

Salt Ecology Short Report 030, prepared by Keryn Roberts for Otago Regional Council, June 2023

OVERVIEW

Hoopers Inlet is a medium sized (437ha) estuarine system located on the Otago Peninsula near Dunedin. The estuary is monitored by Otago Regional Council (ORC) as part of its State of the Environment programme using methodologies described in New Zealand’s National Estuary Monitoring Protocol (NEMP; Robertson et al. 2002). This is a preliminary report that describes a survey conducted in November 2022, which assessed salt marsh vegetation and the terrestrial margin of the estuary. Because the entrance was restricted and the tidal flats did not drain, intertidal substrate, seagrass and macroalgae in areas outside the saltmarsh were not assessed. The intent is to map these areas in the summer of 2023/24, and then produce a more comprehensive report on the ecological health of Hoopers Inlet.

METHODS

Broad scale mapping was undertaken on 27 November 2022 using NEMP methods and refinements by Salt Ecology that improve the utility and accuracy of the approach (Stevens et al. 2023). The main broad scale elements presented in this report were as follows.

- Vegetation mapping characterised the areal extent of the main species and vegetation types in salt marsh and the 200m terrestrial margin.
- Substrate mapping subjectively classified sediments within the salt marsh, according to Stevens et al. (2023).

In addition to expert interpretation, results are assessed against established or developing estuarine health metrics, drawing on approaches from New Zealand and overseas (Table 1; Stevens et al. 2023).

KEY FINDINGS

A summary of the preliminary broad scale mapping survey of Hoopers Inlet is provided below and in Fig. 1, Fig. 2 and Table 2. Supporting GIS files, spreadsheet summaries and maps have been separately supplied to ORC.

Like the catchment, the terrestrial margin surrounding the estuary was dominated (66.9% of the terrestrial margin area) by pasture, shown as ‘high’ and ‘low producing grassland’ on Fig. 1. There is a small area of mānuka and/or kānuka (9.3%) and broadleaved indigenous hardwoods (7.7%) toward the head of the estuary. Duneland (7%) east of the estuary entrance was dominated by exotic species (i.e., tree lupin and marram grass).



Steep pasture on Hoopers Inlet margin (top) and duneland (bottom), comprising a mix of marram grass and tree lupin.

Table 1. Indicators used to assess results in the current report.

Indicator	Unit	Very good	Good	Fair	Poor
Mapped indicators					
200m terrestrial margin ¹	% densely vegetated	≥ 80 to 100	≥ 50 to 80	≥ 25 to 50	< 25
Salt marsh extent (current) ¹	% of intertidal area	> 20	> 10 to 20	> 5 to 10	0 to 5
Historical salt marsh extent ^{1,2}	% historical remaining	≥ 80 to 100	≥ 60 to 80	≥ 40 to 60	< 40

1. General guidance as used in SOE reports for council(s) since 2007.
2. Estimated from historic aerial imagery.

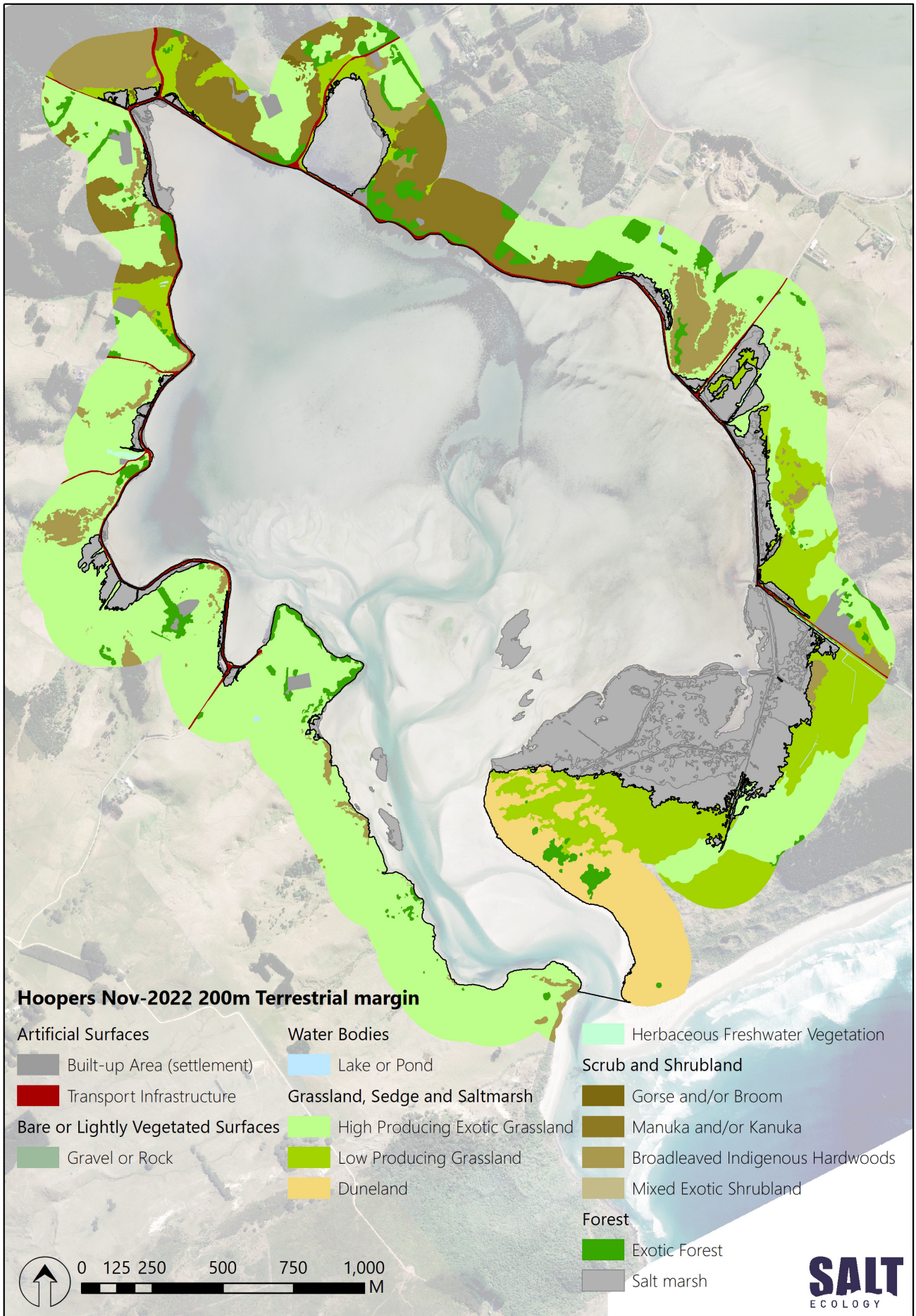
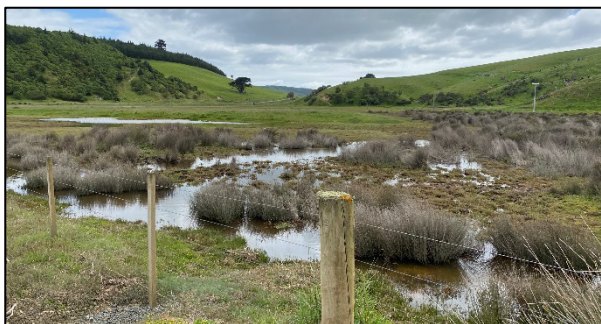


Fig. 1. Map of 200m terrestrial margin land cover, Hoopers Inlet, November 2022.

The estuary margin is modified with a road around the estuary edge and a rock wall preventing landward migration of the estuary with sea level rise. Tidal flushing has been restricted in parts of the estuary (i.e., lagoon on the north-east margin; Fig. 1) since at least 1942, with other areas reclaimed for farming. Culverts under the road allow for restricted flow of salt water into these areas, however drainage channels are common. Nonetheless salt marsh species (e.g., sedges, rushes and herbs) persist (see photos).



Salt marsh species on the landward side of the road (top) and drainage channels through sedgeland (bottom).

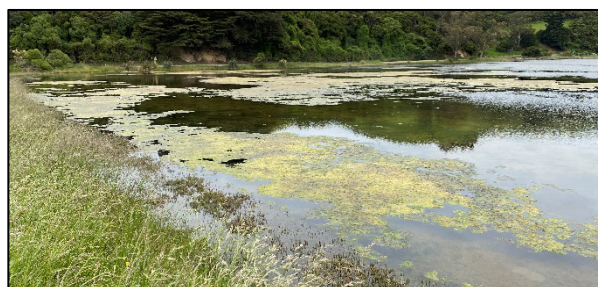
Salt marsh covered an area of 58.8ha and comprised 33ha of herbfield (Fig. 2), 11.3ha of rushland, 8.9ha of estuarine shrub and 4.9ha of sedgeland. It was predominantly growing in firm muddy sand (>25% mud) and sandy muds (>50% mud). The most extensive salt marsh area was on the southern margin of the estuary, being limited in other areas due to the road and steep topography of the margin. An estimated ~85% of the historic salt marsh remains in the estuary (a condition rating of 'very good'), with losses attributed to drainage and reclamation.

The largest remaining area of salt marsh on the southern margin of Hoopers Inlet is classified as a regionally significant wetland in the Regional Plan: Water for Otago. Despite this classification, there was evidence of vehicle use and pugging in the southern herbfields (see photos). Other smaller remnant patches of salt marsh are under ongoing pressure due to drainage and grazing. Further, the extensively modified margin, including shoreline hardening, limits the scope for managed retreat of salt marsh in response to sea level rise.



Pugging (top) and vehicle tracks (bottom), southern herbfields.

While not specifically mapped in November 2022, there were signs of nutrient enrichment in the estuary with low oxygen sediments on the southern margin and filamentous algae growing within herbfield ponds and in the north-east lagoon. Similar eutrophication symptoms have been observed in Pleasant River Estuary (Roberts et al. 2022). These symptoms suggest nutrients are potentially exceeding the estuary's assimilative capacity, likely exacerbated by the restricted entrance and reduced tidal flushing.



Filamentous algae growing in herbfield ponds (top), low-oxygen muddy sands on the southern tidal flats (middle) and filamentous algae growing in the north-east lagoon (bottom).

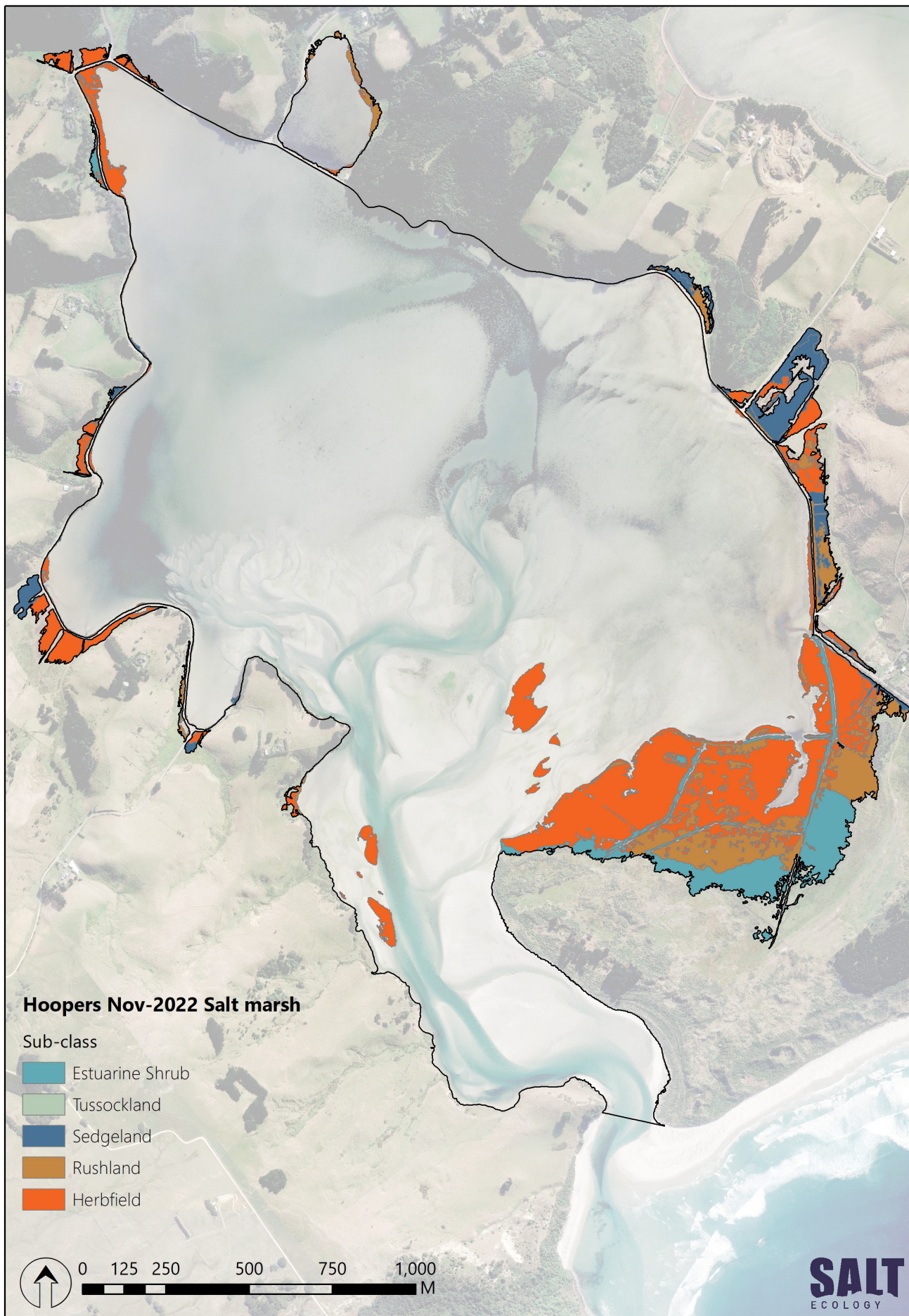
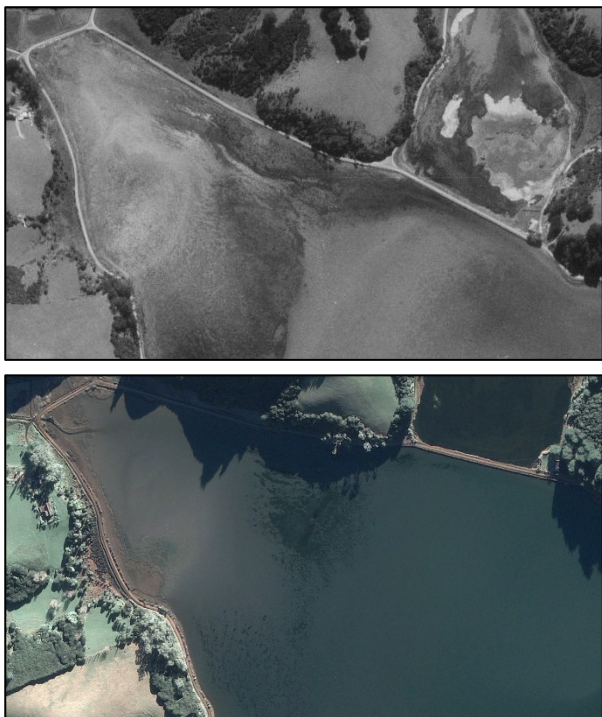


Fig. 2. Distribution of salt marsh, Hoopers Inlet, November 2022.

While not mapped in November 2022 due to high water levels, seagrass was observed growing on the lower southern flats. This is in contrast to previous studies that have recorded no seagrass in Hoopers Inlet (e.g., Goerlitz 2012). A review of historic aerial imagery shows seagrass has been present since at least the earliest record in 1942, and while extent and cover have been variable over time, it is consistently present on aerials. It is possible that seagrass has not been previously recorded due to limited sampling effort.



Seagrass beds observed in 1975 (top) and 2009 (bottom).

SUMMARY

Overall, the relatively steep terrestrial margin was dominated by pasture, with only 22.3% of the margin densely vegetated (a condition rating of 'poor'). Salt marsh in Hoopers Inlet was rated 'good' to 'very good' (Table 2). However, if these ratings are to be maintained, protection of the remaining salt marsh, including the exclusion of stock and vehicles, will be critical. Further, reclamation and shoreline hardening has disrupted the natural connectivity between the land and estuary and greatly limits the capacity of the

estuary to adapt to predicted sea level rise. While not mapped due to high water levels, high-value seagrass was also recorded. Concerningly, symptoms of nutrient enrichment were evident on the tidal flats and in ponded areas, however the extent of the problem is uncertain. Restriction of the estuary entrance, as observed in November 2022, likely exacerbates the estuary's susceptibility to nutrient problems.

RECOMMENDATIONS

Based on the findings of this preliminary survey it is recommended that ORC consider the following:

- As planned, complete the broad-scale habitat mapping survey when the estuary entrance is not restricted, with a particular focus on intertidal substrate, seagrass and macroalgae.
- Carry out synoptic sampling of sediment quality, sediment-dwelling biota, and water quality to complement the broad-scale habitat mapping survey (see Stevens et al. 2023).
- Protect and enhance salt marsh, where possible (e.g., exclude vehicles and stock, reconnect areas of remnant salt marsh to the estuary).

REFERENCES

- Goerlitz S. 2012. The lugworm *Abarenicola affinis* (Arenicolidae, Polychaeta) in tidal flats of Otago, southern New Zealand. (Thesis, Doctor of Philosophy). University of Otago.
- Roberts KL, Stevens LM, Forrest BM. 2022. Broad Scale Intertidal Habitat Mapping of Pleasant River (Te Hakapupu) Estuary. Salt Ecology Report 086, prepared for Otago Regional Council, June 2022. 57p.
- Robertson B, Gillespie P, Asher R, Frisk S, Keeley N, Hopkins G, Thompson S, Tuckey B 2002. Estuarine Environmental Assessment and Monitoring: A National Protocol. Prepared for supporting Councils and the Ministry for the Environment, Sustainable Management Fund Contract No. 5096. .
- Stevens LM, Roberts KL, Forrest BM, Scott-Simmonds T 2023. Synoptic Broad Scale Ecological Assessment of Pūrākaunui Inlet. Salt Ecology Report 113, prepared for Otago Regional Council, June 2023. 53p.

Table 2. Summary of broad scale indicator condition ratings.

Broadscale Indicators	Unit	November-2022	Rating
200m terrestrial margin	% densely vegetated	22.3	Poor
Salt marsh extent (current)	% of intertidal area ¹	13.3	Good
Historical salt marsh extent ²	% of historical remaining	>80%	Very Good

¹Estimated from total estuary area because the intertidal and subtidal areas were not mapped in November 2022; ²Estimated from historic aerial imagery.