Assessing ^{88}Sr Concentration and $^{86/87}$Sr Ratio Variations in Rainbow Smelt Otoliths using Laser Ablation Mass Spectrometry

URSA
UNDERGRADUATE RESEARCH & SCHOLARLY ACTIVITY

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Research Objective

Examine variations in Rainbow smelt otolith core and edge ^{88}Sr concentrations across marine and freshwater sites.

Figure 1.- Rainbow Smelt from Prudhoe Bay, AK.

Introduction

This study aims to understand the life history of Rainbow Smelt *Osmerus mordax* in the nearshore waters of the Beaufort Sea, a species that is data limited throughout the state of Alaska. Understanding Rainbow Smelt life history is critical for creating a holistic picture of the Arctic marine ecosystem. The Rainbow Smelt found in the Beaufort Sea and surrounding estuaries are anadromous[3], breeding and spawning in freshwater, with adults being found in rivers, estuaries, and marine waters. They are an important cultural resource as they serve as a food source for predators, like Ringed Seals[4] *Pusa hispida* and Chinook Salmon[2] *Oncorhynchus tshawytscha*. Our objective is to analyze Rainbow Smelt otolith ^{88}Sr concentrations and $^{86/87}$Sr ratios to gain a better understanding of their life history, using a Laser Ablation Multi Collector Inductively Coupled Mass Spectrometer (LA-MC-ICPMS) system. This beam-based method uses small beam diameters that allows for high spatial resolution and will help produce detailed chronologies of isotopic variation over the fish's lifetime. We hypothesize that otoliths from marine sites will exhibit higher ^{88}Sr concentrations and $^{86/87}$Sr ratios at the edge of the otolith compared to freshwater sites.

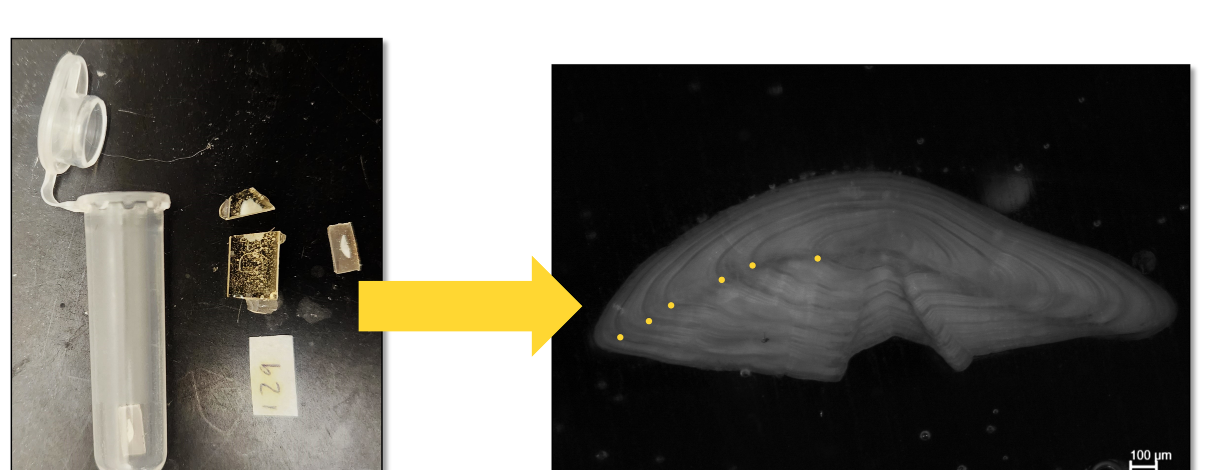

Figure 2.- Thin section of whole otoliths are digitized for aging. This fish was aged at six years old.

Methods

- Rainbow Smelt samples were collected in the summer months of 2022 (n=150) and 2023 (n=177). Data gathered included: total length, total weight, sex, sexual maturity, and sagittal otolith removal.
- A subsample of otoliths (n=80) will be taken for stable isotope analysis (SIA) to investigate ^{88}Sr concentrations. Subsamples are chosen to represent various life histories in both males and females.
- Preparation of samples for SIA is in conjunction with fish aging methods where otoliths are encapsulated in epoxy resin, cut transversely into a thin sections and aged by counting the annuli on the otolith as depicted in Figure 3. An additional step of mounting the thin section for stable isotope analysis then occurs.
- Figure 3 illustrates the process of preparing individual samples and mounting multiple otoliths for SIA to streamline processing. By increasing the number of otoliths that can be loaded into the instrument, the total time and cost of beam-based analyses can be reduced[1].

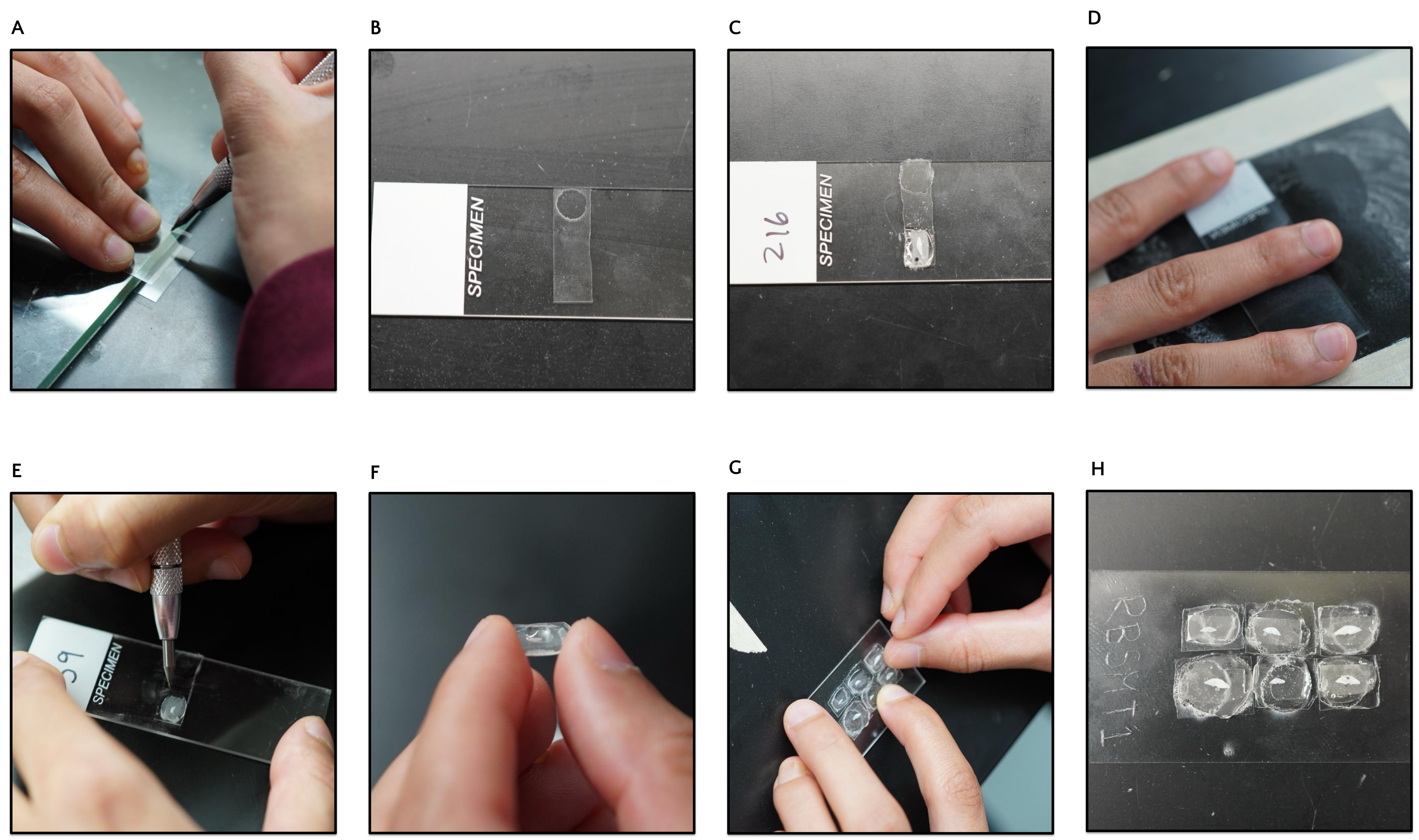

Figure 3.- To mount multiple otoliths for beam-based microchemical analysis, **A** score a cover glass with a diamond tipped scribe to slice into three strips, **B** attach one end of the glass strip to a microscope slide, **C** mount the otolith thin section in in thermoplastic resin on the free edge of the glass slip, **D** polish the mounted otolith using 800 and 3000 grit paper, **E** score the glass strip to cut and free the otolith from the slide, **F** apply cyanoacrylate glue to free otolith mount, **G** and affix otolith to slide. Petrographic slides **H** can hold up to nine otoliths for stable isotope analysis.

Future Research

We will be using the LA-MC-ICPMS system the week of April 14, 2024, to measure the ^{88}Sr concentrations and $^{86/87}$Sr ratios of 80 Rainbow Smelt otoliths. We will graph the data from the spectrometry in R and analyze potential life history trends. Continued yearly data collection of Rainbow Smelt otoliths in the future could increase our understanding of their life history, as well as the potential current and future effects of climate change on their habitat usage.

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Alaska Stable Isotope Facility

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