

ALL HANDS ON DECK: COOPERATIVE RESEARCH TO HELP RECOVER PUGET SOUND ROCKFISH.



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3 ROCKFISH SPECIES IN PUGET SOUND LISTED UNDER THE ESA

Yelloweye rockfish



Canary rockfish

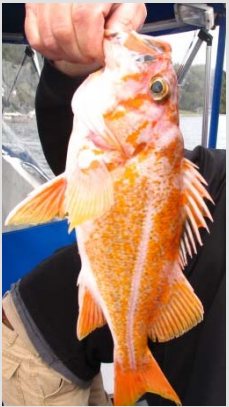


Bocaccio



2 CRITERIA FOR ESA LISTINGS

1. Are these populations of rockfish in Puget Sound Distinct Population Segments (DPS)?



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- Must be “discrete”
 - Separate from other populations based on physical, physiological, ecological or behavioral factors.
 - Genetics
 - Life history traits – e.g., site fidelity
 - Ecological features of the oceanic and terrestrial environment
 - Delimited by international governmental boundaries



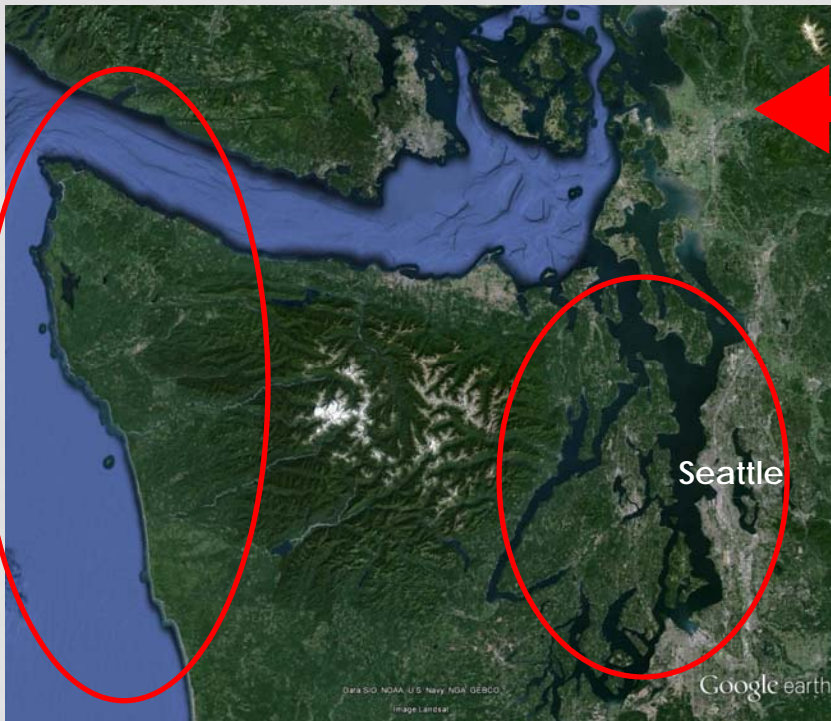
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 - Ecological features of the oceanic and terrestrial environment
 - Delimited by international governmental boundaries
- Must be “significant”
 - Unique ecological setting
 - Loss would result in significant gap in the range of the taxon
 - Represents the only surviving natural occurrence
 - Differs markedly in its genetic characteristics



ROCKFISH IN PUGET SOUND ARE MOST LIKELY GENETICALLY DISTINCT



Copper, Brown and Quillback rockfish in Puget Sound are genetically distinct from outside waters (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

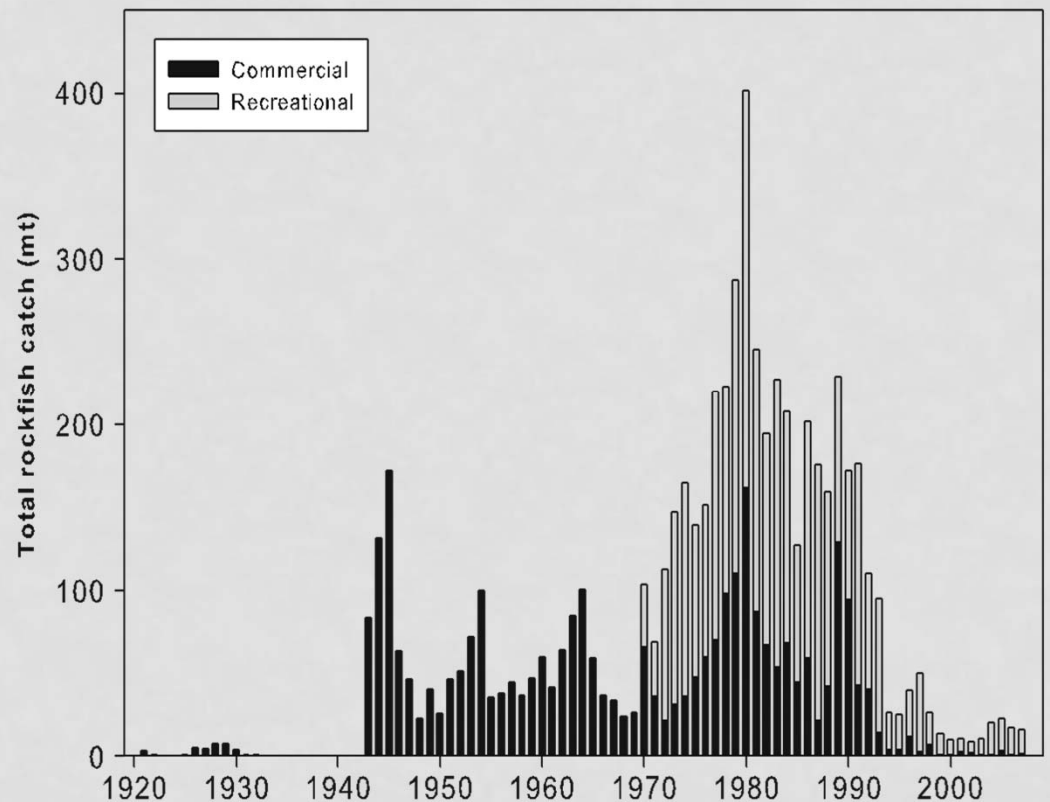
2. Level of extinction risk

- 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 FISHING IN PUGET SOUND

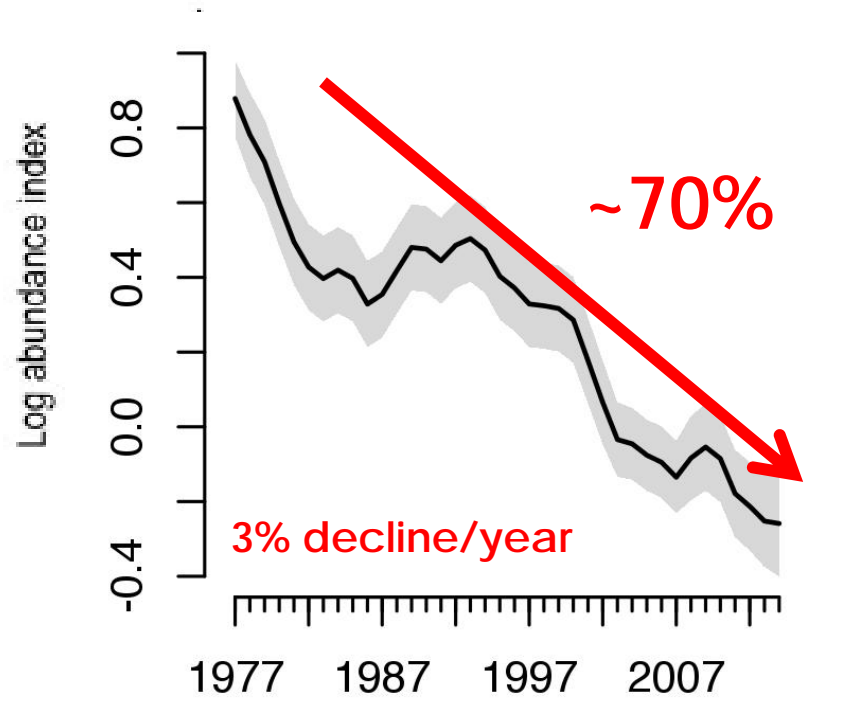
- Commercial catch begins ~ WW2
- Recreational fishery increased in the 1980's with reduced Salmon fishing
- Both recreational and commercial fisheries phased out due to declines in abundance



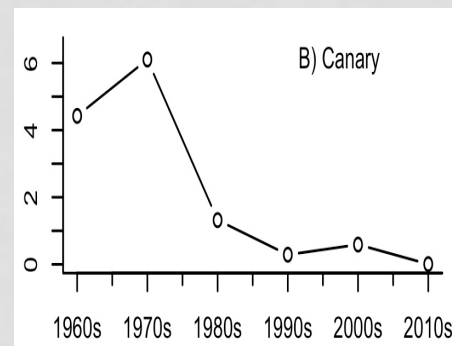
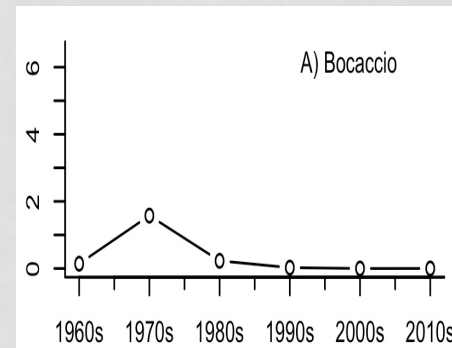
Williams et al. 2010

ROCKFISH POPULATIONS IN DECLINE

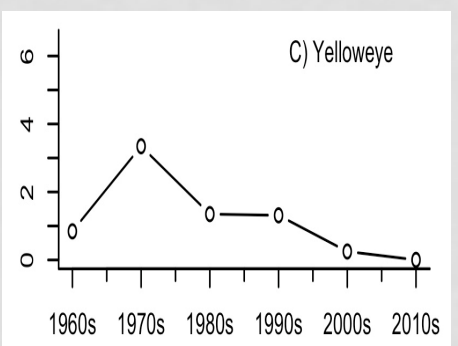
Rockfish in Puget Sound



2015 5-year ESA review

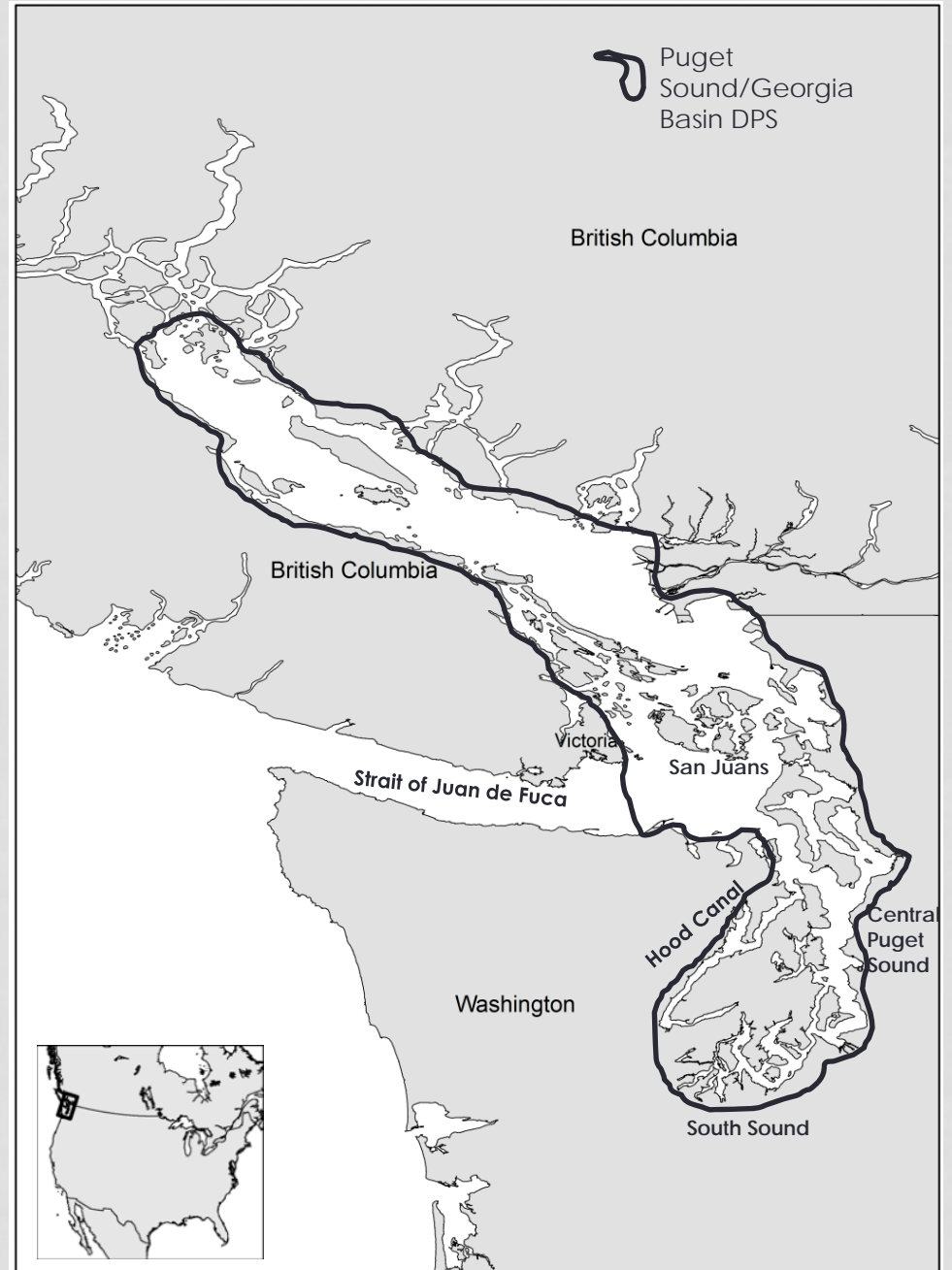


And...proportion of rockfish that were bocaccio, canary and yelloweye have decreased.



2015 5-year ESA review

PUGET SOUND/GEORGIA BASIN DPS



COOPERATIVE RESEARCH



Sampling design

British Columbia

San Juan Islands

Strait of Juan de Fuca

**Genetically similar
or
dissimilar?**

Central
Puget
Sound

Washington
Coast

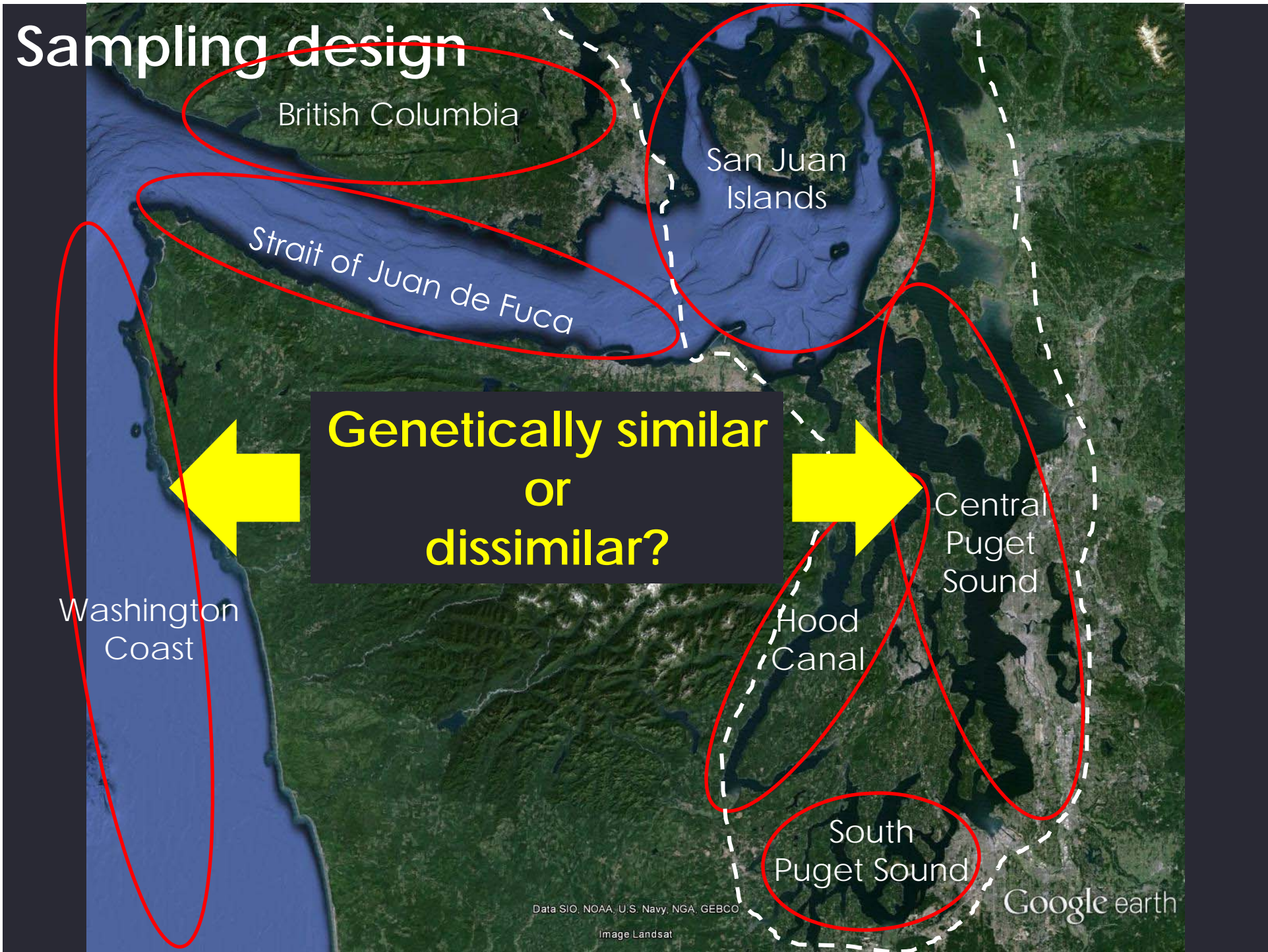
Hood
Canal

South
Puget Sound

Google earth

Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Image Landsat



Fishing locations



Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Image Landsat

Listed species collected



Listed species collected

30 Yelloweye

28 Yelloweye
26 Canary

19 Yelloweye
22 Canary

5 Yelloweye
25 Canary
3 Bocaccio

16 Yelloweye
0 Canary

30 Yelloweye
30 Canary

0 Yelloweye
0 Canary

ARE THEY GENETICALLY DISTINCT?

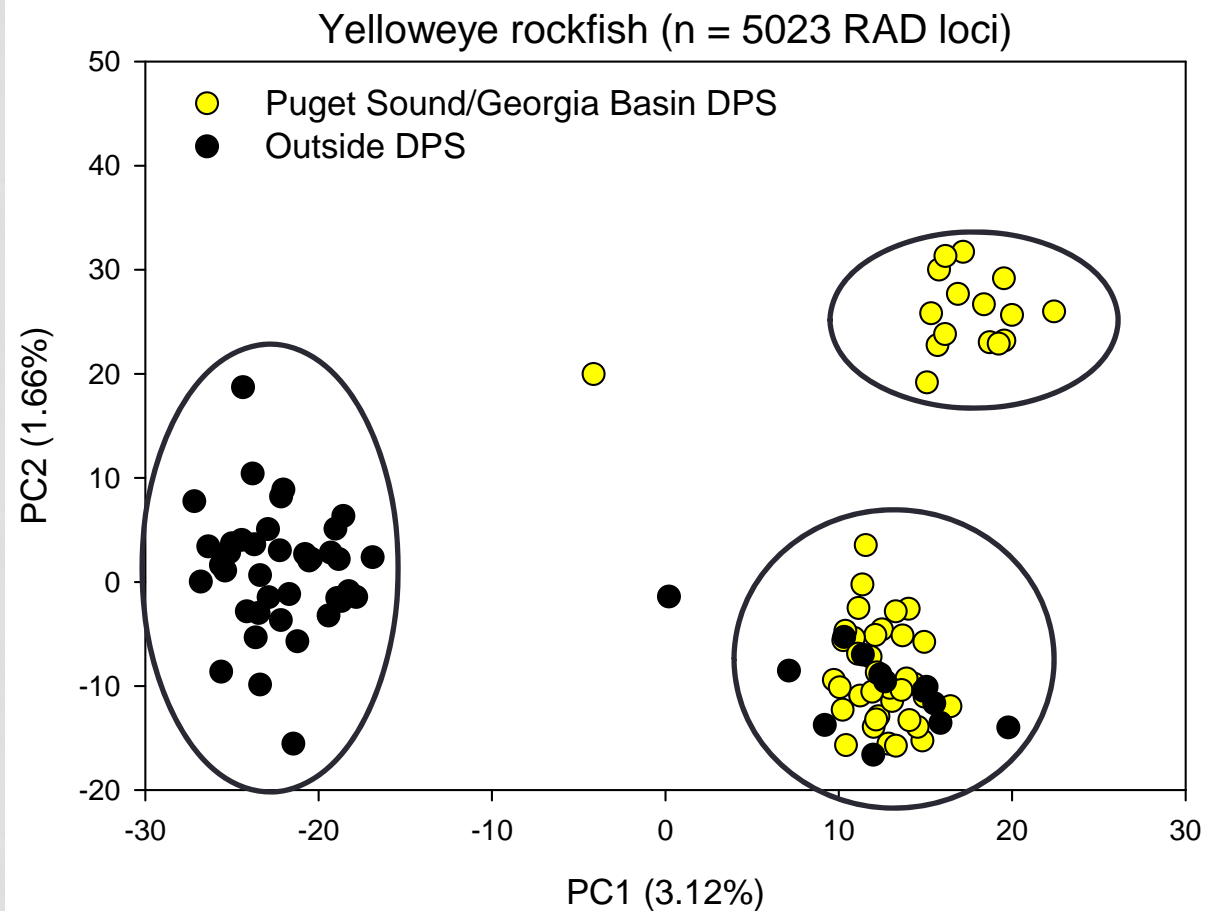


Restriction-site Associated DNA (RAD) sequencing

- Produces 1000's of individual sequence reads (SNPs)
 - Need fewer samples
 - Critical for listed species research

YELLOWEYE ROCKFISH ARE GENETICALLY DISTINCT

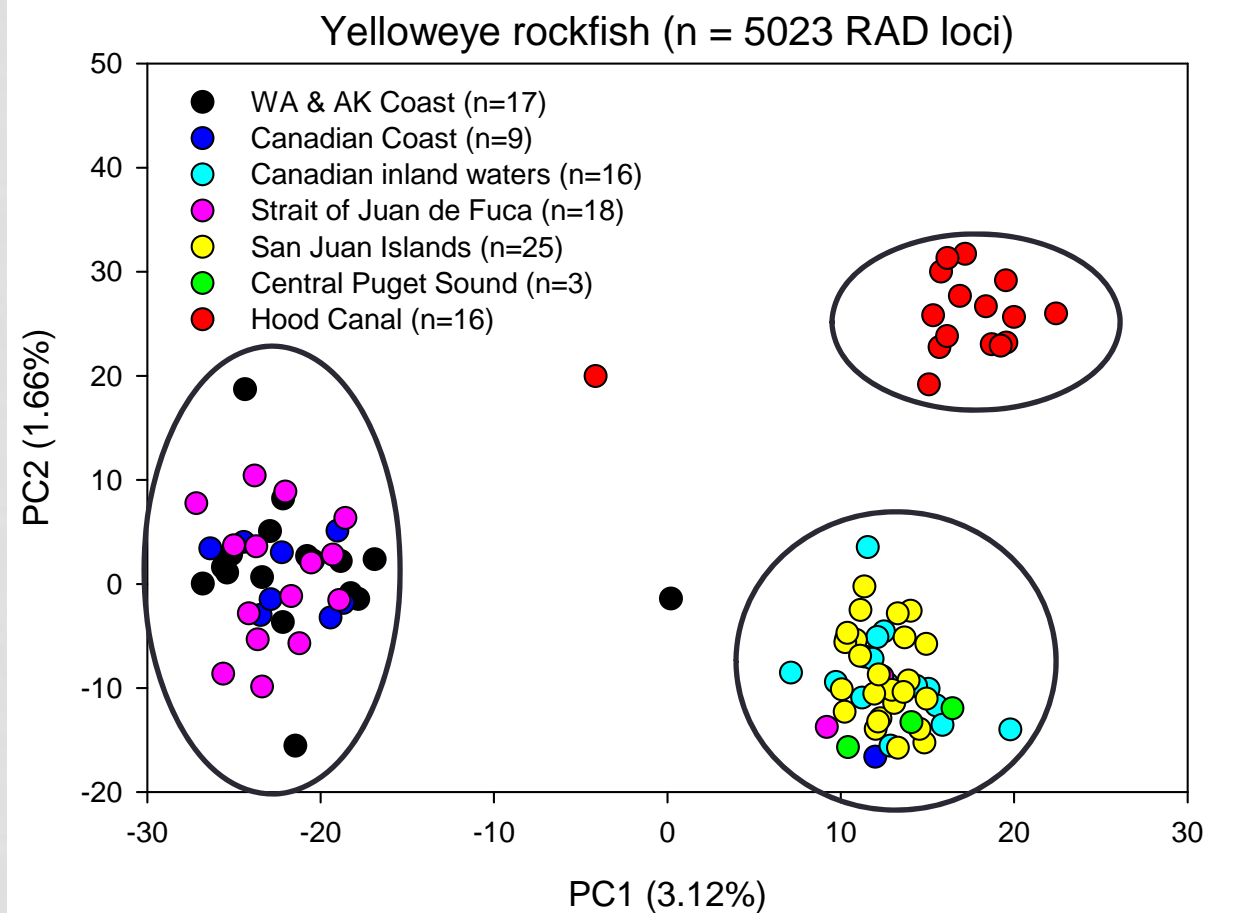
Three distinct clusters of yelloweye based on genetic variation:



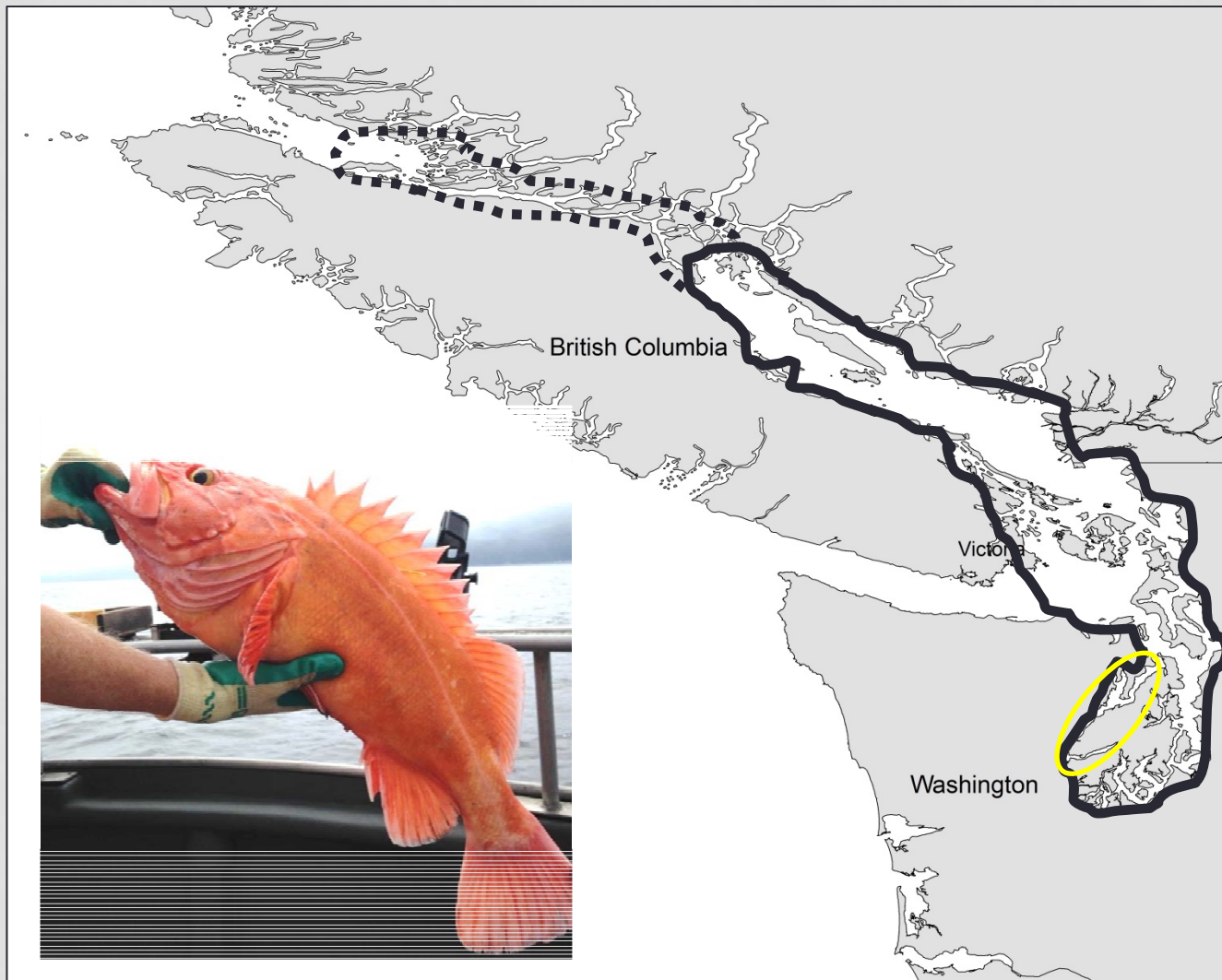
YELLOWEYE ROCKFISH ARE GENETICALLY DISTINCT

Three distinct clusters of yelloweye based on genetic variation:

- 1) San Juan Islands, Central Puget Sound and Canadian inside waters.
- 2) Washington coast, Strait of Juan de Fuca and Canadian outside waters
- 3) Hood Canal isolated.
- 4) Four fish (of 104) defy the inside/outside pattern

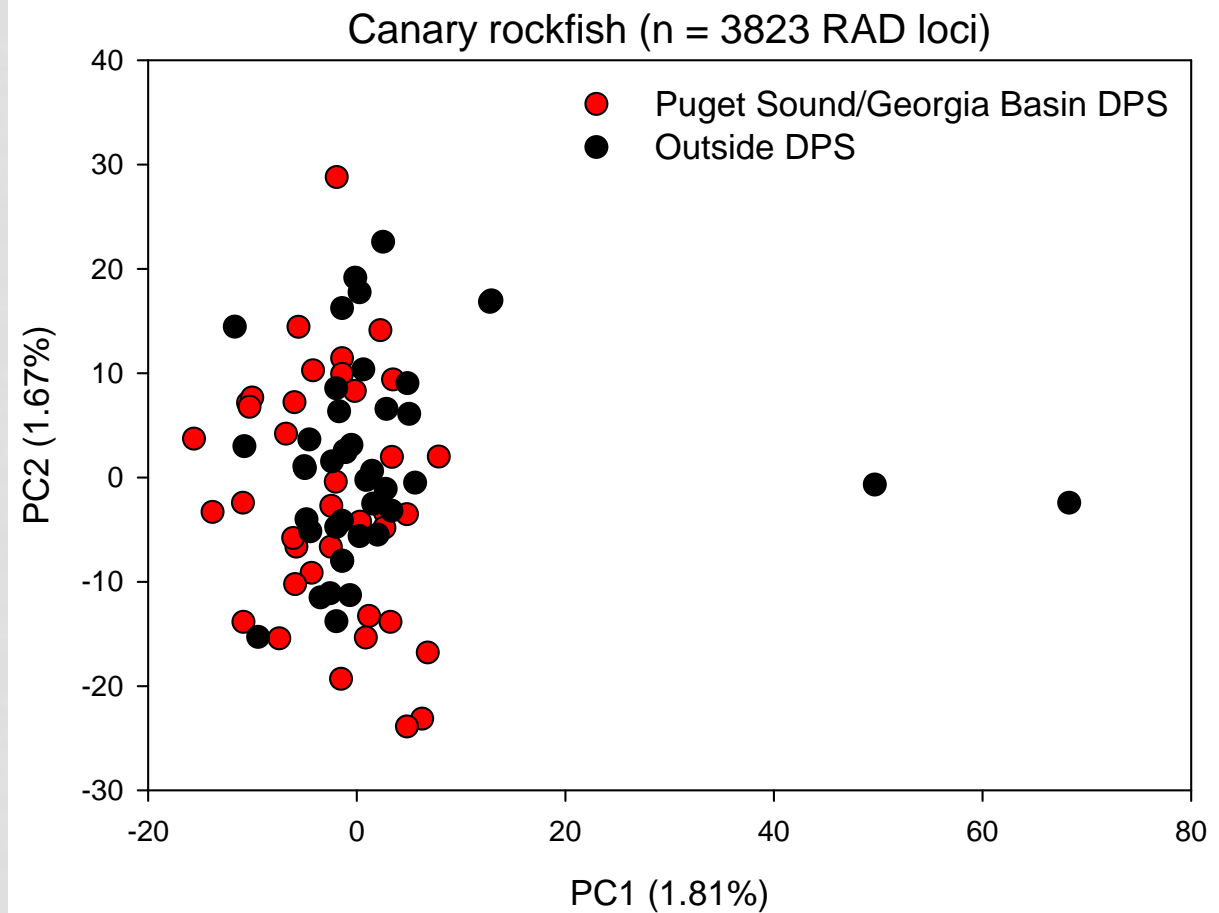


CHANGE YELLOWEYE DPS BOUNDARIES?

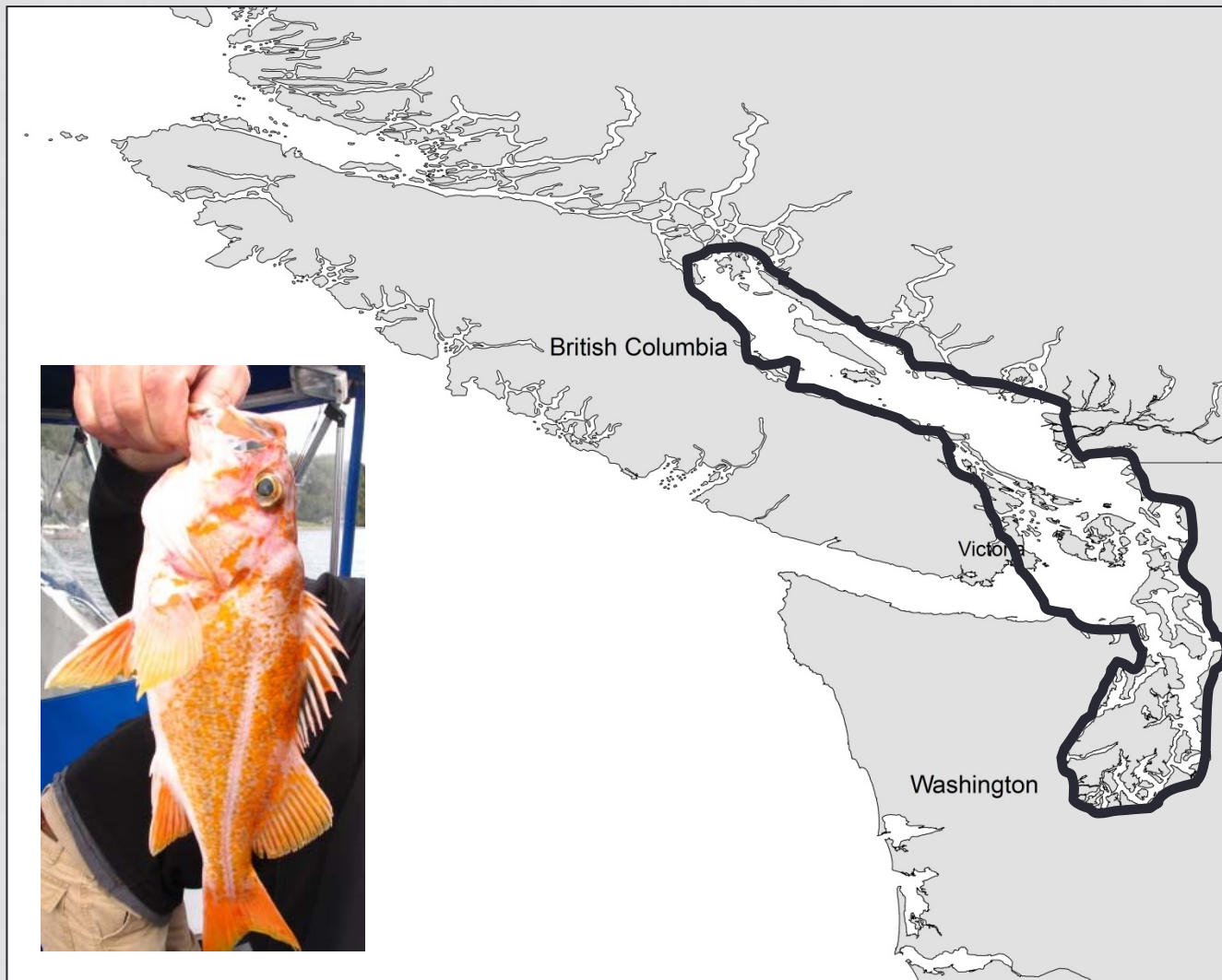


CANARY ROCKFISH ARE NOT GENETICALLY DISTINCT

No distinct genetic structure observed.



POTENTIAL DELISTING OF CANARY?



FUTURE WORK

- Only a handful of samples left to run.
- 3 bocaccio caught in Central Puget Sound!
 - Plus 1 sample from Strait of Juan de Fuca
 - Compare with samples from Canada and U.S. outer coasts
- Larval dispersal or adult movement?
 - Oceanographic model with larval dispersal
 - Acoustic tracking of adult yelloweye
- Are there specific alleles accounting for differences in Hood Canal yelloweye?
 - Environmental influence (e.g., dissolved oxygen) on alleles?



CONNECTIONS WITH ANGLERS

“Challenging”



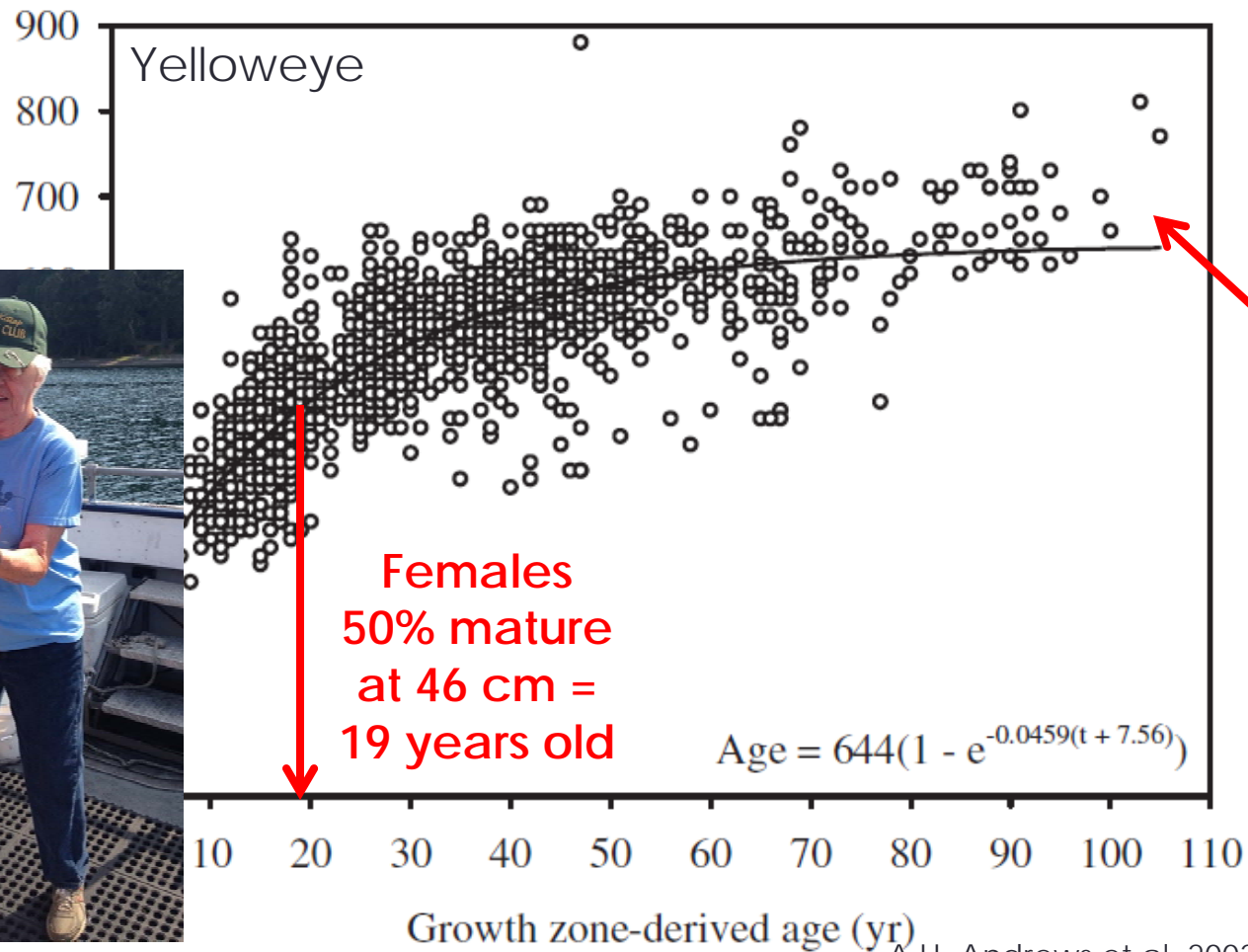
“How old is this fish?”



“Where can I get that?”

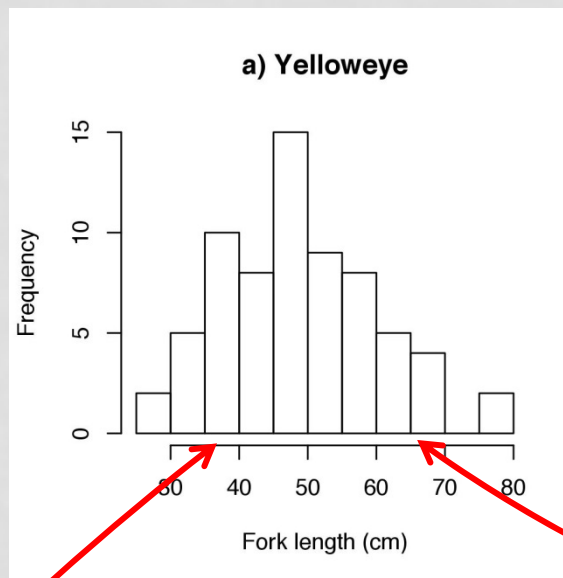


LONG LIVED & LATE MATURING

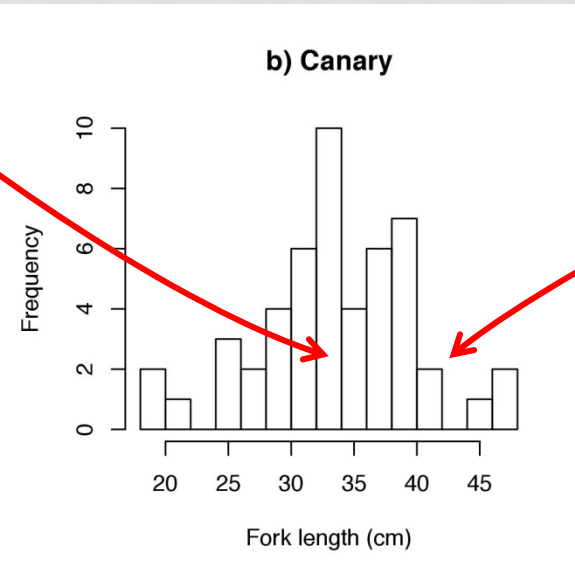


100+ year-
old fish!

LENGTH FREQUENCIES



LENGTH FREQUENCIES



BAROTRAUMA



“WHERE CAN I GET ONE OF THOSE!?”



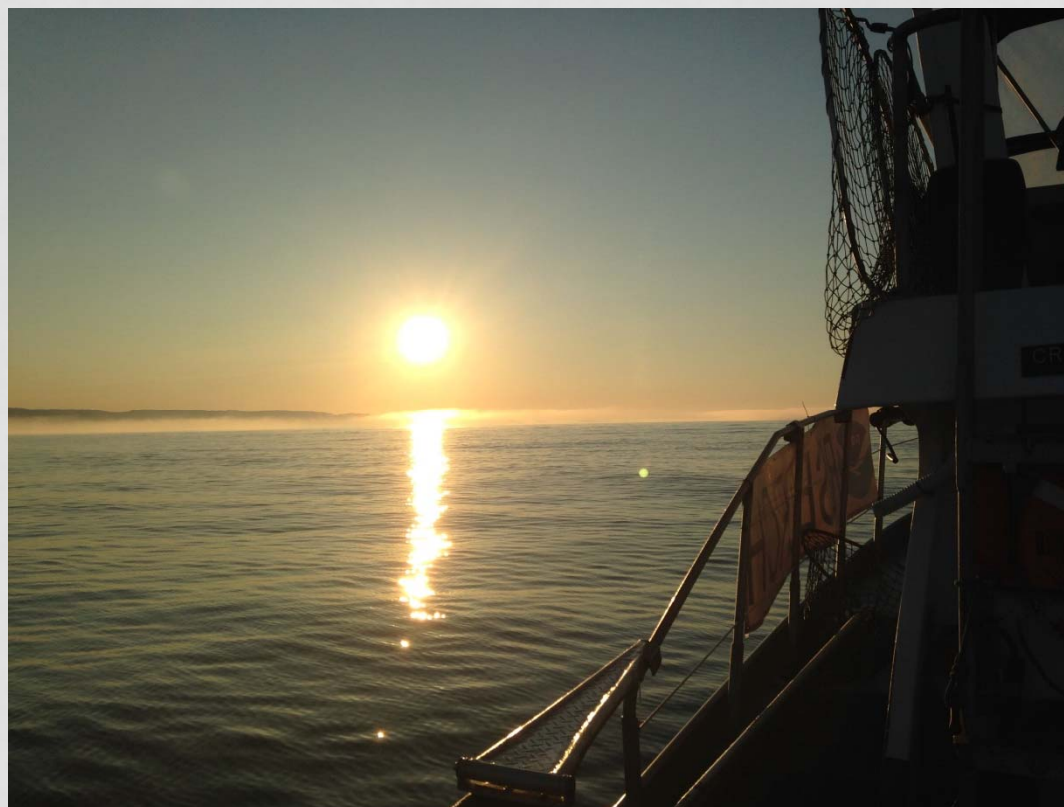
www.nwfsc.noaa.gov/news/features/rockfish/index.cfm

HOW CAN YOU HELP?

- Educate others
 - Long-lived, late maturing fish
 - Descending devices – “It’s surely better than just letting them float.”
- SCUBA diver?
 - Young-of-year citizen science program
- Kayaker?
 - Kelp monitoring program
 - Seagrass beds may be important also
- Photograph rare rockfish species that you see and send them to me: kelly.andrews@noaa.gov



QUESTIONS?



Thanks to NOAA's Cooperative Research Program for funding!
www.nwfsc.noaa.gov/news/features/rockfish/index.cfm