Off to a Rocky Start: Uncovering Climate Risk for Rockfish Species in the Gulf of Alaska

Catelyn D. Chang[1]*, Isabelle Galko[2], Peri E. Gerson[2], Cheryl L. Barnes[2]

*presenting author, [1]School of Liberal Arts and Life Sciences, Arizona State University, [2]Coastal Oregon Marine Experiment Station, Oregon State University

Understanding CVAs and Rockfish

Climate vulnerability assessments (CVAs) identify species at risk from projected environmental changes by integrating varied information sources (e.g., peer-reviewed literature) into a single structured evaluation.

- These environmental changes are especially pronounced in higher latitude regions such as the **Gulf of Alaska (GOA)**[1]
- Environmental changes like marine heatwaves have had severe effects on ecosystem productivity in the GOA [5]

Rockfish in the GOA characterized with long lifespans, slow growth, and late maturity are particularly susceptible to overfishing and climate impacts.[2,3]

- We selected the **8 species** below due to their cultural, commercial, and recreational importance

CVA Framework

Vulnerability is a species susceptibility climate change, determined by a combination of:

- **Sensitivity**: the extent that a species is affected based on biological traits (e.g., physiological tolerances, dispersal ability)[4]
- **Exposure**: the degree to which a species is exposed to environmental variability[4]
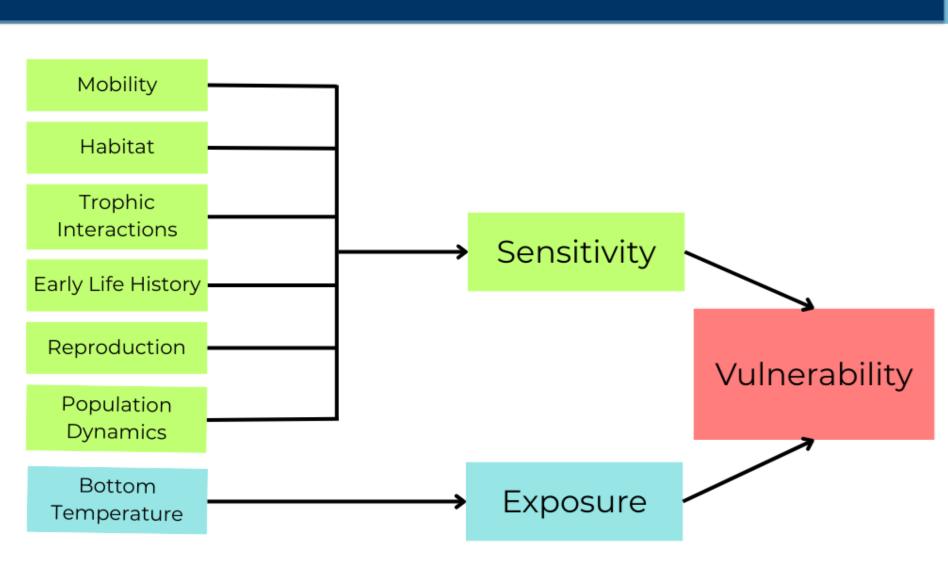

Fig 1. Workflow used to assess the climate vulnerability for rockfish species in the Gulf of Alaska

Meet the 8 Rockfish

Pacific Ocean Perch *(Sebastes alutus)*

Dusky Rockfish *(Sebastes variabilis)*

Northern Rockfish *(Sebastes polyspinis)*

Shortraker Rockfish *(Sebastes borealis)*

Rougheye Rockfish *(Sebastes aleutianus)*

Sharpchin Rockfish *(Sebastes zacentrus)*

Shortspine Thornyhead *(Sebastolobus alascanus)*

Yelloweye Rockfish *(Sebastes ruberrismus)*

Rockfish Species Profiles

Species profile compile biological and ecological information about each rockfish species

- Conducting a standardized literature review
- Answering questions based on sensitivity attributes
  - E.g., habitat specificity, adult mobility, and reproductive strategy

Stock Name: Pacific ocean perch (*Sebastes alutus*)		Range: Southern Japan to central Baja California, Mexico			
Attribute	Questions	Data	Level of Analysis	Region	Source
E.g., Habitat Specificity	What is the geographic and depth distribution of this stock for adult and juvenile life stages?	POP are found on the continental shelf from depths of 37m to 320m (Pirtle, 2019).	Stock	GOA	Pirtle, 2019

Fig 2. Example of a species profile for Pacific ocean perch

Sea Where We GOA

Fig 3. Study area of the climate vulnerability assessment for the Gulf of Alaska

Scoring Sensitivity

To score each rockfishes' sensitivity attributes, a group at the Hatfield Marine Science Center (undergraduate students to senior scientists) were given the following:

- 8 rockfish species profiles
- Scoring guidelines for each sensitivity attribute
- Individual scoring sheets for each species

Sensitivity Attribute	Low	Moderate	High	Very High
Habitat Specificity		||||	|	

Fig 4. Each attribute was scored following a 5-tally scoring system

Overall Sensitivity

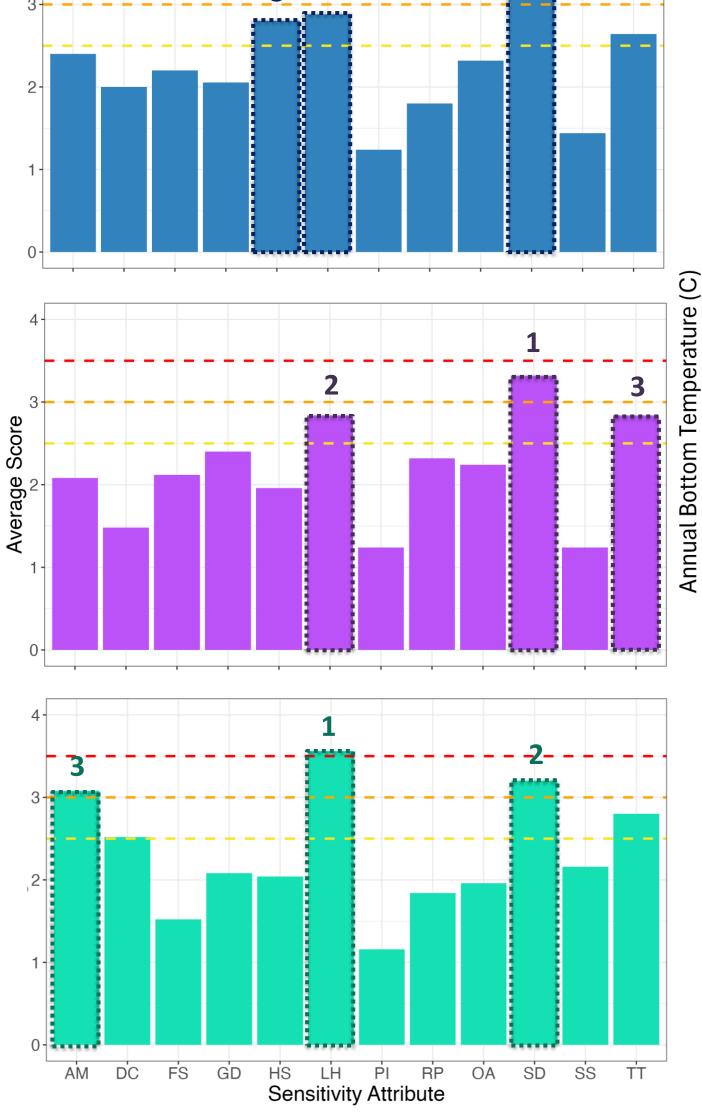| Moderate	High	
Dusky	**Northern**	**Sharpchin**
Pacific ocean perch	**Shortraker**	**Yelloweye**
Rougheye	**Shortspine Thornyhead**	

Sensitivity + Exposure = Vulnerability

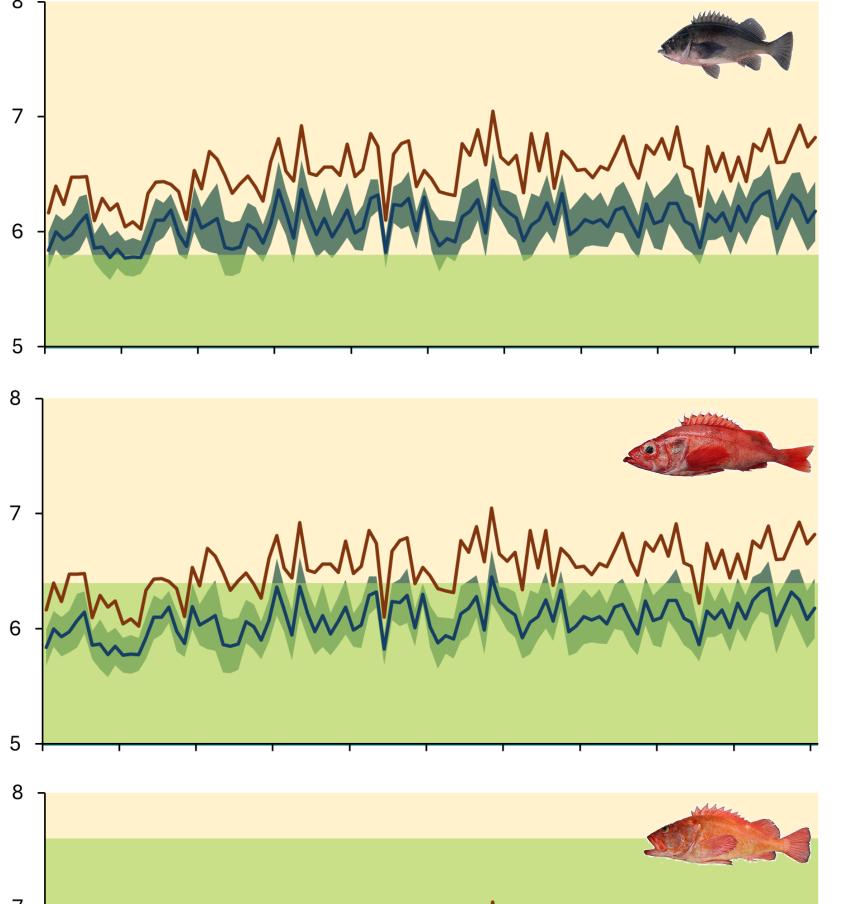The top **three sensitivity attributes** driving these species' overall sensitivity are:

AM = Adult Movement, DC = Dispersal Capability, FS = Foraging Strategy, GD = Genetic Diversity, HS = Habitat Specificity, LH = Life History, PI = Parental Investment, RP = Reproduction Plasticity, OA = Ocean Acidification, SD = Spawning Duration, SS = Stock Status, TT = Thermal Tolerance

The optimal temperature ranges of these species' were overlaid with projected bottom temperatures in the GOA:

- Optimal Temperature Range
- Outside of Optimal Temperature Range
- Mean Bottom Temperature
- Maximum Bottom Temperature

Here we used the following data from the Regional Ocean Modeling System (ROMS) for projected bottom temperatures from 2000 to 2100 under Emissions scenario – SSP2-4.5

- This is a **moderate** emissions scenario

We can see **three potential exposure outcomes** next to the following species

- **Dusky** is **most** likely to be impacted
- **POP** has **potential** to be impacted
- **Yelloweye** is **least** likely to be impacted

When combining both **sensitivity** and **exposure**, the **vulnerability** of these species are predicted to be **Moderate** to **High**

Because these species **play important roles in fisheries and ecosystem dynamics in the GOA**, monitoring and management will need to be improved.

Acknowledgments

Limitations

- Some sensitivity attributes lacked data
- Scorers' may have relied on prior knowledge, introducing potential bias
- ROMS sea surface temperatures were converted to bottom temperatures, with some inaccuracy

Next steps?

- Integrate these species into the first CVA for the GOA
- Improve overall methods and scoring process
- Apply refined methodology to 40 additional species in the GOA