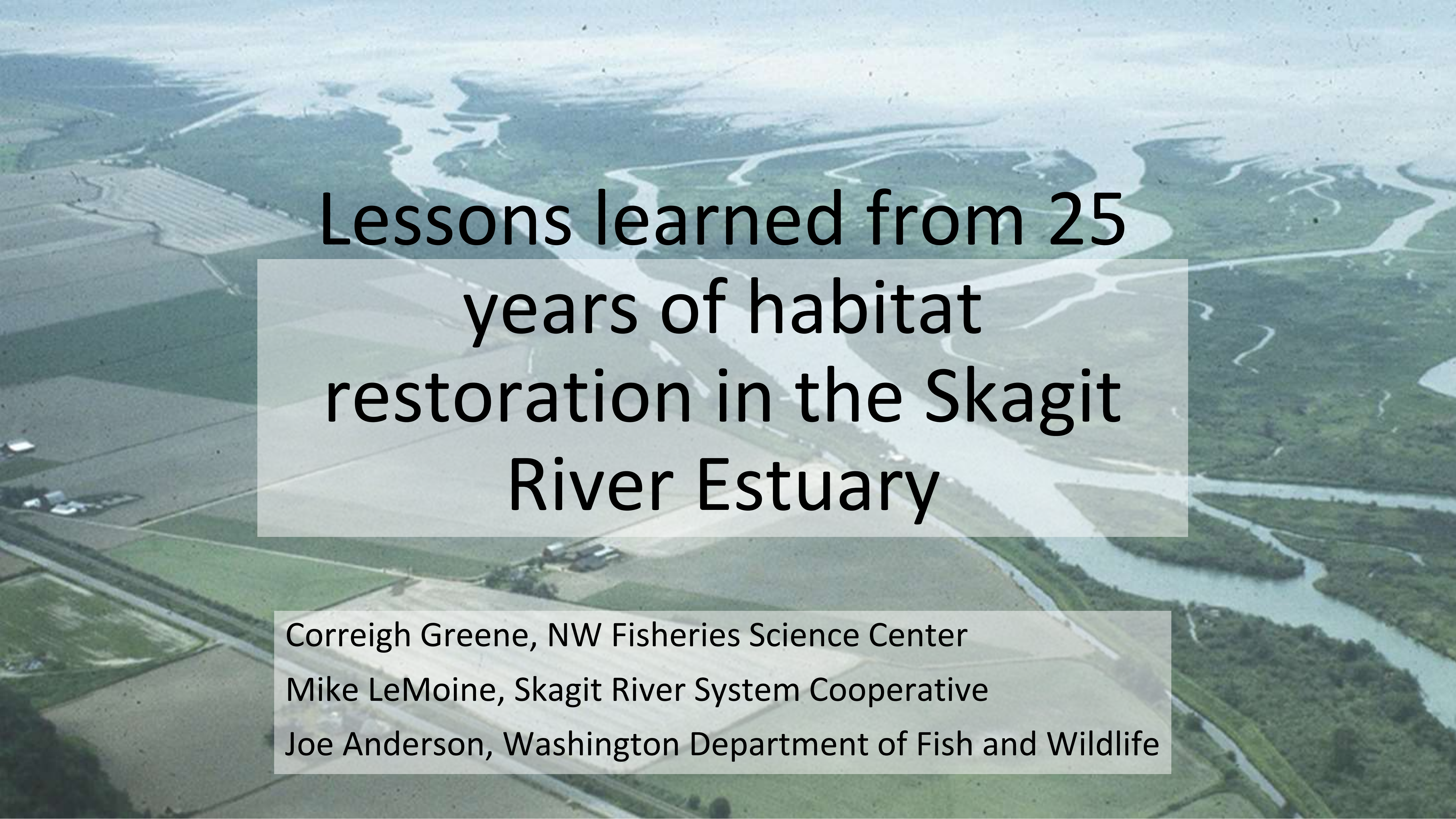


Lessons learned from 25 years of habitat restoration in the Skagit River Estuary

Correigh Greene, NW Fisheries Science Center

Mike LeMoine, Skagit River System Cooperative

Joe Anderson, Washington Department of Fish and Wildlife

Overview in a nutshell

- Skagit IMW: linking restoration science with recovery objectives
- Addresses effectiveness of estuary restoration at project and population scales
- Big restoration projects are a challenging social experiment
- Therefore, observing benefits of restoration is a long-term endeavor

Lessons from long-term monitoring

1. Set up clear restoration objectives with testable hypotheses

1. Be responsive to emerging estuary restoration techniques

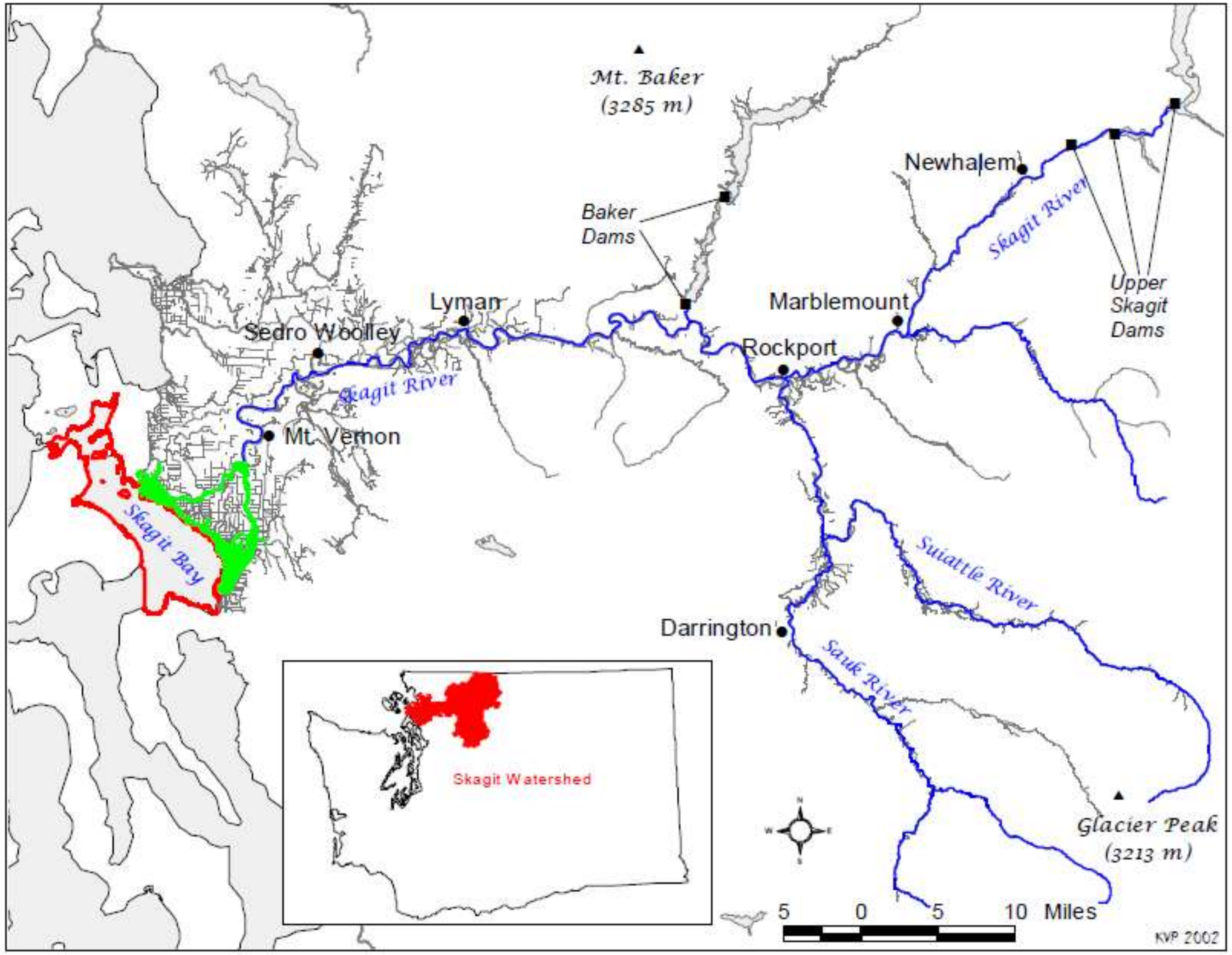
1. Set up monitoring for successful learning

1. Expect surprises

1. Timelines are fluid: work together and be patient

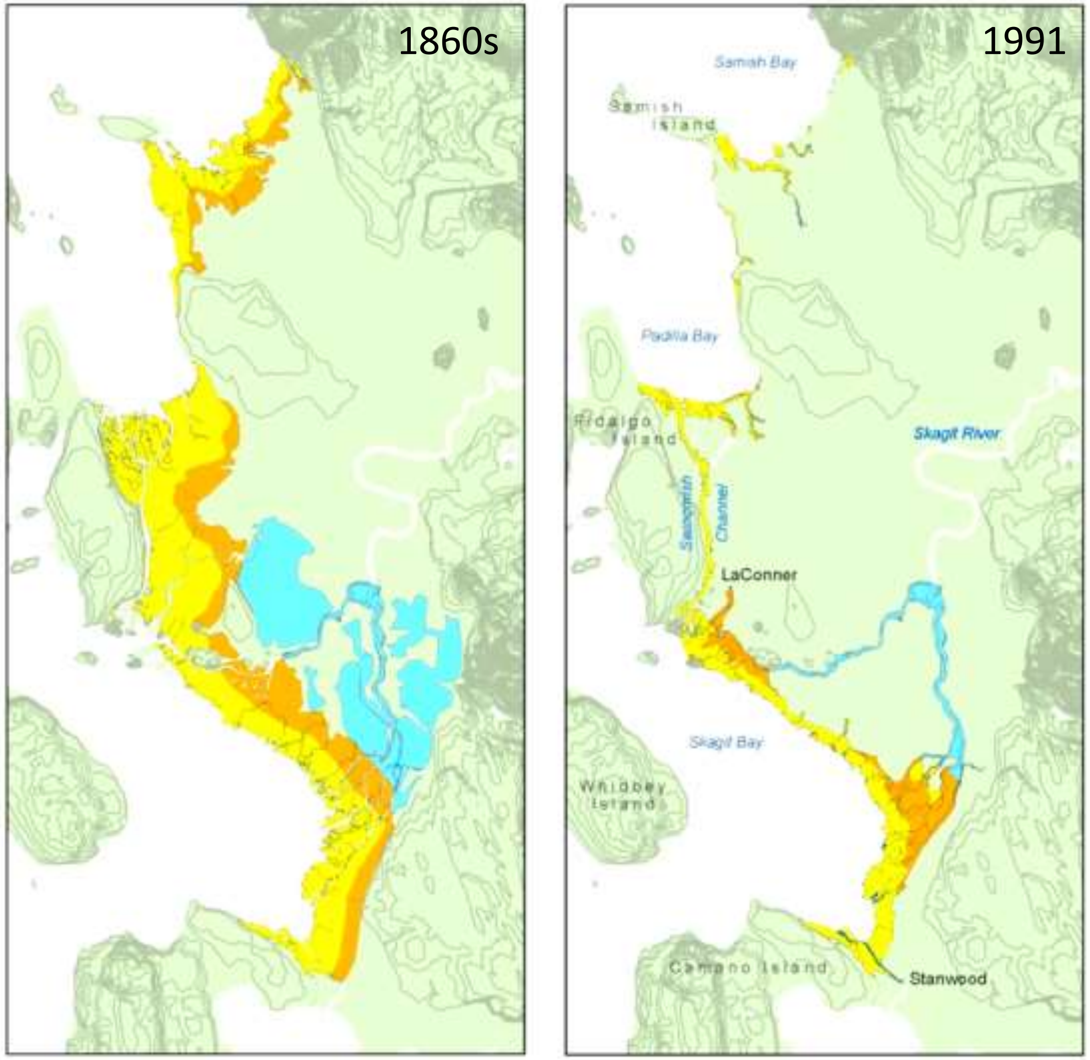
The Skagit watershed in a nutshell

- Largest river in Puget Sound
- Largest wild populations of all salmon species
- Chinook, steelhead, and bull trout are threatened under Endangered Species Act
- Long history of logging, mining, hydropower, flood control, and agriculture



Estuary habitat loss

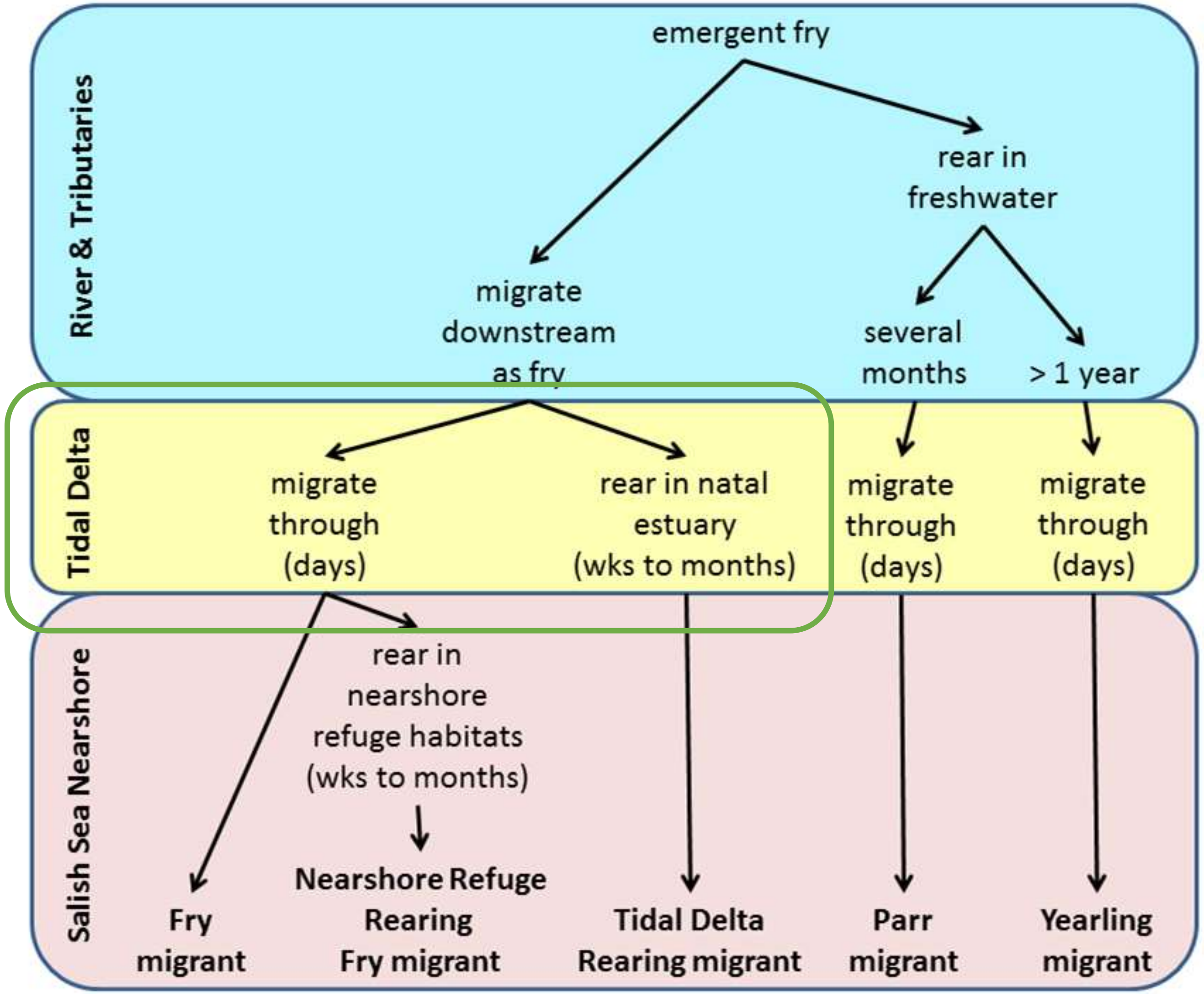
- Extensive historical tidal delta with diverse wetland types
- Diking and infill for agriculture and homes began in the late 1800s leading to
    - Tidal delta: 75 - 85% loss
    - Skagit Bay shoreline: ~ 90% loss
- Important for juvenile Chinook salmon (Healey 1991)



Chinook salmon life history and tidal delta residence

- Life cycle with multiple potential pathways
- Based on variable residence in freshwater, tidal delta, and marine waters

Tidal delta residence: Days - months



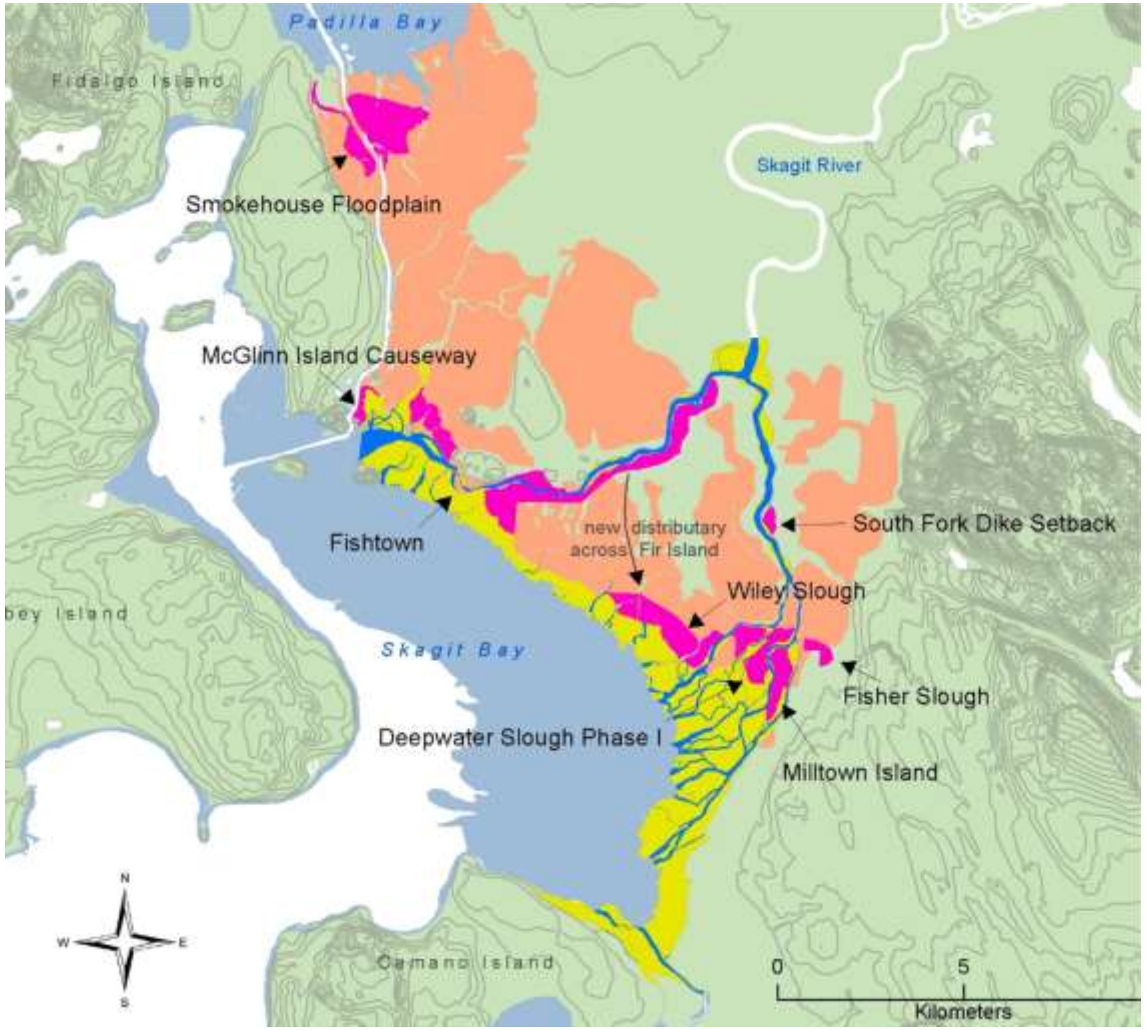
IMW study design and questions

- **Does restoration of tidal wetlands improve capacity and connectivity for juvenile Chinook salmon?**

- Linked to recovery plan actions
  - Loss of estuary habitat = reduced capacity
  - Loss of connectivity = reduced access to habitat

- Initially designed around Before-after-control-treatment design (S Fork treatments vs N Fork control)

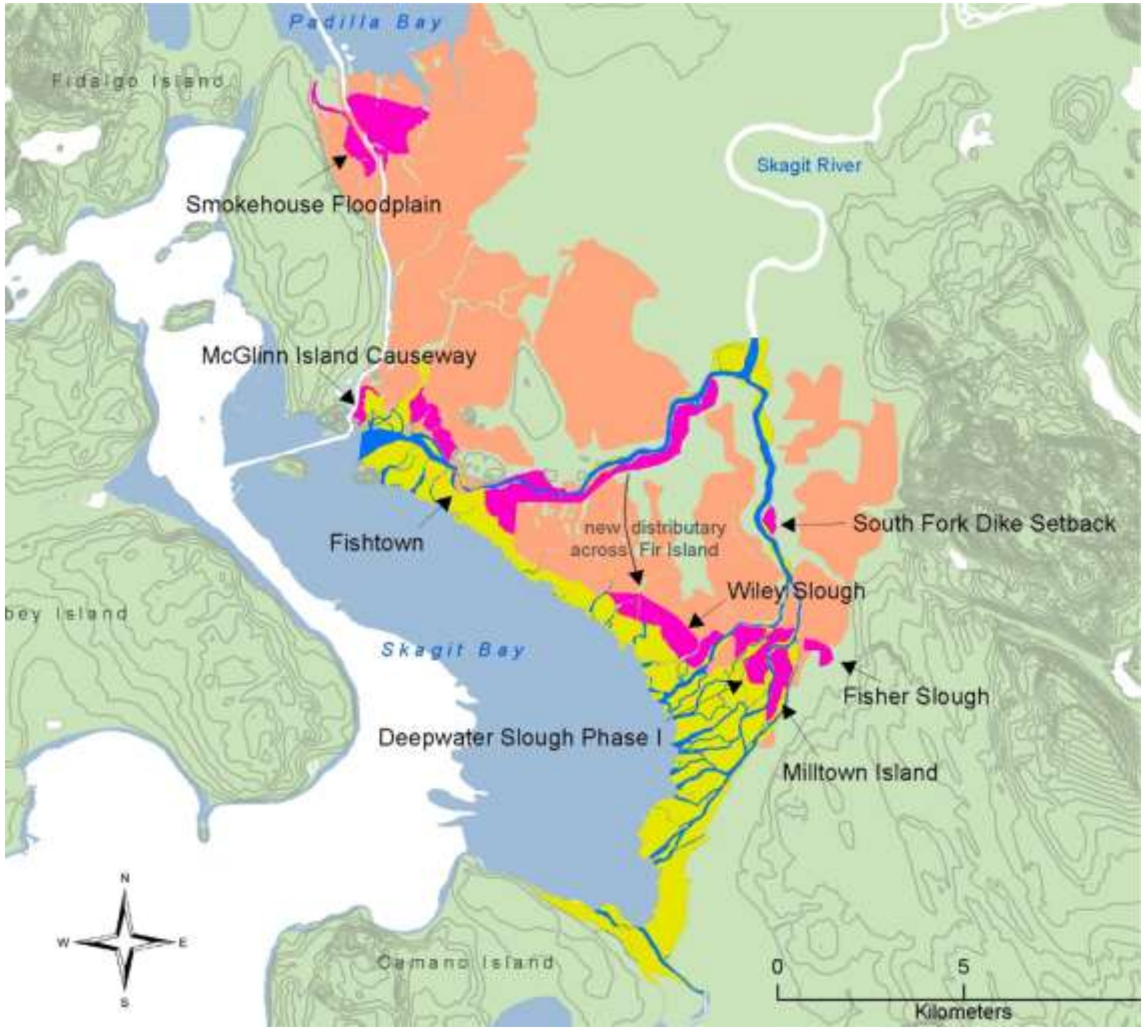
- Multiple extensive restoration projects



Planning of estuary restoration

- Recovery plan: 2700 ac of wetland restoration to meet recovery goals
- > 660 ac implemented to date since 2000
- 410 ac planned over next 10 years
- Monitoring at each restoration project to verify effectiveness

Given relatively slow pace (~27 ac/yr), need long-term monitoring program to verify success



What do estuary restoration projects look like?

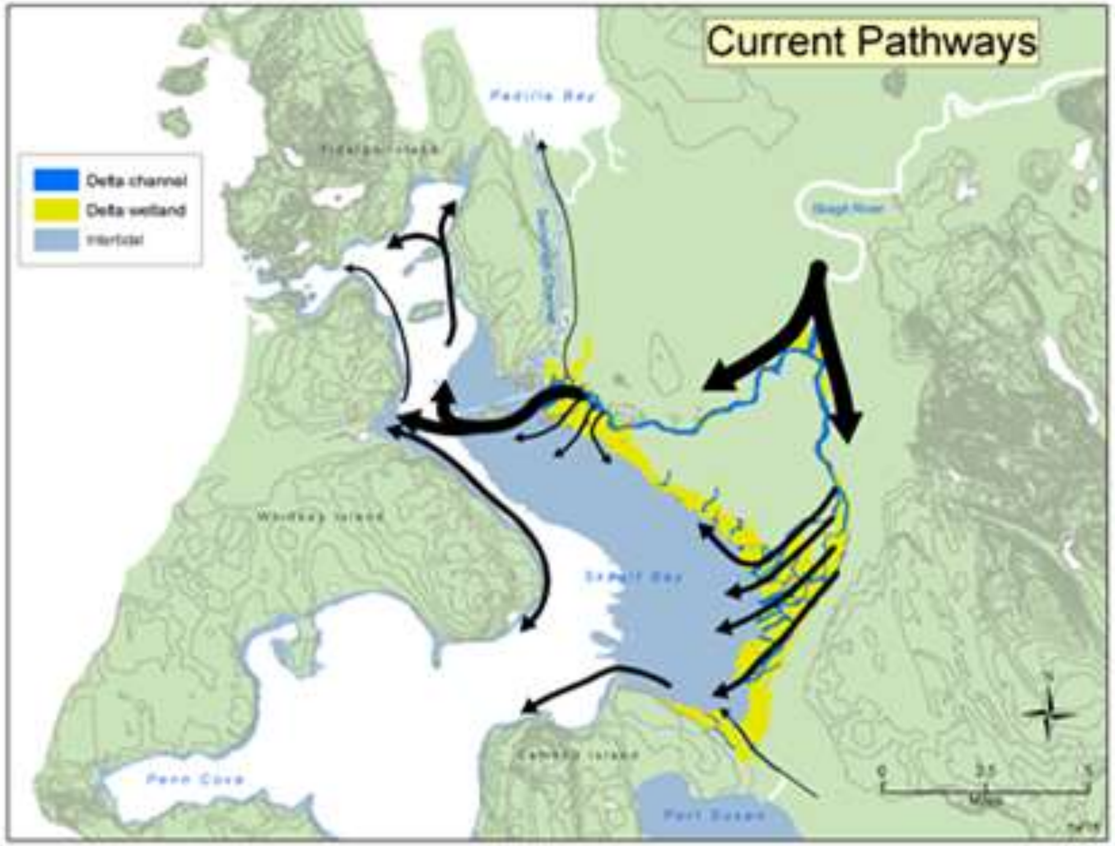

Tidegate replacement

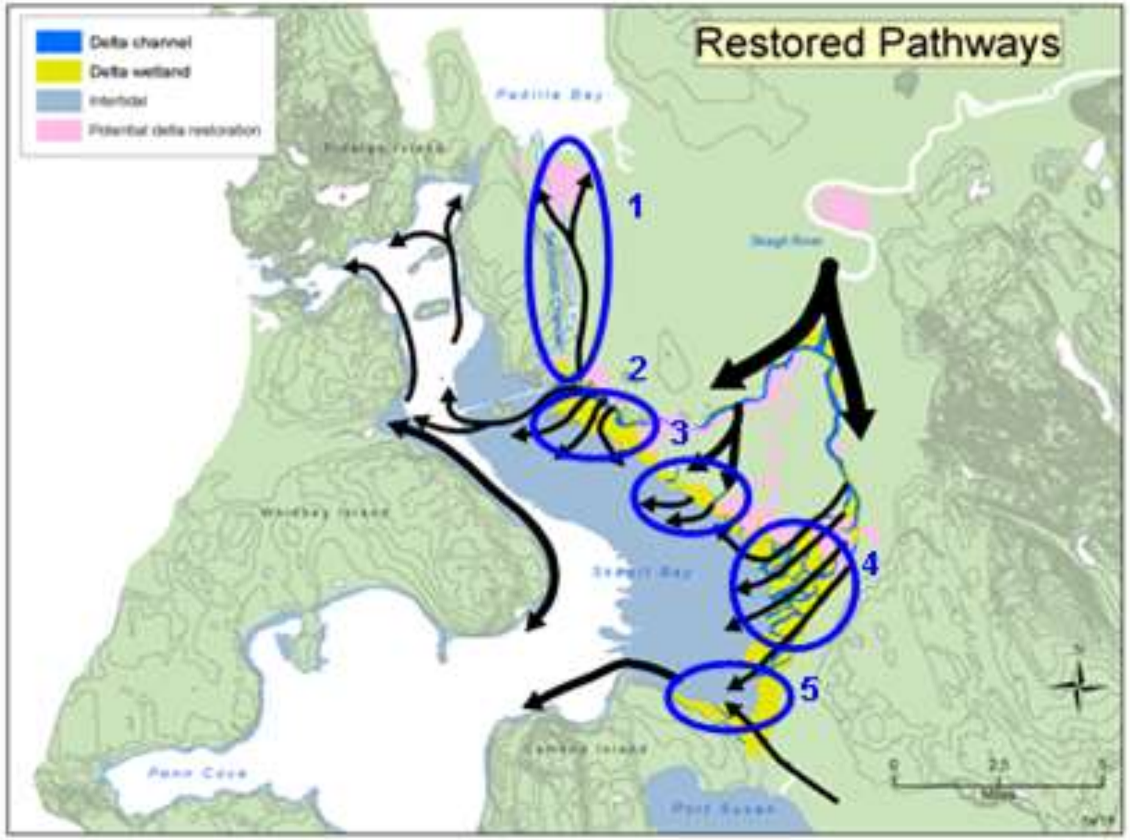

Dike breach
Historylink.org


Dike setback
Stillaguamish Tribe


Fill removal

Conceptual view of population benefits of restoration





Lesson 1: Determine clear restoration objectives that set up strong hypotheses

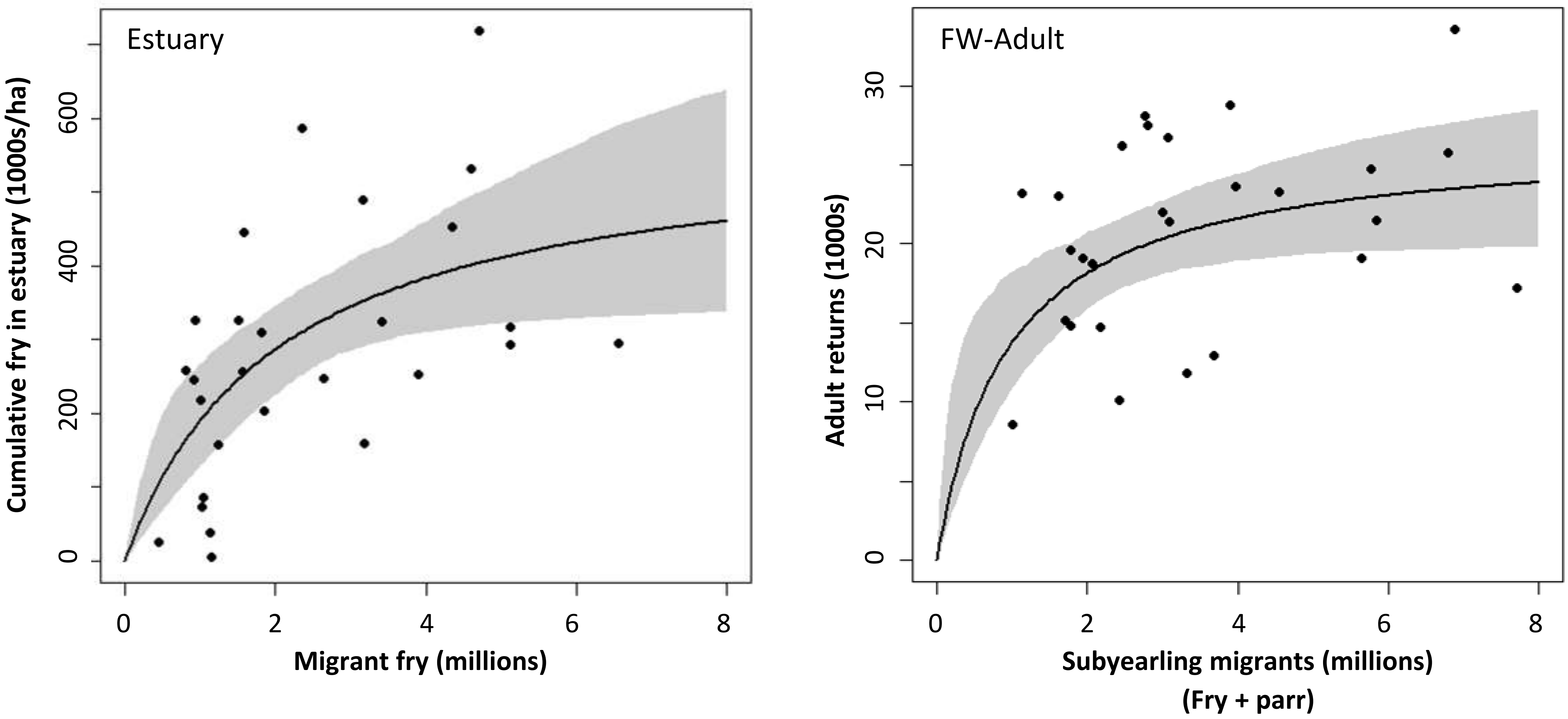
- Skagit Chinook Recovery establishes site specific restoration objectives to establish a population scale response

- Hypotheses can be formed to direct monitoring
  - Newly available habitat is immediately used, and project design influences use
  - Multiple projects reduce overall rearing density (i.e., fish can spread into restored areas)
  - Improved connectivity allows juveniles access to distant rearing areas
  - Restoration increases estuary residence and reduces abundance of fry migrants in Skagit Bay
  - Restoration increases marine survival and hence the rate of adult return

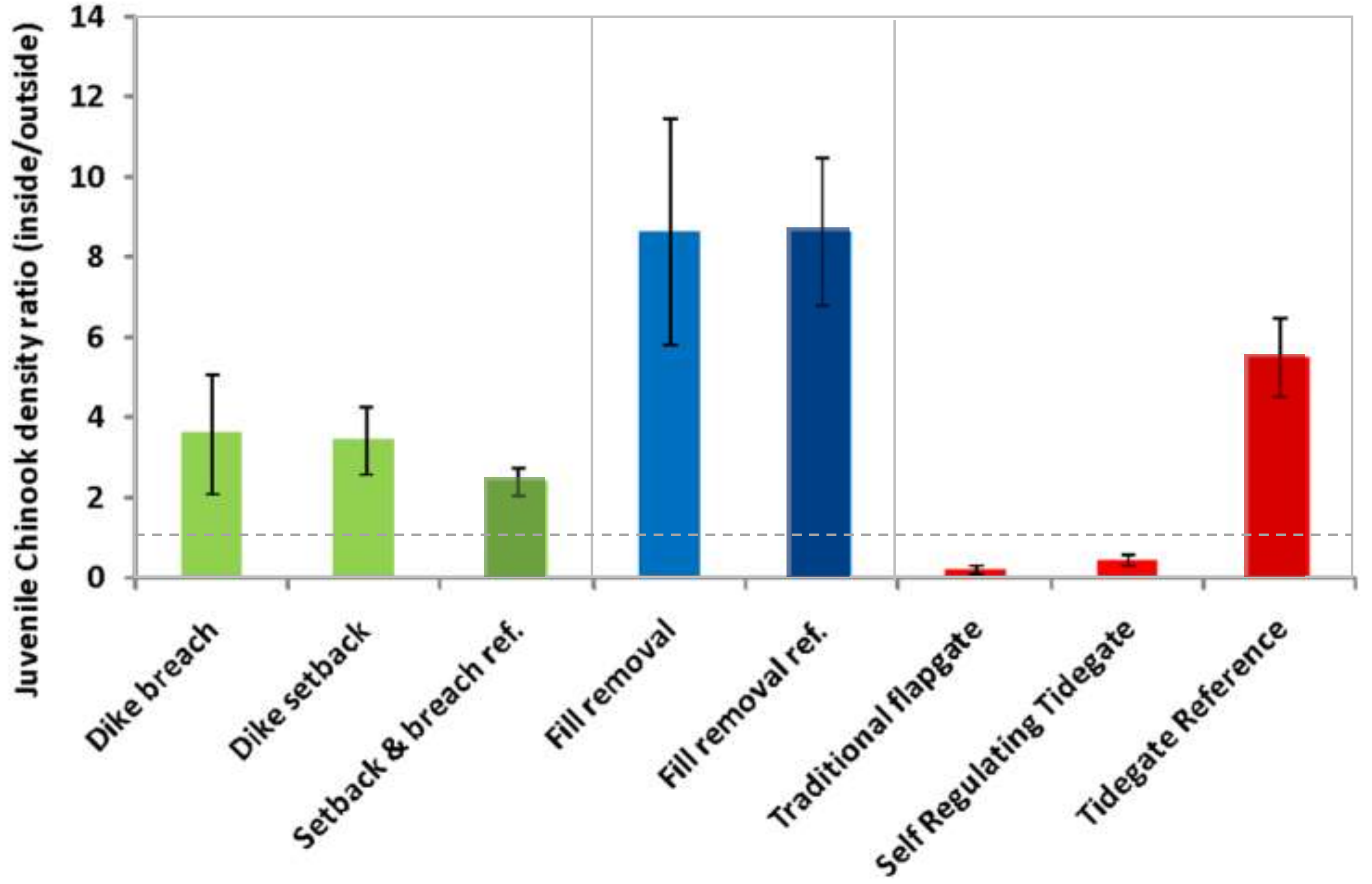
Compelling results

- Limited capacity in the estuary translates to a population bottleneck
- Certain restoration project designs are better than others
- Estuary restoration is having direct benefits on juvenile salmon cohorts
- Adult productivity tracks cumulative estuary restoration

Evidence for density-dependent limitations



Newly available habitat are immediately used, and project design influences use



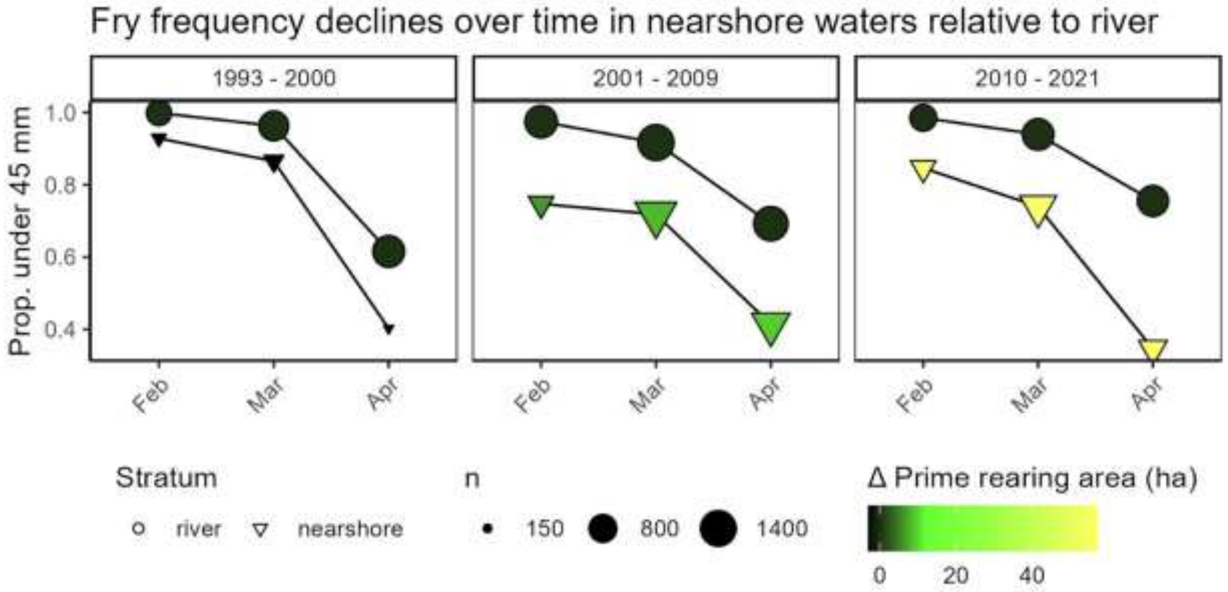
Other techniques on the horizon:

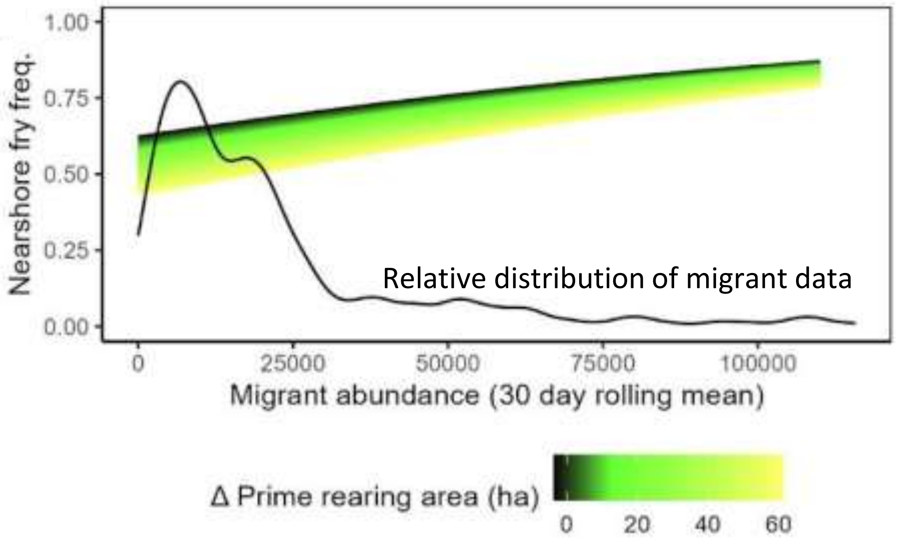
- Jumpstarting configuration of channels
- Distributary reconnection
- Beaver as estuary engineers
- Duck hunting ponds
- Spur dikes

Lesson 2: Monitoring program needs to be responsive to emerging restoration techniques

Lesson 3: Set up monitoring designs for successful learning

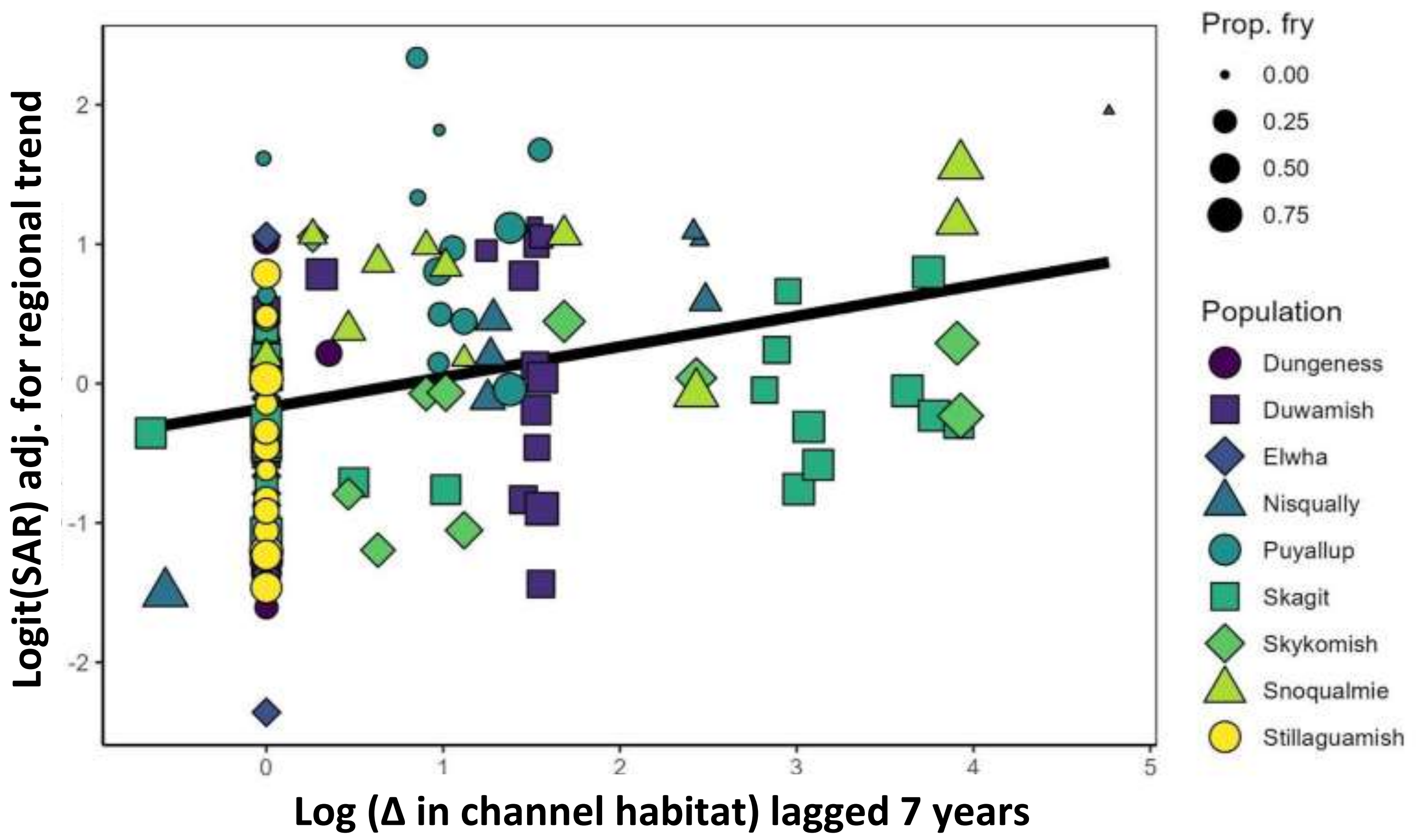
Cumulative restoration reduces density-dependent spillover into Skagit Bay

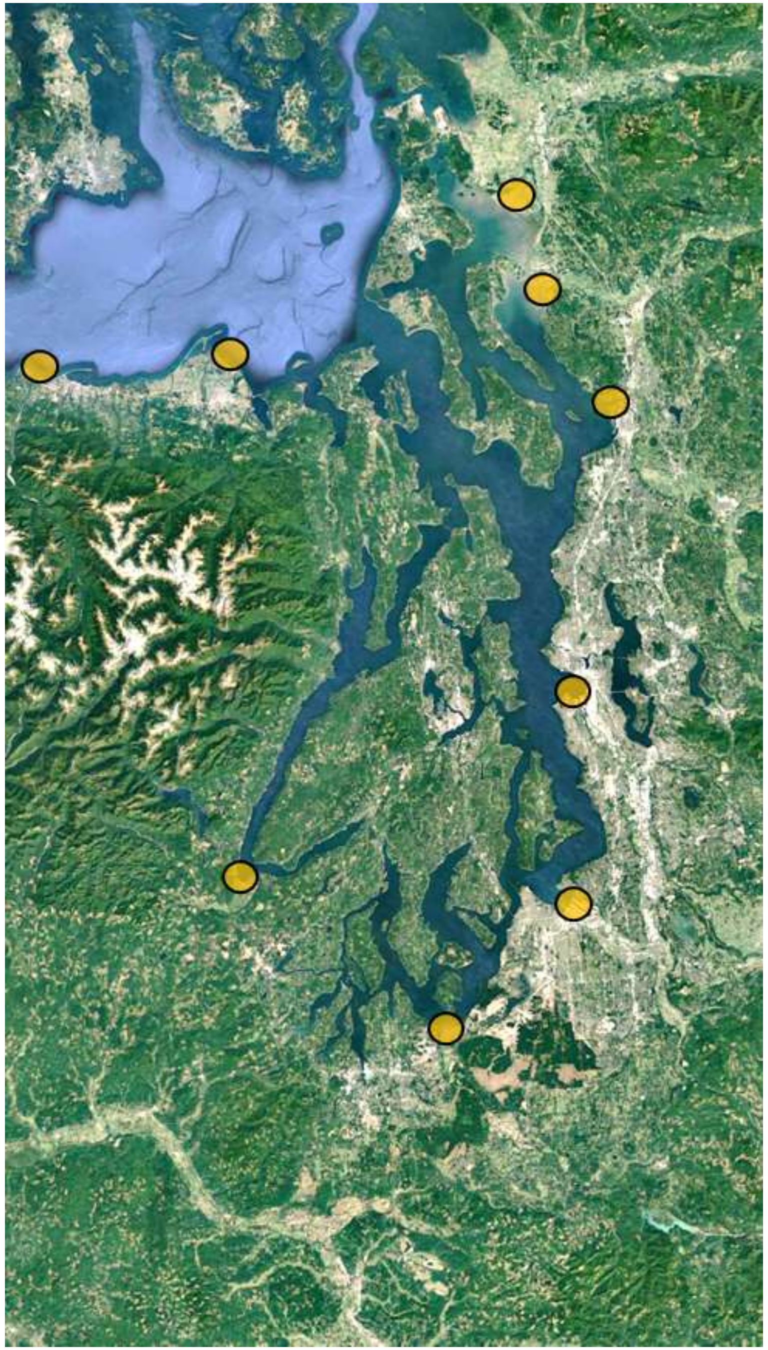




- Positive relationship between outmigrants and frequency of fry in the nearshore
- Restoration decreased the proportion of fry in the nearshore

Adult productivity tracks cumulative estuary restoration



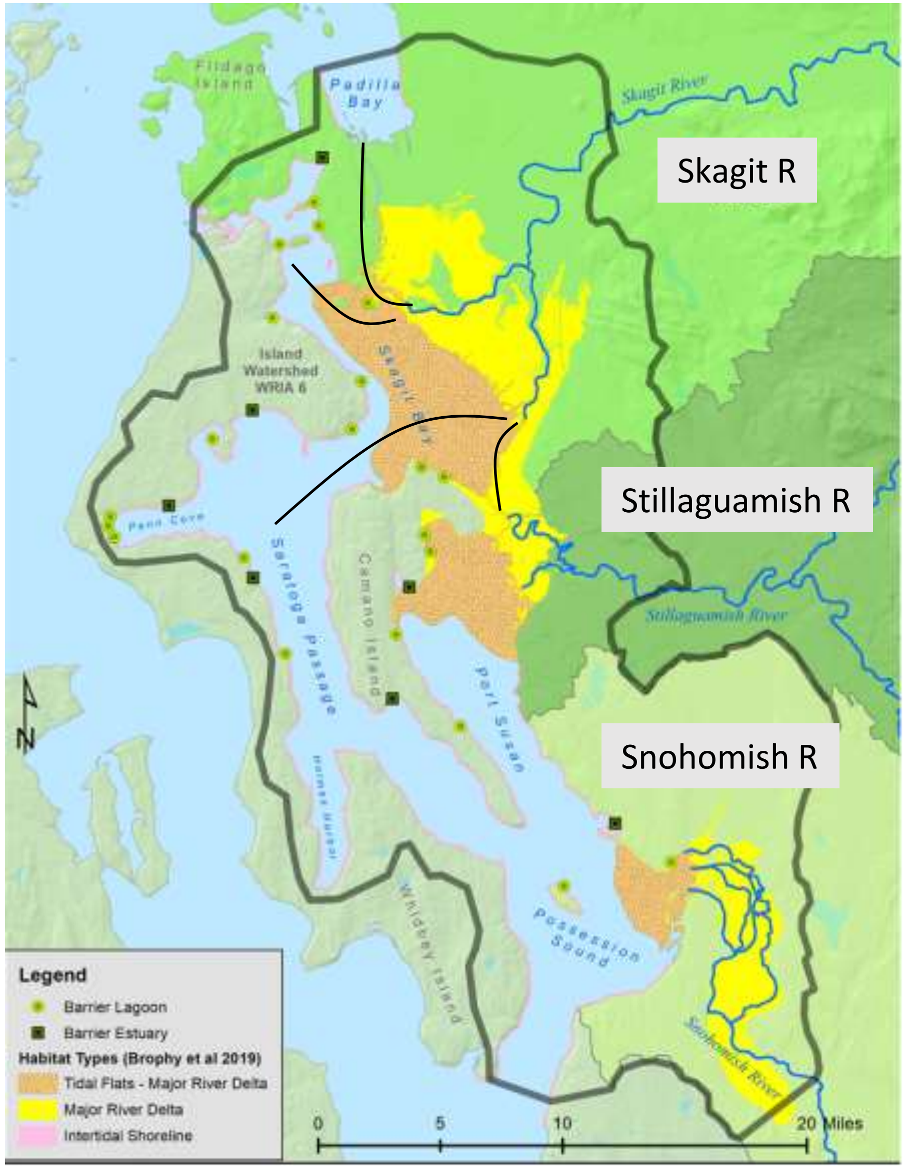


Lesson 4: Expect surprises

- Nonnatal estuary habitat use
- Impacts of aging infrastructure
- Impacts of climate change

Nonnatal estuary habitat use

- Other tidal deltas – determined via genetics
- Lagoons – migrant fry rapidly colonize accessible ones
- Coastal creeks – involve migration back into FW

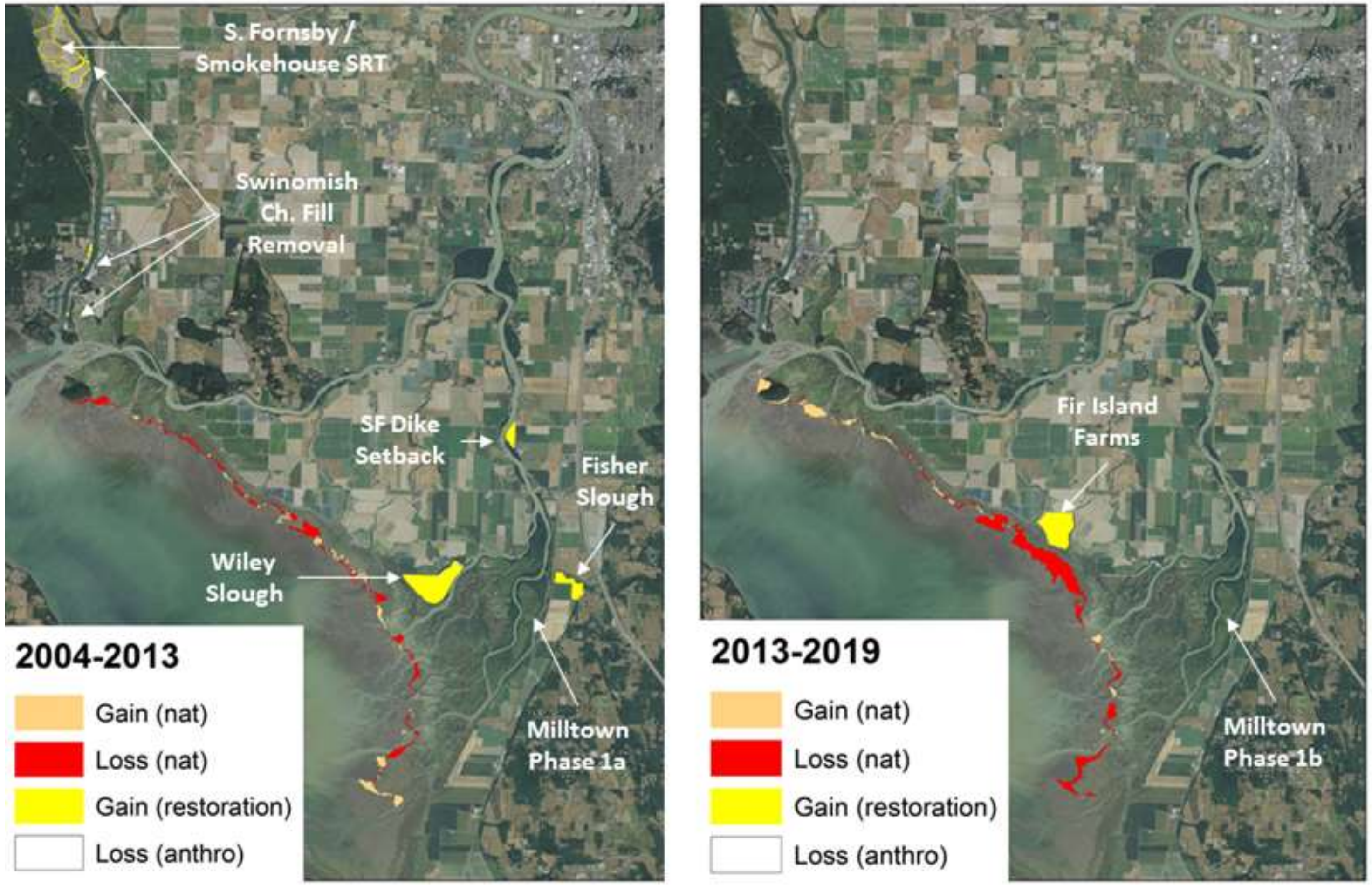


Aging infrastructure: McGlinn Island Jetty

- Blocks access to Swinomish Channel and Padilla Bay wetlands since the 1920s
- Kills juveniles through tidal stranding
- 3-13% of outmigration encounters the jetty

Emerging climate impacts

- IMW revealed wetland habitat loss caused by increasing coastal storms and sea level rise
- Total loss is equivalent to multiple restoration projects
- Importance for more restoration in landward portions of the delta



Lesson 5:
Timelines must be fluid - work together and be patient

- Restoration is a social experiment

- Spirit of volunteerism
  - Shared interest in Salmon Recovery
  - Willing landowners
  - Protect human life and property
  - Community leader support

- Spirit of patience
  - 10-15 years for project planning and implementation
  - Similar time frame for recovery of function for salmon

Conclusions: Lessons learned from Skagit IMW

1. Set up clear restoration objectives with testable hypotheses

1. Be responsive to emerging estuary restoration techniques

1. Set up monitoring for successful learning

1. Expect surprises

1. Timelines are fluid: work together and be patient

Thank you

Questions?

Correigh Greene (correigh.greene@noaa.gov)

Mike LeMoine (mlemoine@skagitcoop.org)

Reports: skagitcoop.org