

Hatchery and wild salmon in the Columbia River estuary --similar or different?



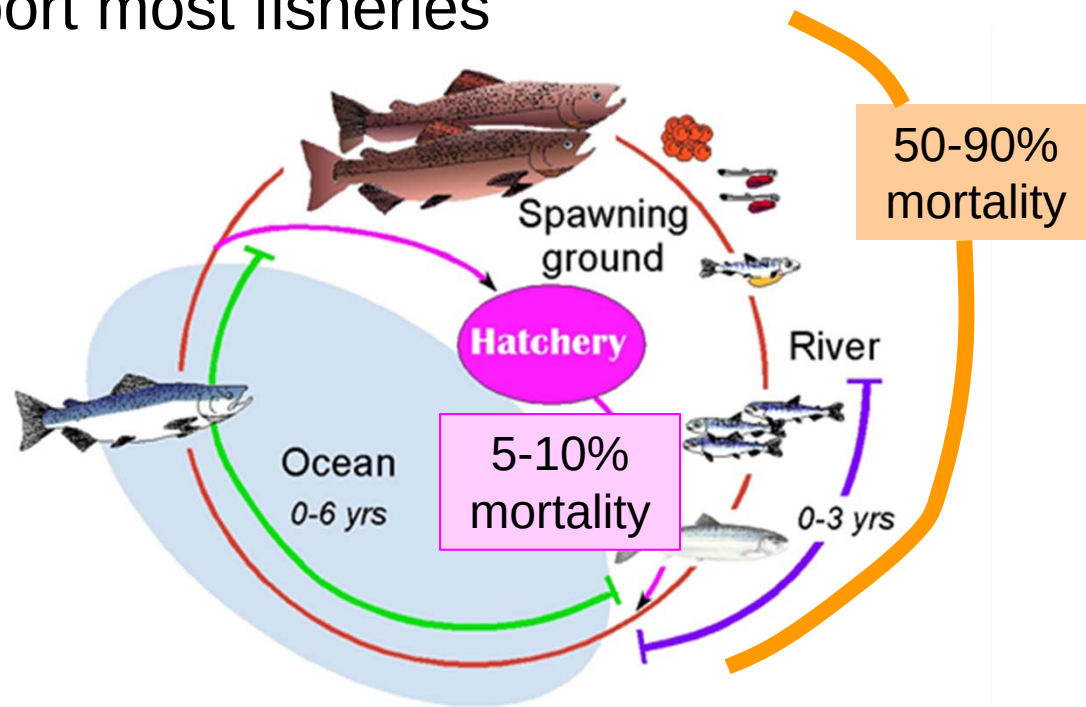
Laurie Weitkamp
Northwest Fisheries Science Center
Newport Field Station

Talk outline

- **Background:** Columbia River hatchery and wild salmon production and issues
- **Methods:** H vs. W, geographic origins, studies
- **Results:** General patterns of juvenile salmon use
Hatchery and wild salmon comparisons
 - Habitat use
 - Relative abundance
 - Timing & size
 - Food habits
- **Summary & Conclusions**

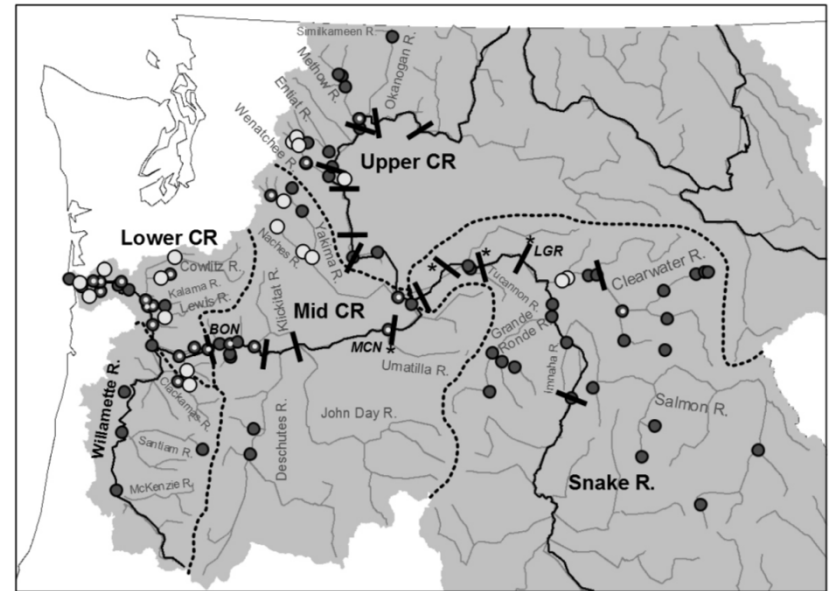
Why salmon hatcheries?

- Hatcheries bypass high egg incubation and early rearing mortality
 - Often started as compensation for habitat loss, declining fish runs
- Currently support most fisheries



Columbia River salmon hatcheries

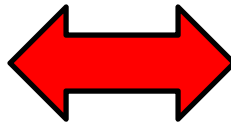
- First Columbia River hatchery started 1872
 - in response to declining Chinook runs
- Peak production 1988: 250 million salmon
= 9.8 million pounds
- Currently 140 million from >70 facilities
 - 70 million fall Chinook
 - 31 million spring Chinook
 - 23 million coho
 - 15 million steelhead
- Failed to restore salmon runs to historical levels



Concerns about hatchery salmon

Potential impacts to wild populations:

- Competition for food & space
- Predation (attract predators, prey on wild fish)
- Disease transmission
- Genetic effects if interbreeding
- Hatchery harvest rates too high for wild populations



Concerns about wild Columbia R salmon

- 13 groups listed under the U.S. Endangered Species Act
 - 5 Chinook, 5 steelhead, 1 ea. sockeye, chum, coho
- Huge effort underway on restore wild salmon through habitat restoration, dam passage improvements, predator controls, fishery restrictions, etc.
- Uncertain impacts of hatchery fish on wild salmon, especially where opportunities to mix:
 - river corridors
 - estuaries
 - marine waters

What do we know about H & W salmon in the Columbia Estuary?

Similar or different with respect to:

- Habitat use
- Relative abundance
- Size & timing
- Food habits

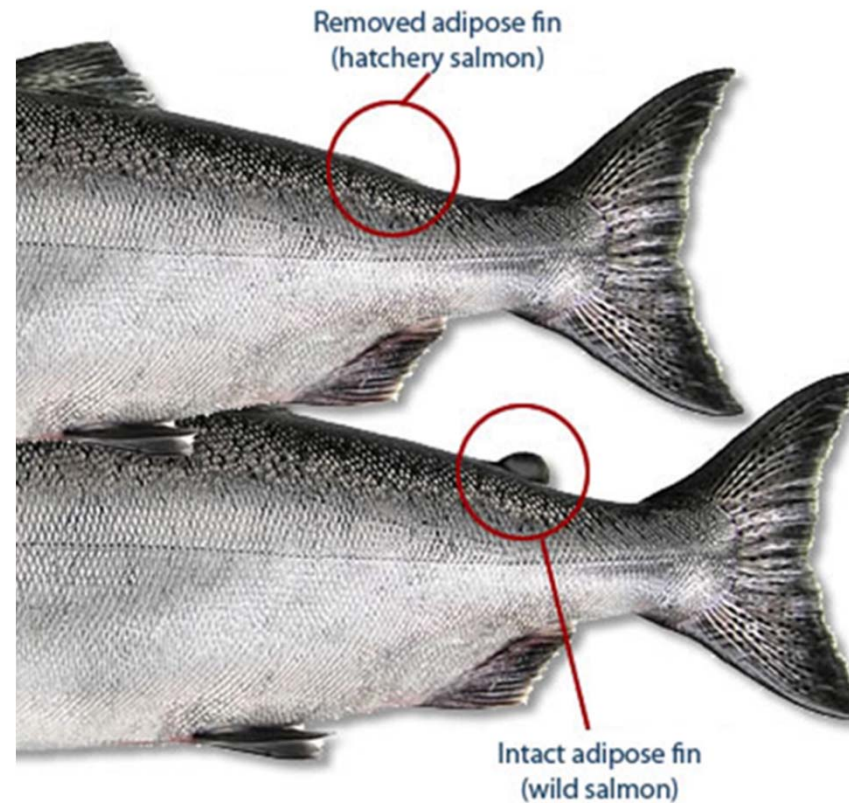
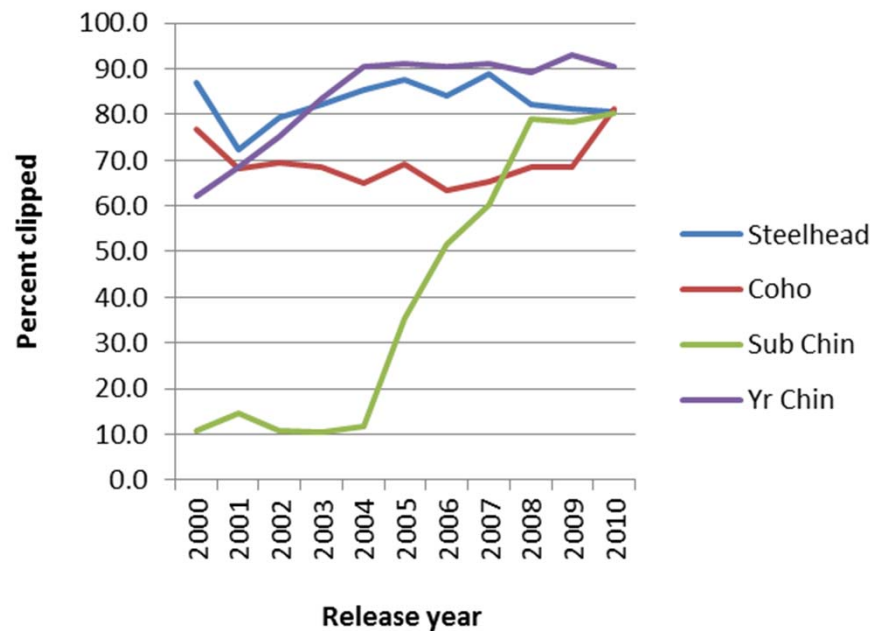


Challenge: telling hatchery from wild fish

Adipose fin clips

- Clipped = hatchery
- Unclipped = hatchery + wild

Hatchery clip rates



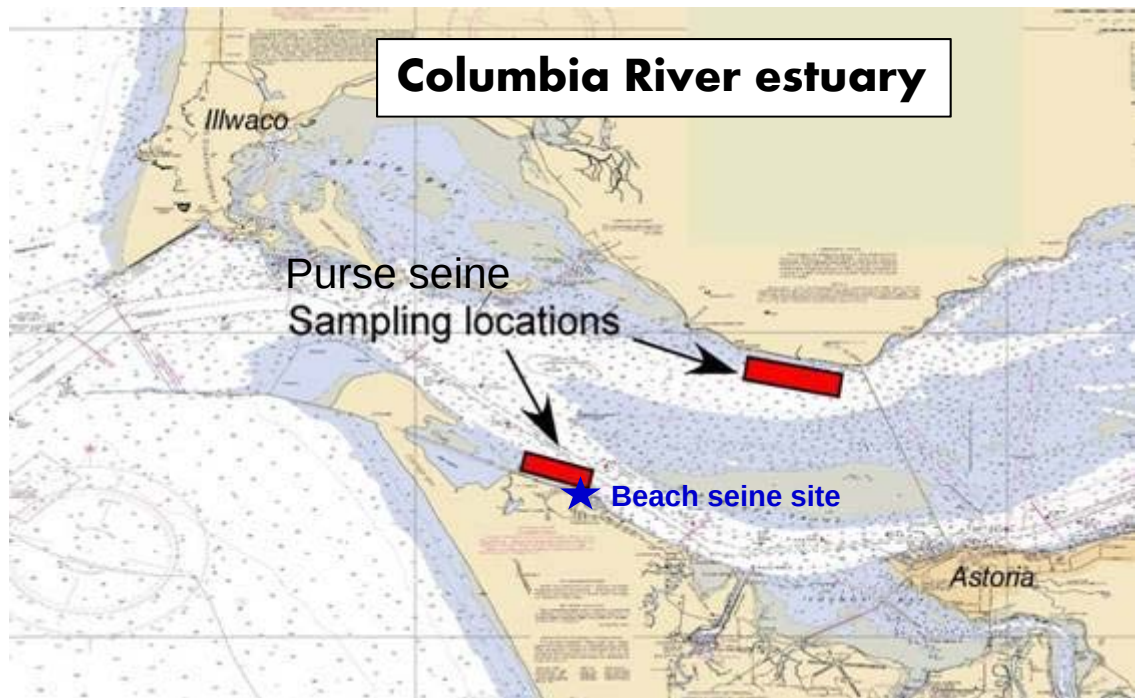
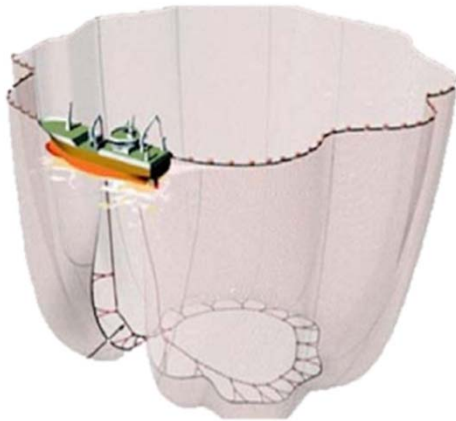
Estuary sampling methods

Purse seines in deep water, beach seine in shallow water

Beach seine



Purse seine



Purse seine

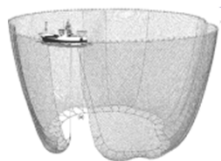


Beach seine



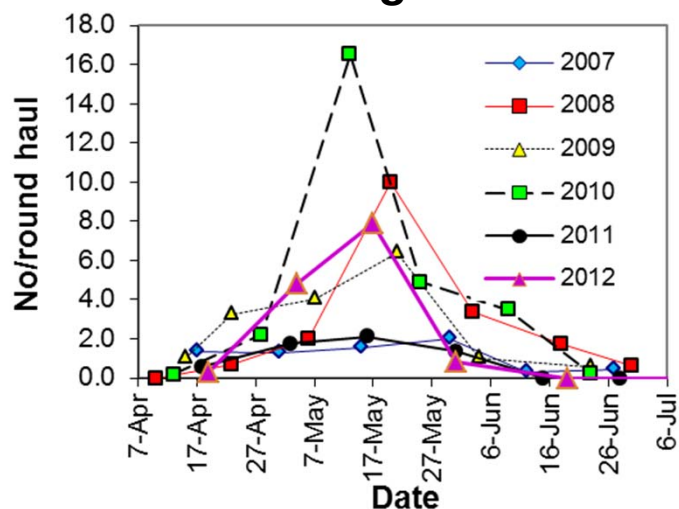
General patterns of juvenile salmon in the Columbia River estuary



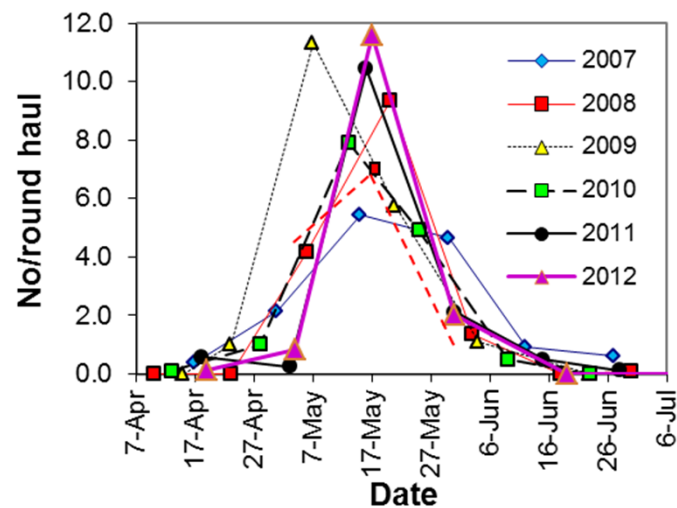


Juvenile salmon abundance (PS)

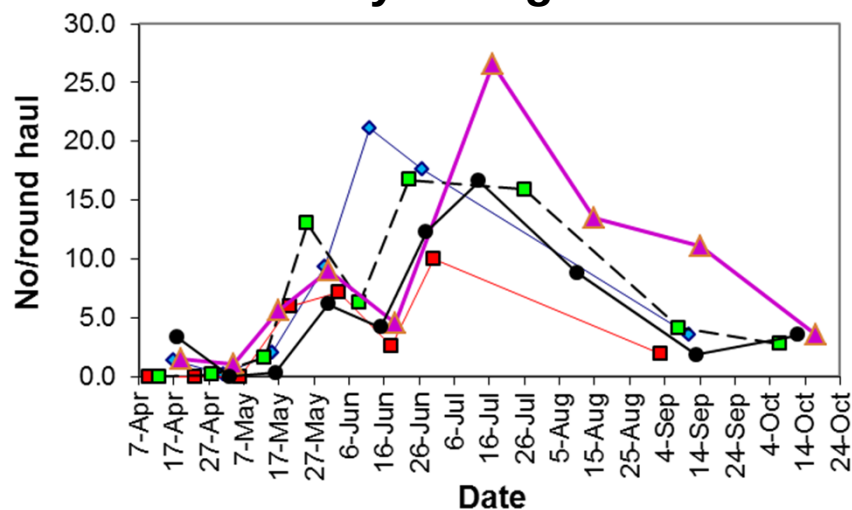
Yearling Chinook



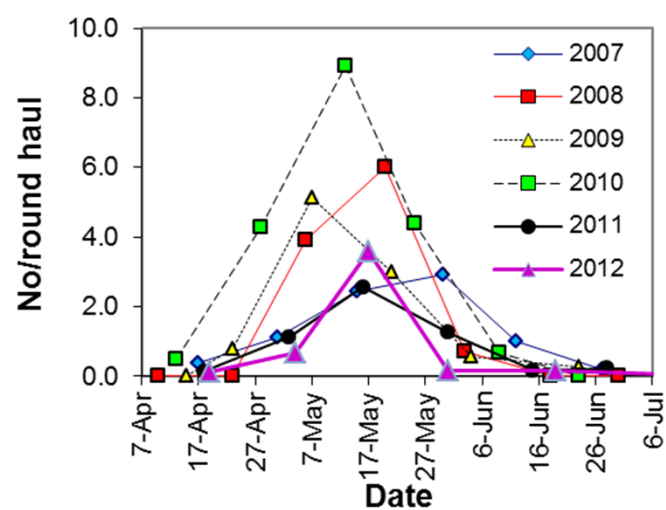
Coho



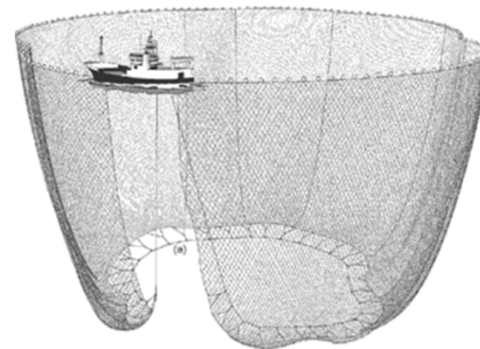
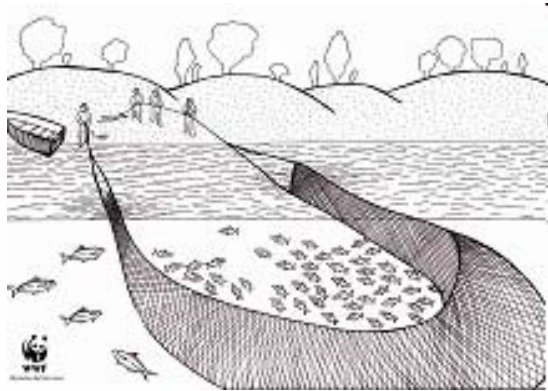
Subyearling Chinook



Steelhead



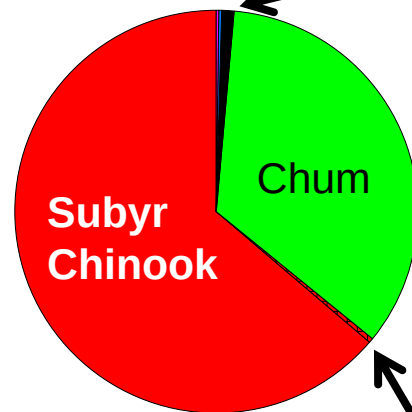
Juvenile salmon habitat use



Beach Seine

N = 8475

Coho

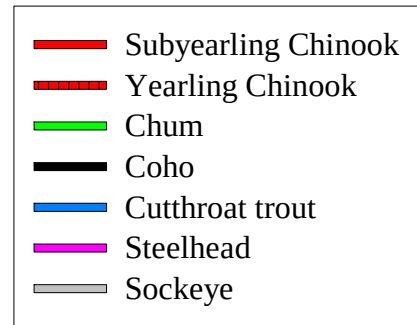
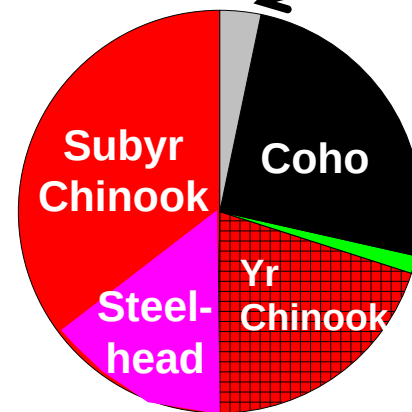


Yr
Chinook

Purse Seine

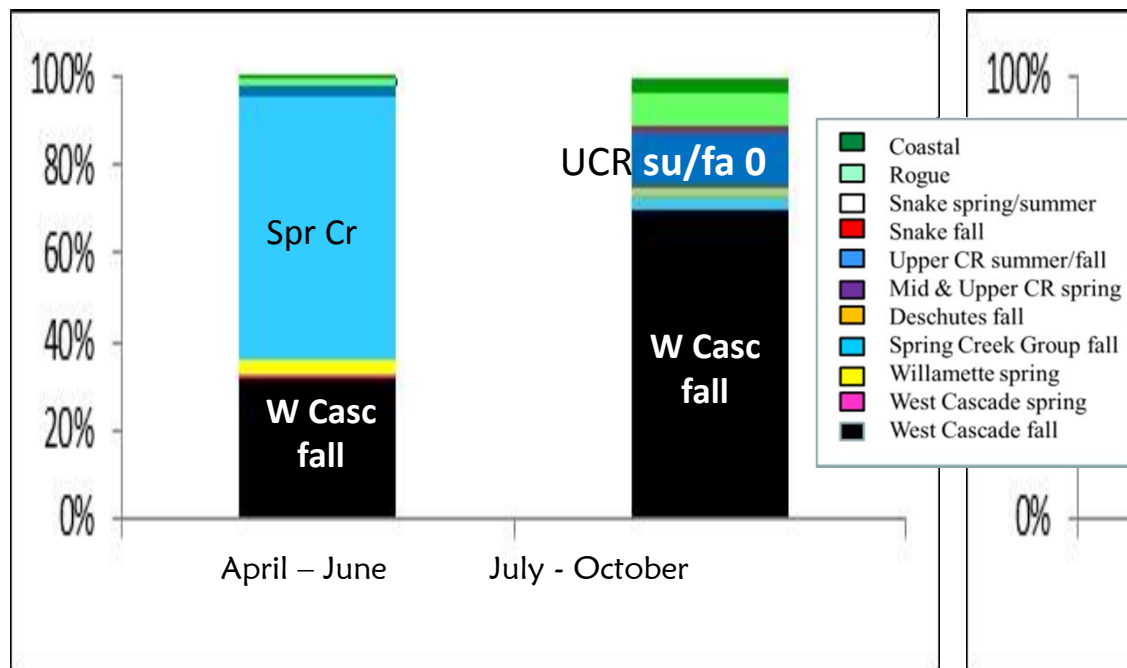
N = 1731

Sockeye

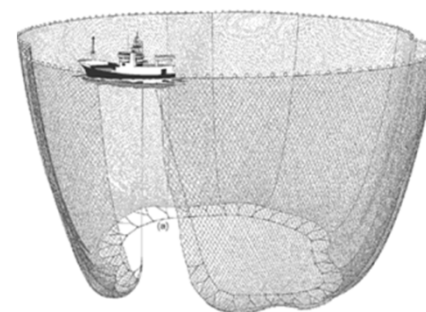
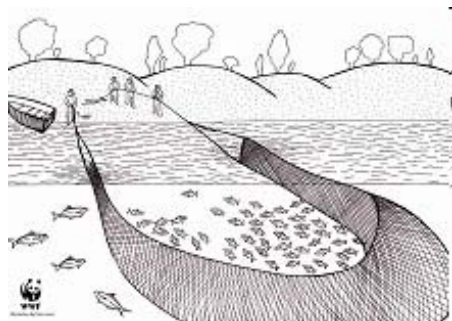
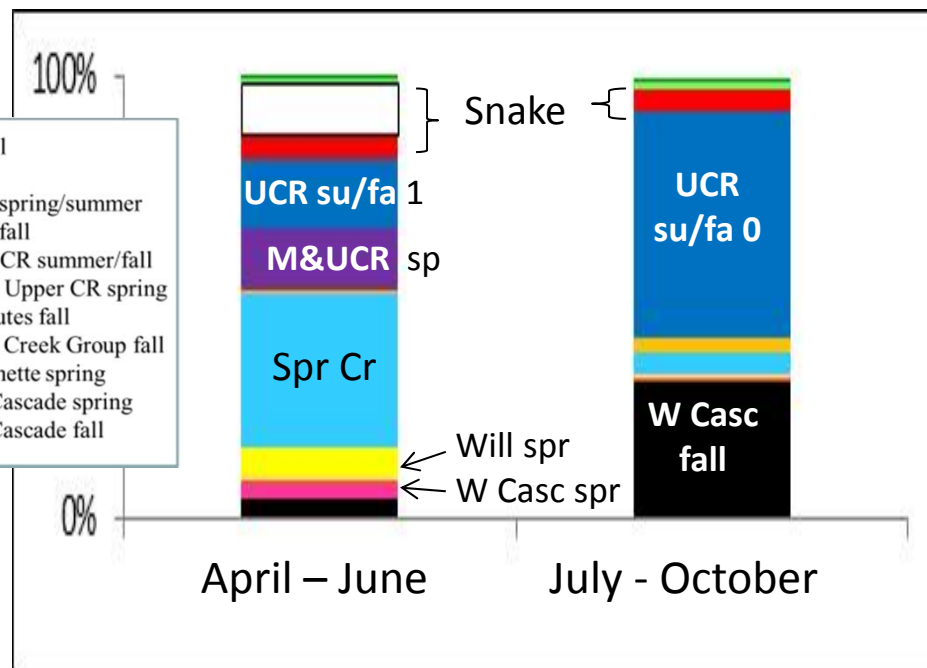


Genetic stock composition of Chinook salmon

Shallow Water Beach Seine



Deep Water Purse Seine



Graphics: D Teel

Hatchery-wild comparisons

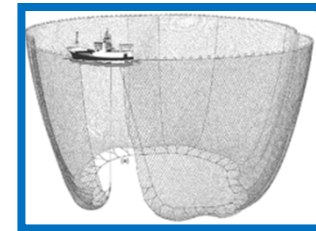
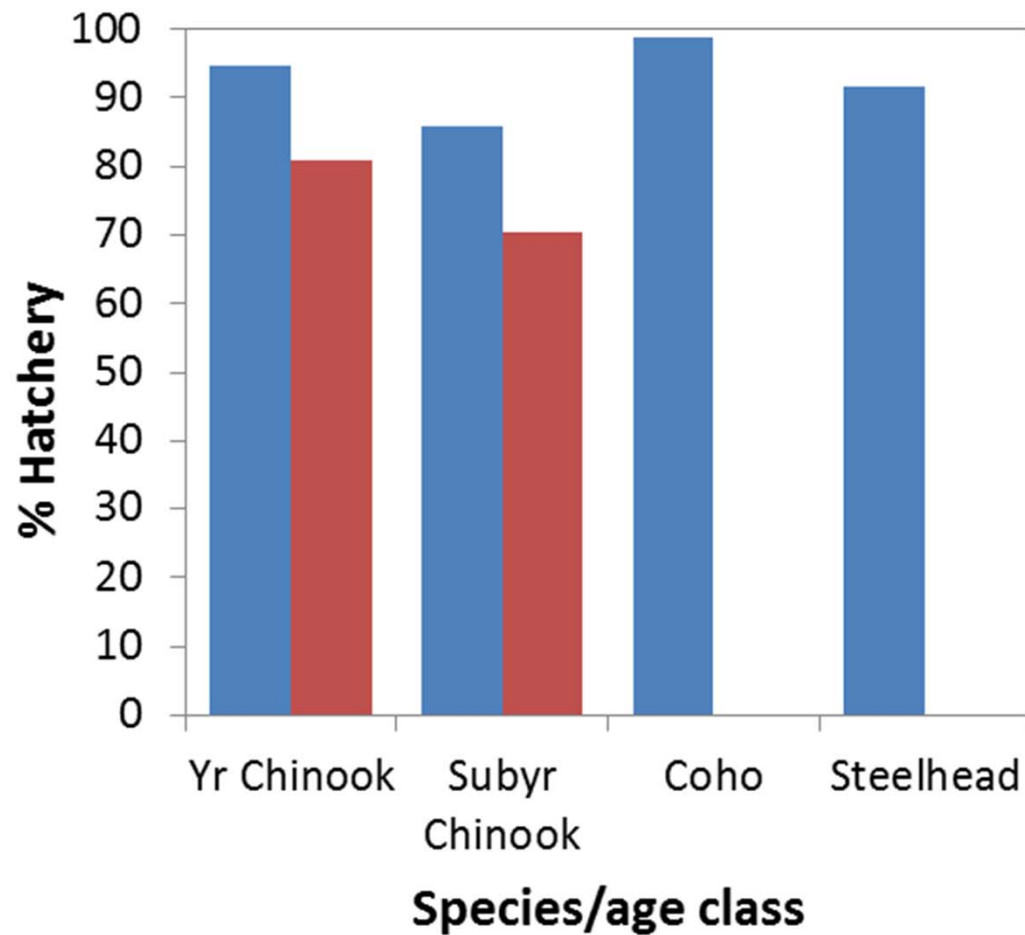


Purse seine H-W relative abundance

Attribute\Spp.	Yr Chinook	Subyr. Chinook	Coho	Steel- head
Hatch. production (millions)	32.7	69.5	21.9	15.1
% ad clipped at hatchery	91.1	75.7	68.6	84.9
% ad clipped in estuary	86.2	65.8	75.4	77.8
Estimated % hatchery in purse seine catches	94.7	85.8	98.7*	91.6

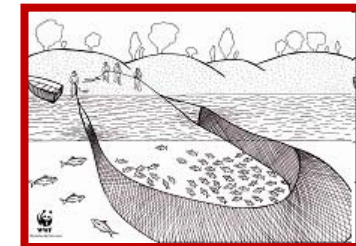
* Capped at 100% 2007-2009

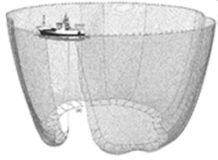
Hatchery-wild relative abundance



■ Purse seine

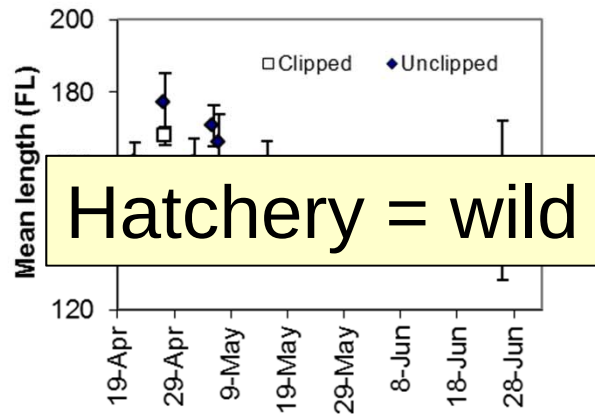
■ Beach seine



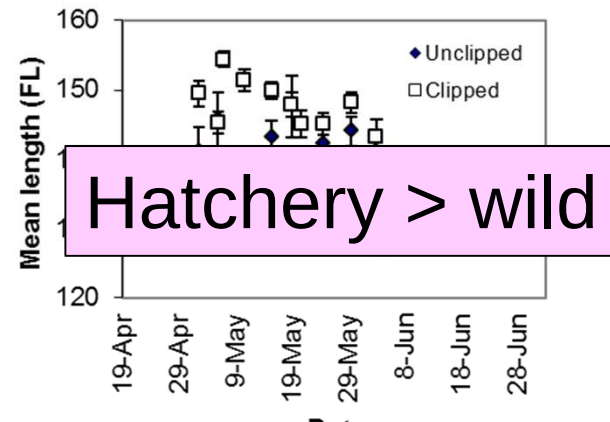


Size differences: H vs. wild salmon

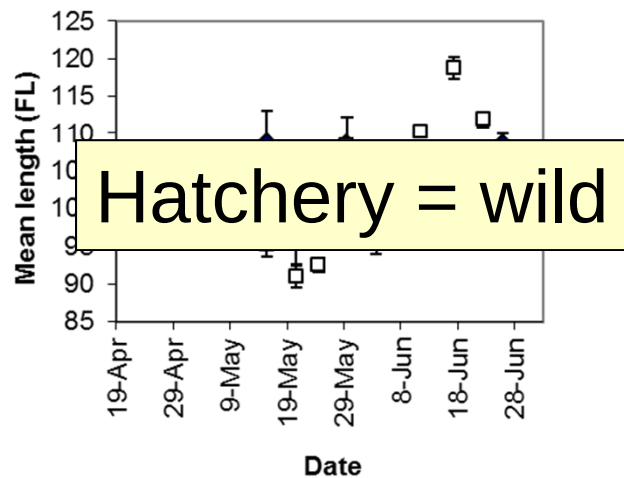
Chinook 1



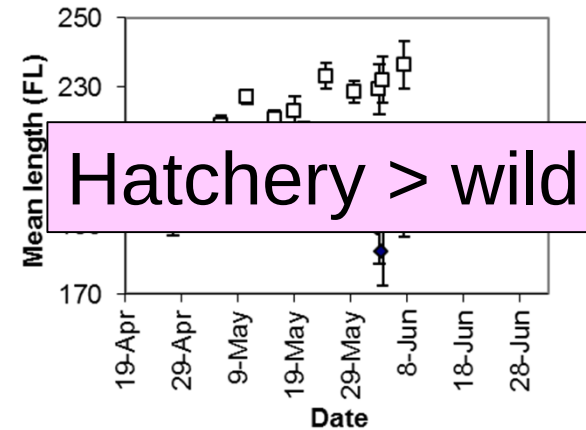
Coho



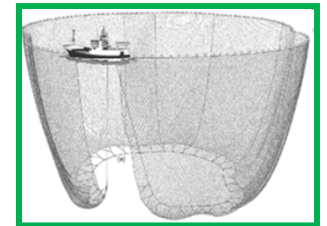
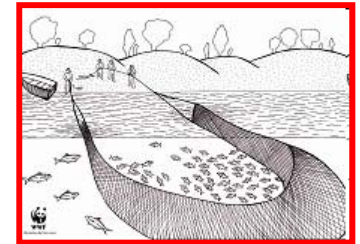
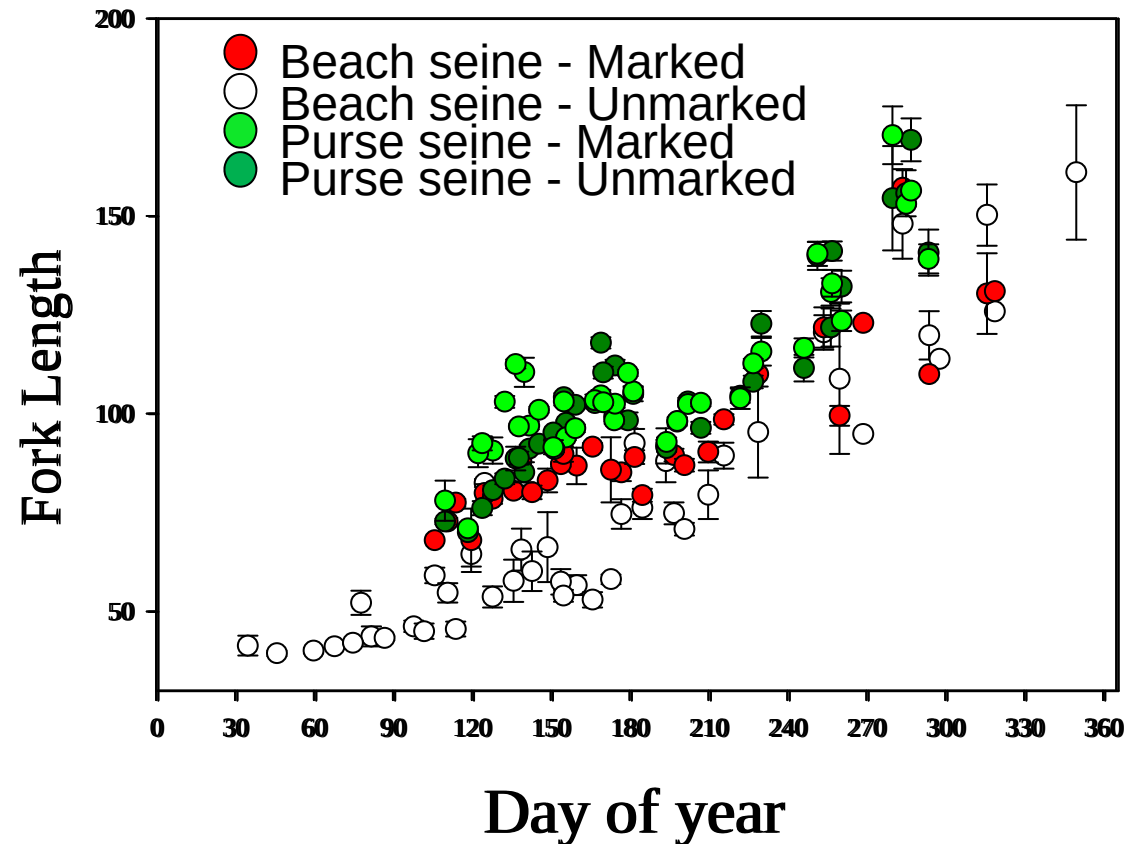
Chinook 0



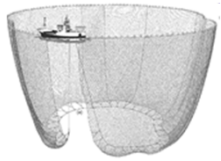
Steelhead



Hatchery-wild subyr. Chinook size

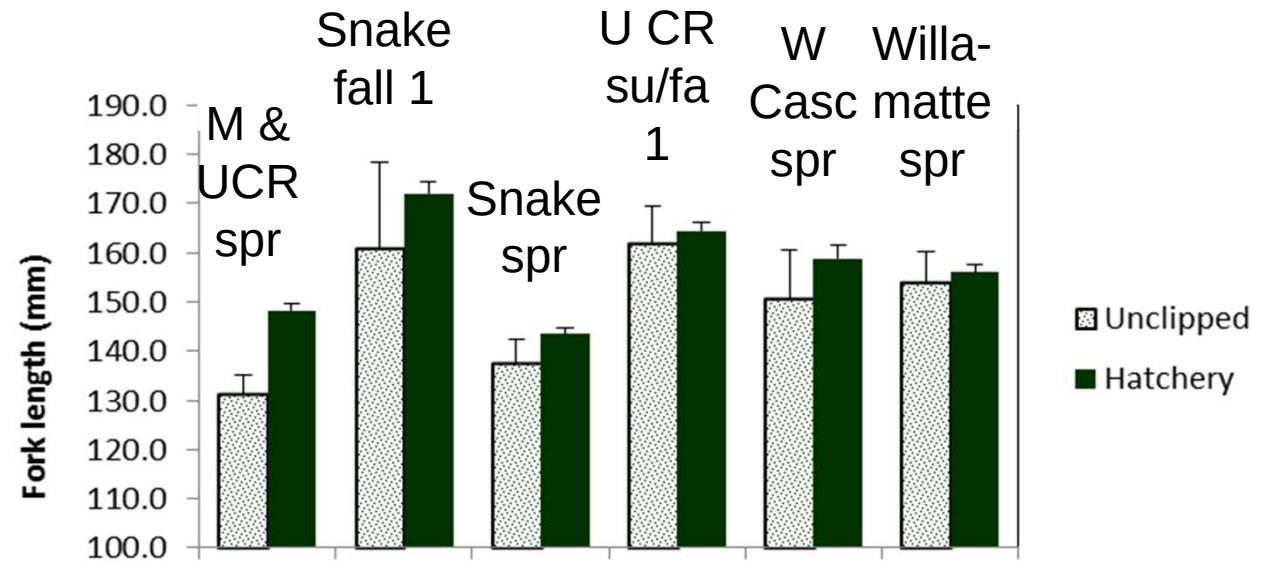


Larger fish in deeper (PS) than shallow water (BS)
Big size difference between marked & unmarked in shallow
water (BS) but not deep water (PS)

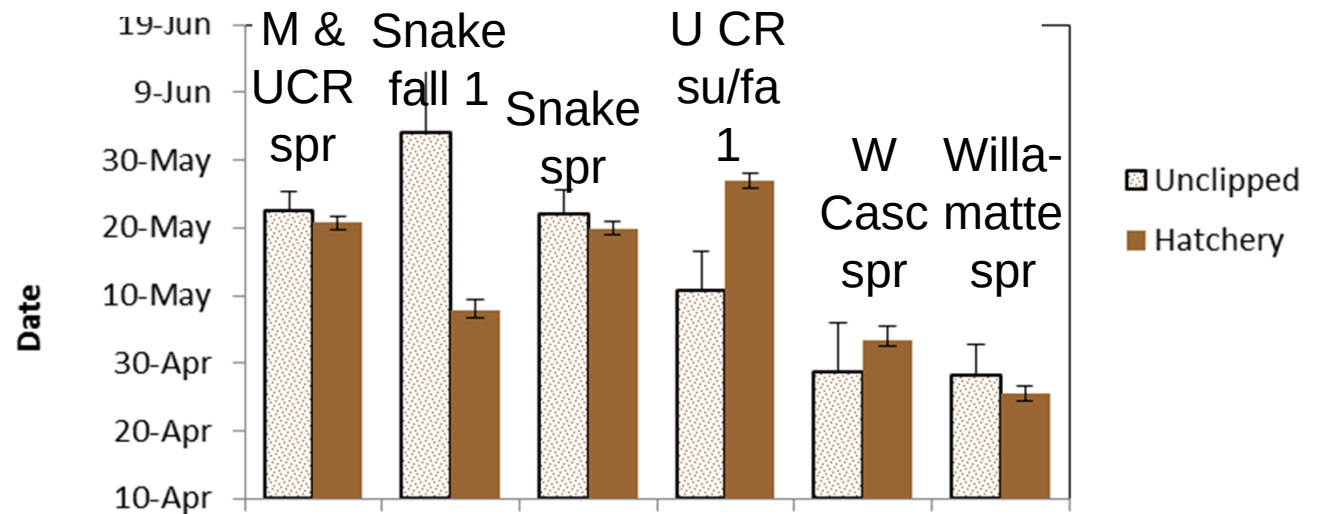


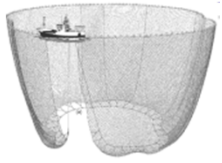
Yr. Chinook timing and size

Length in estuary



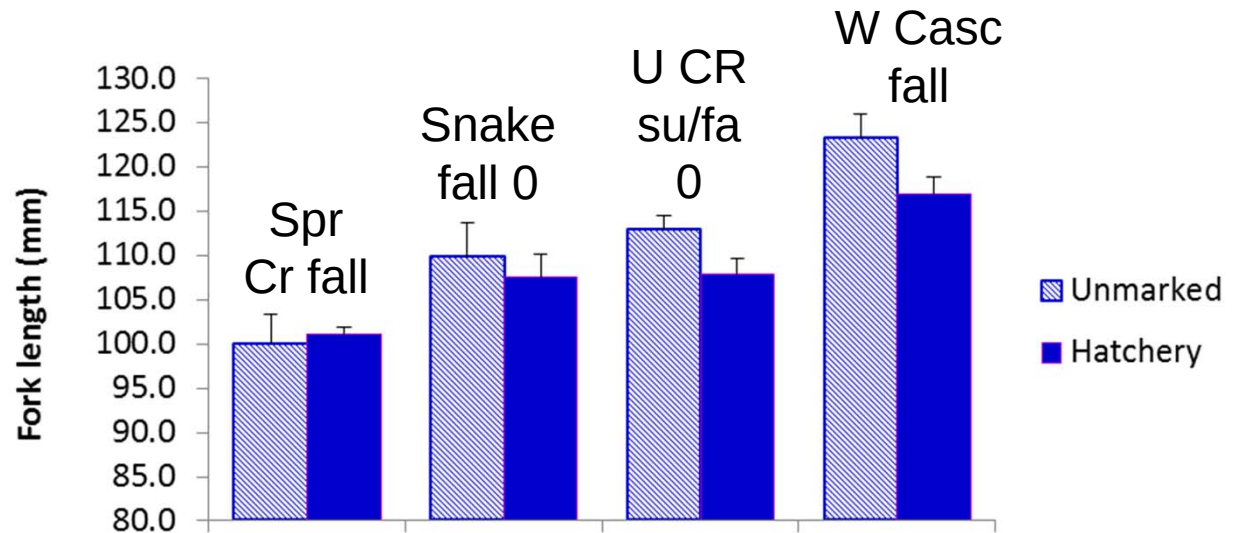
Date in estuary



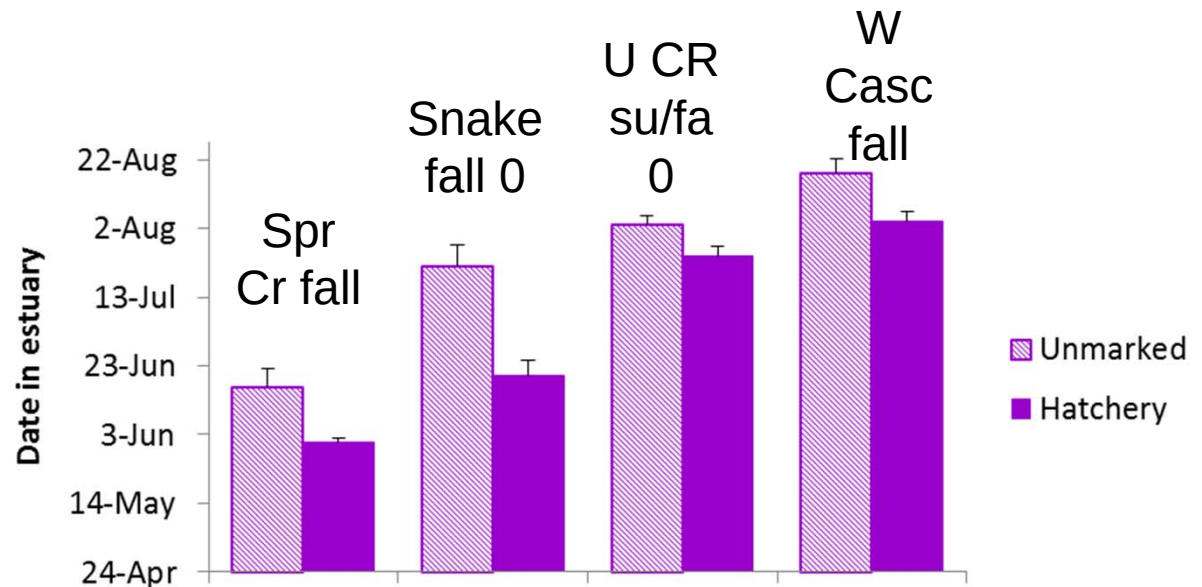


Subyr. Chinook timing and size

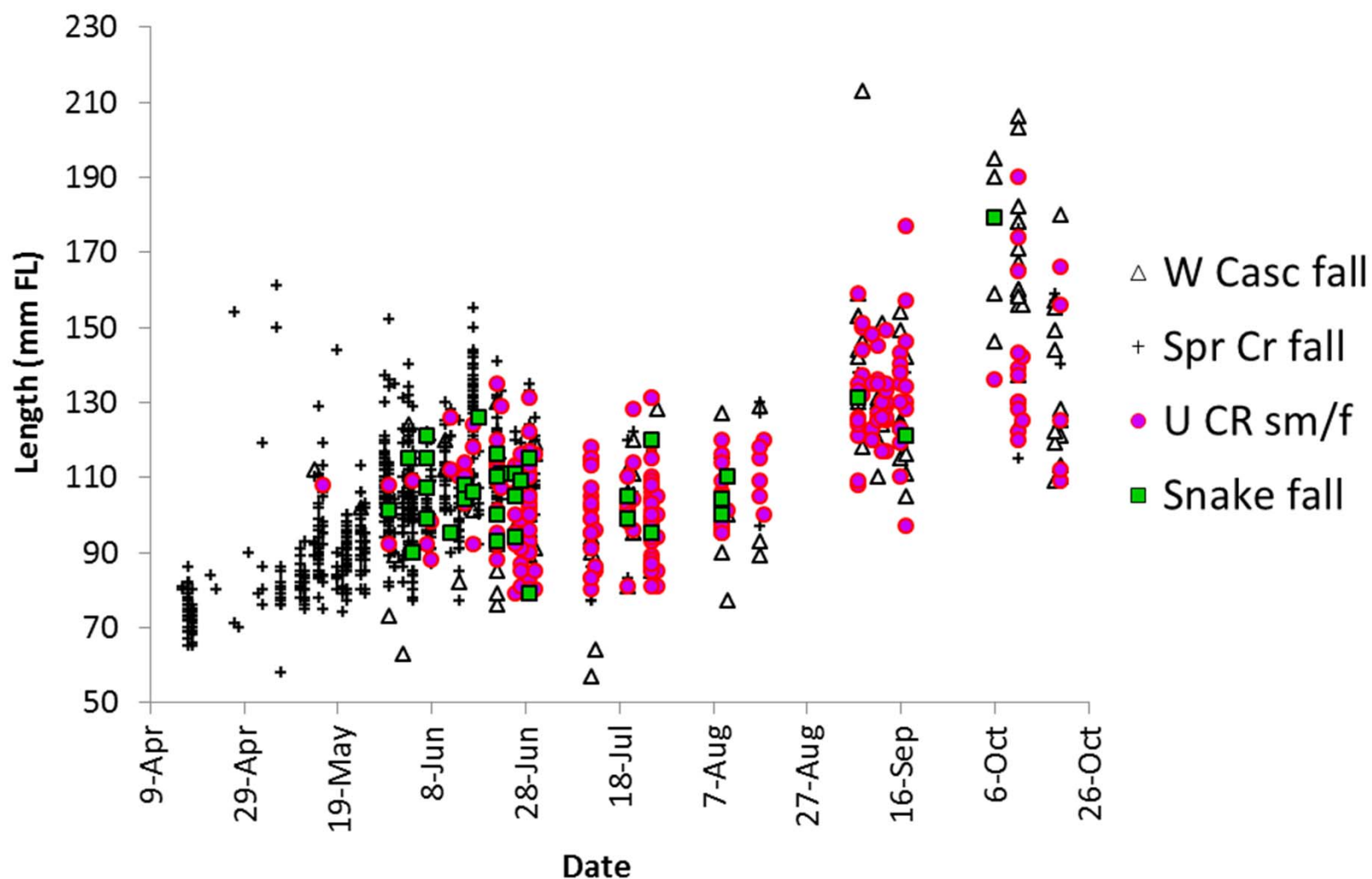
Length in estuary

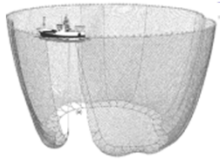


Date in estuary



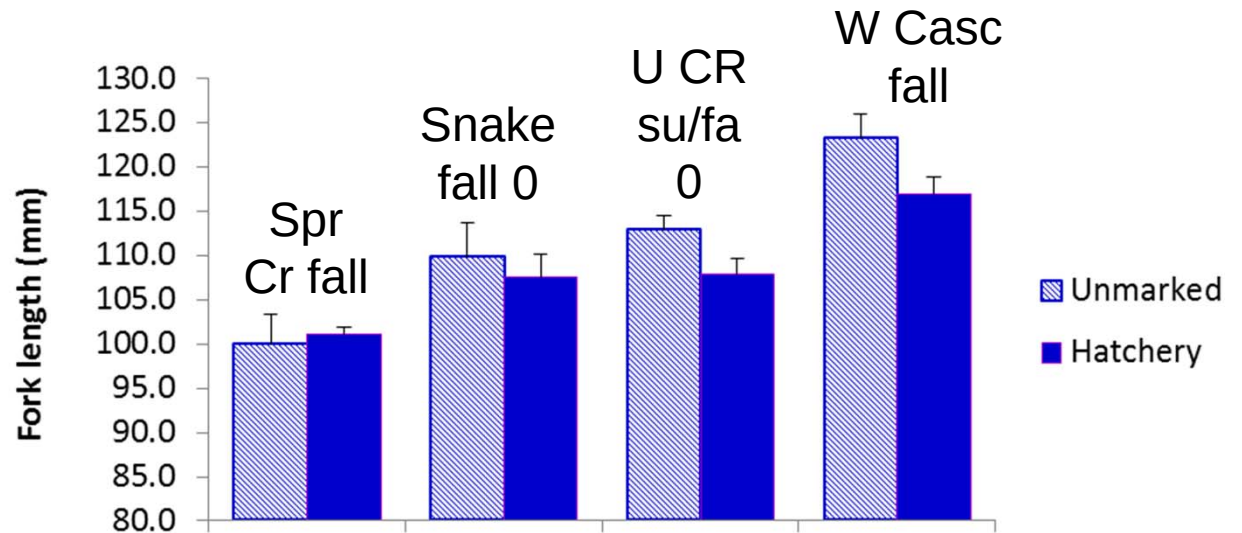
Subyr. Chinook size & time in estuary (GSI)



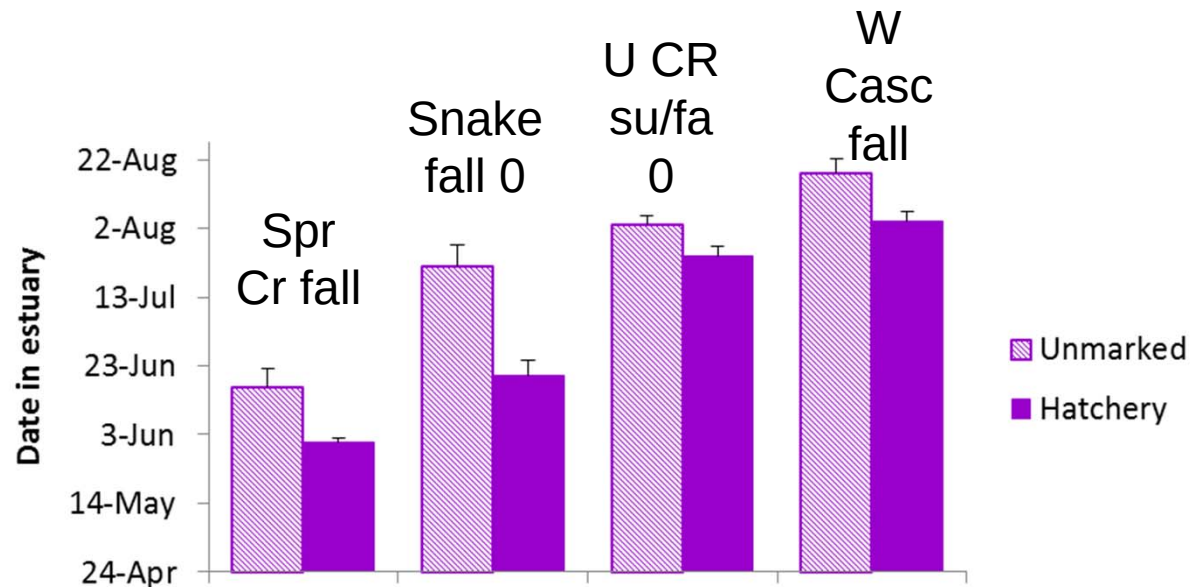


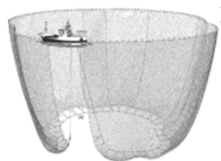
Subyr. Chinook timing and size

Length in estuary



Date in estuary



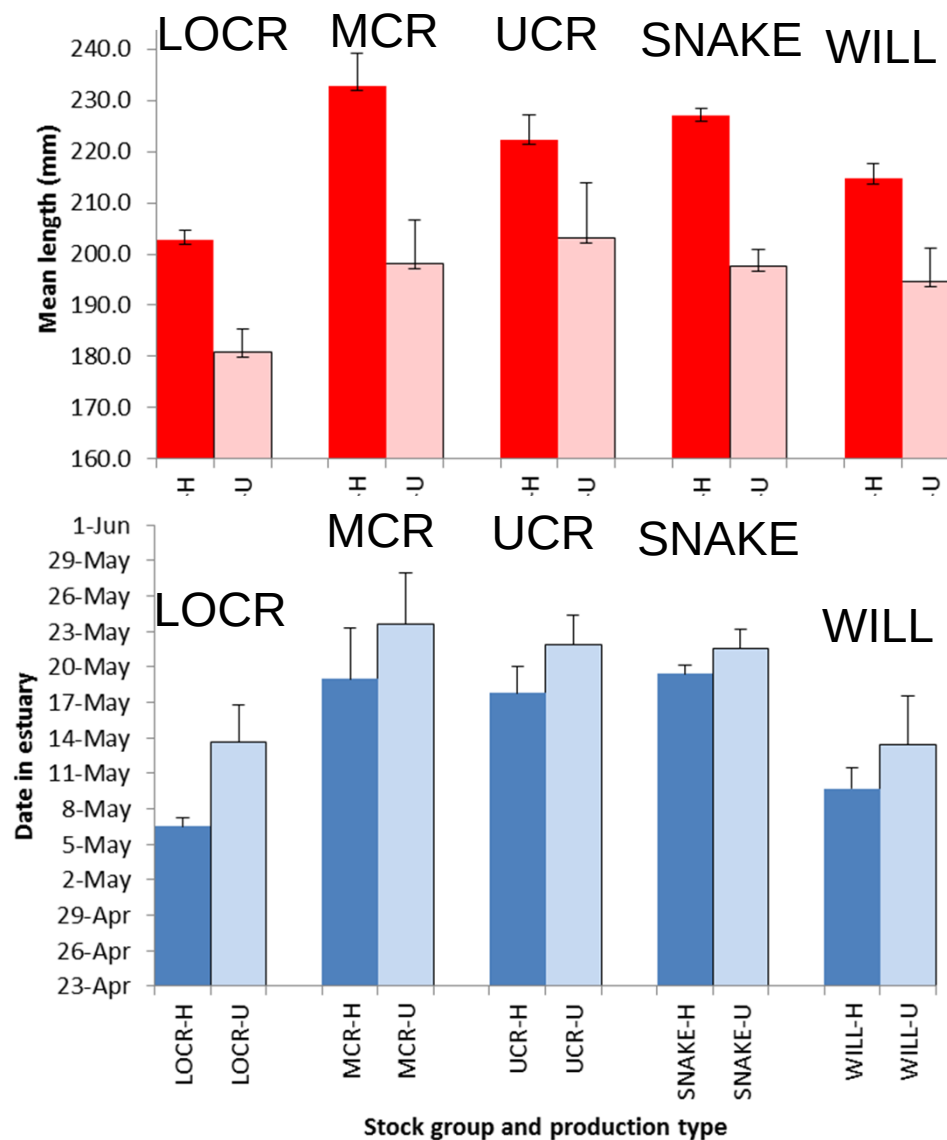


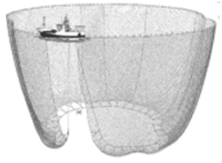
Steelhead timing and size

Length in estuary

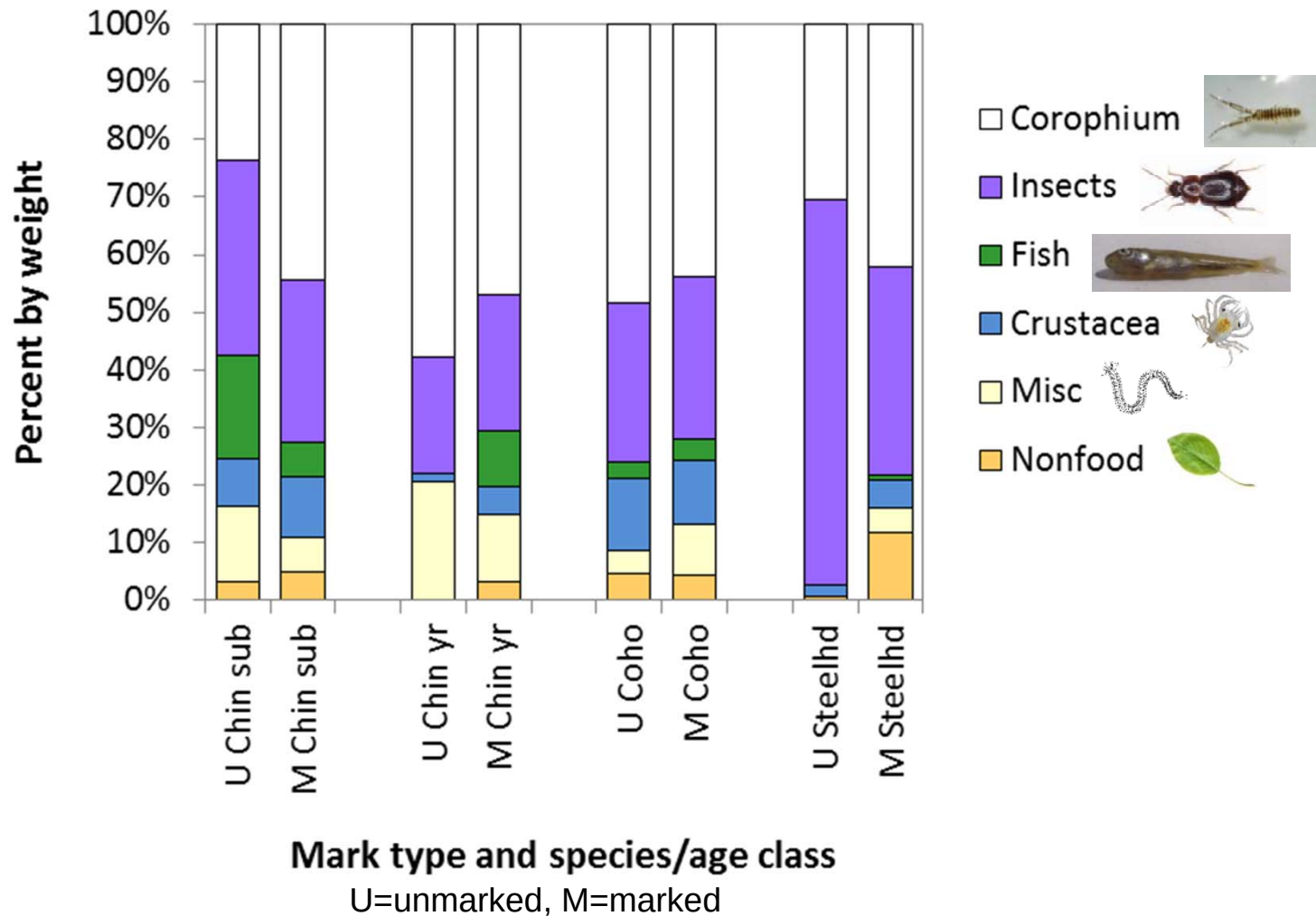
Dark bars: Hatchery
Light bars: Unclipped
(=H+W)

Date in estuary





Prey consumed by H-W salmon



Summary

- Majority (>70%) of juv. salmon in CR estuary are of hatchery origin
 - <100% hatchery marking = difficult to tell hatchery from wild
- Habitat use similar between Hatchery and wild salmon
 - H & W coho, yr. Chinook, and steelhead in deep water habitats
 - Slightly more wild than hatchery subyearling Chinook in shallow water
- Hatchery fish generally larger than unmarked fish (esp. steelhead)
 - exception: subyearling Chinook salmon (timing = size)
- Timing similar between H & W salmon (~1 week)
 - exception: wild subyr Chinook salmon 2-4 weeks later than hatchery
- Diet overlap appears to be high among and within groups
 - No evidence that H steelhead consuming wild salmon (subyr Chinook or chum)

Conclusions

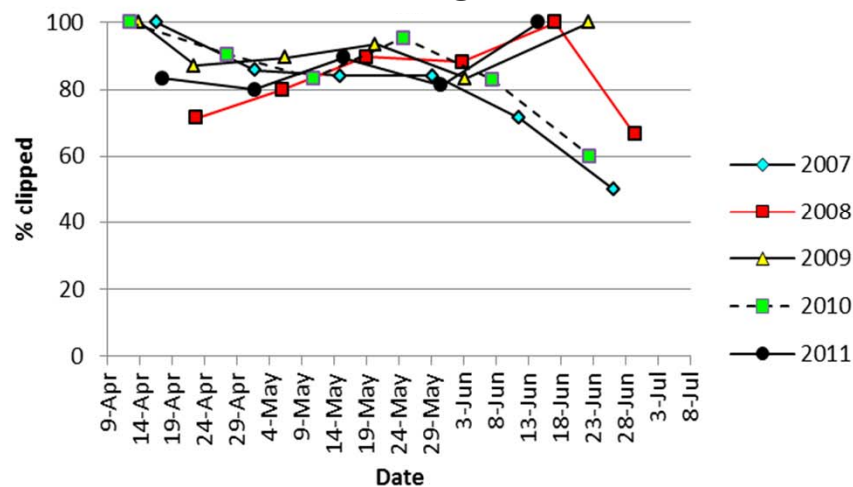
- High potential for competition between hatchery and wild salmon (within and among species) in estuaries
 - Occupying same habitats at same times (ex. subyr Chinook)
 - Consuming same prey types
- Also potential for direct behavioral interactions
 - Larger hatchery fish may have size advantage
- 100% mark rates for hatchery fish would greatly improve ability to make comparisons



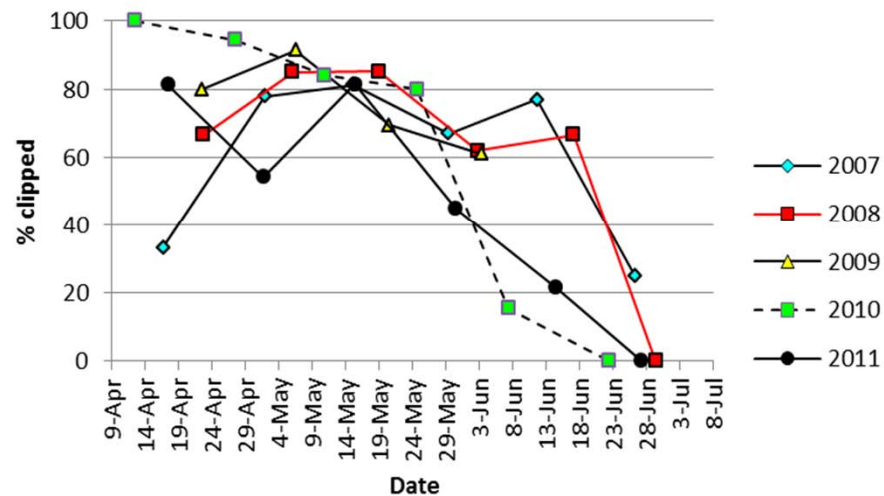


Clip rates by group (% clipped)

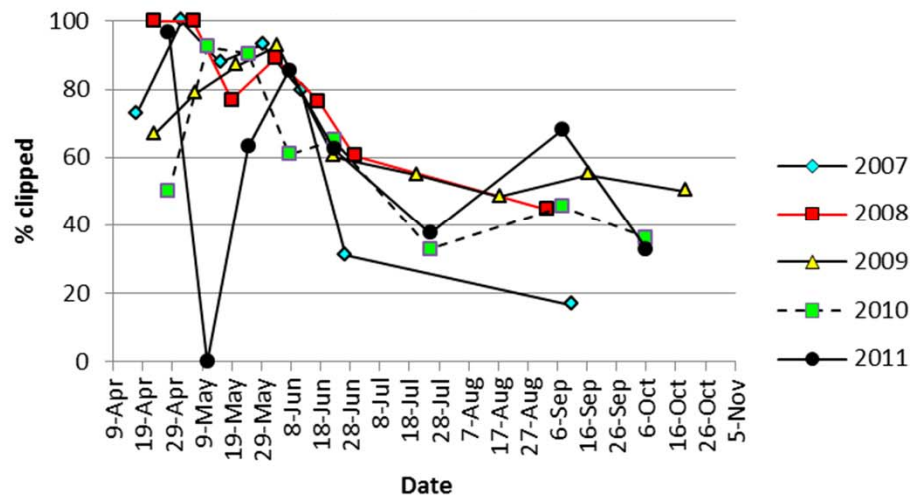
Yearling Chinook



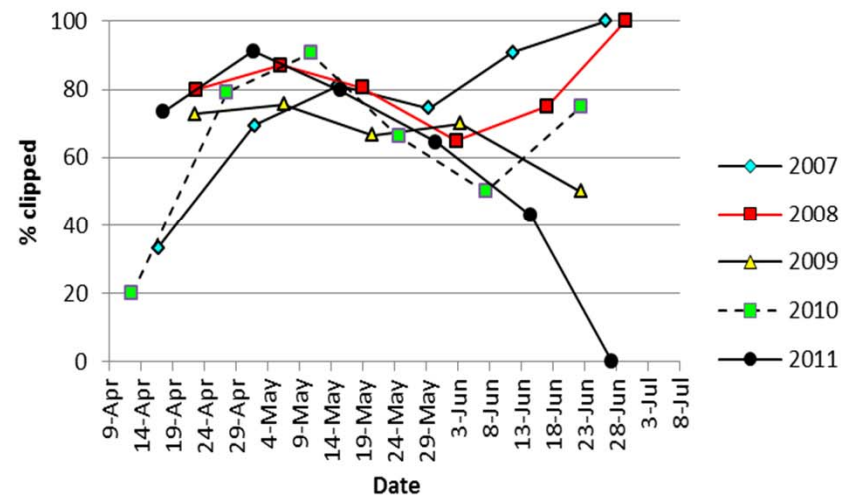
Coho



Subyearling Chinook

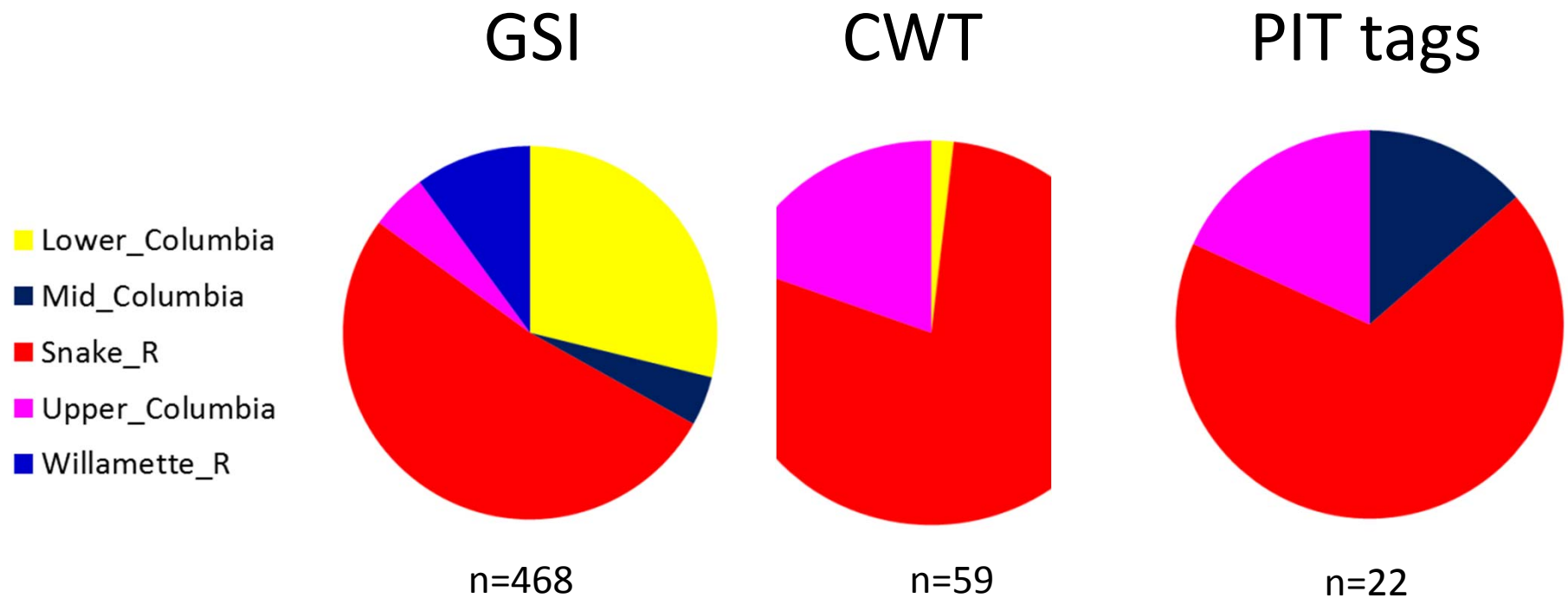


Steelhead



Bias from fish origin method

Ex. Steelhead origins



Geographic origins of Columbia salmon

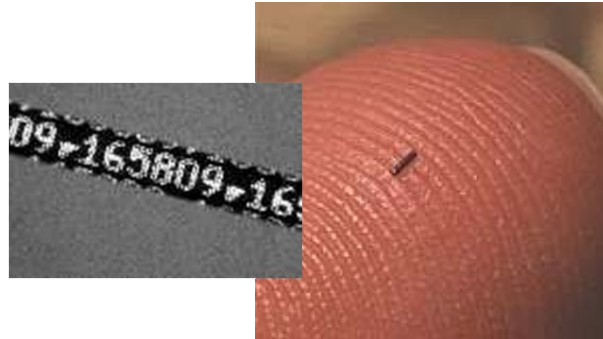
Genetics



Chinook
Steelhead

Everything
"tagged"
CR coho mush

Coded wire tags (CWT)



Coho
Chinook
Steelhead

24 mil tagged
(h)

PIT tags



[Coho]
Chinook
Steelhead

2 mil tagged
(h & w)
Bias: UCR & Snake