Genetic Stock Composition Analysis of Chum Salmon from the Prohibited Species Catch of the 2015 Bering Sea Walleye Pollock Trawl Fishery and Gulf of Alaska Groundfish Fisheries

C. Kondzela, J. Whittle, S. Vulstek, Hv. Nguyen, and J. Guyon
Genetics Program
Auke Bay Laboratories
Juneau, AK

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April 4-6, 2017
Bering Sea, chum salmon bycatch from pollock-directed fishery

- **1994:** Scales
- **1994-1996:** Allozymes

### Genetic sample size

<table>
<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,084</td>
<td>1,472</td>
<td>1,367</td>
<td>673</td>
<td>1,279</td>
<td>4,094</td>
<td>629</td>
<td>1,741</td>
<td>1,437</td>
<td>2,041</td>
<td>1,048</td>
</tr>
</tbody>
</table>

**237,796**
Chum salmon stock groupings

- **SE ASIA**
- **NE ASIA**
- **W AK**
- **UP/MID YUKON**
- **SW AK**
- **E.GOA/PNW**

Beacham et al. 2009
100% chum baseline simulations

Stock Proportion

- SE Asia
- NE Asia
- Western AK
- Up/Mid Yukon
- SW Alaska
- E. GOA/PNW
2015 Bering Sea chum salmon bycatch

- Catch (236,686)
- Samples (7,762)
2015 Bering Sea chum salmon bycatch

Statistical areas

<table>
<thead>
<tr>
<th>Sample set</th>
<th>X²</th>
<th>d.f.</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collected</td>
<td>4.92</td>
<td>16</td>
<td>&gt;0.99</td>
</tr>
<tr>
<td>Genotyped</td>
<td>3.95</td>
<td>16</td>
<td>&gt;0.99</td>
</tr>
<tr>
<td>Analyzed</td>
<td>8.49</td>
<td>16</td>
<td>0.93</td>
</tr>
</tbody>
</table>
2015 Bering Sea chum salmon bycatch

Correlation coefficient, $r > 0.99$
2015 Bering Sea chum salmon bycatch

Stock proportions (1,836 samples)

<table>
<thead>
<tr>
<th>BAYES Region</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE Asia</td>
<td>0.097</td>
<td>0.008</td>
</tr>
<tr>
<td>NE Asia</td>
<td>0.175</td>
<td>0.012</td>
</tr>
<tr>
<td>Western Alaska</td>
<td>0.160</td>
<td>0.011</td>
</tr>
<tr>
<td>Upper/Middle Yukon</td>
<td>0.039</td>
<td>0.007</td>
</tr>
<tr>
<td>SW Alaska</td>
<td>0.016</td>
<td>0.005</td>
</tr>
<tr>
<td>Eastern GOA/PNW</td>
<td>0.514</td>
<td>0.013</td>
</tr>
</tbody>
</table>

B-season

- **mean 1994, 1995, 2005-2010**
- **mean 2011-2014**
- **2015**

1,000s chum

- **166,140**
- **141,798**
- **236,686**
2015 Bering Sea chum salmon bycatch

Stock proportion

← Northwest         Southeast →

Early

Late

SE Asia
NE Asia
Western AK
Up/Mid Yukon
SW Alaska
E GOA/PNW
2015 salmon excluder device

Stock proportion

- Haul 113 (n=201)
- Haul 116 (n=168)
2015 Gulf of Alaska chum salmon bycatch

131 genetic samples

2015 GOA groundfish fisheries

- Hook-and-line
- Non-pelagic trawl
- Pelagic trawl

- Bottom pollock
- Midwater pollock
- Arrowtooth flounder
- Halibut
- Rockfish
- Sablefish

131 genetic samples
2015 Gulf of Alaska chum salmon bycatch

![Map of Alaska with genetic samples and GOA pollock season]

- Stock proportion
  - SE Asia
  - NE Asia
  - Western AK
  - Upper/Middle Yukon
  - SW Alaska
  - Eastern GOA/PNW

- GOA pollock season
  - Prior to C
  - C (Aug 25-Sep 30)
  - D (Oct 1-31)

- Genetically sampled stocks
  - SE Asia
  - NE Asia
  - Western AK
  - Upper/Middle Yukon
  - SW Alaska
  - Eastern GOA/PNW

- 2014 and 2015 data comparison
  - Green bars represent 2014 data
  - Blue bars represent 2015 data
2015 Bering Sea chum salmon bycatch

Age composition

A Season
B Season

Proportion

Total age

Age 3 chum salmon, 2 ocean annuli

Ellen Yasumiishi, Alaska Fisheries Science Center
2015 Bering Sea chum salmon bycatch

Age composition

Proportion
0 0.2 0.4 0.6 0.8
2 3 4 5 6 7
Total Age

2015 B-season

Age 3 chum salmon, 2 ocean annuli

Ellen Yasumiishi, Alaska Fisheries Science Center
2015 Bering Sea chum salmon bycatch

B-season
Age by finer strata
2015 Bering Sea chum salmon bycatch

<table>
<thead>
<tr>
<th>Region</th>
<th>Age 3</th>
<th>Age 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE Asia</td>
<td>B-season total</td>
<td>Cluster 1 Wk 31-33</td>
</tr>
<tr>
<td>NE Asia</td>
<td>Cluster 1 Wk 34-36</td>
<td></td>
</tr>
<tr>
<td>Western Alaska</td>
<td>Cluster 1 Wk 37-39</td>
<td></td>
</tr>
<tr>
<td>Up/Mid Yukon</td>
<td>ADFG stat area 655430</td>
<td></td>
</tr>
<tr>
<td>SW Alaska</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastern GOA/PNW</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Age 3: B-season total

Age 4: Cluster 1 Wk 31-33, Cluster 1 Wk 34-36, Cluster 1 Wk 37-39, ADFG stat area 655430
Salmon bycatch – future direction?

Relatively large datasets

- From large portions of Bering Sea and GOA shelf during much of the year.
- Systematic sampling in Bering Sea since 2011.
- Improved sampling in GOA.

How can this add to our understanding of ocean distribution?

Are there analyses/models that may inform groundfish management and users of salmon resources?
Salmon ocean distribution

Stock-specific Ocean Distribution and Migration of Chum Salmon
in the Bering Sea and North Pacific Ocean

Single-nucleotide polymorphisms reveal distribution and migration of Chinook salmon (Oncorhynchus tshawytscha) in the Bering Sea and North Pacific Ocean

NOAA Fisheries

U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries
Analyses that inform management?

E.g., model stock estimates by:

- Location – how to define areas, how large an area?
- Time – week, season, year
- Vessel effort
- Age of salmon
- Water temperature
- Run size
- Pink salmon abundance?
Bering Sea pollock fleet effort

A-season, Jan-Apr

Proportion of A season hauls that occurred in each stat area

B-season, Jun-Oct

Proportion of B season hauls that occurred in each stat area

Jordan Watson, Alaska Fisheries Science Center
Run size

Photo credit: Jack Helle

'Greatest' recorded chum salmon run: 2 million fish nets, burden boats

I knew guys that were having nets starting to sink there were so many extra fish.

By Tyson Brown, CBCNews

Published: January 8, 2016, 8:48 AM

Chum salmon return to Columbia in big numbers

Pacific blob, El Niño could be trouble for future populations

A fish biologist displays a bright spawning chum salmon male in just tagged of Wades landing past of the rainshower 206 Bridge on the Columbia River (The Columbian files)

By Damien Perasch, Columbian staff writer

Published: January 8, 2016, 8:48 AM

This winter’s Columbia River chum salmon return could be the largest in more than a decade.

Fisheries biologists monitoring the return say the 2016 run could be as high as 20,000 salmon — the largest since 2005. In 1999, the federal government listed the Columbia River chum salmon as threatened under the Endangered Species Act.

According to the Washington Department of Fish and Wildlife, the vast majority of returning chum are held in fish.
Acknowledgements

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  Ren Narita
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  Liz Chilton
  Brian Mason

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Rob Ames
Bob Ryznar

**N Pacific Fish Research Foundation**

**NMFS-Alaska Regional Office**
Bering Sea chum salmon bycatch

SE Asia  |  NE Asia  |  Western Alaska  |  Up/Mid Yukon  |  SW Alaska  |  Eastern GOA/PNW


2015 Bering Sea chum salmon bycatch

- Stock proportion
  - West of 170°W (n = 429)
  - East of 170°W (n = 1,407)

- Locations:
  - SE Asia
  - NE Asia
  - Western AK
  - Upper/Middle Yukon
  - SW Alaska
  - Eastern GOA/PNW

Map showing distribution and catch data for different regions.
2015 Bering Sea chum salmon bycatch

Area 521
- Early
- Middle
- Late

Area 517
- Early
- Middle
- Late

Legend:
- SE Asia
- NE Asia
- Western AK
- Upper/Mid Yukon
- SW Alaska
- Eastern GOA/PNW

Map showing areas of Alaska with different bycatch levels.
CIAP-WASC chum salmon collections

Goal II

Objective 1  ○
Genotype 144 samples from each of 32 collections at pre-existing and new microsatellite markers.

Objective 2  ●
Genotype mixture samples from lower Yukon and Kuskokwim rivers.
## 2015 GOA Chum Salmon Bycatch

### Stock Proportions

<table>
<thead>
<tr>
<th>Region</th>
<th>Bycatch 2014</th>
<th>Bycatch 2015</th>
<th>Urawa Late summer 2003</th>
<th>WASSIP Early summer 2007</th>
<th>WASSIP Mid-summer 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia</td>
<td>0.05</td>
<td>0.08</td>
<td>0.14</td>
<td>0.11</td>
<td>0.06</td>
</tr>
<tr>
<td>Western Alaska</td>
<td>0.02</td>
<td>0.03</td>
<td>0.30</td>
<td>0.20</td>
<td>0.02</td>
</tr>
<tr>
<td>Up/Mid Yukon</td>
<td>0</td>
<td>0</td>
<td>0.03</td>
<td>0</td>
<td>0.01</td>
</tr>
<tr>
<td>SW Alaska</td>
<td>0.01</td>
<td>0</td>
<td>0.13</td>
<td>0.11</td>
<td>0.04</td>
</tr>
<tr>
<td>Eastern GOA/PNW</td>
<td>0.92</td>
<td>0.88</td>
<td>0.40</td>
<td>0.58</td>
<td>0.88</td>
</tr>
</tbody>
</table>

- **WASSIP, 2007-2009**
- **WASSIP, ADFG Eastern District, Chignik Mgt Area**
Principal coordinate analysis
11 microsatellites

- Upper/Middle Yukon
- Eastern GOA – Pacific NW
- Southwest Alaska
- Western Alaska
- Northeast Asia
- Southeast Asia