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Boat electrofishing survey of fish abundance in the Ohau Channel, Rotorua, in 2013

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by

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Cover picture: Ray Tana holding a longfin eel (*Anguilla dieffenbachii*) captured from the Ohau Channel in 2013. Photo credit: Brendan Hicks.

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Executive summary

The aim of this survey was to provide on-going monitoring of the fish communities and abundance in the Ohau Channel, especially fish species that are taonga to Maori (eels, goldfish, and koura). In the current study we present the findings from the seventh year of sampling (2013) in view of previous surveys using boat electrofishing in the Ohau Channel.

We used the University of Waikato's 4.5 m-long, aluminium-hulled electrofishing boat to catch a total of 1,025 fish (20.3 kg) from 11 sites comprising 2,817 lineal m and 11,484 m^2 in area on 27 November 2013. Common bully were the most abundant fish species (57% of the catch) followed by common smelt (36% of the catch).

Goldfish had their highest biomasses in the lower channel, especially at site 10 near Lake Rotoiti (up to 7.25 g m^{-2}). Catch per unit effort (CPUE) for common bullies exceeded smelt CPUE at all sites except site 1, reflecting their greater densities. CPUE for rainbow trout was variable between the sites, and greatest at site 3.

The abundance of common bullies in 2013 reversed the apparent trend of reducing abundance since these surveys started in 2007. The cause of fluctuating bully abundance is not known, and was not accounted for by water clarity expressed as black disc distance (BDD) or water conductivity. Poor water clarity can reduce the efficiency of electrofishing, but BDD was greater in 2012 than in 2011 when common bully densities were lower. In 2013, the apparent decline in smelt abundance was also reversed, but the relatively inefficient sampling resulting from boat electrofishing for these two species should be considered.

The increased goldfish biomass in 2011-2013 arose because of targeted fishing in the excavated side branch, which clearly offers good habitat for goldfish. Removal of goldfish in the previous years may have reduced the density in the excavated side channel (site 11) compared to previous years. In 2013, a shortfin eel was caught, following the first shortfin eel encountered in the Ohau Channel in 2012.

Table of contents

List of tables

List of figures

1. Introduction

The Bay of Plenty Regional Council (BOPRC) contracted the University of Waikato to conduct a survey of the fish abundance in the Ohau Channel. Similar surveys using boat electrofishing had been previously carried out in each December from 2007 to 2012 (Brijs et al. 2008, 2009, 2010, Hicks et al. 2011). The original purpose of these surveys was to apply an independent method to estimate the densities of common smelt and bullies in the Ohau Channel at fixed points along the bank that coincided with trap netting sites used by the National Institute of Water and Atmospheric Research (NIWA). Since the low number of smelt captured by a single day’s boat electrofishing became apparent compared to the numbers captured by seasonal trapping, the aim of the survey has been modified to provide on-going monitoring of the fish communities and abundance in the Ohau Channel, especially fish species that are taonga to Maori (eels, goldfish, and koura). In the current study, we present the findings from the seventh year of sampling (2013) and compare catches to previous surveys.

2. Methods

We used a 4.5 m-long, aluminium-hulled electrofishing boat with a 5-kilowatt pulsator (GPP model 5.0, Smith-Root Inc, Vancouver, Washington, USA) powered by a 6-kilowatt custom-wound generator. Two anode poles, each with an array of six stainless steel droppers, created the fishing field at the bow, with the boat hull acting as the cathode. A total of 11 sites in the Ohau Channel were fished in 2013 (Table 1, Figure 1).

Table 1. Habitat types and dimensions of sites that were boat electrofished in the Ohau Channel on 27 November 2013.

Site	Description	Length (m)	Area (m^2)	Depth range (m)
1	Edge habitat below weir	209	836	0.8-1.2
2	Edge habitat by net site 1	512	2,048	0.4-1.0
3	Mid channel habitat by net site 1	337	1,348	0.6-1.8
4	Edge habitat by net site 2	286	1,144	0.4-1.1
5	Edge habitat by net site 3	227	908	0.6-2.1
6	Mid channel habitat	310	1,240	1.1-2.6
7	Edge habitat	196	784	0.4-1.2
8	Edge habitat near side channel	225	900	0.5-1.8
9	Willow edge	179	716	0.9-2.1
10	Edge habitat by net site 4	162	648	0.9-2.2
11	Side channel	228	912	0.8-1.0
Total		2,871	11,484	

As in previous seasons, sites 2, 4, 8 and 10 coincided with NIWA trap netting sites. Electrofishing subsequently commenced upstream of NIWA trap locations and proceeded to move downstream past them. The remaining sites were spread throughout the Ohau Channel and generally incorporated different habitat characteristics representative of the entire channel. All of the sites had a fishing effort of 10-12 minutes across each of the habitats (Table 5), which included littoral areas, macrophyte beds and mid-channel habitats for the specified target species.

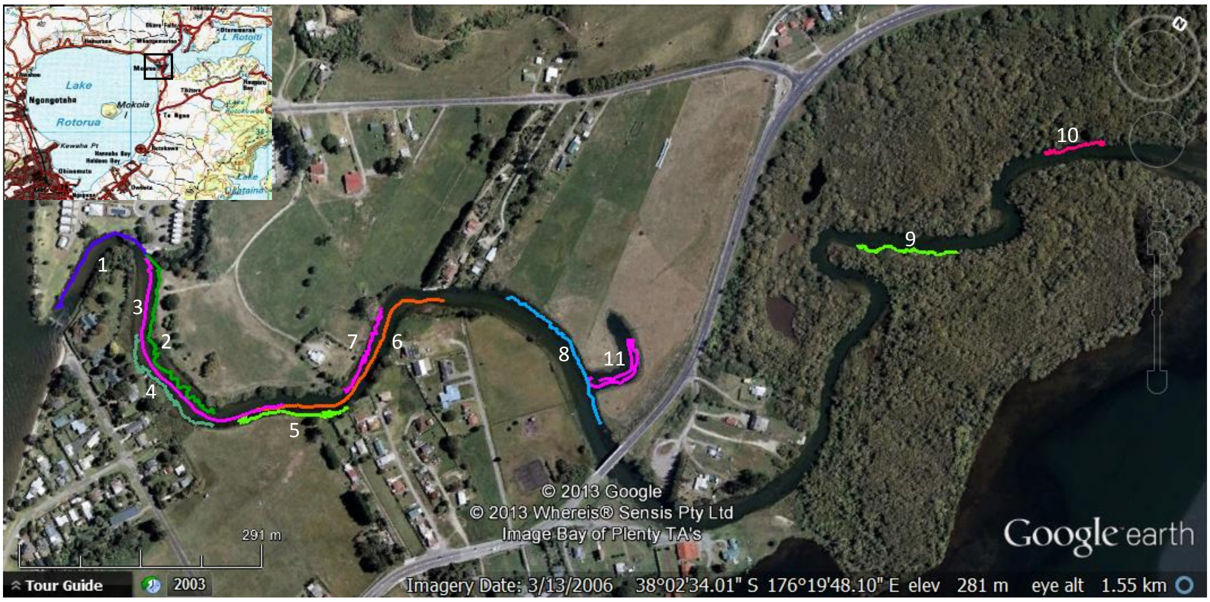

Figure 1. Fishing transects sampled on 27 Nov 2013 in the Ohau Channel starting from Lake Rotorua and ending at Lake Rotoiti. Site codes correspond to locations in Table 1.

Prior to fishing, electrical conductivity was measured with a YSI 3200 conductivity meter and horizontal water visibility was measured using a black disc (Davies-Colley 1988). All sites were fished with the pulsator set to low range (50-500 V direct current) and a frequency of 60 pulses per second. The percent of range of the pulsator was set to 60%, which gave an applied current of 3-4 A root mean square. From past experience, an effective fishing field was achieved a depth of about 2-3 m, and 2 m either side of the centre-line of the boat. This suggests that the boat fished a transect about 4-m wide, consistent with behavioural reactions of fish at the water surface, and so the linear distance fished, measured with hand-held Garmin GPSMAP 60Cx global positioning system, was multiplied by 4 m to calculate the area fished (Table 1).

All goldfish, smelt, and bullies were euthanised in benzocaine after collection then transferred into labelled bags for weighing (g) and measurement (mm) back at the lab for processing. Trout and eels were then anaesthetised in benzocaine, measured, and allowed to recover in labelled mesh bags (4-mm mesh) that were secured in the channel at each sample station. When all sites had been fished, holding bags at each sample station were recovered and the trout and eels were released at their point of capture.

3. Study site

The Ohau Channel begins below the weir that controls the outflow of Lake Rotorua; the current is relatively strong and fast at this point. As distance from the weir increases, the current slows as the channel widens and deepens and the extent of macrophyte beds increases. At the downstream end of the Ohau Channel before it discharges into Lake Rotoiti the riparian zone is mainly dominated by overhanging willows.

Water temperature at the start of fishing was 20.9^{o}C at 1100 h NZDST on 27 Nov 2013; the fishing depths ranged between 0.4 to 2.6 m (Table 1). Specific conductivity, i.e., standardised to 25^{o}C, was 183.5 μS cm^{-1}, and ambient conductivity, which controls power transfer of the electrical field, was 169.3 μS cm^{-1}. The riparian zones of the Ohau Channel were consisted mainly of residential gardens and pasture in the upstream half of the channel (the Lake Rotorua end) and riparian willows in the downstream half of the channel (near Lake Rotoiti). Submerged macrophytes, such as pondweed (*Potamogeton crispus*) and parrot's feather (*Myriophyllum aquaticum*), were observed throughout the channel as well as the presence of freshwater mussels (*Echyridella menziesii*) in bare sandy areas. The black disc distance (BDD), which measures horizontal underwater visibility (Davies-Colley 1988), was 0.80 m in 2013, which was within the middle of the range for previous surveys (0.50 m in 2010 to 2.0 m in 2007).

4. Results

A total of 1,025 fish (20.3 kg) were caught at the 11 sites that were fished in 2013, which comprised 2,871 lineal m and area (Table 1). Koura and 7 fish species were present, with common bully the most abundant species (57% of the catch; Table 2). One shortfin eel was found at site 4. Common smelt (373 fish) was the next most abundant species (36% of the catch), followed by goldfish (42 fish, 4% of the catch), which were most abundant in sites the lower channel, especially at site 10, the most downstream site.

Common smelt had the highest densities of any fish species in 2013 (up to 34 fish 100 m^{-2} at site 1 immediately downstream of the weir), but common bullies were consistently more abundant than smelt at all other sites (Table 3). The majority of common bullies were taken from edge habitats at sites 1, 4, 5, 7, and 8. Mean bully biomass (5.56 g m^{-2}) was higher than for smelt (3.97 g m^{-2}; Table 4).

Goldfish had their highest biomasses in the lower channel, especially at site 10 near Lake Rotoiti (up to 7.25 g m^{-2}, Table 4). Catch per unit effort (CPUE) for common bullies exceeded smelt CPUE at all except site 1 (Table 5), reflecting their greater densities (Table 3). CPUE for rainbow trout was variable between the sites, and greatest at site 3 (Table 5).

Table 2. Total number of each species in the Ohau Channel collected in 10-min passes at 11 sample sites with boat electrofishing on 27 November 2013. Blank cells indicate no catch for that species.

	Number of individuals per site								
Site	Common bully	Common smelt	Goldfish	Longfin eel	Shortfin eel	Rainbow trout	Brown trout	Koura	Total
1	66	287							353
2	67	7				4			78
3	1					15			16
4	90	19		1	1			1	112
5	104	22							126
6	3					2	1		6
7	88	25							113
8	90	7	9						106
9	28	2	5			2			37
10	5	4	24						33
11	41		4						45
Total	583	373	42	1	1	23	1	1	1,025

Table 3. Density of each species in the Ohau Channel collected in 10-min passes at 11 sample sites with boat electrofishing on 27 November 2013.

	Density (number 100 m^{-2})								
Site	Common bully	Common smelt	Goldfish	Longfin eel	Shortfin eel	Rainbow trout	Brown trout	Koura	Total
1	7.89	34.33	0.00	0.00	0.00	0.00	0.00	0.00	42.2
2	3.27	0.34	0.00	0.00	0.00	0.20	0.00	0.00	3.8
3	0.07	0.00	0.00	0.00	0.00	1.11	0.00	0.00	1.2
4	7.87	1.66	0.00	0.09	0.09	0.00	0.00	0.09	9.8
5	11.45	2.42	0.00	0.00	0.00	0.00	0.00	0.00	13.9
6	0.24	0.00	0.00	0.00	0.00	0.16	0.08	0.00	0.5
7	11.22	3.19	0.00	0.00	0.00	0.00	0.00	0.00	14.4
8	10.00	0.78	1.00	0.00	0.00	0.00	0.00	0.00	11.8
9	3.91	0.28	0.70	0.00	0.00	0.28	0.00	0.00	5.2
10	0.77	0.62	3.70	0.00	0.00	0.00	0.00	0.00	5.1
11	4.50	0.00	0.44	0.00	0.00	0.00	0.00	0.00	4.9
Mean	5.56	3.97	0.53	0.01	0.01	0.16	0.01	0.01	10.3

Table 4. Areal biomass of each species in the Ohau Channel collected in 10-min passes at passes at 11 sample sites with boat electrofishing on 27 November 2013.

	Biomass (g m^{-2})							
Site	Common bully	Common smelt	Goldfish	Longfin eel	Shortfin eel	Rainbow trout	Brown trout	Total
1	0.10	0.24	0.00	0.00	0.00	0.00	0.00	0.34
2	0.03	0.00	0.00	0.00	0.00	0.85	0.00	0.88
3	0.00	0.00	0.00	0.00	0.00	0.71	0.00	0.71
4	0.07	0.01	0.00	3.13	1.48	0.00	0.00	4.69
5	0.13	0.01	0.00	0.00	0.00	0.00	0.00	0.14
6	0.00	0.00	0.00	0.00	0.00	1.30	1.60	2.90
7	0.09	0.02	0.00	0.00	0.00	0.00	0.00	0.12
8	0.08	0.01	1.88	0.00	0.00	0.00	0.00	1.97
9	0.08	0.00	0.72	0.00	0.00	0.01	0.00	0.80
10	0.02	0.01	7.25	0.00	0.00	0.00	0.00	7.28
11	0.06	0.00	1.06	0.00	0.00	0.00	0.00	1.13
Mean	0.06	0.03	0.99	0.28	0.13	0.26	0.15	1.90

Table 5. CPUE (fish min^{-1}) of common bully, common smelt, goldfish and rainbow trout in the Ohau Channel caught at passes at 11 sample sites with boat electrofishing on 27 November 2013.

	Time	Catch per unit effort (fish per min^{-1})			
Site	fished (min)	Common bully	Common smelt	Goldfish	Rainbow trout
1	10	6.60	28.70	0.00	0.00
2	10	6.70	0.70	0.00	0.40
3	10	0.10	0.00	0.00	1.50
4	10	9.00	1.90	0.00	0.00
5	10	10.40	2.20	0.00	0.00
6	10	0.30	0.00	0.00	0.20
7	10	8.80	2.50	0.00	0.00
8	10	9.00	0.70	0.90	0.00
9	10	2.80	0.20	0.50	0.20
10	10	0.50	0.40	2.40	0.00
11	12	3.42	0.00	0.33	0.00
Total	112				
Mean		5.24	3.39	0.38	0.21

5. Discussion

The abundance of common bullies in 2013 reversed the apparent trend of reducing abundance since these surveys started in 2007 (Table 6). The cause of fluctuating bully abundance is not known, and was not accounted for by water clarity expressed as black disc distance (BDD) or water conductivity (Table 7). Poor water clarity can reduce the efficiency of electrofishing, but does not appear to influence our catch rates of bullies or smelt. BDD was greater in 2012 than in 2011 when common bully densities were lower. In 2013, the apparent decline in smelt abundance was also reversed despite the relatively low BDD.

The increasing goldfish biomass between 2011 and 2013 arose partly because of targeted fishing in the excavated side branch (site 11), which was not fished in previous years but which clearly offers good habitat for goldfish. In 2013, a shortfin eel was caught, following the first shortfin eel encountered in the Ohau Channel in 2012.

Table 6. Mean fish and koura densities in the Ohau Channel measured by boat electrofishing between 2007 and 2013. (Source of data: Brijs et al. 2008, 2009, 2010, Hicks et al. 2011, 2013).

	Density (individuals 100 m^{-2})									Time fished (min)	Distance fished (m)	Area fished (m^2)
Year	Common bully	Common smelt	Goldfish	Longfin eel	Shortfin eel	Rainbow trout	Brown trout	Koura	Total			
2007	22.28	3.30	0.14	0.03	0.00	0.41	0.00	0.00	26.16	82	1,582	6,328
2008	6.14	4.12	0.03	0.01	0.00	0.22	0.00	0.00	10.52	100	2,033	8,133
2009	1.45	1.46	0.07	0.01	0.00	0.36	0.00	0.00	3.34	101	2,721	10,884
2010	4.34	1.65	0.16	0.01	0.00	0.53	0.00	0.10	6.79	112	3,488	13,952
2011	2.76	0.32	0.31	0.04	0.00	0.27	0.03	0.02	3.75	129	2,721	10,884
2012	0.86	0.99	0.33	0.01	0.01	0.12	0.01	0.02	2.35	115	3,625	14,500
2013	5.56	3.97	0.53	0.01	0.01	0.16	0.01	0.01	10.30	112	2,871	11,484

Table 7. Conductivity and black disc distance measured in the in the Ohau Channel at the time of boat electrofishing surveys between 2007 and 2013. NZDST = New Zealand daylight saving time, i.e., UTC+13 h. UTC = Universal time coordinated. (Source of data: Brijs et al. 2008, 2009, 2010, Hicks et al. 2011, 2013).

Date	Time (h NZDST)	Water temperature (°C)	Ambient conductivity (µS cm^{-1})	Specific conductivity (µS cm^{-1})	Black disc distance (m)
13-Dec-07	1015	18.8	159.3	180.9	2.00
11-Dec-08	1030	20.4	167.8	183.7	0.80
7-Dec-09	1045	19.4	172.4	193.4	0.65
7-Dec-10	1100	20.1	169.7	187.4	0.50
5-Dec-11	1030	17.8	148.5	173.5	0.85
4-Dec-12	0900	17.4	144.1	169.4	1.30
27-Nov-13	1100	20.9	169.3	183.5	0.80

6. Acknowledgements

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