

Salt Ecology Short Report 022. Prepared by Barrie Forrest for Otago Regional Council, March 2023

OVERVIEW

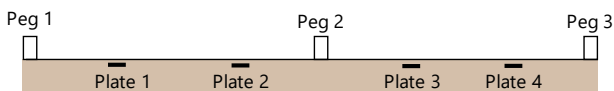
Since December 2016, Otago Regional Council has undertaken annual State of the Environment monitoring in Shag Estuary to assess trends in the deposition rate, mud content, and oxygenation of intertidal sediments. Sediment monitoring is undertaken at two sites (Fig. 1), with the latest survey carried out on 26 November 2022.



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),

enabling assessment of sediment muddiness. Sediment oxygenation 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 and the respective condition ratings. Annual results for all surveys are provided in Table 3.

Table 2. Indicator summary and condition ratings from the November 2022 survey.

Indicator	A	B
Sedimentation (mm/yr)*	2.9	0.8
Mud content (%)	29.3	28.9
aRPD (mm)	45	50

* Long-term sedimentation is calculated as a 5-yr mean value. Five years of data are required for a meaningful trend.

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 at Site A has exceeded the national guideline value of 2mm/yr, corresponding to a condition rating of ‘poor’. Long-term sedimentation has been relatively low at Site B. However, at both sites sediment accrual was observed between November 2021 and November 2022, with the annual sedimentation rate at both sites exceeding 2mm/yr (rated ‘poor’, Table 3). The temporal variance in erosion and accretion at the monitoring sites, illustrated by Fig. 2, likely reflects the river-dominated hydrological setting, periodic restriction of the estuary

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

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

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

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

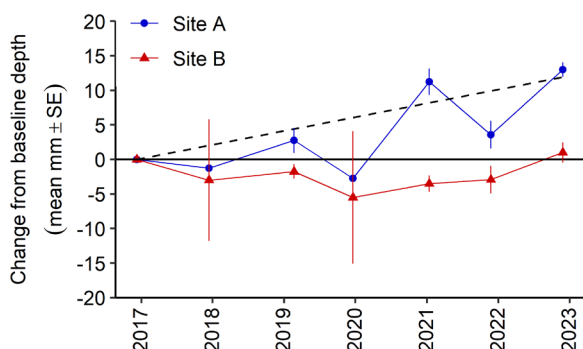


Fig. 2. Temporal change in mean sediment depth over buried plates (\pm SE) relative to the Dec-2016 baseline. The diagonal black dashed line represents accretion since the baseline at the national guideline value of 2mm/yr.

Sediment mud content and oxygenation

Sediment mud content at both sites was slightly higher than in the previous survey, and was rated as 'poor', as it exceeded the biologically relevant threshold of 25% (Table 3).

Table 3. Annual sedimentation, grain size and aRPD results up to Nov-2022.

Site	Survey	Sed rate mm/yr	Gravel %	Sand %	Mud %	aRPD mm
A	Dec-2016	na	3.5	77.4	19.1	30
	Dec-2017	-1.2	1.0	80.0	19.0	-
	Feb-2019	3.4	2.8	78.6	18.6	38
	Dec-2019	-6.7	3.0	79.5	17.5	45
	Jan-2021	13.1	0.7	44.0	55.3	45
	Nov-2021	-8.9	0.9	71.5	27.6	30
	Nov-2022	9.4	0.9	69.8	29.3	45
B	Dec-2016	na	25.1	51.9	23.0	30
	Dec-2017	-3.0	6.3	77.2	16.5	-
	Feb-2019	1.0	13.3	63.0	23.7	35
	Dec-2019	-4.5	9.2	69.8	21.0	35
	Jan-2021	1.9	6.4	70.2	23.4	45
	Nov-2021	0.7	2.9	71.5	25.7	30
	Nov-2022	3.9	7.0	64.1	28.9	50

The average aRPD depth in November 2022 was ~45mm at Site A and 50mm at Site B, reflecting well-oxygenated conditions. 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 November 2022

CONCLUSIONS

The sedimentation rate over the past 6 years has been highly variable, but the average has exceeded the 2mm/yr national guideline value at Site A. The November 2022 results show that fine sediment deposition has occurred in the past year and that the estuary flats remain under pressure from muddy sediments. These findings 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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