NIWA
Taihoro Nukurangi

Annual report on smelt monitoring in the Ohau Channel and Lake Rotoiti (2014/2015)

Prepared for Bay of Plenty Regional Council

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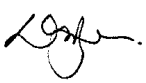	Approved for release by:	David Roper

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Executive summary

In 2008, a diversion wall was installed in Lake Rotoiti to channel nutrient-laden water exiting Lake Rotorua via the Ohau Channel (which connects these lakes) around the edge of Rotoiti to the Kaituna River (the lake's outlet). This wall was designed to reduce nutrient loading on Lake Rotoiti and hence to assist in its restoration. Concerns were raised that the diversion wall could adversely affect the migrations of smelt and trout from Lake Rotoiti to Lake Rotorua via the Ohau Channel. Hence, monitoring has been carried out before and after the wall was constructed to identify any significant adverse impacts of the wall on these fish. In this report, we present the results of monitoring on smelt for the 2014/2015 season.

Runs of smelt were recorded in 2015 by both trapping and direct observation. A run of adult smelt occurred in May 2015 and, although the trap catch rate was relative low (2.9 smelt/minute), visual observations indicated that the run lasted for approximately 8 days.

Environmental conditions in the Channel were similar to those reported in previous years, except that water temperatures were hotter in December and January than in previous years. There was no indication that the hotter conditions would prevent or limit runs of smelt up the Channel and previous investigations have established that smelt do not avoid or prefer water temperatures within the range occurring at this time.

Larval smelt monitoring in Lake Rotoiti in 2014/2015 indicated that there was little change in abundance compared with the previous year. The pattern of higher larval densities in December compared with April over most of the past 9 years indicates that most spawning generally occurs in spring even though it continues over summer months until at least March.

Overall, the results for 2014/2015 complement and strengthen those obtained in previous years and indicate that:

(a) The diversion wall does not prevent migrations of smelt up the Ohau Channel. Migrations of both adults and juveniles have continued since the wall was constructed.

(b) There is no evidence to date indicating that a decline in the size of smelt runs has occurred since the diversion wall was installed. The maximum size of a run detected by trapping before installation of the wall (34.1 smelt/minute in February 2006) was exceeded in October 2013 (38.4 smelt/minute).

(c) There is high variation in the seasonal timing, frequency, size, duration and composition (adults vs. juveniles) of the smelt runs, with adults able to migrate up the Channel in any month from September to May, whereas juveniles only migrate up the Channel during summer months (December to April). It appears that the weir at the top of the Ohau Channel impedes smelt movements up the Channel when high flows (yet to be identified) occur and when water velocities exceed smelt swimming capabilities. The resultant build-up of smelt below the weir creates the pre-conditions for an important trout fishery to develop at this site. But this is dependent on the coincidence of both smelt runs and high flows.

(d) Long-term monitoring would be required to detect any long-term decline and/or change in the seasonal timing, frequency or duration of smelt runs up the Ohau Channel. Alternatively, research would be required to identify the main environmental drivers controlling the timing and duration of smelt runs and whether these have been influenced by the diversion wall.

1 Introduction

In 2008, a diversion wall was installed at the outlet of the Ohau Channel in Lake Rotoiti to divert the nutrient-enriched water flowing out of Lake Rotorua into Lake Rotoiti. This water is channelled along the lake edge by the diversion wall such that it now flows down the Kaituna River rather than entering Lake Rotoiti. In time, this diversion is expected to reduce nutrient loading into Lake Rotoiti and this will help restore its water quality.

Eastern Region Fish and Game Council were concerned that this diversion wall may reduce the migrations of smelt and trout up the Ohau Channel from Lake Rotoiti and thereby affect the trout fishery in the Channel and Lake Rotoiti. In addition, there were concerns that changes to smelt migrations up the Ohau Channel could affect the population dynamics of smelt in Lake Rotoiti, resulting in an impact on the trout fishery in this lake. Local iwi were also concerned that the fishery for smelt in the Ohau Channel would be adversely affected.

Studies were therefore initiated by the Bay of Plenty Regional Council between 2005 and 2008 to provide more information on smelt migrations up the Channel prior to the installation of the wall, thus providing a pre-wall baseline for assessing any impacts of the diversion wall on smelt runs (Rowe et al. 2006; 2008). These studies were continued on a near annual basis after the diversion wall was completed in July 2008 to provide further information on the smelt migrations up the Ohau Channel and to establish any effects of the wall on smelt in both the Channel and Lake Rotoiti (Rowe et al. 2009, 2010, 2011, 2012, 2013, 2014).

Results from the annual trapping of smelt runs up the Ohau Channel between 2006 and 2014 showed that runs of both juvenile and adult smelt continued to occur after the wall was constructed. Hence the wall does not prevent the migration of either adult or juvenile smelt through the Ohau Channel (Rowe et al. 2014). However, the size and/or frequency of smelt runs may have changed over time and monitoring is therefore continuing to provide information on these characteristics of the smelt migration.

In addition to smelt monitoring in the Channel, the abundance of larval smelt in Lake Rotoiti is also being monitored. The aim is to determine whether the smelt population in Lake Rotoiti changes as a consequence of any effect of the diversion wall on smelt population dynamics in Lake Rotoiti. A sustained decline in larval smelt would indicate lake-wide recruitment failure due to a reduction in the size of the adult smelt population and this could reduce the size of smelt runs up the Ohau Channel.

In considering all the results available up to November 2014, the Technical Advisory Group advising the Bay of Plenty Regional Council on the impacts of the diversion wall on fish recommended that smelt monitoring in the Ohau Channel and larval smelt monitoring in Lake Rotoiti be continued until 2017 when the resource consent will need to be renewed.

In this report, we present the results of smelt monitoring carried out in the Ohau Channel from September 2014 to May 2015 as well as the measurements of larval smelt density in Lake Rotoiti carried out for the 2014/2015 summer season. These data are interpreted with respect to the baseline data obtained before the wall was constructed and the monitoring results obtained annually since then.

2 Methods

2.1 Smelt runs in the Ohau Channel

The locations of the sites used to monitor smelt movements in the Ohau Channel over the past 10 years are shown in Figure 2-1. Only trap sites 1 and 2 were used after 2012 as the contribution of Sites 3 and 4 was generally minor (Rowe et al. 2011) and Sites 1 and 2 have been monitored since 2006 so provide a longer record for comparing temporal changes.

Figure 2-1: Location of sampling sites used for smelt trapping in the Ohau Channel. Only sites 1 and 2 were trapped in 2014. Inset shows a smelt trap and the platform below which it is set.

Trapping was carried out at 3-4 weekly intervals during the nine month period from September 2014 to May 2015. Traps were placed close to the bank at each site, facing downstream in order to capture upstream migrant smelt. The traps were triangular with a 1 m wide by 0.5 m deep opening tapering to a 20 cm wide capture compartment (Figure 2-1 inset). Mesh size was 2 mm. Traps were usually set close to daybreak and the catch removed every 3-4 hours until late evening. The total number of smelt caught per trap per day and the total time for which the trap was fished per day were recorded. Depending on the number of fish present, all or a subsample were used to determine the proportions of juveniles and adults in the catch. Both the length (under or over 45 mm total length) and coloration of smelt are used to distinguish juveniles from adults. The daily catch per unit of effort (CPUE) for smelt on each sampling date was calculated as the total daily catch for the two traps divided by the total trapping time in minutes.

Runs of smelt were defined through both long-term direct observation and the trapping data as the movement of two schools of 50-60 smelt, or one school of 100-120 smelt per hour, past a given point on the bank of the Channel, or a trap-based catch rate of over 2 smelt per minute (Rowe et al. 2012). Shag numbers (both on the banks and in trees lining the channel) were counted along the channel's entire length on each sampling occasion. Shags are predators of adult smelt and their abundance can provide an additional measure to detect the presence of prolonged high densities of adult (but not juvenile) smelt in the Channel (Rowe et al. 2010, 2011).

Daily, and in some cases sub-daily observations on smelt, anglers, trout (caught by anglers) and the presence of gulls and shags (predators of smelt) at the head of the Ohau Channel were made by George Proud over November and December 2014 and from March until June 2015. These observations provide valuable additional information on smelt runs up the channel that complements the quantitative data obtained by smelt trapping. As a consequence, these observations are attached as an Appendix and serve to corroborate the results from the trapping programme as well as to indicate the existence of runs on days when trapping was not carried out.

In addition to these data, water temperatures (Tidbit© data loggers), water clarity (black disc visibility), water velocities near the entrance to each trap, the flow rate of water through the Ohau Channel, and the by-catch of other fish species (i.e., common bullies, koaro, trout) were recorded.

2.2 Larval smelt density in Lake Rotoiti

Larval smelt in Lake Rotoiti have been sampled annually since 2007 to determine whether annual changes in larval abundance (reflecting smelt recruitment) could account for any large changes in adult smelt abundance in the lake and hence moving up the Ohau Channel.

In the Rotorua lakes, smelt have an extended spawning period lasting from spring until the end of summer (Jolly 1967, Rowe & Kusabs 2007, Blair 2012). After hatching, the transparent larvae become pelagic and remain in the water column at depths down to 50 m until they reach a length close to 25 mm. At this stage, they become pigmented and move towards the lake surface where they form large schools in response to the increased risk of predation from trout and avian predators.

The peak months for smelt reproduction in Lake Rotoiti during the spring/summer period are unknown. As recently hatched larvae are present in samples taken in both December and April (Rowe et al. 2013), but especially in December, spawning is expected to peak in spring with some spawning continuing over summer. The size and likely growth rate of the larvae indicates that they can be expected to be present in the hypolimnetic zone of Lake Rotoiti for up to 5 months post-hatch. Hence, larvae are expected to be present in all months of the year, with highest densities from September until May. Measurements of larval smelt abundance in Lake Rotoiti are therefore carried out in both December and April to encompass the main spawning periods.

Vertical drop netting using a closable Wisconsin plankton net (mouth area of 0.25 m^2, mesh size 250 µm) was used to sample larval smelt throughout the water column (surface to near the lake-bottom) of Lake Rotoiti in both December 2014 and April 2015, as per previous years. Sampling was carried out at 31 sites located throughout the lake. Larval fish sampled from the water column at each site were sorted into species (larval bullies vs. larval smelt), counted and their length was measured to the nearest millimetre. Secchi disc depth was also measured because the overall number of smelt larvae in the Rotorua lakes has been found to co-vary with water clarity, which reflects their trophic status (Rowe & Taumoepeau 2004). The lake-wide mean CPUE of larval smelt over the whole spawning season (December plus April data) was calculated for the 2014/2015 summer season and plotted against secchi disc depth to indicate any change in density, independent of changes in water clarity. The data for the 2014/2015 season were then compared to those for previous seasons to identify any marked change or long-term trends in larval smelt density.

3 Results

3.1 Smelt runs in the Ohau Channel

Runs of smelt up the Ohau Channel could potentially be influenced by water quality variables such as flow rate, water temperature and water clarity. Hence, these variables are measured when smelt sampling occurs even though Rowe et al. (2012) found no significant correlation between the incidence or size of smelt runs and the state of these variables.

Flow rates in the Ohau Channel on the days in 2014 and 2015 when smelt were being trapped were within the range for those recorded in previous years and were not noticeably higher or lower than in the past (Figure 3-1).

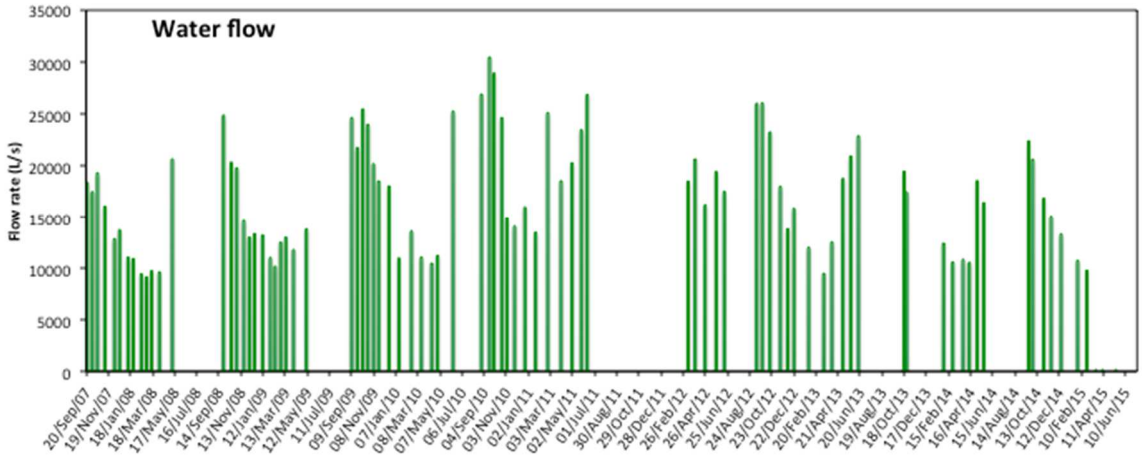

Figure 3-1: Flow rates in the Ohau Channel at the times when smelt were being trapped between 2007 and 2015.

Water clarity measurements taken in the Ohau Channel on the days when smelt were sampled during the September 2014 to May 2015 period were generally lower than those recorded between 2012 and 2014. However, they were comparable with those recorded between 2007 and 2011 (Figure 3-2). These water clarity records are snapshots obtained at the time of sampling and so may not always reflect longer term trends in the clarity of lake water entering the Channel. Nevertheless, the higher values noted over the past three years are thought to reflect an improvement in water quality in Lake Rotorua after 2011. The lower clarity in 2014/2015 is unlikely to have affected smelt runs in the Ohau Channel because previous investigations have found no relationship between the occurrence and/or size of smelt runs and water clarity within the range of values encountered in the Ohau Channel between 2007 and 2012 (Rowe et al. 2012).

Water temperatures in the Ohau Channel during the 2014/2015 season were higher in December 2014 than in the previous two seasons (Figure 3-3). The influence of water temperature on the timing and occurrence of smelt migrations up the Channel was examined in 2012 and although juvenile smelt runs occur mainly in the warmer summer months, there was no evidence that they are linked to a specific temperature threshold (Rowe et al. 2012). Hence, the warmer temperatures in 2014/2015 are not expected to have had any influence on the runs of smelt up the Channel in 2014/2015.

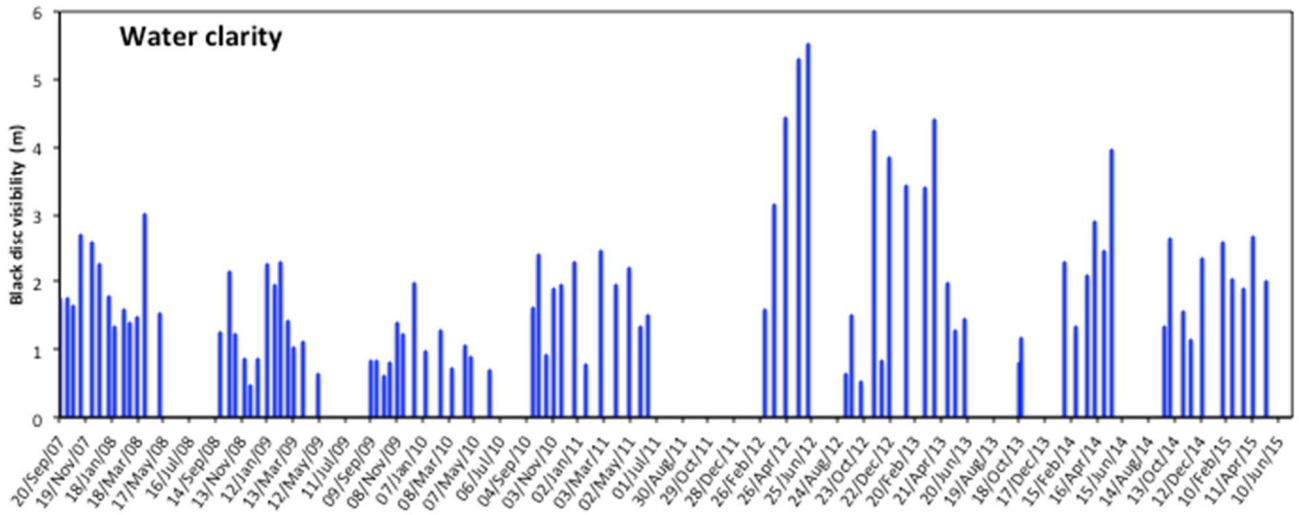

Figure 3-2: Water clarity (as measured by secchi disc depth) on the days when smelt were trapped between 2007 and 2015.

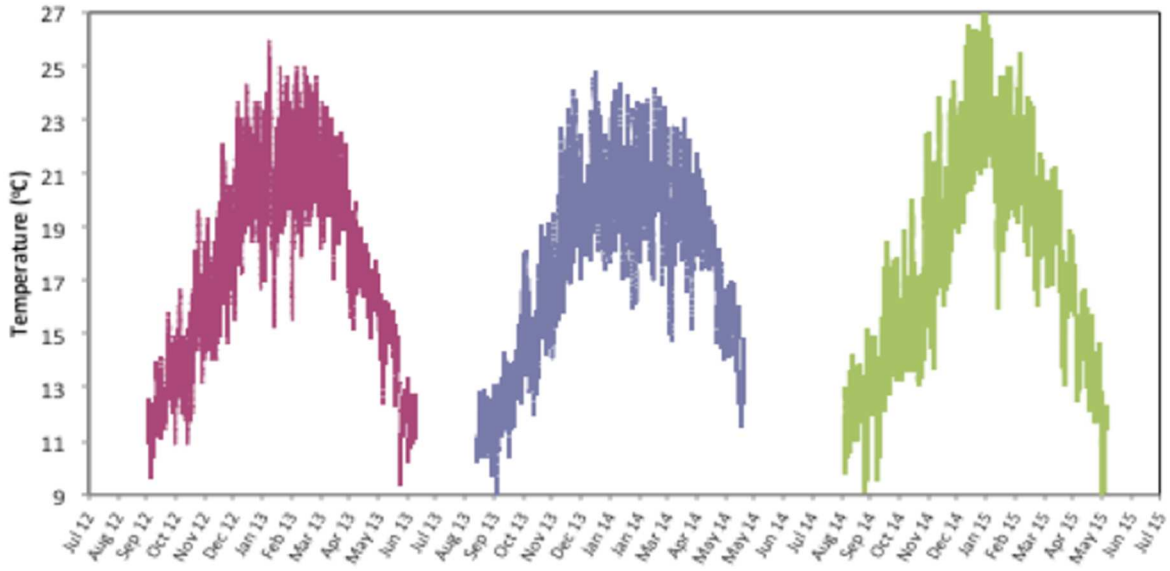

Figure 3-3: Water temperatures in the Ohau Channel during the sampling periods for 2012-2015.

A small run of mainly adult smelt was recorded in the Ohau Channel on 11th May 2015, but no runs of adults or juveniles were recorded by trapping in other months sampled during the summer 2014/2015 period (Figure 3-4). The May 2015 run was consistent with observations recorded by George Proud at the weir near the top of the Ohau Channel (Appendix 1). He noted the presence of 'lots of smelt' or a 'run of smelt' on the 2nd May, 5th May, 7th May and 9th May 2015. Hence, adult smelt were abundant in the Channel from the 2nd May until at least the 11th May in 2015, with this relatively 'long' run of adults being recorded by both quantitative (trapping) and qualitative (visual observation) methods. The observations indicated that there were no runs of smelt in the Channel on the other occasions when trapping occurred. However, runs of smelt were observed on 1st March 2015 and 12th April 2015 when no trapping occurred (Appendix 1).

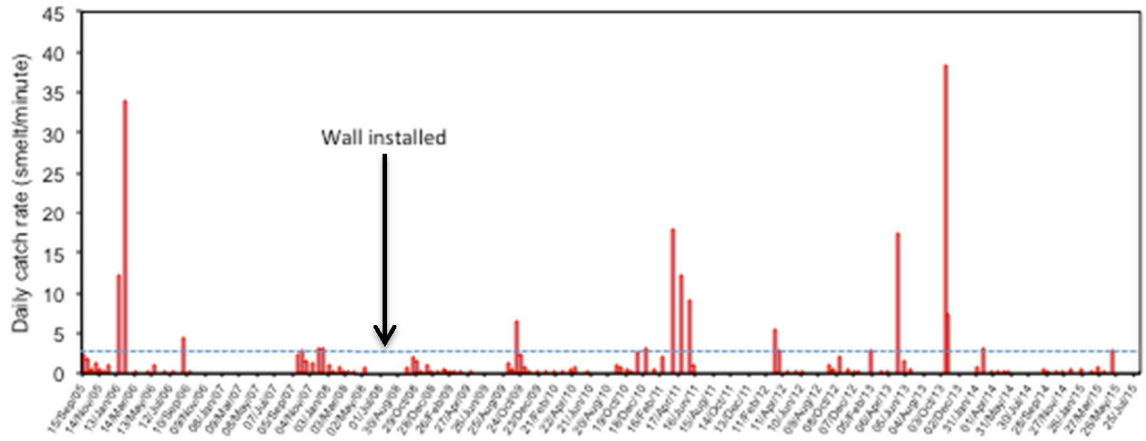

Figure 3-4: Smelt catch rates recorded in the Ohau Channel between 2005 and 2014 showing times when runs of smelt were recorded. The diversion wall was installed in July 2008 (solid black arrow). The CPUE threshold (2 smelt/minute) defining a run is shown by the blue-dashed line.

The mean percent of adult smelt trapped over the past 10 years (Figure 3-5) indicates that, whereas runs of adults can occur in most months of the year, they predominate in both spring (September, October, November) and autumn months (April, May, June). In comparison, juveniles only dominate in summer months (January, February, March) (Rowe et al. 2012, 2013).

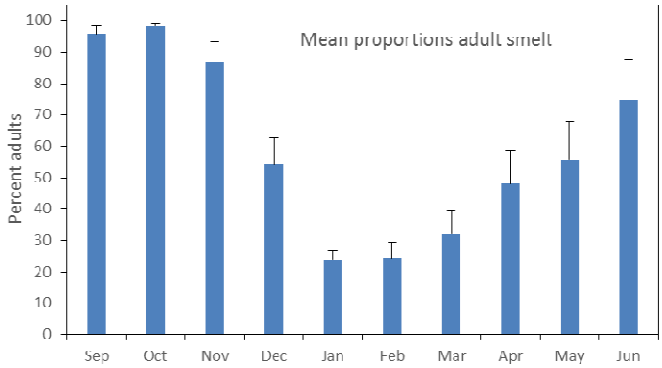

Figure 3-5: Mean percent composition of the smelt catch for each month over the period 2005-2014. Bars are standard errors.

Rowe et al. (2013) noted a gradual but statistically significant decline in the catch rates for common bullies over the seven year period between 2007 and 2013. However, the mean catch rate for bullies was higher in 2014 than in both 2012 and 2013 and the highest catch recorded to date occurred in 2015 (Fig 3-6).

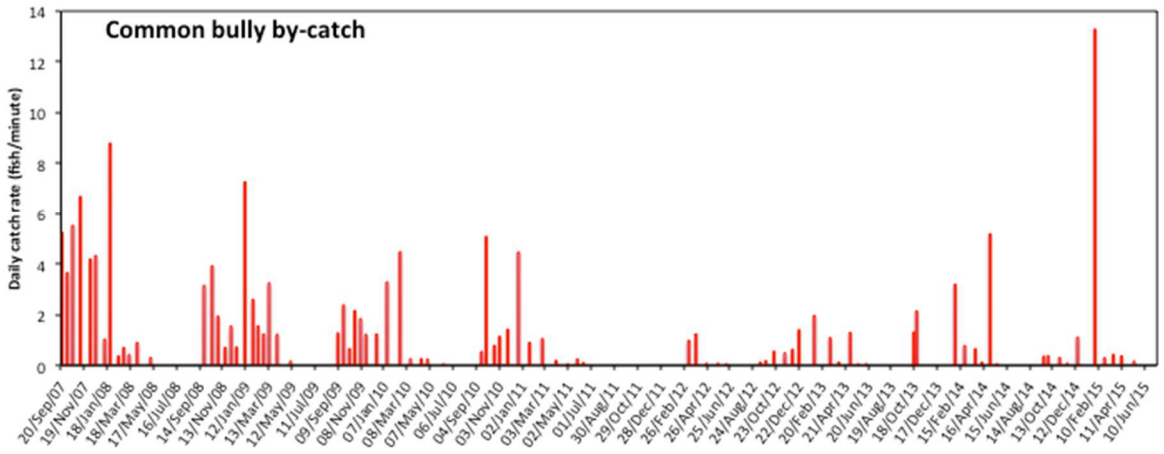

Figure 3-6: Catch rates for common bully in the Ohau Channel between 2007 and 2014.

3.2 Larval smelt densities in Lake Rotoiti

The catch rate of larval smelt in Lake Rotoiti was 3.29 larvae/net haul in December 2014 and 1.06 in April 2015 (Table 3-1). Over both months (i.e., for the 2014/15 season), the overall mean catch rate was 2.18 larvae/net haul. The higher density of larval smelt in December 2014 compared with April 2015 is in accordance with most of the previous years (Table 3-1).

Table 3-1: Mean catch rates of smelt larvae in Lake Rotoiti in December and April of each summer since 2005/06. Shaded cells indicate when a statistically significant (ANOVA, $P < 0.05$) and higher mean density occurred between the December (for spring spawning) and April (for summer spawning) samples.

Summer	Net hauls per survey	Mean catch rate (No. net^{-1} ± SE) per survey		
		December	April	Overall
2005/2006	15	0.60 ± 0.74	0.47 ± 0.52	0.53 ± 0.63
2007/2008	31	0.65 ± 1.28	0.94 ± 1.15	0.79 ± 1.22
2008/2009	31	1.00 ± 1.34	0.42 ± 0.76	0.71 ± 1.12
2009/2010	31	2.52 ± 1.39	1.68 ± 1.49	2.10 ± 1.49
2010/2011	31	0.81 ± 1.22	0.97 ± 1.14	0.89 ± 1.17
2011/2012	31	4.07 ± 0.48	2.58 ± 0.39	3.32 ± 0.32
2012/2013	31	10.50 ± 1.60	0.45 ± 0.14	5.47 ± 1.02
2013/2014	31	1.26 ± 0.19	2.45 ± 0.49	1.86 ± 0.27
2014/2015	31	3.29 ± 0.55	1.07 ± 0.23	2.18 ± 0.33

As there is a relationship between larval smelt abundance and water clarity across the Rotorua Lakes (Rowe & Taumoepeau 2004, Figure 3-7), larval density in Lake Rotoiti can be expected to increase as water clarity increases. The pattern of higher larval density in December versus April continued in the 2014/15 season and suggests that spring spawning dominates. On this basis, the low densities of larvae in December 2010 and 2013 would represent periods of poor spring recruitment due to either low levels of egg deposition, and/or to higher mortality of eggs laid.

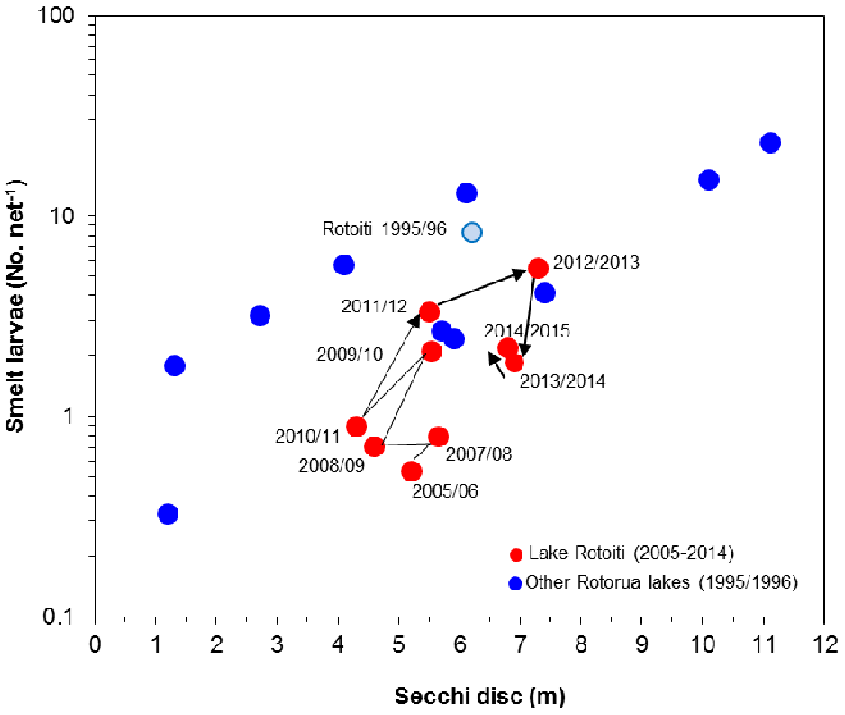

Figure 3-7: Abundance of smelt larvae in Lake Rotoiti in relation to mean secchi disc depth. Secchi disc depth in the Rotorua lakes is a measure of water clarity and is influenced mainly by plankton abundance and hence trophic status. Lakes with a high secchi disc depth are clearer and less productive than those with a low secchi depth (Note the log scale for larval smelt abundance).

4 Conclusions

Results obtained to date indicate that the diversion wall does not prevent smelt migrations up the Ohau Channel. Runs of both adult and juvenile smelt have continued to occur after the wall was constructed and some of these runs have been as large as those recorded before the wall was constructed. Some of the runs are also long in duration and last more than a day. Observations carried out by Mr G. Proud over the 2014/2015 season revealed a 7-8 day long run of mainly adult smelt up the Ohau Channel in early May 2015. This was consistent with the results of trapping, which also detected a run of smelt at this time. Runs of smelt were observed by Mr Proud on two other occasions during the 2014/2015 season when trapping was not scheduled. Collectively, the records of smelt runs up the Ohau Channel obtained in 2014/2015 reinforce and add to those obtained in previous years.

The relatively low level of larval recruitment recorded in Lake Rotoiti in December 2013 compared with April 2014 was expected to result in a small (or nil) run of adults in spring 2014 and a larger one in summer/autumn 2015 (Rowe et al. 2014). No run of adult smelt was recorded in spring 2014 and a large run of adults occurred in autumn 2015. There is therefore some consistency between the density of larval smelt in the lake and runs of smelt up the Channel in the following year. However, the available data are too few to confirm this and a much longer data set would be required to determine whether the size of smelt runs up the Channel is linked to the abundance of adults in Lake Rotoiti and ultimately to the level of recruitment in the preceding year.

Results obtained over the past eleven years also indicate that the timing, frequency, size and duration of smelt runs varies greatly. To date, there is no evidence that the frequency, timing, size or duration of smelt runs has changed over the past eleven years. However, the high variation in these characteristics indicates that long-term monitoring would be required to detect any decrease indicative of a long-term effect of the diversion wall.

The physical environmental variables and endogenous biotic factors which trigger runs of smelt (adults or juveniles) up the Ohau Channel are unknown. Although specific threshold values for flow, water clarity, water temperature and moon-phase have been ruled out, rapid changes in such values over time, or differences between the lake and channel water, both need to be considered. Research would be required to investigate and identify whether such factors stimulate a positive rheotactic response in juvenile and adult smelt in order to better understand the factors influencing the timing of the smelt migrations. If it were possible to identify the key environmental drivers, such knowledge could be used to develop a model to predict the runs of smelt up the channel and to determine whether the drivers are affected by the diversion wall.

5 References

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Appendix A Observations on smelt in the Ohau Channel made by George Proud

(Days when runs of smelt observed are indicated by blue highlighting. The occurrence of anglers catching trout is highlighted in green).

8/11/14	18.45pm. No shags, a few gulls and herons. No smelt. Two fisherman and no fish caught.
9/11/14	6.00am. Shags and gulls 5-10 and a few herons. No smelt. No fisherman and no fish caught.
10/11/14	7.30am. A few shags and gulls, no herons. No smelt. One fisherman and fish caught.
12/11/14	8.00am. A few shags, 10-20 gulls, no herons. No smelt. No fisherman and no fish caught.
15/11/14	19.00pm. No shags or gulls, a few herons. No smelt. No fisherman and no fish.
16/11/14	8.20am. 5-10 shags, many gulls (30-40), a few herons. No smelt seen. No fisherman and no fish.
17/11/14	7.30am. A few shags and gulls and no herons. No smelt. No fisherman and no fish.
22/11/14	9.15am. 5-10 shags and gulls and a few herons. No smelt. No fisherman and no fish.
23/11/14	7.00am. No shags or herons, a few gulls. No smelt. No fisherman and no fish.
24/11/14	7.00am. A few shags, no gulls or herons. No smelt. One fisherman and no fish caught.
25/11/14	6.30am. A few shags and herons, 5-10 gulls. No smelt. One fisherman and no fish caught.
29/11/14	8.00am. 5-10 shags, many gulls and a few herons. No smelt seen. No fisherman and no fish.
1/12/14	7.30am. 5-10 shags, 10-20 gulls and a few herons. No smelt seen. No fisherman and no fish.
3/12/14	7.30am. 5-10 shags, 10-20 gulls and a few herons. No smelt. One fisherman and no fish caught.
3/12/14	20.00pm. A few shags, gulls and herons. No smelt. No fisherman and no fish.
6/12/14	19.30pm. No shags, a few gulls and herons. No smelt. Two fisherman and no fish caught.
7/12/14	7.30am. A few shags and gulls, no herons. No smelt. Four fisherman and fish caught.
13/12/14	7.00am. A few shags and gulls, no herons. No smelt. No fisherman and no fish.
14/12/14	7.30am. A few shags and herons, 10-20 gulls. No smelt. No fisherman and no fish.
14/12/14	20.00pm. A few shags and herons, no gulls. No smelt. No fisherman and no fish.
1/03/15	7.00am. 5-10 shags, a few gulls and no herons. A run of smelt. No fisherman and no fish.
8/03/15	9.00am. A few shags and gulls, no herons. No smelt. No fisherman and no fish.
15/03/15	8.15am. No shags, a few gulls and herons. No smelt. One fisherman and no fish caught.
21/03/15	7.50am. A few shags and herons, no gulls. No smelt. No fisherman and no fish.
21/03/15	18.10pm. No shags, a few gulls and herons. A few smelt. No fisherman and no fish.
22/03/15	7.45am. A few shags and gulls, no herons. No smelt. Three fisherman and no fish caught.
30/03/15	18.00pm. No shags or herons, a few gulls. No smelt. No fisherman and no fish.
4/04/15	17.45pm. No shags, 5-10 gulls and a few herons. No smelt. No fisherman and no fish.
12/04/15	7.20am. 5-10 shags and gulls and a few herons. A run of smelt. One fisherman and fish caught.
12/04/15	17.15pm. 10-20 shags, 5-10 gulls and herons. No smelt. Two fisherman and no fish caught.
16/04/15	17.30pm. A few shags and herons, no gulls. A few smelt. No fisherman and no fish.
19/04/15	17.35pm. 5-10 shags and herons, a few gulls. No smelt. One fisherman and no fish caught.
20/04/15	8.00am. 10-20 shags and gulls and a few herons. No smelt. Four fisherman and fish caught.
25/04/15	7.00am. A few shags and herons, 10-20 gulls. No smelt. Three fisherman and no fish caught.
26/04/15	7.30am. 10-20 shags and gulls and a few herons. No smelt. Four fisherman and fish caught.
2/05/15	7.30am. 10-20 shags, many gulls and a few herons. A lot of smelt. One fisherman and no fish.
3/05/15	17.00pm. 10-20 shags, many gulls and a few herons. A few smelt. No fisherman and no fish.
5/05/15	17.15pm. 5-10 shags and gulls and a few herons. A run of smelt. One fisherman and no fish caught.
7/05/15	7.30am. 5-10 shags and herons, 10-20 gulls. A lot of smelt. One fisherman and fish caught.
9/05/15	7.45am. 10-20 shags and gulls, 5-10 herons. A lot of smelt. Four fisherman and fish caught.
9/05/15	18.00pm. A few shags and herons, 5-10 gulls. A lot of smelt. Two fisherman and fish caught.
21/05/15	17.30pm. A few shags, no gulls or herons. No smelt. One fisherman and no fish caught.
24/05/15	8.15am. Many shags, 10-20 gulls and a few herons. No smelt seen. Three fisherman, no fish caught.
27/05/15	17.30pm. 5-10 shags, no gulls and a few herons. No smelt. No fisherman and no fish.
30/05/15	17.20pm. A few shags and gulls and no herons. No smelt. No fisherman and no fish.
31/05/15	17.00pm. A few shags and herons, no gulls. No smelt. Three fisherman and no fish caught.
7/06/15	8.30am. A few shags and gulls and no herons. A few smelt. Four fisherman and fish caught.
7/06/15	17.00pm. A few shags and herons, no gulls. No smelt seen. Two fisherman and fish caught.
8/06/15	18.30pm. A few shags and herons, no gulls. No smelt. Two fisherman and fish caught.
13/06/15	7.30am. Many shags, a few gulls and herons. No smelt seen. One fisherman and no fish caught.

13/06/15	17.30pm. A few shags and herons, no gulls. No smelt seen. No fisherman and no fish.
18/06/15	17.30pm. No shags or gulls and a few herons. No smelt. No fisherman and no fish.
21/06/15	7.30am. 5-10 shags, 10-20 gulls and a few herons. No smelt seen. No fisherman and no fish.
21/06/15	17.15pm. No shags or gulls and a few herons. No smelt. No fisherman and no fish.
24/06/15	18.30pm. No shags or gulls and a few herons. No smelt. One fisherman and fish caught.
27/06/15	7.30am. A few shags and herons, 5-10 gulls. No smelt. Seven fisherman and fish caught.
28/06/15	17.15pm. A few shags and herons, no gulls. No smelt. No fisherman and no fish.
29/06/15	17.30pm. A few shags and herons, no gulls. No smelt. Three fisherman and fish caught.