Mellish Stream salmon age and likely freshwater residency patterns

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Introduction

Chinook salmon (*Oncorhynchus tshawytscha*) were introduced to New Zealand, likely from a single California population in about 1905 having since developed a number of different life history traits (Quin and Unwin 1993). One such trait is variable freshwater residency times prior to an ocean migration. Within the Rakaia River salmon population a subset consisting up to 25% of the entire catchment run spawn in Mellish Stream, a tributary of Lake Heron. Within Lake Heron there is also population of lake resident adult fish.

By assessing the age of otoliths and examining otolith structure this study aims to explore what proportion of the lives of salmon returning to spawn in Mellish Stream is spent within Lake Heron.

Methods

During November 2018 33 salmon were caught from Lake Heron, and over the 2018 and 2019 spawning seasons (May to June) 68 post spawning salmon were sampled from Mellish Stream.

Otoliths from all fish were aged twice, firstly by counting annual bands within whole otoliths under transmitted light as in Flain and Glova (1988)(Figure 1), and then secondly after being cut and polished in the transverse plane to reveal the core region (Figure 2).

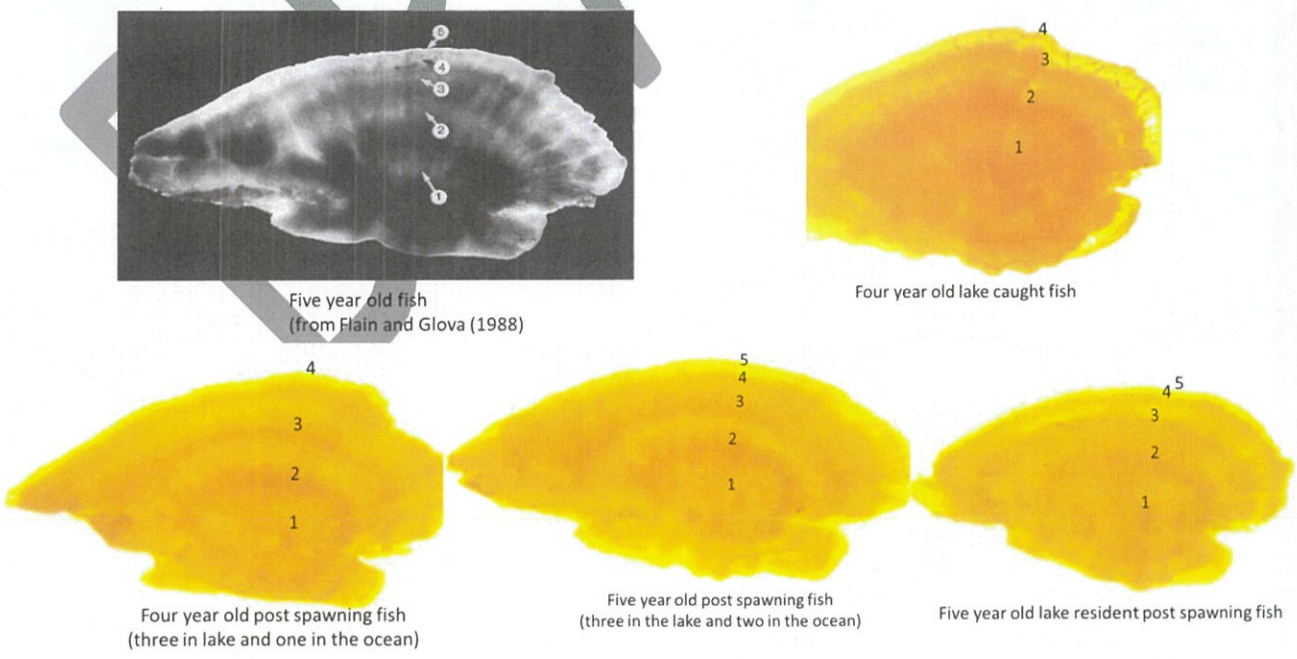

Figure 1: Examples of salmon otoliths aged whole under transmitted light. (Note: otolith sizes not shown to scale)

The widths between the bands radiating out from the core of the sectioned otoliths were measured to give an indication of likely freshwater residency times. Although influenced by a number of metabolic processes and external influences such as temperature, it is assumed otolith growth will be faster in fish living in the ocean compared to those living in a high altitude freshwater lake. Hence the annual bands from the lake fish were used as a reference against those from the post spawning fish. Any bands significantly wider than the freshwater average for that age were considered to have been formed while within the ocean (Figure 2).

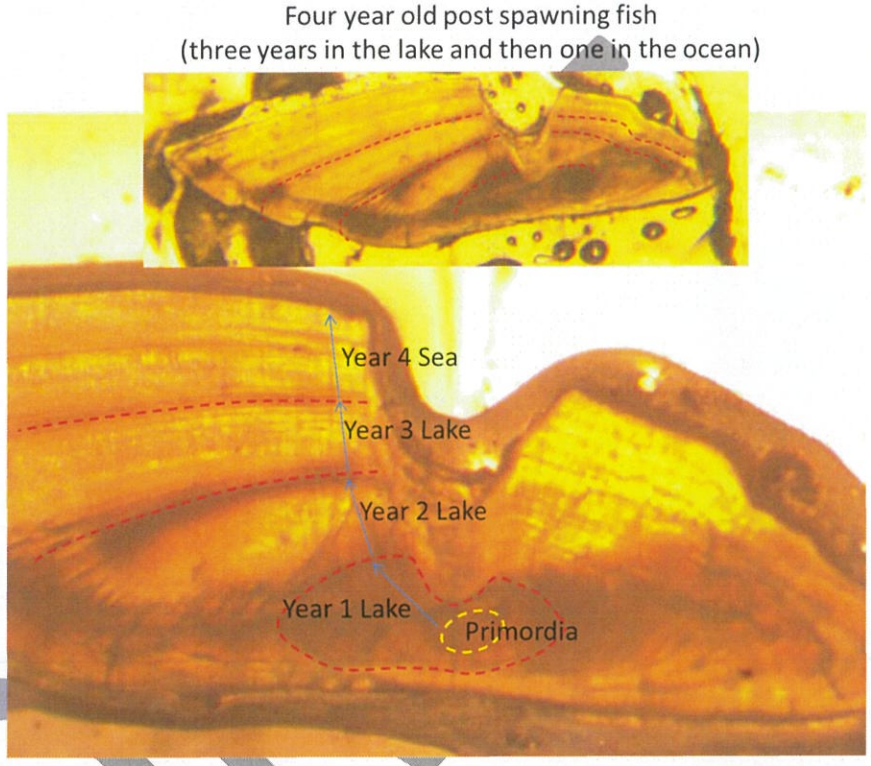

Figure 2: An example of an otolith from a post spawning salmon aged following sectioning through the transverse plane. Note that the year four band is proportionately wider than would be expected from freshwater residency.

Results

Lake Fish

Of the 33 salmon caught from Lake Heron 13 fish were considered to be two years old, 18 three years old and two four years old (Figure 3).

Because these fish were caught in November, the area of growth beyond the final visible band close to the outside edge of each sectioned otolith is interpreted as representing perhaps three to four months of spring growth prior to being caught. This growth is considered additional to the ages reported above.

Post spawning fish

Of the 68 salmon sampled post spawning, 42 fish were considered to be three years old, 24 four years old and two five years old (Figure 3).

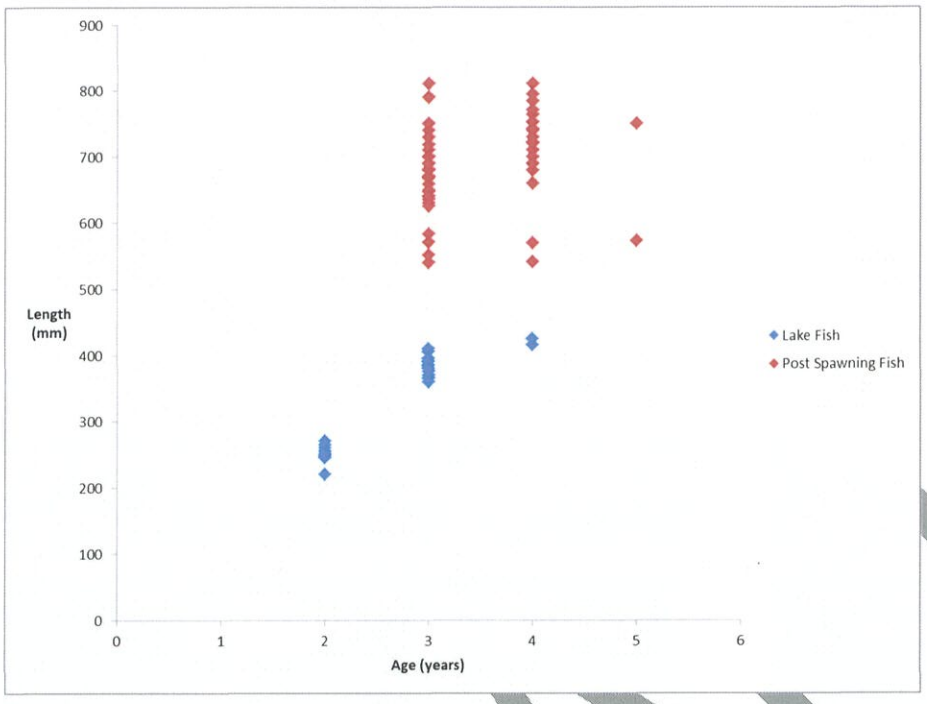

Figure 3: Age vs length of lake caught and post spawning salmon

Annual band widths within these fish suggested 42 spent two years in the lake and then one in the ocean, 18 spent three years in the lake and then one in the ocean, six spent two years in the lake and then two in the ocean, one spent three years in the lake and then two in the ocean and one fish appeared to spend all five years of its life in the lake (Figure 4).

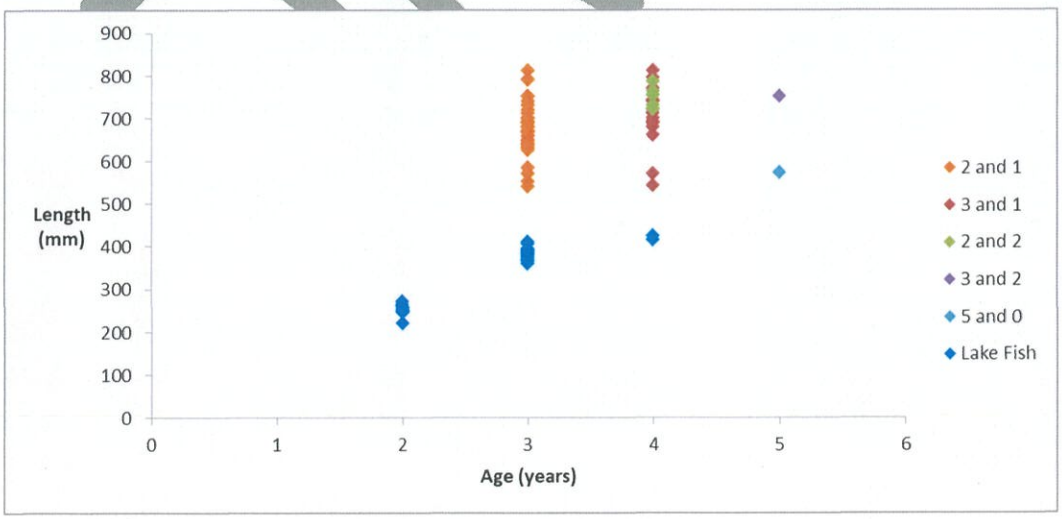

Figure 4: Age vs length of lake caught and post spawning salmon with the post spawning fish sub grouped by time spent in the lake, for instance "2 and 1" fish spent two years in the lake and one in the ocean before returning to spawn.

Discussion

In a meta-analysis of Central South Island rivers Quin and Unwin (1993) found among all populations and sexes, 58 to 80% of salmon matured at age three. Generally four-year-olds were the next most numerous group, while only 1 to 5% matured at two years of age, and none of the populations examined contained more than 0.4% five year olds.

Of the post spawning salmon examined in this work, 62% were considered to be three years old, 35% four years old, and 3% five years old. No two year olds were found. It is reasonable to conclude that although generally matching the age structure of South Island salmon populations, the salmon spawning in Mellish Stream are on average older than those of other populations.

Flexible freshwater residency patterns is a trait of Chinook Salmon populations worldwide, two general types are accepted, ocean type and stream type, but even within stream type populations, spending more that the first year of their lifecycle within freshwater is unusual. All of the salmon spawning in Mellish stream appeared to have spent at least the first two (71%) or three (28%) years of their life in freshwater. One individual or 1% of the population appeared not to have left the lake, or at least left for a very short period prior to spawning. 88% of all Mellish salmon returned to spawn having spent only one year in the ocean while 10% spent two years.

Thus, it is the lake component of their lifecycle that is lengthening the age of Mellish Stream salmon, while ocean residence is only for a comparatively short period of time. Having spent at least two years in Lake Heron is likely to have benefits for these fish when an ocean migration is made. Due to their larger size upon entering the sea, Lake Heron salmon are likely to have comparatively high survivorship and growth rates. Regardless, this life history variation, differing from other Rakaia River salmon sub populations, is likely to add strength to catchment wide recruitment processes occurring over multiple seasons.

From a fisheries perspective it seems prudent to manage the Lake Heron population conservatively under the assumption that fish living within the lake may eventually contribute to a significant portion of the wider Rakaia fishery.

References

Flain M. and Glover G.J. (1988) A test of the reliability of otolith and scale readings of Chinook salmon (*Oncorhynchus tshawytscha*), New Zealand Journal of Marine and Freshwater Research, 22:4: 497-500.

Quin T.P. and Unwin M.J. (1993) Variations in Life History Patterns among New Zealand Chinook Salmon (*Oncorhynchus tshawytscha*) Populations, Can. J. Fish. Aquat. Sci. 50: 1414-1421.