

Salt Ecology Short Report 041. Prepared by Hayden Rabel for Otago Regional Council, May 2024

OVERVIEW

Since December 2016, Otago Regional Council has undertaken annual State of the Environment monitoring in Catlins River (Pounawea) 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 5 December 2023.

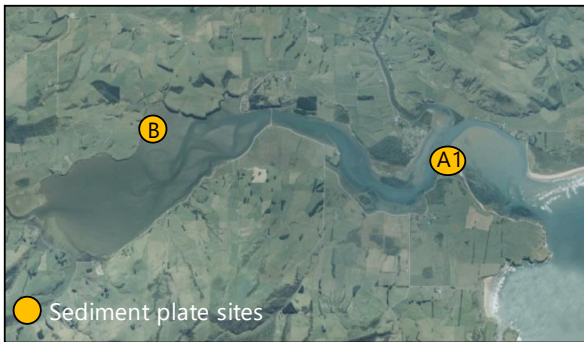
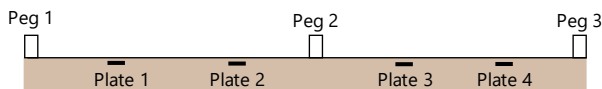


Fig. 1. Location of Catlins River Estuary monitoring sites. Site A was washed away in 2020 and replaced by Site A1 in the same general location.

METHODS

Sedimentation is measured using the ‘sediment plate’ method (e.g., O’Connell-Milne et al. 2023). 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 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.

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 adapted from: ¹Townsend and Lohrer (2015), ²Robertson et al. (2016), ³FGDC (2012) – references in O’Connell-Milne et al. (2023).

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 for the latest survey and their respective condition ratings. Annual results for all surveys are provided in Table 3, and cumulative changes in sediment depth over plates are shown in Fig 2.

Table 2. Indicator summary and condition ratings from the December 2023 survey.

Indicator	A1	B
Sedimentation (mm/yr)*	+8.4	+6.2
Mud content (%)	3.5	28.1
aRPD (mm)	25	25

* Sedimentation is presented as the long-term mean annual rate over the monitored period (n=4 yrs Site A1, n=7 yrs Site B). Five years of data are recommended for a meaningful trend.

Sedimentation rate

The December 2023 survey showed another year of sedimentation rates in exceedance of the 2mm/yr national guideline (Tables 1-3, Fig 2). While accrual has been observed at Site A1, there is high variability across plates owing to the sites proximity to the main channel, the deposition of mobile sands and infauna sediment redistribution (Table 3). Sedimentation at Site B, however, likely reflects fine sediment inputs from the pasture dominated catchment (approx. 64% pastoral land uses; Stevens & Robertson. 2017).

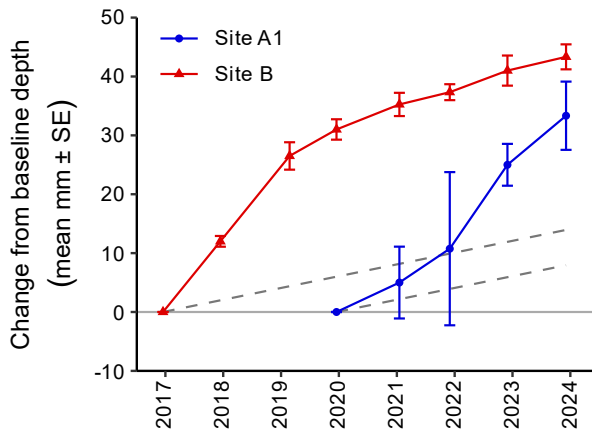


Fig. 2. Change in mean sediment depth over buried plates (\pm SE) relative to baseline depths. The dashed grey line shows sediment accrual at the national guideline upper limit of 2mm/yr.

Sediment mud content and oxygenation

As discussed, the locations of each monitoring site influence their sediment composition. Site A1 is located on mobile sand dominated intertidal flats and has had a mud-content around 3% over the monitoring period (rated 'very good'; Table 3). Site B, in the upper estuary, is within a deposition zone and consistently exceeds the biologically relevant threshold of 25% mud-content (rated 'poor').

Sediment oxygenation has been generally rated as 'good' (aRPD >20mm; Table 3) at both sites and does not appear to be impacted by sediment accrual. In general, elevated mud-content can restrict oxygen penetration into the sediment. However, at Site B high abundances of bioturbating macrofauna (see Morrisey and Forrest 2023) draw oxygen deeper into the sediment leading to good sediment oxygenation.

Table 3. Annual sedimentation, grain size and aRPD results up to December 2023.

Site	Survey	Sed rate mm/yr	Gravel %	Sand %	Mud %	aRPD mm
A1	Dec-2019	na	0.1	96.9	3.1	200
	Jan-2021	4.6	< 0.1	97.7	2.3	70
	Dec-2021	6.6	0.3	96.7	3.0	20
	Nov-2022	14.3	< 0.1	96.6	3.4	21
	Dec-2023	8.2	0.1	96.5	3.5	25
B	Dec-2016	na	0.1	75.2	24.7	20
	Dec-2017	12.1	0.1	69.6	30.4	-
	Feb-2019	12.1	0.1	57.1	42.9	10
	Dec-2019	5.5	0.1	59.0	41.0	35
	Jan-2021	3.9	< 0.1	67.6	32.4	25
	Dec-2021	2.4	< 0.1	65.4	34.6	30
	Nov-2022	3.7	< 0.1	70.6	29.4	20
	Dec-2023	2.3	0.1	71.9	28.1	25

< All values below lab detection limit



December 2023 site photos: Sand-dominated sediment at Site A1 near the main channel (top), and mud-dominated sediment with surface dwelling macrofauna at Site B (bottom).

CONCLUSIONS

At Site A1 sediments are sandy, mobile and both temporally and spatially variable, consistent with the location of the site on the well-flushed lower estuary flats near the main river channel. In contrast, Site B in the upper estuary remains at risk of degraded ecosystem health due to fine sediment impacts, likely derived from pastorally dominated upstream land uses. While Fig. 2 and Table 3 show sedimentation rates and mud-content have slowly decreased, these indicators are still above thresholds of concern (i.e., rated 'poor'). The results reinforce previous recommendations (e.g., Stevens & Robertson. 2017) to continue managing catchment inputs to the estuary.

RECOMMENDED MONITORING

Continue annual monitoring of sedimentation rate, sediment grain size and aRPD depth, and report results annually via a summary report. Consider site suitability and ongoing monitoring as part of a wider estuary programme review to be undertaken by ORC.

REFERENCES

- O'Connell-Milne S, Forrest BM, Rabel H. 2023. Fine Scale Intertidal Monitoring of Blueskin Bay, Waitati Inlet. Salt Ecology Report 110, prepared for Otago Regional Council, July 2023. 40p.
- Stevens LM, Robertson BM. 2017. Catlins Estuary broad scale habitat mapping 2016/17. Prepared for Otago Regional Council. 38p.
- Morrisey D, Forrest BM. 2023. Catlins/Pounaweia Estuary Intertidal Fine-Scale Monitoring Data Summary. Salt Ecology Report 130, prepared for Otago Regional Council, February 2024. 13p.