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Boat electrofishing survey of the Kaituna River and Bell Road oxbow

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by

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Cover picture: Part of the Bell Road oxbow closest to the Kaituna River.

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Executive summary

The Department of Conservation (DOC) and Bay of Plenty Regional Council contracted the University of Waikato to conduct a boat electrofishing survey of the Kaituna River and Bell Road oxbow. This survey was in response to sightings of large orange fish in the oxbow by members of the public and the consequent concern that these fish might be koi carp (*Cyprinus carpio*). We also recorded species of native fish to determine their relative density and biomass in the oxbow and the adjacent Kaituna River.

The 10 sites fished in the Kaituna River and Bell Road oxbow (latitude 37.743780°S, longitude 176.359509°W) are located about 5 km northeast of Te Puke township and about 5.5 km upstream from the sea. Both the oxbow and the main river channel are tidal at this point. The oxbow had a diverse macrophyte assemblage of hornwort (*Ceratophyllum demersum*), the oxygen weed *Egeria densa*, floating sudds of reed sweetgrass (*Glyceria maxima*), and water pepper (*Persicaria hydropiper*), with scattered plants of curly-leaved pondweed (*Potamogeton crispus*). There were also small amounts of parrot's feather (*Myriophyllum aquaticum*), floating water fern (*Azolla rubra*), duckweed (*Lemna minor*), watercress (*Nasturtium officinale*), and native pondweed (*Potamogeton ochreatus*). The main river channel had fringing beds of the oxygen weeds *Lagarosiphon major* and *Elodea canadensis* below the low water mark.

All sites where fished on 8 October 2014; surface water temperature was 14.7°C in the oxbow at the start of fishing at 1030 h, ambient conductivity was 187.0 µS cm^{-1}, and specific conductivity was 232.8 µS cm^{-1}. Black disc distance was 0.98 m. In the main river channel at 1440 h ambient conductivity was 106.6 µS cm^{-1}, and specific conductivity was 136.7 µS cm^{-1}. We fished 1,953 m in length and an area of 7,812 m^2 from a total of ten sites. We caught a total of 127 fish, with shortfin eel the most abundant species. Longfin eel comprised 14.0 kg of the total fish biomass caught of 26.4 kg. The 24 goldfish caught in the oxbow comprised 3.3 kg of biomass. Common, giant, and redfin bullies were about equally abundant. Yelloweye mullet were caught only in the main channel of the river. Shrimp were caught in varying numbers at all sites except site 8, the mid-water shot in the oxbow.

As the purpose of this fishing was to establish the identity of large orange fish seen in the Bell Road oxbow, the finding of goldfish was significant. From the size and colour ranges and abundance of the goldfish caught in the oxbow it is highly likely that any orange fish seen in the oxbow were large orange goldfish and not koi carp.

1. Introduction

The Department of Conservation (DOC) and Bay of Plenty Regional Council contracted the University of Waikato to conduct a boat electrofishing survey of the Kaituna River and Bell Road oxbow. This survey was in response to sightings of large orange fish in the oxbow by members of the public and the consequent concern that these fish might be koi carp (*Cyprinus carpio*; Brad Angus, DOC, Tauranga). We also recorded species of native fish to determine their relative density and biomass in the oxbow and the adjacent Kaituna River.

2. Methods

To conduct the electrofishing we used a 4.5 m-long, aluminium-hulled electrofishing boat with a 5-kilowatt petrol-powered pulsator (GPP model 5.0, Smith-Root Inc, Vancouver, Washington, USA) powered by a 6-kilowatt custom-wound Honda generator. Two anode poles, each with an array of six 1-m long stainless steel wire droppers, created the fishing field in front of the bow, with the boat hull acting as the cathode.

All sites were fished with the pulsator set to low range (50-500 V), direct current, and a frequency of 60 pulses per second. We adjusted the percent-of-range setting of the pulsator to 60% to give a consistent applied current of 3-4 amps root mean square, adjusting the setting as the boat fished water of varying ambient conductivity. We assumed from past experience (Hicks et al. 2006) that an effective fishing field was developed to a depth of 2-3 m, and about 2 m either side of the centre line of the boat. The boat therefore fished a transect 4 m wide, which was generally consistent with behavioural reactions of fish at the water surface. This assumption was used to calculate the area fished from the linear distance measured with a hand-held Garmin GPSMAP 60Cx global positioning system.

All sites where fished on 8 October 2014 with a consistent fishing time of 10 minutes. Fork length (FL) for goldfish and yelloweye mullet and total length (TL) for all other fish was measured to the nearest millimetre and weight was calculated from length with length-weight regressions from Jellyman et al. (2013), with the exception of the largest longfin eel, for which weight was measured. Electrical conductivity was measured with a YSI 3200 conductivity meter and horizontal visibility through the water was measured using a black disc (Davies-Colley 1988). All native fish were released after allowing recovery from the benzocaine anaesthetic. Goldfish were humanely sacrificed with an overdose of benzocaine and removed from the site for disposal.

3. Study site

The 10 sites fished in the Kaituna River and Bell Road oxbow (latitude 37.743780°S, longitude 176.359509°W) are located about 5 km northeast of Te Puke township and about 5.5 km upstream from the sea (Fig. 1). Both the oxbow and the main river channel are tidal at this point. The Kaituna River has a catchment area upstream of the fishing sites of 1167 km^2, and the tributary feeding the oxbow has a catchment of 16 km^2. The oxbow had a diverse macrophyte assemblage of hornwort (*Ceratophyllum demersum*), the oxygen weed *Egeria densa*, floating sudds of reed sweetgrass (*Glyceria maxima*), and water pepper (*Persicaria hydropiper*), with scattered plants of curly-leaved pondweed (*Potamogeton crispus*). There were also small amounts of parrot's feather (*Myriophyllum aquaticum*), floating water fern (*Azolla rubra*), duckweed (*Lemna minor*), watercress (*Nasturtium officinale*), and native pondweed (*Potamogeton ochreatus*). The main river channel had fringing beds of the oxygen weeds *Lagarosiphon major* and *Elodea canadensis* below the low water mark (Table 1).

4. Results

Surface water temperature was 14.7°C in the oxbow at the start of fishing at 1030 h, ambient conductivity was 187.0 µS cm^{-1}, and specific conductivity was 232.8 µS cm^{-1}. Black disc distance was 0.98 m. In the main river channel at 1440 h ambient conductivity was 106.6 µS cm^{-1}, and specific conductivity was 136.7 µS cm^{-1}. We fished 1,953 m in length and an area of 7,812 m^2 at a total of ten sites (Table 1, Fig. 1). We caught a total of 127 fish, with shortfin eel (*Anguilla australis*) the most abundant species (Table 2). Common, giant, and redfin bullies were about equally abundant (Tables 2 and 3). Yelloweye mullet (*Aldrichetta forsteri*) were caught only in the main channel of the river. Areal density and biomass reflect the numbers and weights of fish caught (Tables 4 and 5). Longfin eel (*Anguilla dieffenbachii*) comprised 14.0 kg of the total fish biomass caught of 26.4 kg (Table 3). The 24 goldfish caught in the oxbow comprised 3.3 kg of biomass. Shrimp (*Paratya curvirostris*) were caught in varying numbers at all sites except site 8.

Mean weights of longfin eels exceeded all other fish species (Table 6), so even at low densities they can dominate the fish biomass. Some goldfish caught were large for the species in New Zealand, e.g., at site 1 (Fig. 3). Many small shortfin eels, including some glass eels, were caught in the main channel of the Kaituna River.

Table 1. Lengths, areas, depths, and macrophytes at sites boat electrofished in the Kaituna River and the Bell Road oxbow on 8 October 2014.

Site	Habitat	Length (m)	Area (m^2)	Depth range (m)	Start time (h)	Bank	Macrophytes
1	Oxbow	178	712	0.2-2.5	1020	Grass, gorse, herbaceous weeds	Hornwort
2	Oxbow	149	596	0.2-2.5	1033	Willows, herbaceous weeds, rock riprap	Hornwort
3	Oxbow	142	568	0.5-2.3	1055	Herbaceous weeds, Agapanthus	Hornwort
4	Oxbow	177	708	0.2-2.4	1110	Grass, herbaceous weeds	*Glyceria* , curly leaved pondweed, water pepper
5	Oxbow	167	668	2.5	1127	Raupo, willows	Hornwort, parrot's feather, water pepper, *Glyceria*
6	Oxbow	145	580	0.5-1.8	1300	Willows	*Lagarosiphon* , parrot's feather, water pepper
7	Oxbow	208	832	1.8	1315	Willows and inlet weir	Water pepper, *Azolla rubra* , *Lemna minor* , *Egeria* , watercress
8	Midwater	253	1,012	1.8-4.4	1330		Hornwort
9	Main river channel	265	1,060	0.2-1.4	1430	Sand	*Lagarosiphon* , *Elodea* , curly leaved pondweed
10	Main river channel	269	1,076	0.2-1.7	1442	Grass and willows	*Lagarosiphon* , *Elodea* , curly leaved pondweed
Total		1,953	7,812				

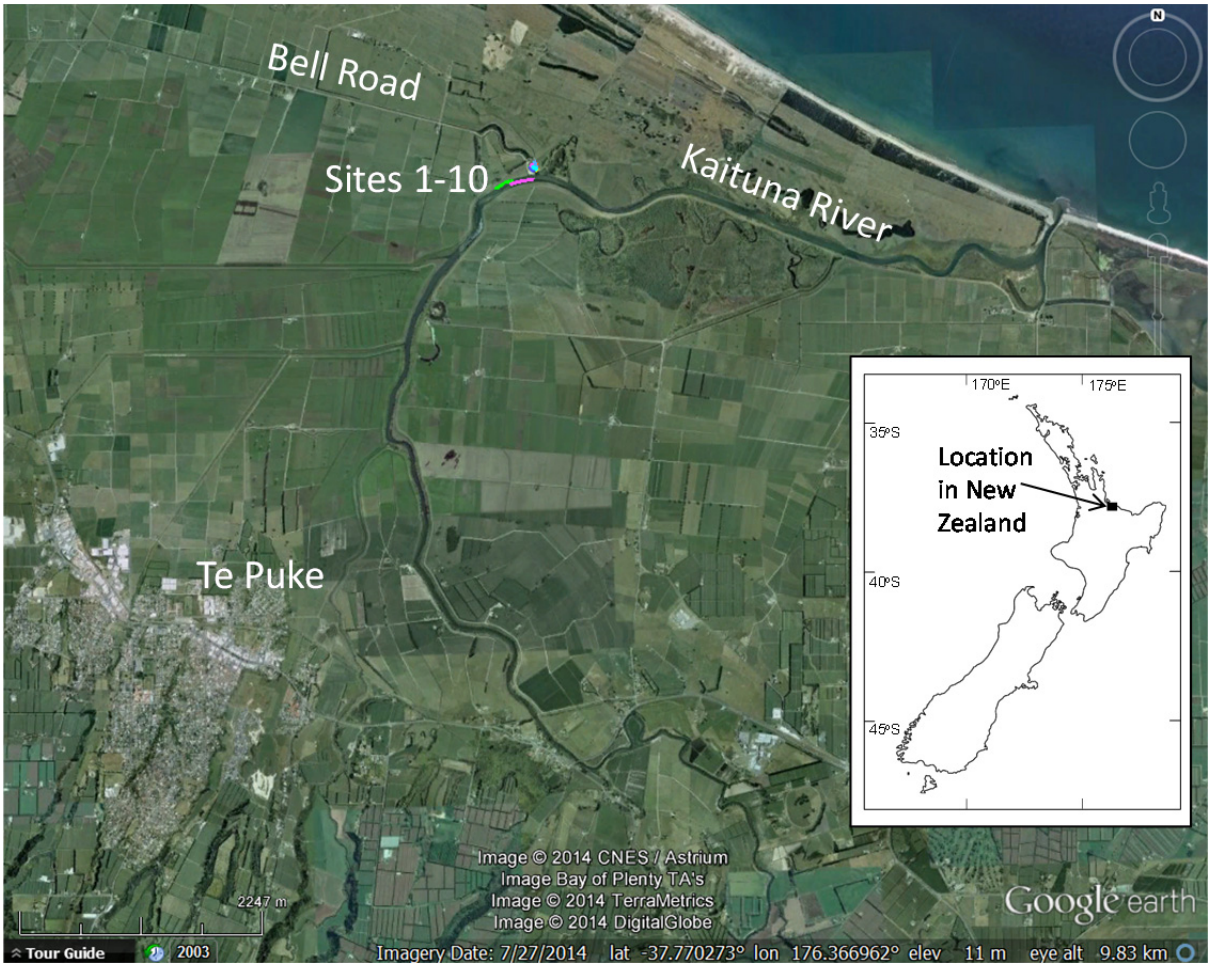
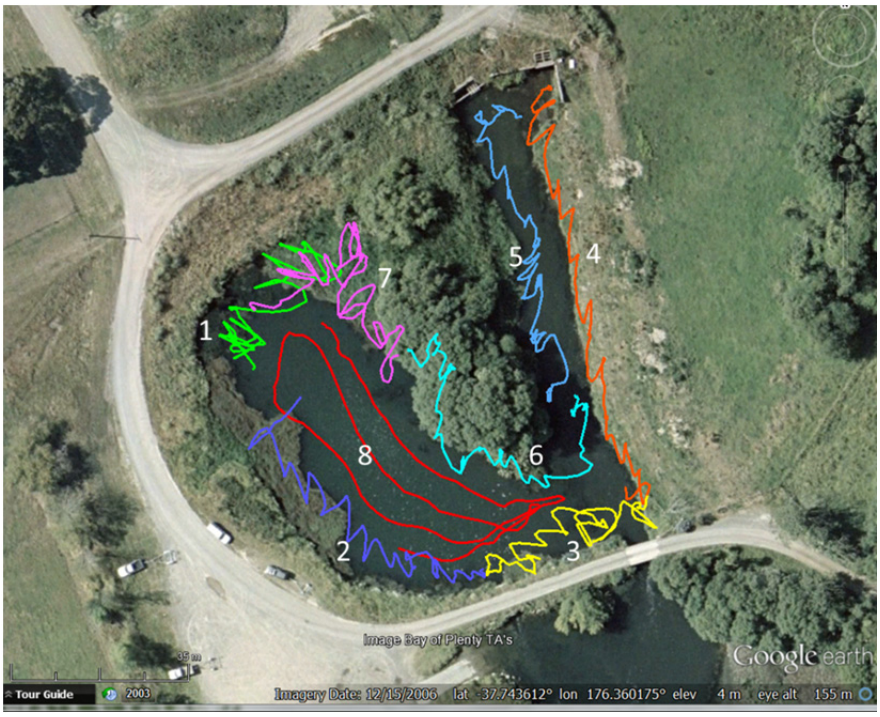


Figure 1. The Kaituna River, Bell Road, and sites fished on 8 October 2014. Site codes correspond to locations in Table 1.

A. Bell Road oxbow



B. Main channel of the Kaituna River

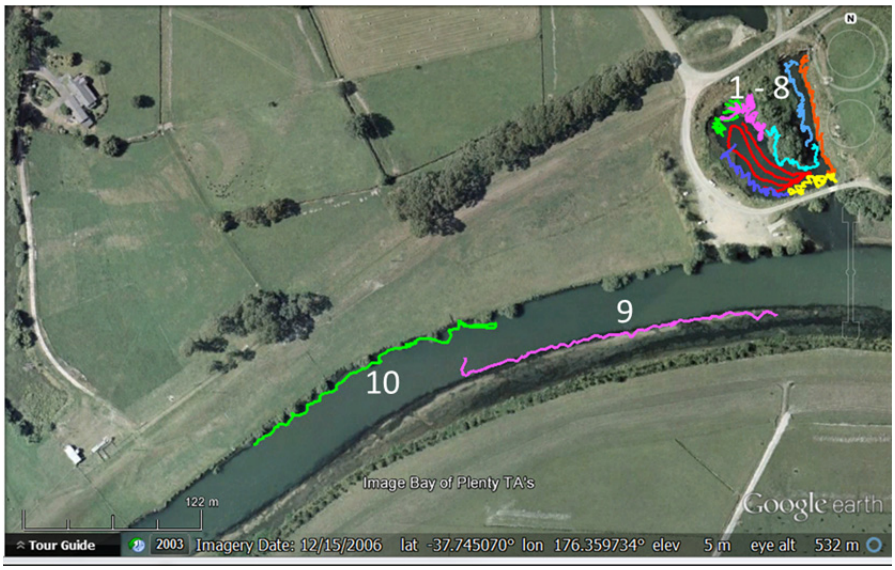


Figure 2. Sites fished on 8 October 2014 in the A. Bell Road oxbow and B. main channel of the Kaituna River. Site codes correspond to locations in Table 1.

Table 2. Number of fish caught by species in ten 10-min fishing shots by boat electrofishing in the Kaituna River and the Bell Road oxbow on 8 October 2014. Blank cells represent no catch.

Site	Habitat	Number of fish per 10-minute shot									
		Common bully	Gambusia	Giant bully	Goldfish	Inanga	Longfin eel	Redfin bully	Shortfin eel	Yelloweye mullet	Total
1	Oxbow		1	2	1			1	3		8
2	Oxbow			2	5			1			8
3	Oxbow	1		3	2	1		1	2		10
4	Oxbow				1		1	1	1		4
5	Oxbow				6				3		9
6	Oxbow	1		1	2						4
7	Oxbow				7				2		9
9	River	7						6	28	1	42
10	River	3		4		1	1	9	13	2	33
Total		12	1	12	24	2	2	19	52	3	127

Table 3. Biomass of fish caught by species in ten 10-min fishing shots by boat electrofishing in the Kaituna River and the Bell Road oxbow on 8 October 2014. Blank cells represent no catch.

Site		Biomass of fish per 10-min shot (g)									
		Common bully	Gambusia	Giant bully	Goldfish	Inanga	Longfin eel	Redfin bully	Shortfin eel	Yelloweye mullet	Total
1	Oxbow		0.10	59.15	390.40			2.38	1562.98		2015
2	Oxbow			45.10	764.22			0.47			810
3	Oxbow	3.05		127.79	217.16	3.06		0.24	657.94		1009
4	Oxbow				53.06		10860	3.09	347.47		11264
5	Oxbow				232.66				1497.37		1730
6	Oxbow	5.18		61.28	304.80						371
7	Oxbow				1331.62				168.91		1501
9	River	58.24						7.71	2507.44	345.18	2919
10	River	17.99		222.29		2.89	3108	8.68	962.90	503.69	4826
Total		84	0.10	516	3294	6	13968	23	7705	849	26444

Table 4. Density of fish caught by boat electrofishing of the Kaituna River and the Bell Road oxbow on 8 October 2014.

Site		Density of fish (number 100 m^{-2})									
		Common bully	Gambusia	Giant bully	Goldfish	Inanga	Longfin eel	Redfin bully	Shortfin eel	Yelloweye mullet	Total
1	Oxbow	0.00	0.14	0.28	0.14	0.00	0.00	0.14	0.42	0.00	1.12
2	Oxbow	0.00	0.00	0.34	0.84	0.00	0.00	0.17	0.00	0.00	1.34
3	Oxbow	0.18	0.00	0.53	0.35	0.18	0.00	0.18	0.35	0.00	1.76
4	Oxbow	0.00	0.00	0.00	0.14	0.00	0.14	0.14	0.14	0.00	0.56
5	Oxbow	0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.45	0.00	1.35
6	Oxbow	0.17	0.00	0.17	0.34	0.00	0.00	0.00	0.00	0.00	0.69
7	Oxbow	0.00	0.00	0.00	0.84	0.00	0.00	0.00	0.24	0.00	1.08
9	River	0.69	0.00	0.00	0.00	0.00	0.00	0.59	2.77	0.10	4.15
10	River	0.28	0.00	0.38	0.00	0.09	0.09	0.85	1.23	0.19	3.11
Mean		0.15	0.02	0.19	0.40	0.03	0.03	0.23	0.62	0.03	1.69

Table 5. Areal biomass of fish caught by boat electrofishing of the Kaituna River and the Bell Road oxbow on 8 October 2014.

Site		Areal biomass of fish (g m^{-2})									
		Common bully	Gambusia	Giant bully	Goldfish	Inanga	Longfin eel	Redfin bully	Shortfin eel	Yelloweye mullet	Total
1	Oxbow	0.00	0.01	8.31	54.83	0.00	0.00	0.33	219.52	0.00	283.0
2	Oxbow	0.00	0.00	7.57	128.23	0.00	0.00	0.08	0.00	0.00	135.9
3	Oxbow	0.54	0.00	22.50	38.23	0.54	0.00	0.04	115.83	0.00	177.7
4	Oxbow	0.00	0.00	0.00	7.49	0.00	1533.90	0.44	49.08	0.00	1590.9
5	Oxbow	0.00	0.00	0.00	34.83	0.00	0.00	0.00	224.16	0.00	259.0
6	Oxbow	0.89	0.00	10.57	52.55	0.00	0.00	0.00	0.00	0.00	64.0
7	Oxbow	0.00	0.00	0.00	160.05	0.00	0.00	0.00	20.30	0.00	180.4
9	River	5.75	0.00	0.00	0.00	0.00	0.00	0.76	247.77	34.11	288.4
10	River	1.70	0.00	20.97	0.00	0.27	293.20	0.82	90.84	47.52	455.3
Mean		0.99	<0.01	7.77	52.91	0.09	203.01	0.27	107.50	9.07	381.6

Table 6. Mean weights of fish at ten sites caught by boat electrofishing of the Kaituna River and the Bell Road oxbow on 8 October 2014. Blank cells represent no data.

Site	Mean individual weight (g)								
	Common bully	Gambusia	Giant bully	Goldfish	Inanga	Longfin eel	Redfin bully	Shortfin eel	Yelloweye mullet
1		0.1	29.6	390.4			2.4	521.0	
2			22.5	152.8			0.5		
3	3.0		42.6	108.6	3.1		0.2	329.0	
4				53.1		10,860	3.1	347.5	
5				38.8				499.1	
6	5.2		61.3	152.4					
7				190.2				84.5	
9	8.3						1.3	89.6	345.2
10	6.0		55.6		2.9	3,108	1.0	74.1	251.8
Total	7.0	0.1	43.0	137.2	3.0	6,984	1.2	148.2	283.0

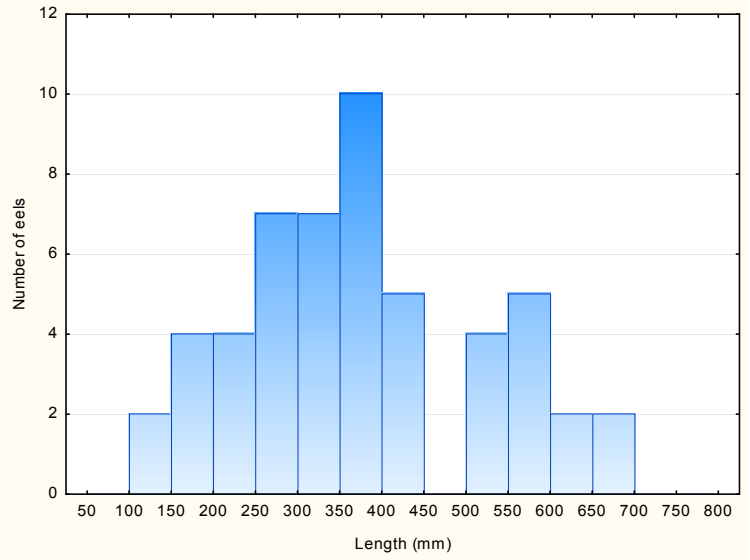


Figure 2. Length frequency of shortfin eels caught by boat electrofishing of the Kaituna River and the Bell Road oxbow, 8 October 2014. *N* fish = 52.

A. Large (260 mm FL, 441 g) bright orange-coloured goldfish

B. A representative range of sizes and colours of goldfish

Figure 3. Goldfish captured from the Bell Road oxbow; A. a large (260 mm FL, 441 g) bright orange-coloured goldfish and B. a representative range of sizes and colours.

Giant bullies were common at most sites, and were identified by 6 spines in the first dorsal fin, which is diagnostic for the species (Fig. 4). Yelloweye mullet were an average size for the species (Fig. 5). One longfin eel was an exceptionally large size compared with most eels captured (Fig. 6).

Figure 4. Giant bully showing the diagnostic 6 spines in the first dorsal fin.

Figure 5. Yelloweye mullet (262 and 286 mm FL) from the main channel of the Kaituna River.

Figure 6. Warrick Powrie holding a large longfin eel (1330 mm, 10.86 kg) from site 3 of the Bell Road oxbow.

5. Discussion

As the main purpose of this fishing was to establish the identity of large orange fish seen in the Bell Road oxbow, the finding of goldfish was significant. From the size and colour ranges and abundance of the goldfish caught in the oxbow it is highly likely that any orange fish seen in the oxbow were large orange goldfish and not koi carp. Some surprising elements of the survey were the low number of inanga (*Galaxias maculatus*) found and the absence of common smelt (*Retropinna retropinna*), which are normally very abundant in large rivers (e.g., Hicks et al. 2005a) and which do occur in the Kaituna River (Ellery and Hicks 2009). Black flounder (*Rhombosolea retiaria*), common in the Whanganui River (Hicks et al. 2003) were also absent. Giant bullies are quite common in the lower reaches of large river systems (Hicks et al. 2005b), so their abundance in the Kaituna River is not surprising. Boat electrofishing is a useful survey tool but has biases like most fishing methods. It is most likely that the abundance of eels was underestimated in this survey because previous boat electrofishing has shown that first-pass estimates can be as low as 5-19% of the population estimate form shortfin eels (Hicks et al. 2006; Hicks, unpublished data).

Fish abundance estimates referred to in this report are derived from single-pass boat electrofishing, so are robust estimates of relative abundance but are not estimates of absolute abundance, which can be derived from removal electrofishing (Hicks et al. 2006).

6. Acknowledgements

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