Stock-specific Distributions of Juvenile Chinook Salmon Along the Oregon and Washington Coasts

David Teel, Brian Burke, David Kuligowski,

Cheryl Morgan, Donald Van Doornik and Laurie Weitkamp

NOAA Fisheries, Northwest Fisheries Science Center

Cooperative Institute of Marine Resources Studies, Oregon State University

Juvenile Chinook Salmon Distribution Study

- Premise #1:

The weeks and months following ocean entry is a critical period for salmon growth and survival.

- Premise #2:

Understanding where and how ocean conditions affect survival and growth depends on knowing initial marine dispersal patterns.

Outline

- **Background**

  Coastwide perspective on the early marine dispersal of Chinook salmon: Coded-wire tag recoveries in juvenile salmon surveys

  Examples of Columbia River migrations

  #1: Migrates rapidly northward

  #2: Spreads out widely along the coast

  #3: Remains relatively near it's point of ocean entry

- **Methods: Genetic analysis of juvenile distributions**

- **Results: Ocean entry timing and distribution**

  Two life history types and four CR genetic stocks

Yearling outmigrants	Subyearling outmigrants
Willamette River spring	Spring Creek Group fall (lower CR)
Snake River spring/summer	Upper Columbia River summer/fall

- **Synthesis**

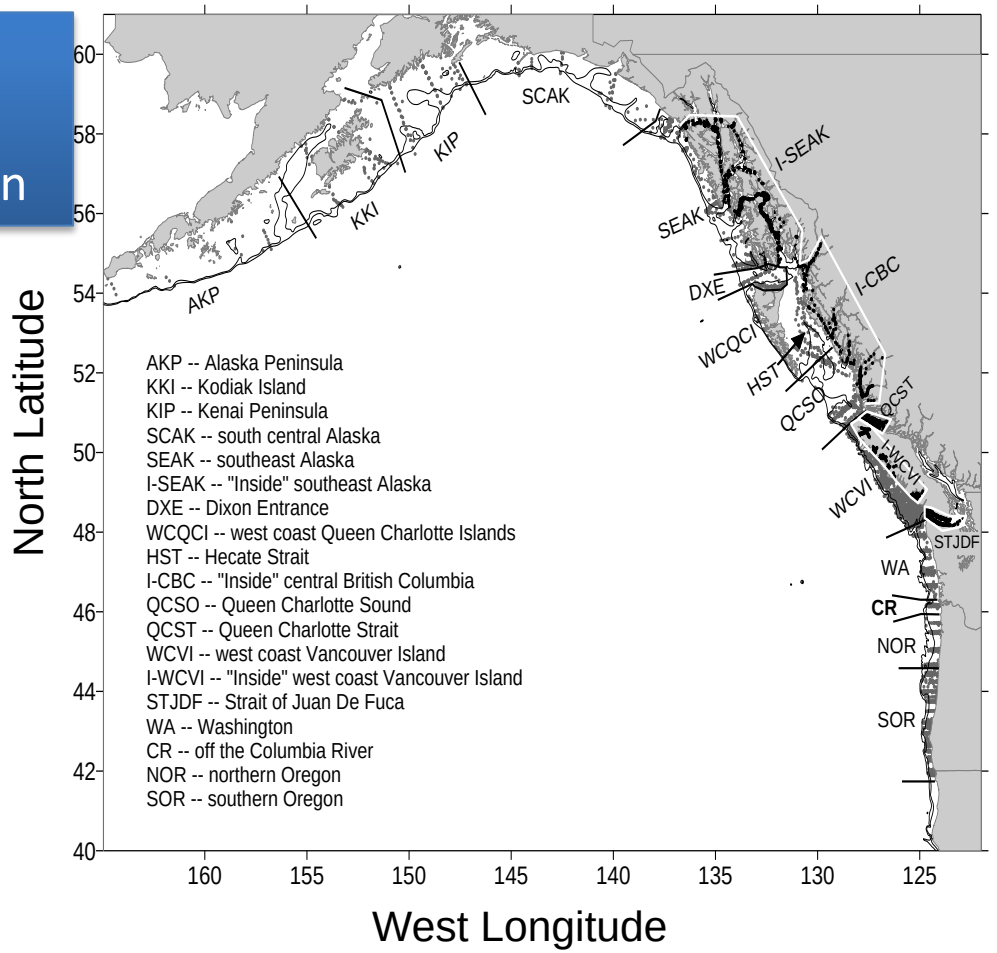
Coastwide Juvenile Salmon CWT Sampling Along the Continental Shelf 1995 - 2006

Fisher et al. 2014 TAFS
Early ocean dispersal patterns of Columbia River Chinook and Coho salmon

<u>NOAA Auke Bay Lab</u>
- ocean carrying capacity
- Southeast AK coastal monitoring

<u>DFO Pacific Biological Lab</u>
- High-seas salmon
- Salmon interactions

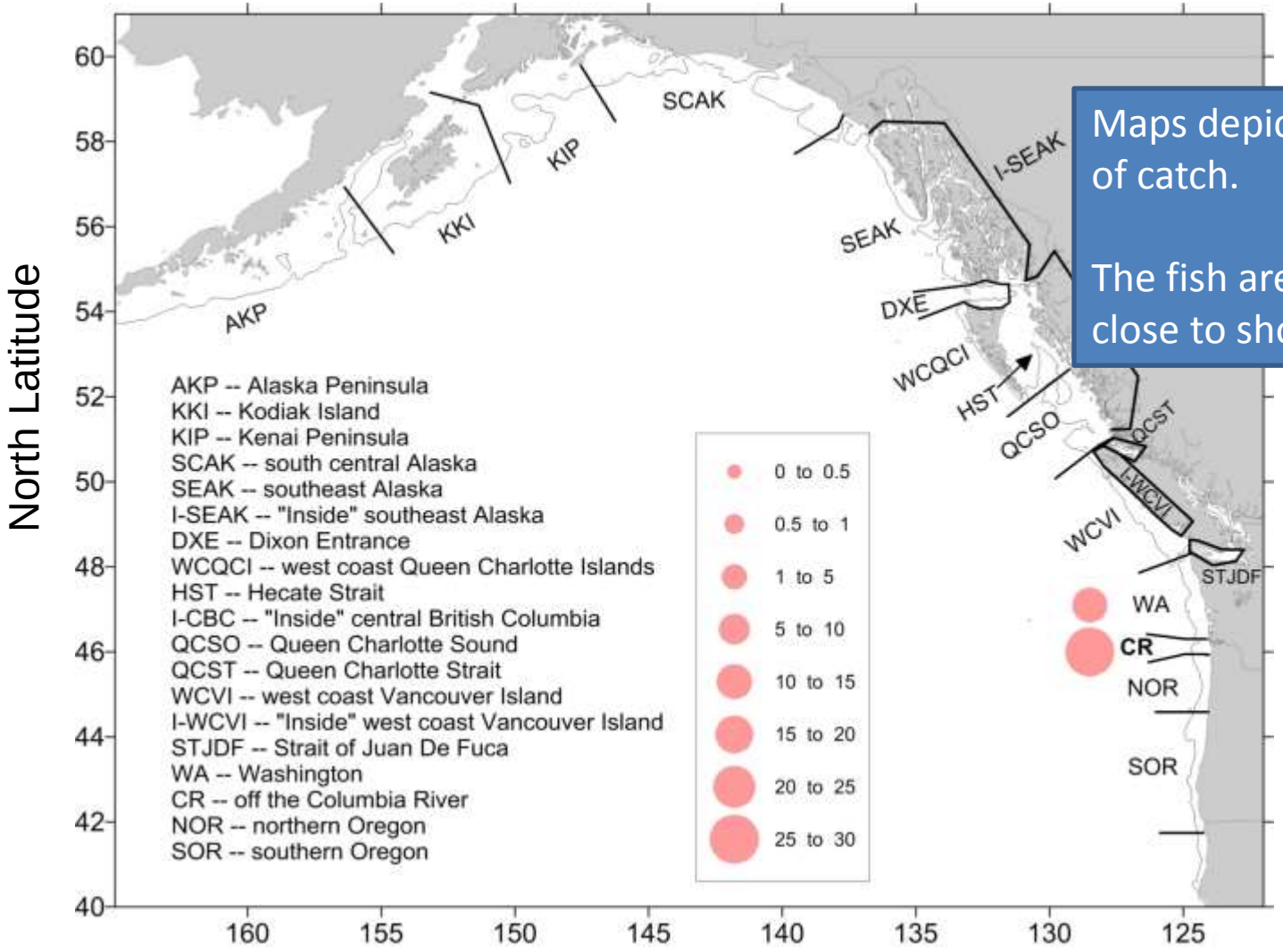
<u>NOAA NWFSC & OSU</u>
- Columbia River plume study
- NEP-GLOBEC



CPUE by Region: CWT Catch - expanded for associated untagged fish

April - May

Snake River Spring/Summer Yearlings



Maps depict regions of catch.

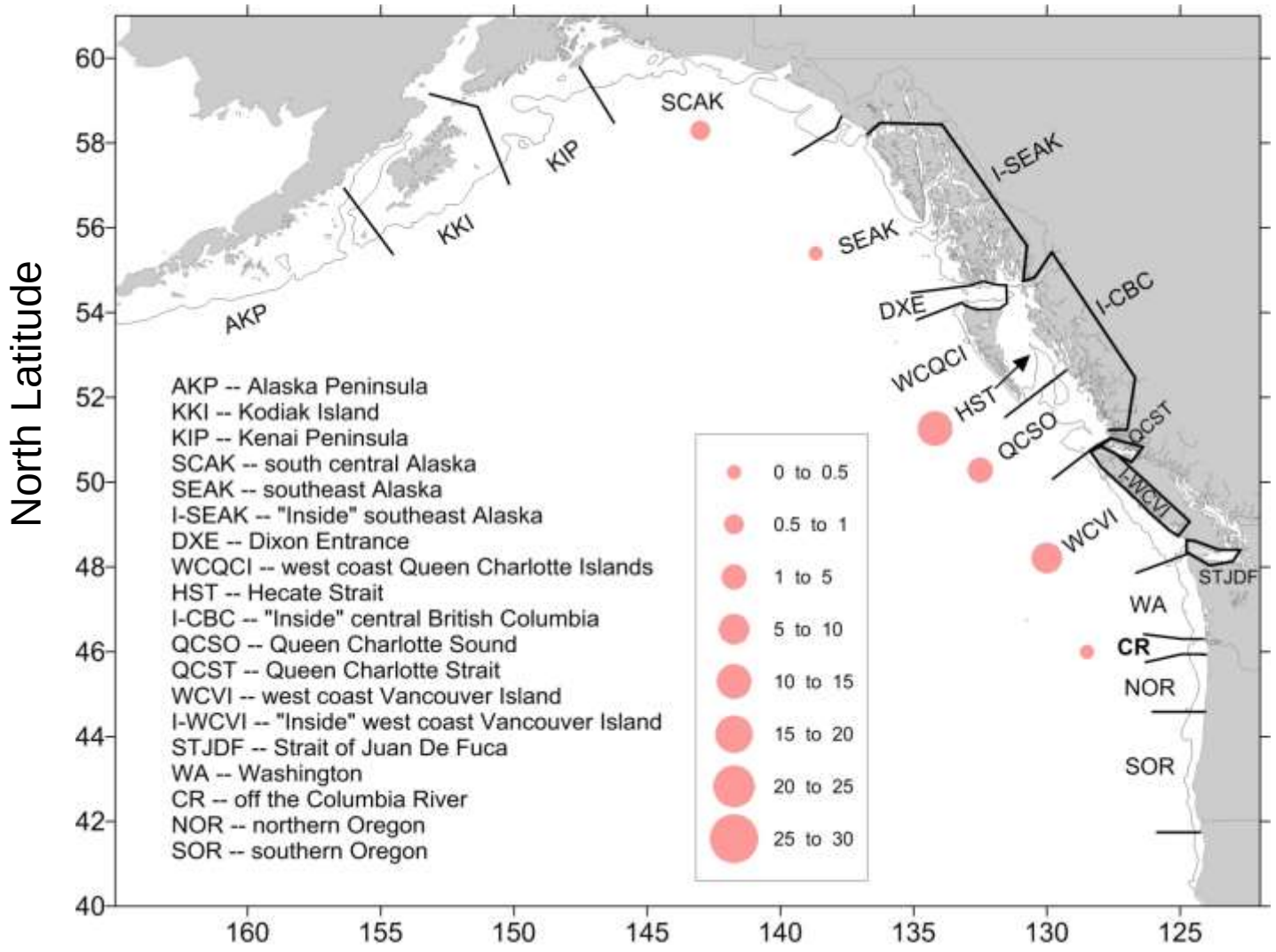
The fish are actually close to shore

Fish / km^2 by Region

Fisher et al. 2014 TAFS

June - July

Snake River Spring/Summer Yearlings

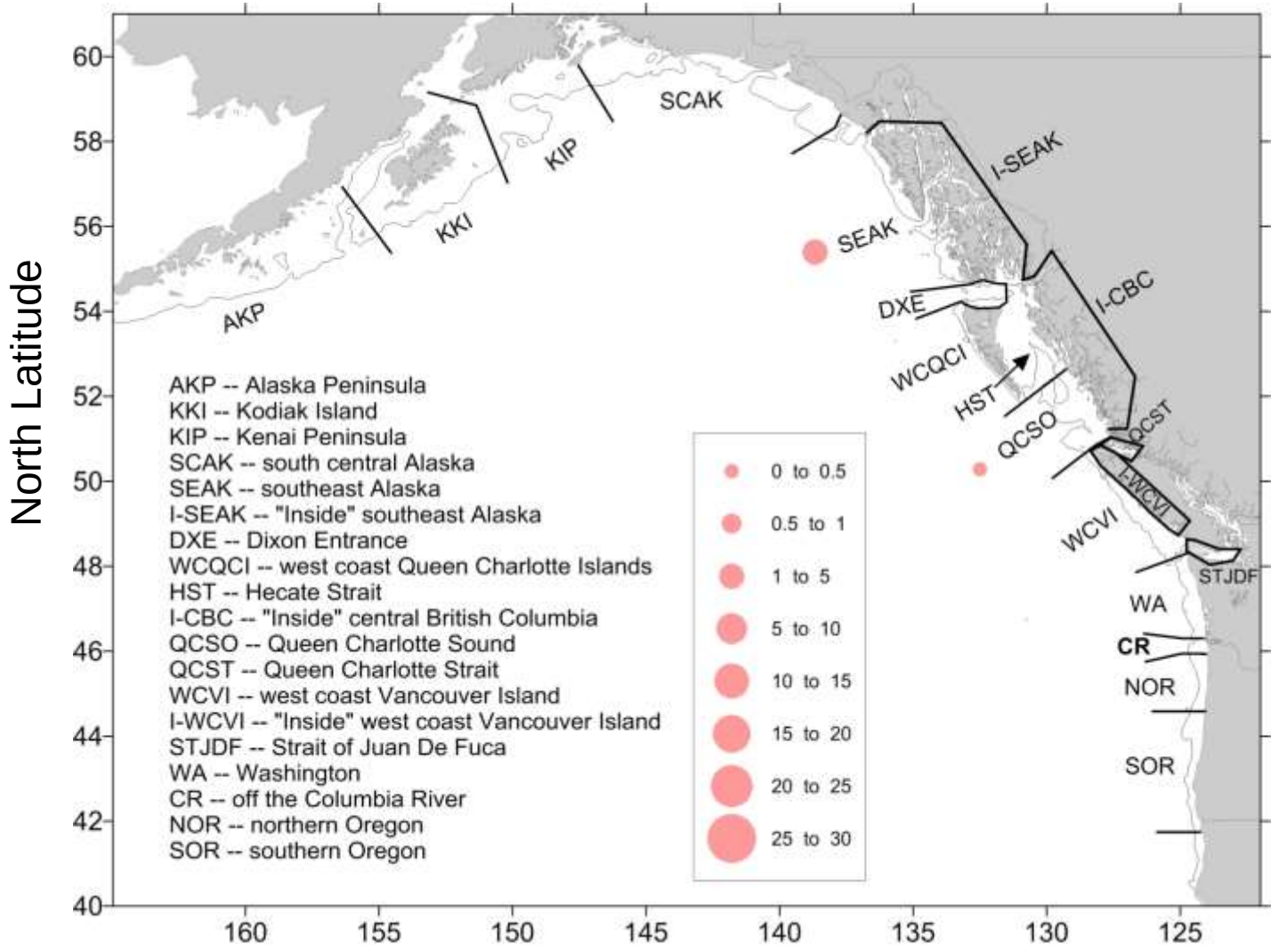


Fish / km^2 by Region

Fisher et al. 2014 TAFS

August - September

Snake River Spring/Summer Yearlings



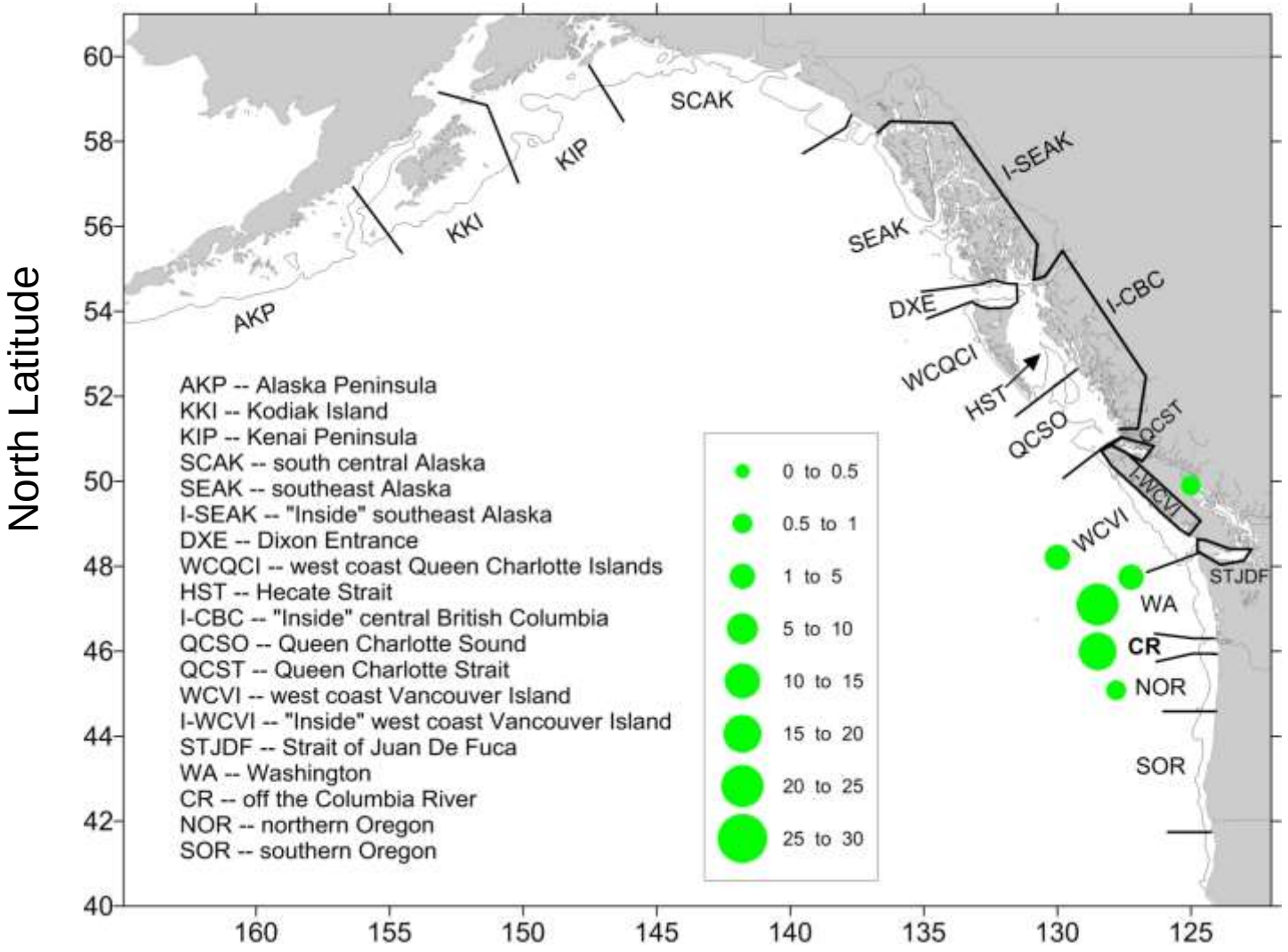
Fish / km^2 by Region

West Longitude

Fisher et al. 2014 TAFS

April - May

Willamette River Spring Yearlings

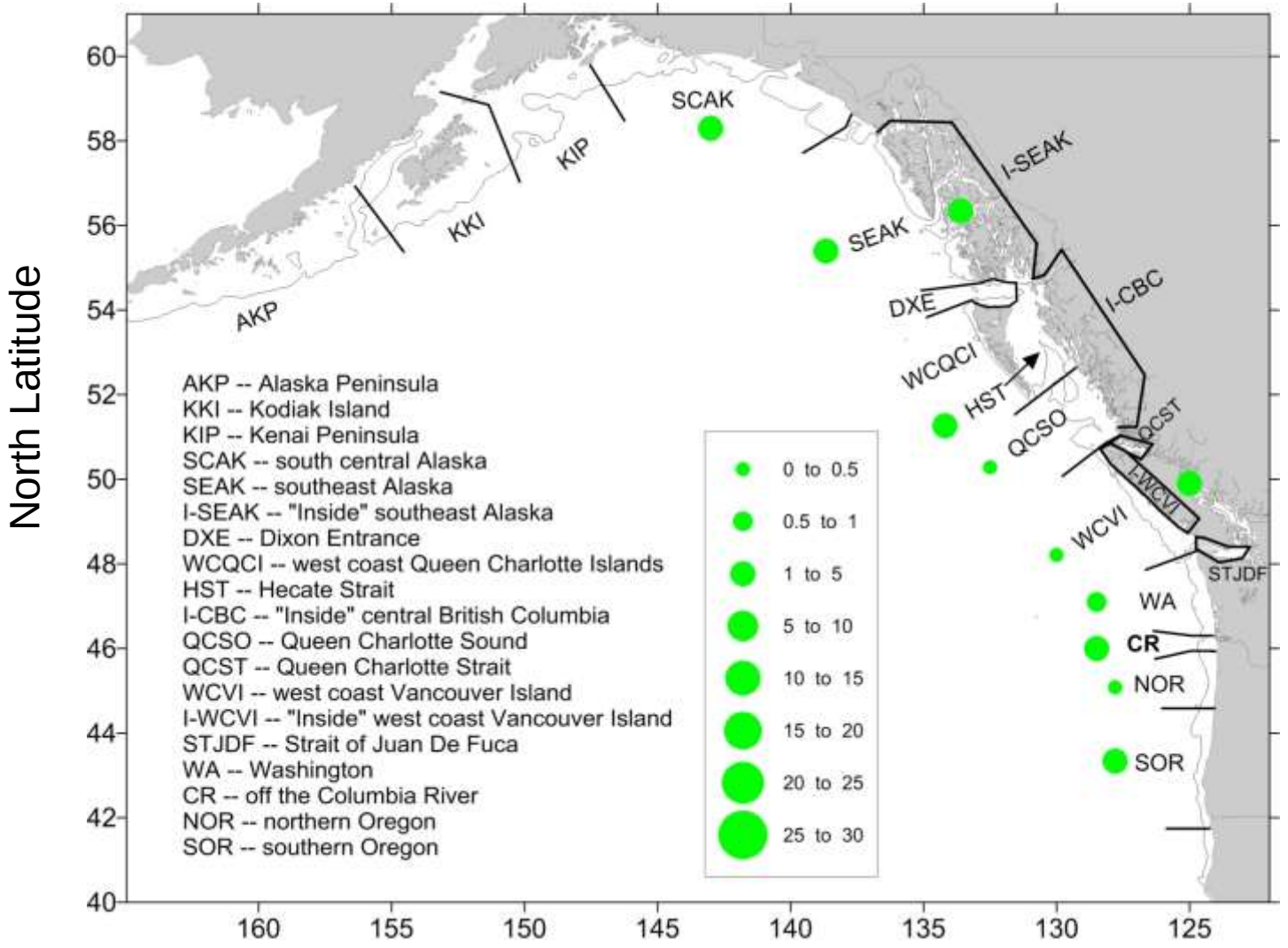


Fish / km^2 by Region

Fisher et al. 2014 TAFS

June - July

Willamette River Spring Yearlings

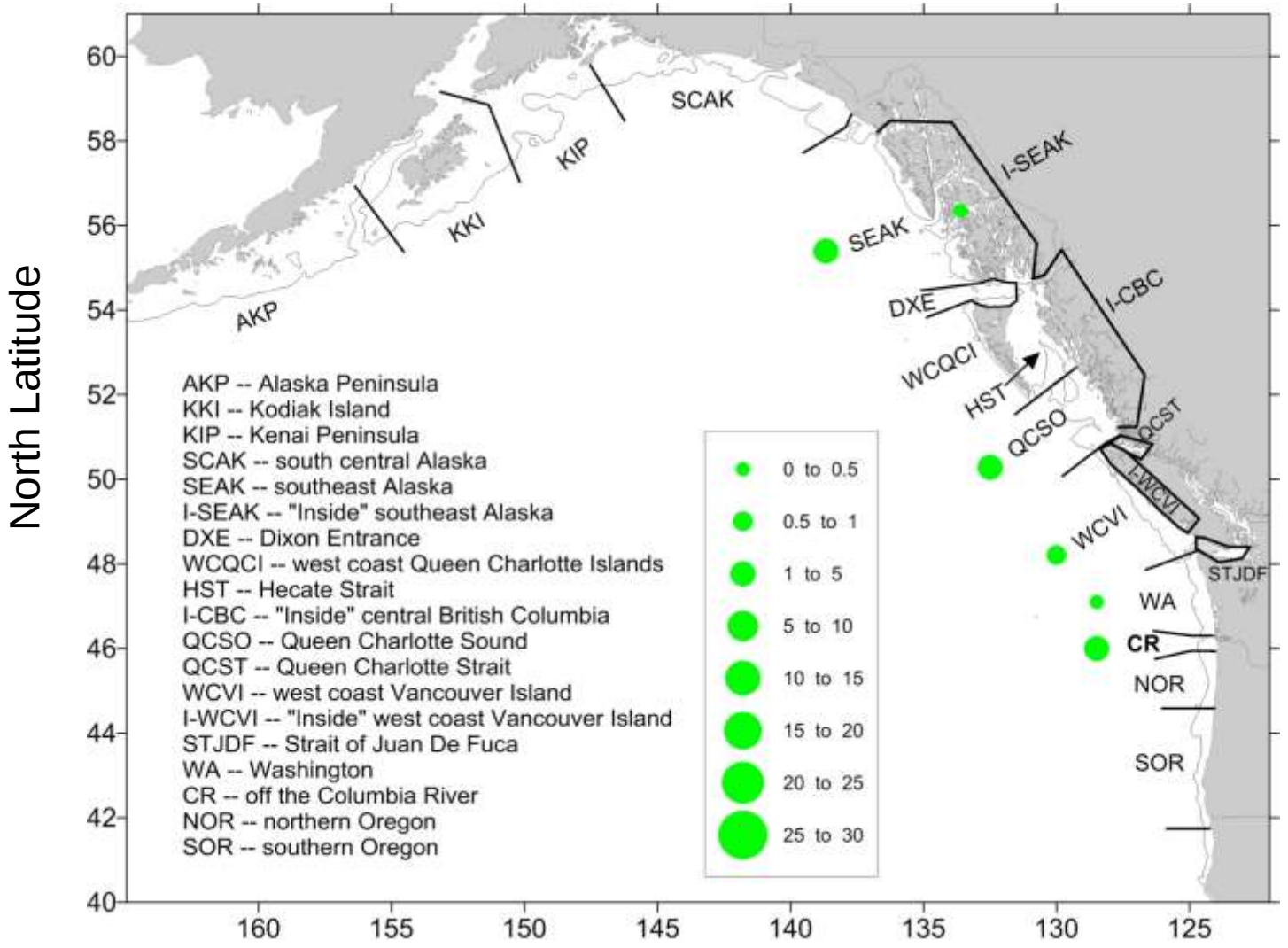


Fish / km^2 by Region

Fisher et al. 2014 TAFS

August - September

Willamette River Spring Yearlings

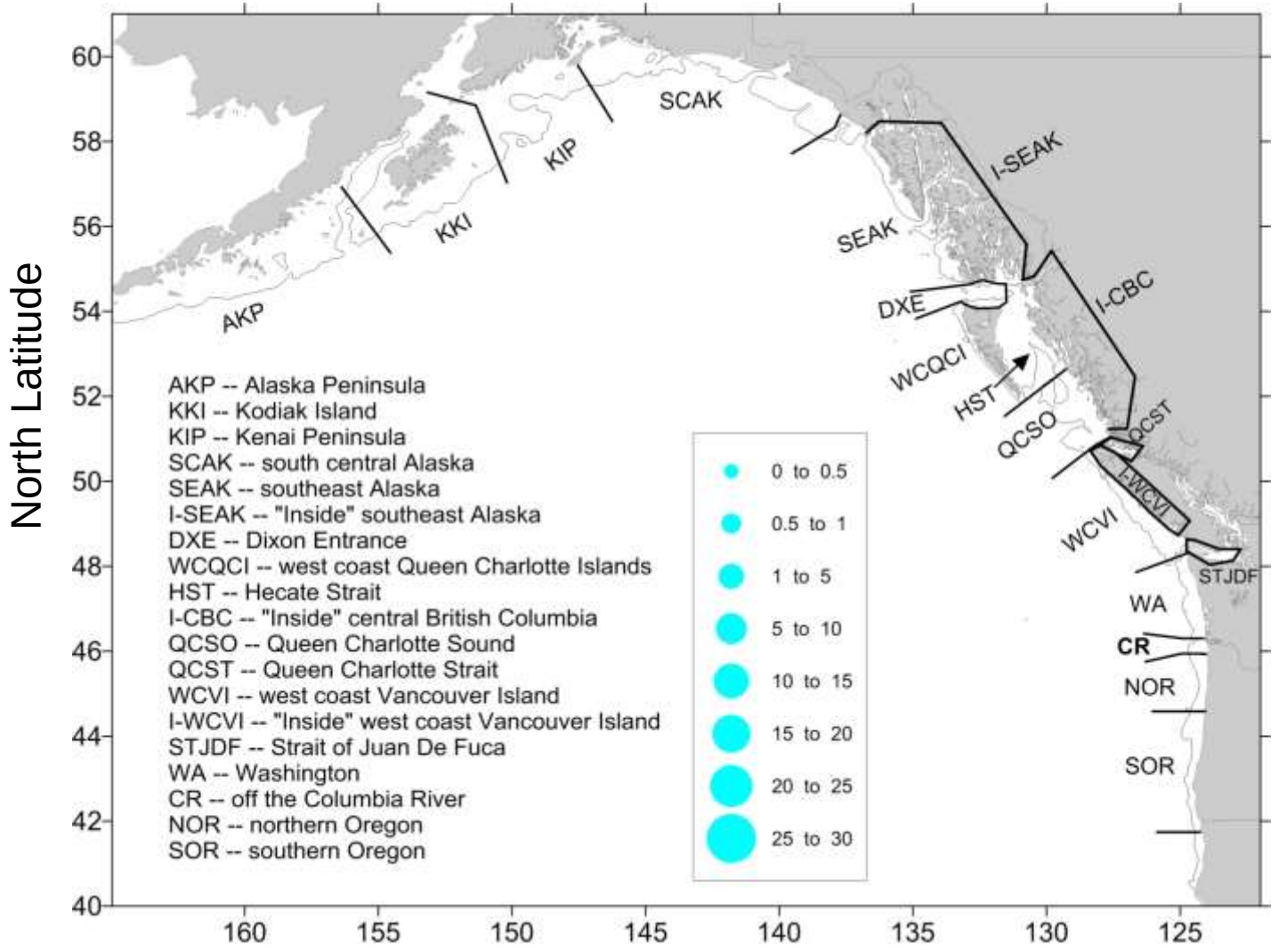


Fish / km^2 by Region

Fisher et al. 2014 TAFS

April - May

Upper Columbia River Summer/Fall Subyearlings

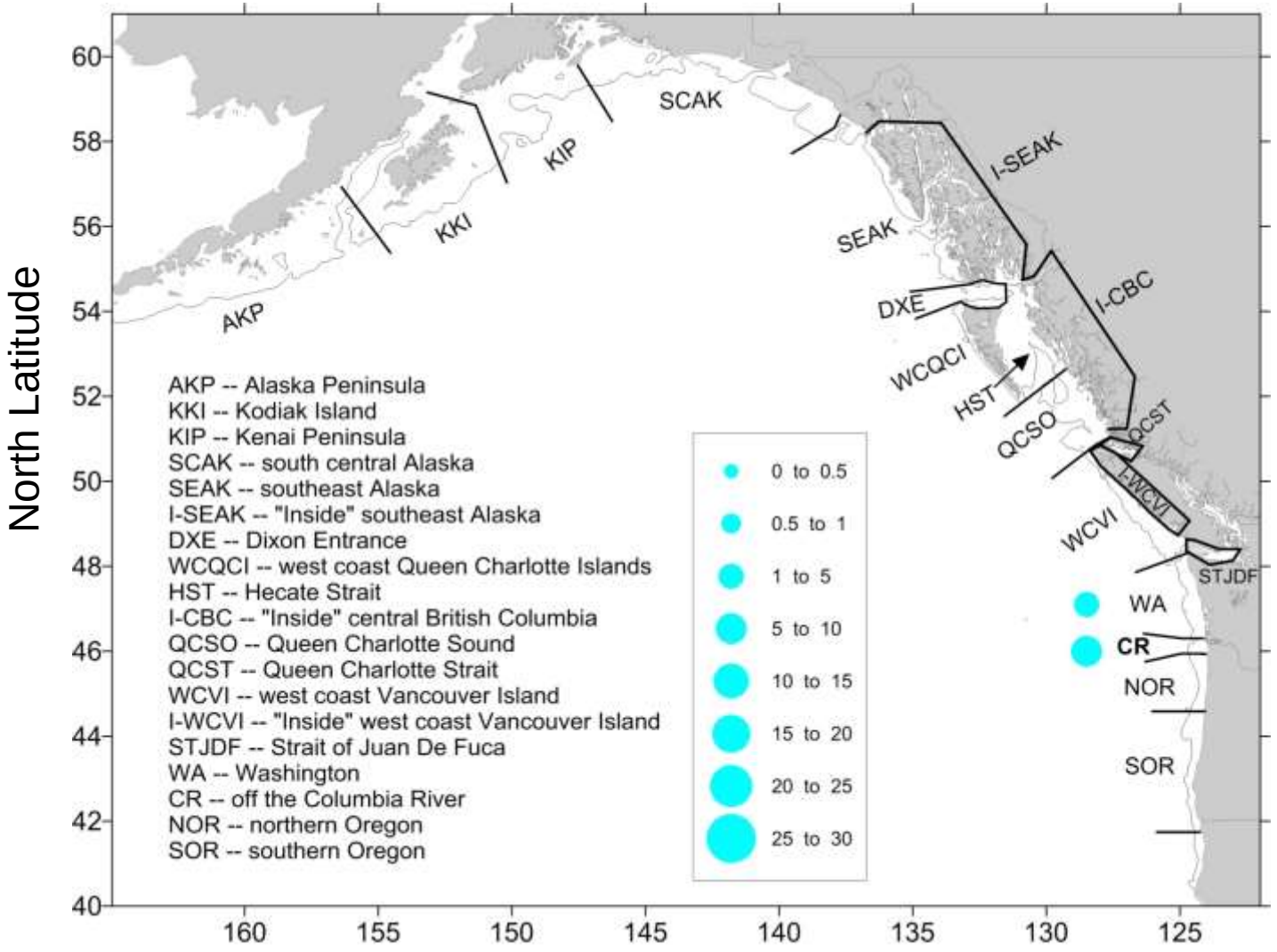


Fish / km^2 by Region

Fisher et al. 2014 TAFS

June - July

Upper Columbia River Summer/Fall Subyearlings



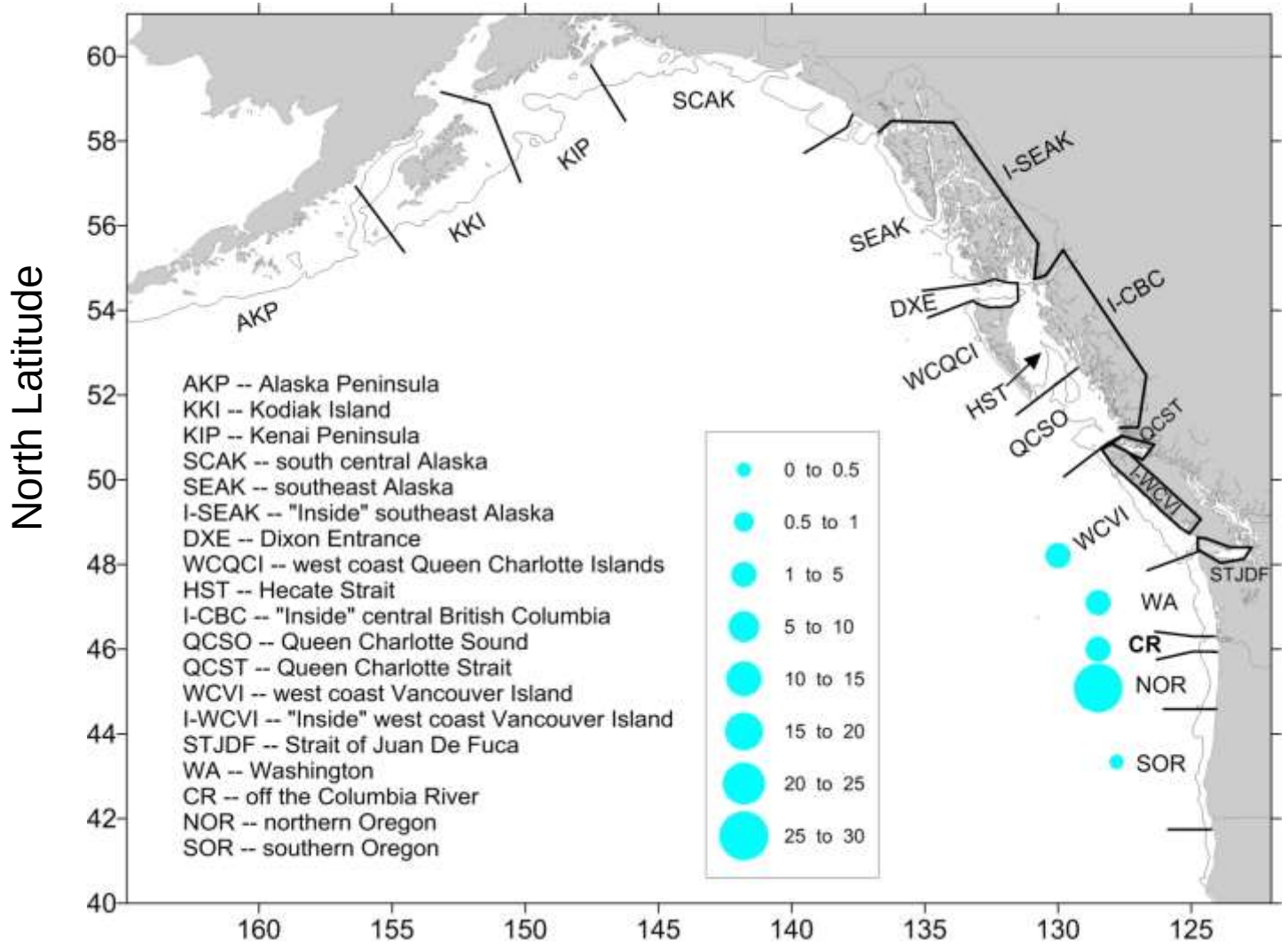
Fish / km^2 by Region

West Longitude

Fisher et al. 2014 TAFS

August - September

Upper Columbia River Summer/Fall Subyearlings

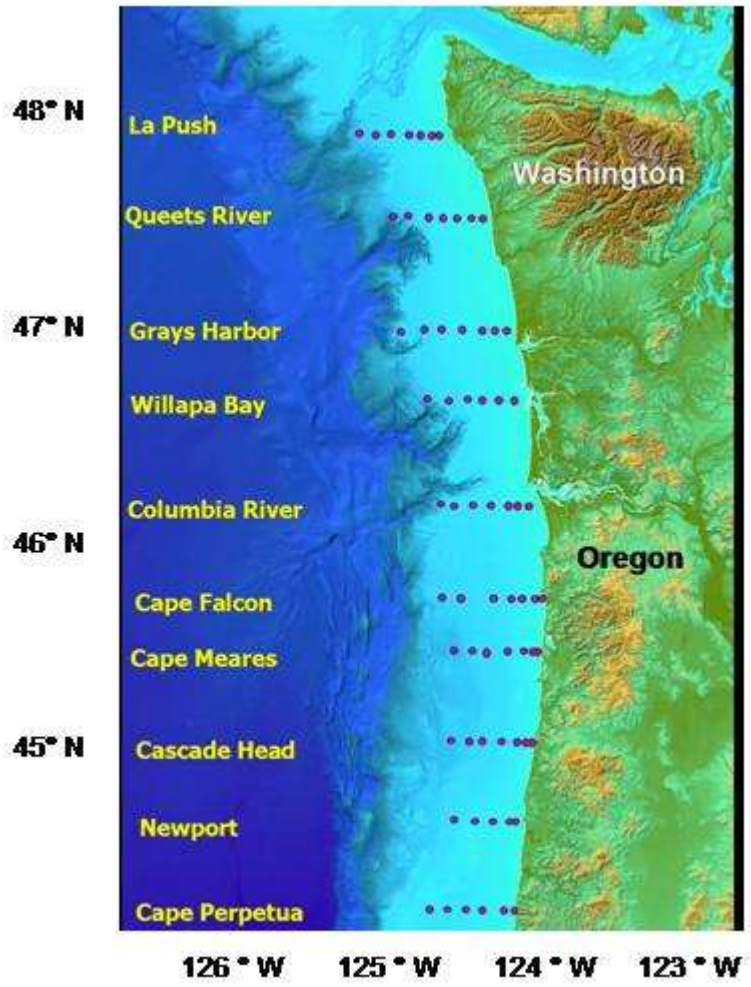


Fish / km^2 by Region

Fisher et al. 2014 TAFS

Ocean Survival of Salmonids Study

Genetic Analysis of Juvenile Chinook Salmon



Surveys

- May, June, & September
- 1998 to 2012 (May from 2006)

Transects

- central Oregon to northern Washington

Stations

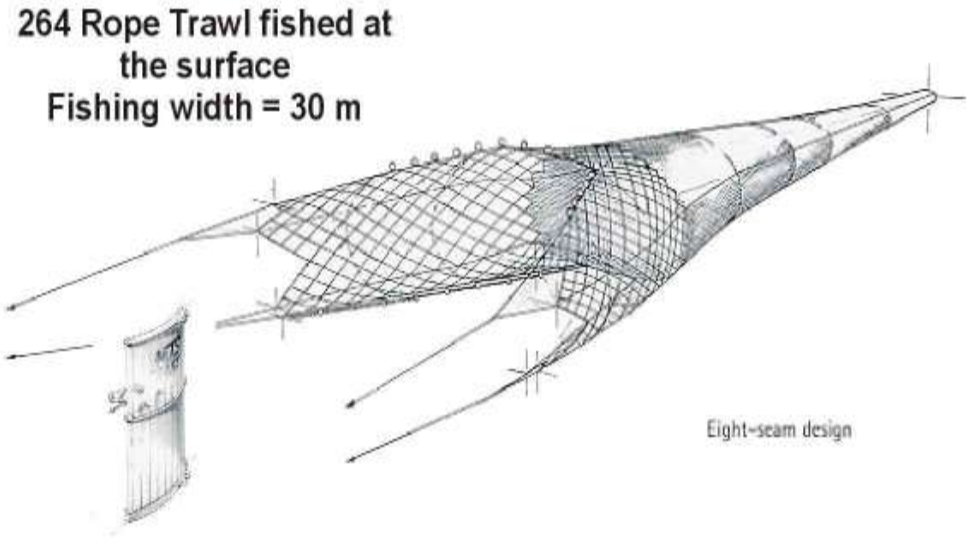
- 50 from 1 to 30 miles offshore

Nekton Sampling Methods

- Sample fish with a NET 264 rope trawl: 20 m high x 30 m wide x 200 m long

- Standard half hour surface (0-20 m) tows

- Fish frozen at sea for later tissue dissection



Genetic and Spatial Statistical Methods

- Genetic Stock Identification used a regional multi-agency microsatellite DNA dataset.

- Stock compositions were used to estimate stock-specific CPUEs at each sampling station.

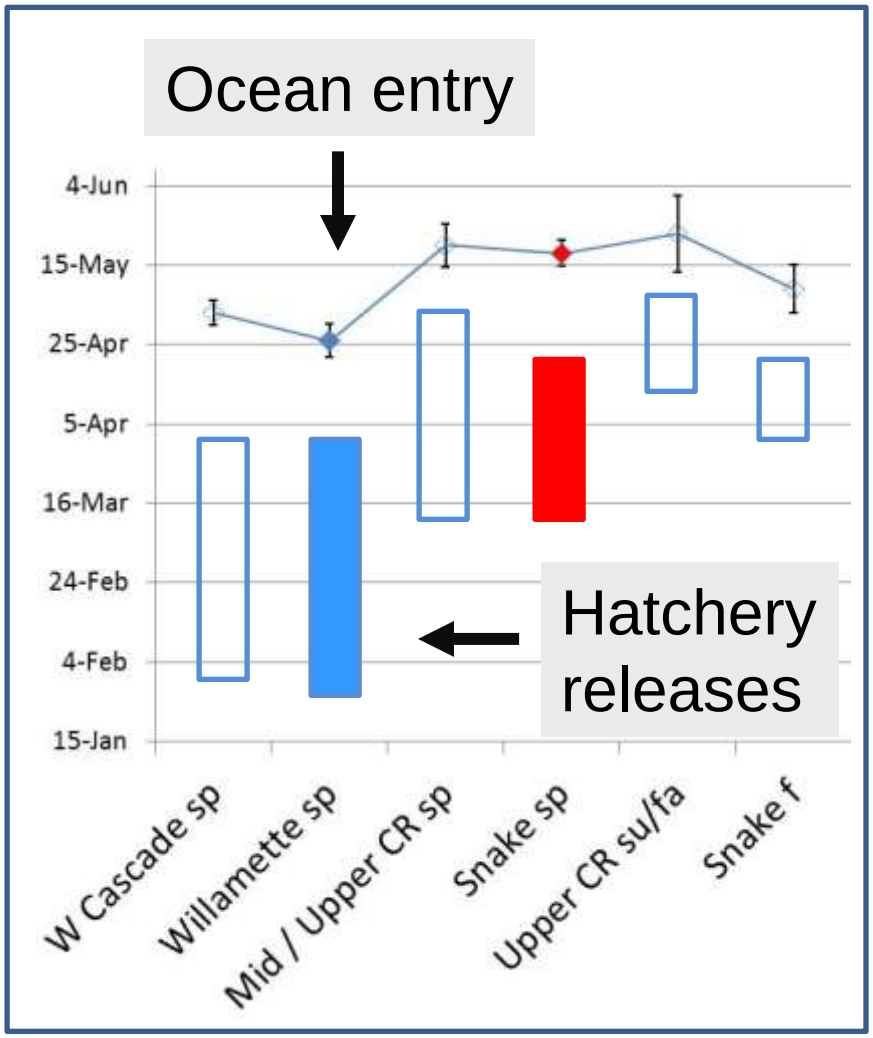
- Mean location (latitude or distance from shore) was calculated by weighting each sample by the CPUE for a given stock.

- Spatial comparisons between stocks:

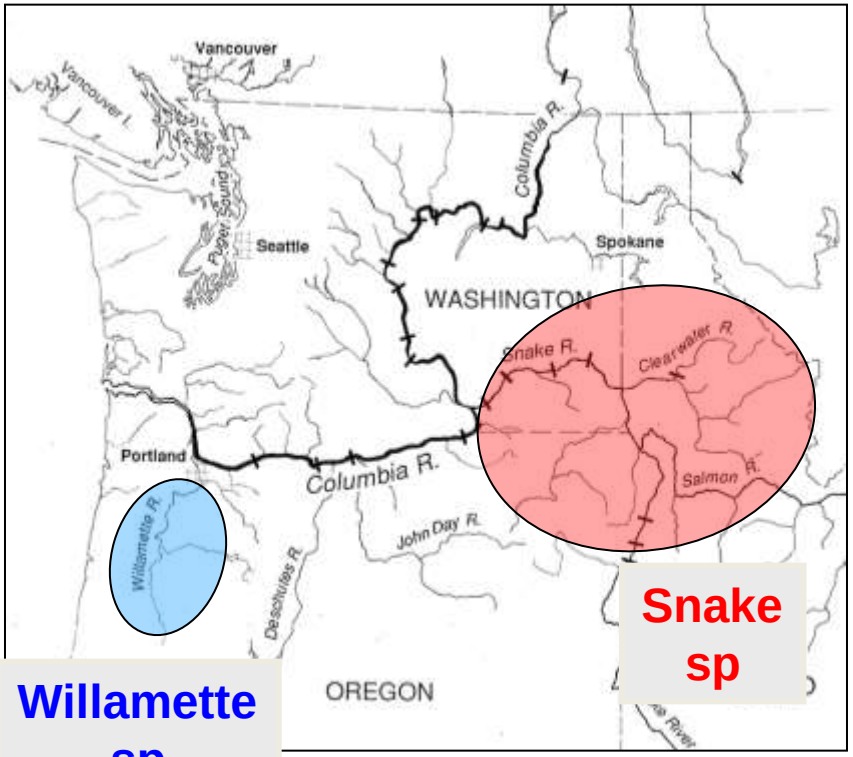
  Differences in weighted mean latitude and distance from shore were calculated.

  Statistical significance was estimated by comparing observed differences to those obtained from permutations of the CPUE data.

Yearling Timing Differences

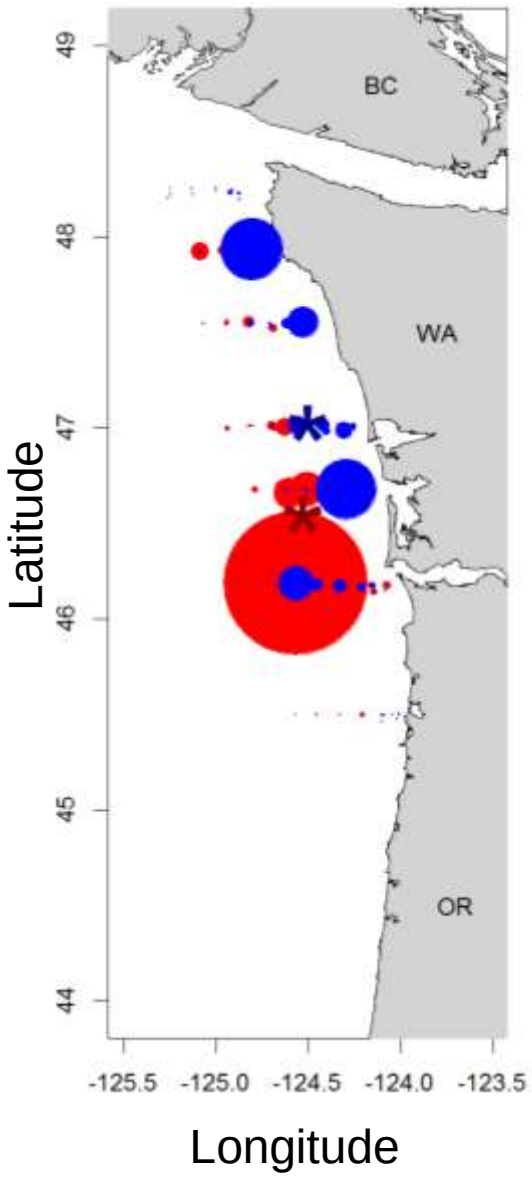


- Willamette spring 3 weeks before Snake spring



Ocean entry data from lower estuary purse seining

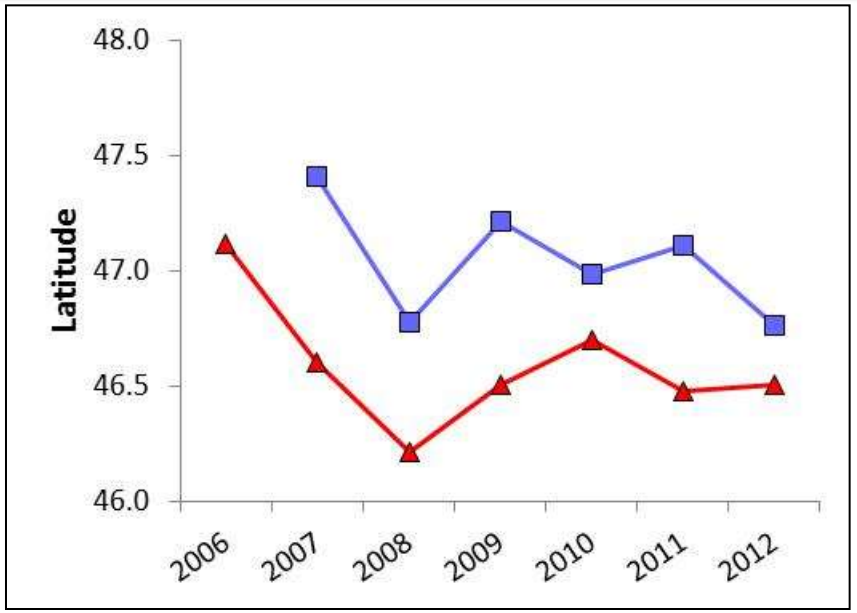
Yearling Distributions in May



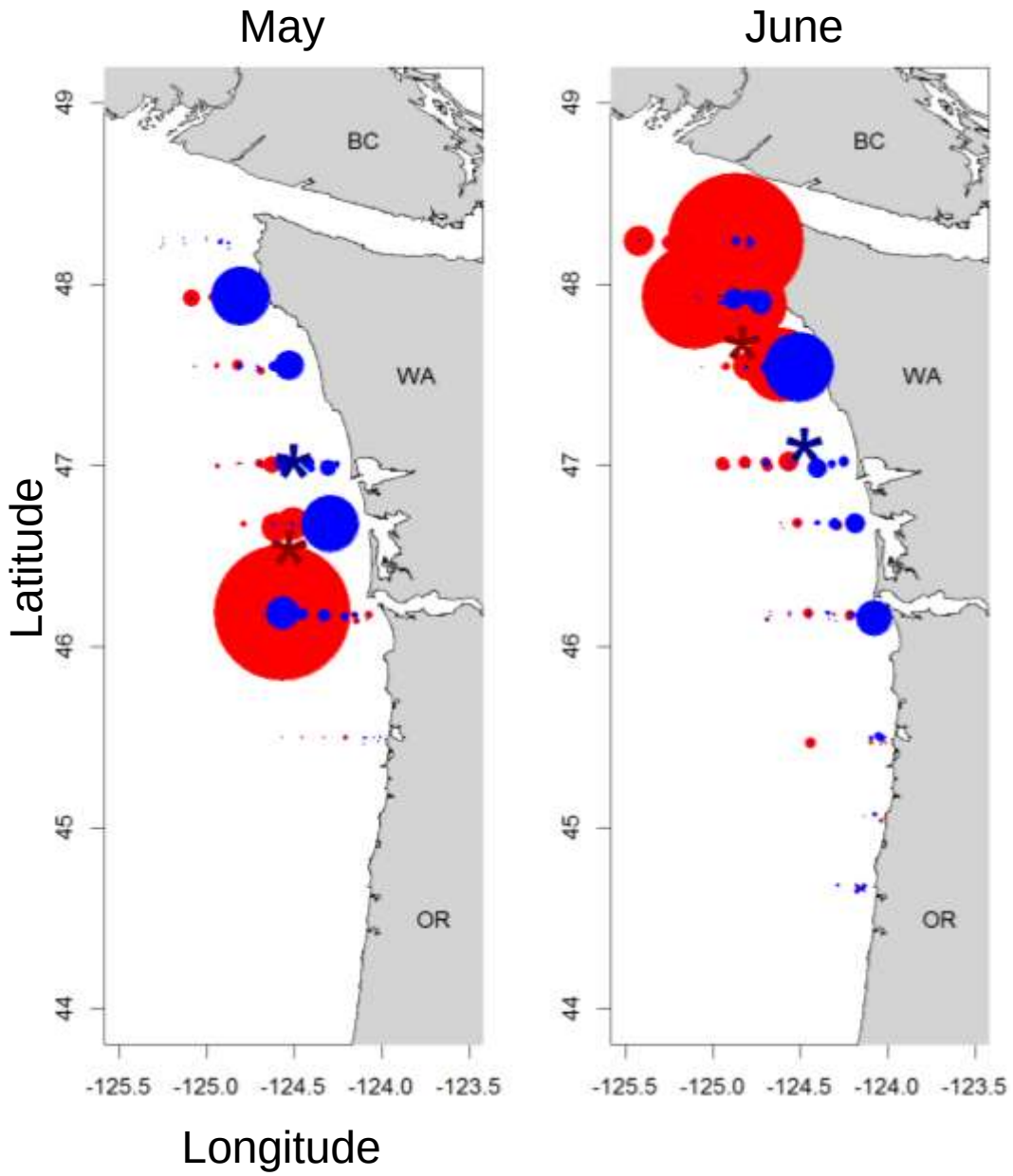
Bubble size indicates CPUE (mean) at each station.

Star indicates center of mass of each stock.

Early emigrating Willamette stock is further north than later Snake stock ($P < 0.01$)



Yearling Distributions



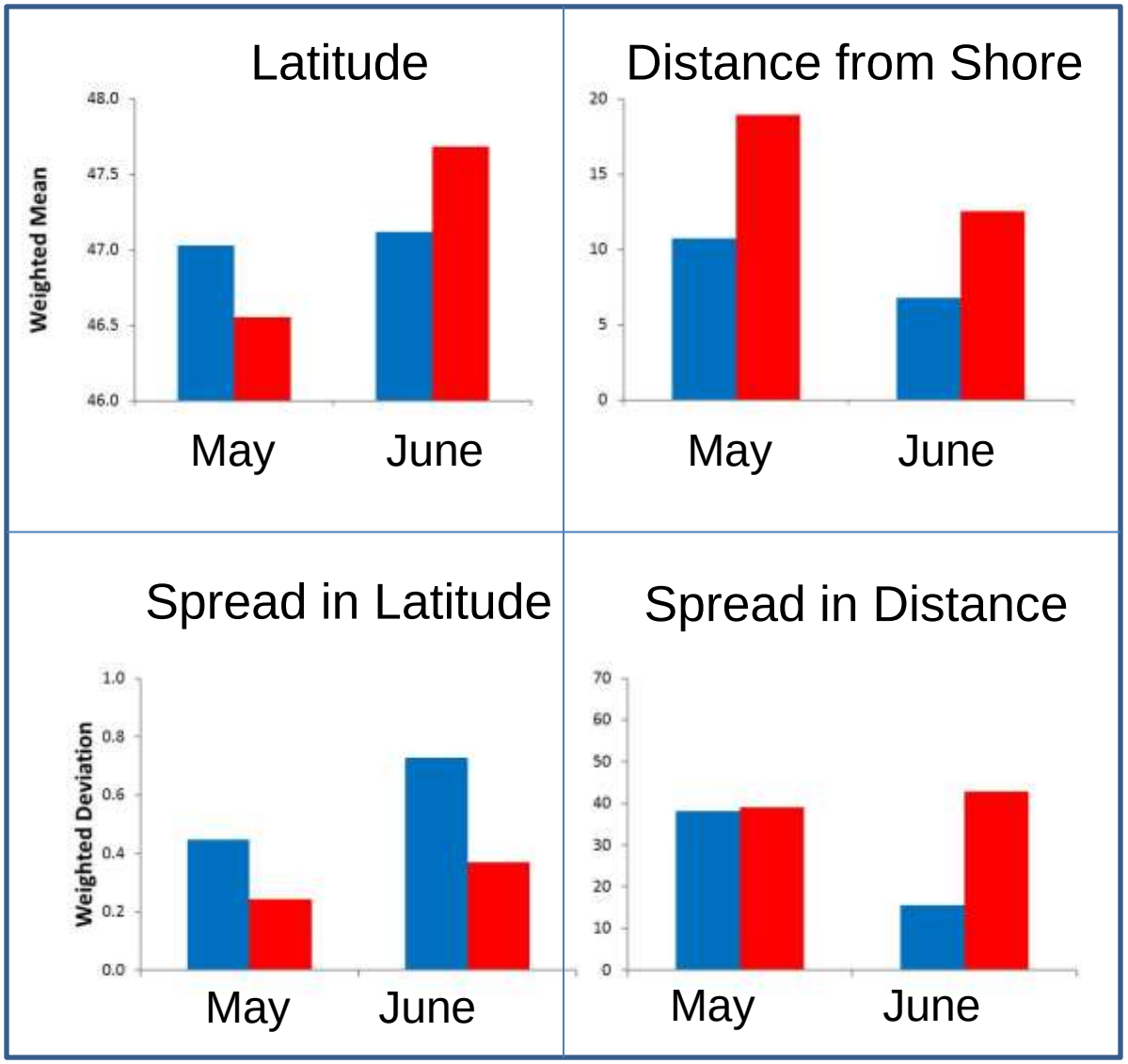
Willamette R spring

Snake R spring

In June

- Snake further north than Willamette ($P < 0.01$)
- June spread in latitude: Willamette > Snake ($P < 0.01$)
- Both stocks closer to shore in June. Willamette closer than Snake ($P < 0.001$) and with less spread in distance ($P < 0.001$).
- Stock-specific differences in latitude and distance are consistent from year to year

Yearling Distributions

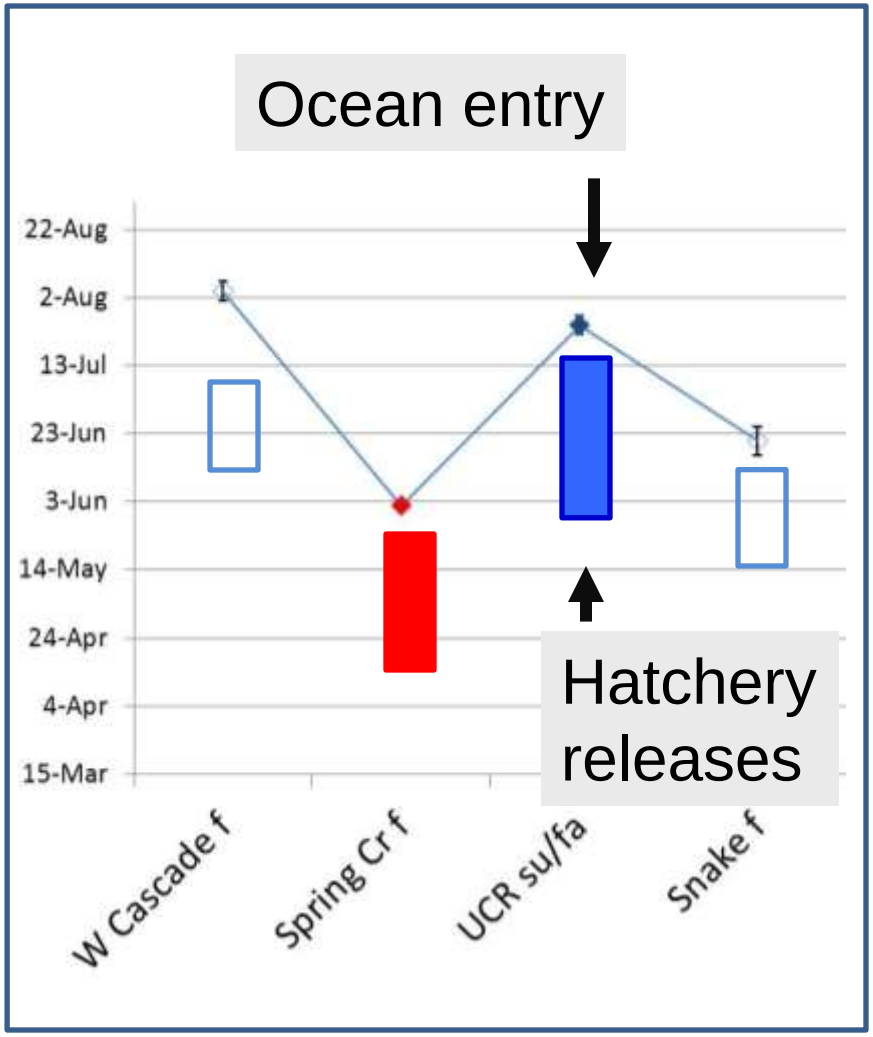


Willamette R spring

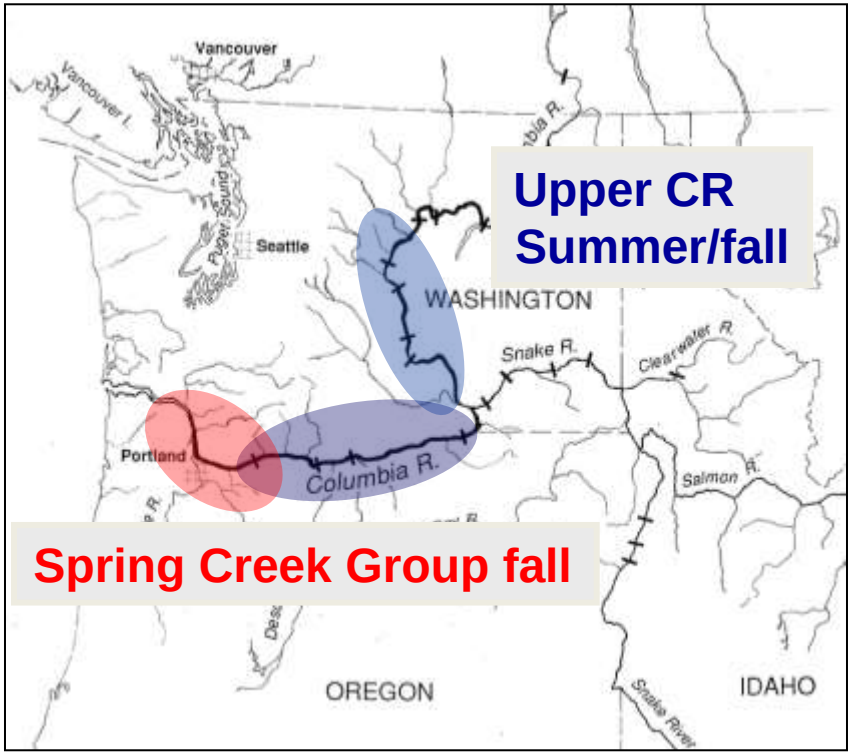
Snake R spring

- In May, Willamette further north than Snake ($P < 0.01$).
- In June, Snake latitude > Willamette ($P < 0.01$)
- June spread in latitude: Willamette > Snake ($P < 0.01$)
- Both stocks closer to shore in June. Willamette closer than Snake ($P < 0.001$) and with less spread in distance ($P < 0.001$).
- May patterns reflect ocean entry timing differences.
- June patterns reflect differences in migration:
  "Rapid, complete northward"
  vs
  "diverse dispersal".

Subyearling Timing Differences

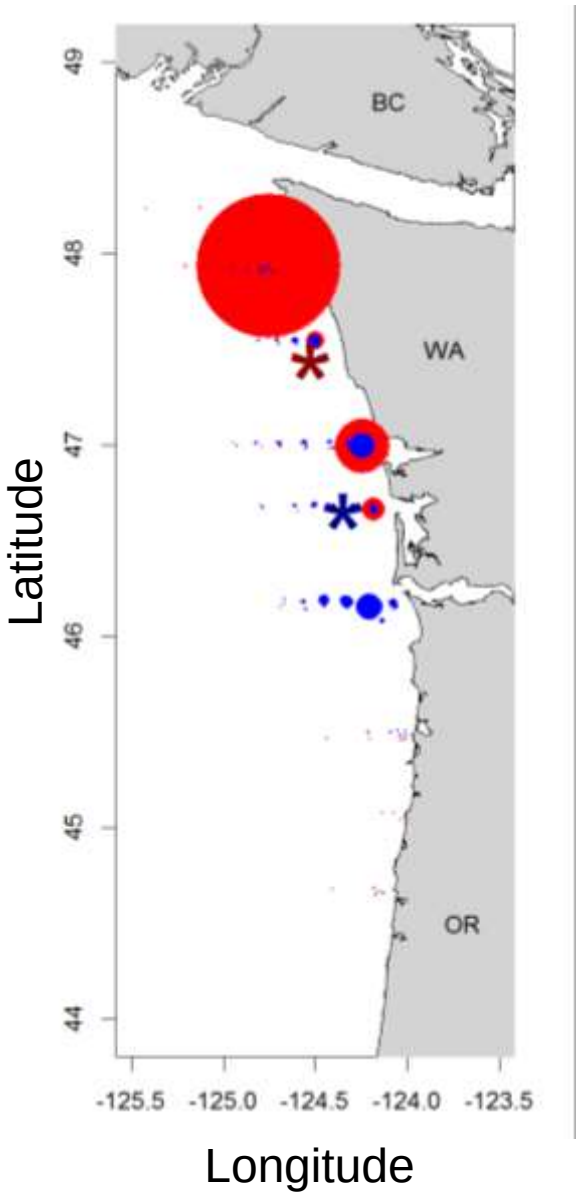


- Spring Creek Group fall 6 weeks before Upper CR summer/fall



Ocean entry data from lower estuary purse seining

Subyearling Distributions in June

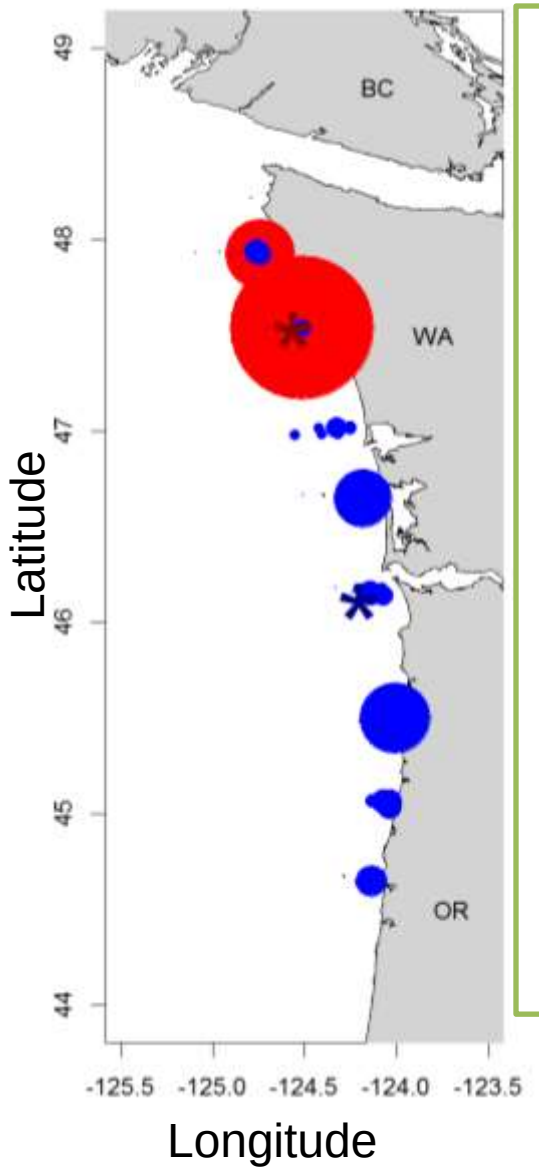


Upper CR summer / fall

Spring Creek Group fall

In June, both stocks are along the WA coast and Spring Creek is further north than Upper CR ($P < 0.01$).

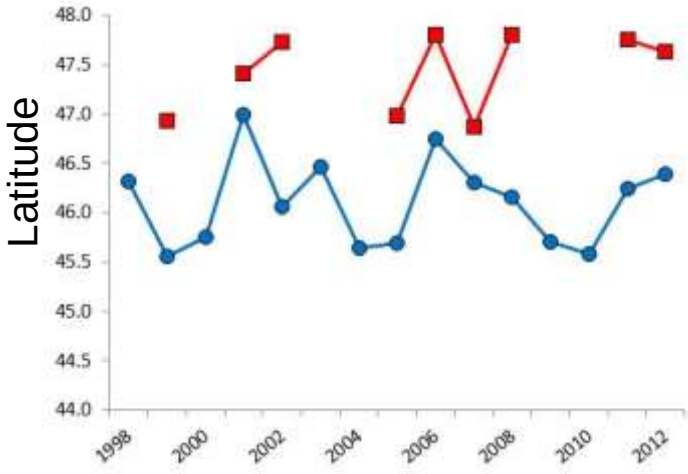
Subyearling Distributions in September



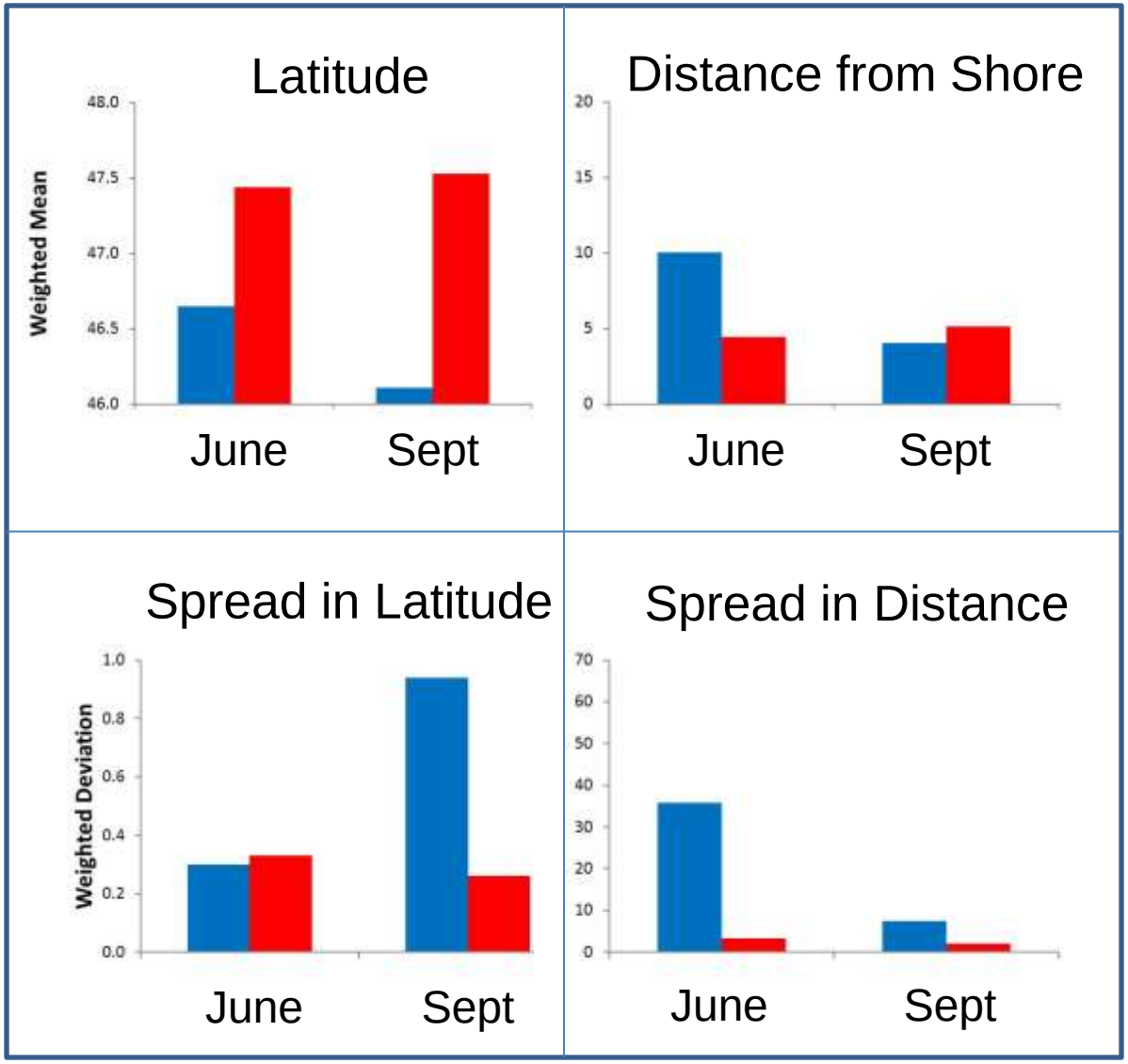
- By September, Upper CR are off both WA and OR. Spring Creek fish do not disperse south of the Columbia.
- During the summer Upper CR subyearlings shift strongly towards shore ($P < 0.001$).
- In September, UCR fish are closer to shore than Spring Creek ($P = 0.05$).
- These 3 patterns are consistent each year.

Upper CR summer / fall

Spring Creek Group fall



Subyearling Distributions



Upper CR summer / fall

Spring Creek Group fall

- In June, both stocks are along the WA coast and Spring Creek is further north than Upper CR ($P < 0.01$).
- By September, Upper CR are off both WA and OR. Spring Creek fish do not disperse south of the Columbia.
- During the summer Upper CR subyearlings shift strongly towards shore ($P < 0.001$).
- These stocks exhibit distinct variations of the "slow dispersing" distribution pattern.

Synthesis

- The marine distributions of Columbia River Chinook salmon differ among stocks that have been previously defined by genetic and life history attributes. The existing conservation and management units for these fish (ESUs) are therefore appropriate for studying juveniles during their early marine phase.

- Different spring run stocks (e.g., Snake and Willamette rivers) have contrasting ocean distributions. Patterns are also very different among fall run stocks (e.g., Upper Columbia "brights" and lower river "tules").

- Not included in this presentation: Marine distributions differ between yearlings and subyearlings from the same genetic stock.

- Marine life history differences are mostly consistent each outmigration year.

- Hatchery practices (timing of release and age at release) influence the timing of ocean entry and initial marine distributions. These patterns likely result in differences among stocks in early ocean growth and survival.

- By autumn, subyearlings from interior basin stocks (Upper CR summer/fall, Snake fall) are abundant in nearshore habitats along the Oregon and Washington coasts. Marine survival studies of these stocks should focus on summer and fall sampling in this region.

Thanks to

The many people who participated in ocean sampling and fish cutting, and otherwise contributed to the success of this study.

Bonneville Power Administration and NOAA for funding