

JUVENILE SALMON USE OF SMALL COASTAL STREAMS IN THE WHIDBEY BASIN

Project Partners:

Tulalip Tribes

Skagit River System Cooperative

Island County

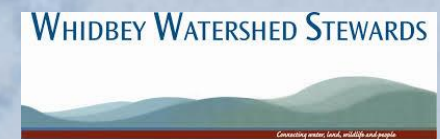
Northwest Indian Fisheries Commission

Adopt a Stream Foundation

Whidbey Watershed Stewards

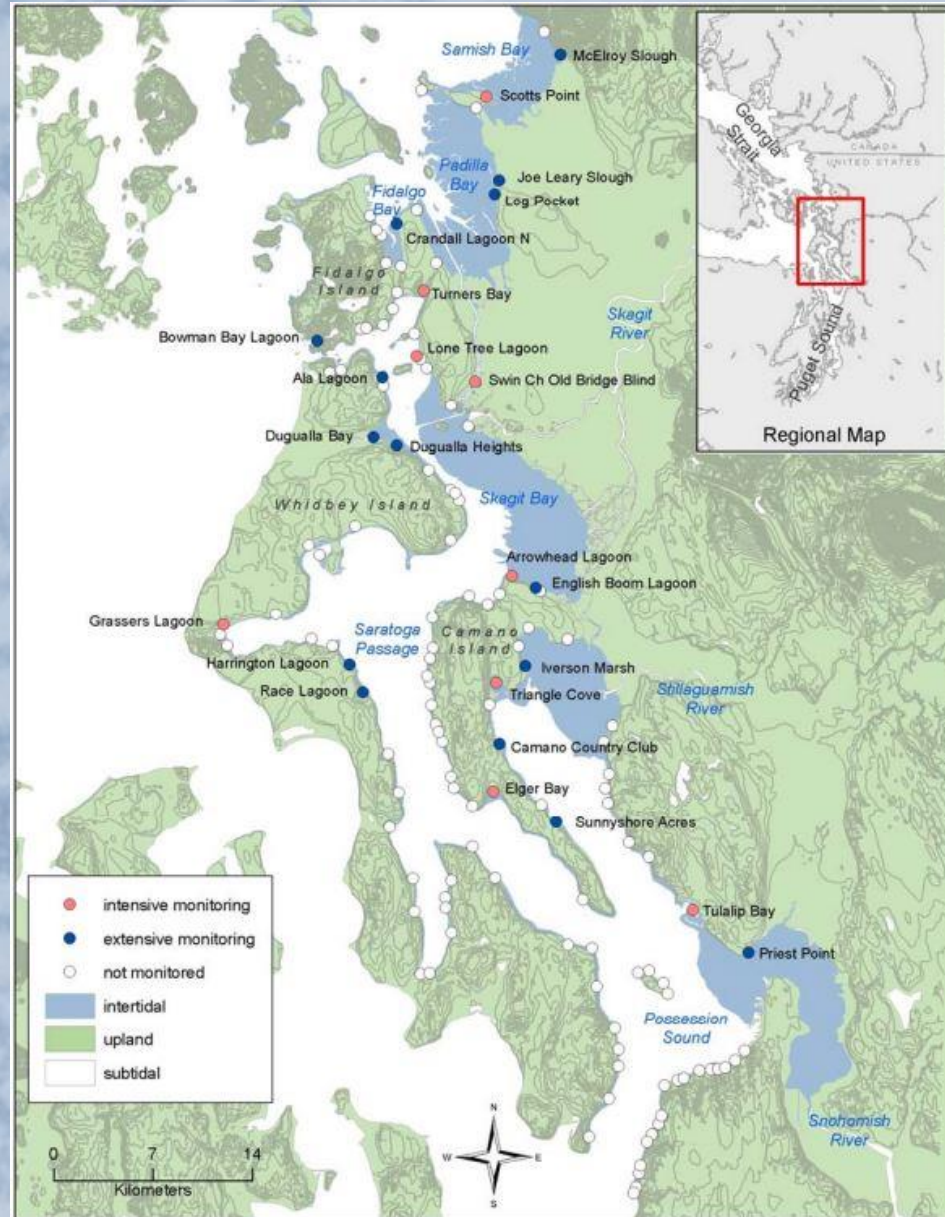
Todd Zackey¹, Eric Beamer², Derek Marks¹, Richard Henderson², David Teal³, & D. Kuligowski³

¹Tulalip Tribes, ²Skagit River System Cooperative, ³NOAA



Background

Juvenile Chinook and other salmon found to be rearing in pocket estuaries around Whidbey Basin (Beamer et al. 2005)

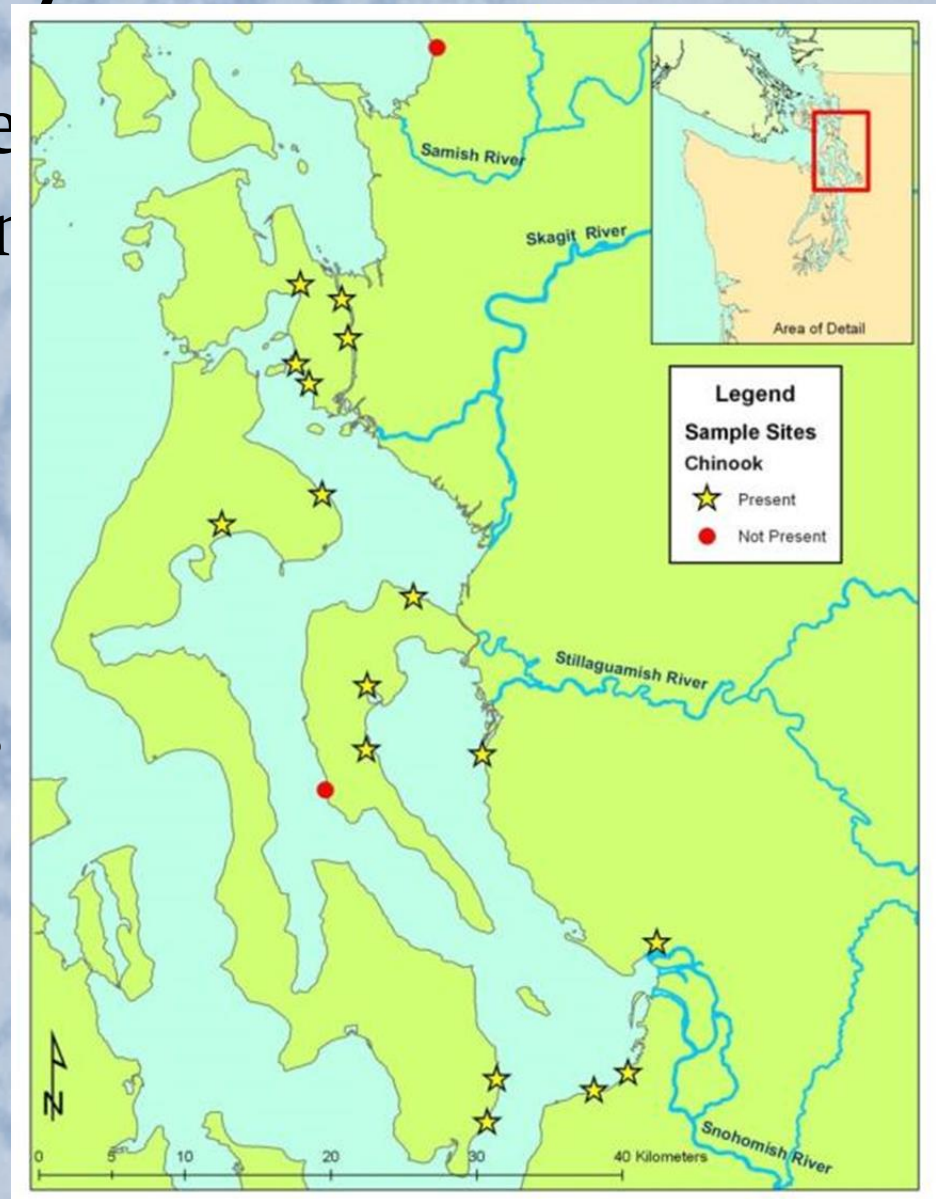


Pilot Study 2009-2010

- Hypothesis: Juvenile Chinook found in 16 of 18 streams sampled in small streams drain Basin

Other Species Caught

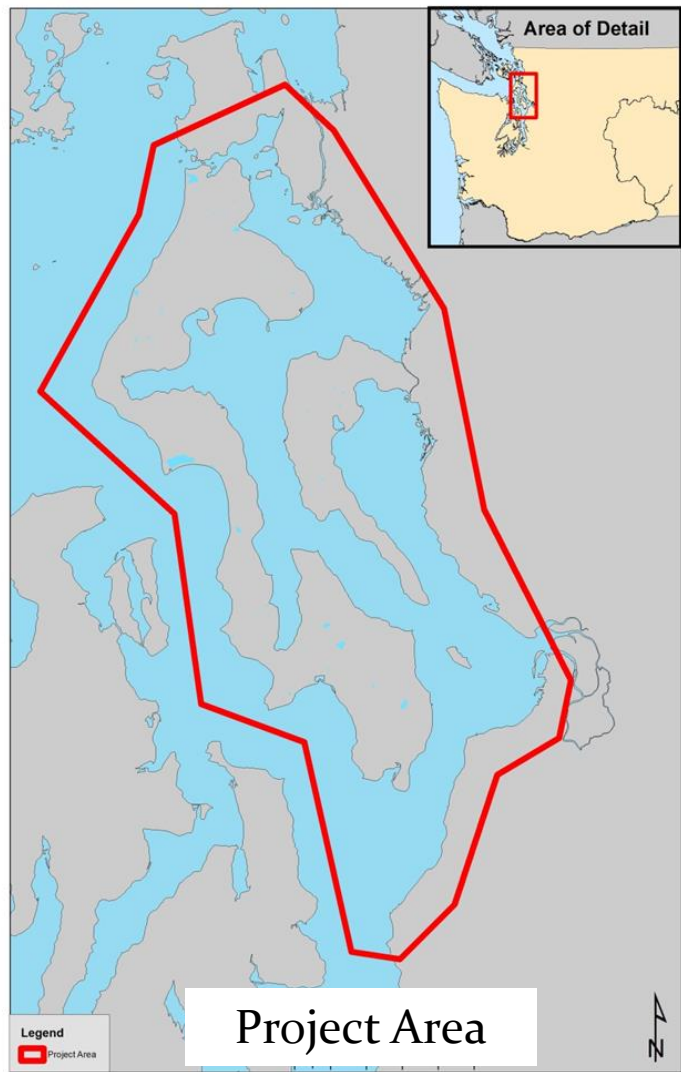
- What size?
- Coho
- Gumm
- How far upstream?
- Cutthroat
- Rainbow Trout
- How long do they stay?
- Pink
- What other species?
- Sculpin
- Three-Spine Stickleback
- Peamouth
- Starry Flounder



Questions from Pilot Study

- How wide spread is juvenile Chinook and other salmon use of small coastal streams?
- Are there physical stream characteristics that can be used to predict juvenile salmon presence?
- What conditions are coastal streams in?
- How do we protect, manage, and restore coastal streams?

Study: Predictive Modeling and Protection of Coastal Salmon Streams in WRIA 6



2011 Secured Grant to Fund further stream sampling and work

Grant from Washington Department of Ecology Watershed Protection and Restoration National Estuary Program (NEP) Puget Sound Projects

Stream Census

Comparison of Washington Department of Natural Resources Hydrology Datalayer to Confirmed Drainages from Drainage Census



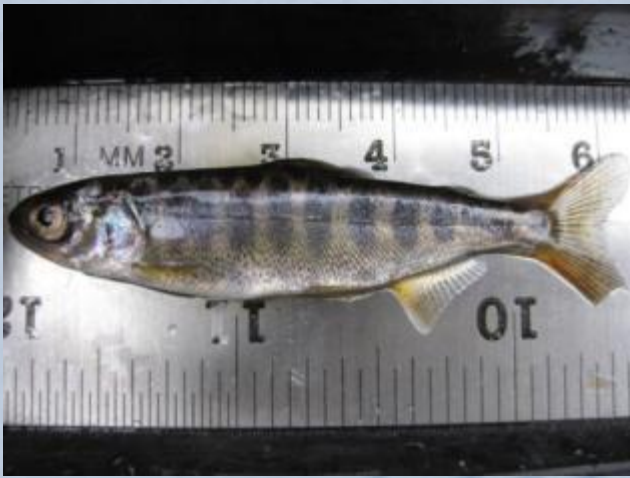
Le
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Stream Habitat Surveys

Site ID	Reach #	Unit Type	Reach Unit Length (meters)	Average Reach Gradient %	Average Max Depths (meters)	Average Reach Wetted Width (meters)	Average Reach Bankful Width (meters)
BRBA07	1	Intertidal		1.5%		2.02	
BRBA07	2	Stream	15	1.5%	0.70	3.80	4.60
BRBA07	3	CUL	12.4				
BRBA07	4	Stream	43	3.6%		2.07	3.30
BRBA07	5	Stream	24.9	6.0%		1.28	3.36
BRBA07	6	Stream	69.9	1.4%	0.49	1.94	3.48
BRBA07	7	CUL	22	7.0%			
BRBA07	8	Stream	37.2	9.5%		2.64	4.08



Stream Sampling



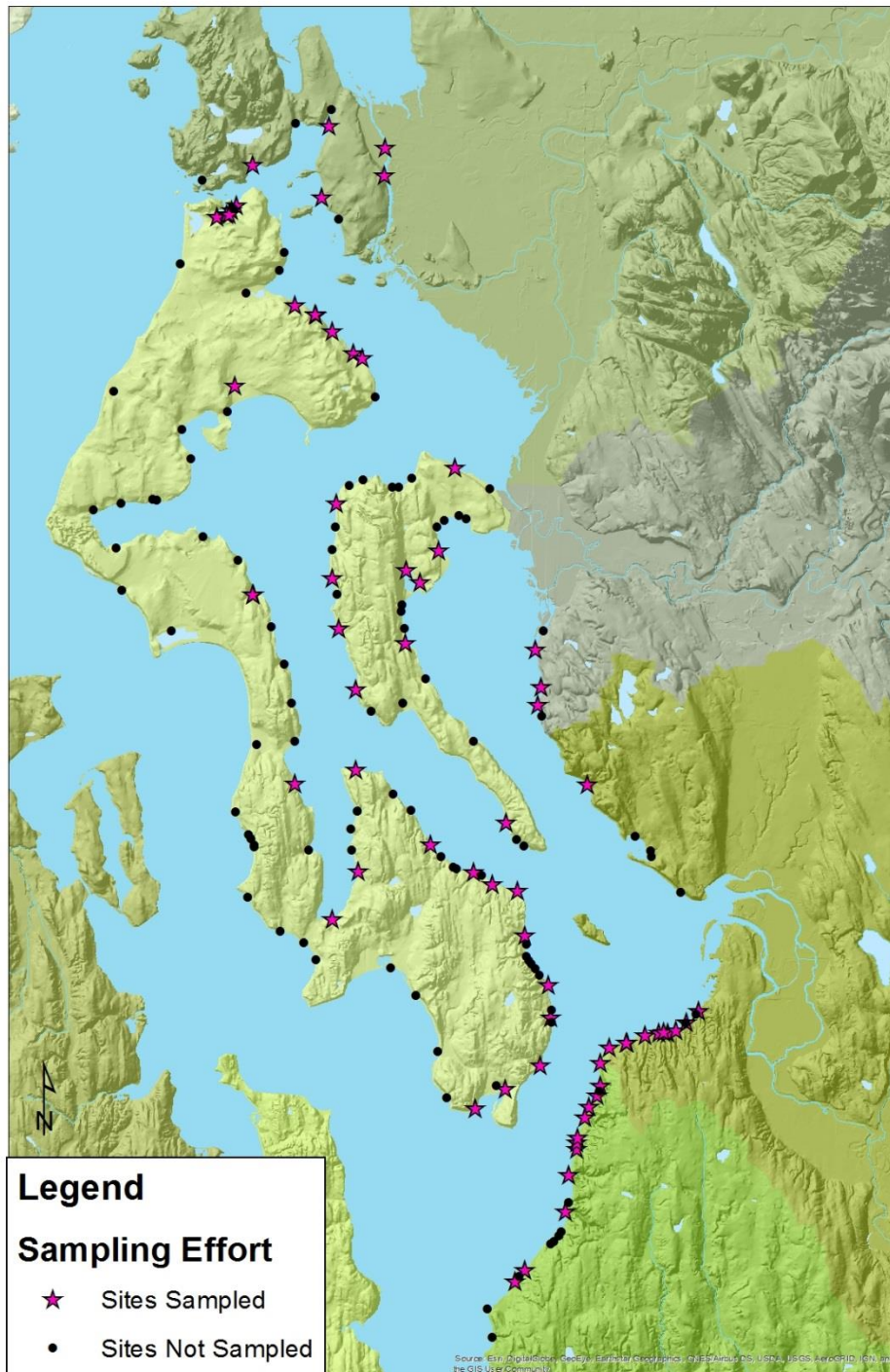
- ID to Species
- Salmon Lengths
- Count all species
- Chinook DNA



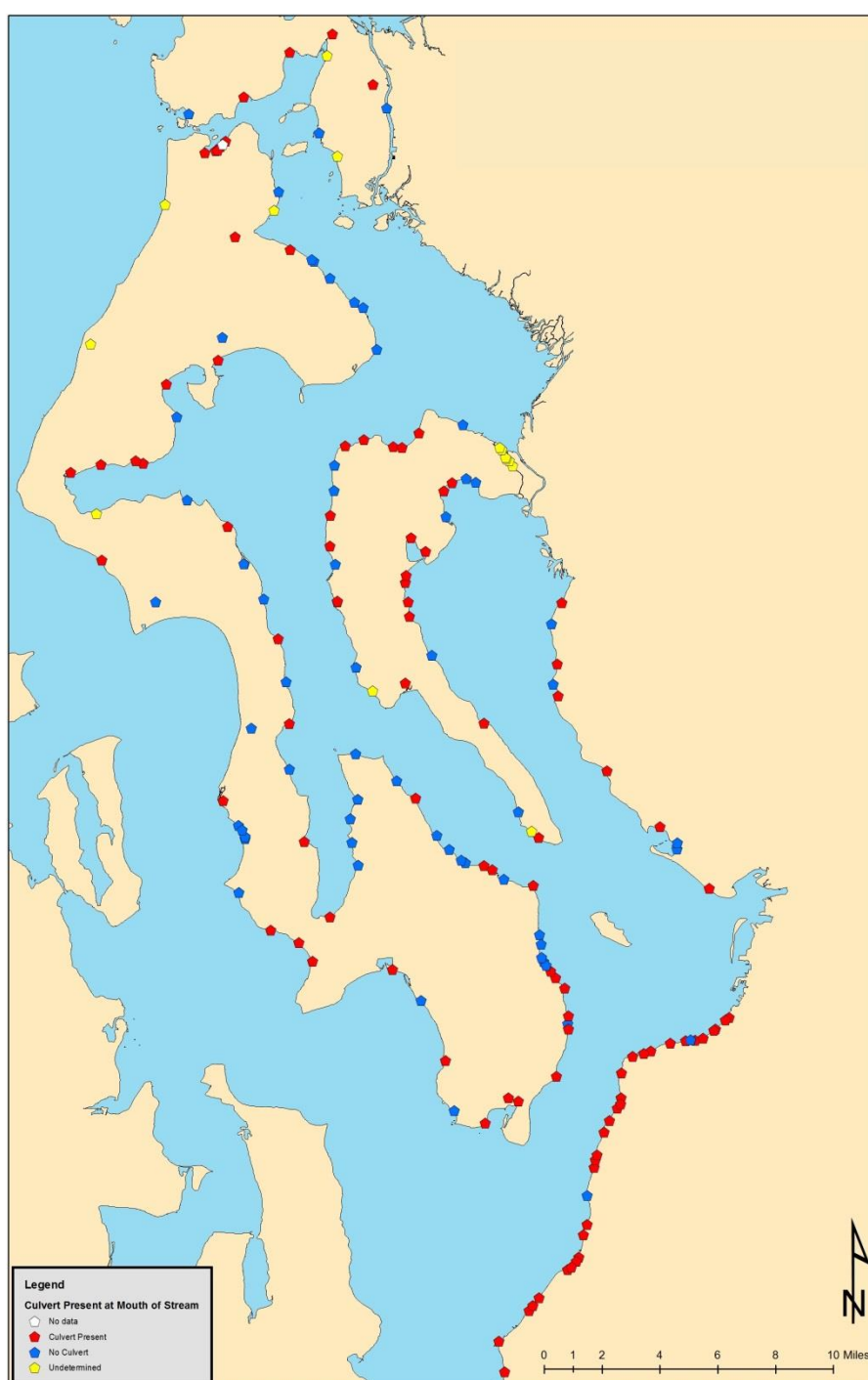
**1 Pass Electrofishing
Up to 200 m or to fish barrier**

Stream Sampling

- 63 Streams Sampled
- 61 Habitat Surveys
- Sampled intertidal and stream channel



Fish Barriers? Culverts at Stream Mouths

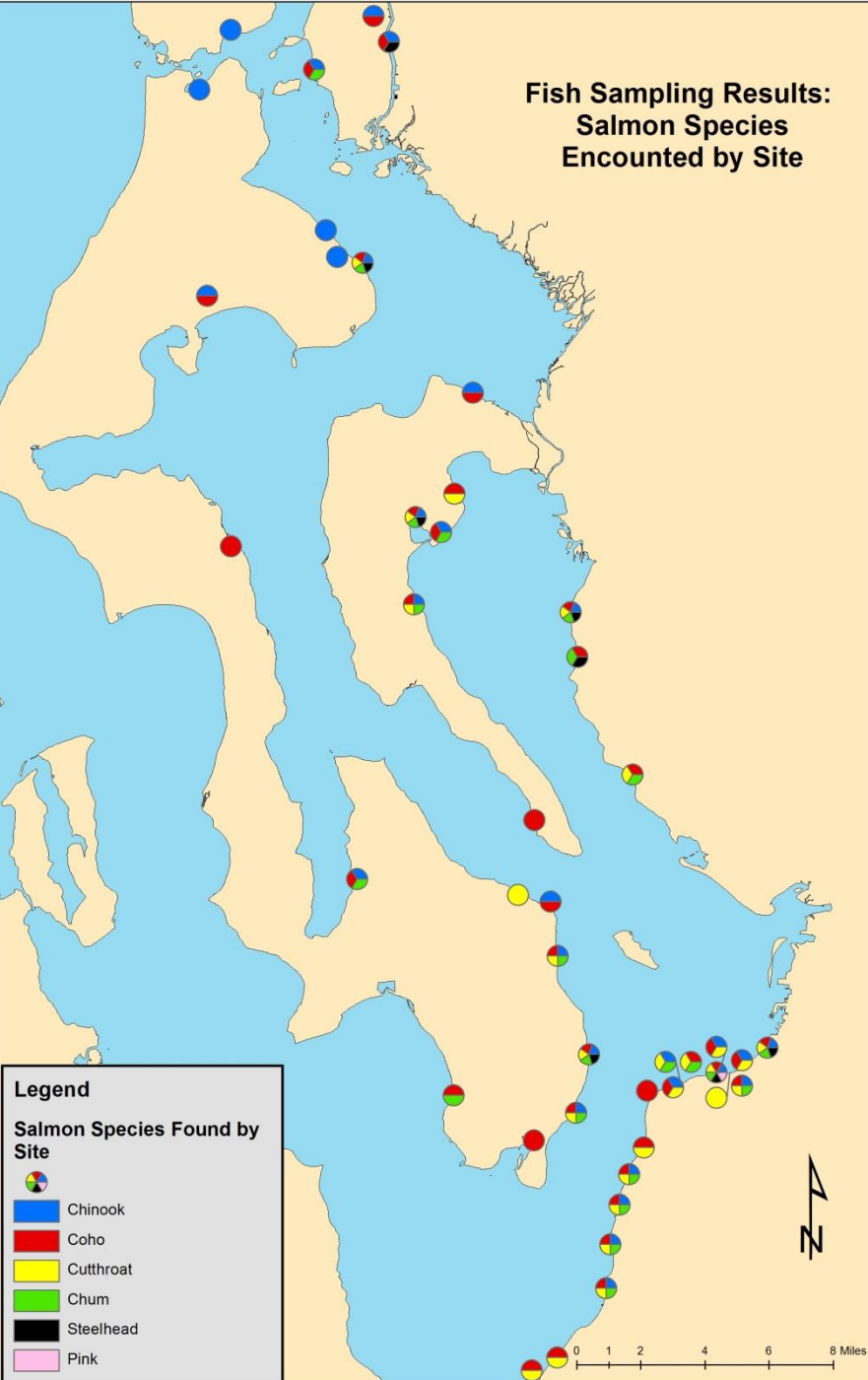


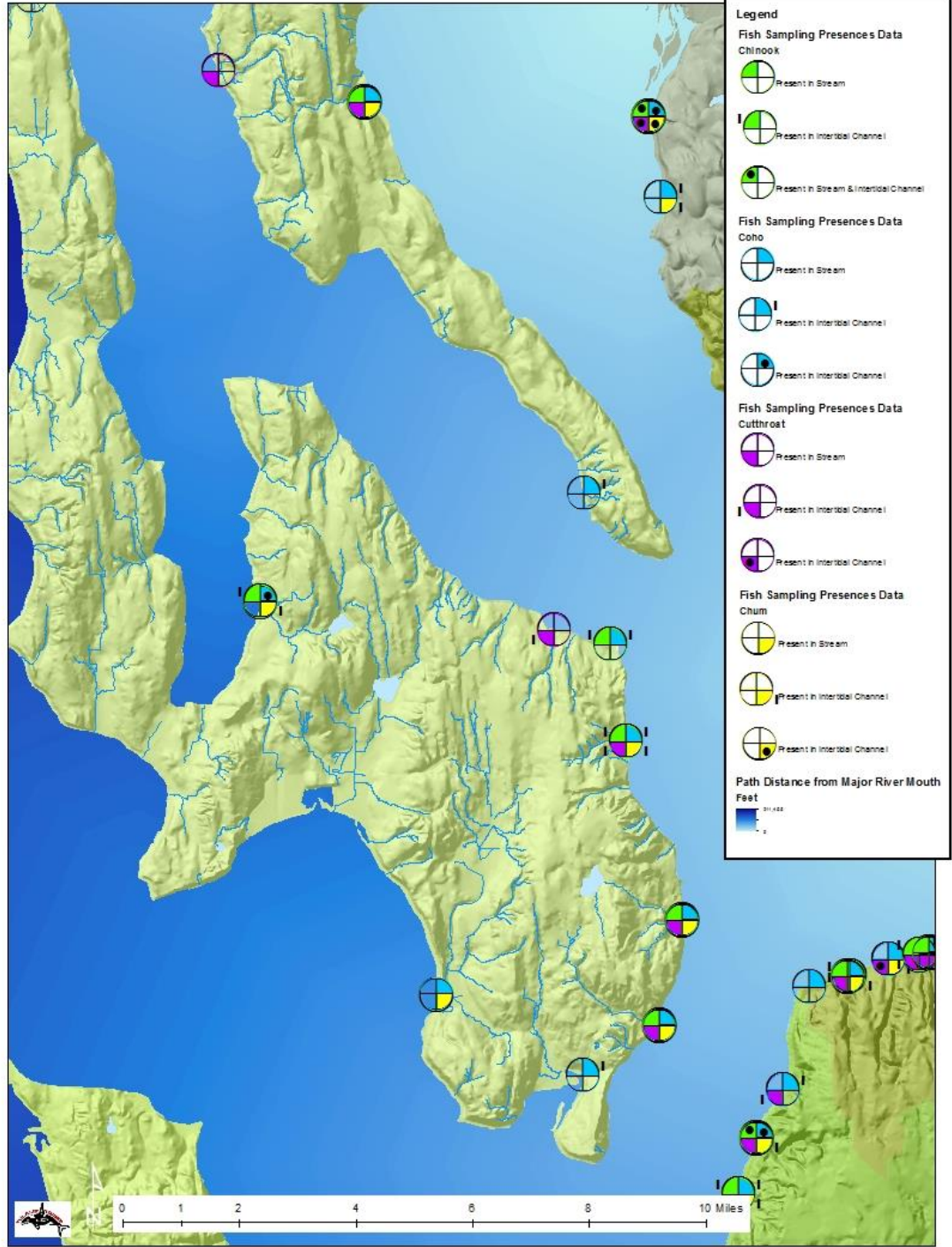
Stream Sampling Results

- 63 Streams Sampled
- 61 Habitat Surveys
- Sampled intertidal and stream channel

Salmonid Species	Number of streams	
	Present	Not found
Chinook salmon	32	31
Steelhead trout	9	54
Coho salmon	31	32
Cutthroat trout	23	40
Chum salmon	23	40
Pink salmon	2	61

Fish Sampling Results:
Salmon Species
Encountered by Site





Stream Sampling Results

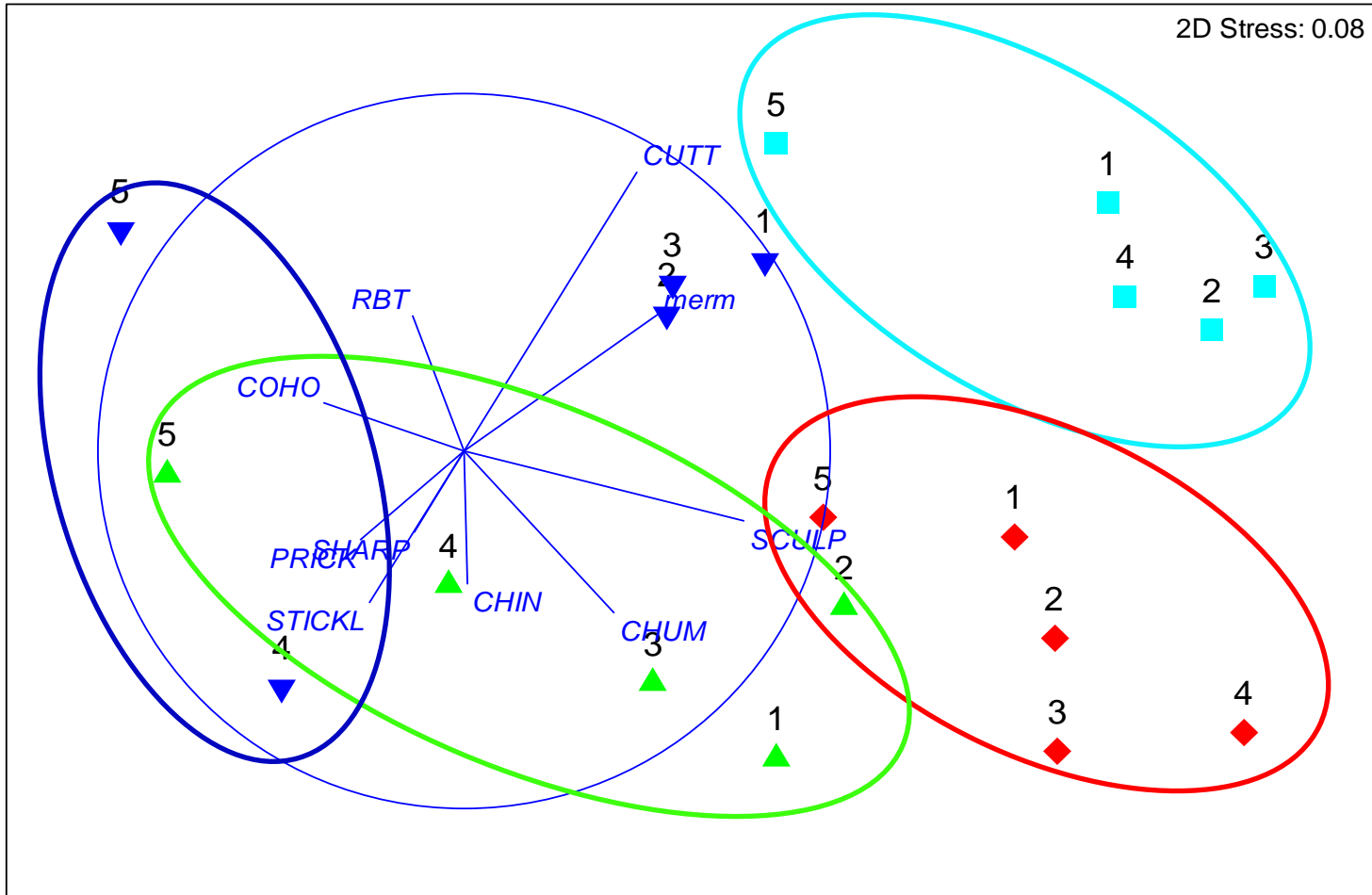
SSv1

Standardise Samples by Total
 Transform: Square root
 Resemblance: S17 Bray Curtis similarity

2D Stress: 0.08

culR_desc

- ▲ 0Intertidal
- ▼ 0Stream
- 1Stream
- ◆ 1Intertidal



- ▲ Intertidal Channel No Culvert at Stream Mouth
- ▼ Stream Channel No Culvert at Stream Mouth
- Stream Channel Culvert at Stream Mouth
- ◆ Intertidal Channel Culvert at Stream Mouth

MDS: Salmonids 2010

(1 point = 1 mo)



Glendale Creek

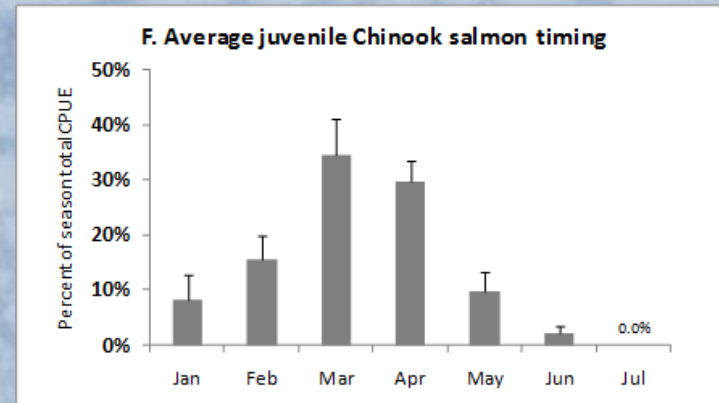
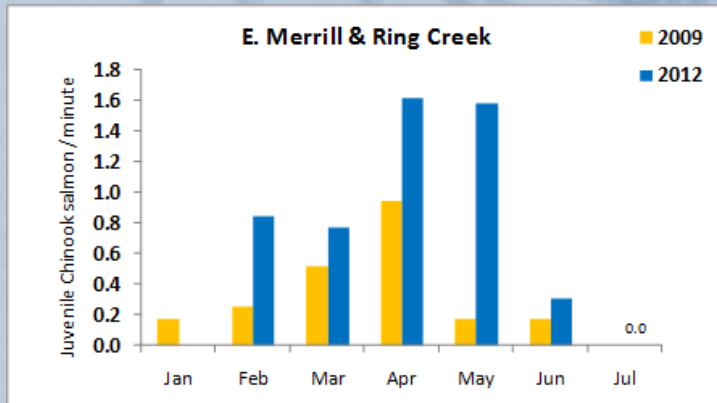
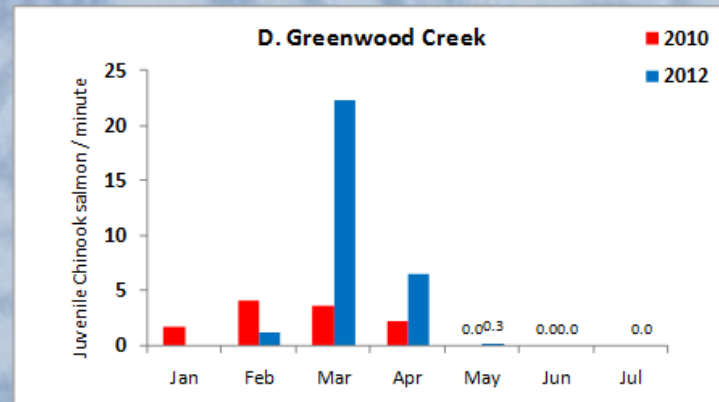
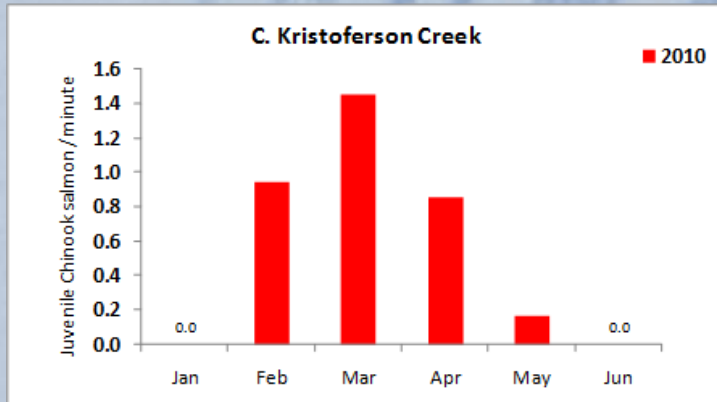
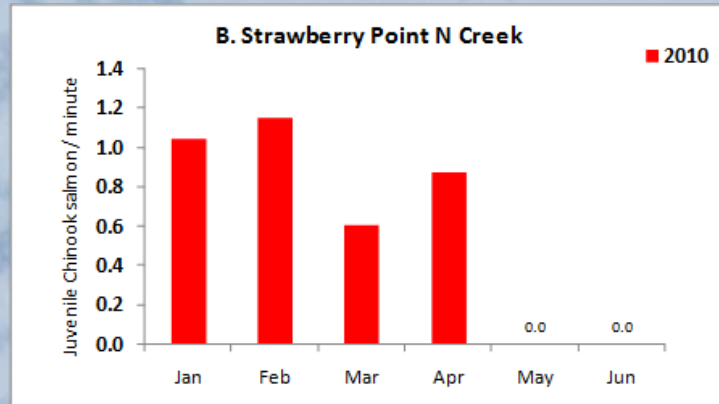
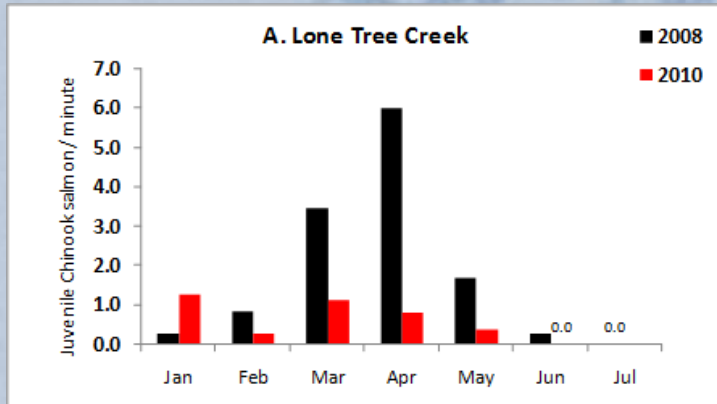


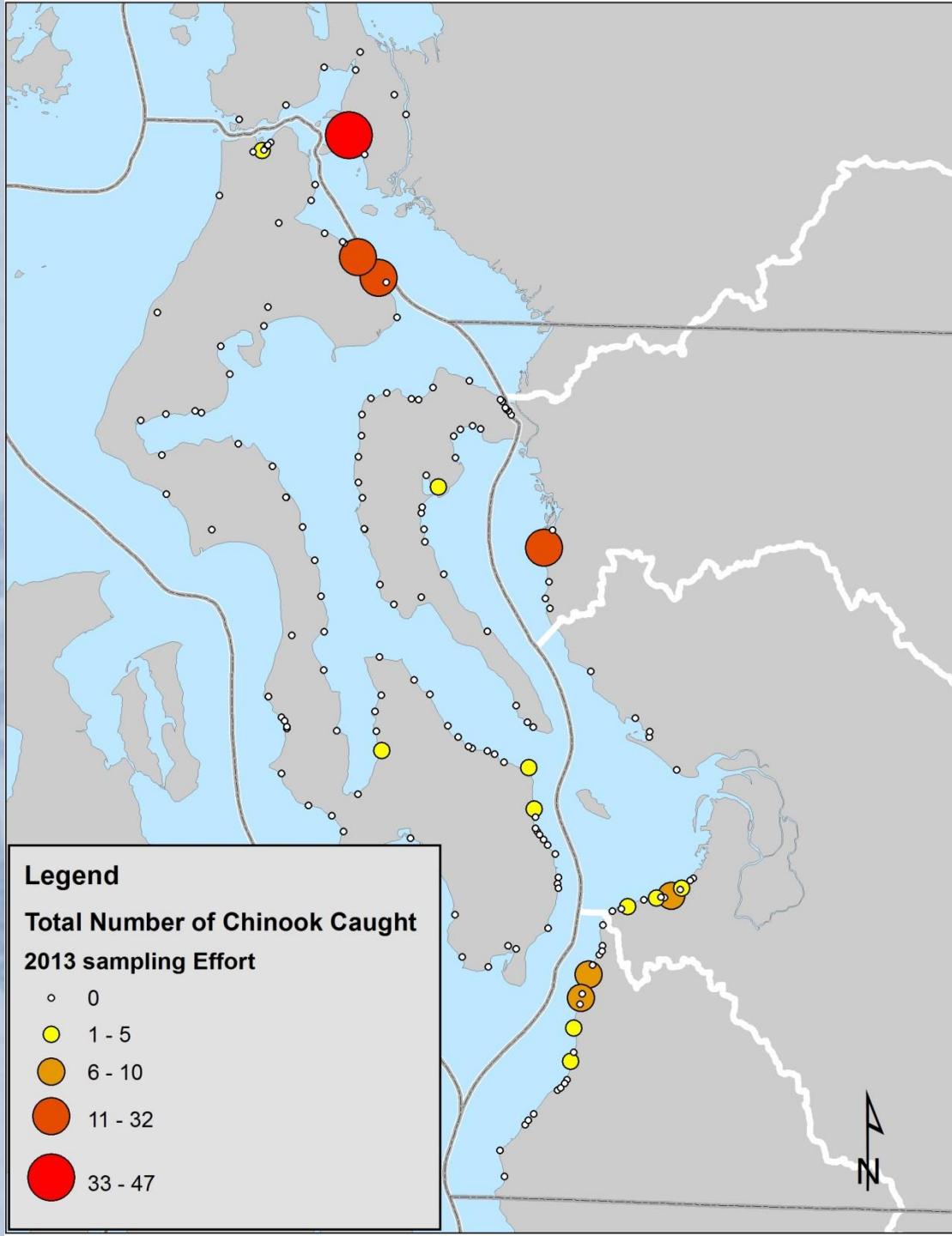
Warm Beach South

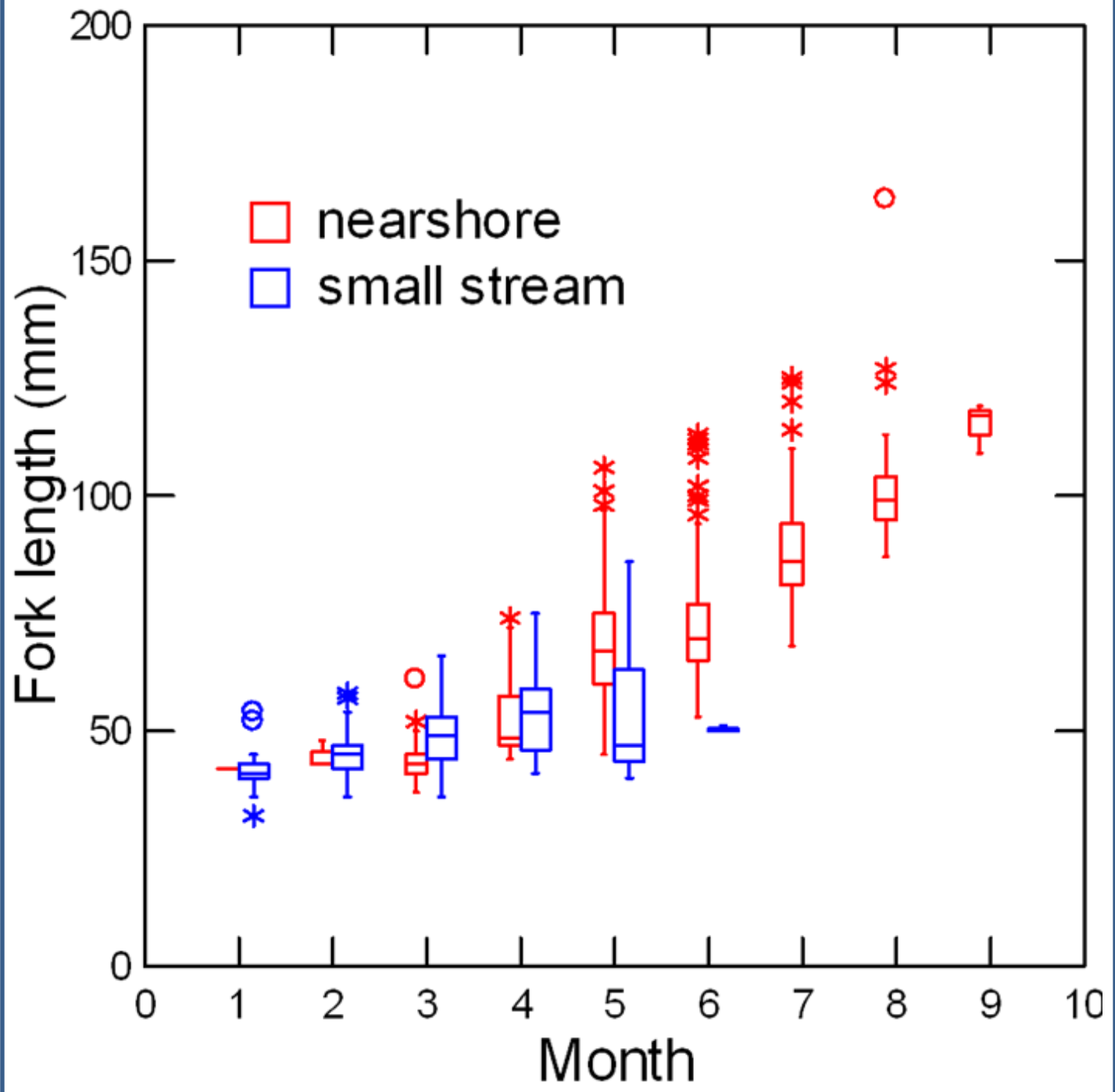
$P=0.002$

- Warm Beach South
- + Pigeon #1 Creek
- × Warm Beach South
- * Zook Creek

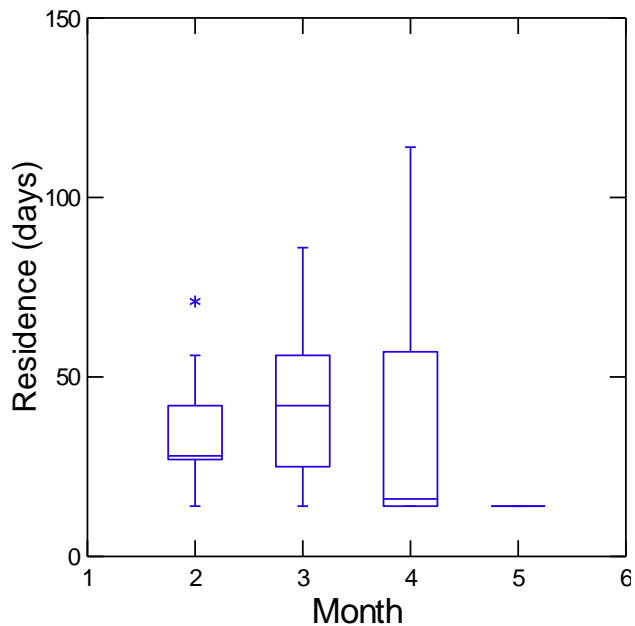
Chinook Abundance in Different Streams



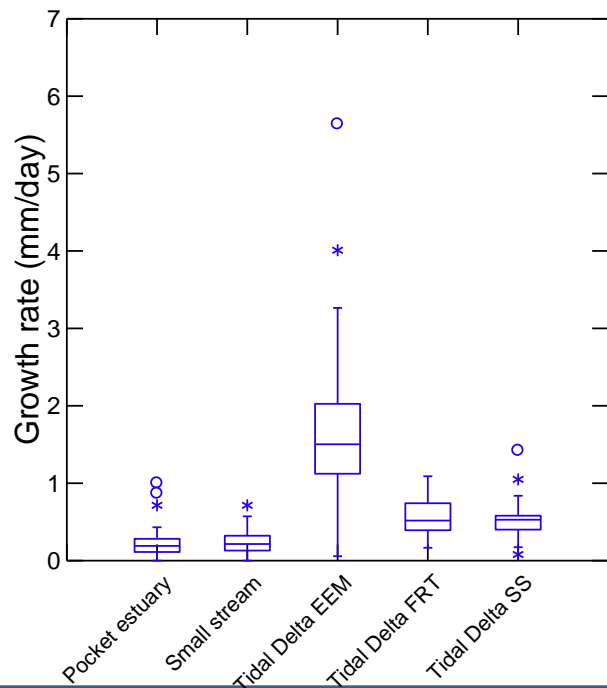
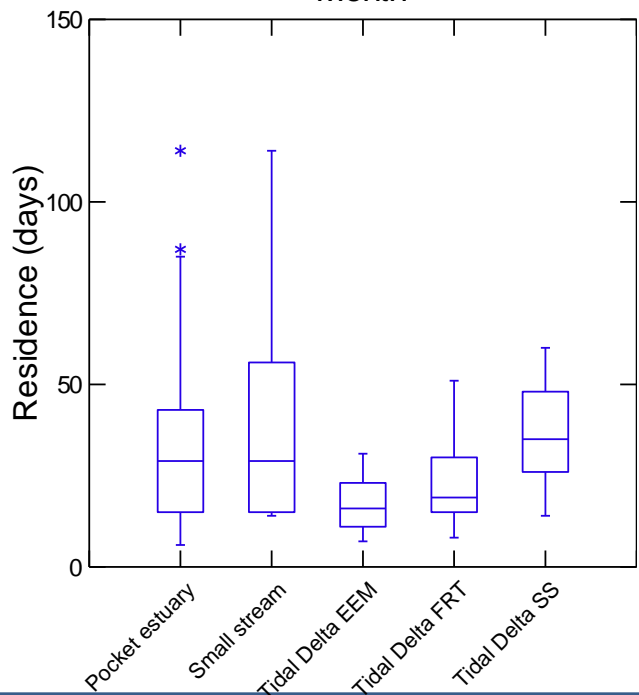
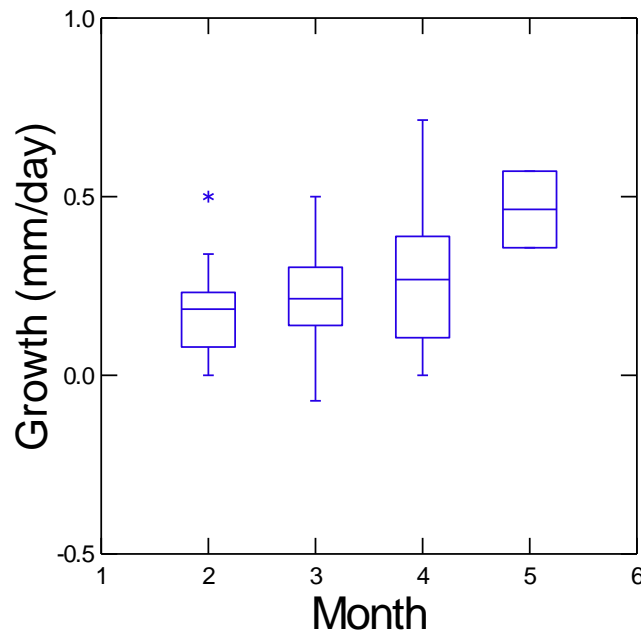


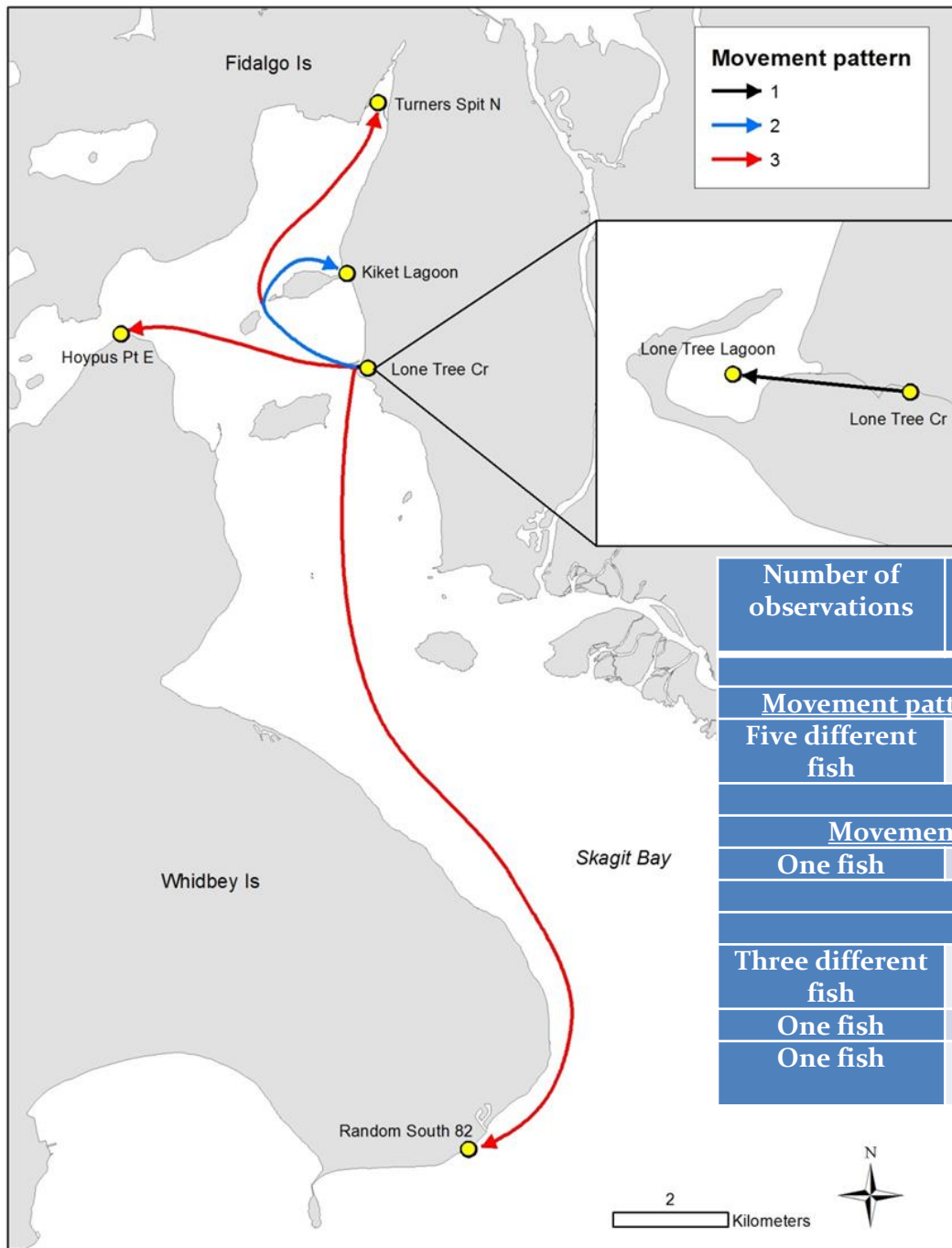


Chinook Residence Times



Chinook Growth Rates

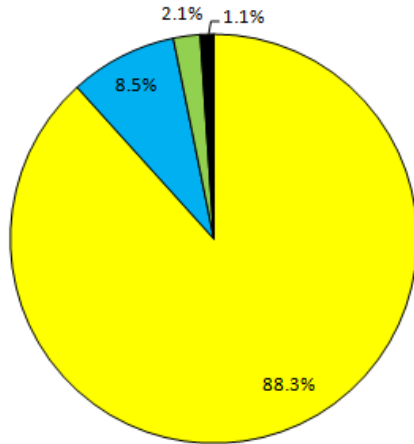




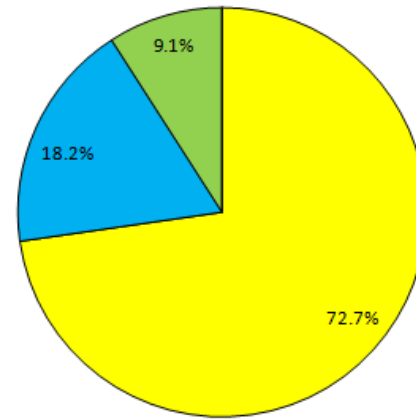
Number of observations	Starting location	Ending location	Between starting and ending location	
			Time	Distance
<u>Movement pattern 1: stream to lagoon within same pocket estuary system</u>				
Five different fish	Lone Tree Cr	Lone Tree Lagoon	22-64 days	0.2 km
<u>Movement pattern 2: stream to different pocket estuary system</u>				
One fish	Lone Tree Cr	Kiket Lagoon	56 days	5.1 km
<u>Movement pattern 3: stream to nearshore</u>				
Three different fish	Lone Tree Cr	Turners Spit N	50-91 days	8.1 km
One fish	Lone Tree Cr	Hoypus Pt E	168 days	5.9 km
One fish	Lone Tree Cr	Random South 82	100 days	19.4 km

Origin of Chinook Found in Small Streams from DNA Analysis

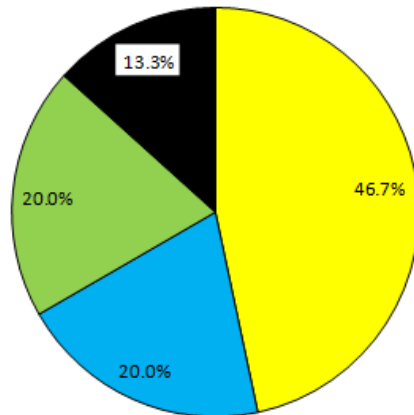
Skagit Bay



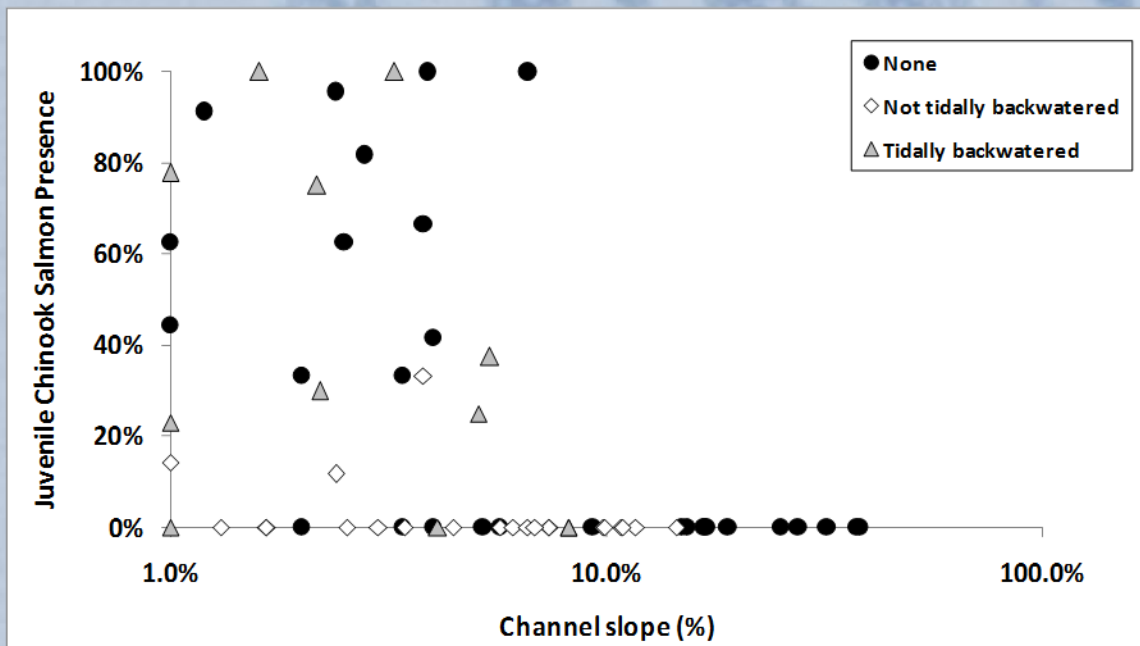
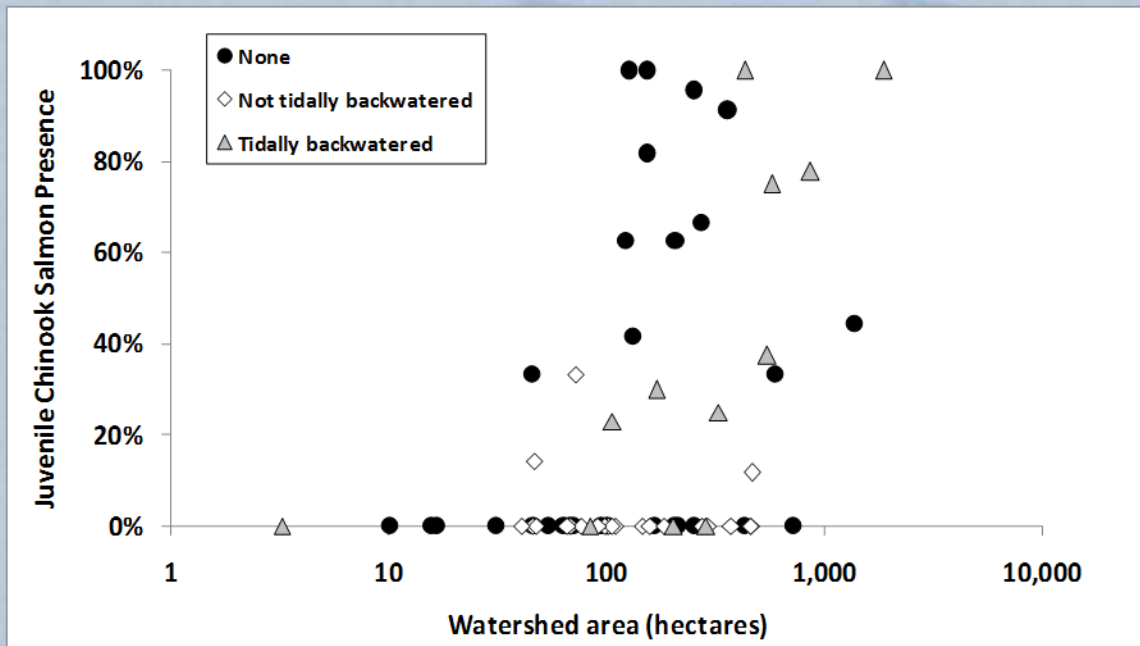
Port Susan



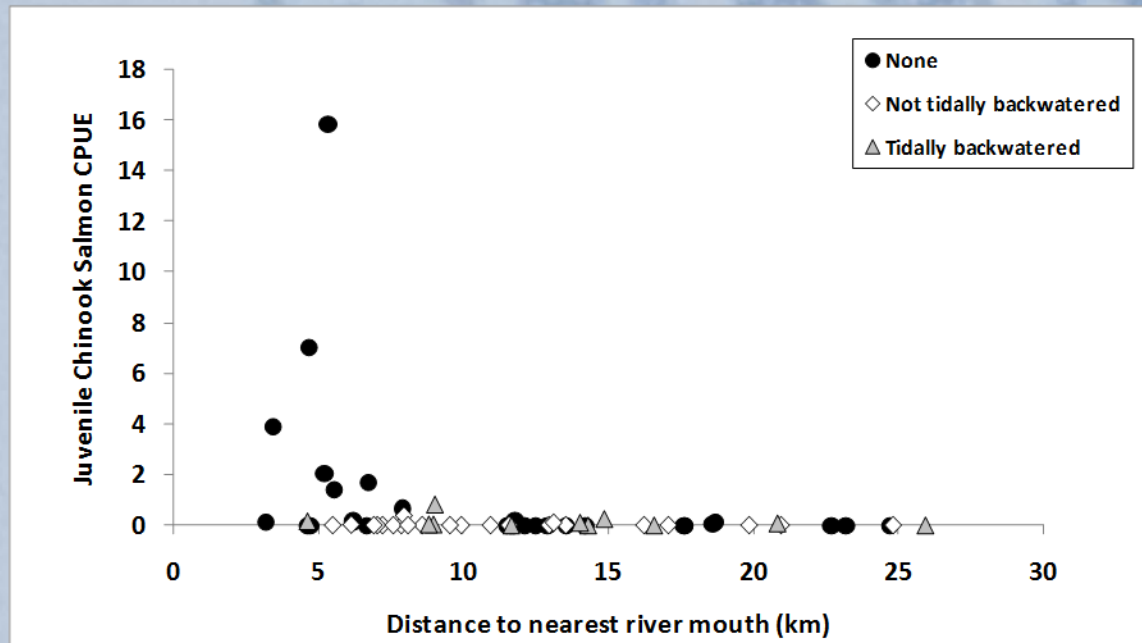
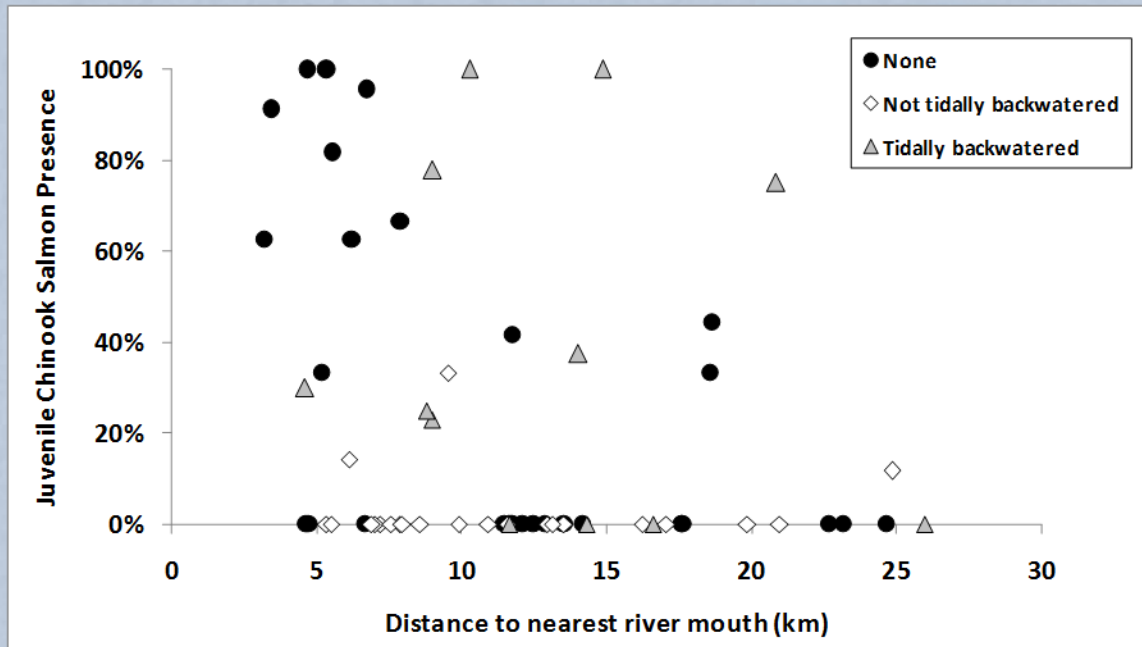
Possession Sound



- Skagit
- Stillaguamish
- Skykomish
- SSF/HC

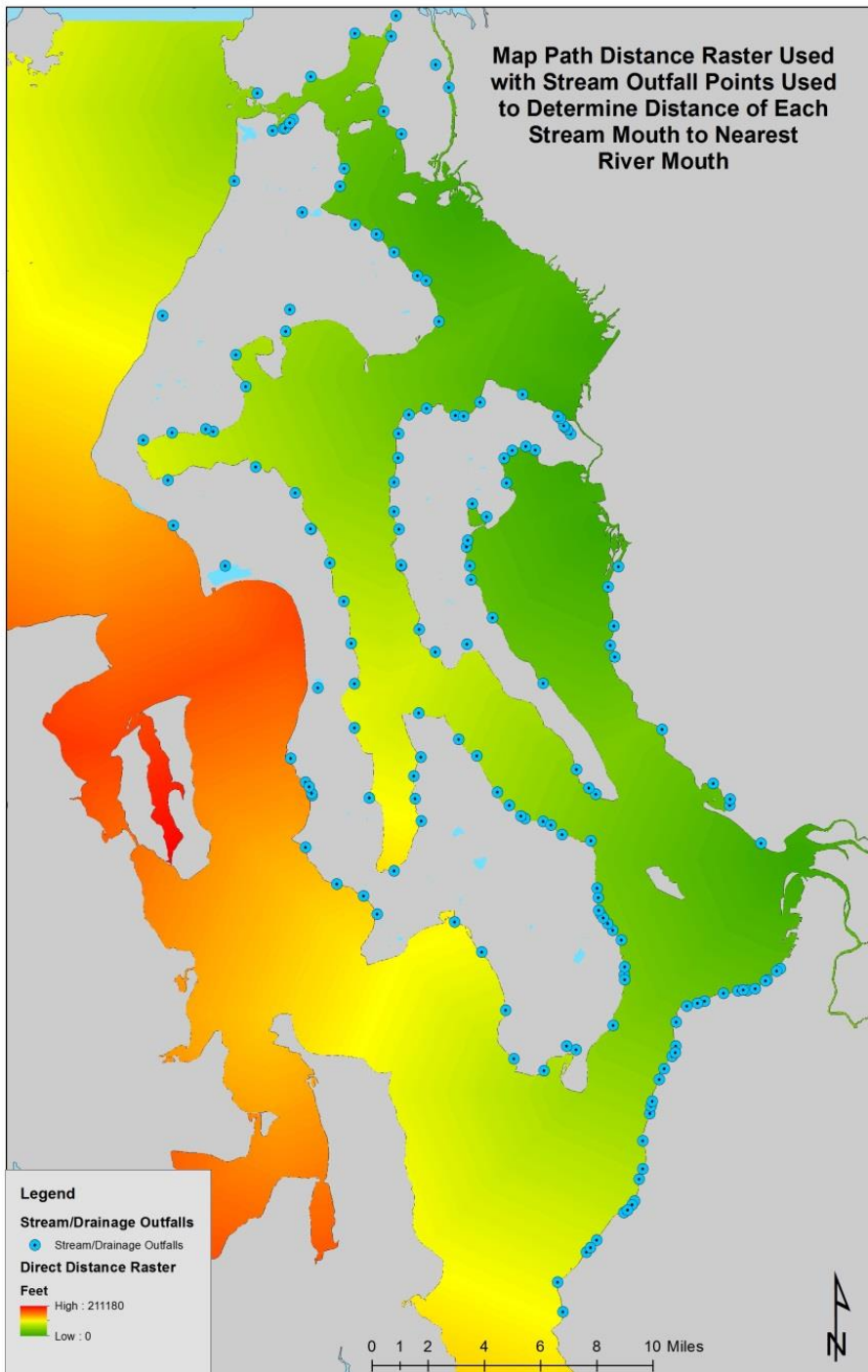


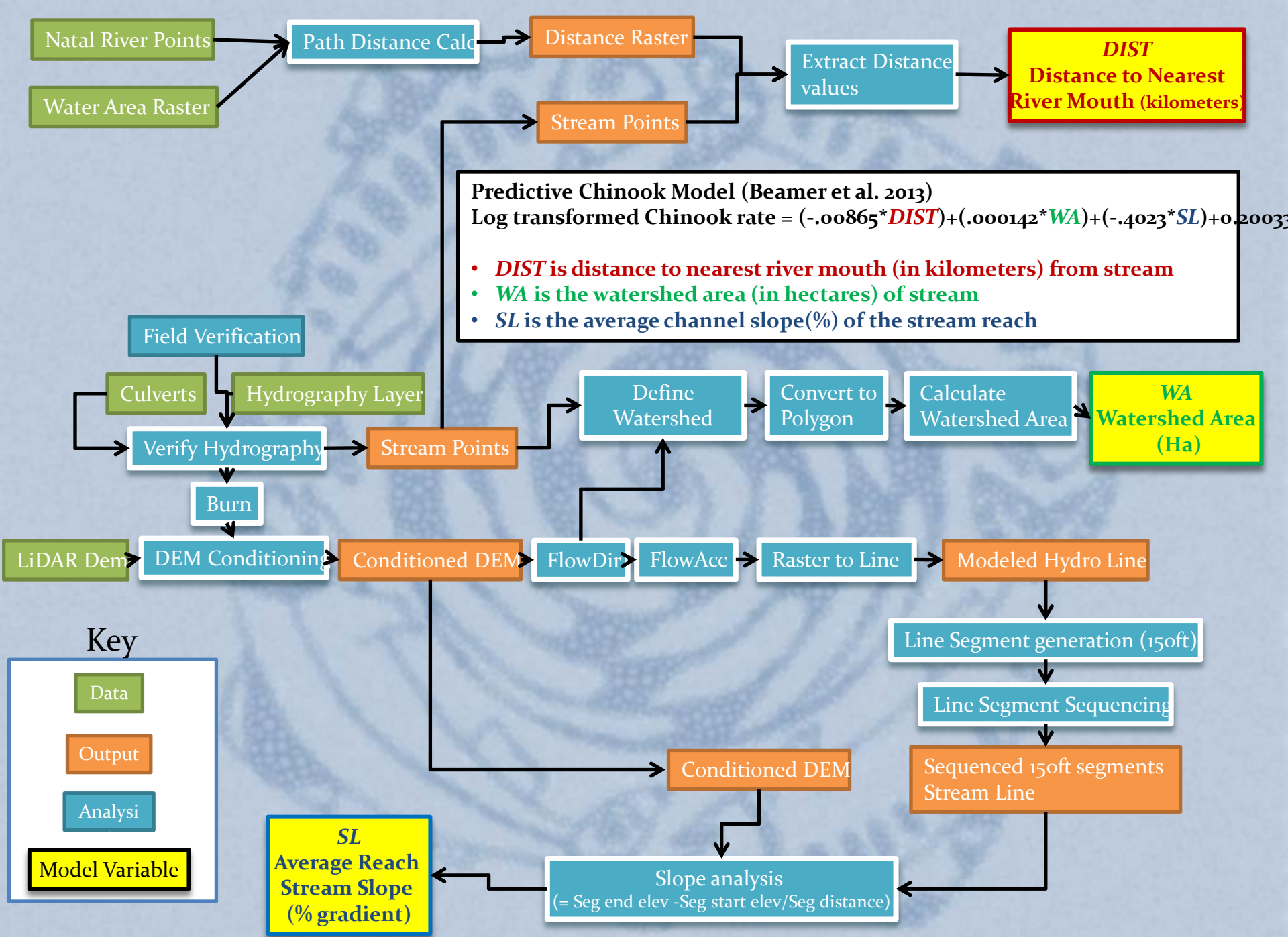
Relationship between watershed area (top panel) or channel slope (bottom panel) and juvenile Chinook salmon presence rate



The relationship between distance to nearest river mouth and juvenile Chinook salmon presence rate (top panel) or juvenile Chinook salmon abundance (bottom panel)

Map Path Distance Raster Used with Stream Outfall Points Used to Determine Distance of Each Stream Mouth to Nearest River Mouth





Predictive Chinook Model (Beamer et al. 2013)

$$\text{Log transformed Chinook rate} = (-.00865 * DIST) + (.000142 * WA) + (-.4023 * SL) + 0.2003$$

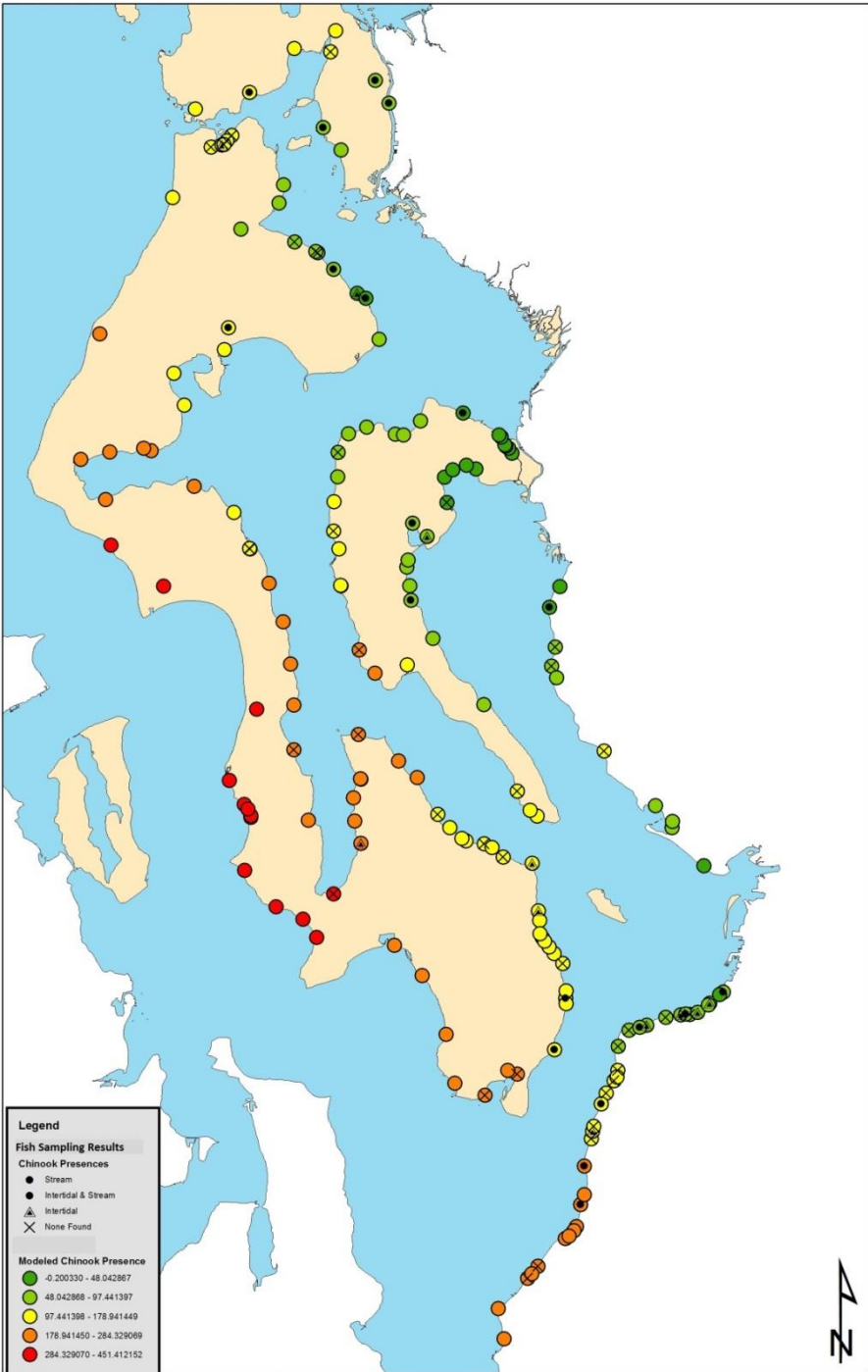
- **DIST** is distance to nearest river mouth (in kilometers) from stream
- **WA** is the watershed area (in hectares) of stream
- **SL** is the average channel slope(%) of the stream reach

Key

- Data (Green box)
- Output (Orange box)
- Analysis (Blue box)
- Model Variable (Yellow box)

Model Run for Project Area

Stream Outfall ID	Log transformed Chinook Presence Rate	Chinook Presence Probability
ADBA01	-446.7046399	9.9687E-195
ADBA08	-451.2642775	1.0433E-196
ADBA12	-401.7754837	3.2443E-175
ADBA13	-401.7871423	3.2067E-175
ADBA14	-400.1895747	1.5844E-174
ADBA15	-397.129205	3.3805E-173
ADBA16	-396.2945354	7.7888E-173
BOBA01	-142.5072214	1.28795E-62
BRBA00	-92.36972766	7.66191E-41
BRBA01	-122.0729611	9.64687E-54
BRBA01A	-122.0823917	9.55633E-54
BRBA02	-122.0757114	9.62038E-54
BRBA03	-132.0123941	4.65314E-58
BRBA04	-153.4782177	2.2144E-67
BRBA05	-153.460689	2.25356E-67
BRBA06	-153.476892	2.21734E-67
BRBA07	-186.559127	9.51482E-82
BRBA08	-186.5835492	9.28526E-82
BRBA09	-191.9981687	4.1329E-84
BRBA10	-203.9903843	2.55919E-89
BRBA11	-206.3518026	2.41296E-90
BRBA12	-211.800851	1.03767E-92
BRBA13	-236.1145244	2.8626E-103
BRBA14	-236.1109506	2.8729E-103
BRBA15	-236.0528715	3.0447E-103
BRBA16	-261.2190939	3.5809E-114
BRBA17	-274.5470023	5.8311E-120
BRBA18	-138.4749973	7.26228E-61
BRBA19	-210.0789692	5.80581E-92



Coho predictive model

Cutthroat predictive model

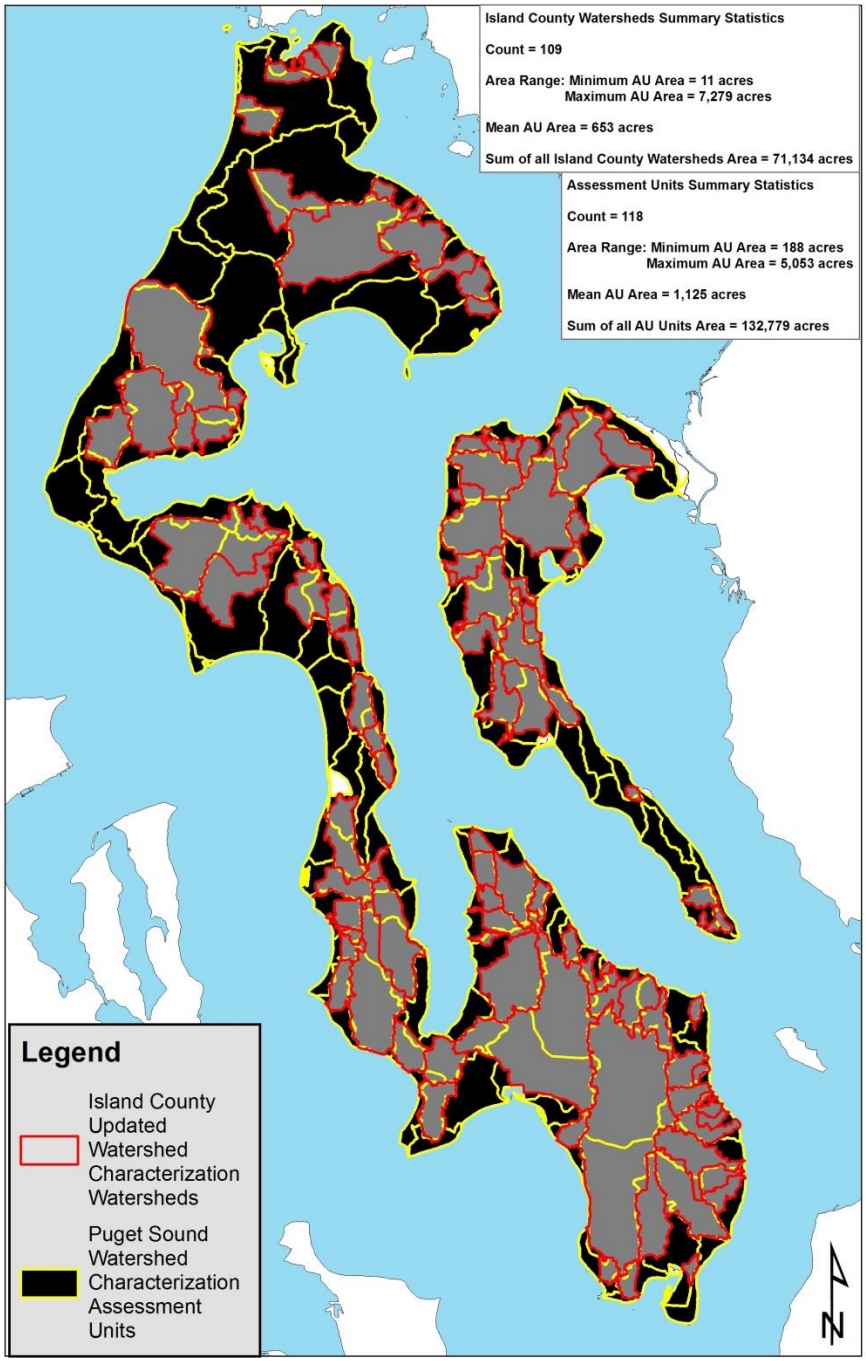


Model Run for Project Area

- Model results are log transformed and were converted to probability presence

Problems

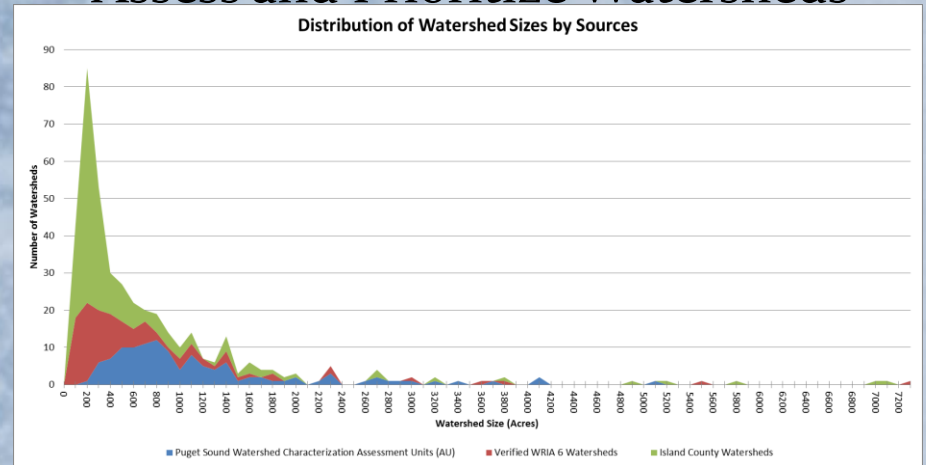
- Probabilities are really small and do not match actual sampling rates
- Culverts resulted in a lot of zeros for streams so not is much strength in the data
- Only 3 sampling events for each stream so harder to get strong relationships.



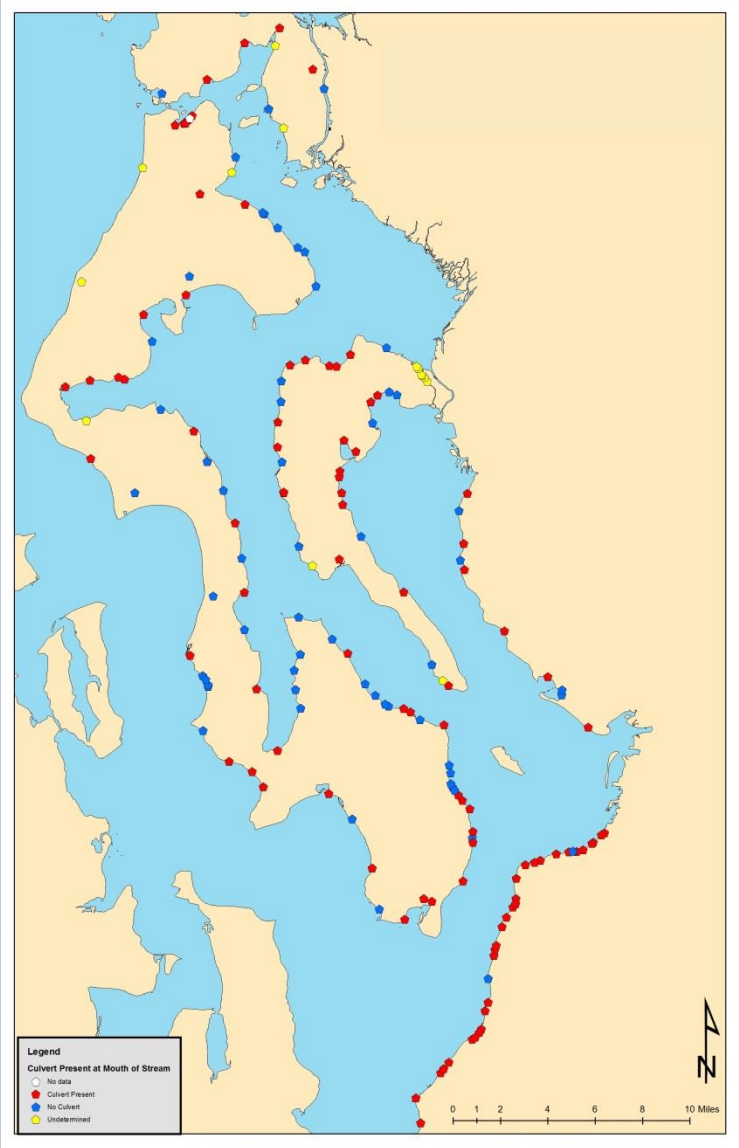
WRIA 6 Watershed Characterization

Goals

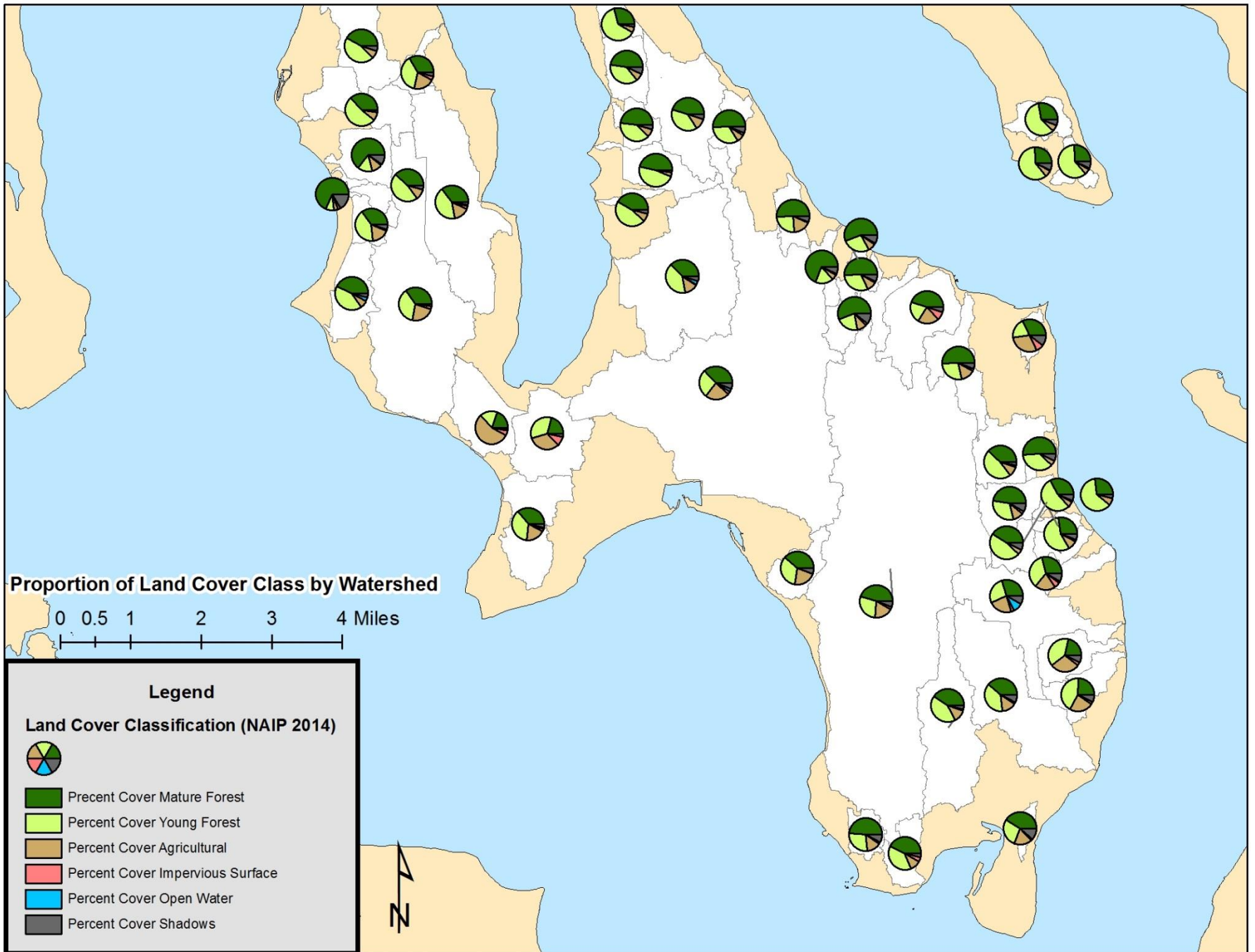
- Identify actual watershed with confirmed surface water runoff
- Inventory existing conditions to assess watershed health and status
- Assess and Prioritize Watersheds



WRIA 6 Watershed Characterization

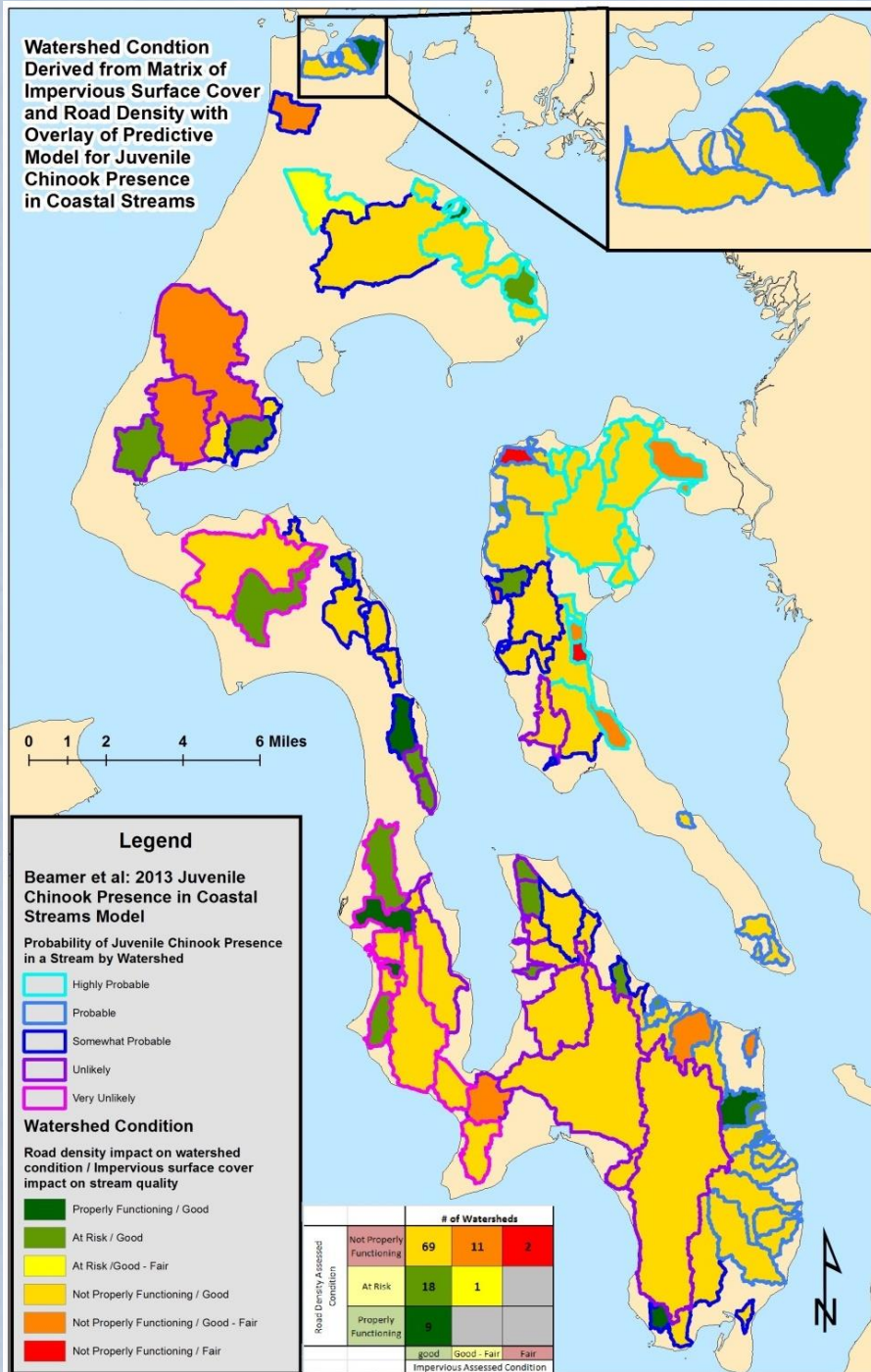


- Used stream census to generate watersheds
- Island Co provided data layers for watershed Inventory
- A land cover analysis was generated for Island Co



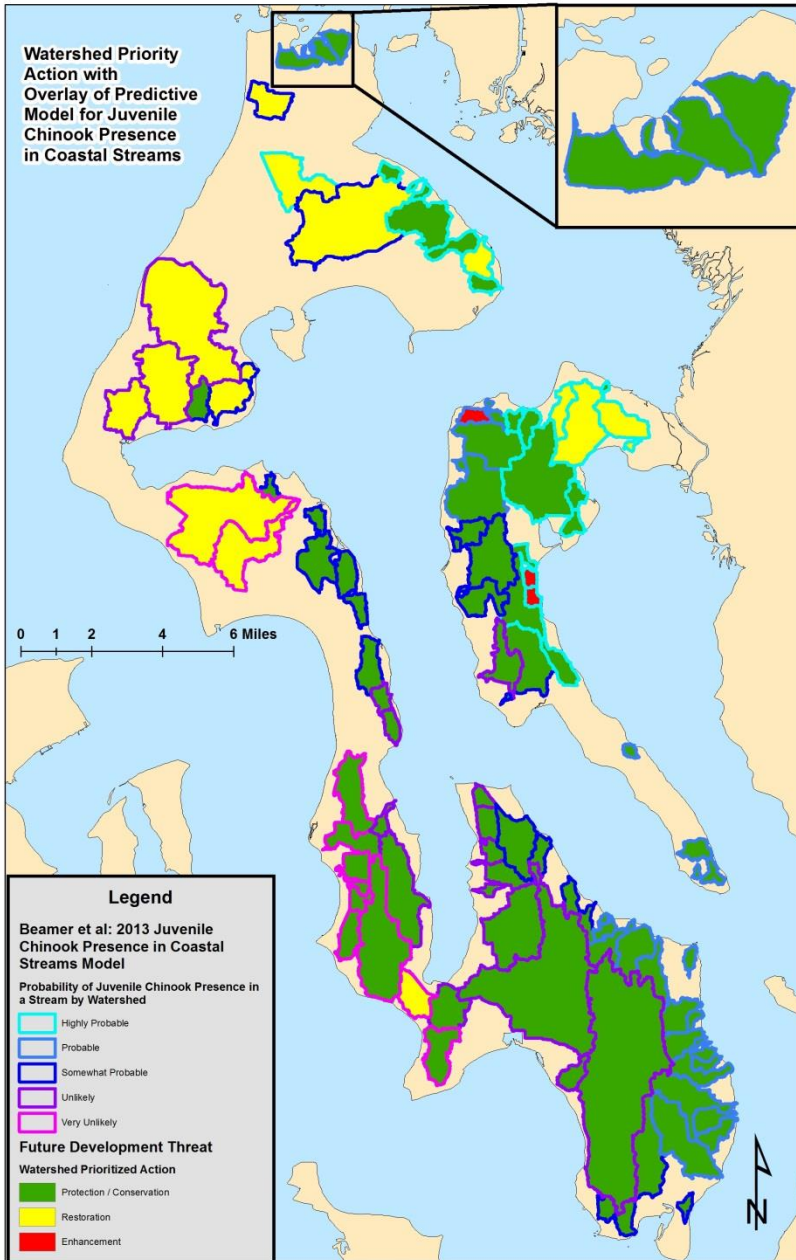
Watershed Prioritization

- Compare Chinook model to current impacts



Watershed Prioritization

- Identify Salmon Recovery Strategies



Questions?

Acknowledgement

Eric Beamer, Rich Henderson, Josh Demma, Karen Wolf, - SRSC
Tom Murdoch, Walter Rung, CK Eidem - Adopt a Stream Foundation
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Barbara Brock - Island WRAC & TAG
Derek Marks, Nick Weatherly, Luke Dailey, Michelle Totman
Brett Shattuck, Josh Kubo, Diego Holmgren, and Matt Pouley - Tulalip Tribes
Island County Salmon Technical Advisory Group
Island County Marine Resources Committee