A landscape context for salmon restoration in the Skagit River basin

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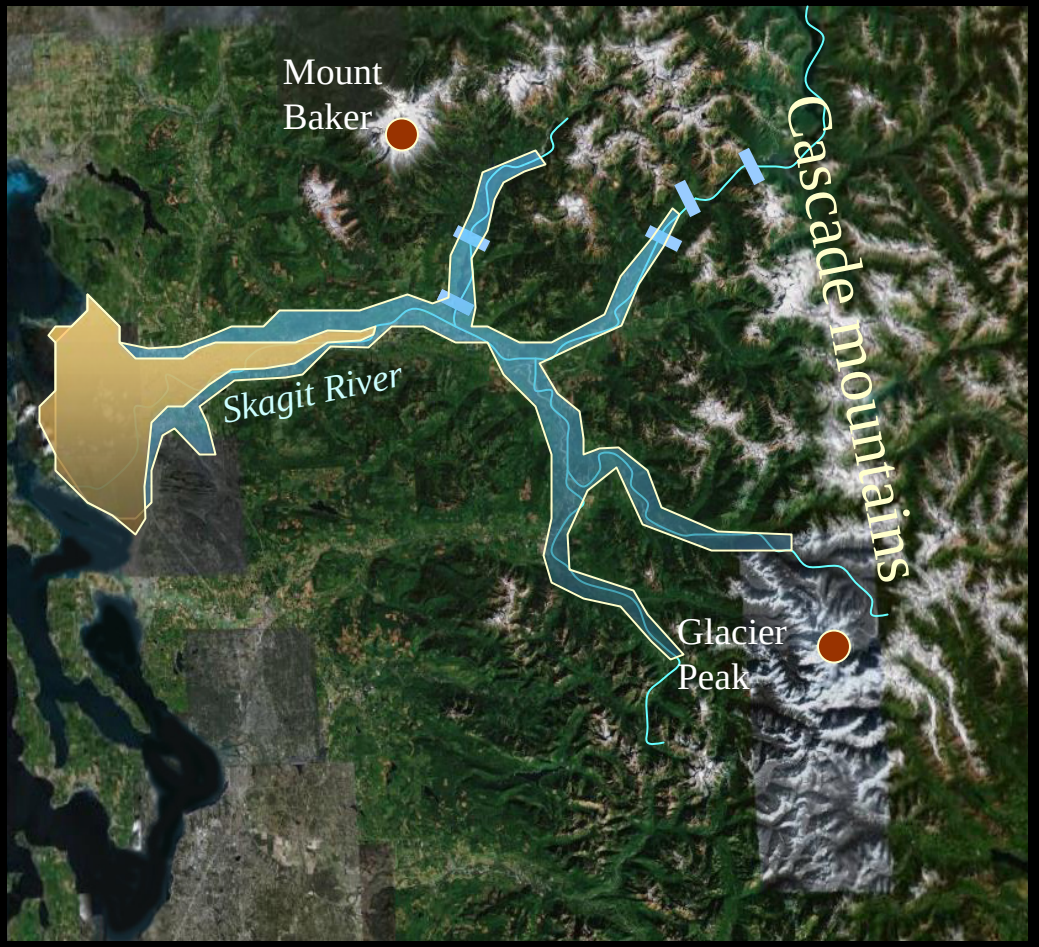
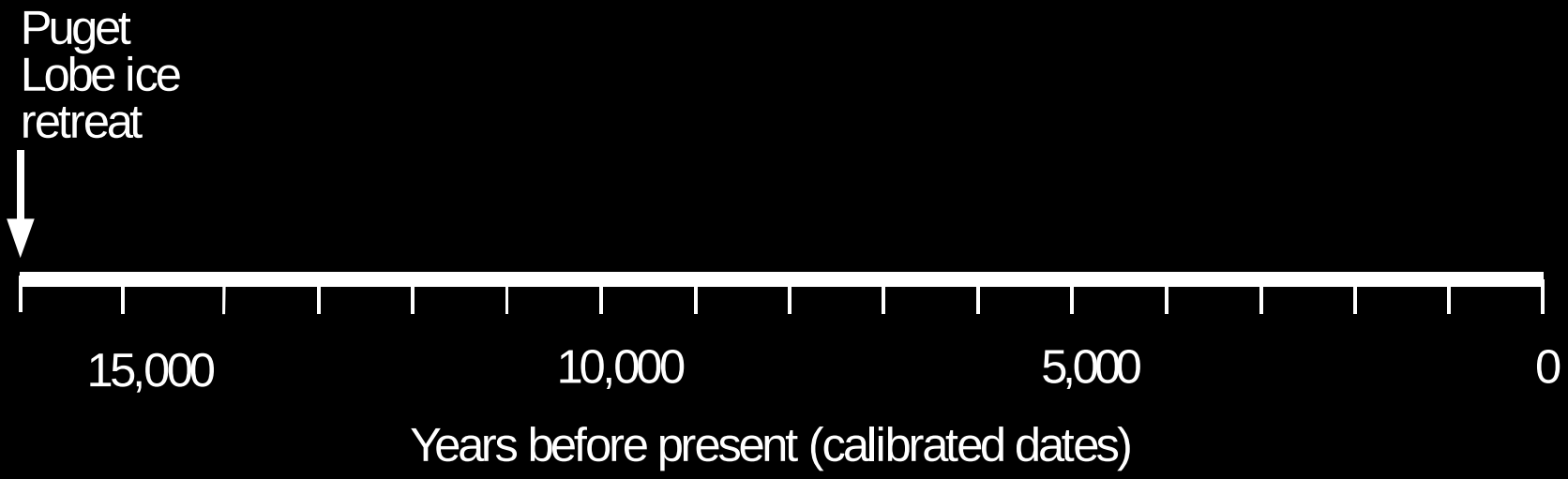
The Skagit basin

- Area: 8,000 km^2
- Glaciated between 18,000 and 16,000 ybp

- Salmon in all main basins
- Intensive land use in lower rivers



Holocene history



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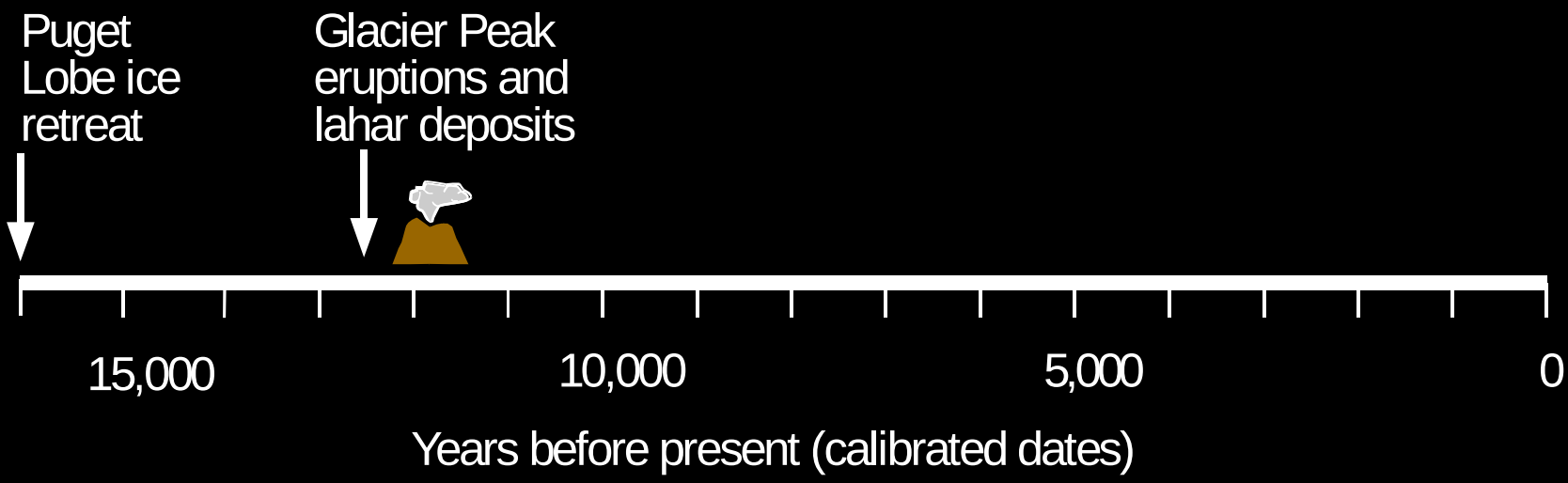

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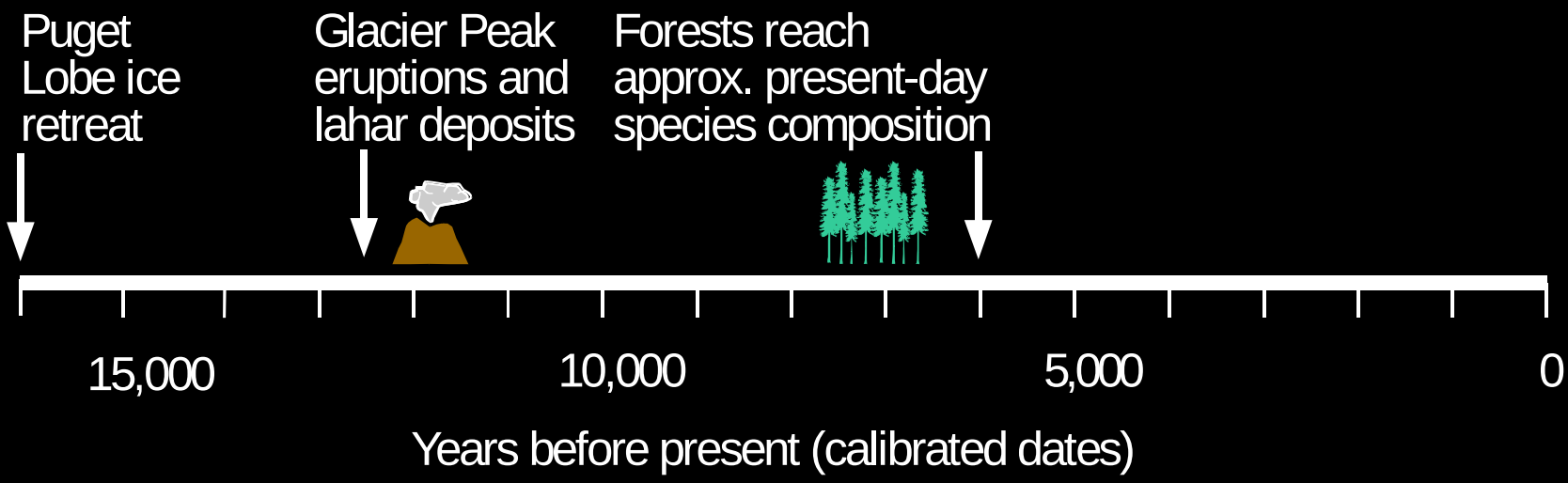

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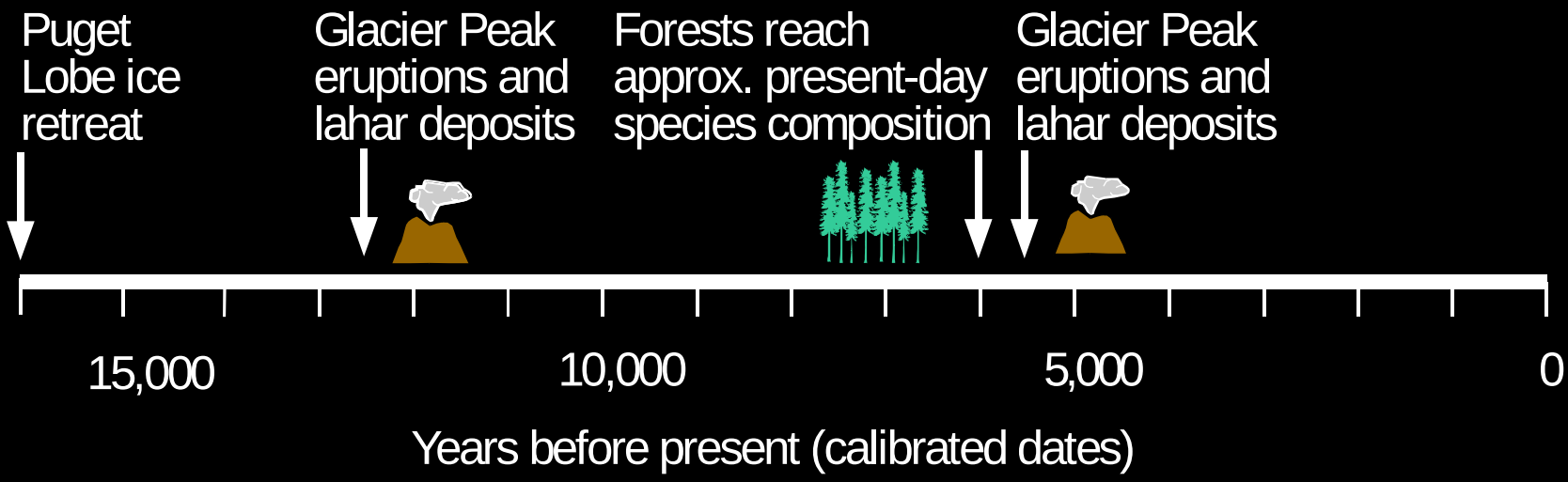

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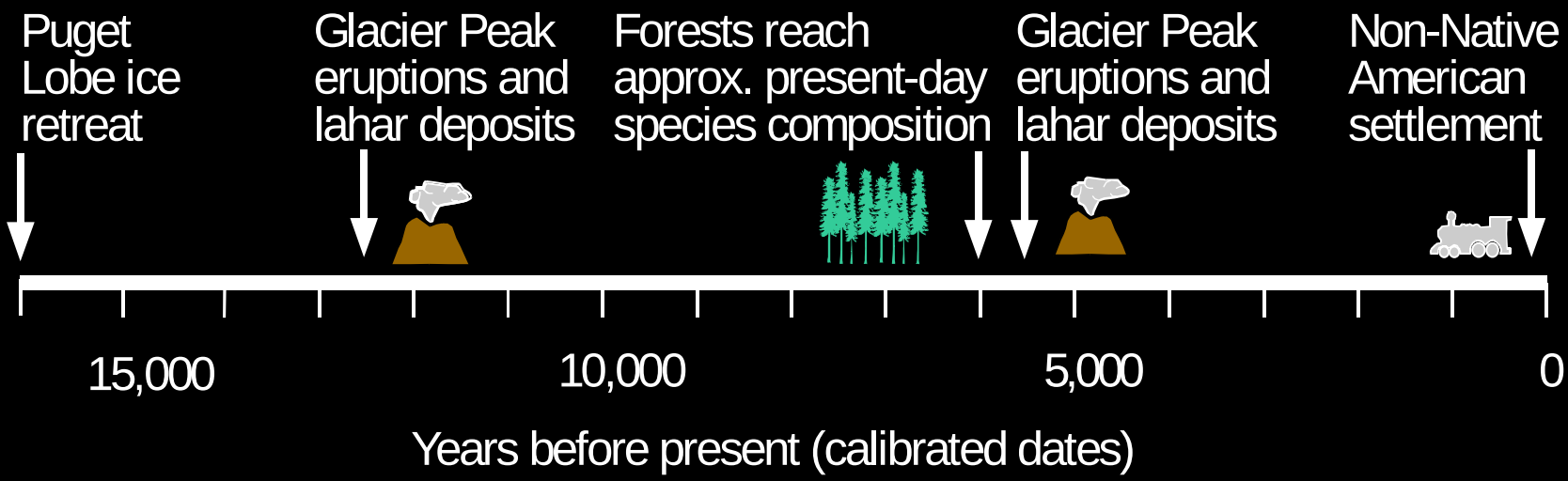
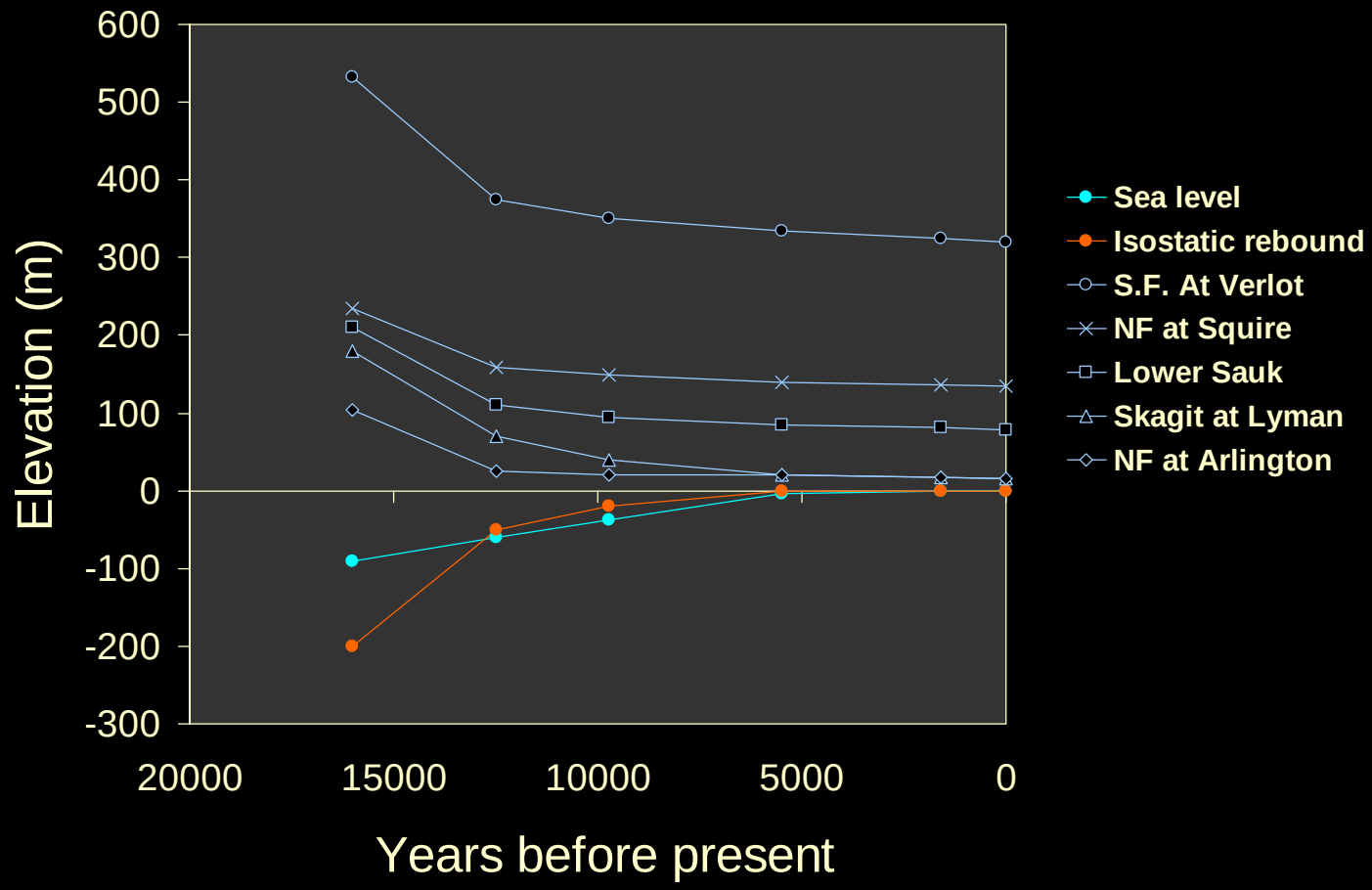


Post-glacial elevation changes

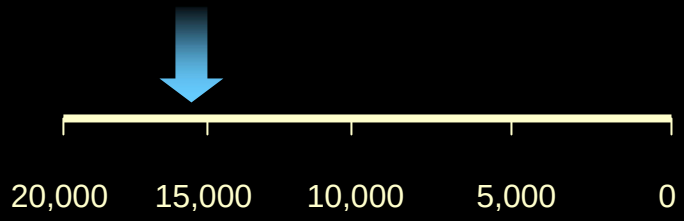
- Isostatic rebound: 200 m
- Sea level rise: 90 m
- River incision: 100-200 m

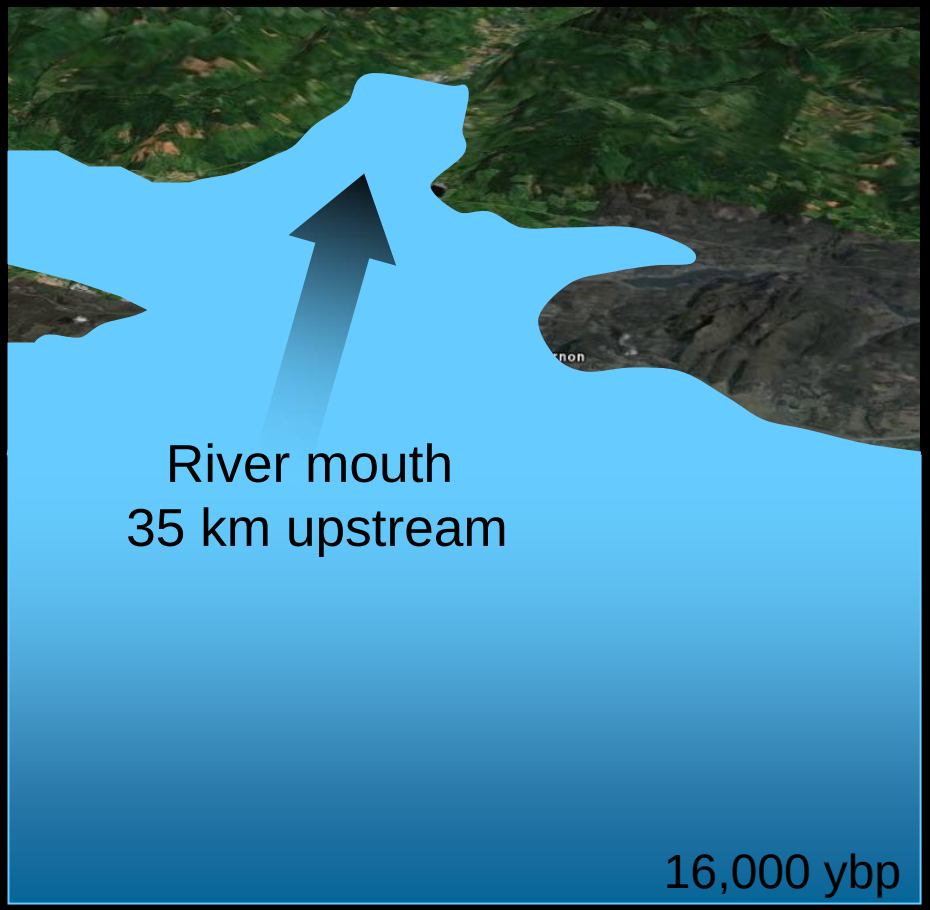
Post-glacial river mouth locations



Post-glacial river mouth locations

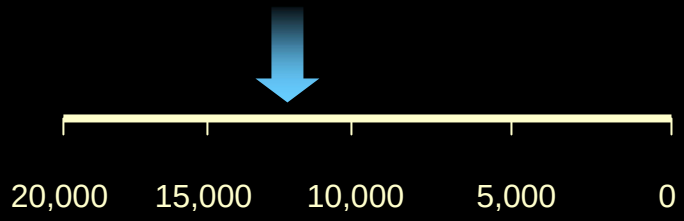
- 16,000 ybp

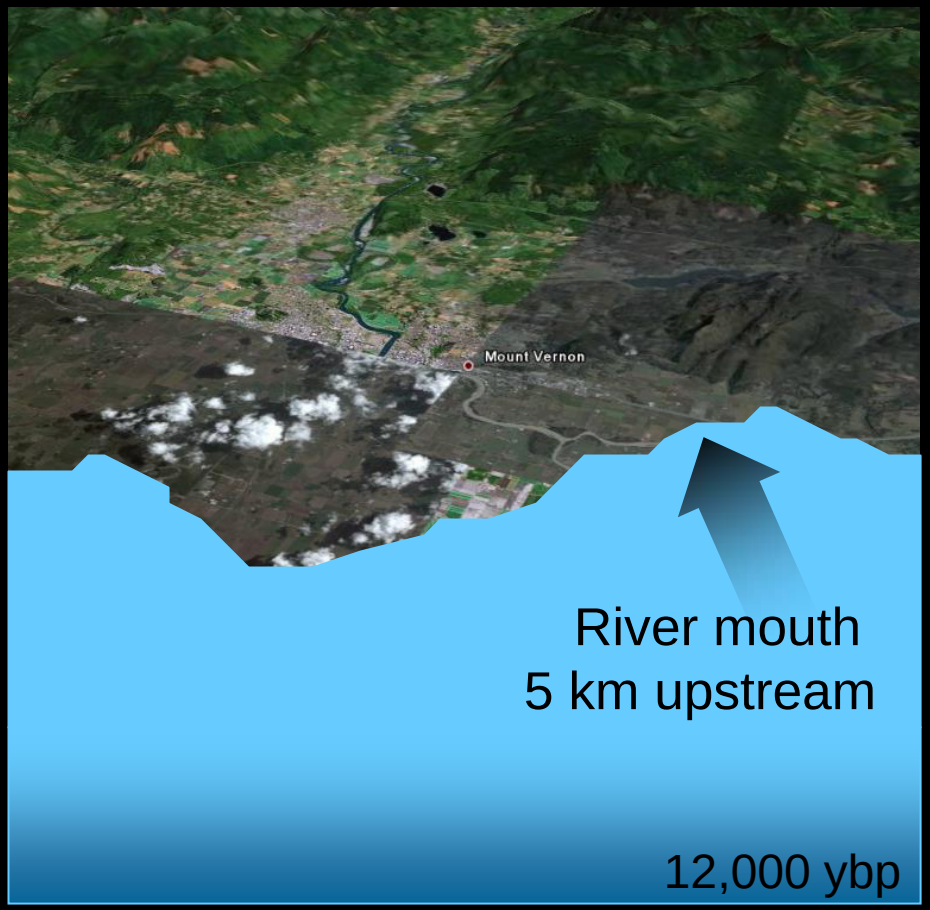




Post-glacial river mouth locations

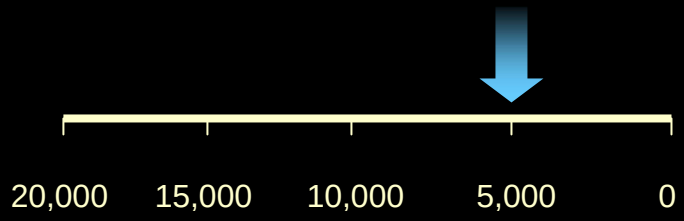
- 12,000 ybp

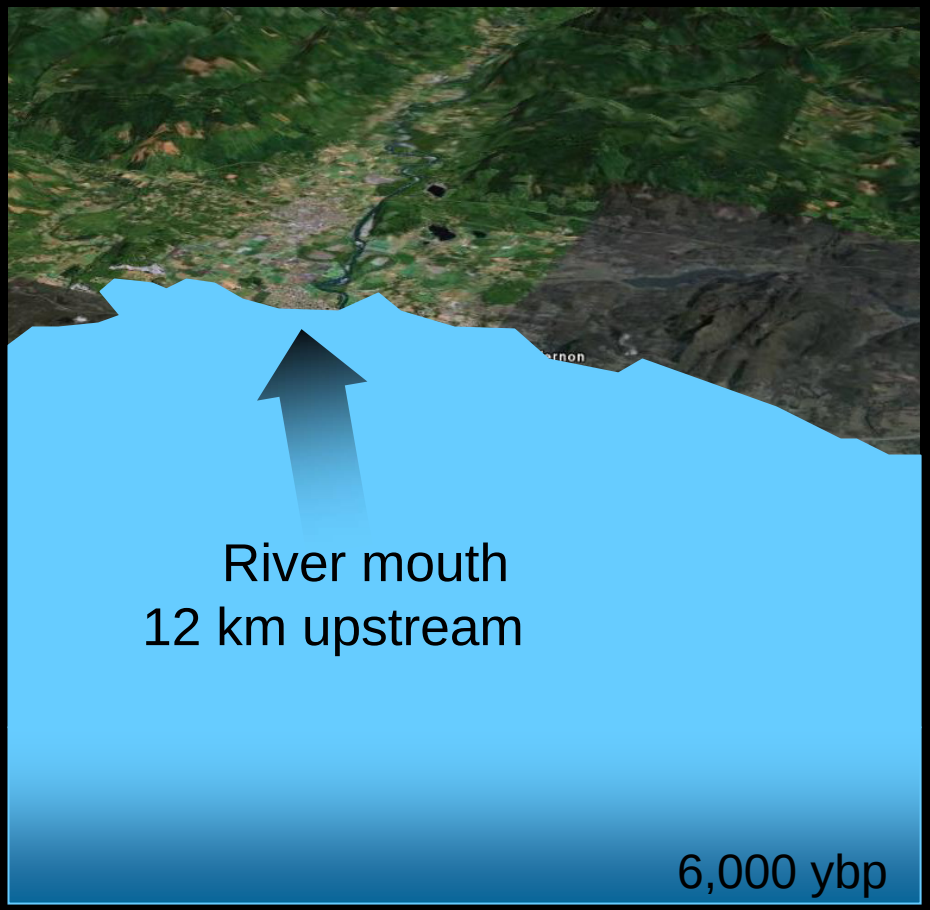




Post-glacial river mouth locations

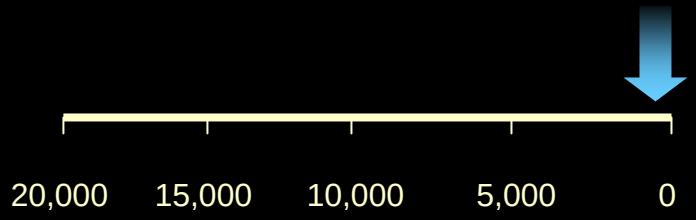
- 5,500 ybp

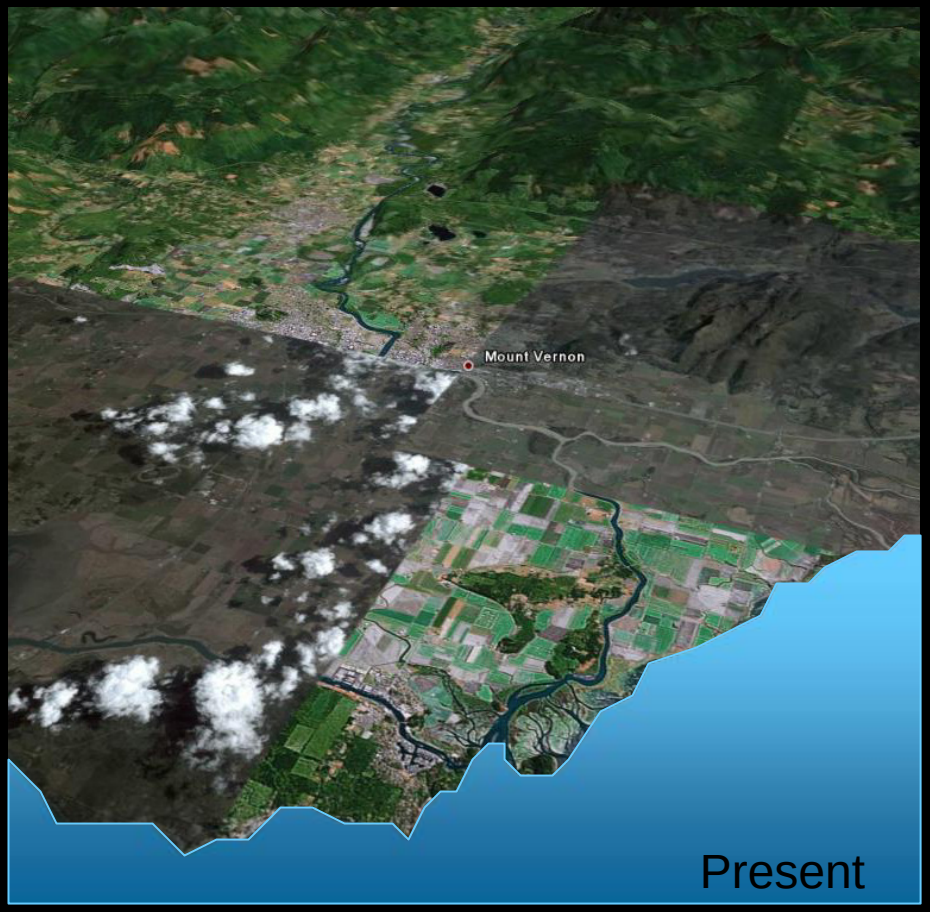




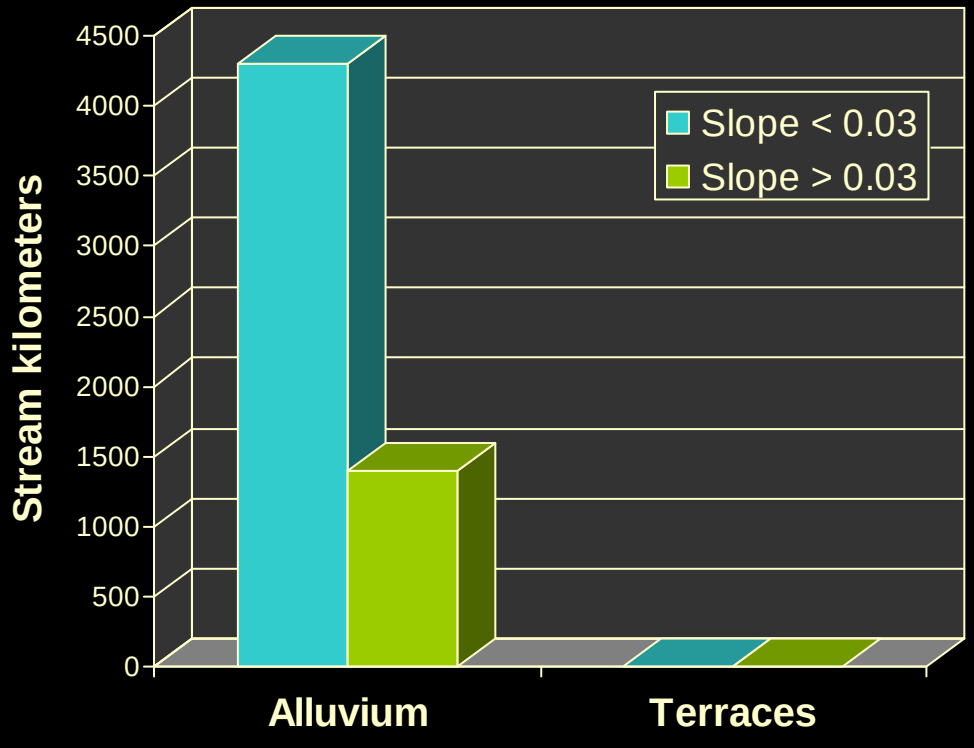
Post-glacial river mouth locations

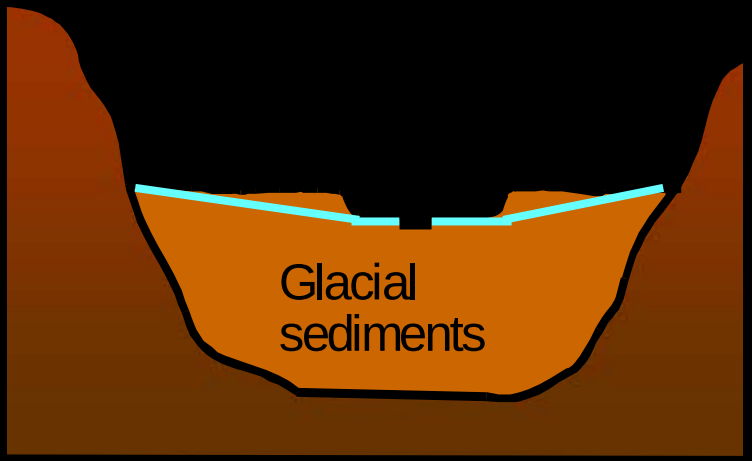
- Present day





Holocene changes in tributary gradients

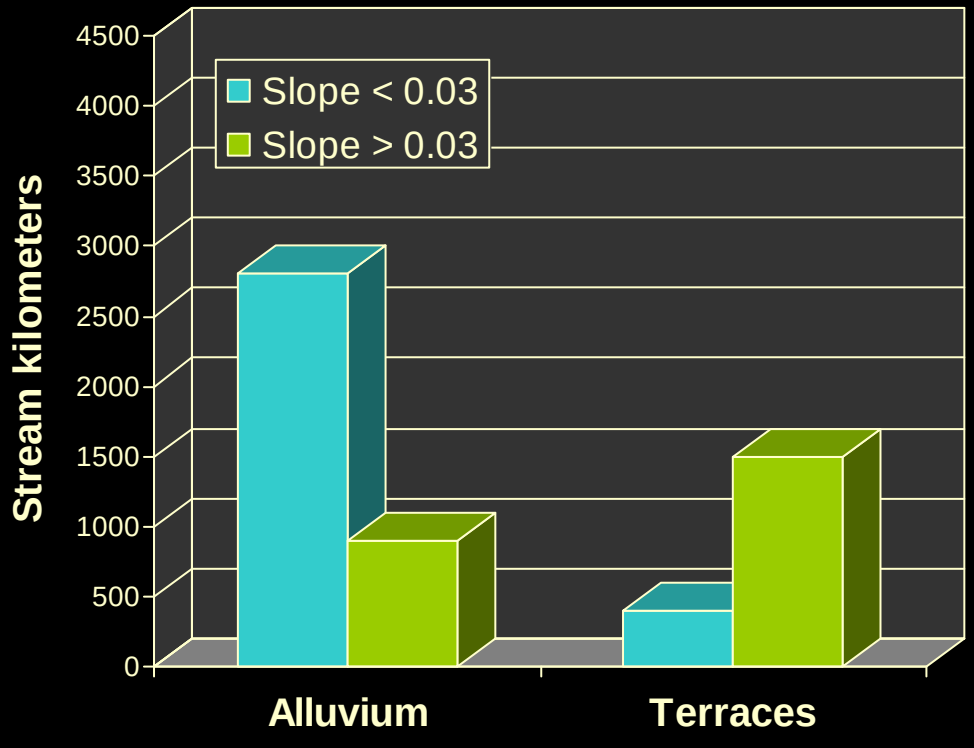


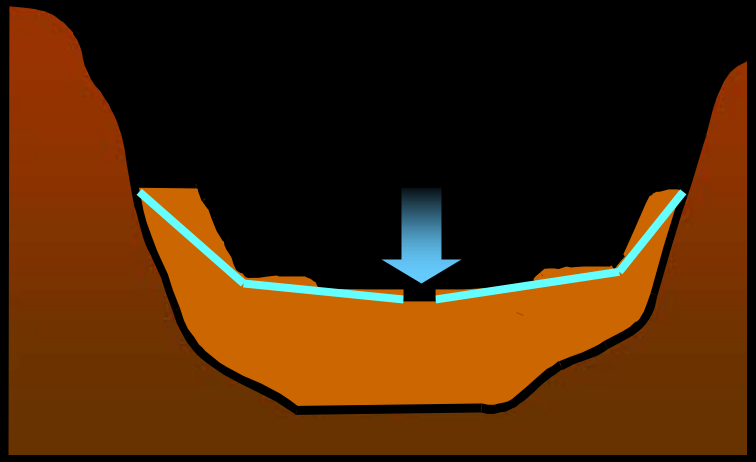


15,000 ybp

Tributary habitat: 4,300 km

Holocene changes in tributary gradients

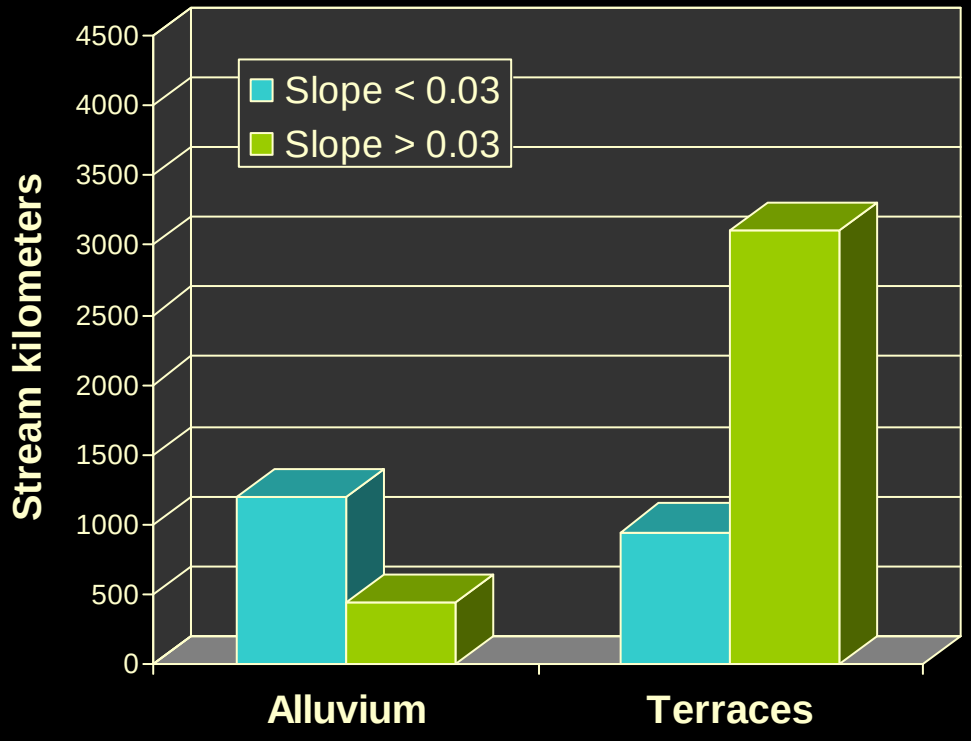


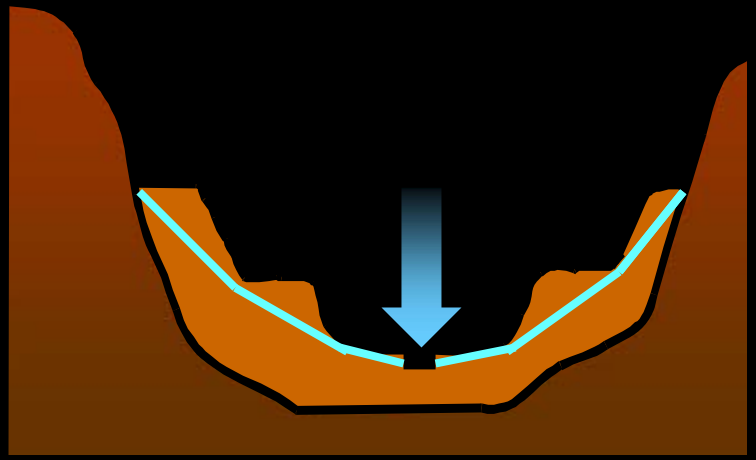


6,000 ybp

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

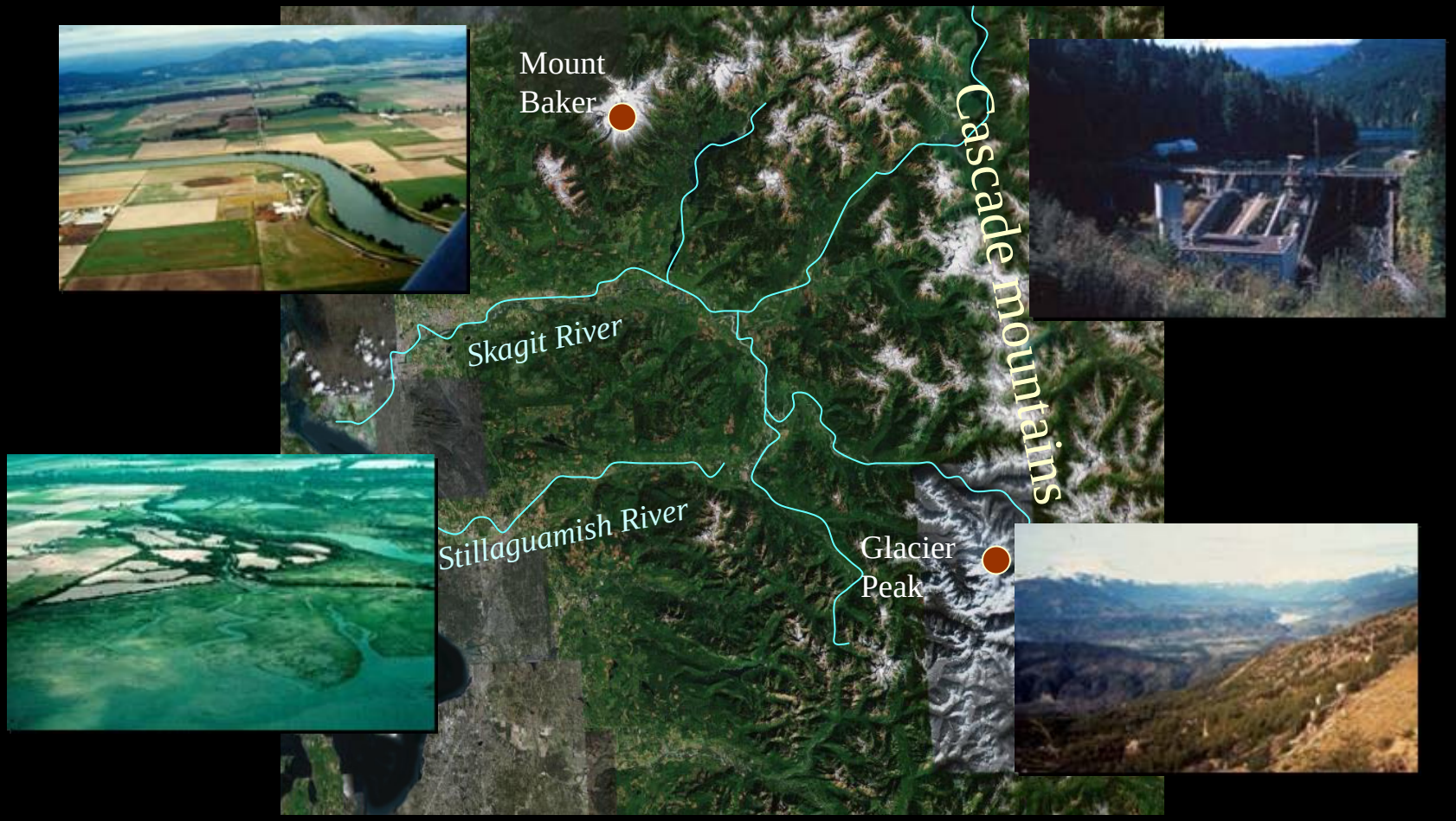
- Sauk River outflow is northward
- Expanded delta in Stillaguamish River

After 5,000 ybp eruptive phase

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

Landscape evolution and habitat diversity

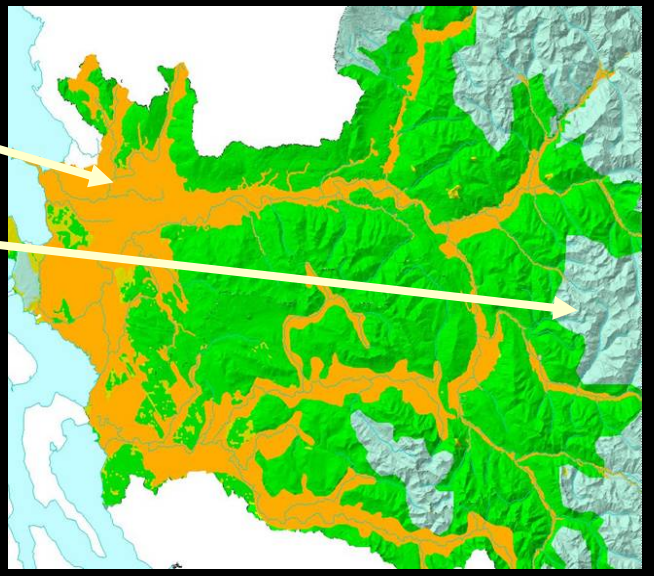
Recent changes in processes and habitat



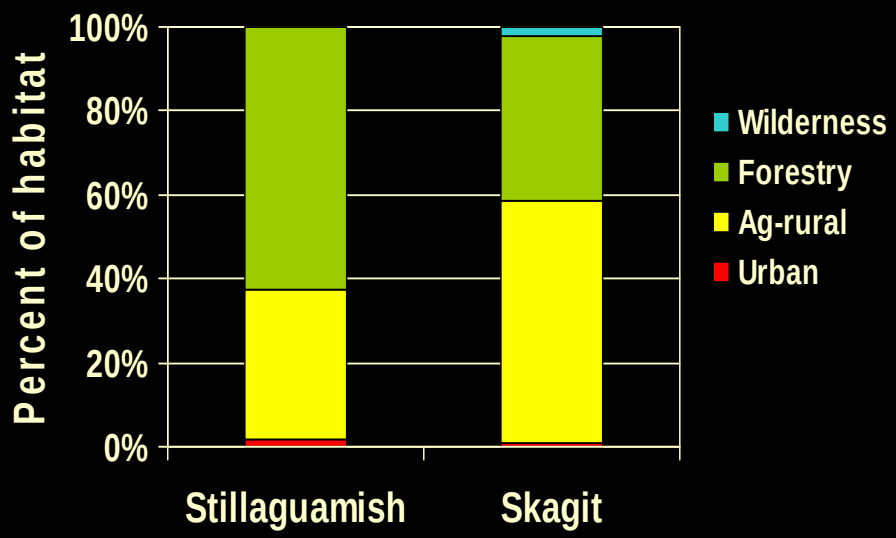
Land use and salmon habitat

Salmon habitat

Protected area

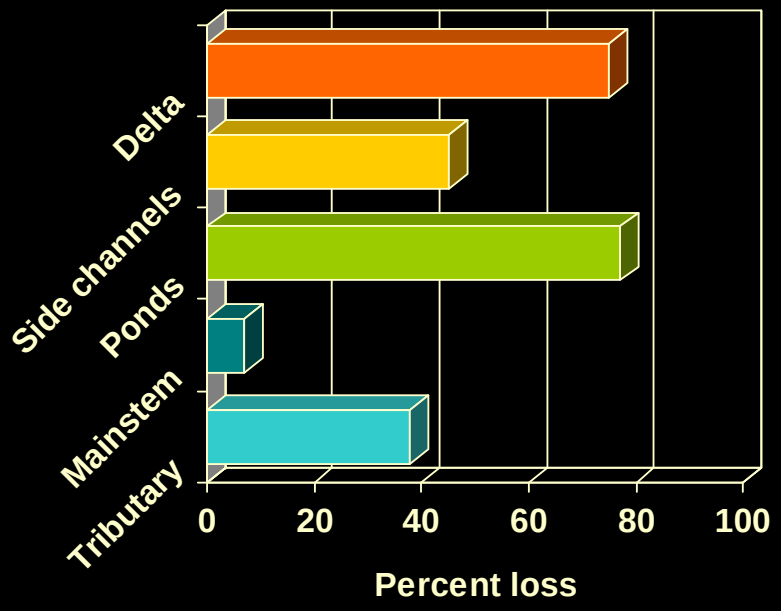


Land use and salmon habitat

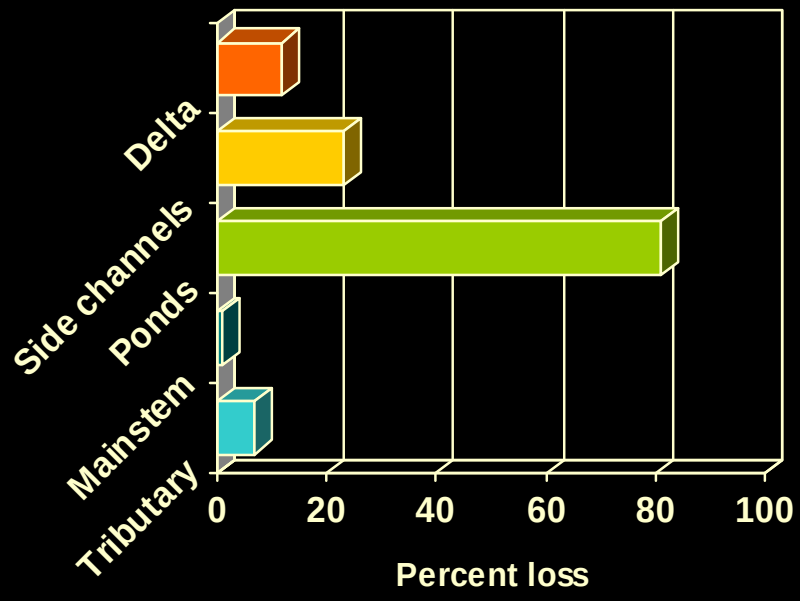


Habitat losses

Skagit



Stillaguamish



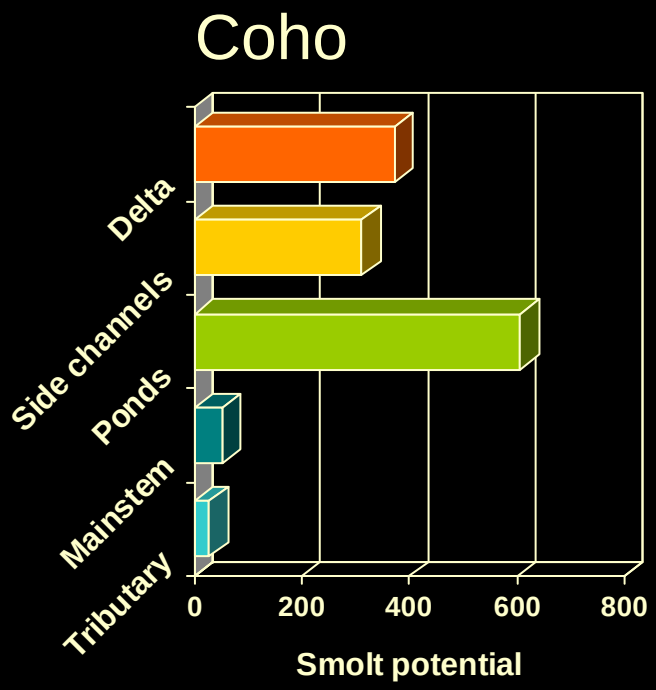
Habitat losses

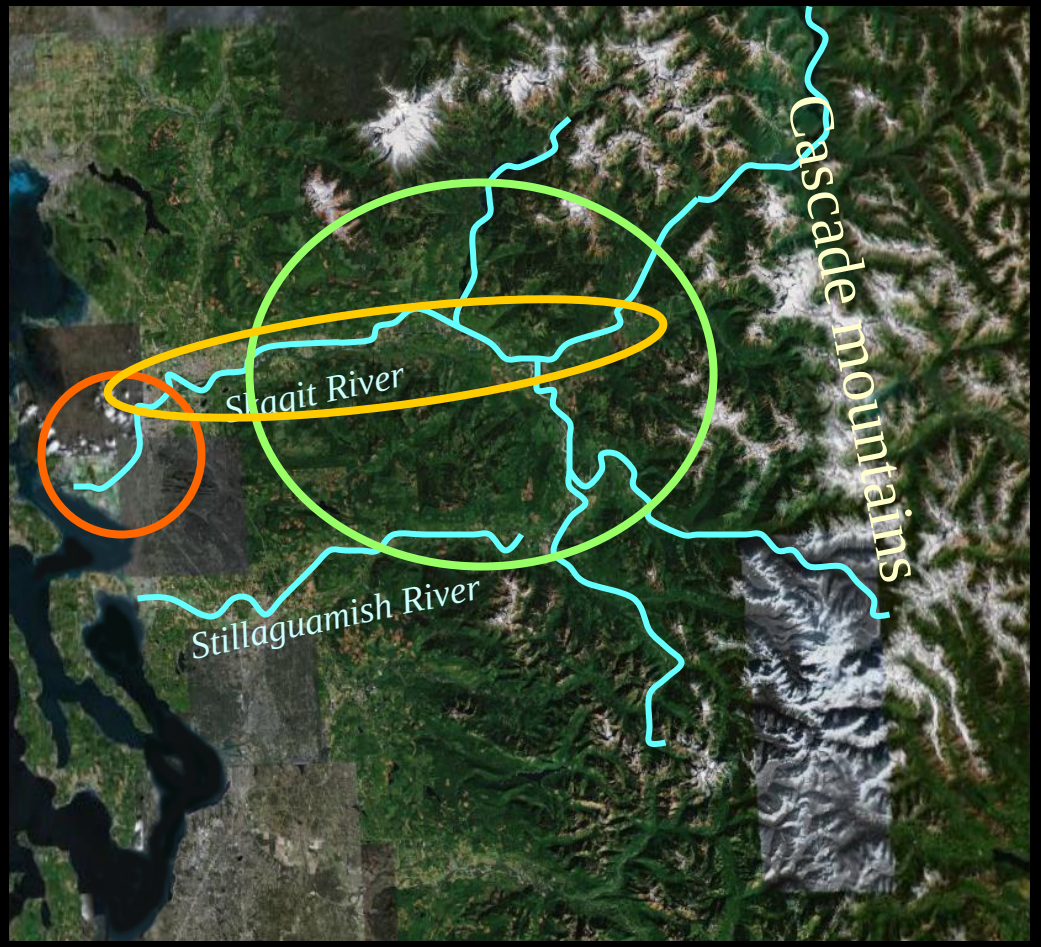
- Habitat losses are ‘permanent’
- Land uses constrain restoration options

Looking forward

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

Priorities vary by species





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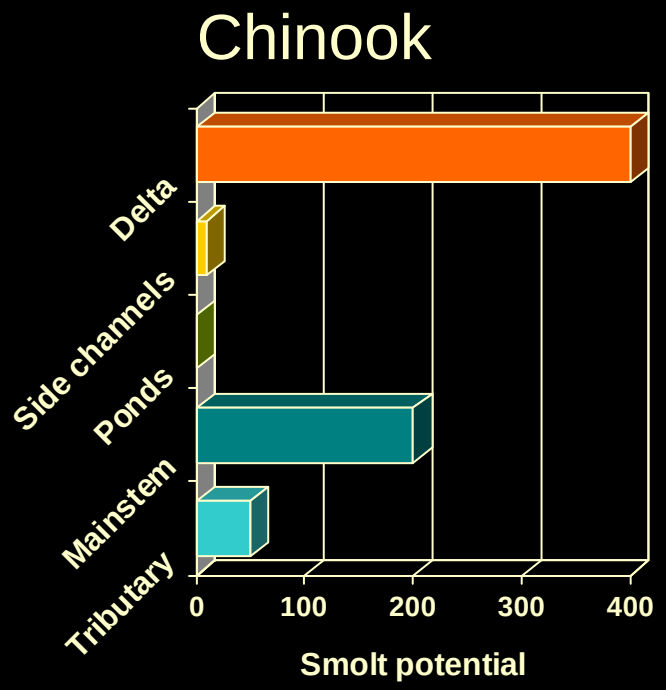

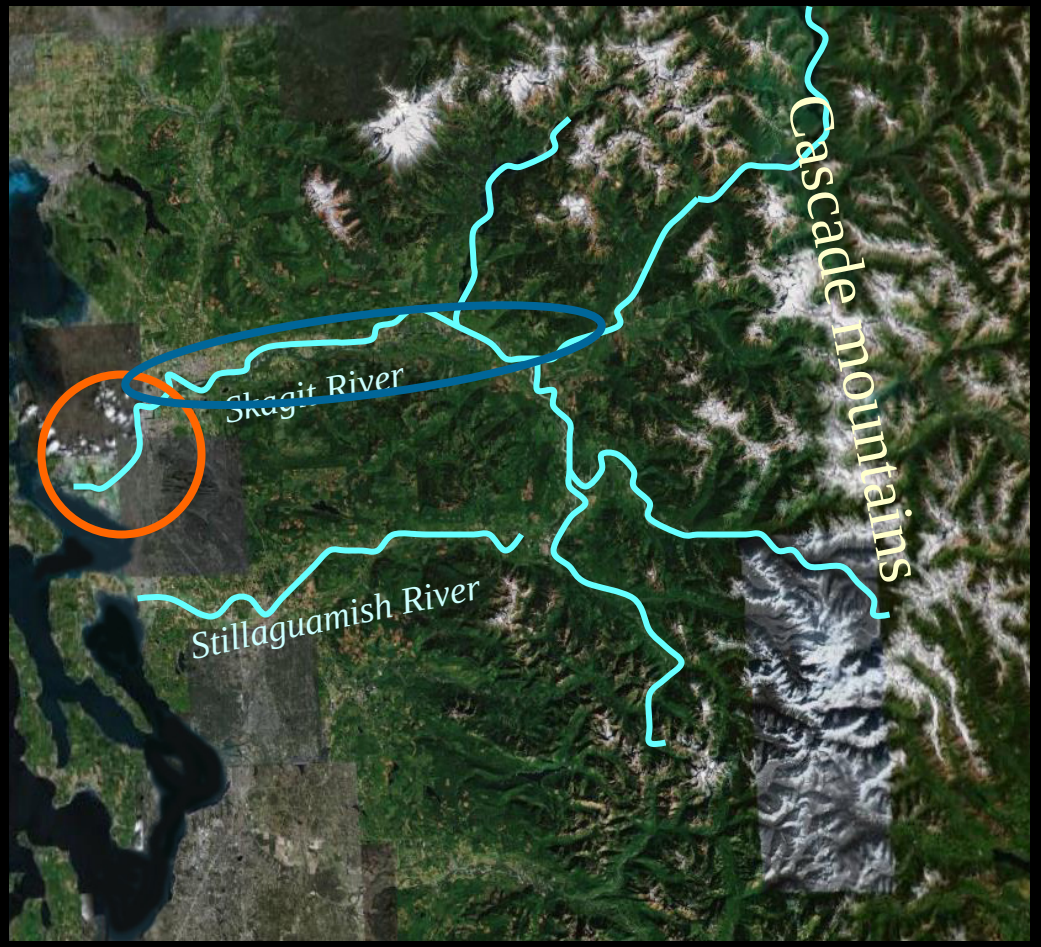

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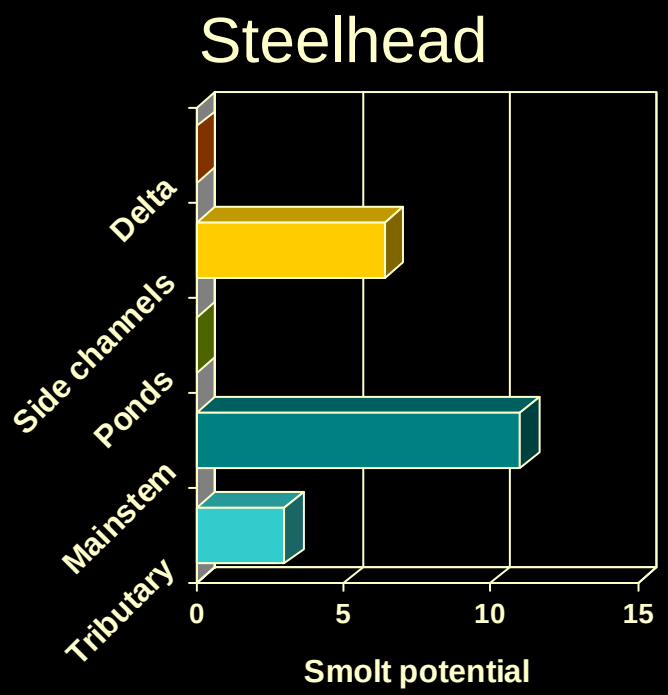

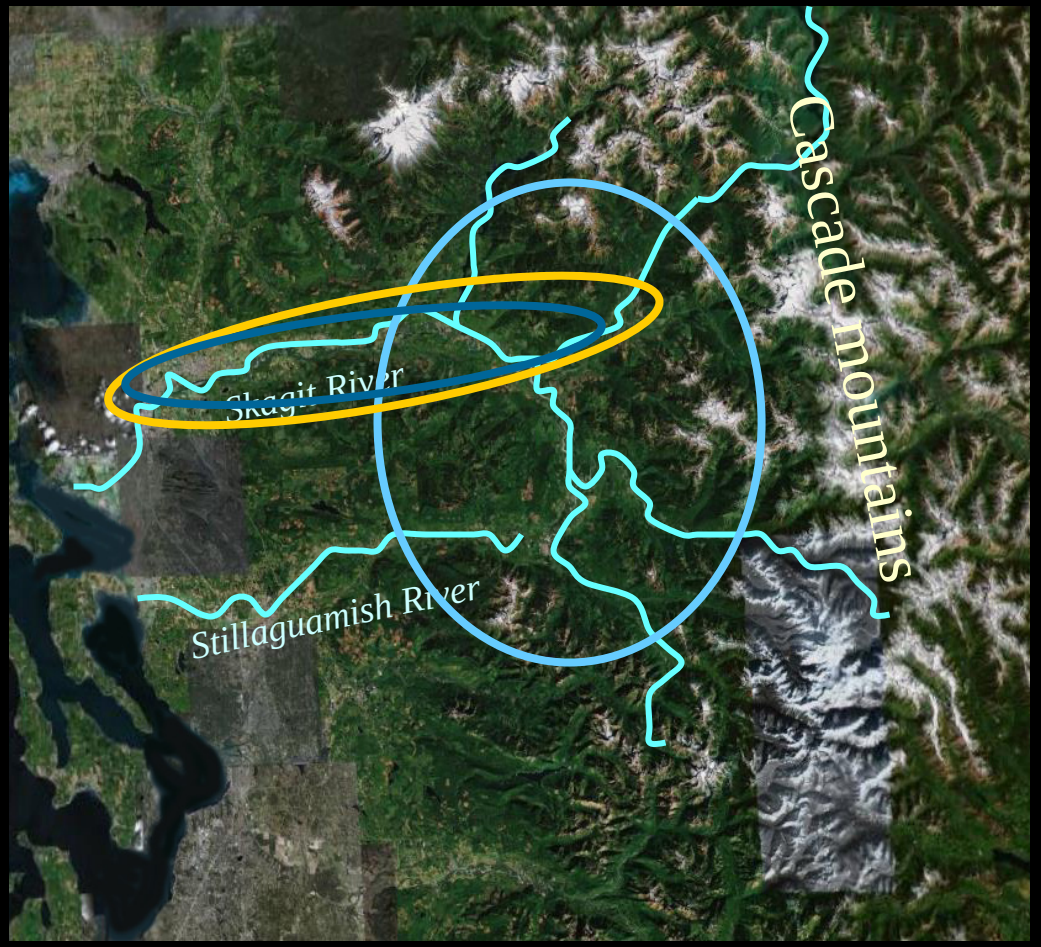

So what did we learn?

- Habitats are a product of landscape dynamics
- Salmon are adaptable
- Restoration priorities vary by species

Some restoration guidance

- Sustainable restoration should re-establish habitat-forming processes
- We need enough salmon for adaptive mechanisms to operate
- Restoration goals should encompass multiple species