Early life history of juvenile sablefish using eye lens stable isotopes and trophic discrimination factors: An experimental lab study

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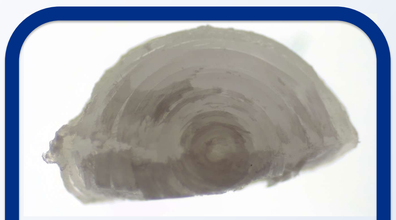
Background

- Sablefish (*Anoplopoma fimbria*) are a commercially important, deep water species, with early life stages occupying coastal shallow water habitats.
- Eye lenses are formed in sequential layers, like an onion, that store isotopic information about carbon sources and relative trophic position. Eye lens diameter is highly correlated to fish length, so we can tell roughly at what size observed trophic or habitat shifts occurred.
- Goal: Evaluate eye lens layering and trophic discrimination factor (the difference between food source and eye lens tissue isotopes) through a wet lab feeding experiment.



Sablefish eye lens photographed at 50x magnification. Not to scale.

Sample Collection & Wet Lab Experiment

- Juvenile sablefish in Southeast Alaska were collected live (n = 42).
- Wet lab study was conducted on juvenile sablefish for ~6 months (Oct 2022-Apr 2023). Feed consisted of BioTrout 6mm pellets and squid (*Illex argentinus*), mean seawater temperature ~5°C.
- Adult sablefish from the Gulf of Alaska were measured to determine relationship between eye lens diameter and fish length.

Analysis Methods

- Juvenile fish lengths were measured before and after wet lab feeding experiment.
- Linear regression model was used to evaluate relationship between eye lens diameter and fish length across juvenile and adult sablefish.
- Eye lens layers (12-24 layers per fish) were extracted from n = 17 juvenile sablefish and measured using stable isotope analysis for $\delta^{13}C$ and $\delta^{15}N$.

Acknowledgements

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Eye Lens Diameter as a Proxy for Length

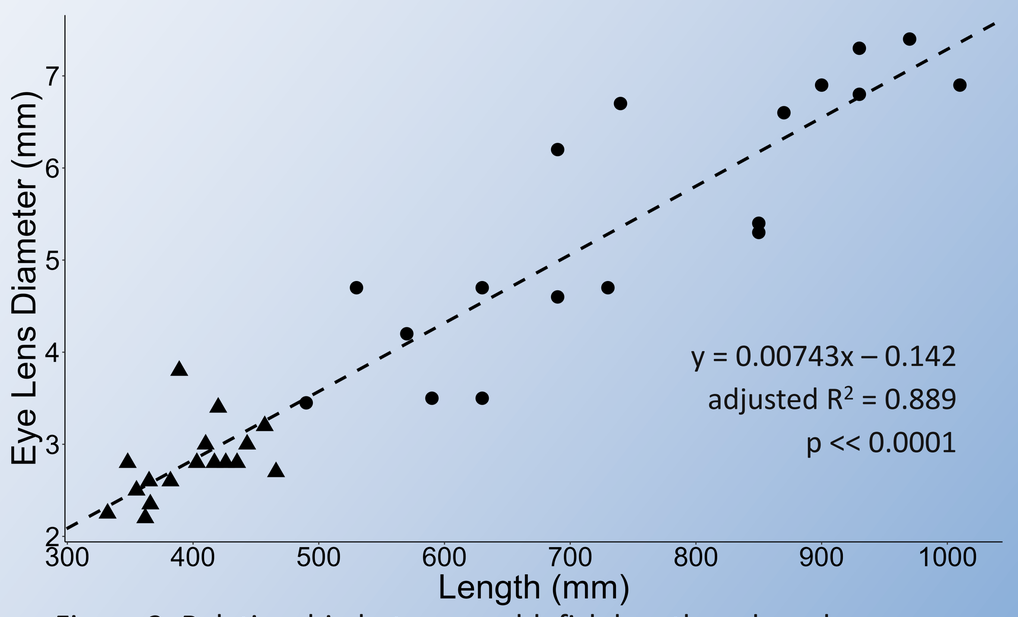

Figure 2: Relationship between sablefish length and eye lens diameter from juveniles (triangles, n = 17) and adults (circles, n = 18). Linear regression model fit indicated by dashed line.

Sablefish Eye Lens Stable Isotopes

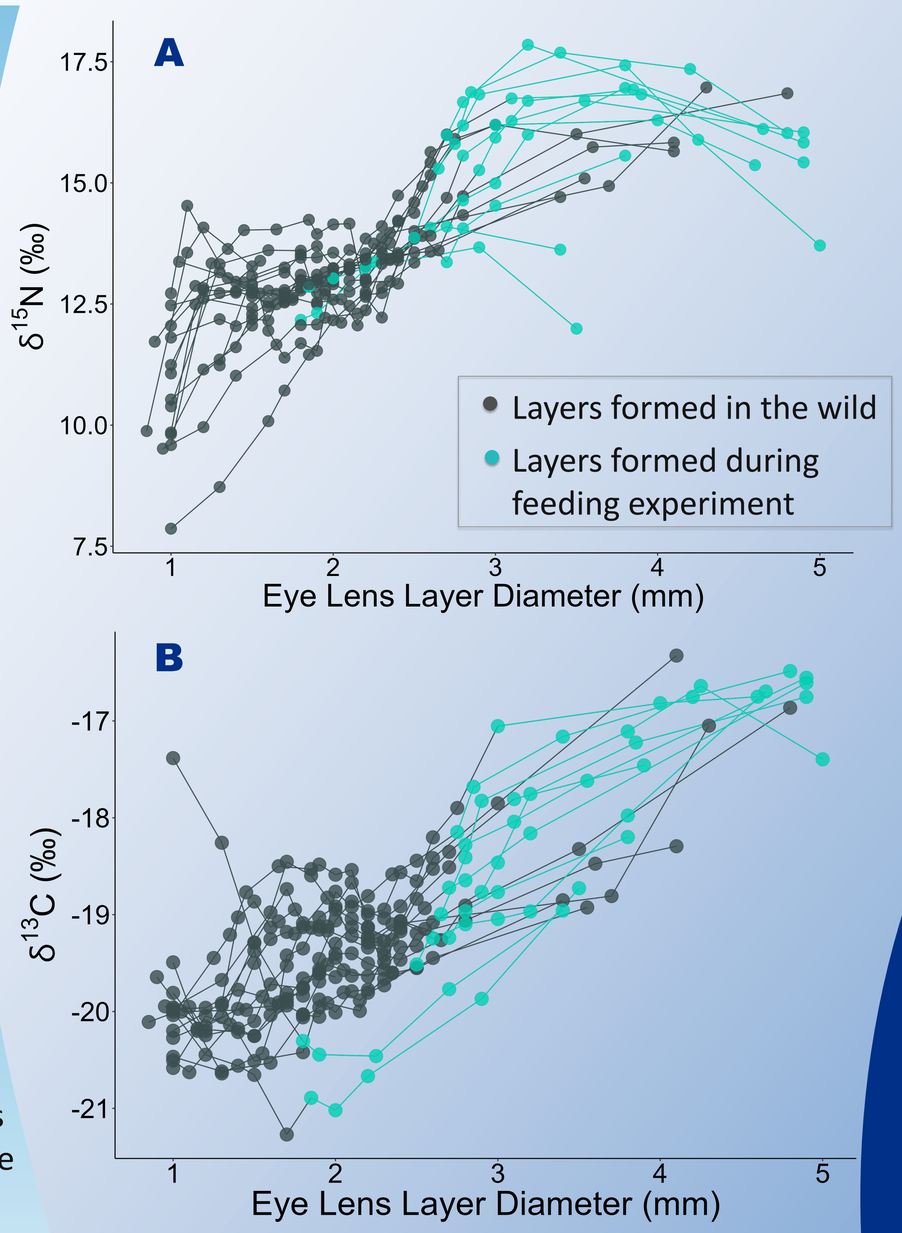

Figure 1: Eye lens $\delta^{15}N$ (upper panel A) and $\delta^{13}C$ (lower panel B) from n = 17 juvenile sablefish from wet lab study for layers formed in the wild (gray) and during laboratory feeding experiment (teal). Each data point represents an individual eye lens layer.

Results & Conclusions

- Juvenile sablefish eye lens $\delta^{15}N$ shows beginning of equilibration with low $\delta^{15}N$ (~5‰) commercial diet by the last 2-3 lens layers (Figure 1). Equilibration less evident in $\delta^{13}C$ most likely due to commercial diet $\delta^{13}C$ too similar (~-17.5‰) to wild lens layer isotopes.
- Early isotopic shift and convergence at ~2 mm eye lens diameter (Figure 1) corresponds to an estimated fish length of ~288 mm and suggests similar early life history and ontogeny for juvenile sablefish.
- Strong relationship between length and eye lens diameter (Figure 2), helpful in interpreting eye lens isotope patterns and identifying size corresponding to observed isotope shifts.
- Average of ~5 eye lens layers were added during laboratory feeding experiment (~30% of total layers per juvenile eye lens).
- Juvenile sablefish growth rates in the laboratory were too low (mean SGR ~0.26 %mass per day) to determine eye lens tissue trophic discrimination factor.

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