

# What can vaterite on Chum salmon (*Oncorhynchus keta*) smolt otoliths tell us about accurate fish length and survival?



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## Introduction

Chum Salmon (*Oncorhynchus keta*) have a distinctive life history and are very abundant in Pacific waters. Hatcheries release millions of salmon smolts into the wild every year making them an important part of marine and human food webs. Chum salmon generally enter the ocean at a small size making them easy prey and susceptible to environmental pressures. Fish release from hatcheries tend to be larger than their wild counterparts, and may have differences such as frequency of vaterite amounts on otoliths.

- Vaterite is a polymorph of CaCO<sub>3</sub> that eats away at teleost otoliths and morphs structure
- Vaterite may be more prevalent among hatchery salmon
- Determining the amount of vaterite on teleost otoliths can help determine where the fish originated
- When otoliths are the only part of a fish remaining, knowing the relationship between otolith and fish length can allow us to estimate fish length



Figure 1. One of the hatchery Chum salmon smolts used in sample.

## Objective

The objective of this study is to analyze the relationship of body length to otolith length in Chum salmon smolts, and to determine vateritic variations on otoliths when fish are subject to selective pressure.

## Methods

Chum salmon smolts were obtained via beach seine, DIPAC Salmon Hatchery, and from predator stomach contents of Dolly Varden and Staghorn Sculpin (see figure 1). Otoliths were extracted from the Chum salmon smolts and measured for length and categorized for vaterite amount. They were then mounted to glass slides, ground, and read at the ADF&G Mark, Tag, and Age Lab as shown in Figure 2.

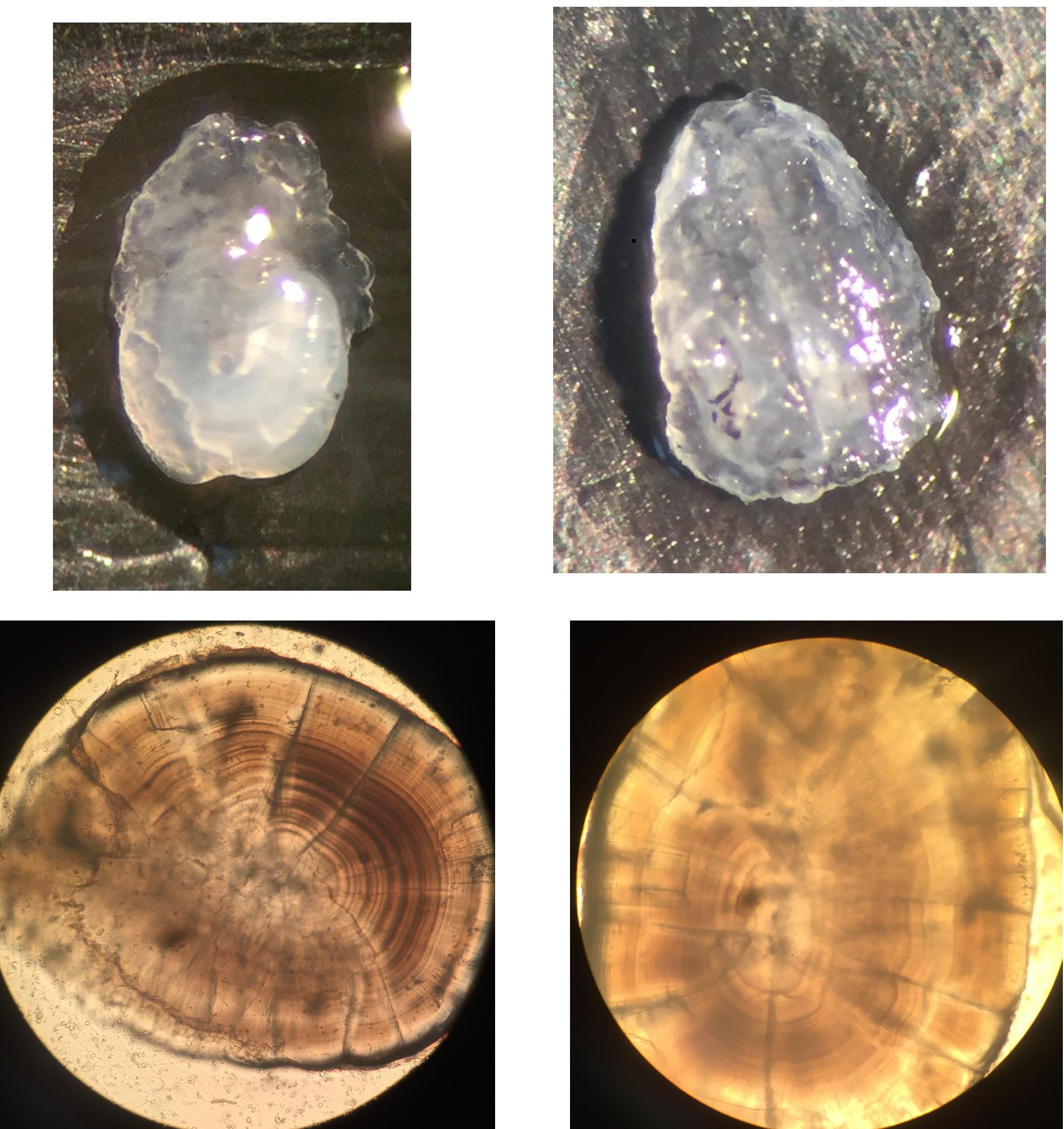


Figure 2. Chum salmon otoliths. (Top Left) shows a category 2 vateritic otolith with a significant amount of vaterite growth on the tip of the otolith. (Top right) Shows a category 1 vateritic otolith where the center is normal opaque surrounded by vaterite structure. (Bottom Left) Wild Chum Salmon otolith after mounting and grinding. (Bottom Right) Hatchery Chum Salmon otolith after mounting and grinding. This allowed us to accurately compare hatchery origin salmon.

## Results

Hatchery salmon have a higher frequency of vaterite (shown on Figure 3) than salmon found in the beach seine or prey stomachs. Salmon from beach seines show low amounts of vaterite compared to prey and hatchery salmon. Prey salmon mainly showed low amounts of vaterite, although few showed higher vaterite levels.

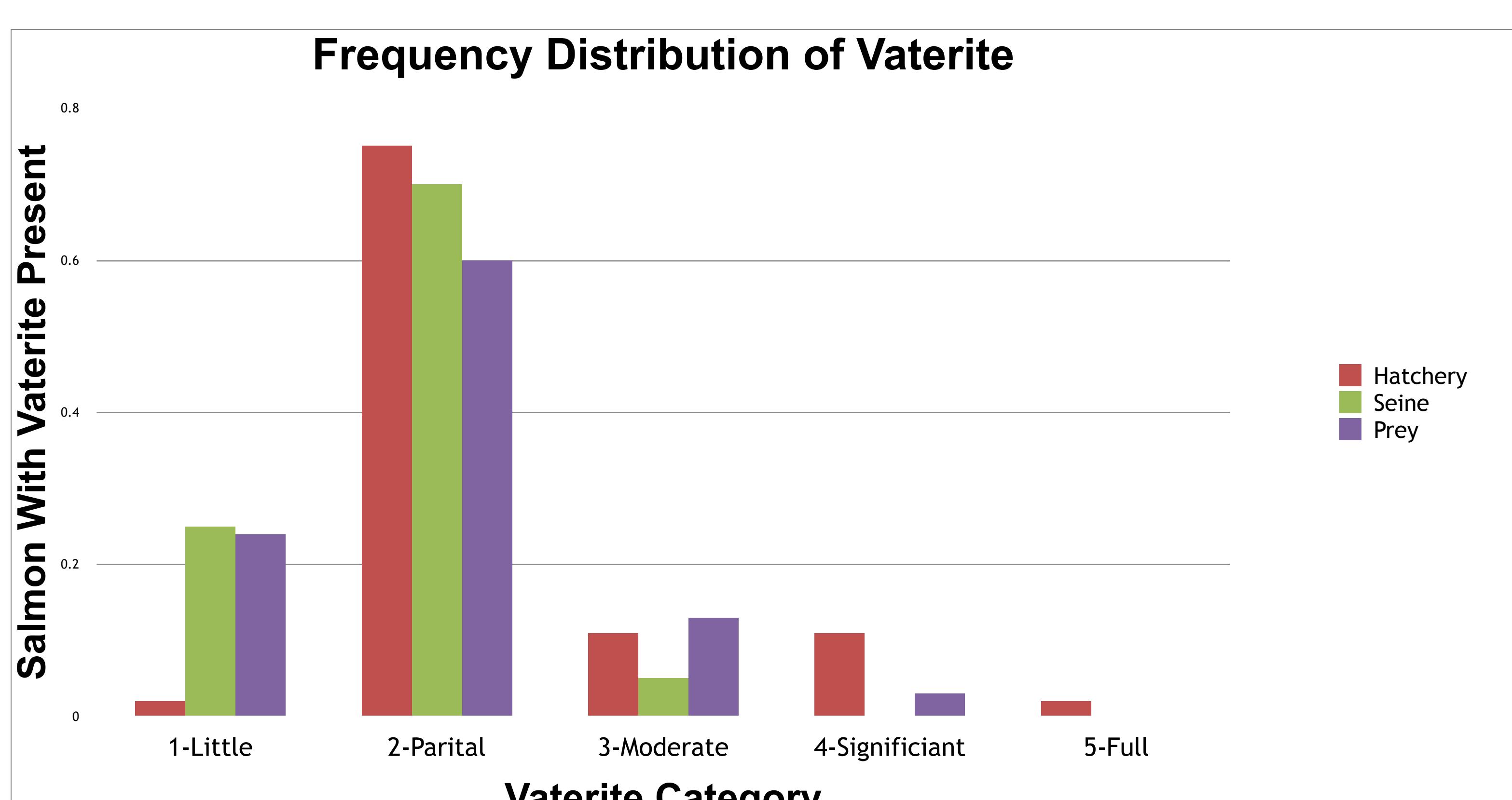


Figure 3. Vaterite amounts among hatchery salmon from the hatchery, beach seining, and predator stomachs, ranking 1 (lowest)- 5 (highest).

Using a chi-squared test for independence we found the amount of vaterite present on the otolith and the location of the fish were not independent of one another (P-values: hatchery/predator stomach 1.313E-59, hatchery/beach seine; 1.356E-53, predator stomach/beach seine; 0.0475, chi-squared value= 26.58, hatchery n=64, beach seine n=40, prey n=99). the frequencies of vaterite on otoliths.

There is a moderately positive relationship between standard fish length and otolith length. The outliers in figure 4 show otoliths with high amounts of vaterite. This suggests that vaterite on otoliths obscure the accuracy of otolith length.

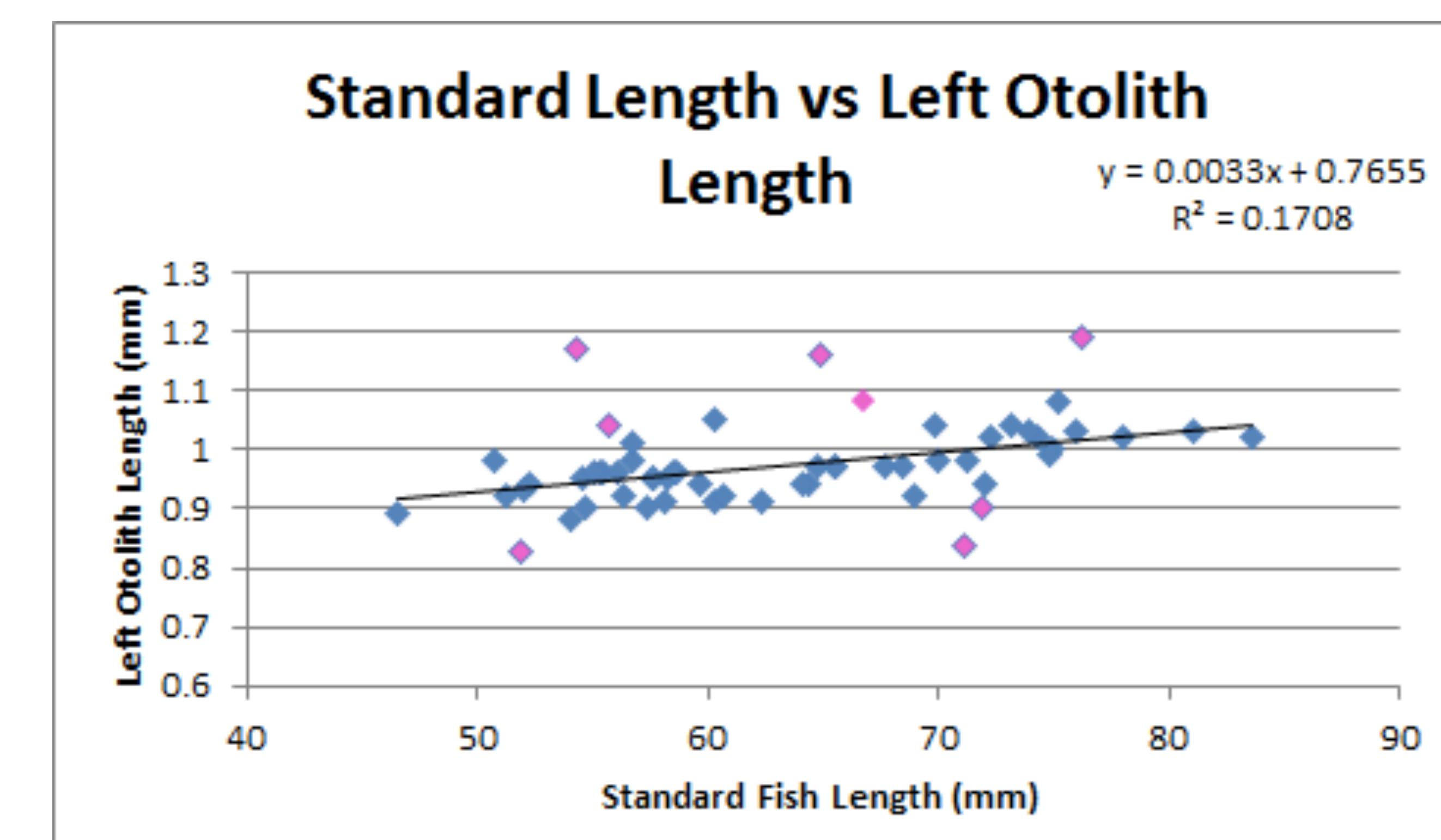


Figure 4. Linear regression of hatchery fish standard length with the length of the left otoliths. This generated an R-squared value of.

In continuing this project, vaterite on wild and hatchery salmon will be examined and the relationship of body and otolith length on wild salmon as well.

## Questions Raised By This Research

- What environmental factors cause vaterite to occur and at what rate?
- What overall effect does vaterite have on teleosts health?

## Acknowledgments

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