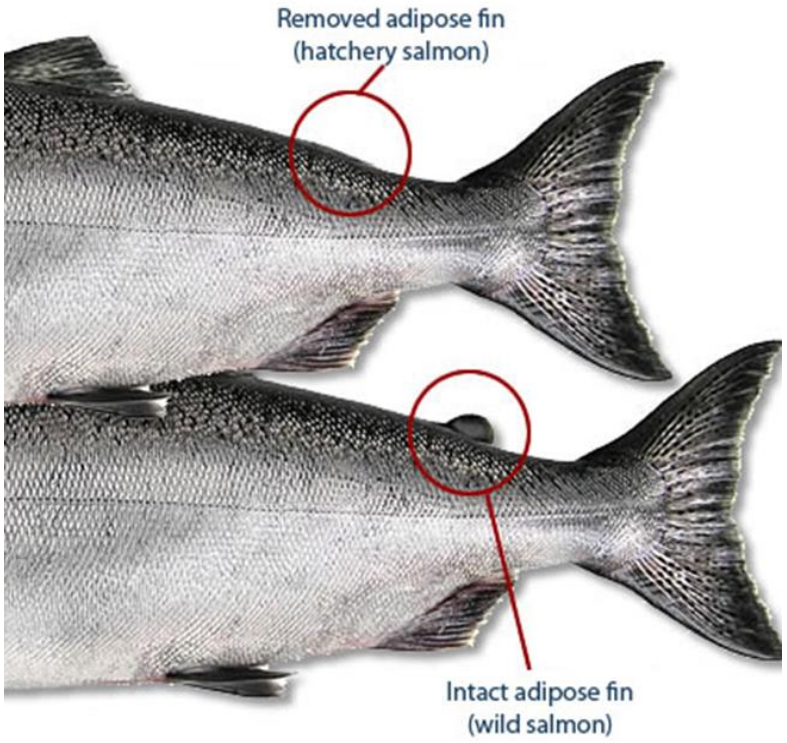
Practical considerations for detecting density dependence in the Columbia River estuary

(It's not just about hatchery and wild salmon)



Direct competition for prey resources

Diet overlap + limited resource = competition

From diet studies

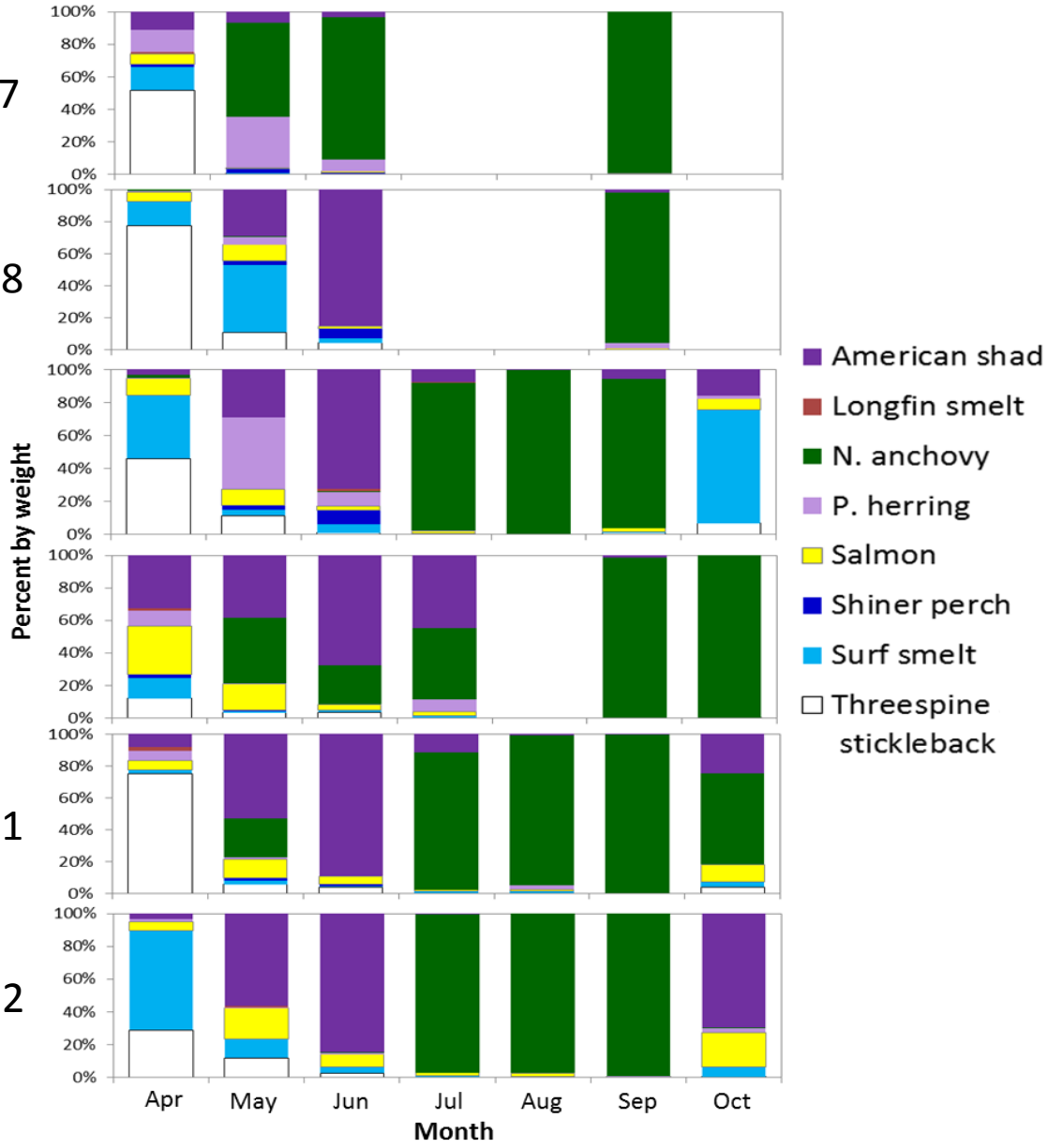
From estimates of prey availability

Challenges

Challenge 1. Need diets of other (non-salmonid) fish, too

Challenge 2. Where to sample?
Challenge 3. Prey don't stay still

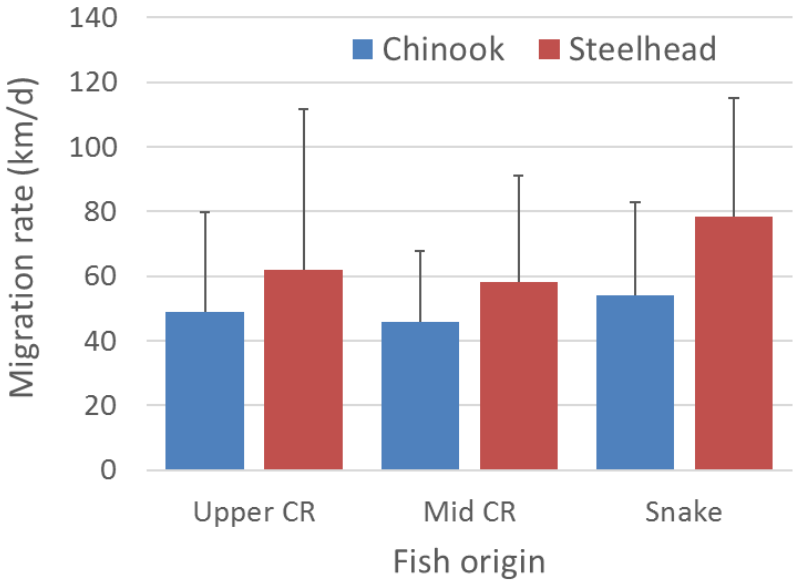
Challenge 1. Juvenile salmon are minor members of the estuarine fish community.
To understand competition, need info on diets of all fish



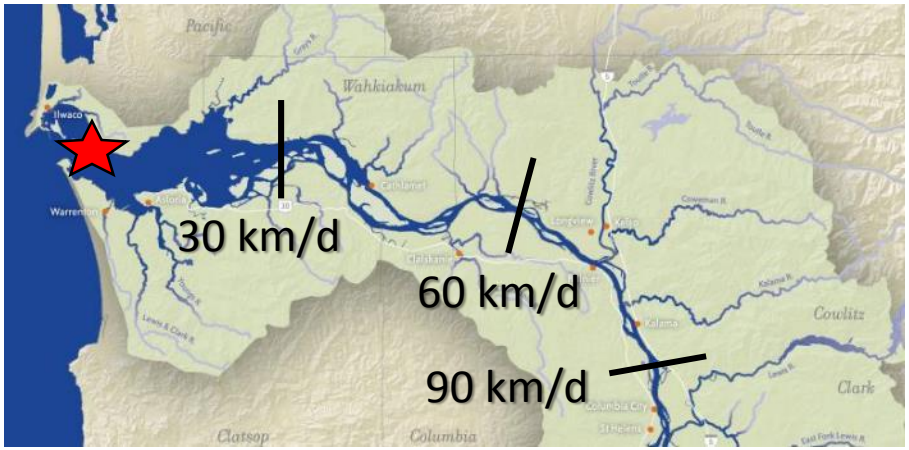
Fish community composition from the lower Columbia River Estuary

Challenge 2. Where to sample prey when fish are migrating rapidly downstream?

Migration rates for PIT-tagged juvenile Chinook and steelhead detected at dams and subsequently caught in the lower estuary.

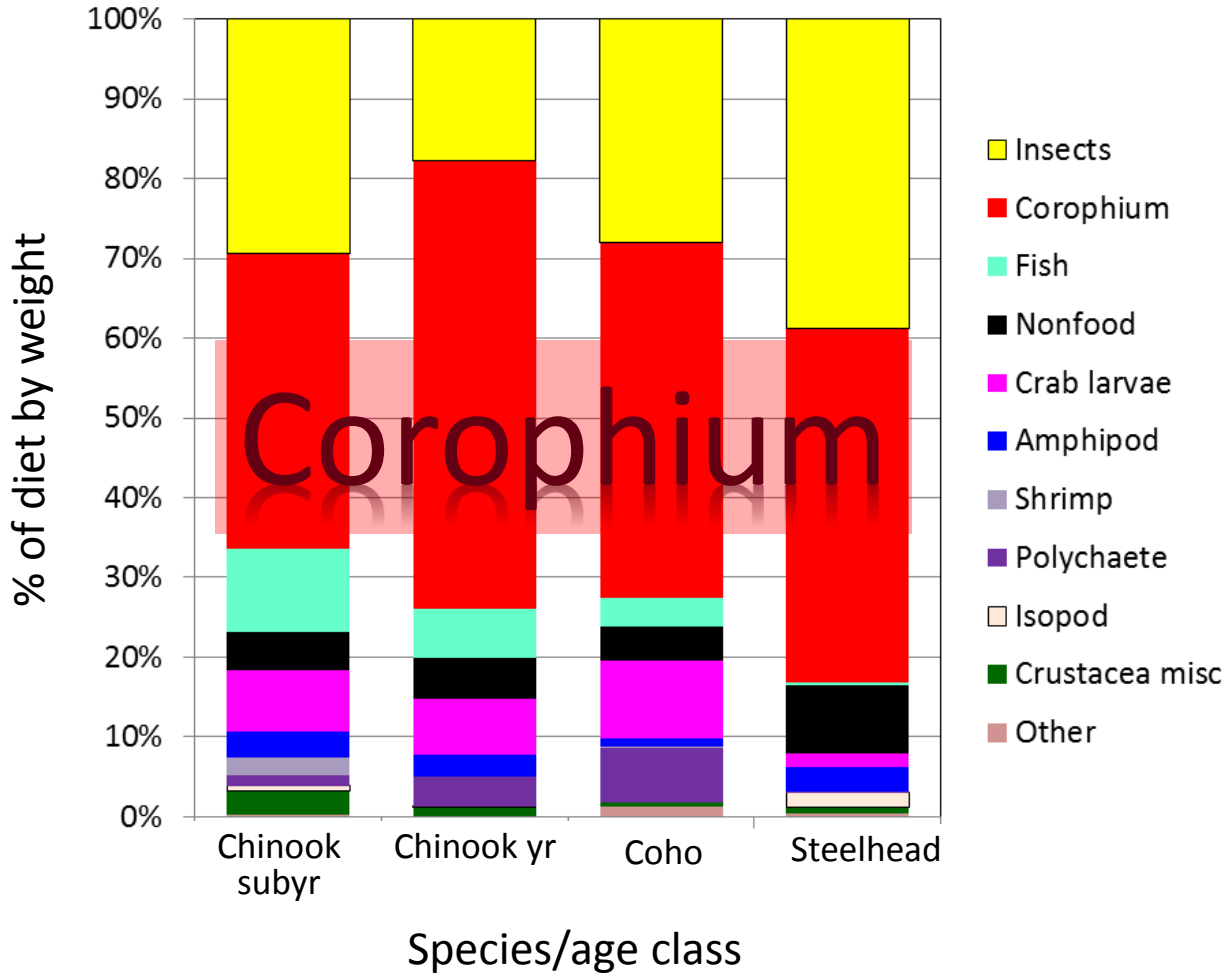


Feeding areas for fish moving at different rates and collected at the mouth

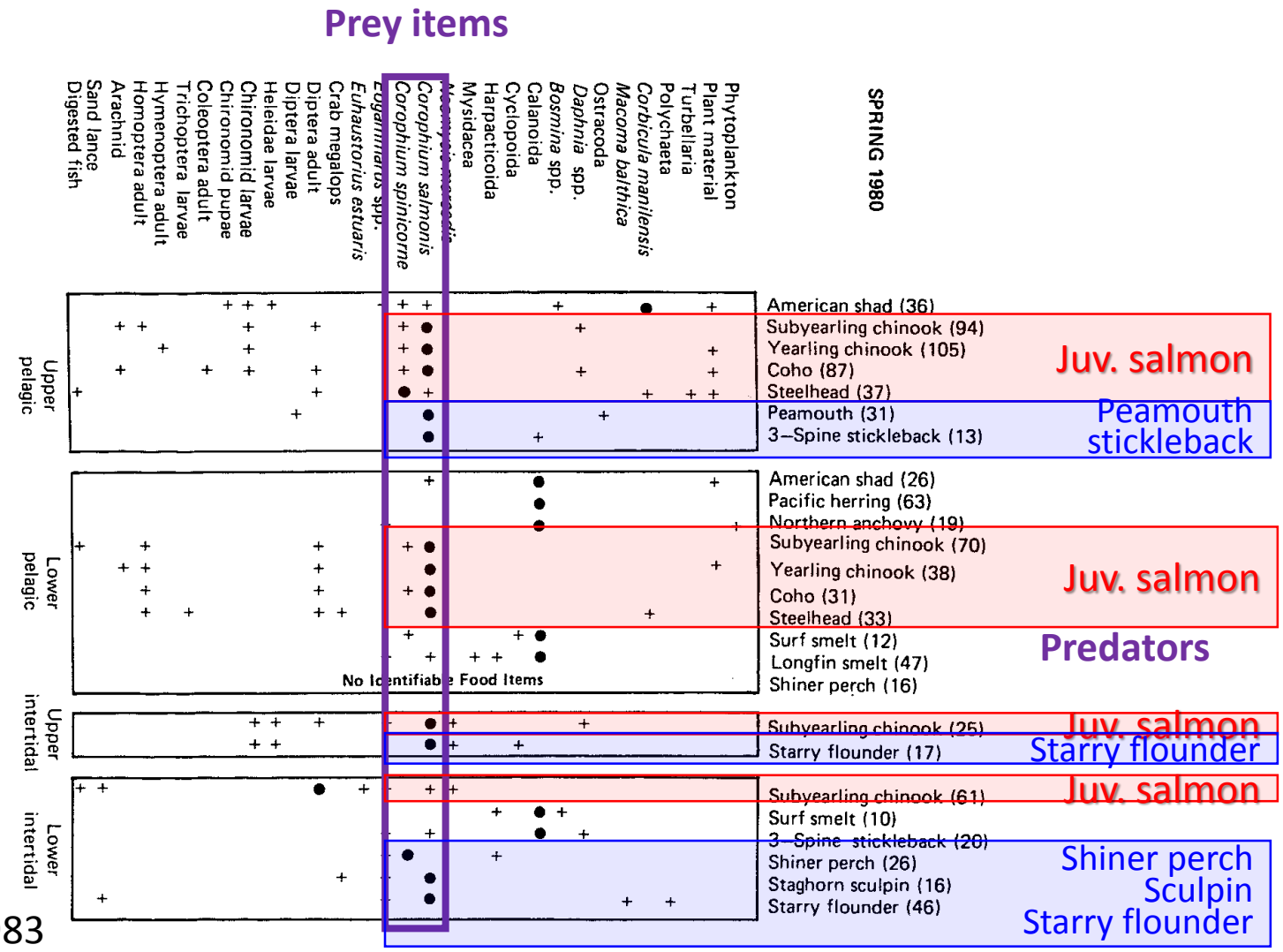


Challenge 3: The amphipod *Americorophium* is a key prey species in the Columbia estuary but doesn't sit still

Americorophium is a important prey for juvenile salmon in the Columbia River estuary



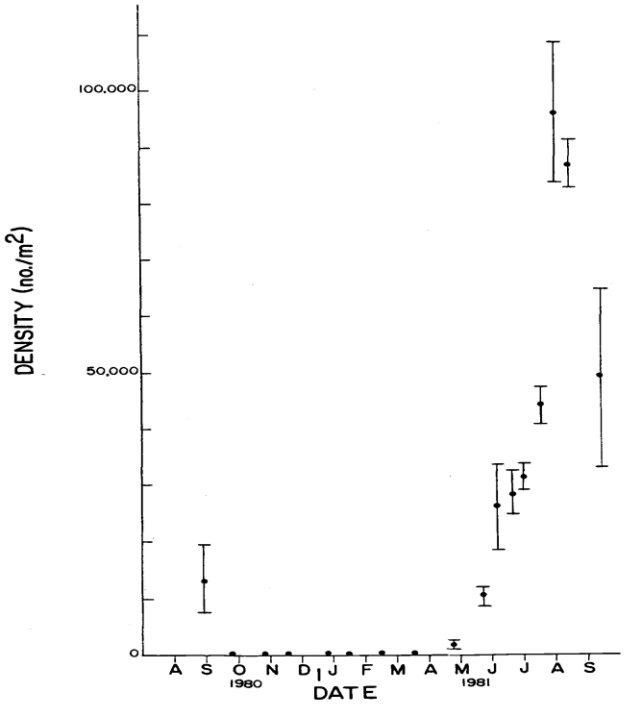
It is also important prey for other estuarine fishes

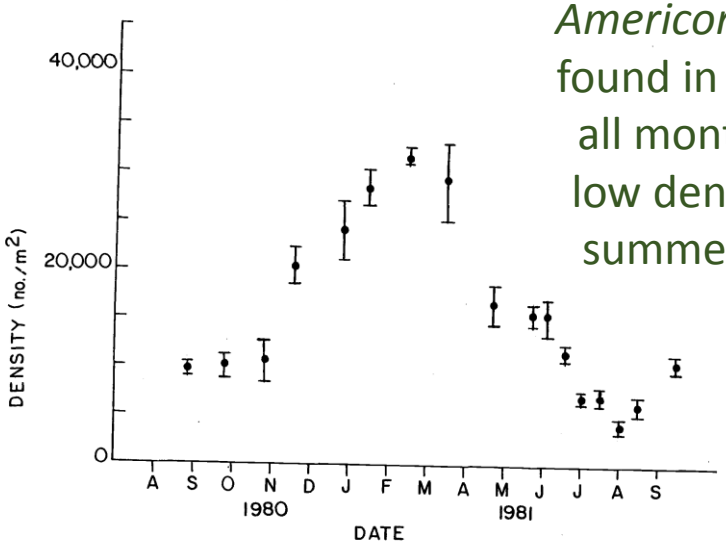


McCabe et al. 1983

The only study (in 1980/81) of *Americorophium* showed it moved around in the Columbia estuary. Need to understand its movements and dynamics to estimate abundance.

Americorophium only present at Desdemona Sands during summer, but at very high densities.





Americorophium was found in Grays Bay in all months but had low densities in the summer (moved?)

How to study density dependence in the CR estuary?

Ongoing work

- Better understanding of prey dynamics and abundance
  - *Americorophium* dynamics in lower estuary (*could be greatly expanded*)
  - Prey (insect) production & export from wetlands (*could be expanded*)
- Diets of juvenile salmon migrating from BON to mouth
- Diets & consumption rates of juvenile salmon in wetland habitats

Could be done

- Modeling to determine size of potential effects, including:
  - Estimated prey consumption by different guilds of fish (eat common prey)
  - Biomass to support consumption at range of rates
  - Environmental factors influencing prey availability & consumption
  - Putting it all together to identify potential bottlenecks
- Diets and abundance of likely non-salmonid competitors
- Once we know more (about prey, competitors), putting it all together

I wasn't going to show this slide

Summary

- Estuarine (and ocean) environments are extremely dynamic, from daily tides to seasonal freshets
- Fish (and their prey) respond to dynamic environments in a variety of way that are generally poorly understood.
- Documentation of density dependence is complicated in systems like the Columbia. It requires:
  - Diet information from likely predators, which may be rapidly migrating (salmon) or numerous (other fishes)
  - Abundance information for key prey (which also move)
- Need focused studies to understand predator/prey dynamics and therefore opportunities for density dependence.

Hatchery-wild origins (2

I was going to keep this as an extra slide, if we need to make the points that

1) Its hard to tell which fish are truly wild
2) Wild sample sizes are so low its hard to do anything with them.

Species/ age class	Clip rates (%)	% hatchery	% wild
Yearling Chinook	91	95.5	4.5
Subyr. Chinook	76	83.6	16.4
Coho	75	94.8	5.2
Steelhead	78	91.7	8.3