Rapid spotlight survey for migratory fish in the Rakautara catchment, Kaikōura coast

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Prepared for

Environment Canterbury
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Adult koaro (*Galaxias brevipinnis*) in the lower Rakautara River
Photo: S. Orchard

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1. Introduction

1.1 Background

This project investigated and trialled a spotlight-based approach for fish surveys with the objective of obtaining relative abundance data for a target species at a relatively large scale. The initial intention was to trial this general approach to explore the feasibility of completing catchment-wide surveys for shortjaw kōkopu (*Galaxias postvectis*) in hill-country catchments on the Kaikōura coast. Within the overall project scope four rivers of particular interest were identified. Two of these (Blue Duck Creek and Ohau Stream) have previous records of shortjaw kōkopu, and the other two catchments (Irongate and Rakautara) are situated between the Blue Duck and Ohau streams. For Blue Duck Stream two shortjaw kōkopu were captured in a University of Canterbury survey using minnow-traps in 1998. In Ohau Stream, one shortjaw kōkopu was detected by electric fishing in 1998, and another two in a spotlight survey in 2000 by the Department of Conservation. All four catchments have similar habitat conditions that include potential shortjaw kōkopu habitat (Fig. 1).

The initial intention for the 2021 summer was to attempt a whole-of-catchment survey for shortjaw kōkopu in Blue Duck Stream using a combination of the rapid spotlighting method described here and eDNA sampling at the bottom of the catchment. The latter was part of a trial to develop the protocol for this technology and to look for a DNA signature of shortjaw kōkopu in the Blue Duck catchment. The eDNA analysis was funded by ECan's Fish Habitat Fund, and the sampling was conducted by ECan's Surface Water Science team. However, complexities in contacting and securing approval from the many landowners in the Blue Duck catchment were encountered, leading to a back-up plan being developed for the spotlight surveys in the Rakautara River catchment following contact with the landowners there. This was subsequently selected for the 2021 survey (Fig. 2). Although this meant that an eDNA sample was not available to complement the spotlight survey results it is hoped that all four catchments will be sampled using both methodologies in the near future.

1.2 Scope and purpose

This report provides a brief summary of the above project. The primary objectives involved the refinement and trialling of existing Department of Conservation (DOC) guidelines for fixed reach spotlight surveys. The scope was limited by the time and resources available to the team but greatly assisted by the generous support of several volunteers. In total, these resources allowed for the survey of 2.8 km of river comprising seven survey reaches (each 400 m) as described further below.

Because of the larger size of the Rakautara catchment in relation to the original trial site in the Blue Duck, two key decisions were taken to maximise the value of the results obtained that are reflected in the location of the survey areas. First, the lower 2 km of the catchment below a major (c. 10 m) waterfall (Fig. 1b) was surveyed in its entirety to assess the fish population in this area which was suspected to be potentially enriched due to a natural barrier effect. Second, the remaining survey effort was deployed in the upper catchment above the waterfall (Fig. 2). Although the latter consisted of only two survey reaches (800 m total) it provides an indication of the barrier effect.

Fig. 1 (a) A typical section of stream habitat in the lower Rakautara River. (b) Large waterfall approximately 2 km from SH1 in the lower Rakautara River. The first five survey reaches were located in the lower catchment downstream of this point.

2. Methods

2.1 Survey area

The Rakautara is a 4th order catchment with an area of 16.1 km^2 located in coastal hill-country north of Kaikōura (Fig. 2). The State Highway 1 bridge was selected as the origin point for five 400 m survey reaches that cover a contiguous 2 km section of the lower catchment. The remaining two survey reaches were located in the upper catchment immediately upstream of the Seaward Valley track which provides a convenient access point. The track crossing point is situated immediately below a prominent confluence and a decision was made to locate one survey reach in the mainstem and one in the un-named smaller tributary (hereafter 'South tributary') above this point (Fig. 2). Additional reconnaissance was completed in the upper catchment to identify other potentially suitable (i.e., safe and accessible) survey reaches in the mainstem. In the upstream direction a series of major cascades featuring large boulders was

identified that is unsuitable for spotlighting, although other suitable reaches are likely to be present further upstream. In the downstream direction a reach of 400 m was inspected and is suitable for spotlighting. Further downstream there is approximately 800 m of additional terrain above the waterfall that was not directly observed but could likely be accessed by streambed travel from the Seaward Valley track.

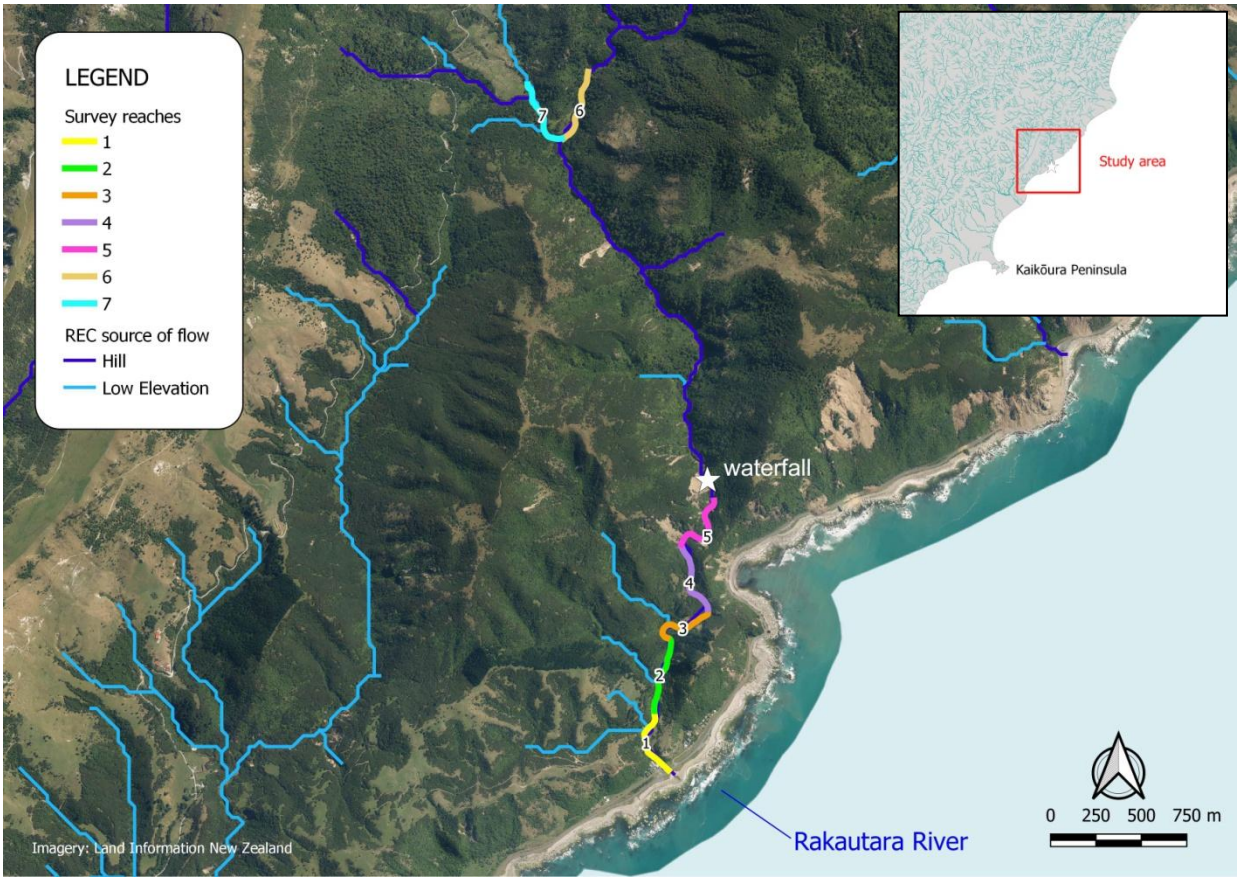

Fig. 2 Location of the 400 m survey reaches in the Rakautara catchment on the Kaikōura coast. REC = River Environment Classification (Snelder & Biggs 2002).

2.2 Background to survey method

The field approach for these surveys was developed during a workshop and subsequent discussions with DOC and ECan staff convened for that purpose (D. Jack, S. Bowie, D. Gray, J. Arthur, C. Armour, pers. comm.).

The overall rationale was to keep the procedure as efficient as possible with regards to time and cost, and targeted at the detection of a priority species being shortjaw kōkopu in this case. The performance metrics essentially boil down to covering a lot of ground quickly while identifying shortjaw presence and abundance in a relatively robust and repeatable way, and recording other fish species based primarily on visual observations and length estimates to reduce the time spent attempting to catch and measure fish. However, we did devote some time to catching other species to obtain positive identifications.

Questions that were refined and incorporated in the specific method used for this survey included:

- extent of environmental information to be collected from the survey reaches

- spatial resolution (grain) of the field measurements within the fixed reach
- appropriate formats for data storage

The starting point for the workshop and subsequent discussions was the DOC toolkit for freshwater fish spotlighting in fixed reaches (Allibone 2013). The field procedures were also designed to be consistent with DOC's recent programme of repeat surveys at sites where shortjaw have been previously recorded (Jack 2020). These surveys used a 400 m fixed reach as the standard survey unit, which is also the longest reach length recommended in Allibone (2013) for fixed reach surveys. This reach length was also adopted here. Most of the field procedures used in the Jack (2020) surveys were also adopted to ensure consistency with the recent DOC surveys but with the omission of total dissolved solids (TSD) as a water quality measurement, which requires a specialist meter to be available.

In addressing spatial resolution aspects, several refinements were explored to support the inclusion of fine-grained data from a large survey reach within open access data storage formats such as the New Zealand Freshwater Fish Database (NZFFD). The solution that was developed involved the aggregation of data to create a single NZFFD record for each 400 m reach that incorporated the following aspects in the data collection and entry steps:

- during the field survey, environmental parameters were measured separately in each of four 100 m sub-reaches and mean values for the 400 m reach were calculated from the sub-reach data.
- fish data were recorded separately for each 100 m sub-reach and these were uploaded to the NZFFD as an aggregated record for the 400 m reach but identified according to sub-reach using an existing field within the NZFFD. This step extends the data entry time a little but allows for the 100 m sub-reach fish data to be identified and accessed directly from the national repository if desired.

The following sections provide details of the field survey and data collection protocols.

2.3 Survey protocol

Pre-survey planning

A desktop assessment of the catchment was completed using high resolution aerial imagery and other publicly available datasets in a GIS environment, and augmented by local knowledge sources. This process identified several useful aspects for survey planning including the location of potential access points, an impression of streambed and riparian vegetation conditions, location of landslides and sections of steep gradient, and other evidence of potential hazards or difficult terrain. Land tenure information was also identified and landowner approval obtained.

Daylight habitat assessment

A daytime reconnaissance survey was completed during which each fixed reach was established by direct measurement from a pre-determined origin point using a 50 m tape. This procedure adds no additional time to the survey process when performed by a team of two, and improves the accuracy of reach length delineation in comparison to using a handheld GPS to record a track, especially where a continuous track may be difficult to record due to canopy cover. Width and depth measurements were made every 50m during this procedure.

For each 400 m survey reach, four 100 m sub-reaches were marked using brightly coloured flags to assist visual identification at night. GPS coordinates were measured at the start and end of each 100 m sub-reach along with temperature and conductivity at the deepest part of the channel in flowing water at that point (Table 1).

The following environmental parameters were also measured as per the standard NZFFD data fields and recorded separately for each 100 m sub-reach:

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

Two additional subjective assessments, the Pfankuch Stability Assessment (Pfankuch 1975), and the National Rapid Habitat Assessment Protocol (NRHAP) (Clapcott 2015), were completed at the 400 m reach scale with the assistance of the other habitat measurements as above. Both of these assessments were used in the recent DOC shortjaw remeasurement surveys (Jack 2020) and their inclusion will facilitate comparisons between sites and over also time if the fixed reaches are re-surveyed in future years. Additional notes on threats and pressures affecting the streambed or riparian zones were noted when observed.

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	Rakautara	SH1	24/3/21	1	173.8051699	-42.265987
				2	173.8043579	-42.2654344
				3	173.8036574	-42.2646353
				4	173.8038456	-42.263873
2	Rakautara	SH1	24/3/21	1	173.8041759	-42.2630521
				2	173.80445	-42.2620723
				3	173.8045204	-42.2613012
				4	173.805018	-42.2604749
3	Rakautara	SH1	25/3/21	1	173.8050099	-42.2594363
				2	173.8047622	-42.258951
				3	173.805848	-42.2589558
				4	173.8069737	-42.2585811
4	Rakautara	Half Moon Bay track	29/3/21	1	173.8077006	-42.2579937
				2	173.8070258	-42.2573148
				3	173.8064975	-42.2565997
				4	173.8065082	-42.2557821
5	Rakautara	Half Moon Bay track	29/3/21	1	173.8058812	-42.2547948
				2	173.8067124	-42.2543495
				3	173.8076606	-42.2542366
				4	173.8074341	-42.2534151
6	Rakautara	Seaward Valley track	28/4/21	1	173.7977707	-42.2347359
				2	173.7985595	-42.2340361
				3	173.7989248	-42.233182
				4	173.798971	-42.2323266
7	South tributary	Seaward Valley track	28/4/21	1	173.7976417	-42.2347292
				2	173.7964207	-42.2341066
				3	173.7961909	-42.2334171
				4	173.7956389	-42.2328302

Spotlight survey

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 the survey team. The spotlighting process generally followed the descriptions in Joy et al. (2013) for a single-pass survey with a team of 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 reliably be seen.

To facilitate the above field procedures, an adapted version of the NZFFD form was developed to support the collection of all key data at 100 m reach scale and subsequent aggregation into a 400 m reach record for upload to the NZFFD (Appendix 1). This format was subject to a degree of trial in the field and refined during the survey programme.

Data archiving

All environmental data were uploaded to the NZFFD using the applicable values (i.e., average or maximum) calculated for the 400 m reach. For the NZFFD channel width and depth data fields (which require individual measurements to be uploaded), 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 100 m sub-reach separately using the 'Pass/ Trap/ Net No.' field to distinguish the observations from each sub-reach (Table 2). Using this approach, all observations from sub-reach 1 (0-100 m) were recorded first with '100' entered in the 'Pass/ Trap/ Net No.' field and so on.

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

A total of six fish species were recorded across all survey reaches in the catchment (Table 1). A seventh category ('unidentified eel') was also recorded but it is likely that the majority if not all of these individuals were longfin eels (*Anguilla dieffenbachia*) with no shortfin eels (*Anguilla australis*) being positively identified. Four other migratory species were recorded that generally rely on connectivity to the sea for completion of their life cycles; īnanga (*Galaxias maculatus*), koaro (*Galaxias brevipinnis*), redfin bully (*Gobiomorphus huttoni*), and torrentfish (*Cheimarrichthys fosteri*). No shortjaw kōkopu or other kōkopu species were caught or seen.

Table 3. Summary of Rakautara fish survey results by 100 m sub-reach.

400 m reaches	100 m sub-reaches	Wetted area (m^2)	Fished area (m^2)	Abundance						
				GALMAC	GALBRE	GOBGOB	GOBHUT	CHEFOS	ANGDIF	ANGUIL
1	1	575	460	172	1	4		1		5
	2	415	332		6					8
	3	430	344		4				3	3
	4	520	416		10		1		1	9
2	1	665	266		2		4			8
	2	735	257		9		10			3
	3	590	236		7		3		1	7
	4	425	170		7		1			
3	1	375	206		9		2		1	5
	2	380	228		3				3	3
	3	435	239		9					10
	4	560	336		9					8
4	1	550	275		17		4			6
	2	500	250		17					11
	3	450	315		9		2			
	4	425	213		1					
5	1	400	200		7					6
	2	580	232		11		1			7
	3	540	162		13					11
	4	590	207		13					9
6	1	540	270						1	2
	2	520	260		1					4
	3	520	234							1
	4	810	446							3
7	1	280	210							
	2	350	245							1
	3	370	241							1
	4	230	150							3

Several spatial patterns of note are evident in the presence and abundance data. They include numerous īnanga being recorded in the first 100 m sub-reach and none recorded further upstream. This pattern coincided with the presence of a near vertical cascade c.1 m high which evidently creates an effective barrier to upstream īnanga migration (Fig. 3a). The only torrentfish recorded was also found in this reach

and was a large female. Another striking pattern was the high abundance of koaro above this barrier, but particularly further upstream in survey reaches 4 and 5. Over 40 koaro were recorded in each of these reaches, with the average length of the fish being highest in reach 5 (Table 4). As reach 5 ended a short distance below the large waterfall, this pattern is consistent with a 'bottleneck' effect caused by the natural barrier in combination with suitable habitat. In survey reach 2, the average length of koaro was smallest (102 mm) which reflects the presence of numerous juveniles that were observed in pool habitat in this reach.

Fish diversity and abundance was much reduced in the upper catchment survey reaches, but two migratory species were still present: koaro and longfin eel. Although only a single koaro was recorded, it was the largest found in the entire survey campaign (232 mm). Two additional koaro were also observed outside of the survey reaches downstream of the Seaward Valley track.

Table 4. Abundance, density and length data[†] for fish species recorded in 400 m fixed reaches.

400 m reaches	Metric	GALMAC	GALBRE	GOBGOB	GOBHUT	CHEFOR	ANGDIF	ANGUIL
1	Abundance	172	21	4	1	1	4	25
	Density (fish / m^2)	0.111	0.014	0.003	0.001	0.001	0.003	0.016
	Mean length	72	136	130	87	166	525	391
	Max. length	90	192	150	87	166	700	650
2	Abundance		25		18		1	18
	Density (fish / m^2)		0.027		0.019		0.001	0.019
	Mean length		102		77		400	464
	Max. length		162		100		400	700
3	Abundance		30		2		4	26
	Density (fish / m^2)		0.030		0.002		0.004	0.026
	Mean length		106		95		700	383
	Max. length		170		100		800	600
4	Abundance		44		6			17
	Density (fish / m^2)		0.042		0.006			0.016
	Mean length		110		98			479
	Max. length		195		105			750
5	Abundance		44		1			33
	Density (fish / m^2)		0.055		0.001			0.041
	Mean length		145		100			476
	Max. length		220		100			800
6	Abundance		1				1	10
	Density (fish / m^2)		0.001				0.001	0.008
	Mean length		232				600	615
	Max. length		232				600	1000
7	Abundance							5
	Density (fish / m^2)							0.006
	Mean length							334
	Max. length							400

[†] length data are total fish length (mm) as estimated or measured in the field

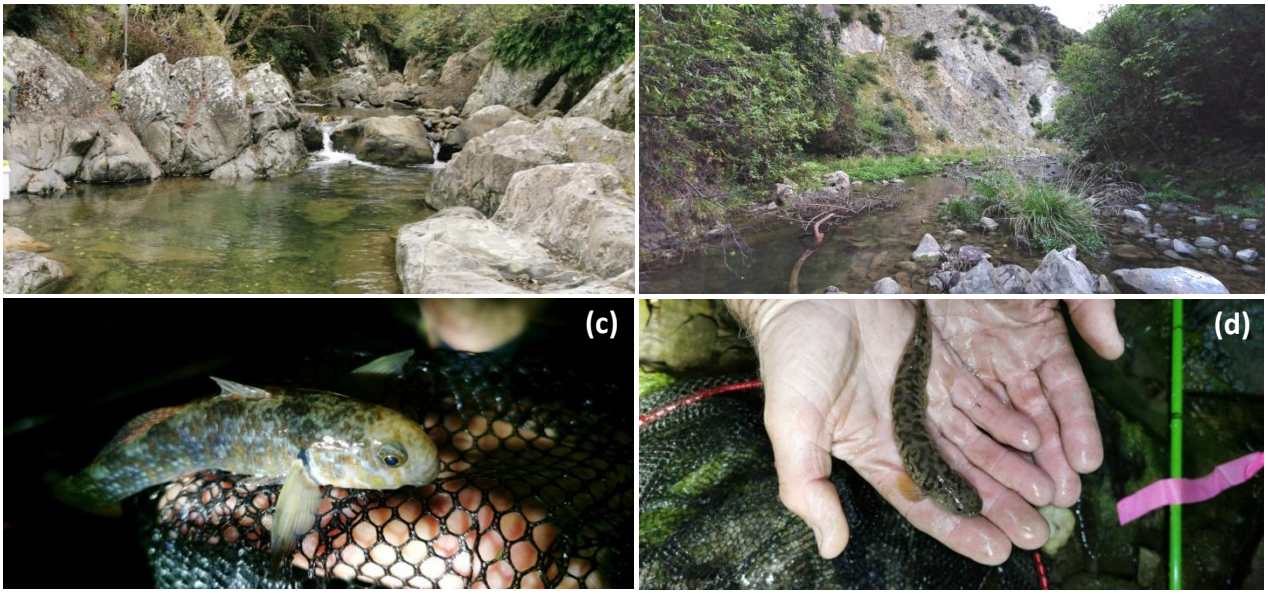

Fig. 5 (a) A small cascade in the lower catchment (survey reach 1). There were no īnanga (*Galaxias maculatus*) recorded above this point. (b) Earthquake slips are common in the catchment and filled in the riverbed in some places creating dry reaches broken by pools. (c) Redfin bully (*Gobiomorphus huttoni*) were numerous in the lower catchment but not found upstream of the major waterfall above survey reach 5 (Fig. 1b). (d) Koaro (*Galaxias brevipinnis*) are able to climb the major waterfall but their abundance appears to be much reduced in the upper catchment based on the two survey reaches completed there.

4. Discussion

4.1 Key findings

Results from this project highlight the importance of lower section of the catchment for migratory species due to the presence of a natural migration barrier. Despite the presence of two species above the large waterfall, they were much more abundant in the lower catchment survey reaches due to an apparent bottleneck effect. Three other migratory species (īnanga, torrentfish and redfin bully) were only found below the barrier. Implications for management include a need to identify the lower catchment as important habitat for all of these five species, and taking steps to ensure its protection over time.

The results also showed a clear delineation in the upstream penetration of the īnanga population that was comprehensively documented using the contiguous sub-reach approach. A similar effect was also evident for torrentfish, which is also a poor climber, although there was only one individual found. As a result, the available habitat for these two species in the Rakautara appears to be extremely limited; yet these species are found there as a result of their migratory life cycles. Consequently, the very bottom of the catchment is highly important and indeed critical for fish to complete their life cycle. A particular focus protecting this short reach (c. 100 m above SH1 and to the river mouth below) would be advantageous. Similarly, habitat restoration efforts in this area could be beneficial and would represent a highly targeted proposition given the small area involved. They could include a focus on improving adult fish or spawning habitat, or both. The availability of īnanga spawning habitat is of particular note since the īnanga population must spawn in this reach and the spawning grounds likely conform to the patterns observed in other non-tidal river mouth systems on the Kaikōura coast (Orchard & Schiel 2021).

Related aspects for management include monitoring of fish population changes into the future (particularly for the at-risk species present), for which these results provide a useful baseline. Although the lower catchment is clearly a conservation priority, it is also intriguing to consider the upper catchment further given the limited number of surveys we were able to complete there. The upper catchment terrain

also includes habitat types such as large rock gardens and cascades that differ from the habitats that were sampled in this campaign. In the future, a combination of eDNA sampling and further spotlighting would likely provide the best approach for surveying these areas if desired.

4.1 Survey time requirements

The time requirements for this survey approach averaged around 2 hours for the daytime reconnaissance survey per 400 m reach, depending on any additional time needed for access. As a result, it is feasible to mark out two or possibly three contiguous 400 m reaches in the same section of waterway during a typical field day. However, if spotlighting is scheduled for later that night, more than two would make for an extremely long day and thus is not recommended. Each spotlight survey took between two and four hours in this project with the main determinant on the time being the wetted area to be surveyed. Additional and variable time requirements resulted from the level of effort devoted to catching and measuring fish, which itself is dependent on the clarity, depth and water surface conditions in which the fish are found since these factors affect the level of confidence for species identification based on visual clues. Life stage of the fish encountered is another consideration for estimating time requirements since juveniles are typically more difficult to identify with confidence based on visual clues. An example in our case occurred in survey reach 2 where numerous juvenile koaro were found. Many of these exhibited a grey colour morph that was obviously different from the golden colouration of most fish which is a useful clue for spotlighting, especially where the substrate colour is mostly grey. This discovery complicated visual identification until quite a few individuals had been caught, after which morphological features such as shape of the body could be used more confidently for visual identification in the smaller size ranges, and since no confirmed shortjaw kōkopu were found. This example also shows how the overall process of the survey may evolve during the night depending on what is found.

4.3 Efficiency and scalability

The best strategy to reduce overall survey time was the availability of a third team member who can operate a second spotlight. In this project we found that this approach was particularly useful when the wetted width was greater than c. 4m, and also where deep pools make spotlighting more difficult from the streambed forcing the spotlighter(s) to take up positions on the bank. A second spotlight may also improve detection efficiency in fast riffle sections which can easily be ‘glanced over’ by a single spotlighter in the interest of saving time, but in many cases fish can be found in these sections by simply spending more time to cover the same area of water than would be required for a section where the water surface is smooth. These logistics relate to the behaviour of broken water surfaces where occasionally there will be a window of improved visibility as the current pattern changes, and this can permit the observer to see into the water column at that time. In this project, several koaro were found in fast riffle sections using this technique.

In relation to the standardisation of survey effort, a second spotlighter in these sections does not result in a material difference to the theoretical survey effort (in which all of the wetted area should have been covered), but does reduce the time requirement. In any event, the team will need to estimate the percentage of the waterway that was reliably ‘fished’ at the completion of the reach, and where two spotlighters are available this estimate may be slightly higher from the same overall survey time. Where the streambed was open and less than c. 4 m in width, the single spotlight was relatively fast and the benefit of having a third person diminished as a result. Decisions on whether a third person will significantly reduce overall survey time might therefore be guided by the width of the waterway to be surveyed, accessibility to the riverbed, and the level of effort to be devoted to catching fish (which in turn is influenced by the number of target species to some degree).

The combinations of factors and considerations discussed above suggests that the approach used in these surveys can be scaled to tackle two 400 m survey reaches per night in favourable conditions (e.g., smaller stream sizes) and with the strategic use of a third team member to improve efficiency in larger stream sizes. As was found in the recent DOC surveys using 400 m fixed reaches, a decision on whether to commit to two reaches must still be taken and can be difficult to make (D. Jack, pers. comm.). It is hoped that results from this project may assist these considerations in the design of targeted surveys for relatively large survey areas. In our original plan we also anticipated having two teams working concurrently on different survey reaches. This did not eventuate due to timing and logistical circumstances but could assist the objective of upscaling the survey effort to obtain a wider catchment view during a single survey campaign.

eDNA and rapid survey combinations

Although the eDNA sampling aspects of this project did not eventuate as planned, it is important to note the potential for combinations of the two techniques. At the time of writing there were several projects underway or recently completed that involved trials of eDNA sampling protocols and applications for the detection of freshwater fish. In the near future it is expected that combinations of eDNA sampling as a screening tool, and targeted spotlight surveys as used here, will provide efficient survey approaches for obtaining relative abundance data at increasingly larger scales.

6. Acknowledgements

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Appendix 1. 400 m fixed reach data collection form

400m fixed reach DATA COLLECTION FORM			Data collected from 100 m sub-reaches are aggregated for NZFFD entry as a 400m reach
Sub-reach breakpoints	WGS X coordinate	WGS Y coordinate	Notes
1 (0 -100m)			
2 (100-200m)			
3 (200-300m)			
4 (300-400m)			

SUB-REACH 1 (0-100m) Fishing start time: Fished area (%): Fished area (m^2):

Widths						Temp	Cond.
Depths						pH	DO
Average width (m)	Average depth (cm)	Maximum depth (cm)	Clarity: clear/milky/dirty	Clarity (m) Black disk	Colour: blue/green/tea/uncoloured/other:		
Habitat type (%)	Still	Backwater	Pool	Run	Riffle	Rapid	Cascade
Substrate type (%)	Mud	Sand	Pebble	Gravel	Cobble	Boulder	Bedrock

Riparian vegetation (%)	Native forest	Exotic forest	Pasture	Tussock	Scrub Willow	Raupo Flax	Exposed bed	Other
Fish cover / Inverts	Weed	Algae	Instream debris	Undercut banks	Bank vegetation	Mussels	Koura	Shrimp

Notes

Species and life stage	Length data / Abundance*	Habitat

* circle lengths actually measured. For abundance record total number observed or classify as abundant/common/occasional/rare

SUB-REACH 2 (100-200m) Fishing start time: Fished area (%): Fished area (m^2):

Widths						Temp	Cond.
Depths						pH	DO
Average width (m)	Average depth (cm)	Maximum depth (cm)	Clarity: clear/milky/dirty	Clarity (m) Black disk	Colour: blue/green/tea/uncoloured/other:		
Habitat type (%)	Still	Backwater	Pool	Run	Riffle	Rapid	Cascade
Substrate type (%)	Mud	Sand	Pebble	Gravel	Cobble	Boulder	Bedrock

Riparian vegetation (%)	Native forest	Exotic forest	Pasture	Tussock	Scrub Willow	Raupo Flax	Exposed bed	Other
Fish cover / Inverts	Weed	Algae	Instream debris	Undercut banks	Bank vegetation	Mussels	Koura	Shrimp

Notes

Species and life stage	Length data / Abundance*	Habitat

SUB-REACH 3 (200-300m) Fishing start time: Fished area (%): Fished area (m^2):

Widths						Temp	Cond.
Depths						pH	DO
Average width (m)	Average depth (cm)	Maximum depth (cm)	Clarity: clear/milky/dirty	Clarity (m) Black disk	Colour: blue/green/tea/uncoloured/other:		
Habitat type (%)	Still	Backwater	Pool	Run	Riffle	Rapid	Cascade
Substrate type (%)	Mud	Sand	Pebble	Gravel	Cobble	Boulder	Bedrock

Riparian vegetation (%)	Native forest	Exotic forest	Pasture	Tussock	Scrub Willow	Raupo Flax	Exposed bed	Other
Fish cover / Inverts	Weed	Algae	Instream debris	Undercut banks	Bank vegetation	Mussels	Koura	Shrimp

Notes

Species and life stage	Length data / Abundance*	Habitat

SUB-REACH 4 (300-400m) Fishing start time: Fished area (%): Fished area (m^2):

Widths						Temp	Cond.
Depths						pH	DO
Average width (m)	Average depth (cm)	Maximum depth (cm)	Clarity: clear/milky/dirty	Clarity (m) Black disk	Colour: blue/green/tea/uncoloured/other:		
Habitat type (%)	Still	Backwater	Pool	Run	Riffle	Rapid	Cascade
Substrate type (%)	Mud	Sand	Pebble	Gravel	Cobble	Boulder	Bedrock

Riparian vegetation (%)	Native forest	Exotic forest	Pasture	Tussock	Scrub Willow	Raupo Flax	Exposed bed	Other
Fish cover / Inverts	Weed	Algae	Instream debris	Undercut banks	Bank vegetation	Mussels	Koura	Shrimp

Notes

Species and life stage	Length data / Abundance*	Habitat

Appendix 2. NZFFD records

Sampling event 121546

Freshwater Fish Database Card: 121546			Your Organisation's Reference number:
Date: 24 Apr 2021	Catchment No. & Name: 626.000 Rakautara Stream P31 Rakautara		Purpose of work: Distribution mapping
Time: 21:00	Sampling locality: Rakautara mainstem		Water body type: Stream
Observer name: Shane Orchard	How accessed: from SH1		Stream type: Perennial
	NZMS260 :		Water Level: Medium
Organisation: environment canterbury	Topo50 :		Downstream barriers: No
	GPS (lat. long.) : 173.804577,-42.265528		Tidal Water: No
			Landlocked: No
Reach length (m): 400	Average reach width (m): 4.85	Reach widths measured (m): 5.75, 4.15, 4.3, 5.2	Reach depths measured (cm): 33, 40, 28, 24
	Maximum reach depth (cm): 120		
Altitude (m): 31	Distance inland (km): 0	NZ Reach: 13005927	NZ Segment: 13064708

Habitat Data

Colour: Colourless	Clarity (cm):	Clarity method:	Temperature (°C): 12.9	Conductivity (µS/m): 145	pH:	Oxygen (ppm):	Salinity (ppt):
Habitat type (%): Backwater 3 Cascade 2 Pool 38 Rapid 3 Riffle 23 Run 30 Still 1 Torrent 0							
Substrate type (%): Bedrock 3 Boulders (> 257 mm) 25 Cobbles (64-257 mm) 36 Gravel (3-64 mm) 35 Mud/Silt (< 1mm) 1 Sand (1-2 mm) 0							
Fish instream cover presence: Bank vegetation y Cobbles y Macrophytes y Periphyton y Wood/instream debris y							
Riparian vegetation (%): Exotic forest 5 Native forest 55 Other 25 Pasture 5 Scrub/willow 10							
Invertebrate abundance:		Predominant invertebrate:		Macro-invertebrates present:			

Fish catch data

Capture method	Pass/trap/net No	Species	No captured	weight g	Lengths mm	Comment
Observation - Spotlighting (dip net)	1	Unidentified eel (Anguilla)	5		250, 300, 600, 500, 600,	
Observation - Spotlighting (dip net)	100	Inanga (Galaxias maculatus)	172		90, 60, 70, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 60, 60, 70, 70, 70, 70, 60, 60, 60, 60, 60, 60, 60, 60, 60, 60, 60, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 80, 80, 70, 70, 80, 80, 50, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 60, 60, 60, 60, 60, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 80, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 90, 90, 80, 80, 80, 80, 80, 60, 60, 60, 60, 60, 60, 60, 60, 60, 60, 60, 80, 80, 80, 80, 80, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 70, 60, 60, 60, 60, 60, 70, 70, 70, 70, 70, 80, 80, 80, 80, 80,	
Observation - Spotlighting (dip net)	100	Torrentfish (Cheimarrichthys fosteri)	1		166	
Observation - Spotlighting (dip net)	100	Koaro (Galaxias brevipinnis)	1		100	

Fish catch data

Capture method	Pass/trap/net No	Species	No captured	weight g	Lengths mm	Comment
Observation - Spotlighting (dip net)	100	Giant bully (Gobiomorphus gobioides)	4		150, 140, 120, 110,	
Observation - Spotlighting (dip net)	200	Unidentified eel (Anguilla)	8		350, 300, 500, 400, 450, 400, 650, 300,	
Observation - Spotlighting (dip net)	200	Koaro (Galaxias brevipinnis)	6		110, 95, 130, 130, 100, 80	
Observation - Spotlighting (dip net)	300	Longfin eel (Anguilla dieffenbachii)	3		700, 500, 500,	
Observation - Spotlighting (dip net)	300	Unidentified eel (Anguilla)	5		250, 300, 450, 350, 300,	
Observation - Spotlighting (dip net)	300	Koaro (Galaxias brevipinnis)	5		120, 190, 170, 170, 175,	
Observation - Spotlighting (dip net)	400	Longfin eel (Anguilla dieffenbachii)	1		400	
Observation - Spotlighting (dip net)	400	Unidentified eel (Anguilla)	9		300, 250, 500, 250, 500, 550, 350, 300, 600,	
Observation - Spotlighting (dip net)	400	Koaro (Galaxias brevipinnis)	10		70, 120, 150, 190, 150, 140, 190, 192, 130, 90,	
Observation - Spotlighting (dip net)	400	Redfin bully (Gobiomorphus huttoni)	1		87	

Freshwater Fish Database Card: 121640			Your Organisation's Reference number:
Date: 24 Mar 2021	Catchment No. & Name: 626.000 Rakautara Stream P31 Rakautara		Purpose of work:
Time: 21:00	Sampling locality: Rakautara mainstem		Water body type: Stream
Observer name: Shane Orchard	How accessed: from SH1		Stream type: Perennial
	NZMS260 :		Water Level: Medium
Organisation: environment canterbury	Topo50 :		Downstream barriers: No
	GPS (lat. long.) : 173.8036574,-42.2646353		Tidal Water: No
			Landlocked: No
Reach length (m): 400	Average reach width (m): 6.04	Reach widths measured (m): 6.65, 7.35, 5.9, 4.25	Reach depths measured (cm): 20, 29.5, 28.5, 28.5
	Maximum reach depth (cm): 80		
Altitude (m): 11	Distance inland (km): 0	NZ Reach: 13005883	NZ Segment: 13064639

Habitat Data

Colour: Colourless	Clarity (cm):	Clarity method:	Temperature (°C): 12.8	Conductivity (µS/m): 139	pH:	Oxygen (ppm):	Salinity (ppt):
Habitat type (%): Backwater 1 Cascade 0 Pool 8 Rapid 0 Riffle 52 Run 39 Still 0 Torrent 0							
Substrate type (%): Bedrock 0 Boulders (> 257 mm) 22 Cobbles (64-257 mm) 38 Gravel (3-64 mm) 39 Mud/Silt (< 1mm) 1 Sand (1-2 mm) 0							
Fish instream cover presence: Bank vegetation y Cobbles y Macrophytes n Periphyton y Undercut banks n Wood/instream debris y							
Riparian vegetation (%): Exotic forest 0 Native forest 35 Other 50 Pasture 0 Raupo/flax 0 Scrub/willow 5 Tussock 10 Urban zone 0							
Invertebrate abundance: Unknown	Predominant invertebrate:	Macro-invertebrates present:					

Fish catch data

Capture method	Pass/trap/net No	Species	No captured	weight g	Lengths mm	Comment
Observation - Spotlighting (dip net)	100	Koaro (Galaxias brevipinnis)	2		100, 110,	
Observation - Spotlighting (dip net)	100	Redfin bully (Gobiomorphus huttoni)	4		70, 80, 90, 50,	
Observation - Spotlighting (dip net)	100	Unidentified eel (Anguilla)	8		400, 600, 500, 500, 450, 450, 300, 400,	
Observation - Spotlighting (dip net)	200	Koaro (Galaxias brevipinnis)	9		150, 90, 70, 120, 70, 65, 65, 60, 60, 60,	
Observation - Spotlighting (dip net)	200	Redfin bully (Gobiomorphus huttoni)	10		90, 90, 50, 70, 50, 70, 50, 80, 80, 80,	
Observation - Spotlighting (dip net)	200	Unidentified eel (Anguilla)	3		400, 700, 350,	
Observation - Spotlighting (dip net)	300	Koaro (Galaxias brevipinnis)	7		120, 110, 105, 115, 70, 100, 162,	
Observation - Spotlighting (dip net)	300	Redfin bully (Gobiomorphus huttoni)	3		100, 100, 90	
Observation - Spotlighting (dip net)	300	Unidentified eel (Anguilla)	7		500, 700, 350, 450, 450, 400, 450	
Observation - Spotlighting (dip net)	300	Longfin eel (Anguilla dieffenbachii)	1		400	
Observation - Spotlighting (dip net)	400	Koaro (Galaxias brevipinnis)	7		90, 110, 140, 100, 110, 100, 110,	
Observation - Spotlighting (dip net)	400	Redfin bully (Gobiomorphus huttoni)	1		100	

Freshwater Fish Database Card: 121641			Your Organisation's Reference number:
Date: 24 Mar 2021	Catchment No. & Name: 626.000 Rakautara Stream P31 Rakautara		Purpose of work:
Time: 23:40	Sampling locality: Rakautara mainstem		Water body type: Stream
Observer name: Shane Orchard	How accessed: from SH1		Stream type: Perennial
	NZMS260 :		Water Level: Medium
Organisation: environment canterbury	Topo50 :		Downstream barriers: No
	GPS (lat. long.) : 173.805848,-42.2589558		Tidal Water: No
			Landlocked: No
Reach length (m): 400	Average reach width (m): 4.5	Reach widths measured (m): 3.7, 3.8, 3.8, 4.9, 6.3	Reach depths measured (cm): 40, 27, 25, 22, 17
	Maximum reach depth (cm): 80		
Altitude (m): 20	Distance inland (km): 0.3	NZ Reach: 13005809	NZ Segment: 13064500

Habitat Data

Colour: Colourless	Clarity (cm):	Clarity method:	Temperature (°C): 12.5	Conductivity (µS/m): 214	pH:	Oxygen (ppm):	Salinity (ppt):
Habitat type (%): Backwater 0 Cascade 0 Pool 20 Rapid 0 Riffle 47 Run 33 Still 0 Torrent 0							
Substrate type (%): Bedrock 0 Boulders (> 257 mm) 31 Cobbles (64-257 mm) 40 Gravel (3-64 mm) 29 Mud/Silt (< 1mm) 0 Sand (1-2 mm) 0							
Fish instream cover presence: Bank vegetation y Cobbles y Macrophytes n Periphyton y Undercut banks y Wood/instream debris y							
Riparian vegetation (%): Exotic forest 0 Native forest 40 Other 20 Pasture 0 Raupo/flax 0 Scrub/willow 20 Tussock 20 Urban zone 0							
Invertebrate abundance: Unknown	Predominant invertebrate:		Macro-invertebrates present:				

Fish catch data

Capture method	Pass/trap/net No	Species	No captured	weight g	Lengths mm	Comment
Observation - Spotlighting (dip net)	100	Koaro (Galaxias brevipinnis)	9		141, 110, 110, 70, 70, 65, 70, 170, 70	
Observation - Spotlighting (dip net)	100	Redfin bully (Gobiomorphus huttoni)	2		90, 100	
Observation - Spotlighting (dip net)	100	Unidentified eel (Anguilla)	5		350, 250, 400, 400, 400,	
Observation - Spotlighting (dip net)	100	Longfin eel (Anguilla dieffenbachii)	1		600	
Observation - Spotlighting (dip net)	200	Koaro (Galaxias brevipinnis)	3		110, 90, 90,	
Observation - Spotlighting (dip net)	200	Unidentified eel (Anguilla)	3		300, 600, 400	
Observation - Spotlighting (dip net)	200	Longfin eel (Anguilla dieffenbachii)	1		800	
Observation - Spotlighting (dip net)	300	Koaro (Galaxias brevipinnis)	9		170, 40, 100, 110, 60, 70, 90, 100, 130	
Observation - Spotlighting (dip net)	300	Redfin bully (Gobiomorphus huttoni)	3		88, 125, 102,	
Observation - Spotlighting (dip net)	300	Unidentified eel (Anguilla)	10		500, 250, 250, 600, 400, 300, 300, 250, 500, 500,	
Observation - Spotlighting (dip net)	400	Koaro (Galaxias brevipinnis)	9		135, 120, 140, 140, 130, 120, 120, 110, 130	
Observation - Spotlighting (dip net)	400	Unidentified eel (Anguilla)	8		450, 500, 250, 400, 500, 400, 500, 600	

Freshwater Fish Database Card: 121642			Your Organisation's Reference number:
Date: 29 Mar 2021	Catchment No. & Name: 626.000 Rakautara Stream P31 Rakautara		Purpose of work:
Time: 21:00	Sampling locality: Rakautara mainstem		Water body type: Stream
Observer name: Shane Orchard	How accessed: from Half Moon Bay track		Stream type: Perennial
	NZMS260 :		Water Level: Medium
Organisation: environment canterbury	Topo50 :		Downstream barriers: No
	GPS (lat. long.) : 173.8064975,-42.2565997		Tidal Water: No
			Landlocked: No
Reach length (m): 400	Average reach width (m): 4.9	Reach widths measured (m): 6, 5, 5, 4, 4.5	Reach depths measured (cm): 19, 11, 25, 30, 20
	Maximum reach depth (cm): 60		
Altitude (m): 63	Distance inland (km): 0.92	NZ Reach: 13005441	NZ Segment: 13063833

Habitat Data

Colour: Colourless	Clarity (cm):	Clarity method:	Temperature (°C): 13.2	Conductivity (µS/m): 189	pH:	Oxygen (ppm):	Salinity (ppt):
Habitat type (%): Backwater 1 Cascade 0 Pool 20 Rapid 0 Riffle 68 Run 11 Still 0 Torrent 0							
Substrate type (%): Bedrock 2 Boulders (> 257 mm) 19 Cobbles (64-257 mm) 42 Gravel (3-64 mm) 35 Mud/Silt (< 1mm) 2 Sand (1-2 mm) 0							
Fish instream cover presence: Bank vegetation n Cobbles n Macrophytes n Periphyton n Undercut banks n Wood/instream debris n							
Riparian vegetation (%): Exotic forest 0 Native forest 35 Other 40 Pasture 0 Raupo/flax 0 Scrub/willow 19 Tussock 6 Urban zone 0							
Invertebrate abundance: Unknown		Predominant invertebrate:		Macro-invertebrates present:			

Fish catch data

Capture method	Pass/trap/net No	Species	No captured	weight g	Lengths mm	Comment
Observation - Spotlighting (dip net)	100	Koaro (Galaxias brevipinnis)	17		70, 75, 100, 90, 60, 90, 142, 140, 90, 65, 95, 150, 160, 70, 140, 105, 110	
Observation - Spotlighting (dip net)	100	Unidentified eel (Anguilla)	6		400, 750, 700, 500, 500, 400,	
Observation - Spotlighting (dip net)	100	Redfin bully (Gobiomorphus huttoni)	4		100, 80, 105, 100	
Observation - Spotlighting (dip net)	200	Koaro (Galaxias brevipinnis)	17		50, 75, 150, 110, 60, 110, 115, 65 ,130, 150, 150, 180, 145, 120, 120, 130, 110,	
Observation - Spotlighting (dip net)	200	Unidentified eel (Anguilla)	11		350, 300, 600, 500, 300, 500, 400, 600, 600, 500, 250,	
Observation - Spotlighting (dip net)	300	Koaro (Galaxias brevipinnis)	9		195, 140, 100, 105, 110, 60, 140, 110, 70,	
Observation - Spotlighting (dip net)	300	Redfin bully (Gobiomorphus huttoni)	2		105, 100,	
Observation - Spotlighting (dip net)	400	Koaro (Galaxias brevipinnis)	1		80	

Freshwater Fish Database Card: 121643			Your Organisation's Reference number:
Date: 29 Mar 2021	Catchment No. & Name: 626.000 Rakautara Stream P31 Rakautara		Purpose of work:
Time: 23:00	Sampling locality: Rakautara mainstem		Water body type: Stream
Observer name: Shane Orchard	How accessed: from Half Moon Bay track Section of stream with the reach are buried by rock debris from earthquake slips in two places - approx 150m affected		Stream type: Perennial
	NZMS260 :		Water Level: Medium
Organisation: environment canterbury	Topo50 :		Downstream barriers: Yes
	GPS (lat. long.) : 173.8076606,-42.2542366		Tidal Water: No
			Landlocked: No
Reach length (m): 400	Average reach width (m): 5.8	Reach widths measured (m): 2.4, 5.1, 8, 7.5, 5.9	Reach depths measured (cm): 10, 11, 50, 24, 26
	Maximum reach depth (cm): 120		
Altitude (m): 63	Distance inland (km): 0.92	NZ Reach: 13005441	NZ Segment: 13063833

Habitat Data

Colour: Colourless	Clarity (cm):	Clarity method:	Temperature (°C): 12.9	Conductivity (µS/m): 190	pH:	Oxygen (ppm):	Salinity (ppt):
Habitat type (%): Backwater 0 Cascade 2 Pool 22 Rapid 0 Riffle 66 Run 10 Still 0 Torrent 0							
Substrate type (%): Bedrock 2 Boulders (> 257 mm) 38 Cobbles (64-257 mm) 31 Gravel (3-64 mm) 27 Mud/Silt (< 1mm) 2 Sand (1-2 mm) 0							
Fish instream cover presence: Bank vegetation y Cobbles y Macrophytes y Periphyton y Undercut banks y Wood/instream debris y							

Riparian vegetation (%): Exotic forest 0 Native forest 30 Other 25 Pasture 0 Raupo/flax 0 Scrub/willow 20 Tussock 25 Urban zone 0		
Invertebrate abundance: Unknown	Predominant invertebrate:	Macro-invertebrates present:

Capture method	Pass/trap/net No	Species	No captured	weight g	Lengths mm	Comment
Observation - Spotlighting (dip net)	100	Koaro (Galaxias brevipinnis)	7		100, 160, 70, 120, 150, 180, 190,	
Observation - Spotlighting (dip net)	100	Unidentified eel (Anguilla)	6		350, 500, 500, 450, 400, 650,	
Observation - Spotlighting (dip net)	200	Koaro (Galaxias brevipinnis)	11		150, 150, 160, 150, 130, 170, 180, 150, 190, 130, 100,	
Observation - Spotlighting (dip net)	200	Unidentified eel (Anguilla)	7		400, 500, 500, 600, 550, 500, 800,	
Observation - Spotlighting (dip net)	200	Redfin bully (Gobiomorphus huttoni)	1		100	
Observation - Spotlighting (dip net)	300	Koaro (Galaxias brevipinnis)	13		160, 140, 110, 120, 140, 110, 130, 180, 140, 110, 120, 150, 140,	
Observation - Spotlighting (dip net)	300	Unidentified eel (Anguilla)	11		550, 450, 550, 450, 450, 550, 450, 750, 400, 400, 450,	
Observation - Spotlighting (dip net)	400	Koaro (Galaxias brevipinnis)	13		100, 160, 140, 140, 160, 170, 140, 170, 190, 190, 170, 60, 220,	
Observation - Spotlighting (dip net)	400	Unidentified eel (Anguilla)	9		300, 350, 500, 450, 450, 400, 300, 350, 450,	

Freshwater Fish Database Card: 121644			Your Organisation's Reference number:
Date: 28 Apr 2021	Catchment No. & Name: 626.000 Rakautara Stream P31 Rakautara		Purpose of work:
Time: 20:00	Sampling locality: Rakautara mainstem		Water body type: Stream
Observer name: Shane Orchard	How accessed: from Seaward Valley track		Stream type: Perennial
	NZMS260 :		Water Level: Medium
Organisation: environment canterbury	Topo50 :		Downstream barriers: Yes
	GPS (lat. long.) : 173.7989248,-42.233182		Tidal Water: No
			Landlocked: No
Reach length (m): 400	Average reach width (m): 5.5	Reach widths measured (m): 5.2, 5, 5, 7, 5.2	Reach depths measured (cm): 27, 25, 70, 24, 23
	Maximum reach depth (cm): 90		
Altitude (m): 198	Distance inland (km): 4.27	NZ Reach: 13004969	NZ Segment: 13062892

Habitat Data

Colour: Clear	Clarity (cm):	Clarity method:	Temperature (°C): 9	Conductivity (µS/m): 207	pH:	Oxygen (ppm):	Salinity (ppt):
Habitat type (%): Backwater 1 Cascade 2 Pool 23 Rapid 0 Riffle 44 Run 30 Still 0 Torrent 0							
Substrate type (%): Bedrock 6 Boulders (> 257 mm) 37 Cobbles (64-257 mm) 29 Gravel (3-64 mm) 26 Mud/Silt (< 1mm) 2 Sand (1-2 mm) 0							
Fish instream cover presence: Bank vegetation y Cobbles y Macrophytes y Periphyton y Undercut banks y Wood/instream debris y							
Riparian vegetation (%): Exotic forest 0 Native forest 61 Other 24 Pasture 0 Raupo/flax 0 Scrub/willow 0 Tussock 15 Urban zone 0							
Invertebrate abundance: Unknown	Predominant invertebrate:	Macro-invertebrates present:					

Fish catch data

Capture method	Pass/trap/net No	Species	No captured	weight g	Lengths mm	Comment
Observation - Spotlighting (dip net)	100	Unidentified eel (Anguilla)	2		250, 300	
Observation - Spotlighting (dip net)	100	Longfin eel (Anguilla dieffenbachii)	1		600	
Observation - Spotlighting (dip net)	200	Koaro (Galaxias brevipinnis)	1		232	
Observation - Spotlighting (dip net)	200	Unidentified eel (Anguilla)	4		600, 500, 550, 600	
Observation - Spotlighting (dip net)	300	Unidentified eel (Anguilla)	1		1000	
Observation - Spotlighting (dip net)	400	Unidentified eel (Anguilla)	3		900, 550, 900	

Freshwater Fish Database Card: 121645			Your Organisation's Reference number:
Date: 28 Apr 2021	Catchment No. & Name: 626.000 Rakautara Stream P31 Rakautara		Purpose of work:
Time: 22:00	Sampling locality: South tributary joining mainstem above Seaward Valley track		Water body type: Stream
Observer name: Shane Orchard	How accessed: from Seaward Valley track		Stream type: Perennial
	NZMS260 :		Water Level: Medium
Organisation: environment canterbury	Topo50 :		Downstream barriers: Yes
	GPS (lat. long.) : 173.7961909,-42.2334171		Tidal Water: No
			Landlocked: No
Reach length (m): 400	Average reach width (m): 2.9	Reach widths measured (m): 2.7, 2.5, 4.2, 3.5, 1.5	Reach depths measured (cm): 26, 68, 11, 44, 20
	Maximum reach depth (cm): 75		
Altitude (m): 208	Distance inland (km): 4.4	NZ Reach: 13005102	NZ Segment: 13063125

Habitat Data

Colour: Colourless	Clarity (cm):	Clarity method:	Temperature (°C): 8	Conductivity (µS/m): 150	pH:	Oxygen (ppm):	Salinity (ppt):
Habitat type (%): Backwater 1 Cascade 1 Pool 24 Rapid 2 Riffle 40 Run 32 Still 0 Torrent 0							
Substrate type (%): Bedrock 19 Boulders (> 257 mm) 20 Cobbles (64-257 mm) 29 Gravel (3-64 mm) 30 Mud/Silt (< 1mm) 0 Sand (1-2 mm) 2							
Fish instream cover presence: Bank vegetation y Cobbles y Macrophytes n Periphyton y Undercut banks y Wood/instream debris y							
Riparian vegetation (%): Exotic forest 0 Native forest 81 Other 14 Pasture 0 Raupo/flax 0 Scrub/willow 0 Tussock 5 Urban zone 0							
Invertebrate abundance: Unknown	Predominant invertebrate:		Macro-invertebrates present:				

Fish catch data

Capture method	Pass/trap/net No	Species	No captured	weight g	Lengths mm	Comment
Observation - Spotlighting (dip net)	200	Unidentified eel (Anguilla)	1		400	
Observation - Spotlighting (dip net)	300	Unidentified eel (Anguilla)	1		350	
Observation - Spotlighting (dip net)	400	Unidentified eel (Anguilla)	3		350, 250, 320,	