Freshwater angler expectations and experiences following a sub-tropical cyclone

A report to the Hawke's Bay Fish & Game Council: September 2024

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Vision Thinking

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1 Structure and content of this report

This report details angler's expectations and experiences of the 2023/24 season across the five main river systems in Hawke's Bay. The season followed extensive flood damage caused by sub-tropical Cyclone Gabrielle in February of 2023.

The report is structured to present key points from the research in a readable format, while containing enough technical detail to allow others to build on this work, should they choose to do so. The executive summary is followed by an introduction, survey design, and results. A separate results summary section has been included as a 'quick guide.'

The final sections include a discussion followed by a list of conclusions and recommendations.

2 Executive Summary

A survey of Hawke's Bay anglers was conducted to quantify their expectations and experiences of the 2023/24 season following the effects of Cyclone Gabrielle in February of 2023. There were 267 complete responses, with 66 not having a current licence. Of those 66, a third cited flood damage as the main reason for not purchasing a licence. Data was collected on fishing habits, experience, knowledge, and ability. Four attributes were used to quantify angler's expectations and experiences of the Mohaka, Esk, Tutaekuri, Ngaruroro, and Tukituki/Waipawa River systems. These were, *trout numbers*, *trout condition*, *stream ecology*, and *angler numbers* encountered.

Fly Fishers (*FF*) rated themselves as more knowledgeable, experienced, and confident in their ability to spot fish compared to spin-fishers (*SP*). *SP* had a younger age profile than *FF* and were four times more likely to purchase a family licence. Most *SP* (71%) fished once a month or less compared to 46% of *FF*. For 88% of respondents, their usual fishing habit involved releasing fish, with 73% of *FF* releasing all fish. When choosing a location most respondents relied on their own thoughts and observations, although *SP* were more than twice as likely to rely on social media than *FF*. Most *FF* (52%) were satisfied or very satisfied with the season at the time of the survey, compared to 37% of *SP.* Satisfaction was strongly correlated with the comparative number of fish landed.

The number of fish landed had an unusual bi-modal distribution with modes at *less than half normal* and *normal*. The reason for these two classes of anglers remains open to interpretation, and further comment is offered in Section 7.4. Of those who had landed less fish than they would normally expect, 52% of *FF* attributed it to a high trout death rate compared to 32% of *SP*. Thirty-nine percent of *SP* attributed it to not fishing as often as they usually would. A poor experience may have reduced *SP's* motivation to fish, as *SP* were also more likely to forgo licence purchase due to future severe weather events than *FF*.

Only two respondents had fished the Esk River with poor expectations and experiences that mostly matched. The largest proportion of those that did not fish the Tutaekuri cited flood damage to the river as the main reason, whereas for all other systems either angler habit or unfulfilled intention predominated responses.

Most anglers that fished the Mohaka River system expected *trout numbers* (58%), *trout condition* (58%), and *stream ecology* (63%) to be below what they considered normal. In contrast, *angler numbers* were expected to be at least normal. Experiences were better than expectations, with most anglers experiencing *trout numbers* (55%), *trout condition* (77%), *stream ecology* (59%), and *angler numbers* (56%) at levels they considered normal or better.

Most anglers that fished the Tutaekuri River system expected *trout numbers* (92%), *trout condition* (95%), *stream ecology* (95%), and *angler numbers* (84%) to be below what they considered normal. Although some moderation in sentiment was evident, most anglers had a poor experience, with *trout numbers* (95%), *trout condition* (81%), *stream ecology* (81%), and *angler numbers* (81%) at levels they considered below normal. This was the poorest overall experience of the four remaining rivers.

Most Anglers that fished the Ngaruroro River system expected *trout numbers* (79%), *trout condition* (70%), *stream ecology* (71%), and *angler numbers* (59%) to be below what they

considered normal. Experiences validated expectations other than *trout condition*, which 56% of anglers found at least normal.

Most anglers that fished the Tukituki/Waipawa River system had a poor outlook and expected *trout numbers* (65%), *trout condition* (55%), and *stream ecology* (65%) to be below what they considered normal. Whereas expectations of *angler numbers* were positive with 59% expecting numbers to be at least what they considered normal. Experiences were better than expectations, with anglers experiencing *trout numbers* (58%), *trout condition* (81%), *stream ecology* (67%), and *angler numbers* (67%) to be at least what they considered normal.

There are temporal and spatial elements not captured by the survey, and this should not be ignored. Anglers will target different parts of a river system at different times of the season, and some will only seek the opportunity to fish during extended leave and statutory holidays. Although respondents were asked to think of the river system as a whole, their responses will reflect where and when they fished.

Water clarity and stream ecology are discussed in detail in Section 7.3. Possible relationships between angler experiences and Macroinvertebrate Community Index (MCI) scores and the percentage of total benthic invertebrate abundance that are *Ephemeroptera* (Mayflies), *Plectoptera* (Stoneflies), and *Trichoptera* (Caddisflies) (%EPTa) are discussed in detail in Section 7.3.2. Fifteen out of 21 relevant HBRC sample sites returned an MCI score lower than the 2019-2022 mean, and 13/21 returned an elevated %EPTa. Five sites returned MCI scores above the 2019-2022 mean. While the sites with elevated MCI scores would have contributed to positive perceptions of ecological health, elevated %EPTa may have given a falsely positive impression of health, given these species are more relevant to anglers.

Historical spawning data is focussed on the Tukituki/Waipawa fishery and only a few sites lent themselves to extracting a time-series dataset. The 2024 spawning counts at those sites appeared to be normal. Until 2024, spawning data for the other rivers appears to be held as Field Officer and fishing guide knowledge.

One hundred and five respondents chose to comment on what they felt were the main activities a Fish and Game Council should undertake following extreme flooding. The main thematic categories were *River and Stream Management*, *Angler Management*, and *Advocacy*. *River and Stream Management* was the most common theme, with its most common sub-theme being restocking. Those advocating restocking either specified an approach best described as restocking the most affected waterways, an ecologically informed approach, or did not specify an approach. Comments on *Angler Management* were focused on improving communication, limiting access to some areas, reducing bag limits, and shortening seasons. Comments on *Advocacy* were mainly focussed on erosion control.

3 Introduction

In February of 2023, Cyclone Gabrielle caused flood damage to Hawke's Bay streams, rivers, and their catchments (HBRC, 2024a). The National Institute of Water and Atmospheric Research (NIWA) has classified the event as extreme (Lane, 2024). NIWA's subsequent modelling found that at 13 of 20 monitored sites, the flooding was the worst on record (Lane, 2024). They also revised the Annual Recurrence Interval from 1:1000 to a 1:550 year event for one site (Lane, 2024).

Flood flows, heavy siltation, and debris have negatively impacted instream ecology, including sports fish populations (Newshub, 2023, August 08). Some of the worst affected rivers were the Ngaruroro, Tutaekuri, Esk, and Mangaone (Lane, 2024). Following the cyclone, rivers coloured quickly after rain, with the Tutaekuri and Esk Rivers suffering long periods of poor water quality due to siltation from cyclone-related slips.

Extreme weather events are predicted to become more frequent (HBRC, 2024b). Despite being a Crown entity under Schedule 4 of the Crown Entities Act (2004), the current funding model means almost 90% of funding for the Hawke's Bay Fish and Game Council (HBFGC) comes from the sale of sports fish and game licences (HBFGC, 2023). Fishing licences provide approximately twice the income of game licences (HBFGC, 2023), so a reduction in uptake affects the HBFGC's ability to fulfill its statutory responsibilities under the Conservation Act (1987).

3.1 Project definition

This report is part two of a two-part study. The complete study aims to quantify anglers' and upland game bird hunters' perceptions of cyclone damage on their recreational prospects.

3.1.1 Objective

To quantify freshwater angler expectations and experiences following a sub-tropical cyclone.

3.2 Approach

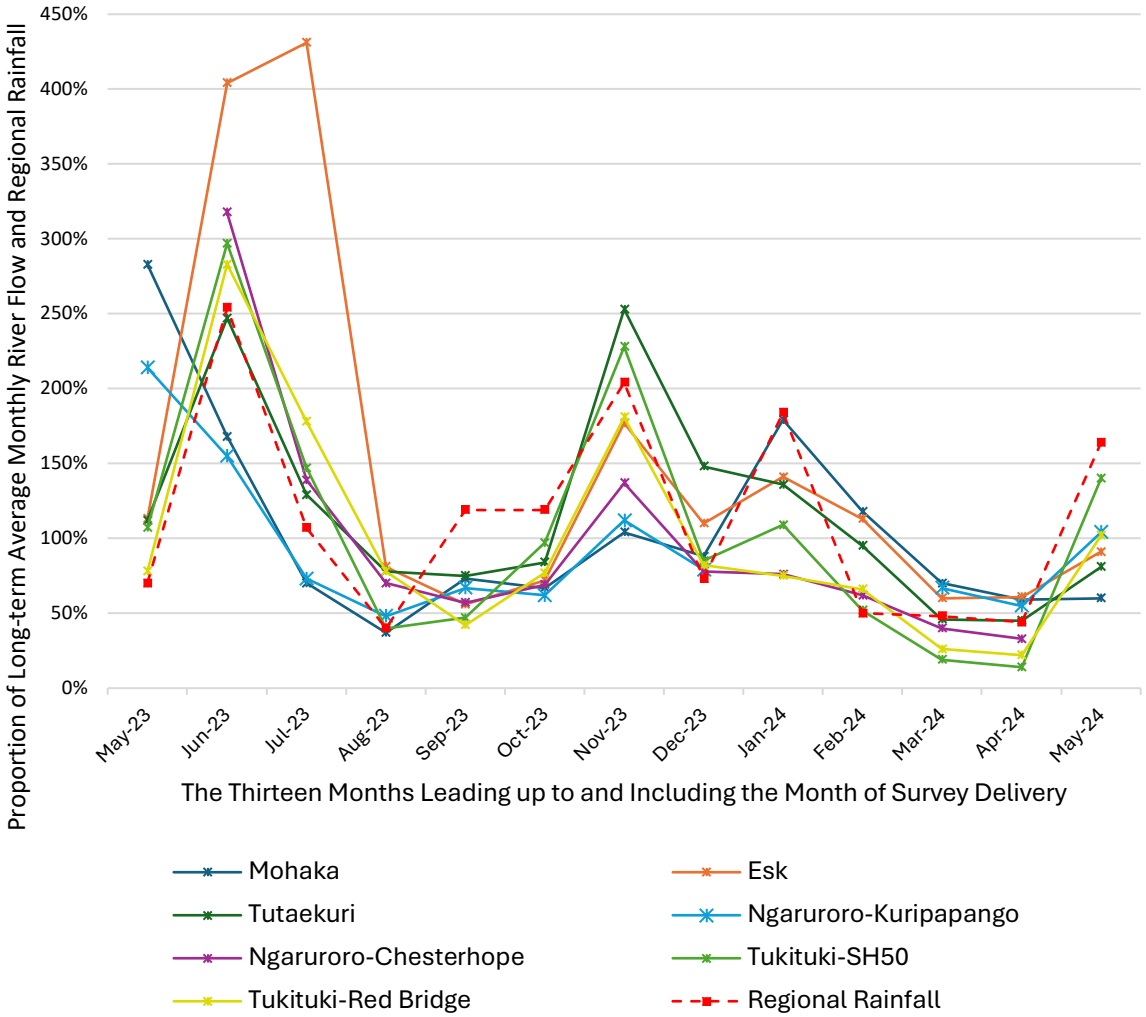
The research approach outlined in this report centred on surveying Hawke's Bay anglers regarding their expectations and experiences of the 2023/24 fishing season. The target population was those who had fished the region's five main river systems. These are the Mohaka, Esk, Tutaekuri, Ngaruroro, and Tukituki/Waipawa Rivers. For this study, a river system is defined as being the main river and its tributaries. It was acknowledged to anglers that there could be a difference between the main river and its tributaries, and they were asked to answer considering river systems as a whole. The survey was constructed and hosted on Survey Monkey Premier, and the data was analysed using SPSS V29.

3.3 Contribution

Insights from this study objective will help guide efforts to engage, support, and retain licensees following future flood events. It should also help guide the post-flood narrative among anglers in Hawke's Bay and will be of interest to all Fish & Game Councils and other catchment practitioners.

3.4 Regional rainfall and river flows

Seasonal context is provided in Figure 1 depicting the proportion of long-run average monthly river flows and regional rainfall for the thirteen months leading up to and including the month of survey delivery. The Hawke's Bay Regional Council[1] reports on two flow points for the Ngaruroro and Tukituki Rivers, and these are included to demonstrate spatial variability of flows within a river system. In general, flows and rainfall were higher than average in mid-winter 2023, lower than average in early spring 2023, higher than average in summer 2023/24, and then dropped well below average in Autumn 2024.



Note: This graph is constructed from data sourced from the Hawke's Bay Regional Council's monthly State of the Environment reports (HBRC, 2023a, 2023b, 2023c, 2023d, 2023e, 2023f, 2023g, 2023h, 2024c, 2024d, 2024e, 2024f, 2024g). Gaps in data points are due to those flow measurements being missing from the HBRC report for that month.

Figure 1 Monthly River Flows and Regional Rainfall as a Proportion of the Long-term Average

[1] The Hawke's Bay Regional Council is responsible for environmental monitoring in the region and provides a monthly State of the Environment report which contains summary data.

4 Survey design and delivery

A survey of anglers was undertaken following pre-testing and feedback from the HBFGC. The survey ran from the 29th April – 13th May 2024. This followed approximately three months of settled weather across the region, with rainfall and river flows below monthly averages during February, March, and April (HBRC, 2024d, 2024e, 2024f). An electronic link was delivered directly to Hawke's Bay 2023/24 licence holders via the usual HBFGC administrative email channel. Survey delivery was accompanied by a HBFGC Facebook post and a paid 'boost' to page followers. The choice to enter the draw for a $250 voucher to a local sports retailer was used as an incentive. Respondents were required to be 18 years or older.

The survey had seven blocks. Survey logic filtered out respondents without a current fishing licence and directed them to a question regarding reasons for non-purchase. The first block gathered information on respondent's perceived ability, knowledge, fishing habits, and demographic data. This was followed by a block for each of the Mohaka, Esk, Tutaekuri, Ngaruroro, and Tukituki/Waipawa River systems. Each block used eight 5-point Likert questions to quantify angler expectations and experiences of a particular river system. These five blocks were randomised to minimise order effects. The final block asked questions regarding the impact of severe flooding events on licence purchasing behaviour and offered the opportunity to comment on how a Fish & Game Council should respond to such events in the future.

5 Results

The survey was started by 285 respondents over 18 years old, with 267 completing it, yielding a completion rate of 94%. Sixty-six respondents did not have a current trout fishing licence. Flood damage to the rivers accounted for twice the number of non-purchases than affordability. Reasons for non-purchase are shown in Table 1. The remaining 201 respondents represent the intended sample and will be termed *Anglers*.

Table 1 Main Reason for Not Purchasing a Current Licence

Main reason for not purchasing a current licence.	***Non-purchasers* (%)**
I have decided not to purchase a licence this season due to flood damage to the rivers.	36.4
I intend to purchase a licence but have not yet done so.	22.7
I no longer find a licence affordable.	18.2
Other.	18.2
I no longer trout fish.	4.5
Total	**100**

5.1 Age, frequency, and fishing habit

The *Angler* sample was 94% male, most (61%) were 55 or older, and 74% had held a licence each year for the past five years. Seventy-four percent of *Anglers* (n=149) mostly fly fished, while the remainder (n=52) fished mostly with a spinning rod. In this report these sub-groups will be termed *Fly Fishers* (*FF*) and *Spinners* (*SP*). Most *FF* (60%) purchased a whole-season-adult licence and most (70%) fished twice a month or less. The largest single proportion of *SP* (42.3%) purchased a whole-season-family licence and most (54%) fished less than once a month. Nineteen percent of *FF* and 10% of *SP* were members of an angling club. The age distribution of *SP and FF* are shown in Figure 2, the frequency of licence purchase by licence type is shown in Table 2, the frequency of licence type by age group in Table 3, and the frequency of fishing is shown in Table 4.

The majority of *Angler's* closest towns were Hastings (21%), Napier (20%), Havelock North (17%), and Taradale (12%). Sixteen percent of *FF* and 6% of *SP* lived outside of Hawke's Bay. Overall, 33% of *Anglers* (*FF* 36%, *SP* 25%) demonstrated an environmental orientation by donating either time or money to an environmental organisation over the previous two years. Although the rate of donation in the general population is unknown, this proportion is at the upper end of an expected sample when compared to the findings described by Hughey et al (2019) and is similar to a sample of Hawke's Bay anglers by Walker (2020).

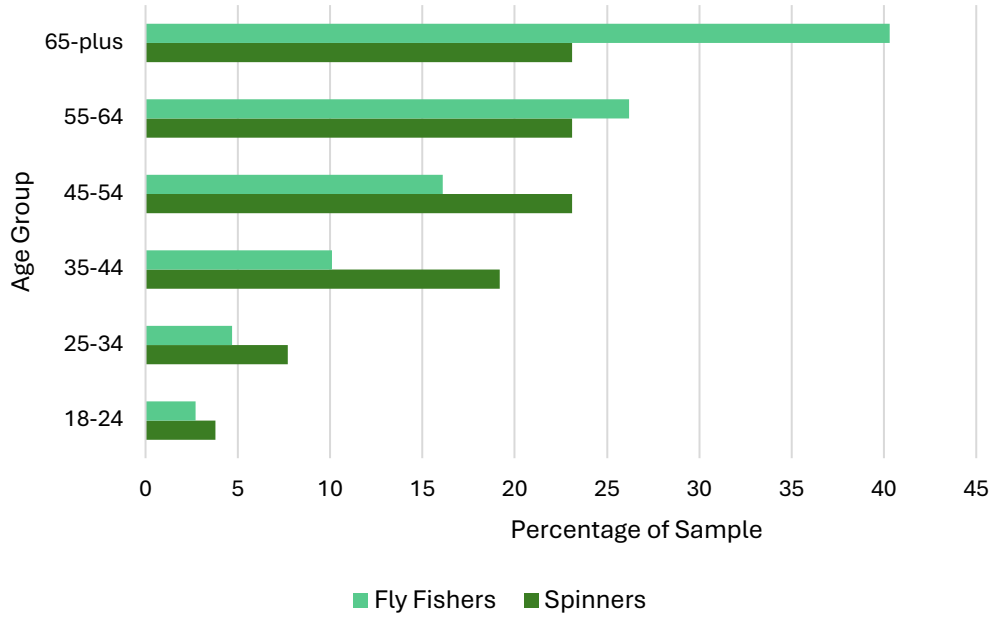


Figure 2 Age Distribution of Spinners and Fly Fishers

Table 2 Licence Purchase by Licence Type

Type of Fishing Licence Purchased.	***Anglers* (%)**	***Fly Fishers (%)***	***Spinners (%)***
Whole Season Adult.	53.2	60.4	32.7
Whole Season Adult Local Area.	7.0	5.4	11.5
Whole Season Family.	18.9	10.7	42.3
Whole Season Loyal Senior.	14.4	16.8	7.7
Winter Season Adult.	0.5	-	1.9
One Day Adult.	1.0	0.7	1.9
Short Break Adult.	1.0	0.7	1.9
Whole Season Non-resident.	4.0	5.4	-
Total	100	100	100

Table 3 Licence Type by Age Group

	Type of Licence Purchased								
Age	**Whole Season Adult**	**Whole Season Local Area**	**Whole Season Family**	**Whole Season Loyal Senior**	**Winter Season Adult**	**One Day Adult**	**Short Break Adult**	**Whole-Season Non-resident**	**Total**
18-24	5	-	1	-	-	-	-	-	6
25-34	8	2	1	-	-	-	-	-	11
35-44	14	2	7	-	-	-	1	1	25
45-54	18	4	12	-	1	-	-	1	36
55-54	35	3	10	-	-	-	1	2	51
65+	27	3	7	29	-	2	-	4	72
Total	107	14	38	29	1	2	2	8	201

Table 4 Frequency of Fishing

Frequency of Fishing (River conditions permitting).	***Anglers* (%)**	***Fly Fishers (%)***	***Spinners (%)***
Less than once a month.	33.8	26.8	53.8
Once a month.	18.9	19.5	17.3
Twice a month.	20.9	23.5	13.5
Once a week.	14.9	18.1	5.8
Twice a week.	7.0	6.7	7.7
More than twice a week.	4.5	5.4	1.9
Total	100	100	100

The fish-taking habits of Anglers are detailed in Table 5. Overall, the usual habit of most *Anglers* (61%) is to catch-and-release all fish, with 97% usually taking less than the daily bag limit. Seventy-three percent of *SP* habitually sought the opportunity to harvest at least one fish, compared to 27% of *FF*.

Table 5 Fish-Taking Habit

Fishing Habit.	***Anglers (%)***	***Fly Fishers (%)***	***Spinners (%)***
I usually take fish until I reach the daily limit and then catch-and-release any further fish.	1.0	0.7	1.9
I usually take fish until I reach the daily limit and then I stop fishing.	1.5	0.7	3.8
I usually catch-and-release all fish.	61.2	73.2	26.9
I usually take less than the daily limit and then stop fishing.	10.9	7.4	21.2
I usually take less than the daily limit and catch-and-release any further fish.	25.4	18.1	46.2
Total	100	100	100

5.2 Experience, knowledge, and ability

This section details respondents' self-rated level of river/stream ecology, fishing experience, confidence in their ability to spot fish, and their perceived knowledge of the Hawke's Bay Fish and Game Council's role and activities. The distribution frequencies are reported as well as a comparison of central tendencies (medians) between the responses form *FF* and *SP* using a Mann-Whitney *U*-test. This test is non-parametric and is designed to compare mean rank sum values. It is appropriate for ordinal and non-normally distributed data and for unequal sample sizes (Fowler et al.,2003). The measure of effects used is the rank-biserial correlation coefficient (*r*). The hypotheses are:

H_0: The distribution of scores of the two groups is equal.
H_A: The distribution of scores of the two groups is not equal.

H_0 was rejected and H_A accepted for self-rated knowledge of stream ecology[2] (U=23400.00; z=-4.584; p<.001; r=-.323), self-rated fishing experience (U=2627.50; z=-3.628; p<.001; r=-.256), confidence in spotting fish (U=2610.50; z=-3.676; p<.001; r=-.259), perceived knowledge of the Hawke's Bay Fish and Game Council's role and activities (U=2858.00; z=-2.972; p=.003; r=-.210), and the likelihood future flooding events would lead to reconsideration of purchasing a licence (U= 2602.50; z=-3.620; p<.001; r=-.465) all at the p<.01 level.

[2] Respondents were informed that for the purpose of the survey, stream ecology was limited to the life cycles and habits of river/stream insects, native fish, and trout.

The frequency distributions are shown in Figures 3, 4, 5, and 6. In general, *Fly Fishers* rate themselves as more knowledgeable, more experienced, and are more confident in their ability to spot fish.

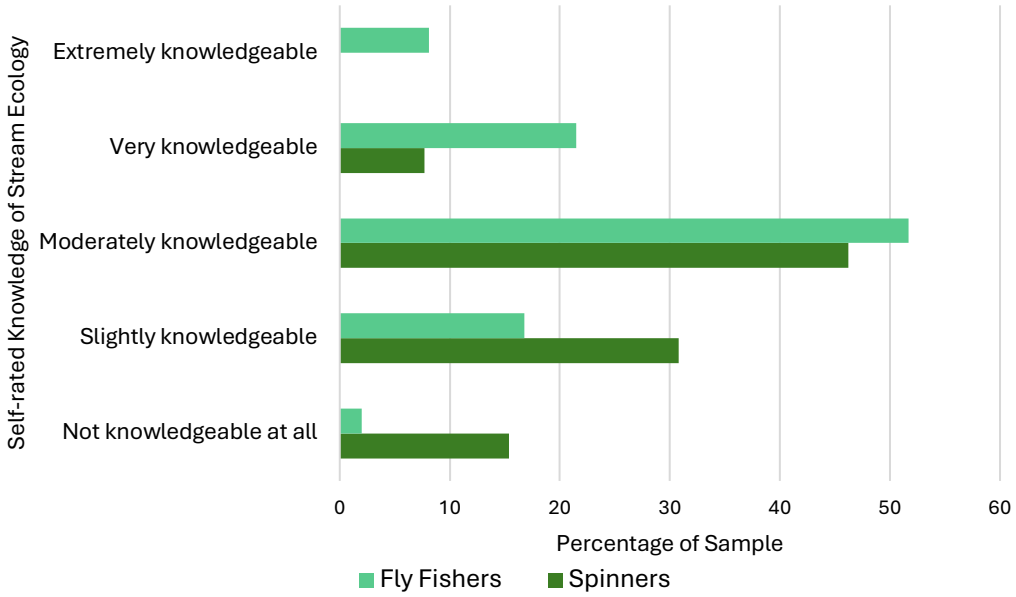


Figure 3 Spinner and Fly Fisher Self-rated Knowledge of Stream Ecology

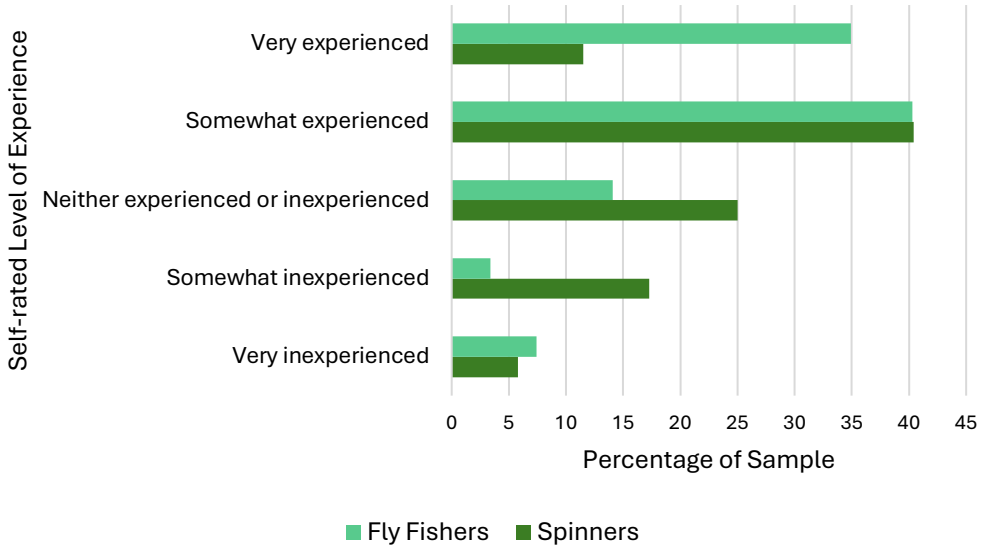


Figure 4 Spinner and Fly Fisher Self-rated Level of Fishing Experience

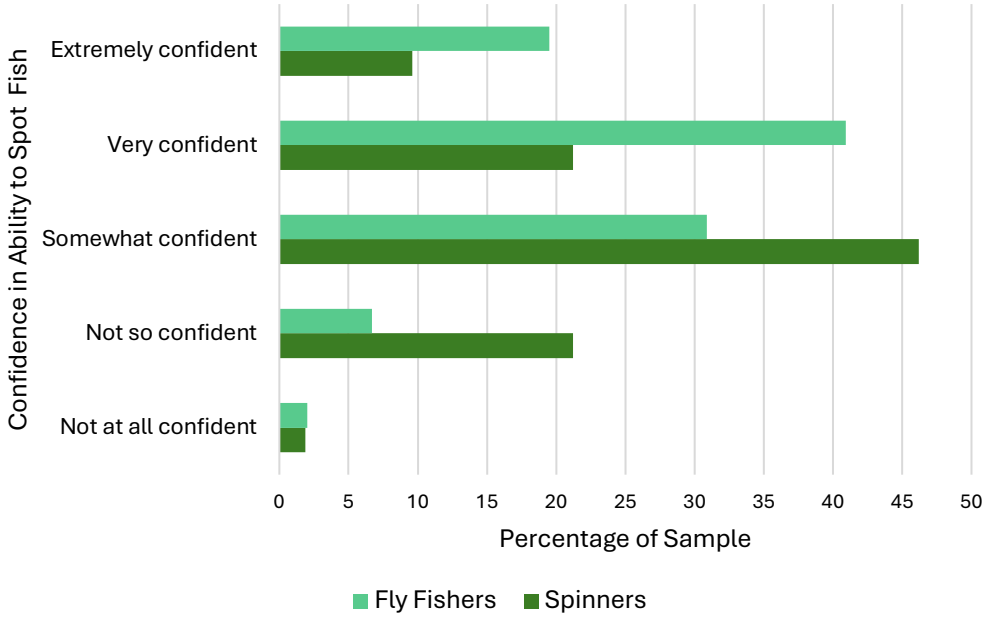


Figure 5 Spinner and Fly Fisher Confidence in their Ability to Spot Fish

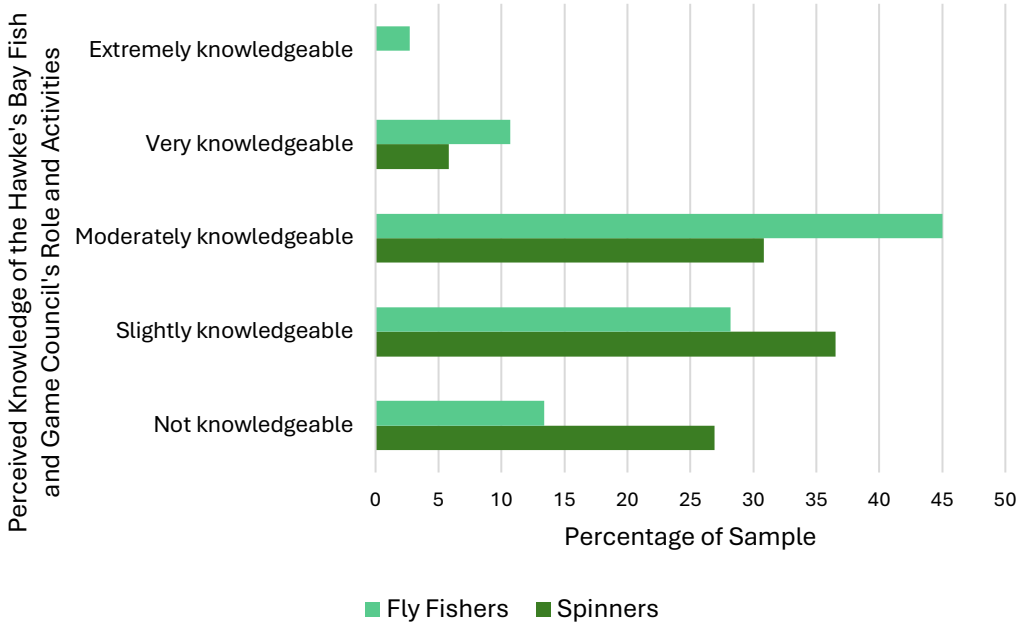


Figure 6 Spinner and Fly Fisher Perceived Knowledge of the Hawke's Bay Fish and Game Council's Role and Activities

Overall, half of *Anglers* considered themselves moderately knowledgeable of stream ecology, most (69%) considered themselves somewhat or very experienced, most (53%) were at least very confident in their ability to spot fish, and most (72%) considered themselves slightly or moderately knowledgeable of the Hawke's Bay Fish and Game Council's role and activities.

5.3 Information channels, harvest comparison, and satisfaction

The sources of information used to choose fishing locations are shown in Table 6. Personal thought and observation were the chief source of information used by 59% of *Anglers*, 62% of *FF*, and 52% of *SP* to determine where they fished. Social media was used by twice as many *SP* as *FF*.

Table 6 Main Source of Information Used to Determine Fishing Locations

Main source of information used to determine fishing locations.	**Anglers (%)**	**Fly Fishers (%)**	**Spinners (%)**
Your own thoughts and observations.	59.2	61.7	51.9
Friends and family.	15.9	15.4	17.3
Social media.	9.0	6.7	15.4
Fish & Game emails or website.	5.5	4.7	7.7
Other.	4.5	5.4	1.9
Advice from outdoors/fishing shops.	2.5	2.0	3.8
Use of a fishing guide.	2.0	2.7	-
News media reports (Radio, TV, internet, newspaper).	1.5	1.3	1.9
Total	100	100	100

Angler satisfaction is detailed in Table 7. Overall, 48% of *Anglers* were either satisfied or very satisfied with their season at the time of taking the survey. There was no statistical difference in satisfaction between *FF* and *SP* (U=3267.00; z=-1.752; p=.080; r=-.589) at the p<.05 level.

Table 7 Satisfaction with the Season at Time of Survey

Satisfaction with the season at time of taking the survey.	***Anglers (%)***	***Fly Fishers (%)***	***Spinners (%)***
Very satisfied.	10.9	12.8	5.8
Satisfied.	36.8	38.9	30.8
Neither satisfied nor dissatisfied.	28.9	26.2	36.5
Dissatisfied.	16.4	15.4	19.2
Very dissatisfied.	7.0	6.7	7.7
Total	100	100	100

Figure 7 shows that the comparative number of fish landed by *Anglers* had a bi-modal distribution with two distinct peaks across *FF* and *SP*. Overall, 43% of *Anglers* landed what they would normally expect or more, and 45% reported half or less than half what they consider normal. There was no statistical difference in the distribution of fish landed between *FF* and *SP* (U=3521.50; z=-1.012; p=.311) at the p<.05 level.

There was no statistical difference in *fishing frequency* (U=1952.00; z=-.466; p=.641) at the p<.05 level between *Anglers* that landed what they would normally expect and those that landed less than half they would normally expect. Although there was a weak negative correlation (-.222; p<.05) between *fish-landed* and *age*, there was no significant difference in age distribution between these two populations (U=1719.50; z=-1.636; p=.102) at the p<.05 level. *Fish-landed* did have positive correlations with *Angler's* experiences of the Mohaka (.424), Ngaruroro (.292), and the Tukituki/Waipawa (.634), all at the p<.01 level.

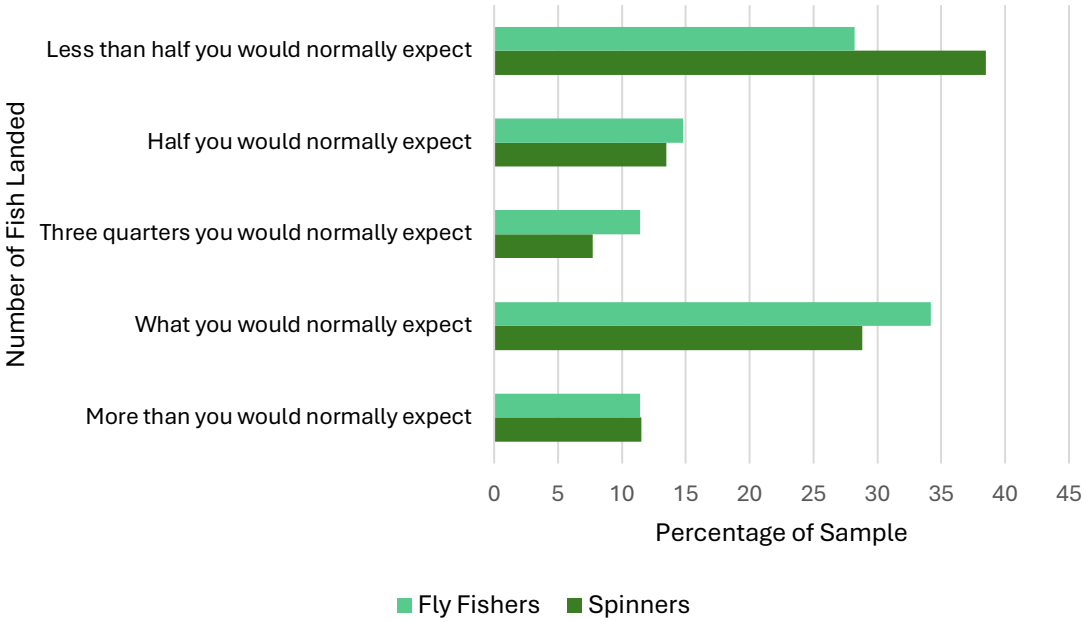


Figure 7 Comparative Number of Fish Landed at Time of Survey

It must be concluded that factors outside of those captured in the survey have influenced the comparative number of fish landed, and this is considered further in the discussion (section 7, page 24). The correlation analysis is reported in section 5.10, page 19, and is shown in full in Table 11 Appendix A.

5.4 Perceived reason for a reduced harvest

Of the 112 *Anglers* that reported a harvest less than they would normally expect, 46% attributed it to a high trout death rate from flooding. Below-normal fishing activity also featured as a reason for a reduced number of fish landed and there was a notable difference in this attribute between *FF* and SP. The findings are detailed in Table 8. Of the *Spinners* that didn't fish as often, only 17% were satisfied with the season at the time of survey.

Table 8 Perceived Main Reason for a Reduction in Fish Landed

Perceived Main Reason for a Reduction in Fish Landed.	***Anglers (%)***	***Fly Fishers (%)***	***Spinners (%)***
A high trout death rate due to an extreme flooding event.	46.4	51.9	32.3
I didn't fish as often as I usually do this season.	27.7	23.5	38.7
A lack of food for trout due to a disrupted ecosystem.	15.2	16.0	12.9
Normal seasonal variation in opportunity.	4.5	2.5	9.7
Other.	6.3	6.2	6.5
Total	100	100	100

5.5 Out-of-region fishing and the potential for weather-related non-purchase

One hundred and twenty-four *Anglers* (62%) had fished outside of Hawke's Bay and their reasons are detailed in Table 9. Taking the opportunity to fish while travelling for other reasons accounted for 35% of those respondents. Visiting a high-profile fishery looking for an experience not offered locally was the second highest reason, and Taupo was the destination for 39% of travelling *Anglers*. Relatively few travelled due to disappointment with local prospects. Fly Fishers were more likely to fish outside the region than *SP* (*FF* 69%, *SP* 40%) and

were over four times more likely to travel solely for a fishing experience. '*Other*' accounted for 20% of *Anglers* fishing outside Hawke's Bay, and of those, six lived outside Hawke's Bay, which likely accounted for their response. Proportionally, this left 16% of *Anglers* with reasons not captured by the choices offered.

Table 9 Reasons for Fishing Outside of Hawke's Bay

Reasons for Fishing Outside of Hawke's Bay.	***Anglers (%)***	***Fly Fishers (%)***	***Spinners (%)***
I was travelling for other reasons and fished while I was away.	34.7	29.1	61.9
I visited a high-profile fishery looking for an experience not offered in Hawke's Bay.	19.4	22.3	4.8
I wanted to explore somewhere new.	13.7	14.6	9.5
I was disappointed with fishing prospects in Hawke's Bay.	12.1	12.6	9.5
Other.	20.2	21.4	14.3
Total	100	100	100

Note: *Anglers* n=124, *Fly Fishers* n=103, *Spinners* n=21

Thirty-seven percent of *Anglers* had considered not purchasing a fishing licence this season based on the effects of flood damage to the river systems, and 29% had friends or family that did not purchase for the same reason. *Spinners* (48%) were more likely to consider non-purchase than *FF* (33%). Most *FF* (51%) felt it was *unlikely* or *very unlikely* that flooding from future extreme weather events would make them reconsider purchasing a licence. This figure fell to just 31% for *SP* and the difference in mean rank sum between *FF* and *SP* for possible future non-purchase was significant (z = -3.620; p = .000) at the p<.01 level.

5.6 Proportion of respondents fishing the target river systems

Of the 201 *Anglers*, 175 (87%) had fished one or more of the Mohaka, Esk, Tutaekuri, Ngaruroro, or Tukituki/Waipawa river systems. The proportion of *FF* and *SP* fishing each river system are shown in Figure 8.

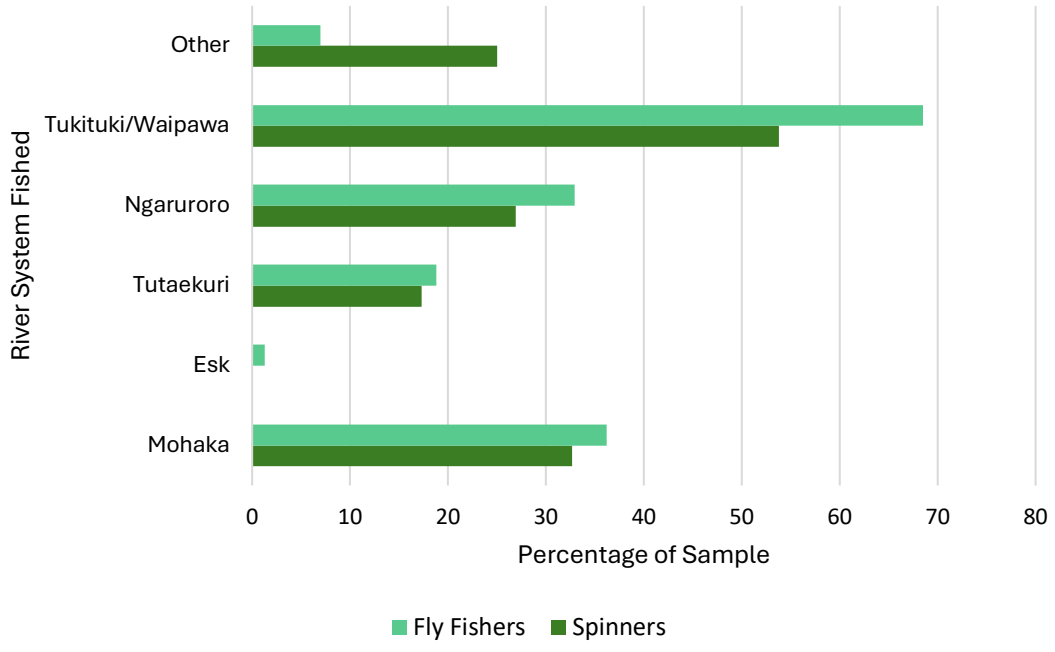


Figure 8 Proportion of Fly Fishers and Spinners Fishing Each River System

Of the 187 *Anglers*, 46% had fished only one system, 39% had fished two, 13% had fished three, and the remaining 2% had fished four or more river systems. Whereas Stoffels and Unwin (2023) found that nationally only 22% of anglers fished two or more waterbodies.

Only two *Anglers*, both *FF*, had fished the Esk River or its tributaries and so the results are treated as useful anecdotes. The Esk River catchment accounts for only 1.3% of angler effort in Hawke's Bay (Stoffels and Unwin, 2023) and so, given the severity of flood damage, and its low profile as a fishery, the low response rate for this system is not surprising.

5.7 Geographic dispersion of *Anglers* by closest town

The geographic dispersion of *Anglers* fishing the Mohaka, Tutaekuri, Ngaruroro, and Tukituki/Waipawa river systems is shown in Figure 9.

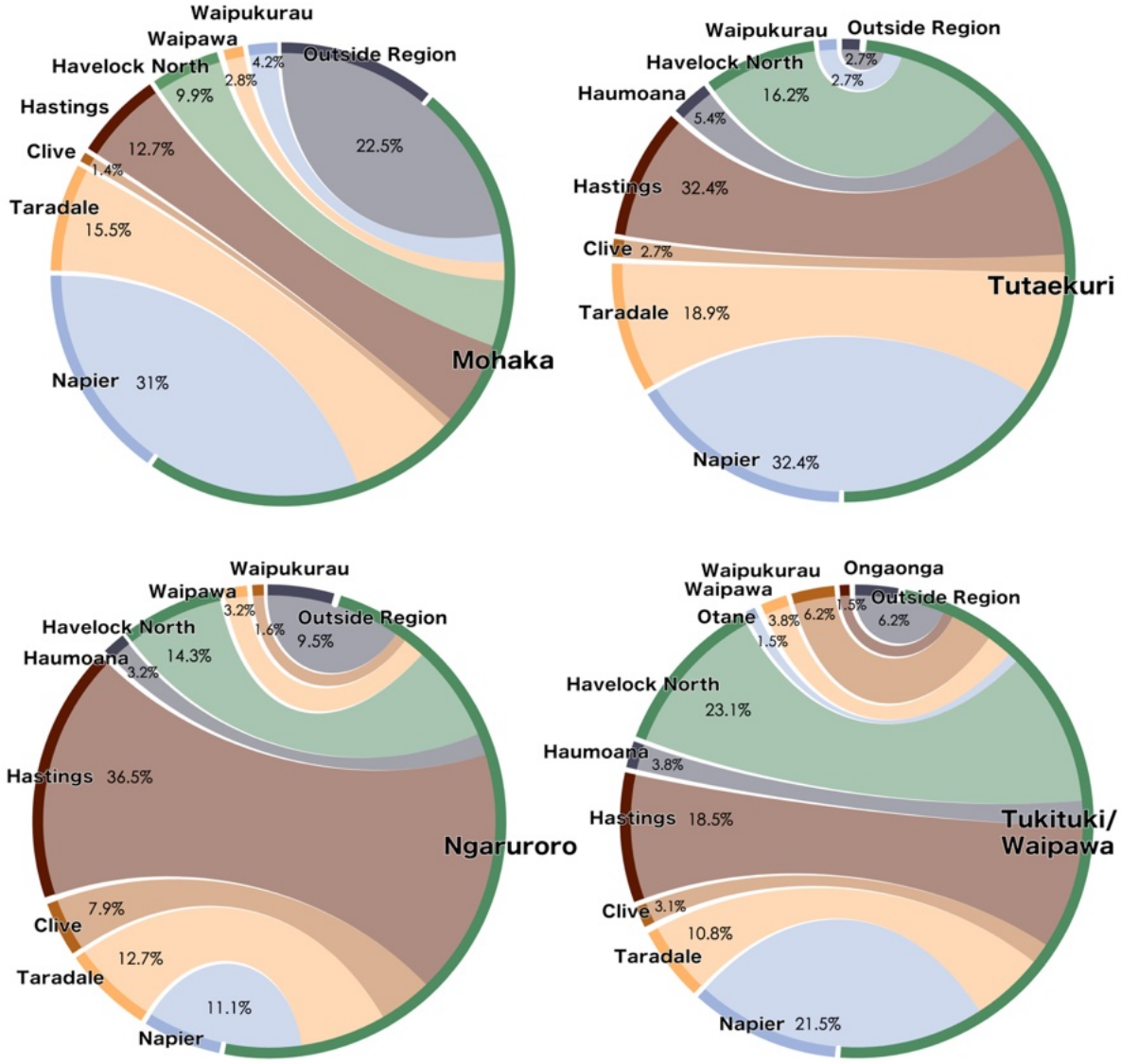


Figure 9 Geographic Dispersion of Anglers Fishing a River System Classified by their Closest Town

Anglers from outside the region comprised 22% of those that fished the Mohaka River system and 9% of the Ngaruroro. The largest source of anglers for the Mohaka (31%) and Tutaekuri (32%) was from the Napier area, with Hastings contributing the bulk of those that fished the Ngaruroro (36%). The Tukituki/Waipawa system had the most geographically diverse anglers, with its location no doubt contributing to the representation of anglers from Central Hawke's Bay. Havelock North contributed 23% of those fishing the Tukituki/Waipawa, and only 6% were from outside the region.

5.8 Main reason for not fishing a river system

Table 10 shows reasons for not fishing a river system. The largest proportion of those who did not fish the Tutaekuri cited flood damage to the river as the main reason. For all other systems, either angler habit or unfulfilled intention predominated responses.

Table 10 Main Reason for Not Fishing a River System

	Respondents that did not fish a river system (%)				
Main reason for not fishing a river system.	Mohaka	Esk	Tutaekuri	Ngaruroro	Tukituki/ Waipawa
This is not a river I usually fish.	30.8	51.3	37.2	34.8	40.8
I intend to fish this river but have not done so at the time of this survey.	30.8	4.0	9.1	29.0	26.8
I feel the river system is too damaged from flooding to bother fishing.	10.8	33.7	40.9	21.7	11.3
This river system is too far to travel.	18.5	6.5	6.1	8.0	7.0
Other.	9.2	4.5	6.7	6.5	14.1
Total	100	100	100	100	100

5.9 Angler expectations and experience

It is important to bear in mind that the results represent *Angler* expectations and experiences against their individual perception of normality for each variable and not against a known baseline state. A Mann-Whitney *U*-test was applied to compare mean rank sums of *FF's* and *SP's* across all expectation and experience variables for all river systems other than the Esk. Only three pairs of variables had distributions with opposite skews and a magnitude that exceeded the combined standard errors. The *z* scores showed there was no difference between *FF's* and *SP's* for any expectation or experience variable at the $p<.05$ level, therefore, their combined distributions are reported. A brief summary of each river system follows with detailed results depicted in Figure 10.

5.9.1 Mohaka River

In the 2021/2022 season, the Mohaka River system accounted for 23% of the total Hawke's Bay angler effort (Stoffels & Unwin, 2023). In this study, the Mohaka River system was fished by 35% of *Anglers* who recreated on the target rivers. Most *Anglers* expected *trout numbers* (58%), *trout condition* (58%), and *stream ecology* (63%) to be below what they considered normal. Despite negative expectations for trout numbers, most expected *angler numbers* (53%) to be at least what they consider normal. Experiences were more positive than expectations. Most *Anglers* experienced *trout numbers* (55%), *trout condition* (77%), stream *ecology* (59%), and *angler numbers* (56%) at levels they considered normal or better. The positive experience of *trout numbers* and *condition* indicates some resilience in this river.

5.9.2 Esk River

Only two *Anglers* fished the Esk River system, and their results are reported as anecdotes. Both expected trout numbers to be far below what they considered normal and trout condition to be somewhat or far below normal. One expected the ecology and number of anglers to be far below normal, and the other expected them to be normal. The experience of both *Anglers* largely matched their expectations.

5.9.3 Tutaekuri River

In the 2021/2022 season, the Tutaekuri River system accounted for 15% of the total Hawke's Bay angler effort (Stoffels & Unwin, 2023). In this study, the Tutaekuri River system was fished by 18% of *Anglers* that recreated on the target rivers. Overall, both expectations and experiences were very negative. Most *Anglers* expected *trout numbers* (92%), *trout condition* (95%), *stream ecology* (95%), and *angler numbers* (84%) to be below what they considered normal. Confirming the negative expectations, most *Anglers* experienced *trout numbers* (95%), *trout condition* (81%), stream *ecology* (81%), and *angler numbers* (81%) at levels they consider below normal. Although there appears to be some consistency in the level of negative experiences, there was variability in the proportions of those responding *far below normal* and *somewhat below normal* and some moderation towards the latter.

5.9.4 Ngaruroro River

In the 2021/2022 season, the Ngaruroro River system accounted for 16% of the total Hawke's Bay angler effort (Stoffels & Unwin, 2023). In this study, the Ngaruroro River system was fished by 31% of *Anglers* that recreated on the target rivers. Most *Anglers* expected *trout numbers* (79%), *trout condition* (70%), *stream ecology* (71%), and *angler numbers* (59%) to be below what they considered normal. Experiences of *trout numbers* matched expectations however, *stream ecology* moderated slightly, with 63% finding it below what they considered normal. Experience of *angler numbers* was lower than expectations with 63% finding them below what they considered normal. In contrast, 56% of *anglers* experienced *trout condition* as being at least what they considered normal. Unlike the Mohaka River system, this result was not supported by a majority having positive experiences of *stream ecology*.

5.9.5 Tukituki/Waipawa River

In the 2021/2022 season, the Tukituki/Waipawa River system accounted for 41% of the total angler effort in Hawke's Bay (Stoffels & Unwin, 2023). In this study, the Tukituki/Waipawa River system was fished by 65% of *Anglers* who recreated on the target rivers. Most anglers expected *trout numbers* (65%), *trout condition* (55%), and *stream ecology* (65%) to be below what they considered normal. Expectations of *angler numbers* was much more positive, with 59% expecting numbers to be at least what they considered normal. This sentiment may have reflected the known popularity of this fishery and a perception that it was not hit as hard by the cyclone.

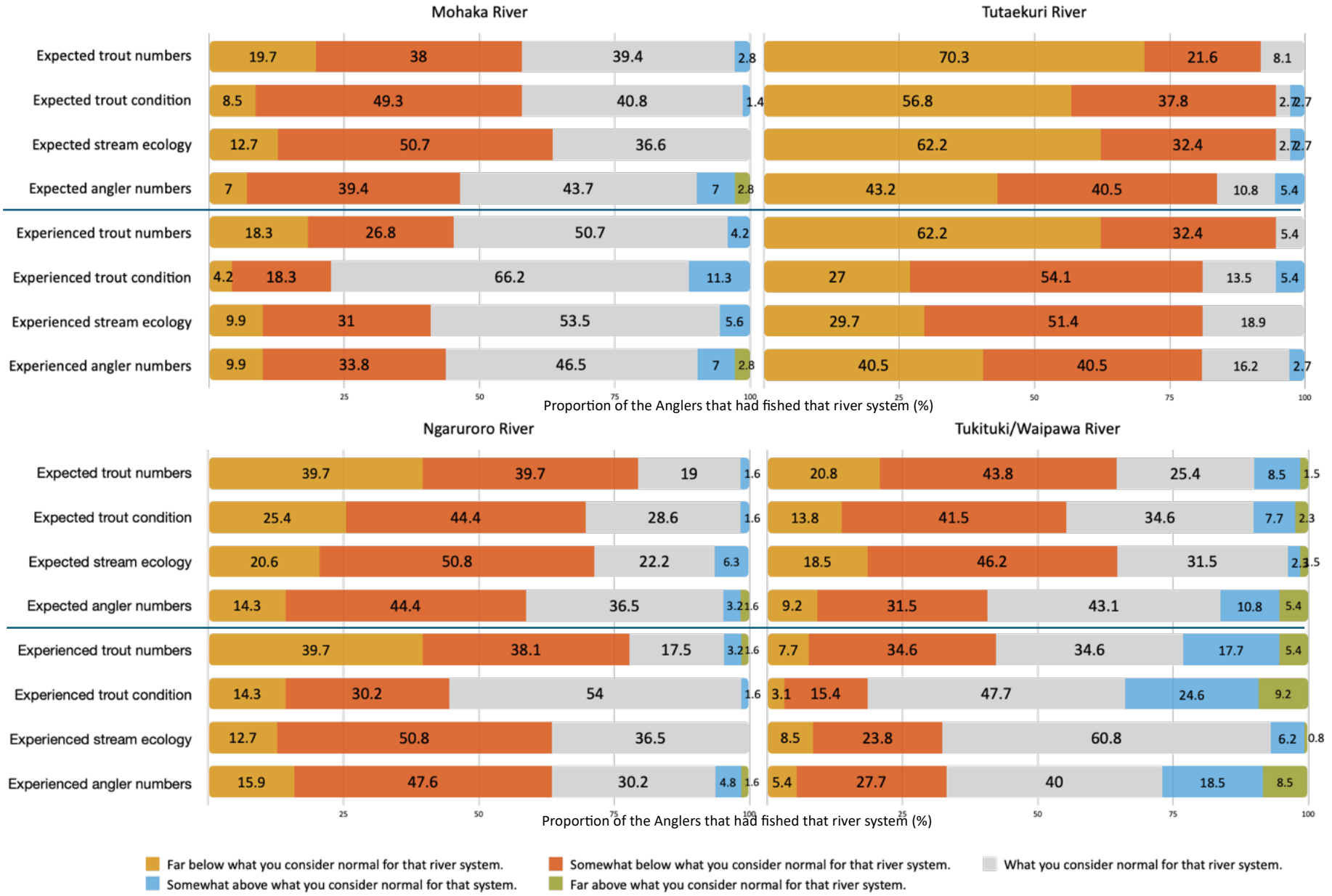


Figure 10 Angler Expectations and Experiences of the Mohaka, Tutaekuri, Ngarururo, and Tukituki/Waipawa River Systems

Similar to the Mohaka River, *Angler* experiences were more positive than their expectations. Most *Anglers* experienced *trout numbers* (58%), *trout condition* (81%), *stream ecology* (67%), and *angler numbers* (67%) to be at least what they considered normal. The Tukituki/Waipawa River system appeared the least affected by cyclone flood flows. A feature of this system was the proportion of *Anglers* experiencing *trout numbers* (23%), *trout condition* (34%), and *angler numbers* (27%) at levels *somewhat* or *far above* what they considered normal. While it is rational to assume a well recovered ecosystem supported the fish that survived flood flows, a spike in fish condition suggests either a more complex relationship between river ecology and the flows received during the cyclone. It may also be that surviving adult fish thrived with some reduction in competition. Higher angler numbers experienced by some on this system may be partially explained by the promotion of positive experiences on this river system by Fish & Game in their email newsletter Reel Life.

5.10 Relationships between variables

A new combined variable was created representing each individual's mean expectation and experience for each river system. Some ambiguity was attached to the presence of other anglers being a positive or negative element of expectation and experience. Arguably, seeing other anglers may both validate the choice of location and reduce perceptions of a tranquil experience. For this reason, *Angler numbers* was omitted. The combined variable was applied in a correlation analysis with descriptive variables using Spearman's ρ.

Correlations indicate whether the scores of two variables move together in a measurable relationship. A significant correlation means the relationship is statistically unlikely to have occurred by chance. A significant correlation does not mean that one variable is the sole cause of movement in the other. In this study, a third of all correlations were significant at the $p<.05$ level or less and most had weak coefficients. A synopsis of these significant interactions follows below. For a detailed view of the full output see Appendix A Table 11.

5.10.1 Angler characteristics

Being a *Spinner* had weak negative correlations with *Experience level*, *Ability to spot fish*, *Knowledge of ecology*, and *Knowledge of HBFGC*. This supports the emerging younger, less confident, and more family-oriented typology for *Spinners*. A positive environmental orientation (*Enviro*) also had a weak negative relationship with *Experience level*, *Ability to spot fish*, *Knowledge of ecology*, and *Knowledge of HBFGC*. However, there was no correlation between fishing modality and environmental orientation.

Experience level had a moderate positive relationship with *Ability to spot fish* and *Knowledge of ecology* and a weak positive relationship with *Knowledge of HBFGC*. This suggests that although time on the river may develop an angler's skills, involvement in the sport does not infer knowledge of the regulator's role and activities to the same extent. There was a strong positive relationship between a respondent's self-assessed *Ability to spot fish* and their perceived *Knowledge of ecology*.

As expected, a strong positive relationship existed between the number of *Fish-landed* and *Angler satisfaction*. There was a moderate negative relationship between *Angler satisfaction* and both the likelihood of not purchasing a licence due to a future severe weather event (*Future licence*) and whether they considered not purchasing a licence this season due to the effects of extreme flooding (*Non-purchase*). This suggests that more satisfied *Anglers* were

not only more positive about their future prospects in the face of extreme weather events but were also more dedicated to licence purchase heading into the current season.

5.10.2 Expectations and experiences

Angler experiences strongly correlated with their expectations for the Mohaka, Tutaekuri, and Ngaruroro River systems. This suggests that the majority of respondents had made reasonably accurate assessments of the rivers states and their recreational prospects.

Given 74% of respondents had held a licence each of the past five years, it is reasonable to expect informed decision-making. It is also possible an element of confirmation bias is expressed in responses. While the other systems had strong positive relationships, there was only a moderate positive relationship between expectations and experiences of the Tukituki/Waipawa River system. This likely reflects the substantially more positive experiences had by *Anglers* compared to their expectations.

Fish-landed and *Angler satisfaction* had weak positive relationship's with experiences of the Mohaka, Tutaekuri (*satisfaction* only), and Ngaruroro (*fish landed* only) river systems. Both variables had a strong positive relationship with *Angler's* experience of the Tukituki/Waipawa River system, suggesting this system played an important role in *Angler satisfaction* in 2023/24.

There were no significant relationships between *Experience level*, *Ability to spot fish*, and *Knowledge of ecology,* and the combined expectation and experience variables for any river system. In addition to the combined variables, *Angler confidence spotting fish* and *Angler* self-rated *knowledge of stream ecology* were correlated with *experienced trout numbers* and *experienced stream ecology* respectively. There were no significant relationships at the $p<.05$ level between the respective variables for any of the river systems (Esk River excluded).

5.11 Thematic analysis of angler's desired Fish & Game flood response.

One hundred and five respondents chose to comment on what they felt were the main activities a Fish and Game Council should undertake following extreme flooding. Many comments contained multiple themes. Analysis revealed three main categories of activity anglers felt should be conducted, each with various subcategories. The main thematic categories were *River and Stream Management*, *Angler Management*, and *Advocacy*. *River and Stream Management* was the most common theme, with its most common sub-theme being *Restocking*. Those advocating *Restocking* either specified an approach best described as restocking the *Most Affected Waterways*, an *Ecologically Informed Approach*, or did not specify an approach (*Unspecified*). A small number of responses did not lend themselves to categorisation and were coded as *Other.* The thematic analysis results are shown in Figure 11 where themes are hierarchical and represented by the frequency of occurrence among responses.

Responses with a singular theme made comments such as:

"Restock trout in rivers" and *"Restock all rivers ASAP"*

Responses with multiple themes made comments such as:

"Carry out observation surveys (fish traps on spawning streams) to determine effect on population/size etc. Use data to assess overall health and need for stocking of rivers, setting bag limits etc" and *"Restocking if possible. Perhaps a shorter season in the areas not fished 12 mths of the year."*

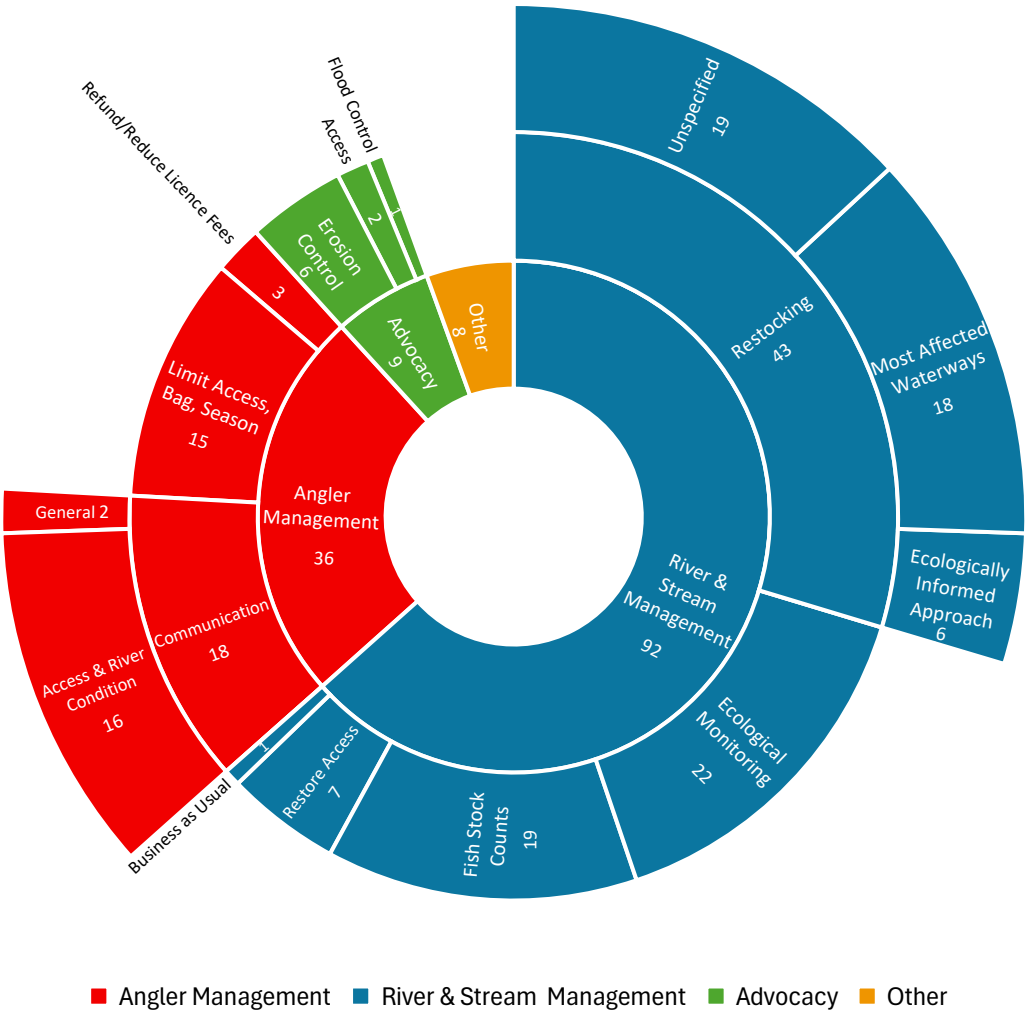
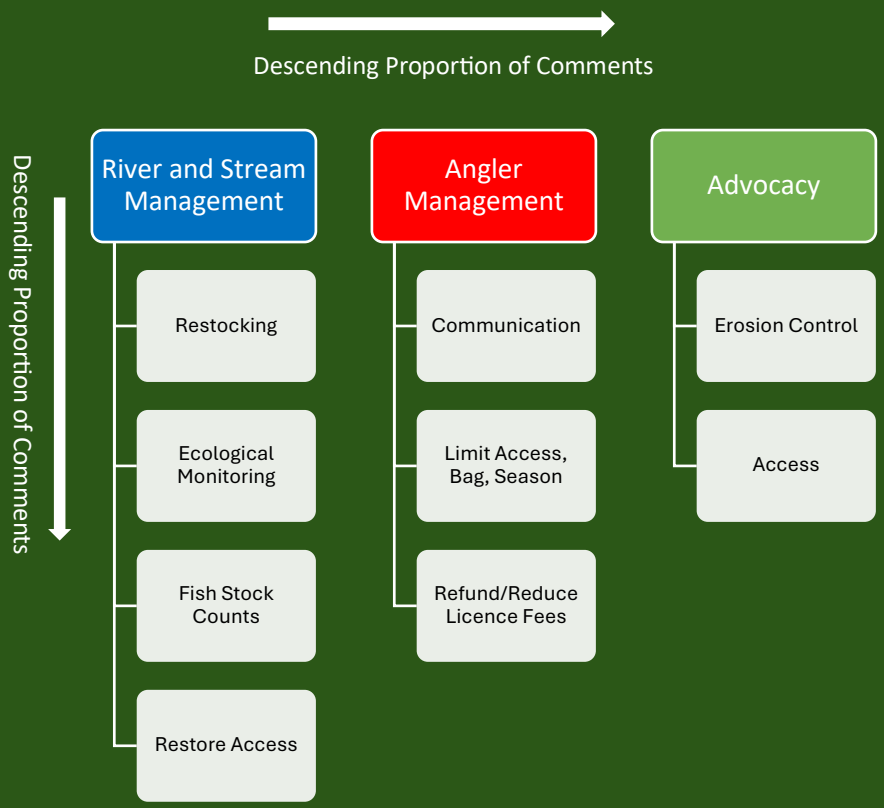


Figure 11 Thematic Analysis of Anglers Response Priorities Following an Extreme Flooding Event

6 Results Summary

- 36% of those who did not purchase a licence in 2023/24 did so because of flood damage to the rivers.
- Spin fishers had a younger age profile than fly fishers and were four times more likely to purchase a family licence.
- Most spin fishers (71%) fished once a month or less compared to 46% of fly fishers.
- *Fly Fishers* rated themselves as more knowledgeable, experienced, and confident in their ability to spot fish.
- 88% of anglers engaged in the practice of releasing fish.
- Most fly fishers (59%) and most spin fishers (62%) relied on their own thoughts and observations when choosing a fishing location. Spin fishers were more than twice as likely to rely on social media than fly fishers.
- Most fly fishers (52%) were satisfied or very satisfied with the season at the time of survey, compared to 37% of spin fishers.
- The number of fish landed had an unusual bimodal distribution showing two main types of experience. The first was those who had landed the number they would usually expect, the second was those who landed less than half the number they would normally expect.
- Of those who had landed less fish than they would normally expect, 52% of fly fishers attributed it to a high trout death rate compared to 32% of spin fishers. Thirty-nine percent of spin fishers attributed it to not fishing as often as they normally would.
- Only two respondents had fished the Esk River system.
- The largest proportion of those that did not fish the Tutaekuri cited flood damage to the river as the main reason. For all other systems either angler habit or unfulfilled intention predominated responses.
- Most anglers that fished the Mohaka River system expected trout numbers (58%), condition (58%), and stream ecology (63%) to be below what they considered normal, whereas angler numbers were expected to be at least normal. Most Anglers experienced trout numbers (55%), trout condition (77%), stream ecology (59%), and angler numbers (56%) at levels they considered normal or better.
- Most anglers that fished the Tutaekuri River system expected trout numbers (92%), trout condition (95%), stream ecology (95%), and angler numbers (84%) to be below what they considered normal. Most anglers experienced trout numbers (95%), trout condition (81%), stream ecology (81%), and angler numbers (81%) at levels they consider below normal.
- Most Anglers that fished the Ngaruroro River system expected trout numbers (79%), trout condition (70%), stream ecology (71%), and angler numbers (59%) to be below what they considered normal. Experiences validated expectations other than trout condition, which 56% of anglers found to be normal or better.
- Most anglers that fished the Tukituki/Waipawa River system expected trout numbers (65%), trout condition (55%), and stream ecology (65%) to be below what they considered normal. Expectations of angler numbers was positive with 59% expecting numbers to be at least what they considered normal. Most Anglers experienced trout numbers (58%), trout condition (81%), stream ecology (67%), and angler numbers (67%) to be at least what they considered normal.

- A perception of reduced trout numbers, but normal or better trout condition, was a feature of the Mohaka, Ngaruroro, and Tukituki/Waipawa River systems.
- There was a strong positive relationship between a respondent's self-assessed *Ability to spot fish* and their perceived *Knowledge of ecology*.
- As expected, a strong positive relationship existed between the number of *Fish-landed* and *Angler satisfaction*.
- There was no relationship between *confidence spotting fish* and *experienced trout numbers* or between self-rated *knowledge of stream ecology* and *experienced stream ecology*.
- A strong or moderate relationship existed between expectations and experiences for all river systems, excluding the Esk River.
- Licence-holder main desired response by a F&G council to an extreme flooding event were:



7 Discussion

7.1 Licence composition of the sample

Stoffels & Unwin (2023) reported 65% of 2021/22 licence sales in Hawke's Bay were in Stratum 1 (whole-season family, whole-season-adult, senior loyal adult, local area adult, winter adult), and they represented 89% of the season's total angling effort. In this study, 94% of respondents were stratum 1 licence holders. While that means these licence types are overrepresented in this study, they do provide the richest concentration of fishing effort and, therefore, the most concentrated experience of the post-cyclone season.

7.2 Angler mobility

There was a high level of angler mobility in this study, in which 54% had fished two or more water bodies compared with 22% nationally (Stoffels & Unwin, 2023). It may be that poor experiences had driven greater movement between rivers as anglers search for improved prospects. However, the region is blessed with a number of rivers within a relatively short drive of each other, and higher mobility may be a regional characteristic.

7.3 Angler experiences versus water clarity, ecological, and spawning data

There is a temporal and spatial element to *Angler* experiences that has not been captured in responses which should not be ignored. Flows (see *Figure 1*, page 5), water clarity (see Figure 12, Figure 13, Figure 14, Figure 15, Figure 16, Figure 17, Appendix B), and ecological health (see Figure 18, Appendix C) vary over time and within each river system. Given that most *Anglers* (53%) fished once a month or less and that their personal window of opportunity to fish is unknown, some respondents will have faced less favourable river conditions than others. Anglers target different waterways within a catchment at varying times of the season based on trout movement to and from spawning streams, and some may only find an opportunity to fish over the traditional Christmas holiday period (Fish & Game Hawke's Bay Region, n.d). The discussion that follows does not propose concrete explanations in the face of so many unknown variables, rather it explores how the available data may relate to *Angler's* experiences.

7.3.1 Clarity

As a general trend, clarity was variable but comparatively low in the man rivers between May 2023 and January 2024, with the best clarity achieved during the three months before survey delivery. Appreciably different clarity experiences were available across the length of the Mohaka, Tutaekuri, and Ngaruroro Rivers with the upper reaches holding the best clarity. Clarity across the Tukituki River was less disparate by measurement, however clarity could double between sites across the main river.

7.3.2 Ecology

Stream ecology is also subject to variability, and the visual cues used by individual *Anglers* to assess ecological health may differ. Two metrics have been used to compare *Angler's* experiences of stream ecology with scientific assessment. First is the Macroinvertebrate Community Index (MCI)[3] (see Figure 18, Appendix C), which indicates ecological health.

[3] The MCI is a widely used measure of aquatic ecological health. MCI scores range from 0-200. In practice it is unusual to find scores higher than 150 and lower than 50. Scores >120 are considered to represent excellent ecological health and those <80 are considered poor health (Stark & Maxted, 2007).

Second is the proportion of total benthic invertebrate abundance that are *Ephemeroptera* (Mayflies), *Plectoptera* (Stoneflies), and *Trichoptera* (Caddisflies) (%EPTa)[4] (see Figure 19, Appendix D). Although less relevant to *Spinners*, the %EPTa provides an angler-focussed metric as these groups of aquatic insects are commonly imitated as trout flies (Marsh, 1983). The use of %EPTa is predicated on the assumption that *Fly Fishers* would focus most on EPT species and that their relative abundance would exert the most influence on perceptions of ecological health. It is accepted that this metric may have less relevance to *Spinners*.

Fifteen of the 21 sites (71%) across the five river systems had a 2024 MCI score that was less than the 2019-2022 mean[5] score, meaning the 2024 ecological health was less than the recent 'normal' for those sites. The MCI at all sites on the Esk and Tutaekuri Rivers were appreciably lower. In particular, the Waipunga Bridge site (mean=99, 2024=78) on the Esk River, the Upstream Mongaone River (mean=101, 2024=83) site, and Brookfields Bridge site (mean=90, 2024=75) on the Tutaekuri River had a poor ecological state. However, despite the low MCI for the two Tutaekuri River sites, the %EPTa for the Upstream Mongaone site (mean=40.7%, 2024=69.8%) and Brookfields Bridge site (mean=38.3%, 2024=70%) were greatly increased. As EPT would have appeared to be in relative abundance at these sites, this may account for some of those perceiving ecology as normal. Overall, the comparison supports the collective *Angler* experiences of ecology on the Tutaekuri River and one of the two respondents who fished the Esk River. As the %EPTa at the Esk was very low across both sites (9.6%, 1.9%) this measure provides no explanation for the one respondent's experience of a normal ecology.

Although 4 of the 5 sites on the Mohaka River had 2024 MCI scores lower than the mean, the scores were close, and most showed excellent or good ecological health. The remaining Ripia River Downstream site had an MCI that was elevated above the mean. The Mohaka River also had variation in %EPTa, with the Ripia River Downstream site (mean=71%, 2024=94%) and the Taharua River Upstream site (mean=81%, 2024=94%) having elevated proportions of EPT. This spatial variation may explain *Angler's* more positive than expected ecological experiences of this river, where 53.5% experienced what they would consider normal ecology and 5.6% experienced ecology somewhat above what they considered normal. The other Mohaka sites had a lower %EPTa than the mean, with the proportion at Raupunga being only 1.5%, which may account for the 9.9% that experienced ecology far below what they considered normal. Overall, the ecological health of this system also supported *Angler* experiences of trout condition, with 77.5% finding condition to be normal or somewhat above normal for this system.

The Ngaruroro sites at Whanawhana (mean=114, 2024=103) and Fernhill (mean=98, 2024=91) had 2024 MCI scores lower than the mean. However, both were reasonably close to their means. The Kuripapango site was almost identical to its mean score, whereas the Hawke's Bay Dairies site (mean=96, 2024=123) was substantially improved over the mean. All sites had %EPTa scores that were elevated from their means. While EPT at the Kuripapango and Whanawhana had somewhat elevated proportions, at Hawke's Bay Dairies (mean=35.7%, 2024=97.6%) and Fernhill (mean=50.2%, 2024=94.3%) the proportion of EPT was near double the means or greater. Despite the prevalence of EPT and elevated MCI within this river system, no *Anglers* reported an experience of ecology above that which they

[4] Samples for both MCI and the %EPT calculations were taken by the HBRC using a 0.1m^2 Surber and following the hard-bottomed C3 protocol from Stark et al (2001). Annual samples were taken between January and March.

[5] The 2023 MCI score was excluded from the mean to eliminate the immediate effect of Cyclone Gabrielle.

considered normal, and most (63.5%) experienced ecology somewhat or far below what they considered normal for that system. While the scientific data does not explain the poor ecological experiences, the relative health and %EPTa do support experiences of trout condition in the Ngaruroro, where 55.6% found trout condition to be normal or somewhat above normal.

Five of the seven sites on the Tukituki and Waipawa Rivers returned 2024 MCI scores at or below their 2019-2022 means. The Tukituki River's most upstream site at SH50 (mean=107, 2024=124) had an elevated MCI, as did the Tapairu Road site (mean=97, 2024=103), while Red Bridge returned a very low but normal score (mean=73, 2024=74). Similarly, 5 out of 7 sites had elevated proportions of EPT with sites at Waipukurau (mean=55.8%, 2024=80.2%) and Waipawa SH50 (mean=65.3%, 2024=94.6%) returning a substantial increase in the proportion of these insects. The Waipawa SH2 site returned a more modest increase in %EPTa (mean=57.8%, 2024=66%).

Easy river access at the townships of Waipawa and Waipukurau may have meant a number of *Anglers* experienced raised %EPTa at these sites, prompting them to perceive the stream ecology as normal. These *Anglers* may help explain some of the 60.8% that reported normal ecology for this river system. The Tapairu Road sample site stands out as it returned both an elevated MCI (mean=97 ,2024=103) and elevated %EPTa (mean=49%, 2024=69.3%). This site is very close to the confluence of the Tukituki and Waipawa Rivers and the popular fishing access via Walker Road. Together with the Tukituki SH50 site (EPTA; mean=65.5%, 2024=69.3%), it is possible *Anglers* in these areas experienced elevated insect life that may have appeared amplified by the apparent abundance of EPT species. If this were the case, it would explain the 7% of *Anglers* that experienced ecology that was either somewhat or far above what they considered normal. Overall, perceived ecological health seems better than the data suggests. However, this will depend on where and when angler effort was concentrated.

7.3.3 Spawning counts

Spawning occurs principally from June through to the end of August. During this period weather and stream conditions must be favourable to carry out spawning surveys and the exact same 1km transect may not be accessible every year (Maclean, 2012). The Tukituki/Waipawa River system attracts 41% of the region's total angling effort (Stoffels & Unwin, 2023), and historical spawning data is focussed on this fishery. Even so, extracting time-series data was challenging. Data for other systems is sparse and appears to be held more as Field Officer and fishing guide knowledge. Spawning surveys from the Mangaonuku and Tukipo Rivers on the Tukituki/Waipawa system between 2020-2022 are compared with those from 2024 in Figure 20, Appendix E. There is variation over time at all four selected sites. A comparison of yearly survey totals across the four sites supports the experience of most *Anglers* that fished this system, where 56% reported at least normal numbers of trout. This, in turn, supports the 67% of those who fished this system and reported normal or greater numbers of other anglers seeking out the apparent healthy stock of fish.

During the cyclone, the Esk River was the most heavily flood struck. A Field Officer survey of a single 12km stretch of the Esk returned only four fish. Surveys of the Donald River (key spawning tributary of the Tutaekuri River) and upper Tutaekuri River (downstream of the end of Lawrence Road) returned zero and eight fish respectively. The Ohara Stream (key spawning tributary of the Ngaruroro River) was surveyed upstream from Big Hill Bridge and upstream from Mangleton Bridge and returned 14 fish at both locations. The results for the Ohara

Stream are considered good by Hawke's Bay Fish & Game staff, and those from the upper Tutaekuri and Donald Rivers are quite reduced, although all are without historical data (Lumsden, 2024).

The experienced *fish numbers* and *fish condition* from this study likely represents one of the few collated accounts of fish stocks and *Angler* prospects during the post-cyclone season. Natural recruitment and recovery take time with a lag of two years from spawning to the progeny being of catchable size (0.5-1.0kg) and another year after that before they reach breeding age. Given the chance, trout will carry on spawning for several years once they mature (Lumsden, 2024). This underscores the importance of those remaining breeding fish in damaged fisheries.

7.4 Bimodal distribution of *fish landed*

While confounding, the bimodal distribution of *fish landed* may be caused by the unknown temporal and spatial elements but must also be considered in the context of a Likert scale based on perceived normality. It is possible the two modes were i) *Anglers* that were more skilled, with high expectations, that experienced a disappointing yield; and ii) *Anglers* that were less skilled, with low expectations, that were matched by their experience, or i) *Anglers* that were more skilled and so overcame challenging conditions to meet their expectations, and ii) *Anglers* that were less skilled, did not overcome challenging conditions, and did not meet their expectations. The bimodal distribution may also be due to a response bias in which *Anglers* who felt dissatisfied gravitated towards the *less-than-half-normal* response, and those who felt satisfied gravitated towards *normal*, both without real consideration of actual proportions. Nonetheless, two distinct classes of *Anglers* were apparent based on the number of *fish landed*.

7.5 Angler satisfaction

Although the survey period did not capture winter fishing, the strong positive correlation between the number of fish landed and *Angler* satisfaction is consistent with the extensive meta-analysis conducted by Hunt et al (2019). Hunt et al clarified that although a valued angling experience has several attributes, such as proximity, size, scenic beauty, facilities, and congestion, catch-related factors were critical to site selection. Although this study shows *Anglers* have a habitually high rate of fish release, the results also reflect the importance of landing a fish to the Hawke's Bay angler.

Of those Spinners that landed less fish than they would normally expect, 39% cited fewer than normal fishing trips as the main reason. The reason for fewer trips is not captured in the survey, however, given only 17% of those *Spinners* were satisfied with their season, it is possible that poor experiences reduced the motivation to fish. There was a moderate negative correlation with the level of *satisfaction* and *future licence*. This means that as satisfaction drops there is an increase in the likelihood of not purchasing a licence due to a future extreme weather event. Although anglers may well accept that weather will exert some influence over their season, the experience following Cyclone Gabrielle may make more anglers reconsider purchasing a licence following any future event.

8 Conclusions

1. Extreme flood damage to rivers caused twice as many anglers to forgo purchasing a licence in the following season compared to affordability.

2. Nearly nine out of ten anglers engage in some form of catch-and-release as part of their fishing habit.

3. Fly Fishers rate themselves as more knowledgeable, more experienced and more confident in their ability to spot fish.

4. Spinners emerged as younger, more family orientated, fish less frequently, are less confident, and less knowledgeable.

5. 2023/24 Angler expectations for the Mohaka, Tutaekuri, Ngaruroro, and Tukituki/Waipawa River systems were mostly poor (Esk excluded as only two anglers fished that river).

6. Experiences of the Tutaekuri River were poor and anglers tended to avoid it due to its flood damage.

7. The Mohaka and Tukituki/Waipawa River systems faired best post-cyclone.

8. Reduced trout numbers, but normal or better trout condition, was a feature of experiences on the Mohaka, Ngaruroro, and Tukituki/Waipawa River systems.

9. EPT (Mayfly, Stonefly, and Caddisfly) species were often overrepresented as a proportion of total benthic invertebrate abundance in recovering waterways, and this may have positively influenced angler perceptions of the overall stream ecology.

10. Despite poor expectations, most anglers were satisfied with the 2023/24 season and their satisfaction was positively related to the number of fish they landed.

11. Two classes of Anglers emerged based on the number of fish they landed relative to their expectations. The reason for this remains open to interpretation.

12. Confidence in spotting fish and self-rated knowledge of ecology had no relationship with angler's experiences of fish numbers or stream ecology respectively.

13. Hawke's Bay anglers fish across more waterways when compared to national averages and favour Lake Taupo when fishing outside the region.

14. Licence-holders desire a proactive response by Fish & Game following extreme flooding. They mostly want restocking, ecological and fish stock monitoring, restored access, better communication, and advocacy for erosion control.

9 Recommendations

1. That a post-flooding communications strategy be made ready for future events. This should provide for frequent updates, prioritise the state and availability of access points, and track river conditions.

2. That educating anglers towards best practice when releasing fish and emphasising the value of breeding age fish be regarded as an essential element of managing recovering fisheries.

3. That consideration be given to restocking depleted rivers when water quality and stream ecology favour survival.

4. That a data collection strategy be formed focussing on creating time-series datasets. The strategy should prioritise collection sites with a view to being robust in the face of fluctuating human resources.

5. That, given the importance of bringing young people and families into the sport, particular consideration be given to supporting spin-fishing and its associated demographics.

6. That some optimism regarding the more resilient fisheries be conveyed to 2024/25 prospective licence holders.

10 Final comment

It is hoped that highlighting post-cyclone angler expectations and experiences raises awareness of post-flooding fishery management, fuels discussion, and promotes an approach to management that integrates expertise from practitioners across organisations.

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Appendix A – Bivariate correlations

Table 11 Bivariate Correlation Coefficients (Spearman's ρ) for Descriptive Variables and Angler Mean Expectations and Experiences

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1. Age group.																							
2. Licence tenure.	.471**																						
3. Fishing frequency.	.015	.088																					
4. Club membership.	-.104	-.076	-.103																				
5. Fly/Spin .	-.190**	-.292**	-.237**	.108																			
6. Enviro.	-.159*	-.186**	-.123	.171*	.104																		
7. Experience level.	.172*	.357**	.287**	-.097	-.257**	-.229**																	
8. Ability to spot fish.	.057	.397**	.277**	-.020	-.260**	-.211**	.500**																
9. Knowledge of ecology.	.208**	.399**	.356**	-.115	-.324**	-.270**	.421**	.632**															
10. Knowledge of HBFGC.	.200**	.244**	.239**	-.141*	-.210**	-.222**	.216**	.344**	.451**														
11. Angler satisfaction.	-.182**	-.021	.235**	-.077	-.124	.016	.075	.130	.090	.032													
12. Fish-landed.	-.222**	-.081	.132	-.015	-.072	.054	.062	.031	.002	-.024	.705**												
13. Fishing elsewhere.	-.091	-.156*	-.058	.073	.259**	.145*	-.231**	-.241**	-.251**	-.145*	-.128	-.106											
14. Non-purchase.	.116	.149*	.068	-.088	-.138	.007	.036	.017	.009	.109	.390**	.299**	-.205**										
15. Frnd non-purchase.	.010	-.044	-.054	-.050	-.018	.100	-.086	-.145*	-.091	-.054	.281**	.240**	-.076	.369**									
16. Future Licence.	-.096	-.223**	-.223**	.038	.256**	.115	-.131	-.180*	-.126	-.136	-.452**	-.271**	.196**	-.422**	-.245**								
17. Mohaka_Expect.†	-.124	-.199	-.287*	.150	.052	-.017	-.070	-.143	-.148	-.160	.323**	.299*	-.064	.208	.347**	-.008							
18. Mohaka_Experi.†	-.029	-.210	-.229	.075	-.015	-.034	-.152	-.091	-.039	-.085	.373**	.323**	-.180	.193	.233*	-.144	.716**						
19. Tutaekuri_Expect.†	-.273	.033	-.078	.118	-.197	.223	.210	-.085	.026	.075	.117	.228	.077	-.075	.019	-.182	.052	-.113					
20. Tutaekuri_Experi.†	-.301	-.024	-.151	-.105	-.270	.330*	.149	.081	.155	.189	.345*	.316	-.048	.023	-.140	-.223	.317	.120	.705**				
21. Ngaruroro_Expect.†	-.246	-.108	-.036	.036	.031	-.025	-.094	.034	-.024	.019	.197	.307*	-.168	.288*	.195	.028	.416	.286	.107	.150			
22. Ngaruroro_Experi.†	-.116	-.131	-.135	-.112	-.068	-.019	.081	.009	.057	-.031	.174	.301*	-.195	.305*	.281*	.012	.262	.250	-.196	.486	.613**		
23. Tuki/Waip_Expect.†	-.258**	-.140	.009	.183*	.075	.081	.015	-.042	-.098	-.029	.251**	.233**	.024	-.003	-.009	-.186*	.293	.208	.187	.212	.323*	.152	
24. Tuki/Waip_Experi.†	-.304**	-.106	.169	-.019	-.032	.140	.129	.048	-.019	.014	.615**	.636**	-.076	.147	.063	-.229*	.252	.155	.218	.436*	.224	-.103	.429**

*The correlation was significant at the p<.05 level, ** at the p<.01 level. † Mean variables for trout numbers, trout condition, and river/stream ecology. Angler numbers were excluded and are treated separately.

2. Licence tenure = over the past 5 seasons, how many times have you held a fishing licence? 3. Fishing frequency = River conditions permitting, how often do you fish? 4. Club membership = Are you a member of a fishing club? 5. Fly/Spin = Do you mainly fly fish or spin fish? 6. Enviro = In the past two years have you donated either money or time to an environmental organisation? 7. Experience level = How would you rate your level of angling experience? 8. Ability to spot fish = How confident are you in your ability to spot fish? 9. Knowledge of ecology = How would you rate your knowledge of stream ecology? 10. Knowledge of HBFGC = How would you rate your knowledge of the Hawke's Bay Fish and Game Council's role and activities? 11. Angler satisfaction = Overall, how satisfied are you with your season to date? 12. Fish-landed = Overall, so far this season, has the number of fish you have landed been...? 13. Fishing elsewhere = Have you fished outside of Hawke's Bay so far this season? 14. Non-purchase = Did you consider not purchasing a fishing licence this season based on the effects of flood damage to the river systems? 15. Frnd non-purchase = Do you have any friends or family that did not purchase a fishing licence this season because they felt there was too much flood damage to rivers? 16. Future Licence = How likely is it that flooding caused by future extreme weather would make you reconsider purchasing a fishing licence? 17. Mohaka_Expect = mean expectation for the Mohaka River system. 18. Mohaka_Experi = mean experience of the Mohaka River system. 19. Tutaekuri_Expect = mean expectation for the Tutaekuri River system. 20. Tutaekuri_Experi = mean experience of the Tutaekuri River system. 21. Ngaruroro_Expect = mean expectation for the Ngaruroro River system. 22. Ngaruroro_Experi = mean experience of the Ngaruroro River system. 23. Tuki/Waip_Expect = mean expectation for the Tukituki/Waipawa River system. 24. Tuki/Waip_Experi = mean experience of the Tukituki/Waipawa River system.

Appendix B – Water clarity

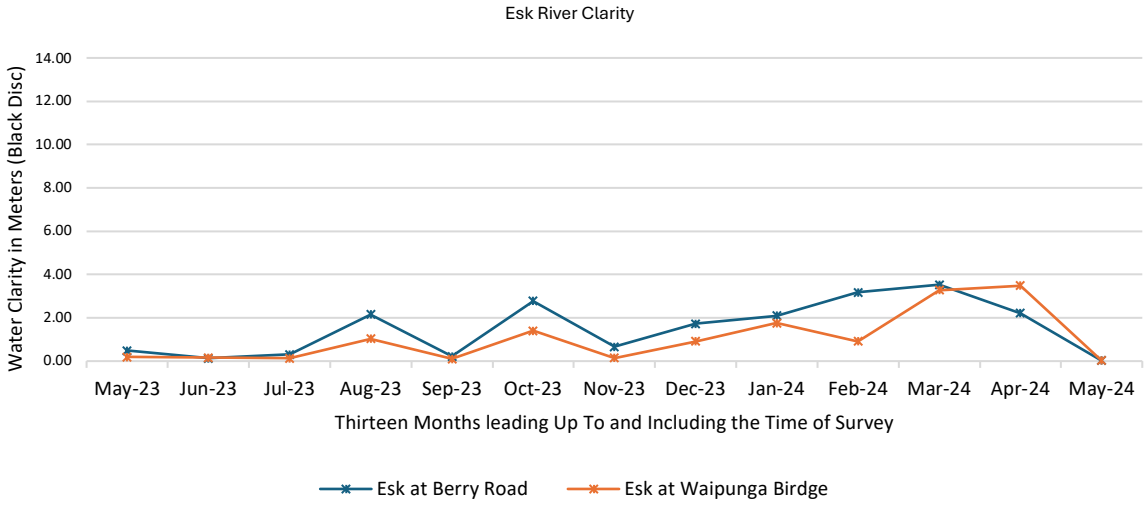


Figure 12 Esk River Water Clarity (HBRC, 2024h)

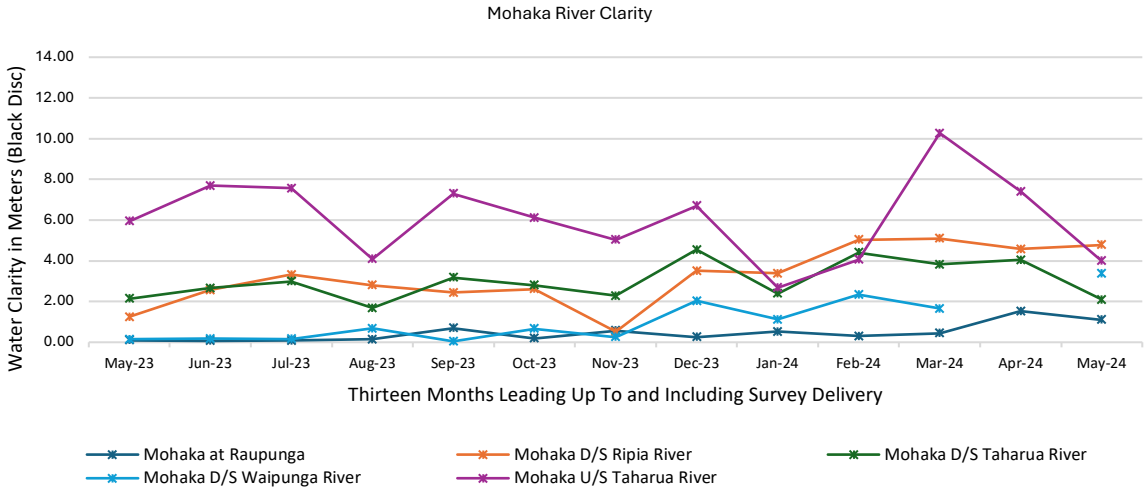


Figure 13 Mohaka River Water Clarity (HBRC, 2024h)

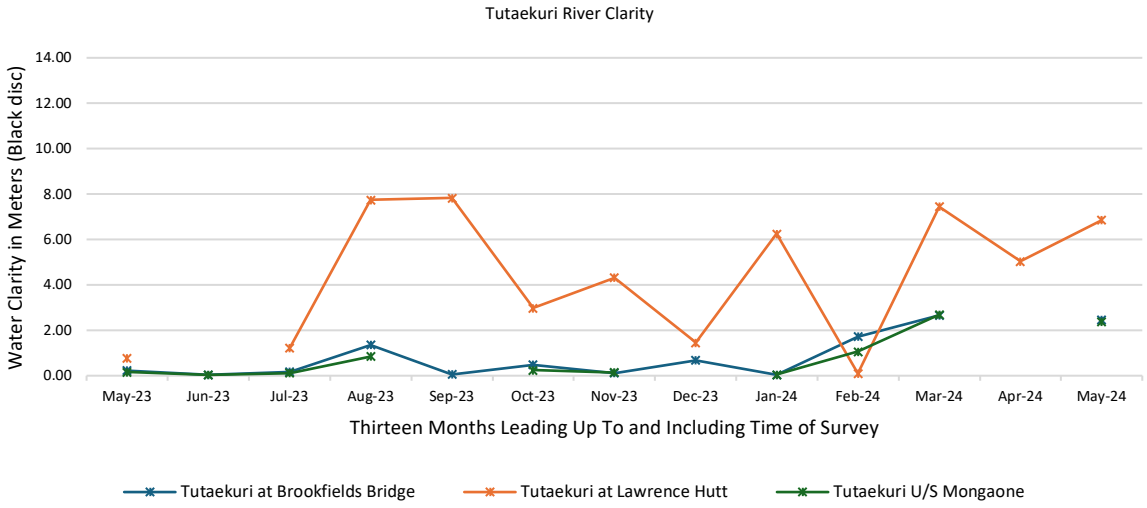


Figure 14 Tutaekuri River Water Clarity (HBRC, 2024h)

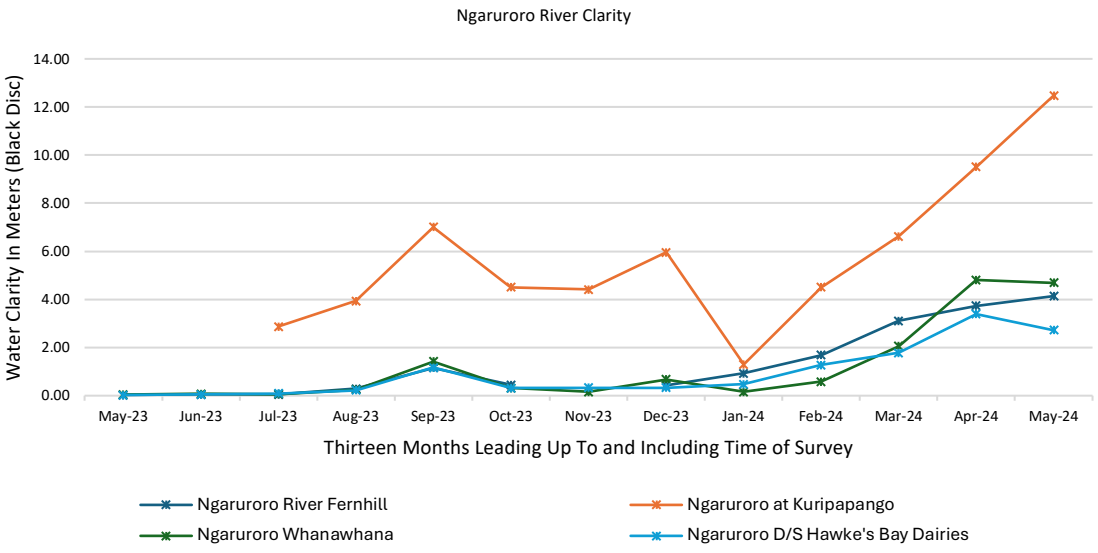


Figure 15 Ngaruroro River Water Clarity (HBRC, 2024h)

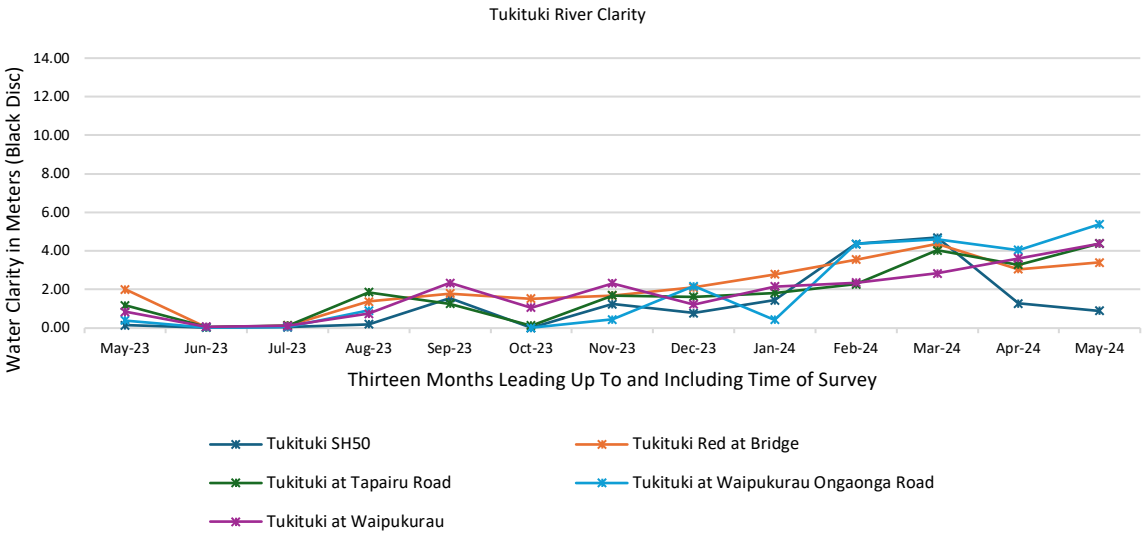


Figure 16 Tukituki River Water Clarity (HBRC, 2024h)

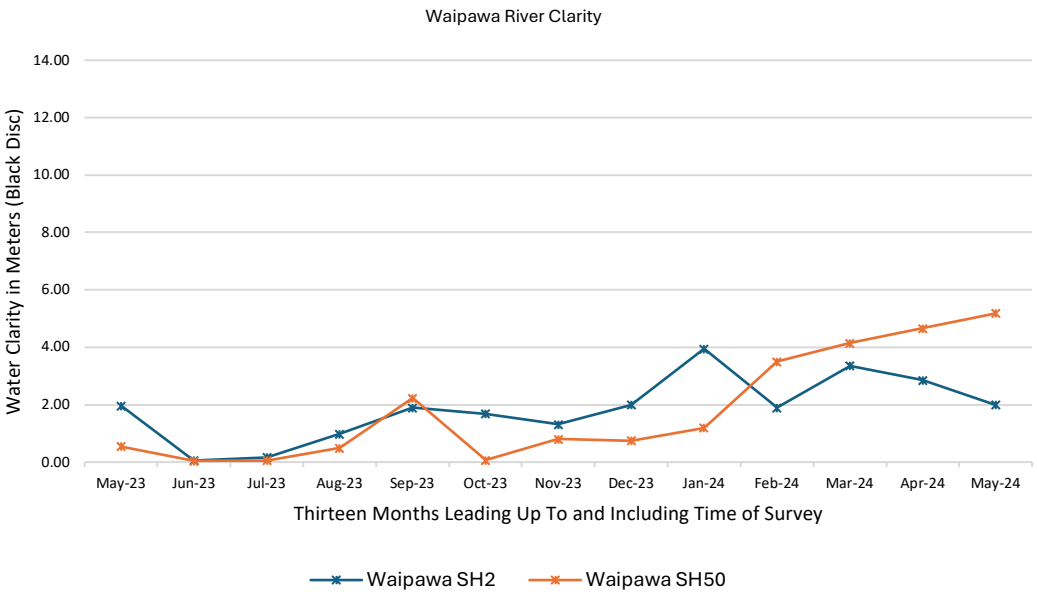
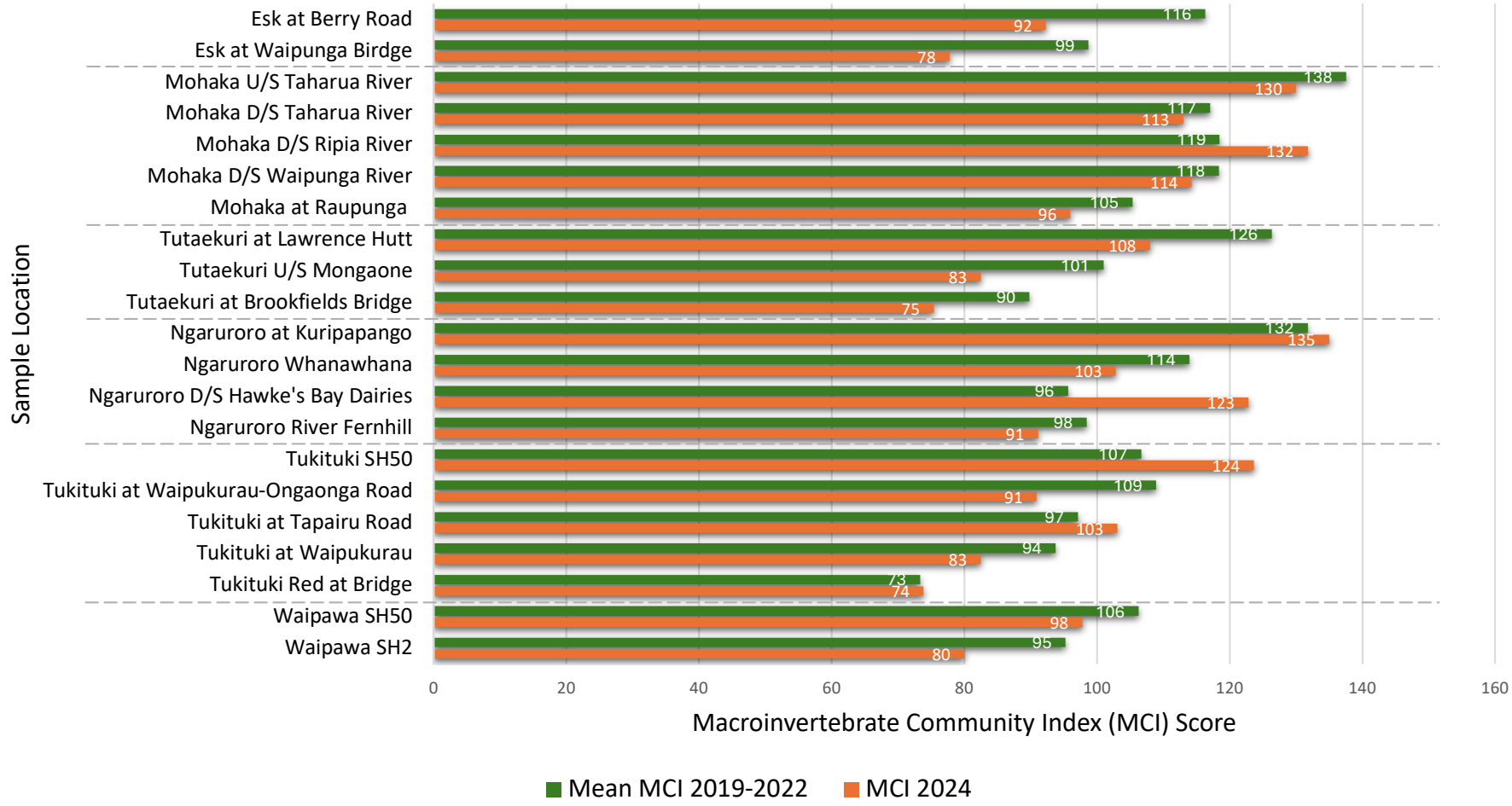


Figure 17 Waipawa River Water Clarity (HBRC, 2024h)

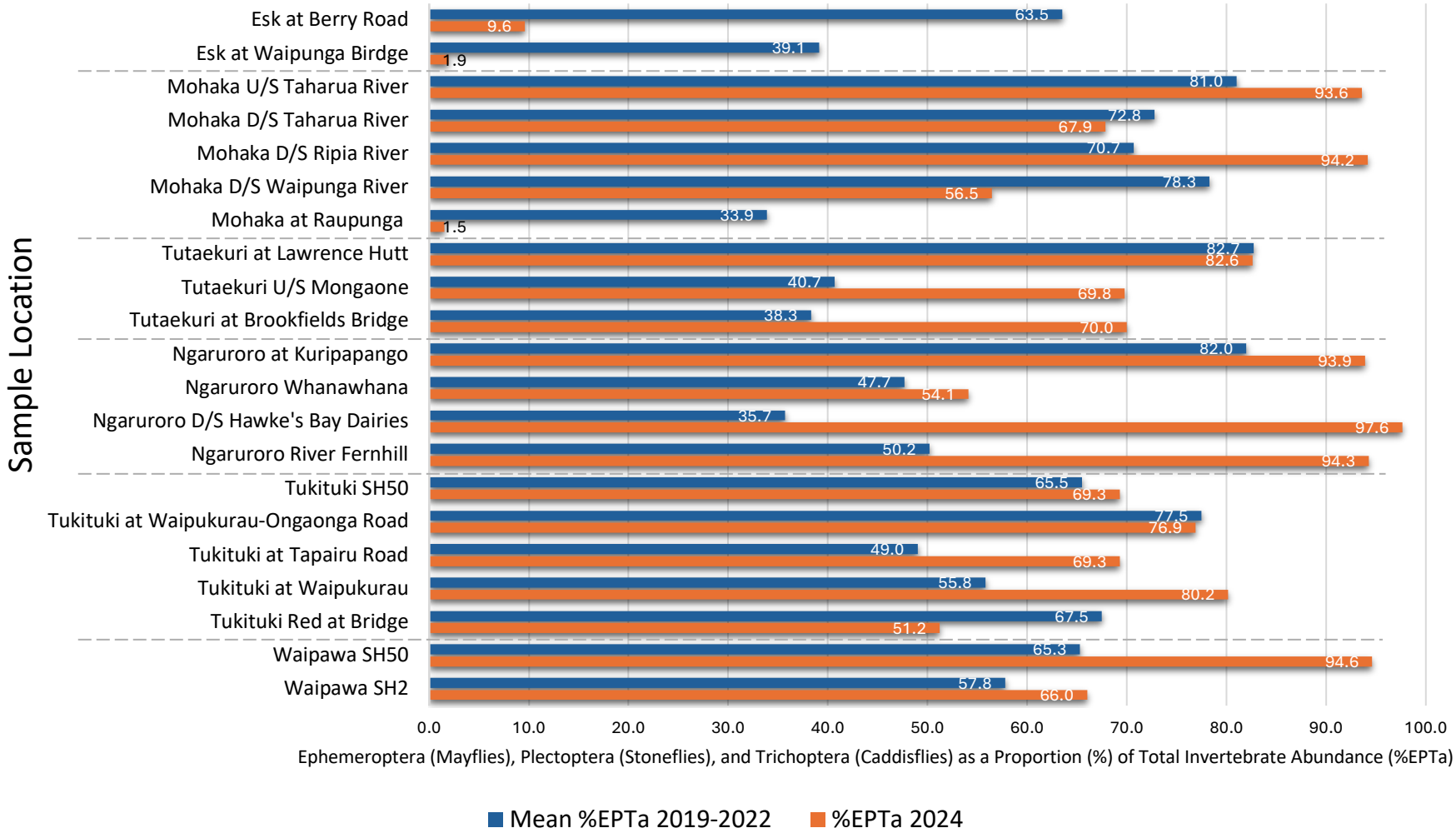
Appendix C – Comparison of the 2024 Macroinvertebrate Community Index Scores with the 2019-2022 Mean Score



Note: MCI scores range from 0-200. In practice it is unusual to find scores higher than 150 and lower than 50. Scores >120 are considered to represent excellent ecological health and those <80 are considered poor health (Stark & Maxted, 2007). Samples are taken yearly between January and March and MCI calculated using the hard-bottom taxon scores. Data extracted from HBRC (2024h). The MCI score from 2023 is excluded from the mean to eliminate the effect of Cyclone Gabrielle.

Figure 18 Comparison of the 2024 Macroinvertebrate Community Index Scores with the 2019-2022 Mean Score

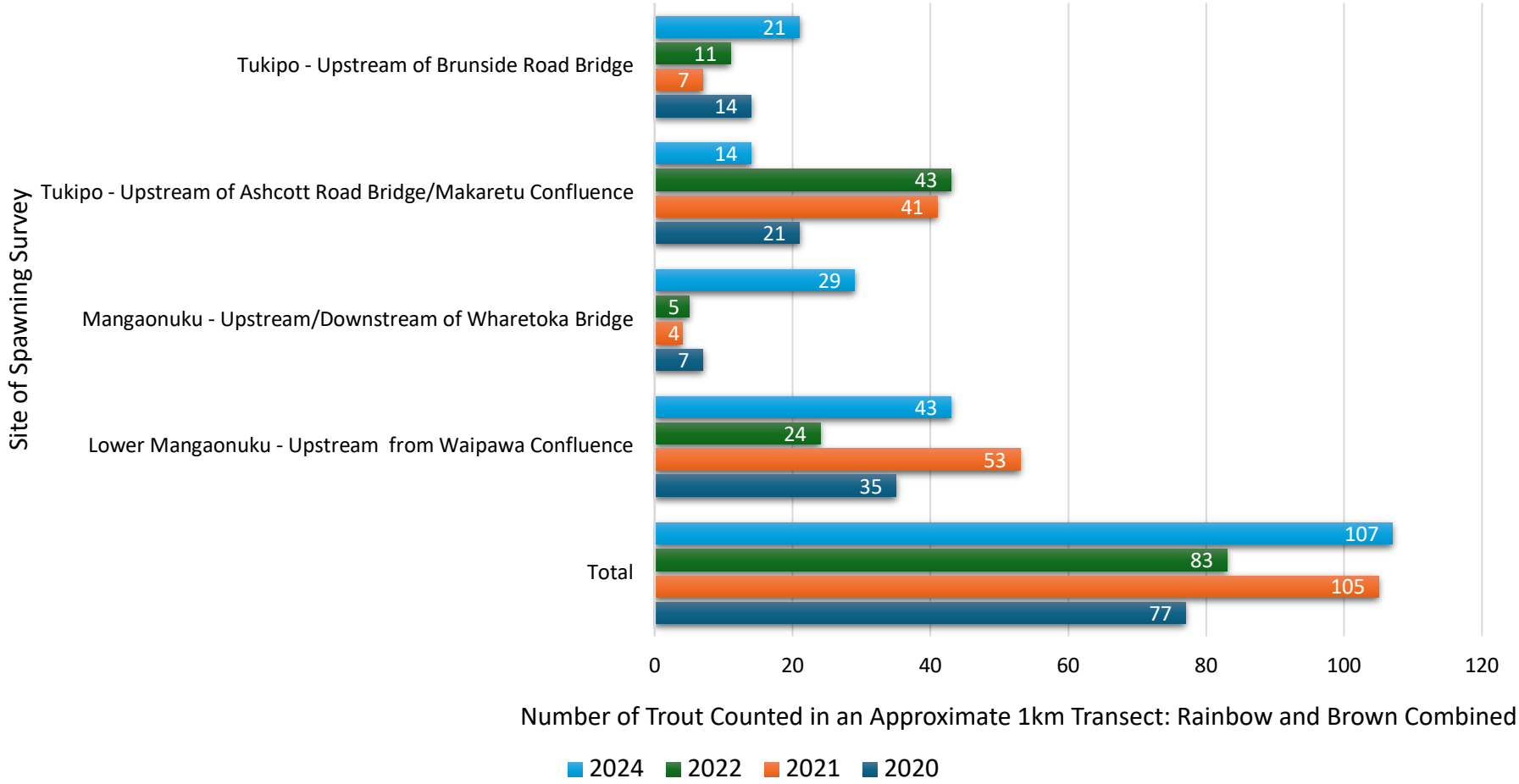
Appendix D – Ephemeroptera (Mayflies), Plecoptera (Stoneflies), and Trichoptera (Caddisflies) as a Proportion of Total Invertebrate Abundance (%EPTa)



Note: Anglers are particularly interested in Mayflies, Stoneflies, and Caddisflies (EPT taxa) as they are commonly imitated as fishing flies. The %EPT nymphs compared to other taxa may distort angler perceptions of ecological health compared to actual health. Samples are taken yearly between January and March. Data extracted from HBRC (2024h). The %EPTa score from 2023 is excluded from the mean to eliminate the effect of Cyclone Gabrielle.

Figure 19 Ephemeroptera (Mayflies), Plectoptera (Stoneflies), and Trichoptera (Caddisflies) as a Proportion (%) of Total Invertebrate Abundance (%EPTa)

Appendix E – Selected Tukituki/Waipawa Spawning Survey Sites



Note: The selected sites represent those within the river system for which time series data could be collated. Other river systems either had no apparent historical records or records did not lend themselves to time series analysis. Where multiple surveys were conducted at a site across a spawning season, the single highest count is reported. Data extracted from Fish & Game Hawke's Bay Region (2024).

Figure 20 Selected Tukituki/Waipawa Spawning Survey Sites