Growth Chronology of Lenses in Whitefish Species

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Introduction

- It is important to understand the life history and ecology of Whitefish species as they provide a source of food for marine mammals, birds, larger fish and humans.
- Eye lens data can be used to gain an understanding of fish feeding and migration patterns. To understand the full scope of the information that comes from the lens, it first must be known how lens grow and change throughout the fishes' lifetime.
- The objective of this study is to gauge if there is a relationship between the growth of the fish in both age and fork length.
- Knowing the correlation between these two variables provides the foundation for future research into migration patterns and habitat usage.

Fig. 1. Humpback Whitefish

Fig. 2. Least Cisco Whitefish

Methods

- Fish were caught with gill nets from four sites. These sites correspond to the historically sampled sites of the Beaufort Sea Long Term Nearshore Fish Monitoring Program[1], which has been ongoing since the 1980s.
- Fork length (length between head and fork in tail), eye lenses, and otoliths were collected on site then frozen and transferred.
- In the laboratory the lenses and otoliths were set in epoxy and later sectioned for access to the lamina and annuli, respectively.
- The epoxy cross sections were imaged using a Leica DFC425 camera mounted to a Leica M165 C microscope at a magnification of 2.5. The photographs were then analysed.
- Otolith annuli were counted to determine fish age (years). The lens were measured and the lamina counted.
- Using R-2.3.3[2] coding program, the data were analyzed and graphed.

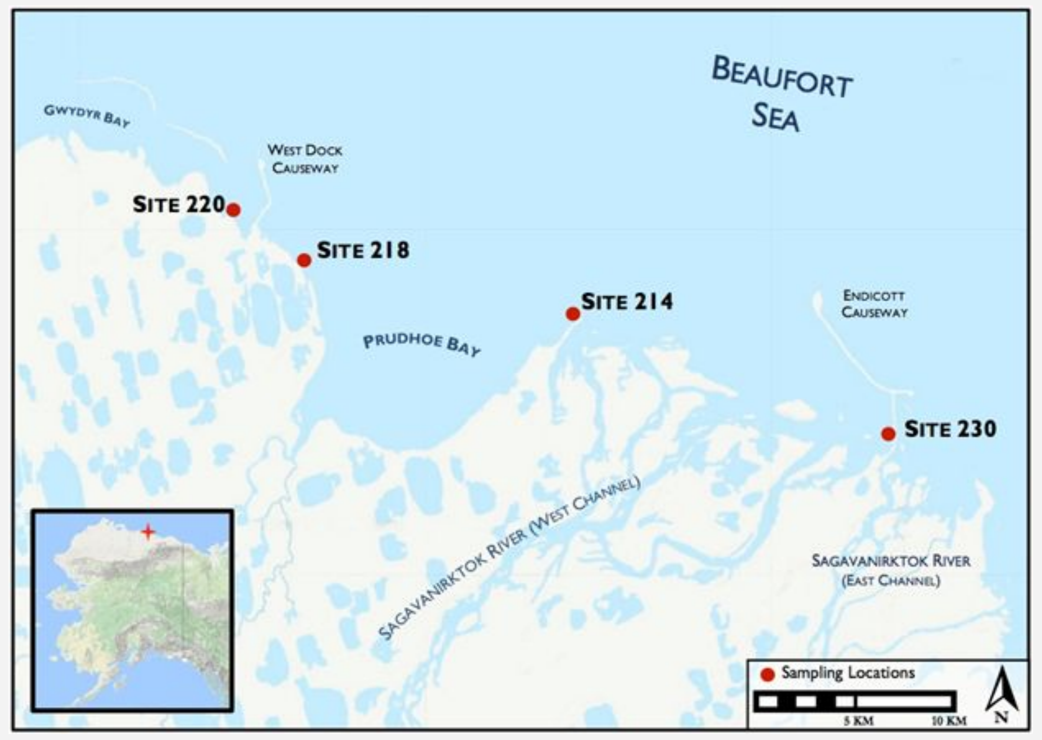

Fig. 3. Sites from which samples were obtained.

Results

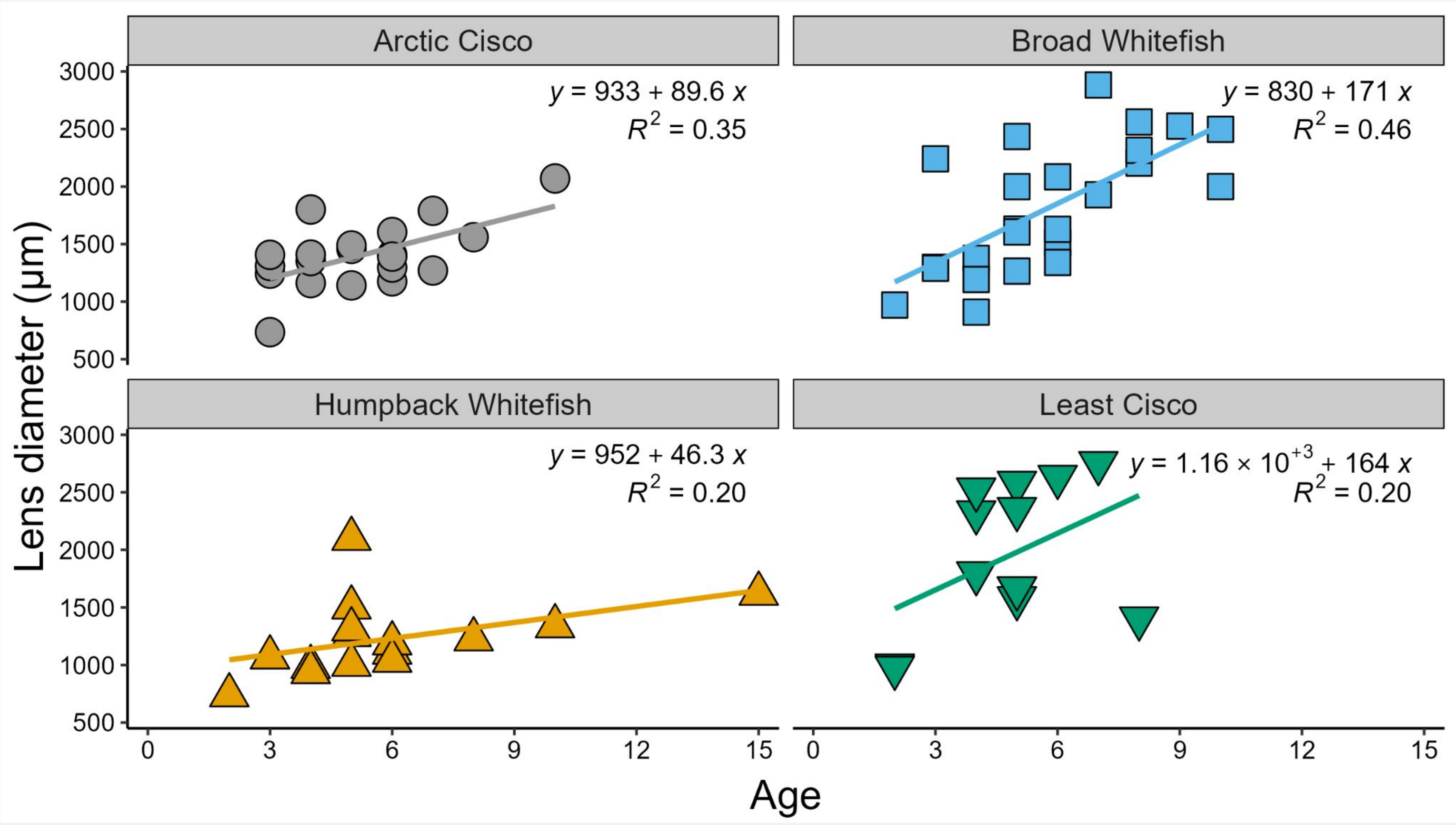

Fig. 4. The comparison between age of fish and the diameter of the eye lens. Arctic Cisco n=23, Broad Whitefish n=34, Humpback n=16, Least Cisco n=20.

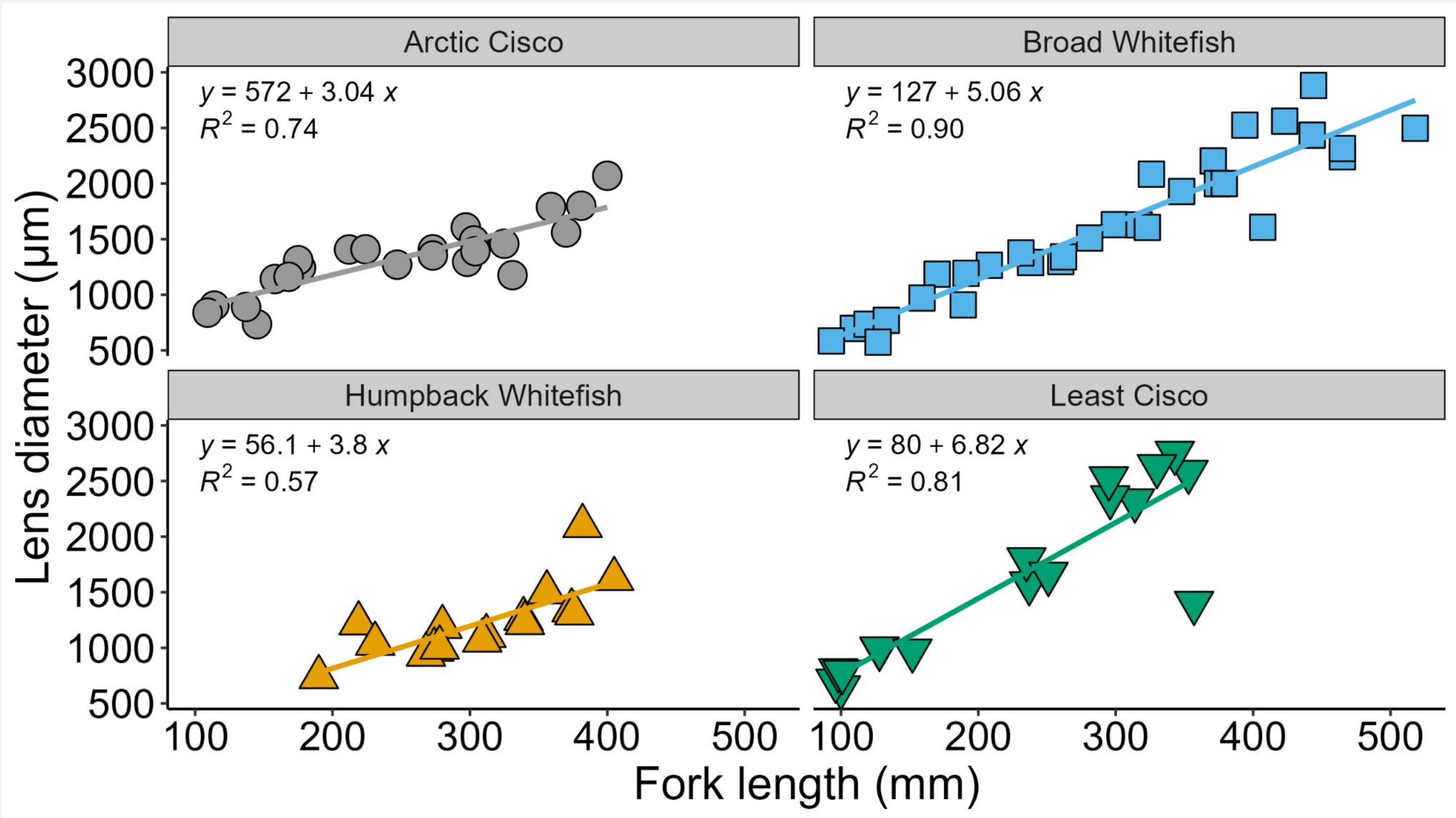

Fig. 5. Fork length and lens diameter between the four whitefish species. Arctic Cisco n=23, Broad Whitefish n=34, Humpback n=16, Least Cisco n=20.

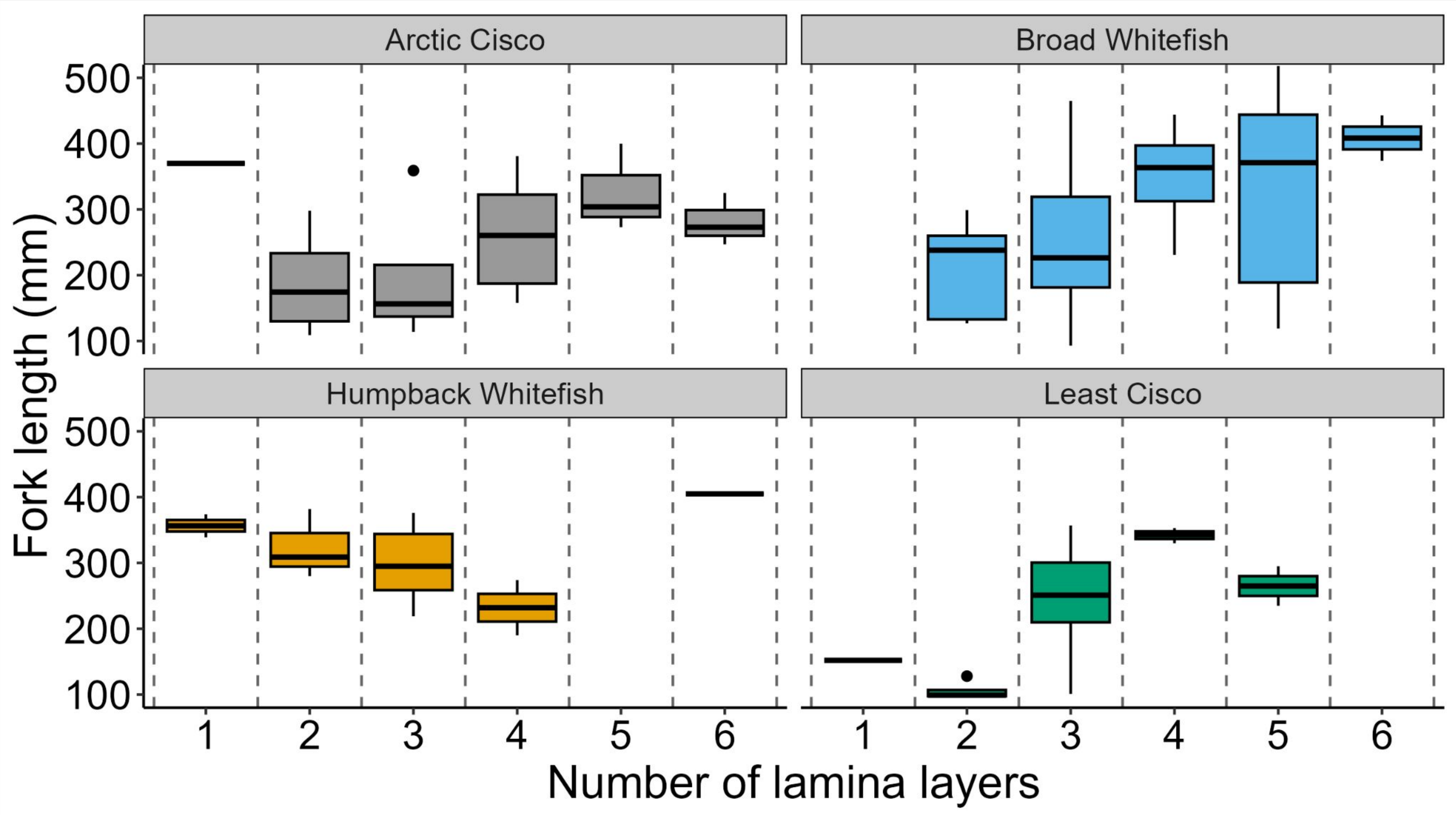

Fig. 6. Number of lamina and the fork length of the fish. Arctic Cisco n=23, Broad Whitefish n=34, Humpback n=16, Least Cisco n=20.

Discussion

- The fish were randomly selected. Age was unknown until the otolith analysis was completed so equal representation of all age groups is limited.
- Observing the trendline we can infer that there is a significant positive relationship between diameter of lens and age of fish (Fig. 4).
- The relationship between diameter of lens and fork length is strongly positively correlated (Fig. 5).
- These data indicate that the lens grows as the fish ages but not as the fork length increases.
- In all species studied, the correlation between fork length and number of lamina is not strong (Fig.6).

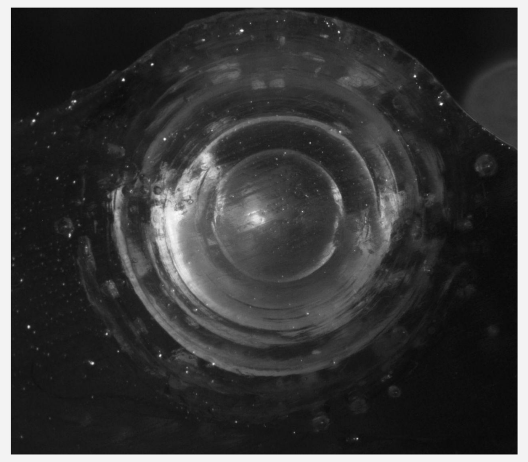

Fig. 7 Cross sectioned eye lens

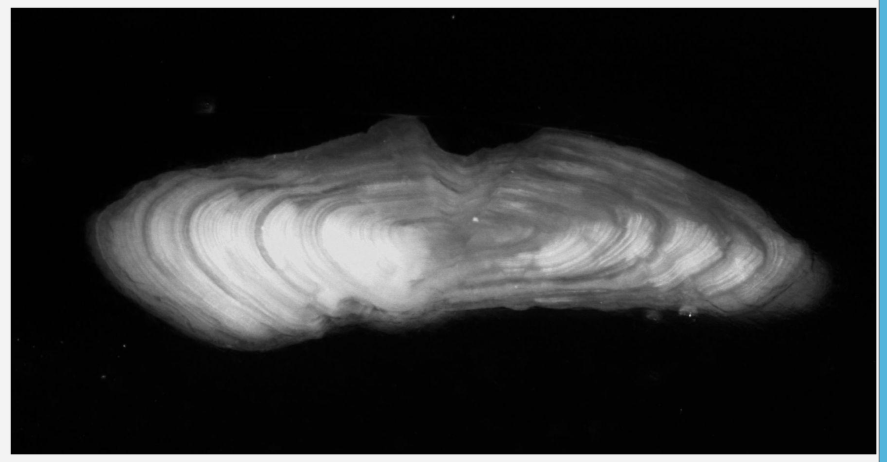

Fig. 8. Thin sectioned otolith

Future Directions

- Explore alternative methods of lens preservation and lamina determination.
- Increase sample size to allow for the determination of the rate of lens diameter increase in relation to age and fork length.
- Understand migration patterns[3], habitat usage, and trophic dynamics within the four whitefish species using lenses, map stable isotopes and other chemical makers.
- Using stable isotope mapping and climate data, research changes in Whitefish migration and other disturbances in life histories.

Fig.9. Arctic Cisco

Fig.10. Broad Whitefish

Citations

1. https://www.north-slope.org/wp-content/uploads/2022/05/Year_31_of_the_Long_Term_Monitoring_of_Nearshore_Beaufort_Sea_Fishes_in_the_Prudhoe_Bay_Region_2013_Annual_Report.pdf
2. https://posit.co/download/rstudio-desktop/
3. https://www.sciencedirect.com/science/article/pii/S027843431830205X

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