2025

Whitebait season information capture, 2022

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Te Kāwanatanga o Aotearoa
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Cover: Compliant whitebait set net on the Waikanae River. *Photo: Department of Conservation*

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Executive summary

This report presents a range of data collected during the 2022 whitebait season, including the identification and ranking of major whitebaiting rivers, a remote (aerial) and riverbank whitebaiter census, a whitebaiter social survey, and an in-depth whitebait catch composition study. It follows a similar report detailing data collected during the 2021 whitebait season (Watson and West 2023).

Using a framework set out in a 1988 assessment of South Island rivers of recreational and commercial significance for whitebaiting (Kelly 1988), Department of Conservation staff assessed the state of the major whitebaiting rivers in their district in the 2022 season. North Island rivers were also categorised using limited historical data. Estimates of 2022 significance largely matched 1988 categories, but estimates of number of whitebaiters fishing the same river were lower in 2022 than in 1988 or the 1990s.

An expansion of aerial counts in areas of the South Island enabled greater coverage of key whitebaiting regions, investigation of the effect of the timing of counts (early or late season) on estimates of whitebaiters, and analysis of the effect of day of the week (weekdays vs weekend days) on whitebaiter counts. Counts of whitebaiters in South Westland rivers appeared higher later in the season, although an increase in numbers of scoop netters may have driven the change. The variability of increased fishing when there are greater 'runs' of whitebait also confounds identifying seasonal patterns in whitebaiting activity. We were surprised to find that day of the week did not affect the number of whitebaiters present on the Waimakariri River (we expected weekend days to be busier). However, we noted that limited fishing area was available at this site due to tides and the river-mouth geomorphology at the time.

The 2022 whitebaiter social survey expanded the reach, depth and survey response numbers of the 2021 survey. Respondent demographics and fishing habits were largely consistent with 2021 results, with European males being the largest group of fishers mostly fishing in their home regions. Given the high numbers of whitebait stands in key whitebaiting regions, it was surprising that the vast majority of respondents (> 80%) did not fish from stands. Responses to the impact of the new 2021 regulations were mixed, with approximately as many respondents being affected as unaffected by regulation changes. Responses indicated strong support for commercial catch limits and daily catch limits, but mixed views were expressed for the necessity of improvements in whitebait fishery management (including the utility of a licence system). The greater willingness to provide contact details suggested greater levels of engagement in 2022 than 2021.

The Bay of Plenty catch-composition study showed a desire by communities to better understand their whitebait species and fishers. Catch composition was surprisingly variable in the studied rivers given they all discharge into the same region of the coast and flow from the same district. Visual identification was possible for common species such as īnanga (*Galaxias maculatus*) and smelt (*Retropinna retropinna*), but rarer species such as shortjaw kōkopu (*G. postvectis*) and giant kōkopu (*G. argenteus*) were more difficult to detect, and environmental DNA (eDNA) data were needed to reveal the presence of these species later in the season.

We give suggestions for the frequency and types of data capture, so that sufficient data are collected in a cost-effective manner. For example, aerial counts have been proven to be a cost-effective method to capture consistent large-scale information about whitebaiters and their methods, but do not provide the engagement and enforcement opportunities of riverbank patrols. We suggest that aerial counts could be used at longer intervals, such as every 3–5 years, but that riverbank patrols are done annually so the most comprehensive information and outcomes are achieved. The new data collected provide managers with information that will allow more attributes of the whitebait fishery to be included in planning improvements for the management of the fishery.

1. Introduction

In April 2021, as part of the whitebait fishing regulation review, the Department of Conservation (DOC) was directed by Cabinet to gather further information about the current state of the whitebait fishery in Aotearoa New Zealand. In addition to announcing the amendments to the regulations that were being phased in over three fishing seasons (2021 to 2023), Cabinet tasked DOC to gather new data over the 2021 and 2022 whitebait fishing seasons. This was to better understand the fishery and help inform the development of future management options in 2023.

Historically, knowledge relating to the whitebait fishery has been highly variable or absent. Consequently, in 2021, we trialled several ways (social, remote and riverbank surveys) to begin building a national picture on who whitebaits, how many people whitebait, where they whitebait and what type of fishing gear whitebaiters use. Trials were undertaken in four pilot areas (Bay of Plenty, Waikato, Marlborough and the West Coast) with the purpose of assessing which methods should be scaled up in 2022 for broader nationwide application (see Watson and West 2023).

The 2021 social survey produced new information, from characterising why people go whitebaiting to the distance they travel to fish during the whitebait season. This pilot survey was expanded on in 2022.

An eastern Bay of Plenty community research project initiated in 2021 to identify and describe the species present in the whitebait catch, and how these change through the fishing season, was also continued in the 2022 season.

1.1 Objective

The purpose of this 2022 season report is to detail the scaled-up remote and riverbank surveys, the social survey and whitebait catch-composition study that were completed during the 2022 whitebait fishing season. In addition to the description of the information captured, we provide a discussion of the results and a general conclusion of the data collected. These results, alongside the 2021 season report (Watson and West 2023) will further DOC's understanding of the whitebait fishery and facilitate the development of future options for the sustainable management of this unique and important fishery.

2. Methods

2.1 Identification and rankings of major whitebaiting rivers

We asked Operations staff to identify the major whitebaiting rivers within their district. Major whitebaiting rivers were defined as the waterways where the majority of whitebaiting activity occurs. In each district, staff were asked to qualitatively rank each river for its commercial, recreational and cultural/customary importance. We followed a similar approach to Kelly (1988)[1] where a ranking of 1 = minor importance, 2 = significant or average importance and 3 = major importance for each fishery type (commercial, recreational and cultural/customary). Like in Kelly (1988), the ranking of a particular river was relative to that district only, so rankings could not be compared between districts. Where available, however, river comparisons within districts were made between the 1988 and 2022 rankings. Kelly (1988) noted that identifying the major whitebaiting rivers (commercial and recreational fisheries within a district) is not difficult; however, it is very difficult to rank rivers of lesser importance due to seasonal variability in fishing pressure and catch. We also utilised a list of 92 rivers sampled by Yungnickel (2017) throughout Aotearoa New Zealand to identify additional whitebaiting rivers.

2.2 Riverbank data gathering

Operations staff or contracted 'whitebait rangers' conducted whitebaiter riverbank surveys at selected rivers during the season. At each river, the number of whitebaiters and their fishing methods were counted and recorded. Fishing methods included whitebait net type (e.g., scoop net, box net, sock net) and whether whitebaiters were observed fishing from a structure. Interpretation of what constitutes fishing gear, a licensed structure, a whitebait net and other terminology can be found in the Whitebait Fishing Regulations 2021. DOC staff and contractors were provided with an updated 'whitebaiter activity recording form' from the 2021 pilot season (Appendix 1). This form standardised our approach to data collection across the country, and ensured that key information was captured. Throughout the 8-week fishing season, completed forms were scanned or entered digitally then sent to DOC's whitebait inbox (whitebait@doc.govt.nz) weekly. All received forms were compiled into a master dataset for record keeping and analyses.

2.3 Remote (aerial) data gathering

In addition to the riverbank data gathering exercise, we surveyed whitebaiter activity by flying fixed-wing aircraft across 15 major South Westland rivers and 23 east and southern coast South Island whitebaiting rivers. South Westland remote (aerial) surveys were completed twice per river (early and late season), and the southern and east coast South Island whitebaiting rivers were flown once during the 2022 whitebait season. Canterbury Aviation worked with local DOC rangers or whitebaiters to target the right stage of tides and days where whitebaiting was occurring. High-resolution images were captured flying at 2,000 feet above ground. Images were then processed and mosaicked for counting whitebaiters and identifying fishing methods (see Watson and West [2023] for a detailed description of the remote data collection method).

[1] In the late 1980s, G. R. Kelly undertook an inventory of whitebaiting rivers in the South Island, providing subjective assessments of the regional importance of both recreational and commercial whitebaiting rivers.

The remote data gathering method, which produces aerial images, was chosen for South Westland because it is particularly useful for surveying isolated rivers (rivers with dense riparian vegetation – where riverbank surveys are only possible with the use of a jetboat or helicopter). Added benefits to the high-resolution, georeferenced aerial imagery is the ability to map and measure whitebait structures, and the ability to fly multiple rivers in one day. South Westland is a highly commercialised whitebaiting district (along with Southland) and a notable feature of these fisheries is that most rivers have structures from which whitebaiters fish.

2.4 Whitebaiter social survey

A whitebaiter monitoring and evaluation social survey was carried out during the whitebait season. The objective was to upscale from the pilot social survey of whitebaiters (Hickford 2021) and gather baseline data to describe whitebaiters and the whitebait fishery. The results from this survey will support the identification of issues of most concern to whitebaiters and inform future whitebait fishery management options. Responses from whitebaiters included where and how they fished, their fishing experience, and feedback on the new regulations.

Surveying occurred between October and November 2022 using two methods to reach responders. The first method was an online advertising campaign, posted on Google, Facebook and Instagram as a digital form of the survey. The second method was through the distribution of printed surveys to whitebait fishers on the riverbank by DOC rangers.

2.5 Whitebait catch-composition study

In addition to the social survey, riverbank and remote data collection, a district-led community engagement research project in three eastern Bay of Plenty whitebaiting rivers was supported. The Tarawera, Whakatāne and Waioweka Rivers were sampled from September to November 2022 to document the change in species composition of the whitebait catch throughout the fishing season (see Watson and West [2023] for a detailed description of the sampling methods).

3. Results and discussion

Here we provide a summary of the whitebaiter activity captured from riverbank (North and South Islands) and remote/aerial (South Island only) surveys around the country during the 2022 whitebait season. Rivers were grouped by region, starting from the Bay of Plenty and following an anticlockwise direction around the North Island to Hawke's Bay, and starting from Tasman and ending in Canterbury for the South Island. As in the Watson and West (2023) report of the 2021 whitebait season, the discussion of each region commences with a summary of the region's fishery and, where possible, comparisons between each individual river and its whitebait fishery with that reported in Kelly (1988) and Watson and West (2023). The results of the whitebaiter social survey and whitebait catch-composition study are also included.

3.1 North Island

This was the first time that an inventory of whitebaiters and whitebaiting rivers for the North Island had been completed. No remote (aerial) surveys were performed for the North Island in 2022, only riverbank surveys were collected across all regions except Northland, Auckland and Gisborne. A list of all rivers inventoried is included in Appendix 2.

3.1.1 Bay of Plenty

A study by Rowe et al. (1992) identified 12 rivers where whitebait fishing occurs in the Bay of Plenty. These rivers span between Mount Maunganui and Cape Runaway on the East Cape. The rivers identified previously were the Kaituna, Pongakawa, Tarawera, Rangitaiki, Whakatāne, Wainui, Waiotahe, Waioweka, Ōtara, Waiaua, Mōtū and Whangaparāoa Rivers. Whitebaiting in other rivers along this stretch of coastline is rare or non-existent (Rowe et al. 1992).

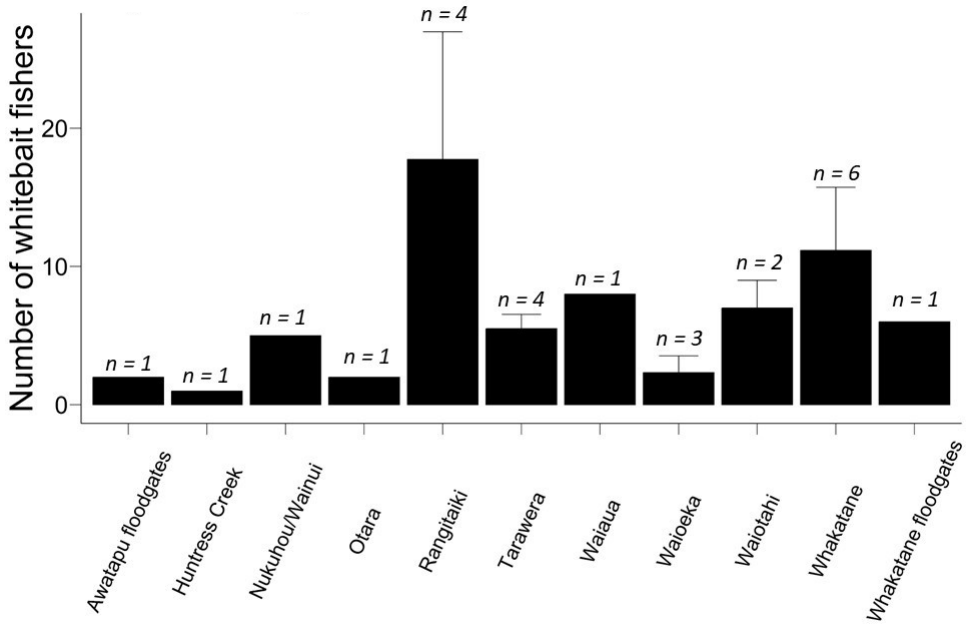

Figure 1. Mean (+SE) number of whitebait fishers recorded during the 2022 whitebait season on Bay of Plenty rivers. Sample sizes are shown above the bars and correspond to the number of riverbank whitebaiter activity counts per river.

Results from 2022 identified 10 of these rivers as still supporting whitebait fisheries. The Rangitaiki and Whakatāne Rivers were the most popular in terms of the number of whitebait fishers observed (Fig. 1). Whitebait fishers were also observed fishing from the floodgates on the Whakatāne River (including Awatapu floodgates) and Huntress Creek (a tributary to the Waioweka River; Fig. 1). Other notable fishing locations not included in Rowe et al. (1992) but identified before the 2022 season by Operations staff as major whitebaiting rivers in the Bay of Plenty include the Raukokore, Haparapara and Kereu Rivers (Appendix 3, Table S1).

All the rivers identified as major whitebaiting rivers were ranked by local staff as minor for commercial importance, with most being average for recreational importance, and all rivers ranked significant or major for cultural/customary importance (Appendix 3, Table S1). In the Bay of Plenty, whitebaiters fish with a variety of nets, and some fishers were observed by local staff fishing from structures (Appendix 3, Figs S1 and S2).

3.1.2 Waikato

In 2015, Yungnickel (2017) sampled seven whitebaiting rivers in the Waikato region. These rivers included the Waikato, Waingaro, Ōpārau, Marokopa, Waikawau, Awakino and Mōkau Rivers. In 2021, as part of our pilot study, we flew fixed-wing aircraft over the Waikato, Marokopa, Waikawau, Awakino and Mōkau Rivers (Watson and West 2023). In addition to these major whitebaiting rivers, Operations staff observed fishers on the Kiritehere Stream. Of the four whitebaiting rivers surveyed during the 2022 whitebait season, the Awakino was the most popular (Fig. 2). Most fishers were observed whitebaiting with box nets (metal-framed set nets; Appendix 3, Fig. S3), and fishers were only observed whitebaiting from structures on the Awakino and Marokopa Rivers (Appendix 3, Fig. S4).

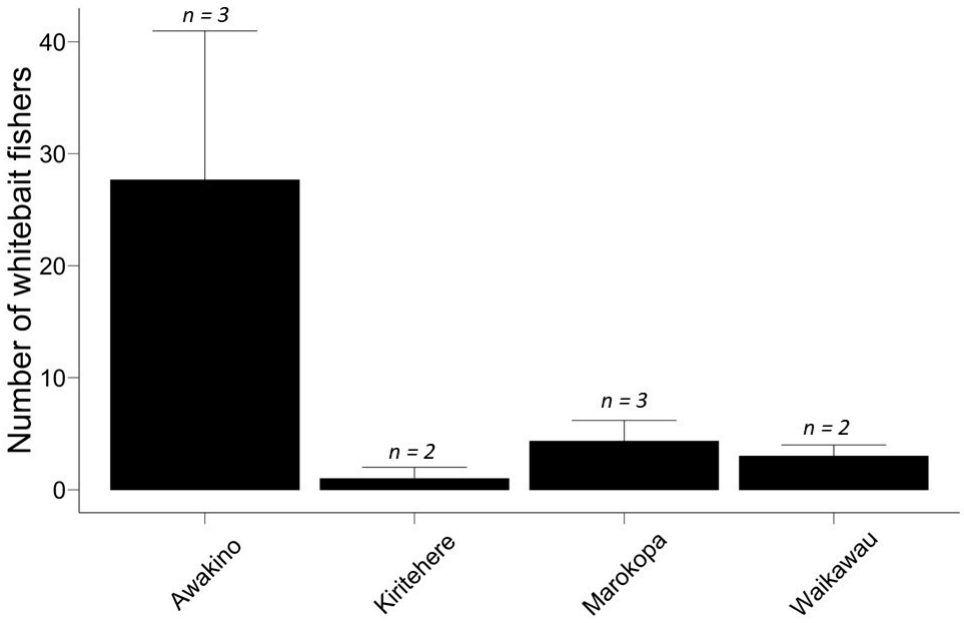

Figure 2. Mean (+SE) number of whitebait fishers recorded during the 2022 whitebait season on Waikato rivers. Sample sizes are shown above the bars and correspond to the number of whitebaiter riverbank activity counts per river.

3.1.3 Taranaki

The whitebaiting rivers in the Taranaki region were only surveyed once during the 2022 whitebait season. The Mōkau River was the most popular (Fig. 3) with all fishers observed using box nets (Appendix 3, Fig. S5). The Mōkau was also the only river in the region where whitebaiters fished from structures (Appendix 3, Fig. S6). Although the Mōkau River is technically in the Waikato region, Operations staff from the Ngāmotu / New Plymouth office (Taranaki) recorded the whitebaiting activity observed on the Mōkau during the 2022 season. In addition to the whitebaiting rivers we identified and surveyed, Yungnickel (2017) identified the Onaero and Waingongoro Rivers as whitebaiting rivers.

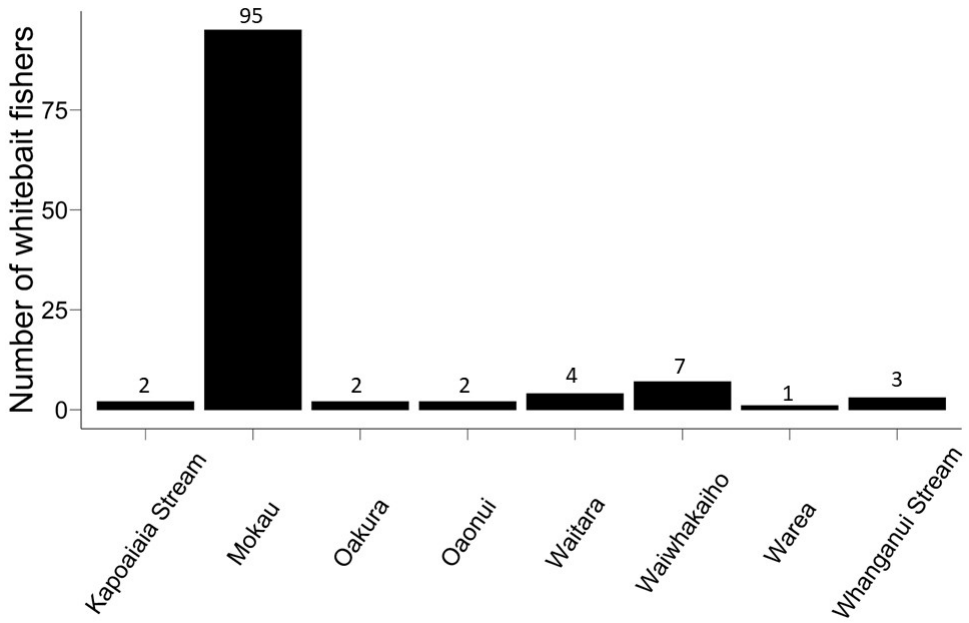

Figure 3. The number of whitebait fishers recorded during the 2022 whitebait season on Taranaki rivers. Each river was surveyed only once.

3.1.4 Manawatū-Whanganui

All the whitebaiting rivers in the Manawatū-Whanganui region were ranked pre-season as being of major cultural / customary importance (Appendix 3, Table S2). Their recreational importance ranged from minor to major, and none were ranked as being commercially important (Appendix 3, Table S2). In addition to the major rivers identified by Operations staff in 2022, Yungnickel (2017) also identified the Aohanga River as a whitebaiting river. Whitebait Creek and the Kaikokopu Stream were the most popular fishing sites observed during the 2022 whitebait season (Fig. 4), and most fishers used box nets (Appendix 3, Fig. S7). Whitebaiters do not fish from structures in the Manawatū-Whanganui region.

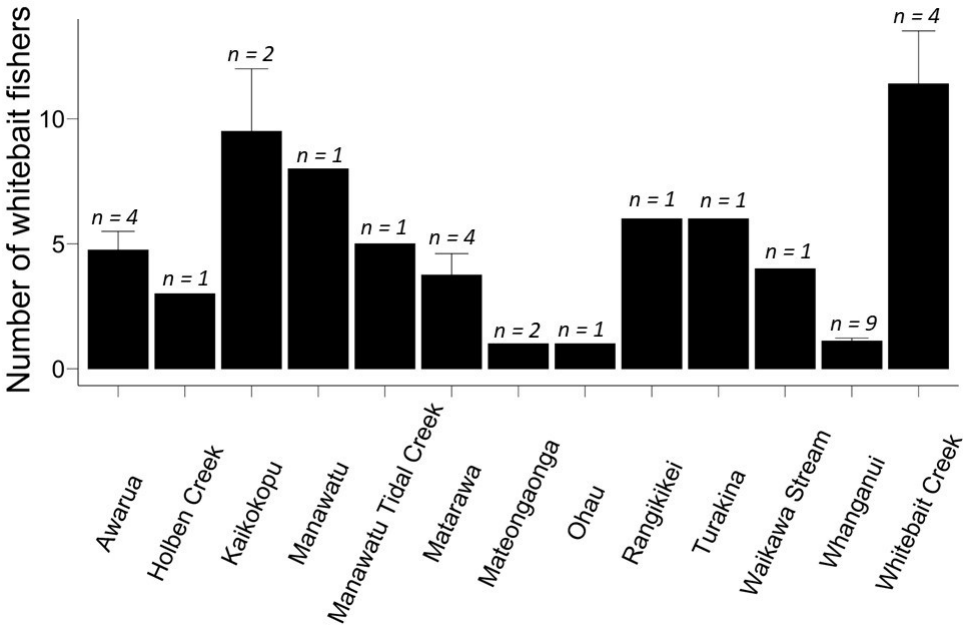

Figure 4. Mean (+SE) number of whitebait fishers recorded during the 2022 whitebait season on Manawatū-Whanganui rivers. Sample sizes are shown above the bars and correspond to the number of whitebaiter riverbank activity counts per river.

3.1.5 Kapiti-Wellington-Wairarapa

Similar to the Manawatū-Whanganui region, whitebaiters were not observed fishing from structures in the Kapiti-Wellington-Wairarapa region. The Waikanae River on the Kapiti Coast was the most popular whitebaiting river (Fig. 5) and has an active, well-established whitebaiters association. The second most popular fishing site was Lake Ōnoke (Lake Ferry), where fishers were observed using scoop and box nets (Appendix 3, Fig. S8). In addition to the whitebaiting rivers that were surveyed by Operations staff during the 2022 whitebait season, other notable whitebaiting rivers include the Peka Peka Stream and Whareama River (Yungnickel 2017).

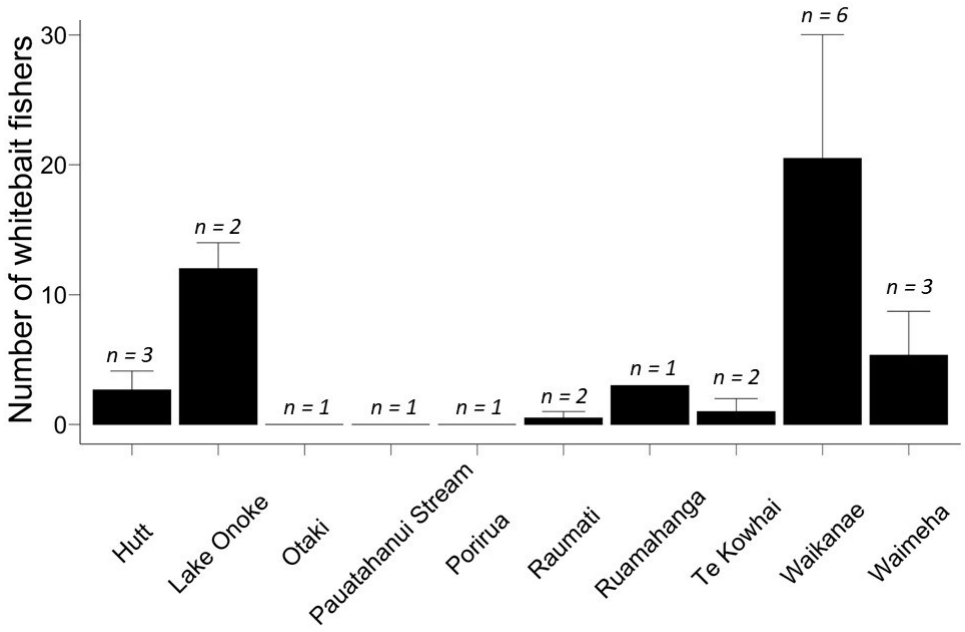

Figure 5. Mean (+SE) number of whitebait fishers recorded during the 2022 whitebait season on Kapiti-Wellington-Wairarapa rivers. Sample sizes are shown above the bars and correspond to the number of whitebaiter riverbank activity counts per river. There were no whitebait fishers observed on the Ōtaki River, Pāuatahanui Stream or Porirua Stream when the surveys were completed.

3.1.6 Hawke's Bay

Six rivers were identified and ranked by Operations staff pre-season as being major whitebaiting rivers in Hawke's Bay (Appendix 3, Table S3). Although the Wairoa River and Tutaekuri-Waimate Stream were not surveyed, both were ranked as being of major recreational importance, minor commercial importance and average cultural/customary importance compared with other rivers in the region (Appendix 3, Table S3). Of the rivers surveyed during the 2022 whitebait season, the Ngaruroro and Tukituki were the most popular among whitebaiters (Fig. 6). Box nets were only observed being used on the Tukituki River, with most fishers using scoop and sock nets (Appendix 3, Fig. S9). No whitebaiters were observed fishing from structures on the Esk, Mangakuri or Maraetotara Rivers (Appendix 3, Fig. S10).

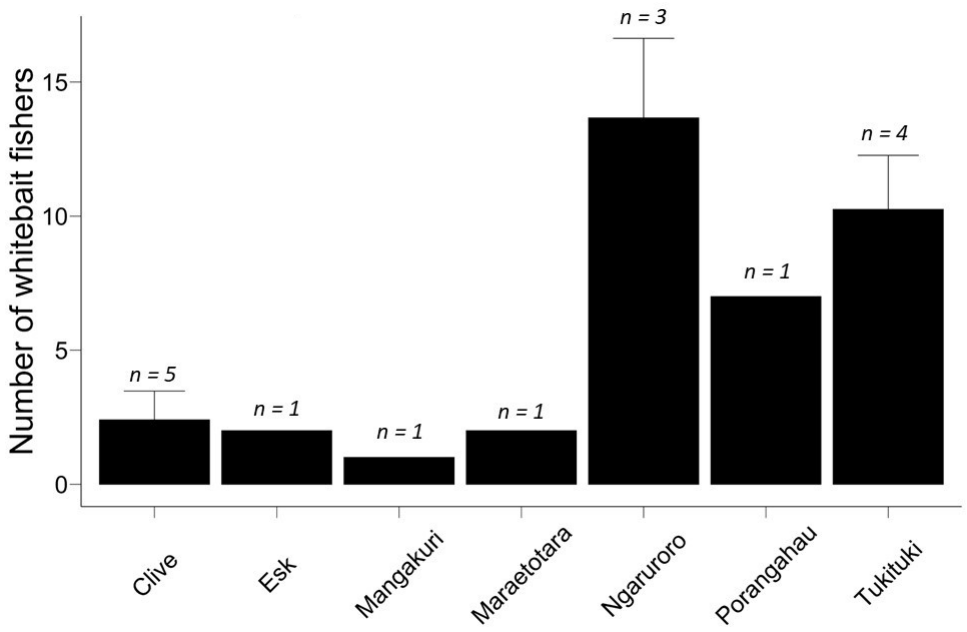

Figure 6. Mean (+SE) number of whitebait fishers recorded during the 2022 whitebait season on Hawke's Bay rivers. Sample sizes are shown above the bars and correspond to the number of whitebaiter riverbank activity counts per river.

3.2 South Island

All regions in the South Island except Marlborough (which was a pilot region in 2021) were inventoried for whitebaiter activity by either remote (aerial) or riverbank surveys in 2022. In Canterbury and coastal Otago, both methods were used. Information was collected on fisher numbers, gear/net types and whether whitebaiters were observed fishing from structures. A list of all rivers inventoried is included in Appendix 2.

3.2.1 Tasman

Only riverbank surveys were completed in Tasman. Our results from the 2022 whitebait season for Tasman were very similar to those obtained for the 2021 whitebait season (Watson and West 2023) and provided in Kelly (1988). The most popular rivers in this region are the Motueka, Tākaka, Aorere and Waimea Rivers (Fig. 7; Table 1). Other notable fishing locations include Moturoa / Rabbit Island. The 2022 whitebait catch was described as normal by Operations staff and whitebaiters alike (D. de Vries, pers. comm.). The most productive fishing locations were the Waimea, Appleby and Rabbit Island sites of the Motueka catchment (D. de Vries, pers. comm.).

Approximately 5% of whitebaiters camp at their fishing sites, and sock nets are becoming more popular among whitebaiters (Appendix 3, Fig. S11; D. de Vries, pers. comm.). In general, there was no negative feedback about the shortened season.

Before the 2022 whitebait season, all the major whitebaiting rivers identified were ranked as having major cultural/customary importance, average to major recreational importance and minor to major commercial importance (Appendix 3, Table S4). No rivers declined in recreational importance compared with the rankings from Kelly (1988). However, commercial importance rankings fluctuated among rivers compared with those provided in Kelly (1988) (Appendix 3, Table S5).

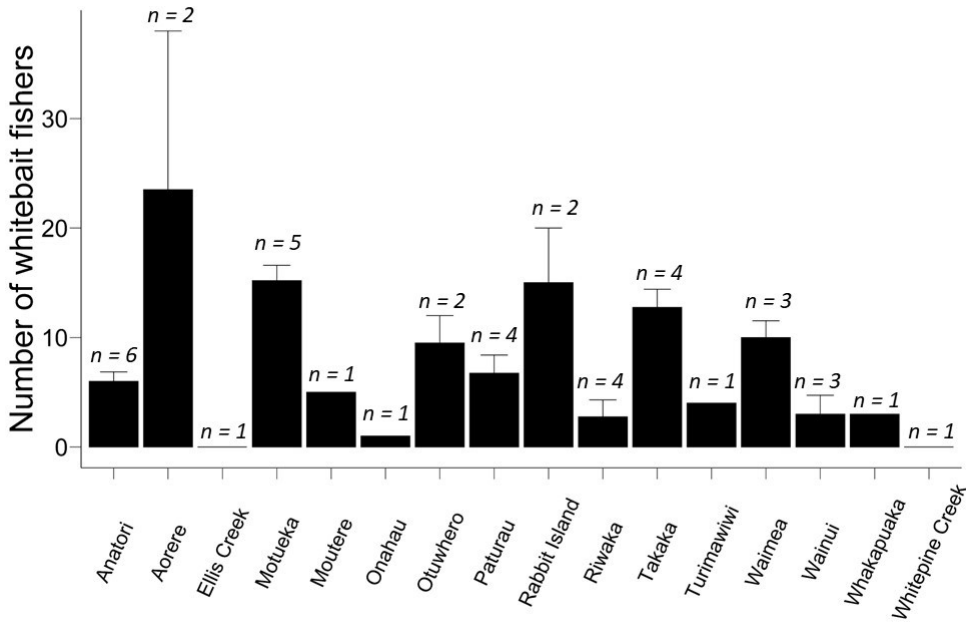

Figure 7. Mean (+SE) number of whitebait fishers recorded during the 2022 whitebait season on Tasman rivers. Sample sizes are shown above the bars and correspond to the number of whitebaiter riverbank activity counts per river. There were no whitebait fishers observed on Ellis Creek or White Pine Creek when the surveys were completed.

Table 1. Maximum numbers of whitebait fishers observed on Tasman rivers in 2021 and 2022 compared with Kelly (1988). Dashes (–) indicate data unavailable.

RIVER	2021 MAX NO.	2022 MAX NO.	KELLY (1988)	COMMENT FROM KELLY (1988)
Anatori	12	8	10–12 commercial fishers; up to 20 regular recreational fishers.	Although isolated, attracts a moderate recreational fishery.
Paturau	19	11	Up to 8 commercial and 15 recreational fishers.	6–8 commercial operators. Minor recreational fishery.
Aorere	32	38	Up to 8 commercial and between 50 and 60 recreational fishers.	One of the most important whitebaiting rivers in Tasman.
Tākaka	18	16	Up to 10 commercial and between 50 and 60 recreational fishers.	The most popular whitebaiting river in the region.
Riwaka	0	7	Up to 15 recreational fishers.	Minor fishery.
Motueka	27	19	10–12 commercial and 40–50 recreational whitebaiters per day.	One of the most popular and highest commercial ranking rivers in the region.
Moutere	6	5	Up to 20 recreational whitebaiters per day at peak season.	Minor recreational fishery.
Waimea	11	12	2–3 commercial and up to 50 recreational whitebaiters per day.	High recreational value.
Turimawiwi	–	4	10–12 commercial fishers.	The most isolated river in the region.
Wakapuaka	–	3	Up to 15 regular whitebaiters.	Isolated area. Low recreational importance.
Motupipi	–	–	Up to 20 recreational whitebaiters per day at peak season.	Average recreational fishery only.

3.2.2 North Westland

Only riverbank surveys were completed in North Westland. Results from the 2022 whitebait season for North Westland were similar to those obtained for 2021 whitebait season. The most popular rivers were the Buller, Hokitika and Mōkihinui Rivers (Table 2). Other notable whitebaiting rivers in terms of popularity include the Karamea, Orowaiti, Taramakau and Waitaha (Fig. 8).

Reports from Operations staff in Greymouth suggest that the 2022 whitebait catch was worse than normal, although it is unknown how the whitebaiters themselves described it. For the Greymouth district, the Grey River/Māwheranui was the most popular among whitebaiters, but catch varied, with no rivers standing out as being more productive than others (D. Haworth, pers. comm.). The majority of whitebaiters commute to their fishing sites in Greymouth and use scoop nets from the riverbank (Appendix 3, Figs S12 and S13; D. Haworth, pers. comm.). Regarding the pre-season major whitebaiting river rankings, all rivers identified were of minor cultural/customary and commercial importance apart from the Hokitika River (Appendix 3, Table S6). Most rivers ranked as major recreational importance (Appendix 3, Table S6), and some declined in commercial importance when compared with Kelly (1988)(Appendix 3, Table S7). Other notable whitebaiting rivers include the Heaphy River, Granite Creek, Little Wanganui River, Ōkari River and Waimea Creek.

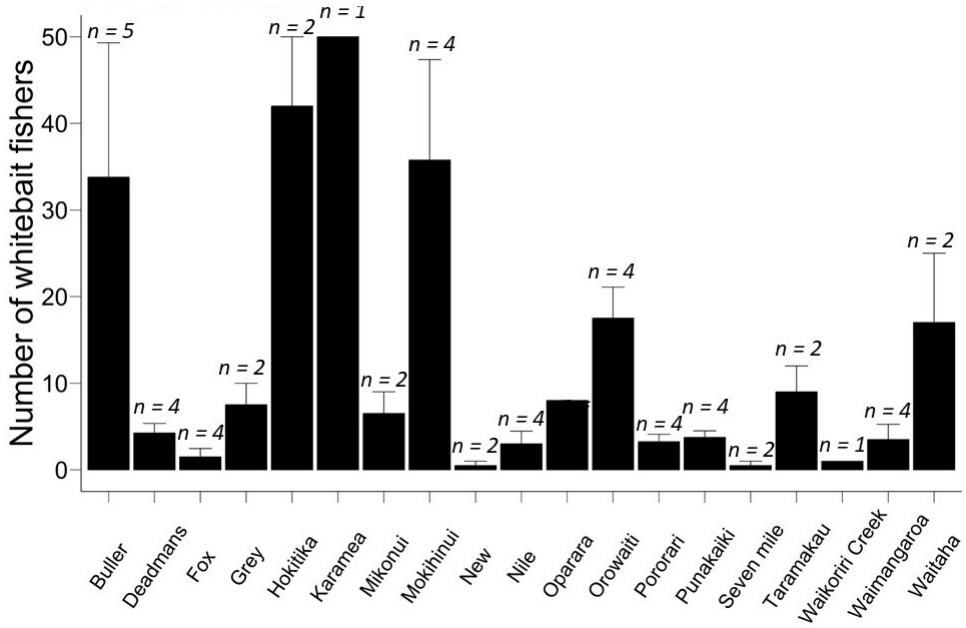

Figure 8. Mean (+SE) number of whitebait fishers recorded during the 2022 whitebait season on North Westland rivers. Sample sizes are shown above the bars and correspond to the number of whitebaiter riverbank activity counts per river.

Table 2. Maximum numbers of whitebait fishers observed on North Westland rivers in 2021 and 2022 compared with Kelly (1988). Dashes (–) indicate data unavailable.

RIVER	2021 MAX NO.	2022 MAX NO.	KELLY (1988)	COMMENT FROM KELLY (1988)
Granite	17	–	Up to 50 recreational fishers.	Popular recreational fishery.
Little Wanganui	6	–	Up to 30 whitebaiters.	Small recreational fishery with commercial component.
Mōkihinui	79	62	Up to 80 whitebaiters.	Large and competitive recreational and commercial fishery.
Buller	108	78	Up to 360 whitebaiters.	Largest commercial and recreational fishery.
Grey/Māwheranui	30	10	Up to 300 whitebaiters.	Small commercial fishery. Very popular recreational fishery.
Taramakau	12	12	20 regular whitebaiters, 38 registered stands.	Most whitebaiters are retired people and a small number could be classed as commercial fishers.
Hokitika	49	50	Up to 140 whitebaiters, 78 registered stands.	Large commercial and recreational fishery.
Waitaha	–	25	12 registered sites on the lower river.	Small commercial and recreational fishery.
Punakaiki	–	6	–	Small recreational fishery.
Pororari	–	5	–	Small competitive recreational fishery.
Orowaiti	–	24	23 registered stands.	Popular local fishery.
Waimangaroa	–	7	Up to 10 whitebaiters.	Small recreational fishery. Has suffered from severe pollution from coal mining.
Karamea	–	50	Fished by about 40 people per day.	Small commercial fishery.

3.2.3 South Westland

Remote (aerial) surveys were chosen over riverbank surveys for South Westland as it remains one of the most isolated regions of Aotearoa New Zealand. Many of the rivers have remained undeveloped, unlike some of the more popular whitebaiting rivers in North Westland. There is little doubt that the rivers of the Haast district have and still support Aotearoa New Zealand's most productive whitebait fishery (Kelly 1988). During the whitebait season, the fishery attracts whitebaiters from all over the South Island (Kelly 1988). Although South Westland produces huge quantities of whitebait compared with other districts, it is extremely difficult to distinguish commercial whitebaiters from recreational whitebaiters (Kelly 1988). For example, there are many commercial whitebaiters who prefer to use a scoop net at river mouths who do not whitebait from a stand, and whitebaiters who fish recreationally until they have a large enough catch and then decide to sell it (Kelly 1988). South Westland rivers are generally recognised as the preserve of the commercial whitebaiter (Kelly 1988).

Our results for South Westland from the 2022 season were consistent with those of Kelly (1988). The most popular rivers for whitebaiting were the Haast, Okuru, Waiatoto and Waita Rivers (Fig. 9; Table 3). Our results from the 2022 whitebait season show that most fishers use set nets (i.e., box nets and sock nets; Appendix 3, Fig. S14), and most rivers have whitebait stands or structures, which is a notable feature of the West Coast whitebait fishery (Appendix 3, Fig. S15). There are over 600 registered whitebait stands on the West Coast (West Coast Regional Council 2014). Other notable whitebaiting rivers include the Ōkārito and Wanganui Rivers.

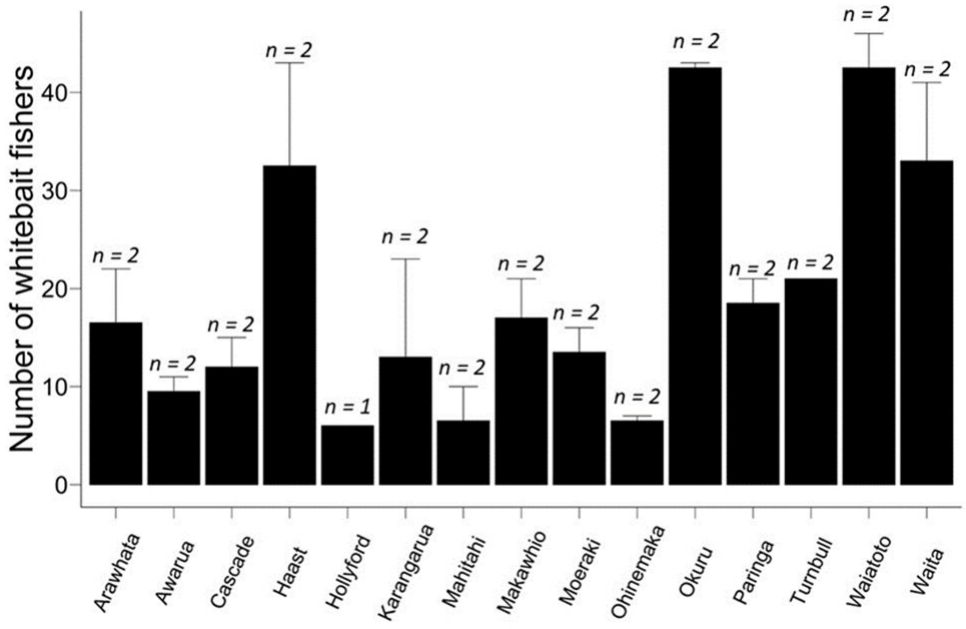

Figure 9. Mean (+SE) number of whitebait fishers recorded from aerial surveys during the 2022 whitebait season on South Westland rivers. Sample sizes are shown above the bars and correspond to the number of whitebaiter aerial activity counts per river.

Table 3. Mean and maximum numbers of whitebaiters observed on South Westland rivers from 2022 aerial surveys compared with Kelly (1988).

RIVER	2022 MEAN NO. (±SD)	2022 MAX NO.	KELLY (1988)	COMMENT FROM KELLY (1988)
Hollyford / Whakatipu Kā Tuka	6.0	6	5 registered sites.	Minor commercial fishery.
Awarua Stream	9.5 (2.1)	11	15 registered stands.	Significant commercial fishery, minor recreational fishery.
Cascade	12.0 (4.2)	15	31 registered stands.	Major commercial fishery.
Arawhata	16.5 (7.8)	22	26 registered stands.	Significant commercial and recreational fishery.
Waiatoto	42.5 (4.9)	46	51 registered stands.	Major commercial and recreational fishery.
Turnbull	21.0 (0.0)	21	24 registered stands.	Minor fishery.
Okuru	42.5 (0.7)	43	48 registered stands.	Significant commercial fishery, high number of recreational fishers.
Haast	32.5 (14.8)	43	31 registered fishing sites (1987 season).	Same as Okuru.
Waita	33.0 (11.3)	41	No registered stands or sites.	Significant recreational fishery, minor commercial fishery.
Moeraki / Blue River	13.5 (3.5)	16	21 registered fishing sites (1987 season).	Significant commercial fishery.
Paringa	18.5 (3.5)	21	Up to 150 whitebaiters. 24 registered stands. Average of 30 fishers per day.	Major commercial fishery.
Ohinemaka	6.5 (0.7)	7	7 registered fishing sites.	Small commercial fishery.
Mahitahi	6.5 (4.9)	10	Usually about 8 stands.	Small commercial fishery, moderate number of recreational fishers.
Makawhio / Jacobs River	17.0 (5.7)	21	22 registered sites.	Same as Moeraki / Blue River.
Karangarua	13.0 (14.1)	23	–	Significant commercial fishery, minor recreational fishery.

3.2.4 Southland

During the 2022 whitebait season, no riverbank surveys were completed in Southland. However, six major whitebaiting rivers were surveyed using remote (aerial) methods. Similar to the 2021 whitebait season, the Mataura and Aparima Rivers were the most popular (Fig. 10; Table 4). Reports from Operations staff and whitebaiters in Murihiku suggested that the 2022 whitebait catch was worse than normal. Operations staff also identified post-season that the most popular rivers for whitebaiting were the Clutha River/Mata-Au, Titiroa Stream, Mataura, Aparima and Waiau Rivers (A. Christie, personal communication). Approximately 60% of whitebaiters commute and 40% of whitebaiters camp at their fishing sites using set nets from a stand (Appendix 3, S16 and S17; A. Christie, personal communication). The Mataura and Ōreti Rivers ranked highest for commercial importance (Appendix 3, Table S8). Most rivers ranged from average to major recreational importance and all rivers ranked as minor cultural/customary importance (Appendix 3, Table S8). Most major whitebaiting rivers in the region increased in recreational value when compared with Kelly (1988)(Appendix 3, Table S9).

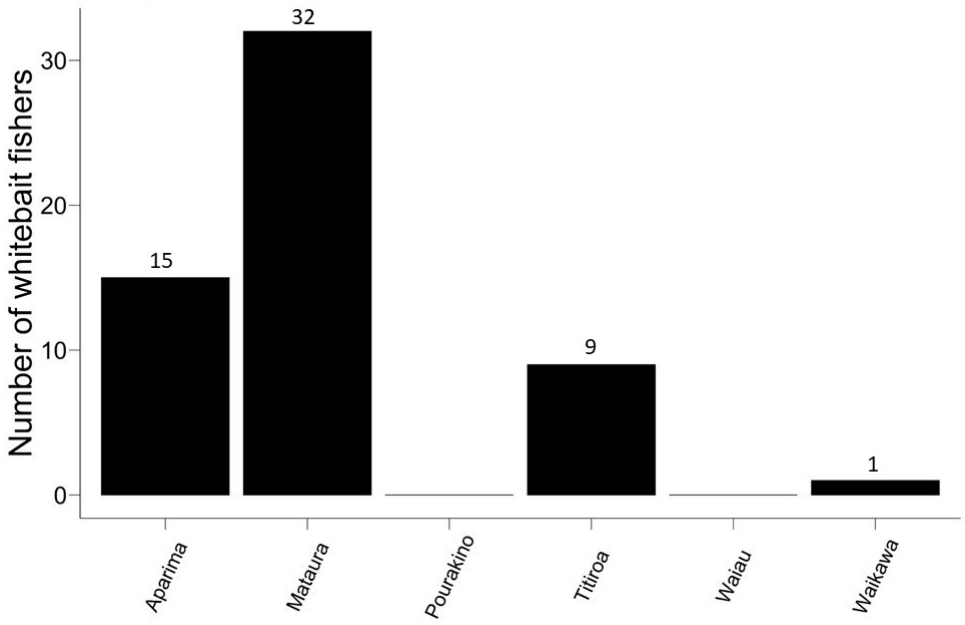

Figure 10. Number of whitebait fishers recorded from aerial surveys during the 2022 whitebait season on Southland rivers. Rivers were only surveyed once. There were no whitebait fishers observed on the Pourakino or Waiau Rivers when the surveys were completed.

Table 4. Maximum numbers of whitebait fishers observed on Southland rivers in 2021 and 2022 compared with Kelly (1988). Dashes (–) indicate data unavailable.

RIVER	2021 MAX NO.	2022 MAX NO.	KELLY (1988)	COMMENT FROM KELLY (1988)
Clutha River / Mata-Au	8	–	Can attract up to 200 whitebaiters on a good day.	Major whitebait fishery of regional importance. Catch rates consistently higher than on other rivers in the region. Minor commercial component.
Titiroa	14	9	65 registered stands.	Important fishery. Large commercial component. Heavy fishing pressure during weekends.
Mataura	25	32	222 registered stands.	Most important whitebait fishery in Southland. Large commercial component. Major recreational fishery.
Aparima	15	15	125 registered stands.	Very popular, good access. Small commercial component.
Pourakino	1	–	11 registered stands during the 1986 season.	Small local fishery. Mostly recreational.
Waikawa	–	1	70–90 nets, 16 registered stands.	Popular local fishery.
Waiau	–	–	50–60 whitebaiters on an average day.	Significant recreational fishery.

3.2.5 Coastal Otago

To capture the extent of whitebaiting activity in Coastal Otago rivers, a combination of riverbank and remote (aerial) surveys were used. Similar to the 2021 whitebait season, the most popular rivers were the Kakanui, Taiari (Taieri) and Waikouaiti Rivers (Table 5). Other notable rivers where whitebaiters were observed fishing were the Waihemo / Shag, Waianakarua and Waitati Rivers (Fig. 11). Yungnickel (2017) identified the Waitaki and Ōwaka Rivers as important whitebaiting rivers in the region. Whitebaiters were observed fishing with only scoop nets on the Waianakarua River and only set nets on the Waihemo / Shag River (Appendix 3, Fig. S18). There were no whitebaiters observed fishing from structures on the Waihemo / Shag, Waianakarua or Waikouaiti Rivers (Appendix 3, Fig. S19). All the major whitebaiting rivers identified by Operations staff pre-season were ranked as being of significant recreational importance (Appendix 3, Table S10), consistent with the results from Kelly (1988)(Appendix 3, Table S11).

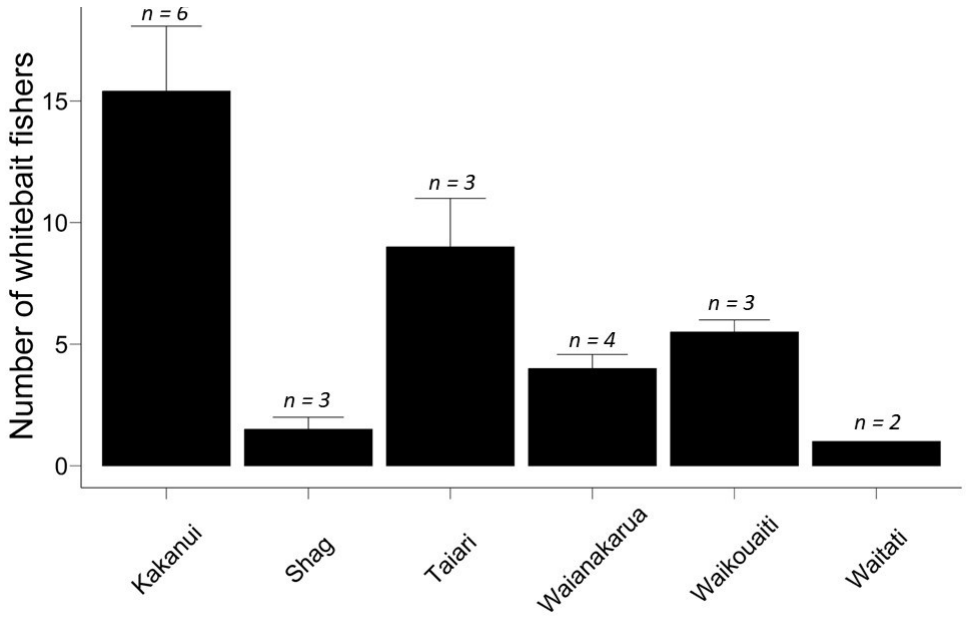

Figure 11. Mean (+ SE) number of whitebait fishers recorded from riverbank and aerial surveys during the 2022 whitebait season on Coastal Otago rivers. Sample sizes are shown above the bars and correspond to the number of surveys per river.

Table 5. Maximum numbers of whitebait fishers observed on Coastal Otago rivers in 2021 and 2022 compared with Kelly (1988). Dashes (–) indicate data unavailable.

RIVER	2021 MAX NO.	2022 MAX NO.	KELLY (1988)	COMMENT FROM KELLY (1988)
Kakanui	13	22	Up to 50 people on a good day. A maximum count of 67 recorded.	Although small, can attract up to 50 whitebaiters. Catches generally small.
Waikouaiti	6	11	Average of about 25 people with up to 100 on a holiday weekend.	Reasonably popular. Fished mainly by locals and some from Dunedin. Up to 50 whitebaiters on a good day.
Taiari	12	11	Up to 150 whitebaiters on a good weekend when the whitebait are running.	Good access and 25–30 km of slow tidal reach to fish attracts whitebaiters from a wide area.
Waihemo / Shag	–	6	Up to 50 whitebaiters on a good day.	Reasonably popular. Fished mainly by locals and some from Dunedin.

3.2.6 Canterbury

Like in Coastal Otago, a combination of riverbank and remote (aerial) surveys was used to capture the nature and extent of whitebaiter activity in Canterbury. Our results showed that the Waimakariri River, a river close to Christchurch, was the most popular among whitebaiters during the 2022 whitebait season (Fig. 12; Table 6). This is consistent with what was recorded during the 2021 whitebait season (Watson and West 2023) and reported by Kelly (1988). In addition to the riverbank survey carried out on the opening day of the 2022 whitebait season (1 September), three aerial surveys were conducted throughout the season on the Waimakariri River. The subsequent flights allowed us to compare the effect of weekday vs weekend on whitebaiter counts at the Waimakariri River. Our results suggest that the time of season affects whitebaiter counts more than the day of the week (weekdays vs weekend days). Other notable whitebaiting rivers in North Canterbury during the 2022 whitebait season were the Ashley / Rakahuri, Avon / Ōtakaro and Kaiapoi Rivers.

For South Canterbury, the most popular whitebaiting rivers were the Orari and Ōpihi Rivers (Fig. 12; Table 6). Similar to what was reported in Kelly (1988), Canterbury whitebaiting rivers ranged in rankings from average to major recreational importance (Appendix 3, Tables S12 and S13). Saltwater Creek, the Ōpihi River and the Waihao River were all ranked as major importance for cultural / customary reasons, and the Waitaki River (border of South Canterbury and Coastal Otago) ranked as major commercial importance (Appendix 3, Table S12). Whitebaiters do not fish from structures in Canterbury and most fishers use set nets (Appendix 3, Fig. S20).

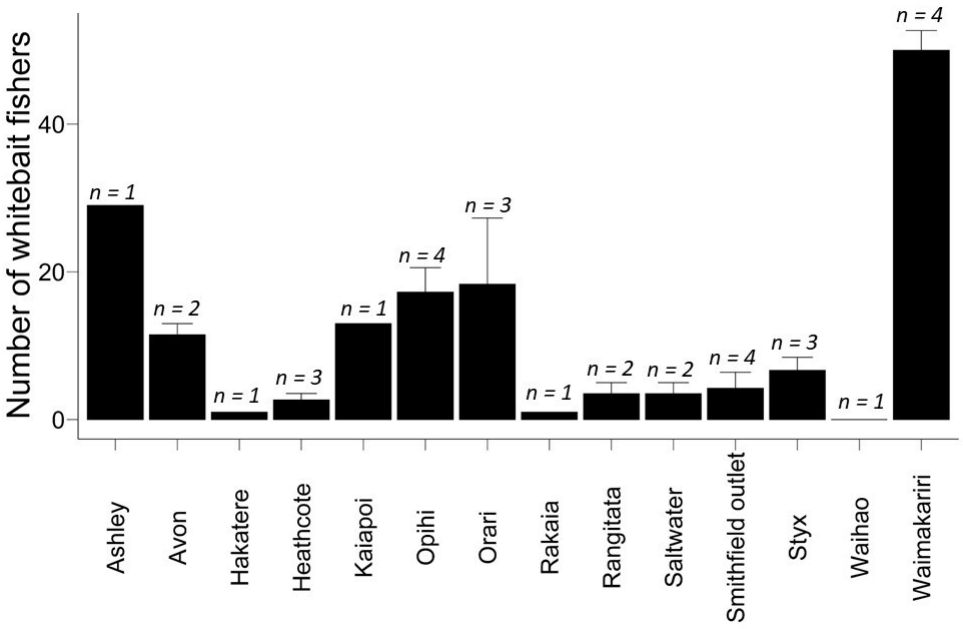

Figure 12. Mean (+SE) number of whitebait fishers recorded from riverbank and aerial surveys during the 2022 whitebait season on Canterbury rivers. Sample sizes are shown above the bars and correspond to the number of surveys per river. There were no whitebait fishers observed on the Waihao River when the survey was completed.

Table 6. Maximum numbers of whitebait fishers observed on Canterbury rivers in 2021 and 2022 compared with Kelly (1988). Dashes (-) indicate data unavailable.

RIVER	2021 MAX NO.	2022 MAX NO.	KELLY (1988)	COMMENT FROM KELLY (1988)
Ashley / Rakahuri	3	29	Fished regularly by 40–50 people.	Second most popular whitebaiting river in the region.
Waimakariri	20	57	Weekend counts of whitebaiters averaging 169 and weekday counts averaging 124 on good days. An average of 89 persons per survey day.	Most popular river in the region. Supports a major recreational fishery of regional importance. Small commercial component.
Avon / Ōtakaro	12	13	10–15 during a weekday and up to 100 on a good weekend day.	Popular because of good access and proximity to Christchurch. Used by 16% of Canterbury whitebaiters. Catch rates generally low.
Rangitata	–	5	7–10 whitebaiters per day.	Average recreational fishery.
Orari	–	31	20 people on an average day.	Fished by locals.
Ōpihi	–	26	30 people on an average day.	Fished by locals and tourists.
Waihao	–	0	50–60 whitebaiters on an average day.	Minor fishery.
Rakaia	–	1	Fished regularly by 20+ whitebaiters.	Small recreational fishery.

3.3 Social survey of whitebaiters

A social survey distributed in October–November 2022 collected data describing the perceptions of whitebait fishers. Building on the 2021 social survey (Hickford 2021), the 2022 research gathered data to help describe the whitebait fishery. These data will help identify the issues of most concern to whitebaiters and will be used to inform future whitebait fishing practices and management options.

The 2022 online survey resulted in 1,247 questionnaires being completed, more than double the completed surveys received in the 2021 social survey (n = 589). Survey respondents also completed 55 paper-based surveys giving a total sample of 1,302 surveys. However, due to DOC's Privacy Policy, only those participants who indicated they were over the age of 16, had read the study information, understood what was involved in participating and consented to participating in the survey were included in the analysis report. As a result, of the 1,302 participants that submitted a response, 1,274 were included for analysis.

As with the 2021 results, most respondents were male, New Zealand European, over 45 years old, lived in the South Island (Canterbury, 23.8%; Southland, 7.9%; West Coast, 5.6%) and whitebaited in their home region. Almost 50% of the respondents in 2022 had been whitebaiting for more than 20 years.

Similar to the respondents in 2021, the respondents in 2022 placed considerable importance on social reasons, recreational reasons and food-gathering reasons for whitebaiting. In general, they placed little importance on commercial reasons for whitebaiting. More than 75% stated that they never sold or traded their whitebait catch.

In common with the 2021 survey data, most respondents had only whitebaited in a single river and region during the previous 5 years. And in line with the 2021 survey results, scoop, set and sock nets were the most commonly used type of whitebaiting gear in 2022.

More than 80% of respondents in 2021 and 2022 did not whitebait from a registered stand. Survey respondents in both years also fished similar averages of 12 days and 5 hours per day per season.

Whitebaiters responding to the 2022 survey had mixed perceptions of the impact the 2021 regulations had on their whitebaiting experience; 45% believed that they had not been affected while 44% believed that the regulations had reduced their whitebait catch.

Like in the 2021 survey, most respondents had mixed views on whether improvement was needed to the whitebait fishery. Most agreed that the fishery would be improved by better enforcement of the current regulations and restoration of adult fish habitats. However, contrary to the 2021 respondents, those surveyed in 2022 strongly supported commercial catch limits. The 2022 respondents also disagreed with the introduction of a whitebaiting licence or closing more rivers to fishing. The 2022 respondents strongly disagreed that the current regulations needed changing. However, there was strong agreement among 2022 respondents that a daily catch limit was needed to improve the whitebait fishery.

Higher levels of ongoing engagement were recorded among the 2022 survey respondents, with over 65% providing their contact details (approximately 40% in 2021).

Finally, the social survey completed and analysed by DOC towards the end of the 2022 whitebait season produced interesting results, from characterising reasons why people go whitebaiting to the impacts of the whitebait fishing regulations introduced in 2021. In future surveys, it may be useful to supplement such quantitative results with more in-depth targeted qualitative research using focus groups and oral history methodologies to help inform future management decisions.

3.4 Bay of Plenty catch-composition study

During the 2022 whitebait season, we continued data collection for the district-led community engagement project in the eastern Bay of Plenty (initiated in 2021). The overall goal of the project was to sample the whitebait catch throughout the whitebait season in accordance with maramataka, the Māori lunar calendar, to identify and describe 'whitebait' species composition in three major whitebaiting rivers in the Whakatāne district. Detailed descriptions of the specific questions that the community wanted DOC Whakatāne staff to address, sampling methodologies and bimonthly results can be found in Watson and West (2023).

In 2022, the duration of the whitebait season was shortened, for the first time, from 1 September to 30 October throughout the country (except the Chatham Islands). To help address the question identified by the Whakatāne community around whether a change in season length would benefit the threatened species in the whitebait catch (i.e., shortjaw kōkopu [*Galaxias postvectis*] and giant kōkopu [*G. argenteus*]), whitebait were collected from the three study rivers in November (post-season). In addition to answering this question, there was added benefit of having another season of data to begin to identify trends in how whitebait catch composition varies at different times of the season in the study rivers.

The 2022 results showed that the proportion of species in the whitebait catch changed through time which is consistent with the 2021 results (Watson and West 2023) and research by Yungnickel et al. (2020) and Rowe et al. (1992). For the Tarawera and Whakatāne Rivers, the whitebait catch predominantly comprised īnanga (*G. maculatus*) at the beginning of the season (September) and shifted to greater proportions of common smelt (*Retropinna retropinna*) later in the season (October; Fig. 13). The Waioweka River had greater proportions of banded kōkopu (*G. fasciatus*) early in the season (September; Fig. 13). Environmental DNA (eDNA) sampling detected the rarer species (giant or shortjaw kōkopu) in the Whakatāne and Waioweka samples collected in October, and kōaro (*G. brevipinnis*) were detected in all of the rivers sampled (Fig. 13). While it is unknown if shortening the length of the whitebait season will protect the more threatened species from harvest during their migration as post-larvae to their adult freshwater habitats, research suggests that these species are not recruitment limited, but rather their populations are limited by the amount of habitat available (Hansen and Closs 2009; Akbaripasand et al. 2014).

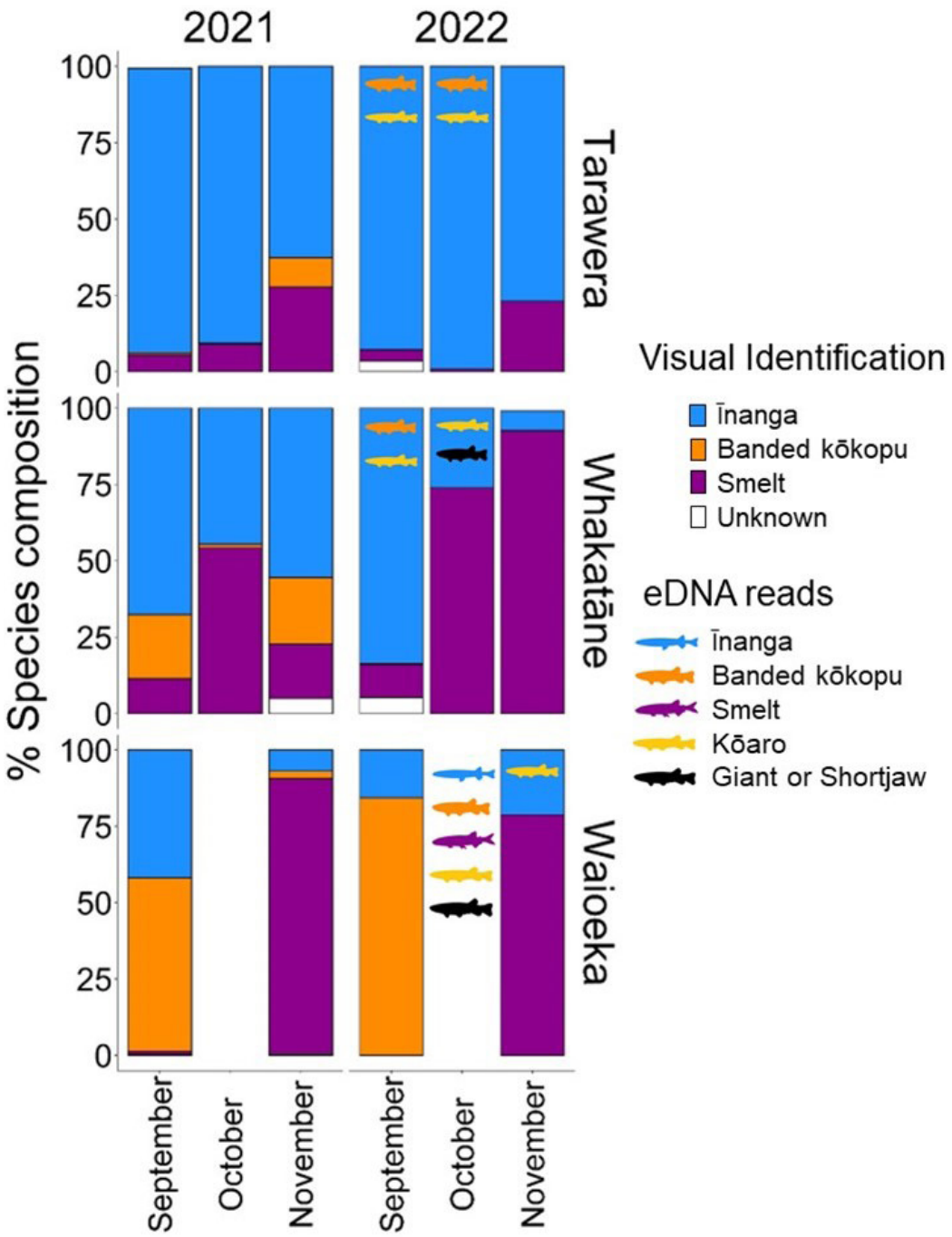

Figure 13. Percent species composition of the whitebait catch at three rivers in the eastern Bay of Plenty throughout the 2021 and 2022 fishing seasons. In 2022, environmental DNA (eDNA) detections were in addition to those species that were visually identified. No eDNA sample was collected for the Waioweka River in September 2022.

4. Conclusions and recommendations

As a result of the 2022 data collection programme, a total of 103 whitebaiting rivers across Aotearoa New Zealand (52 North Island rivers in six regions and 51 South Island rivers in five regions) were surveyed. Of the rivers surveyed, a total of 3,100 whitebaiters were observed fishing during 53 days of the 60-day season. It is important to note that this number only reflects the numbers of whitebaiters captured during specific river surveys – not the total number of whitebait fishers nationally.

In general, West Coast rivers had the greatest number of whitebaiters observed, but rivers close to urban centres (e.g., Waimakariri and Waikanae) also had high numbers of fishers. Riverbank and remote (aerial) surveys showed that most whitebaiters were observed fishing without a structure using a scoop net. The second most frequent whitebaiting fishing method observed was whitebaiters fishing without a structure using a box net. Where sock nets were used, most were observed in South Island rivers, and the majority of whitebaiters fishing from structures were in South Westland.

Based on the 2022 social survey results, most whitebaiters are male, over 45 years old, Pākehā (83%) and/or Māori (18%), have wide-ranging incomes and have whitebaited for more than 20 years. Like the remote (aerial) and riverbank survey results, social survey results showed that most whitebaiters fish without a structure using a scoop net. However, additional information indicated that whitebaiters fish for an average of 5.5 hours a day across 12 days during the season (1 September – 30 October). Furthermore, whitebaiters live across the country and fish locally as well as in other rivers further afield. The most popular whitebaiting rivers are the Hokitika and Waimakariri Rivers (West Coast and Canterbury, respectively). Participants' reasons for whitebaiting are recreational (disconnecting from work, being in nature), social (time with friends and family), and feeding themselves and others. They do not want to make money selling whitebait.

The results of the whitebait species catch-composition study on three eastern Bay of Plenty whitebaiting rivers were similar to what was observed in 2021. The sampling showed that the proportion of species in the whitebait catch changes through time and is catchment specific. For the Tarawera and Whakatāne Rivers, īnanga – the species that forms the majority of Aotearoa New Zealand's whitebait catch – dominates the catch early in the season (September). The catch then shifts towards greater proportions of smelt later in the season (October). The Waioweka River had greater proportions of banded kōkopu in September, which is likely due to the greater cover of forest in the catchment. Environmental DNA (eDNA) indicated that the rarer species (giant or shortjaw kōkopu) were present in the whitebait catch in October. eDNA may be a useful conservation tool for identifying the rarer species in the whitebait catch if their populations become recruitment-limited rather than habitat-limited.

The whitebait fishery is recognised as being recreationally and commercially important (McDowall 1984; Kelly 1988). It is also important to mana whenua for customary reasons. In addition to revisiting the ranking of major whitebaiting rivers for their recreational and commercial importance, we attempted to rank rivers for their cultural/customary importance for the first time. While river rankings cannot be compared between districts/regions, river ranking comparisons within a district/region may provide helpful information on how recreation, commercial and/or cultural values change through time. The acknowledgement of cultural/customary whitebaiting values is an important part of Aotearoa New Zealand's whitebait fishery, and recognising and supporting these values will be an important part of future management of the fishery.

Overall, the data collection methods that we trialled during the 2021 season, and their broader application during the 2022 season, provided an improved understanding of whitebaiting and whitebaiters at a national scale. Not surprisingly, the national information gathered over the 2021 and 2022 whitebait fishing seasons illustrates how diverse the whitebait fishery is. Not only do fishing methods and species catch compositions vary from region to region, but also from river to river. Although whitebait fisher numbers recorded on specific rivers during the 2021 and 2022 whitebait fishing seasons were generally lower than those observed by Kelly (1988), it is important to remember that a lot has changed over the last 35 years. For example, the mobility of whitebaiters has greatly improved, along with the knowledge of where and when whitebait runs occur. The change in regulations (e.g., whitebait fisher distances from one another) may also influence numbers.

Although there has been a considerable amount of research relevant to the management of Aotearoa New Zealand's whitebait fishery over the past 20 years (e.g., Hickford and Schiel 2003, 2011, 2016; Stevens et al. 2016; Orchard and Hickford 2018; Egan et al. 2019; Yungnickel et al. 2020; Watson et al. 2021, 2022, 2023; Crichton et al. 2023), knowledge on the fishery and the species that form it remains limited. Data gaps include information on the size of the fishery harvest, the economic value of the fishery, the size of commercial effort, the basic knowledge of the larval biology and ecology of the whitebait species in the marine environment, and more (Booth et al. 2013; Goodman 2018). As stated in Watson and West (2023), basic information such as a nationwide inventory of whitebaiting rivers, estimated numbers of whitebaiters using those rivers and their fishing methods are critical components of fishery management decisions. These data are especially useful without knowledge of whitebait catch.

Compared with other fisheries in Aotearoa New Zealand, there are very little whitebait catch data available. From about the mid-1970s, there has been no official attempt to measure or publish whitebait catch, so the amount of whitebait harvested is unknown (McDowall 1996). The lack of records in part reflects the considerable difficulty in obtaining reliable data. It is discussed at length in McDowall's (1996) critical review of the role and performance of DOC's management of the fishery. While clarifying the whitebait fishery harvest would be extremely valuable, it would come at a financial cost and require the collaboration of whitebaiters to supply catch records (there is currently no legal requirement to report catch data). Therefore, it is recommended that DOC continues to gather data on whitebaiter numbers and the gear they use for catching whitebait during compliance and law enforcement patrols. However, a scaled-up inventory, as we have done here, would not need to be repeated annually. Instead, this broad-scale data-gathering exercise could be completed every 2–3 years. This could be revisited if/when new management decisions (i.e., changes in regulations or rāhui [fishery closures]) are made. Additionally, it will depend on the type of data requested. For example, although we did not document much difference in whitebaiter effort between the 2021 and 2022 seasons – where comparisons could be made – whitebaiter attitudes may change more frequently (quite possibly related to variability in catch). Either way, the type of reassessment (whitebaiter effort vs whitebaiter attitudes) will depend on the type of data needed. This baseline data gathering exercise over the 2021 and 2022 seasons will be of value to help determine future changes in whitebaiter efforts and attitudes.

Effort should also be made to standardise the terminology used when recording whitebaiter activity (e.g., through the production of a photo catalogue with definitions of different whitebaiter gear/net types and whitebaiting stands/structures). Finally, if there is to be any investment in quantifying harvest, it must be based on a long-term (decades-long) commitment, accompanied by an environmental monitoring programme to help aid in the identification of causes in catch variation, and must include all species that sustain the fishery (McDowall 1996).

5. Acknowledgements

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Appendix 1

2022 whitebaiter activity recording form: example

River: Mokihinui

Weather Conditions (circle one): Storm (heavy rain) Rain (steady rain) Showers (intermittent) (Clear/Sunny)

Rangers: Rick

District: WSI

% Cloud Cover: 20%

Tide you are working (circle height, direction and type): Low (Mid) High; (Incoming) Outgoing; Spring / (Neap)

Tide times: High 16:13 Low 09:59

Date: 14-Sep-2021

Reason for survey: CLE

Amount of Rain in the last # of hours (circle):

24 hrs	≤ 2 cm (NONE)	2cm < 4cm	≥ 4 cm
48 hrs	(≤ 2 cm)	2cm < 4cm	> 4 cm
72 hrs	≤ 2 cm	2cm < 4cm	(≥ 4 cm)

Start time: 13:00
Coordinates (NZTM): 1511386 E, 5402969 N

Finish time: 13:30
Coordinates (NZTM): 1513333 Easting, 5401883 Northing

River Bank		Fishing Method						Time observed	Catch (Additional info not required, but if available very helpful)	
		Structure	Set net		Scoop net	Drag net	Other/Notes (e.g., pole net from pontoon)			
TL	TR	or Stand	Box net	Sock net					Approx. amount	Time spent fishing
✓		Y or (N)			3		Starting patrol at river mouth TL bank	13:00		
	✓	Y or (N)			2			13:01		
		Y or (N)			1		Fishing in middle of river mouth	13:03		
✓		Y or (N)			1			13:06	1 kg	3 hrs
	✓	Y or (N)	2					13:10		
✓		(Y) or N			1			13:11		
✓		(Y) or N		3				13:25		
✓		(Y) or N					Fishing from pontoon using pole net	13:26		
	✓	(Y) or N	6					13:29		
✓		(Y) or N			1		can provide catch diary whitebaitjoe@gmail.com	13:30	2 kg	4 hrs
✓		Y or (N)	2					13:30		
		Y or N						:		
		Y or N						:		

Appendix 2

Inventory of whitebaiting waterways

REGION	WATERWAY	RIVER NUMBER	YEAR INVENTORIED
Auckland	Hōteo River	1	n/a
Waikato	Waikato River	2	2021
	Waingaro Stream	3	n/a
	Ōpārau River	4	n/a
	Marokopa River	5	2021, 2022
	Waikawau River	6	2021, 2022
	Awakino River	7	2021, 2022
	Mōkau River	8	2021, 2022
	Kiritehere Stream	9	2022
Taranaki	Onaero River	10	n/a
	Waitara River	11	2022
	Waingongoro River	12	n/a
	Kapoaiaia Stream	13	2022
	Oakura River	14	2022
	Oaonui Stream	15	2022
	Waiwhakaiho River	16	2022
	Warea River (Teikaparua)	17	2022
	Pātea River	39	n/a
	Whanganui Stream	18	2022
Manawatū-Whanganui	Kai Iwi Stream	19	n/a
	Whangaehu River	20	n/a
	Rangitīkei River	21	2022
	Manawatū River	22	2022
	Aohanga River	23	n/a
	Awarua Stream	24	2022
	Holben Creek	25	2022
	Kaikokopu Stream	26	2022
	Manawatū tidal creek	27	2022
	Mateongaonga Stream	28	2022
	Ōhau River	29	2022
	Turakina River	30	2022
	Waikawa Stream	31	2022
	Whanganui River	32	2022
	Whitebait Creek	33	2022
	Kaitoke Stream	34	n/a
	Waiau Stream	35	n/a
	Kauarapaoa Stream	36	n/a
	Mākirikiri Stream	37	n/a
	Whenuakura River	38	n/a
	Pātea River	39	n/a
	Waitōtara River	40	n/a

Continued on next page

Appendix 2 continued

REGION	WATERWAY	RIVER NUMBER	YEAR INVENTORIED
Kapiti-Wellington-Wairarapa	Ōtaki River	41	2022
	Peka Peka Stream	42	n/a
	Waikanae River	43	2022
	Pāuatahanui Stream	44	2022
	Te Awa Kairangi / Hutt River	45	2022
	Ruamāhanga River	46	2022
	Lake Ōnoke	47	2022
	Porirua Stream	48	2022
	Raumati River	49	2022
	Te Kowhai River	50	2022
	Waimeha Stream	51	2022
	Whareama River	52	n/a
Coromandel	Wentworth River	53	n/a
Bay of Plenty	Tuapiro Creek	54	n/a
	Kaituna River	55	n/a
	Tarawera River	56	2022
	Rangitaiki River	57	2022
	Whakatāne River	58	2022
	Nukuhou River	59	2022
	Ōtara River	60	2022
	Waiaua River	61	2022
	Waiotahe River	62	2022
	Whangaparāoa River	63	n/a
	Huntress Creek	64	2022
	Mōtū River	65	n/a
	Raukokore River	66	n/a
	Haparapara River	67	n/a
	Kereu River	68	n/a
	Waioweka River	69	2022
Hawke's Bay	Wairoa River	70	n/a
	Ngaruroro River	71	2022
	Tūtaekurī River	72	n/a
	Clive River	73	2022
	Tukituki River	74	2022
	Pōrangahau River	75	2022
	Esk River	76	2022
	Mangakuri River	77	2022
	Maraetotara River	78	2022

Continued on next page

Appendix 2 continued

REGION	WATERWAY	RIVER NUMBER	YEAR INVENTORIED
Tasman-Nelson	Anatori River	79	2021, 2022
	Aorere River	80	2021, 2022
	Atua Stream	81	2021
	Ellis Creek	82	2021, 2022
	Maitai River	83	2021
	Motueka River	84	2021, 2022
	Moutere Stream	85	2021, 2022
	Ōnahau River	86	2022
	Otūwhero River	87	2022
	Parapara River	88	n/a
	Paturau River	89	2021, 2022
	Moturoa/Rabbit Island	90	2021, 2022
	Riwaka River	91	2021, 2022
	Stringer Creek	92	2021
	Tākaka River	93	2021, 2022
	Tasman River	94	2021
	Thawleys Creek	95	2021
	Turimawiwi River	96	2021, 2022
	Waimea River	97	2021, 2022
	Wainui River	98	2021, 2022
	Wakapuaka River	99	2022
	White Pine Creek	100	2021, 2022
	Motupipi River	101	n/a
Marlborough	Wairau River	102	2021
	Flaxbourne River	103	2021
	Ōpaoa River	104	n/a
	Awatere River	105	n/a

Continued on next page

Appendix 2 continued

REGION	WATERWAY	RIVER NUMBER	YEAR INVENTORIED
Canterbury	Hāpuku River	106	n/a
	Lyell Creek	107	n/a
	Kowhai River	108	n/a
	Saltwater Creek	109	2021, 2022
	Ashley River / Rakahuri	110	2021, 2022
	Waimakariri River	111	2021, 2022
	Styx River	112	2021, 2022
	Avon River / Ōtakaro	113	2021, 2022
	Heathcote River	114	2021, 2022
	Opara Stream	115	n/a
	Le Bons Stream	116	n/a
	Robinsons Stream	117	n/a
	Pawsons Stream	118	n/a
	Orari River	119	2022
	Ōpihi River	120	2022
	Waihao River	121	2022
	Cam River / Ruataniwha	122	2021
	Jockey Baker Creek	123	2021
	Kaiapoi River	124	2021, 2022
	Ashburton River / Hakatere	125	2022
	Rakaia River	126	2022
	Rangitata River	127	2022
	Hurunui River	128	n/a
	Lake Ellesmere / Te Waihora	129	n/a
	Smithfield outlet (Taitarakihi Creek)	130	2021
Otago	Waitaki River	131	n/a
	Kakanui River	132	2021, 2022
	Waihemo / Shag River	133	2022
	Taiari River	134	2021, 2022
	Waianakarua River	135	2021, 2022
	Waikouaiti River	136	2021, 2022
	Waitati River	137	2021, 2022
	Ōwaka River	138	n/a
Southland	Aparima River	139	2021, 2022
	Clutha River / Mata-Au	140	2021
	Mataura River	141	2021, 2022
	Pourakino River	142	2021, 2022
	Titiroa Stream	143	2021, 2022
	Waihopai River	144	2021
	Waikawa River	145	2022
	Ōreti River	146	n/a
	Waiau River	147	2022
	Catlins River	148	n/a
	Waimatuku Stream	149	n/a
	Wakaputa Stream	150	n/a

Continued on next page

Appendix 2 continued

REGION	WATERWAY	RIVER NUMBER	YEAR INVENTORIED
North Westland	Ōpārara River	151	2021
	Karamea River	152	2022
	Heaphy River	153	2021
	Granite Creek	154	2021
	Little Wanganui River	155	2021
	Mōkihinui River	156	2021, 2022
	Deadmans Creek	157	2022
	Orowaiti River	158	2022
	Buller River	159	2021, 2022
	Ōkari River	160	n/a
	Punakaiki River	161	2022
	Grey River / Māwheranui	162	2021, 2022
	New River / Kaimata	163	2021, 2022
	Taramakau River	164	2021, 2022
	Seven Mile Creek / Waimatuku	165	2021, 2022
	Waimea Creek	166	n/a
	Hokitika River	167	2021, 2022
	Pororari River	168	2022
	Waimangaroa River	169	2022
	Waitaha River	170	2022
	Fox River	171	2022
	Mikonui River	172	2022
	Nile River	173	2022
	Waikoriri Creek	174	2022
South Westland	Wanganui River	175	n/a
	Ōkārito River	176	n/a
	Paringa River	177	2022
	Waiatoto River	178	2022
	Cascade River	179	2022
	Arawhata River	180	2022
	Awarua River	181	2022
	Haast River	182	2022
	Hollyford River / Whakatipu Kā Tuka	183	2022
	Karangarua River	184	2022
	Mahitahi River	185	2022
	Makawhio / Jacobs River	186	2022
	Moeraki / Blue River	187	2022
	Ohinemaka River	188	2022
	Okuru River	189	2022
	Turnbull River	190	2022
	Waita River	191	2022

Appendix 3

Supplementary information

This appendix includes figures and tables for each region showing, where applicable, the proportion of whitebaiter net types for each river, the proportion of whitebaiters fishing from structures for each river, tables ranking the major whitebaiting rivers and how river rankings compared with Kelly (1988).

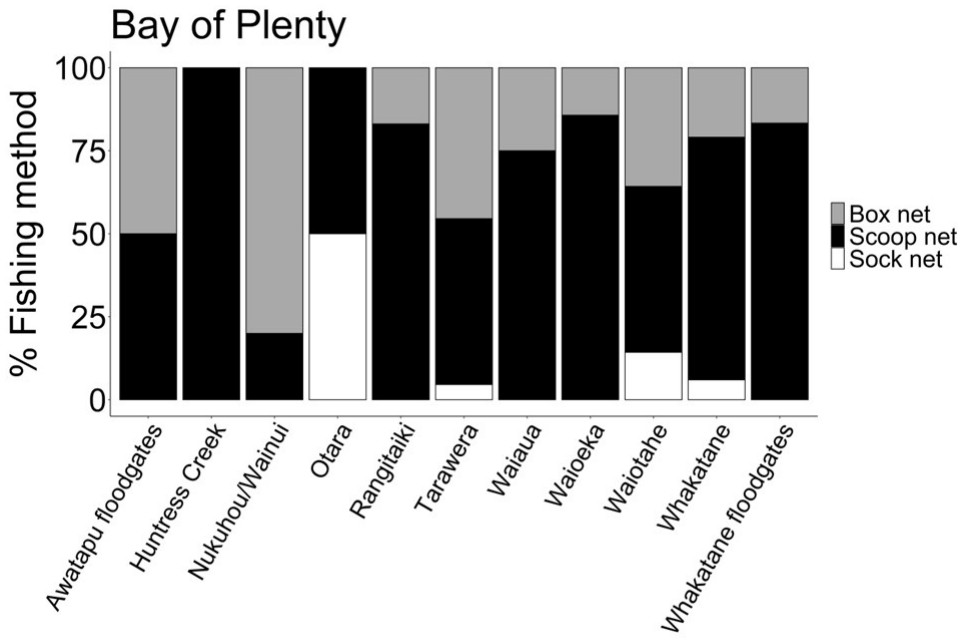

Figure S1. Proportion of whitebaiter net types used on Bay of Plenty rivers where riverbank whitebaiter activity counts were completed during the 2022 whitebait fishing season.

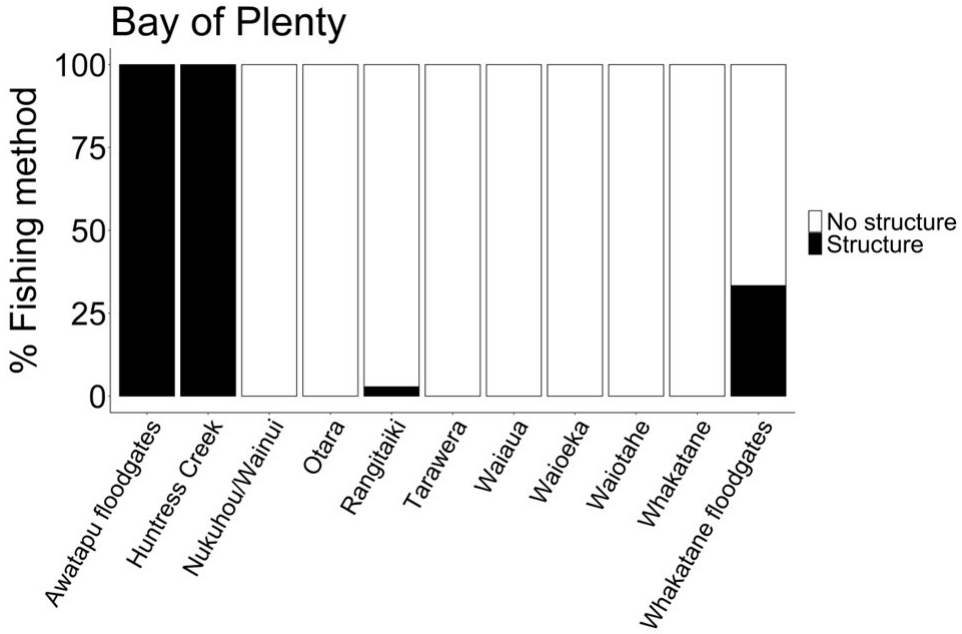

Figure S2. Proportion of whitebaiters fishing from structures on Bay of Plenty rivers where whitebaiter riverbank activity counts were completed during the 2022 whitebait fishing season.

Table S1. Commercial, recreational and cultural/customary importance of whitebaiting rivers in the Whakatāne district of the Bay of Plenty. 1 = minor importance, 2 = significant or average importance, 3 = major importance.

RIVER	DISTRICT	COMMERCIAL IMPORTANCE	RECREATIONAL IMPORTANCE	CULTURAL / CUSTOMARY IMPORTANCE
Tarawera	Whakatāne	1	2	3
Rangitaiki	Whakatāne	1	3	3
Whakatāne	Whakatāne	1	3	3
Waioweka	Whakatāne	1	3	3
Ōtara	Whakatāne	1	2	2
Whangaparāoa	Whakatāne	1	1	3
Mōtū	Whakatāne	1	3	3
Waiaua	Whakatāne	1	2	3
Waiotahe	Whakatāne	1	1	2
Wainui/Nukuhou	Whakatāne	1	2	2
Raukokore	Whakatāne	1	1	3
Haparapara	Whakatāne	1	1	3
Kereu	Whakatāne	1	1	3

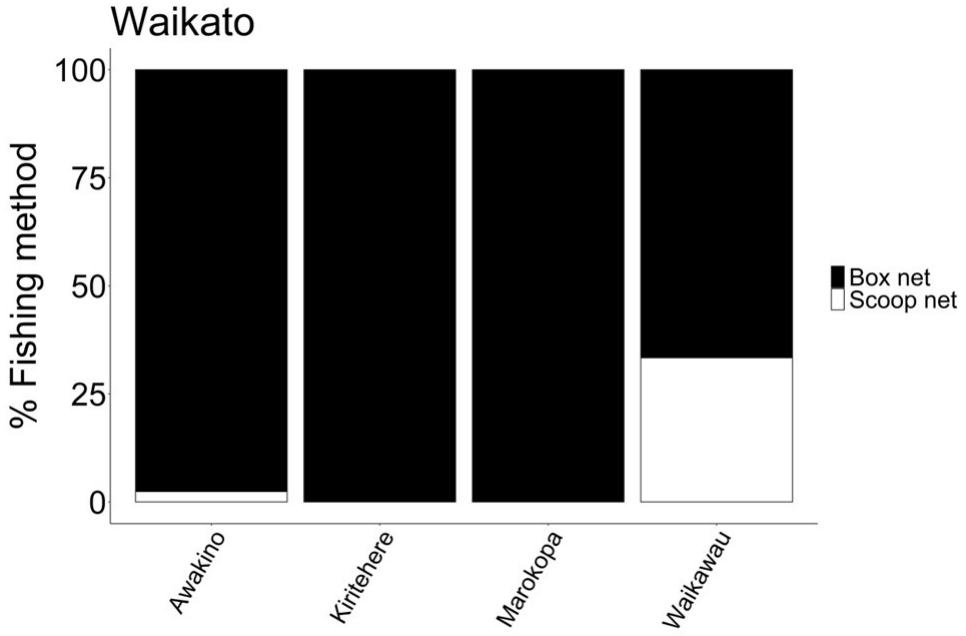

Figure S3. Proportion of whitebaiter net types used on Waikato rivers where whitebaiter riverbank activity counts were completed during the 2022 whitebait fishing season.

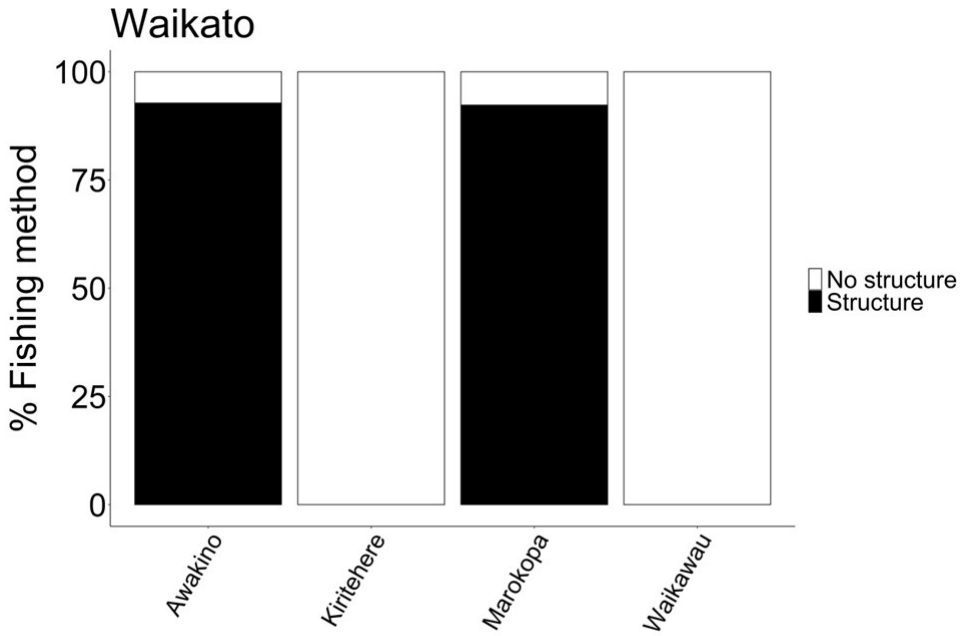

Figure S4. Proportion of whitebaiters fishing from structures on Waikato rivers where whitebaiter riverbank activity counts were completed during the 2022 whitebait fishing season.

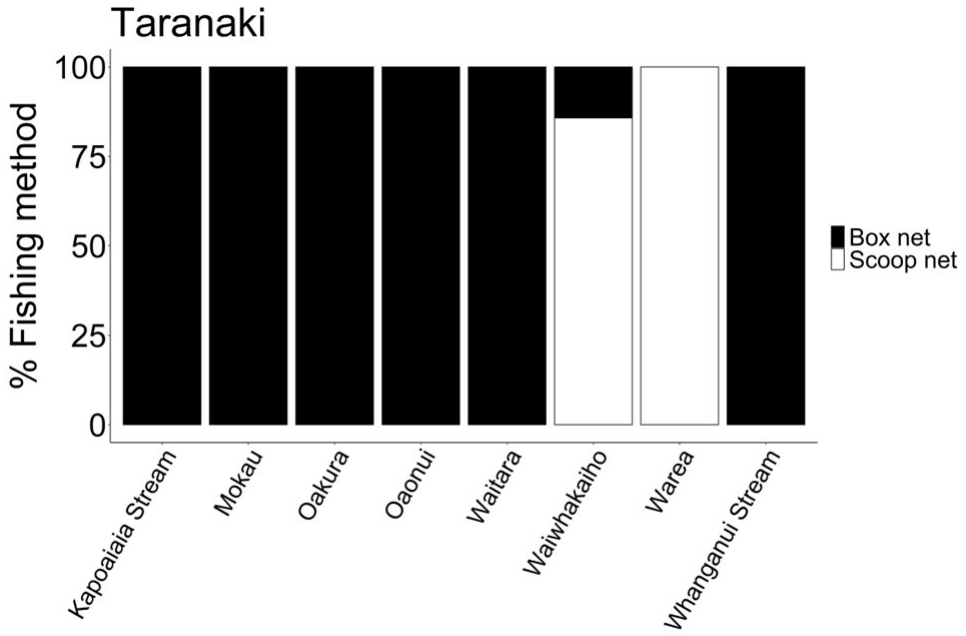

Figure S5. Proportion of whitebaiter net types used on Taranaki rivers where whitebaiter riverbank activity counts were completed during the 2022 whitebait fishing season.

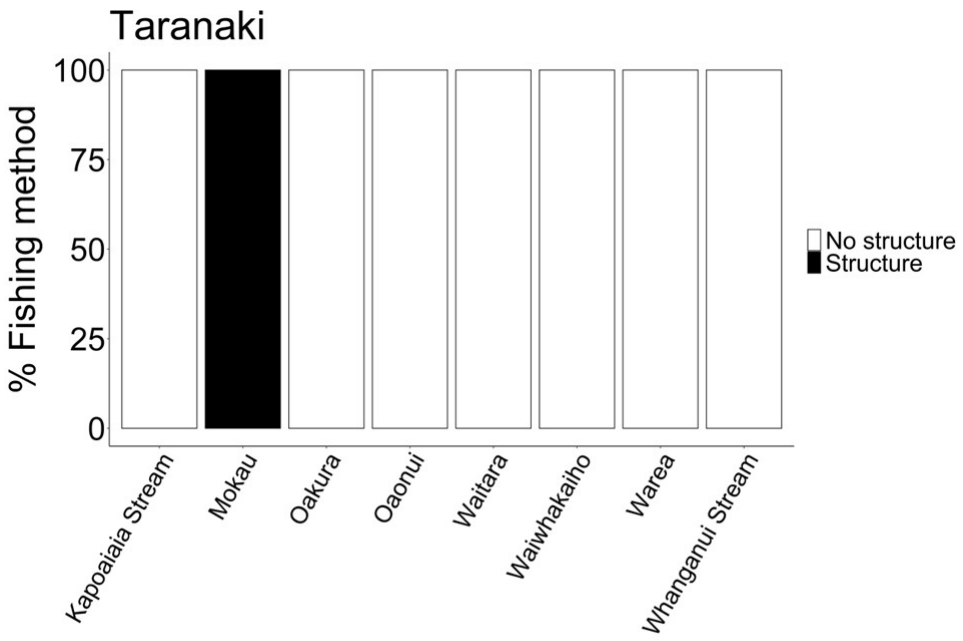

Figure S6. Proportion of whitebaiters fishing from structures on Taranaki rivers where whitebaiter riverbank activity counts were completed during the 2022 whitebait fishing season.

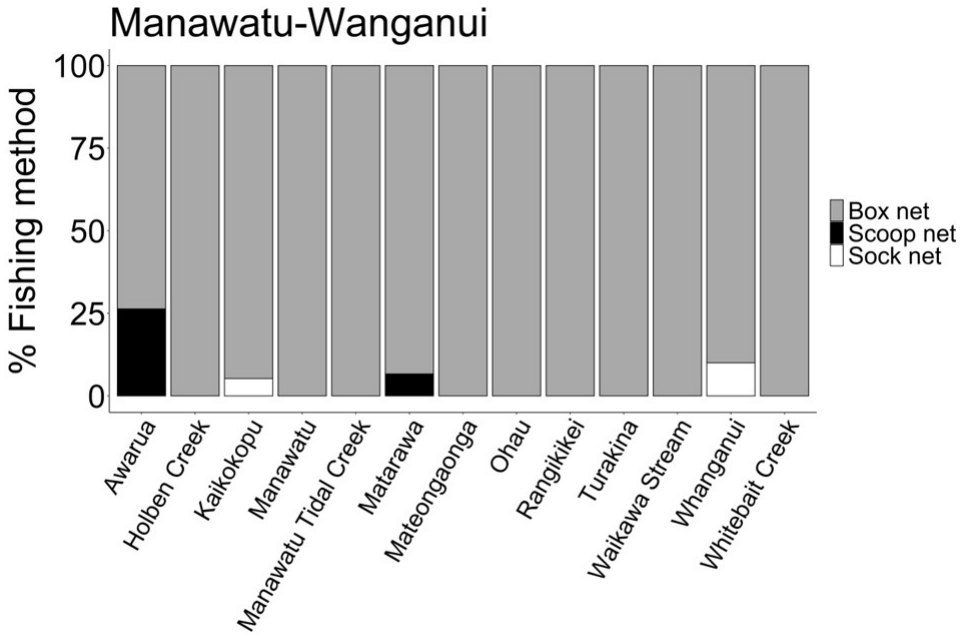

Figure S7. Proportion of whitebaiter net types used on Manawatū-Whanganui rivers where whitebaiter riverbank activity counts were completed during the 2022 whitebait fishing season.

Table S2 Commercial, recreational and cultural/customary importance of whitebaiting rivers in Manawatū-Whanganui. 1 = minor importance, 2 = significant or average importance, 3 = major importance.

RIVER	DISTRICT	COMMERCIAL IMPORTANCE	RECREATIONAL IMPORTANCE	CULTURAL / CUSTOMARY IMPORTANCE
Whanganui	Whanganui	0	3	3
Whangaehu	Whanganui	0	3	3
Kai Iwi Stream	Whanganui	0	2	3
Turakina	Whanganui	0	2	3
Waitōtara	Whanganui	0	2	3
Pātea	Whanganui	0	2	3
Whenuakura	Whanganui	0	2	3
Mākirikiri Stream	Whanganui	0	1	3
Kai Iwi Stream	Whanganui	0	1	3
Waiau Stream	Whanganui	0	1	3
Kauarapaoa Stream	Whanganui	0	1	3
Kaitoke Stream	Whanganui	0	1	3

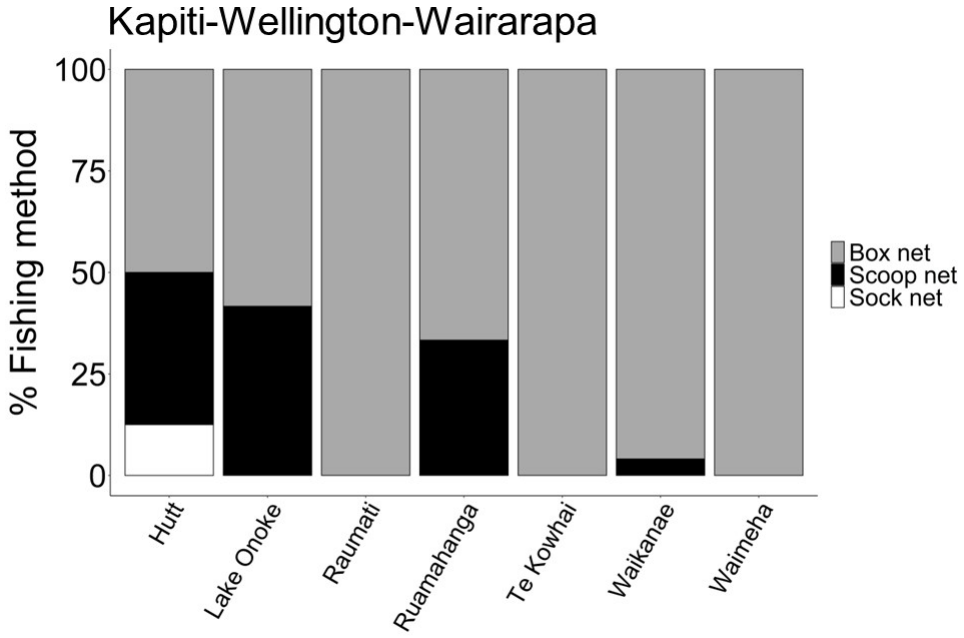

Figure S8. Proportion of whitebaiter net types used on Kapiti-Wellington-Wairarapa rivers where whitebaiter riverbank activity counts were completed during the 2022 whitebait fishing season.

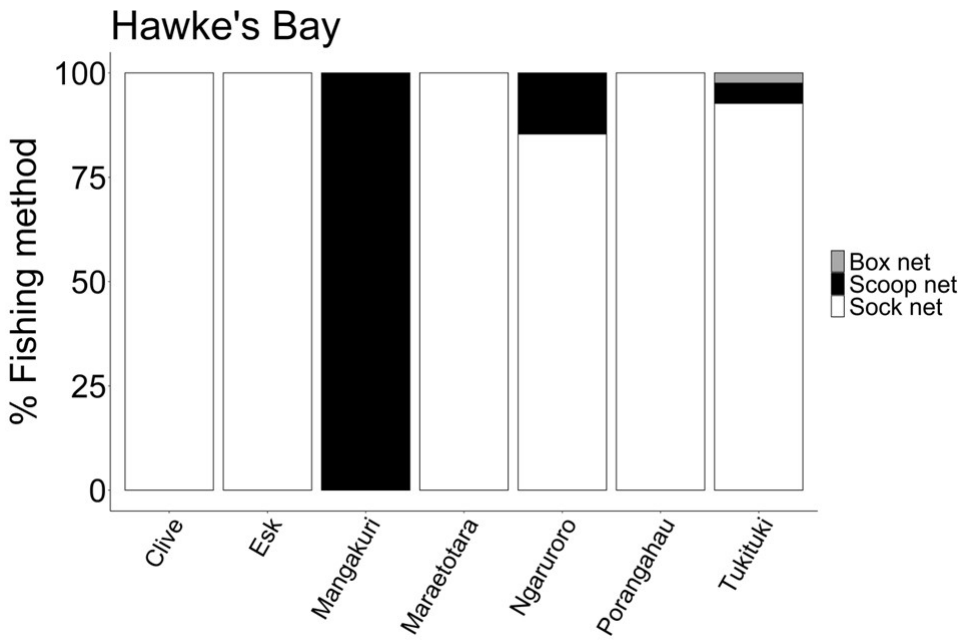

Figure S9. Proportion of whitebaiter net types used on Hawke's Bay rivers where whitebaiter riverbank activity counts were completed during the 2022 whitebait fishing season.

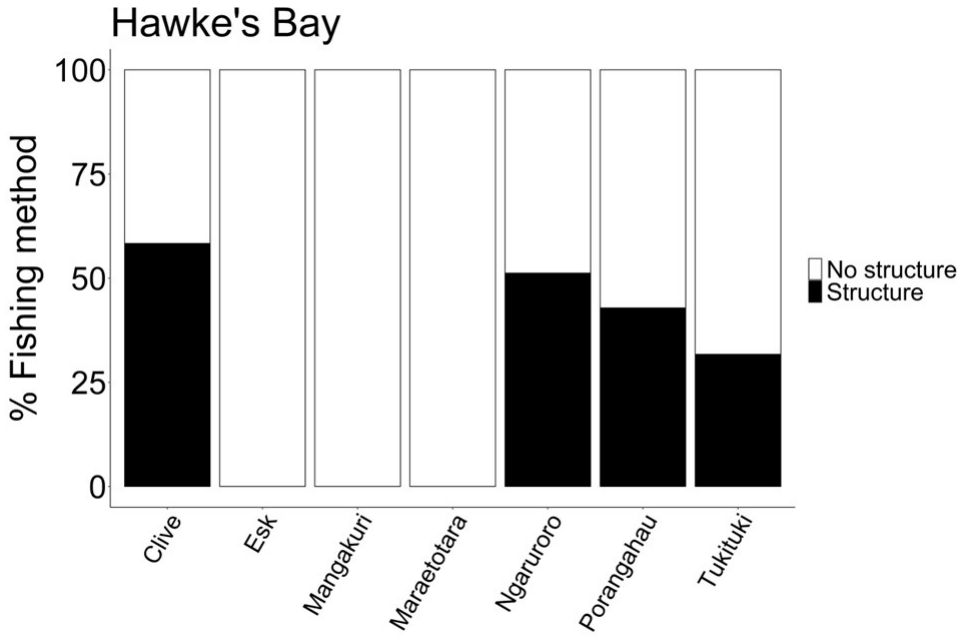

Figure S10. Proportion of whitebaiters fishing from structures on Hawke's Bay rivers where whitebaiter riverbank activity counts were completed during the 2022 whitebait fishing season.

Table S3. Commercial, recreational and cultural / customary importance of whitebaiting rivers in Hawke's Bay. 1 = minor importance, 2 = significant or average importance, 3 = major importance.

RIVER	DISTRICT	COMMERCIAL IMPORTANCE	RECREATIONAL IMPORTANCE	CULTURAL / CUSTOMARY IMPORTANCE
Wairoa	Hawke's Bay	1	3	2
Ngaruroro	Hawke's Bay	1	3	2
Tūtaekurī	Hawke's Bay	1	3	2
Clive	Hawke's Bay	1	3	3
Tukituki	Hawke's Bay	1	3	2
Pōrangahau	Hawke's Bay	1	2	3

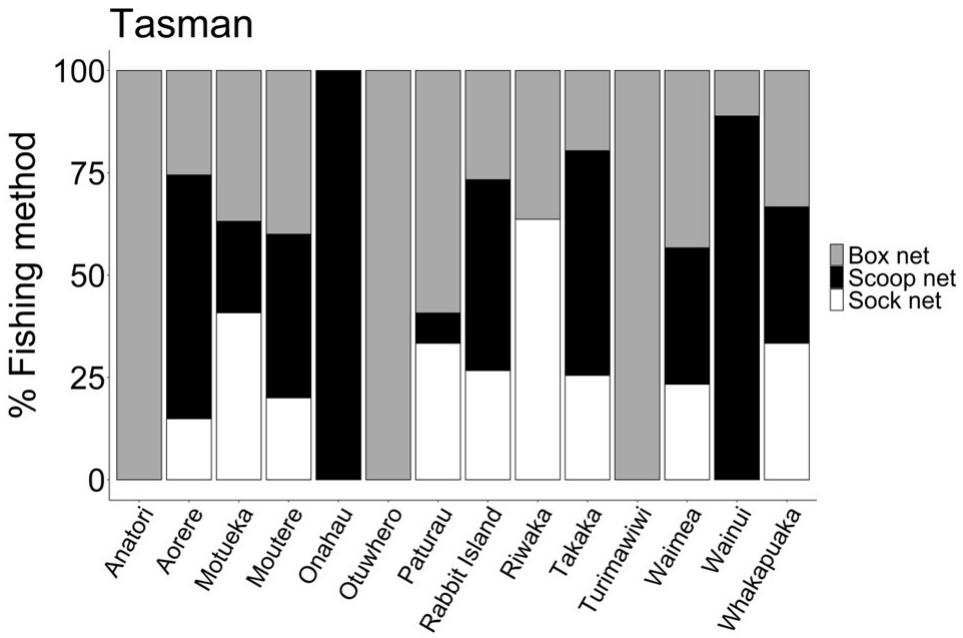

Figure S11. Proportion of whitebaiter net types used on Tasman rivers where whitebaiter riverbank activity counts were completed during the 2022 whitebait fishing season.

Table S4. Commercial, recreational and cultural / customary importance of whitebaiting rivers in the Tākaka and Motueka districts of Tasman. 1 = minor importance, 2 = significant or average importance, 3 = major importance.

RIVER	DISTRICT	COMMERCIAL IMPORTANCE	RECREATIONAL IMPORTANCE	CULTURAL / CUSTOMARY IMPORTANCE
Anatori River	Tākaka	1	3	3
Aorere River	Tākaka	3	3	3
Motueka River	Motueka	3	3	3
Motupipi River	Tākaka	1	2	3
Moutere River	Motueka	1	3	3
Paturau River	Tākaka	2	3	3
Riwaka River	Motueka	2	3	3
Tākaka River	Tākaka	3	3	3
Turimawiwi River	Tākaka	1	2	3
Waimea River	Motueka	3	3	3
Wakapuaka River	Motueka	2	3	3
Wainui River	Tākaka	1	2	3

Table S5. Changes in the commercial and recreational importance of whitebaiting rivers in the Tākaka and Motueka districts of Tasman from 1988 to 2022. Values from 1988 were taken from Kelly (1988).

RIVER	DISTRICT	CHANGE IN COMMERCIAL IMPORTANCE	CHANGE IN RECREATIONAL IMPORTANCE
Anatori River	Tākaka	–2	+1
Aorere River	Tākaka	+1	No change
Motueka River	Motueka	No change	No change
Motupipi River	Tākaka	n/a	No change
Moutere River	Motueka	n/a	+2
Paturau River	Tākaka	No change	+2
Riwaka River	Motueka	n/a	+2
Tākaka River	Tākaka	+1	No change
Turimawiwi River	Tākaka	–2	No change
Waimea River	Motueka	+2	No change
Wakapuaka River	Motueka	n/a	+2

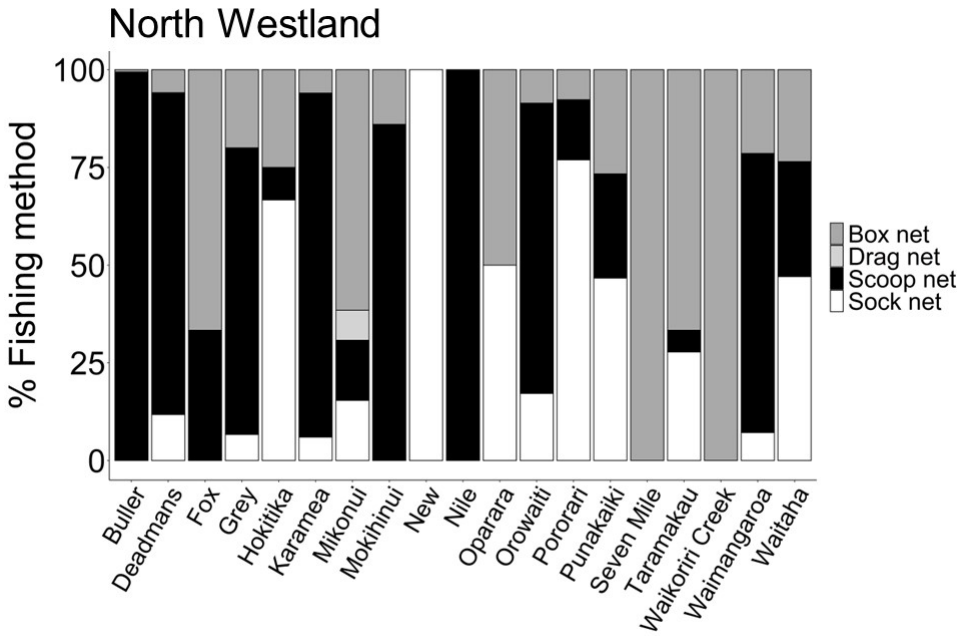

Figure S12. Proportion of whitebaiter net types used on North Westland rivers where whitebaiter riverbank activity counts were completed during the 2022 whitebait fishing season.

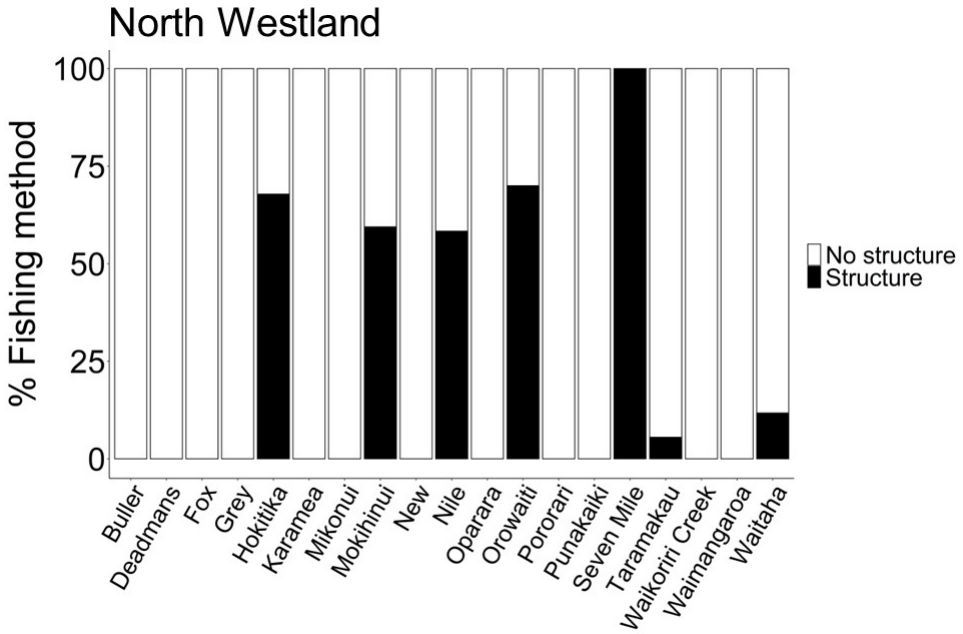

Figure S13. Proportion of whitebaiters fishing from structures on North Westland rivers where whitebaiter riverbank activity counts were completed during the 2022 whitebait fishing season.

Table S6. Commercial, recreational and cultural / customary importance of whitebaiting rivers in the Buller, Greymouth and Hokitika districts of Westland. 1 = minor importance, 2 = significant or average importance, 3 = major importance.

RIVER	DISTRICT	COMMERCIAL IMPORTANCE	RECREATIONAL IMPORTANCE	CULTURAL / CUSTOMARY IMPORTANCE
Buller River	Buller	1	3	1
Granite Creek	Buller	1	2	1
Grey River / Māwheranui	Greymouth	1	2	1
Hokitika River	Hokitika	2	3	1
Karamea River	Buller	1	1	1
Little Wanganui River	Buller	1	2	1
Mōkihinui River	Buller	1	2	1
Orowaiti River	Buller	1	2	1
Pororari River	Buller	1	1	1
Punakaiki River	Buller	1	1	1
Taramakau River	Greymouth	1	2	1
Waimangaroa River	Buller	1	1	1
Waitaha River	Hokitika	1	2	1

Table S7. Changes in the commercial and recreational importance of whitebaiting rivers in the Buller, Greymouth and Hokitika districts of Westland from 1988 to 2022. Values from 1988 were taken from Kelly (1988).

RIVER	DISTRICT	CHANGE IN COMMERCIAL IMPORTANCE	CHANGE IN RECREATIONAL IMPORTANCE
Buller River	Buller	–2	No change
Granite Creek	Buller	n/a	No change
Grey River / Māwheranui	Greymouth	No change	No change
Hokitika River	Hokitika	–1	No change
Karamea River	Buller	–1	–1
Little Wanganui River	Buller	No change	+1
Mōkihinui River	Buller	–2	–1
Orowaiti River	Buller	–1	No change
Pororari River	Buller	No change	–1
Punakaiki River	Buller	n/a	No change
Taramakau River	Greymouth	No change	No change
Waimangaroa River	Buller	n/a	No change
Waitaha River	Hokitika	No change	+1

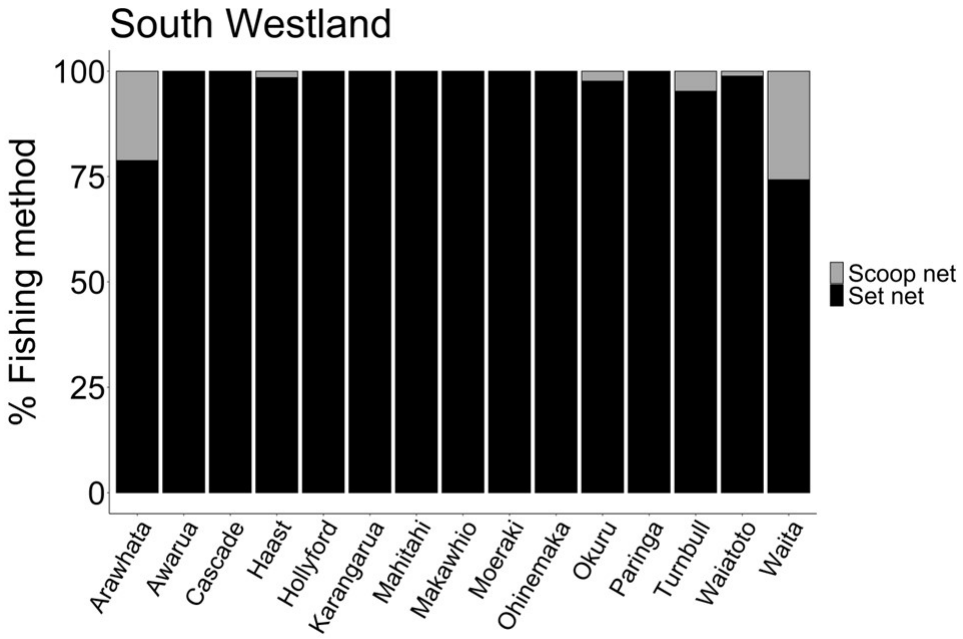

Figure S14. Proportion of whitebaiter net types used on South Westland rivers where aerial surveys were completed during the 2022 whitebait fishing season (note – aerial imagery has the resolution to identify specific types of set nets from the images, i.e., sock nets versus box nets).

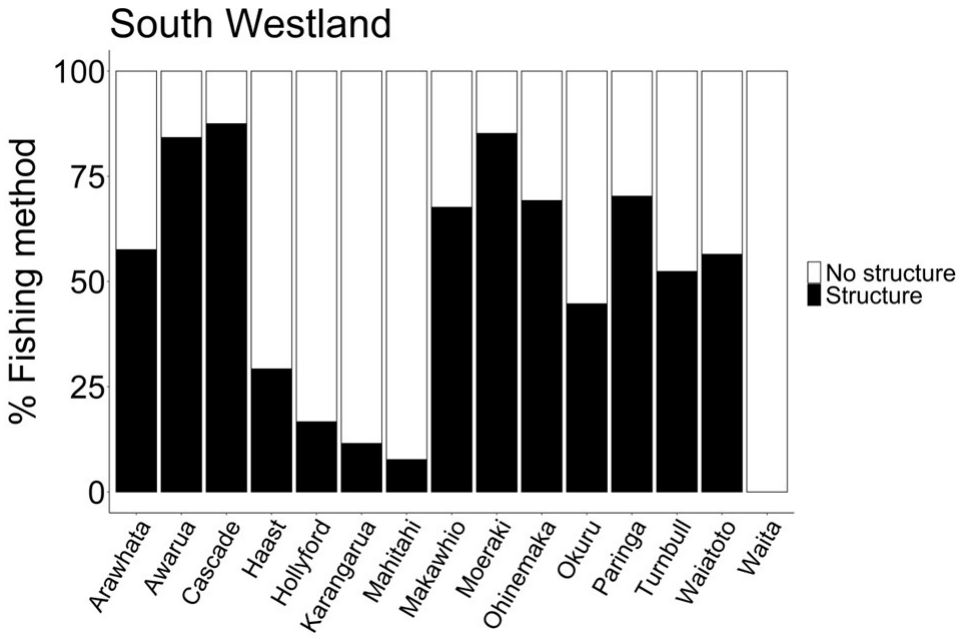

Figure S15. Proportion of whitebaiters fishing from structures on South Westland rivers where aerial surveys were completed during the 2022 whitebait fishing season.

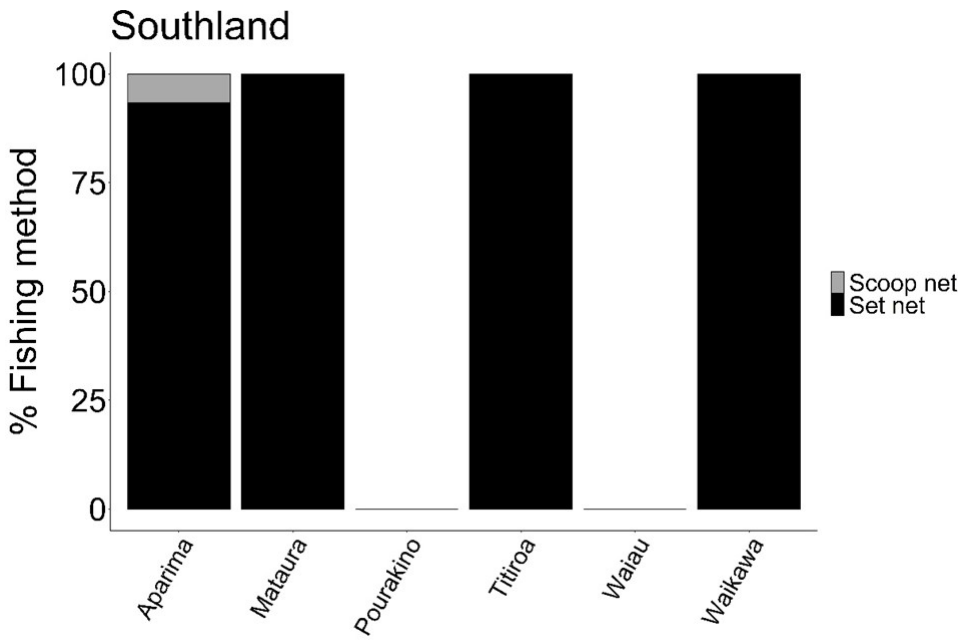

Figure S16. Proportion of whitebaiter net types used on Southland rivers where aerial surveys were completed during the 2022 whitebait fishing season (note – aerial imagery has the resolution to identify specific types of set nets from the images, i.e., sock nets versus box nets).

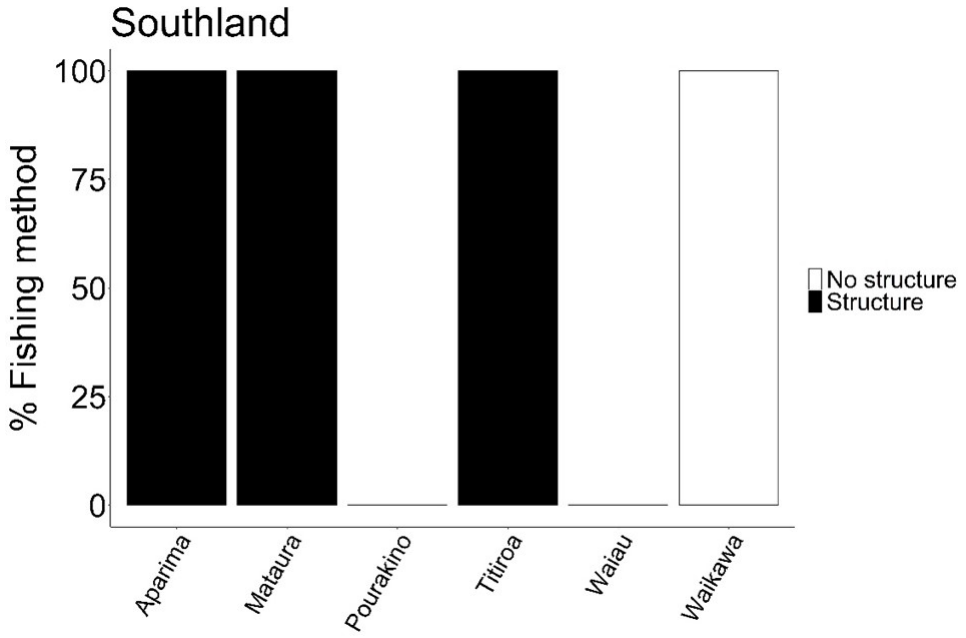

Figure S17. Proportion of whitebaiters fishing from structures on Southland rivers where aerial surveys were completed during the 2022 whitebait fishing season.

Table S8. Commercial, recreational and cultural / customary importance of whitebaiting rivers in Southland.
1 = minor importance, 2 = significant or average importance, 3 = major importance.

RIVER	DISTRICT	COMMERCIAL IMPORTANCE	RECREATIONAL IMPORTANCE	CULTURAL / CUSTOMARY IMPORTANCE
Aparima River	Murihiku	1	3	1
Catlins River	Murihiku	1	2	1
Clutha River / Mata-Au	Murihiku	3	3	1
Mataura River	Murihiku	3	3	1
Ōreti River	Murihiku	1	2	1
Pourakino River	Murihiku	1	2	1
Titiroa River	Murihiku	2	3	1
Waiau River	Murihiku	2	3	1
Waikawa River	Murihiku	1	2	1
Waimatuku Stream	Murihiku	1	1	1
Wakaputa Stream	Murihiku	1	1	1

Table S9. Changes in the commercial and recreational importance of whitebaiting rivers in Southland from 1988 to 2022.
Values from 1988 were taken from Kelly (1988).

RIVER	DISTRICT	CHANGE IN COMMERCIAL IMPORTANCE	CHANGE IN RECREATIONAL IMPORTANCE
Aparima River	Murihiku	No change	+1
Catlins River	Murihiku	n/a	+1
Clutha River / Mata-Au	Murihiku	+2	No change
Mataura River	Murihiku	+1	No change
Ōreti River	Murihiku	No change	No change
Pourakino River	Murihiku	No change	+1
Titiroa River	Murihiku	–1	+2
Waiau River	Murihiku	n/a	+2
Waikawa River	Murihiku	n/a	+1
Waimatuku Stream	Murihiku	n/a	+1
Wakaputa Stream	Murihiku	n/a	No change

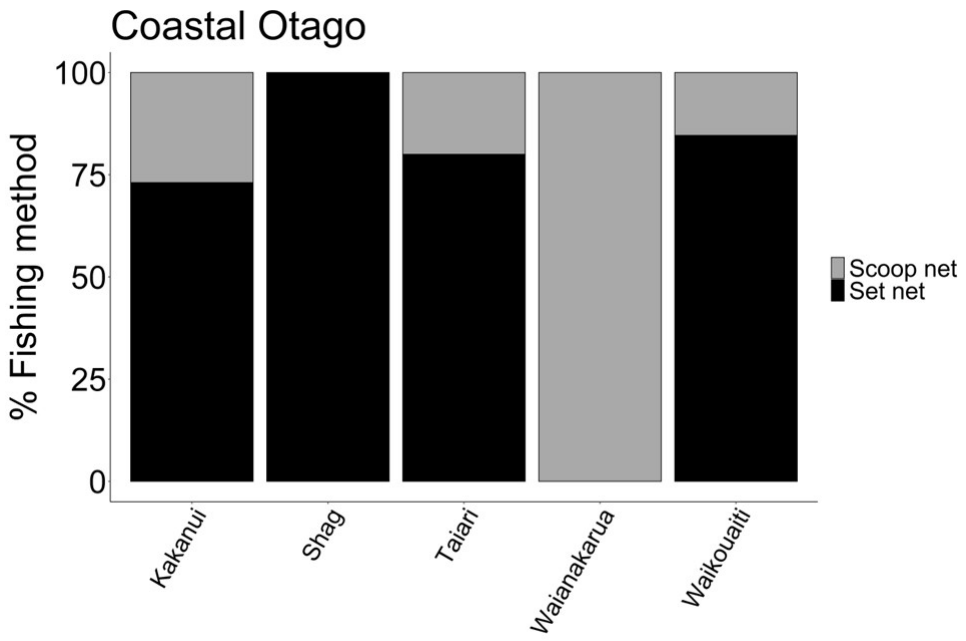

Figure S18. Proportion of whitebaiter net types used on Coastal Otago rivers where surveys were completed during the 2022 whitebait fishing season.

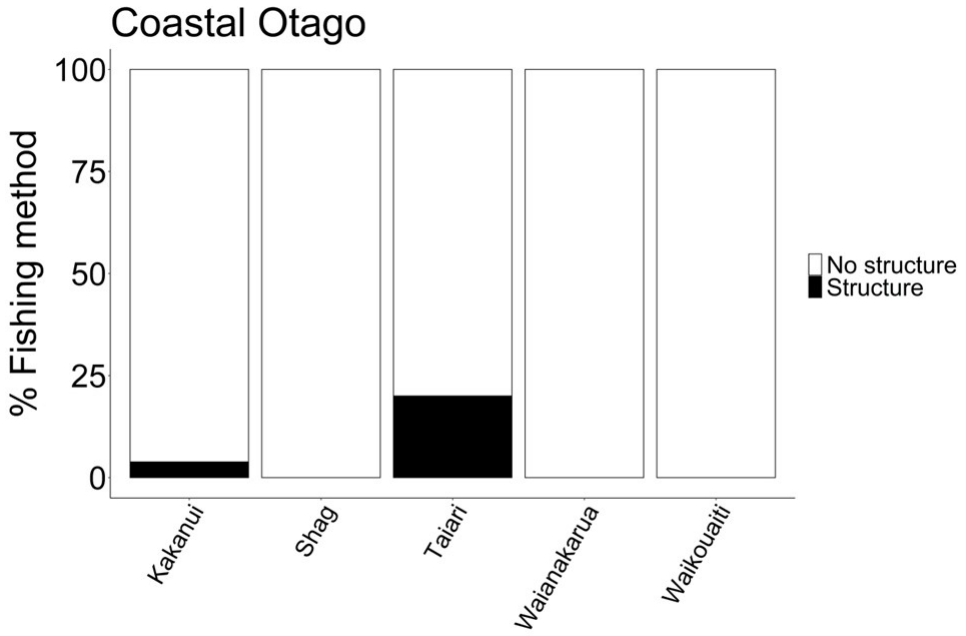

Figure S19. Proportion of whitebaiters fishing from structures on Coastal Otago rivers where surveys were completed during the 2022 whitebait fishing season.

Table S10. Recreational and cultural / customary importance of whitebaiting rivers in Coastal Otago. 1 = minor importance, 2 = significant or average importance, 3 = major importance.

RIVER	DISTRICT	RECREATIONAL IMPORTANCE	CULTURAL / CUSTOMARY IMPORTANCE
Kakanui River	Coastal Otago	2	1
Waihemo / Shag River	Coastal Otago	2	1
Taiari River	Coastal Otago	2	1
Waikouaiti River	Coastal Otago	2	1

Table S11. Changes in the recreational importance of whitebaiting rivers in Coastal Otago from 1988 to 2022. Values from 1988 were taken from Kelly (1988).

RIVER	DISTRICT	CHANGE IN RECREATIONAL IMPORTANCE
Kakanui River	Coastal Otago	No change
Waihemo / Shag River	Coastal Otago	No change
Taiari River	Coastal Otago	No change
Waikouaiti River	Coastal Otago	No change

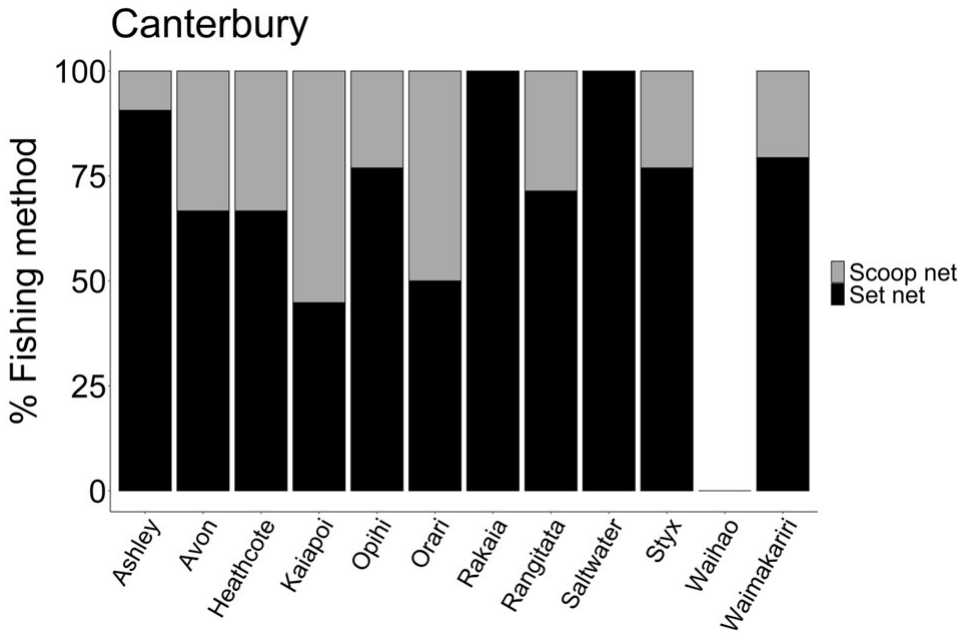

Figure S20. Proportion of whitebaiter net types used on Canterbury rivers where surveys were completed during the 2022 whitebait fishing season.

Table S12. Commercial, recreational and cultural/customary importance of whitebaiting rivers in the Mahaanui and Geraldine districts of Canterbury. 1 = minor importance, 2 = significant or average importance, 3 = major importance.

RIVER	DISTRICT	COMMERCIAL IMPORTANCE	RECREATIONAL IMPORTANCE	CULTURAL/ CUSTOMARY IMPORTANCE
Saltwater Creek	Mahaanui	n/a	2	3
Heathcote River	Mahaanui	n/a	3	n/a
Kaiapoi River	Mahaanui	n/a	3	n/a
Ashley River/Rakahuri	Mahaanui	n/a	2	n/a
Avon River/Ōtakaro	Mahaanui	n/a	3	n/a
Hurunui River	Mahaanui	n/a	n/a	n/a
Lake Ellesmere/Te Waihora outlet	Mahaanui	n/a	3	n/a
Waimakariri River	Mahaanui	n/a	3	n/a
Rakaia River	Mahaanui	n/a	n/a	n/a
Hakatere/Ashburton River	Geraldine	n/a	2	n/a
Ōpihi River	Geraldine	n/a	3	3
Orari River	Geraldine	2	3	n/a
Rangitata River	Geraldine	1	2	n/a
Smithfield outlet (Taitarakihi Creek)	Geraldine	1	2	n/a
Waihao River (if mouth open)	Geraldine	n/a	3	3
Waitaki River	Geraldine	3	3	n/a

Table S13. Changes in the recreational importance of whitebaiting rivers in Canterbury from 1988 to 2022. Values from 1988 were taken from Kelly (1988).

RIVER	DISTRICT	CHANGE IN RECREATIONAL IMPORTANCE
Saltwater Creek	Mahaanui	n/a
Heathcote River	Mahaanui	n/a
Kaiapoi River	Mahaanui	n/a
Ashley River/Rakahuri	Mahaanui	No change
Avon River/Ōtakaro	Mahaanui	+1
Hurunui River	Mahaanui	n/a
Lake Ellesmere/Te Waihora outlet	Mahaanui	+2
Waimakariri River	Mahaanui	No change
Rakaia River	Mahaanui	n/a
Hakatere/Ashburton River	Geraldine	+1
Ōpihi River	Geraldine	+1
Orari River	Geraldine	+1
Rangitata River	Geraldine	No change
Smithfield outlet (Taitarakihi Creek)	Geraldine	n/a
Waihao River (if mouth open)	Geraldine	No change
Waitaki River	Geraldine	+2