Boat electrofishing survey of common smelt and common bullies in the Ohau Channel

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by

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Executive summary

We conducted a boat electrofishing survey of the Ohau Channel, which flows from Lake Rotorua to Lake Rotoiti, on 13 December 2007. The purpose of the survey was to investigate the longitudinal pattern in densities of common smelt (*Retropinna retropinna*) and common bullies (*Gobiomorphus cotidianus*) along the Ohau Channel. We caught 1,267 fish comprising three native fish species and two introduced fish species in 1.58 km of fished distance at a total of 10 sites. Native species caught were the common smelt, common bully and longfinned eel (*Anguilla dieffenbachii*) and introduced species were rainbow trout (*Oncorhynchus mykiss*) and goldfish (*Carassius auratus*). Assuming that the bow-mounted anodes effectively fished a 4 m swath then the total area fished was 6,328 m^2 (0.632 ha).

Common smelt densities varied among the 10 different sites in the Ohau Channel ranging from 0 to 10.6 fish 100 m^{-2}. Smelt density was higher at the upstream end of the channel near the weir at the Lake Rotorua outlet, decreasing with increasing distance from the weir. Smelt were found in the littoral zones but were not caught in mid-channel habitats. In the upstream reaches of the Ohau Channel, directly below the weir, a high number of juveniles (4.4 fish 100 m^{-2}) were captured compared to the amount of juveniles captured at the other sites (0 – 1.2 fish 100 m^{-2}).

Common bully densities varied among the 10 different sites in the Ohau Channel ranging from 0.2 to 58.3 fish 100 m^{-2}. No longitudinal pattern in the distribution of common bullies was evident along the channel. The highest densities were found halfway along the Ohau Channel where there was an abundance of dense macrophyte beds. Common bully densities were found to be much higher in the edge habitats with macrophyte beds compared to the mid-channel habitats and the willow edge habitat where there were relatively low densities. Size frequency data shows that there is generally a higher proportion of small bullies than larger ones suggesting that recruitment is occurring.

Both adult and juvenile rainbow trout were observed in the Ohau Channel. Most of these individuals were found in the upstream section of the channel below the weir and ranged from a 75 mm juvenile to a fully grown adult about 500 mm long. Large longfinned eels were also captured and were only found in the downstream section of the Ohau Channel in willow-dominated edges. In the bottom third section of the channel, near the possible artificial embayment, goldfish were present.

1. Introduction

Environment Bay of Plenty (EBOP) contracted the Centre for Biodiversity and Ecology Research (CBER) to conduct an independent survey of common smelt abundance by boat electrofishing in the Ohau Channel which runs from Lake Rotorua to Lake Rotoiti. The purpose of the survey 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 which coincided with trap netting sites used by the National Institute of Water and Atmospheric Research (NIWA).

2. Methods

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 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.

We fished 10 sites in the Ohau Channel on 13 December 2007 (Table 1; Fig. 1). The sites chosen for electrofishing were based around the sites that NIWA had used for their trap netting survey so that direct comparisons of fish densities using two different methods could be made. Sites 2, 4, 8 and 10 coincided with the NIWA trapping sites and fishing started upstream of the site and carried on downstream past the site for 5 minutes. The remaining 6 sites were spread thoughout the Ohau Channel and were chosen for different habitat characteristics so that data representative of the whole channel was collected. At these 6 sites the fishing effort was increased to 10 minutes. We attempted to fish most of the habitats found such as the littoral areas, macrophyte beds and mid-channel habitats for the target species. Eels and juvenile trout were also collected, weighed and measured but due to low numbers of individuals caught no attempt was made to estimate their density and biomass. Adult rainbow trout were counted but not caught.

Electrical conductivity was measured with a YSI 3200 conductivity meter and horizontal water visibility was measured using a black disc. Specific conductivity for the Ohau Channel, i.e., standardised to 25^{o}C, was 180.9 μS cm^{-1}, so all sites were fished with the GPP 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 GPP to 70% to give an applied current of 3-4 A root mean square. We assumed from past experience 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. We thus assumed that the boat fished a transect about 4 m wide, which was generally consistent with the behavioural reactions of fish at the water surface. This assumption was used to calculate area fished from the linear distance measured with the global positioning system.

3. Results

On 13 December 2007 the water temperature was relatively warm (18.8°C). The depths fished ranged from 0.30 to 2.5 m. The littoral zones of the Ohau Channel consisted mainly of residential gardens and pasture in the upstream half of the channel (Lake Rotorua end) and riparian willows in the downstream half of the channel (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 in bare sandy areas.

Table 1: Locations of the 10 sites fished on 13 December 2007 in the Ohau Channel .

		Start position for fishing		End position for fishing	
Site	Habitat	NZMG Easting	NZMG Northing	NZMG Easting	NZMG Northing
1	Edge habitat below weir	2801827.1	6345384.8	2801875.6	6345476.0
2	Edge habitat by net site 1	2801907.1	6345472.5	2801979.3	6345369.7
3	Mid channel habitat by net site 1	2801891.4	6345475.4	2802115.2	6345405.6
4	Edge habitat by net site 2	2801987.4	6345352.1	2802086.4	6345353.9
5	Edge habitat	2802106.5	6345383.1	2802200.3	6345501.8
6	Mid channel habitat	2802187.8	6345484.1	2802387.9	6345626.4
7	Edge habitat with artificial enlargement	2802274.3	6345658.3	2802440.0	6345602.4
8	Edge habitat by net site 3	2802687.6	6345598.7	2802711.9	6345677.4
9	Willow edge	2802681.7	6345736.1	2802674.6	6345863.3
10	Edge habitat by net site 4	2802828.2	6346183.2	2802891.5	6346224.2

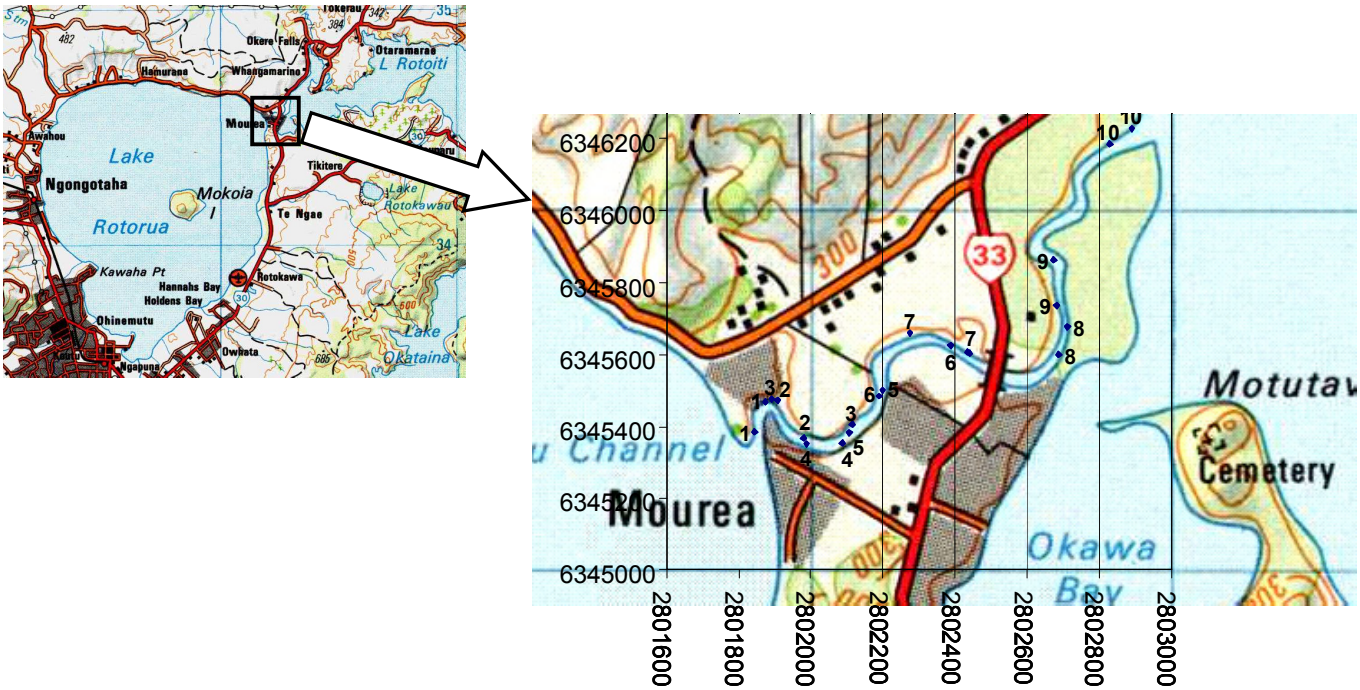

Figure 1. Sites fished on 13 December 2007 in the Ohau Channel which flows from Lake Rotorua to Lake Rotoiti. Site codes correspond to NZ map grid coordinates in Table 1.

The Ohau Channel begins where a weir has been constructed to control the outflow of Lake Rotorua (Figure 2) and 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 (Figure 3) and an increase in the density of macrophyte beds occurs. At the downstream end of the Ohau Channel before it discharges into Lake Rotoiti the littoral zone is mainly dominated by willows (Figure 4).

Figure 2. The weir between Lake Rotorua and the Ohau Channel where currents are relatively strong and fast. Photo: Brendan Hicks.

Figure 3. Halfway down the Ohau Channel at old oxbow on the true left bank. Photo: Brendan Hicks.

Figure 4. Willows dominating the true left bank of the lower Ohau Channel. Photo: Brendan Hicks.

We caught 1,267 fish comprising three native and two introduced fish species in 1.58 km of fished length from a total of 10 sites. Native species were common smelt, common bullies and longfinned eels, and introduced species were rainbow trout and goldfish (Table 2). Goldfish were observed in the Ohau Channel with densities of 1.25 fish 100 m^{-2} at site 9 around the macrophyte beds.

Common smelt were caught at all sites except for the mid-channel habitats (Sites 3 & 6) and the willow edge habitat (Site 9). For the common smelt, an increase in the duration of time fished from 5 to 10 minutes did not appear to increase the catch rate. In both the 5 minute and 10 minute fishing efforts the numbers of smelt caught decreased with increasing distance downstream (Table 2). Densities ranged from 1.1 to 10.6 fish per 100 m^2 at the upstream sites and 0 to 3.0 fish per 100 m^2 at the downstream sites (Table 3). Catch per unit effort (CPUE) data also shows a similar trend with higher CPUE at the upstream end of the channel compared to the downstream end of the channel (Table 4).

Common bullies were caught at all of the sites along the Ohau Channel (Table 2) and were present in high densities at all sites except for the mid-channel habitats (Sites 3 & 6) and the willow edge habitat (Site 9) (Table 2). The 5 and 10 minute fishing efforts showed that bully densities varied along the Ohau Channel (Table 3). The 10 minute fishing efforts resulted in a large increase in the number of common bullies caught and the highest bully densities were found to be located in the middle section of the Ohau Channel associated with large macrophyte beds. CPUE data (Table 4) also shows that bully catch rates were variable between the 10 different sites throughout the Ohau Channel and that no longitudinal pattern in bully distribution was evident.

Rainbow trout were seen in the upstream section of the Ohau Channel below the weir (sites 1 - 4) in the swiftly flowing habitats. Five juvenile rainbow trout were captured and measured and the individual lengths ranged from 75 mm to 150 mm. Numerous large adult trout were also observed but no attempt was made to capture them. Longfinned eels were only found in the downstream section of the Ohau Channel amongst the
willow-dominated edges (Site 9). The eels that were caught were large individuals with total lengths of 880 and 1010 mm.

Table 2. Numbers of fish caught by boat electrofishing at 10 sites in the Ohau Channel on 13 December 2007.

			Number of fish per site					
Lake Rotorua	Site	Habitat	Bullies	Common smelt	Goldfish	Longfin eels	Juvenile rainbow trout	Adult rainbow trout
↓	1	Left bank edge habitat immediately below weir	184	44	1	0	4	0
	2	Left bank edge habitat us/ds of trap site 1	42	37	0	0	0	6
	3	Mid-channel habitat around trap site 1	12	0	0	0	0	4
	4	Right bank edge habitat us/ds of trap site 2	54	37	0	0	0	1
	5	Right bank edge habitat	381	7	0	0	0	0
	6	Mid-channel habitat	2	0	0	0	0	0
	7	Left bank edge habitat with possible artificial enlargement	299	4	8	0	0	0
	8	Right bank edge habitat us/ds of trap site 3	56	10	0	0	0	0
	9	Left bank willow edge	16	0	0	2	1	0
Lake Rotoiti	10	Left bank edge habitat us/ds of trap site 4	53	1	0	0	1	0
	Total	1267	1099	96	8	2	2	11

Table 3. Numbers and densities of common smelt and common bullies at sites in the Ohau Channel that were fished on 13 December 2007.

Lake Rotorua	Site	Habitat	Time fished (mins)	Total distance fished (m)	Area fished (m^2)	Number of bullies per site	Number of smelt per site	Bully density (fish 100 m^{-2})	Smelt density (fish 100 m^{-2})
↓	1	Edge habitat below weir	10	103	413	184	44	44.5	10.6
	2	Edge habitat by net site 1	5	127	506	42	37	8.3	7.3
	3	Mid channel habitat by net site 1	10	292	1168	12	0	1.0	0.0
	4	Edge habitat by net site 2	5	105	419	54	37	12.9	8.8
	5	Edge habitat	10	163	653	381	7	58.3	1.1
	6	Mid channel habitat	10	324	1296	2	0	0.2	0.0
	7	Edge habitat	10	180	721	299	4	41.4	0.6
	8	Edge habitat by net site 3	5	83	332	56	10	16.8	3.0
	9	Willow edge	10	129	514	16	0	3.1	0.0
Lake Rotoiti	10	Edge habitat by net site 4	5	76	303	53	1	17.5	0.3

Table 4. CPUE (fish/min) of common bully and common smelt in the Ohau Channel on 13 December 2007.

Lake Rotorua ↓ Lake Rotoiti

Site	Habitat	Time fished (mins)	Bully CPUE (fish/min)	Smelt CPUE (fish/min)
1	Edge habitat below weir	10	18.4	4.4
2	Edge habitat by net site 1	5	8.4	7.4
3	Mid channel habitat by net site 1	10	1.2	0.0
4	Edge habitat by net site 2	5	10.8	7.4
5	Edge habitat	10	38.1	0.7
6	Mid channel habitat	10	0.2	0.0
7	Edge habitat	10	29.9	0.4
8	Edge habitat by net site 3	5	11.2	2.0
9	Willow edge	10	1.6	0.0
10	Edge habitat by net site 4	5	10.6	0.2

Table 5 shows that at all of the sites where populations of common smelt were present, the proportion of adults (>44 mm total length) greatly exceeded that of juveniles with the exception of site 1.

Table 5. Composition of common smelt populations with respect to numbers of juveniles and adults in the Ohau Channel on 13 December 2007.

Lake Rotorua ↓ Lake Rotoiti

Site	No. Juveniles (<44mm)	No. Adults (>44 mm)	Total weight (g)
1	18	26	30
2	6	31	40
3	0	0	0
4	5	32	33
5	0	7	8
6	0	0	0
7	0	4	2
8	2	8	17
9	0	0	0
10	0	1	1

Size frequency data collected for common bullies in the Ohau Channel (Table 6) shows that at most of the sites the number of individuals in the smallest size range (up to 35 mm) exceed the numbers of individuals in the other size ranges. Generally as the size class increased (e.g. 25-35 to 35-50) the numbers of individuals in the size class decreased.

Table 6. Lengths and total weights of common bullies in Ohau Channel on 13 December 2007. Size class 1 = < 35 mm, 2 = 36-50 mm, 3 = 51-60 mm and 4 = > 60 mm.

Lake Rotorua ↓ Lake Rotoiti

Site	Size class	Min length (mm)	Max length (mm)	Number	Total weight (g)
1	1	25	35	114	61
	2	36	50	35	44
	3	51	60	26	65
	4	61	90	9	42
2	1	20	35	25	12
	2	36	45	9	9
	3	50	60	8	17
	4	-	-	-	-
3	1 to 4	-	-	12	-
4	1	25	35	34	18
	2	36	50	8	8
	3	51	60	9	24
	4	61	75	3	14
5	1	15	35	243	123
	2	36	50	91	100
	3	51	60	35	86
	4	61	78	12	46
6	1 to 4	-	-	2	-
7	1	15	35	115	25
	2	36	50	119	117
	3	51	60	43	91
	4	61	85	22	91
8	1	25	35	27	13
	2	36	50	19	18
	3	51	60	7	15
	4	61	92	3	25
9	1	25	35	5	3
	2	36	45	6	6
	3	50	60	4	9
	4	68	-	1	5
10	1	15	35	18	9
	2	36	50	16	16
	3	51	60	9	21
	4	61	78	10	49

4. Conclusions

Fish species caught by boat electrofishing in the Ohau Channel on 13 December 2007 were common smelt, common bullies, longfinned eels, rainbow trout and goldfish. The moderate conductivity of the Ohau Channel allowed efficient power transfer from the water to the fish because the range of conductivities was about the same as the presumed conductivity of the fish. Previous fishing with the electrofishing boat in the North Island, in similar conductivities and habitats and with similar machine settings, has caught a full size range eels, smelt, bullies, grey mullet, rudd, brown bullhead catfish, perch, tench, goldfish, and koi carp (Hicks et al., 2005). Thus we consider that the fishing carried out on the Ohau Channel was representative of the sizes and species present.

Common smelt displayed a longitudinal pattern in their distribution along the Ohau Channel. With increasing distance down the Ohau Channel from Lake Rotorua to Lake Rotoiti a decrease in the density and CPUE of common smelt occured. Smelt were found in the littoral zones but were completely absent from the mid-channel habitats in the Ohau Channel. This could be due to the high water velocity in the mid-channel habitats as smelt have limited swimming capabilities compared to other New Zealand freshwater fishes (McDowall, 1998) and this may limit them to the low velocity edges of the channel. It could also be due to the presence of macrophyte beds in the littoral areas which provide cover and habitat for the smelt. In the upstream reaches of the Ohau Channel, directly below the weir, a high number of juveniles were captured and previous studies in the Waikato River have shown that juvenile smelt migrate upstream during the day (Stancliff et al., 1988). Site 1 was the most upstream in the Ohau Channel and thus it is possible that the juvenile smelt migrate to this point and congregate.

Changing the duration of the fishing effort from 5 minutes to 10 minutes during the survey did not have a great affect on the amount of smelt caught. Common smelt are found in schools and the success of capturing smelt with boat electrofishing relies heavily on how many schools of smelt can be targeted. During this survey we found that increasing the time of fishing effort from 5 to 10 minutes did not generally increase the capture of smelt.

Common bullies showed variable densities throughout the Ohau Channel and the highest densities were associated with the presence of macrophyte beds. The 10-minute fishing efforts caught a greater number of bullies than the 5-minute fishing efforts and this is most likely due to the fact that the bullies are amongst the macrophyte beds and thus with more fishing time it allows more fish to be flushed out from the macrophytes. There were very low common bully densities in the mid-channel habitats and the willow edge habitat. Mid-channel habitats may not be favourable for bullies due to the lack of macrophyte beds and the presence of strong currents whereas the willow edge may not be favourable for bully populations due to the presence of longfinned eels. Self recruiting populations of eels have shown to reduce the abundance of bullies in lakes (Rowe, 1999) and so the same pattern may be occurring in the Ohau Channel.

Rainbow trout were seen in the upstream section of the Ohau Channel below the weir by sites 1, 2, 5 and 6. The presence of trout coincided with the presence of higher densities of common smelt which is known to be a major prey for both the brown and rainbow trout (Ward et al., 2005). Longfinned eels where only found in the downstream section of the Ohau Channel in amongst the willow dominated edges with relatively low flow velocities.

5. Acknowledgements

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6. References

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