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ESA-listed Puget Sound rockfish: How did we get here and how do we assess progress towards recovery planning goals?

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Speaker

Kelly Andrews, Krista M. Nichols, Jason Cope, Nick Tolimieri, Dan Tonnes, Dayv Lowry, and Robert Pacunski

ESA-LISTED ROCKFISH IN PUGET SOUND: HOW WE GOT HERE AND HOW DO WE ASSESS RECOVERY?



Kelly Andrews, Krista Nichols, Jason Cope, Anna Elz, Nick Tolimieri, Chris Harvey, Dan Tonnes, Dayv Lowry, Bob Pacunski, & Lynne Yamanaka

3 ROCKFISH SPECIES IN PUGET SOUND LISTED UNDER THE ESA

Yelloweye rockfish



Threatened

Canary rockfish



Threatened

Bocaccio



Endangered

2 CRITERIA FOR ESA LISTINGS

1. Are these populations "distinct"?



2 CRITERIA FOR ESA LISTINGS

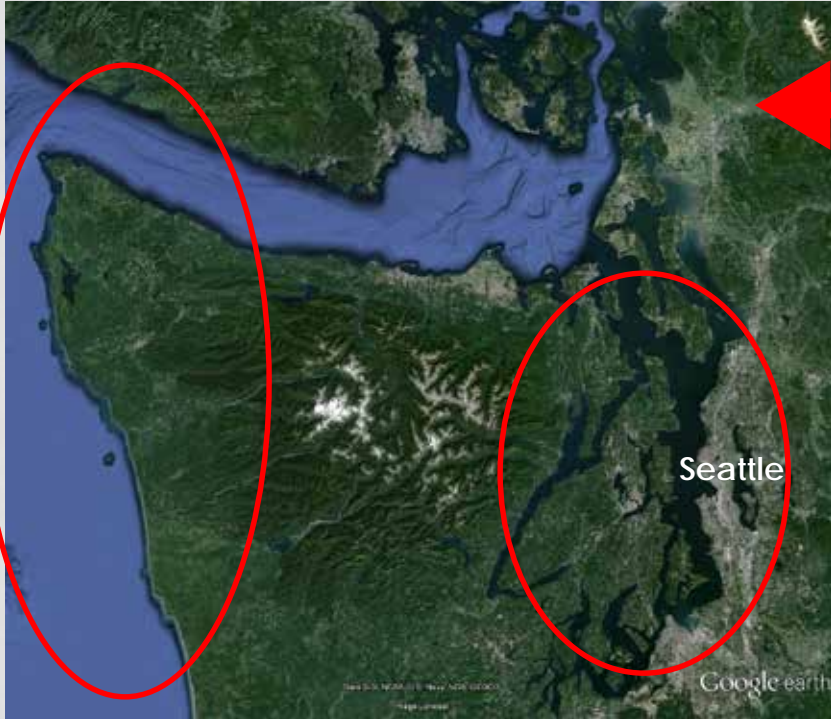
1. Are these populations "distinct"?

∅ Must be markedly different from other populations of the same species

- Physical
- Physiological
- Ecological
- Behavioral
- Morphological
- Genetic



ROCKFISH IN PUGET SOUND ARE MOST LIKELY GENETICALLY DISTINCT



Copper, Brown and Quillback rockfish in Puget Sound are genetically distinct from coastal populations (Seeb 1998, Buonaccorsi et al. 2002, 2005).



Yelloweye in "inside" waters of Canada show slight evidence of being distinct from yelloweye in "outside" waters (Yamanaka et al. 2006, Siegle et al. 2013).

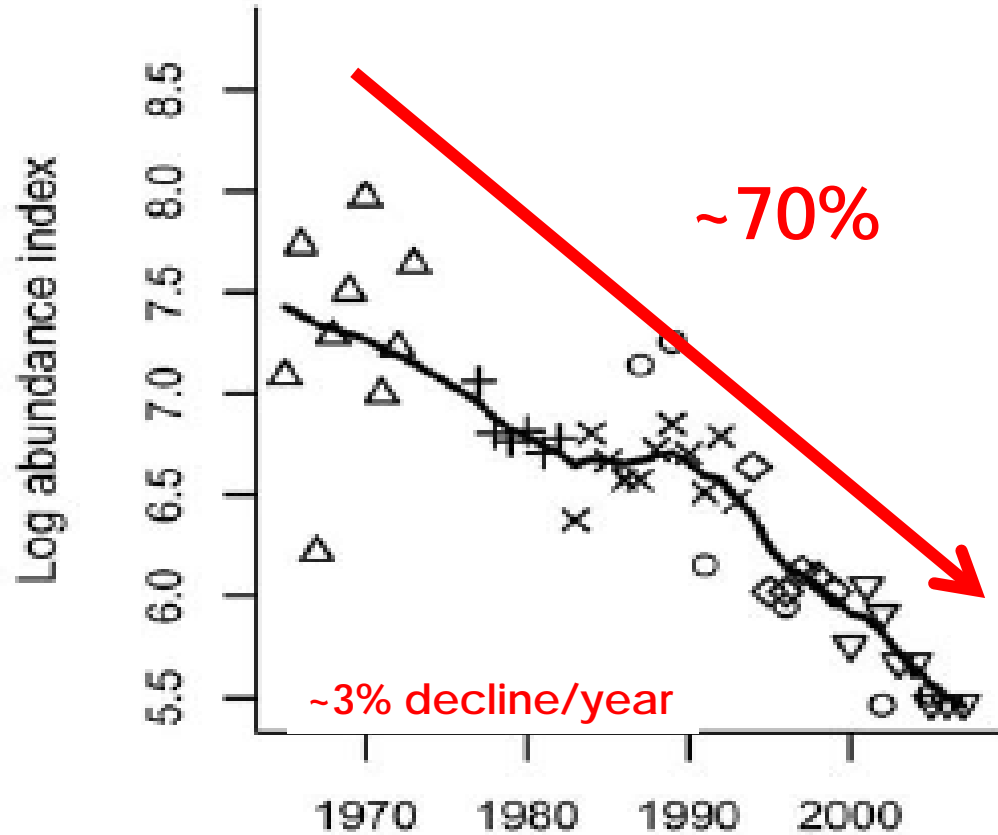
2 CRITERIA FOR ESA LISTINGS

2. Level of extinction risk

- Endangered or Threatened or Not at Risk?
 - Relative or absolute abundance
 - Trends in abundance
 - Environmental and Anthropogenic pressures
 - Threats to genetic integrity
 - Size frequency distributions

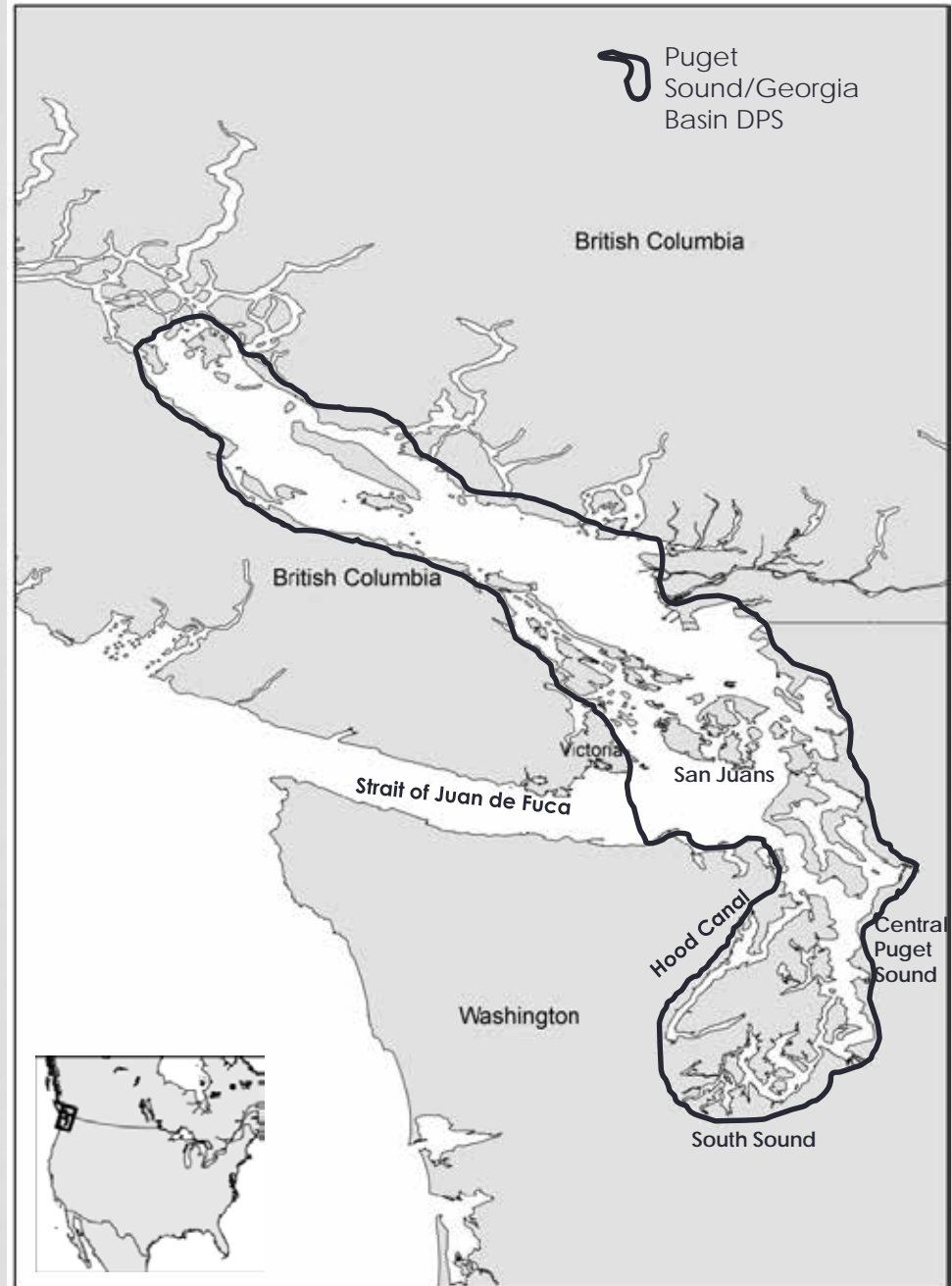


ROCKFISH POPULATIONS IN PUGET SOUND HAVE DECLINED



Drake et. al 2010

PUGET SOUND/GEORGIA BASIN DPS



PRIORITIES FOR RECOVERY

Recovery Plan (October 2017):

- Fisheries Management
- Cooperative research
- Derelict fishing gear removal
- Education and outreach
- Habitat mapping
- Historic rockfish abundance

ROCKFISH RECOVERY PLAN

Puget Sound / Georgia Basin
Yelloweye Rockfish (*Sebastes ruberrimus*)
and Bocaccio (*Sebastes paucispinis*)

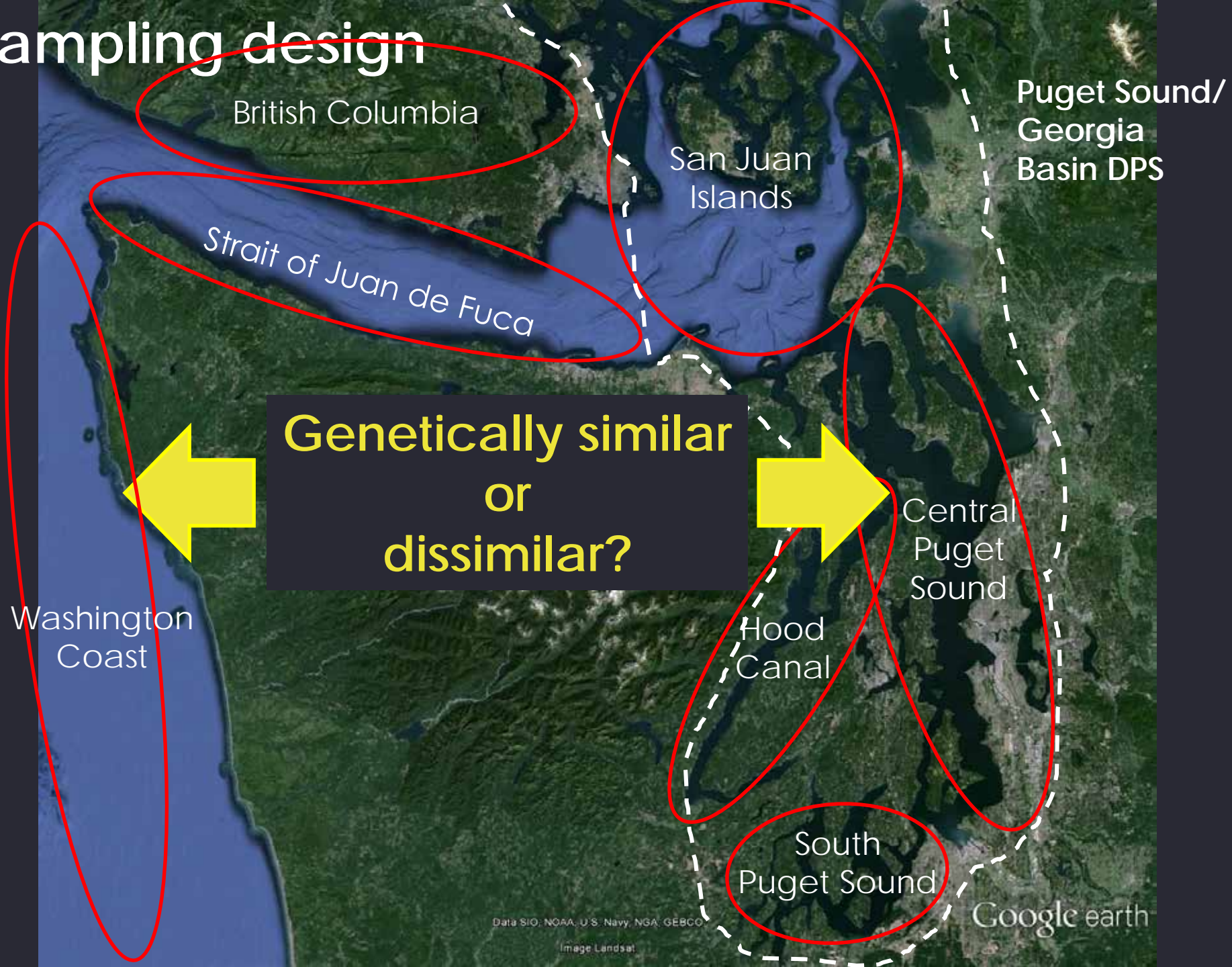


Prepared by
Office of Protected Resources
West Coast Regional Office
National Marine Fisheries Service
National Oceanic and Atmospheric Administration

Approved: Chris Oliver
Chris Oliver, Assistant Administrator for Fisheries
National Oceanic and Atmospheric Administration

Date: 10/13/17

Sampling design



COOPERATIVE RESEARCH



ARE YELLOWEYE ROCKFISH GENETICALLY DISTINCT?

7405 RAD loci



ARE YELLOWEYE ROCKFISH GENETICALLY DISTINCT?

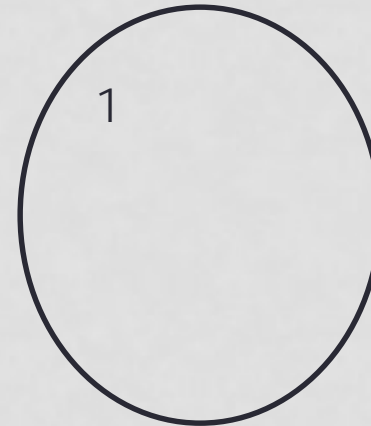
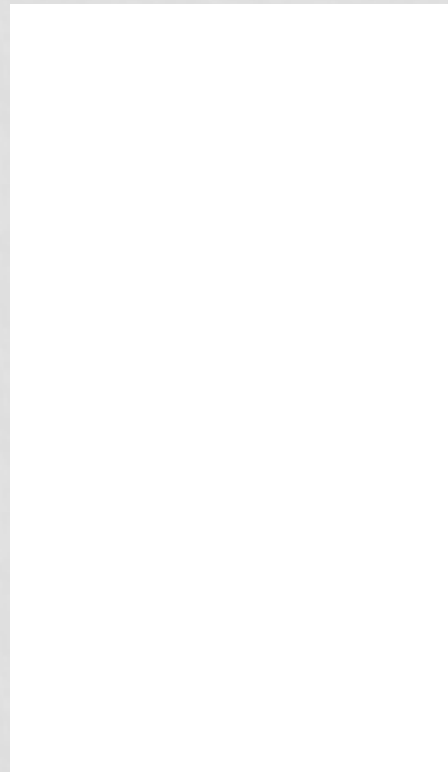
Three distinct clusters of genetic variation:

- 1) CA, OR & WA coast, Strait of Juan de Fuca and Canadian outside waters.
- 2) San Juan Islands, Central Puget Sound and Canadian inside waters.
- 3) Hood Canal isolated.

Six fish (of 151) defy the inside/outside pattern.



7405 RAD loci



3 other analyses support this same conclusion

Andrews et al In Press

ARE YELLOWEYE ROCKFISH GENETICALLY DISTINCT?

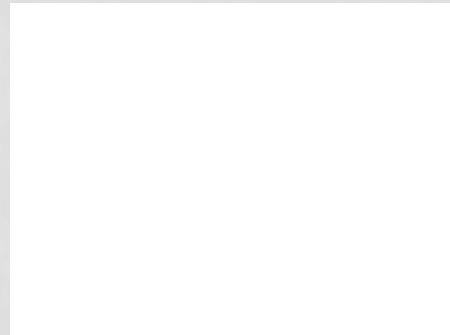
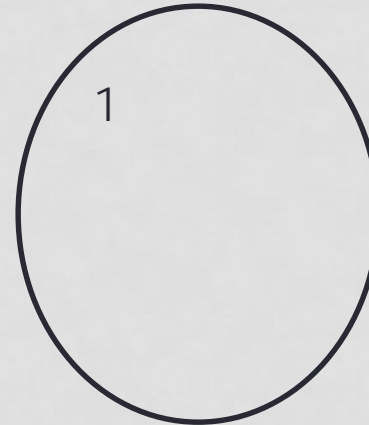
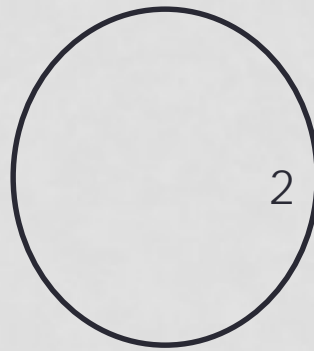
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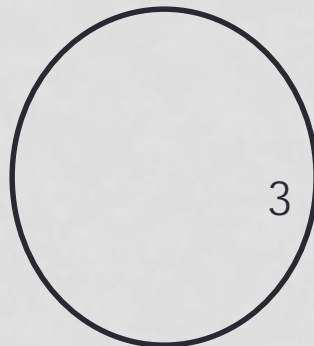
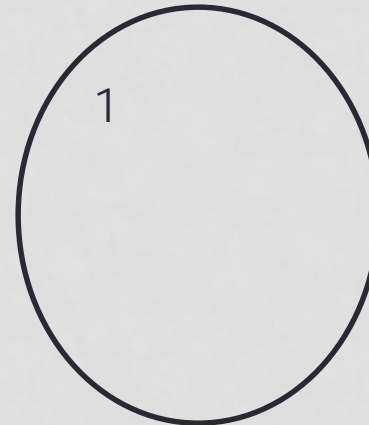
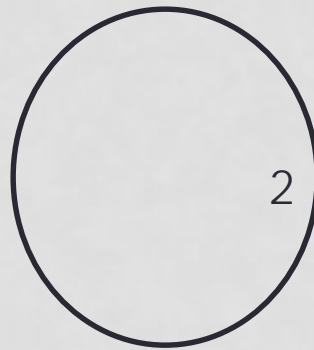
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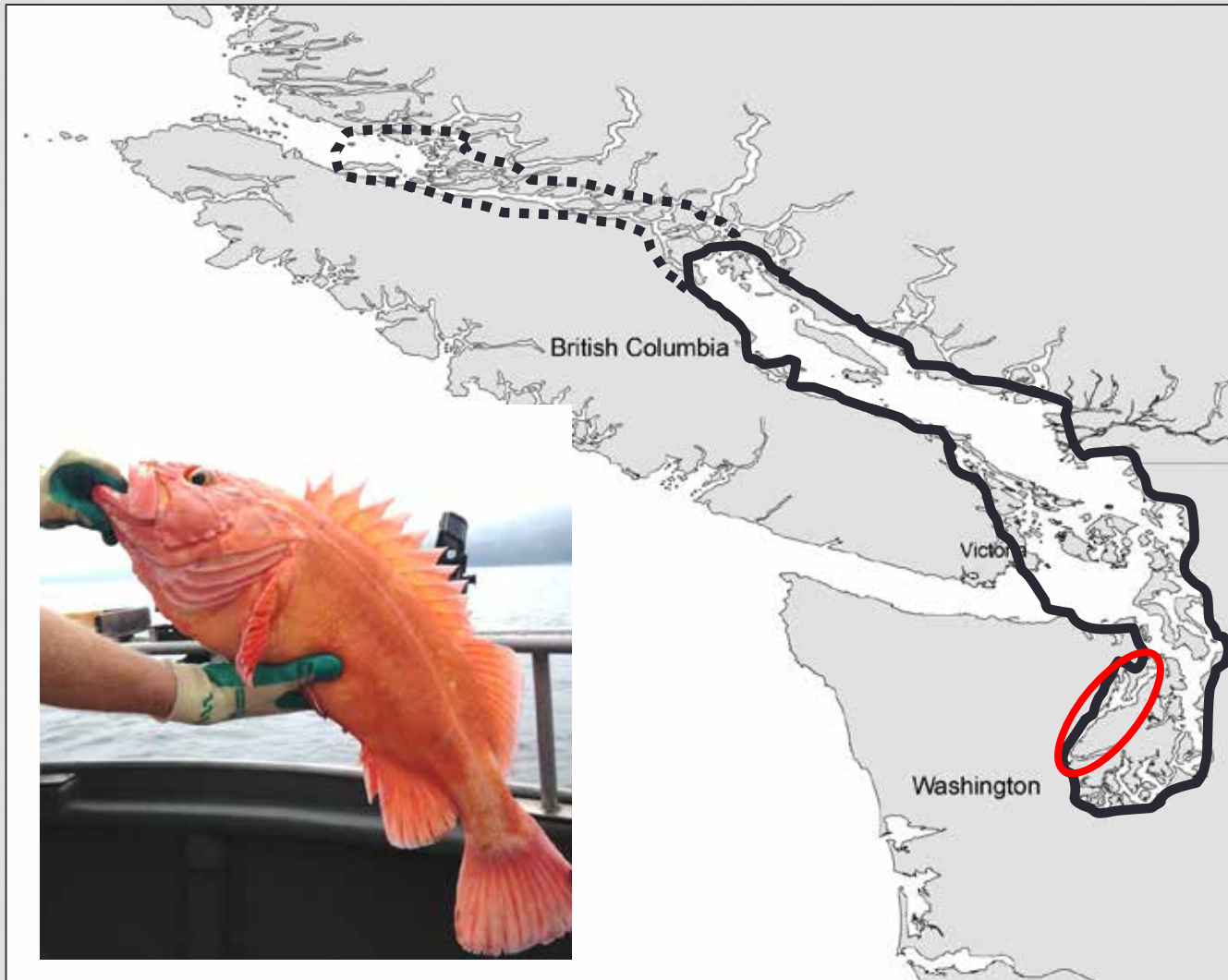
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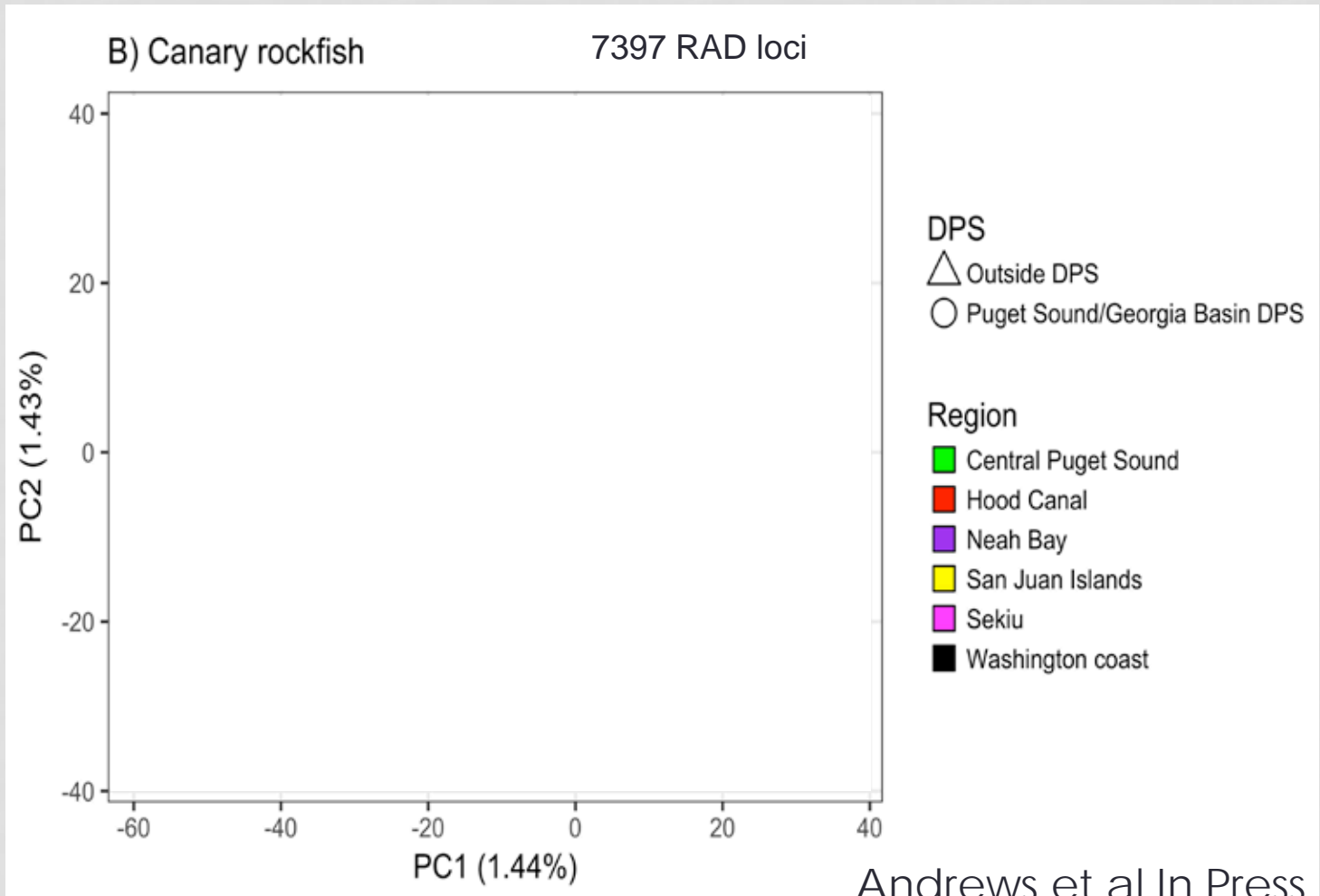
3 other analyses support this same conclusion

Andrews et al In Press

YELLOWEYE ROCKFISH DPS IS SUPPORTED, BUT...



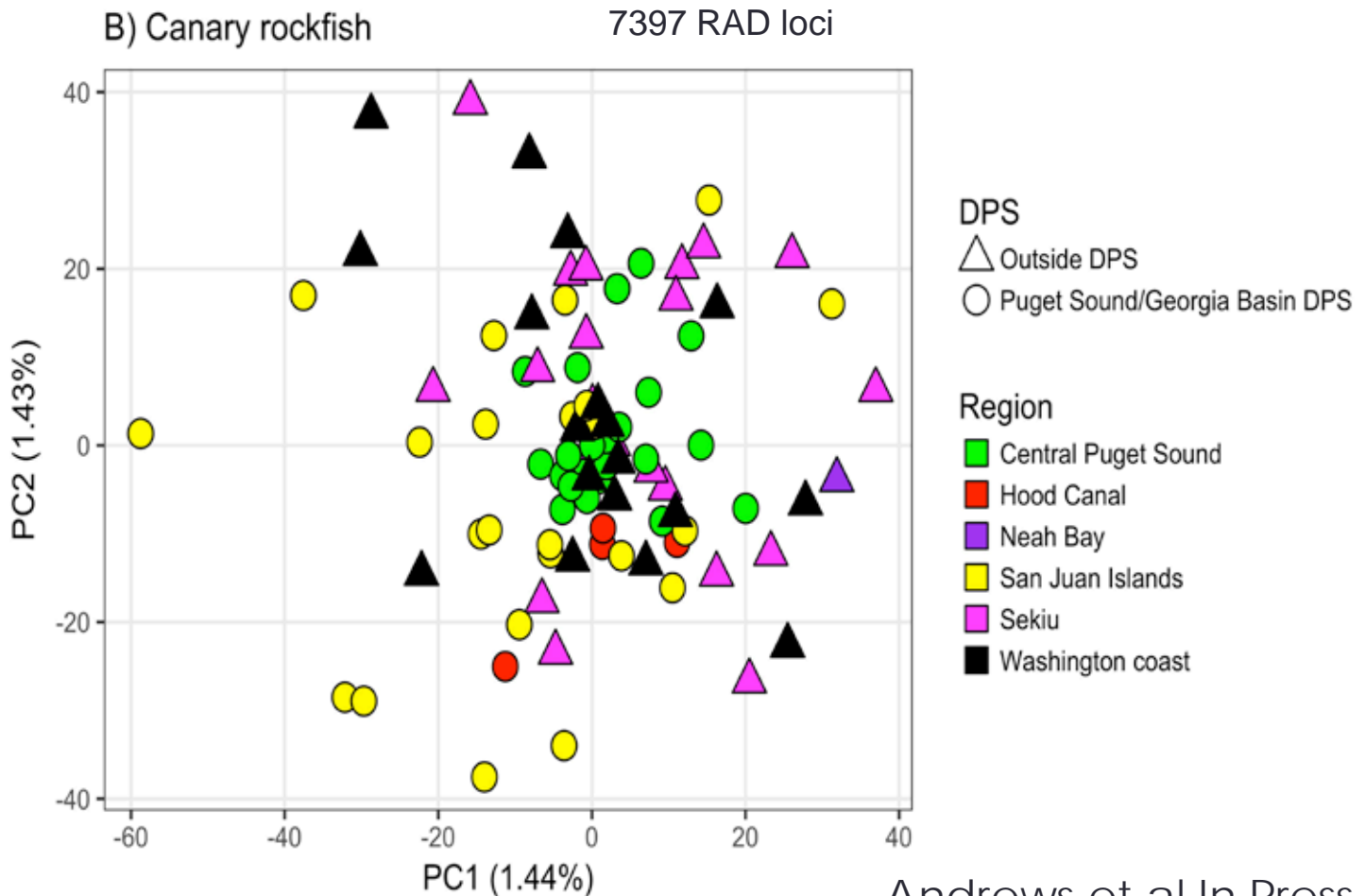
ARE CANARY ROCKFISH GENETICALLY DISTINCT?



Andrews et al In Press

ARE CANARY ROCKFISH GENETICALLY DISTINCT?

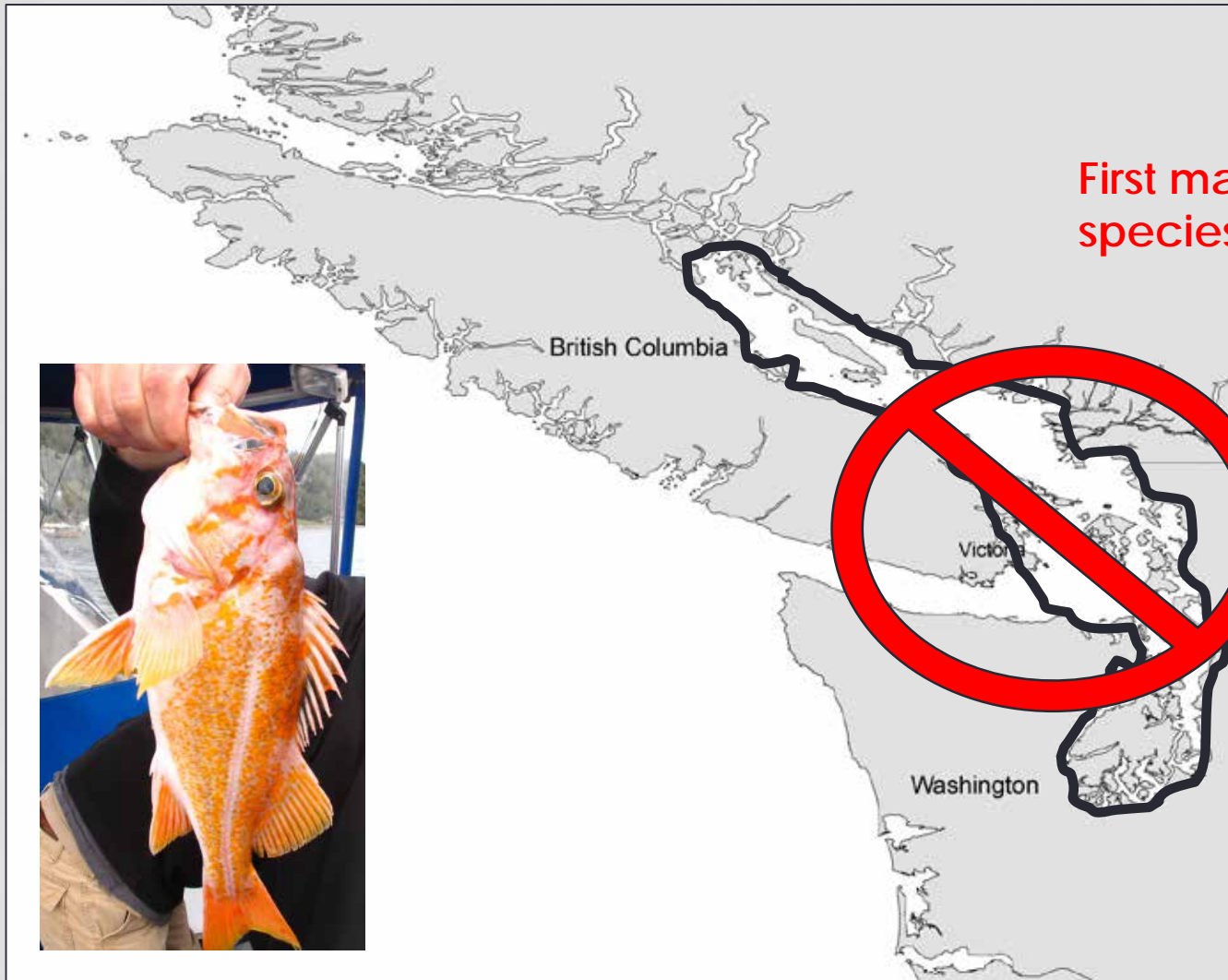
No genetic structure observed.



Andrews et al In Press

3 other analyses support this same conclusion

CANARY ROCKFISH WERE DELISTED ON MARCH 24, 2017



First marine fish
species delisted



ARE BOCACCIO GENETICALLY DISTINCT?

- DUNNO!
- Only 3 samples collected in >100 days of fishing within the DPS
- Opportunistic sampling
 - Fin clip kits to charter captains
 - They have caught one so far!

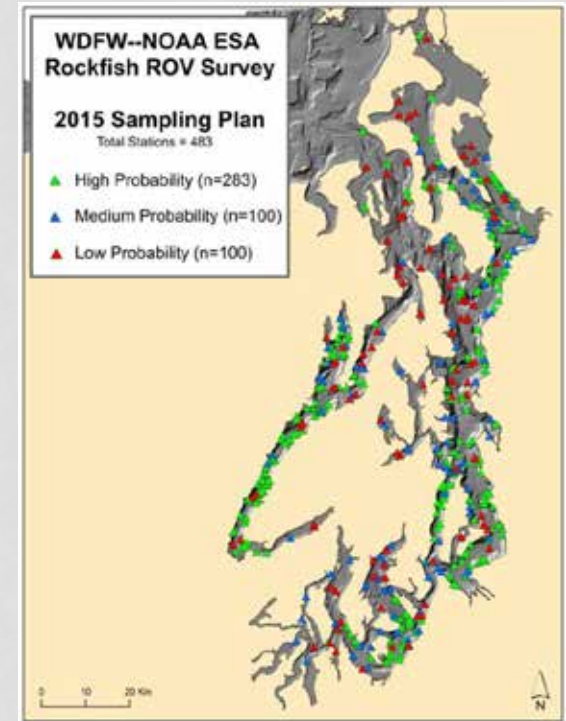
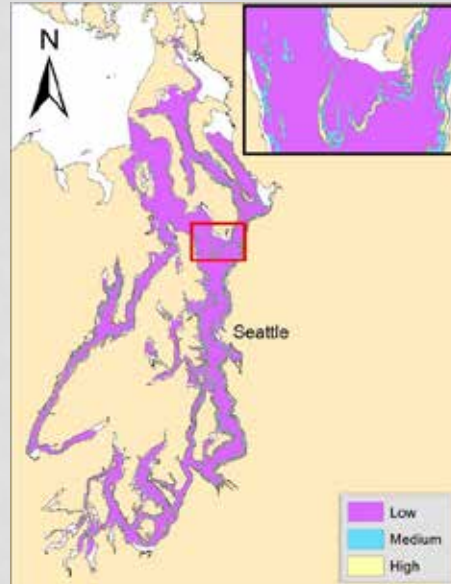


ASSESS RECOVERY: STEP ONE – COUNT RARE FISH

- Monitoring population abundance with ROV survey by WDFW in U.S. and Canadian portions of DPS



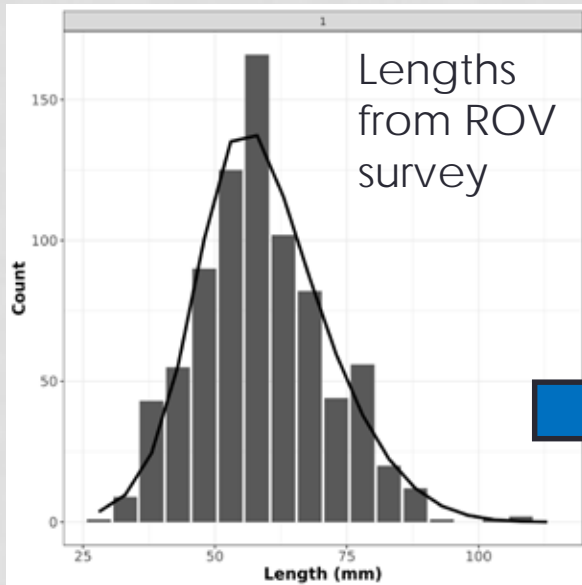
Habitat suitability model



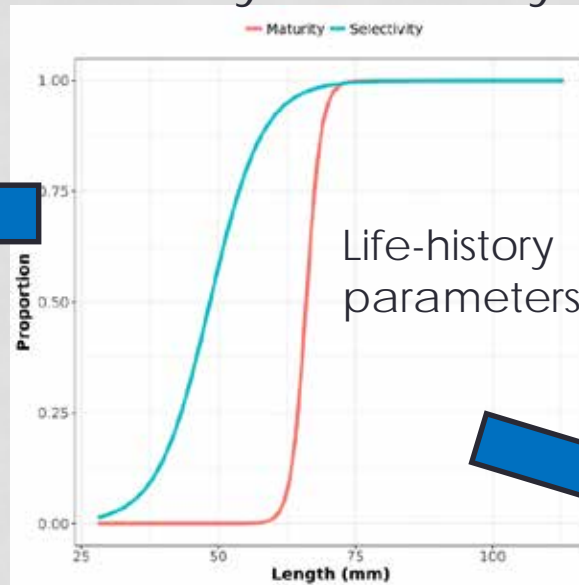
***Provides estimates of abundance and length frequency composition every 5 years.**

STEP TWO – QUANTIFY LENGTH-BASED SPAWNING POTENTIAL RATIO

Fit to data



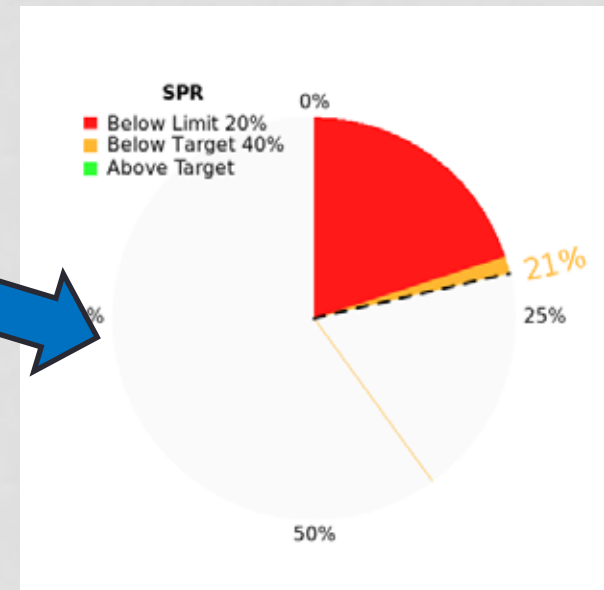
Maturity/Selectivity



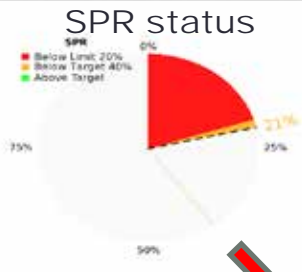
Requirements: 1) Length composition,
2) Life history parameters (M/k ratio & Maturity)
3) Selectivity

(Hordyk et al. 2015, 2016)

SPR status



- Provide an indicator of relative stock status
- SPR compared to target reference points
- SPR measured over time as delisting indicator



STEP THREE – COMPARE LB-SPR TO CRITERIA FOR DELISTING

Yelloweye
rockfish

LB-SPR

(or some other future
decided upon metric)

Minimum Time at Target

Scenario A

15% (and increasing
after first sampling
event finds 15%)

25 years, (no less than five systematic
sampling events with 80% probability)

Scenario B

20 to 24%

15 years (no less than four systematic
sampling events with 80% probability)

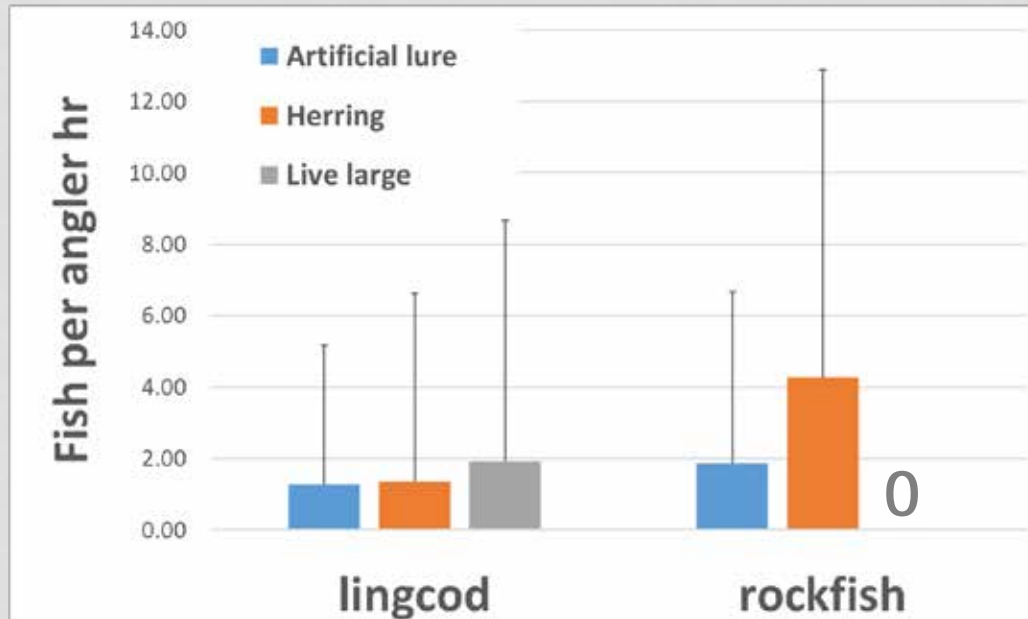
Scenario C

>25%

10 years (no less than three systematic
sampling events with 80% probability)

THREATS-BASED CRITERIA: FISHERIES BYCATCH

Can we reduce rockfish bycatch in the PS lingcod fishery?



THREATS-BASED CRITERIA: ENVIRONMENTAL PRESSURES



Monitoring horizontal and vertical movement of yelloweye in Hood Canal



Do movements correlate with changes in environmental covariates (e.g. dissolved oxygen)?

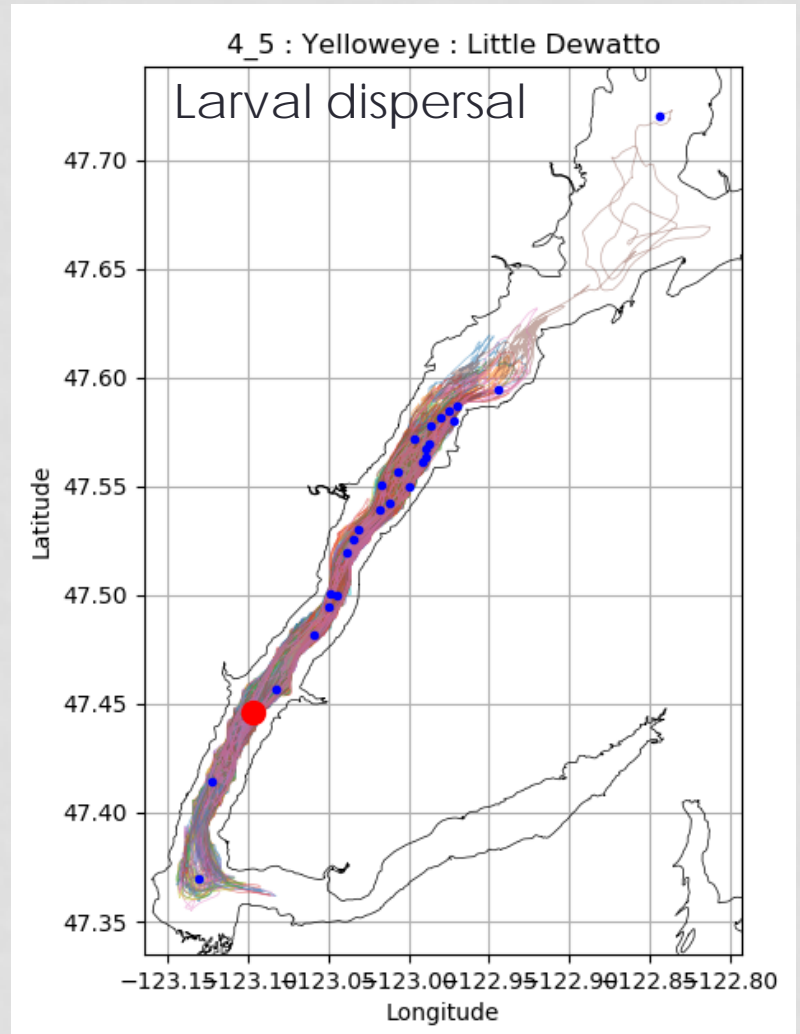


QUESTIONS?



FOLLOW-UP RESEARCH

- Why are yelloweye rockfish genetically different but canary rockfish are not?
 - Larval dispersal?
 - Adult movement?

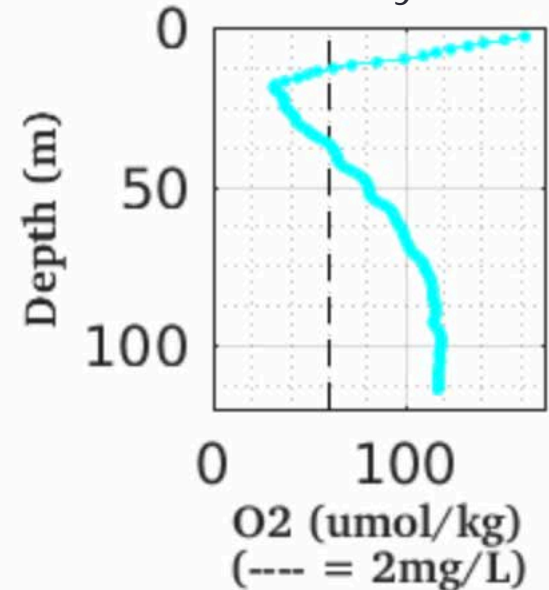


FOLLOW-UP RESEARCH

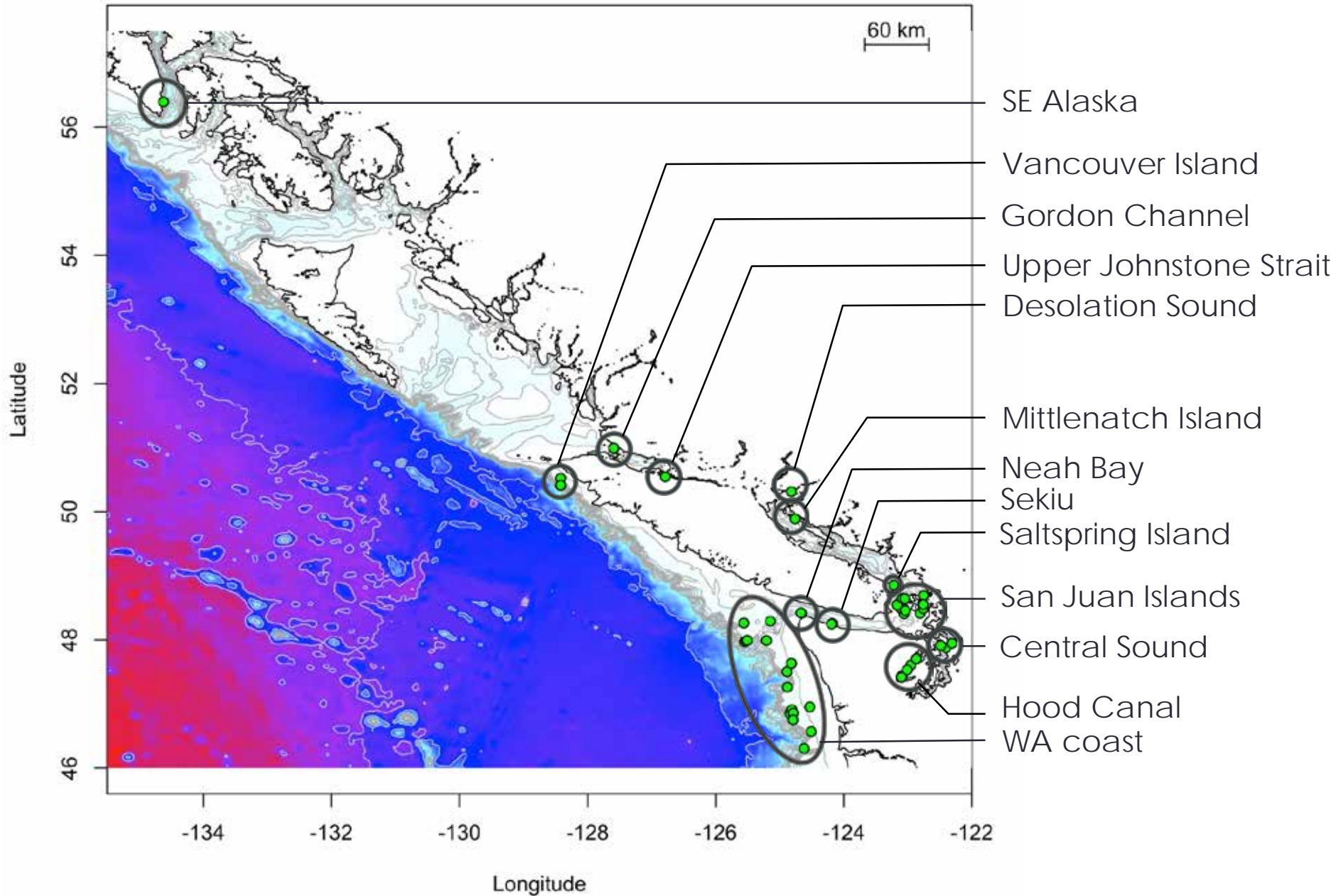
- Why are yelloweye rockfish genetically different but canary rockfish are not?
 - Larval dispersal?
 - Adult movement?
- What alleles are different between Hood Canal yelloweye from the rest of DPS?
 - Environmental influence on alleles (Seascape genetics)?



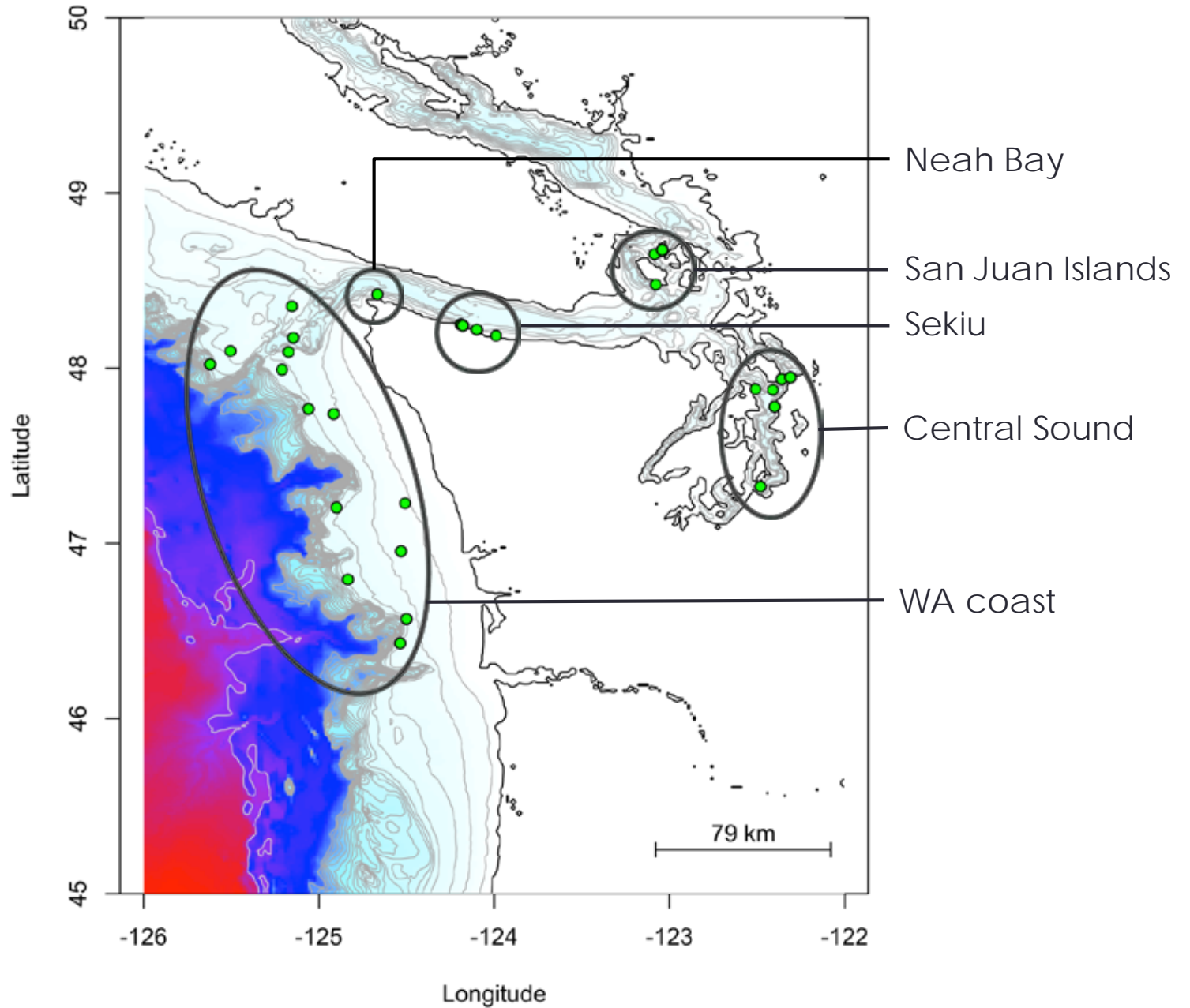
UW ORCA buoy data



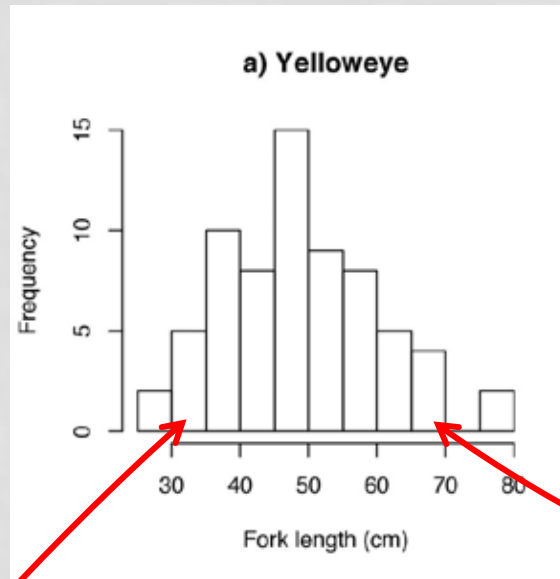
Yelloweye rockfish sample locations



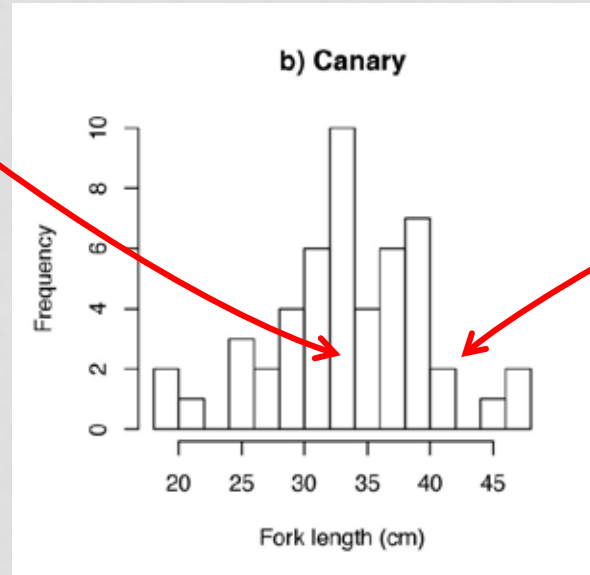
Canary rockfish sample locations



LENGTH FREQUENCIES



LENGTH FREQUENCIES



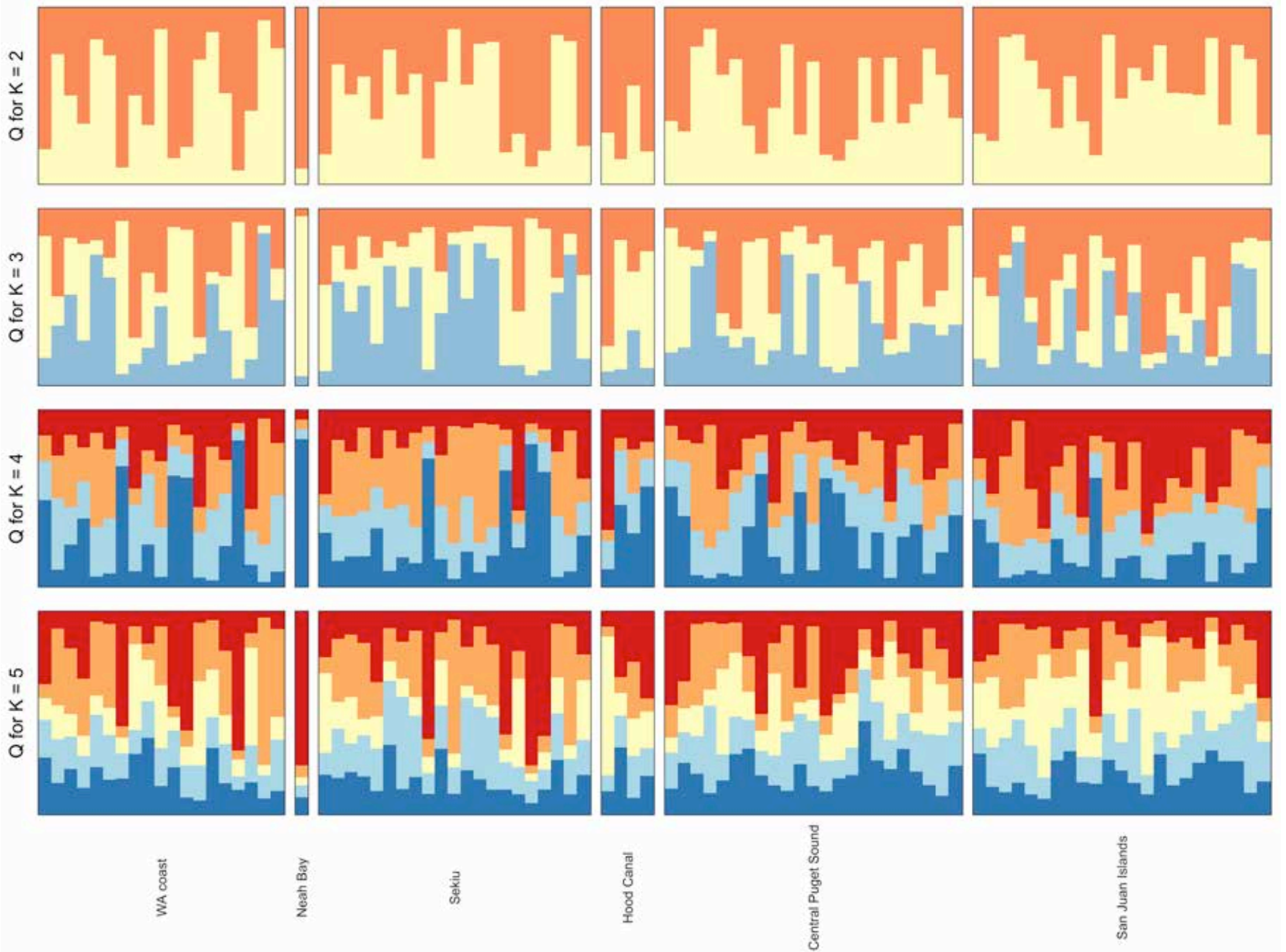
BAROTRAUMA



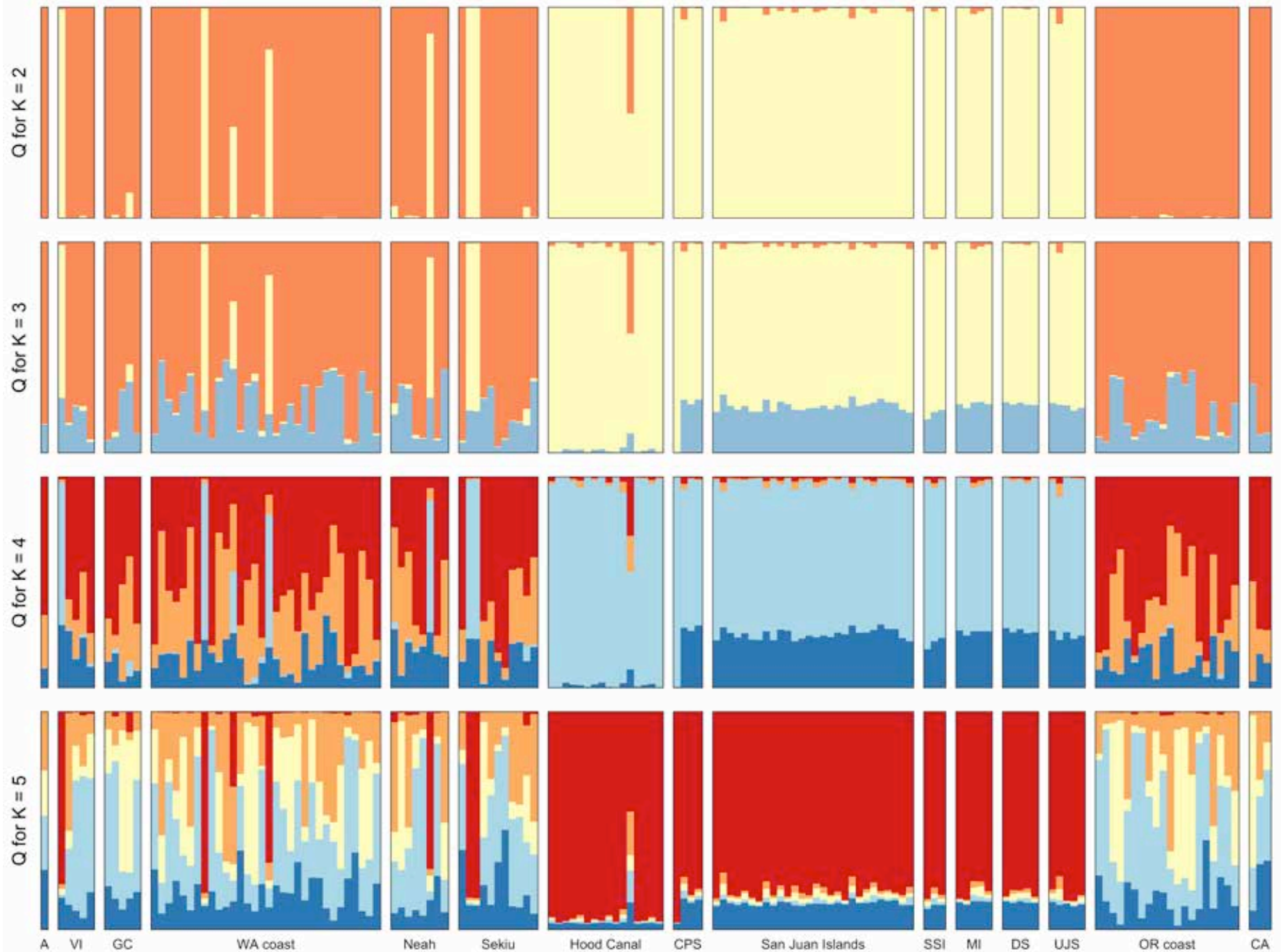
“WHERE CAN I GET ONE OF THOSE!?”

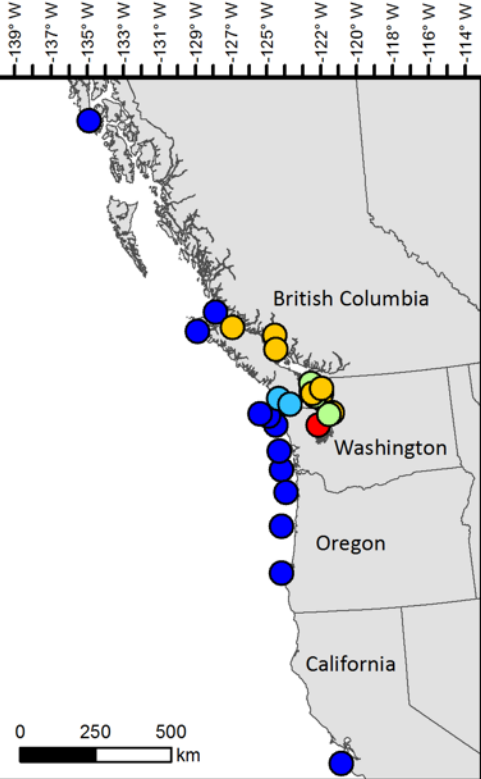
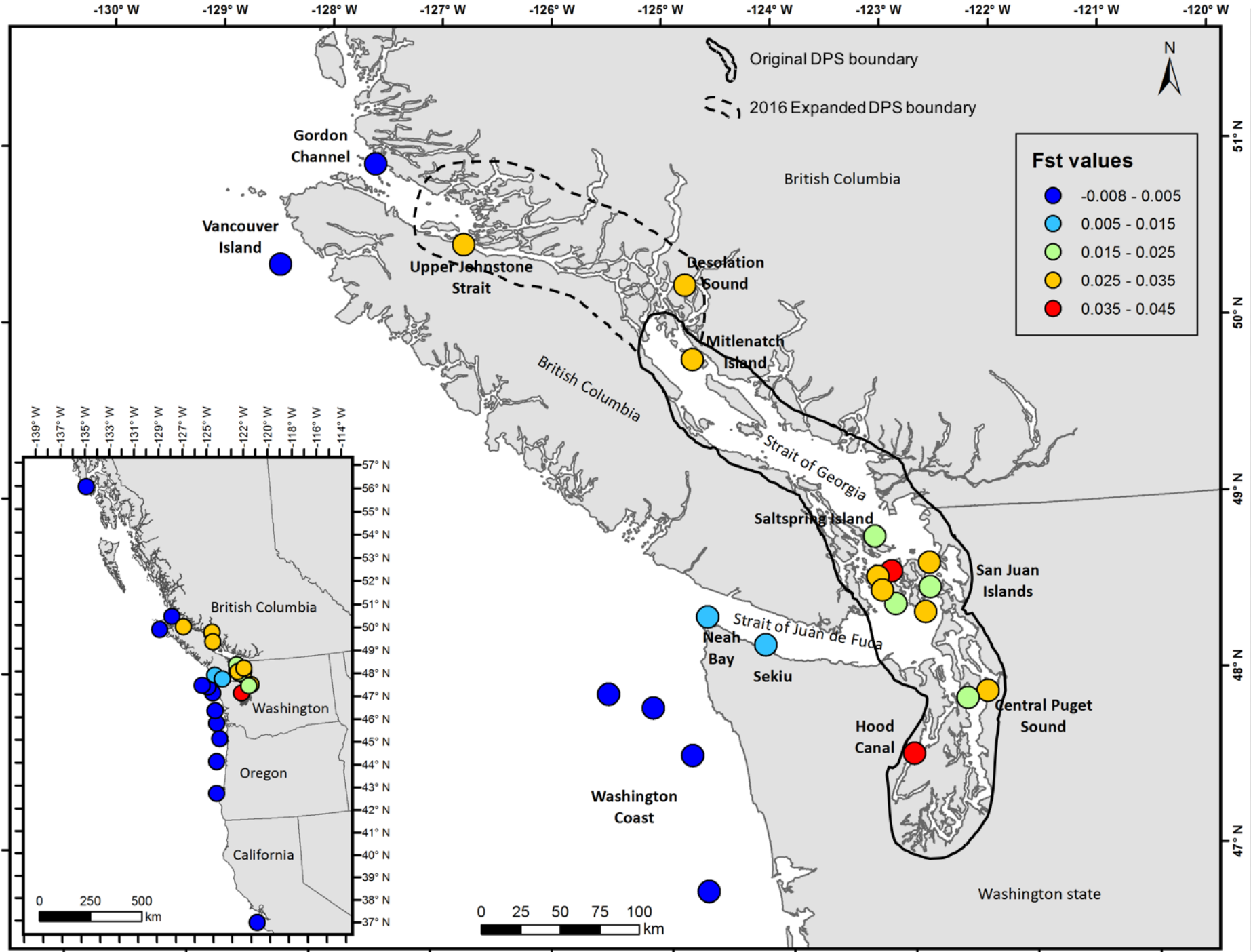


Canary rockfish STRUCTURE

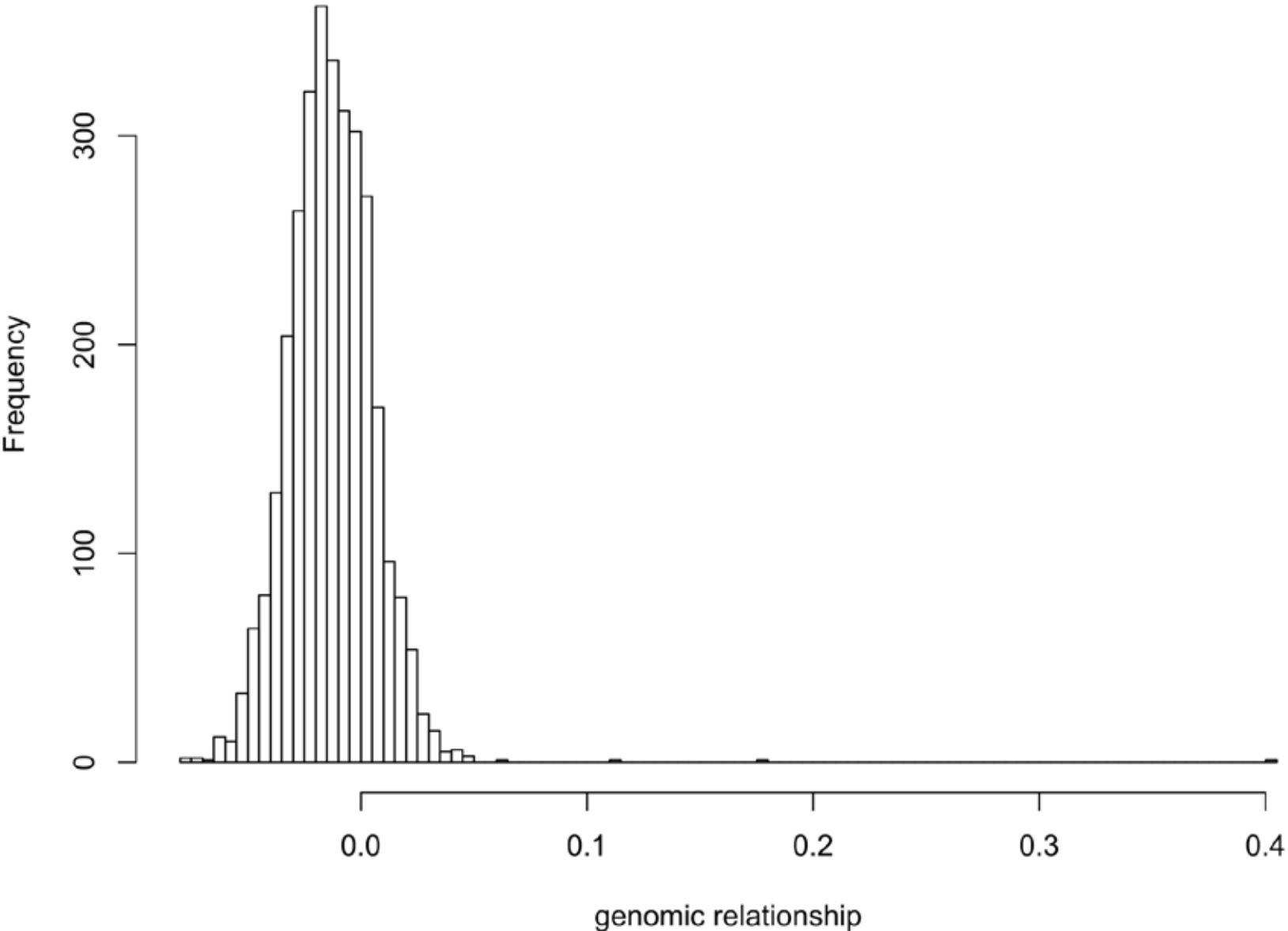


Yelloweye rockfish STRUCTURE





canary histogram of pairwise genomic relationship values



yelloweye histogram of pairwise genomic relationship values

