April 2018

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

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Andrews, Kelly; Nichols, Krista M.; Cope, Jason; Tolimieri, Nick; Tonnes, Dan; Lowry, Dayv; and Pacunski, Robert, 'ESA-listed Puget Sound rockfish: How did we get here and how do we assess progress towards recovery planning goals?' (2018). Salish Sea Ecosystem Conference. 60.

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

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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

Canary rockfish

Bocaccio

Threatened

Endangered
2 CRITERIA FOR ESA LISTINGS

1. Are these populations “distinct”? 
2 CRITERIA FOR ESA LISTINGS

1. Are these populations “distinct”?  
   ý Must be markedly different from other populations of the same species
   • Physical
   • Physiological
   • Ecological
   • Behavioral
   • Morphological
   • Genetic
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).

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

~70%

~3% decline/year

Drake et. al 2010

2015 5-year ESA review
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
Sampling design

Genetically similar or dissimilar?
ARE YELLOWEYE ROCKFISH GENETICALLY DISTINCT?

Andrews et al. In Press

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.

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3 other analyses support this same conclusion.
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Andrews et al In Press
YELLOWEYE ROCKFISH DPS IS SUPPORTED, BUT...
ARE CANARY ROCKFISH GENETICALLY DISTINCT?

Andrews et al In Press

B) Canary rockfish

7397 RAD loci

DPS

△ Outside DPS
○ Puget Sound/Georgia Basin DPS

Region
- Central Puget Sound
- Hood Canal
- Neah Bay
- San Juan Islands
- Sekiu
- Washington coast

PC2 (1.43%)

PC1 (1.44%)
ARE CANARY ROCKFISH GENETICALLY DISTINCT?

No genetic structure observed.

Andrews et al. In Press
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

*Provides estimates of abundance and length frequency composition every 5 years.
STEP TWO – QUANTIFY LENGTH-BASED SPAWNING POTENTIAL RATIO

Fit to data

Requirements: 1) Length composition, 2) Life history parameters (M/k ratio & Maturity) 3) Selectivity
(Hordyk et al. 2015, 2016)

• 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

<table>
<thead>
<tr>
<th>Yelloweye rockfish</th>
<th>LB-SPR (or some other future decided upon metric)</th>
<th>Minimum Time at Target</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scenario A</strong></td>
<td>15% (and increasing after first sampling event finds 15%)</td>
<td><strong>25 years</strong>, (no less than five systematic sampling events with 80% probability)</td>
</tr>
<tr>
<td><strong>Scenario B</strong></td>
<td>20 to 24%</td>
<td><strong>15 years</strong>, (no less than four systematic sampling events with 80% probability)</td>
</tr>
<tr>
<td><strong>Scenario C</strong></td>
<td>&gt;25%</td>
<td><strong>10 years</strong>, (no less than three systematic sampling events with 80% probability)</td>
</tr>
</tbody>
</table>
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?
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• 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)?
LENGTH FREQUENCIES
LENGTH FREQUENCIES
BAROTRAUMA
“WHERE CAN I GET ONE OF THOSE!?”
Canary rockfish STRUCTURE

Q for K = 2

Q for K = 3

Q for K = 4

Q for K = 5

WA coast  Noah Bay  Sekiu  Hood Canal  Central Puget Sound  San Juan Islands
canary histogram of pairwise genomic relationship values
yelloweye histogram of pairwise genomic relationship values