Spotlight surveys for migratory whitebait species in 15 rivers on the South Island's West Coast

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Prepared for

Department of Conservation
June 2021

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Cover photograph:
Giant kokōpu (*Galaxias argenteus*) caught in the spotlight in Liverpool Bills Gully
Photo: S. Orchard

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1. Introduction

1.1 Background

Migratory fish such as the whitebait galaxiids (īnanga, banded kōkopu, koaro, shortjaw kōkopu and giant kōkopu) and eels require management interventions at the whole catchment scale given their migratory life-histories. This requirement does not fit well within species and ecosystem prioritisation systems which operate on a site-based approach. These species were recognised in the Biodiversity Contingency Business Case (BCBC) approved by the Minister of Conservation and the Minister of Finance on 11 November 2018 which released $76m over four years to the Department of Conservation (DOC) to work towards an ultimate future state of 'all migratory and marine species have a representative network of secure, stable or increasing sub-populations'. Funding was secured for a workstream on three priority species: shortjaw kōkopu (*Galaxias postvectis*), classified as threatened - nationally vulnerable; īnanga (*Galaxias maculatus*) and longfin eel (*Anguilla dieffenbachii*) both classified as at risk - declining based on their current population trends (Dunn et al. 2018). The primary objective of the workstream is to ensure population security for these three migratory species. All of these species are vulnerable to impacts from loss of habitat for different life stages, loss of access to upstream habitat, changes in water quality and overharvesting. Useful management interventions are expected to include adult fish and spawning habitat protection and restoration, ensuring compliance with fishing regulations, and improvements in fish passage where needed to address the migratory life cycle.

1.2 Scope and purpose

This report provides a brief summary of results from a targeted survey of rivers in the Hokitika area on the South Island's West Coast that contribute to the BCBC and wider DOC programme of work on migratory species conservation. The main objective of these surveys was to assess fish populations in reaches where there are no previous reports of shortjaw kōkopu presence, but for which species distribution models predict that their presence is likely. An additional aspect of the project involved the trialling of eDNA sampling procedures at the same sites for the purposes of evaluating the sensitivity and potential utility of eDNA techniques as a detection and mapping tool. The results described here are restricted to the fish survey data and the eDNA results will be the subject of a future analysis. Both sets of data are somewhat ongoing in their acquisition and it is likely that they will be augmented with further surveys in a wider range of waterways and geographical areas as the overall project develops. This report provides interim results with this in mind and with a focus on the migratory fish species that were recorded in 15 individual waterways.

Shortjaw kōkopu are distributed throughout New Zealand although they are largely absent from the east coast of both the North and South Island; and there are no records from Stewart Island. They are most often found in small to medium streams with cobbles and boulders, and with a medium to high proportion of native vegetation in the riparian zone and wider catchment (Bowie & Henderson 2002; Goodman 2002; McDowall et al. 1996). Spotlighting for shortjaw kōkopu has been found to be one of the best methods for monitoring this species and is particularly useful for obtaining relative abundance data from larger study areas (Jack et al. 2001; Jack 2020). Modelling of potential shortjaw distributions based on habitat characteristics and known sites of occupancy recorded in the New Zealand Freshwater Fish Database (NZFFD) has also identified previously unsurveyed areas which may be suitable shortjaw habitat (Crow et al. 2014; Leathwick et al. 2008).

2. Study sites

A selection of study sites were identified for this round of surveys based on GIS analysis of shortjaw kōkopu distribution models developed by Leathwick et al. (2008) and Crow et al. (2014). These models were assessed in a previous project that characterised and mapped differences in their predictions (Orchard 2020a). The main focus of the project was to undertake ground-truthing surveys to increase the geographical coverage of field survey data in areas of discrepancy between the models. Areas of discrepancy for shortjaw presence were mapped in Orchard (2020a) where they were identified as 'class 3' reaches for conservation priority. This recognises the uncertainties associated with identifying these areas as shortjaw kōkopu habitat and managing them accordingly using the modelling predictions alone. In comparison, priority class 1 and 2 reaches were defined as those with confirmed shortjaw records or predicted presence in both models, respectively.

To begin with, a set of candidate survey areas were identified using the above criteria, all in the Hokitika area. The desktop GIS assessment was used to identify survey planning aspects that included landowner information, the location of potential access points, and an impression of streambed and riparian vegetation conditions. This process was followed by field visits to check the feasibility of access, nature of hazards, and other site-level planning considerations such as water levels, to inform decisions on the selection of survey sites and potential survey dates. These reconnaissance and desktop assessments were completed in an ongoing fashion as the project progressed and resulted in 15 study sites being included within the survey campaign (Fig. 1).

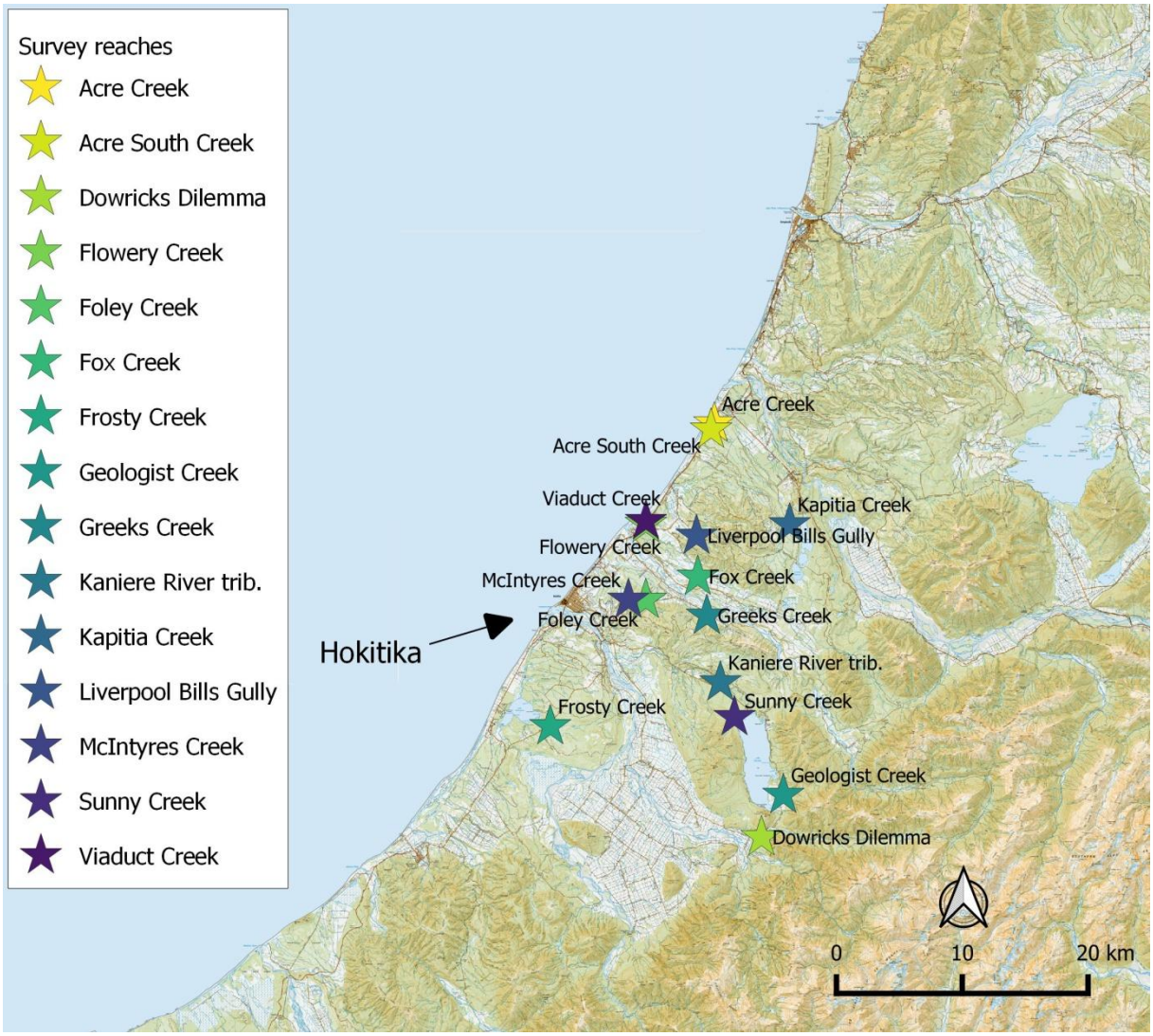

Fig. 1 Location of the 15 study sites in the Hokitika area on the South Island's West Coast.

3. Methods

2.1 Overview

The methodology for this project was based on a prior survey campaign in the Rakautara River on the Kaikōura coast in collaboration with Environment Canterbury and DOC that had a similar set of objectives. These involved the implementation of targeted surveys for shortjaw kōkopu that aimed to cover large survey reaches in a relatively fast yet robust procedure. The survey approach was based on spotlighting in 400 m fixed reaches as used in recent DOC monitoring of previously known shortjaw populations (Jack 2020), with some refinements to the spatial resolution of data collection and archiving to the New Zealand Freshwater Fish Database as described in Orchard (2021). In this project a single 400 m fixed reach was surveyed in each catchment with the exception of Dowricks Dilemma where a large proportion of the streambed was dry at the time of the survey and a 100 m reach was surveyed instead (Table 1). Other aspects of the field survey and data archiving protocols are briefly described below.

2.2 Field survey protocols

Planning aspects
Following selection of each study site a degree of scheduling was necessary to optimise the survey effort and available fine-weather days. Considerations for this step mainly revolved around the weather forecast and expected time requirement for each survey reach which depends substantially on the size of the wetted area to be covered and nature of the terrain, as discussed in Orchard (2021). Each survey was completed by a team of two people at all sites.

Daylight habitat assessment
Daytime surveys were done prior to each spotlighting survey to mark out the fixed reaches and complete habitat assessments. In nearly all cases these were able to be completed on the same day as the spotlighting survey or otherwise during a period of fine weather in which river conditions were similar throughout. Each 400 m fixed reach was established by measurement from a pre-determined origin point using a 50 m tape. Width and depth measurements were made every 50m during this process along with other habitat assessments (as below), and four 100 m sub-reaches were marked using brightly coloured flags for visual identification at night. GPS coordinates were measured at the start and end of each 100 m sub-reach (Table 1).

The following environmental parameters were measured for each 100 m sub-reach:

- maximum depth
- water colour
- temperature
- conductivity
- habitat type
- substrate composition
- instream cover
- riparian vegetation

At the 400 m reach scale habitat conditions were also assessed further using the Pfankuch Stability Assessment (Pfankuch 1975), and National Rapid Habitat Assessment Protocol (NRHAP) (Clapcott 2015). Additional notes on threats and pressures affected the streambed or riparian zones were noted when observed, and in some cases included observations made downstream (e.g., presence of fish passage barriers where previously known or seen).

Table 1. Survey reaches and sub-reaches.

400 m reaches	Waterway	Access point	Survey date	100 m sub-reaches	Downstream coordinates (WGS84)	
					X	Y
1	Acre Creek	SH6	8/4/21	1	171.1102527	-42.5919126
				2	171.1111735	-42.59215975
				3	171.1121476	-42.5923352
				4	171.113157	-42.5928493
2	'Acre South' Creek	SH6	8/4/21	1	171.1080224	-42.5953747
				2	171.1080789	-42.5961751
				3	171.1087306	-42.5967385
				4	171.1095762	-42.5974662
3	Dowricks Dilemma	Upper Kokatahi Rod	4/5/21	1	171.1475398	-42.8880916
				2	171.1480102	-42.8889199
				3	171.1489803	-42.889342
				4	171.1493458	-42.8901106
4	Flowery Creek	SH 6	6/5/21	1	171.0428299	-42.6618761
				2	171.0428242	-42.6627421
				3	171.0435021	-42.663227
				4	171.0430411	-42.6640765
5	Foley Creek	Blue Spur Road	30/4/21	1	171.0397312	-42.71689216
				2	171.0408334	-42.7172504
				3	171.0418332	-42.71756309
				4	171.0429082	-42.71778932
6	Fox Creek	Old Christchurch Road	1/5/21	1	171.0906834	-42.7013194
				2	171.0918492	-42.7014206
				3	171.0928109	-42.7018464
				4	171.0936997	-42.701575
7	Frosty Creek	Woodstock Rimu Road	7/5/21	1	170.9443409	-42.8071141
				2	170.9452514	-42.8067504
				3	170.9461239	-42.8063424
				4	170.9471377	-42.8068131
8	Geologist Creek	Dorothy Falls Road	4/5/21	1	171.1691403	-42.8594
				2	171.1702317	-42.8597166
				3	171.1711903	-42.8593989
				4	171.1717451	-42.8587439
9	Greeks Creek	Humphreys Gully Road	1/5/21	1	171.1014309	-42.7283317
				2	171.1007391	-42.729023
				3	171.1006784	-42.7298733
				4	171.1002382	-42.7306028
10	Kaniere River tributary	Ward Road	1/5/21	1	171.1125744	-42.77645764
				2	171.1123144	-42.77713035
				3	171.1123502	-42.77783993
				4	171.1129939	-42.77868074
11	Kapitia Creek below reservoir	Greenstone Road	7/4/21	1	171.1812301	-42.6664942
				2	171.1823008	-42.6664101
				3	171.1830172	-42.6657836
				4	171.1833522	-42.6649636
12	Liverpool Bills Gully	Stafford Loop Road	7/4/21	1	171.0917874	-42.6712544
				2	171.092298	-42.6718895

				3	171.0924318	-42.6724871
				4	171.0932018	-42.6730134
13	McIntyres Creek	Blur Spur Road	6/4/21	1	171.0234016	-42.7166935
				2	171.0244374	-42.7166403
				3	171.0250059	-42.71718661
				4	171.0251517	-42.7180842
14	Sunny Creek	Sunny Bight Road	30/4/21	1	171.1279136	-42.8029271
				2	171.1266283	-42.80273226
				3	171.1252973	-42.8029171
				4	171.1242584	-42.8033489
15	Viaduct Creek	SH6	7/5/21	1	171.042012	-42.6604061
				2	171.0428057	-42.6610522
				3	171.0437259	-42.6611447
				4	171.0445314	-42.6604806

Spotlight surveys

Spotlight surveys began a minimum of 1 hour after dark at the downstream end of the survey reach. Either one or two reaches were surveyed on a given night depending on factors such as ease of access, length of time to complete the first reach, weather conditions and energy levels of survey team. The spotlighting process generally followed the descriptions in Joy et al. (2013) for a single-pass survey with a team or two or three people. The primary spotlight was a Narva Colt (1000 lumen) lamp operated by one team member and all team members were equipped with powerful head torches. With the primary spotlight moving first, the team works systematically upstream surveying all of the wetted area including shallow areas on the fringes, the immediate confluence of any small side tributaries, and any pools on the riparian margins including those that may have been temporarily disconnected from surface water flow. A second 1000 lumen lamp was also used in some of the surveys to reduce survey time, and in this case the two spotlighters worked in tandem taking one side of the wetted channel each.

All fish species seen were recorded to the closest confident taxonomic level and their size estimated to the nearest 5mm. An attempt was made to catch any suspected shortjaw kōkopu to confirm identification and calibrate visual size estimates. Galaxiids that could not be positively identified to species level were recorded as 'unidentified galaxiid' on the field sheet and similarly in the NZFFD. For the most part no attempt was made to catch eel species and they were mostly recorded as 'unidentified eel' unless a positive identification to species level was obtained through visual inspection in the field. All fish observed were recorded individually along with their measured or estimated length using total length in all cases. The percentage fishable area was estimated for each 100 m sub-reach after it was surveyed to record the proportion of the wetted area in which fish could be reliably seen.

To facilitate the above field procedures, an adapted version of the NZFFD form was used as described in Orchard (2021). This supports the collection of all key data at 100 m reach scale for subsequent aggregation into a 400 m reach record for upload to the NZFFD.

2.3 Data archiving

For each 400 m reach environmental data were calculated from the applicable values (i.e., average or maximum) recorded in the 100 m sub-reaches. For the NZFFD channel width and depth data fields there were n=9 measurements being the values observed at every 50 m along the 400 m reach. Fish data were uploaded the NZFFD for each sub-reach separately using the 'Pass/ Trap/ Net No.' field to

distinguish the observations from each sub-reach (Table 2). This data entry procedure takes a little extra time but allows for the 100 m sub-reach fish data to be accessed directly from the national repository if desired.

Table 2. Notation used for the 'Pass/ Trap/ Net No.' when entering fish data to the NZFFD.

Sub-reach	Notation
0 -100m	100
100 – 200m	200
200 – 300m	300
300 – 400m	400

3. Results and discussion

This section contains a brief overview of the results. Data collected from the surveys are attached in Appendices and available from the relevant NZFFD record online. A brief description of each of the survey reaches is also provided in Appendix 1.

3.1 Fish surveys

Across all survey reaches a total of 1249 fish were recorded. These included all five of New Zealand's migratory galaxiid species (Table 3). The other species recorded were redfin bully (*Gobiomorphus huttoni*) and common bully (*G. cotidianus*), longfin eel (*Anguilla dieffenbachia*), and brown trout (*Salmo trutta*). Because of the targeted protocol for attempting capture of the fish encountered three additional taxonomic categories were recorded in the dataset: 'unidentified galaxiids', 'unidentified eel', and 'unidentified bullies'.

Some aspects of interest in the survey result include marked differences in the distribution of migratory galaxiids as well as variance in the total number of individual fish caught within each survey reach. Giant kōkopu were surprisingly widespread being found in 14 of the 15 survey reaches that included sites above anthropogenic in-stream barriers in Foley, Greeks and Acre South creeks. Banded kōkopu were also widespread being found in 10 of the 15 survey reaches. They were particularly abundant in some (but not all) of the smaller waterways. Īnanga were found in six of the survey reaches and their overall numbers were relatively low. This likely reflects the site selection criteria which targeted shortjaw habitat and indicates that there is only limited overlap between the two. However, īnanga were found in same reach as shortjaw kōkopu at two sites (Flowery and Foley creeks). Koaro were found in six of the survey reaches. Their overall presence likely reflects the relatively low elevation range represented within this selection of sites. However, it was interesting to note the thriving koaro population in Dowricks Dilemma where the streambed in characterised by intermittent dry sections and the overall gradient is steeper than at any of the other sites.

Shortjaw detections

New populations of shortjaw kōkopu were identified in three of the 15 catchments; Acre Creek, Foley Creek, and Flowery Creek (Table 3). In Acre Creek six fish were detected (all of which were captured) at two well-defined locations within the fixed reach. The first of these (with three fish) was a pool-drop situation with relatively fast central flow, prominent eddies on the margins, and abundant fish cover provided by large wood. The second location was quite different being a riffle habitat in a relatively open section of streambed 15-20 cm deep, with moderate flow around boulders and cover provided primarily by interstitial spaces between boulders and cobbles. Three fish were recorded within close proximity of each other (< 50 m) in these riffles. In Foley Creek, four fish were detected and captured at different points along the fixed reach. All four were found in similar riffle habitat with cover provided primarily by

boulders and cobbles as above. In Flowery Creek a total of five fish were recorded (Fig. 2). The first of these was found feeding in centre of the current in open run habitat with cover provided by cobbles and algae. A further two fish were found in riffle habitat further upstream, and the remaining two fish were found together on the margins of a large pool near the end of the survey reach. All five fish were in the open when first detected, although cover was available nearby.

Fig. 2 One of five shortjaw kōkopu caught in Flowery Creek.

Table 3. Summary of fish species and abundance recorded in spotlighting surveys of 15 rivers on the West Coast.

Study site	Reach length (m)	Wetted area (m^2)	Fished area (m^2)	Abundance												
				GALFAS	GALBRE	GALPOS	GALARG	GALMAC	GALAXI	GOBCOT	GOBHUT	GOBIOM	ANGDIF	ANGUIL	SALTRU	TOTAL FISH
Acre Creek	400	1910	835	56	4	6	38	0	51	2	35	0	0	8	0	200
'Acre South' Creek	400	970	532	101	1	0	3	0	10	0	0	0	1	4	0	120
Dowricks Dilemma	100	210	147	0	19	0	0	0	0	0	0	0	1	0	0	20
Flowery Creek	400	3110	2343	4	0	5	21	2	0	0	15	0	2	10	1	60
Foley Creek	400	1620	1180	29	0	4	23	1	12	0	33	0	0	6	0	108
Fox Creek	400	3907	1563	0	0	0	0	0	0	0	40	0	9	0	7	56
Frosty Creek	400	3900	1597	15	0	0	8	1	3	0	0	0	0	7	0	34
Geologist Creek	400	3118	1212	0	4	0	2	0	0	0	0	0	5	12	2	25
Greeks Creek	400	990	679	15	6	0	1	0	0	0	30	0	1	10	0	63
Kaniere River trib.	400	740	598	0	0	0	9	0	0	0	0	0	2	5	0	16
Kapitia Creek	400	1670	879	60	0	0	4	5	1	0	34	0	0	7	0	111
Liverpool Bills	400	1450	1050	40	0	0	16	8	7	0	75	0	3	3	0	152
McIntyres Creek	400	485	184	95	0	0	0	0	0	0	11	0	8	0	0	114
Sunny Creek	400	1320	1056	0	1	0	26	0	4	0	0	0	1	4	1	37
Viaduct Creek	400	1173	977	47	0	0	27	21	7	0	14	7	10	0	0	133
TOTAL				**462**	**35**	**15**	**178**	**38**	**95**	**2**	**287**	**7**	**43**	**76**	**11**	**1249**

4. Acknowledgements

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5. References

Bowie, S., & Henderson, I. M. (2002). *Shortjaw kokopu (Galaxias postvectis) in the northern Tararua Ranges: distribution and habitat selection*. DOC Science Internal Series Vol. 30. Department of Conservation, Wellington, N.Z. 21pp.

Clapcott, J. (2015). *National rapid habitat assessment protocol development for streams and rivers*. Prepared for Northland Regional Council. Cawthron Report No. 2649. 29pp.

Crow, S., Booker, D., Sykes, J., Unwin, M., & Shankar, U. (2014). *Predicting distributions of New Zealand freshwater fishes*. Report prepared for the Department of Conservation. NIWA, Christchurch. 100pp.

Dunn, N. R., Allibone, R. M., Closs, G. P., Crow, S. K., David, B. O., Goodman, J. M., . . . Rolfe, J. R. (2018). *Conservation status of New Zealand freshwater fishes, 2017*. *Zealand Threat Classification Series 24*. Wellington: Department of Conservation. 11 pp.

Goodman, J. M. (2002). *The ecology and conservation of shortjaw kokopu (Galaxias postvectis) in Nelson and Marlborough.* M. Sc. thesis. University of Canterbury. Department of Zoology.

Jack, D., Barrier, R., & Goodman, J. (2001). *Shortjaw kokopu (Galaxias postvectis) Conservation status in Nelson/Marlborough – year three report*. Occasional Publication No. 51. Department of Conservation, Nelson.

Jack, D. C. (2020). *Shortjaw kokopu historic records survey - Nelson Marlborough and Buller regions*. Unpublished internal report. Department of Conservation, Ōtepoti / Dunedin.

Joy, M., David, B., & Lake, M. (2013). *New Zealand freshwater fish sampling protocols. Part 1 Wadeable rivers and streams*. Institute of Natural Resources Te Kura Mataurange o nga Taonga a Papatuanuku, Massey University. 64pp.

Leathwick, J., Julian, K., Elith, J., & Rowe, D. (2008). *Predicting the distributions of freshwater fish species for all New Zealand's rivers and streams*. Report prepared for the Department of Conservation. NIWA, Hamilton. 56pp.

McDowall, R. M., Eldon, G. A., Bonnett, M. L., & Sykes, J. R. E. (1996). *Critical habitats for the conservation of shortjawed kokopu, Galaxias postvectis Clarke*. Department of Conservation, Wellington, N.Z. 30pp.

Orchard, S. (2020a). *Spatial prioritisation strategy for the recovery of migratory galaxiids on the South Island's West Coast*. Report WL20063 for Department of Conservation. 45pp.

Orchard, S. (2020b). *Location and productivity of īnanga (Galaxias maculatus) spawning grounds in the Arahura catchment*. Report prepared for Department of Conservation. 21pp.

Orchard, S. (2021). *Rapid spotlight survey for migratory fish in the Rakautara catchment, Kaikōura coast*. Report prepared for Environment Canterbury. 32pp.

Pfankuch, D. J. (1975). *Stream reach inventory and channel stability evaluation*. U.S.Department of Agriculture Forest Service, Northern Region. Missoula, Montana. 26pp.

Appendix 1: Field notes from study sites

The following sections provide a brief description of each study reach together with notes on threat or other features of significance for management.

Acre Creek and 'Acre South' Creek

Acre Creek is a tributary of the Kapitia, joining the lower Kapitia lagoon from the north (Fig. 3). The study site is a 2nd order stream with an upstream catchment area of 4 km^2. The riparian margins are largely unmodified and the river corridor downstream is also in good condition featuring established native forest cover and fenced buffer zone from the adjacent pastural land with the exception of a single stock crossing downstream of SH6. A characteristic of the study reach is a section of braids in the middle of the reach (c. 100 - 300m) that appear to be associated with a gravel outwash landform (Fig 4a). Further upstream the streambed becomes more confined. It appears that there is considerable bed movement in the reach particularly in the middle section. The six shortjaw kōkopu recorded were found in this relatively high energy setting which contrasts with previous reports of preferred habitat being associated with stable substrates (Bowie & Henderson 2002). This suggests that additional surveys of the habitat upstream may be warranted as there is a considerable length of potentially suitable habitat in that area, and it may support higher fish densities than recorded in the study reach. Overall the stream appears to be in good condition with no obvious threats or immediate management concerns.

'Acre South' is an un-named creek located a short distance south of Acre Creek (Fig. 3). The study site is a 1st order stream with an upstream catchment area of 2.4 km^2. Upstream of SH6 the riparian margins and catchment in general are unmodified with established native forest cover. Downstream of SH6 the riparian margins are in relatively poor condition due to the close proximity of pastural land. Another important feature is an in-stream barrier associated with the culvert beneath SH6. This structure includes a 0.5 m vertical concrete wall at the pipe end (Fig. 4b). Despite this obstacle, XX diadromous fish species were found upstream that (somewhat surprisingly) included giant kōkopu and XXX. This demonstrates the value in conducting connectivity assessments to inform decisions on conservation needs associated with these structures. Given these results there appears to be adequate connectivity to the upstream habitat for several key species, and the benefits of remediated the barrier to improve passage for other species (e.g., īnanga) are unlikely to outweigh the risk of facilitating access for trout in this case. Although there were no shortjaw kōkopu recorded in the survey, it is possible they may be present further upstream given the suitability of habitat, presence of other migratory species and confirmed shortjaw kōkopu population in nearby Acre Creek.

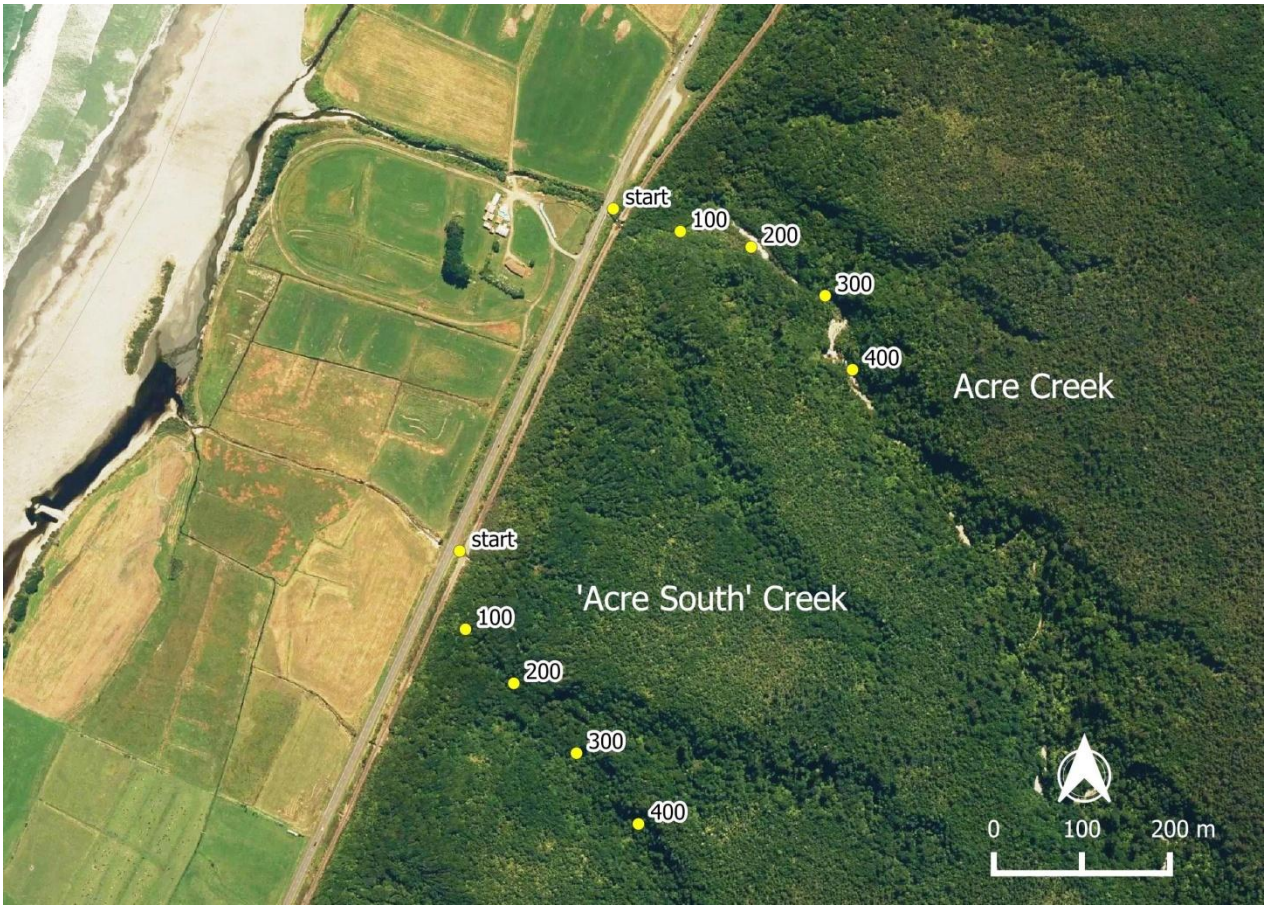

Fig. 3 Location of the Acre Creek and 'Acre South' survey reaches. The lower Kapitia lagoon can be seen on the left.

Fig. 4 (a) View of Acre Creek in the middle section of the study reach. (b) Acre South creek showing the vertical headwall associated with the culvert beneath SH6.

Dowricks Dilemma

Dowricks Dilemma is a relatively steep tributary of the Styx River located 31 km inland (Fig. 5). The study site is a 2nd order stream with an upstream catchment area of 1 km^2. The riparian margins and upper catchment are unmodified with native forest cover. However the steep hillsides are erosion prone and several relatively recent mass wasting events have deposited material in the streambed within the survey reach. Several large log jams are also present and contribute to the available cover for fish.

The streambed is characterised by dry sections both above and below the survey reach. The fish population, which featured numerous koaro, has obviously adapted to these emphemeral characteristics was primarily results from the porous nature of the substrate rather than a lack of flow. Although there is generally an abundance of mobile substrate in the streambed there are also several stable pools formed against bedrock that likely offer refuge at lower flows.

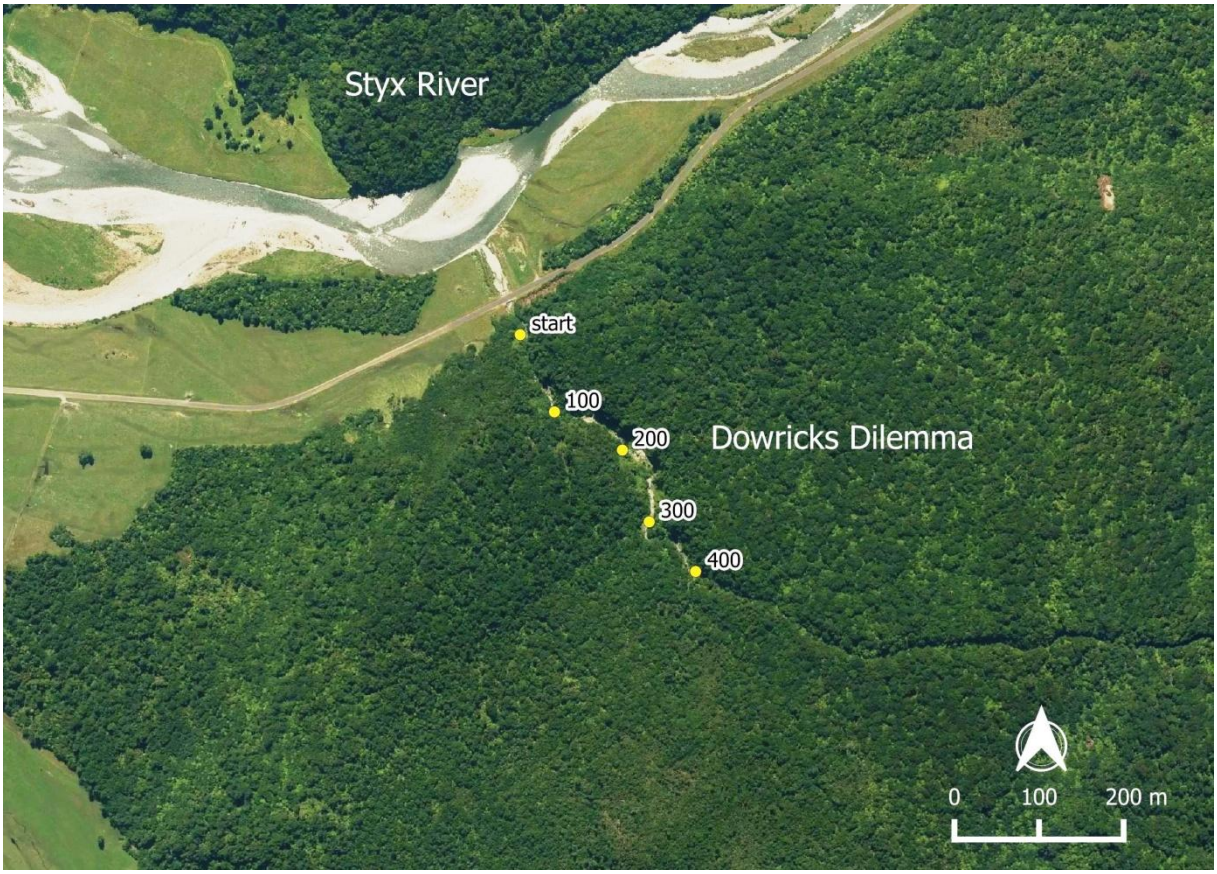

Fig. 5 Location of the Dowricks Dilemma survey reach. Only the first 100 m was surveyed for fish due to the streambed being largely dry above this point. The Styx River can be seen in the upper left.

Flowery Creek and Viaduct Creek

Flowery Creek is a tributary of the Arahura River that joins the northern rivermouth lagoon system downstream of SH6 (Fig. 6). The study site is a 3rd order stream with an upstream catchment area of 10 km^2. The riparian margins are located in private land with a mixture of vegetation types including some regenerating forest, interspersed with grassy banks, tussocks, sedges and scrub. The upper catchment also passes through similar production landscapes with a relatively narrow riparian corridor being typical throughout. As one of the more modified catchments that was surveyed in this project the identification of shortjaw kōkopu was notable in this reach as there is a relatively large stretch of similar habitat upstream. In the wider catchment there are some threats posed by stock access and sedimentation that were noted and should be monitored to help protect the stream. It would also be of interest to determine

the distribution of shortjaw kōkopu in relation to the current pattern of land-uses. In addition to shortjaw there appears to be a healthy population of giant kōkopu in this catchment and a very large adult fish (37 cm) was caught in the study reach.

Viaduct Creek is a tributary of Flowery Creek that joins from the north a short distance below SH6 (Fig. 6). The farm track in this area was selected as the start point for the survey reach due to a large duck pond that is located a short distance downstream. The study site is a 1st order stream at this point with an upstream catchment area of 2.4 km^2. The first 50 m of the survey reach is located in farmland but is well fenced with the exception of a stock crossing point. Further upstream most of the streambed has regenerating forest cover. Despite its small size there were several large giant kōkopu caught in the survey reach. Īnanga were also present as with Flowery Creek, and īnanga spawning sites have been located further downstream at the confluence of Flowery Creek and the northern branch of the Arahura lagoon (Orchard 2020b).

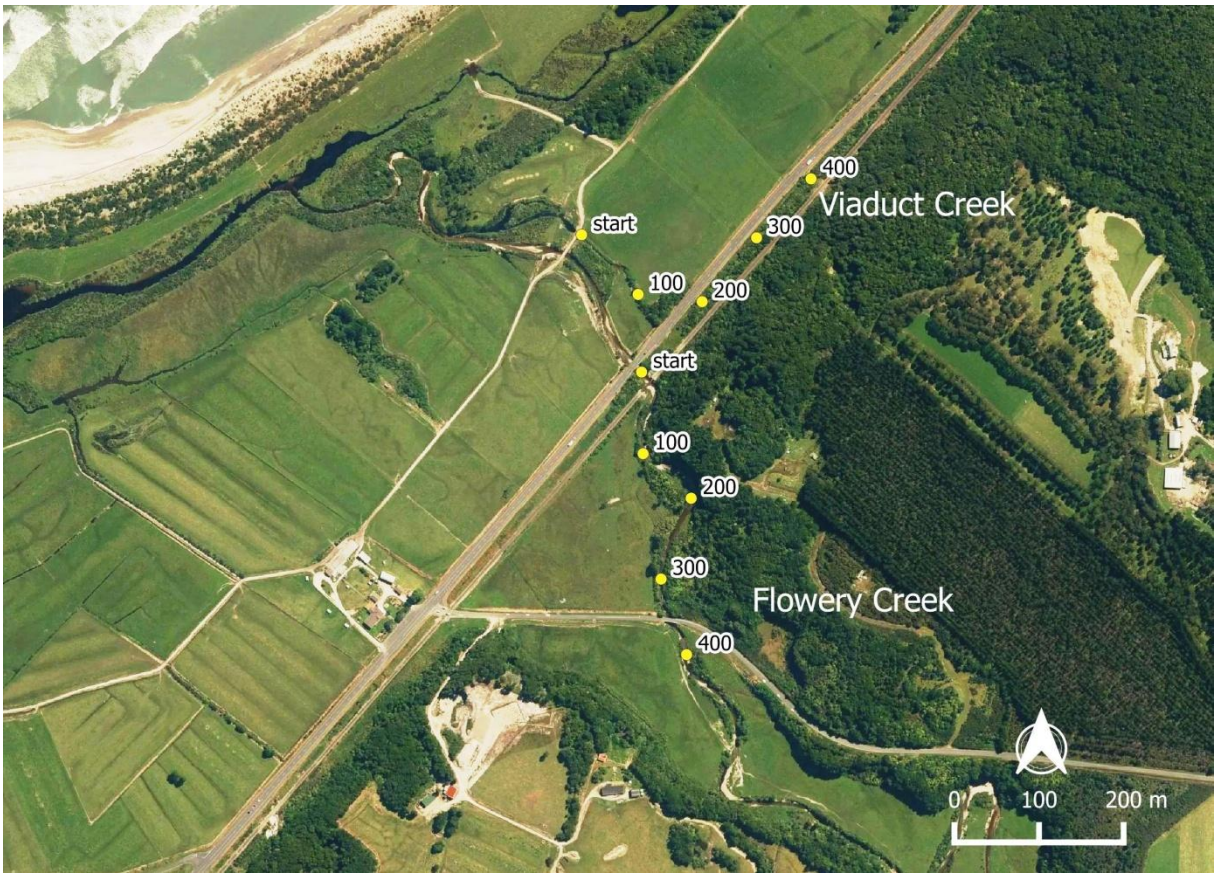

Fig. 6 Location of the Flowery Creek and Viaduct Creek survey reaches. The northern arm of the Arahura rivermouth lagoon system can be seen in the upper left.

Foley Creek

Foley Creek is a tributary of the Houhou Creek situated north of Hokitika (Fig. 7). This was the only survey reach included in the study where shortjaw presence was predicted by both species distribution models. Shortjaw have also been recorded in Houhou Creek lower in the catchment, and in nearby Breenans Stream, although they were not recorded in McIntyres Stream (a tributary of Brennans) in this study (see below).

The study reach upstream of Blue Spur Road is a 2nd order stream with an upstream catchment area of 4.2 km^2. Although the riparian margins are well vegetated within the survey reach there are large areas of cleared land and earthworks in close proximity to the stream (visible in Fig. 7). Despite these potential sources of disturbance the stream was running clear at the time of survey and four shortjaw kōkopu were found.

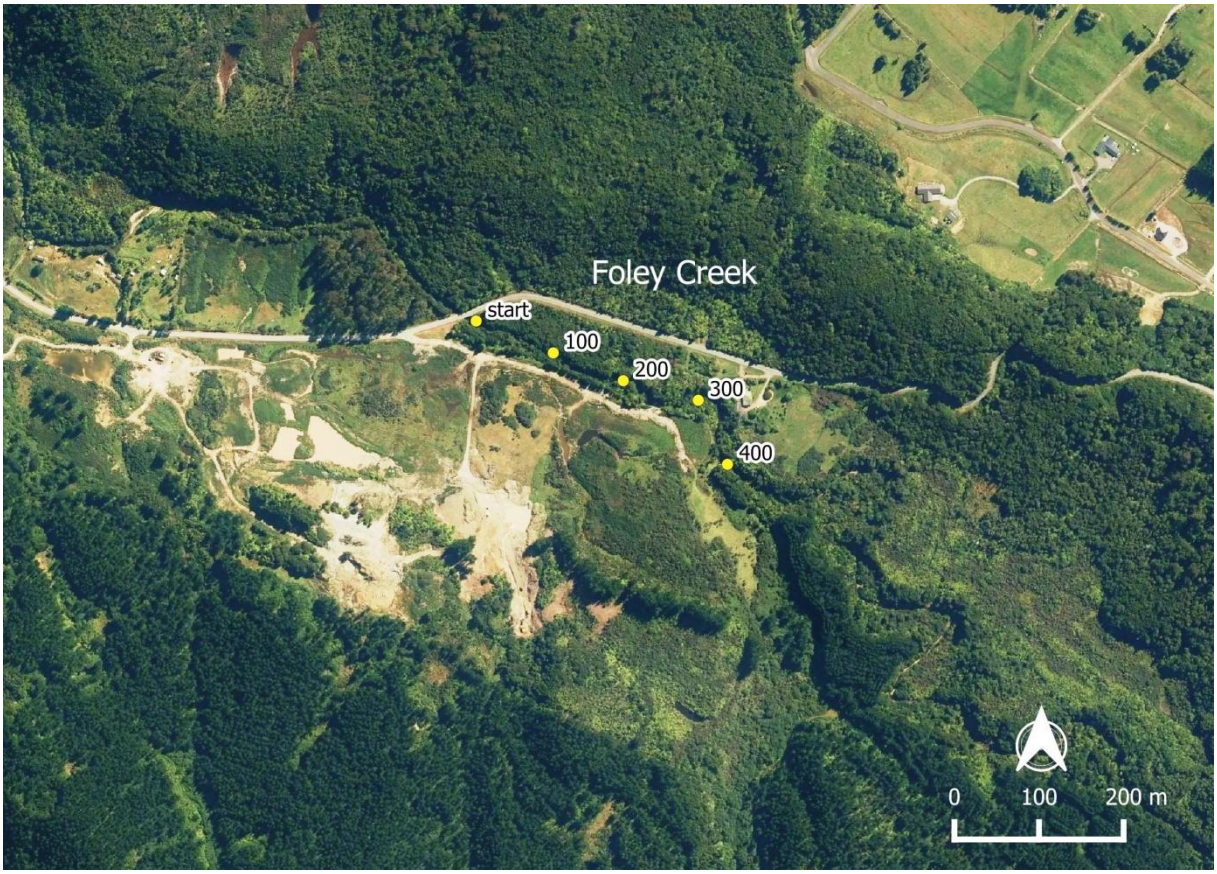

Fig. 7 Location of the Foley Creek survey reach in the Houhou Creek catchment.

Fox Creek

Fox Creek is a tributary of the Arahura River that meanders across a series of river terraces from hill-country to the north (Fig. 8). The study reach is a 3rd order stream with an upstream catchment area of 13.5 km^2. This was one of the widest and deepest survey reaches in the study and the dark tannin-stained waters meant that the 'fished area' estimate was a relatively small proportion of the wetted channel and significantly biased towards the shallower areas. The streambed occupies an incised channel with near vertical gravel scarps in close proximity to the streambed in several places, but little sign of large-scale erosion. The riparian margins are largely vegetated with a mixture of scrub and regenerating native forest with a few pocket of larger established tree particularly at the upstream end of the survey reach. These aspects create an effective buffer from pastural land to the south of the waterway as seen in Fig. 8.

From a management perspective there were few signs of disturbance pressures in the streambed that may relate to its relatively protected position in the landscape. However, the reach was notable for having the highest number of brown trout recorded (n=7) in the study.

Fig. 8 Location of the Fox Creek survey reach in the Arahura catchment.

Frosty Creek

Frosty Creek is a tributary of the Lake Mahinapua catchment located south of Hokitika (Fig. 9). The lake is located approximately 1.5 km downstream of the Woodstock Rimu Road visible in Fig. 9. The study reach is a 3rd order stream with an upstream catchment area of 15.6 km^2. This reach is characterised by a relatively wide and confined channel bordered by steep forested banks in most places. The stream features dark tannin-stained waters and deep pools and runs broken by riffle sections. The riparian margins are largely a mixture of established and regenerating native forest. To the south there is an area of plantation forestry (visible in Fig. 9) which comes close to the stream in several places. Despite the presence of this nearby production land the stream appears relatively stable and is largely unmodified in the riparian corridor.

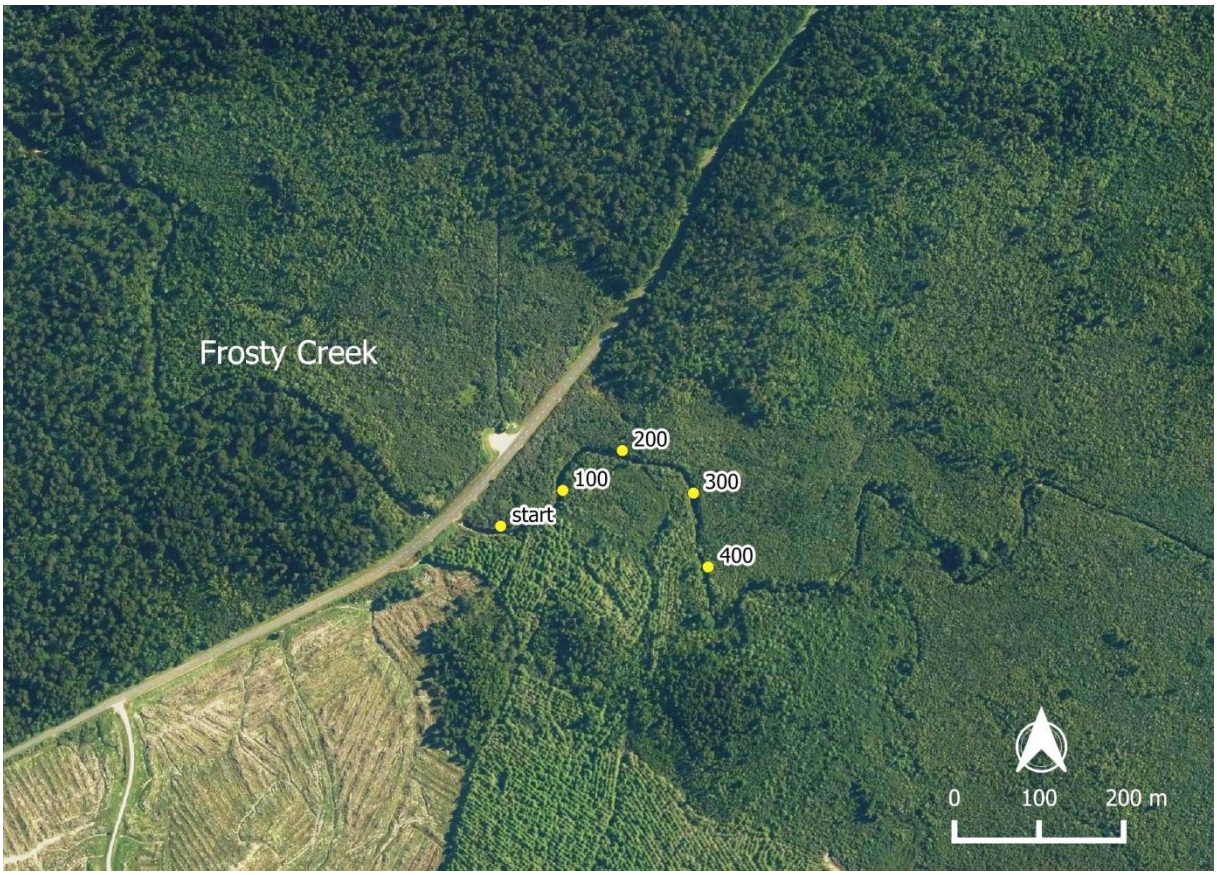

Fig. 9 Location of the Frosty Creek survey reach in the Lake Mahinapua catchment.

Geologist Creek

Geologist Creek is a tributary of the Lake Kaniere. The lake is located approximately 1.5 km downstream of the start point of the survey reach which was positioned a few hundred upstream of the access point at the Dorothy Falls Road bridge (Fig. 10). The study reach is a 3rd order stream with an upstream catchment area of 9.6 km^2. This reach was the most open streambed of all the study sites and is semi-braided in character. Most of the fish recorded were found in the smaller side-branch channels away from the main flow. The streambed is characterised by an abundance of mobile substrates and the flow was relatively swift in main channel at the time of survey with several sections of 'rapid' habitat being recorded. The streambed also steepens a short distance upstream of the survey reach.

Although the riparian margins and upstream catchment have established native forest cover several areas of natural erosion and regeneration were noted in the survey reach consistent with the above description of a high energy setting. In comparison to the natural dynamics few anthropogenic influences of note were observed aside from the presence of weed species in the streambed.

Fig. 10 Location of the Geologist Creek survey reach in the Lake Kaniere catchment.

Kaniere River tributary

This un-named tributary of the Kaniere River is a 1st order stream with an upstream catchment area of 1.4 km^2 (Fig. 11). It was accessed via the West Coast Wilderness trail from Ward Road. The stream is located in bush country under an established podocarp canopy with the occasional small light gap formed by fallen trees. It was one of the smallest streams surveyed and also had the least number of fish (Table 3). Despite this, the reach features a range of habitats that include several pools, and relatively large giant kōkopu were present. The unmodified setting suggests few anthropogenic influences of note aside from the diversion scheme in the Kaniere River downstream of the confluence point

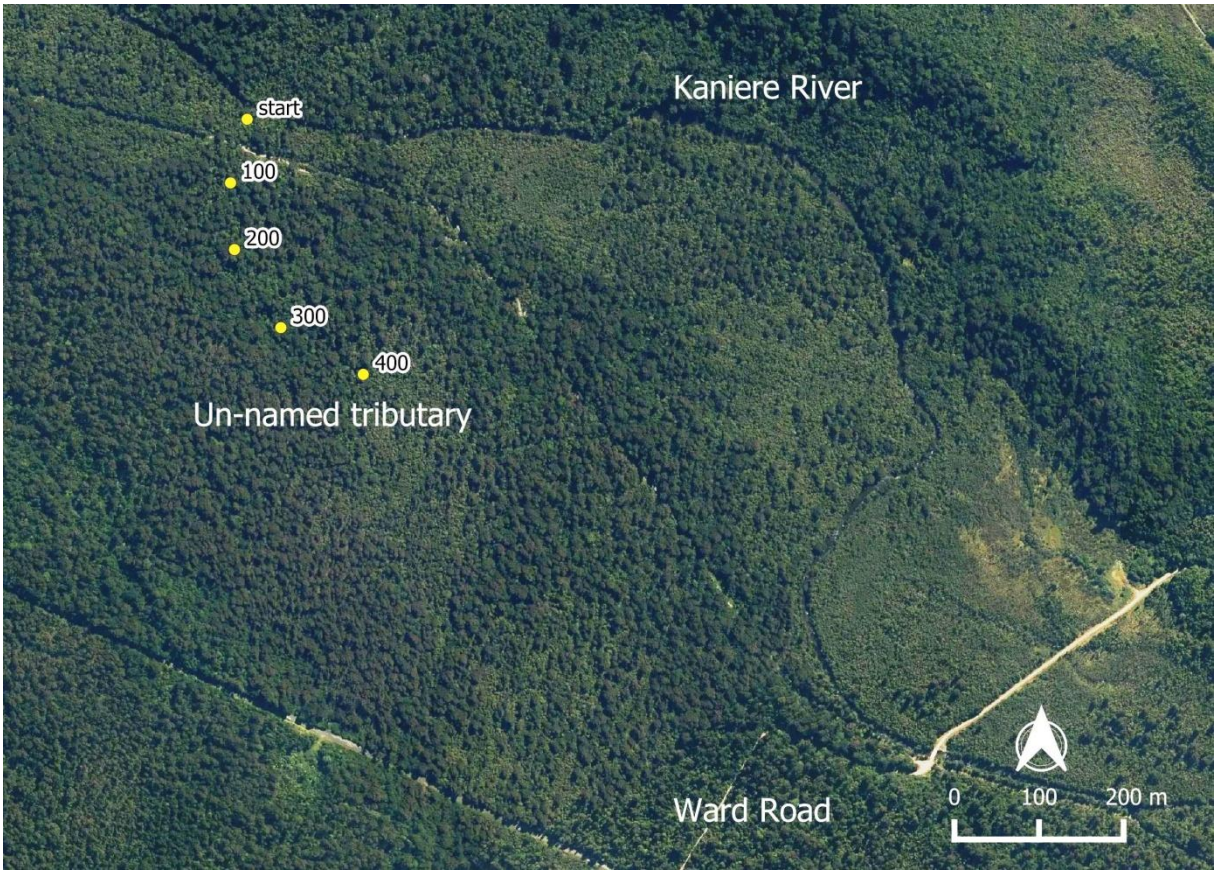

Fig. 11 Location of the (un-named) Kaniere River tributary. The survey reach was accessed via the West Coast Wilderness trail from Ward Road.

Kapitia Creek below Kapitia Reservoir

This upper section of Kapitia Creek is located approximately 2 km below the Kapitia Reservoir (Fig. 12). The study reach is a 3rd order stream with an upstream catchment area of 16 km^2 with the reservoir included in this calculation. The stream appears to be relatively stable due to the regulating effect of the reservoir upstream. This is manifested as an abundance of moss and algal cover on the in-stream substrates throughout most of the reach. The surrounding landscape feature a mixture of cleared land in close proximity to the streambed, are regenerating forest elsewhere. However, the riparian margins are generally well-vegetated with scrub or tussock cover throughout. One of the interesting finding from the fish survey was the presence of īnanga in this reach despite being a considerable distance (11 km) inland, and an abundance of banded kokōpu in the reach (Table 3).

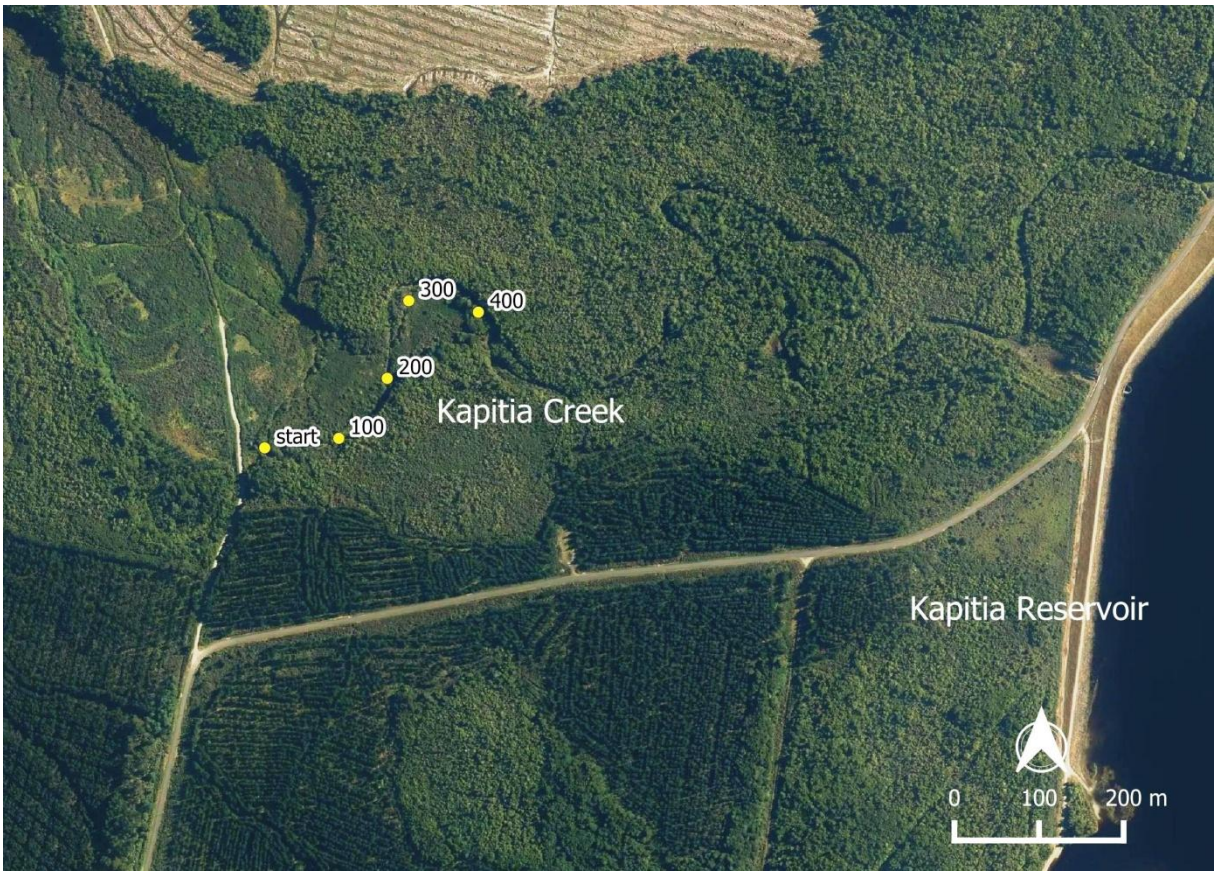

Fig. 11 Location of the Kapitia Creek survey reach a short distance below Kapitia Reservoir.

Liverpool Bills Gully

Liverpool Bills Gully is a tributary of Waimea Creek (Fig. 12). The study reach is a 2nd order stream with an upstream catchment area of 3.4 km^2. The landscape of the upper catchment features low hill country and terraces. There are a range of anthropogenic activities in close proximity to the stream that include forestry and associated roading, especially to the south as seen in Fig. 12. The riparian vegetation at the time of survey reflects these adjacent land uses and includes remnants of plantation forestry, patches of tussock and scrub, and regenerating native forest. The streambed features a mixture of cobbles, gravel and sand. In the wider landscape longer term cycles of activity such as forest harvesting are likely to be important management considerations. At the current point in time there is a thriving fish population that included the highest number of redfin bullies recorded in the wider study. There were also several giant kokōpu recorded including some large individuals found in pool and run habitat in this reach.

Fig. 12 Location of the Liverpool Bills Gully survey reach in the Waimea Creek (Awatuna) catchment.

McIntyres Creek

McIntryes Creek is a tributary of Brennans Creek in the Houhou Creek catchment (Fig. 13). The study reach is a 1st order stream with an upstream catchment area of 0.9 km^2. As noted above, shortjaw kokōpu have been previously recorded in Brennans Creek and Houhou Creek, but they were not detected in McIntyres. The stream is relatively small with a predominantly cobble bottom and established forest cover in most places with exception of a small open area near the gun club. There is also a small cascade at the start of the reach that is located immediately above the culvert running beneath Rifle Range Road but this is not expected to present a migration barrier for most species (except perhaps īnanga). A notable feature of the survey was the large number of banded kokōpu recorded (n=95) despite the relatively small size of the wetted / fished area (Table 3).

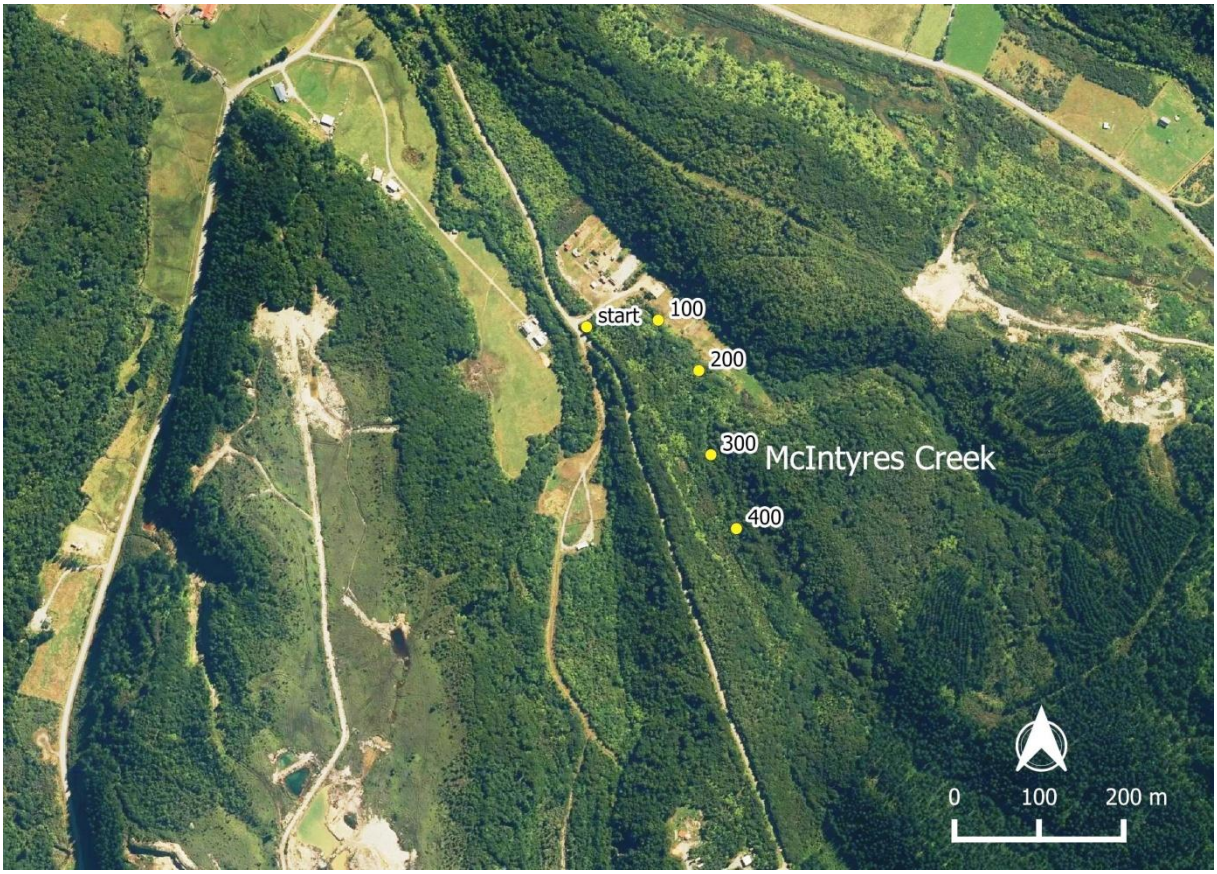

Fig. 13 Location of the McIntryes Creek survey reach in the Houhou Creek catchment.

Sunny Creek

Sunny Creek is a tributary of the Lake Kaniere catchment and flows into the lake a short distance below the study reach (Fig. 14). The study reach is a 3rd order stream with an upstream catchment area of 4 km^2. The riparian margins are largely unmodified with established forest cover with the exception of a cleared grass and swamp area (visible in Fig. 14) that come close to the stream. There are also some small areas of bank erosion alongside the Kahikatea Track within the survey reach. The streambed substrate features a high proportion of gravel which offers limited fish cover. However, the presence of root mat overhangs along the banks, particularly on the true left creates ideal refuges for species such as giant kokōpu. They were found to be numerous in the reach and included several large individuals. A single brown trout was also recorded in the reach

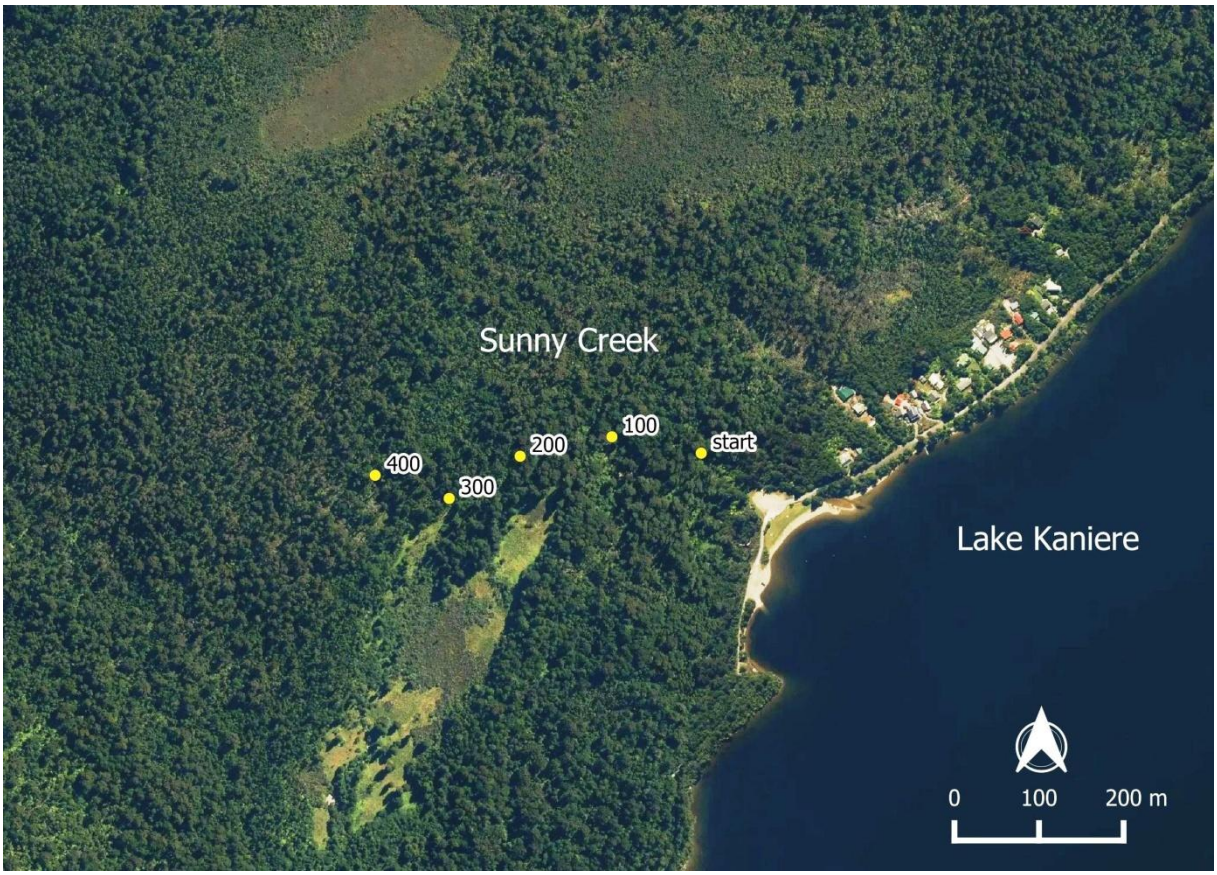

Fig. 14 Location of the Sunny Creek survey reach in the Lake Kaniere catchment.

Appendix 2. NZFFD report cards

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Appendix 3: Pfankuch Stability assessments

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Appendix 4: National Rapid Habitat Assessment Protocol forms

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