Life-history diversity and productivity of Puget Sound Chinook salmon

Joseph H. Anderson  
*Washington (State). Department of Fish and Wildlife, joseph.anderson@dfw.wa.gov*

Peter Topping  
*Washington (State). Department of Fish and Wildlife*

Clayton Kinsel  
*Washington (State). Department of Fish and Wildlife*

Matthew Klungle  
*Washington (State). Department of Fish and Wildlife*

Kelly Kiyohara  
*Washington (State). Department of Fish and Wildlife*

*See next page for additional authors*

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Speaker
Joseph H. Anderson, Peter Topping, Clayton Kinsel, Matthew Klungle, Kelly Kiyohara, and Joshua Weinheimer

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Life-history diversity and productivity of Puget Sound Chinook salmon

Joseph H. Anderson, Peter Topping, Clayton Kinsel, Matthew Klungle, Kelly Kiyohara, Joshua Weinheimer

Science Division, Fish Program

Washington Department of Fish and Wildlife

Salish Sea Ecosystem Conference
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Life-history diversity

Why is diversity important?

Similar to a diverse portfolio of financial assets, life-history diversity confers stability to salmon and steelhead populations given uncertain future environmental conditions.


General patterns of Chinook salmon life-history diversity

- **Subyearling juvenile migrants or ocean-type life-history**
- **Yearling juvenile migrants or stream-type life-history**
WDFW smolt trap sites

Map: Dale Gombert
WDFW smolt trap sites

Skagit River

Nisqually River

Green River

Dungeness River
Subyearling Chinook abundance

- Skagit
- Nisqually
- Green
- Dungeness
Chinook salmon migration timing

Skagit 2005 - 2012

Nisqually 2009 - 2013

Green 2005 - 2013

Dungeness 2005 – 2013
Subyearling Chinook salmon body size

[Graphs showing the average fork length (mm) from Jan 11 to Aug 16 for Skagit, Nisqually, Green, and Dungeness from 2009 to 2013.]
Subyearling Chinook salmon body size

**Skagit**

- Fry
- Parr

**Nisqually**

- Fry
- Parr

**Green**

- Fry
- Parr

**Dungeness**

- Fry
- Parr
Chinook productivity

Which model best describes patterns of productivity for each migrant life-history?

Ricker density dependent

\[ \log \left( \frac{J}{S} \right) = a - \frac{a}{b} S \]

Density independent

\[ \log \left( \frac{J}{S} \right) = a \]

<table>
<thead>
<tr>
<th>Population</th>
<th>Migrant life-history</th>
<th>Best model</th>
<th>ΔAICc</th>
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<tbody>
<tr>
<td>Skagit</td>
<td>Fry</td>
<td>Density independent</td>
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<tr>
<td>Green</td>
<td>Fry</td>
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Chinook productivity

Which model best describes patterns of productivity for each migrant life-history?

Ricker density dependent

\[ \log \left( \frac{J}{S} \right) = a - \frac{a}{b} S \]

Density independent

\[ \log \left( \frac{J}{S} \right) = a \]

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Yearling Chinook
Nisqually


Graphs showing fork length (mm) over time from January 11 to August 23 for each year.

- 2010: Data points for subyearling and yearling Chinook.
- 2011: Similar data as 2010.
- 2012: Data points for yearling Chinook only.
- 2013: Data points for yearling Chinook only.
Yearling Chinook migration timing

**Skagit**
Yearling median catch 2005 – 2013 = 148

**Nisqually**
Yearling median catch 2009 – 2013 = 242

**Dungeness**
Yearling median catch 2005 – 2013 = 37
Conclusions

Life history diversity
• Distinct bimodal subyearling Chinook migration: early small fry followed by later larger parr
• Yearling Chinook observed in Skagit, Nisqually and Dungeness, likely related to colder temperatures from snowmelt/glacial influence

Productivity
• In Skagit and Green, fry production increases consistently with spawners, but parr production shows evidence for density dependent capacity limits
• By inference, freshwater productivity limited by rearing not spawning habitat

Restoration implications
• Efforts to create and maintain juvenile rearing habitat will provide the greatest benefit to Chinook freshwater productivity
• Diverse habitats promote diverse life-histories

Unanswered question
• What is the relative marine survival of fry vs parr subyearling migrants?
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