

A landscape context for salmon restoration in the Skagit River basin

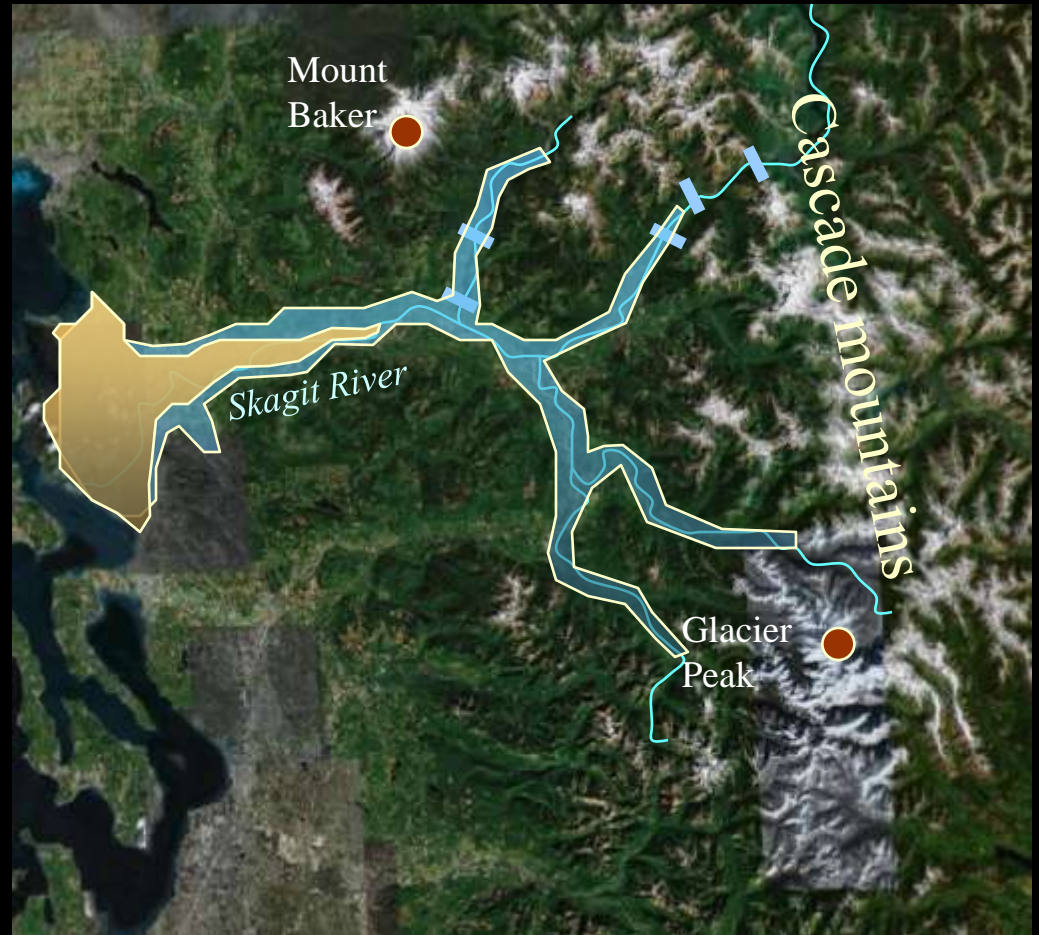


Tim Beechie

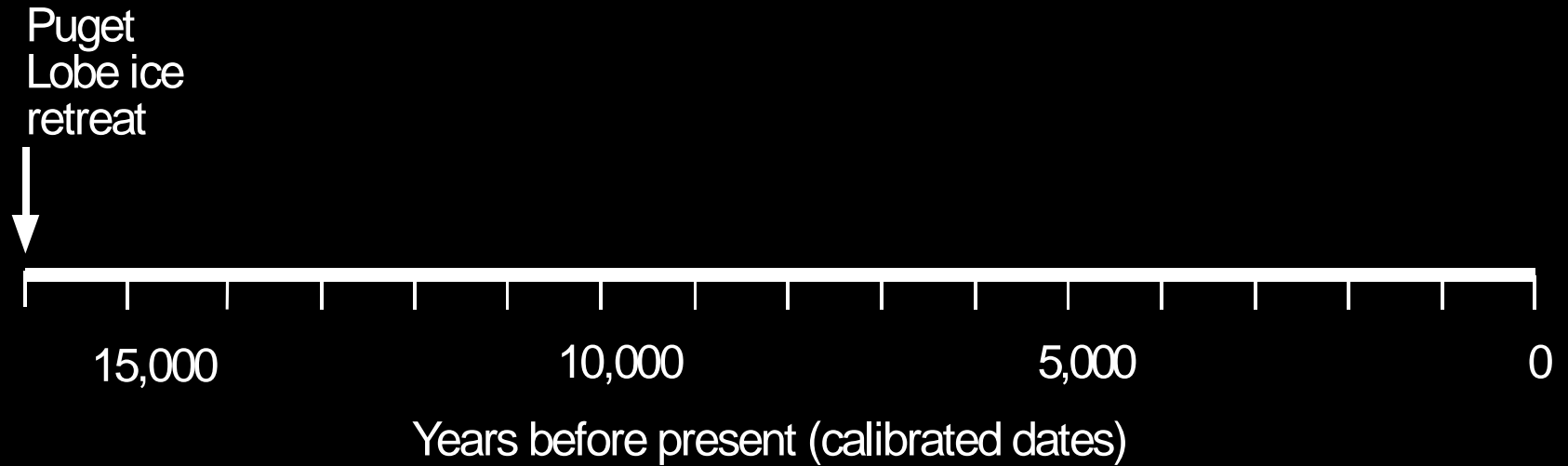
Northwest Fisheries Science Center, NOAA Fisheries, Seattle, Washington

The Skagit basin

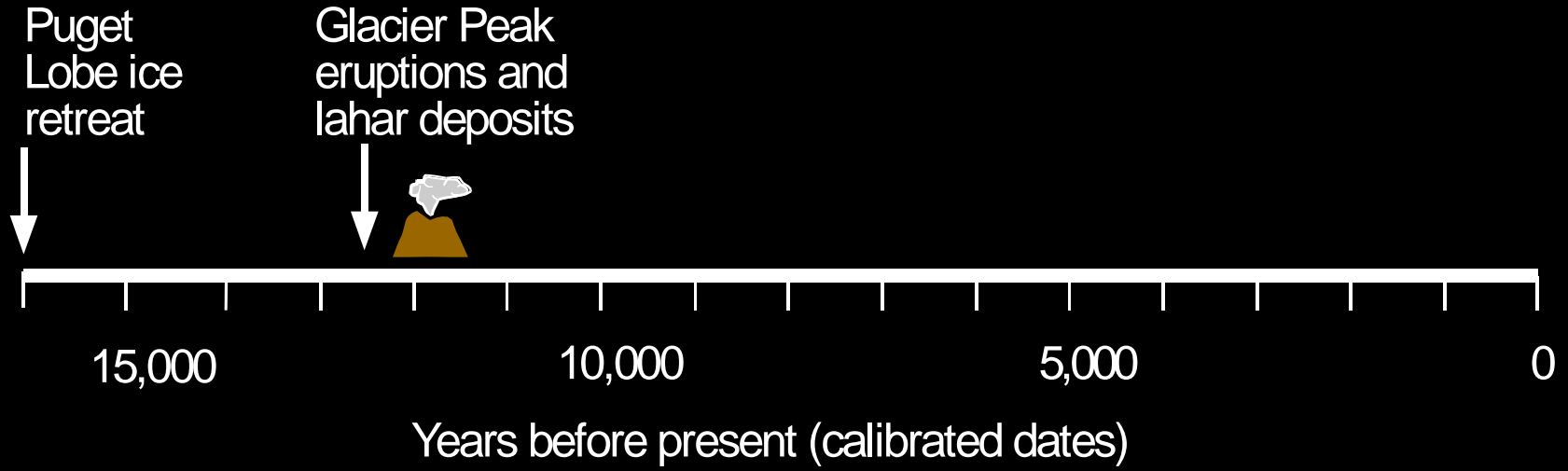
- Area: 8,000 km²
- Glaciated between 18,000 and 16,000 ybp
- Salmon in all main basins
- Intensive land use in lower rivers



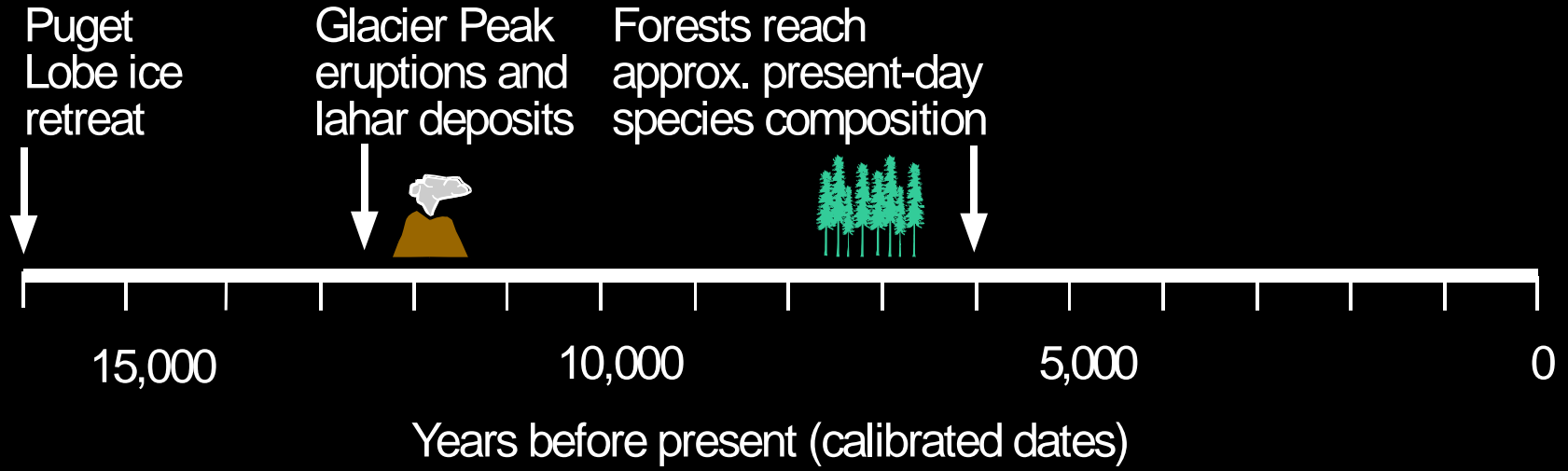
Holocene history



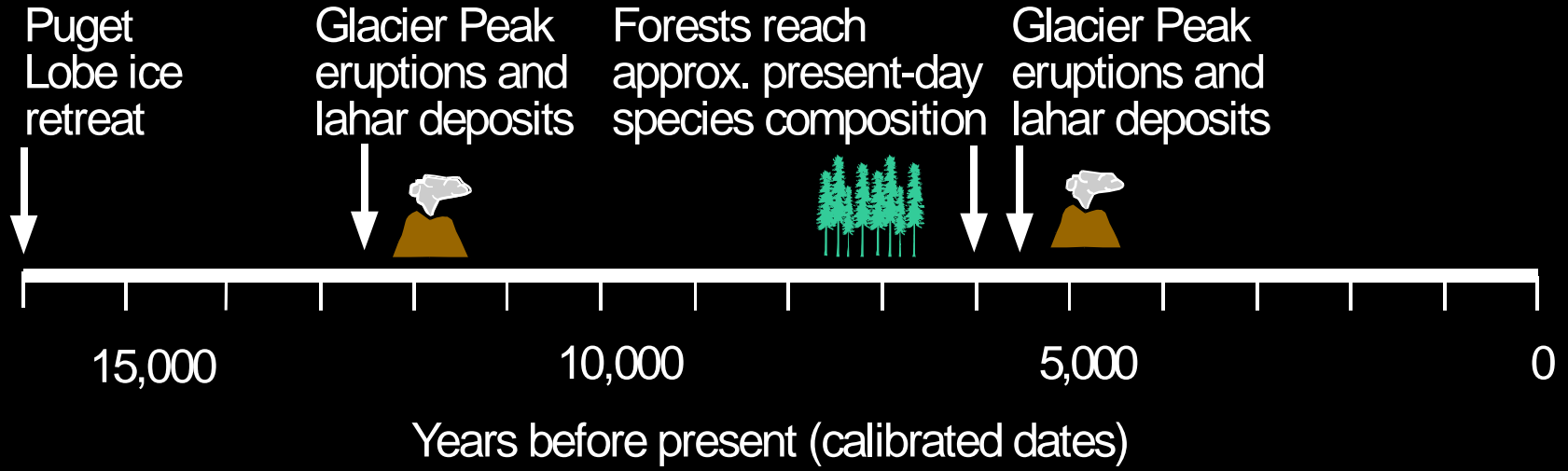
Holocene history



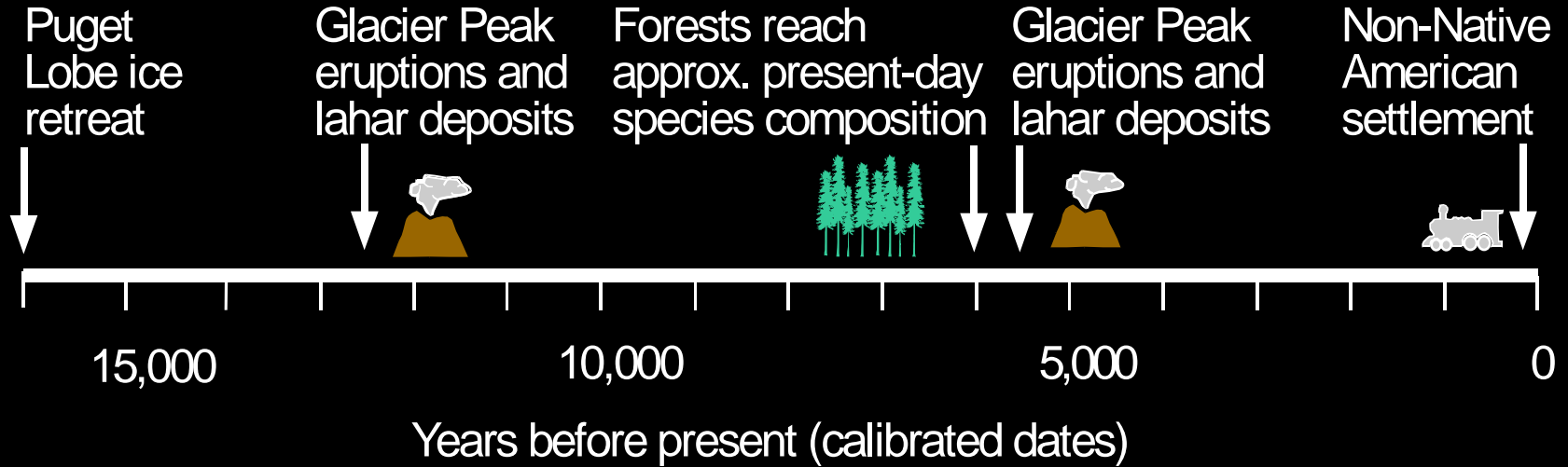
Holocene history



Holocene history



Holocene history



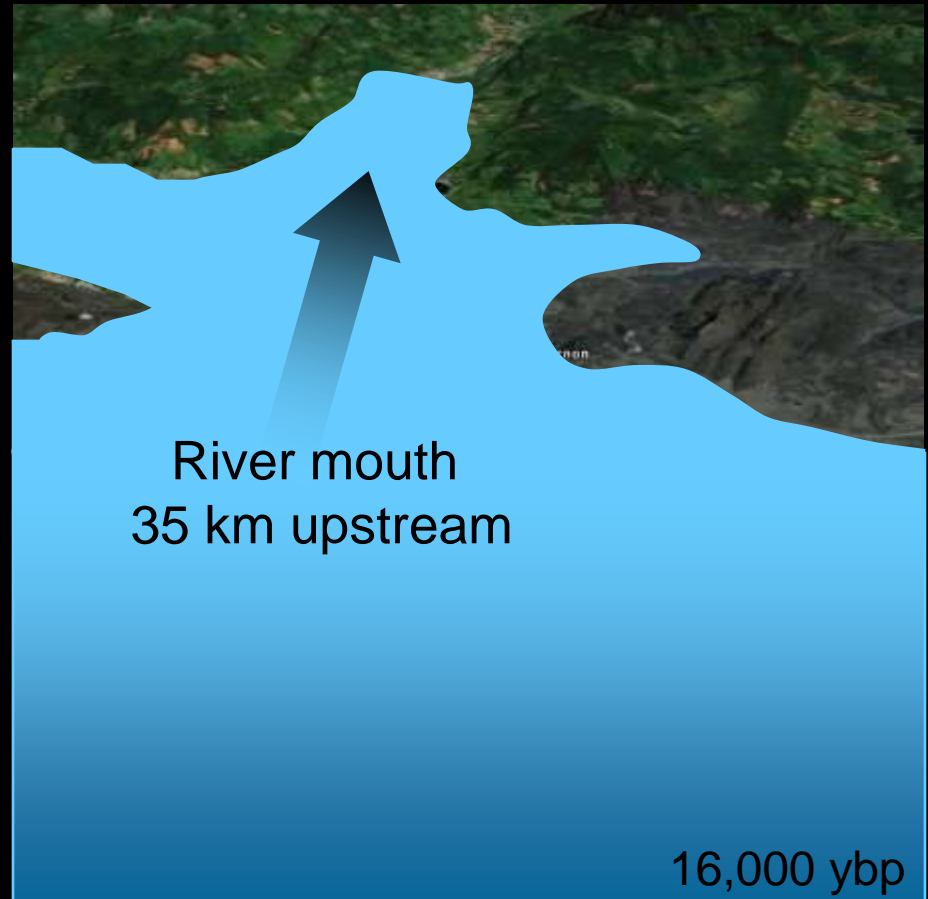
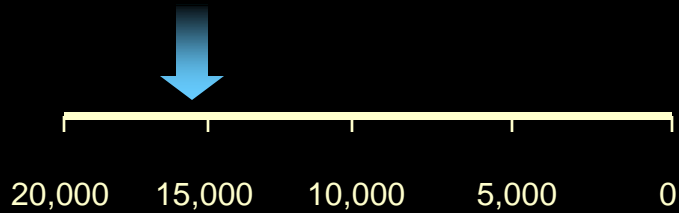
Post-glacial elevation changes

- Isostatic rebound: 200 m
- Sea level rise: 90 m
- River incision: 100-200 m



Post-glacial river mouth locations

■ 16,000 ybp



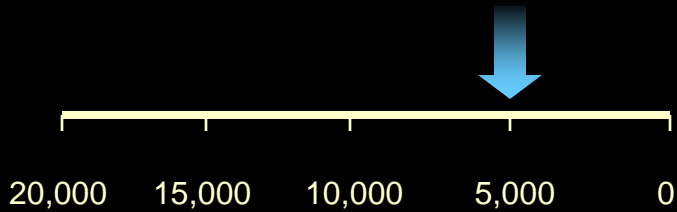
Post-glacial river mouth locations

■ 12,000 ybp



Post-glacial river mouth locations

■ 5,500 ybp

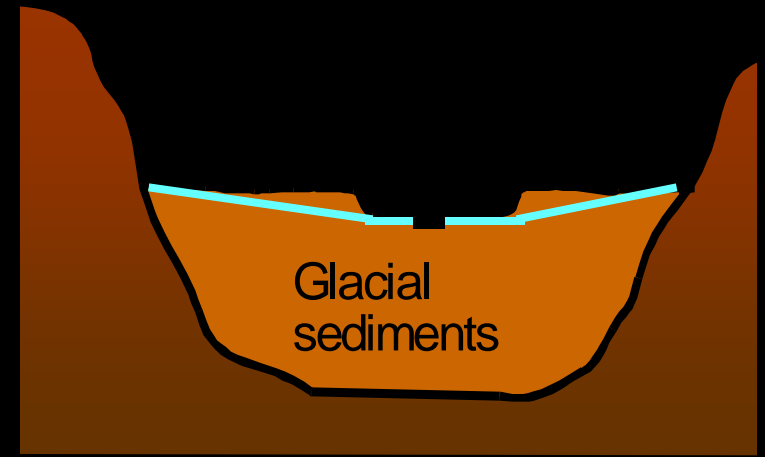
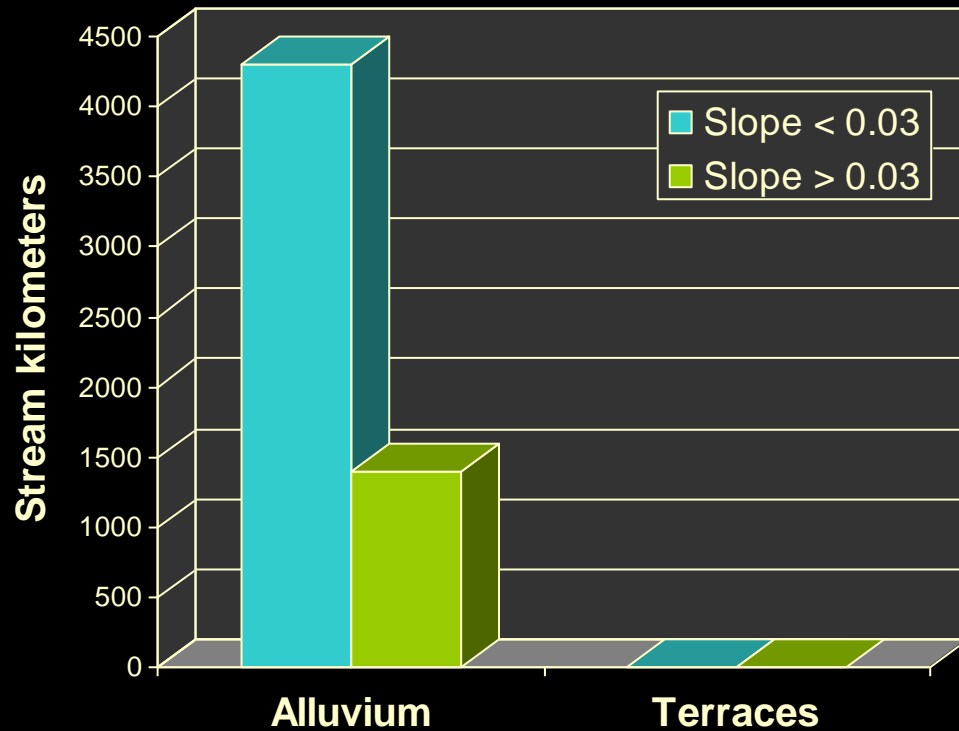


Post-glacial river mouth locations

■ Present day



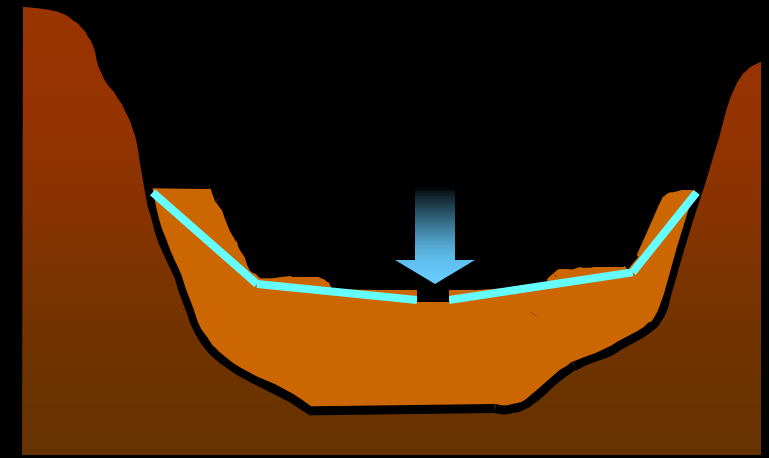
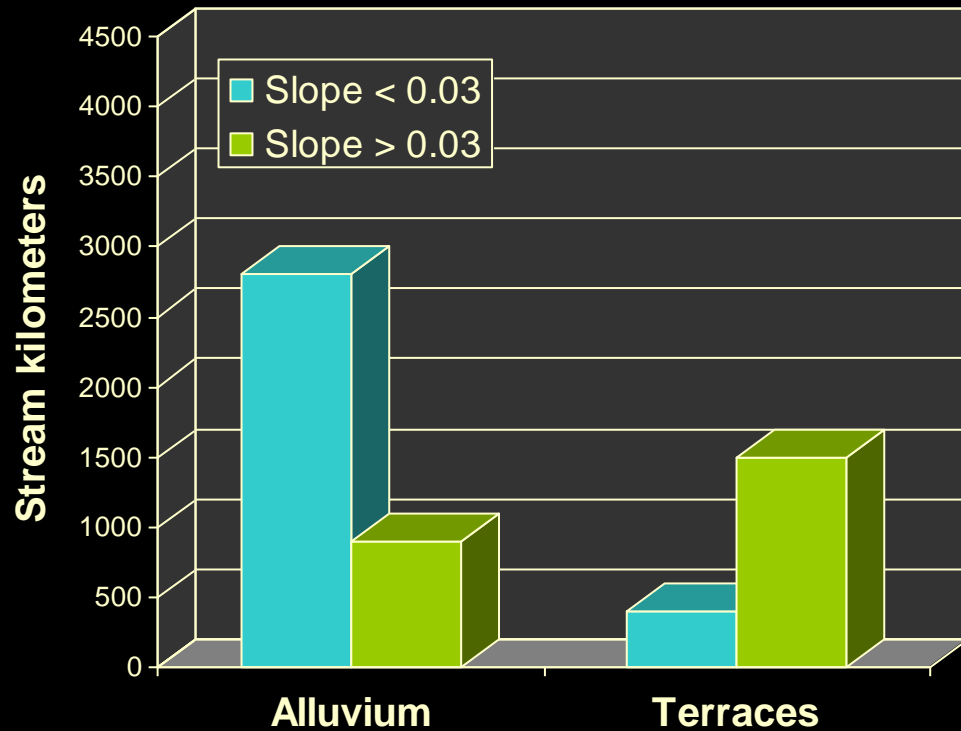
Holocene changes in tributary gradients



15,000 ybp

Tributary habitat: 4,300 km

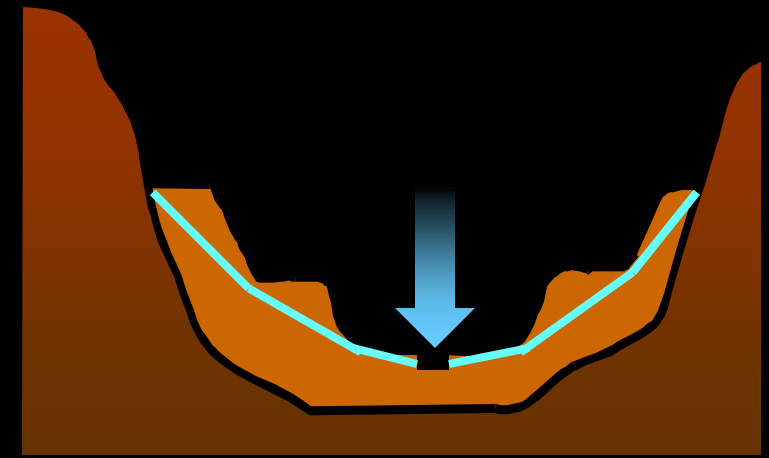
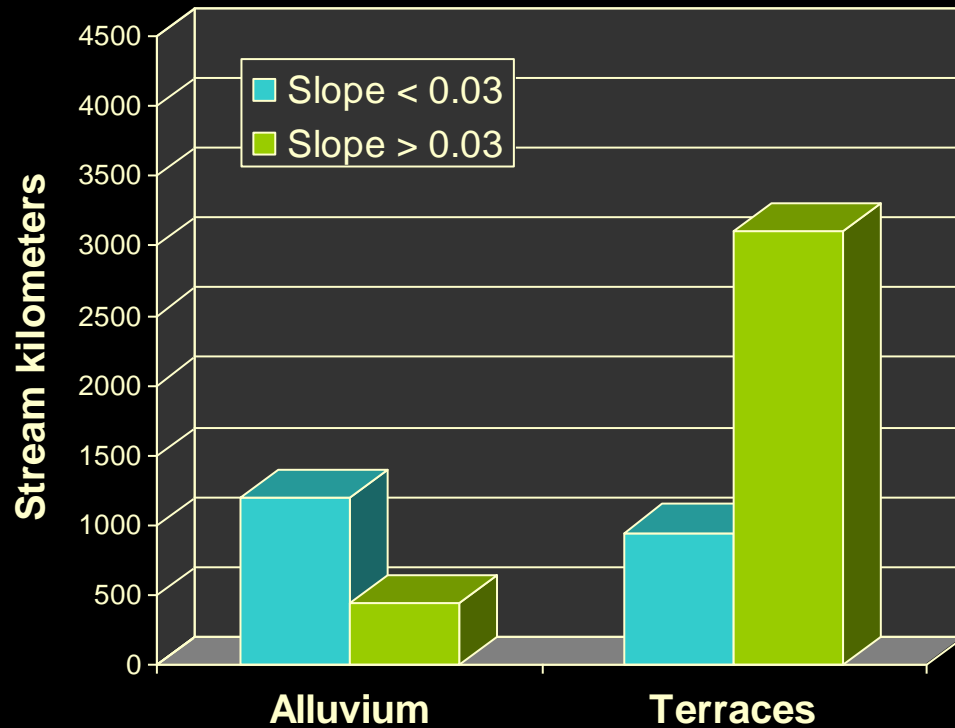
Holocene changes in tributary gradients



6,000 ybp

Tributary habitat: 3,200 km

Holocene changes in tributary gradients

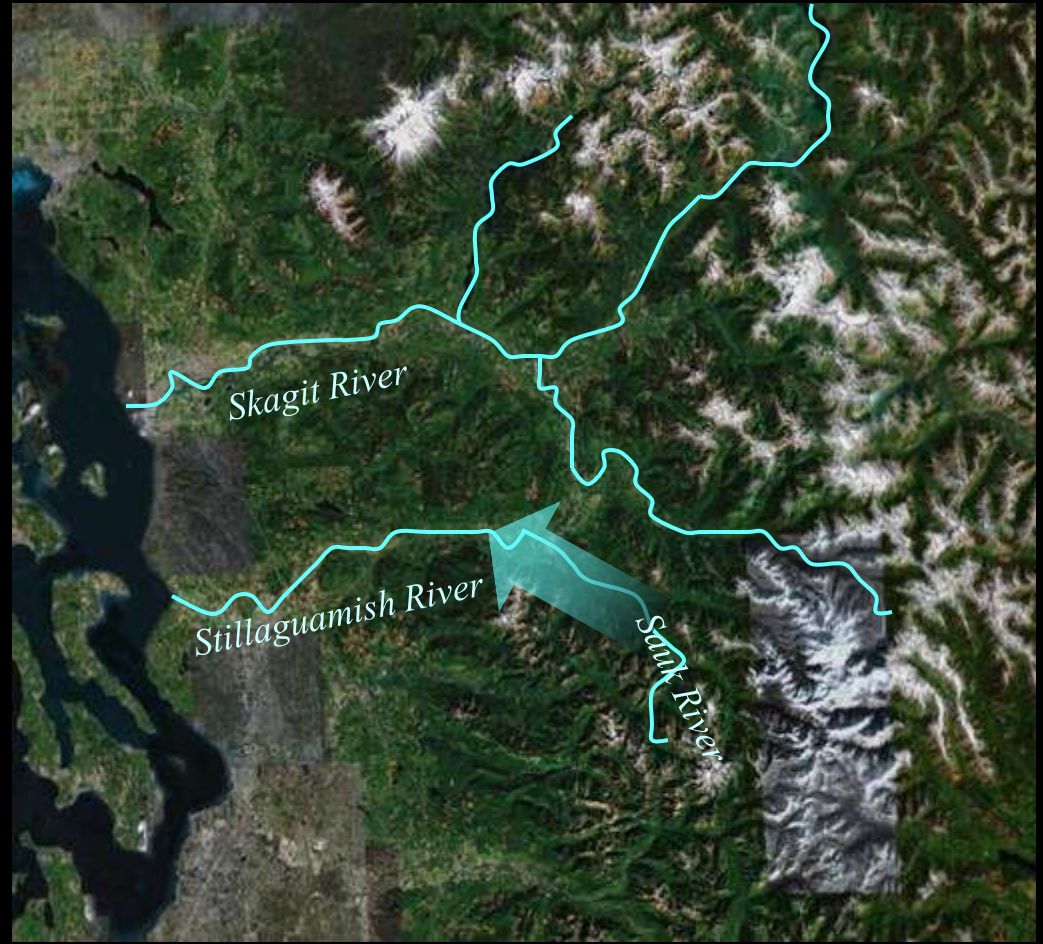


Present

Tributary habitat: 2,150 km

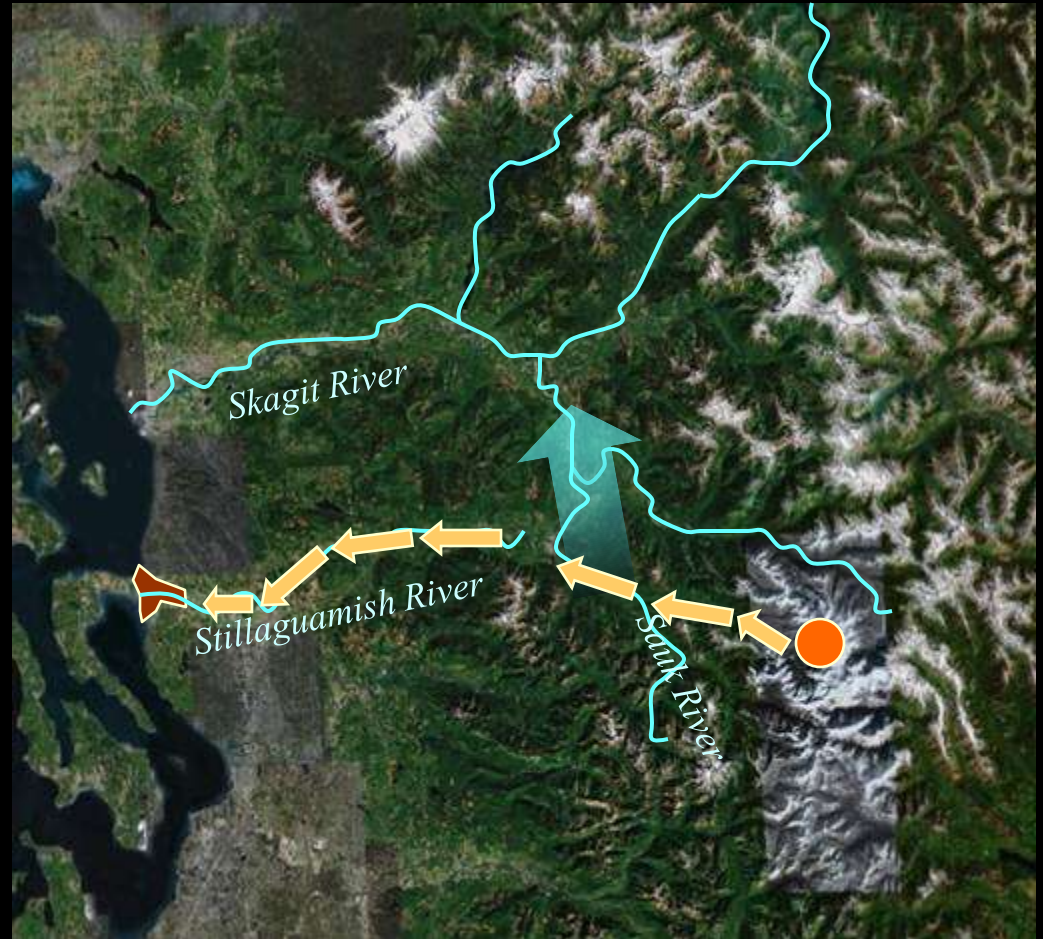
Before 12,000 ybp eruptive phase

- Sauk River outflow is westward
- Short deltas



After 12,000 ybp eruptive phase

- Sauk River outflow is northward
- Expanded delta in Stillaguamish River



After 5,000 ybp eruptive phase

- Sauk River outflow is still northward
- Lahars created extensive delta habitat in Skagit



Landscape evolution and habitat diversity



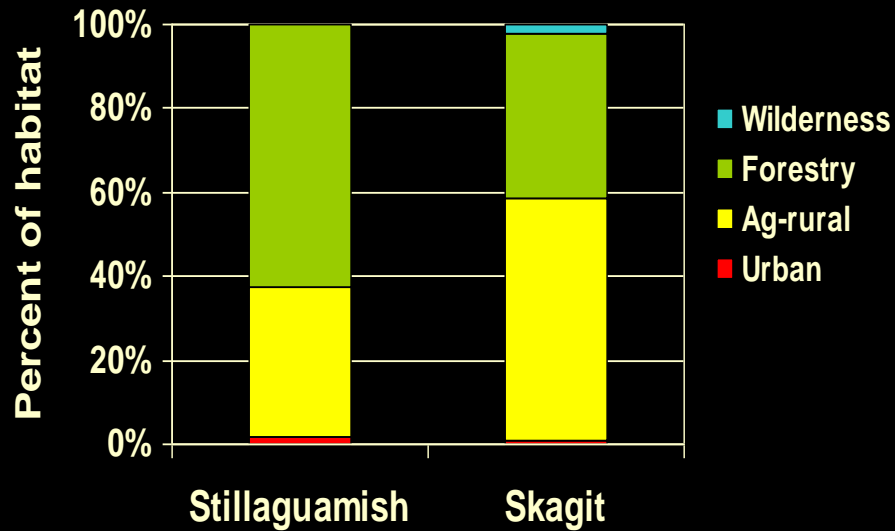
Land use and salmon habitat



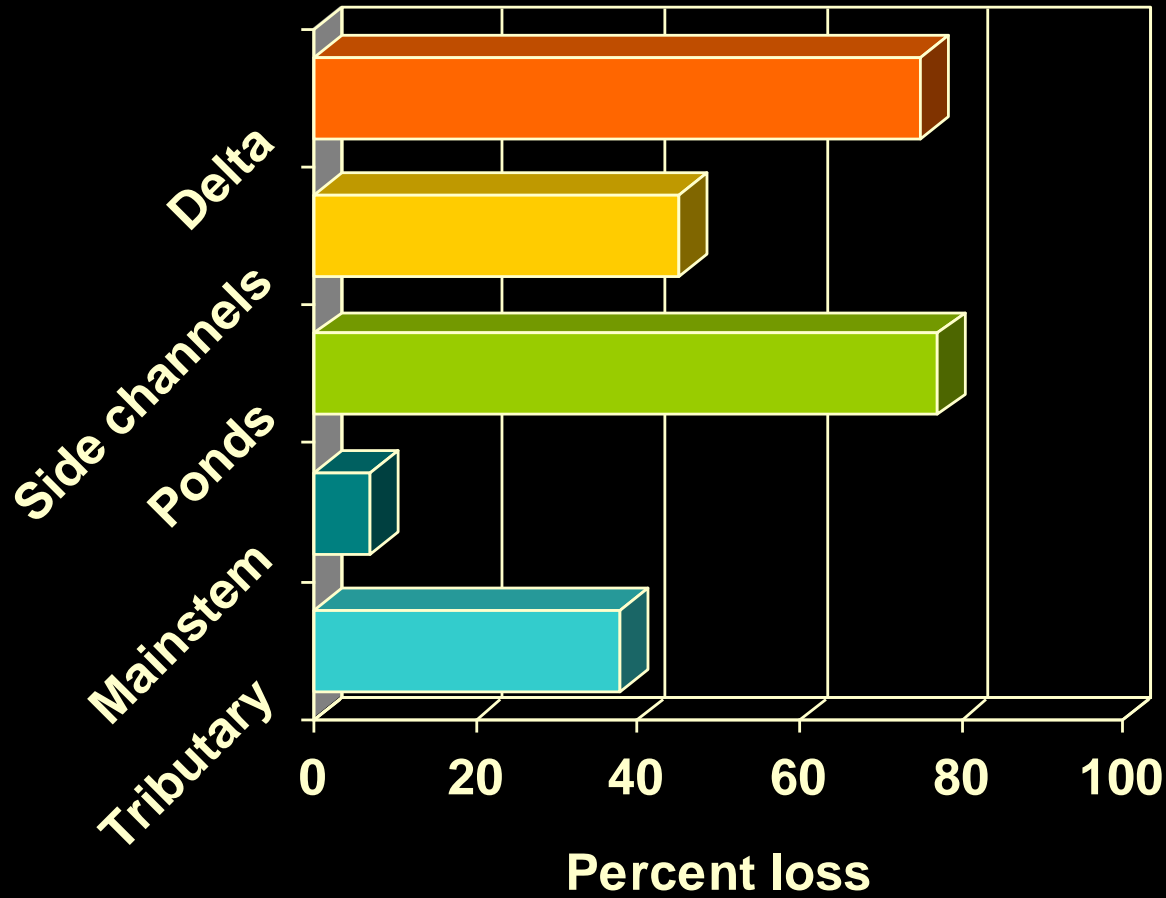
Salmon habitat



Land use and salmon habitat



Habitat losses



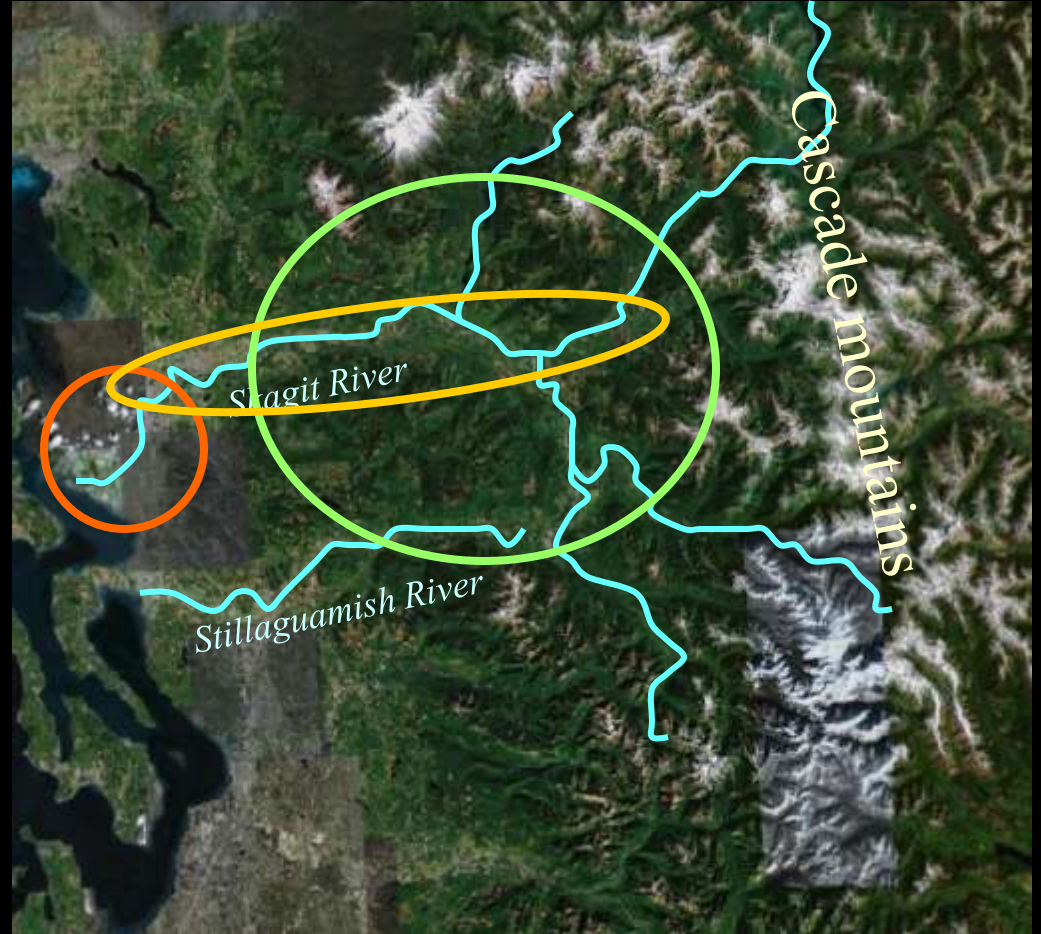
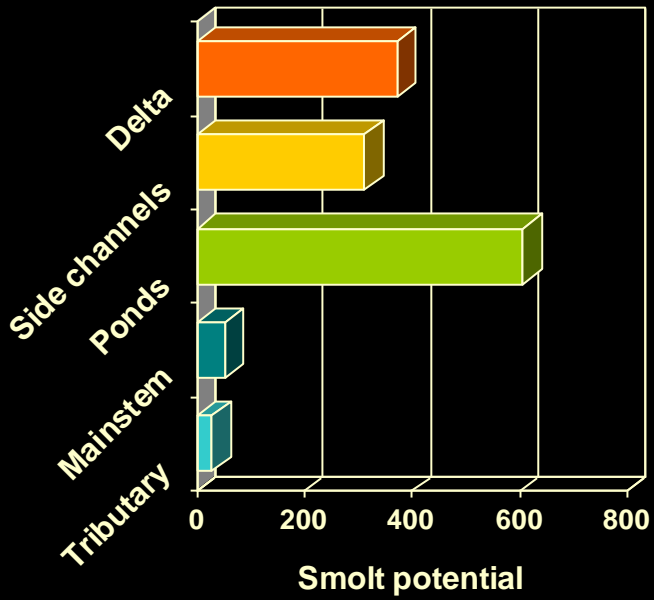
Restoration priorities

- What are the restoration priorities?
- Use models to link habitat change to fish responses



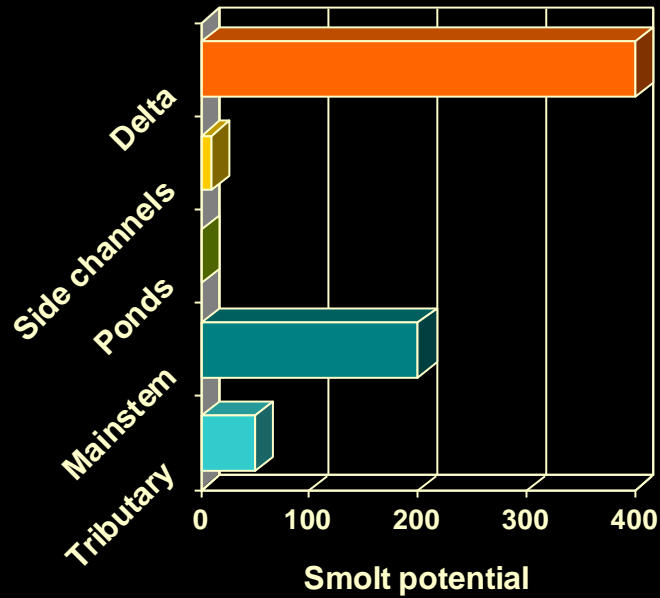
Priorities vary by species

Coho



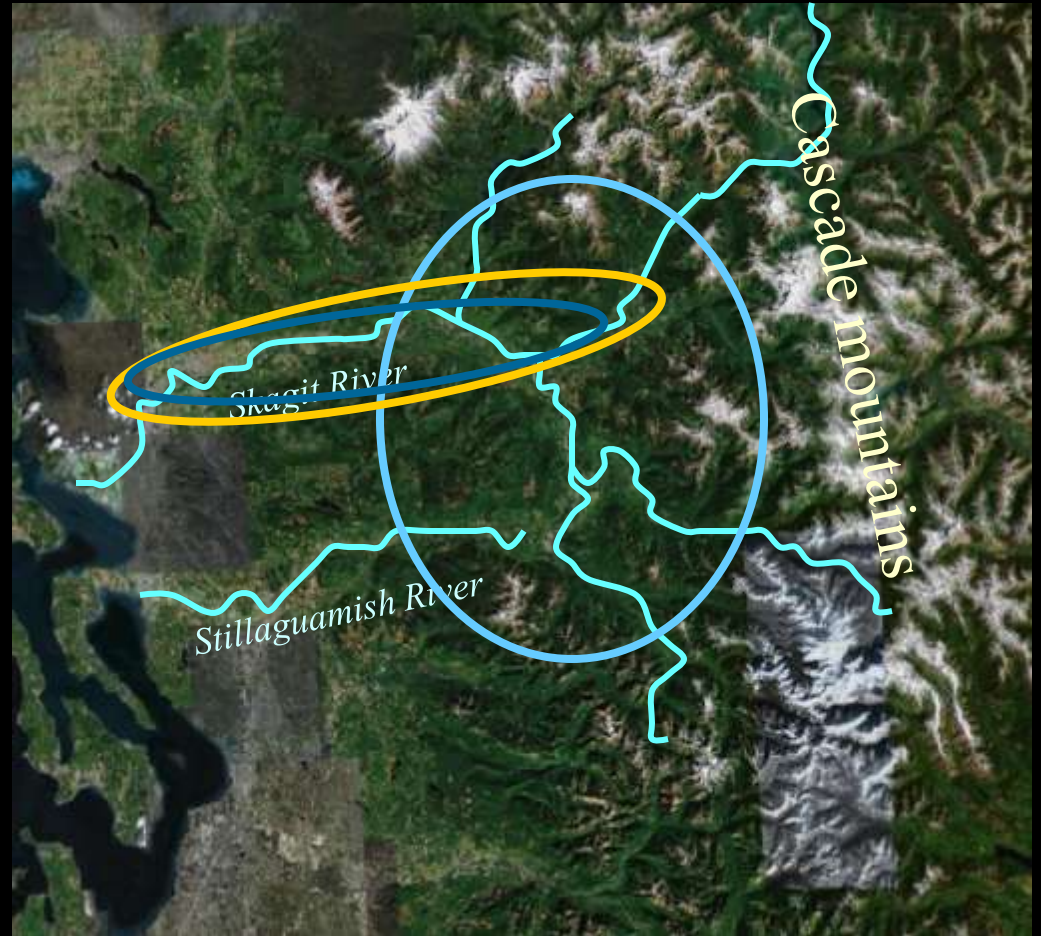
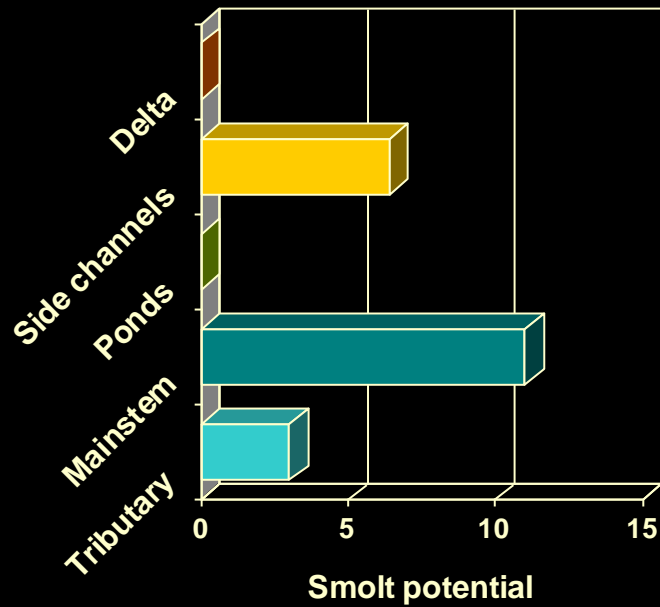
Priorities vary by species

Chinook



Priorities vary by species

Steelhead



Restoring habitat-forming processes

- Restoration plan focuses on causes of habitat change
- Restoration actions target
 - Restored floodplain habitats
 - Restored delta habitats
 - Watershed processes

Conclusions

- Habitat loss greatest in floodplains and delta
- Restoration priorities vary by species
- Focus on delta for Chinook
- Process restoration aims to restore habitat for multiple species