Utilizing otolith shape analysis to better understand stock structure for black rockfish

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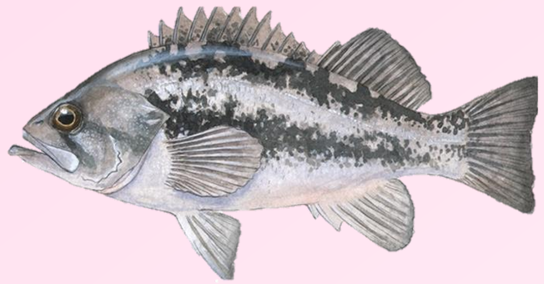
Stock Structure Uncertainty in Black Rockfish

- **Black rockfish** *(Sebastes melanops)* are a valuable species along the US West Coast and the Gulf of Alaska.
- Though they are a ”data rich” species, we still do not understand much of their stock structure (i.e., how life history traits vary across their natural range).
- Project goal: evaluate otolith measurements to make inferences about stock structure of black rockfish throughout their natural range.
- Black rockfish often show conflicting evidence of stock structure in the literature.
  - **Genetic studies**: regional differences
  - **Tagging work**: broad adult movements

Otolith Shape Analysis

- **Otoliths** are fish ear bones that can be used to estimate age[c, e].
- **Otolith shape** may offer insights into population structure[g, i].
  - Shape differences result from **climate, food availability, species, etc**.[f]
  - Understanding otolith shape within a species with a broad range can help evaluate whether multiple lines of evidence point toward consistent, biologically relevant **stock structure**.

Morphometric Measurements



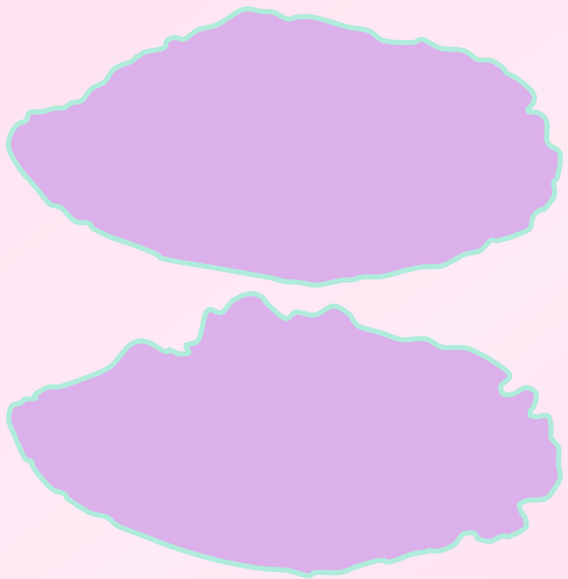
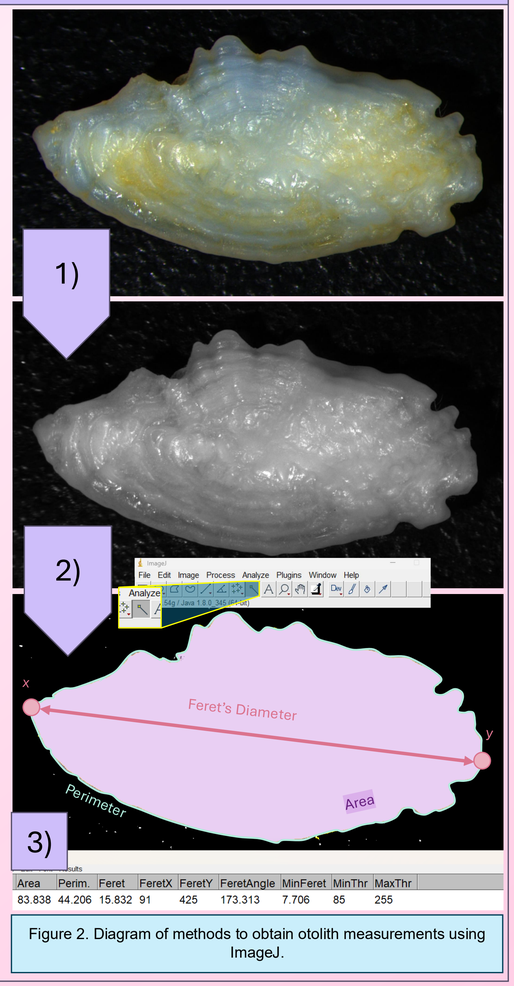


Figure 1. Black rockfish illustration by Amadeao Bachar (California Department of Fish and Wildlife, 2020). Examples of two Male-aged-6 Black rockfish otoliths showing possible differences in shape.

- We minimized ontogenetic effects on otolith shape[4] by restricting analyses to **6-year** black rockfish collected off **Oregon in 2024 and 2025** (n=25).
- Using ImageJ, we:
  1) Converted image to **8-bit grayscale,**
  2) visually maximized **brightness and contrast** (to create a crisp outline) and used **thresholding** (dividing black and white pixels) to remove background noise, then,
  3) measured otolith perimeter (mm), area (mm^2), Feret diameter (the longest Euclidean distance)[b, c, e, g]



Area	Perim.	Feret	FeretX	FeretY	FeretAngle	MinFeret	MinThr	MaxThr
83.838	44.206	15.832	91	425	173.313	7.706	85	255

Figure 2. Diagram of methods to obtain otolith measurements using ImageJ.

Results

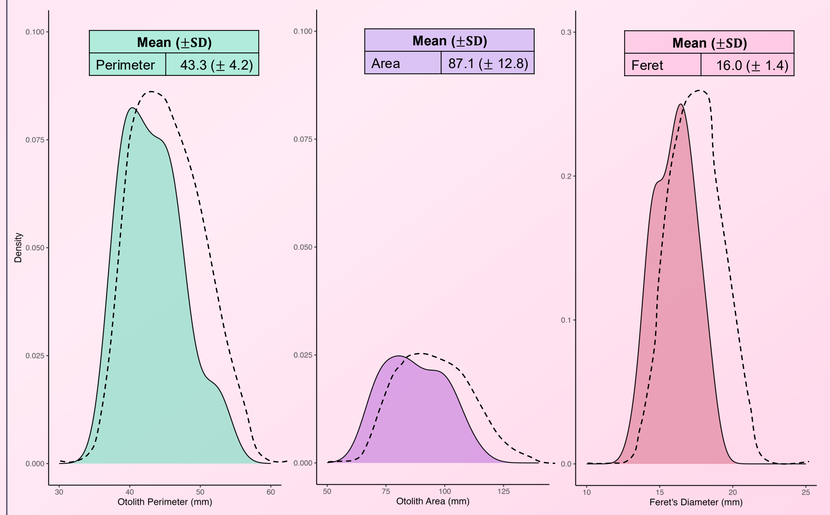


Figure 3. Density plots (colored) for otolith perimeter, area and Ferets Diameter (all in mm) shown for Oregon age-6 otoliths. Dashed line represents hypothesized otolith measurements for Alaska.

- Most of the age-6 samples from Oregon show most samples lying in the 40 - 50 mm range for otolith perimeter, 75 – 100 mm for otolith area, and 15 – 20 mm for Ferets diameter
- The dashed line represents what we hypothesize these plots will look like with Alaska otolith data (slightly larger for the same age)

Next Steps and Future Directions

- Continue taking otolith measurements from age-6 black rockfish off Oregon and include measurements from age-6 black rockfish from Alaska, Washington, and California
  - Use multivariate methods (e.g., PERMANOVA) to test for differences in perimeter, area, and/or ferret diameter[d, h]
  - Expand dataset and include additional age classes
- Explore Fourier-based methods for shape classifications[i, j]
- Evaluate differences in otolith shape by state and make inferences based on statistical analyses for stock structure and management implications

Acknowledgments
Thank you to the fishers of the following organizations for the fish donations used in this project.

Funding Sources: OSU Branch Experiment Station, OSU College of Agricultural Sciences Leadership Academy

Many thanks to the IMF Lab (OSU) for the support and feedback and to the Alaska Department of Fish and Game Age Determination Unit for use of equipment and age training.

LinkedIn

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