

# Insights into steelhead ecology from environmental DNA surveys



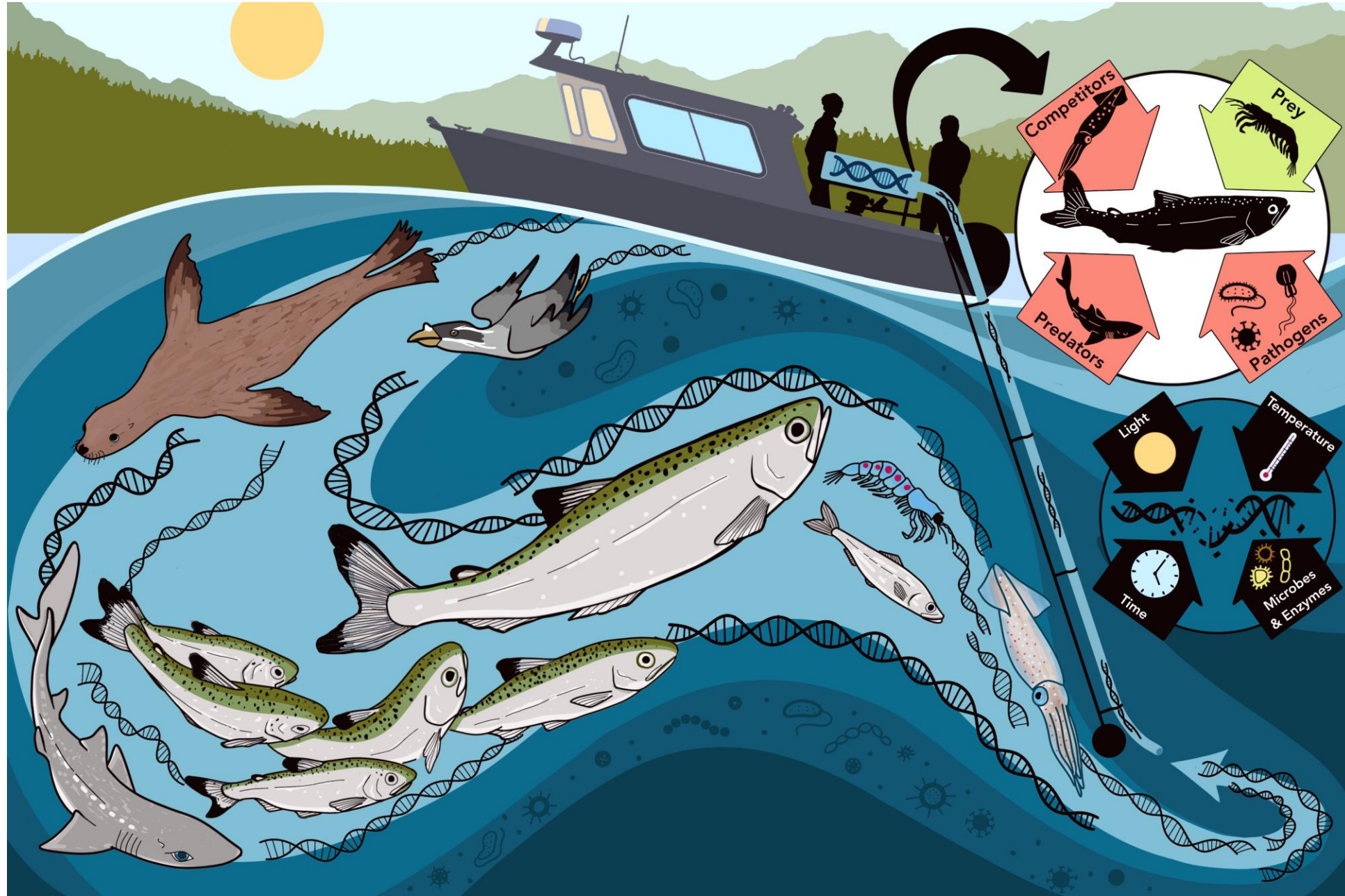
Christoph M. Deeg  
[christoph.deeg@dfo-mpo.gc.ca](mailto:christoph.deeg@dfo-mpo.gc.ca)



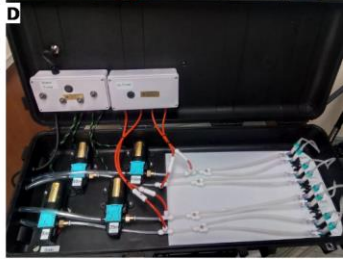
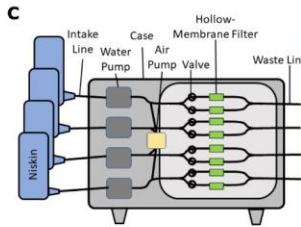
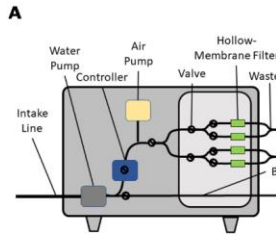
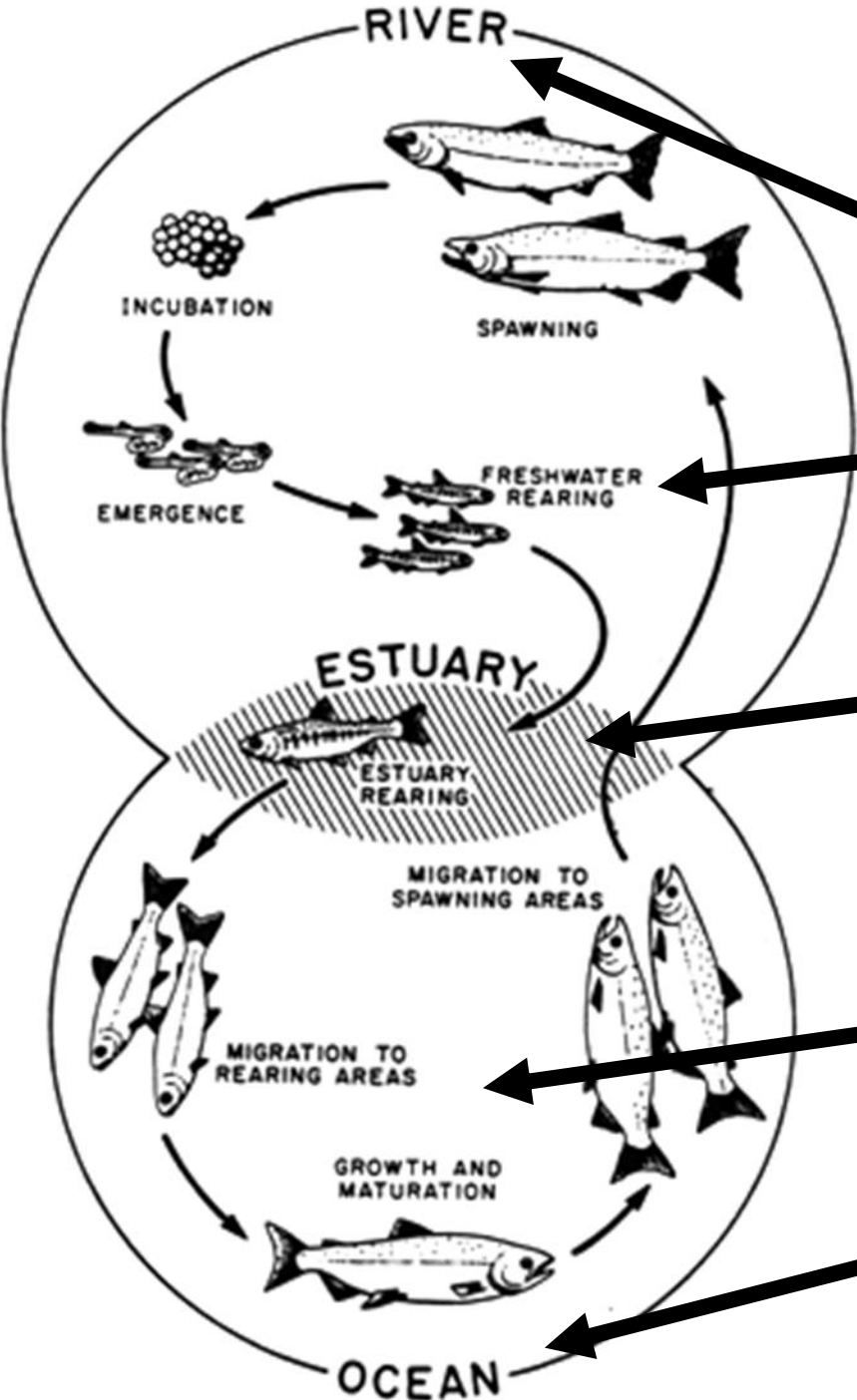
Fisheries and Oceans  
Canada

Pêches et Océans  
Canada

# e(nvironmental) DNA



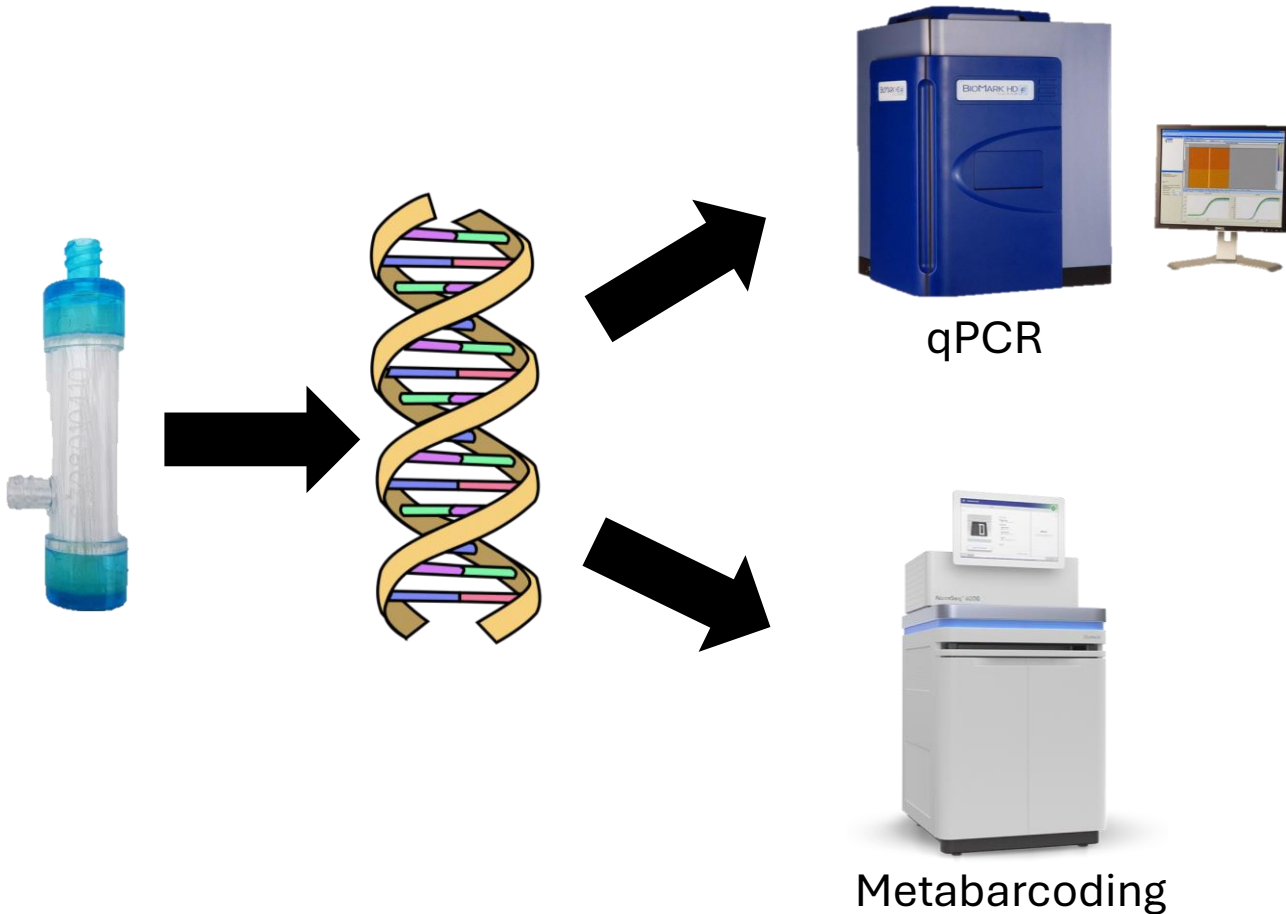
# eDNA sampling technology to cover the salmon lifecycle



Deeg et al. *Environmental DNA* 7.1 (2025): e70059.



# Methods - Sample processing



- qPCR
  - 16 Salmonids/fish
  - 32 salmon infectious agents
- Metabarcoding
  - Fish
  - Vertebrates
  - Cephalopods
  - Salmonids
  - Rockfish
  - Zooplankton



# Steelhead eDNA studies

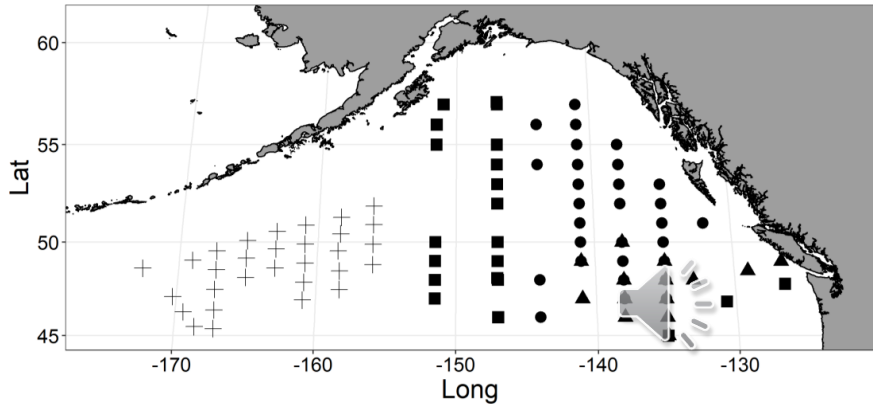
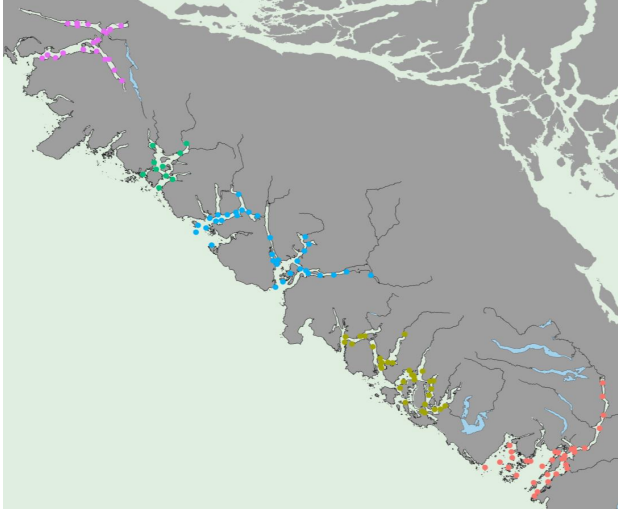
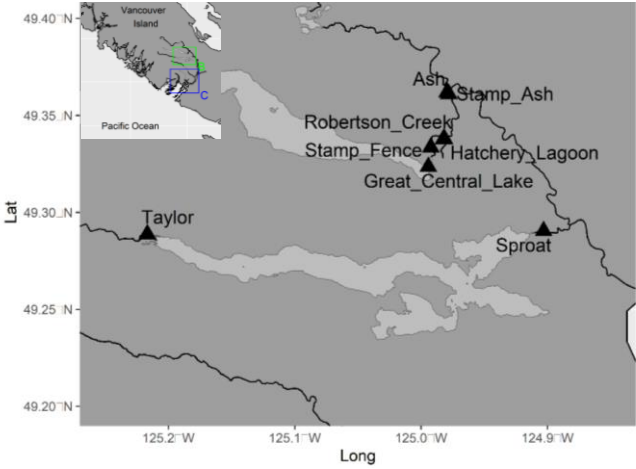
## Freshwater



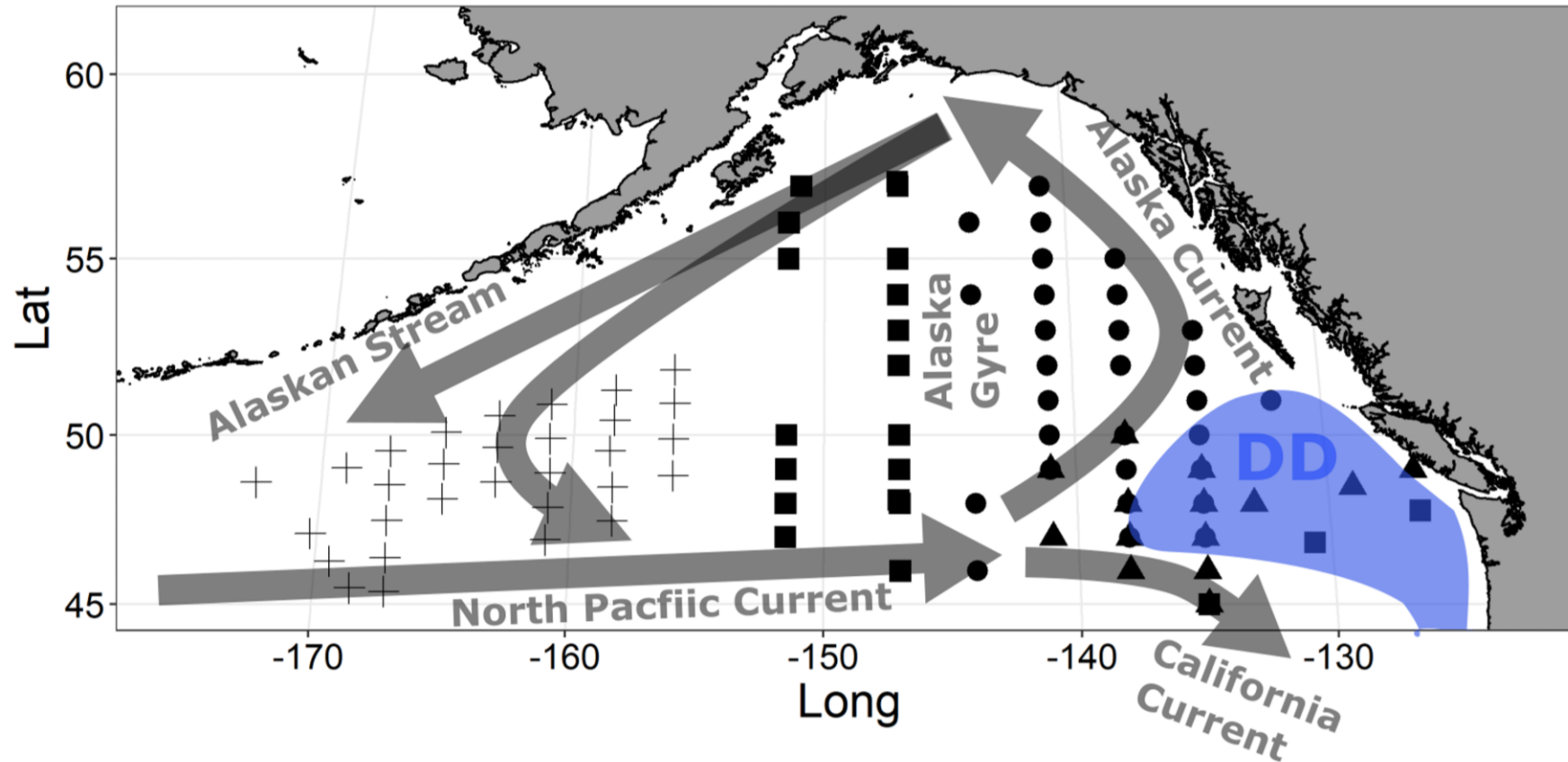
## Nearshore



## Offshore



# Offshore: International Year of the Salmon 2022



eDNA Station (Vessel)

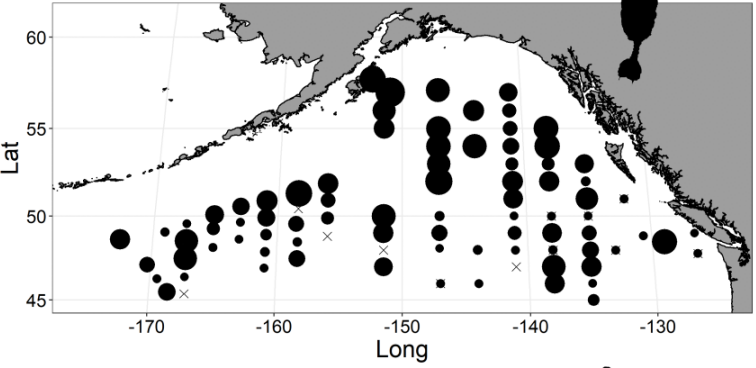
- Franklin
- ▲ Raw\_Spirit
- Shimada
- + TINRO



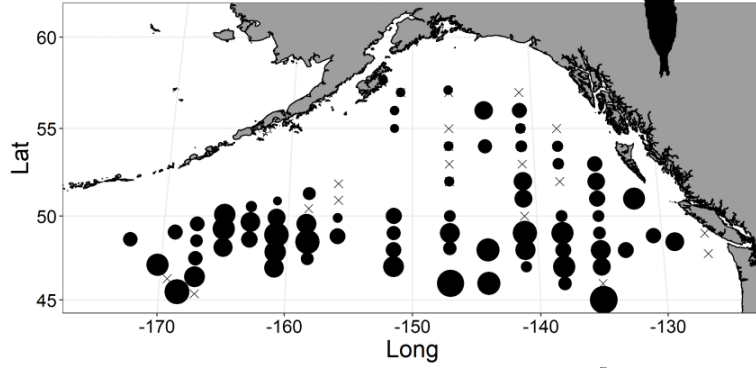
- 101 stations -> ~2.2 million km<sup>2</sup> @ 5m
- Metabarcoding

Deeg et al. ICES Journal of Marine Science (2025) fsaf104

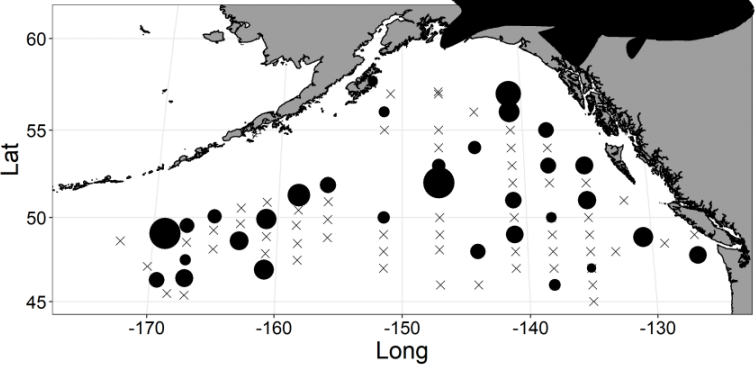
*Neocalanus flemingeri*



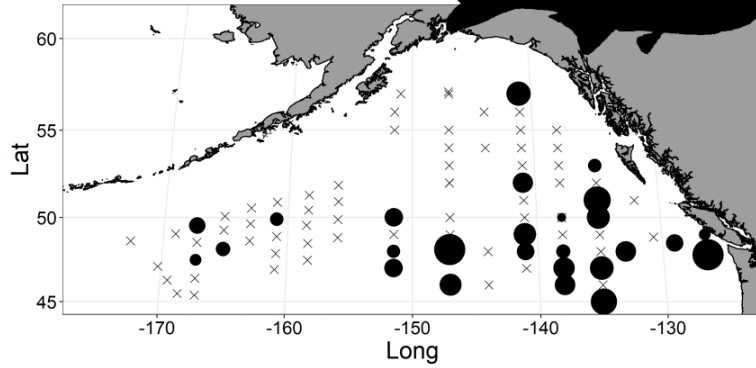
*Neocalanus plumchrus*



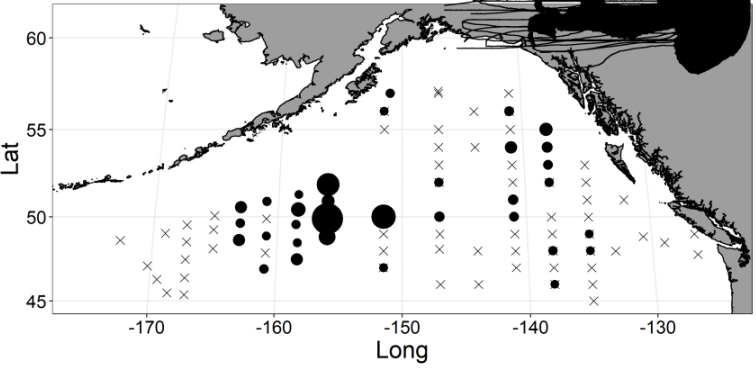
*Stenobrachius* sp



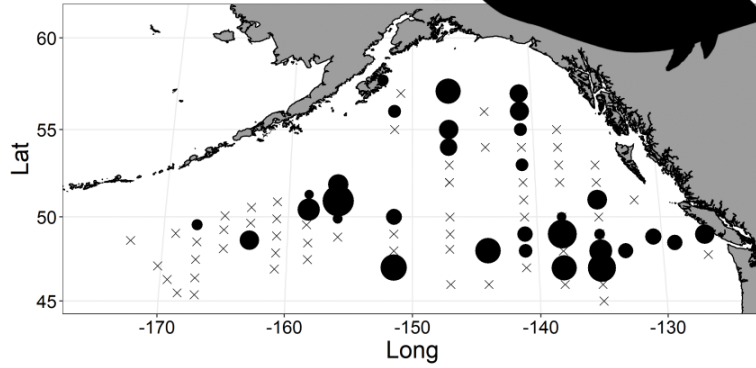
*Tarletonbeania* sp



*Chrysaora melanaster*

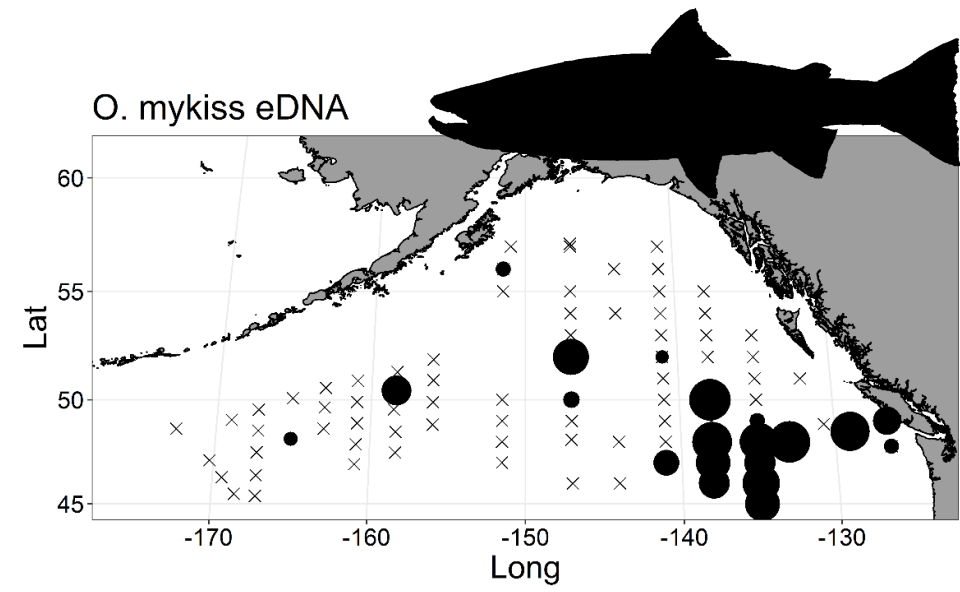


*Phocoenoides dalli*

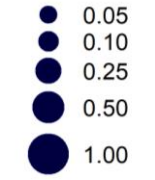


# IYS 2022

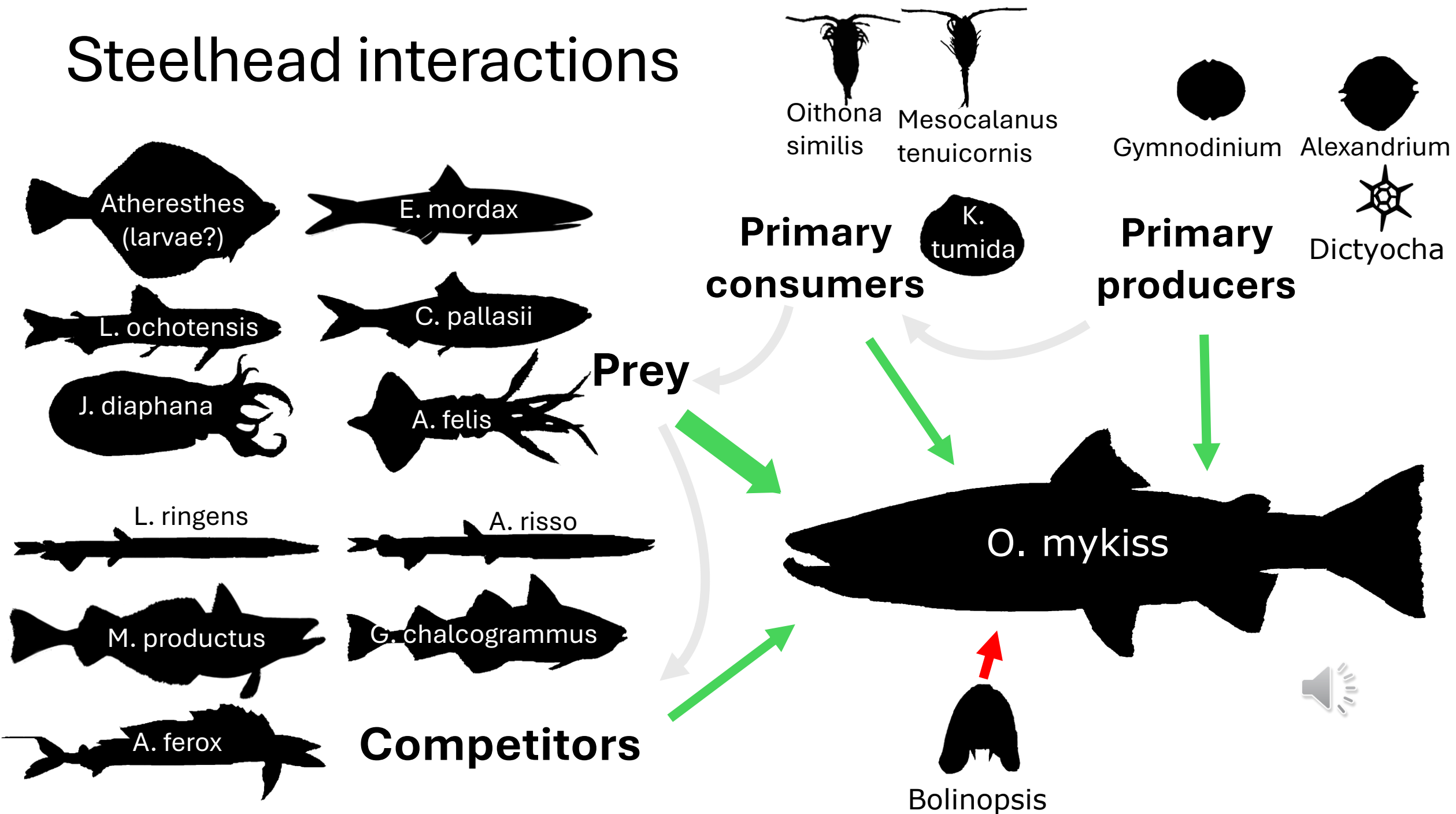
*O. mykiss* eDNA



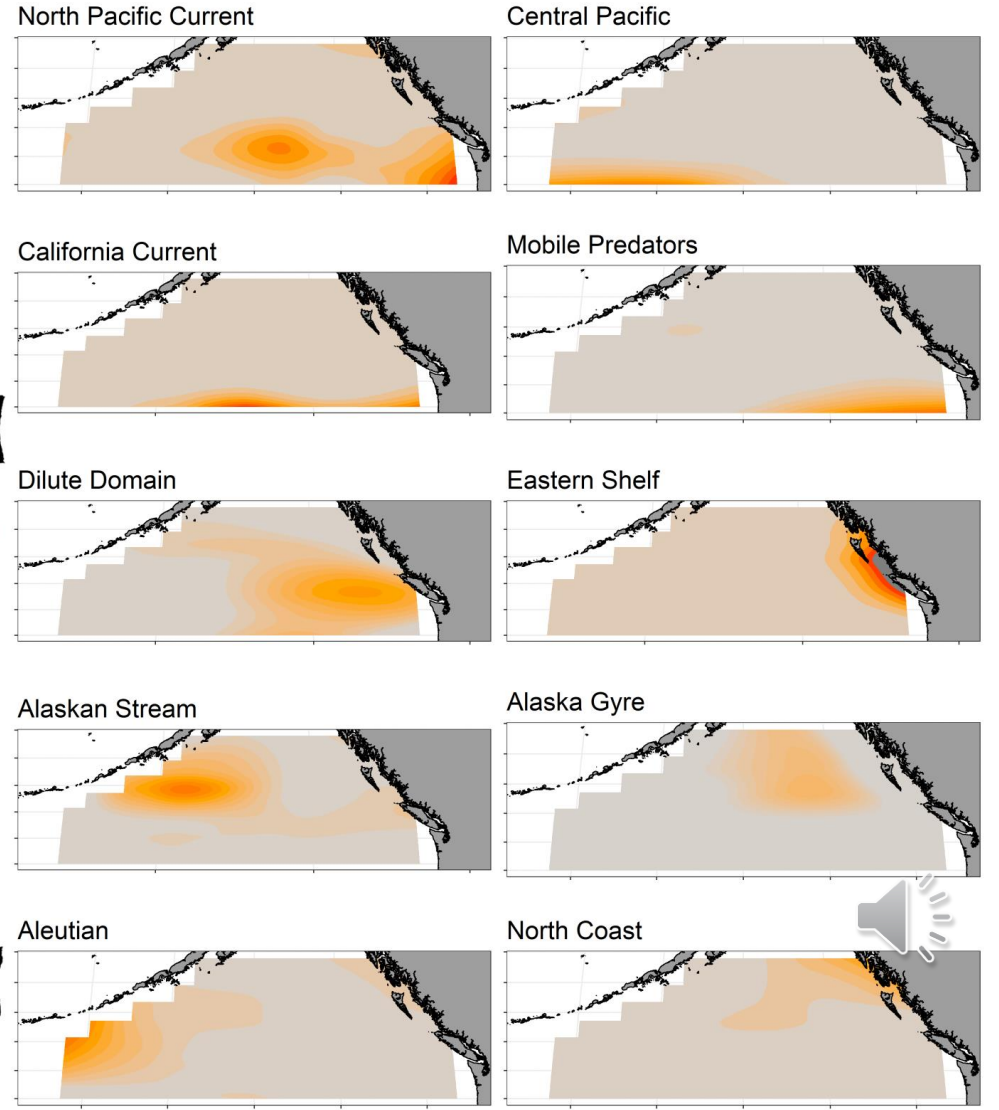
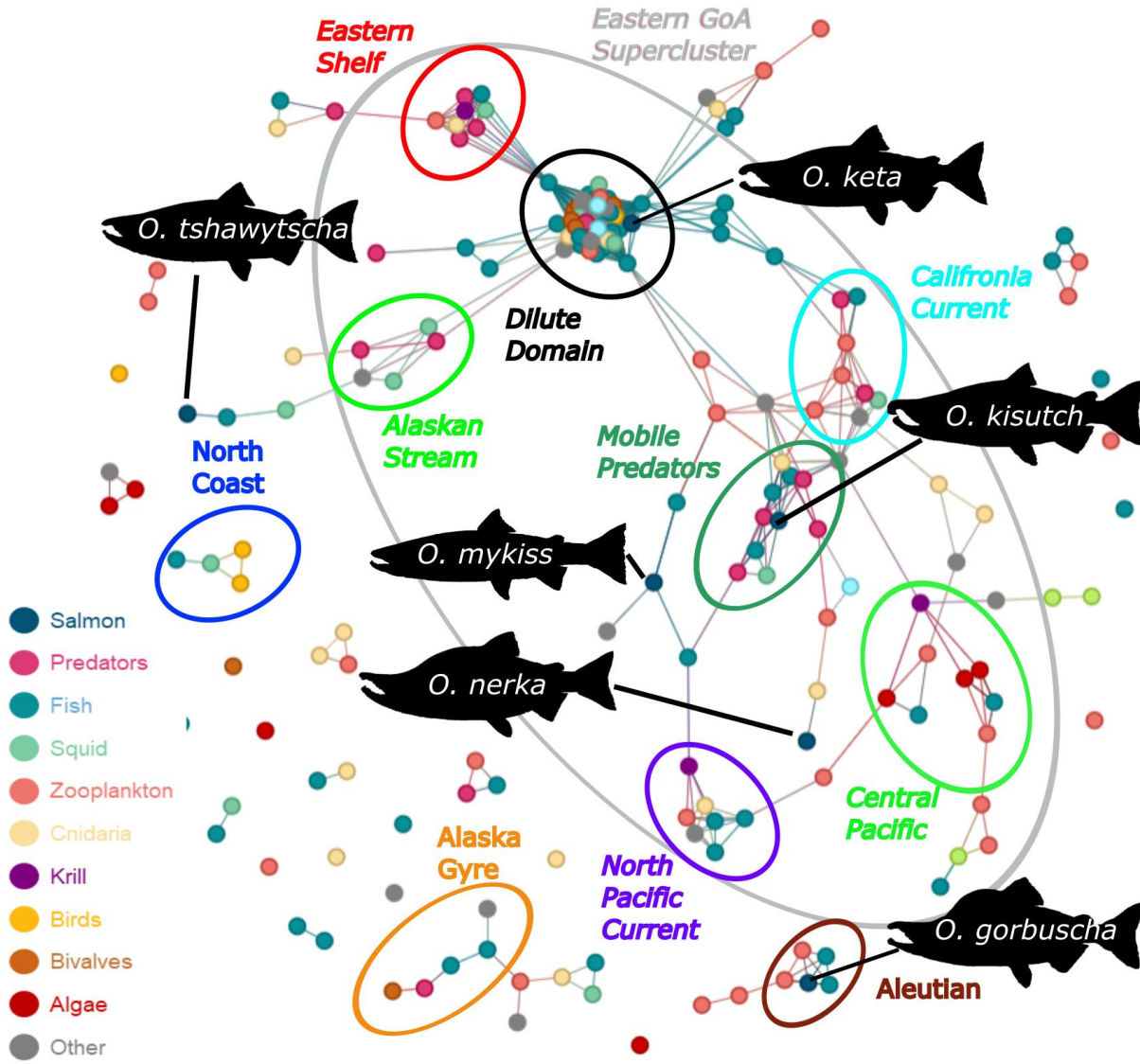
eDNA Index



# Steelhead interactions

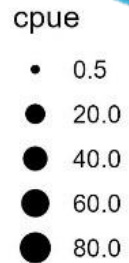
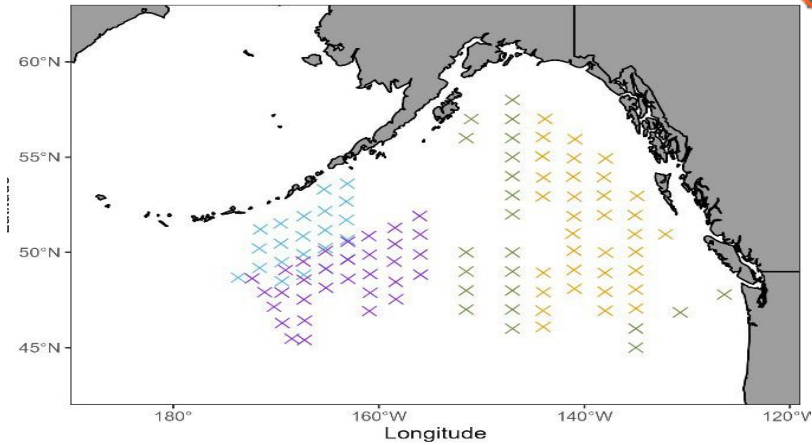


# NE Pacific winter communities

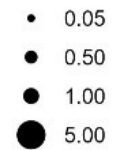
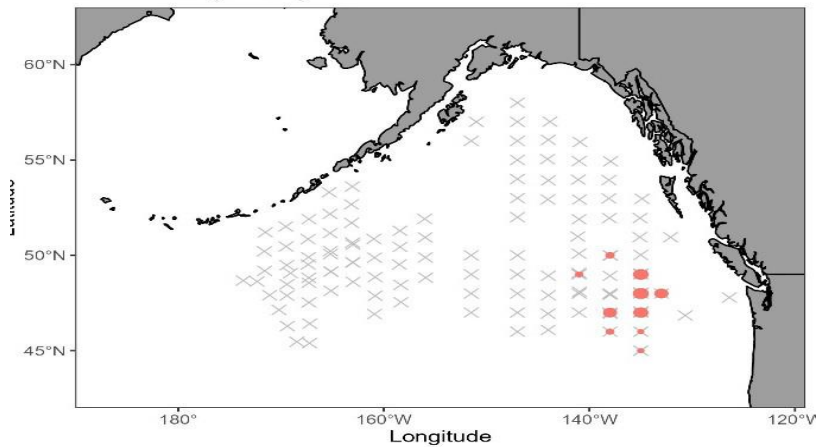


# Steelhead catches

## Trawl catches



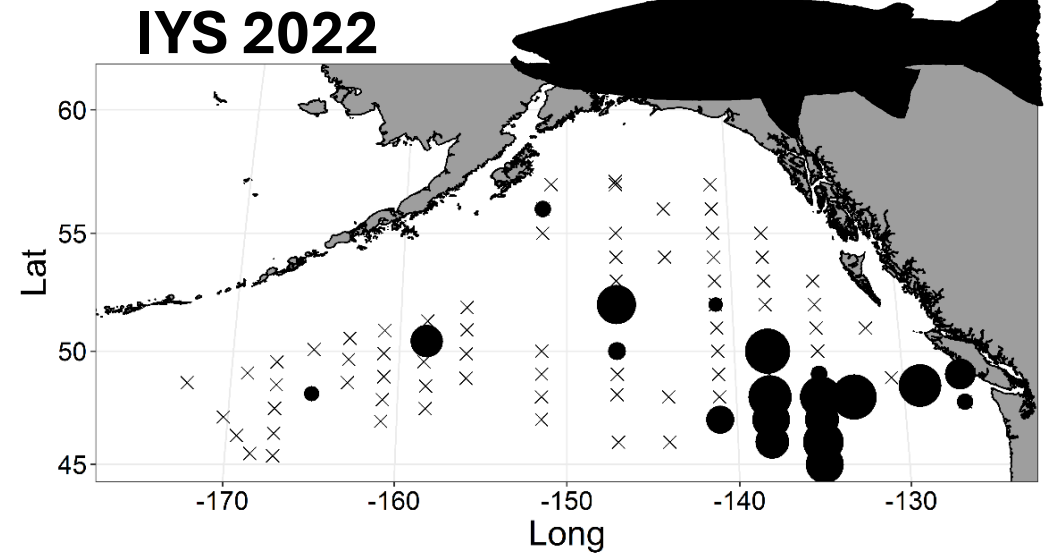
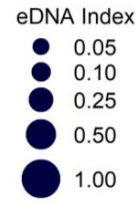
## Gillnet catches



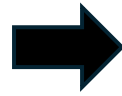
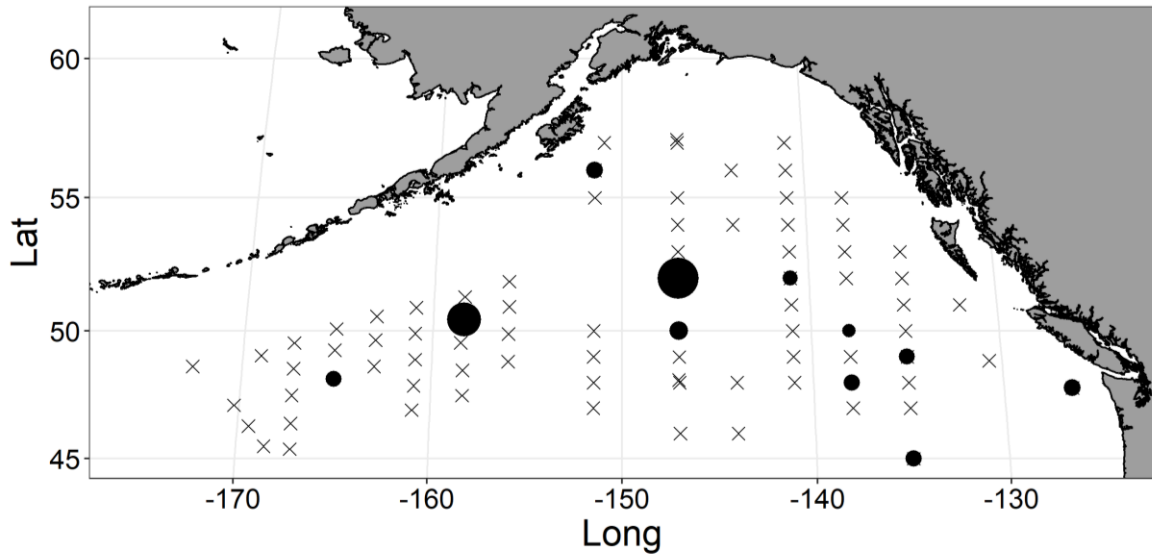
Methodological catch Bias?



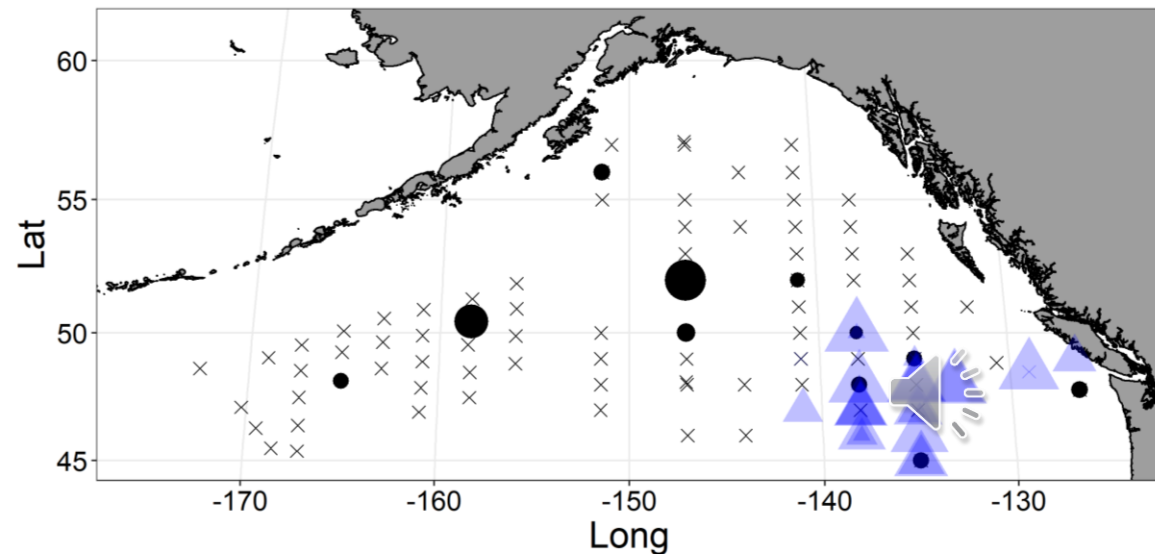
# Steelhead eDNA detections show spatiotemporal pattern!



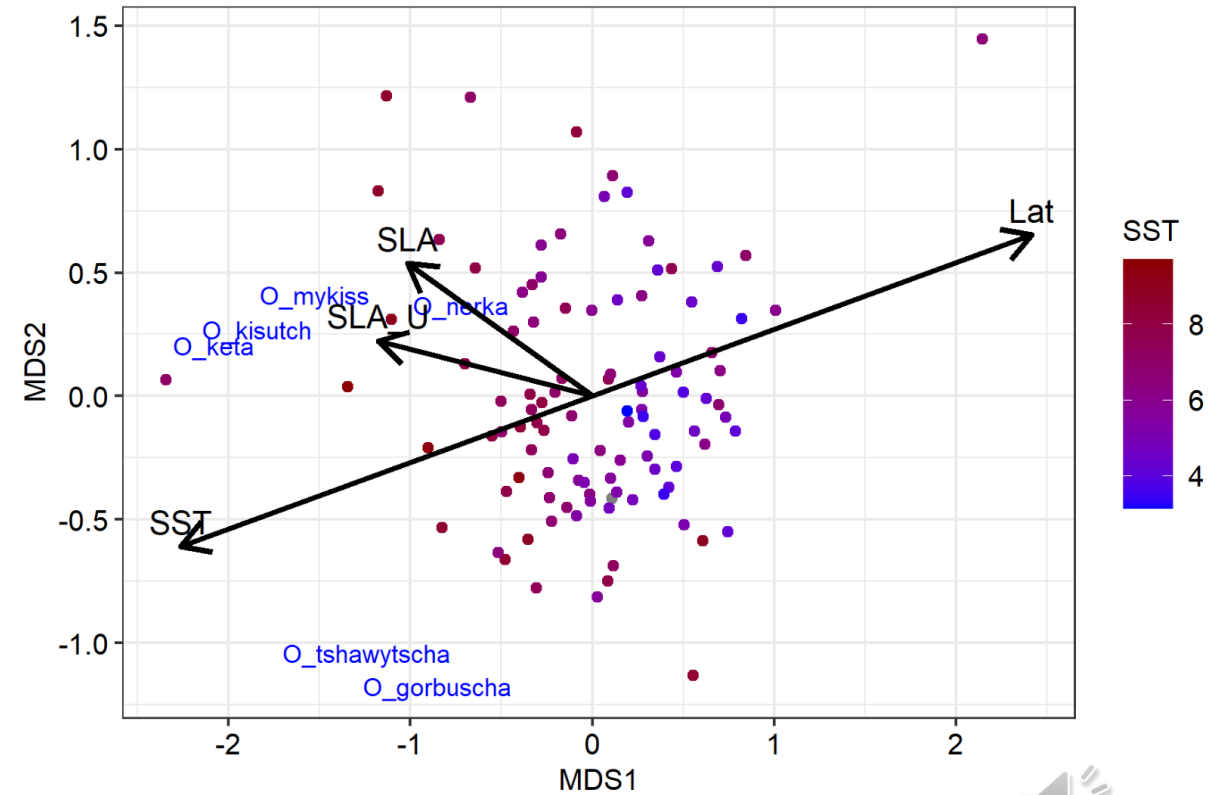
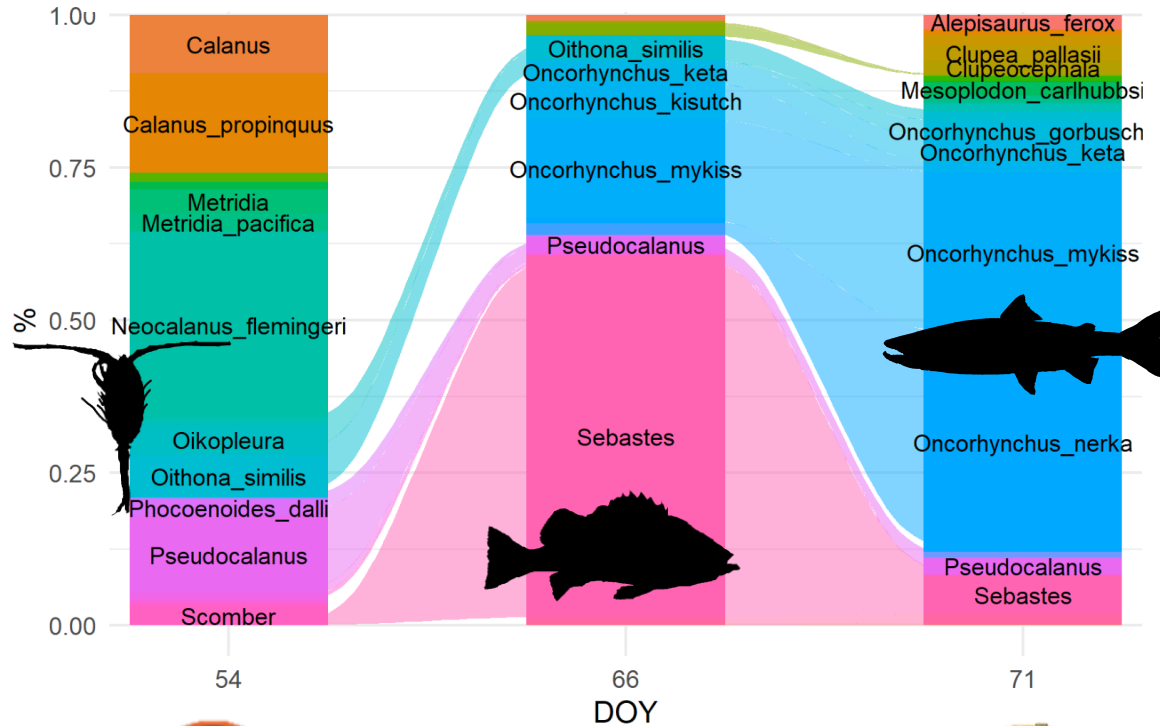
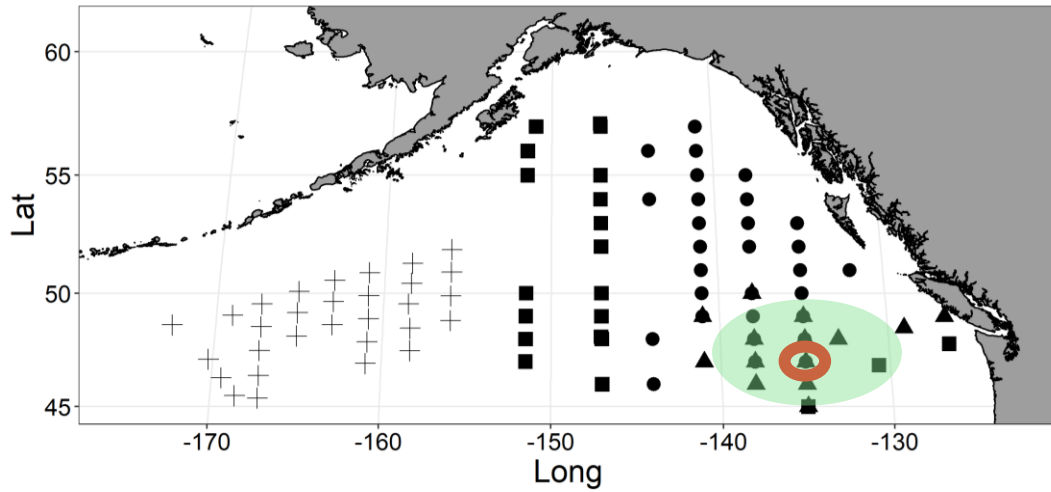
### February 2022



### February + March 2022



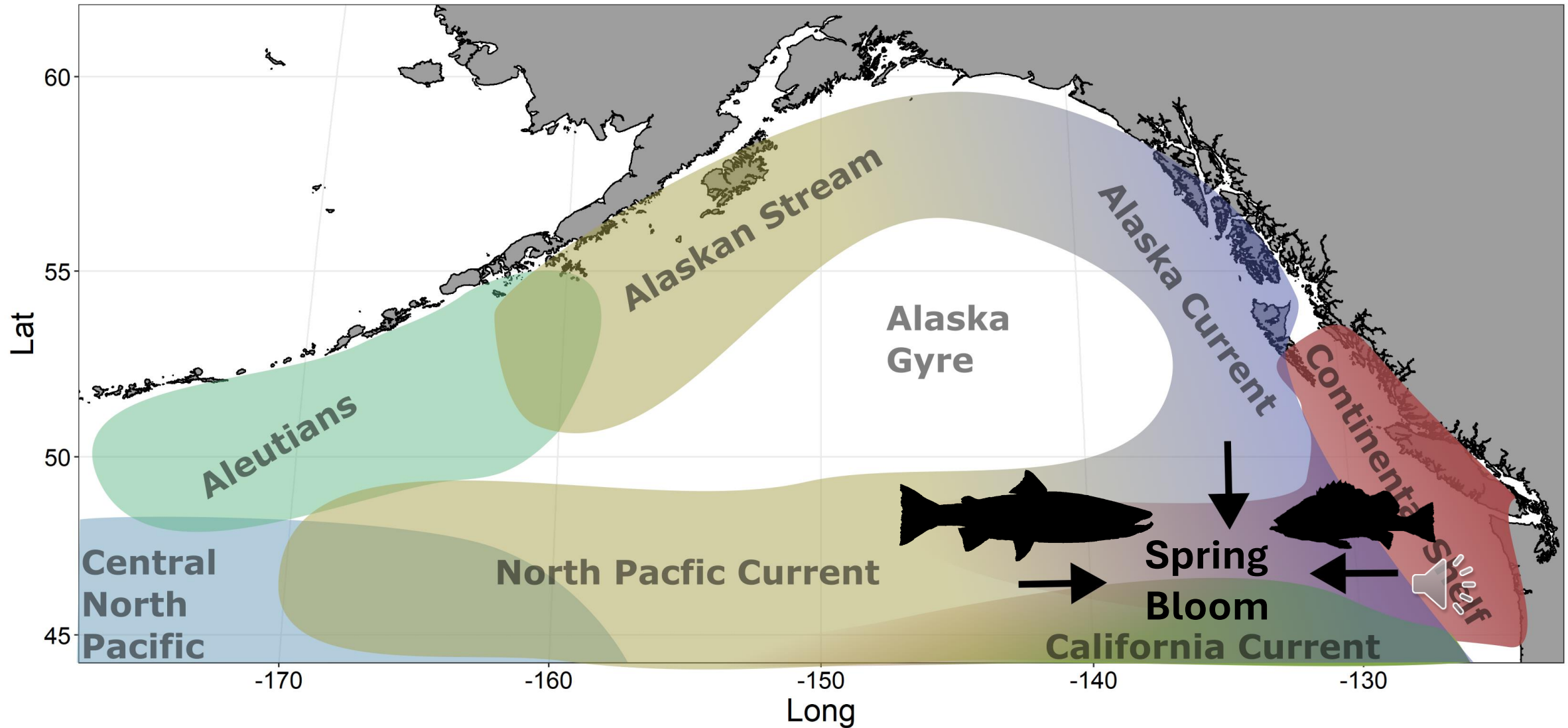
# Steelhead orient towards high productivity oceanic features



SLA = anticyclonic eddies!



# Steelhead and the first spring blooms



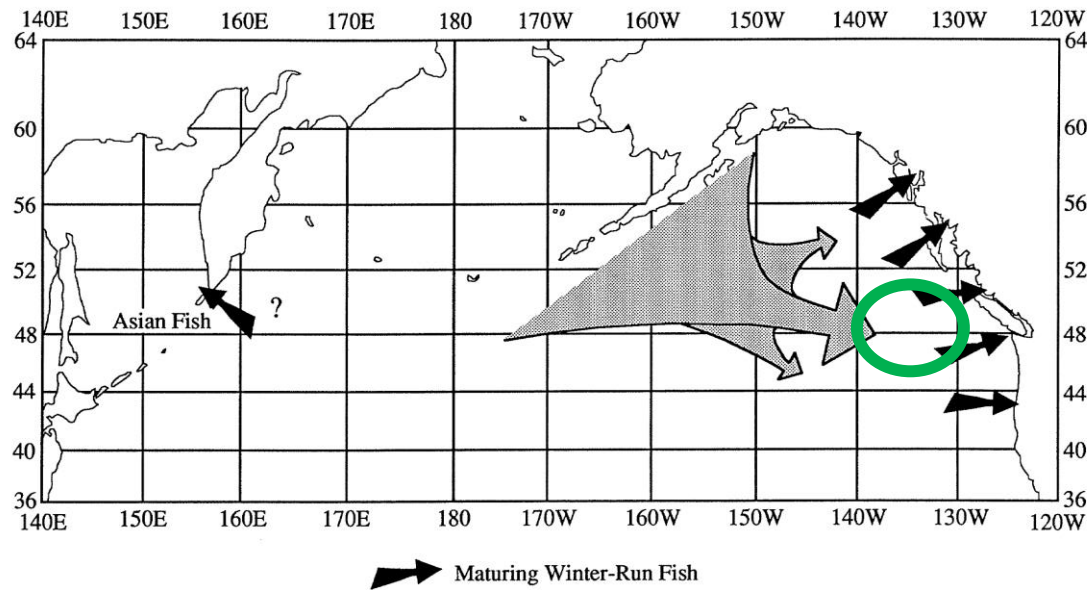
# Steelhead migration models - 1989

## OCEAN DISTRIBUTION AND MIGRATION OF STEELHEAD (*Oncorhynchus mykiss*, formerly *Salmo gairdneri*)

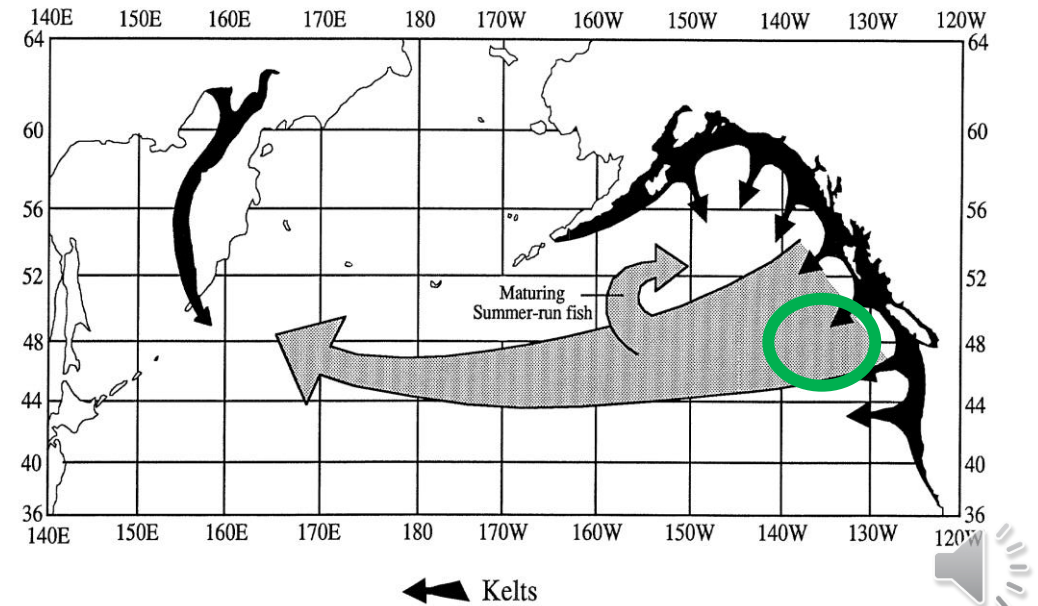
by

Jeffrey T. Light, Colin K. Harris, and Robert L. Burgner

FISHERIES RESEARCH INSTITUTE  
School of Fisheries  
College of Ocean and Fishery Sciences  
University of Washington  
Seattle, Washington 98195  
U.S.A.

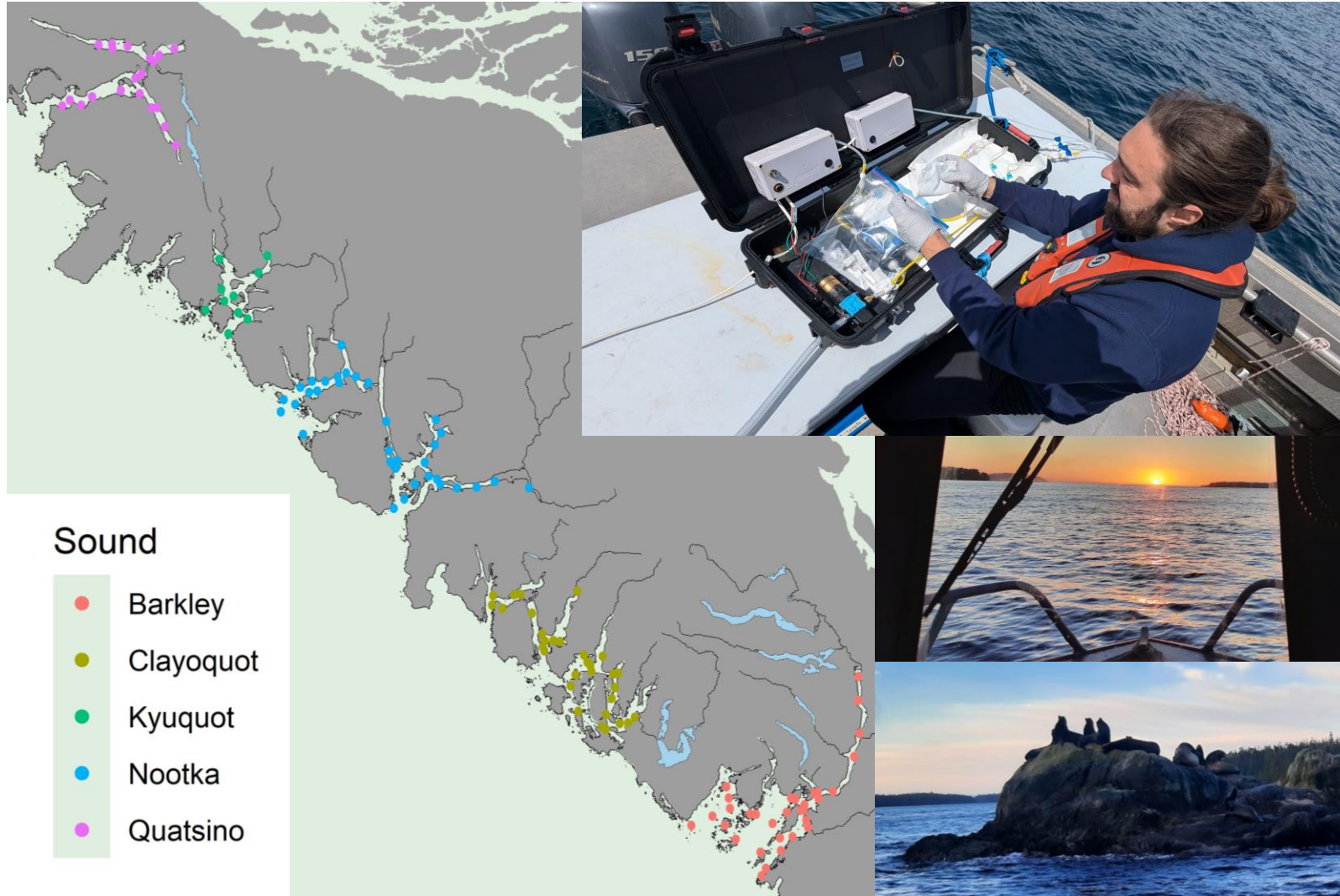


November -> February



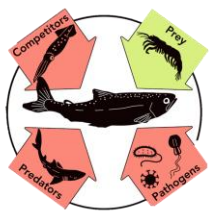
March -> June

# Nearshore: West Coast Vancouver Island (WCVI) eDNA survey



- 5 Sounds
- 131 sites
- 856 sampling events
- 2023-2025
- qPCR
- Metabarcoding
- Preliminary results

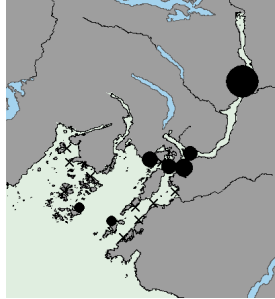




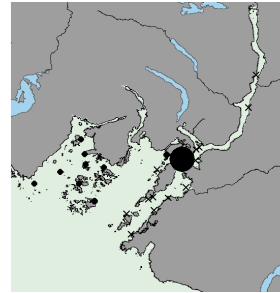
# WCVI communities: Barkley Sound



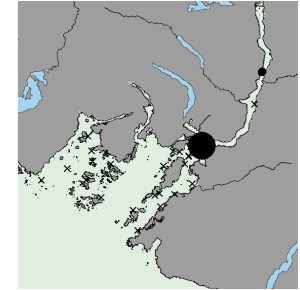
**Steelhead**  
January 2024



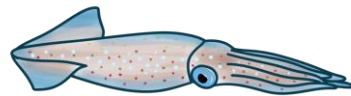
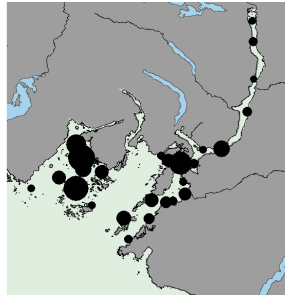
**California Sealion**  
February 2024



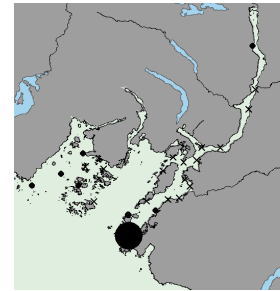
**Auks**  
February 2024



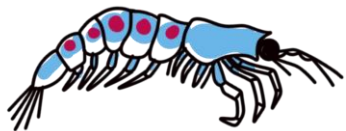
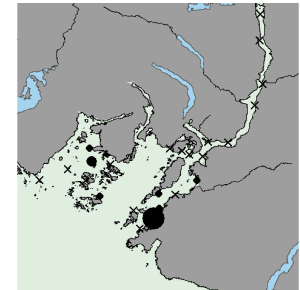
**Herring**  
April 2024



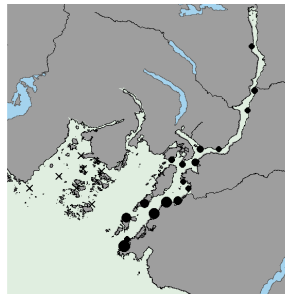
**Opalescent Squid**  
June 2024



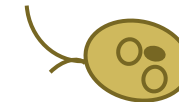
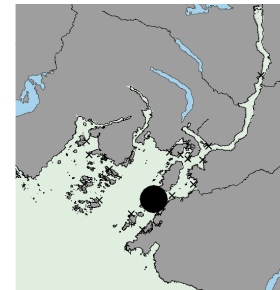
**Tenacibaculum maritimum**  
August 2024



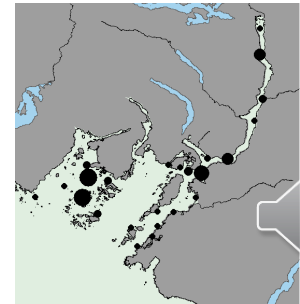
**Krill**  
June 2024



**Dogfish**  
January 2024

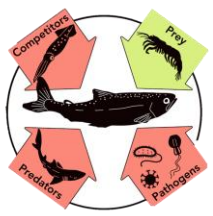


**Heterosigma akashiwo**  
August 2024

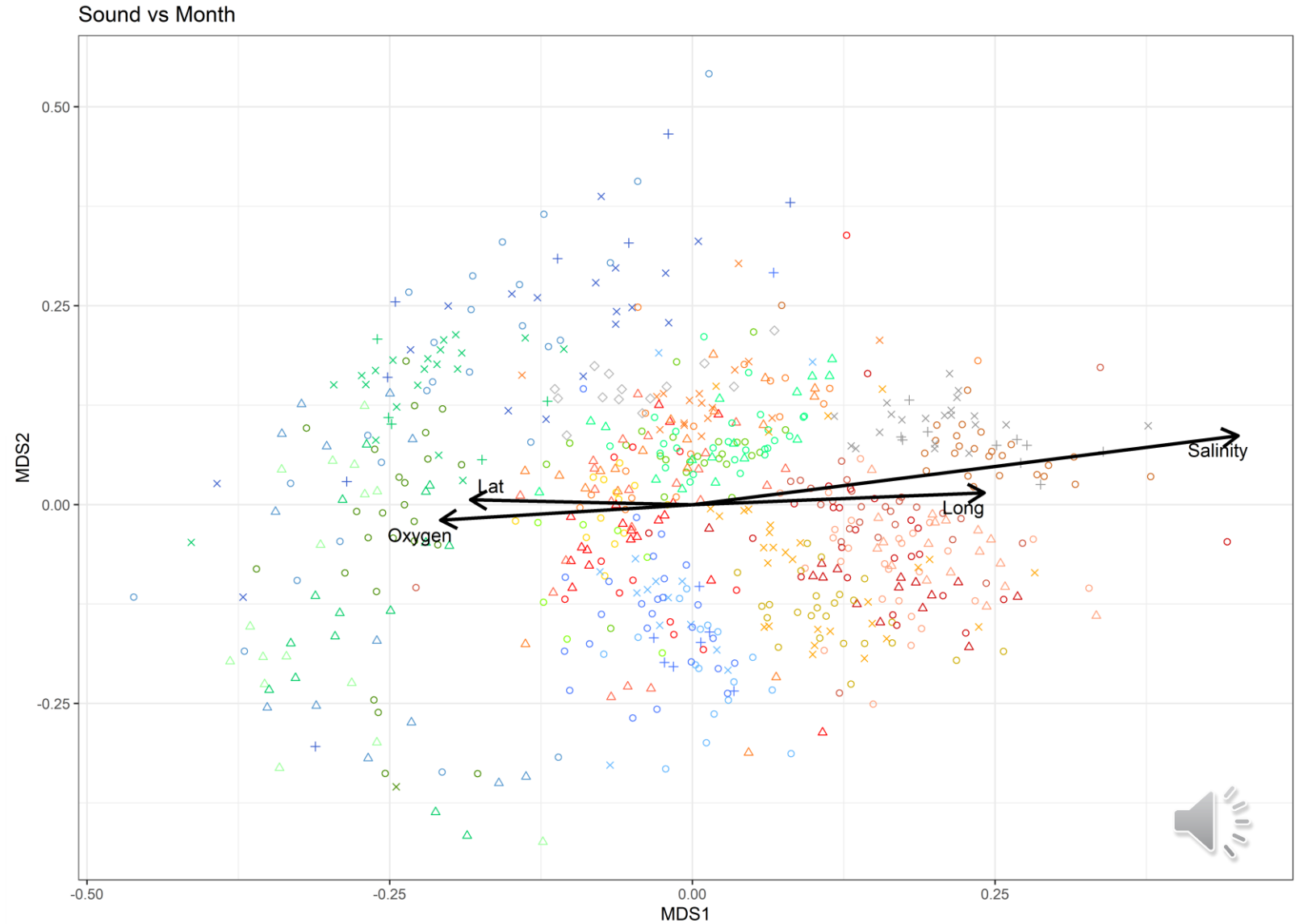


X = Sampling site without detection ; ● = Sampling site with detection (scaled)



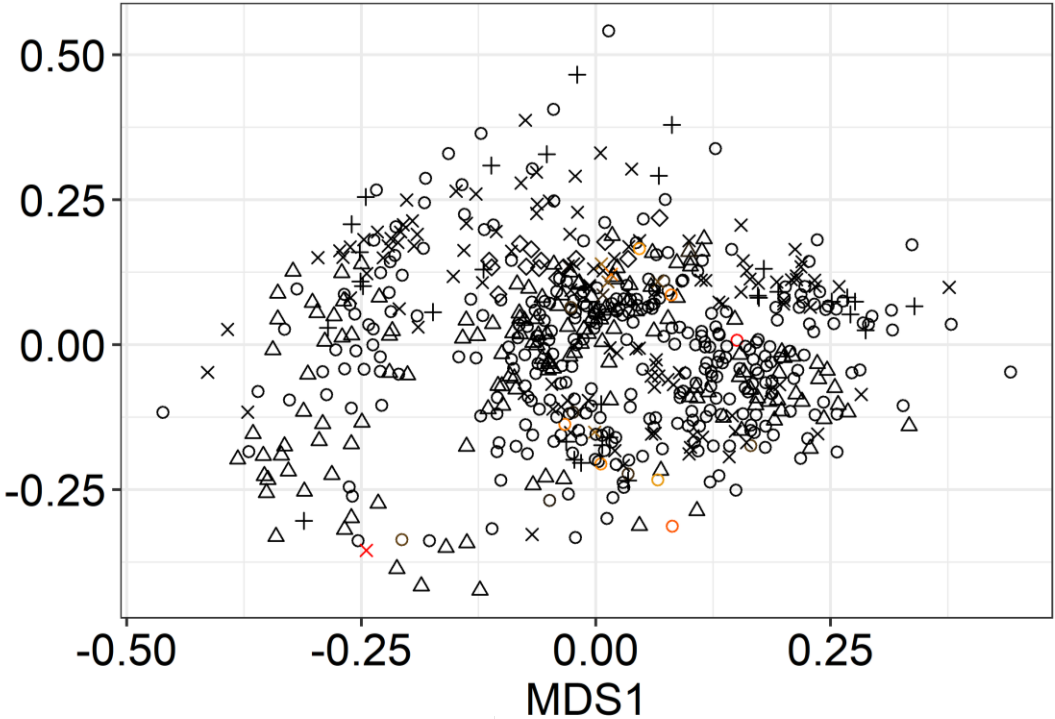


# WCVI communities by eDNA

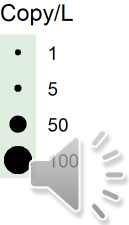
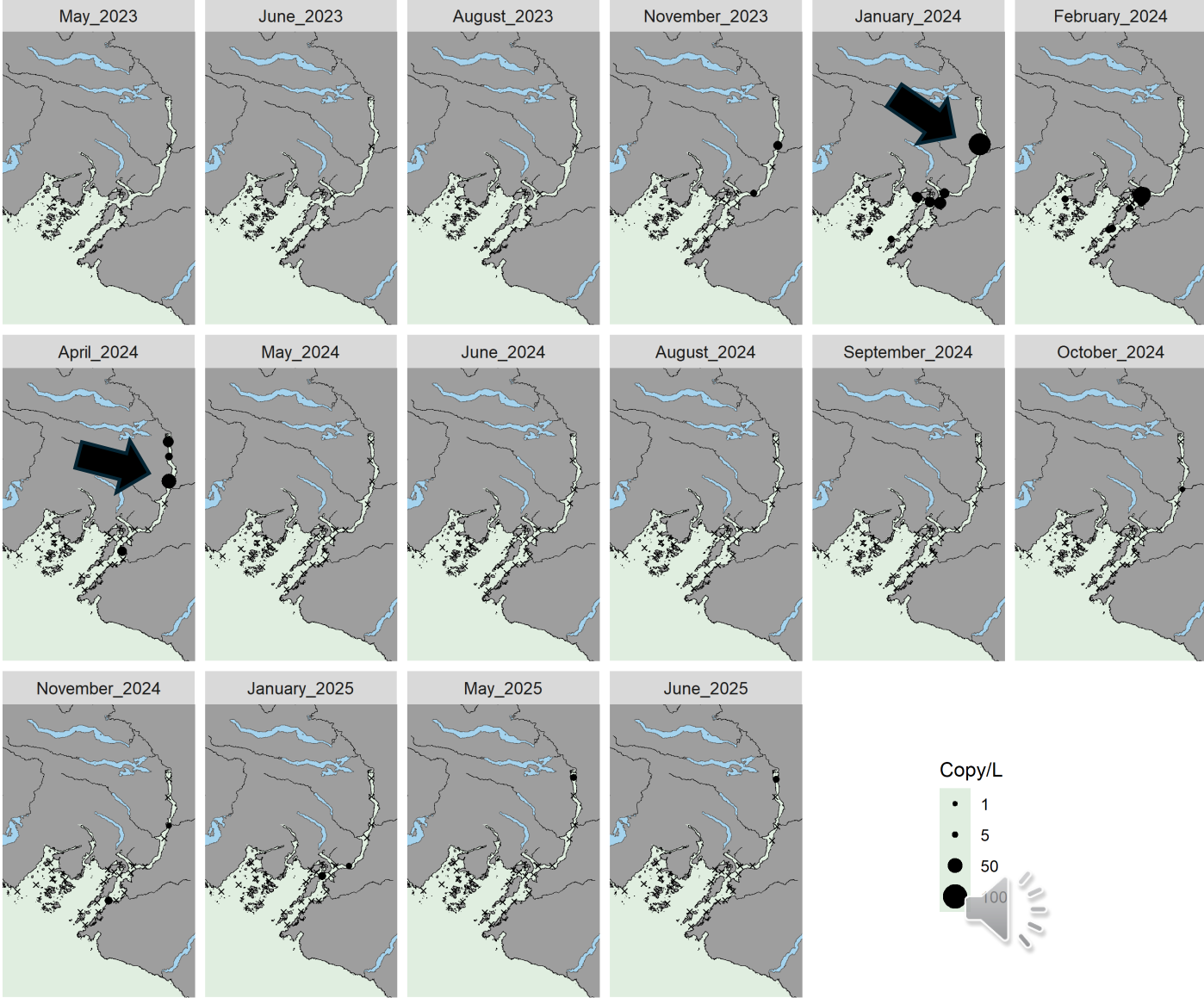
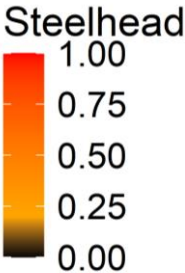


Non-metric multidimensional scaling of WCVI communities

# Steelhead detections

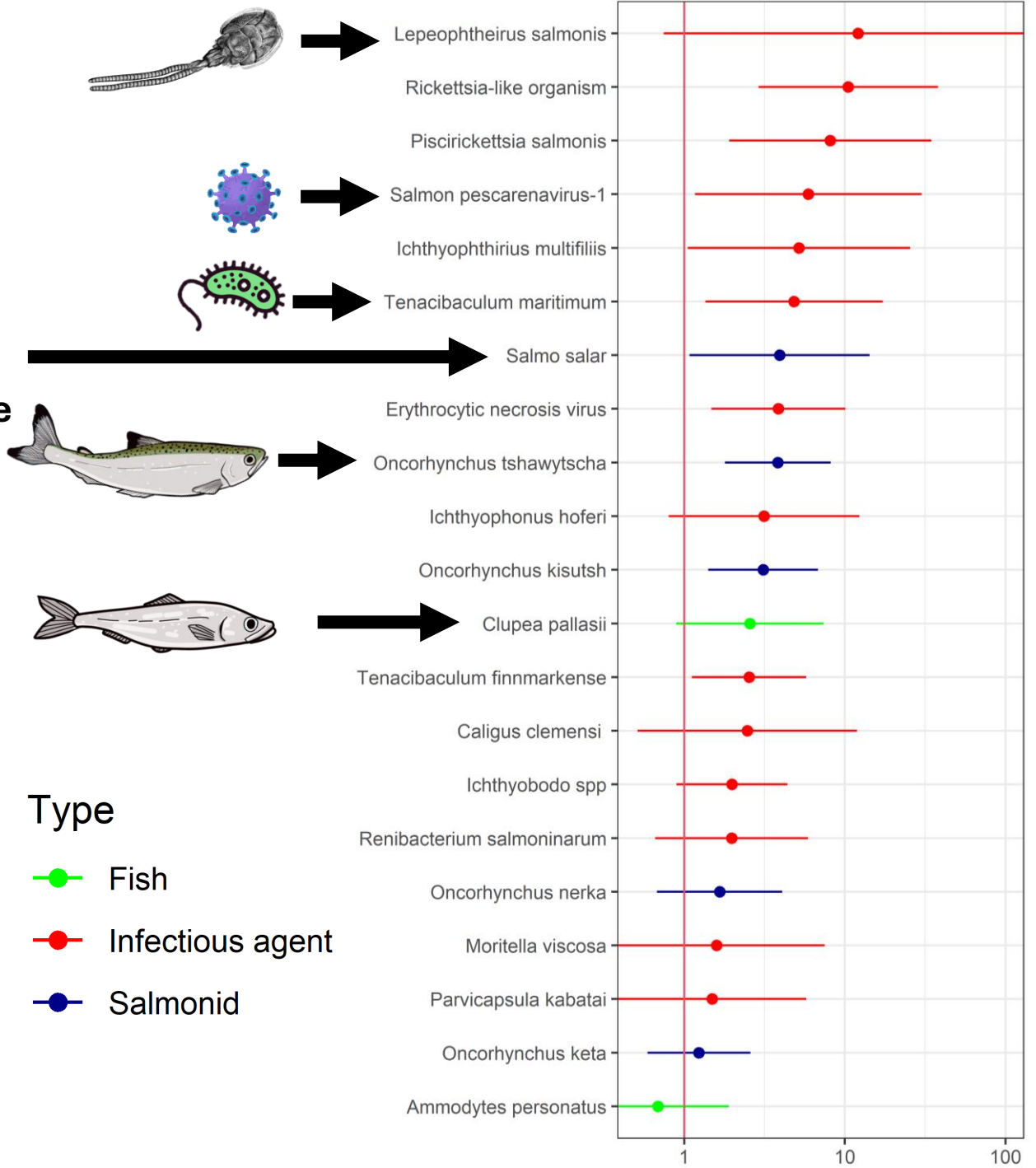


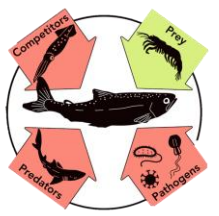
- Sound**
- Barkley
  - △ Clayoquot
  - + Kyuquot
  - × Nootka
  - ◇ Quatsino



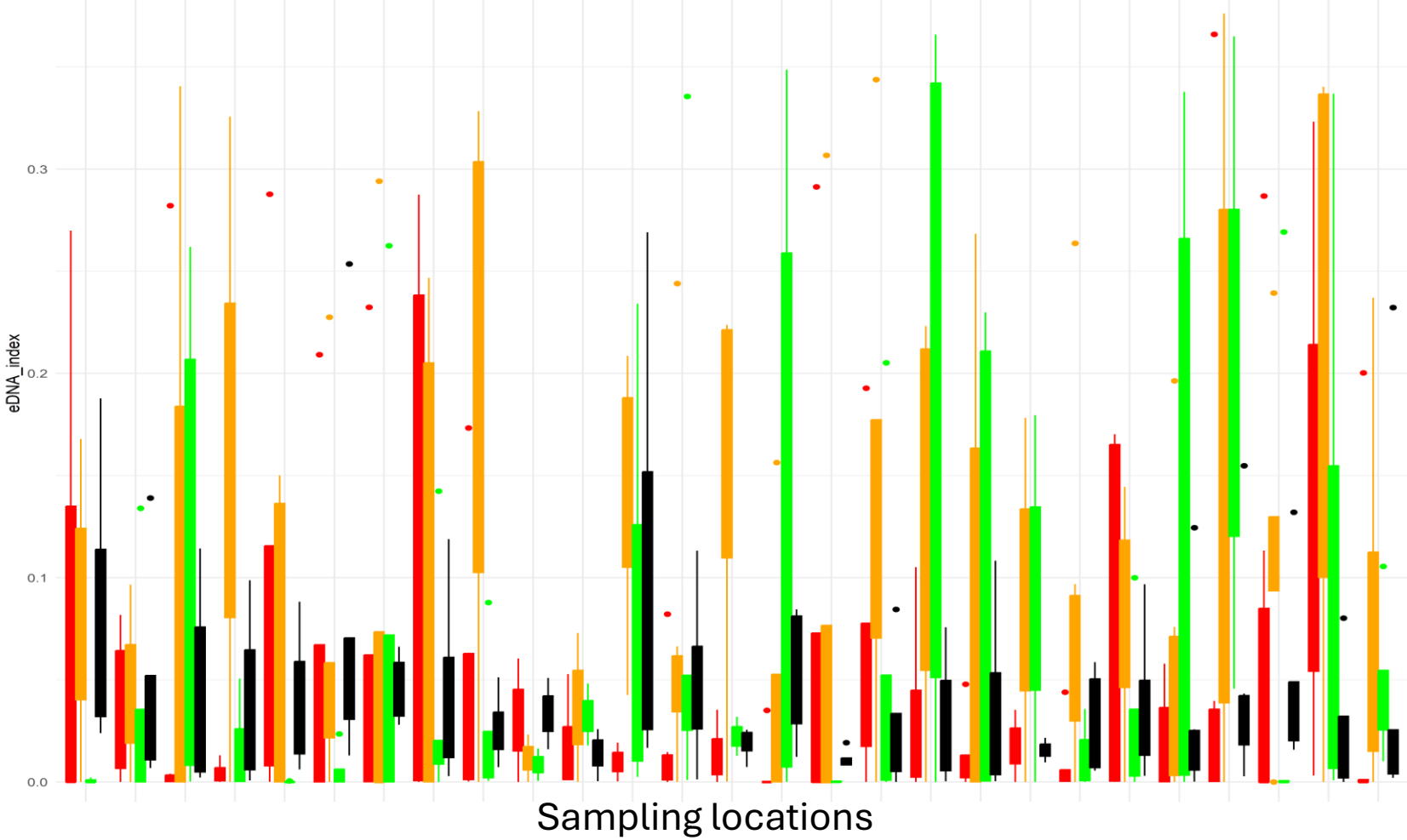
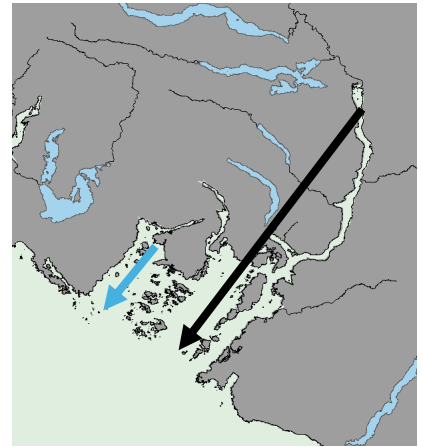
# Steelhead nearshore associations

Atlantic Salmon Aquaculture





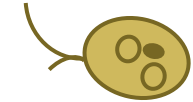
# Barkley Sound habitat: Outmigration window (Apr -> Jun)



■ Invertebrate prey (eDNA index)



■ Smolt predators (eDNA index)

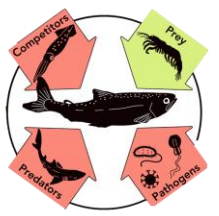


■ Harmful algae (eDNA index)

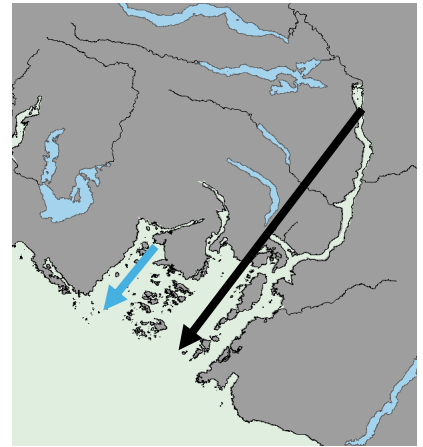


■ Pathogens (RIAB)

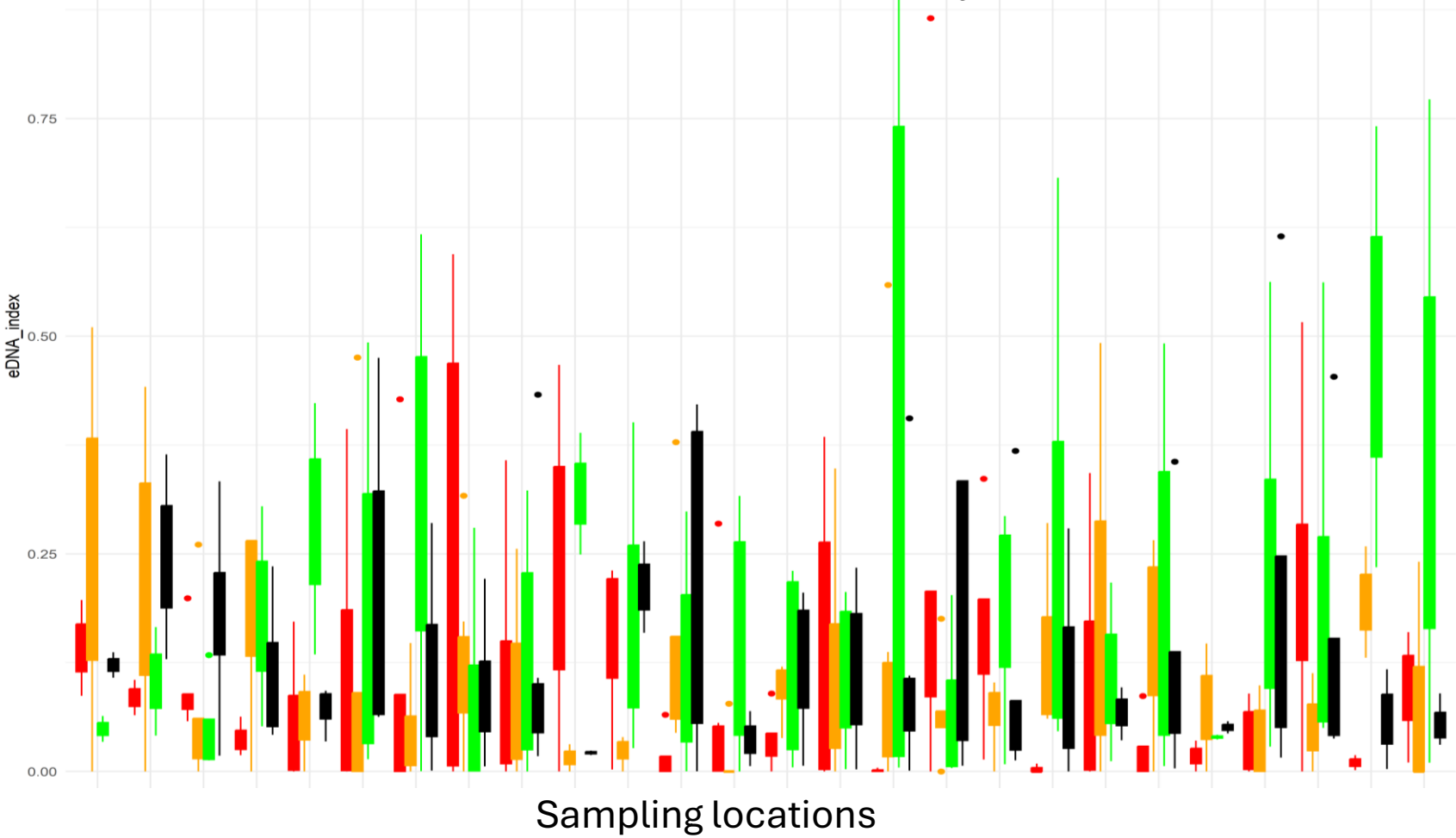




# Barkley Sound habitat: Winter (Nov -> Feb)




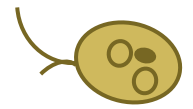
Alberni Inlet    Junction Passage    Deer Group    Broken Group



 Herring (eDNA index)




 Predators of Juveniles (eDNA index)



 Harmful algae (eDNA index)



 Pathogens (RIAB)

**Thank you!**

- Adam Wilcockson
- Shaye Ryan
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- Carl Llewellyn
- Shaorong Li
- Christopher Tam
- Shannon Adams
- Kristina Miller
- Svetlana Esenkulova
- Christopher Tam
- Abigail Wells
- Angela Schulze
- Brian Hunt
- Valeria Soshnina
- Nick Ens

