Salt water influence and riparian habitat condition in the Arahura river mouth lagoon system

MEMORANDUM

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WATERLINK CONSERVATION RESEARCH

Contents

1. Scope & background

This memorandum summarises results from a field survey of spring tide characteristics and riparian vegetation types to support the Arahura River restoration project within the Ngā Awa programme.

The scope of these surveys covered:

a) survey and document īnanga habitat quality of river and tributaries within the tidal zone and beyond (where relevant); and
b) collection of salinity data on one representative big tide

The purpose of the surveys is provide background information for characterising the rivermouth system, delineating search areas, and establishing logistics for surveys of īnanga spawning sites following the census survey approach (Orchard & Hickford 2018).

2. Field survey description

The field survey on 10 March commenced at 10.30am and was timed to capture the spring high tide. River flows were typical of a moderate fresh that was receding after a period of rain. Terrain covered on the 10th included the mainstem true right bank below the road bridge, lower floodplain islands, Flowery Creek and tributaries, and lagoon shoreline in this vicinity. Water levels were observed to be relatively high due to the combination of the spring high tide and river flow. For example, water levels were knee to thigh depth on the 4WD track leading to floodplain islands from the access track at Old School Road.

A second survey was completed on 11 March covering the true left bank downstream of the road bridge and waterways in the vicinity of Greyhound Road. Water levels were again relatively high with strong tidal pushes observed in these tributaries, including inflows to the small lake on the floodplain adjacent to the main channel. The tidal heights and times were 1205 / 3.6 m (10 March) and 1252 / 3.7 m (11 March) according to the New Zealand Hydrographic Authority tide predictions for Charleston, with the 11 March tide being the largest predicted tide for the month.

3. Saltwater intrusion characteristics on spring high tides

3.1 North bank survey, 10 March

Initial measurements taken along the south bank prior to the predicted time of high tide showed an absence of salt water intrusion into the near-shore channels among the floodplain islands even in the presence of strong tidal pushes. Soon after, surveys were conducted in the northern section of the lagoon commencing at the Flowery Creek confluence at 1200. The first detection of salt water was made at 1235 in the lagoon several hundred metres downstream of the Flowery Creek confluence. At this time water levels were observed to have dropped by c. 20 cm from the tidal peak. However, these observations suggest that the salt water limit was likely to have been confined to the lagoon basin on this particular tide in the northern portion of the rivermouth system.

3.2 South bank survey, 11 March

Strong tidal pushes into the south bank tributaries were observed during the incoming tide that included significant in-flow to the small lake in this vicinity. Bottom salinity in the lake (2.7 ppt) was initially higher than in the tributary channels, which are shallower, indicating that higher salinity waters had entered the lake on previous tides. Salinity levels peaked around 1300 as expected, and by this time they were higher than measured in the lake (5.5 ppt). The upstream limit of salt water in the Greyhound Road

tributary was found to be at the stock race adjacent to the farm buildings on the seaward side of Greyhound Road.

3.3 Summary

These preliminary observations provide only an initial picture of salinity conditions within the lagoon system on spring high tides. Further field measurements would be needed for a comprehensive understanding of salt water intrusion characteristics under various combinations of tidal heights and river flows.

Salt water intrusion patterns observed during the above surveys are indicative of a flood-tide directional asymmetry towards the south bank. Additionally, a relatively large circulation cell (back eddy) was observed within the northern portion of the lagoon which results in strong currents between the floodplain islands therein. It is important to note that these effects were observed in the surface layers only, and may be primarily the result of the relatively high river discharge conditions on the day. Different patterns may be observed at lower river flows. In particular, the distribution of salt-tolerant vegetation indicates that the salt water intrusion in northern lagoon tributaries may reach the Flowery Creek confluence on a regular basis. This is considered most likely to occur under conditions of a high spring tide and low river flows.

Table 1. Salinity observations in the Arahura River on spring high tides of 10th and 11th March 2020.

Location	NZTM coordinates		Date	Time	Salinity (ppt)	
	X	Y			Top	Bottom
Arahura River mainstem near end of Old School Road	1438229	5274294	10-Mar-20	1050	0	0
in channel adjacent to 4wd track	1438353	5274520	10-Mar-20	1105	0	0
near tip of triangular island on floodplain	1438468	5274615	10-Mar-20	1115	0	0
at channel confluence near whitebaiting hut	1438495	5274638	10-Mar-20	1125	0	0
farm gate above Flowery Ck confluence	1439403	5275237	10-Mar-20	1140	0	0
200m above Flowery Ck confluence	1439354	5275207	10-Mar-20	1150	0	0
100 m above Flowery Ck confluence	1439265	5275158	10-Mar-20	1155	0	0
opp. Flowery Ck confluence	1439163	5275097	10-Mar-20	1200	0	0
300m downstream from Flowery Ck	1438944	5274983	10-Mar-20	1210	0	0
400m downstream from Flowery Ck	1438840	5274968	10-Mar-20	1220	0	0
junction of the tidal waterway channel with main lagoon	1438689	5274887	10-Mar-20	1230	0	0
in northern lagoon 50 m from farmland	1438595	5274920	10-Mar-20	1235	0	0.2
in northern lagoon opp. whitebaiting hut	1438420	5274884	10-Mar-20	1245	0	0.6
top end of small lake true left	1438089	5274125	11-Mar-20	1155	2.1	2.7
mid section of small lake true left	1438084	5274175	11-Mar-20	1200	2.1	2.4
ephemeral waterway near small lake	1438051	5274182	11-Mar-20	1205	2	2.1
lake entrance channel at blind end	1438023	5274254	11-Mar-20	1210	3	3.3
in lake entrance channel	1438020	5274269	11-Mar-20	1214	5.1	5.5
in lake tributary at the riffle section near willow	1437976	5274330	11-Mar-20	1218	3.3	4.5
at confluence of lake tributary & Greyhound stream	1437947	5274374	11-Mar-20	1222	5.7	6.2
Greyhound stream 50m above lake tributary	1437914	5274353	11-Mar-20	1228	5.5	6.1
Greyhound stream at first riparian wetland entrance	1437890	5274310	11-Mar-20	1235	5.5	5.9
Greyhound stream at second riparian wetland entrance	1437828	5274258	11-Mar-20	1240	5.2	5.6
Greyhound stream at sharp bend near farm track	1437746	5273991	11-Mar-20	1250	0.5	1.5
Greyhound stream on straight above sharp bend	1437628	5273931	11-Mar-20	1255	0.1	0.4
Greyhound stream at culvert opp farm sheds	1437414	5273819	11-Mar-20	1310	0.1	0.1

4. Īnanga spawning habitat

There is generally an abundance of good quality habitat for īnanga spawning on the riparian margins within the survey area.

Based on the inundation patterns observed during the above surveys, locations with suitable conditions for spawning are highlighted in the following sections.

4.1 Northern lagoon / north bank and tributaries

- riparian margins upstream and downstream of the Flowery Creek confluence, particularly on the true right.
- the lower reach of a small un-named tributary originating from the wetland area south of Flowery Creek and drains in adjacent farmland.
- riparian margins of several floodplain islands and overflow channels along the true right bank of the mainstem, several of which form confluences near the whitebaiter's hut in this area.

The majority of potential spawning habitat in the above locations is provided by tall fescue (*Schedonorus arundinaceus*), often in association with lotus (*Lotus pedunculatus*), and creeping bent (*Agrostis stolonifera*).

4.2 Southern lagoon / south bank and tributaries

- lower reach of the stream running parallel with Greyhound Road.
- margins and entrance channels of the small lake on the floodplain adjacent to the main channel.

The majority of potential spawning habitat in the above locations is provided by tall fescue and lotus in association with buttercup (*Ranunculus repens*), burr chervil (*Anthriscus caucalis*), water cress (*Nasturtium officinale*), rushes *(Juncus* spp.) and sedges (*Carex* spp.).

It is important to note that the water level observed during these surveys was relatively high (though by no means at flood levels). Implications for interpretation include:

- riparian habitat quality characteristics at lower water levels were partly obscured in some parts of the survey area due to inundation. However, spawning may occur on lower water levels (i.e. in association with lower river flows).
- Conversely, habitat quality at very high water levels was not specifically considered. In general, riparian habitat would be less suitable for spawning under these conditions at many locations due to higher elevations being occupied by less suitable vegetation (e.g. broom and blackberry) or farmland.

A selection of site photographs is shown in Appendix 1.

5. Conclusions

The above surveys produced useful findings for characterising the rivermouth system, delineating search areas, and establishing logistics for surveys of īnanga spawning sites. These will be completed within the Arahura River restoration project in the upcoming spawning season and will be the subject of a separate report.

6. References

Orchard, S., & Hickford, M. J. H. (2018). Census survey approach to quantifying īnanga spawning habitat for conservation and management. *New Zealand Journal of Marine and Freshwater Research, 52*(2), 284-294. doi:10.1080/00288330.2017.1392990.

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Appendix 1 Site Photographs from spring tide surveys conducted on March 10th & 11th 2020

Figure 1 Spring tide water levels in the tidal waterway north of Flowery Creek (a) and (b) Riparian margins bordering the grazed area of DOC land. Although tidal inundation of pasture was observed, water levels were considered to be relatively high due to a combination of the spring high tide and moderate river flows.

Figure 2 (a) Adult īnanga observed in the lower reaches of Flowery Creek. (b) Tidal inundation in the wetland areas north of Flowery Creek confluence. Several small tributaries and emphemeral waterways occur in this area.

Figure 3 (a) and (b). Two views of the tributary north of Flowery Creek showing suitable riparian vegetation for īnanga spawning.

Figure 4 (a) and (b). Two views of the small lake that occupies an old flood channel on the south bank. Strong tidal flows were observed entering the lake system on the spring high tide of March 11th.

Figure 5 (a) and (b). Tidal flooding into low-lying areas of pasture adjacent to the Greyhound Road.

Figure 6 (a) and (b). Riparian margins of the Greyhound Road tributary on the March 11th spring high tide.