Ecology of Juvenile Salmonids in Tidal Fresh and Estuarine Waters

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Columbia Estuary Research Conference

Astoria, Oregon
29 April 2008

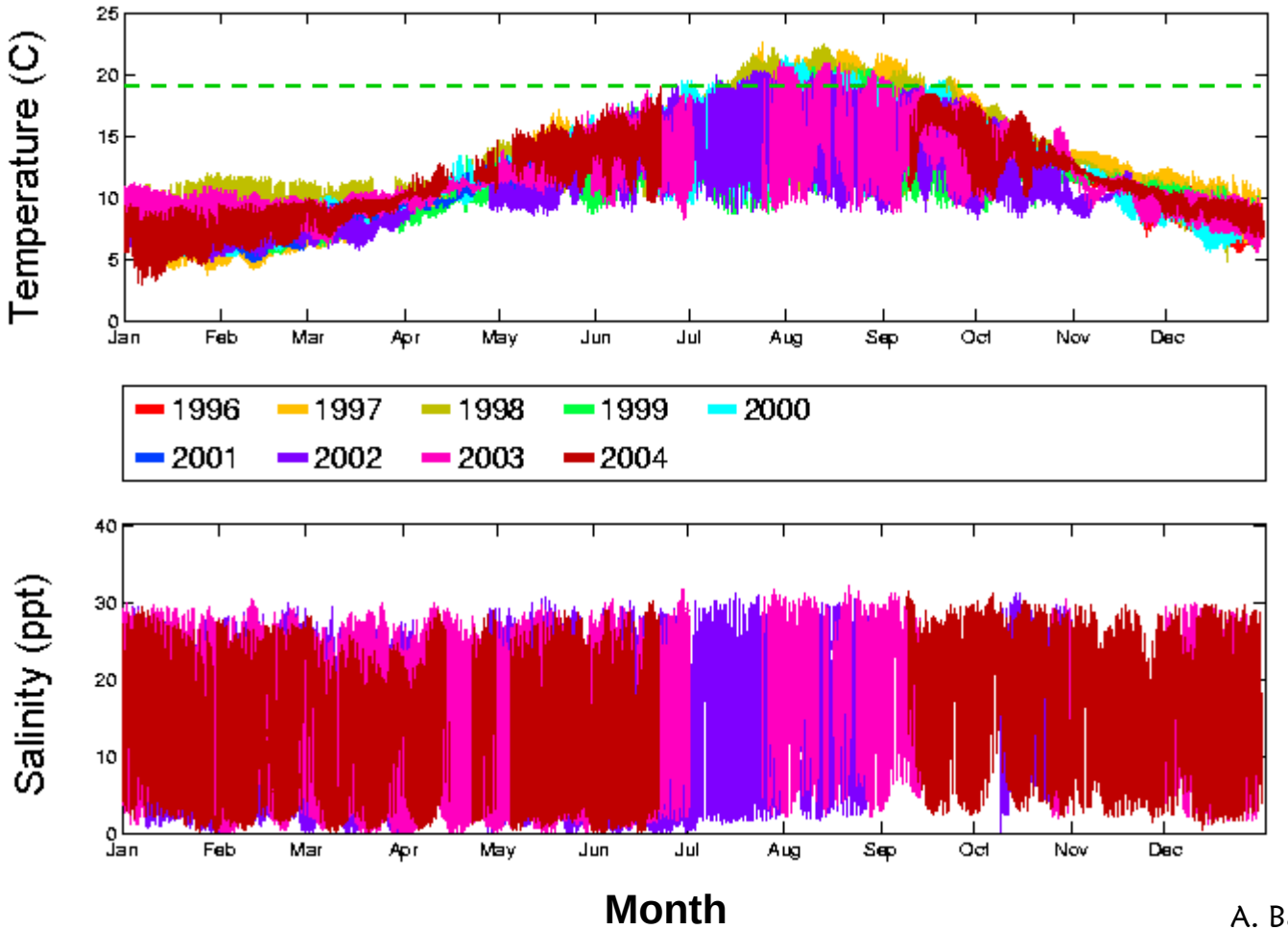
1 NOAA

2 Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

Themes

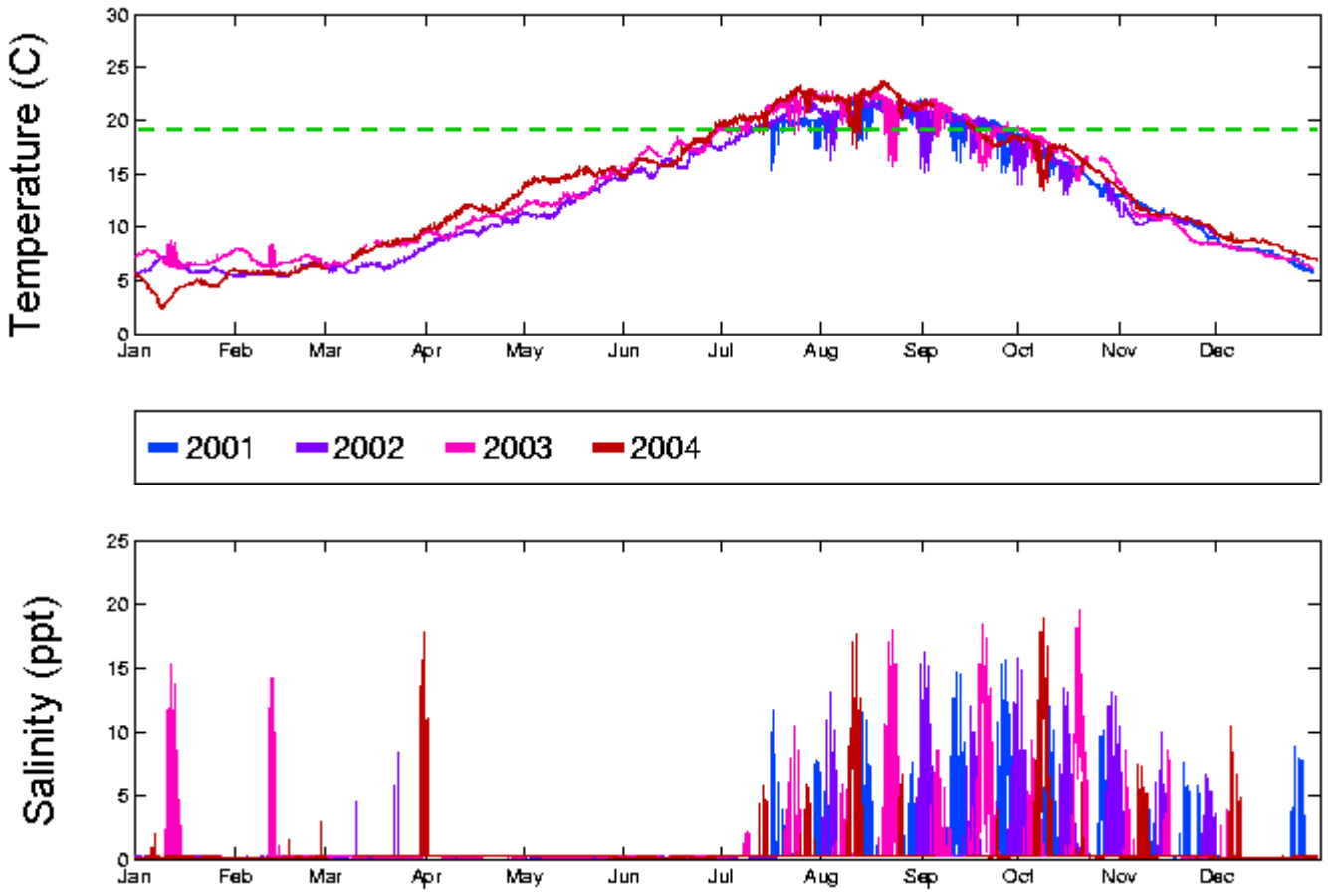
1. Contrast estuarine and tidal freshwater habitat
2. Concentrate on subyearling chum & Chinook salmon
3. Temperature effects

Temperature and salinity patterns: Marine influences



A. Baptista

Ocean temperature influence: lower Cathlamet Bay



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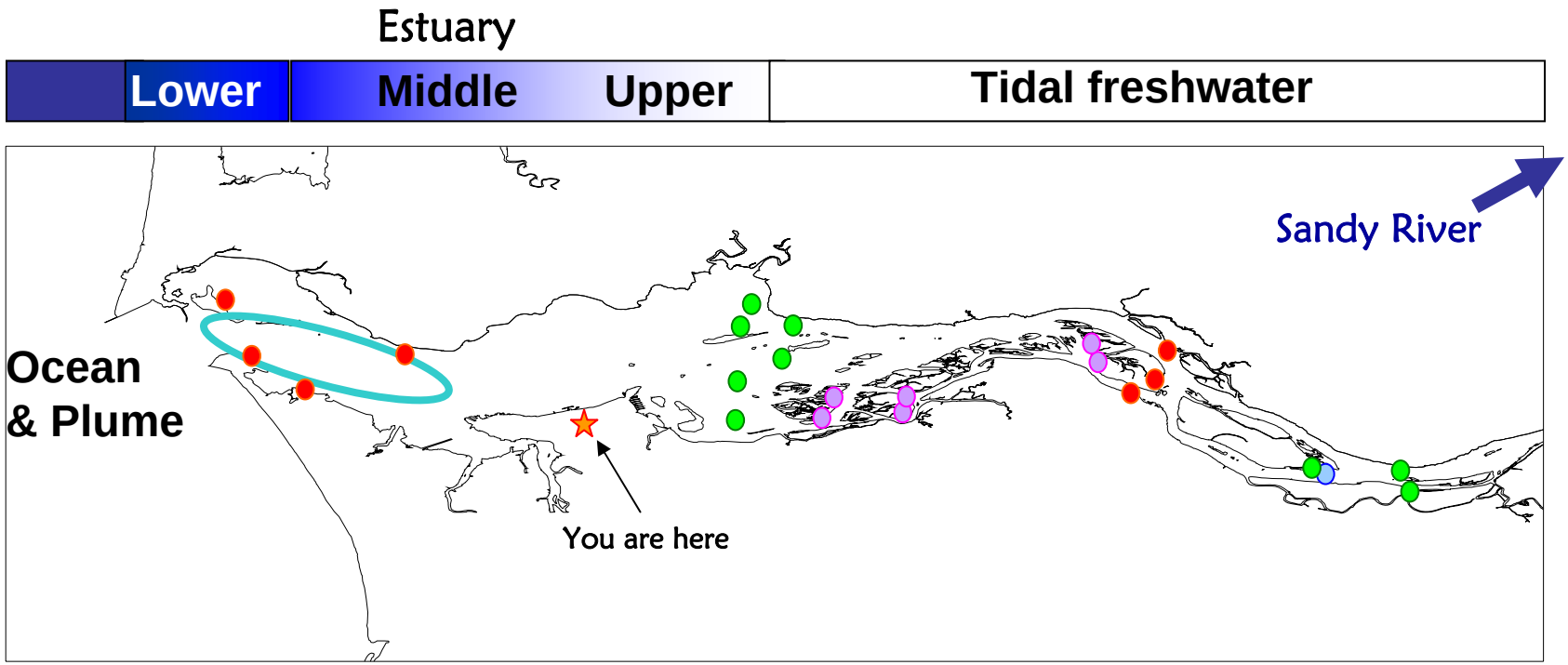
Studies and sample sites 2002-2007

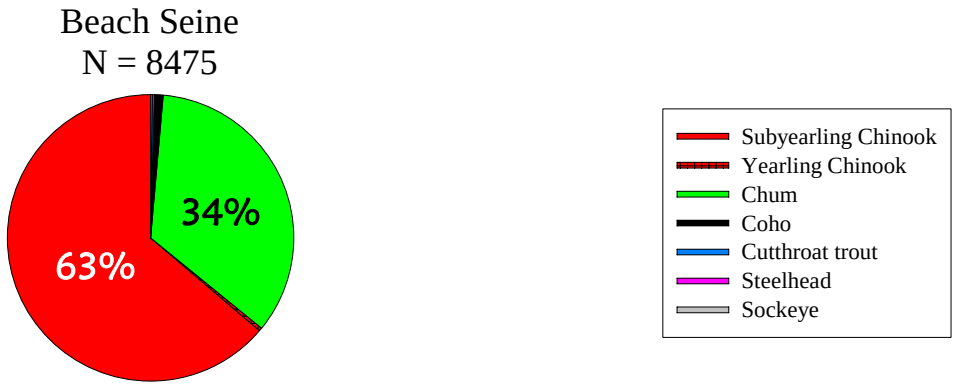


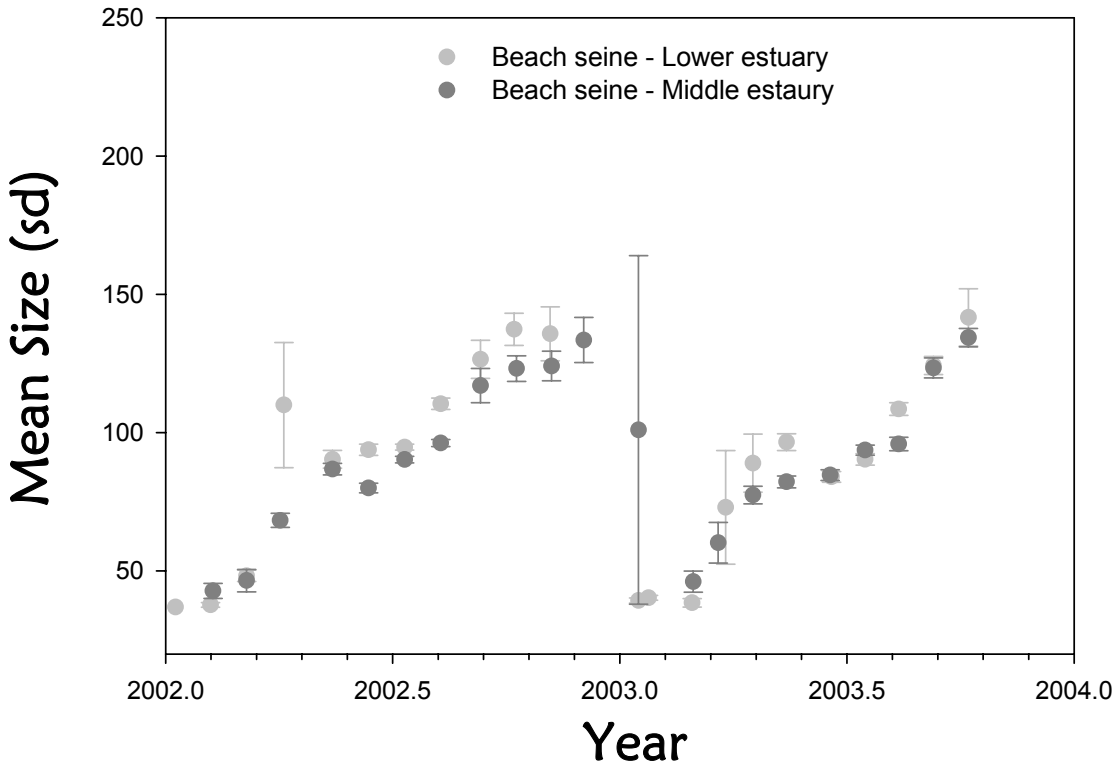
Studies – Spatial and temporal scales

1. Purse seine vrs beach seine
2. Tidal freshwater Sandy River delta
3. Landscape-scale time series monitoring
4. Synoptic spatial-scale “snapshot”
5. Wetland habitat use

Salmon in the Estuary

Proportional catch





Salmon in the Estuary

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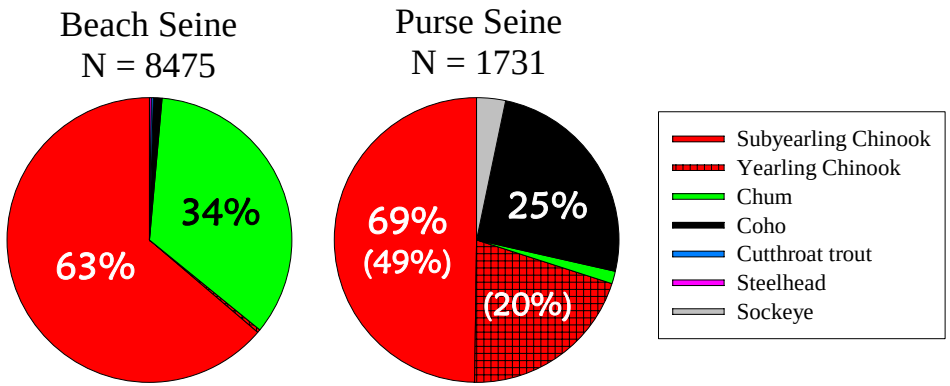
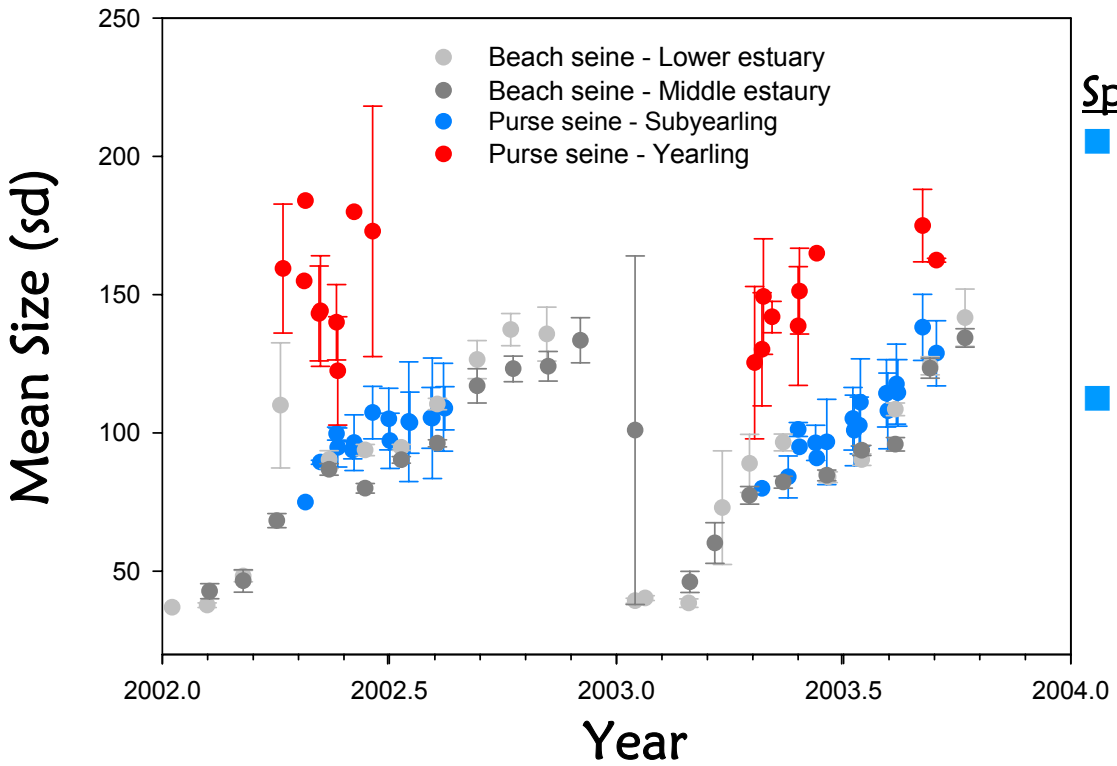




Spatial distribution

- Larger fish in mair stem - move through system relatively quickly
- Smaller fish in shallow water – longer residence

Genetic Analysis May & July 2002-2003

"Stream-type" lineage

Upper Columbia R. sp

Snake R. sp/su

Mid-Columbia R. sp

Upper Willamette R. sp

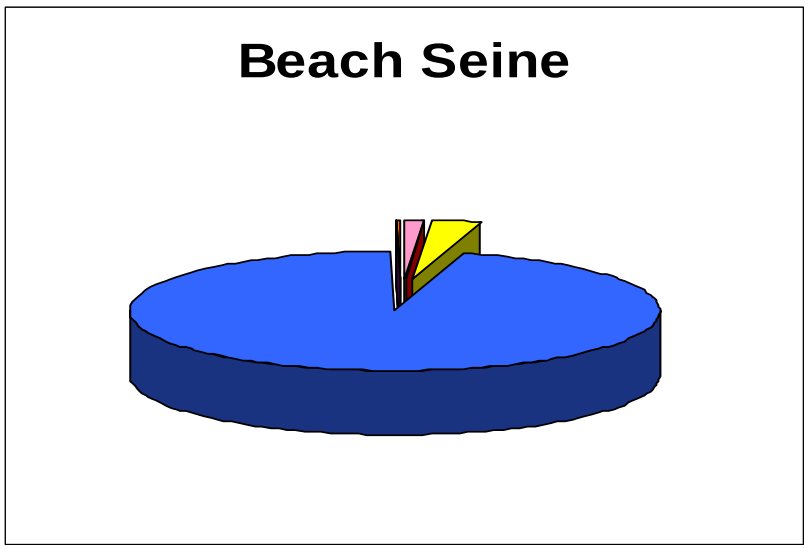
Lower Columbia R.

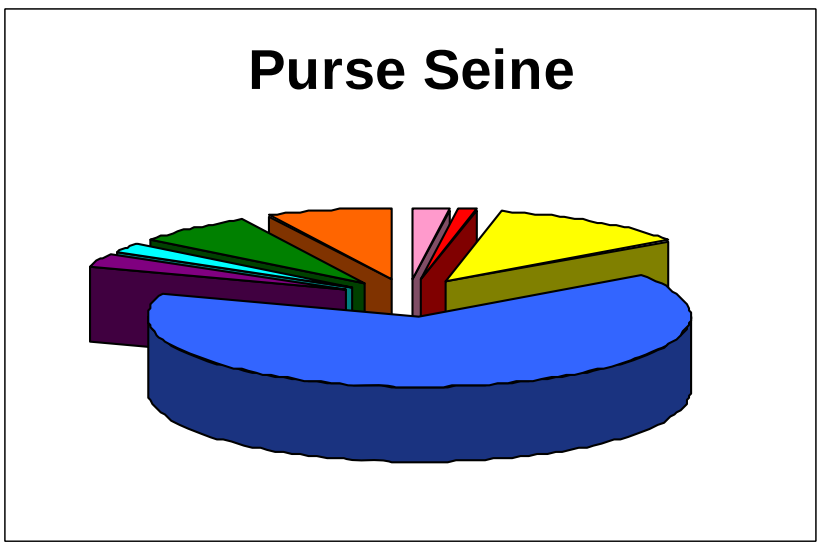
Upper Columbia R. su/fa

Snake R. fa

Deschutes R. su/fa

"Ocean-type" lineage





Method overview

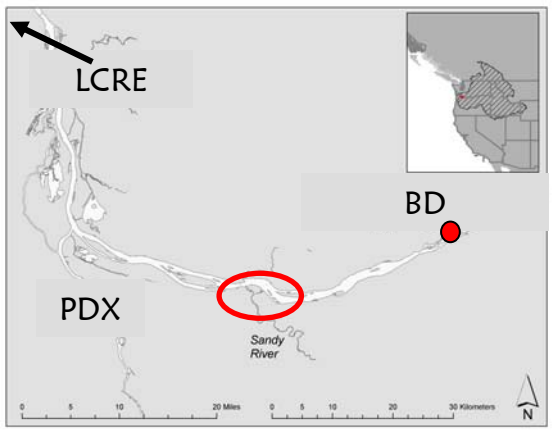
Beach seine sampling: spatial scale

- Shallow water sites
- Counted all fish
- Measured up to 30 individuals / sps
- Measured up to 100 salmon / sps
- Up to 30 salmon retained
  - Genetic (stock identification)
  - Stomach contents (food habits)

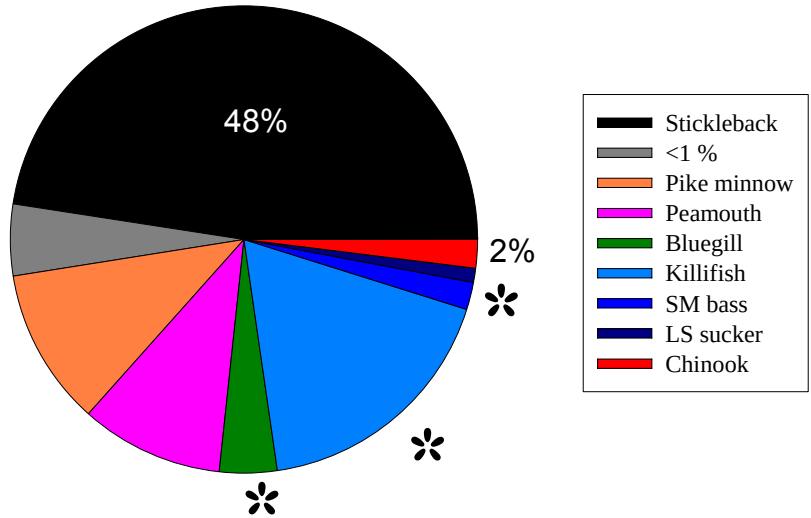
Trap net sampling: Habitat study

- Sampling in tidal channels
- Trap set at high tide and sampled at low tide
- Emergent marsh, scrub-shrub, forested wetlands

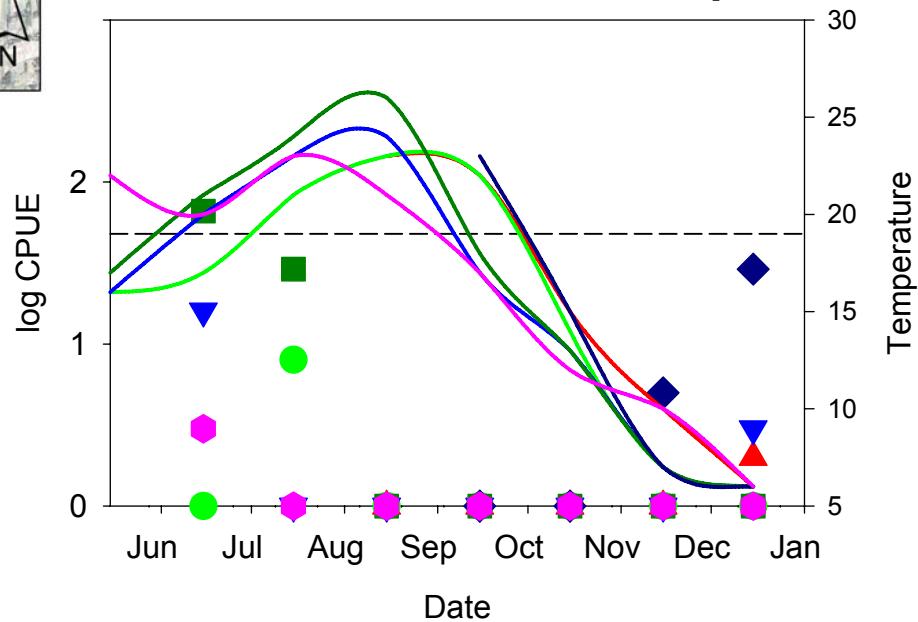
Sandy River delta



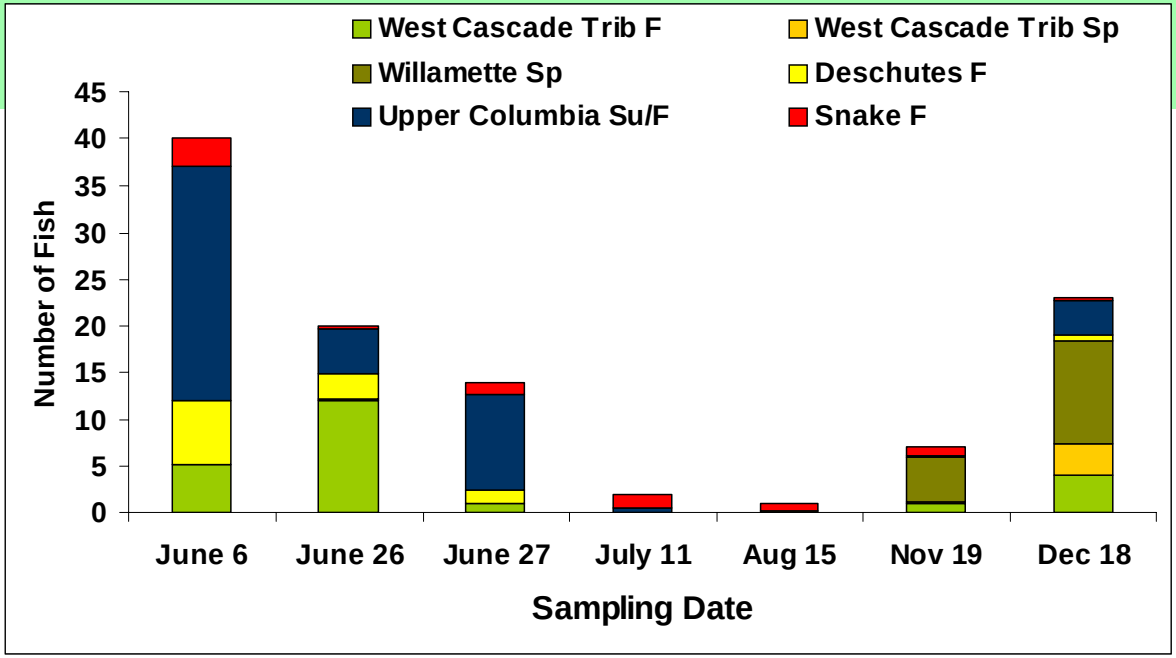
Community structure

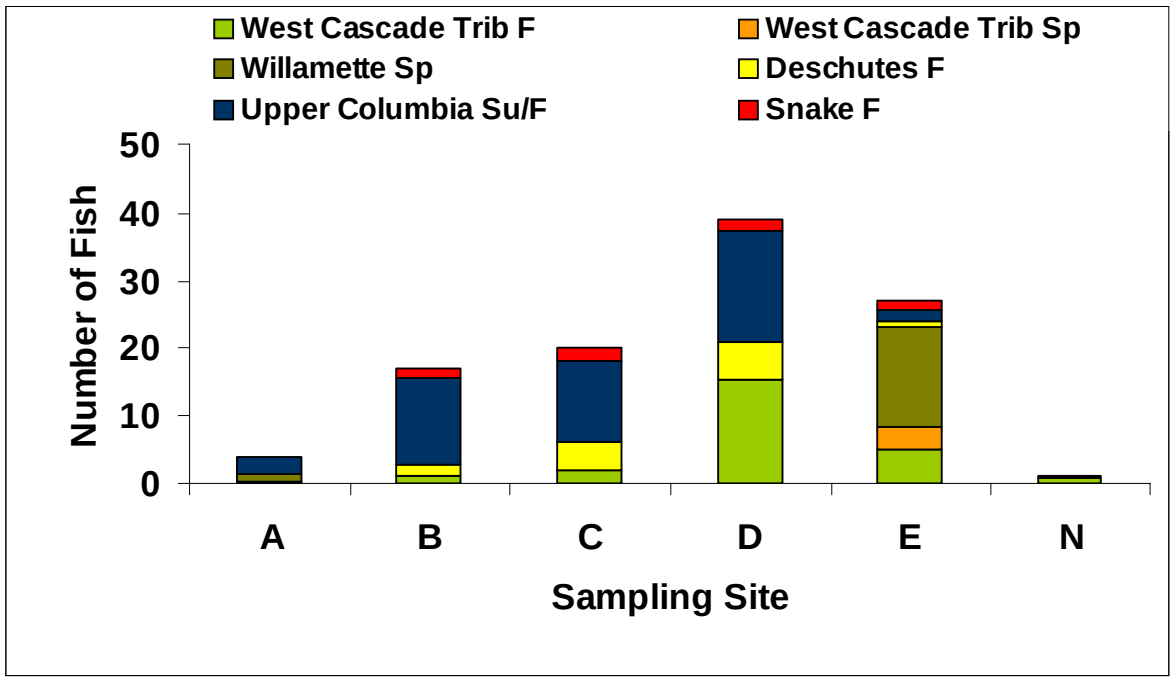


Chinook abundance & Temperature

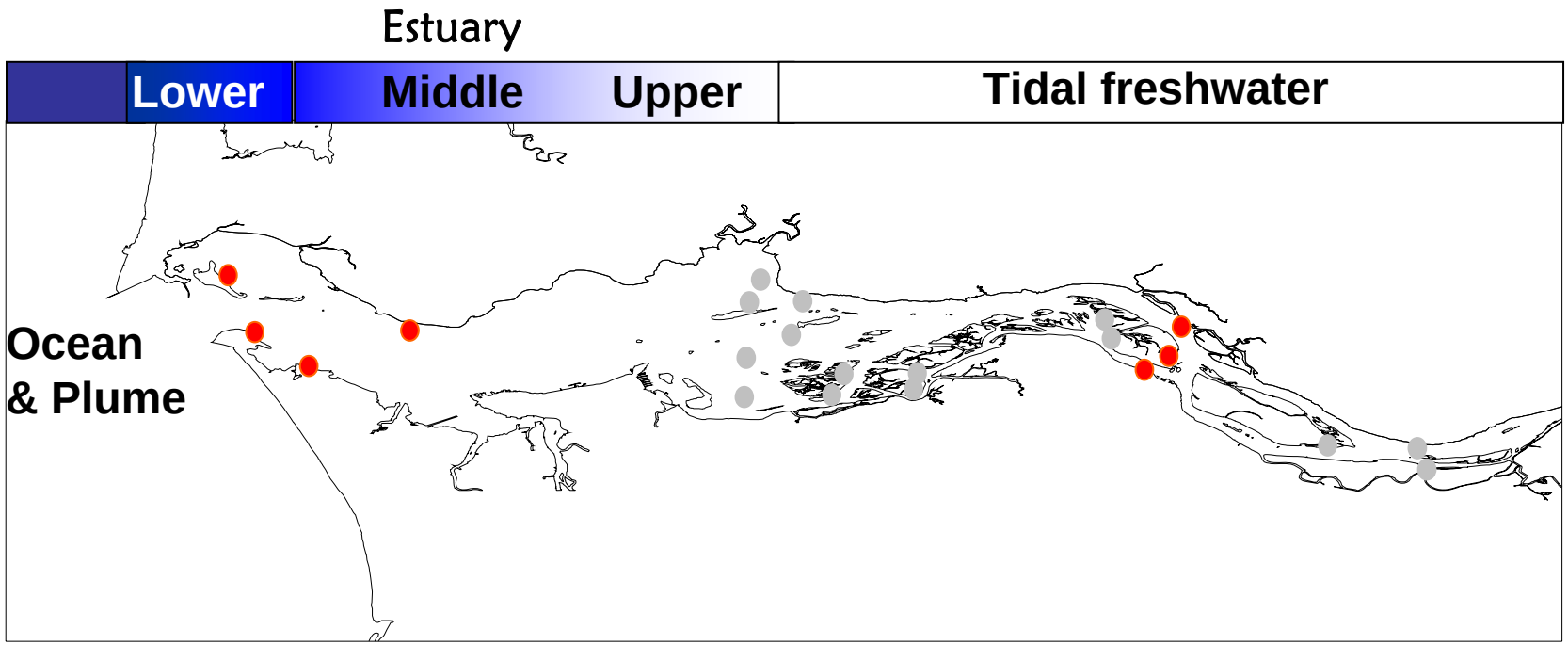


Genetic Analysis





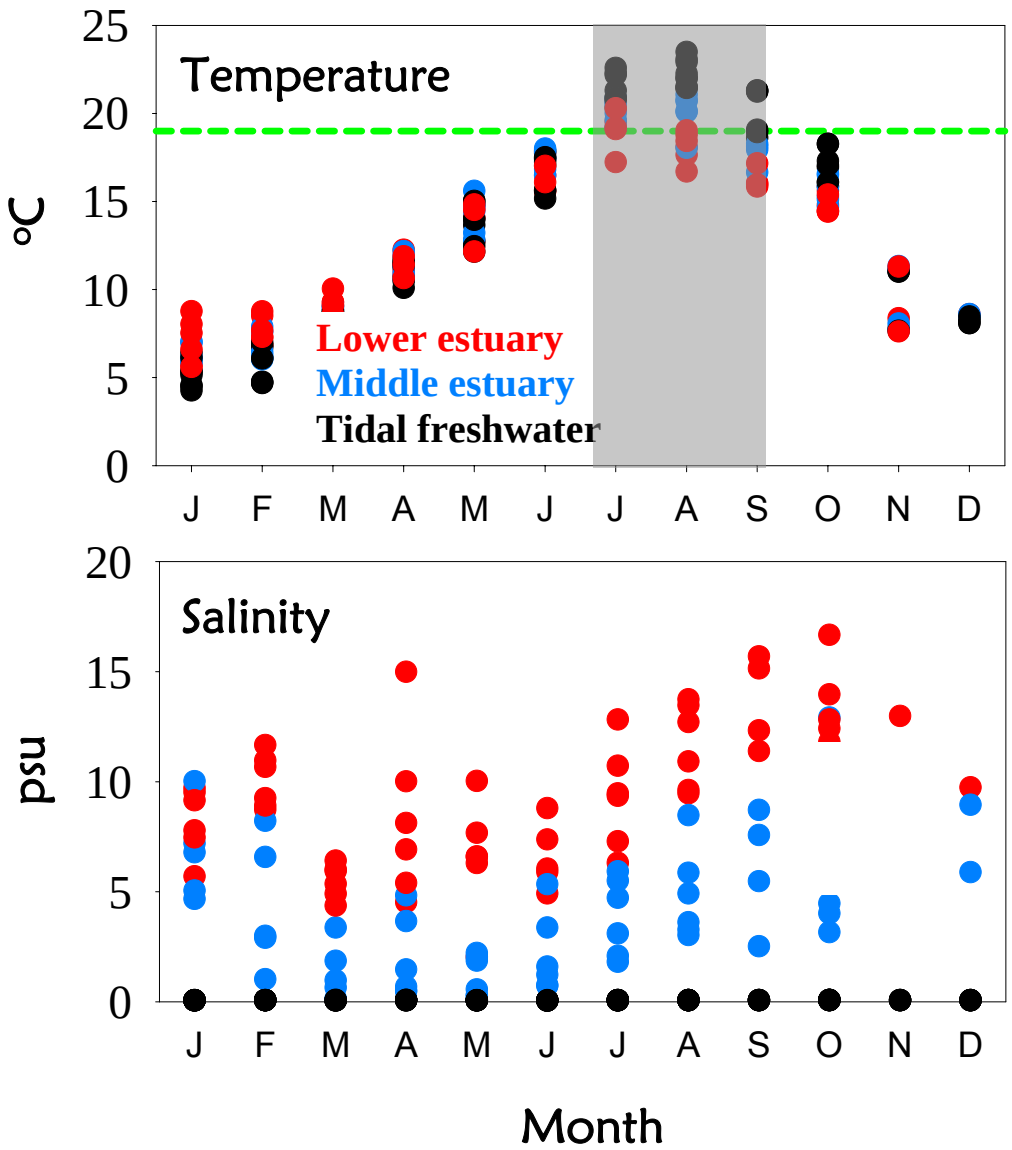
Studies and sample sites



Studies – Spatial and temporal scales

1. Purse seine vrs beach seine
2. Tidal freshwater Sandy River delta
3. **Landscape-scale time series monitoring**
4. Synoptic spatial-scale “snapshot”
5. Wetland habitat use

Monthly water parameters measured during beach seining



Temperature

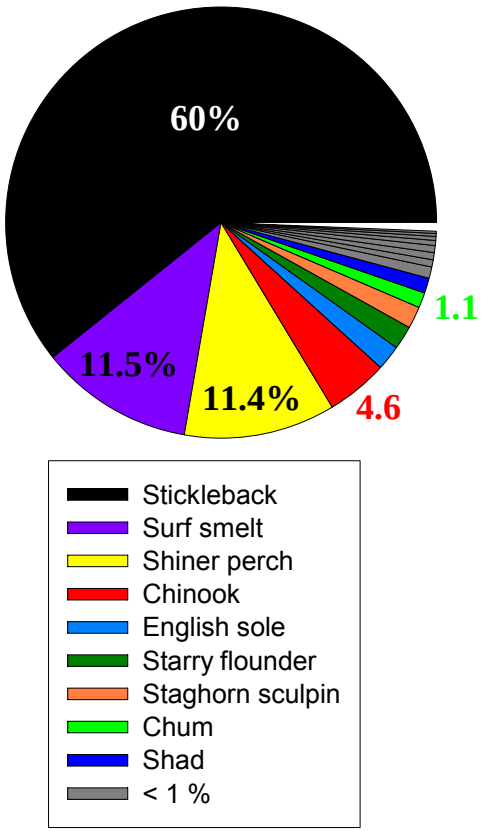
- Exceeds reference Jul-Sep
- TFW > estuary

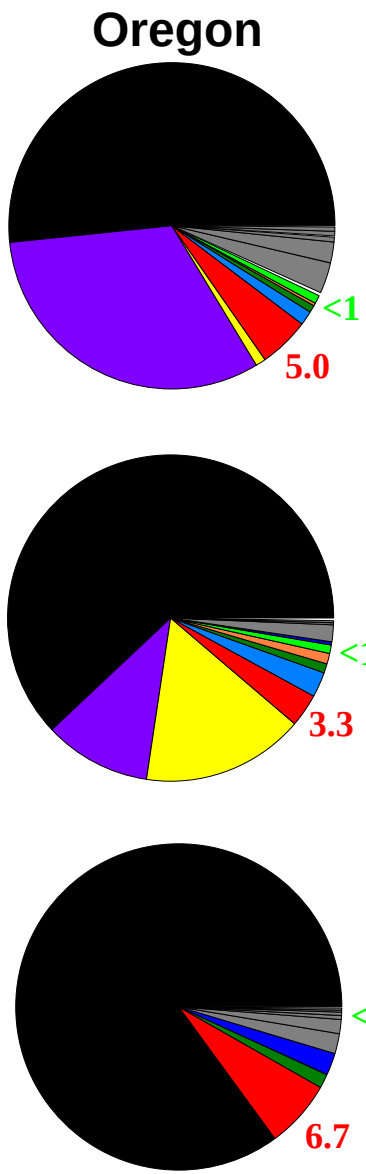
Salinity

- Measurable salinity during all samples in estuary

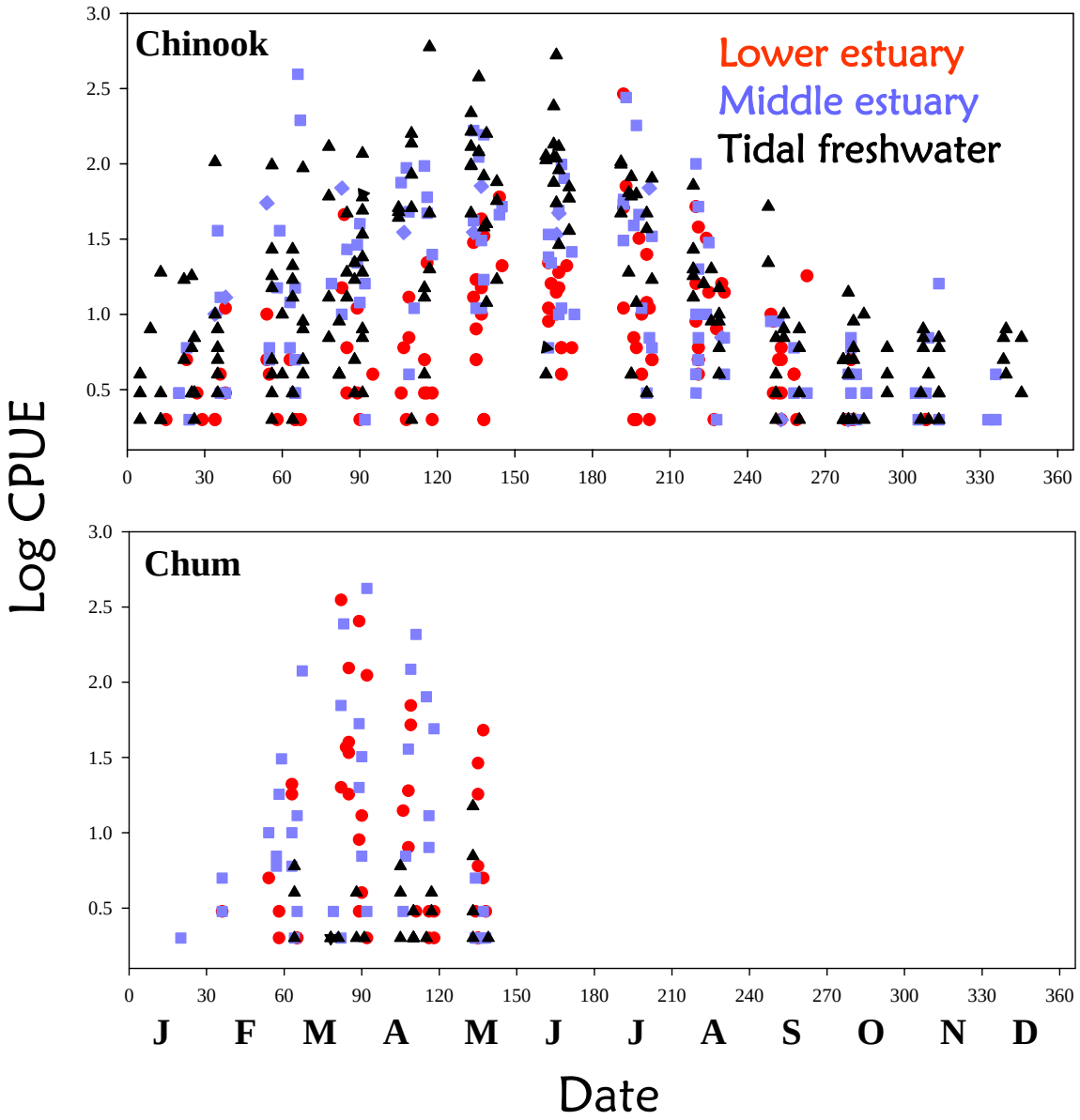
Fish community structure at estuarine beach seine sites 2002-2007

- Spatial variation along salinity gradient
- **Chinook Salmon 2.4-5.0% of catch**
- **Chum Salmon <1-5% of catch**
- **Chum more abundant on Washington side**





Temporal pattern of salmon migration 2002-2007



Chinook

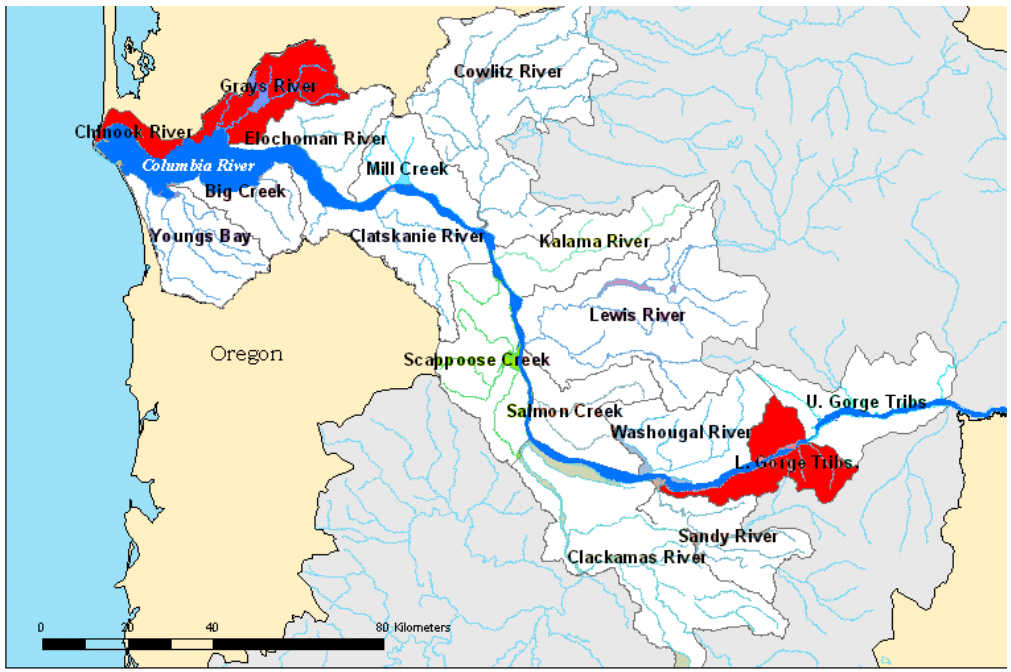
- Broad abundance Feb-Aug
- Year-round distribution
- CPUE tends to be higher in TFW than estuary

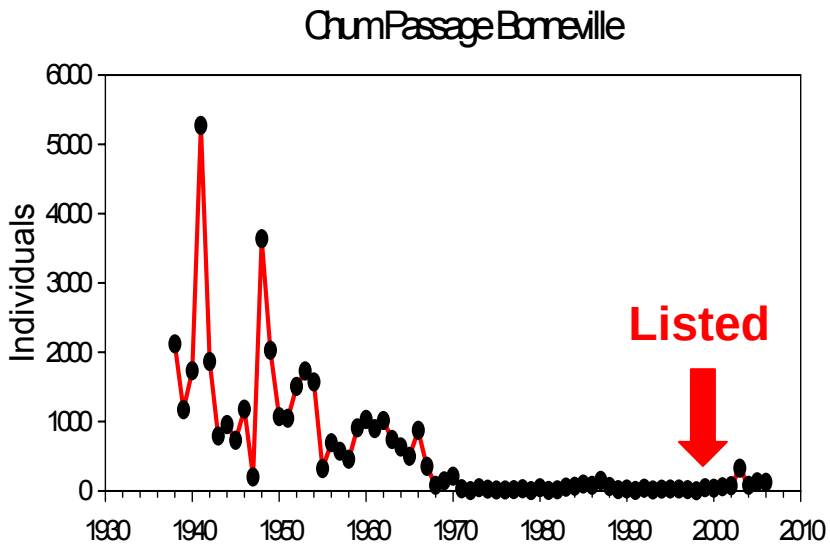
Chum

- Narrow peak Mar-Apr
- Absent > May
- Few chum in TFW

Distribution of chum spawning grounds

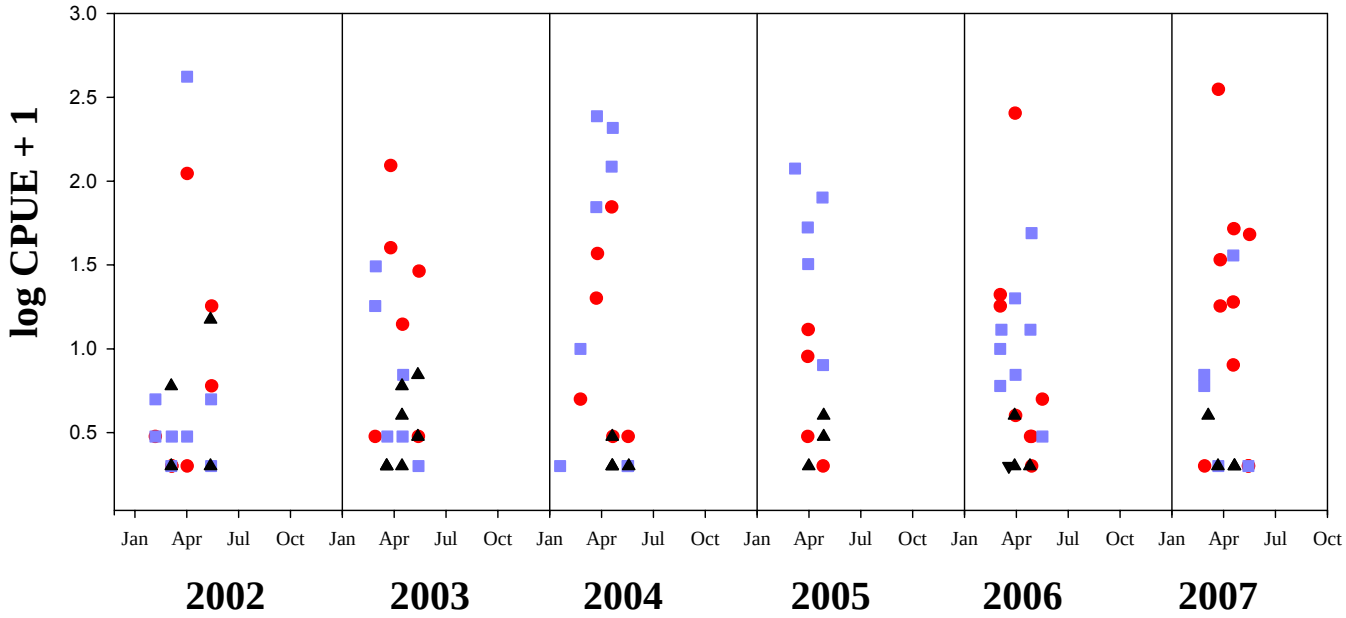
- Historic annual run > 1.3 million fish, After 1959 between 300 and 6000 fish
- Historic distribution: CR mouth to Walla Walla River (mainly below Celillo Fal
- Present pattern: limited number of spawning locations on Washington side:
  - ⇨ Chinook River & Grays River
  - ⇨ In mainstem CR near Ives Island, and nearby Hamilton and Hardy Creeks
  - ⇨ In mainstem near I-205 bridge, also near Multnomah Falls
- Extirpated from Oregon side.
- Appear to spawn where gradient changes and hyporheic flows exist.



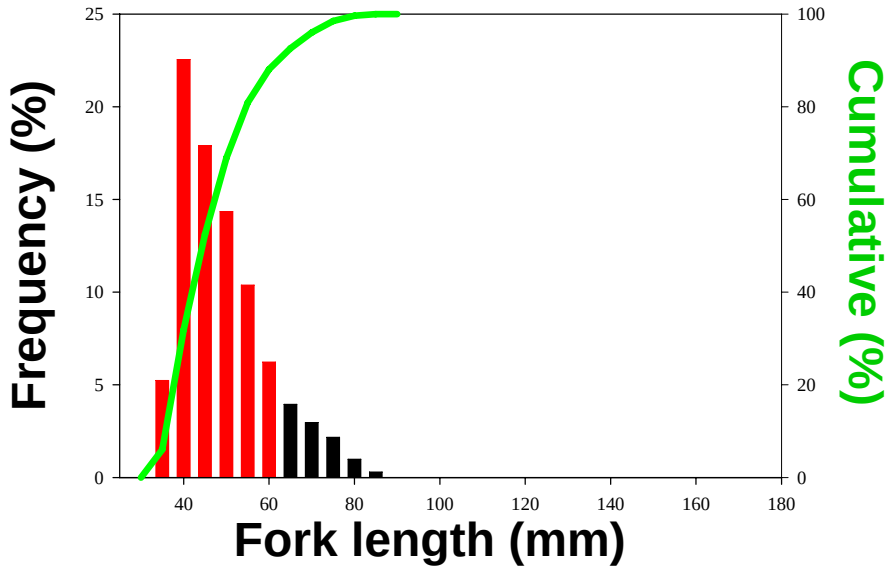


http://wdfw.wa.gov/fish/chum/chum-7.htm

Chum abundance and size at beach seine sites in 2002-2007

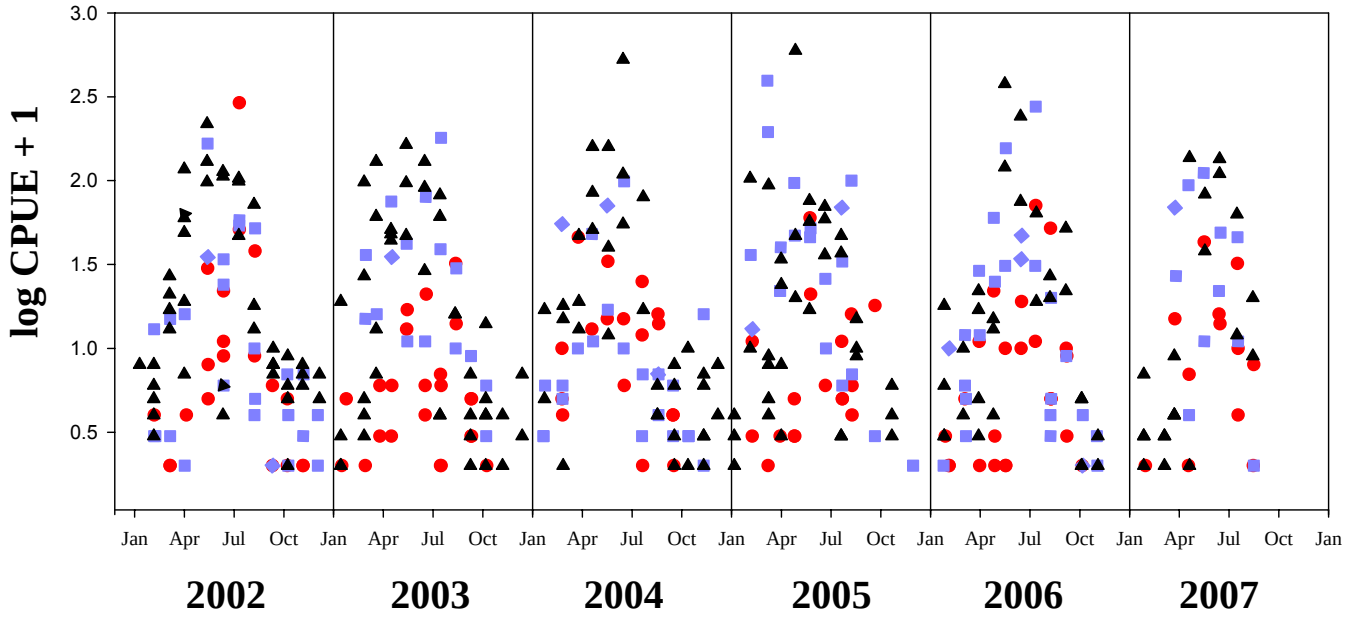


Lower estuary
Middle estuary
Tidal freshwater

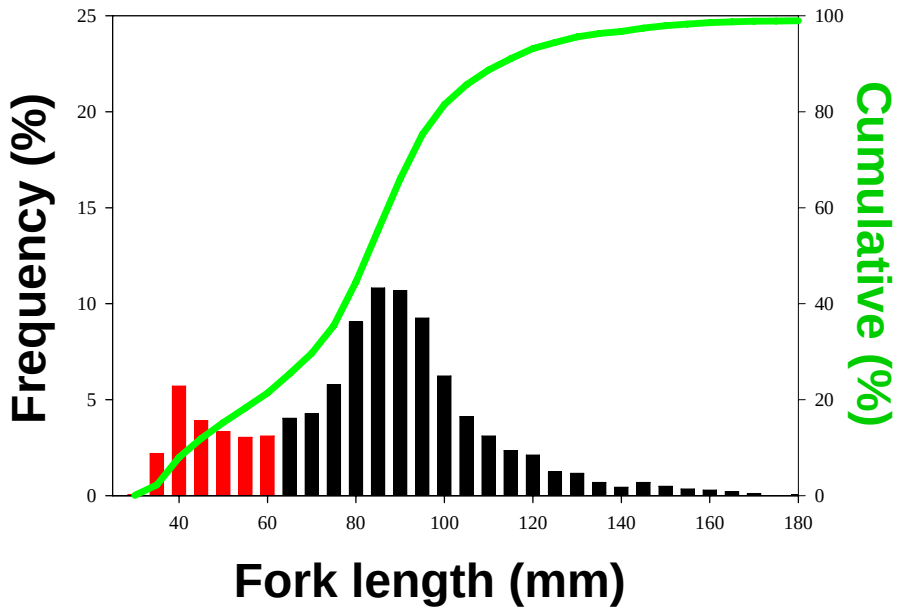


- **Chum: ~85 % are <60mm max size 85 mm**
- **Fry migrant LH**

Chinook abundance and size at beach seine sites in 2002-2007

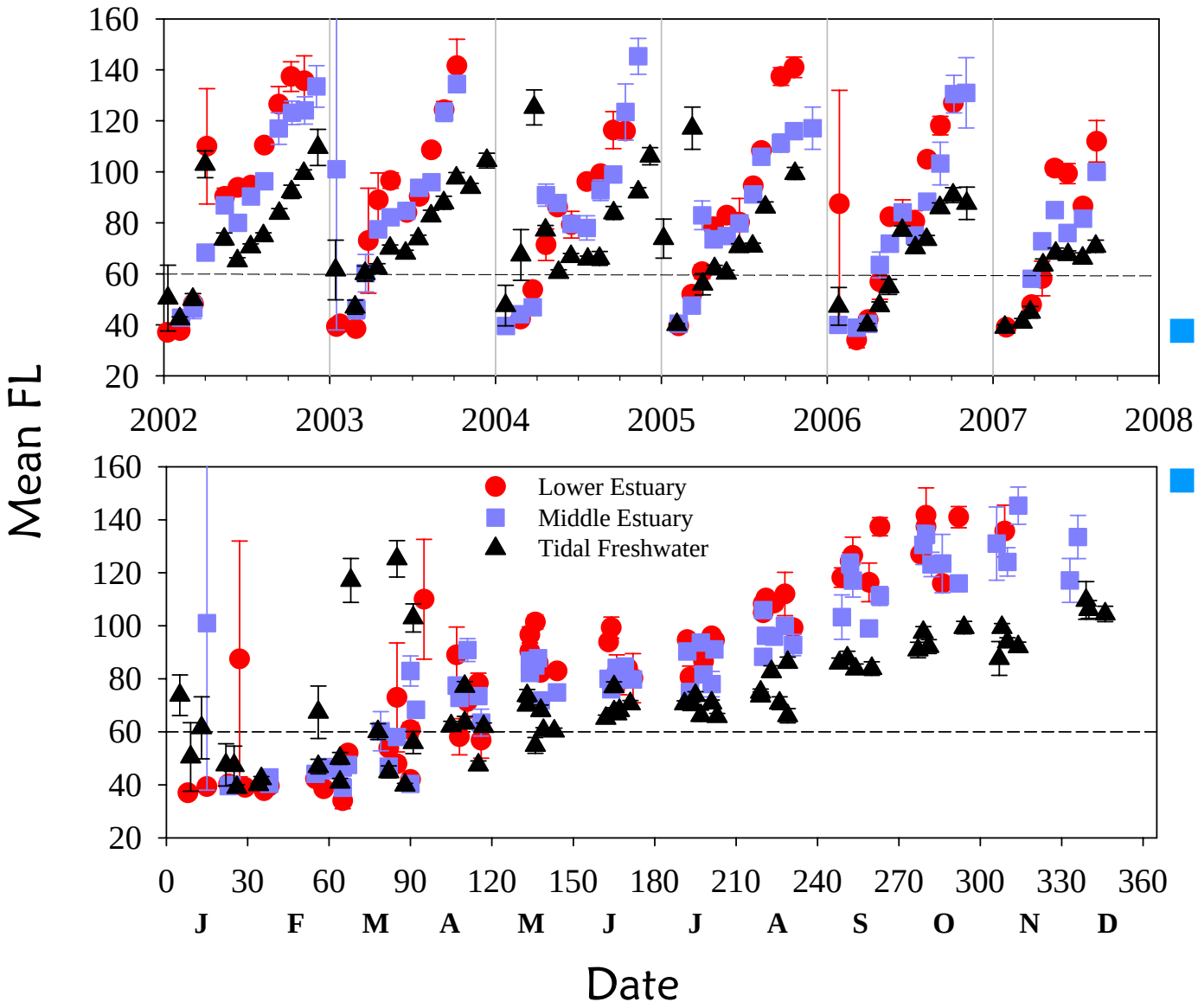


- Broad similarity btw years.
- Higher CPUE in TFW.



- ~20 % are <60 mm
- Remainder are fingerlings & yearlings

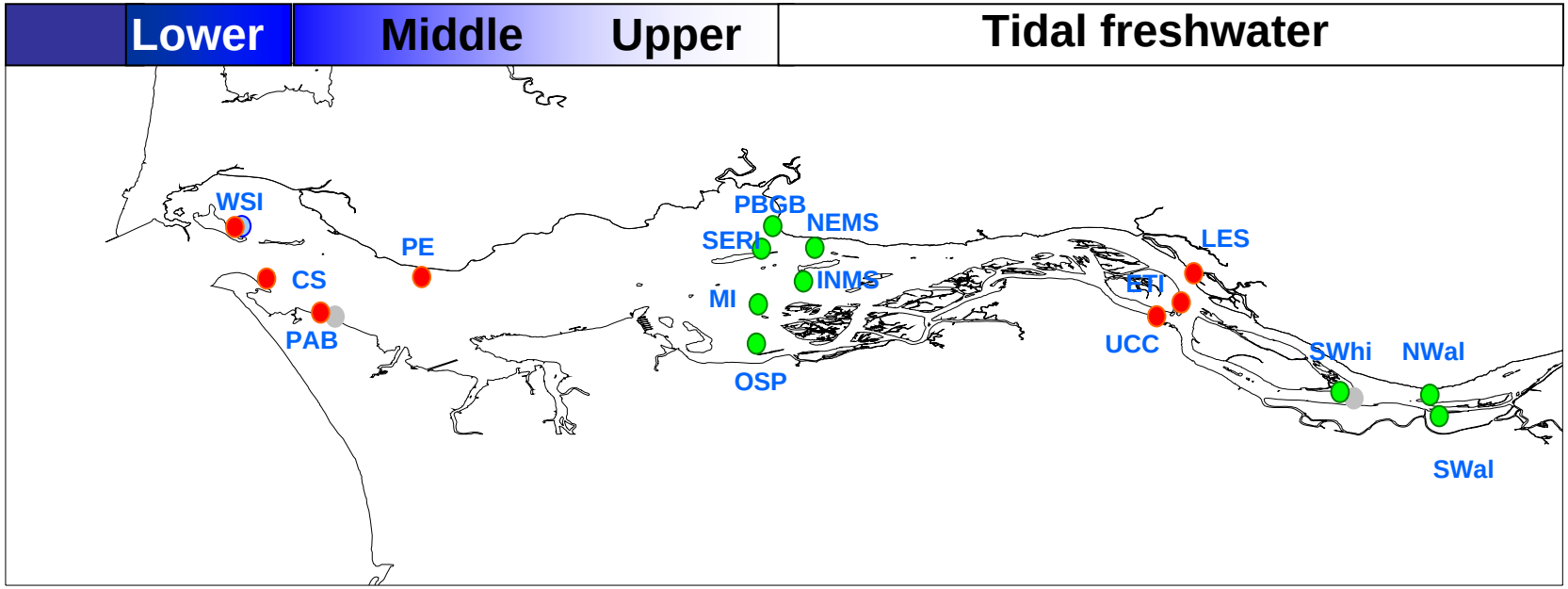
Chinook mean sizes 2002-2007

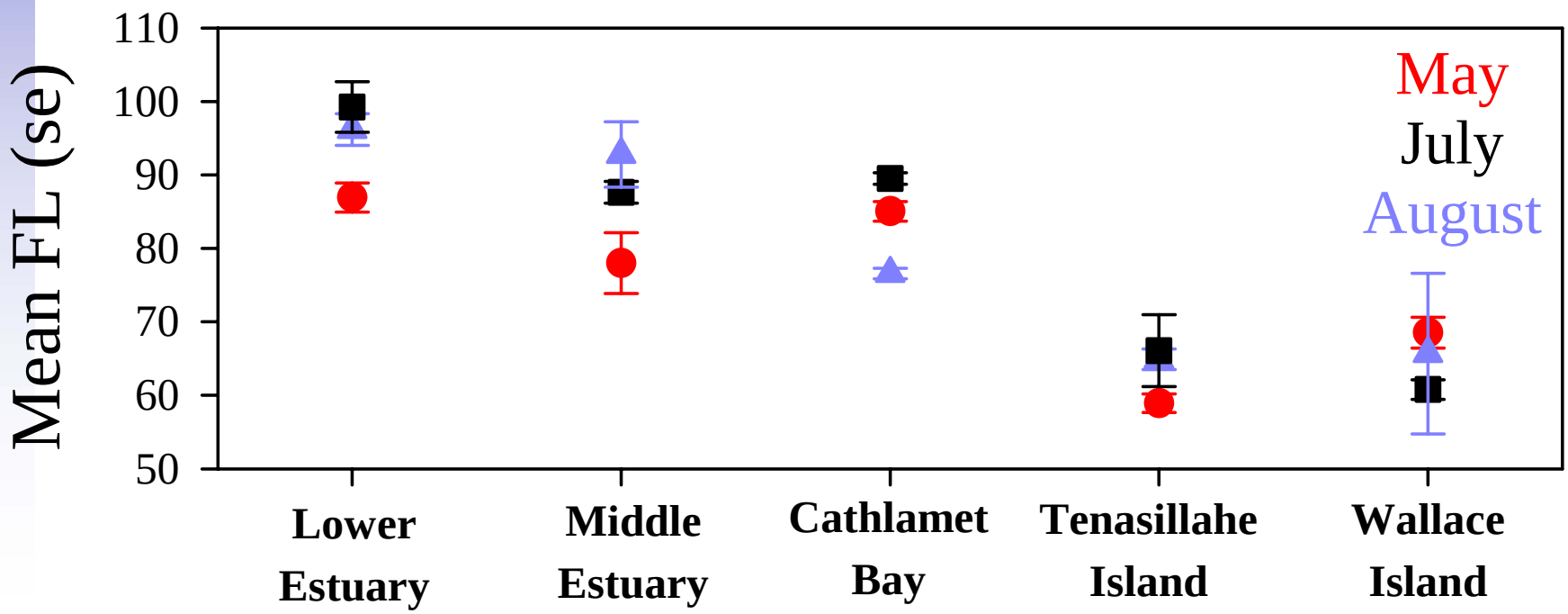


Lower estuary
Middle estuary
Tidal freshwater

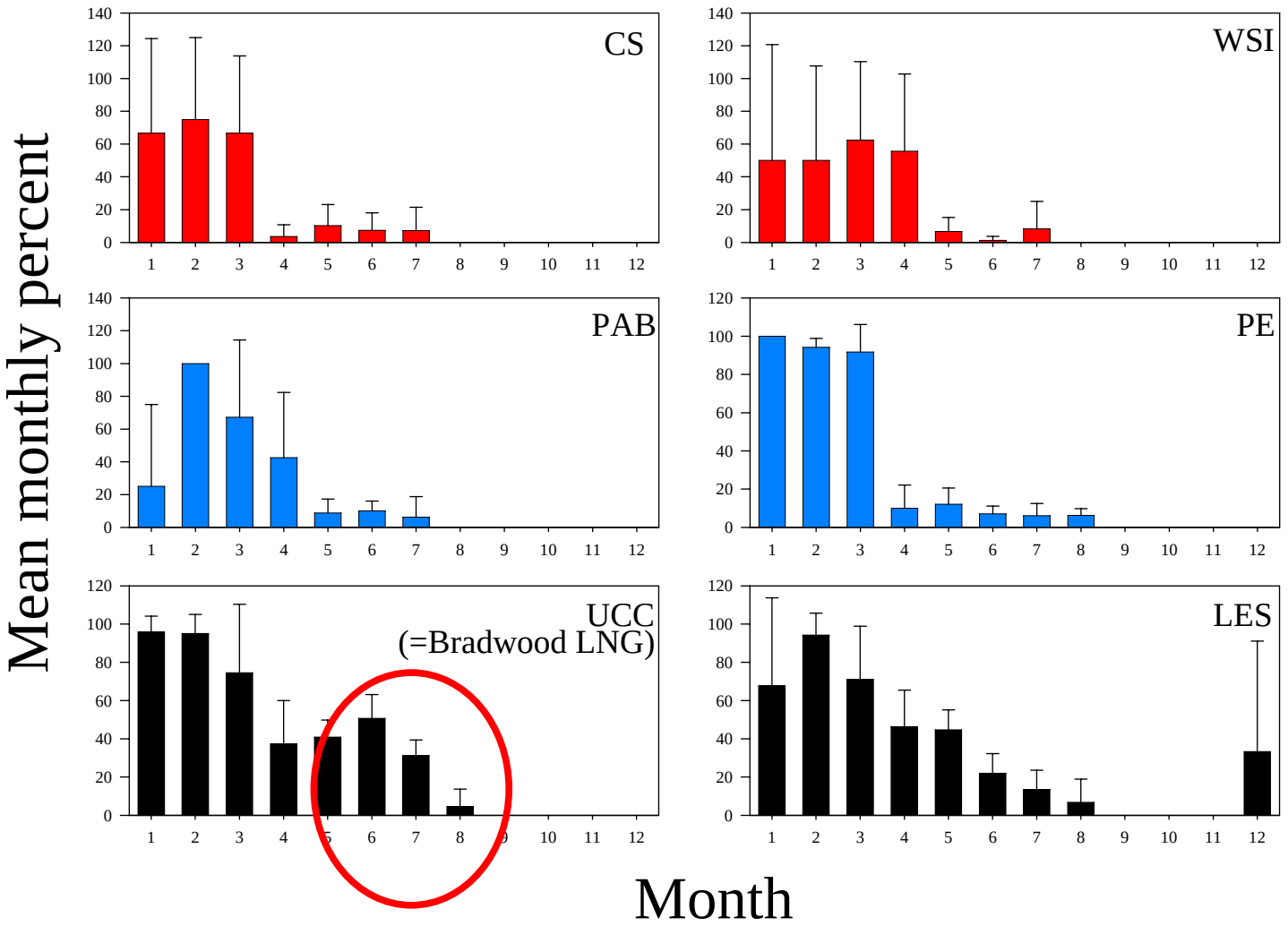
- **Spatial trend: TFW 20-50 mm smaller**
- **Annual trend: Near linear size increases**

Spatial scale "snapshot"

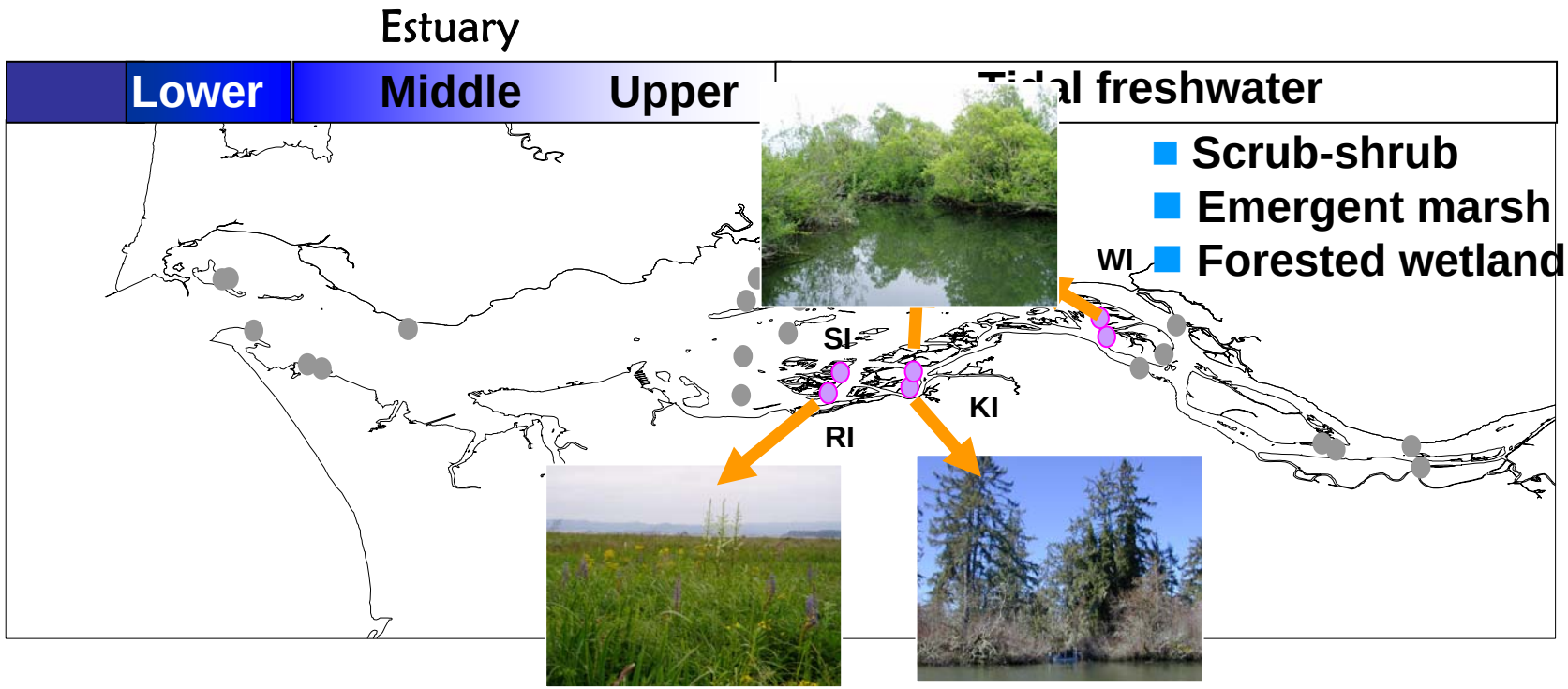




Chinook percent fry



Wetland monitoring in Cathlamet Bay



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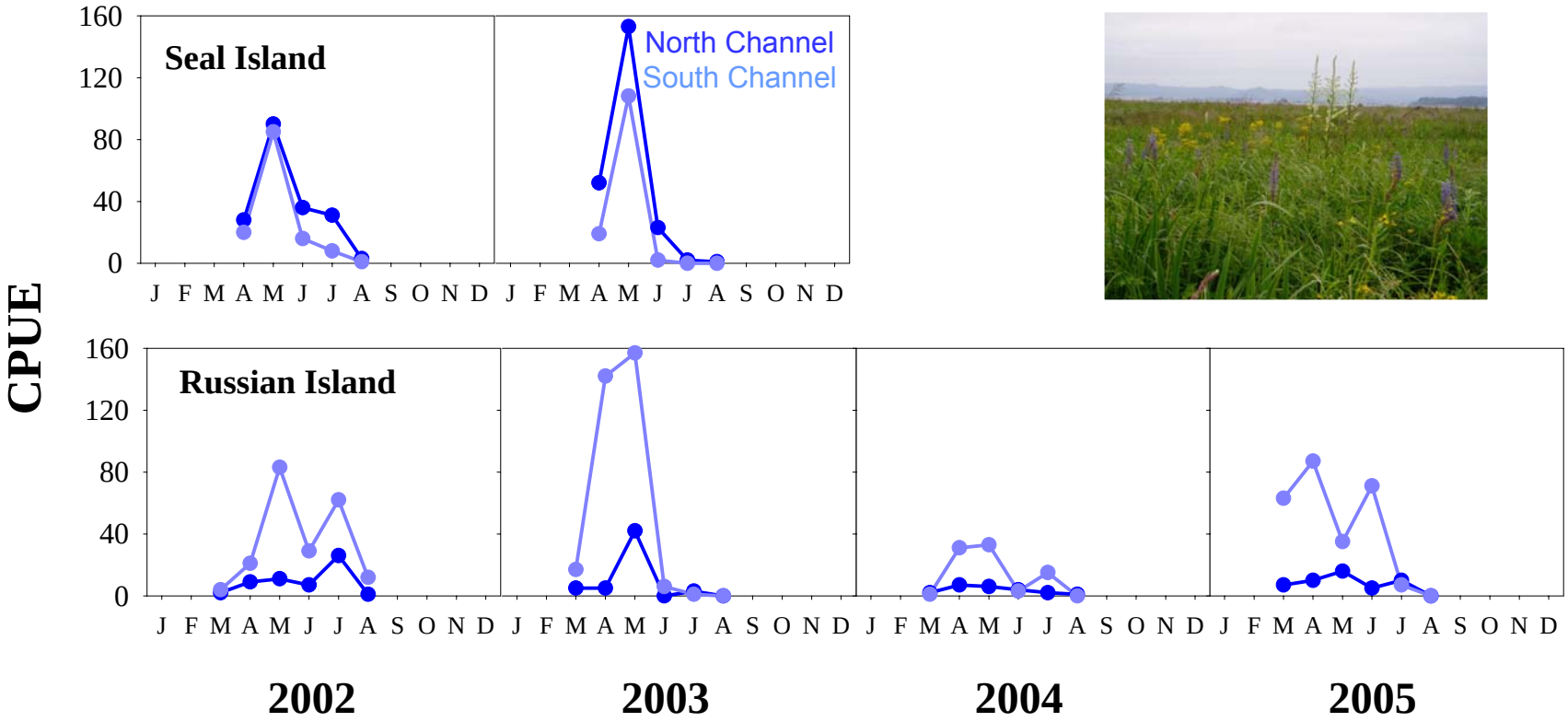
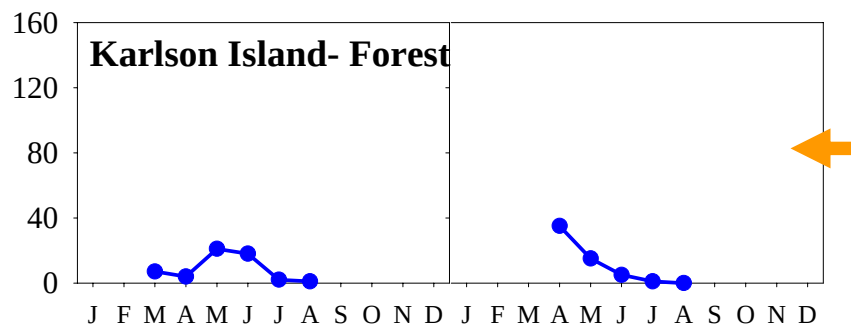
5. **Wetland habitat use**

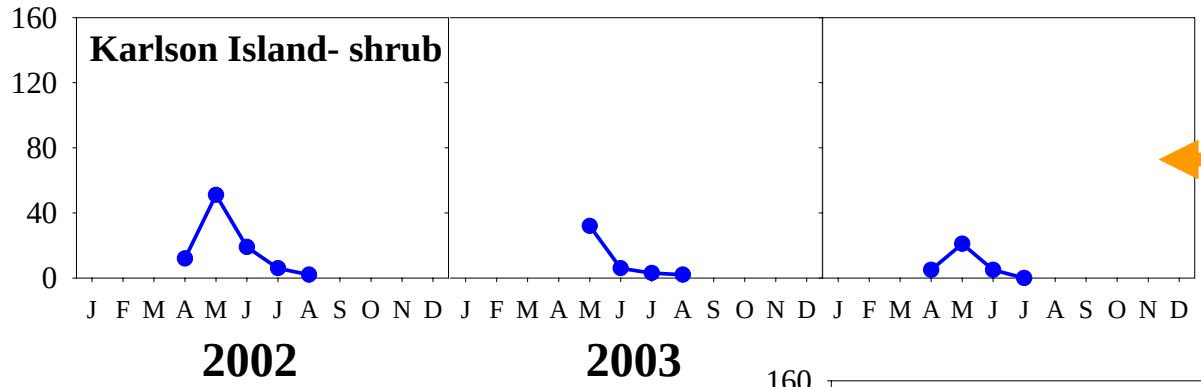
Emergent marsh sites

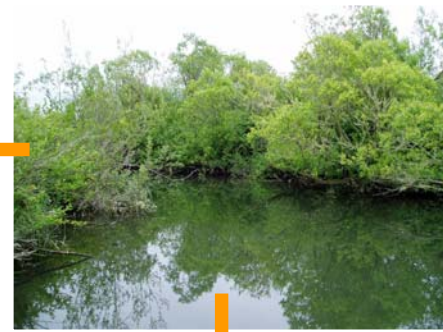


- Spatial trend: Similar patterns between Islands
- Annual trend: Peaks in Apr-May, Absent Jul-Aug

Trap net: Forested and Shrub sites







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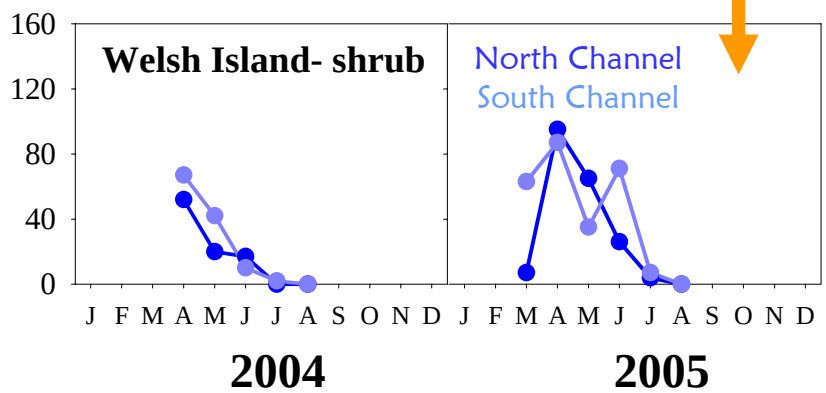
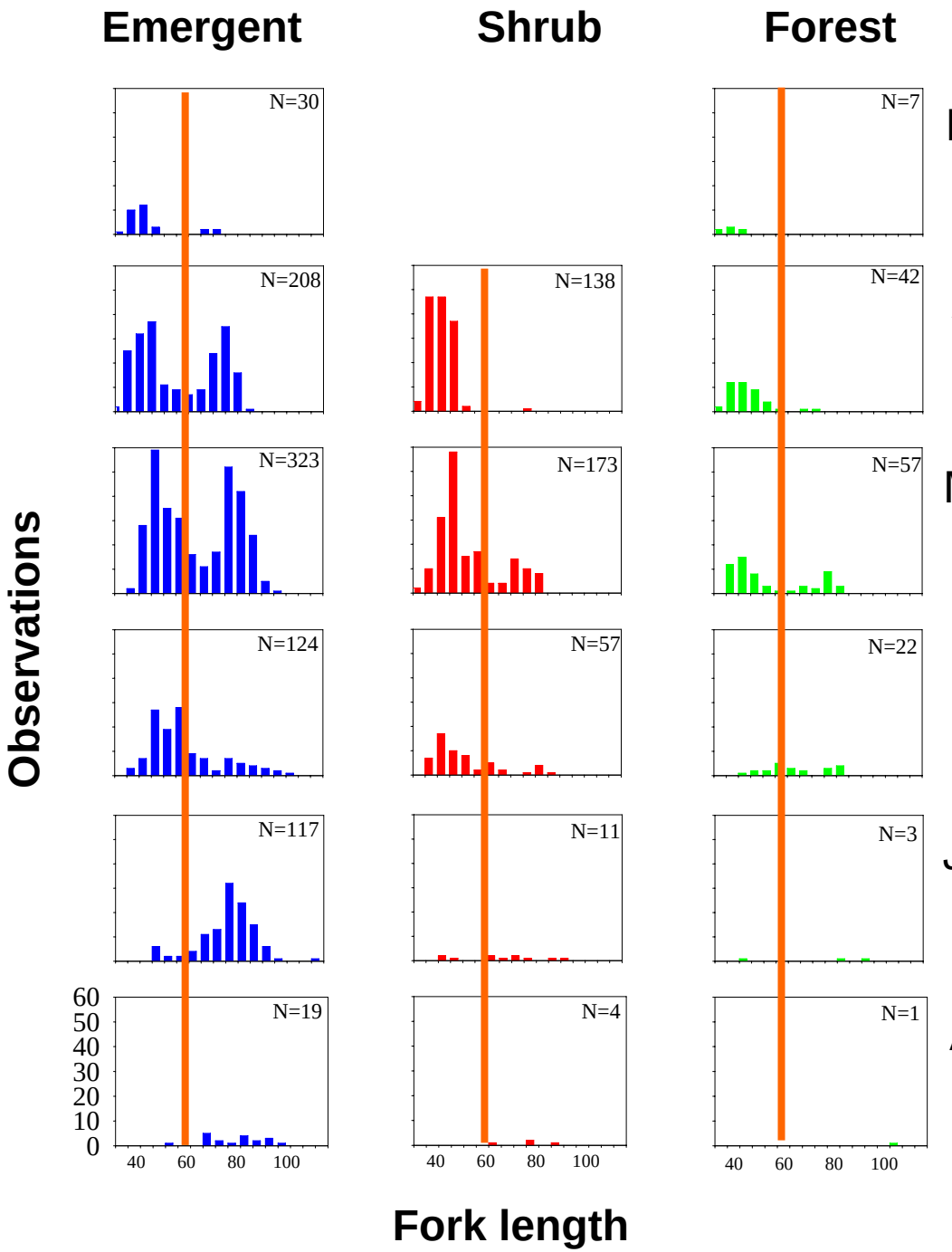
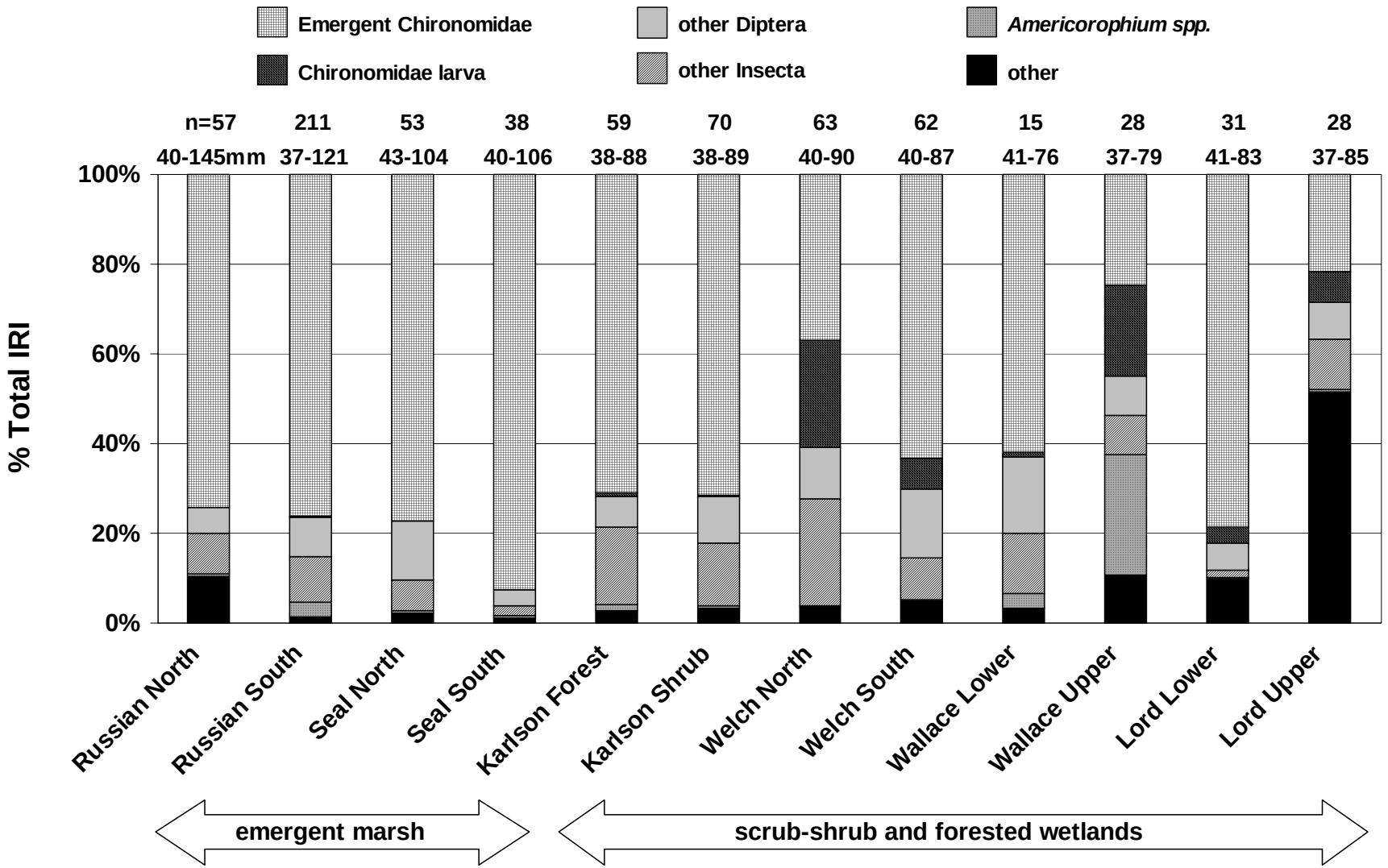


Size frequency by Habitat type



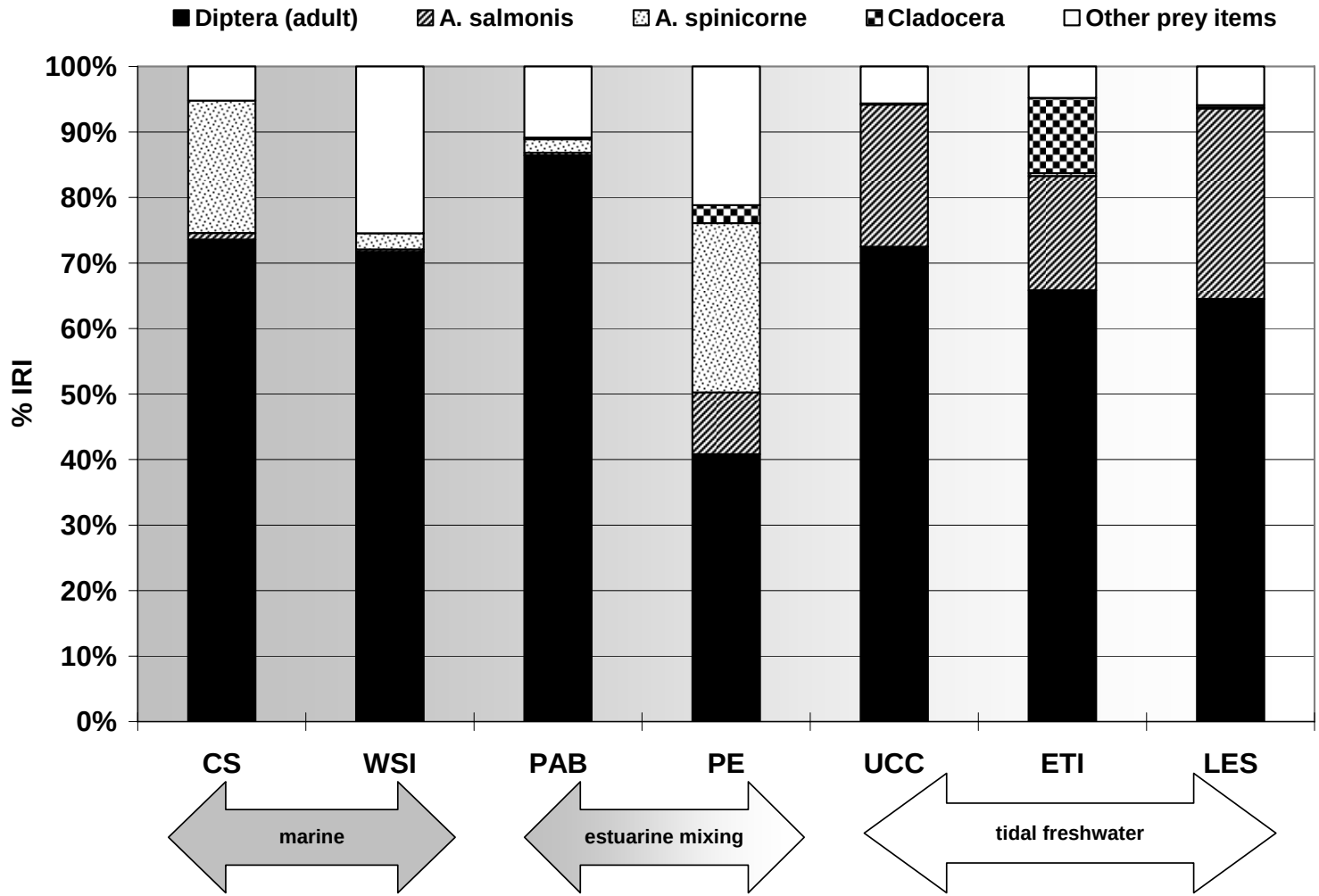
- **Fry < 60 mm dominate catch except in emergent marsh.**
- **Fish present longer in emergent marsh.**

Chinook diet from wetland habitats



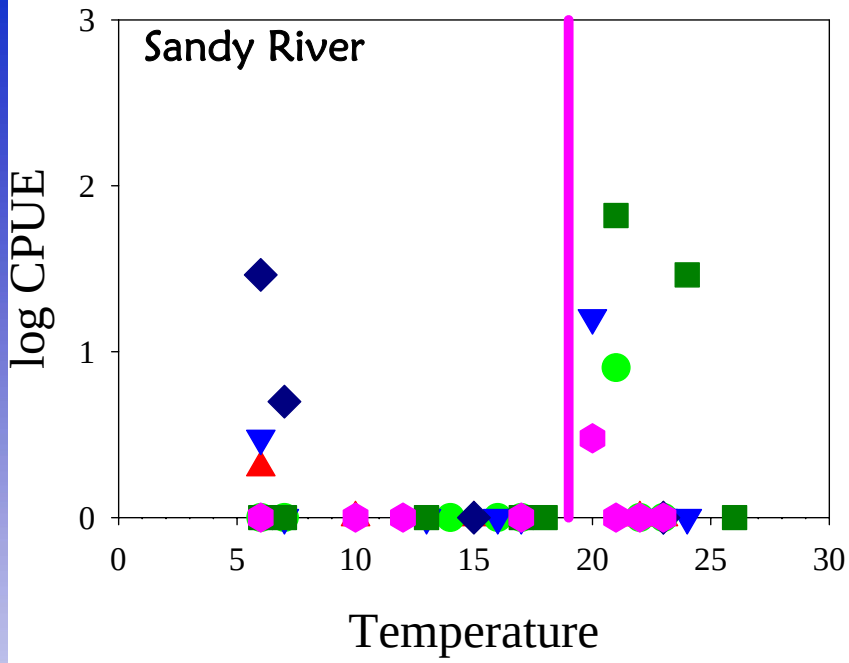
Bottom et al 2007

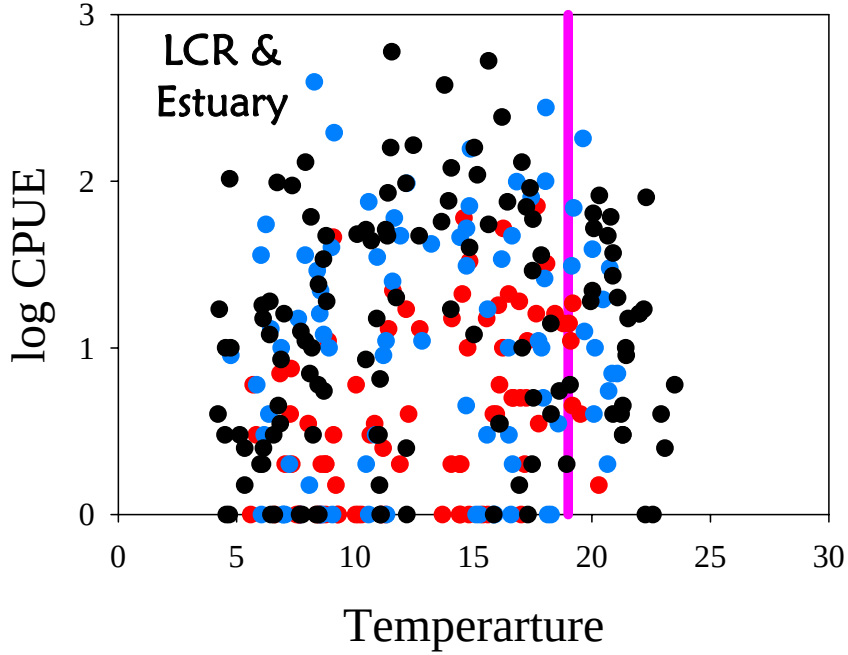
Chinook diet from beach seine sites

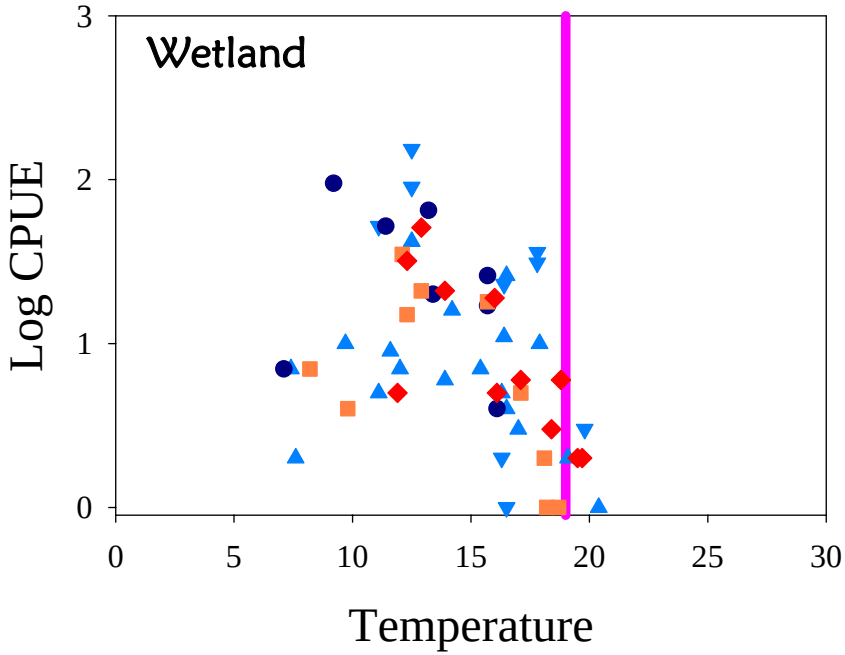


Bottom et al 2007

Chinook abundance and temperature







Stressed?

(Lack of) Marks and tags (2002-2005)

? Hatchery or Wild

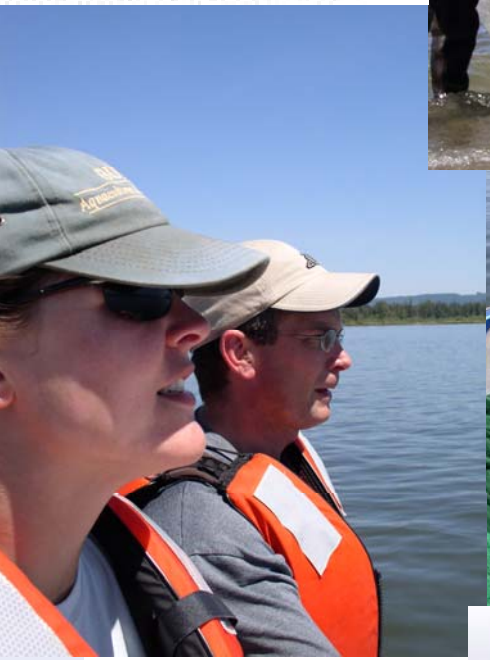
9710 total Chinook examined

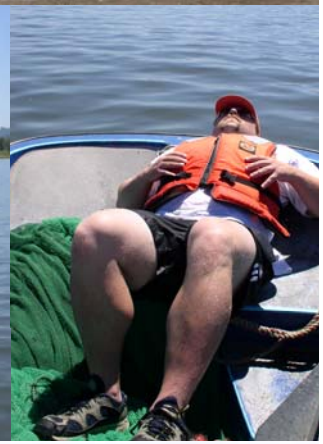
AD. Clip	Pelvic Clip	CWT	AD + CWT	PIT	Total	% Total	Mean FL	SD
222	48	19	78	2	369	**3.8**	125.3	42.5

Summary

1. Salmon are abundant in shallow water habitats at all spatial and temporal scales investigated. **Restoration will benefit migrants (and the rest of the ecosystem!).**
2. Chum are fry migrants that leave by May; subyearling Chinook have year-round presence. **Chum lacking spawning habitat; Chinook lacking rearing habitat.**
3. Chinook exhibit spatial trends in abundance and size over the estuarine gradient:
   – larger fish in marine influenced zones
   – higher CPUE in tidal freshwater zones
   Identify and enhance juvenile rearing in estuarine transition zone.
4. Chinook CPUE in main stem and wetland sites declines markedly >August, but abundance can be high at temperatures > 20^{o}C. **Stressed?**
6. Salmon fry were commonly found as late as August at most shallow water habitats. **Origin?**
7. Very few fish were marked, and so origin is uncertain (presume most are hatchery). **Tag all hatchery fish! PIT tag all possible!**

US Army Corps of Engineers ®
Portland District





Thanks to our many collaborators

Daniel Bottom, Greer Anderson, Antonio Baptista, Paul Bentley, Lance Campbell, Edmundo Casillas, Susan Hinton, Tucker Jones, Regan McNatt, Paul Moran, Charles Simenstad, Vasilia Stamatiou, Adam Sterch, David Teel, Jeannette Zamon