

Salt Ecology Short Report 010. Prepared by Barrie Forrest for Otago Regional Council, March 2022

OVERVIEW

Since Dec-2017, Otago Regional Council has undertaken annual State of the Environment monitoring in Kaikorai Estuary to assess trends in the deposition rate, mud content, and oxygenation of intertidal sediments. Sediment monitoring is undertaken at three sites (Fig. 1), with the latest survey carried out on 29 November 2021.



Fig. 1. Location of Kaikorai Estuary monitoring sites. In Feb-2019, Site D replaced nearby Site C, which was subject to river erosion.

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.

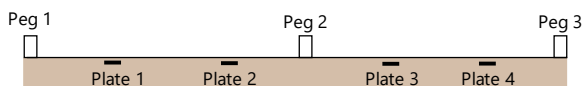


Table 1. Summary of condition ratings for sediment plate monitoring

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).

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	D
Sedimentation (mm/yr)*	6.40	2.42	0.87
Mud content (%)	10.3	86.8	26.2
aRPD (mm)	10	5	15

* Mean annual sedimentation rate relative to the baseline (n=2-4 yrs). Five years of data are required to assess a meaningful trend.

Sedimentation rate

The cumulative change in sediment depth over plates at each site is shown in Fig. 2. These cumulative rates correspond to the mean annual sedimentation at Sites A and B being classified as ‘poor’ due to exceedance of the 2mm/yr guideline value (Table 1). However, the apparent high sedimentation at Site A probably reflects bedload sand movement rather than deposition of fresh sediment from catchment inputs,

due to the dynamic environment at that site. In general, it is evident that sedimentation has been highly variable over time at all sites, with periods of both accretion and erosion recorded.

Sediment mud content and oxygenation

Mud content was rated as 'fair' in the sand-dominated sediment at Site A, and 'poor' at Sites B and D where it exceeded the biologically relevant threshold of 25%. Site B consists of very soft mud - the mud fraction was ~83% in Nov-2021 and within the range recorded over the last 3 years (Fig. 3).

The average aRPD depth was shallowest in the soft mud at Site B (rated 'poor'), and slightly deeper (rated 'fair') at the other sites. These results reflect poorly-oxygenated conditions, which at Sites B and D are likely related to the elevated mud content in the sediment acting as a barrier to oxygenation. Growths of the opportunistic green macroalgae *Ulva* spp. were extensive at Site D in Nov-2021, which is potentially related to elevated nutrient inputs.

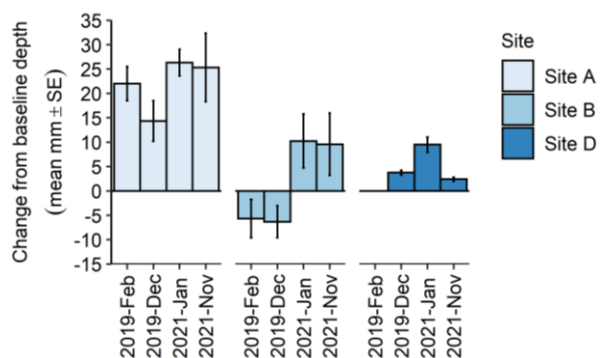


Fig. 2. Change in mean sediment depth over buried plates (±SE) relative to the baseline.

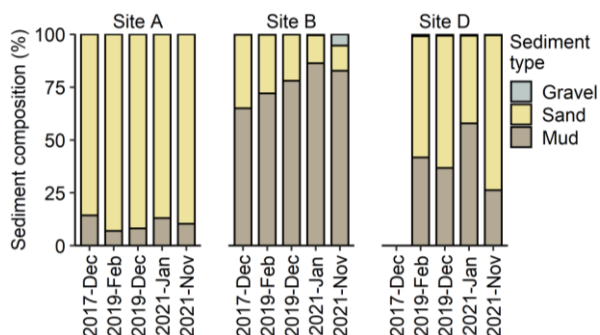


Fig. 3. Sediment particle grain size at each site. The baseline result for each site is also shown.

CONCLUSIONS

The sedimentation rate over the past 5 years has been highly variable, and exceeded the 2mm/yr national guideline value at Sites A and B, although the former is less ecologically significant as it appears related to bedload sand movement. The Nov-2021 results overall show that the estuary flats remain under pressure from fine sediment and organic/nutrient enrichment impacts, and reinforce previous recommendations (e.g. Forrest et al. 2020) to manage catchment inputs to the estuary.



Extensive cover of *Ulva* spp. at Site D in Nov-2021

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 2024/25).

REFERENCES

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