalgae in areas close to the main channel (i.e. areas exposed to elevated nutrient concentrations and low salinity conditions). The nuisance macroalgae is usually *Ulva (Enteromorpha),* which is very tolerant of low salinity, and these growths can break away and be transported to other areas of the estuary through wind and current action. At present, extensive growths of macroalgae in subtidal areas of Fortrose Estuary reflect the estuary's response to high nutrient inputs. Consequently, setting limits on nutrient inputs, and the identification and management of nutrient sources is considered a priority. However, because the estuary is currently in a low to moderate state of enrichment, the estuary doesn't have the same high urgency as New River or Jacobs River estuaries.
CONCLUSION	2012 macroalgal cover had a condition rating of "GOOD", with the highest densities of macroalgae in subtidal channels, and in the central basin and eastern side of the estuary. Nuisance conditions of anoxic muds and sulphide odours were uncommon away from localised areas associated with high cover or windblown accumulations of macroalgae.
RECOMMENDED MONITORING AND MANAGEMENT	Although the condition rating does not trigger annual monitoring, based on the high nutrient inputs to the estuary, a repeat assessment is recommended in Jan/Feb 2013 to allow for any deterioration of sediment quality to be assessed. In addition, the following management is recommended: **Set Limits on Nutrient Inputs** • Nutrient inputs to Fortrose Estuary are high, are strongly related to eutrophication symptoms (Robertson and Stevens 2008), and macroalgal growth rapidly accelerated and was widespread throughout the central basin and eastern side of the estuary in 2009. Nutrient inputs need to be reduced below current levels to achieve a more moderately enriched estuary and to protect it from further degradation. **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.

Luscious growths of *Ulva* and *Gracilaria* growing in shallow subtidal channel margins.

3. REFERENCES

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