

Salt Ecology Short Report 008. Prepared by Barrie Forrest for Otago Regional Council, March 2022

**OVERVIEW**

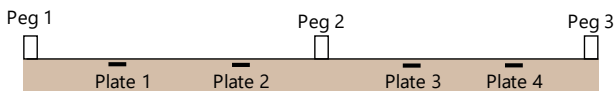
Since Dec-2016, Otago Regional Council has undertaken annual State of the Environment monitoring in Shag Estuary to assess trends in the deposition rate, mud content, and oxygenation of intertidal sediments. Sediment monitoring is undertaken at two sites (Fig. 1), with the latest survey carried out on 24 November 2021.



Fig. 1. Location of Shag Estuary monitoring sites.

**METHODS**

Estuary sedimentation is measured using the ‘sediment plate’ method (e.g. Forrest et al. 2021). The approach involves measuring sediment depth from the sediment surface to the top of each of four buried concrete pavers. Measurements are averaged across each plate (n=3) and used to calculate a mean annual sedimentation rate for each site.



A composite sample of the surface 20mm of sediment is collected adjacent to the plates and analysed for particle grain size (wet sieve, RJ Hill laboratories). This

approach allows changes in sediment muddiness to be determined even where there are no changes in sediment depth. Sediment oxygenation is an ancillary biological health variable that is visually assessed in the field by measuring the depth at which sediments show a change in colour to grey/black, commonly referred to as the apparent Redox Potential Discontinuity (aRPD). Results for all indicators are compared to condition ratings of ecological state shown in Table 1.

**RESULTS**

Table 2 shows a summary of results for the latest survey and their respective condition ratings corresponding to the colours in Table 1.

Table 2. Indicator values and condition ratings from the Nov-2021 survey.

Indicator	A	B
Sedimentation (mm/yr)*	0.72	-0.59
Mud content (%)	27.6	25.7
aRPD (mm)	30	30

\*Sedimentation is the mean annual sedimentation rate since the baseline (n=5 yrs).

**Sedimentation rate**

The cumulative change in sediment depth over plates at each site is shown in Fig. 2. The mean sedimentation rate over the past 5 years has been low, corresponding to condition ratings of ‘good’ and ‘very good’ at Sites A and B, respectively (Table 1). Sedimentation has been highly variable across surveys. At Site A, a significant deposition event in Jan-2021 was followed by subsequent erosion in the period preceding the latest survey. The temporal variance in erosion and accretion at both sites likely reflects the river-dominated hydrological setting, periodic restriction of the estuary entrance, and

Table 1. Summary of condition ratings for sediment plate monitoring.

Indicator	Unit	Very Good	Good	Fair	Poor
Sedimentation rate <sup>1</sup>	mm/yr	< 0.5	≥0.5 to < 1	≥1 to < 2	≥ 2
Mud content <sup>2</sup>	%	< 5	5 to < 10	10 to < 25	≥ 25
aRPD <sup>3</sup>	mm	≥ 50	20 to < 50	10 to < 20	< 10

Condition ratings derived or modified from: <sup>1</sup>Townsend and Lohrer (2015), <sup>2</sup>Robertson et al. (2016), <sup>3</sup>FGDC (2012).

catchment disturbance from land use activities (e.g. 71% pasture and 11% forestry; Stevens & Robertson 2017).

### Sediment mud content and oxygenation

Sediment mud content was rated as 'poor' at both sites in Nov-2021 as it exceeded the biologically relevant threshold of 25%. At Site A, mud content has nonetheless declined since the Jan-2021 deposition event referred to above (Fig. 3).

The average aRPD depth was 30mm at both sites in Nov-2021 reflecting well-oxygenated conditions (a rating of 'good'). This level of oxygenation is partially maintained by the presence of crabs, shellfish (e.g. cockles) and other organisms, which turn over surface sediments and create voids that allow air and water to transfer oxygen to underlying layers.



Muddy surface sediments at Site A in Nov-2021

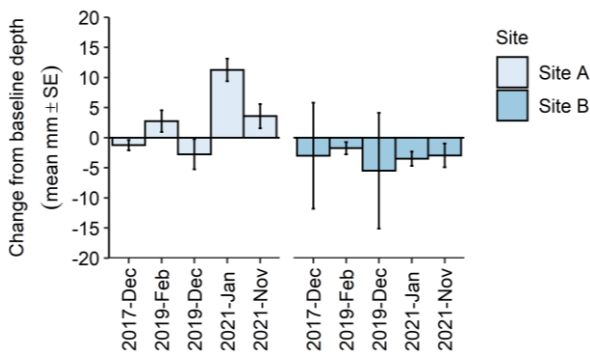


Fig. 2. Change in mean sediment depth over buried plates ( $\pm$ SE) relative to the baseline.

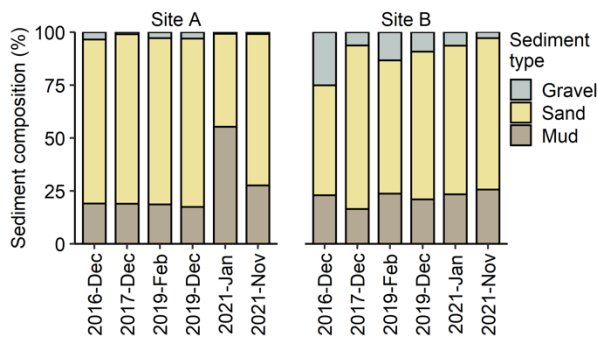


Fig. 3. Sediment particle grain size at each site. The baseline result for each site (Dec-2016) is also shown.

### CONCLUSIONS

The sedimentation rate over the past 5 years has been highly variable, but less than the 2mm/yr national guideline value. The Nov-2021 results nonetheless show that the estuary flats remain under pressure from muddy sediments and reinforce previous recommendations (e.g. Robertson et al. 2017) to monitor and manage catchment sediment sources.

### RECOMMENDED MONITORING

Continue annual monitoring of sedimentation rate, sediment grain size and aRPD depth, and report results annually via a summary report. Comprehensive reporting should be undertaken 5-yearly as part of 'fine scale' ecological and sediment monitoring (next due in the summer of 2023/24).

### REFERENCES

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