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Using metapopulation models to estimate the effects of pesticides and environmental stressors to Spring Chinook salmon in the Yakima River Basin, WA

Chelsea Mitchell
Washington State Univ., United States, chelsea.mitchell@wsu.edu

Valerie R. Chu
Western Washington Univ., United States, chuv@wwu.edu

Meagan J. Harris
Whatcom Conservation District, United States, mharris@whatcomcd.org

Wayne G. Landis
Western Washington Univ., United States, wayne.landis@wwu.edu

Katherine E. von Stackelberg
Harvard Ctr. for Risk Analysis, United States, kvon@hsph.harvard.edu

See next page for additional authors

Speaker

Chelsea Mitchell, Valerie R. Chu, Meagan J. Harris, Wayne G. Landis, Katherine E. von Stackelberg, and John D. Stark

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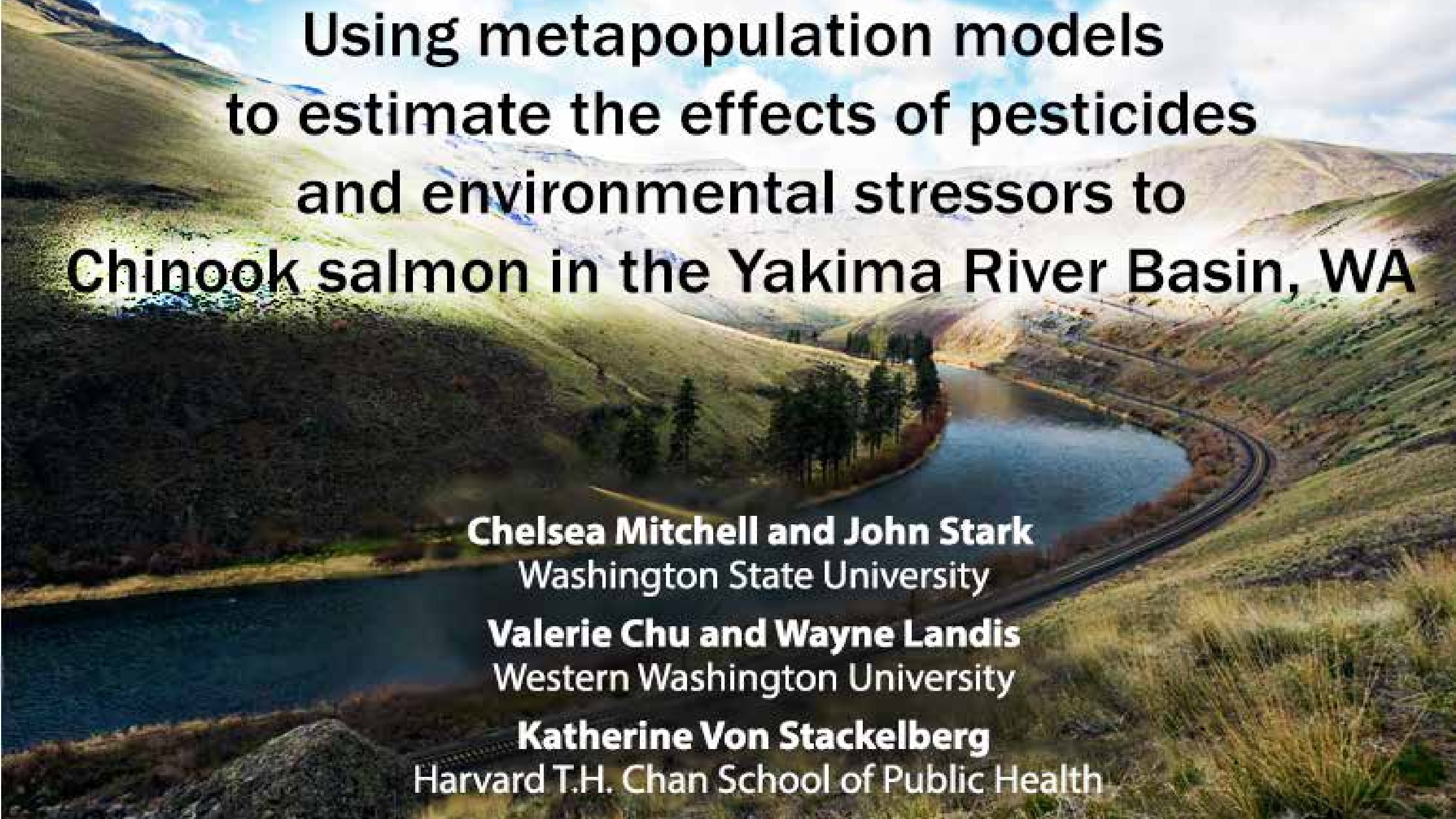


Chelsea Mitchell and John Stark
Washington State University

Valerie Chu and Wayne Landis
Western Washington University

Katherine Von Stackelberg
Harvard T.H. Chan School of Public Health

Ecological Risk Assessment:

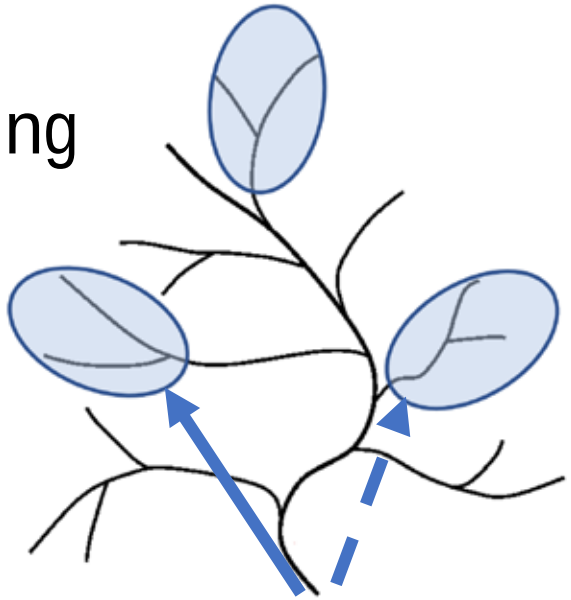
Previous study:

- Bayesian Network- Relative Risk Model (BN-RRM) *(Landis et al.)*
- **Endpoint:** Chinook salmon populations
- **Toxicants**: Organophosphate insecticides
- **Environmental stressors**: Water temperature & dissolved oxygen
- Single Chinook population models *(Baldwin et al. 2009)*

This study: uses site-specific metapopulation as endpoint

Salmon populations & toxicant exposure

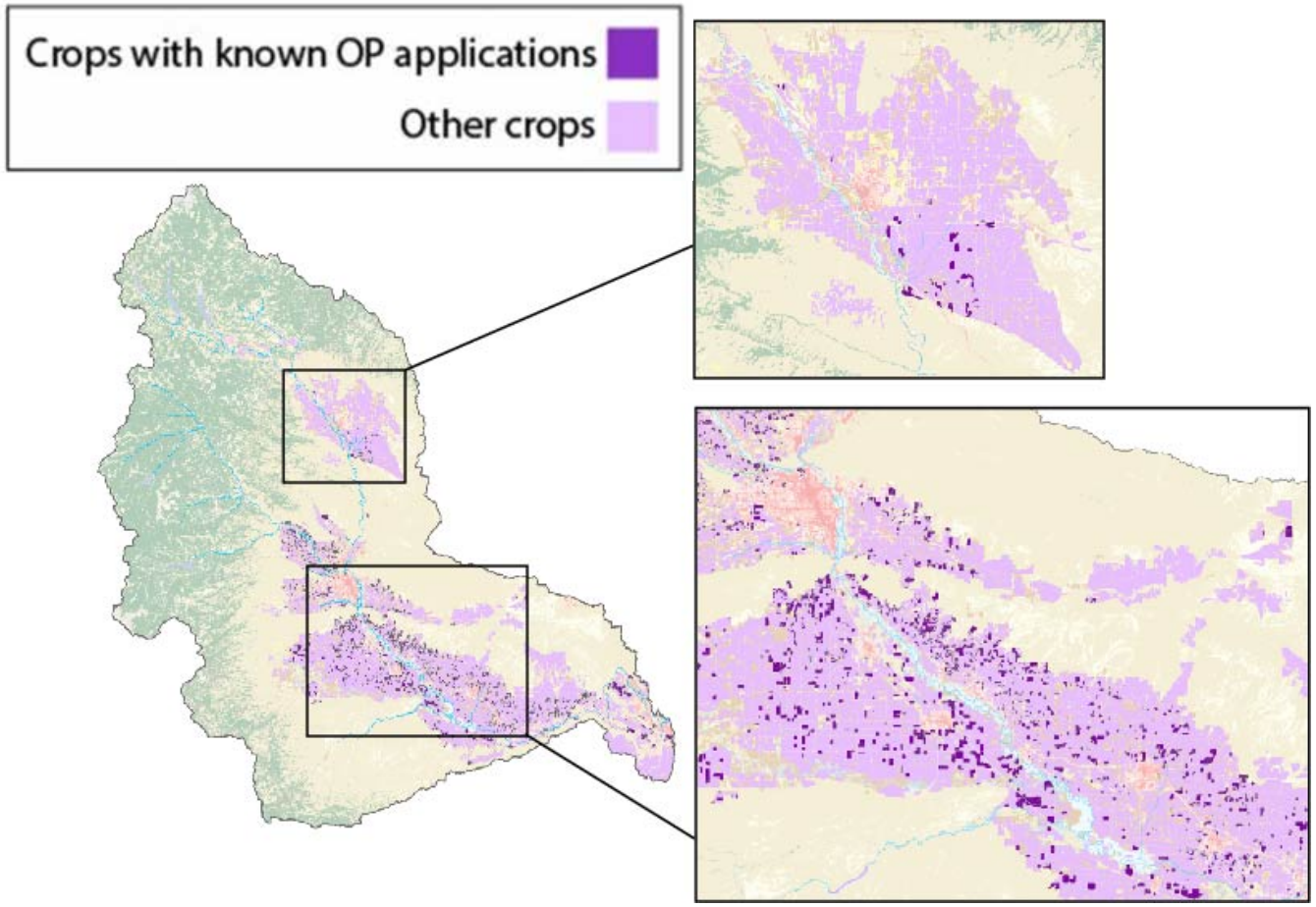
- Salmon connected into **metapopulations** through straying
- **Local adaptation**
  - populations of the same species differ in rates of survival, reproduction, and dispersal
- Salmon habitat conditions change over time



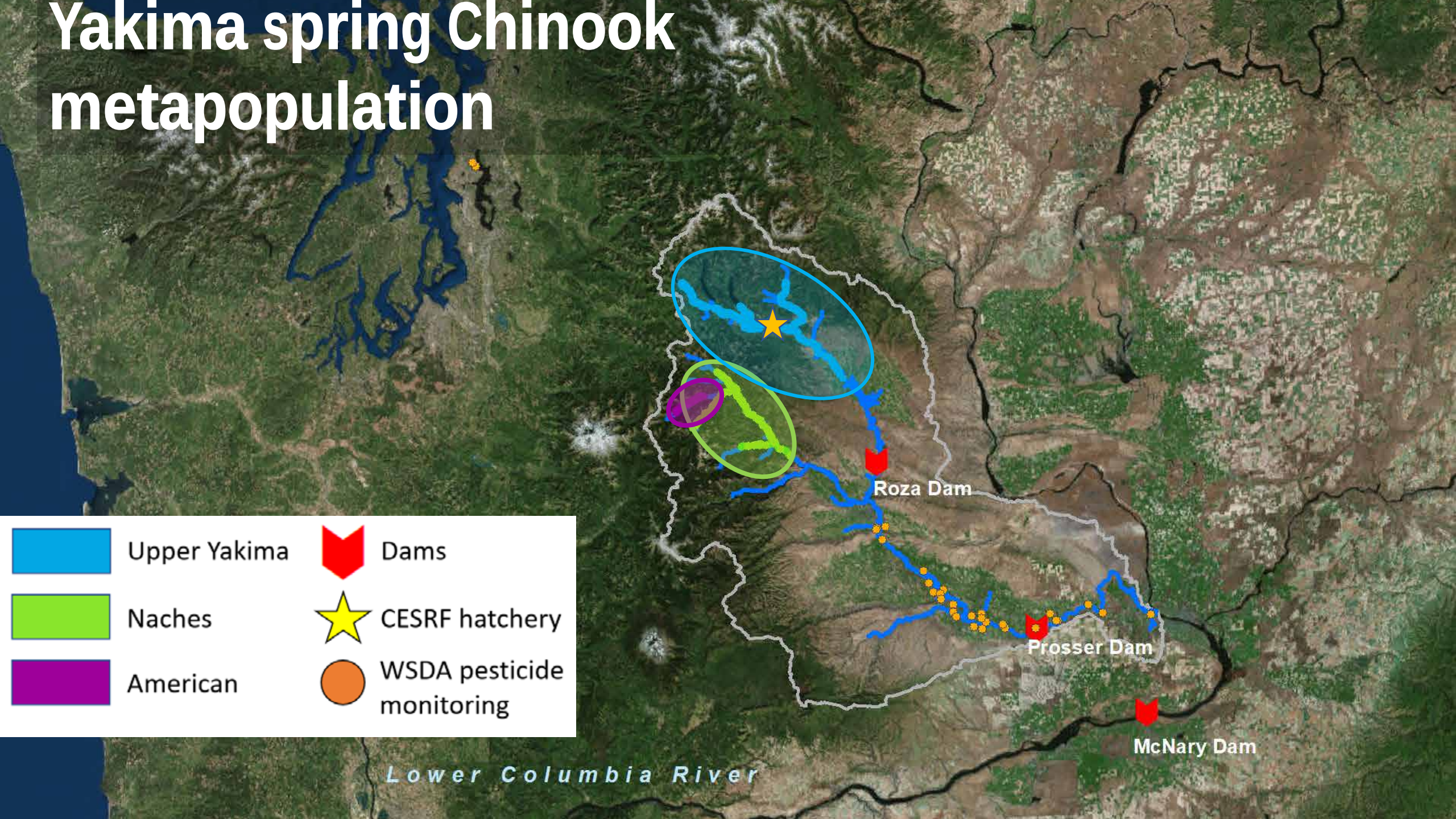
Question 1: Does risk differ between subpopulations within the same metapopulation?
Question 2: Do seasonal changes in habitat impact risk?

Case Study: Yakima River Basin (YRB)

- **Spring Chinook salmon**
- Lower Yakima
  - dense agriculture
  - Habitat use
  - Juveniles rearing and outmigration
  - Adults returning to spawn
- OPs applied throughout Lower Yakima
- This study: Malathion and diazinon

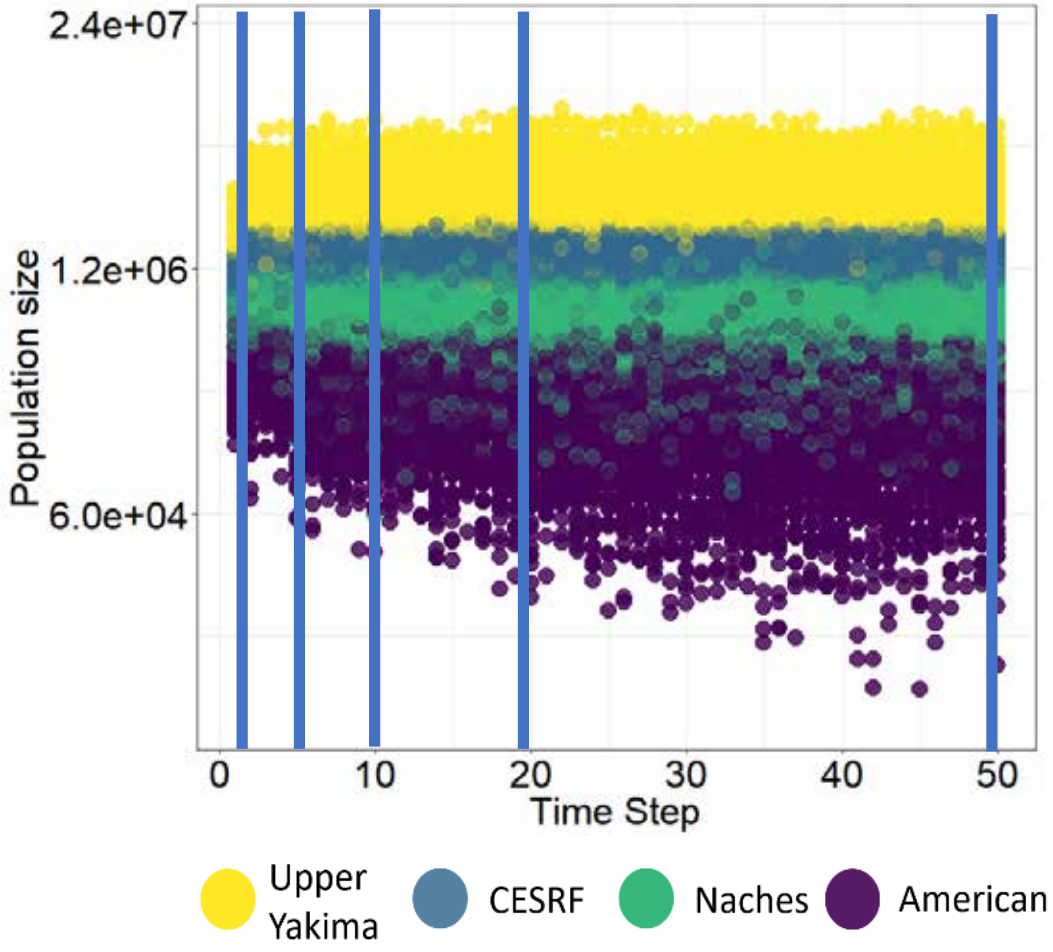


Yakima spring Chinook metapopulation



Metapopulation modeling

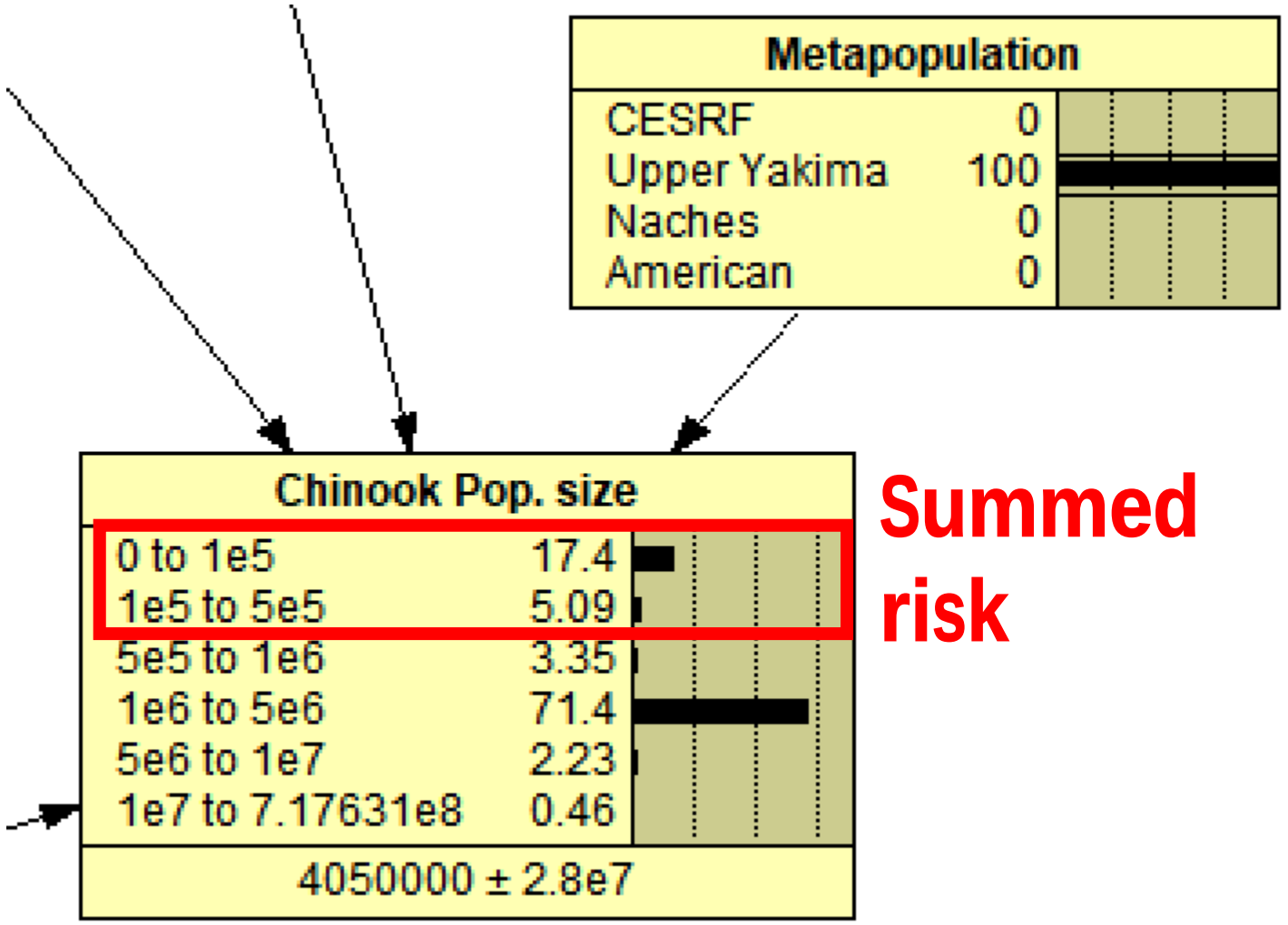
- Developed age-structure matrix models
  - American, Naches, Upper Yakima, CESRF
  - Stochastic survival, reproduction, and dispersal parameters
- Ran simulations in RAMAS Metapop©
  - survival reductions to exposed life stages
  - Incorporated outputs into Bayesian Network



Bayesian Network-Relative Risk Model

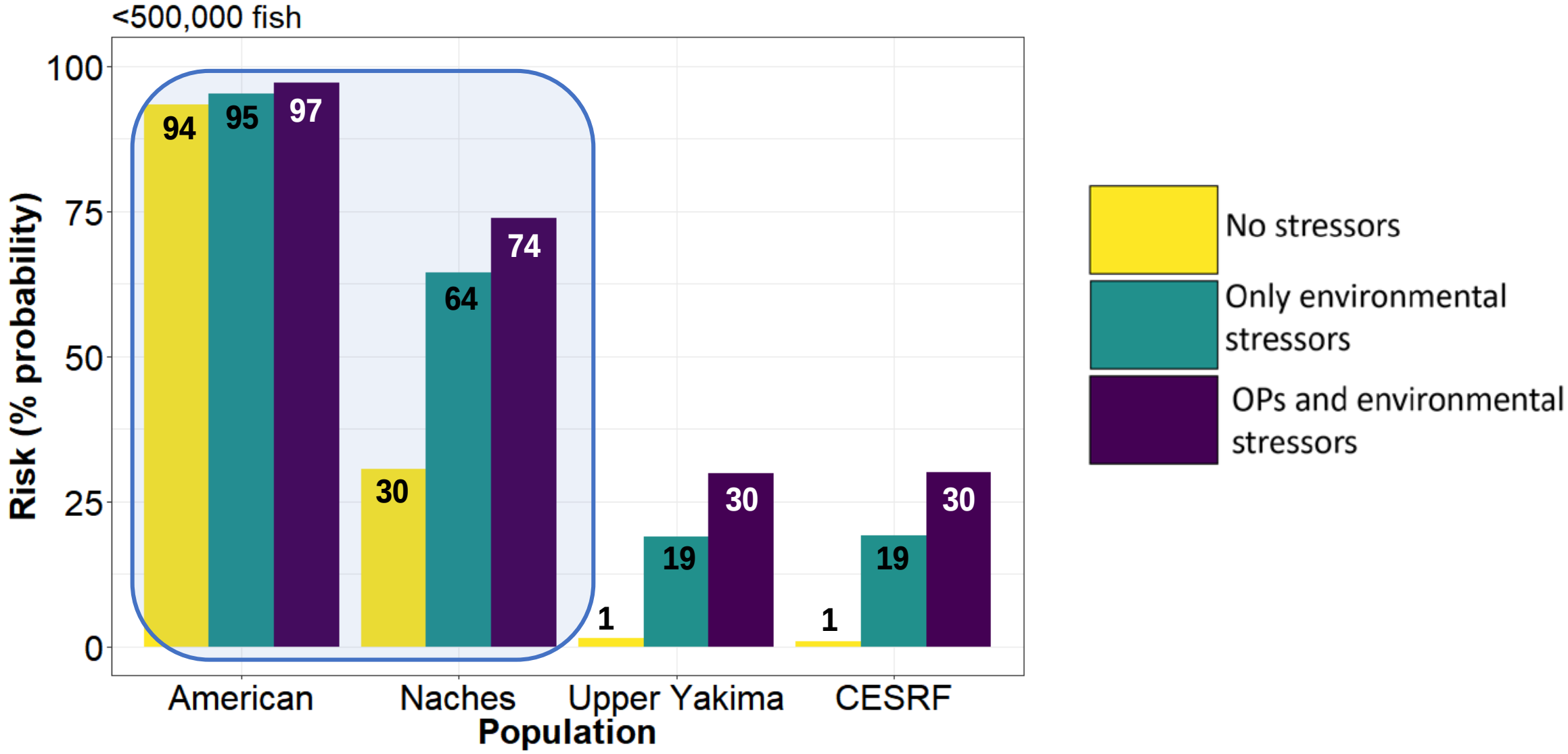
Risk

- No net loss of Chinook (Puget Sound Partnership)
- Initial abundance = 500,000 fish/population
- Risk of declining from initial abundance of 500,000

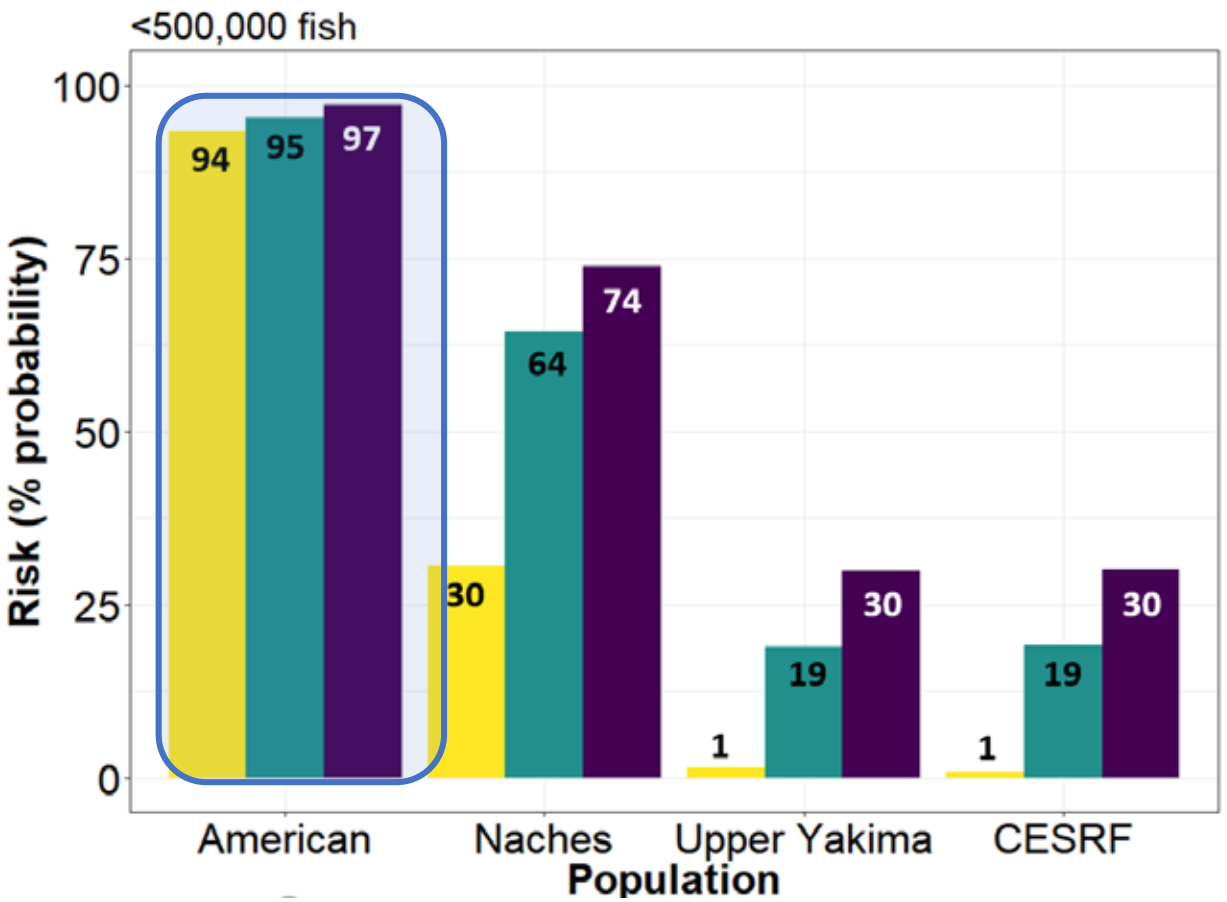


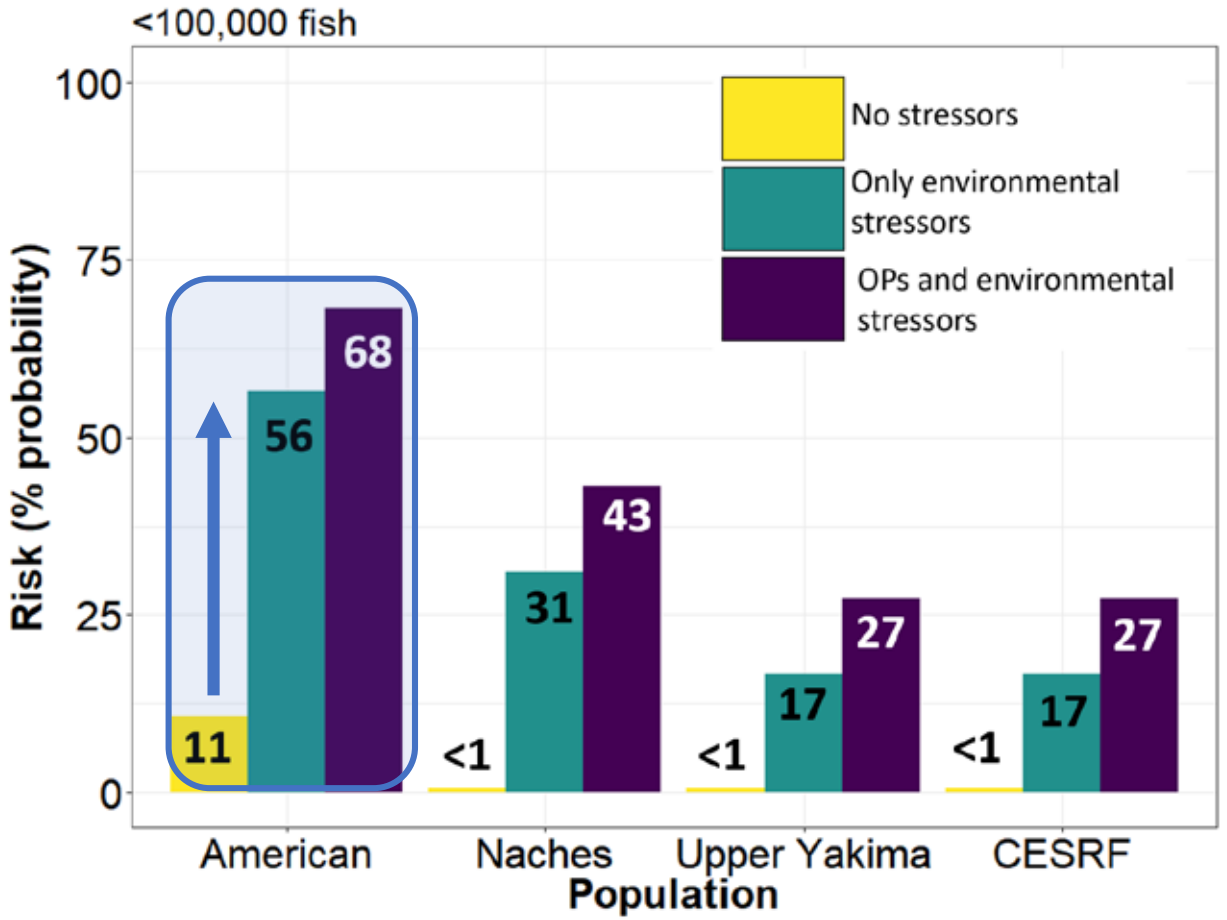
Summed risk

Risk by population (year 20)

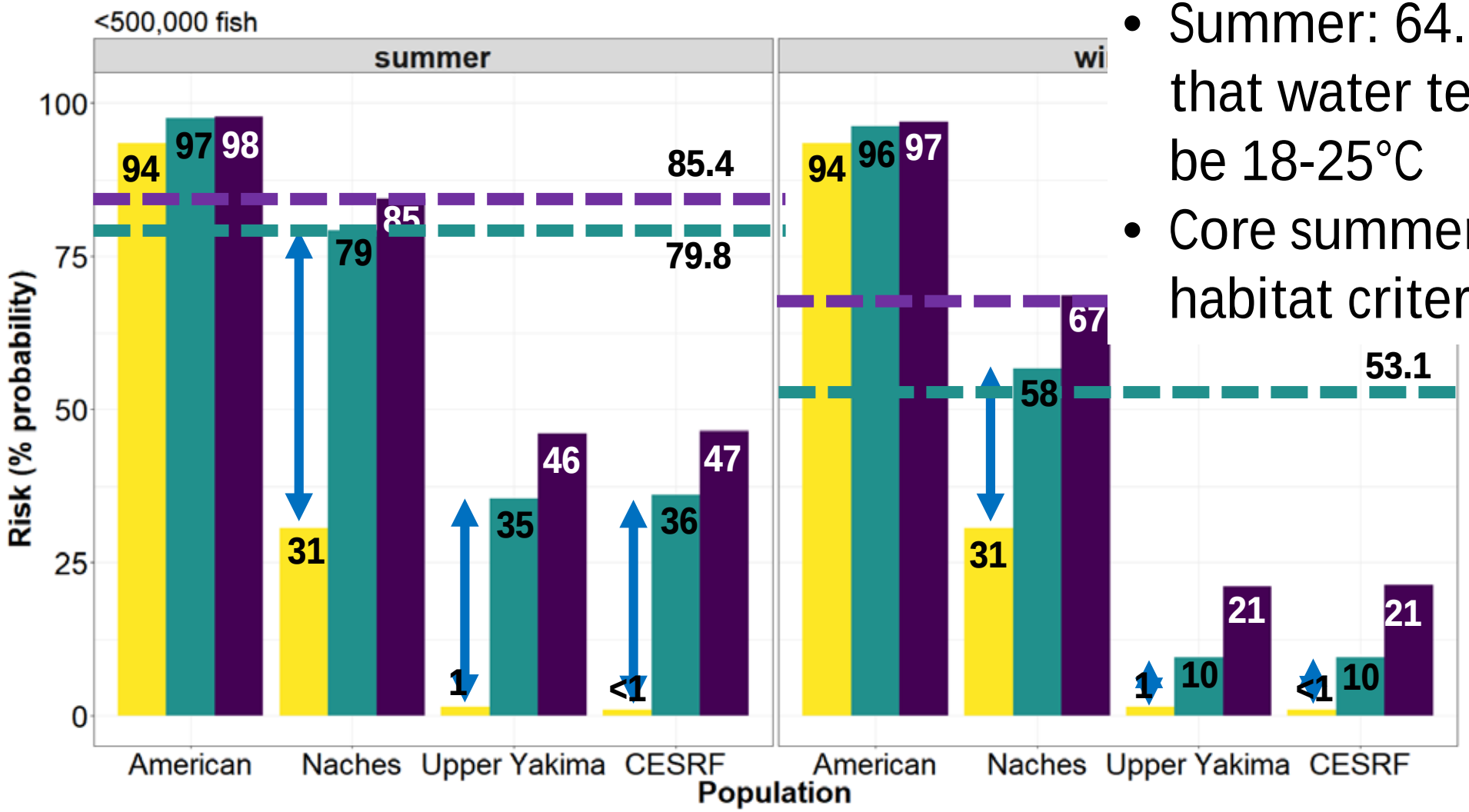


Risk by population (year 20)





Risk by population and season (year 20)



- Summer: 64.7% probability that water temperature will be 18-25°C
- Core summer salmonid habitat criteria = 16 °C

Single population risk from Chu et al.

OPs and environ. Stressors

Environ. Stressors only

Conclusions

- ***Question 1:*** *Does risk differ between subpopulations within the same metapopulation?*
  - Yes, risk is greater in wild populations
  - Differences driven by differences in vital rates, and lower dispersal of wild populations
- ***Question 2:*** *Do seasonal changes in habitat impact risk?*
  - Yes, high temperatures in summer increase risk compared with winter.
- **Environmental stressors make a greater contribution to risk than organophosphates**
- **Measured concentrations of OPs in Lower Yakima still increase risk**

Thank you!

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