Chinook Salmon
Insights from Marine Ecosystem Monitoring in Southeast Alaska

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2012 Alaska Chinook Salmon Symposium
Understanding Abundance and Productivity Trends of Chinook Salmon in Alaska
Anchorage Alaska, 23 October 2012
Presentation outline

- Highlight some past research studies & insights relevant to Chinook: 1982-1996
- Review current long-term Southeast Alaska Coastal Monitoring project: 1997-2012
- Summarize selected findings on Chinook marine distribution, ecology, & production
- Identify future research needs to better understand Chinook production mechanisms
Juvenile salmon research studies 82-87

Small mesh purse seining
July-Aug of 1982-1983

• 253 seine hauls
• 38 Chinook salmon

Salmon power trolling w/small gear-3 regions-May/Sept/Feb inshore/coastal - 1986-1987

• 135 charter days
• 5,838 Chinook salmon (539 coded-wire tags)
Insights from Chinook research

Marine distribution and origin of prerecruit Chinook salmon in southeastern Alaska (Orsi and Jaenicke 1996)

- Described seasonal stock-specific distributions of AK, BC, & WA/OR fish from cwtS (74 stocks)

- Identified SEAK as an important nursery area for prerecruit Chinook salmon from up to 1,800 km south

Catch rate of chinook salmon, *Oncorhynchus tshawytscha*, by ocean age and season in inside and outside marine waters of southeastern Alaska, 1986–87. Catch rate is based on the expanded numbers of coded-wire–tagged fish caught per hour. Actual numbers of coded-wire–tagged fish are shown in parentheses.
Insights from Chinook research...

- Largest Chinook deepest
- Fish shallow in May deep in Winter
- Juvenile Chinook deeper than coho: habitat partitioning in September
- Older Chinook deeper

Marine vertical distribution of Chinook salmon and coho salmon in southeastern Alaska (Orsi and Wertheimer 1995)
Juvenile salmon research studies 1993-2012

Two boat pair trawling
June-Aug 1993-1996

- shallow 3-m, 10 min, night
- ~225 hauls
- 20 Chinook salmon

Surface rope trawling (SECM)
May-Jun-Jul-Aug-Sep 1997-2012

- 20-m deep, 20 min, day
- 1,382 hauls
- 1,299 Chinook salmon
Southeast Alaska Coastal Monitoring (SECM)

Physical data

Zooplankton biomass/diet

Catches (CPUE)

Size & growth

Stock comp

Predation
Seasonal distribution of juvenile salmon

Seasonal habitat use and early marine ecology of juvenile Pacific salmon in southeastern Alaska (Orsi et al. 2000)

Differential habitat use by species?

Seasonal signals from May to September?
Juvenile salmon distribution patterns
May-September 1997-2000

- **Inshore**: distributed evenly among months
- **Strait**: increased from June to September
- **Coastal**: peaked in June, declined in later months

Inshore (high #s)  Strait (medium #s)  Coastal (low #s)
Epipelagic fish assemblages associated with juvenile Pacific salmon in neritic waters of the California Current and the Alaska Current (Orsi et al. 2007)

What is the relative abundance of Chinook compared to other epipelagic fish species?
Daytime surface trawls, inshore & coastal waters, spring/summer & summer/fall periods, 2000-2004

1.6 million fish & squid: 52 fish families - 118 species

<table>
<thead>
<tr>
<th>Large marine ecosystem</th>
<th>Trawl hauls fished</th>
<th>Total fish sampled</th>
<th>Chinook inshore (%)</th>
<th>Chinook Coastal (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska Coastal Current</td>
<td>606</td>
<td>120 K</td>
<td>0.005-0.010</td>
<td>0.002-0.005</td>
</tr>
<tr>
<td>California Current</td>
<td>1,510</td>
<td>1,560 K</td>
<td>0.015-0.190</td>
<td>0.007-0.010</td>
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</tbody>
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Chinook salmon numerically comprised 1/100th of 1% of the catch in the AK Coastal Current
Diets of Chinook salmon vs. coho salmon in Southeast Alaska

SECM sampling stations in Southeast Alaska
May, June, July, August 1997-2012
Strong relationship between SECM juvenile pink catch and adult harvest 1998-2011

Harvest = 16.2x - 3.5
$R^2 = 0.84$

Southeast harvest (millions)

Juvenile pink salmon peak June/July Ln(CPUE+1)

2012 harvest

2005 ocean yr
Diel epipelagic distribution of juvenile salmon, rockfish, sablefish and ecological interactions with associated species in offshore habitats of the northeast Pacific Ocean (Orsi et al. 2006)

July 2005

### Correlations between SECM Chinook catches and wild and hatchery Chinook salmon brood year survival

(Chinook data courtesy: E. Jones ADFG, F. Thrower NOAA, C. Blair NSRAA, and R. Focht)

<table>
<thead>
<tr>
<th>Stock-group</th>
<th>Brood years (BY)</th>
<th># yrs</th>
<th>Age-.0 juveniles CPUE\textsubscript{J-J-A} (BY + 2)</th>
<th>Age-.1 immatures CPUE\textsubscript{J-J-A} (BY + 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stikine River Wild</td>
<td>1998-2002</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chilkat River Wild</td>
<td>1998-2003</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taku River Wild</td>
<td>1995-2005</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hidden Falls Hatchery</td>
<td>1995-2005</td>
<td>11</td>
<td></td>
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</tbody>
</table>

![Graph showing the relationship between Juvenile Chinook salmon CPUE and Taku River marine survival.]
Insights from Chinook sampling in Southeast

Catch rates are low with many sampling techniques: Chinook numerically represent 1/100\(^{th}\) of 1\% of catches.

A multitude of stocks occur in SEAK, some year-round, migrate northward from distant localities - as age -.1 fish

Many SEAK stocks have limited early ocean migrations as evidenced by protracted seasonal habitat use, conversely, some Columbia R. Basin stocks are highly migratory.

Deep vertical distribution relative to the other salmon species, larger/older fish deepest, and seasonally deepest in winter.
Insights from Chinook sampling in Southeast

Juvenile Chinook salmon have habitat-specific seasonal migration patterns, different from the other salmon species.

Chinook salmon are picivores (50-90% of diet), important fish prey are: capelin, herring, sandlance, gadids, & lanternfish.

Chinook salmon CPUE shows promise as a tool for indexing Chinook salmon year class strength of some stock groups.

Long-term ecosystem monitoring on a seasonal basis has enabled biological signals to be detected.
A couple recent studies on Chinook marine distribution and survival...

#1

A refined description of essential fish habitat for Pacific salmon within the U.S. Exclusive Economic Zone in Alaska (Echave et al. 2012)
Juvenile Chinook range, 95% of spatial distribution
Inshore distribution on the continental shelf

Immature Chinook range, 95% of spatial distribution
Offshore distribution in western GOA & Bering Sea

(Echave et al. 2012)
A couple recent studies on Chinook marine distribution and survival...

#2
Relating spatial and temporal scales of climate and ocean variability to survival of Pacific Northwest Chinook salmon (*Sharma et al. 2012*)
Examined smolt-adult survival from 22 Chinook salmon stock groups from the Pacific Northwest to Southeast AK

- Ocean survival grouped into 8 distinct regional clusters
- Chinook survival co varies on spatial scale of 350-450 km
- Local ocean conditions following smolt outmigration had a significant effect on survival for most stock groups
What research is needed to better understand marine production mechanisms for Chinook?

- Prey?
- Immature distribution?
- Juvenile abundance?
- Climate?
- Adult production?
- Predators?
- Competitors?
Future Chinook marine research direction?

- Monitor ecosystems for index stocks seasonally
- Identify stock-specific migration patterns
- Do northern Chinook stocks have protracted early migrations, or perhaps two life history strategies: upper vs. lower Yukon?
- Do Western AK Chinook stocks migrate seasonally like Japanese chum: summer in Bering Sea/winter in GOA?
- Investigate trophic linkages (top-down & bottom-up)
- Explore ecosystem metric relationships with survival
- Maintain collaboration among researchers
Thanks for the survey collaboration!
ADFG, U of AK, NWFSC, & SSRAA

Chinook!