Port Hills Fish Communities

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EXECUTIVE SUMMARY

This report summarises results of a survey of fish populations in waterways draining Te Poho-o-Tamatea, the Port Hills of Ōtautahi – Christchurch. The purpose of the survey was to improve Christchurch City Council's understanding of fish distributions in the district's waterways. Of particular interest is distribution of locally rare species, particularly banded kōkopu (*Galaxias fasciatus*). The focus of this survey was on waterways lacking fish records, as well as waterways with current restoration programmes and stakeholder interest.

Twelve of the 15 Port Hills sampling locations were suitable for fishing and fish were caught at six of those sites. This survey resulted in new banded kōkopu records for Sumnervale Drain (a tributary of Sumner Stream), Richmond Hill Waterway, and Mt Pleasant Waterway. All these waterways drain the city side of the Port Hills, and ultimately flow into either the sea or estuary. Notably, no fish were caught from any Port Hills waterways that ultimately drain into the Ōpāwaho – Heathcote River upstream of the estuary. Review of New Zealand Freshwater Fish Database records indicates a consistent pattern of banded kōkopu being absent from Heathcote River tributaries upstream of the estuary. The lack of banded kōkopu in tributaries of the Heathcote River is likely due to its frequently turbid conditions.

This survey has extended our knowledge of the fish communities in waterways draining the Port Hills. The presence of fish, including banded kōkopu, inanga (*Galaxias maculatus*), common bully (*Gobiomorphus cotidianus*), and shortfin eels (*Anguilla australis*), in waterways on the city side of the Port Hills confirms that many of these waterways do support fish communities. This contrasts with historic assumptions that most Port Hills waterways lacked fish, due to a lack of permanent flow.

1. INTRODUCTION

Te Poho-o-Tamatea, the Port Hills, separate Christchurch city from Whakaraupō-Lyttelton Harbour, and they extend from Awaroa-Godley Head to Gebbies Pass. Streams draining the Port Hills are small and many have intermittent flow. Because of this intermittent flow, it was historically assumed that Port Hills waterways did not support permanent fish populations (e.g., EOS Ecology Ltd et al. 2005). However, a 2018 survey of Glenstrae Stream in McCormacks Bay found banded kōkopu[1] (*Galaxias fasciatus*), a locally uncommon native fish species. A 2022 survey of Sumner Stream also found banded kōkopu.[2] These were the first records of banded kōkopu in the city, with all previous records in the district confined to tributaries of Whakaraupō and Banks Peninsula. This suggests that Port Hills waterways may harbour more significant fish populations than previously assumed, which has implications for waterway management and biodiversity protection.

This report summarises results of a survey of fish populations in Port Hills waterways. The purpose of the survey was to improve Christchurch City Council's understanding of fish distributions. Of particular interest are the distributions of locally rare species, such as banded kōkopu. The focus of this survey was on waterways lacking fish records, as well as waterways with current restoration programmes and stakeholder interest.

2. METHODS

2.1. Sampling Sites

Fifteen locations were visited as part of this survey (Figure 1, Table 1). Most sites were selected due to a lack of previous records in the New Zealand Freshwater Fish Database (NZFFD). The fish survey was also used to provide information in support of waterway planting programmes at Site 2 (Sumnervale Drain), Site 7 (Avoca Valley Stream), Site 10 (Sibleys Drain), Site 12 (Cass Bay Stream), and Site 15 (Omaru Stream). Two sites were sampled along Sumnervale Drain, due to contrasting habitat at the two locations, while three sites were sampled along Omaru Stream, in relation to known fish barriers. A reconnaissance visit was made to each site prior to fish sampling, to confirm there was sufficient surface water to support fish communities, and to confirm sampling reach locations.

2.2. Field Methods

All fieldwork occurred between 29 November and 9 December 2023 under baseflow conditions. Sampling occurred following a year of above average rainfall, preceded by two years of unusually dry conditions. The average to high baseflow conditions, coupled with the early summer timing of fieldwork, provided optimal conditions for sampling fish in these small waterways.

Fish communities were sampled at all sites with sufficient surface water, using both spotlighting and trapping methods. Electric fishing was not undertaken because it underestimates the densities of many migratory galaxiids, including banded kōkopu (see

[1] New Zealand Freshwater Fish Database (NZFFD) record number 115043.
[2] NZFFD record number 123602.

Table 2 of the New Zealand Freshwater Fish Sampling Protocols, Joy et al. 2013). Furthermore, effective electric fishing requires reasonable flow, which may not be present in many of the intermittent waterways that were sampled. Spotlighting is efficient at detecting native galaxiids that are active at night, including inanga (Galaxias maculatus) and banded kōkopu, and it is effective at producing reliable abundance estimates (Joy et al. 2013), because active fish can be seen and counted. Trapping does not provide reliable abundance estimates, because it is a passive sampling technique that does not sample a known area. However, trapping has the advantage of effectively collecting size class data, because the caught fish can be measured accurately. In combination, spotlighting and trapping were considered to provide comprehensive information on the fish communities present.

Table 1: Fish survey locations.

Site No.	Waterway	Location	Easting (NZTM)	Northing (NZTM)
1	Korara Stream	Taylors Mistake Bay	1581714	5174081
2	Sumnervale Drain (Lower)	Sumnervale Reserve (lower)	1580083	5174336
3	Sumnervale Drain (Upper)	Sumnervale Reserve (upper)	1579854	5174265
4	Richmond Hill Waterway	Upstream of Richmond Hill Road	1580145	5175730
5	Mt Pleasant Waterway	Aratoro Place	1577443	5177011
6	Butts Valley Waterway	Upstream of Butts Valley Road	1575523	5175218
7	Avoca Valley Stream	Ferrymead Pony Club	1574596	5175419
8	Victory Drain	Mt Vernon Park	1572659	5175818
9	Victory Drain Branch No. 1	Mt Vernon Park	1572466	5175857
10	Sibleys Drain	End of Bowenvale Avenue	1571665	5174359
11	Patchetts Drain	53 Hollis Ave	1570739	5175366
12	Cass Bay Stream	True Left tributary, upstream of Governors Bay Road	1575215	5172193
13	Omaru Stream (Lower)	Immediately upstream of marae driveway	1574224	5171766
14	Omaru Stream (Middle)	Upstream of private culvert	1574202	5171832
15	Omaru Stream (Upper)	Sampled upstream of Governors Bay Road	1574103	5172082

Spotlighting involved surveying 150 m of waterway at night, using handheld torches. Each survey began a minimum of 45 minutes after sunset (Joy et al. 2013). Any fish seen were recorded, identified while still in the water to the lowest taxonomic level possible, and categorised into size classes. A total of 10 unbaited Gee minnow traps (6.4 mm mesh, Memphis Net & Twine Co., Inc., model G40M) were placed opportunistically over the same reach surveyed via the spotlighting method. Trapping and spotlighting occurred over different nights at each site, with trapping being undertaken before or after spotlighting (i.e., there was no particular order to the methods at a given site). Traps were left overnight and retrieved in the morning. All caught fish were identified and measured, before being returned to the water.

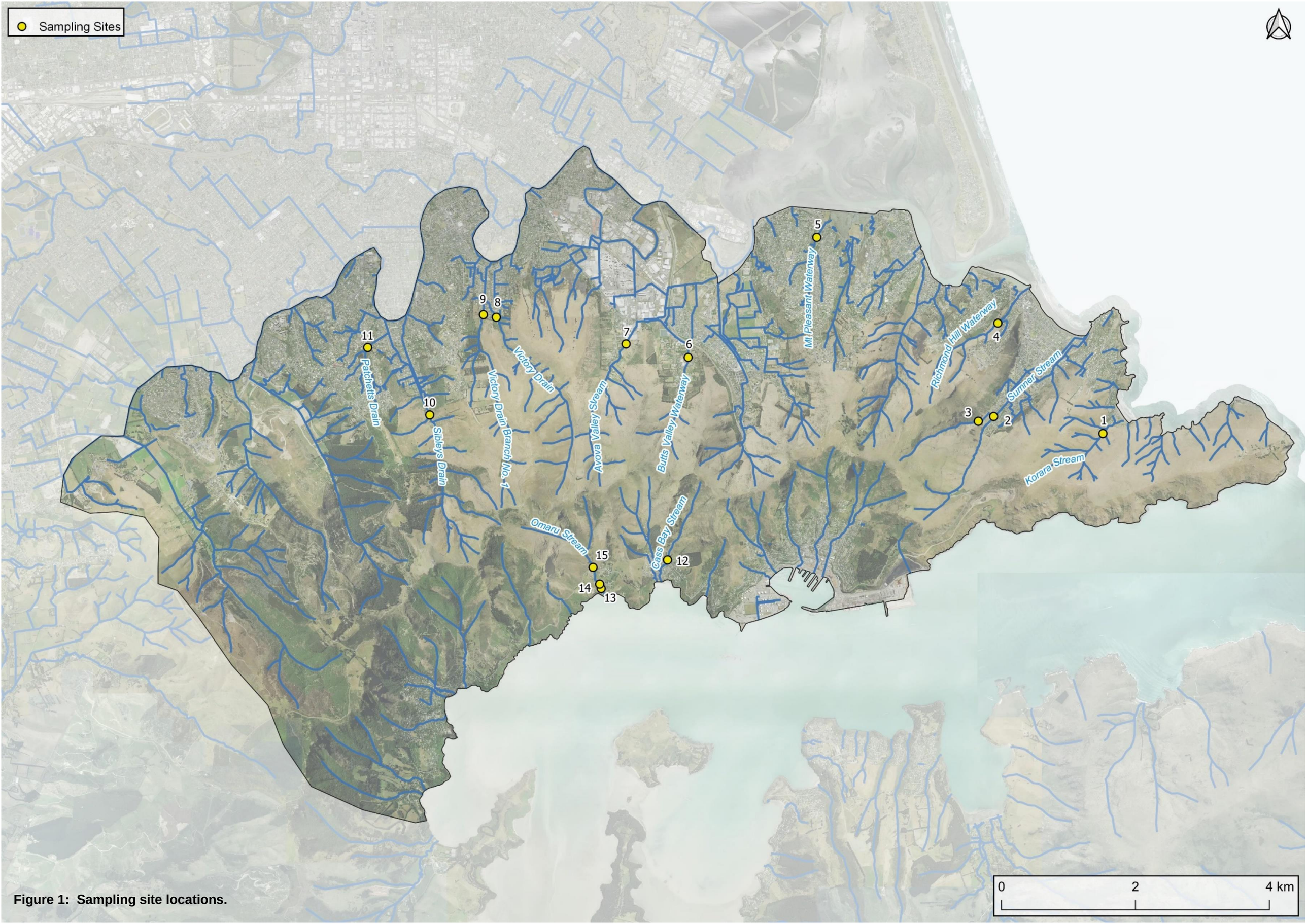

Figure 1: Sampling site locations.

Basic habitat parameters were measured to help explain fish presence. Measurements were taken over a single representative reach within the fish sampling reach, for each waterway. Measured parameters were those required to complete a standard NZFFD card, including: water quality, width, depth, flow character, substrate composition, fish cover presence, catchment landuse, presence of any fish passage barriers, and any other relevant habitat notes.

All fishing and habitat data was entered into the NZFFD via the online portal hosted by NIWA. We reviewed all data, and made any necessary corrections, prior to submission to the NZFFD.

2.3. Desktop Analyses

Following approval of the new NZFFD records by NIWA, all the details were downloaded and saved as an MS Excel file. Basic water quality and habitat characteristics were tabulated, along with fish data. All fish sampling records for the Port Hills area were downloaded from the NZFFD on 18 January 2023, to provide additional context on fish species distribution.

3. RESULTS AND DISCUSSION

3.1. Site Descriptions

Three of the 15 sites visited were dry and therefore did not support fish habitat. The dry sites were Site 1 (Korara Stream) at Taylors Mistake, and Site 6 (Butts Valley Stream) and Site 7 (Avoca Valley Stream), both in Avoca Valley. There was surface water present at Site 7 at a large pond near Port Hills Road. However, the pond was well downstream of the area of native plantings of interest upstream (where the stream was dry), and there were existing NZFFD records for the pond, so we did not undertake fish sampling.

The 12 sites with surface water all had cool water temperatures and moderately high dissolved oxygen concentrations (Table 2). Most sites had near-neutral pH (i.e., around 7) and conductivity at most sites was typical for urban waterways in Christchurch. Conductivity was high at Sites 2 and 4, and pH exceeded guidelines at Site 5. The cause of elevated conductivity and pH is uncertain, although it is common for water quality to be degraded in urban waterways that receive untreated stormwater discharges. Water clarity was low to moderate at most sites, likely reflecting the combined influence of easily erodible loess soils and stormwater washed down residential drains. All 12 fishing sites were small waterways, with mean widths ranging from 0.40 m to 1.75 m and mean depths ranging from 12 cm to 33 cm (Table 3). While most sites had a relatively high abundance of pools that could support fish during drier periods, many were also located upstream of long sections of waterway that were either piped or lined with concrete.

Table 2: Spot measurements of water quality at each site. (Temp.), specific conductivity (Cond.), dissolved oxygen (DO), pH, and clarity. Values in bold do not comply with relevant guidelines.

Site No.	Location	Temp. (°C)	Cond. (µS/cm)	DO (%)	DO (mg/L)	pH	Clarity (cm)
2	Sumnervale Drain (Lower)	15.5	528	**84.9**	8.46	6.67	60
3	Sumnervale Drain (Upper)	15.5	307	94.9	9.46	7.36	38
4	Richmond Hill Waterway	18.0	475	100.3	9.48	7.66	31
5	Mt Pleasant Waterway	15.1	238	96.4	9.69	**8.60**	66
8	Victory Drain	15.1	249	97.9	9.84	7.00	30
9	Victory Drain Branch No. 1	13.5	263	**76.7**	8.00	6.72	17
10	Sibleys Drain	15.5	268	**84.4**	8.22	7.17	25
11	Patchetts Drain	15.4	301	97.1	9.70	7.84	74
12	Cass Bay Stream	16.9	226	101.3	9.79	7.43	28
13	Omaru Stream (Lower)	16.1	188	95.1	9.39	7.69	80
14	Omaru Stream (Middle)	16.1	188	95.1	9.39	7.69	80
15	Omaru Stream (Upper)	14.2	239	**88.7**	9.10	6.99	42
LWRP Guideline		≤20	–	≥90	–	6.5–8.5	–
NPSFM Bottom Line		–	–	–	≥5.0		–

Note: Temp. = temperature, Cond. = specific conductivity, DO = dissolved oxygen; LWRP = Canterbury Land and Water Regional Plan; NPSFM = National Policy Statement for Freshwater Management 2020; "–" = no guideline available;

Table 3: Habitat characteristics and fish presence (✓) or absence (×) at each site with sampleable habitat.

Site No.	Location	Mean width (m)	Mean depth (cm)	Flow habitat (%)	Fish Present?
2	Sumnervale Drain (Lower)	1.01	14	Still:10, Pool:90	✓
3	Sumnervale Drain (upper)	0.60	15	Still:15, Pool:80, Run:5	×
4	Richmond Hill Waterway	0.40	19	Pool:60, Run:30, Cascade:10	✓
5	Mt Pleasant Waterway	1.10	14	Pool:60, Run:40	✓
8	Victory Drain	0.75	19	Still:10, Pool:15, Run:75	×
9	Victory Drain Branch No. 1	0.45	33	Still:20, Pool:80	×
10	Sibleys Drain	1.75	30	Still:15, Pool:85	×
11	Patchetts Drain	0.40	12	Pool:40, Run:40, Riffle:20	×
12	Cass Bay Stream	0.70	24	Pool:90, Run:10	✓
13	Omaru Stream (Lower)	1.20	29	Pool:90, Run:10	✓
14	Omaru Stream (Middle)	0.85	13	Pool:90, Run:10	✓
15	Omaru Stream (Upper)	0.70	15	Pool:100	×

Note: Widths and depths are the mean of five measurements along a 150 m reach.

The following paragraphs briefly summarise habitat characteristics at each site.

Site 1 – Korara Stream at Taylors Mistake

There was no surface water or residual pools present that could provide fish habitat along Korara Stream (Figure 2). The channel was entirely covered in terrestrial grass species, indicating the waterway flows only in response to rain events. No attempt was made to sample fish, due to a lack of aquatic habitat.

Figure 2: Dry channel at Site 1 (Korara Stream).

Sites 2 and 3 – Sumnervale Drain

The downstream extent of Site 2 commenced immediately upstream of the confluence with Sumner Stream. The sampling reach flowed along the northeast margin of Sumnervale Reserve. Potential fish habitat comprised a handful of shallow pools, with varying degrees of cover from overhanging long grass, cobbles, and boulders (Figure 3). There was a dry section between Sites 2 and 3 that had been observed flowing during the initial site reconnaissance. This dry section would present a fish passage barrier during low flows.

Site 3 was further upstream in the reserve, amongst native plantings that provide good waterway shade (Figure 3). High quality pool habitat was abundant, with plenty of fish cover in the form of boulders, cobbles, and woody debris. Natural barriers were present along reach, but they are likely passable by strong climbing fish species.

Figure 3: Sumnervale Stream at Site 2 (left) and Site 3 (right).

Site 4 – Richmond Hill Waterway

The downstream extent of the sampling reach was approximately 25 m upstream of Richmond Hill Road. The terrain is steep, resulting in several small natural barriers through the reach. Only strong climbing fish species would be able to navigate these barriers. The waterway was dominated by moderately deep pools connected by shallow runs and small cascades. There was plenty of fish cover in the pools, including wood, boulders, and cobbles (Figure 4). The channel is quite incised at some points. Native trees and shrubs provide high levels of waterway shade, interspersed with some more open sections. Downstream, there is a steep concrete culvert that would be a fish barrier for poor climbers (Figure 4). The metal trash rack on the upstream end of the culvert also creates a lip that may be difficult for fish to pass. Moving downstream approximately 200 m to the bowling green, the channel is concrete lined, the flow is shallow, and there is no fish cover. This concrete-lined section is also likely to present a barrier to many fish species.

Figure 4: Site 4, Richmond Hill Waterway, showing the fish sampling reach (left) and downstream culvert entrance identified as a fish barrier (right)

Site 5 – Mt Pleasant Waterway

The sampling reach was commenced a short distance upstream of a concrete sump with an approximately 1.5 m vertical drop, which flows into a piped network. The pipes and vertical drop present a very high risk to fish passage. The waterway has sections that are concrete lined and other natural sections with cobble substrate (Figure 5). Potential fish habitat is present in the form of shallow pools in the natural sections and areas of broken lining in the concrete-lined sections. Overhanging grass provides reasonable fish cover along the natural section of waterway, although the grass is regularly trimmed.

Figure 5: Site 5 (Mt Pleasant Waterway), showing minnow traps set in pools located in the broken concrete lining (left) and in a section with natural lining (right).

Site 6 – Butts Valley Waterway

The waterway was dry, with no residual pools that could provide potential fish habitat during dry periods (Figure 6). The channel was covered in terrestrial plants, indicating a lack of flow permanence. Therefore, fish sampling was not practical at this location.

Site 7 – Avoca Valley Waterway

The waterway was dry within the proposed sampling reach within the reserve area (Figure 6), and the channel downstream was too shallow to trap. Spotlighting was also impractical due to a lack of surface flow and poor access. The large pond near Port Hills Road could have been trapped, but it was not banded kōkopu habitat. Previous sampling of the pond at Port Hills Road pond found inanga, shortfin eel (*Anguilla australis*), and common bully (*Gobiomorphus cotidianus*) were present (NZFFD record number 110842). Therefore, no fish sampling occurred.

Figure 6: Dry waterways at Site 6, Butts Valley Drain (left) and Site 7, Avoca Valley Drain (right).

Site 8 – Victory Drain

The downstream end of the sampling reach began approximately 30 m upstream from the entry to the reserve. The waterway meanders through the reserve, surrounded by regenerating native trees and shrubs. The channel form is characterised by slow runs and pools (Figure 7). Shallower run habitat flowed over semi-terrestrial vegetation such as buttercup (*Ranunculus* sp.), indicating that the pools likely become isolated during drier months. These shallow sections are potential fish barriers to poor climbers under the observed flow conditions and the fish passage risk would increase under drier conditions. Some deeper pools hold potential as fish habitat. The substrate was a mixture of mud and embedded cobbles. Periphyton and aquatic snails indicate that the waterway has held water for some time.

Site 9 – Victory Drain Branch No. 1

The downstream end of the sampling reach site was a large pool at the start of the reserve. The waterway meanders through the reserve, with the banks vegetated with long grass and young native plantings (Figure 7). The channel form was comprised of pools and very slow runs. The channel was generally narrow and very incised in parts. The pools likely become disconnected during the drier months, given the shallow water depths in the runs between them. Some small natural steps could prevent upstream passage for fish that are poor climbers. The substrate was dominated by fine sediments (<2 mm diameter). We attempted to sample higher in the catchment, among the established native bush, but there was no periphyton or aquatic invertebrates present, indicating a lack of flow permanence.

Figure 7: The left image is Site 8 (Victory Drain) and the right image is Site 9 (Victory Drain Branch No. 1).

Site 10 – Sibleys Drain

The downstream extent of the sampling reach was approximately 90 m upstream from the driveway to 160 Bowenvale Avenue. The sampling reach meanders along the valley floor, with aquatic habitat comprising pools with varying connectivity (Figure 8). Surface flow was very shallow at some sections through a rush-dominated wetland. There are some substantial natural drops that may limit fish passage. Some pools were quite deep, providing

high quality habitat, with cover provided by large boulders, wetland vegetation, and long filamentous algae. Beyond the valley floor, the valley is vegetated in mostly pasture grass, which was being actively grazed by sheep. Further downstream, the channel is concrete-lined, with minimal water depth, which presents a barrier to fish passage (Figure 8).

Figure 8: Site 10 (Sibleys Drain), showing the fish sampling reach (left) and downstream concrete-lined reach (right) identified as a fish barrier.

Site 11 – Patchetts Drain

There is a long, piped section of the waterway downstream, which had very shallow water depths (1 cm deep). Several medium to high-risk barriers to fish passage occur along the sampling reach, including some natural drops and other short sections of concrete lining with shallow water depths (Figure 9). Aquatic habitat was a combination of pool, run, and riffle. Flood debris was abundant, indicating stormflow several weeks prior. Pool habitat was excellent quality. There was high levels of shading from the native tree canopy, and high levels of fish cover from boulders, cobbles, wood, and overhanging vegetation. Residents reported that the waterway dried to a trickle over summer, however freshwater snails on rocks indicated that there had been water present for some time.

Figure 9: Site 11 (Patchetts Drain), showing sections of waterway with natural stone rock lining (left) and concrete lining (right).

Site 12 – Cass Bay Stream

The downstream extent of the sampling reach was immediately upstream of Governors Bay Road. Several small natural barriers are present along reach, which would exclude poor climbing species. However, the observed the barriers were of equivalent or less risk to fish passage than the numerous natural and artificial fish barriers present downstream of Governors Bay Road. Aquatic habitat is dominated by pools, some of which were deep and provide high quality habitat, with abundant boulder, cobble, and overhanging vegetation cover (Figure 10). The water was slightly turbid. Long brown filamentous algae was abundant in open sections upstream. The waterway is highly incised, with steep banks providing shade. The banks have been recently planted with young native trees, shrubs, flaxes, and sedges, which will provide good shade over time.

Figure 10: Site 12 (Cass Bay Stream), showing the fish sampling reach (left) and minnow trap in a pool (right).

Sites 13–15 – Omaru Stream

These three sites were chosen in relation to previously identified fish barriers. Site 13 was the most downstream site and it started at the culvert under a driveway leading to the marae. Site 14 started at a steep private culvert off Omaru Road, approximately halfway up the hill to Governors Bay Road. Site 15 was upstream of Governors Bay Road.

For Sites 13 and 14, the waterway meanders through reserve land that is vegetated with native trees and shrubs, providing good shade to the stream (Figure 11). Several natural fish barriers are present, in the form of natural drops which range from medium to high risk to fish passage. The private culvert between Sites 13 and 14 is also a medium to high risk to fish passage. Aquatic habitat is dominated by small pools, some of which are quite deep and provide high quality habitat. Fish cover is high, provided by boulders, cobbles, and woody debris.

Figure 11: Omaru Stream at Site 13 (left) and Site 14 (right).

Site 15 is upstream of Governors Bay Road, upstream of a road culvert that is perched and presents a high risk to fish passage. The canopy is much more open than downstream, with low levels of stream shading (Figure 12). As a consequence, long filamentous algae was abundant, covering much of the bed. The reach is steep and boulder-dominated, resulting in several high-risk natural barriers to fish passage. The steep banks have been recently planted with a wide riparian buffer of young native trees, shrubs, and flaxes, which will provide good shade over time. There were some sparse, deep, high-quality pools present. Fish cover is abundant, provided mostly by the large boulders.

Figure 12: Omaru Stream at Site 15, showing an open section with recent native plantings (left) and a minnow trap in pool habitat (right).

3.2. Fish Communities

Fish were caught or observed at six of the 12 waterways where sampling occurred (Table 3). Of the sites where fish were caught, fish were observed at all six sites during spotlighting, while fish were only caught at three of the sites by trapping (Table 4). Juvenile galaxiids were present at all six sites, with adult banded kōkopu present at three sites, and a small eel (*Anguilla* sp.) observed at one site during spotlighting (Table 4). All the juvenile galaxiids

were most likely banded kōkopu, based on their location relative to potential fish barriers, and review of nearby NZFFD records.

This survey resulted in new banded kōkopu records for Sumnervale Drain (Site 2), Richmond Hill Waterway (Site 4), and Mt Pleasant Waterway (Site 5, Figure 1). All these waterways drain the northern, city side of the Port Hills, and ultimately flow into either the sea or Ihutai – the Estuary of the Heathcote and Avon Rivers. No fish were observed or caught from any Port Hills waterways that ultimately drain into the Heathcote River upstream of the estuary.

The presence of juvenile galaxiids at six sites where fish were caught indicates recruitment during the relatively wet spring of 2022. This was particularly notable for Omaru Stream, which suffered from very low flows in previous years, when no fish were caught during sampling (Instream Consulting 2022). The presence of both juveniles and larger banded kōkopu at Sumnervale Drain (Site 2), Richmond Hill Waterway (Site 4), and Cass Bay Stream (Site 12) indicates both recruitment and the presence of sufficient permanent water to support fish populations during very dry summers, given the preceding dry years.

Table 4: Fish caught using each sampling method. Data are number of fish caught, with the size range (mm) in brackets.

Site No.	Location	Method	Banded kōkopu	*Galaxias* sp.	*Anguilla* sp.
2	Sumnervale Drain (Lower)	Trap Spotlight	1 (111)	62 (20–80)	
4	Richmond Hill Waterway	Trap Spotlight	1 (124)	2 (20–30)	
5	Mt Pleasant Waterway	Trap Spotlight		3 (30–50)	
12	Cass Bay Stream	Trap Spotlight	7 (96–135) 2 (90–110)	1 (30–40)	
13	Omaru Stream (Lower)	Trap Spotlight		11 (30–40)	1 (100-200)
14	Omaru Stream (Middle)	Trap Spotlight		12 (30–40)	

Banded kōkopu can live up to at least nine years, with sexual maturity occurring after 2 years for males and 4 years for females (Hopkins 1979). Based on age-length relationships provided for banded kōkopu from Banks Peninsula streams (Hopkins 1979), the banded kōkopu we caught that were around 90 mm to 110 mm long would have been 1 or 2 years old, while the largest fish, which were 124 mm to 135 mm long were likely 2 or 3 years old. This is consistent with the Banks Peninsula study of Hopkins (1979), who found 79% of banded kōkopu caught were less than 5 years old.

Review of NZFFD records for the Port Hills indicates that fish have been recorded from waterways flowing down both the northern and southern sides of the hills (Figure 13). Recent sampling has also revealed fish in intermittent waterways. For example, fish salvage in a temporary pond downstream of the Canterbury Adventure Park in spring 2022 found both shortfin eels (*Anguilla australis*) and inanga were abundant. Overall, our sampling results were comparable to those of previous sampling efforts in Port Hills waterways using similar methods.

Banded kōkopu appear to be restricted to the south side of the Port Hills and northern waterways that drain directly into the sea or estuary, with no records for tributaries that drain directly into the Heathcote River (Figure 14). We found adequate potential habitat for banded kōkopu in Heathcote River tributaries. The presence of fish passage barriers is also an unlikely cause for the absence of banded kōkopu, because we found banded kōkopu at sties above considerable barriers outside the Heathcote River catchment. All sites were also well within the range of elevation and distance from the sea where banded kōkopu are known to occur (McDowall 1990). For example, Baker and Smith (2007) found banded kōkopu were widespread in small tributaries of the Waikato River, 93–94 km inland from the coast. The Heathcote River is blighted by high turbidity, associated with erosion of unforested loess slopes (Hicks 1993). In addition, banded kōkopu are amongst the most sensitive of New Zealand's native fish species to elevated turbidity (Rowe and Dean 1998; Rowe et al. 2000; Rowe et al. 2009). Therefore, the lack of banded kōkopu in tributaries of the Heathcote River is likely due to its frequently turbid conditions.

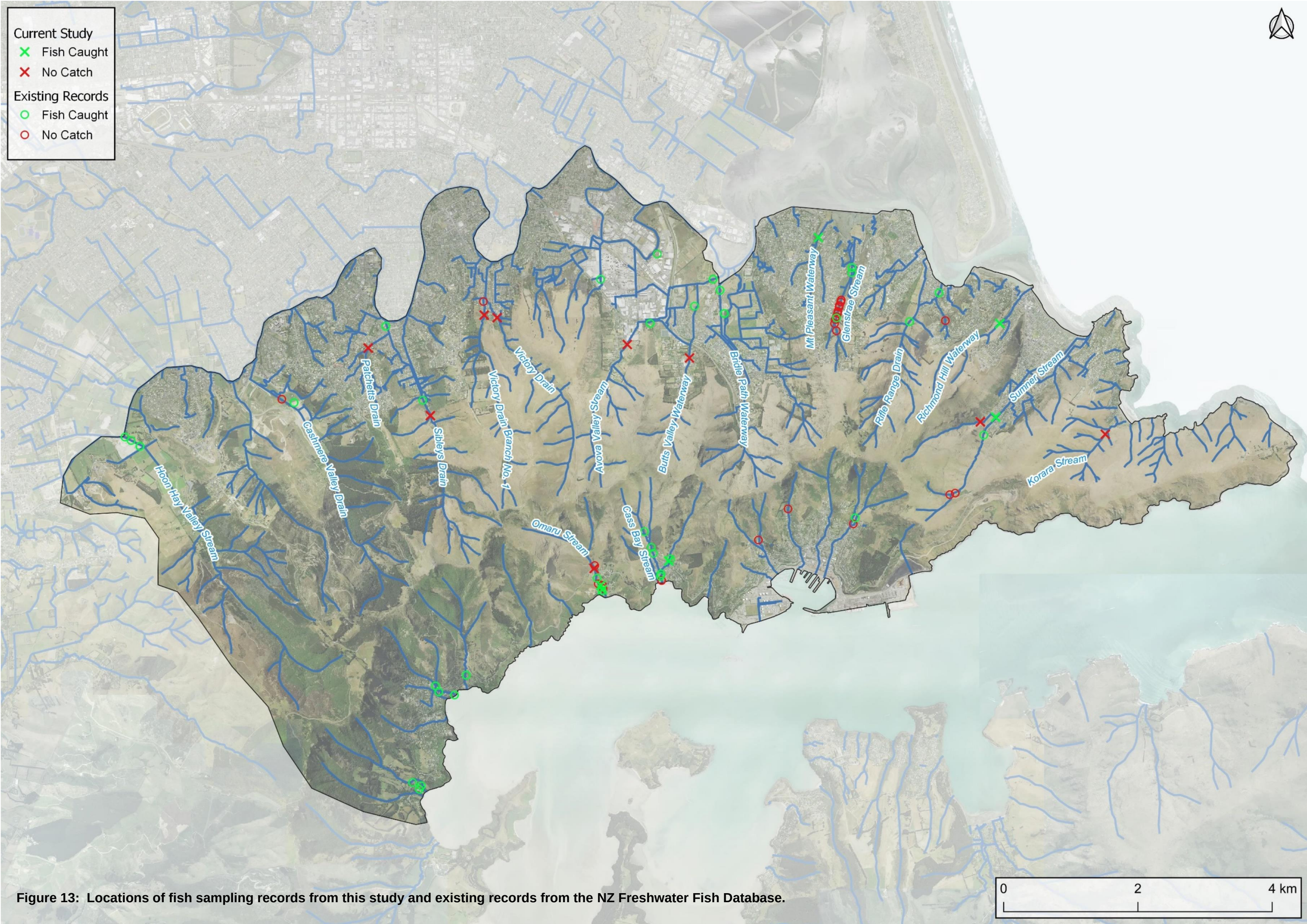

Figure 13: Locations of fish sampling records from this study and existing records from the NZ Freshwater Fish Database.

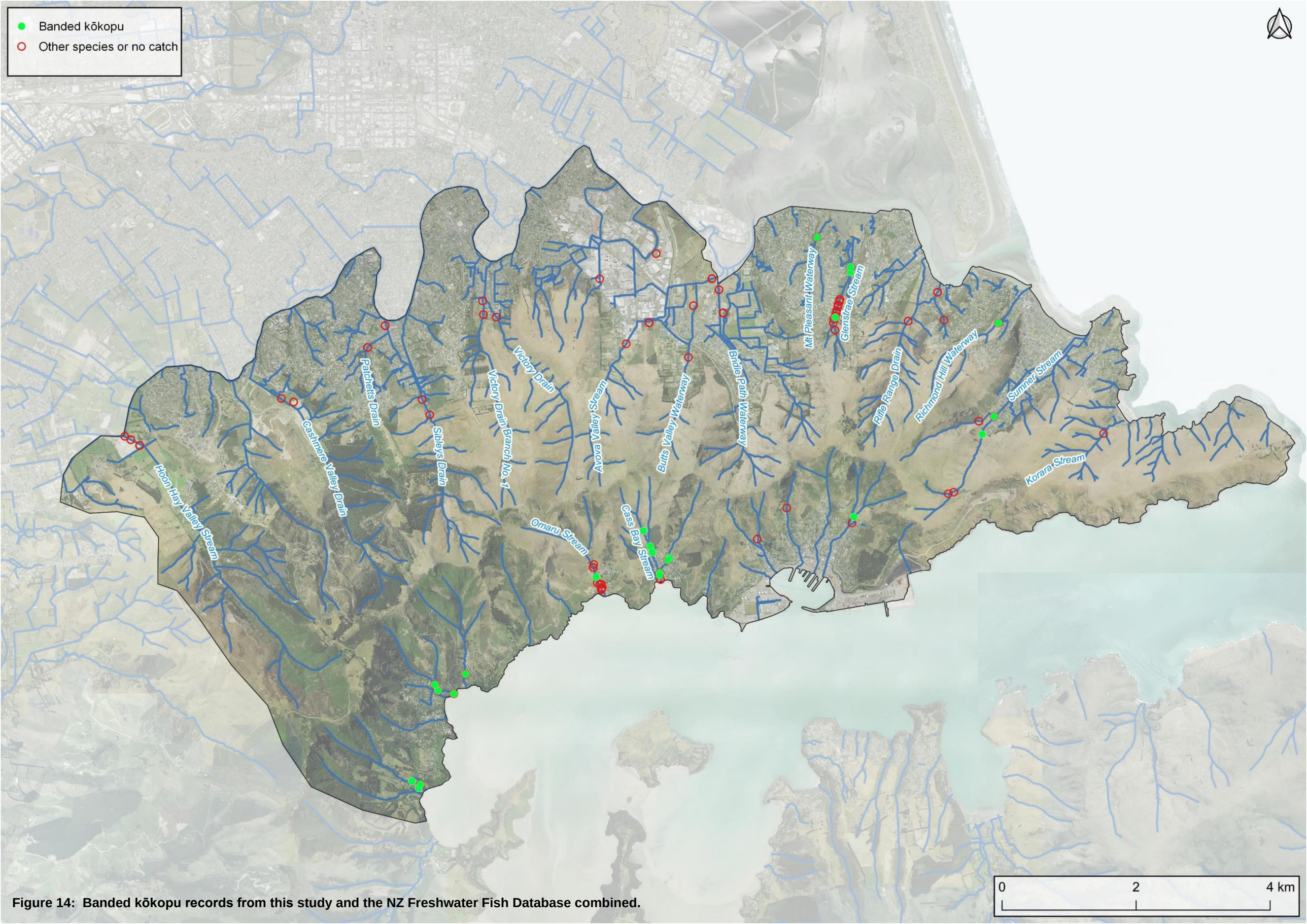

Figure 14: Banded kōkopu records from this study and the NZ Freshwater Fish Database combined.

4. SUMMARY

Twelve of the 15 Port Hills waterway locations were suitable for fishing and fish were caught at six of those sites. This survey resulted in new banded kōkopu records for Sumnervale Drain, Richmond Hill Waterway, and Mt Pleasant Waterway. All these waterways drain the city side of the Port Hills, and ultimately flow into either the sea or estuary. Notably, no fish were caught from any Port Hills waterways that ultimately drain into the Heathcote River. Review of NZFFD records indicates a consistent pattern of banded kōkopu being absent from Heathcote River tributaries. The lack of banded kōkopu in tributaries of the Heathcote River is likely due to its frequently turbid conditions.

This survey has extended our knowledge of the fish communities in waterways draining the Port Hills. The presence of fish, including inanga, banded kōkopu, common bully, and shortfin eels, in waterways on the city side of the Port Hills confirms that many of these waterways do support fish communities. This contrasts with historic assumptions that most Port Hills waterways lacked fish, due to a lack of permanent flow.

5. REFERENCES

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