Genetic Stock Composition Analysis of Chum Salmon from the Prohibited Species Catch of the 2014 Bering Sea Walleye Pollock Trawl Fishery and Gulf of Alaska Groundfish Fisheries

Genetics Program
Auke Bay Laboratories
Juneau, AK

April 5, 2016
2014 Bering Sea Chum Salmon Bycatch

1994: Scales (Patton et al. 1998) – 1,204 samples


1996: Allozymes (Seeb et al. 2004) – eastern shelf

Microsatellites:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>1,084</td>
<td>1,367</td>
<td>1,279</td>
<td>629</td>
<td>1,437</td>
<td>1,048</td>
<td>1,472</td>
<td>673</td>
<td>4,094</td>
<td>1,741</td>
</tr>
</tbody>
</table>
Our Stock Groupings

Figure 1

Map of the Pacific Rim indicating the general geographic regions where chum salmon (*Oncorhynchus keta*) from 381 populations were surveyed. The regions are listed in Table 1.
Principal Coordinate Analysis
11 microsatellites

-8.23 -4.17 -0.10 3.97 8.04
-8.44 -3.85 0.74 5.33 9.92

Upper/Middle Yukon

Eastern GOA - PNW

Southwest Alaska

Western Alaska

Northeast Asia

Southeast Asia
Baseline Analysis – 100% Simulations
11 microsatellite markers

- SE Asia
- NE Asia
- Western AK
- Up/Mid Yukon
- SW Alaska
- E. GOA/PNW

Stock Proportion

- E. GOA/PNW
- SW Alaska
- Up/Mid Yukon
- Western AK
- NE Asia
- SE Asia
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.
2014 Bering Sea Chum Salmon Bycatch

Chum bycatch (219,332)
- Genetic samples (7,253)

Statistical week

Chum bycatch × 1,000

Genetic samples
2014 Bering Sea Chum Salmon Bycatch

Statistical Areas

<table>
<thead>
<tr>
<th>Sample set</th>
<th>$X^2$</th>
<th>d.f.</th>
<th>$P$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collected</td>
<td>1.12</td>
<td>15</td>
<td>$&gt;0.99$</td>
</tr>
<tr>
<td>Genotyped</td>
<td>3.11</td>
<td>15</td>
<td>$&gt;0.99$</td>
</tr>
<tr>
<td>Analyzed</td>
<td>6.81</td>
<td>15</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Chum salmon PSC

Genetic samples
2014 Bering Sea Chum Salmon Bycatch

Correlation coefficient, $r > 0.99$
2014 Bering Sea Chum Salmon Bycatch

Stock Proportions
(1,741 samples)

<table>
<thead>
<tr>
<th>BAYES Region</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE Asia</td>
<td>0.185</td>
<td>0.010</td>
</tr>
<tr>
<td>NE Asia</td>
<td>0.374</td>
<td>0.015</td>
</tr>
<tr>
<td>Western Alaska</td>
<td>0.177</td>
<td>0.012</td>
</tr>
<tr>
<td>Upper/Middle Yukon</td>
<td>0.021</td>
<td>0.006</td>
</tr>
<tr>
<td>SW Alaska</td>
<td>0.007</td>
<td>0.003</td>
</tr>
<tr>
<td>Eastern GOA/PNW</td>
<td>0.236</td>
<td>0.012</td>
</tr>
</tbody>
</table>
2014 Bering Sea Chum Salmon Bycatch

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Dates</th>
<th>Number Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>24-29</td>
<td>June 10 – July 19</td>
<td>249</td>
</tr>
<tr>
<td>30-34</td>
<td>July 20 – August 23</td>
<td>957</td>
</tr>
<tr>
<td>35-40</td>
<td>August 24 – October 4</td>
<td>535</td>
</tr>
</tbody>
</table>

Genetic samples

Stock proportion

Early | Middle | Late

SE Asia

NE Asia

Western Alaska

Upper/Middle Yukon

Eastern GOA/PNW

Number of fish

Statistical week

509 513/514 517/519 521/523 524
2014 Bering Sea Chum Salmon Bycatch

Stock proportion

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

West of 170°W (n = 580)
East of 170°W (n = 1,161)
2014 Bering Sea Chum Salmon Bycatch

Area 509

<table>
<thead>
<tr>
<th>Time period</th>
<th>Number of samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early-mid</td>
<td>90</td>
</tr>
</tbody>
</table>

### Stock Proportion

- **SE Asia**: 0.1 ± 0.05
- **NE Asia**: 0.2 ± 0.05
- **Western AK**: 0.3 ± 0.05
- **Up/Mid Yukon**: 0.05 ± 0.02
- **SW Alaska**: 0.05 ± 0.02
- **Eastern GOA/PNW**: 0.2 ± 0.05
2014 Bering Sea Chum Salmon Bycatch

Area 517

<table>
<thead>
<tr>
<th>Time period</th>
<th>Number of samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early-mid</td>
<td>784</td>
</tr>
<tr>
<td>Late</td>
<td>252</td>
</tr>
</tbody>
</table>

Stock proportion

- SE Asia
- NE Asia
- Western AK
- Up/Mid Yukon
- SW Alaska
- Eastern GOA/PNW
2014 Bering Sea Chum Salmon Bycatch

Area 521

<table>
<thead>
<tr>
<th>Time period</th>
<th>Number of samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early-mid</td>
<td>295</td>
</tr>
<tr>
<td>Late</td>
<td>221</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stock proportion</th>
<th>Early-mid</th>
<th>Late</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE Asia</td>
<td>0.35 ± 0.05</td>
<td>0.28 ± 0.03</td>
</tr>
<tr>
<td>NE Asia</td>
<td>0.42 ± 0.06</td>
<td>0.30 ± 0.04</td>
</tr>
<tr>
<td>Western AK</td>
<td>0.25 ± 0.03</td>
<td>0.18 ± 0.02</td>
</tr>
<tr>
<td>Up/Mid Yukon</td>
<td>0.04 ± 0.01</td>
<td>0.03 ± 0.01</td>
</tr>
<tr>
<td>SW Alaska</td>
<td>0.02 ± 0.00</td>
<td>0.02 ± 0.00</td>
</tr>
<tr>
<td>Eastern GOA/PNW</td>
<td>0.20 ± 0.02</td>
<td>0.15 ± 0.01</td>
</tr>
</tbody>
</table>
2014 GOA Chum Salmon Bycatch

273 genetic samples

2014 GOA groundfish fisheries

- 'B' Bottom pollock
- 'K' Rockfish
- 'P' Midwater pollock
- 'S' Sablefish
- 'W' Arrowtooth flounder
- 'X' Rex sole
2014 GOA Chum Salmon Bycatch

Number of chum salmon

Statistical week

A           B                                 C     D

0          50          100          150          200          250          300          350          400          450          500

Number of genetic samples

Genetic samples

Gulf of Alaska pollock season

Prior to C  C (Aug. 25- Sep. 30)  D (Oct. 1-31)
2014 GOA Chum Salmon Bycatch

Stock Proportions
(252 samples)

<table>
<thead>
<tr>
<th>BAYES Region</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE Asia</td>
<td>0.028</td>
<td>0.011</td>
</tr>
<tr>
<td>NE Asia</td>
<td>0.024</td>
<td>0.016</td>
</tr>
<tr>
<td>Western Alaska</td>
<td>0.020</td>
<td>0.011</td>
</tr>
<tr>
<td>Up/Mid Yukon</td>
<td>0.001</td>
<td>0.002</td>
</tr>
<tr>
<td>SW Alaska</td>
<td>0.012</td>
<td>0.014</td>
</tr>
<tr>
<td>Eastern GOA/PNW</td>
<td>0.916</td>
<td>0.023</td>
</tr>
</tbody>
</table>

Bycatch samples
Urawa et al. 2009
WASSIP, 2007-2009
WASSIP, ADFG Eastern District, Chignik Mgmt Area
2014 GOA Chum Salmon Bycatch

Stock Proportions

- Asia
- Western Alaska
- Up/Mid Yukon
- SW Alaska
- E. GOA/PNW

Legend:
- Bycatch samples
- Urawa et al. 2009
- WASSIP, 2007-2009
- WASSIP, ADFG Eastern District, Chignik Mgmt Area

Map showing stock proportions in different regions with corresponding colors and labels.
Acknowledgements

NMFS-ABL
Genetics Program:
Jeff Guyon
Jackie Whittle
Doug Yates
Hanhvan Nguyen
Scott Vulstek

NMFS-FMA
North Pacific Groundfish and Halibut Observers
Chris Rilling
Julie Blair
Ren Narita
Lisa Thompson
Liz Chilton
Brian Mason