

Freshwater Fish Spotlight Surveying in the Kaeo and Pupuke Catchments Northland

November 2021-February 2022

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Figure 1. Whangaroa. Eastern Northland



Figure 2. hawai red fin bully



Figure 3. panoko, torrentfish, Pupuke river



Figure 4. kaeo, Pupuke river

Methodology

Thomas Hawtin and Donovan Ecological Management were contracted by Reconnecting Northland to undertake surveys of freshwater fish at randomly generated points within the Kaeo and Pupuke rivers and tributary systems using the [Freshwater Fish Spotlighting – Spotfishing](#) method (Allibone, 2013). The objective of these surveys was to gather information on the distribution and density of nocturnal fish species present. A spotlight spotfishing survey is conducted at night using a spotlight and is used for detecting nocturnally active fish such as īnanga and kōkopu. Unlike electrofishing which targets areas of riffle habitat, spotlight spotfishing is effective in sampling fish in pools and run habitats where calm waters help with visibility. At each of the 30 sites approximately 150 metres of stream were surveyed. All fish that were seen were attempted to be caught. They were then identified, measured and photographed. If they weren't caught, they were - where possible - identified and a size estimate was given. Eels were not caught but identified and size was estimated.



Figure 5. Pupuke river, Kaeo river and Touwai stream catchments. Sediment accumulation can be seen in the upper reaches of the Whangaroa harbour.

Field work was undertaken between 1 November 2021 and 25 February 2022. All 24 surveys were taken on privately owned land. One survey reach was undertaken on the Anaotehuru stream, a tributary to the Touwai stream which enters the Whangaroa harbour at Touwai bay on the eastern side of the harbour. Survey reaches were approximately 150 metres long. The start and end points of the survey reaches were recorded by GPS. Habitat (% of rapids, riffles, runs, pools, backwaters etc) and substrate (% mud, sand, gravel, cobbles, boulders and bedrock) features of the reach were recorded as well as other ecosystem features such as riparian vegetation, dominant macroinvertebrates (freshwater insects/arthropods/molluscs), aquatic plants and stream width and depth. Any known downstream obstructions were recorded.

Data from these surveys are entered onto the [NIWA freshwater fish database](#).



Figure 6. Female Giant bully with red fin bully in background, seen in Waiare Stream near site 18 stream confluence

Limitations of the Methodology

Some lower catchment sites had numbers of bullies/hawai (red fins) and smelt/paraki that were at densities that couldn't be counted, so no quantitative estimate. In these cases redfin bullies and smelt were scored as abundant.

When smelt are abundant it is very difficult to identify the īnanga amongst the abundant smelt, especially in larger bodies of water where the fish swim into the open water and are very difficult to catch with hand nets. When this was the case, these fish were put into a category of smelt/īnanga. In all instances where a sample of these fish were caught the majority were identified as smelt.

Because of the above factors this methodology of survey freshwater fish does not provide high resolution quantitative data in low elevation and larger water bodies for some species. Its value as a trend monitoring tool for freshwater fish population health in the catchment is dependent upon high levels of survey replications (24) within the catchment. The lowland survey sites will only give an indication of very coarse changes for the most populous species.



Figure 7. Tuna, female long fin eel, site 26



Figure 8. Red fin bully, Site 49

Kaeo and Pupuke rivers

The Kaeo river catchment is approximately 115 Km². [LAWA](#) data for the Kaeo river from measurements taken at Dip road show both indicators of water clarity (black disc and turbidity) as in the lower 50 percentile of all sites, while indicators for total Nitrogen is in the upper 25 percentile and total Phosphorus is in the upper 50 percentile. Kaeo river scores a 'B' for dissolved reactive Phosphorus and an 'A' for ammoniacal Nitrogen concentrations in the 'National Objectives Framework' set out in the [National Policy Statement for Freshwater Management, 2020](#).

The [LAWA](#) website describes the under lying geology of the Kaeo river as 'soft sediments as reflected in its' high turbidity levels'.

The Pupuke river catchment is approximately 55 Km². There are no LAWA data available for this catchment

Land use in the Kaeo and Pupuke river catchments includes drystock farming, dairy farming and plantation pine forestry. The upper extent of both catchments form part of the large Puketi forest remnant. Approximately 60% of the catchment is in native forest cover.



Figure 9. Banded kōkopu, site 28

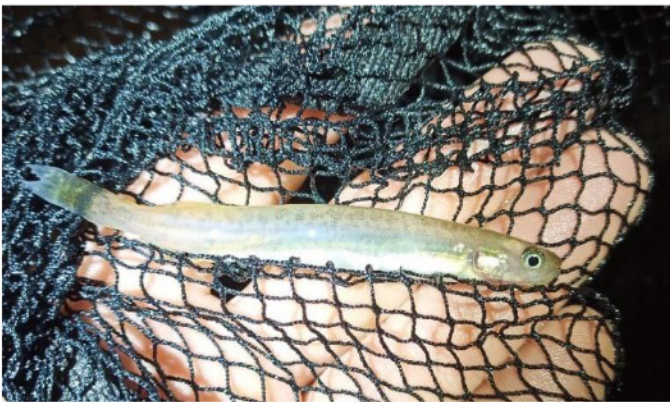


Figure 10. īnanga. Site 4



Figure 11. īnanga. Site LWS

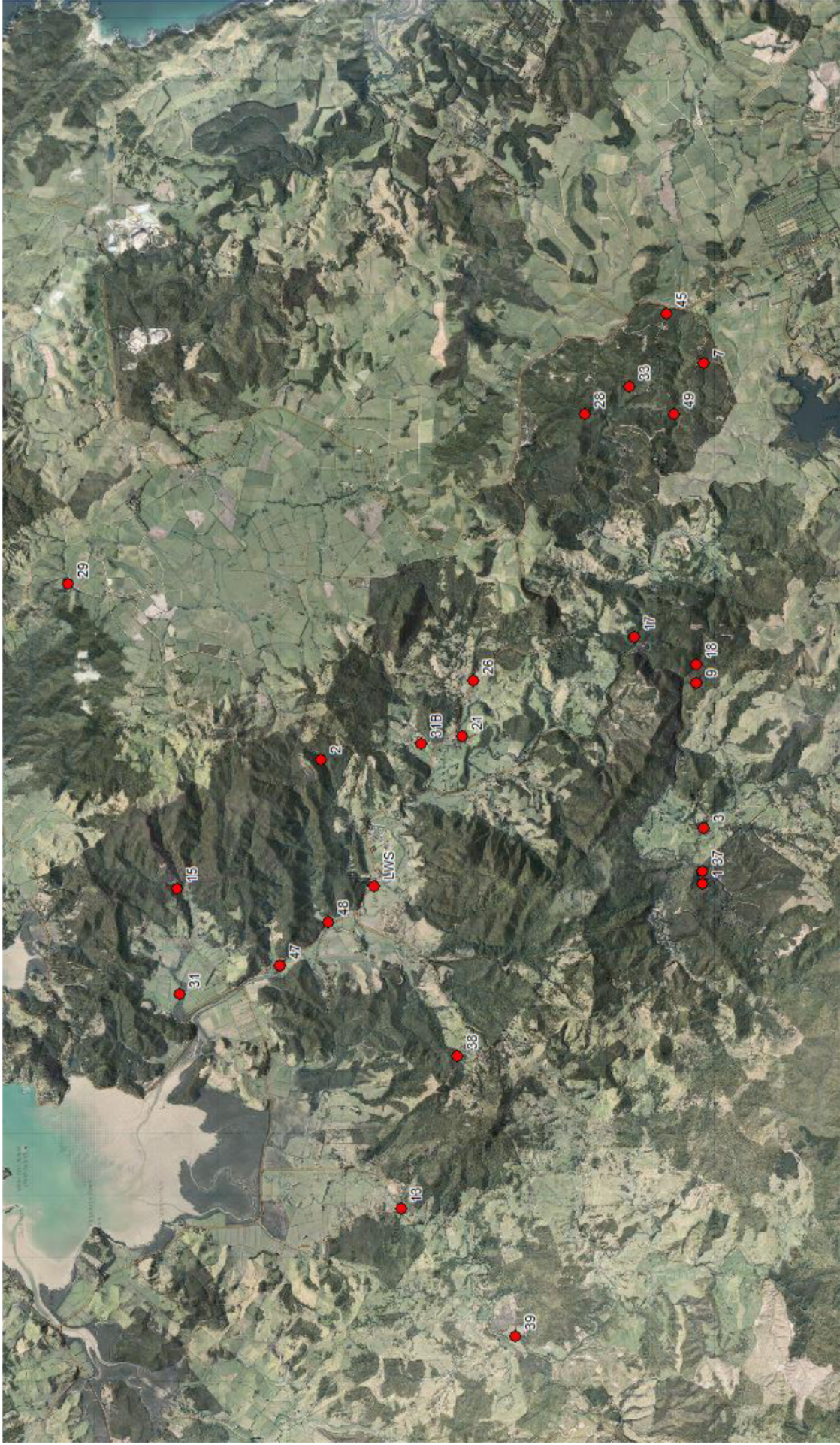


Figure 12. Spot survey start points. Surveys extended ~150m upstream from these points

Results - Overview

Site	Inanga	Banded kōkopu	Long fin eel	Short fin eel	Smelt	Torrentfish	Bully species
1	not recorded	not recorded	1-5	not recorded	not recorded	not recorded	20
2	not recorded	>20	1-5	not recorded	not recorded	not recorded	not recorded
3	1-5	not recorded	1-5	not recorded	>30	not recorded	1-5
7	not recorded	6-10	1-5	not recorded	not recorded	not recorded	not recorded
9	not recorded	10-20	1-5	not recorded	not recorded	not recorded	6-10
13	>20	not recorded	1-5	1-5	>30	not recorded	not recorded
15	>20	>20	1-5	not recorded	not recorded	not recorded	1-5
17	6-10	not recorded	1-5	not recorded	not recorded	not recorded	>30
18	not recorded	>30	6-10	not recorded	not recorded	not recorded	not recorded
21	6-10	1-5	6-10	not recorded	>30	not recorded	>30
26	not recorded	>20	1-5	not recorded	not recorded	not recorded	10-20
28	not recorded	6-10	1-5	not recorded	not recorded	not recorded	10-20
29	not recorded	not recorded	6-10	not recorded	not recorded	not recorded	not recorded
31	1-5	not recorded	not recorded	>20	not recorded	not recorded	not recorded
31B	6-10	not recorded	1-5	not recorded	>30	not recorded	>30
33	not recorded	1-5	6-10	not recorded	not recorded	not recorded	1-5
37	not recorded	not recorded	1-5	not recorded	>30	1-5	>30
38	not recorded	6-10	1-5	not recorded	not recorded		not recorded
39	6-10	not recorded	1-5	not recorded	>30	1-5	>20
45	not recorded	10-20	1-5	not recorded	not recorded	not recorded	not recorded
47	1-5	not recorded	1-5	not recorded	not recorded	not recorded	>20
48	not recorded	1-5	1-5	not recorded	>30	not recorded	1-5
49	not recorded	1-5	1-5	not recorded	>30	1-5	>20
LWS	>20	not recorded	1-5	1-5	not recorded	not recorded	10-20

Figure 13. *Galaxiid* and *Anguilla* (Eel) abundance by site

Banded kōkopu and Inanga

Freshwater fish populations seemed to be in reasonable health and banded kōkopu numbers were good at many sites in smaller tributaries. Lower reaches had abundant smelt and some had good numbers of Inanga.

Pānako/Torrentfish

Pānako or torrentfish are rare to detect through spotlight surveys because they inhabit more turbulent water. They were recorded from 3 sites in this survey.

During the surveys undertaken in Spring reasonable numbers of juvenile galaxiids were recorded. It is probably reasonable to assume that in upper reaches these were predominantly banded kōkopu and Inanga in the lower reaches, however this may not always be the case. It is also possible that kōaro are present within the catchment and make up a percentage of the whitebait run, although no adults were recorded at these survey sites. The

numbers of juvenile galaxiids seen in Spring coupled with the broad size range of adults indicates that recruitment of young galaxiids is healthy at the catchment level.

Sedimentation seems to be an issue in places in the Kaeo catchment and as a result in the upper Whangaroa harbour. Future restoration work could focus on the areas of the catchment with soils most prone to erosion.

Koura

Koura, or freshwater crayfish, were only recorded from 1 site within the catchment.

The Kaeo as an Indicator Species

The kaeo or freshwater mussel (*Hyridella menziesi*) gives its' name to the Kaeo river. During these surveys 1 kaeo was seen alive (in the Pupuke river) and multiple shells were seen.

The kaeo requires good quality water with a low sediment and nutrient load and riparian vegetation to provide shade. Larval kaeo disperse by hitching a ride on freshwater fish such as kōkopu to migrate upstream and move to new habitat. Kaeo are often eaten by rats and most of the dead shells found had the tell-tale gnawing on the anterior end. Kaeo are vulnerable to disruption from large flood events and observations suggest that rat predation increases dramatically with lower water levels associated with droughts.

Because of the habitat requirements and threats to the kaeo, it is perhaps well suited to playing the role of a tohu or indicator of freshwater health alongside suspended sediment, nutrient and E.coli monitoring and these fish surveys.

Pest Fish

Gambusia or Mosquito fish (*Gambusia affinis*) were recorded at 2 sites (site 31 in the lower Waikoura stream and site 48 in the lower Taiwatawa stream). Gambusia are known to have a negative impact on native fish through competition and/or predation. They are listed as an unwanted organism under the Biosecurity Act (1993).

Sites

Site Number: Site 1	River Name: Taita stream	Date: 25/02/22
Start E: 1671021.6	Start N: 6110209.7	Start Time 22:18
End E: 1671124.0	End N: 6110179.5	
Observers: T Hawtin and T Donovan	Water body type; stream	Water Level; Low
Water Colour: Clear	Downstream barriers: No	Reach Length 140 metres
Reach width (avg) 5 metres	Reach width (max) 10 metres	Koura present: No
Reach depth (avg) 600mm	Reach depth (max) 1500mm	Kaeo present: No
Shrimp present: Yes	Invertebrate Abundance: Moderate	Dominant Invertebrate: Shrimp
Stream Habitat % Pool 70 Riffle 20 Run 10	Stream Substrate % Cobbles 10 Gravel/sand 90	Instream Fish Cover Bank vegetation Yes Cobbles Yes macrophytes Yes periphyton Yes undercut banks Yes wood/instream debris Yes
Riparian Vegetation; Willow/Eucalyptus 10% Kikuyu/exotic weeds 90%		
Species	Length mm	
Red fin Bully	70, 70, 70, 70, 70, 100, 70, 70, 70, 70, 70, 70, 50, 70, 60, 60, 70, 70, 100, 70, 70, 100, 60, 70, 60, 60, 30, 30, 30	
Long fin Eel	250, 1000, 350, 500	
Smelt	Abundant	

Site Number: Site 2	River Name: Upper Waikare stream	Date: 2/11/21
Start E: 1673014.1	Start N: 6116363.8	Start Time 21:22
End E: 1673132.1	End N: 6116351.2	
Observers: T Hawtin, T Donovan and K Donovan	Water body type; stream	Water Level; medium
Water Colour: clear	Downstream barriers: 3m waterfall	Reach Length 160 metres
Reach width (avg) 2m	Reach width (max) 3m	Kewai present: no
Reach depth (avg) 100mm	Reach depth (max) 700mm	Kaeo present: no
Shrimp present: no	Invertebrate Abundance: high	Dominant Invertebrate: caddisfly
Stream Habitat % Cascade 10 Pool 40 Rapid 20 Riffle 10 Run 20	Stream Substrate % Boulders 40 Cobbles 30 Gravel 29 Mud/Silt 1	Instream Fish Cover Bank vegetation yes Cobbles yes macrophytes no periphyton yes undercut banks yes wood/instream debris yes
Riparian Vegetation; Native 100%	Note; Stopped reach when bluffed by waterfalls	
Species	Length mm	
Banded Kokopu	30, 40, 40, 40, 40, 40, 40, 40, 35, 110, 37, 35, 40, 40, 40, 40, 35, 60, 120, 120, 160, 185, 90, 120, 80, 80	
Long fin Eel	500, 200	



Figure 14. Banded Kōkopu. Site 2

Site Number: Site 3	River Name: Inumia stream tributary	Date: 25/02/22
Start E: 1671929.7	Start N: 6110188.6	Start Time 23:52
End E: 1671885.0	End N: 6110175.7	
Observers: T Hawtin and T Donovan	Water body type; stream	Water Level; Low
Water Colour: Brown	Downstream barriers: None	Reach Length 150 metres
Reach width (avg) 1.5 metres	Reach width (max) 3.5 metres	Koura present: No
Reach depth (avg) 400mm	Reach depth (max) 800mm	Kaeo present: No
Shrimp present: Yes	Invertebrate Abundance:	Dominant Invertebrate: Snails
Stream Habitat % Pool 70 Riffle 20 Run 10	Stream Substrate % Boulders 5 Cobbles 5 Gravel/sand 10 Mud/silt 80	Instream Fish Cover Bank vegetation Yes Cobbles Yes macrophytes No periphyton No undercut banks Yes wood/instream debris Yes
Riparian Vegetation; Sparse native 50% Grass/ferns 50%	Note: Discoloured stream with easily suspending sediment. There was also the smell of dead animal and a recently active rubbish hole seen adjacent to the stream.	
Species	Length mm	
Red fin Bully	70, 80, 90	
Long fin Eel	1200	
Smelt	x30 fish	
Inanga	90, 100, 90, 90	

Site Number: Site 7	River Name: Upokorau Stream tributary	Date: 24.2.22
Start E: 1679425.2	Start N: 6110187.2	Start Time 00:29
End E: 1679564.4	End N: 6110138.4	
Observers: T Hawtin and T Donovan	Water body type; stream	Water Level; Low
Water Colour: Very Clear	Downstream barriers: Waterfalls	Reach Length 160m
Reach width (avg) 1m	Reach width (max) 2m	Koura present: No
Reach depth (avg) 20mm	Reach depth (max) 1500mm	Kaeo present: No
Shrimp present: No	Invertebrate Abundance: Unknown	Dominant Invertebrate: N/a
Stream Habitat % Pool 90 Run 10	Stream Substrate % Gravel 40 Mud/Silt 60	Instream Fish Cover Bank vegetation Yes Cobbles No macrophytes No periphyton Yes undercut banks wood/instream debris Yes
Riparian Vegetation; Native 50% Pine 50%		
Species	Length mm	
Banded Kokopu	170, 170, 90, 200, 170, 90	
Long fin Eel	500, 600	

Site Number: Site 9	River Name: Waiare Stream tributary	Date: 17/11/21
Start E: 1674256.9	Start N: 6110300.6	Start Time: 20:58
End E: 1674261.2	End N: 6110423.3	
Observers: T Hawtin, T Donovan and F Donovan	Water body type; stream	Water Level; Medium
Water Colour: clear	Downstream barriers: None	Reach Length: 150m
Reach width (avg): 1.5m	Reach width (max): 3m	Koura present: no
Reach depth (avg): 200mm	Reach depth (max): 700mm	Kaeo present: no
Shrimp present: Yes	Invertebrate Abundance: High	Dominant Invertebrate: Mayfly and Caddisfly
Stream Habitat % Pool 50 Rapid 0 Riffle 20 Run 25 Cascade 5	Stream Substrate % Boulders 5 Cobbles 20 Gravel 15 Mud/Silt 0 Bedrock 35 Sand 5 Clay 20	Instream Fish Cover: yes Bank vegetation: yes Cobbles yes macrophytes yes periphyton yes undercut banks no wood/instream debris yes
Riparian Vegetation; Native 100%		
Species	Length mm	
Banded Kokopu	70, 60, 100, 120, 100, 140, 100, 140, 60, 140, 120, 120, 120, 150, 70, 50	
Long fin Eel	250, 200, 200	
Red fin Bully	80, 50, 60, 60, 80, 80, 60	
Common Bully	80, 50	
Larval Galaxias	x36 fish	
Unidentified Bully species	x30 (range 20-50mm)	

[illegible]

Site Number: Site 15	River Name: Waikoura Stream tributary	Date: 18/11/21
Start E: 1670933.3	Start N: 6118675.0	Start Time 21:07
End E: 1671012.0	End N: 6118785.0	
Observers: T Hawtin, T Donovan and F Donovan	Water body type; stream	Water Level; Medium
Water Colour: clear and tannin	Downstream barriers: no	Reach Length 150 metres
Reach width (avg) 1m	Reach width (max) 4m	Koura present: no
Reach depth (avg) 450mm	Reach depth (max) 1200mm	Kaeo present: yes (empty shell found)
Shrimp present: yes	Invertebrate Abundance: high	Dominant Invertebrate: Shrimp
Stream Habitat % Pool 40 Run 60	Stream Substrate % Sand 5 Gravel 15 Clay 80	Instream Fish Cover Bank vegetation Cobbles No macrophytes Yes periphyton undercut banks wood/instream debris
Riparian Vegetation; Native 20% Pasture 80%		
Species	Length mm	
Banded Kokopu	90, 110, 120, 120, 100, 100, 140, 110, 160, 110, 50, 100, 60, 100, 120, 110, 160, 110, 80, 100, 80, 160, 120	
Long fin Eel	500, 800, 700, 1000, 900	
Unidentified Galaxias	120, 60, 60, 100, 30, 120	
Juvenile Galaxias	x15 fish	
Inanga	50, 70, 90, 90, 90, 60	
Unidentified Bully Species	40, 40, 40	

Site Number: Site 17	River Name: Upokorau stream	Date: 3/11/21
Start E: 1674991.8	Start N: 6111290.9	Start Time 21:10
End E: 1675063.9	End N: 6111291.2	
Observers: T Hawtin, T Donovan and K Donovan	Water body type; stream	Water Level; Medium
Water Colour: clear	Downstream barriers: None	Reach Length 175 metres
Reach width (avg) 6m	Reach width (max) 8m	Koura present: No
Reach depth (avg) 300mm	Reach depth (max) 1500mm	Kaeo present: No
Shrimp present: abundant	Invertebrate Abundance: medium	Dominant Invertebrate: snails
Stream Habitat % Pool 30 Riffle 10 Run 60	Stream Substrate % Cobbles 10 Gravel 80 Sand 10	Instream Fish Cover Bank vegetation yes Cobbles yes macrophytes no periphyton yes undercut banks yes wood/instream debris yes
Riparian Vegetation; Native 80% Montbretia 20%	Note; Actively eroding banks	
Species	Length mm	
Redfin bully	60, 60, 40, 40, 40, 50, 50, 80, 80, 50, 50, 50, 50, 50, 50, 50, 70, 70, 70, 70, 70, 60, 60, 90, 60, 60, 60, 60, 60, 60, 60, 60, 90, 90, 90, 40, 40, 40, 40, 40, 40, 40, 40, 40, 30, 30, 30, 30, 50, 50, additional 20+ (30-100)	
Long fin Eel	600, 450, 500, 350, 110	
Unidentified Galaxias	40, 40, 50, 50, 50, 50, 50, 50, 30, 30, 30, 30, 30, 30, 30, 30, 30	
Inanga	100, 40, 40, 40, 110	

Site Number: Site 18	River Name: Waiare stream tributary	Date: 25/02/22
Start E: 1674569.6	Start N: 6110303.1	Start Time 03:31
End E: 1674668.3	End N: 6110250.1	
Observers: T Hawtin and T Donovan	Water body type; stream	Water Level; Low
Water Colour: Clear	Downstream barriers: 2m fall further down tributary	Reach Length 130 metres
Reach width (avg) 1 metres	Reach width (max) 6 metres	Kewai present: No
Reach depth (avg) 150mm	Reach depth (max) 400mm	Kaeo present: No
Shrimp present: No	Invertebrate Abundance: Moderate	Dominant Invertebrate: Caddisfly
Stream Habitat % Pool 30 Riffle 40 Run 25 Cascade 5	Stream Substrate % Bedrock 70 Cobbles 20 Gravel 10	Instream Fish Cover Bank vegetation Yes Cobbles Yes macrophytes No periphyton Yes undercut banks Yes wood/instream debris Yes
Riparian Vegetation; Native 100%		
Species	Length mm	
Banded Kokopu	120, 120, 150, 100, 100, 150, 120, 100, 110, 150, 70, 110, 180, 160, 170, 110, 80, 140, 100, 100, 100, 150, 160, 100, 130, 120, 140, 140, 160, 170, 120, 120, 100, 70, 70	
Long fin Eel	550, 350, 350, 250, 800, 250, 200, 250	

Site Number: Site 21	River Name: Waionepu stream	Date: 24/02/22
Start E: 1673403.5	Start N: 6114085.9	Start Time 23:22
End E: 1673497.0	End N: 6114169.6	
Observers: T Hawtin and T Donovan	Water body type; stream	Water Level; Low
Water Colour: Clear	Downstream barriers: No	Reach Length 160 metres
Reach width (avg) 3 metres	Reach width (max) 5 metres	Koura present: No
Reach depth (avg) 300mm	Reach depth (max) 500mm	Kaeo present: Empty shells
Shrimp present: Unknown	Invertebrate Abundance: Moderate	Dominant Invertebrate: Caddisfly
Stream Habitat % Pool 70 Riffle 10 Run 20	Stream Substrate % Cobbles 5 Gravel 95	Instream Fish Cover Bank vegetation Yes Cobbles Yes macrophytes Yes periphyton Yes undercut banks Yes wood/instream debris Yes
Riparian Vegetation; Native 10% Kikiyu/exotic weeds 90% Fenced	Note; Very difficult to catch īnanga and smelt to differentiate. From the sample of īnanga or smelt caught it seems that smelt are more abundant.	
Species	Length mm	
Banded Kokopu	70	
Long fin Eel	1000, 800, 1000, 900, 700, 500	
Inanga	present	
Smelt	abundant	
Red fin Bully	abundant	

Site Number: Site 26	River Name: Waionepu stream tributary	Date: 18/11/21
Start E: 1674306.3	Start N: 6113892.7	Start Time 22:48
End E: 1674427.9	End N: 6113892.3	
Observers: T Hawtin, T Donovan and F Donovan	Water body type; stream	Water Level; Medium
Water Colour: clear	Downstream barriers: no	Reach Length 140 metres
Reach width (avg) 1.5m	Reach width (max) 2m	Koura present: no
Reach depth (avg) 250mm	Reach depth (max) 500mm	Kaeo present: no
Shrimp present: yes	Invertebrate Abundance: Medium - low	Dominant Invertebrate: Shrimp
Stream Habitat % Pool 40 Riffle 10 Run 50	Stream Substrate % Cobbles 20 Gravel 20 Clay 30 Sand 30	Instream Fish Cover Bank vegetation yes Cobbles yes macrophytes no periphyton no undercut banks yes wood/instream debris yes
Riparian Vegetation; Native 100%		
Species	Length mm	
Banded Kokopu	60, 120, 100, 150, 110, 150, 120, 120, 120, 120, 180, 150, 150, 160, 120, 160, 120, 80, 100, 150, 90, 110, 120	
Long fin Eel	1200, 1300	
Unidentified Galaxias	20, 20, 110, 20	
Unidentified bully species	60, 50, 50, 100, 40, 80, 90, 40, 80	
Red Fin Bully	100, 100, 110, 80, 100, 60	

Site Number: Site 28	River Name: Kaeo River tributary	Date: 18/11/21
Start E: 1678590.1	Start N: 6112090.8	Start Time 00:05
End E: 1678578.5	End N: 6112145.8	
Observers: T Hawtin, T Donovan and F Donovan	Water body type; stream	Water Level; Medium
Water Colour: clear	Downstream barriers: 4m + 8m waterfalls	Reach Length: 170 metres
Reach width (avg) 4m	Reach width (max) 8m	Koura present: yes
Reach depth (avg) 300mm	Reach depth (max) 500mm	Kaeo present: no
Shrimp present: yes	Invertebrate Abundance: low	Dominant Invertebrate: snails
Stream Habitat % Pool 10 Rapid 10 Riffle 30 Run 30	Stream Substrate % Boulders 40 Cobbles 40 Gravel 20	Instream Fish Cover no Bank vegetation yes Cobbles yes Macrophytes no periphyton no undercut banks no wood/instream debris no
Riparian Vegetation; Native 100%		
Species	Length mm	
Banded Kokopu	150, 120, 150, 100, 120, 70, 120	
Long fin Eel	1000, 450, 900, 200	
Red fin Bully	110, 100, 70, 70, 80, 70, 70, 110, 100, 80, 100, 110, 100, 100, 90, 70, 110	
Juvenile Galaxias	x3 fish	
Unidentified Bully Species	100, 70	

Site Number: Site 29	River Name: Anaotehuruhuru stream (Touwai stream tributary)	Date: 1/11/21
Start E: 1675860.8	Start N: 6120436.9	Start Time 23:57
End E: 1676008.8	End N: 6120470.9	
Observers: T Hawtin, T Donovan and K Donovan	Water body type; stream	Water Level; medium
Water Colour: slight tannin	Downstream barriers: high waterfalls	Reach Length 160 metres
Reach width (avg) 1.2m	Reach width (max) 3m	Koura present: no
Reach depth (avg) 500mm	Reach depth (max) 1200mm	Kaeo present: no
Shrimp present: no	Invertebrate Abundance: medium	Dominant Invertebrate: unidentified small soft-bodied species on vegetation
Stream Habitat % Pool 45 Riffle 5 Run 50	Stream Substrate % Boulders 2 Cobbles 5 Gravel 83 Mud/Silt 10	Instream Fish Cover Bank vegetation yes Cobbles no macrophytes yes periphyton yes undercut banks yes wood/instream debris no
Riparian Vegetation; Rank grass/gorse 90% Kiokio 10%		
Species	Length mm	
Long fin Eel	600, 1200, 500, 1000, 550, 1000	

Site Number: Site 31	River Name: Lower Waikoura Stream	Date: 19/11/21
Start E: 1669233.8	Start N: 6118641.2	Start Time 23:13
End E: 1663627.0	End N: 6113110.0	
Observers: T Donovan and F Donovan	Water body type; stream	Water Level; Medium
Water Colour: Unclear	Downstream barriers: None	Reach Length 160 metres
Reach width (avg) 2.5m	Reach width (max) 2.5m	Kewai present: No
Reach depth (avg) 1000mm	Reach depth (max) 1000mm	Kaeo present: No
Shrimp present:	Invertebrate Abundance: low	Dominant Invertebrate: Boatman
Stream Habitat % Pool 100	Stream Substrate % Clay 80 Mud/Silt 20	Instream Fish Cover Bank vegetation Cobbles no macrophytes yes periphyton undercut banks wood/instream debris
Riparian Vegetation;	Note: An artificial drain behind a stop bank, above a (leaky) flood gate. Tidal. Medium/high tide	
Species	Length mm	
Bully Sp.	100	
Inganga	90, 90, 60	
Short fin Eel	800, 800, 800, 700, 700, 700, 700, 700, 700, 700, 700, 700, 700, 700, 600, 600, 600, 600, 600, 600, 500, 500, 500, 500, 250,	
Gambusia	Abundant	



Figure 15. *Inganga*, site 31.

Site Number: Site 31B	River Name: Te Pokapoka stream	Date: 25/02/22
Start E: 1673271.1	Start N: 6114730.7	Start Time 01:06
End E: 1673394.4	End N: 6114796.4	
Observers: T Hawtin and T Donovan	Water body type; stream	Water Level; Low
Water Colour: Clear	Downstream barriers: Yes, goes through long plastic culvert under highway bridge. Natural channel has been converted into a concreted stock underpass. In high flows the culvert is likely to max out and water flow through the underpass carrying effluent to harbour	Reach Length 150 metres
Reach width (avg) 1 metre	Reach width (max) 2.5 metres	Koura present: No
Reach depth (avg) 300mm	Reach depth (max) 1000mm	Kaeo present: No
Shrimp present: Yes	Invertebrate Abundance: High	Dominant Invertebrate: Shrimp Caddisfly, mayfly present
Stream Habitat % Pool 10 Riffle 20 Run 70	Stream Substrate % Cobbles 10 Gravel 90	Instream Fish Cover Bank vegetation Yes Cobbles Yes macrophytes Yes periphyton Yes undercut banks Yes wood/instream debris No
Riparian Vegetation; Kikiyu/exotic weeds 100% Fenced		
Species	Length mm	
Inanga	present	
Long fin Eel	900, 800, 700, 450	
Red fin Bully	abundant	
Smelt	abundant	

Site Number: Site 33	River Name: Kaeo river tributary	Date: 23.2.22
Start E: 1679038.8	Start N: 6111379.0	Start Time 21:11
End E: 1679089.1	End N: 6111247.2	
Observers: T Hawtin and T Donovan	Water body type; stream	Water Level; Low
Water Colour: Clear	Downstream barriers: No	Reach Length 150m
Reach width (avg) 0.5m	Reach width (max) 1m	Koura present: No
Reach depth (avg) 70mm	Reach depth (max) 200mm	Kaeo present: No
Shrimp present: No	Invertebrate Abundance: High	Dominant Invertebrate: Caddis fly
Stream Habitat % Pool 15 Riffle 15 Run 70	Stream Substrate % Boulders 10 Cobbles 40 Gravel 50	Instream Fish Cover Bank vegetation Yes Cobbles Yes macrophytes No periphyton Yes undercut banks wood/instream debris Yes
Riparian Vegetation; Native 100%	Note; Exact start point not loaded on GPS.	
Species	Length mm	
Banded Kokopu	70, 70, 85, 120	
Long fin Eel	250, 300, 600, 450, 500, 250, 500, 500	
Red Fin Bully	70	

Site Number: Site 37	River Name: Taita stream	Date: 25/02/22
Start E: 1671220.3	Start N: 6110206.4	Start Time 21:07
End E: 1671282.9	End N: 6110069.5	
Observers: T Hawtin and T Donovan	Water body type; stream	Water Level; Low
Water Colour: Clear	Downstream barriers: No	Reach Length 160 metres
Reach width (avg) 3.5 metres	Reach width (max) 7 metres	Koura present: No
Reach depth (avg) 400mm	Reach depth (max) 1200mm	Kaeo present: No
Shrimp present: Yes	Invertebrate Abundance: Moderate	Dominant Invertebrate: shrimps and snails
Stream Habitat % Pool 70 Riffle 20 Run 10	Stream Substrate % Cobbles 20 Gravel/sand 80	Instream Fish Cover Bank vegetation Yes Cobbles Yes macrophytes Yes periphyton Yes undercut banks Yes wood/instream debris Yes
Riparian Vegetation; Willow 20% Kikiyu, exotic weeds and ferns 90%	Note; Abundant benthic cyanobacteria	Temperature 21degC
Species	Length mm	
Smelt	Abundant	
Long fin Eel	1200, 1000, 1000	
Red fin Bully	Abundant	
Torrentfish	120	

Site Number: Site 38	River Name: Whawha stream tributary	Date: 1/11/21
Start E: 1668247.7	Start N: 6114157.2	Start Time 21:34
End E: 1668158.1	End N: 6114147.2	
Observers: T Hawtin, T Donovan and K Donovan	Water body type; stream	Water Level; medium
Water Colour: clear	Downstream barriers: None	Reach Length 140 metres
Reach width (avg) 1.5m	Reach width (max) 3m	Koura present: no
Reach depth (avg) 150mm	Reach depth (max) 700mm	Kaeo present: no
Shrimp present: no	Invertebrate Abundance: high	Dominant Invertebrate: Mayfly
Stream Habitat % Pool 30 Rapid 10 Riffle 20 Run 40	Stream Substrate % Boulders 30 Cobbles 25 Gravel 40 Mud/Silt 5	Instream Fish Cover Bank vegetation yes Cobbles yes macrophytes no periphyton no undercut banks yes wood/instream debris yes
Riparian Vegetation; Native 100%	Note; Layer of silt covering rocks Banded Kokopu ca150mm seen on side tributary. Banded Kokopu ca150mm just past end of reach	
Species	Length mm	
Banded Kokopu	130, 90, 120, 120, 110, 40, 45, 40	
Long fin Eel	600	
Unidentified Galaxias	110, 60, 110, 40, 30	

Site Number: Site 39	River Name: Pupuke River	Date: 19/11/21
Start E: 1663719.6	Start N: 6113212.1	Start Time 23:11
End E: 1663627.0	End N: 6113110.0	
Observers: T Hawtin, T Donovan and F Donovan	Water body type; River	Water Level; Medium
Water Colour: clear	Downstream barriers: no	Reach Length: 170 metres
Reach width (avg) 5m	Reach width (max) 6m	Koura present: no
Reach depth (avg) 500mm	Reach depth (max) 1200mm	Kaeo present: yes (live kaeo seen)
Shrimp present: yes	Invertebrate Abundance: Medium	Dominant Invertebrate: Shrimp
Stream Habitat % Pool 30 Riffle 10 Run 60	Stream Substrate % Cobbles 40 Gravel 40 Sand 20	Instream Fish Cover Bank vegetation yes Cobbles yes macrophytes yes periphyton no undercut banks yes wood/instream debris yes
Riparian Vegetation; Native 90% Pasture 10%	Note; Very difficult to catch īnanga and smelt to differentiate. From the sample of īnanga or smelt caught it seems that smelt are more abundant.	
Species	Length mm	
Long fin Eel	1000, 700, 1000, 800	
Bully species	60, 60, 60, 60, 60, 70, 70, 60, 60, 60, 120, 60, 70, 50, 50, 70, 70, 80, 50, 50, 30	
Red fin Bully	100, 60	
Inanga	80, 100	
Inanga/Smelt	50, 50, 50, 50, 50, 50, 50, 50, 50, 50, 50, 50, 50, 50, 50, 50, 50, 50, 50, 100, 80, 60, 60, 60, 60, 60, 40, 40, 40, 40, 50, 50, 70, 70, 70, 50, 50, 50, 80, 80, 80, 70, 70, 80, 50, 40, 40,	
Smelt	80, 50, 50, 80, 90, 100, 100, 40, 100	
Torrent fish	110, 110, 120	

Site Number: Site 45	River Name: Kao River Tributary	Date: 23.2.22
Start E: 1680227.6	Start N: 6110788.2	Start Time 22:51
End E: 1680258.4	End N: 6110923.9	
Observers: T Hawtin and T Donovan	Water body type; stream	Water Level; Low
Water Colour: Orange rust	Downstream barriers: Waterfalls	Reach Length 150 metres
Reach width (avg) 1.2m	Reach width (max) 2.5m	Koura present: No
Reach depth (avg) 300mm	Reach depth (max) 1400mm	Kao present: No
Shrimp present: No	Invertebrate Abundance: None seen	Dominant Invertebrate: N/a
Stream Habitat % Pool 30 Run 70	Stream Substrate % Gravel 40 Mud/Silt 60	Instream Fish Cover Bank vegetation Yes Cobbles No macrophytes Yes periphyton Yes undercut banks wood/instream debris Yes
Riparian Vegetation; Native 80% Exotic weeds 20%	Note: Orange bloom present, consistent with iron-oxidising bacteria Goes underground for circa 20 metres	Exact start point not loaded on GPS.
Species	Length mm * Found above the underground section	
Banded Kokopu	70, 70, 80, 120, 70, 130, 160, 70, 70, 80, 160, 160*, 180*, 140*, 70*	
Long fin Eel	400	

Site Number: Site 47	River Name: Pahuhu creek	Date: 2/11/21
Start E: 1669692.7	Start N: 6117021.9	Start Time 23:40
End E: 1670391.0	End N: 6116234.0	
Observers: T Hawtin, T Donovan and K Donovan	Water body type; stream	Water Level; medium
Water Colour: clear	Downstream barriers: no	Reach Length
Reach width (avg) 2.5m	Reach width (max) 5m	Kewai present: No
Reach depth (avg) 250mm	Reach depth (max) 700mm	Kaeo present: No
Shrimp present: abundant	Invertebrate Abundance: high	Dominant Invertebrate: shrimp
Stream Habitat % Pool 45 Riffle 10 Run 45	Stream Substrate % Cobbles 10 Gravel 60 Sand 10 Clay 20	Instream Fish Cover Bank vegetation yes Cobbles no macrophytes no periphyton yes undercut banks yes wood/instream debris yes
Riparian Vegetation; Rank grass 80% Kiokio/Ponga 20% All over-topped by mature gums		
Species	Length mm	
Redfin Bully	35, 35, 35, 60, 60, 60, 60, 60, 60, 30, 30, 40, 40, 60, 60, 70, 70, 70, 70, 50, 50, 110, 110, 45, 90,	
Long fin Eel	950, 650, 1100, 900	
Unidentified Galaxias	32, 30, 30, 30, 30, 30, 30, 40, 40, 40, 40, 40, 40, 40, 40, 40, 40, 40, 40, 40, 40, 70	
Inanga	95	

Site Number: Site 48	River Name: Taiwatawa stream	Date: 24/02/22
Start E: 1670397.8	Start N: 6116246.9	Start Time 21:36
End E: 1670489.5	End N: 6116357.9	
Observers: T Hawtin and T Donovan	Water body type; stream	Water Level; Low
Water Colour: Tannin	Downstream barriers: No	Reach Length 150 metres
Reach width (avg) 1.5 metres	Reach width (max) 2.5 metres	Koura present: No
Reach depth (avg) 200mm	Reach depth (max) 500mm	Kaeo present: No
Shrimp present: Yes	Invertebrate Abundance: High	Dominant Invertebrate: Shrimp
Stream Habitat % Pool 50 Run 50	Stream Substrate % Gravel 60 Mud/Silt 40	Instream Fish Cover Bank vegetation Yes Cobbles No macrophytes Yes periphyton Yes undercut banks Yes wood/instream debris Yes
Riparian Vegetation; Native and exotic trees 50% Exotic grass 50%	Orange bloom present, consistent with iron-oxidising bacteria	
Species	Length mm	
Smelt	Abundant	
Long fin Eel	1000, 1000, 1000, 100	
Banded Kokopu	120, 60, 120	
Red fin Bully	70, 50, 70	
Gambusia	x7 fish	

Site Number: Site 49	River Name: Kaeo river tributary	Date: 24.2.22
Start E: 1678606.1	Start N: 6110666.7	Start Time 02:44
End E: 1678666.5	End N: 6110643.0	
Observers: T Hawtin and T Donovan	Water body type; stream	Water Level; Low
Water Colour: Clear	Downstream barriers: No	Reach Length 150 metres
Reach width (avg) 2.5m	Reach width (max) 3.5m	Koura present: No
Reach depth (avg) 250mm	Reach depth (max) 500mm	Kaeo present: No
Shrimp present: No	Invertebrate Abundance: Moderate	Dominant Invertebrate: Caddisfly
Stream Habitat % Pool 60 Riffle 20 Run 20	Stream Substrate % Cobbles 10 Gravel 90	Instream Fish Cover Bank vegetation Yes Cobbles Yes macrophytes No periphyton Yes undercut banks Yes wood/instream debris Yes
Riparian Vegetation; Native 100%	Exact start point not loaded on GPS.	
Species	Length mm	
Banded Kokopu	80, 110, 110	
Long fin Eel	100, 450, 600	
Red fin Bully	70, 80, 70, 90, 70, 100, 30, 60, 60, 70, 50, 70, 80, 70, 70, 70, 70, 70, 80, 90, 80, 80, 90, 80, 80, 80, 80	
Torrent fish	90, 110, 100, 110, 110	
Smelt	Abundant	



Figure 16. panako, torrentfish, site 49

Site Number: LWS	River Name: Lower Waikare stream	Date: 3/11/21
Start E: 1670981.8	Start N: 6115497.7	Start Time 22:40
End E: 1671117.2	End N: 6115492.8	
Observers: T Hawtin, T Donovan and K Donovan	Water body type; stream	Water Level; Medium
Water Colour: clear	Downstream barriers: no	Reach Length 165 metres
Reach width (avg) 2m	Reach width (max) 3m	Koura present: no
Reach depth (avg) 600mm	Reach depth (max) 1500mm	Kaeo present: no
Shrimp present: abundant	Invertebrate Abundance: high	Dominant Invertebrate: shrimp
Stream Habitat % Pool 50 Run 50	Stream Substrate % Gravel 30 Mud/Silt 30 Clay 10 Sand 30	Instream Fish Cover Bank vegetation yes Cobbles no macrophytes yes periphyton yes undercut banks no wood/instream debris no
Riparian Vegetation; Rank grass/weeds 100%	Note; Persicaria (Willow weed), Potamogeton cheesemanii, Elodea canadensis (pondweed) abundant A lot of rubbish	
Species	Length mm	
Short fin Eel	600, 650	
Long fin Eel	900, 600	
Unidentified Eel	600	
Unidentified Galaxias	30, 45, 45, 45, 45, 35, 35, 35, 35, 25, 25, 25	
Inanga	60, 60, 80, 80, 90, 90, 90, 90, 90, 95, 110, 50, 50, 50, 50, 50, 50, 50, 40, 40, 70	
Redfin Bully	70, 70, 70, 70, 60, 60, 60, 60, 60, 60, 150, 110	
Common Bully	125	



Figure 17. inanga, site 31.