Assessing effects of increased pinniped abundance on threatened interior Columbia River spring-summer Chinook salmon

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Acknowledgments: Co-authors

- Grande Ronde population modeling – Tom Cooney

- Predation mortality analysis – Rich Zabel, Devin Johnson, Michelle Wargo Rub, Sarah Converse

Acknowledgments: Data

- Mortality – Northwest Fisheries Science Center

- Sea lion abundance – Oregon Department of Fish and Wildlife and U.S. Army Corps of Engineers Field Office

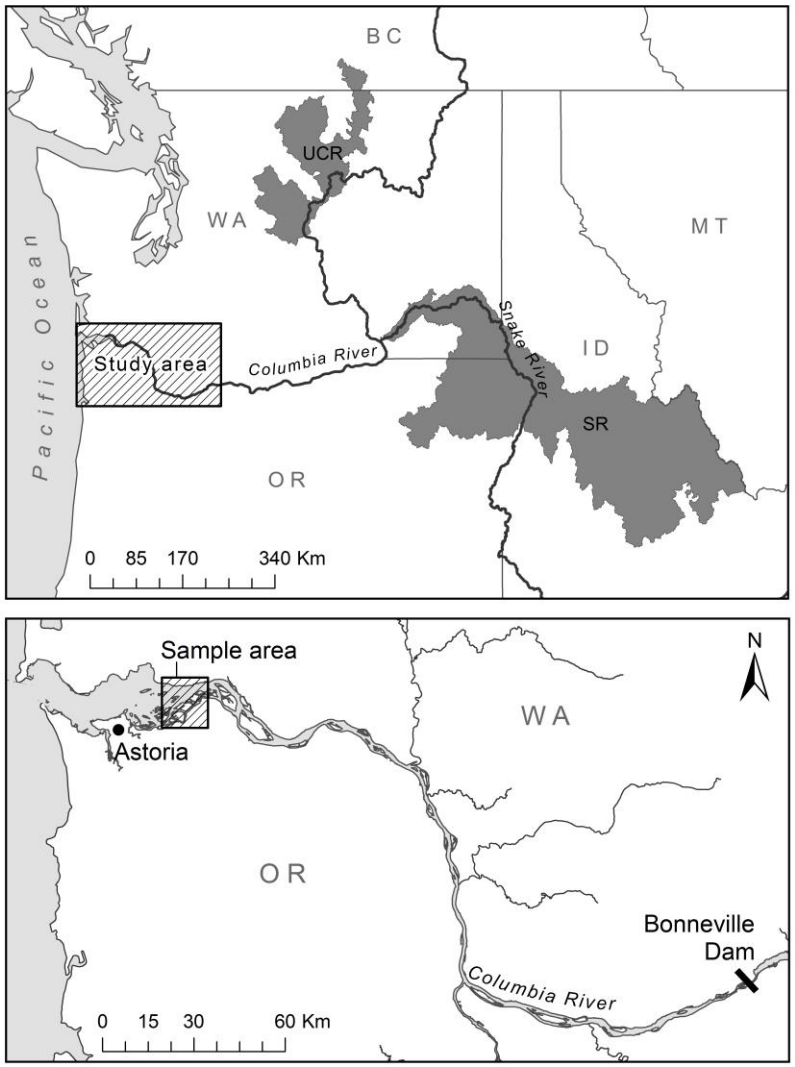
- Salmon migration timing – Numerous organizations including: Idaho Department of Fish and Game, Nez Perce Tribe, Northwest Fisheries Science Center, Oregon Department of Fish and Wildlife, and Washington Department of Fish and Wildlife

Introduction: Carnivore recovery conflicts

- Recovering carnivore populations can negatively impact threatened prey and fisheries
  - e.g., Northern sea otters and endangered northern abalone
- Conflicts arising from marine mammal predation of fish are not uncommon
  - Removing predators can be effective but is controversial
  - Marine mammal interactions with threatened salmon are of particular concern

Introduction: Lower Columbia pinniped-Chinook interactions

- Four Threatened/ Endangered Chinook salmon populations
- Mortality positively associated with pinniped abundance



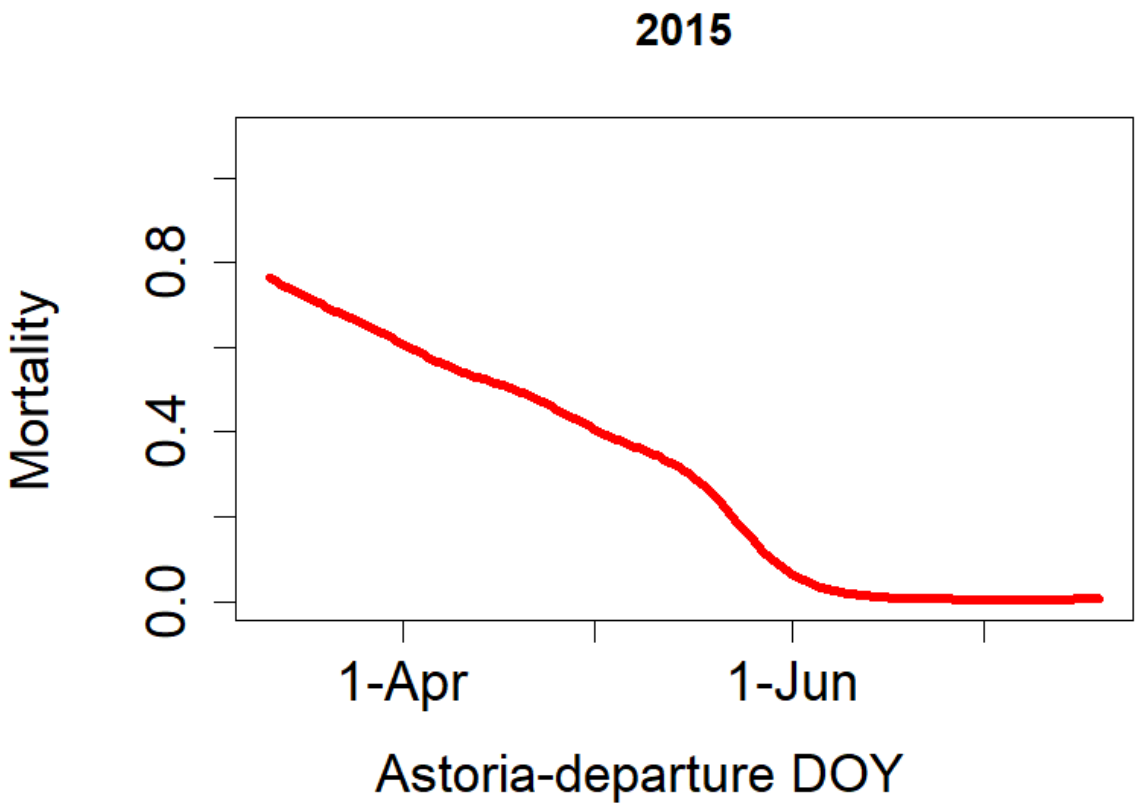
Objectives

1. Estimate relationship between sea lion abundance and population-specific mortality of Chinook
   - Account for population-specific migration timing

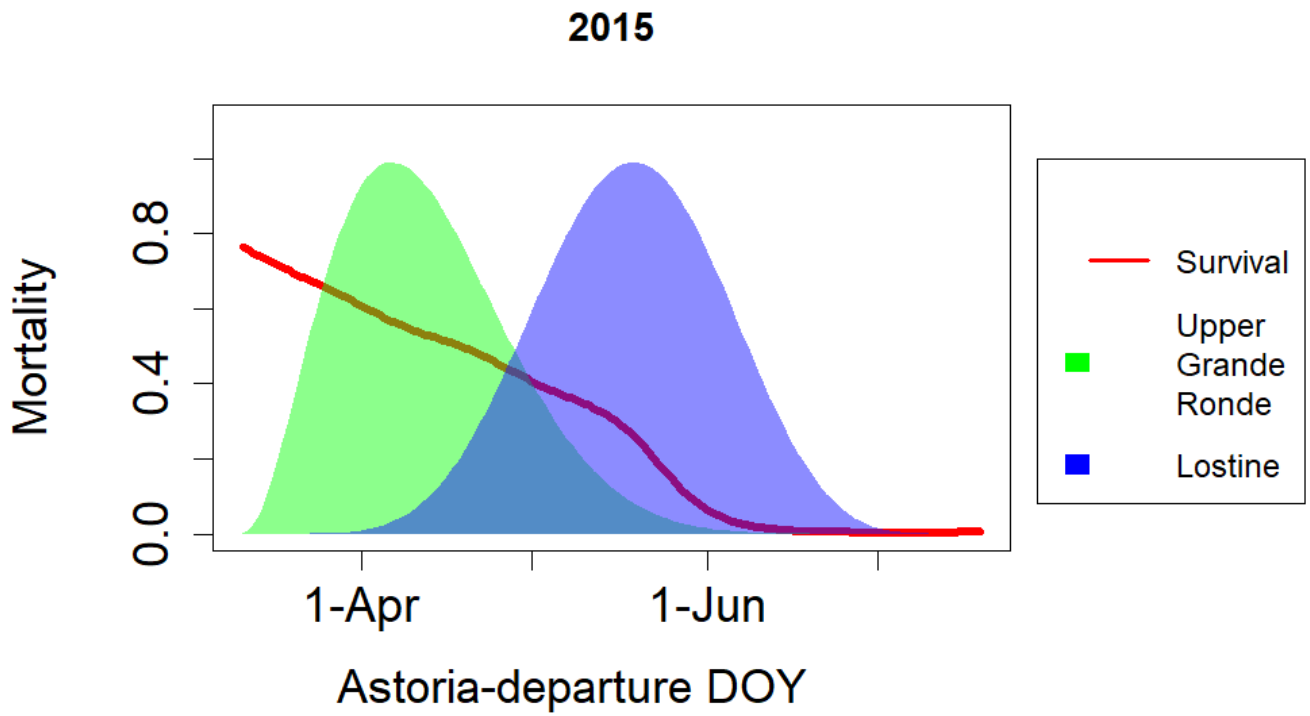
2. Evaluate effects of predation mortality on population viability

OBJECTIVE 1 — IMPACTS ON POPULATION-SPECIFIC MORTALITY (IN REVISION)

Objective 1: Population weighting of mortality



Objective 1: Population weighting of mortality



Population-specific mortality was weighted by population-specific migration timing.

Methods: Mortality given sea lion abundance

- Using data from fish tagged near Astoria and detected/ not detected at Bonneville Dam*

- Modeled mortality as a function of:
  - Origin (hatchery or wild)
  - Sea lion abundance
  - Water temperature
  - Travel time

- Sea lion exposure determined by date of Astoria departure

* Wargo Rub et al. 2019, CJFAS

Methods: Population-specific Astoria departure timing

- Used data on Bonneville arrival dates of adults that had been PIT tagged as juveniles
  - Population known based on juvenile tagging location
- Translated Bonneville-arrival to Astoria-departure based on mortality and travel time model
- Evaluated Astoria-departure for 18 populations
- Weighted daily mortality by population-specific migration timing

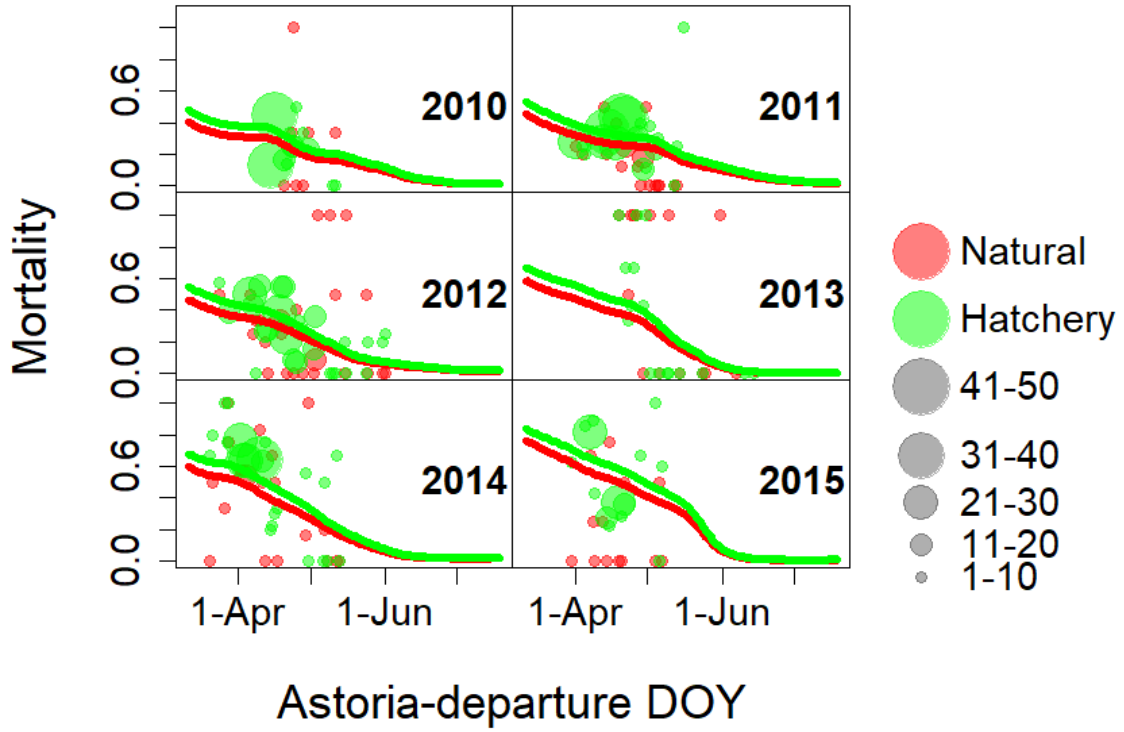
Methods: Mortality associated with increased pinniped abundance

- Estimated mortality with 2010–2012 and 2013–2105 average pinniped abundance
  - All other variables set to average

- Calculated mortality associated with change in pinniped abundance

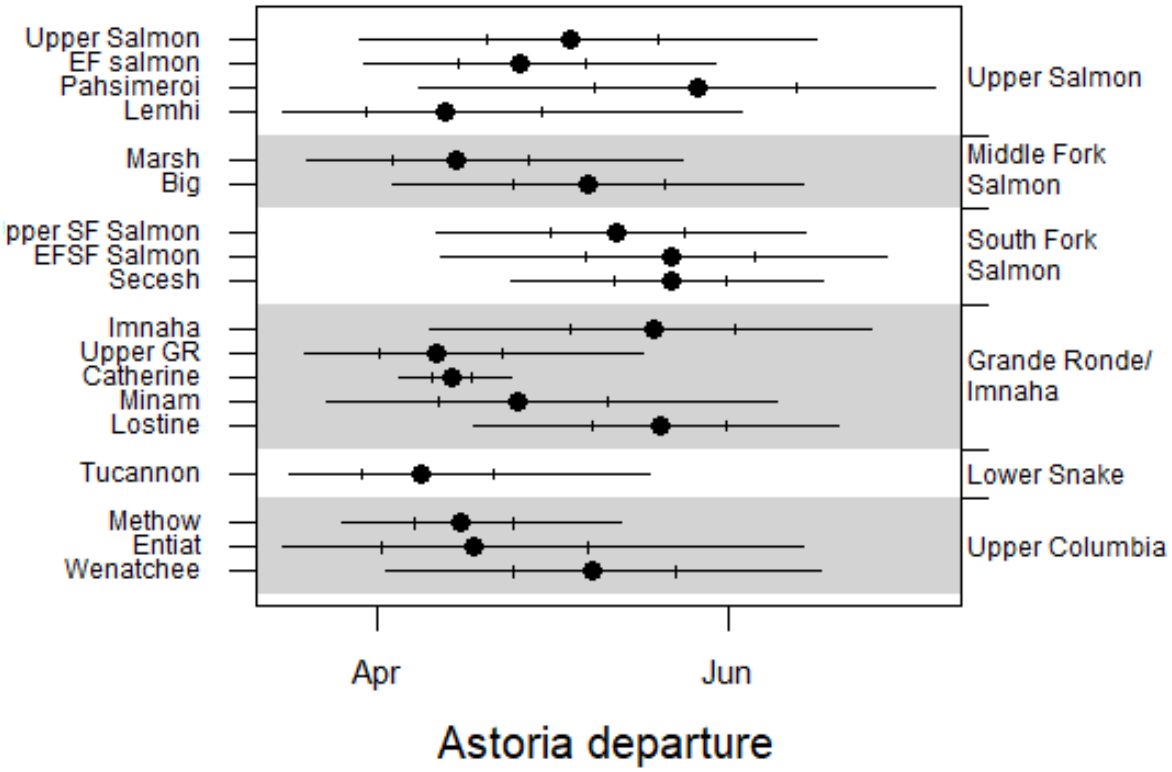
- This metric is useful for simulating effects on population viability because population projection models are fit to data including baseline predation mortality

Results: Mortality by Astoria-departure day



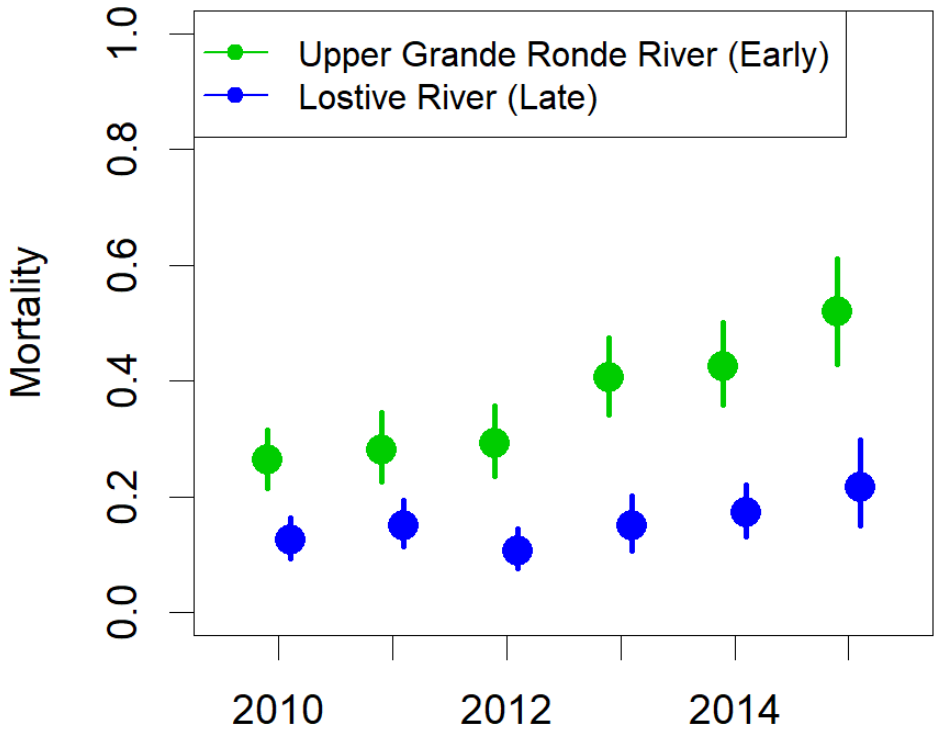
Mortality was higher for fish departing Astoria earlier when sea lion abundance was higher and travel times to Bonneville Dam were longer.

Results: Population-specific Astoria departure timing



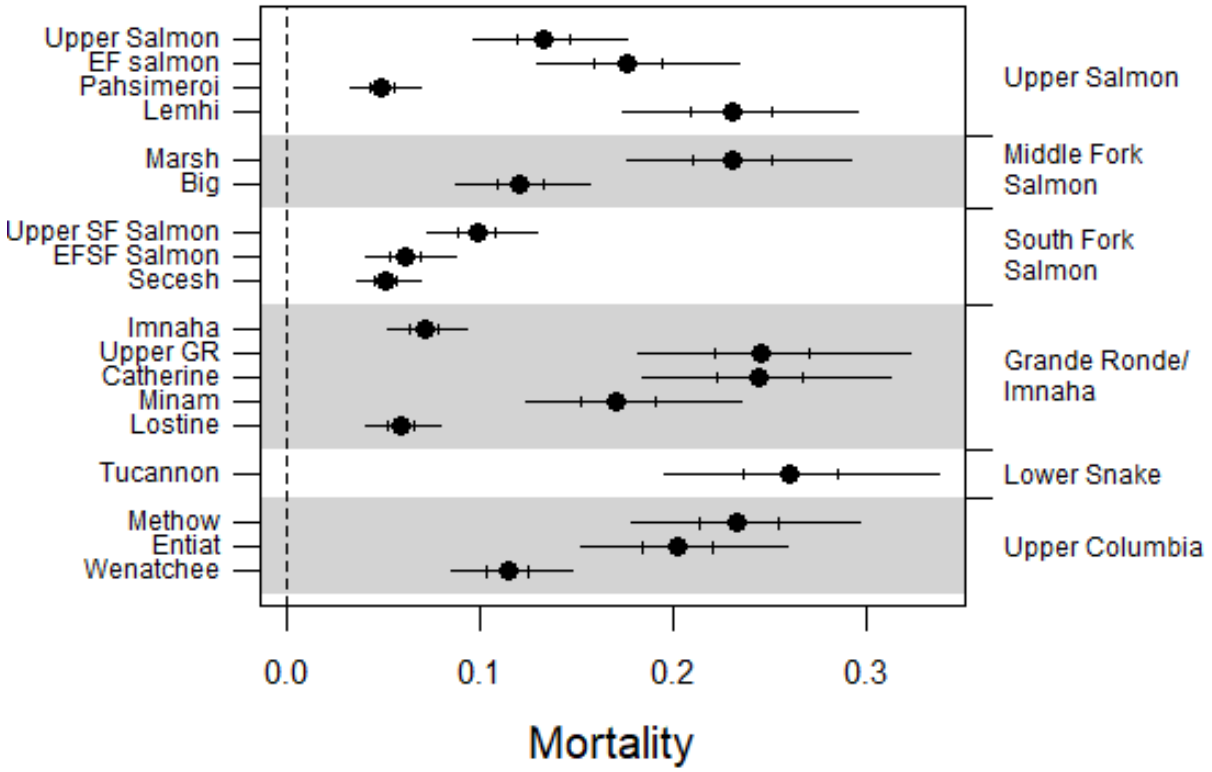
Populations exhibited a range of migration timing, including within Major Population Groups.

Results: Estimated population- and year-specific mortality



Mortality increased from 10-30% in 2010-2012 to 20-50% in 2013-2015. Early-migrating populations experienced greater mortality.

Results: Mortality explained by increased pinniped abundance



All populations experienced some mortality associated with increased pinniped abundance in 2013-2015 relative to 2010-2012. Early-migrating populations experienced the most additional mortality, as much as 25%

OBJECTIVE 2 — IMPACTS ON POPULATION VIABILITY

Methods: Population projection model

- Grande Ronde population projection models
  - Fit to demographic data 1993–2016
    - Spawning escapement
    - Juvenile abundance
    - PIT-tag based survival
  - Accounts for
    - Density dependant juvenile production
    - Variable upstream and downstream dam passage survival
    - Variable marine survival rates
    - Sliding-scale harvest

Methods: Environmental scenarios

- Baseline
  - Hydrosystem operation rules as of 2019
- Habitat restoration
  - 2009–2016 treatments
- Hatchery supplementation
  - Current implementation
- Additional pinniped predation mortality
  - From objective 1

Methods: Hydrosystem scenarios

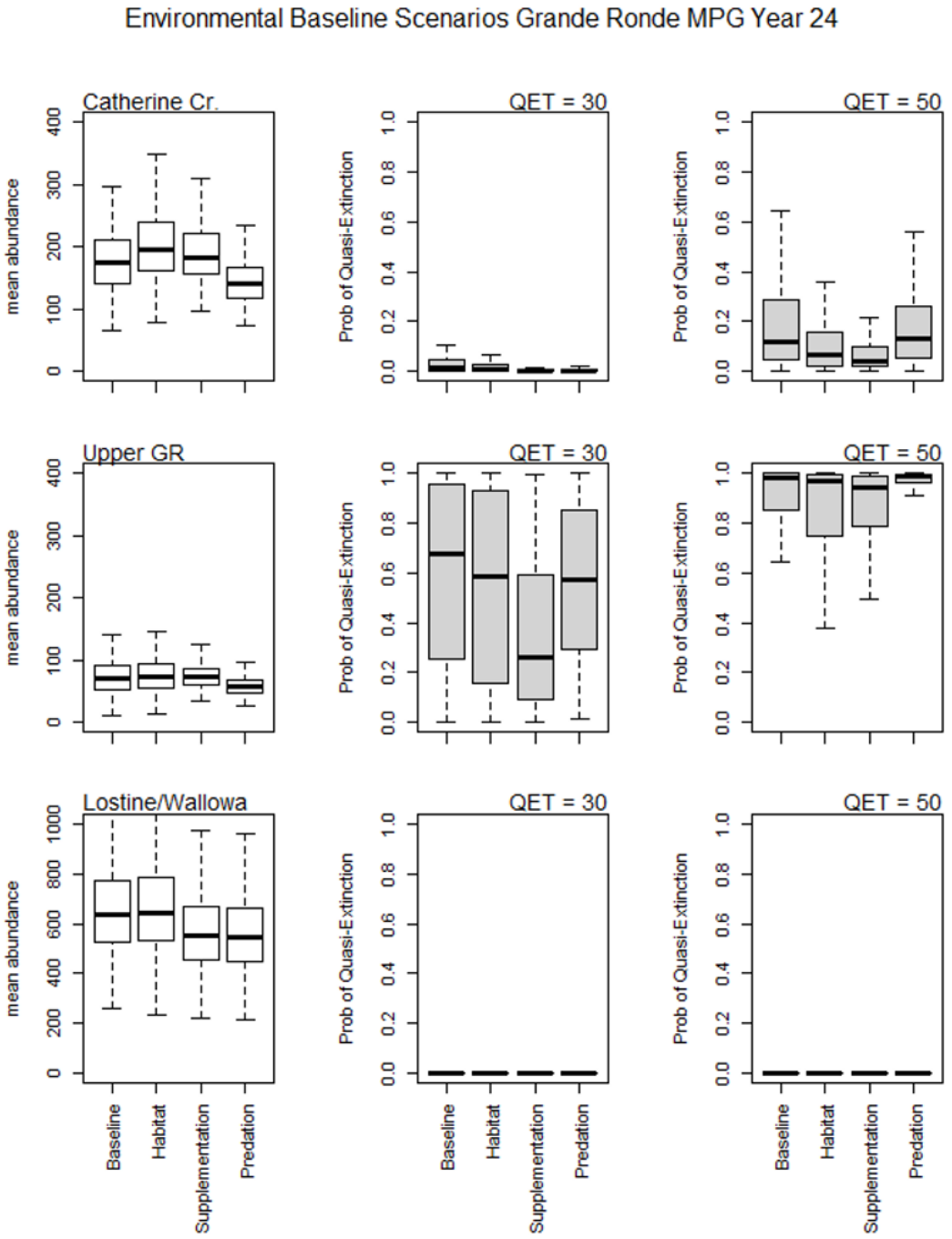
- Proposed hydrosystem operations from the 2019 Federal Columbia River Power System Biological Opinion
  - Spill to 120% of gas cap
    - Latent mortality benefit of 10%, 25%, or 50%

Methods: Response Metrics

- Projections of 24 years
  - Mean abundance
  - Probability of quasi-extinction
    - Did the 4–year mean fall below the quasi-extinction threshold (QET) at any point?
    - QET = 30 or 50 spawners

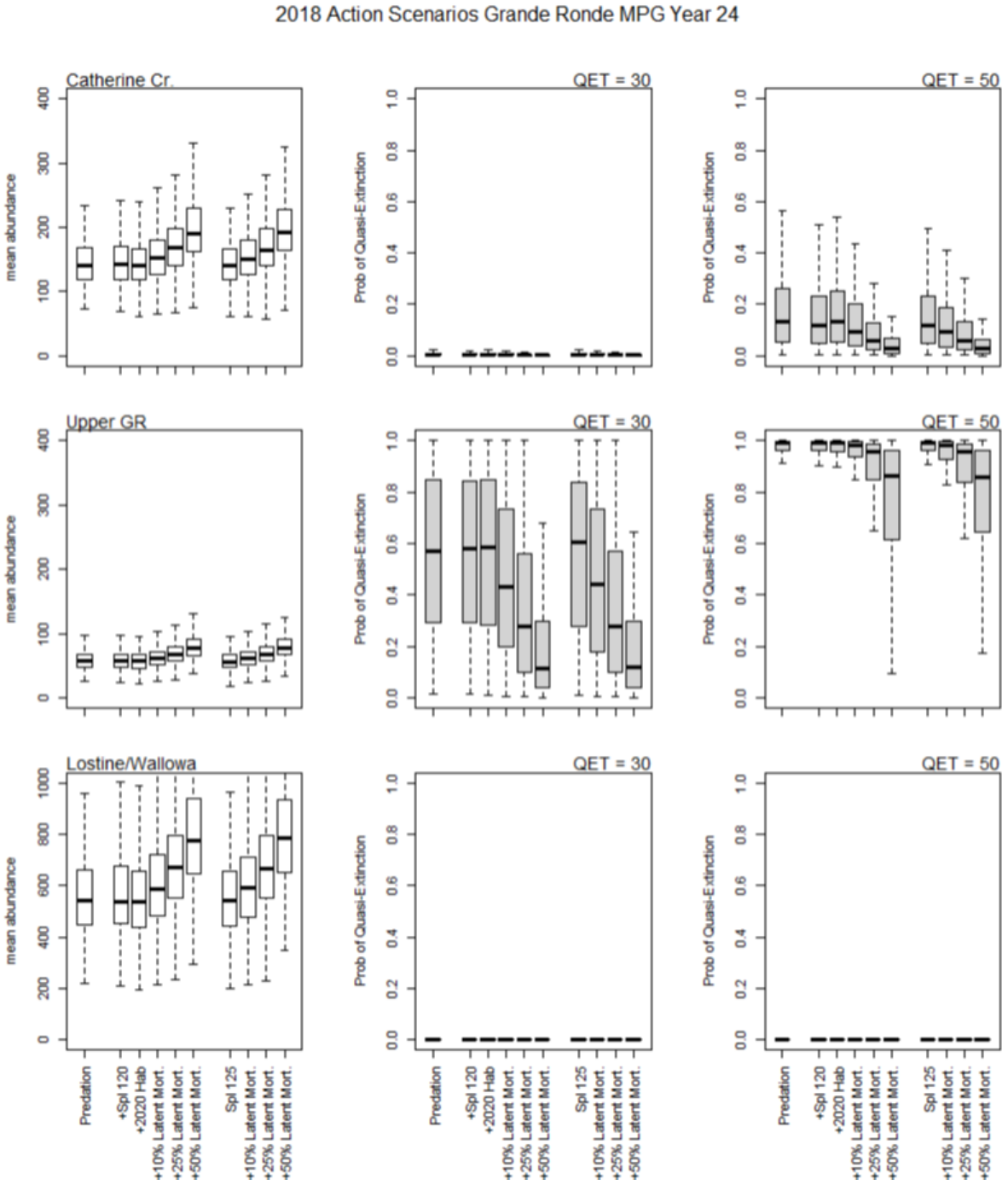
Results

- Increasing pinniped predation reduced mean abundance and increased probability of quasi-extinction for Catherine Creek and Upper Grande Ronde populations



Results

- Benefits of increasing spill depend on assumption about latent mortality benefit.
- Probability of quasi-extinction remains high in many scenarios.



Discussion: Conclusions

- Up to 25% mortality for earliest-migrating populations associated with 2013–2015 pinniped abundance increase
- In simulations, sustained mortality of this magnitude substantially reduced mean spawner abundance and increased the probability of quasi-extinction for at risk populations
- Creative data analysis is valuable for estimating management-relevant quantities

Discussion: Future directions

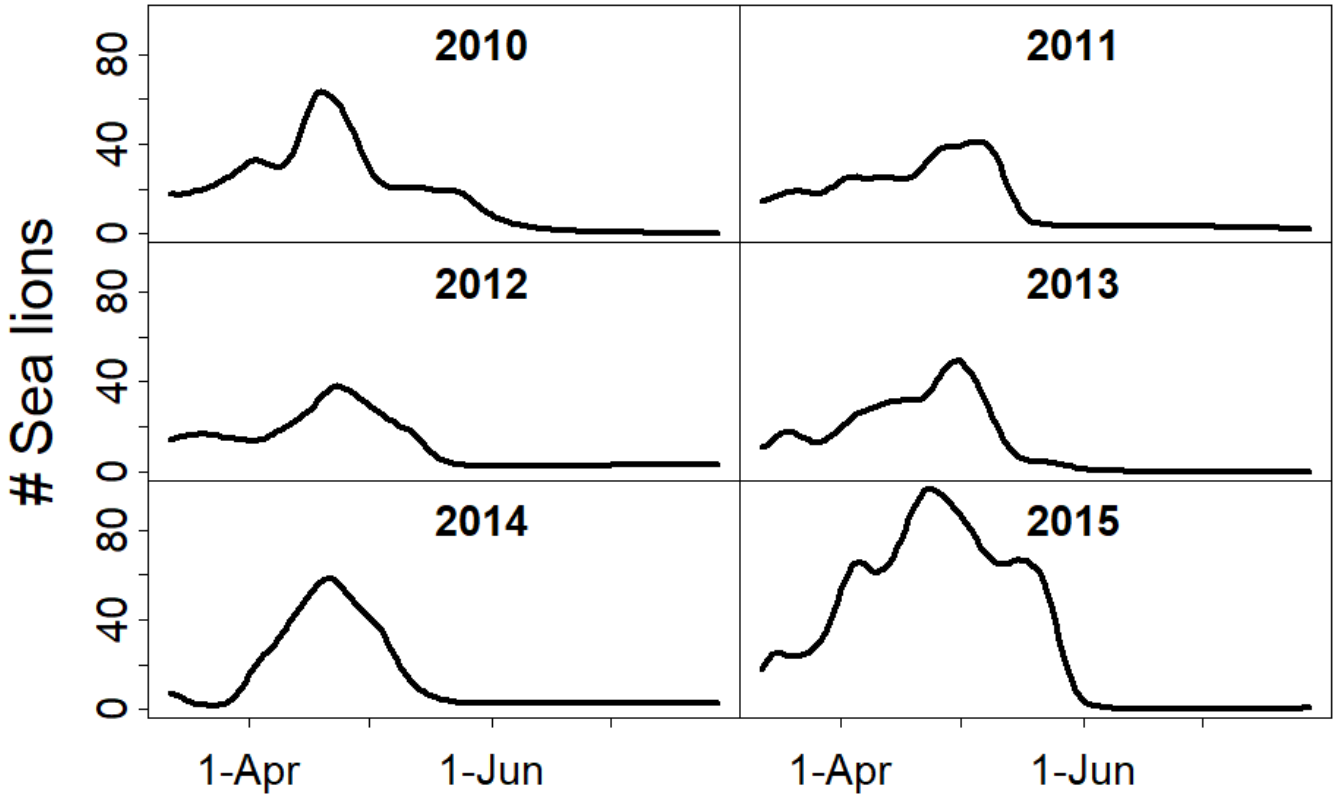
- Projections of future pinniped abundance valuable for population projection
  - Numerical response to salmon abundance
  - Response to management
- Functional response
  - Effect of prey density on mortality

Discussion: Application to managment

- Identify actions that produce optimum trade-offs between conflicting values
  - Use framework that:
    1. explictly wrestles with competing objectives
    2. accounts for uncertainty
- Continue monitoring predator and prey
  - Abundance
  - Demographic rates
  - Mortality
  - Species interactions

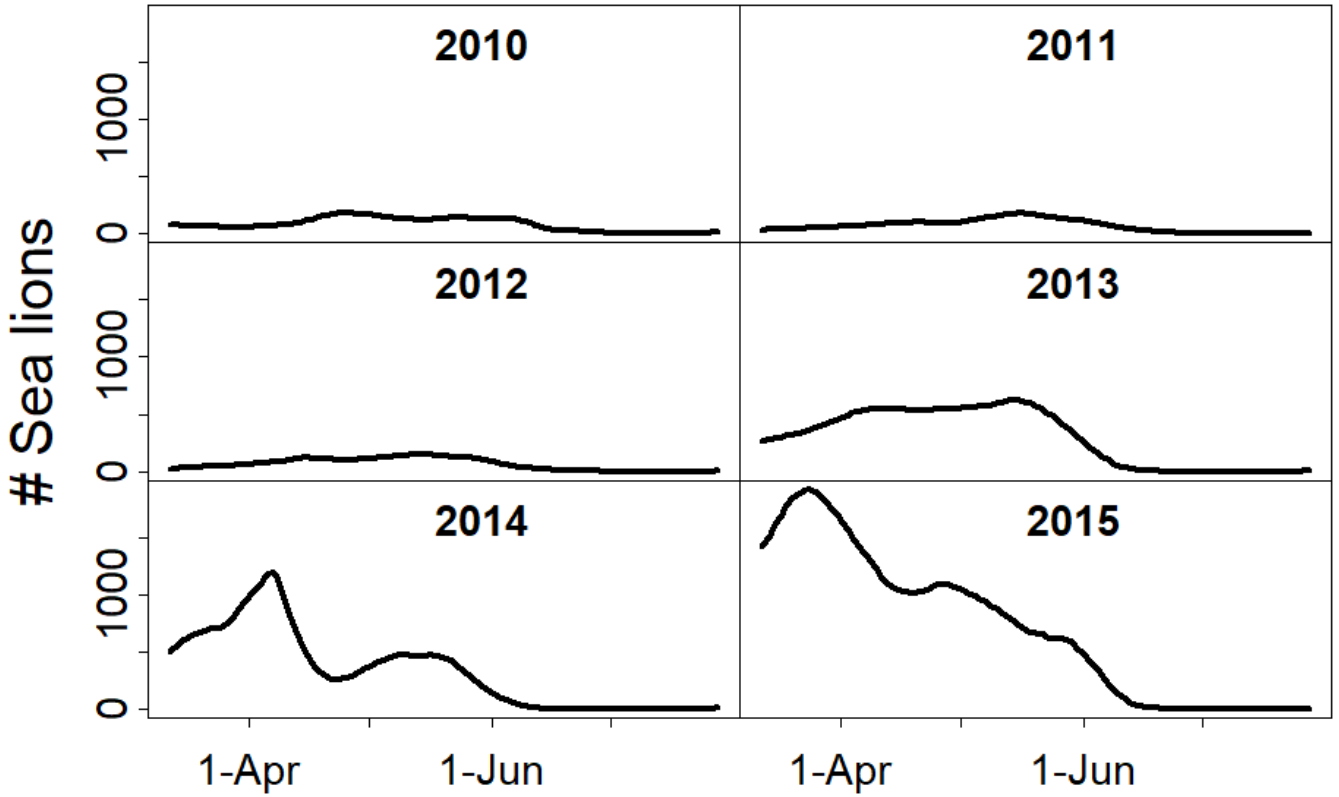
QUESTIONS AND COMMENTS?

Bonneville sea lion abundance



Higher sea lion counts earlier in Chinook migration. Similar counts from 2010 to 2012, then slightly elevated in 2015. Estimates provided by the U.S. Army Corps of Enigineers

Astoria sea lion abundance



Higher sea lion counts earlier in Chinook migration Similar counts from 2010 to 2012, then increased through 2015. Counts provided by the Oregon Department of Fish and Wildlife