LIFE HISTORY DIVERSITY AND RESILIENCE
SPRING CHINOOK IN THE WILLAMETTE RIVER BASIN

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Thanks to the biologists who worked on this project in past years,
and to the many seasonal employees who collected much of the data

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Spring Chinook found in Eastside tributaries

Dams block access to upper reaches of Spring Chinook rivers

Large hatchery program (annual release 5–8 million smolts)

Listed as ‘threatened’ species in 1999

Willamette Basin:
Largest watershed in Oregon (30,000 km²)
70% of Oregon population
Largest urban areas in Oregon

Willamette River
North Santiam River
South Santiam River
McKenzie River
Middle Fork Willamette River
Eugene-Springfield
Corvallis
Albany
Salem
Portland
Columbia River
Clackamas River
Willamette Falls
Why Study Life Histories?

Perception (knowledge) of life history and habitat use will influence consideration and choice of recovery goals & strategies

Information → Perception (of fish & habitat) → Possibilities (strategies)

Life History Information:
- What life histories or variants are present?
- What habitats are used & when?
- What life histories are productive?
- What life histories are lost or depressed?

Use Information To:
- Develop recovery goals and strategies
- Link strategies to proper scales (spatial & temporal)
- Identify habitat usage & constraints

Chinook Salmon General Life History

- Spawn in late Aug–Oct
- Emergence in Jan–Apr
- Subyearling (ocean-type):
  - Stream rearing in Spring of first year
- Yearling (stream-type):
  - Stream rearing to Spring of second year
- Columbia River:
  - Summer of first year → Ocean Entry
  - Spring of second year
McKenzie River as Template: most intact watershed, largest wild population
Sample juvenile Chinook at Leaburg Dam and Downstream

<table>
<thead>
<tr>
<th>Reach</th>
<th>Spawners (%)</th>
<th>Wild Spawners (%)</th>
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<tbody>
<tr>
<td>1. Above South Fork</td>
<td>54</td>
<td>88</td>
</tr>
<tr>
<td>2. South Fork &amp; below</td>
<td>31</td>
<td>52</td>
</tr>
<tr>
<td>3. Below Leaburg Dam</td>
<td>15</td>
<td>12</td>
</tr>
</tbody>
</table>
Catch of Wild Spring Chinook in Leaburg Dam Bypass Trap
Migration from Primary Spawning Areas

Seine Downriver & PIT tag late Spring - Fall
PIT tag & Release at Trap
Fry Migration from McKenzie River
Trap catch 1999-2001

Pole seine catch
March 2011
- 29–47 mm
- 35–55 mm
- 37–72 mm

March 2011
- 29–47 mm
- 35–55 mm
- 37–72 mm
Spring – Summer Rearing & Migration

- Lower McKenzie
- Willamette
- Santiam

Fry too small to tag at time of migration to lower tributaries or Willamette Seine downstream after fry have grown

PIT tag – recaptures for growth; detect at Willamette Falls for emigration
Juvenile Chinook Growth – Spring & Summer Rearing
Willamette & McKenzie rivers

Recaptured 5 or more days after tagging (average = 16 d)
90% recaptured in same area as tagged
Average FL at tagging above bars

Growth (mm/d) \pm SE

<table>
<thead>
<tr>
<th>Recapture location</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
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</thead>
<tbody>
<tr>
<td>Mid Willamette</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Upper Willamette</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>McKenzie</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Average FL at tagging above bars:
- Mid Willamette: 77.7 mm
- Upper Willamette: 81.9 mm
- McKenzie: 79.7 mm

Recaptured 5 or more days after tagging (average = 16 d)
90% recaptured in same area as tagged
Subyearling Migration

Most Chinook rearing in Willamette & Lower McKenzie migrate in first summer as subyearlings.

More summer-fall rearing at upstream sites.

2008, later migration with late snowmelt, high flows & low water temperature.
Generalized Migration of McKenzie Juvenile Spring Chinook

Relative seasonal use of Willamette River
Contribution of Age 0 (Subyearling) in Wild Adult Spring Chinook – McKenzie Basin
(hatchery fish identified by adipose fin clips & otolith marks)

Life History Diversity Matters – Different Life Histories Contribute (spatially & temporally)
Life History Diversity & Species Recovery

**Fry dispersal:** adaptation that gave access to productive winter–spring rearing habitat?

**Subyearling emigrants:** once the most productive life history?

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1850

Fry & subyearling migrations persist despite altered habitat

Subyearlings contribute to adult returns

Restore habitat complexity

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Hulse et al. 2004, Ecological Applications 14: 325–341
Dynamic Rivers provide Diverse Habitats that support Diverse Life Histories

- Pools for larger fish
- Productive riffles
- Small side channels
- Cold water pockets
- Refuge areas during floods
- Narrow channels with shade
- New gravel bars & islands
- Shallow edges for fry

Willamette River downstream of McKenzie confluence
What Do We Know?

• Willamette Chinook have multiple rearing & migratory pathways before ocean entry
• Juvenile Chinook migrate into the river at different life stages
• Juvenile Chinook are present in the river year-round
• Some rear in the river for many months (up to 16)
• Use many different types of habitats:
  o Main river (shallow gravel bars, pools)
  o Side channels
  o Floodplains
  o Small, seasonal tributaries

What Should We Do?

• Manage for multiple life histories
• Protect & conserve: stem the loss of habitat
• Protect intact areas & high potential habitat
• Land purchase or easements to allow room for river
• Move development out of floodplains
• Provide connectivity: lateral, temporal

Flooded gravel bar with willows – upstream of Salem, June 2008

Flooded channels & fields – Harkins Lake, June 2010
  Michael Pope, Greenbelt Land Trust