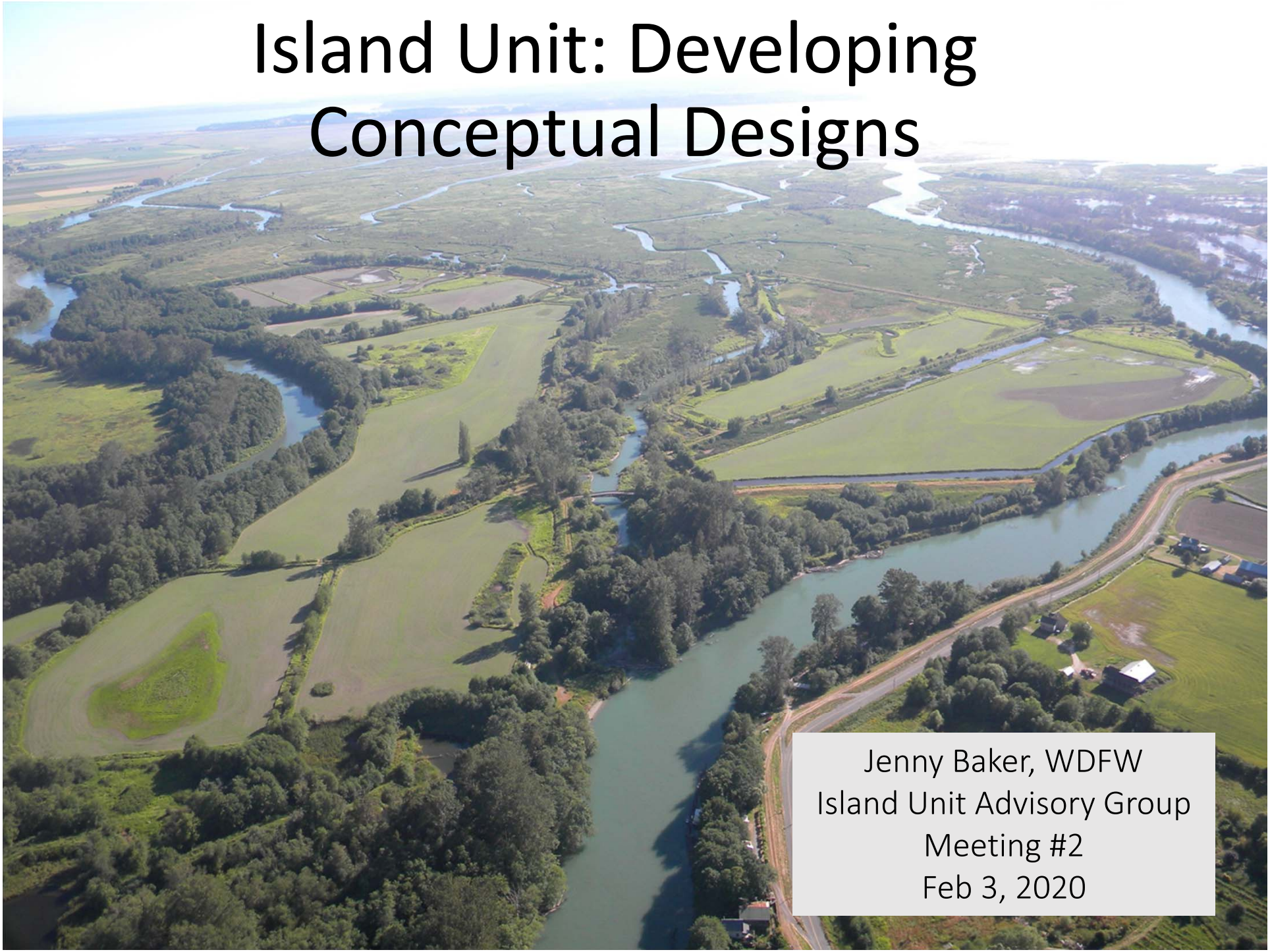
Island Unit: Developing Conceptual Designs

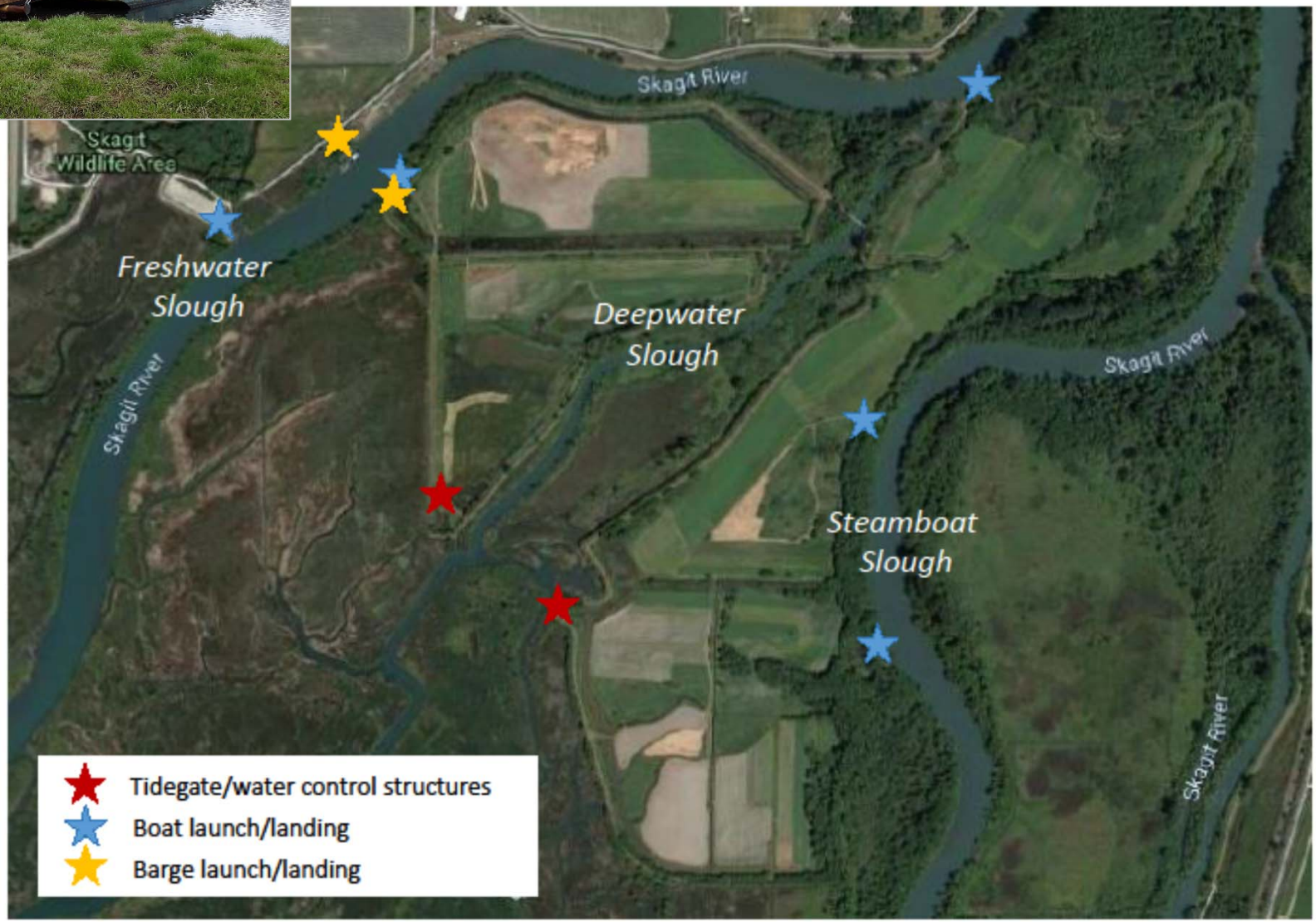


Jenny Baker, WDFW
Island Unit Advisory Group
Meeting #2
Feb 3, 2020

General Scoping

- No restoration and full restoration, plus 2 partial restoration concepts
- High level analysis; no detailed engineering
- Use existing data
- Potential actions:
  - Removing or replacing tidegates/water control structures
  - Removing, repairing, or setting back dikes

Considerations: infrastructure



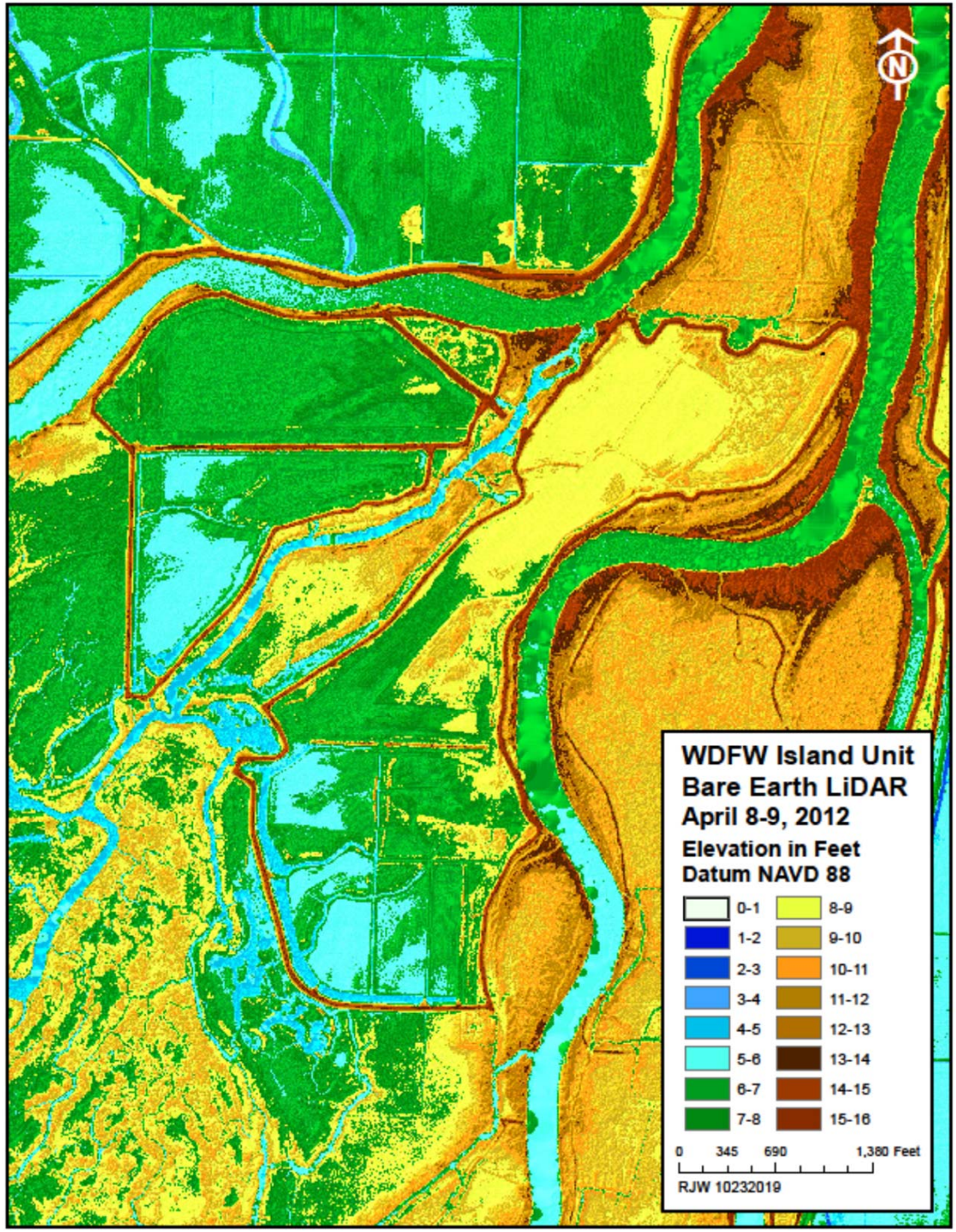
Considerations: Elevation data

What can be seen:

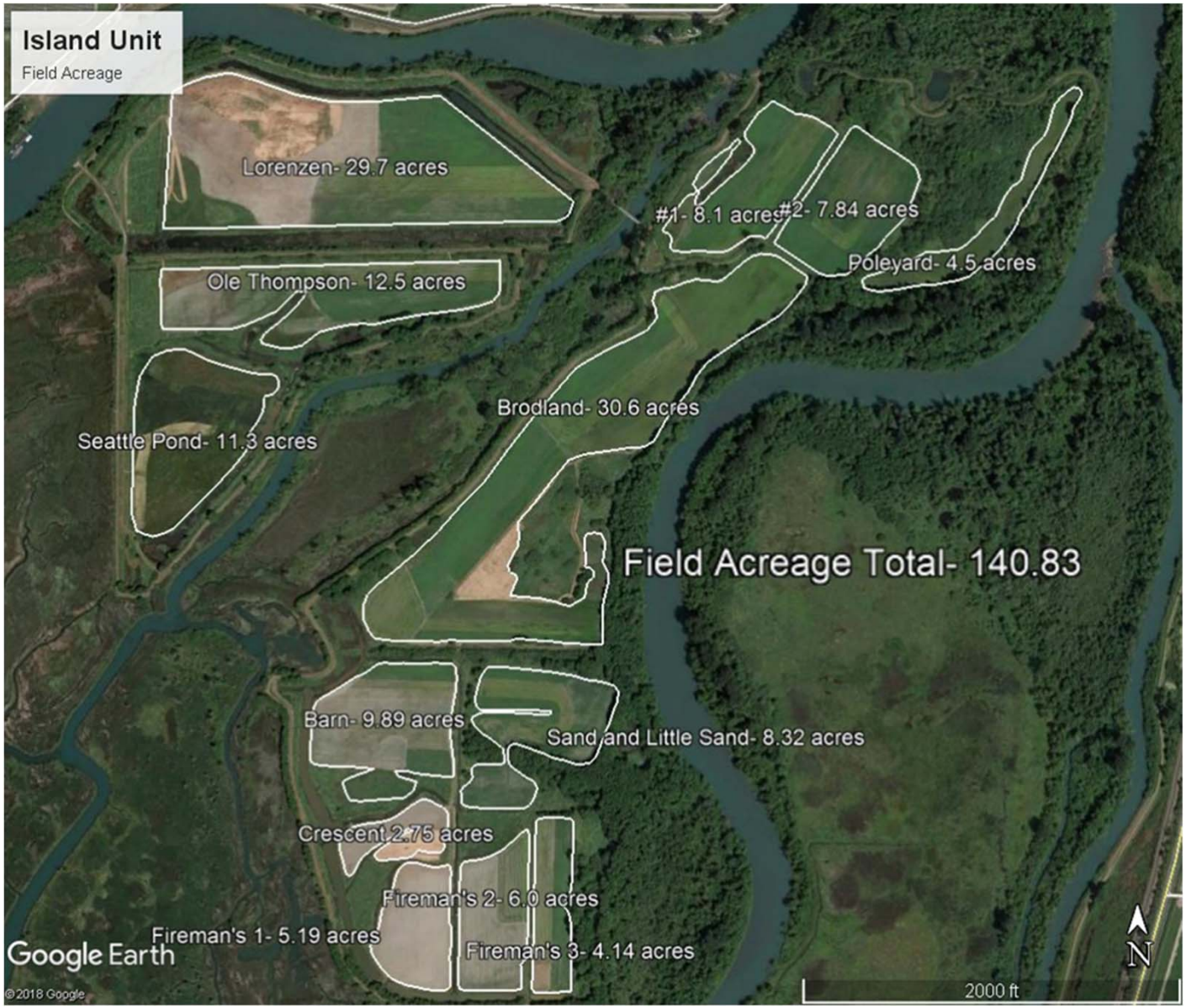
- Perimeter dikes
- Cross-dikes and berm
- Relative elevations of fields

Of note:

- Dikes keep site dry and allow current management.
- Dikes constrict tidal and riverine flows that create and maintain estuary habitats.
- Tides range from approximately 4 to 13 feet NAVD88.

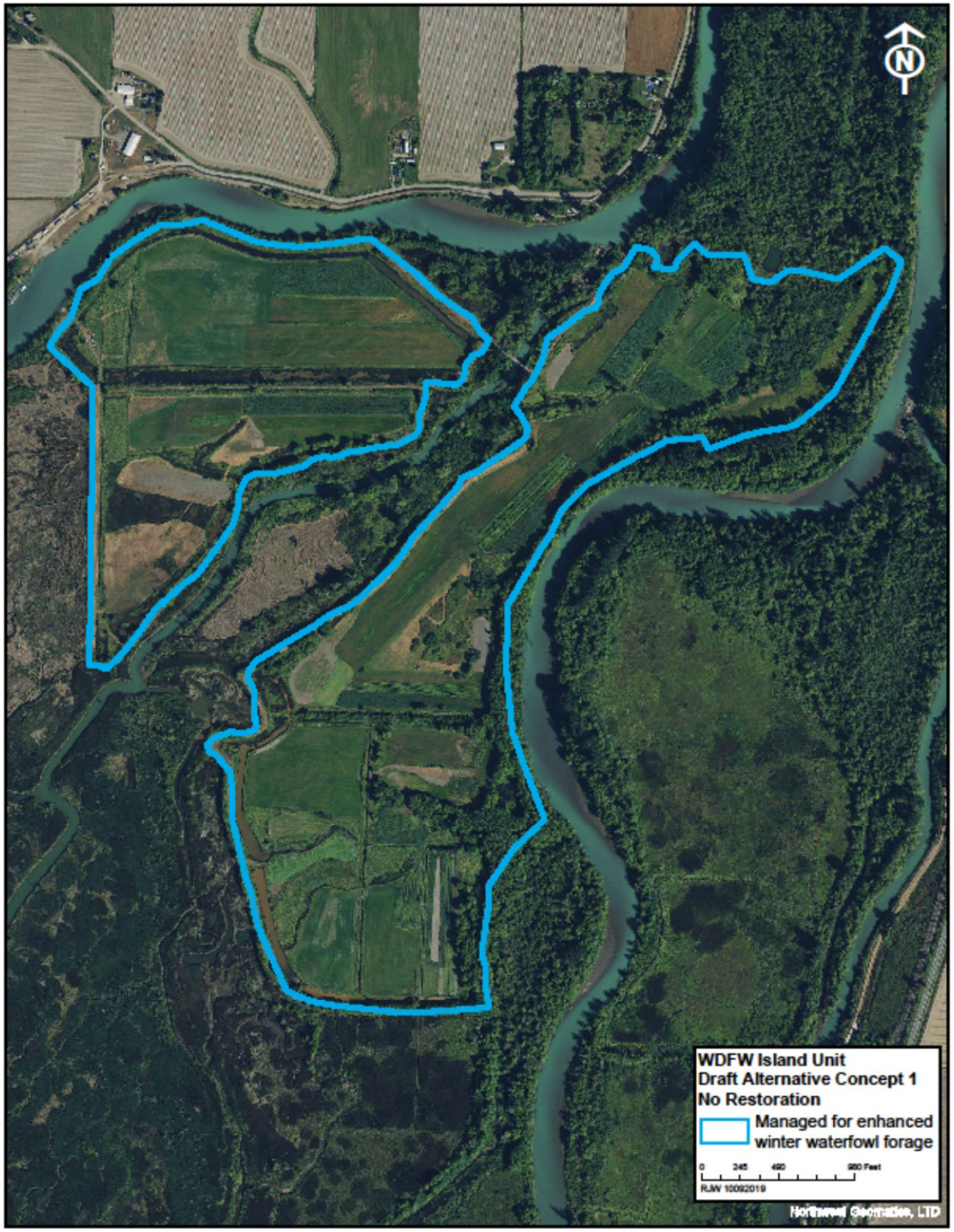


Managed/enhanced field acreages



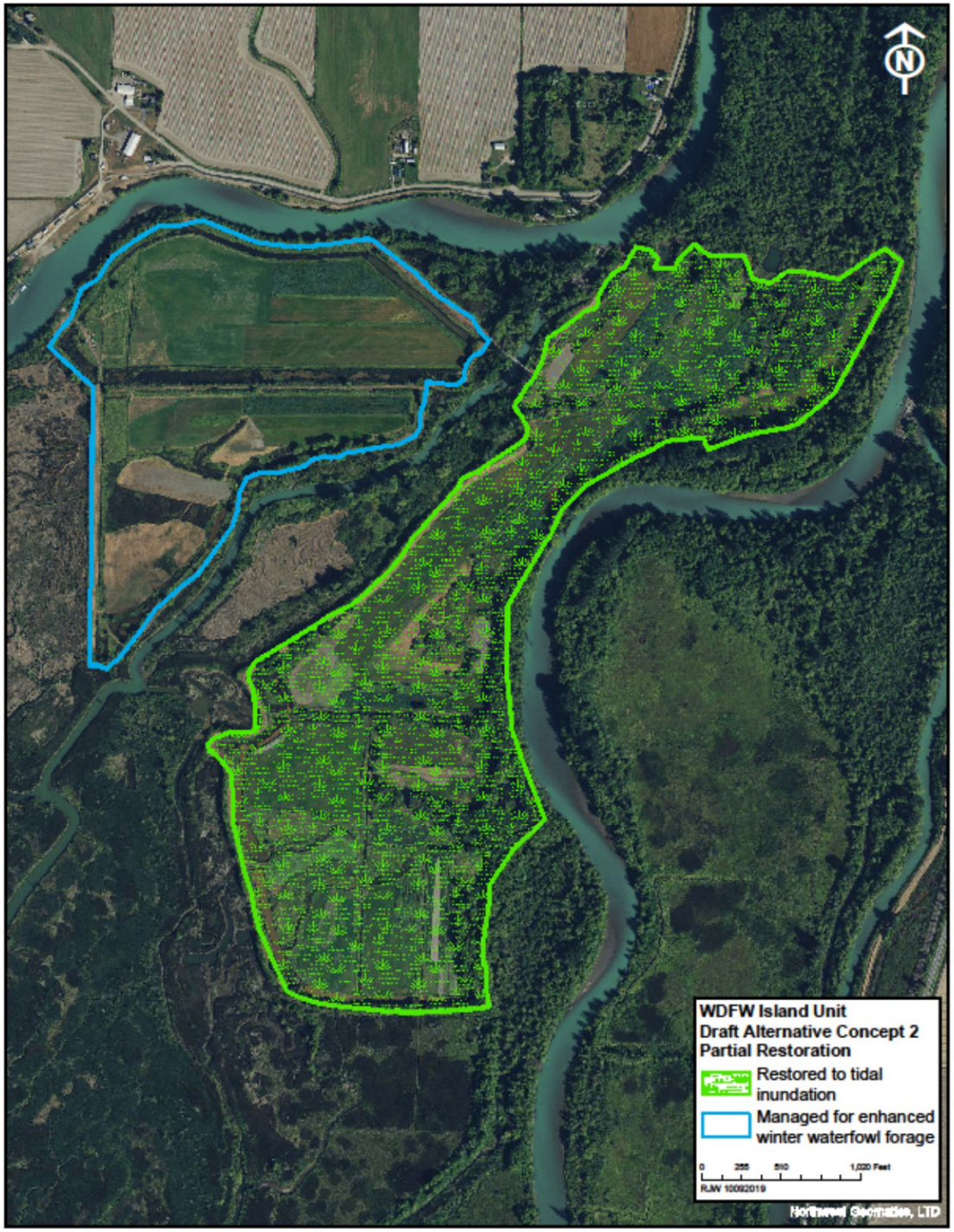
Concept 1: no restoration

- 0 acres restored to estuary
- 270 acres maintained under current management
- 141 acres of managed/enhanced winter waterfowl forage production



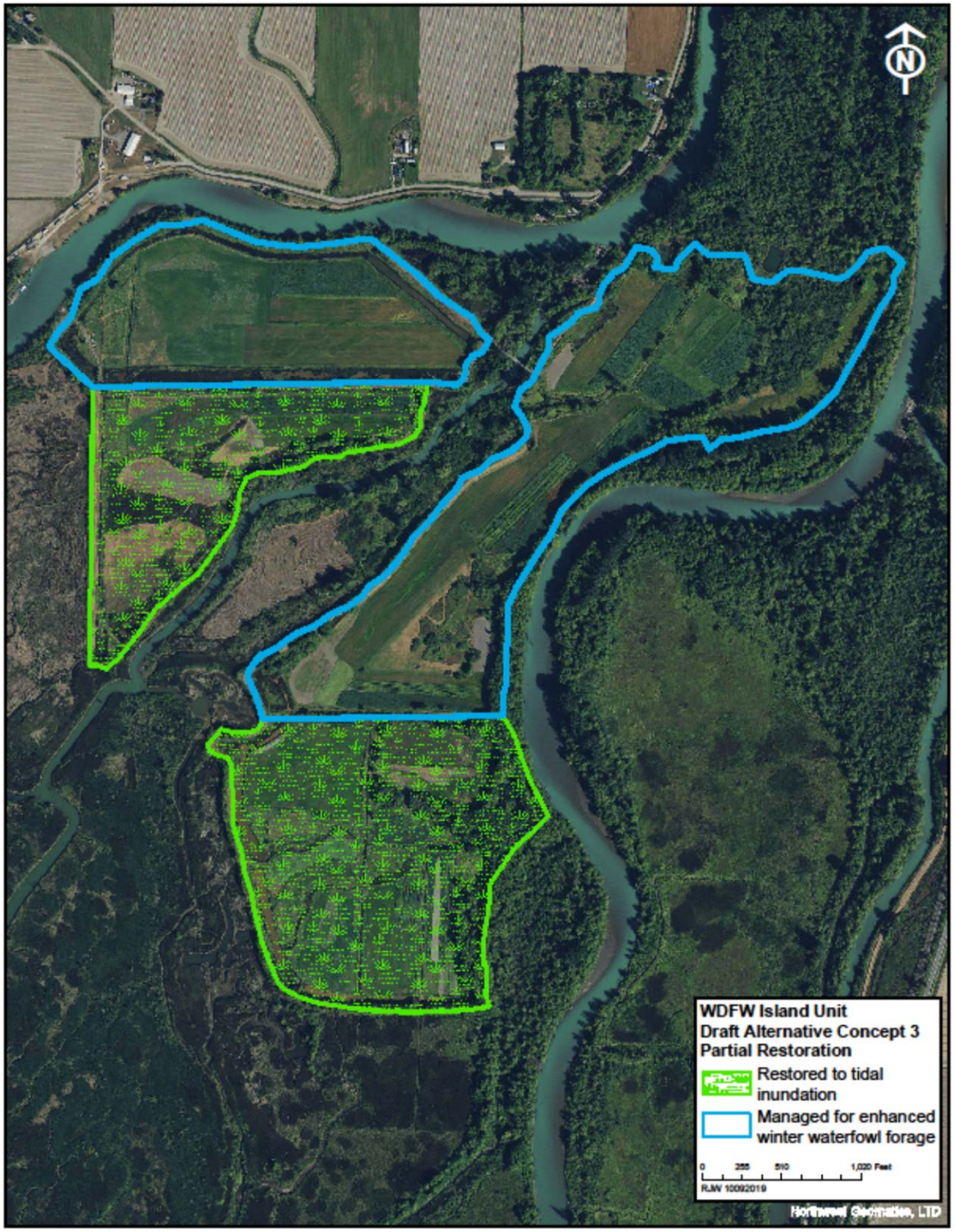
Concept 2: Part. restoration

- 170 acres restored to estuary
- 100 acres maintained under current management
- 54 acres of managed/enhanced winter waterfowl forage production



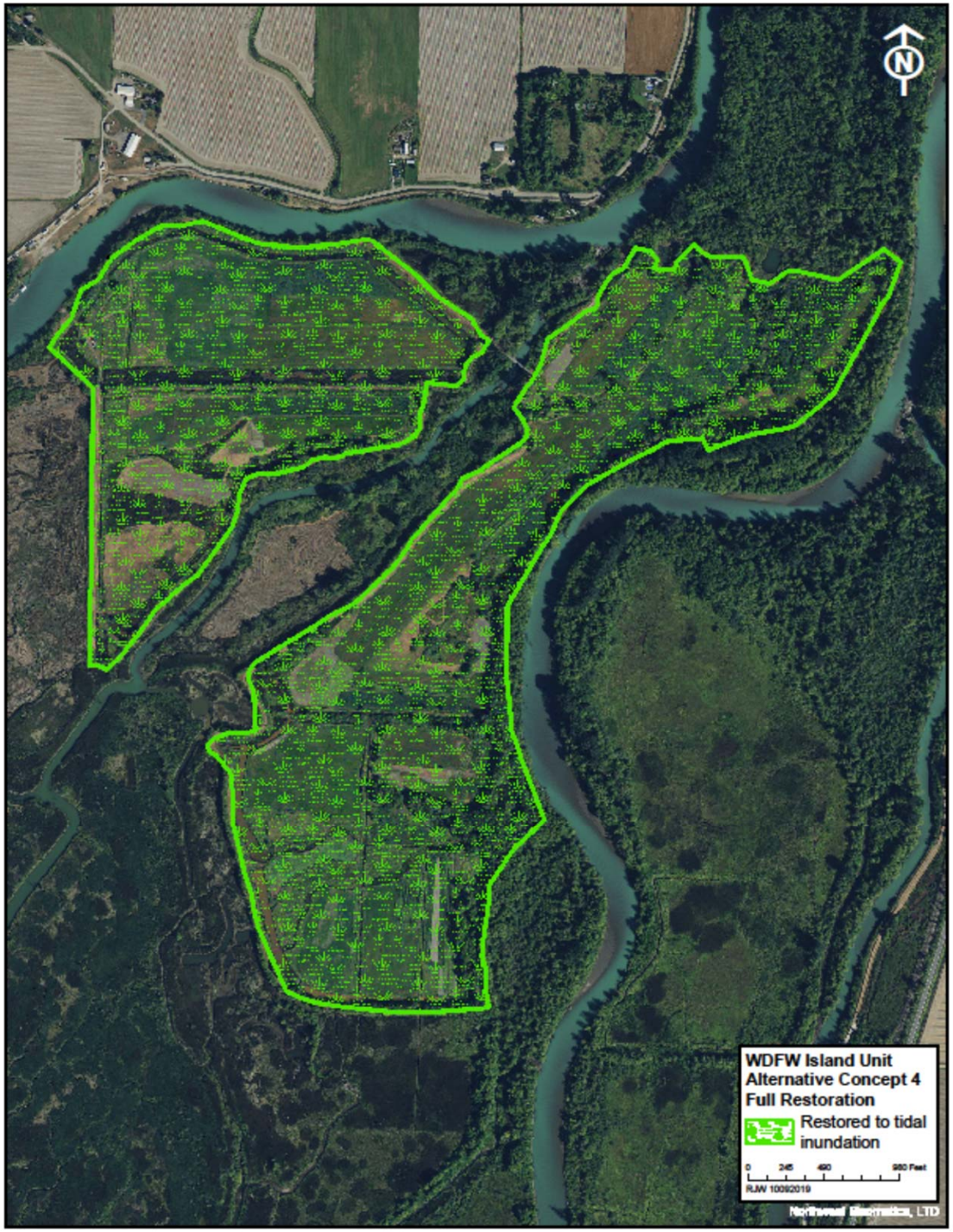
Concept 3: Part. restoration

- 110 acres restored to estuary
- 160 acres maintained under current management
- 81 acres of managed/enhanced winter waterfowl forage production



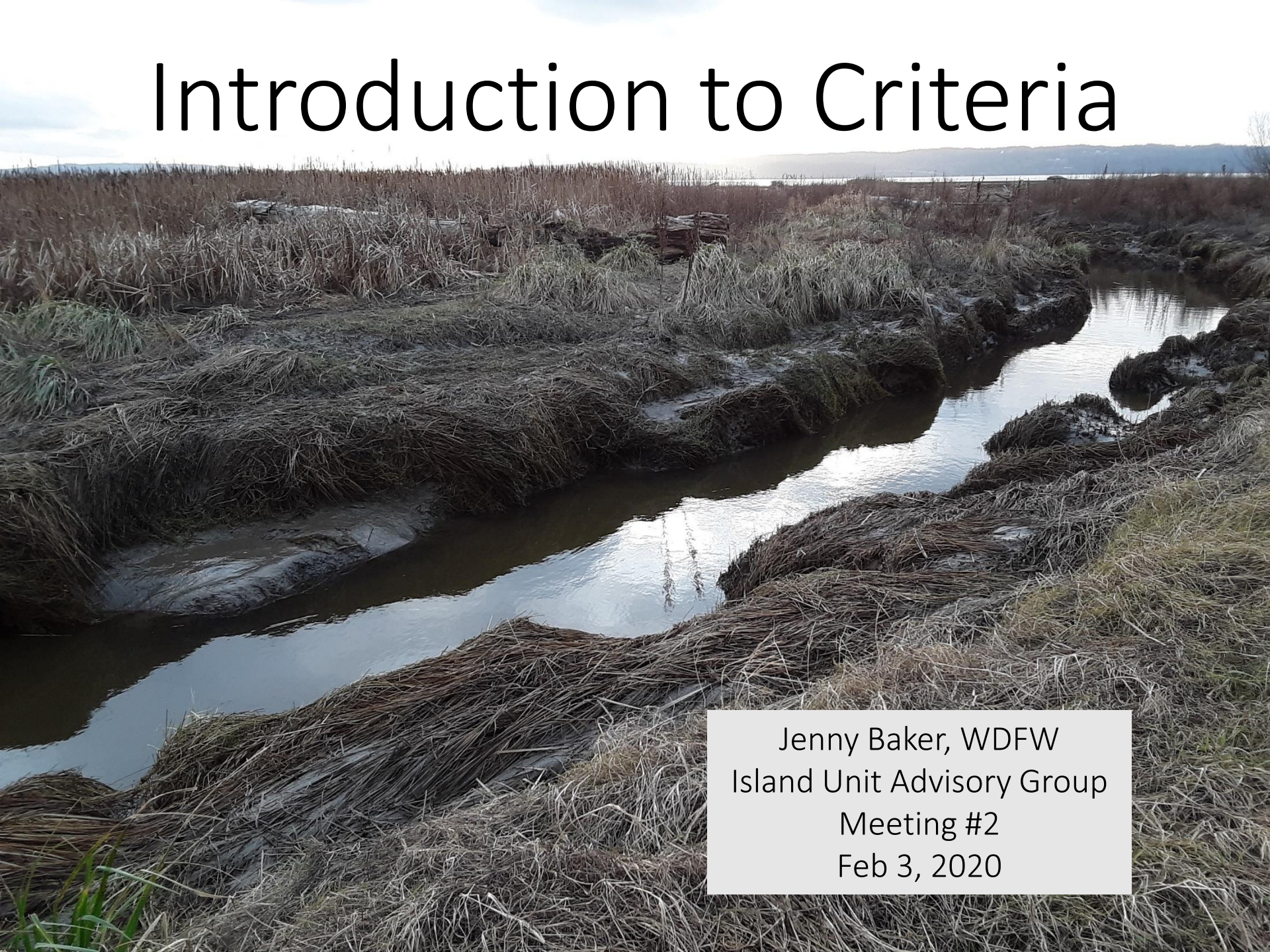
Concept 4: full restoration

- 270 acres restored to estuary
- 0 acres maintained under current management
- 0 acres of managed/enhanced winter waterfowl forage production



Input on any of the concepts?

Introduction to Criteria



Jenny Baker, WDFW
Island Unit Advisory Group
Meeting #2
Feb 3, 2020

Criteria

- Alternatives will be compared using common “criteria”
- Criteria include:
  - issues that affect the Island Unit
  - key topics WDFW needs to consider in how to manage WDFW-owned lands
  - topics specific to the Skagit landscape

Criteria

Management, regulatory and policy considerations:

- WDFW policies, agreements and obligations
- Future cost and funding

Criteria

Fish and wildlife needs

- ESA listed salmon/orca recovery
- Waterfowl and avian conservation

Criteria

Community interests:

- Agriculture
- Waterfowl hunting
- Birdwatching/photography
- Recreational fishing

Draft Criteria – purpose and policies

info today?	category	description	how will this category be considered in the alternatives analysis?
no	WDFW purpose and policies	Declaration of purpose—Department lands: WAC 232-13-020	*"The primary purpose of department lands is the preservation, protection, perpetuation and management of fish and wildlife and their habitats. Public use of department lands may include fishing, hunting, fish and wildlife appreciation, and other outdoor recreational opportunities when compatible with healthy and diverse fish and wildlife populations."* WAC: https://apps.leg.wa.gov/wac/default.aspx?cite=220-500-010
no		Policy 5003: Managing the 21st Century Salmon and Steelhead Initiative	relevant sections: "*WDFW lands provide opportunities for salmon recovery; WDFW lands have historically been purchased and managed for big game, waterfowl, fish and upland birds. Management of these lands has not always addressed the needs of salmon and steelhead. WDFW must develop and implement management plans for WDFW lands with additional emphasis on habitat needs for salmon and steelhead.*" Initiative: https://wdfw.wa.gov/sites/default/files/about/advisory/hcicag/documents/implementation_guidance/pol-5003.pdf https://wdfw.wa.gov/publications/00036
no		Policy 5004: Department's Conservation Initiative and Guiding Principles	relevant sections: "*We practice conservation by managing, protecting, and restoring ecosystems for the long term benefit of people, and for fish wildlife, and their habitat; We work across disciplines to solve problems; We integrate ecological, social, economic, and institutional perspectives; We embrace new knowledge and apply best science; and we collaborate with our co-managers and conservation and community partners.*" https://wdfw.wa.gov/sites/default/files/about/advisory/hcicag/documents/implementation_guidance/pol-5004.pdf
no		Policy 5211: Protecting and Restoring Wetlands	relevant sections: "*WDFW Will Accomplish Long-Term Gain of Properly Functioning Wetlands Where Both Ecologically and Financially Feasible on WDFW-Owned or WDFW-Controlled Properties; WDFW Will Promote the Restoration of Original Hydrology, Elevations and Native Plant Communities*"

Draft Criteria – purpose and policies

info today?	category	description	how will this category be considered in the alternatives analysis?
no	WDFW purpose and policies	Washington State Wildlife Area Goal 1	*"restore and protect the integrity of priority ecological systems and sites"*
no		Washington State Wildlife Area Goal 2	*"sustain individual species through habitat and population management actions where consistent with site purpose and funding"*
no		Washington State Wildlife Area Goal 3	*"provide fishing, hunting and wildlife related recreational opportunities where consistent with goals 1 and 2"*

Draft Criteria – agreements & obligations

info today?	category	description	how will this category be considered in the alternatives analysis?
yes	obligations and agreements	Priority to restore public lands in the estuary first (HB 1418)	Consider framework and priorities outlined in the 1418 report. Clear priority to focus restoration on public lands first; IU called out as a Tier 1 project. • Bill: • https://wdfw.wa.gov/sites/default/files/about/advisory/iuag/1418-s2hbr_.pdf • report: • https://wdfw.wa.gov/sites/default/files/about/advisory/iuag/smith_et_al_2005_tide_gate_salmon_recovery_analysis_skagit.pdf
yes		Skagit Tidegate Fish Initiative Implement-ation Agreement (a multi-party agreement signed by WDFW)	Consider framework and benefits outlined in TFI implementation agreement; IU generates up to 268 credits depending on final project configuration. WDFW signed an agreement saying we would work collaboratively toward salmon recovery goals with other signatories. "assure that mutually supportive actions will occur in a timely and cooperative manner throughout the 25-year duration of this agreement" • https://wdfw.wa.gov/sites/default/files/about/advisory/iuag/tfi_ia_final_4_21_10.pdf

Draft Criteria – obligations & cost

info today?	category	description	how will this category be considered in the alternatives analysis?
no	compatible with in-hand and past funding	compatible with Pittman-Robertson and other acquisition funds	Consider whether project supports waterfowl forage and hunting access
no		Consistent with SRFB grant for alts analysis	Consistent with grant scope; e.g. consider a range of options from no restoration to full restoration; 3-4 alternatives
no	future cost and funding	funding availability for implementation; relative cost of construction	Consider cost and likelihood of funding, include all design, permitting, mitigation and construction costs.
no		funding availability for O&M; relative cost of O&M	Consider cost and likelihood of funding; include total length of dike and other infrastructure to be maintained; farming/moist soils management; control of weeds/undesirable species; design life of infrastructure considering climate change

Draft Criteria – fish & wildlife needs

info today?	category	description	how will this category be considered in the alternatives analysis?
not directly	salmon recovery/ ESA listings	ESA-listed Southern Resident Killer Whale (Orca)	Consider outcomes for SRKW - link to Chinook salmon production and long-term recovery.
yes		ESA-listed Chinook/Skagit Chinook Recovery Plan (co-authored by WDFW and SRSC)	Consider outcomes for Chinook salmon; general habitat needs in the Skagit Chinook Recovery Plan; estuary habitat need in Appendix D with specific mention of IU; site holds mid-point of 160,300 smolts with full restoration. • Plan: https://wdfw.wa.gov/sites/default/files/about/advisory/iuag/skagit-chinook-recovery-plan.pdf • Estuary appendix: https://wdfw.wa.gov/sites/default/files/about/advisory/iuag/skagitchinookrecoveryplanappendix-d-estuary.pdf • Revised smolt numbers: see Appendix D (pgs. 633-787) of the HDM report – link on next slide
yes	waterfowl and avian conservation	waterfowl and avian conservation	consider importance of this site and how its managed to overall waterfowl population at a landscape scale; consider diversity of avian species supported

Draft Criteria – community values

info today?	category	description	how will this category be considered in the alternatives analysis?
yes	agriculture	HDM project (a multi-interest alternatives analysis co-lead by WDFW and others)	consider how this project affects issues related to agriculture; HDM followed TFI and identified IU as a priority project https://wdfw.wa.gov/publications/02123
yes	waterfowl hunting	huntable waterfowl habitats	consider changes to huntable habitats and acreages
no	birding/ photo-graphy	Birding and photography - passive recreation	consider potential to support species of interest to bird watchers and photographers
yes	fishing/ angling	recreational fishing/angling	consider potential to support species and runs available for recreational fisheries

Presentations today

Intended to provide information on:

- Landscape context / topics related to the Skagit delta
- Criteria (noted in criteria tables in previous slides)
- Questions we've gotten, but not directly related to criteria (harvest)

Next steps:

- Information will be presented today on selected topics
- Advisory group to review links and criteria details on your own
- Final input on criteria on March 16

Next slides

Intro to:

1. Endangered Species Act

2. Estuaries

Endangered Species Act

ESA Section 2(b):"The purposes of this Act are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved…"

ESA Section 3(3): "The terms "conserve", "conserving", and "conservation" mean to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary."

Puget Sound Chinook salmon listed as threatened in 1999

Endangered Species Act

Section 7 – Interagency Consultation

- (a)(2) of the Act requires every Federal agency, in consultation… to insure that any action it authorizes, funds, or carries out … is not likely to jeopardize the continued existence of any listed species or results in the destruction or adverse modification of critical habitat.
- *"Jeopardize the continued existence"* of means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of <u>both the survival and recovery</u> of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.
- Covers actions such as fisheries management and tidegate replacement

Endangered Species Act

A recovery plan:

- Road map
- Non regulatory
- Describes specific research and management actions
- Developed in partnership with federal, state, tribal, local governmental, non-governmental, and other interested parties
- Delisting is the goal
- Skagit Chinook Recovery Plan
  - Habitat restoration and protection needed throughout the watershed
  - Estuary restoration goals:
    - Additional space for 1.35M smolts
    - Net gain of *approximately* 2700 acres of estuary

Estuaries

- Zone influenced by tides and river
- Rich and productive areas for fish and wildlife
- Provide environmental services

Diverse habitats:
forested wetlands, shrubby areas, salt marshes, mud- and sand-flats, channels

Diverse functions to humans:
Protection from erosion and storm surge; improved water quality; provide open space; support fisheries, hunting, recreation

Diverse functions to other species:
nesting, rearing, feeding, resting, migration

Diverse species:
invertebrates, fish, crabs, clams, shorebirds, waterfowl, mammals

Chinook and Estuaries

February 3, 2020

Island Unit/Deepwater Stakeholder Advisory Group

Eric Beamer, Skagit River System Cooperative

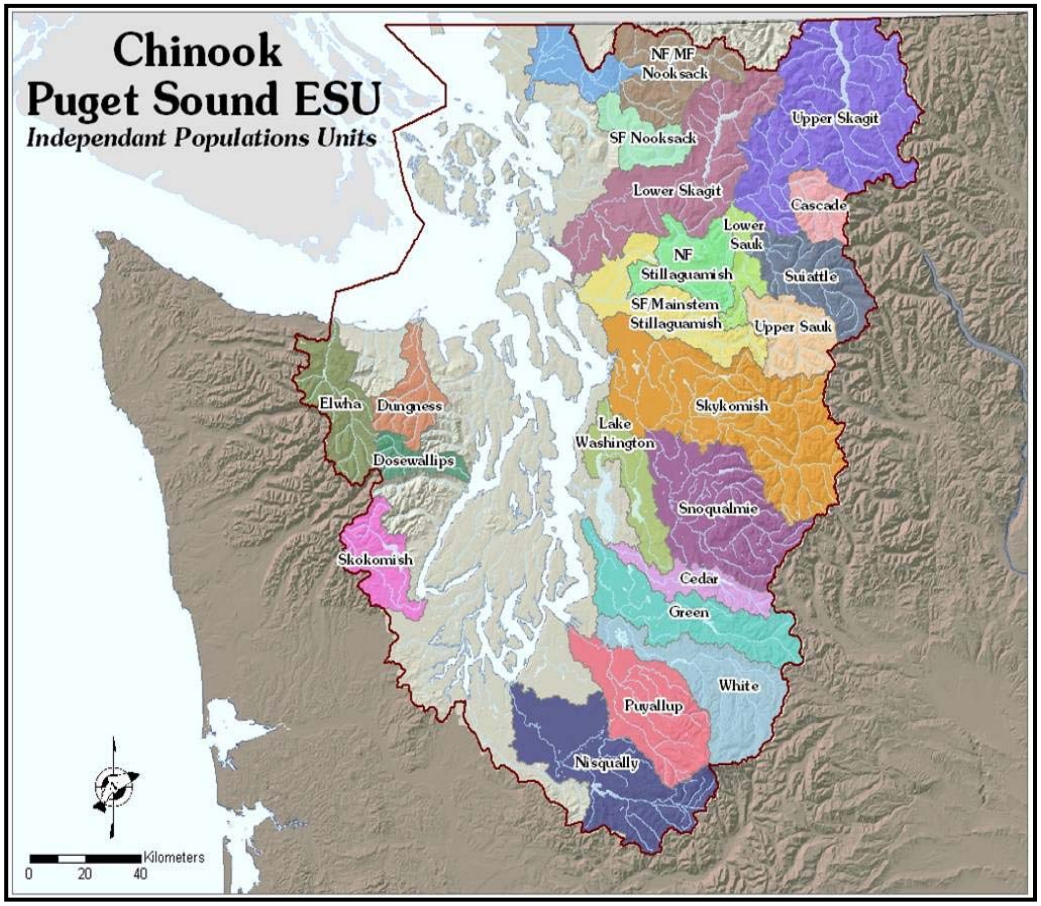
Presentation Outline

1. Estuaries have been lost
2. Estuary habitat is limiting Skagit Chinook salmon recovery
3. Why the Skagit needs space in the estuary for 1.35 million more smolts
4. Skagit estuary restoration that's been completed is working
5. Why we still need to restore more estuary

Puget Sound

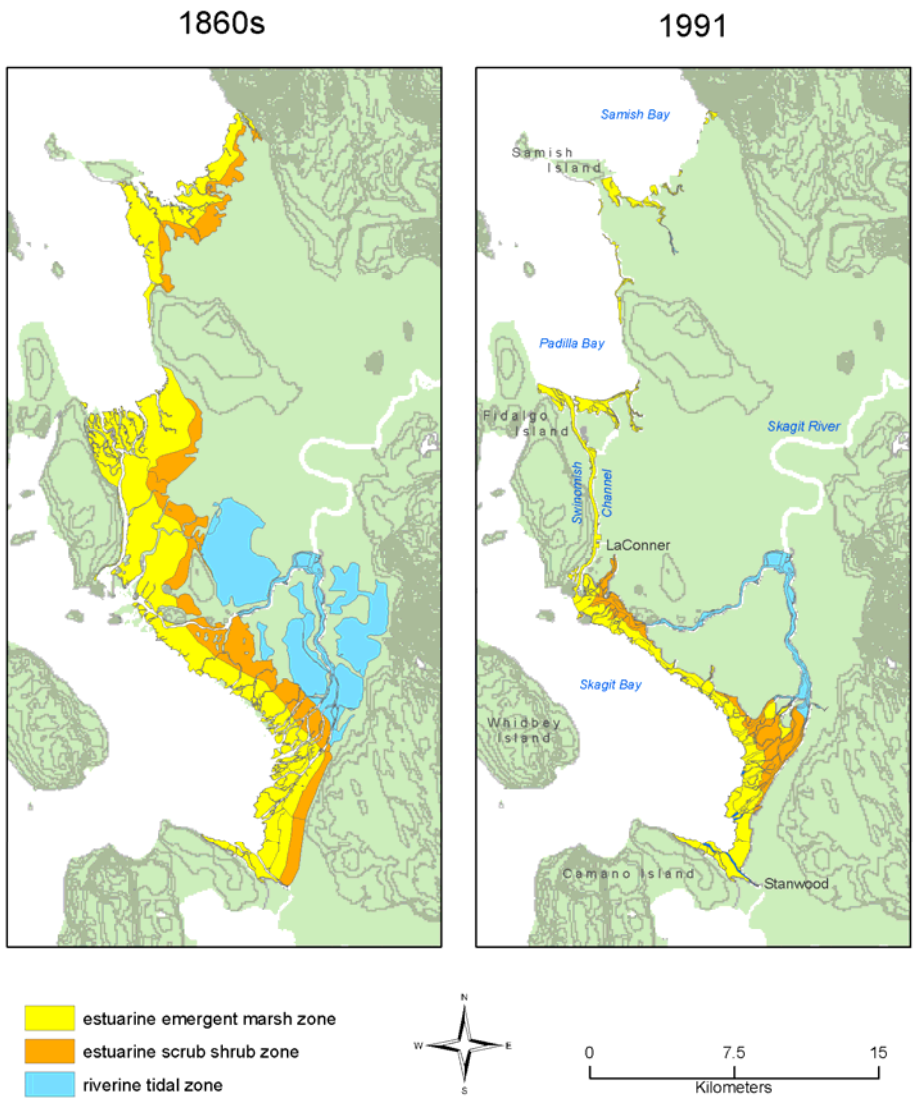
Estuary area of large rivers is 1-55% of their historical extent

From Simenstad et al. 2011



The Skagit Estuary:

- Is smaller and more fragmented than historically.
- Has an 88% loss in the habitat directly used by fish.
- Does this matter to the fish?

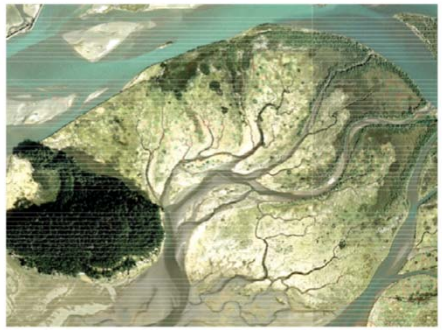


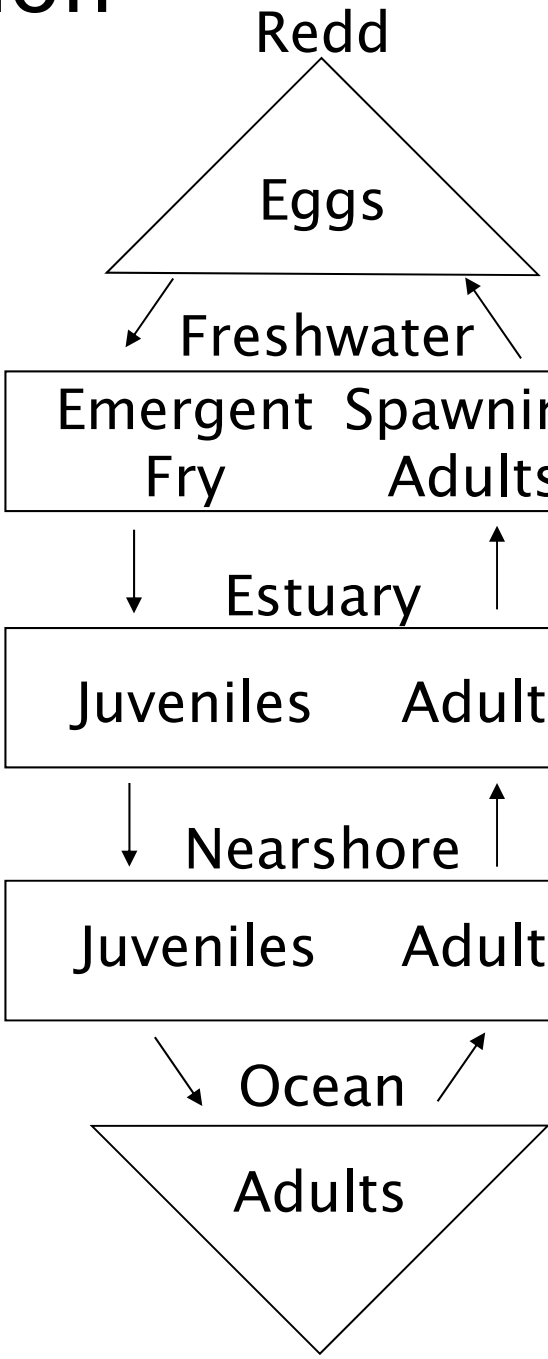
from Beamer et al. 2005

Estuary habitat is limiting Skagit Chinook salmon recovery

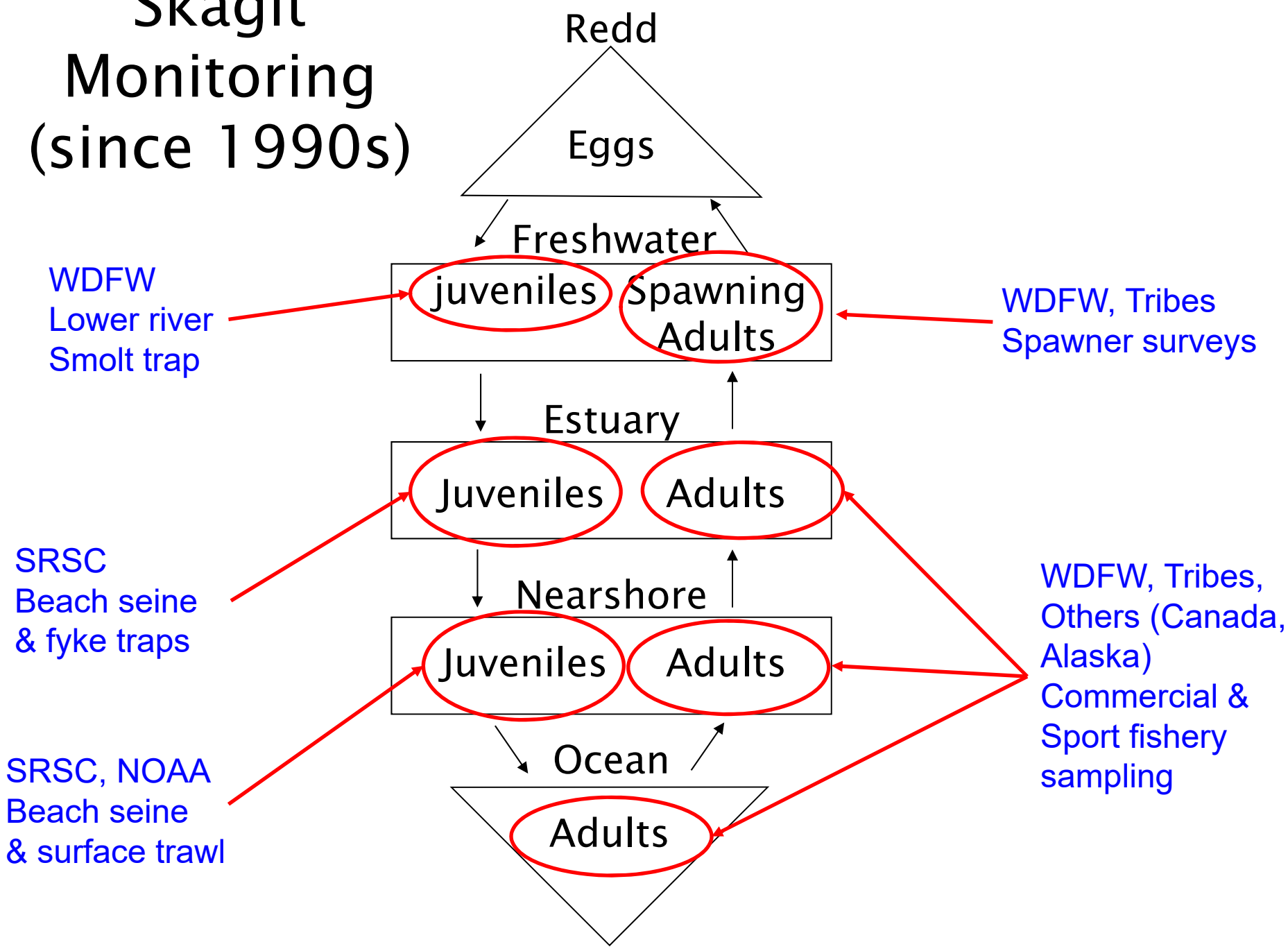
- How do we know?
  - Extensive monitoring of the fish throughout the river, estuary, and early marine system
  - Identification of the juvenile life history types present, their abundance, and unique habitat needs
  - Analyses of stock > recruit relationships to identify habitat limitations to the population

Chinook salmon life cycle





Skagit Monitoring (since 1990s)



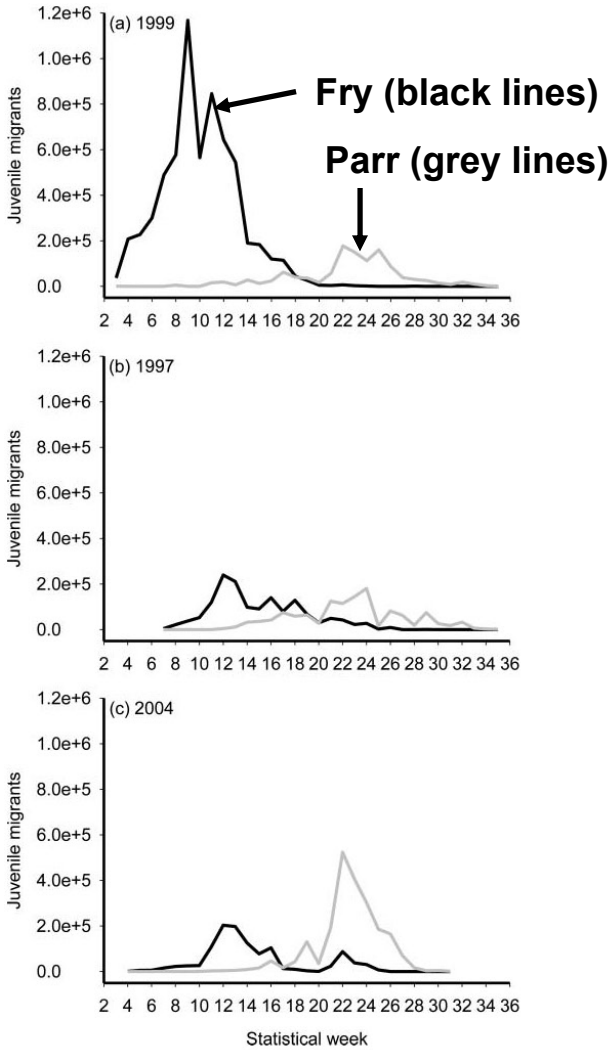
Juvenile Chinook outmigrants leaving the Skagit River:

- Consists of **Fry** (<2” long), **Parr** (2-4” long), and **Yearling** (> 4” long) smolts

23-yr monitoring summary:

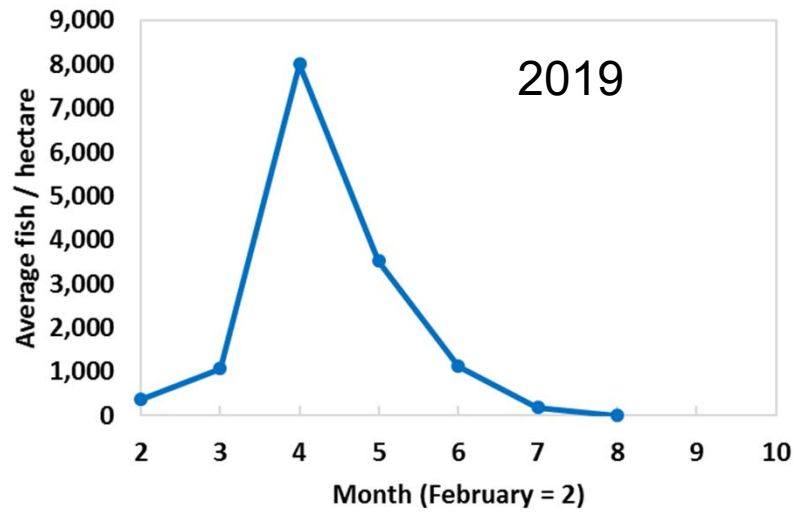
- Fry average 2.25 million/yr. (range = 0.8-6.55 million)
- Parr average 0.8 million/yr. (range = 0.11-2.19 million)
- Yearling average 27k/yr (range = 6k-100k)

Figure from Zimmerman et. al. 2015
Data from J. Anderson & C. Kinsel (WDFW)



Juvenile Chinook outmigrants rearing in the Skagit estuary:

- Peak abundance was in April for 2019
- 27 yr. annual average (Feb-Aug) density is 248.7 fish/ha tidal channel (range 27.7-551.9 fish/ha)



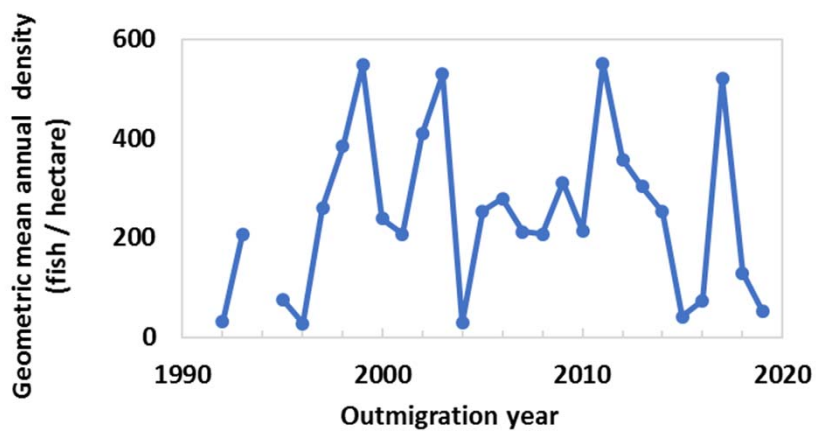
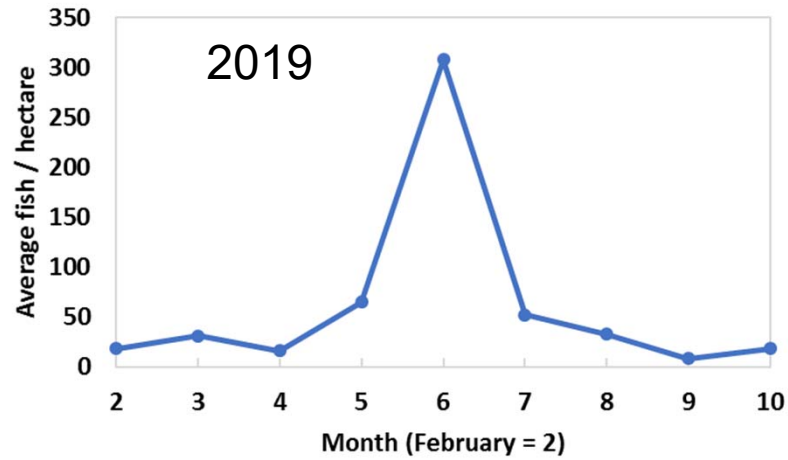


Figure and data from Beamer et. al. 2019

Juvenile Chinook outmigrants rearing in Skagit Bay nearshore:

- Present during all months of sampling
- Peak abundance was in June for 2019
- 25 yr. annual average (Feb-Oct) density is 6.1 fish/ha (range 1.3-11.1 fish/ha)



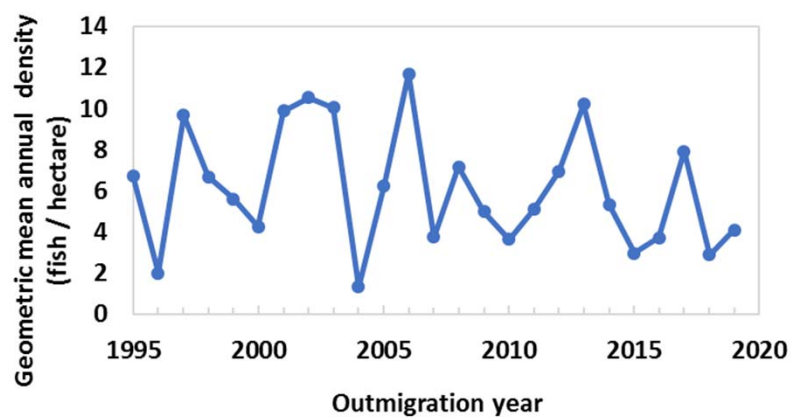
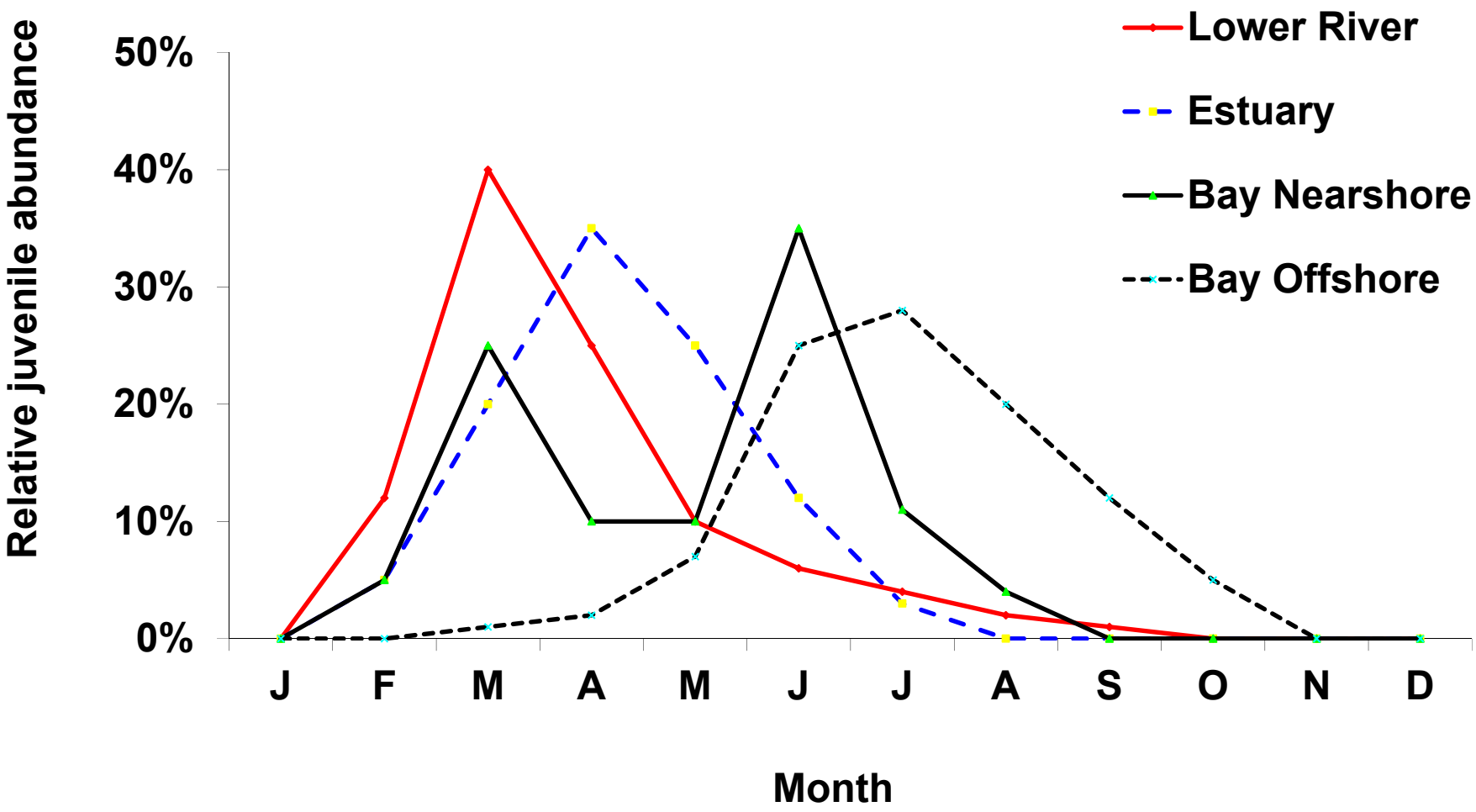
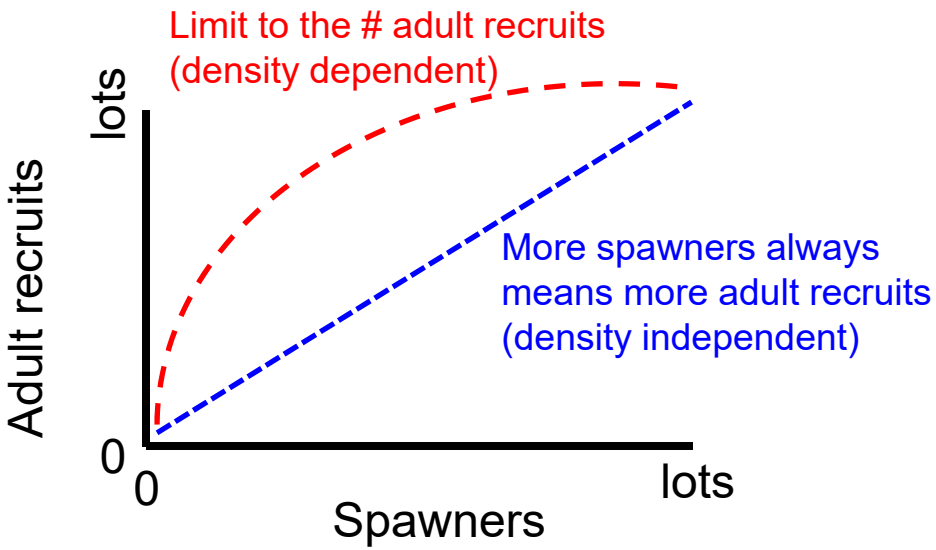


Figure and data from Beamer et. al. 2019

Skagit juvenile Chinook timing through outmigration

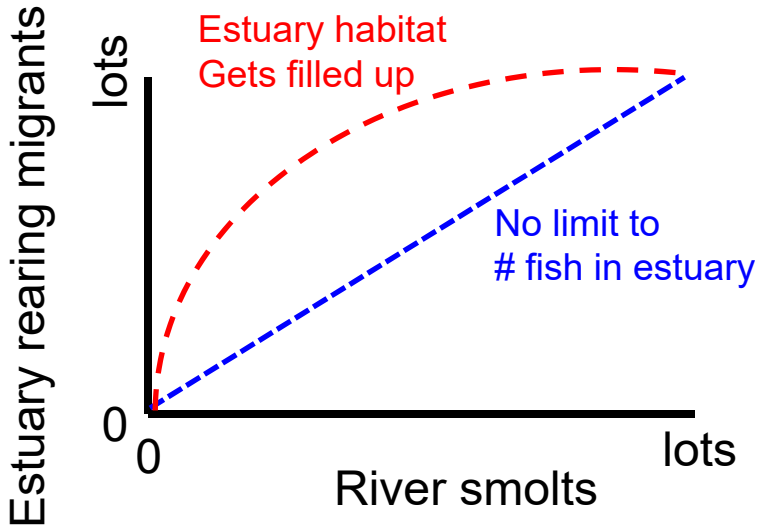


Stock>recruit analysis concepts



Full life cycle analysis:

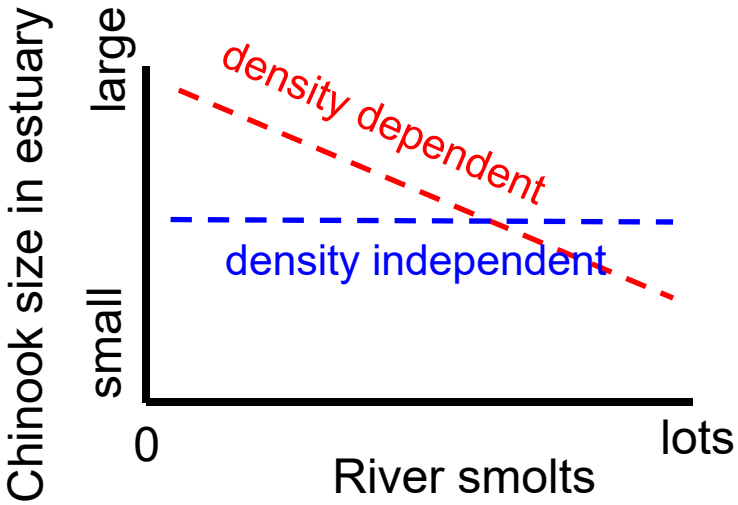
- Spawner to next generation adult recruits (spawners + fish caught in fisheries)



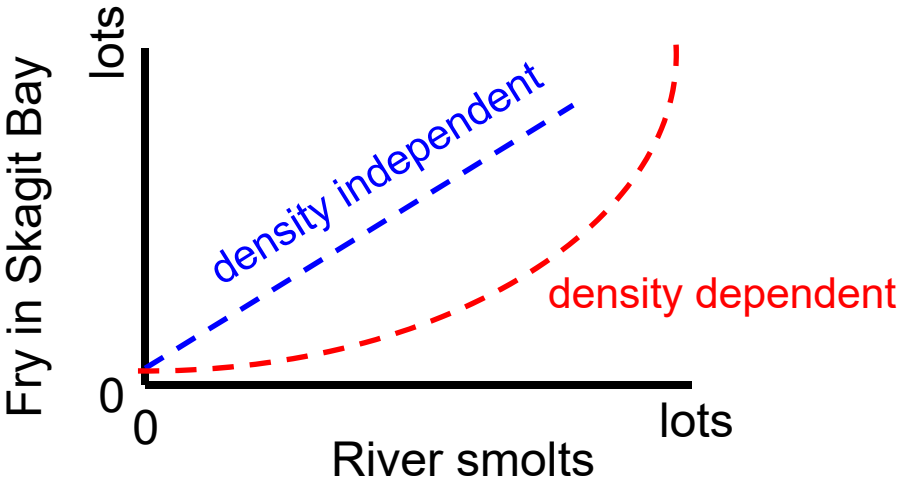
Life stage analysis:

- Smolts outmigrating the river to fish rearing in the estuary

Stock>recruit analyses are more robust if they rely on multiple result types

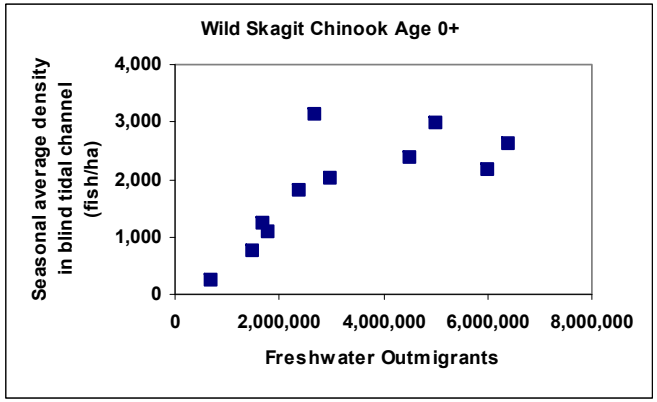


Size of fish in the estuary (indication of slower growth due to crowded conditions)



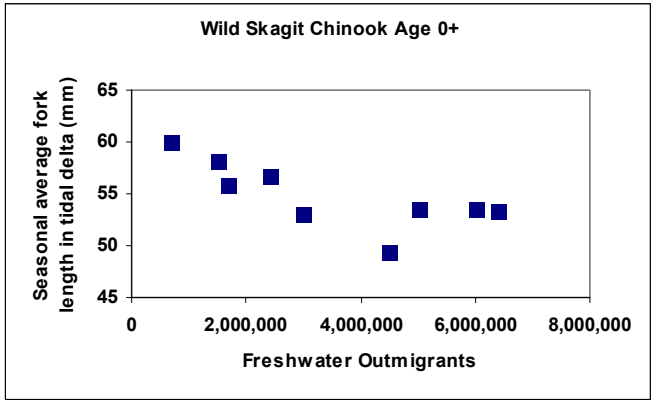
Displacement of fish to the next life stage (indication of migration response to crowded conditions)

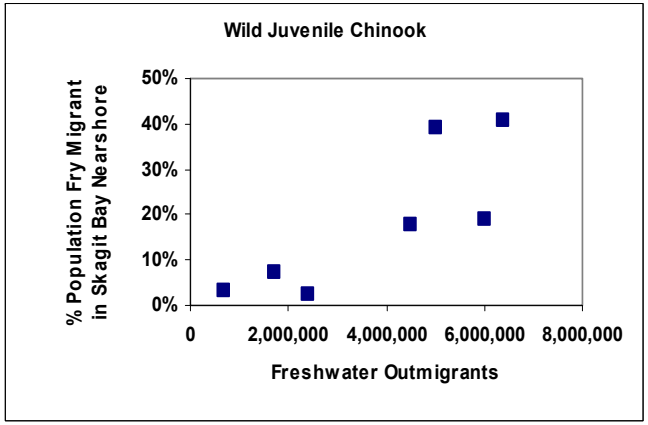
Evidence for habitat limitation in the Skagit estuary used in the Skagit Chinook Recovery Plan (CRP)



Data through 2002 (n=7-11 years depending on result type):

- There is a limit to juvenile Chinook abundance in the estuary
- Fish size declines as more fish enter the estuary
- Proportionally more fry are displaced into Skagit Bay as the estuary fills up.





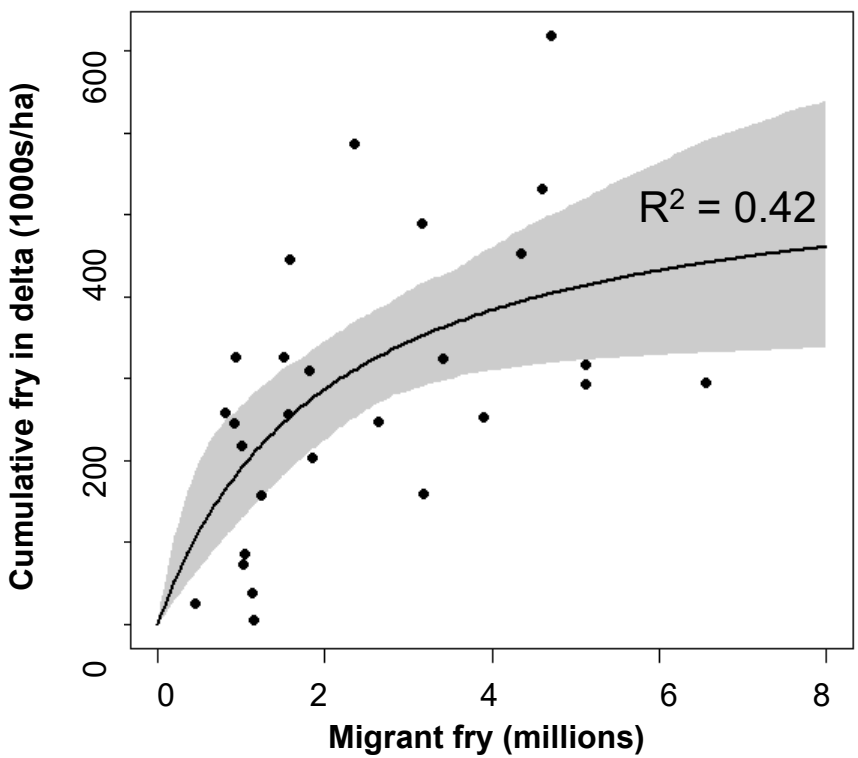
from Beamer et. al. (2005)

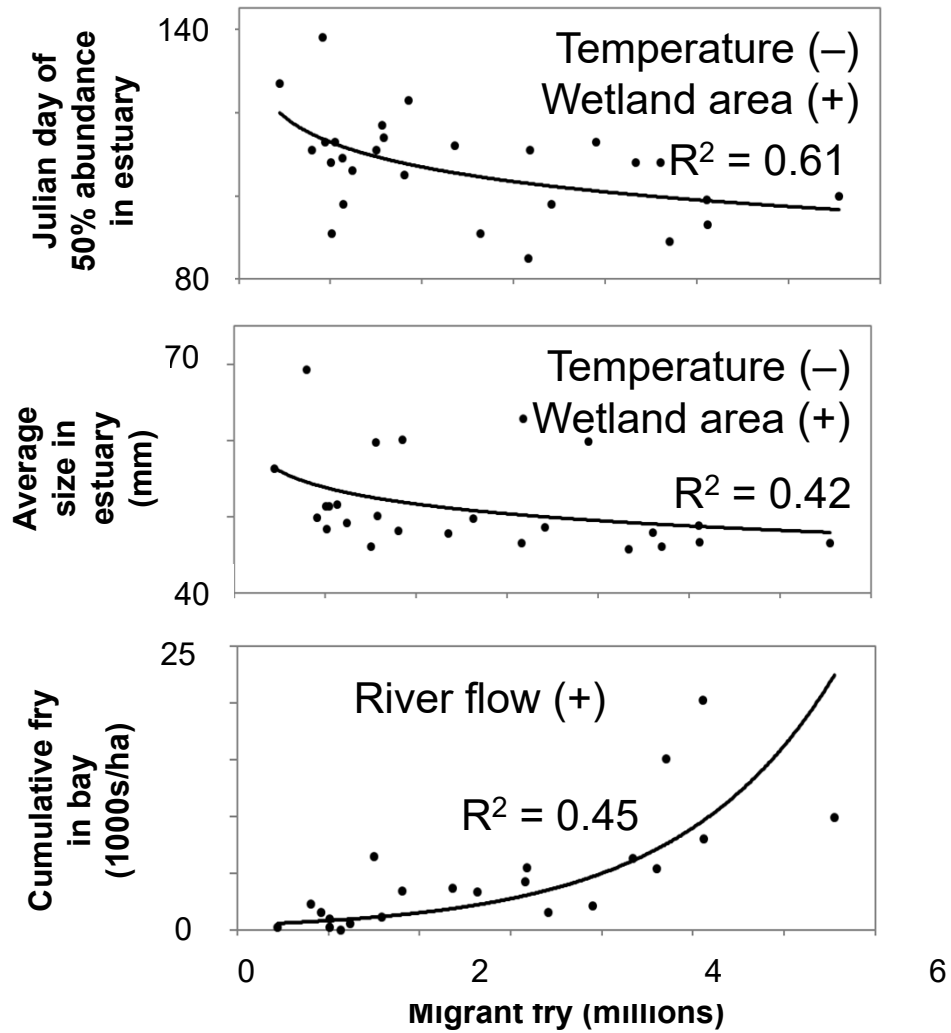
Evidence for Skagit estuary habitat limitation

CRP findings still true: a) limit to abundance, b) fish size declines, and c) proportionally more fry are displaced into Skagit Bay as the estuary fills

New:

- **Residence time of fish decreases as the estuary fills up.**
- **Habitat area (restoration) offsets fish size and residence time trends**





Data through 2018 (23yrs) from Skagit IMW

Summary of Skagit Chinook juvenile life history type characteristics

Life History	Leave River as:	Ave. Fork Length		Smolts per yr	Ave. Marine Survival (low regime)
		Enter Estuary	Exit Estuary		
Yearling	yearling	~120 mm		Up to 100,000	1.2%
Parr	parr	~75 mm		Millions	0.5%
Estuary Rearing	fry	~40 mm	~75 mm	Millions	0.5%
Nearshore refuge rearing fry migrants	fry	~40 mm		5-40% of the river fry	0.5%
Fry migrants (don't find pocket estuaries or small streams)	fry				0.06%

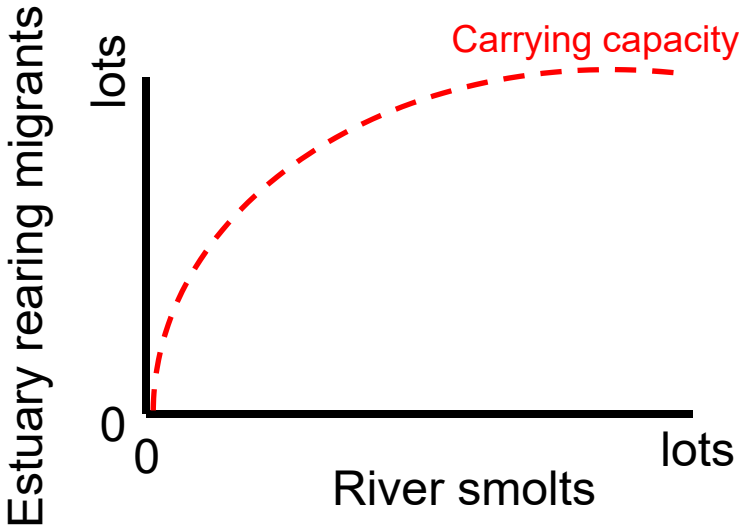
Summarized from Beamer et. al. (2005) and Greene et al (2016)

Conclusions

- The Skagit River annually produces up to millions of migrant juvenile Chinook capable of rearing in estuary habitat.
- Pre-CRP (< 2005) Skagit estuary conditions limit juvenile Chinook abundance, residence time, and growth within the estuary forcing fish toward lower survival in the estuary or to a lower surviving life history type (fry migrant).

Why the Skagit needs space in the estuary for 1.35 million more smolts

Stock>recruit analysis was used to determine the estuary's: a) pre-CRP carrying capacity and b) carrying capacity necessary to achieve the CRP's adult Chinook goals

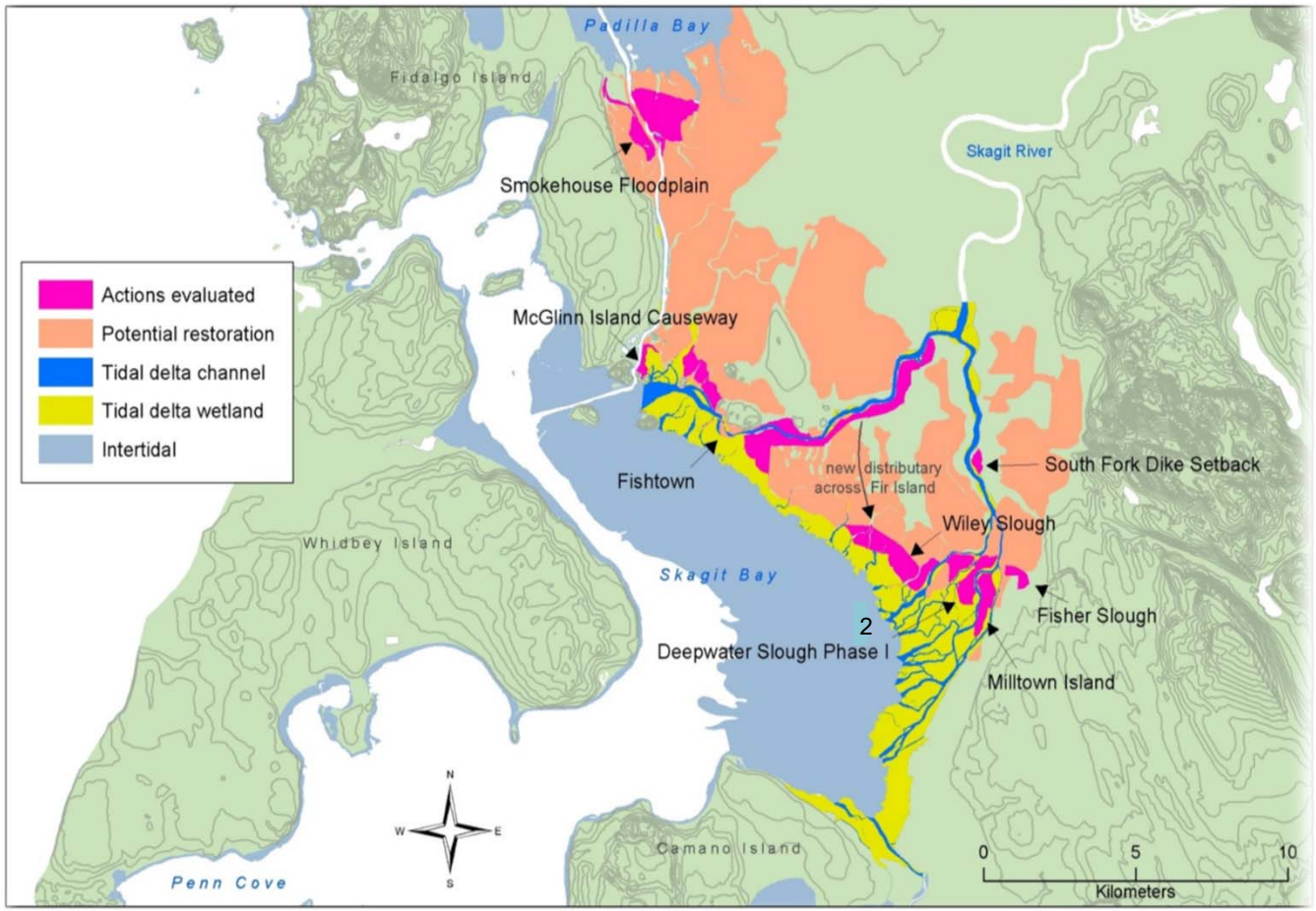


What the Skagit Chinook Recovery Plan (CRP) says:

Capacity (fish/yr)	**Description**
3.60 million	CRP Goal for entire estuary
2.25 million	Estimated pre-CRP adoption (<2005)
1.35 million	**CRP goal for restoration**

Map of CRP "potential restoration" portfolio:

- If built, adds ~2,700 acres to the existing estuary
- Includes projects to restore **capacity** and **connectivity** (fish access to habitat thus optimizing overall estuary capacity)



Skagit estuary restoration that's been completed is working

- Is there more estuary habitat for fish?
- Is restoration working for fish?

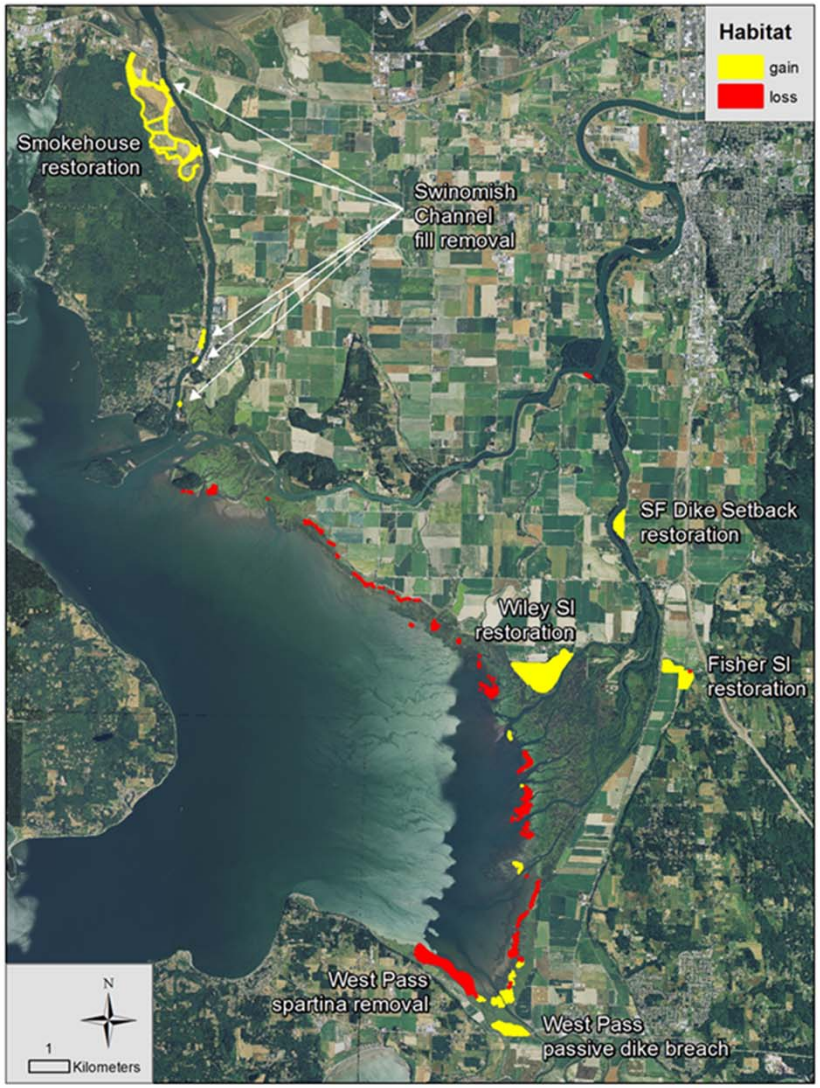
Estuary restoration completed

Site	Year	Design type	Benefit to salmon	
Deepwater Slough (Phase 1)	2000	Dike setback	Capacity, Connectivity	**Pre-CRP**
Smokehouse Floodplain	2005-8	Tide gate	Capacity	
Milltown Island	2006-7	Dike breach	Capacity thru connectivity	
South Fork dike setback	2007	Dike setback	Capacity	
Swinomish Ch. fill removal	2008	Fill removal	Capacity	
Wiley Slough	2009	Dike setback	Capacity	
Fisher Slough	2010-11	Dike setback w tide gate	Capacity	
Fir Island Farms	2016	Dike setback	Capacity	

Is there more estuary habitat for fish?

- The Skagit estuary is gaining more habitat than it is losing
- Restoration is the main reason why.
- Natural gains and losses of estuary occur, with a net loss observed from 2004-2013.
- Most loss areas are along the bay front of Fir Island (sheltered from river sediment deposition and more exposed to wave caused erosion)

Skagit estuary gains/loss 2004-2013



Beamer and Wolf 2017

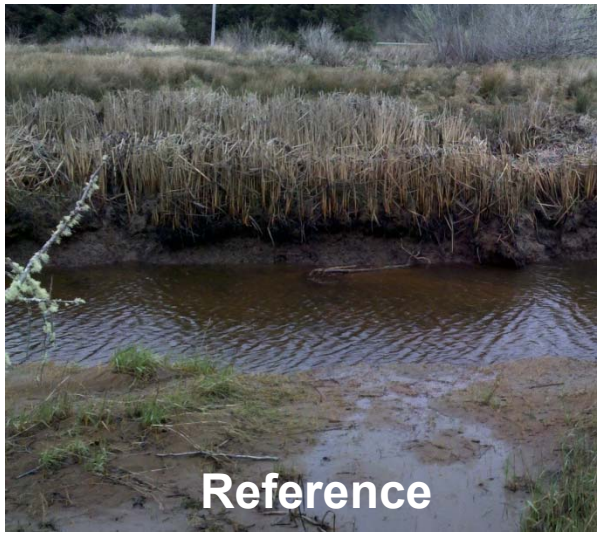
Evaluating restoration effectiveness

- Fish sampling before/after restoration & compared to reference sites
- Results by project and design type (e.g., tide gates, fill removal, dike breach, dike setback
- Example for tide gate restoration:

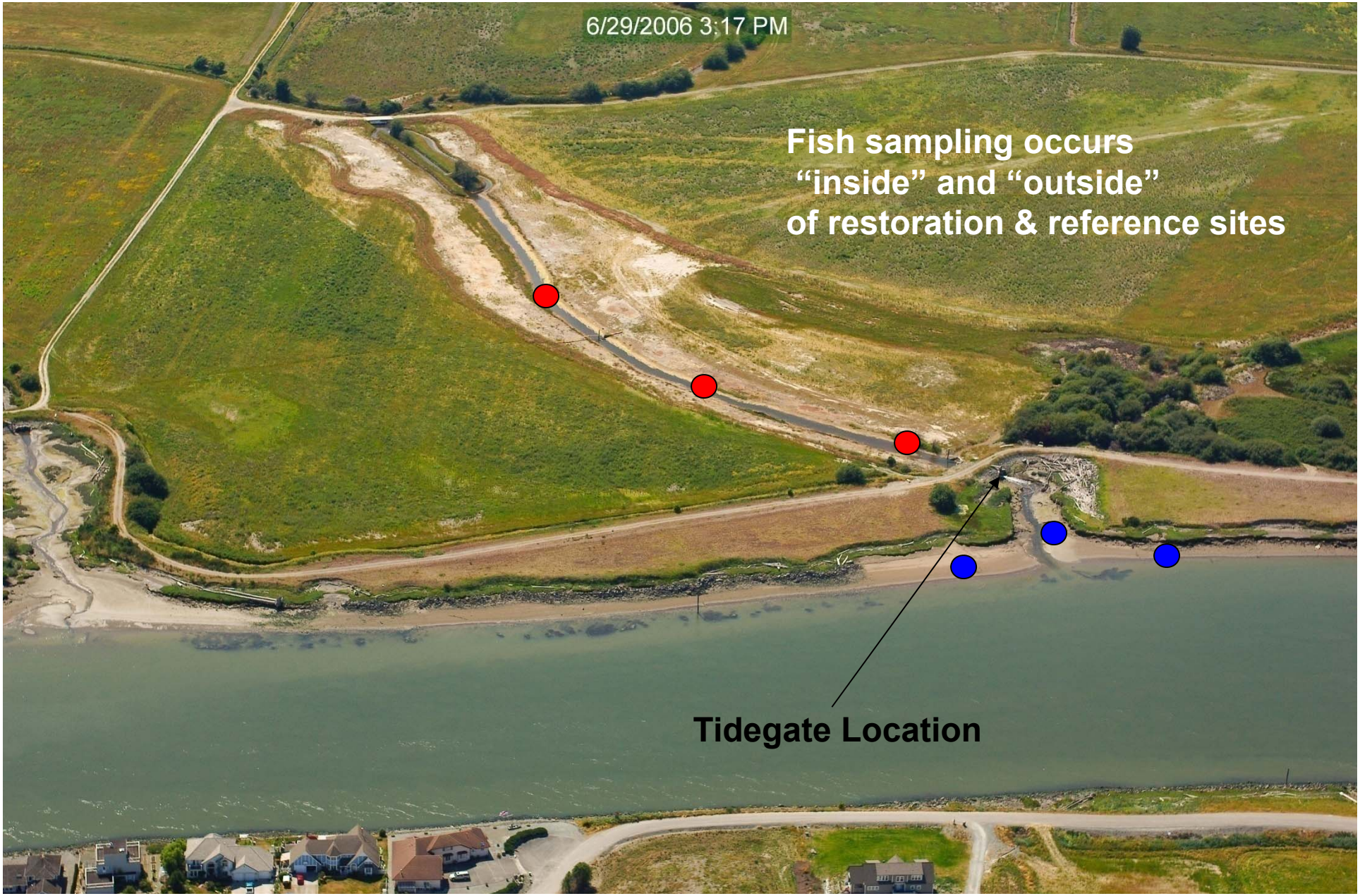
Before restoration

After restoration

Compared to reference



Smokehouse Restoration Phase 1

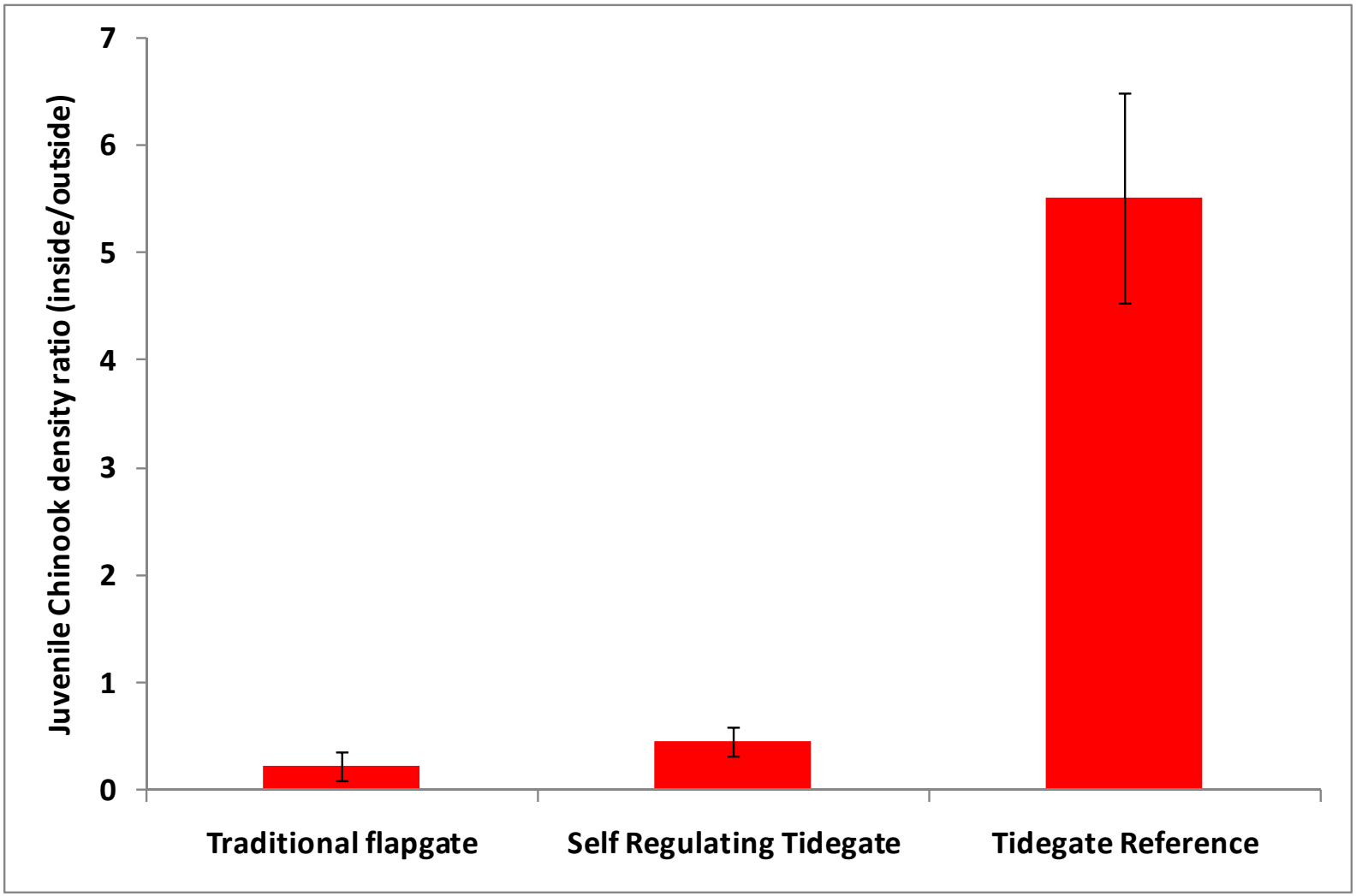


Is restoration working for fish?

Local (restoration project) response:

- If you build it they will come. Juvenile Chinook used restored habitat generally consistent with reference sites.
- Some restoration designs work better than others for fish. Projects using dike setback, dike breach, or fill removal worked best

Effects of SRT restoration in the Skagit & Samish estuaries for juvenile Chinook salmon (3 sites, 8 years)



Summarized from Greene et. al. 2012

Summary: effects of different types of restoration in the Skagit estuary for juvenile Chinook salmon

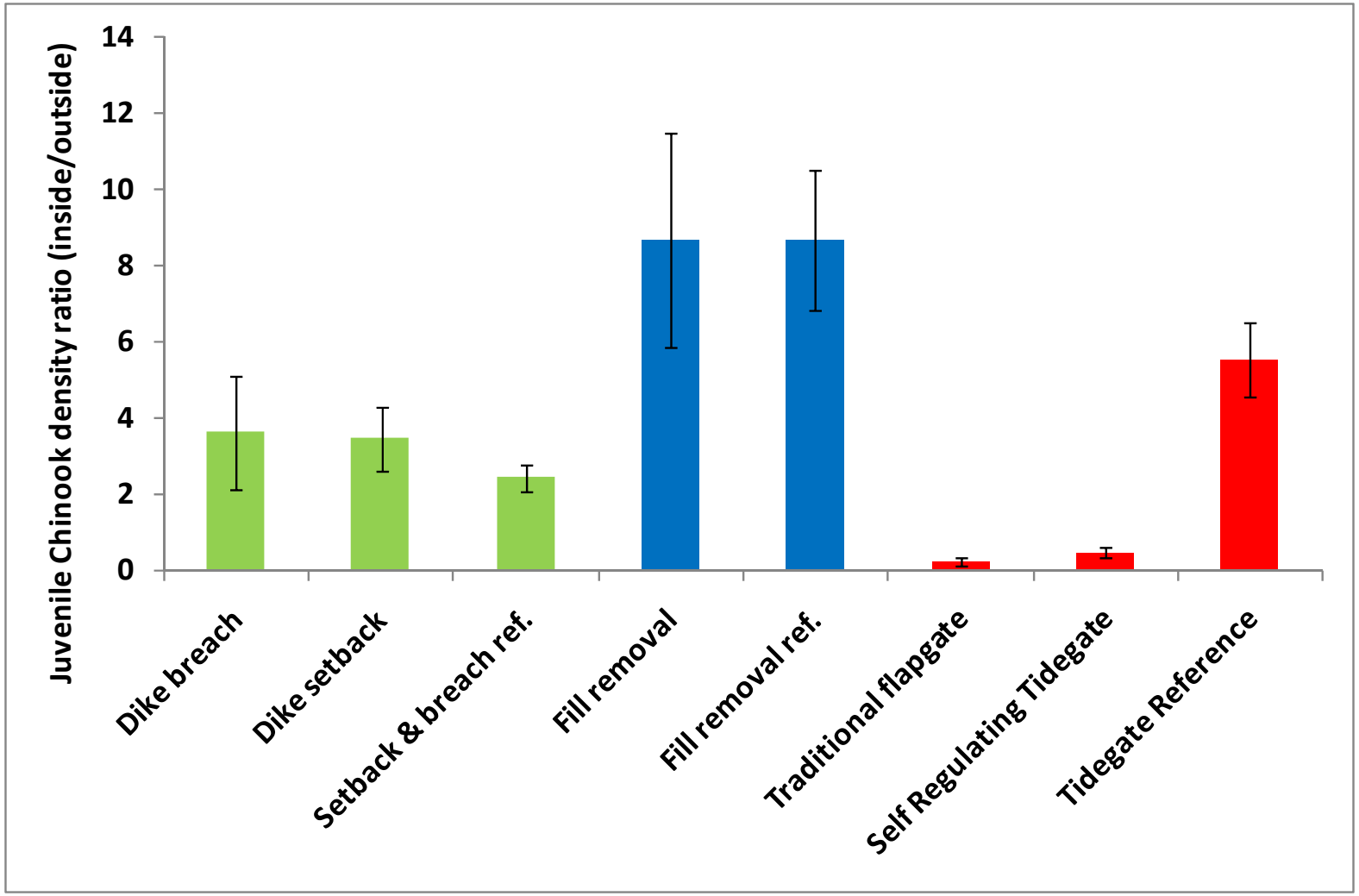
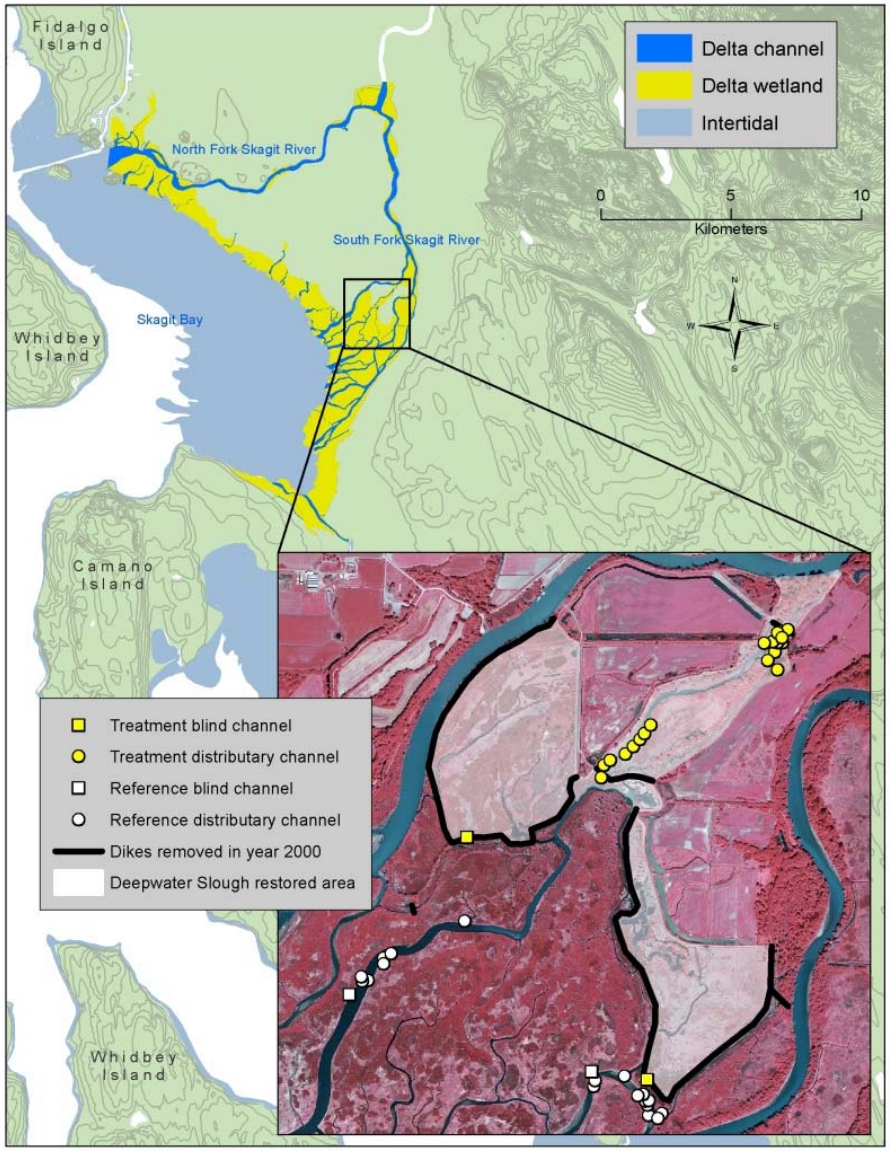


Figure from Greene et al. 2016

Deepwater Slough Phase 1

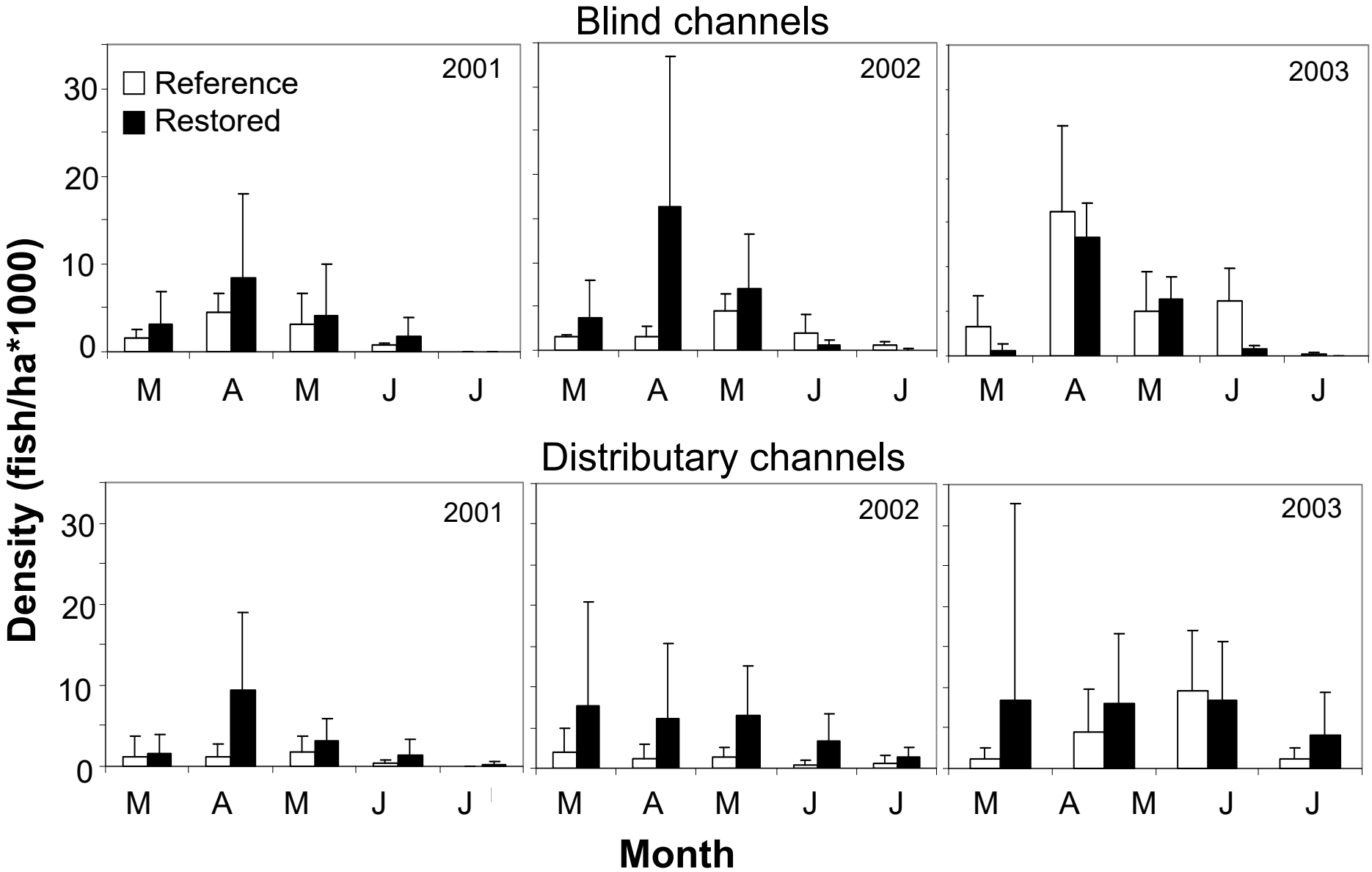


Completed before CRP

Monitoring design:

- did not estimate carrying capacity
- compared restored to reference areas

Deepwater Slough Phase 1

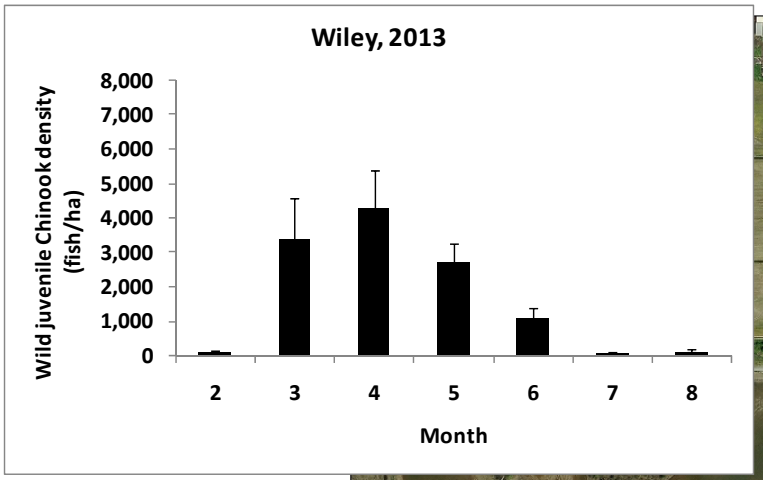


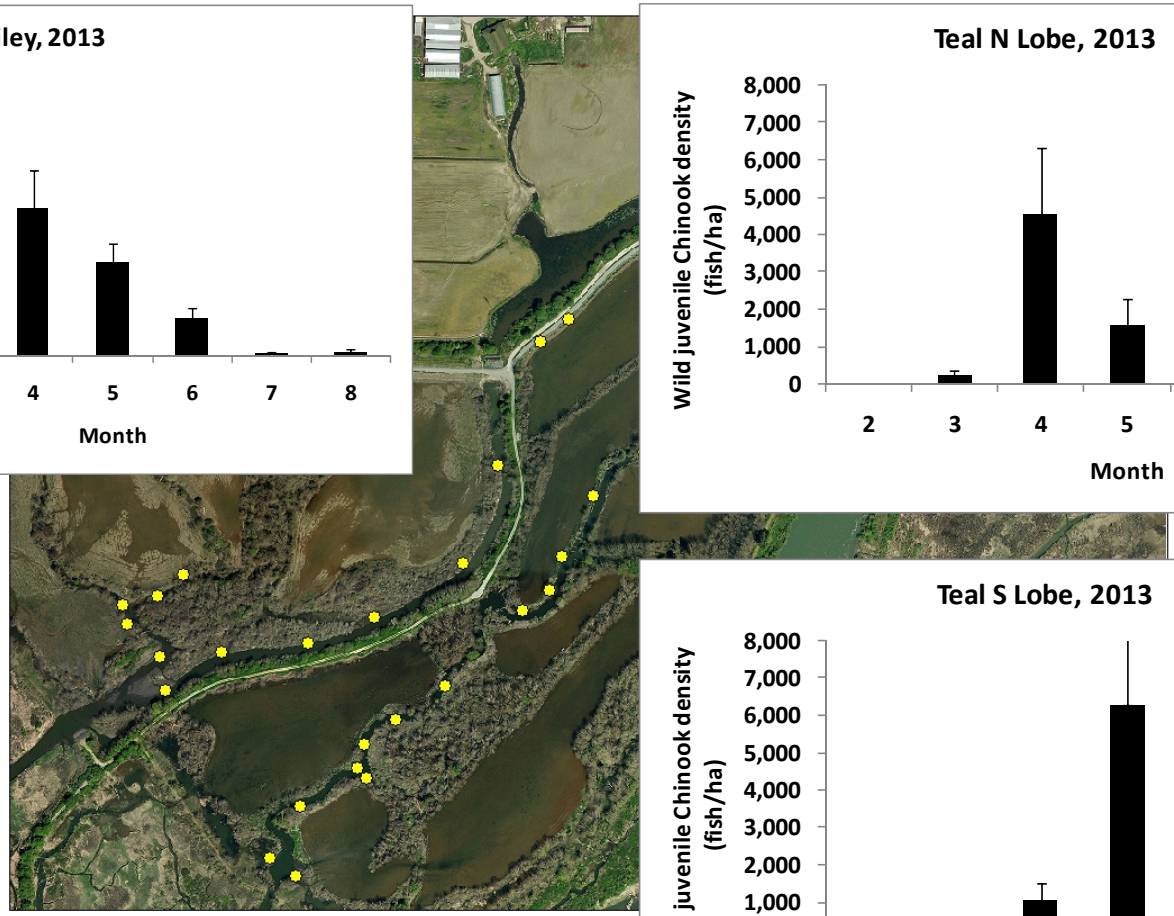
Beamer et al. 2006

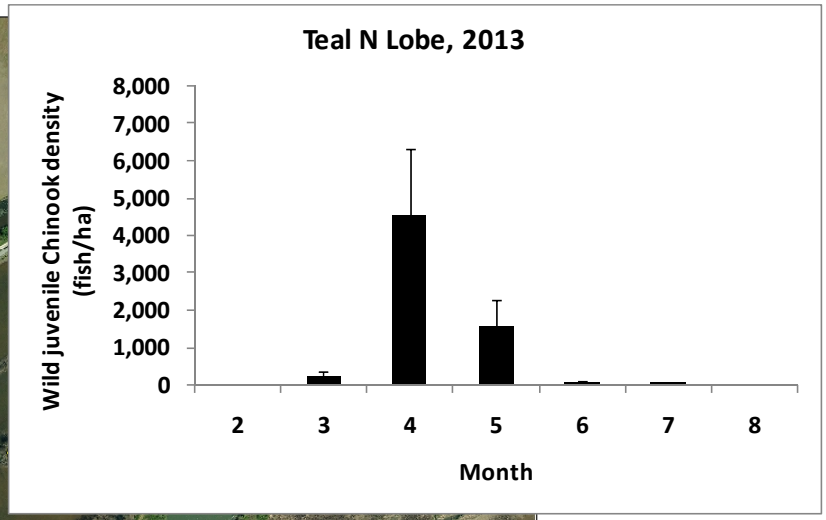
Wiley Slough Restoration

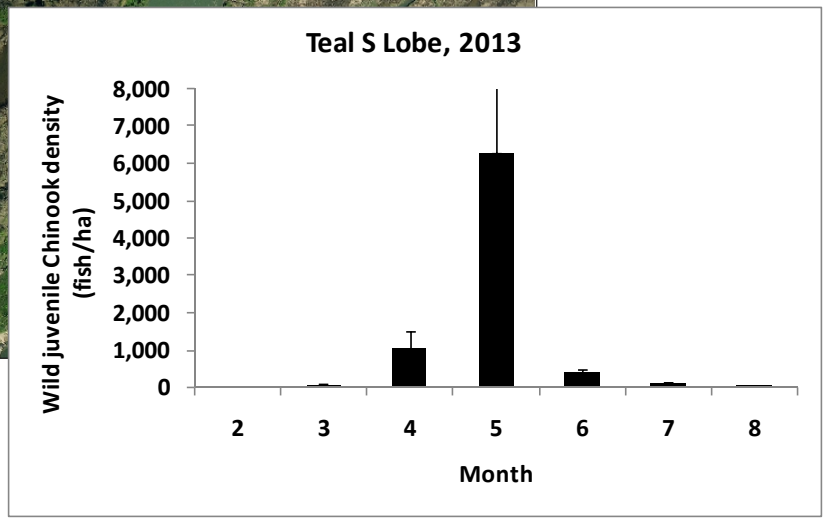
Juvenile Chinook abundance

- **No before restoration monitoring (site blocked fish access)**
- **after restoration (88,000 and 248,000 fish)**
- **Capacity estimate 75,000 to 370,000 fish (depends on habitat trajectory)**





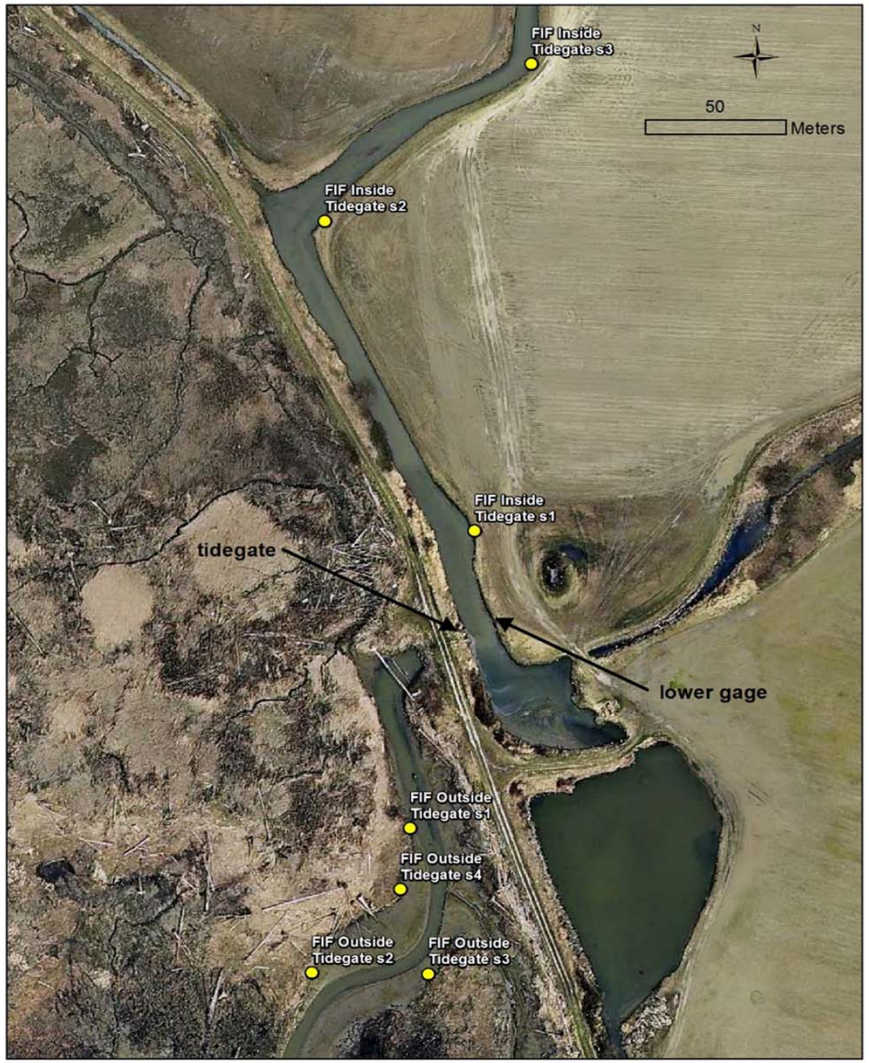




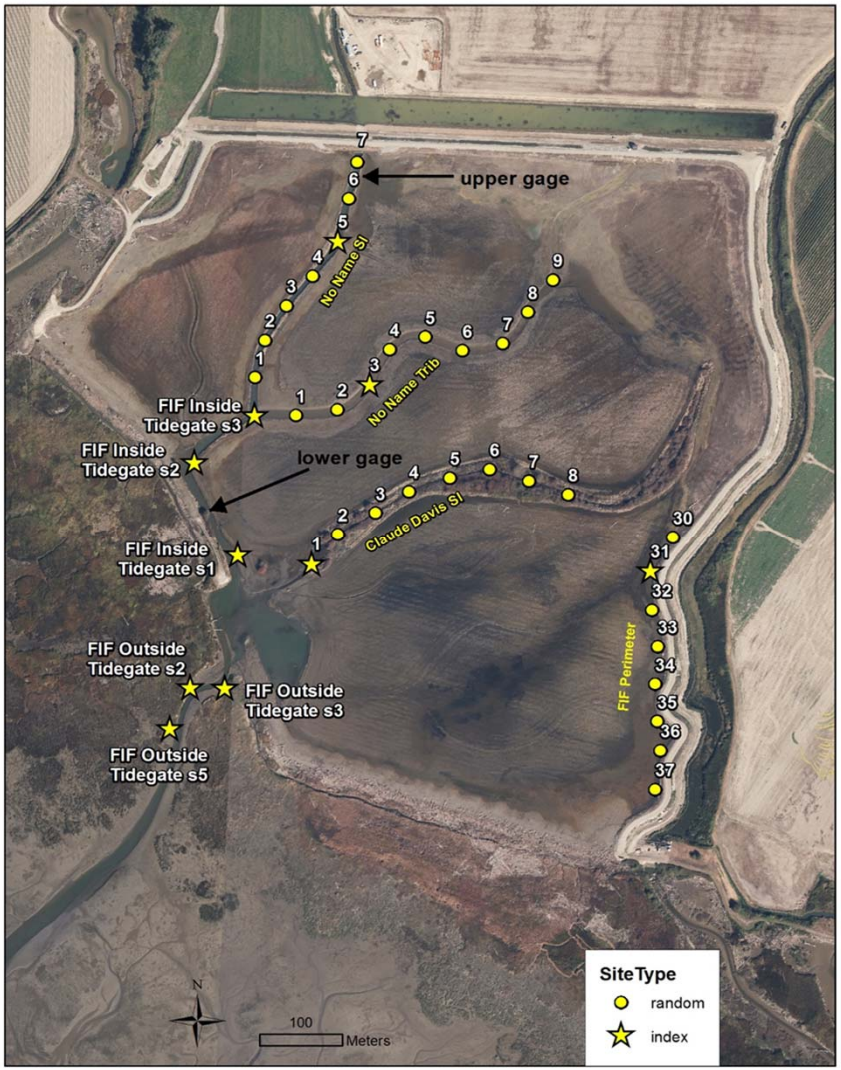
From Beamer et al. 2015

Fir Island Farms

Before Restoration



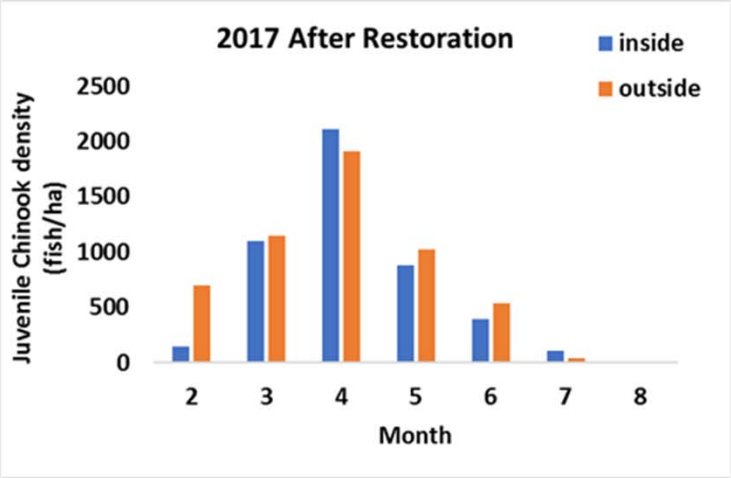
After Restoration

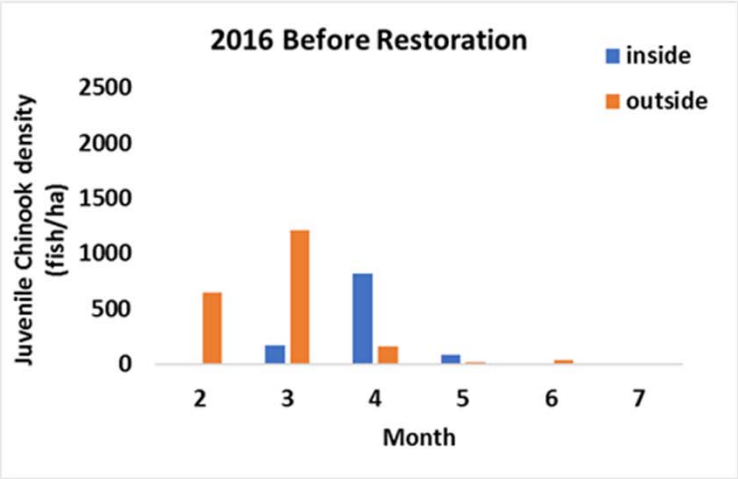


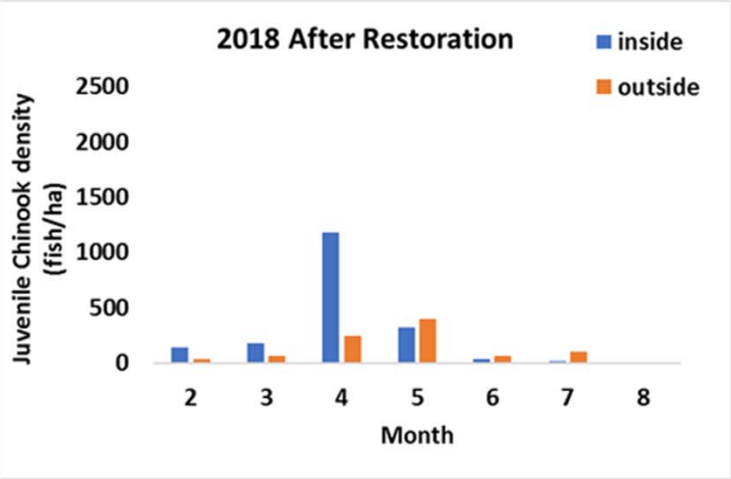
Fir Island Farms

Juvenile Chinook abundance

- **before restoration (118 and 566 fish)**
- **after restoration (50,522 and 11,124 fish)**
- **Capacity estimate 50,000 fish**







Is it working for fish?

System (population) response:

- Juvenile Chinook are less crowded in the estuary as restoration increases habitat opportunity.
- The length of fish residence in the estuary increases as restoration increased.
- More weakly supported include: a) reduced frequency of fry migrants in marine habitats and b) higher smolt-adult return rates as restored area increased

Conclusions from Greene et al. 2016

Why we still need to restore more estuary

- Carrying capacity status compared to CRP goal
- Restoration projects “in the works”
  - Public Lands (Deepwater Phase 2, Milltown)
  - Other large projects (McGlinn Is, Smokehouse)

What's the status compared to CRP goals?

Capacity (fish/yr)	Description
1.350 million	CRP goal for restoration
~0.475 million	Capacity restored thru 2016
~0.875 million	**Capacity need remaining**

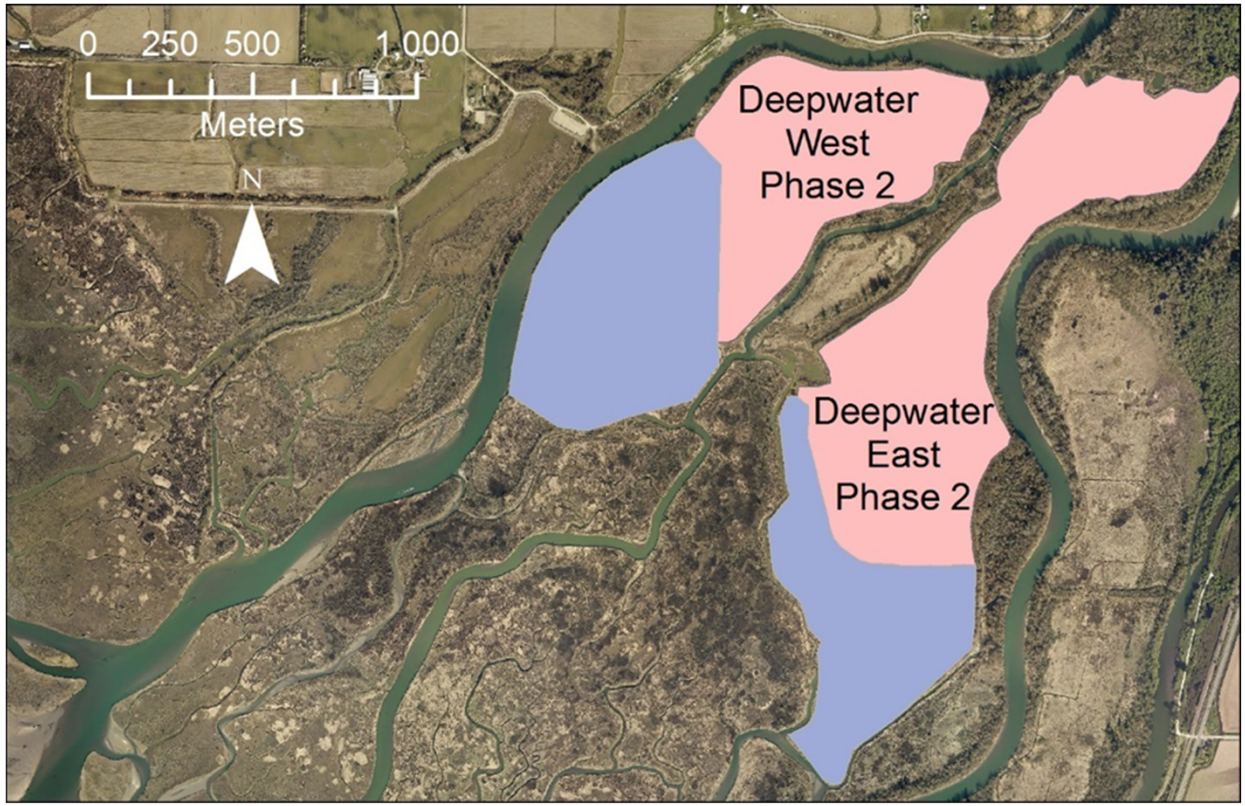
Potential benefit of projects currently in feasibility/design stage:

~0.625 million **(best case)**

~0.090 million **(worst case)**

Deepwater Phase 2

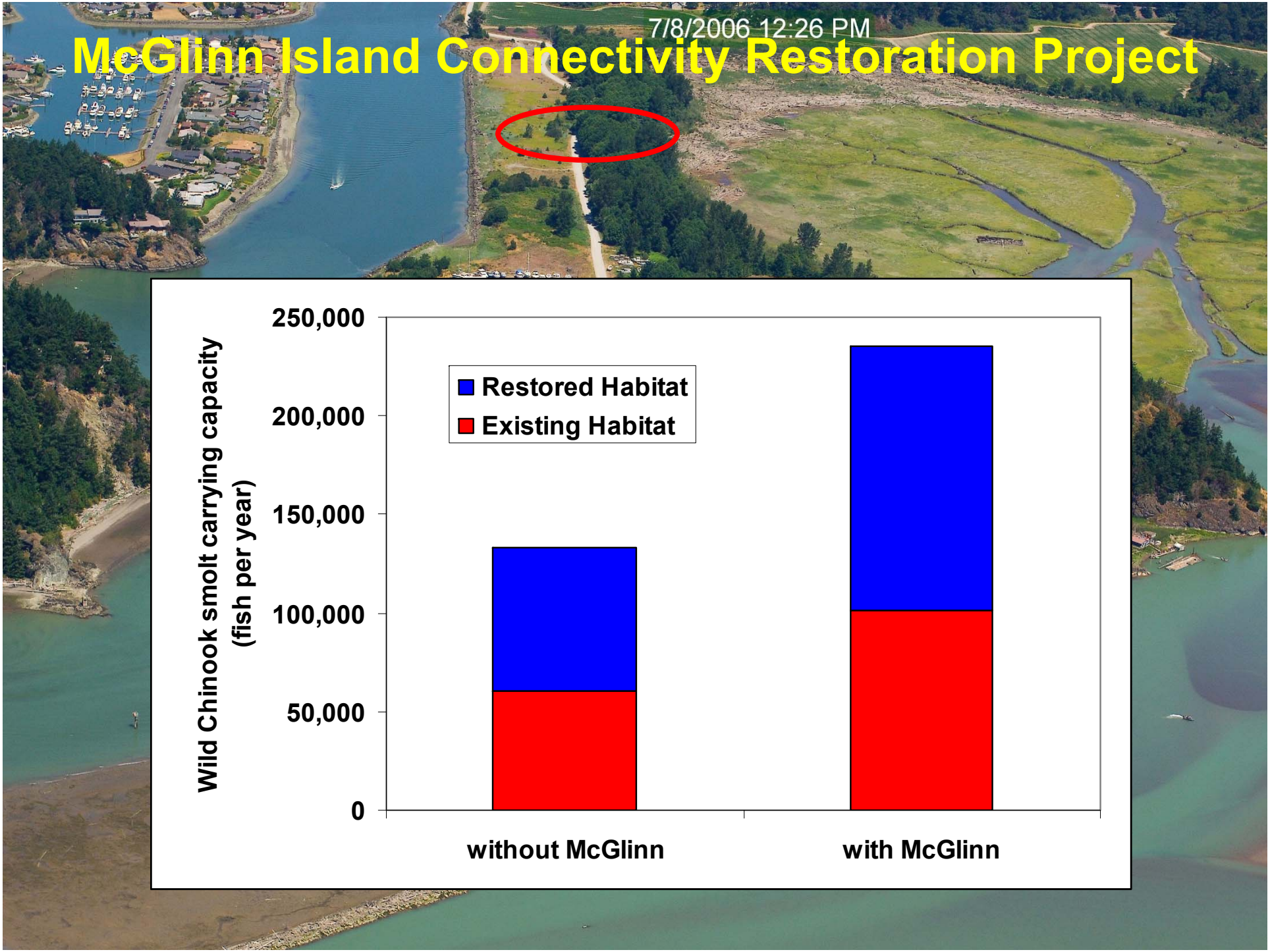
Skagit Hydrodynamic Model (SHDM) Project



Beamer et al. 2016

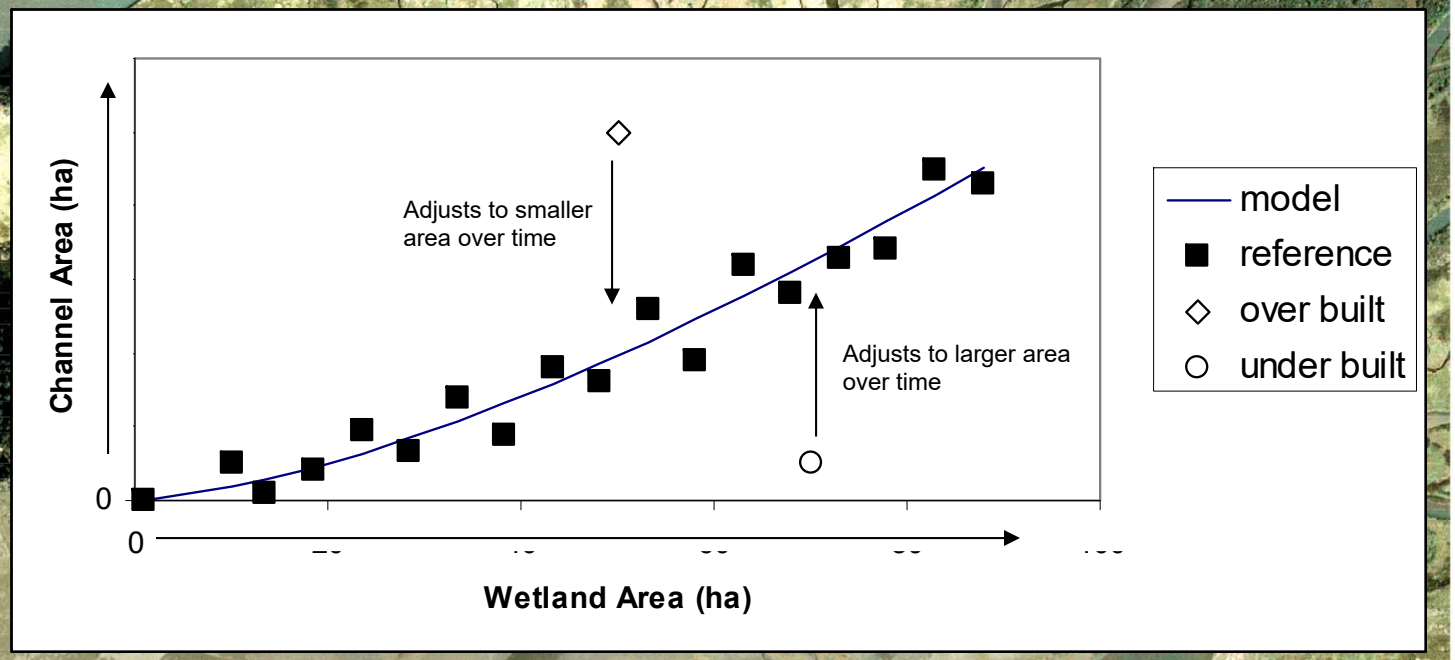
- Habitat and carrying capacity estimates updated
- Included “outside the dikes benefit”
- Included multiple connectivity pathways
- Updated capacity 160,000 (52,000-475,000) fish per year,
- CRP estimate ~96,000 fish per year.

McGlinn Island Connectivity Restoration Project



Why is there uncertainty?

1. Statistical uncertainty of models
2. Habitat is not static
   - Considerations:
     - Fate of impoundments & development of channels
     - Vegetation colonization



Summary

1. Estuary habitat have been lost throughout Puget Sound.
2. Prior to Chinook Recovery Plan adoption, the Skagit estuary had an 88% loss in the habitat directly used by fish.
3. The Skagit River annually produces up to millions of migrant juvenile Chinook capable of rearing in estuary habitat.
4. Pre-CRP (< 2005) Skagit estuary conditions limit juvenile Chinook abundance, residence time, and growth within the estuary forcing fish toward lower survival in the estuary or to a lower surviving life history type (fry migrant).
5. Stock recruit analysis estimated 1.35 million more smolt capacity is needed in the estuary to achieve CRP recovery goals
6. Restoration is adding habitat and carrying capacity to the Skagit estuary but more needs to be completed to achieve CRP goals
7. Juvenile Chinook are less crowed & staying longer in the estuary resulting in higher survival to adulthood
8. Full citation of references used are available in Word Document with weblinks

References associated with Eric Beamer's presentation

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Estuary habitat is limiting Chinook recovery

Beamer, E.M., A. McBride, C. Greene, R. Henderson, G. Hood, K. Wolf, K. Larsen, C. Rice, and K. Fresh. 2005b. Delta and nearshore restoration for the recovery of wild Skagit River Chinook salmon: linking estuary restoration to wild Chinook salmon populations. Appendix to the Skagit Chinook Recovery Plan. Skagit River System Cooperative, LaConner, WA.

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No link available

We need space in the estuary for 1.35 million more smolts

Beamer, E.M., A. McBride, C. Greene, R. Henderson, G. Hood, K. Wolf, K. Larsen, C. Rice, and K. Fresh. 2005b. Delta and nearshore restoration for the recovery of wild Skagit River Chinook salmon: linking estuary restoration to wild Chinook salmon populations. Appendix to the Skagit Chinook Recovery Plan. Skagit River System Cooperative, LaConner, WA.

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Estuary restoration that's been completed is working

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Washington Department of Fish and Wildlife under Interagency Agreement Number 15-02641. Skagit River System Cooperative, La Conner, WA 98257.

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We need to restore more estuary

Beamer E., and Karen Wolf. 2017. Skagit Chinook Habitat Monitoring Status and Trends: Change in Skagit Tidal Delta Habitat Extent, 2004 – 2013. Skagit River System Cooperative, P.O. Box 368, La Conner WA 98257.

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Beamer, E., G. Hood, and K. Wolf. 2016. Technical Memo to Polly Hicks (NOAA Restoration Center), Jenny Baker (TNC), Jenna Friebel (WDFW) on December 27, 2016 regarding Habitat and juvenile Chinook benefit predictions of candidate restoration projects within the Skagit tidal delta. Work completed under NOAA/WRCO SRFB Skagit Hydrodynamic Model (SHDM) Project (P104051-A102542-n/a). Skagit River System Cooperative, La Conner, WA 98257.

See Appendix D (pgs. 633-787) in this document: https://wdfw.wa.gov/publications/02123

Chinook Salmon Management

Aaron Dufault WDFW

Andrew Fowler WDFW

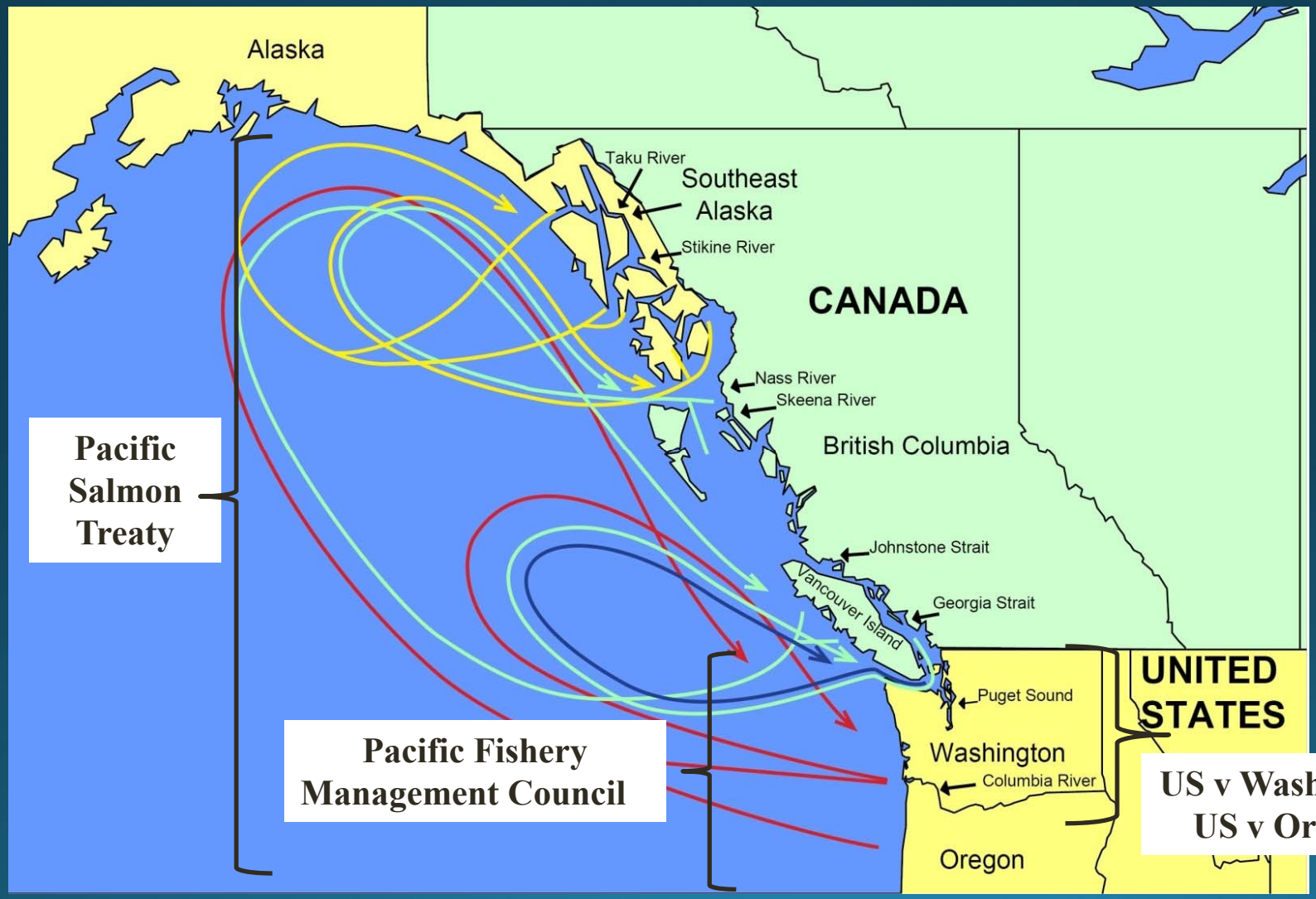
Casey Ruff Skagit River System Cooperative

Bob McClure Upper Skagit Indian Tribe

Outline

- Salmon Harvest Management
  - Mgmt Framework
  - NOF
- Data Collection
- Skagit Chinook
- Climate Change Impacts
- Summary

Complex, multi-jurisdictional processes



Annual Fishery Planning

Annual monitoring / data collection

- Monitor numbers impacted by fisheries and numbers returning to spawning grounds
- Ages – scales and otoliths
- Determine stock of origin (Coded-wire tags, genetics)

Impacts of all fisheries from Alaska to California accounted for during pre-season planning

- 100's of stocks monitored to ensure conservation goals are met
- ESA-listing of population groups in the Columbia and Puget Sound → stricter limitations on fisheries to protect depressed populations

North of Falcon Process

- Planning process that runs concurrently with Pacific Fishery Management Council (PFMC) process
- Started process to move towards cooperative state-tribal management in the mid-1980's – Co-management

What do we do at NOF?

Washington state and tribal co-managers plan fisheries that meet conservation objectives for each stock when linked with PST and PFMC fisheries

Goal - provide sustainable recreational, commercial, and treaty fishing opportunities in a manner that does not jeopardize the recovery of salmon or other species listed under the ESA

North of Falcon Process Cont.

1. Forecast the abundance of each stock
2. Determine if there is a harvestable surplus
3. State/ Tribes propose fisheries - predict harvest
4. Model fisheries to determine which stocks are of conservation concern

FRAM – Fisheries Regulation Assessment Model

- Inputs – Stock abundance forecasts & fishery impacts (harvest)
- Predicts exploitation rate (# of fish caught/impacted) on stocks to compare to conservation objectives
- Chinook and Coho only – other fisheries 'impacts' included

North of Falcon Process Cont.

5. State and tribes negotiate sharing of catch and modify fisheries plans to meet conservation objectives

6. Final agreed-to State and Tribal salmon fisheries (ocean, Puget Sound) are described in the List of Agreed Fisheries document (LOAF)

Endangered Species Act (ESA)

ESA-listed species in Puget Sound

- PS Chinook – 1999
- PS Bull trout – 1999
- Hood Canal Summer Chum - 1999
- PS Steelhead - 2007
- Southern resident Orcas - 2008
- PS bocaccio, canary and yelloweye rockfish – 2010

- NOAA must approve state and tribal salmon fisheries – ESA permit to impact listed chinook salmon
- Biological opinion (BiOp) – annual salmon fisheries plan cannot jeopardize the species

Outline

- Salmon Harvest Management
  - Mgmt Framework
  - NOF
- **Data Collection**
- Skagit Chinook
- Climate Change Impacts
- Summary

Data Collection

Annual Data Needs

- Escapement – fish that "escape fisheries" to spawn
- Catch/impacts
- Ages – scales/otoliths
- Stock origin – Coded wire tags (CWTs) and genetics
- Test fisheries – predict runsize from known relationships with catch

Data Sharing

- Comanagers share data in-season – needed for management decisions
  - Fishery Dependent – treaty and commercial harvest ready in day(s) – recreational fishery harvest range from weeks to > 1 year

Data Collection – In-river Sport

Creel surveys

- Recreational fishery samplers collect catch and effort information throughout the fishing season
  - Rely on anglers to provide truthful recounting of catch/bycatch
- Used to create catch estimates of target and non-target species
  - EG. In-river sockeye creel – enumerating all bycatch and sockeye catch estimate

Data collection – Skagit Fisheries

- Cooperative test fisheries are conducted to collect data on timing, species and age composition, and abundance
- Tribal and State managers monitor the fisheries in ways that allow comparison of observations with pre-season expectations
- Data are collected from each fishery and the landings, for use in subsequent evaluation and analysis
- In-season fisheries are modified to ensure conservation/harvest goals are met

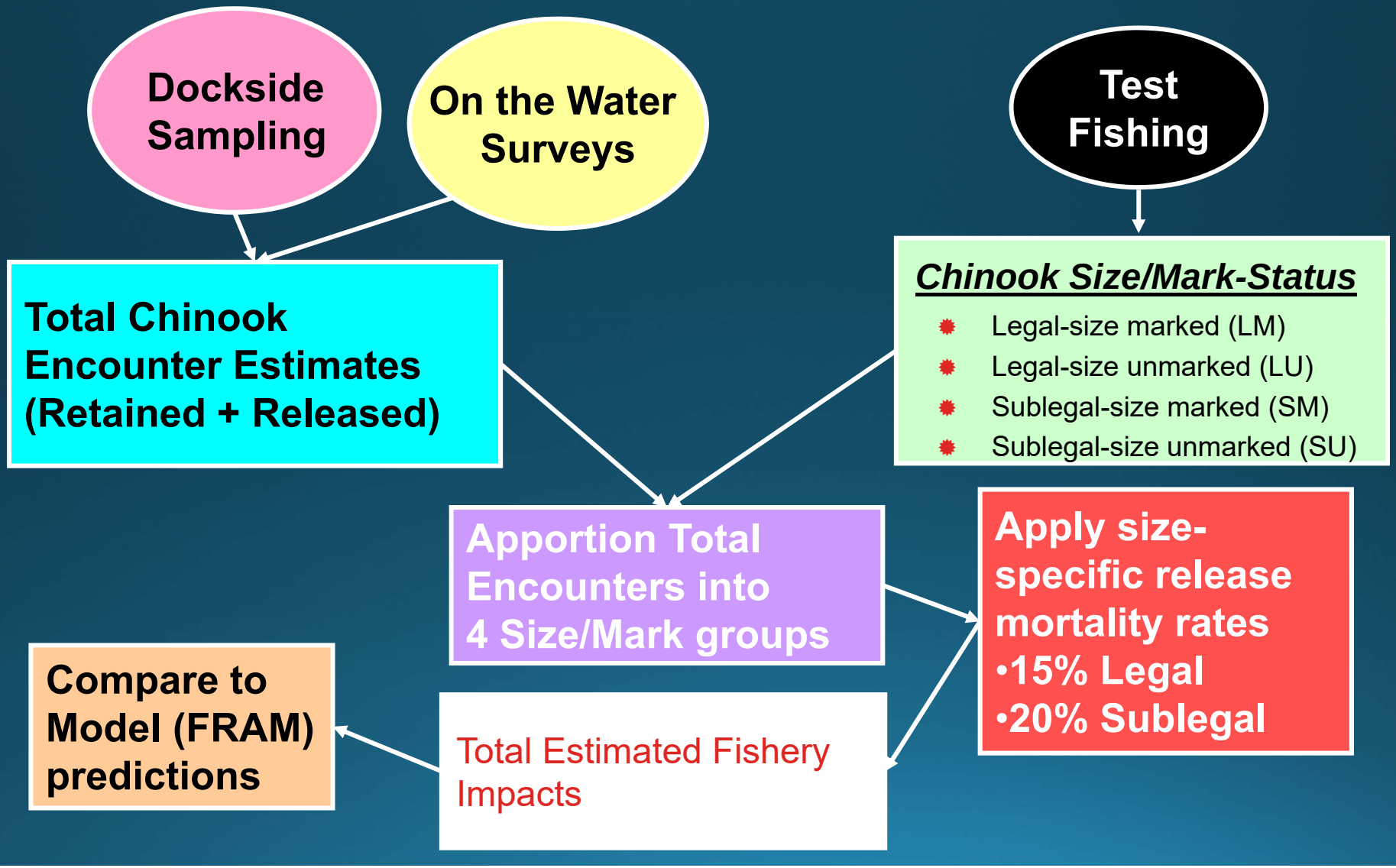
Data Collection – Marine Mark-selective Fisheries (MSF)

Management Criteria for MSFs – 4 categories of fish tracked

- Legal Marked – >22" min. size, no adipose fin
- Legal Unmarked – >22" min. size, intact adipose fin
- Sublegal Marked – <22" min. size, no adipose fin
- Sublegal Unmarked – <22" min. size, intact adipose fin

- Not all "encountered" fish are legal to retain – apply size-specific release mortality rate
  - We estimate 15% of released adult Chinook salmon and 20% of sublegal Chinook will die after being released from hook and line fishery.

Data Collection – Creating MSF catch estimates



WDFW Chinook Fishing Priority

WDFW Commission guidance – prioritize chinook salmon for recreational harvest

Commercial harvest only occurs on select "terminal" (near-river mouths) hatchery returns

E.G. Bellingham Bay – gillnet

Hoodsport Hatchery – beach seine

Outline

- Salmon Harvest Management
  - Mgmt Framework
  - NOF
- Data Collection
- **Skagit Chinook**
- Climate Impacts
- Summary

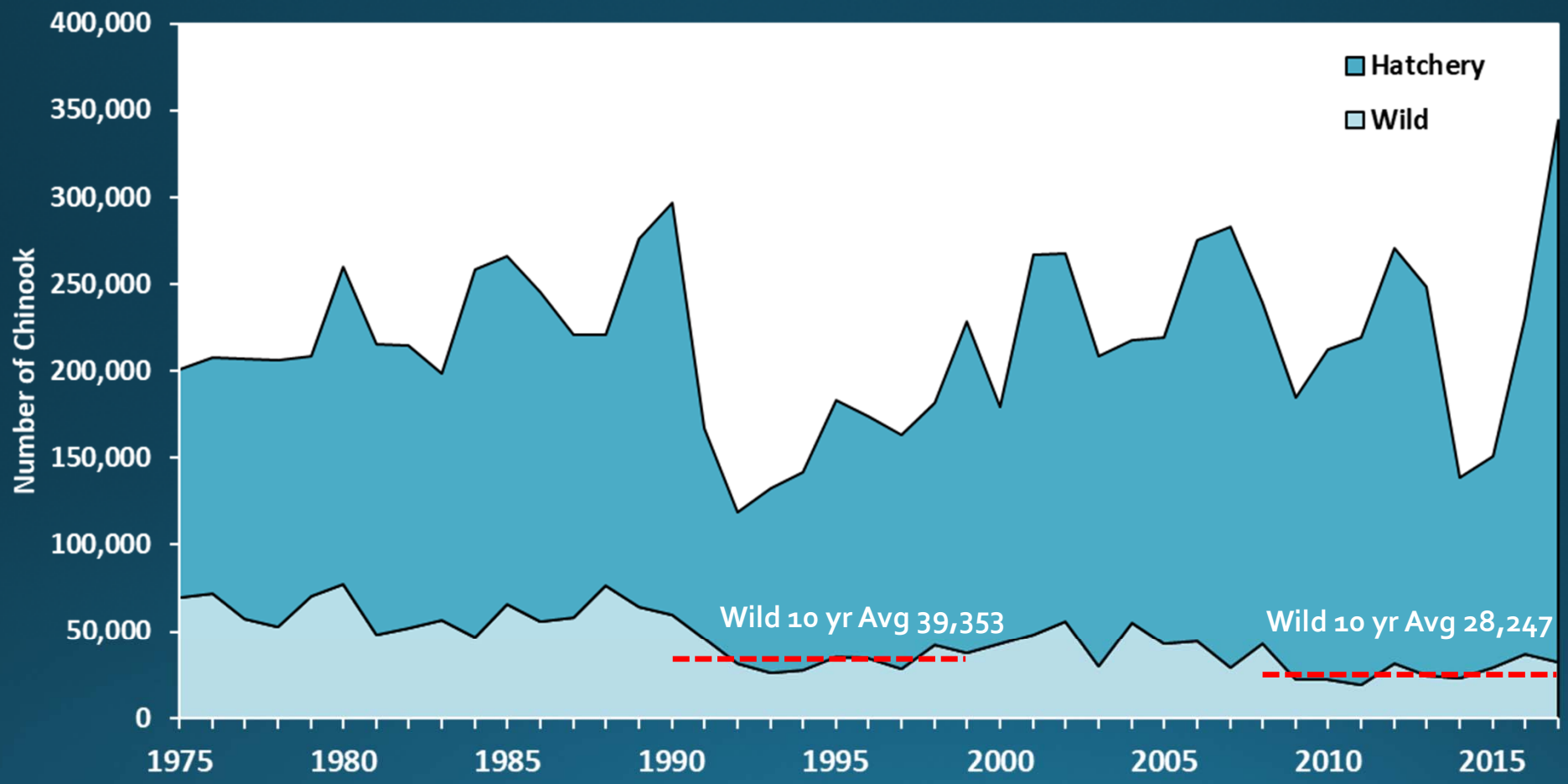
Puget Sound Chinook ESU

Puget Sound Evolutionary Significant Unit (ESU)

- 22 populations
  - 14 Management Units
- Classified according to run timing (e.g. spring, summer, fall)

Management Unit	Component Populations
Nooksack Early	North/Middle Fork Nooksack River (1) South Fork Nooksack River (1)
Skagit Summer / Fall	Upper Skagit River Summer (1) Lower Sauk River Summer (1) Lower Skagit River Fall (1)
Skagit Spring	Upper Sauk River (1) Suiattle River (1) Upper Cascade River (1)
Stillaguamish Summer / Fall	Stillaguamish Summer (1) Stillaguamish Fall (1)
Snohomish	Skykomish River Summer (1) Snoqualmie River Fall (1)
Lake Washington	Cedar River Fall (1) Sammamish Fall (2)
Green	Green River Fall (1)
White	White River Spring (1)
Puyallup	Puyallup River Fall (2)
Nisqually	Nisqually River Fall (2)
Skokomish	North and South Fork Skokomish River Fall (2)
Mid-Hood Canal [1]	Hamma Hamma River Fall (2), Duckabush River Fall (2), and Dosewallips River Fall (2)
Dungeness	Dungeness River Spring/Summer(1)
Elwha	Elwha River Summer (1)
Western Strait of Juan de Fuca	Hoko River Fall (1)

Chinook Historical Runsize – Puget Sound



Wild Chinook ⬇~28% since 10yr avg. prior to listing under ESA in 1999

Skagit Chinook

- 2 Management Units (MU's)

Spring Chinook

- Populations: Upper Sauk R., Suiattle R., Upper Cascade R.
- Life History – yearling and sub-yearling

Summer/Fall Chinook

- Populations: Lower Sauk (Summer), Upper Skagit (summer), Lower Skagit (fall)
- Life History: majority sub-yearling

Large proportion of Chinook salmon rely on estuarine habitat to rear. The Chinook fry that migrate directly to Skagit Bay without utilizing the estuary is likely a response to habitat limitation in freshwater and the estuary (Zimmerman et al. 2015)

Skagit Chinook – Management Objectives

Management Unit	Low Abundance Threshold (LAT)	Exploitation Rate Ceiling (ERC)
Skagit Spring	823	37.5%
Skagit Summer/Fall	9,100	48%

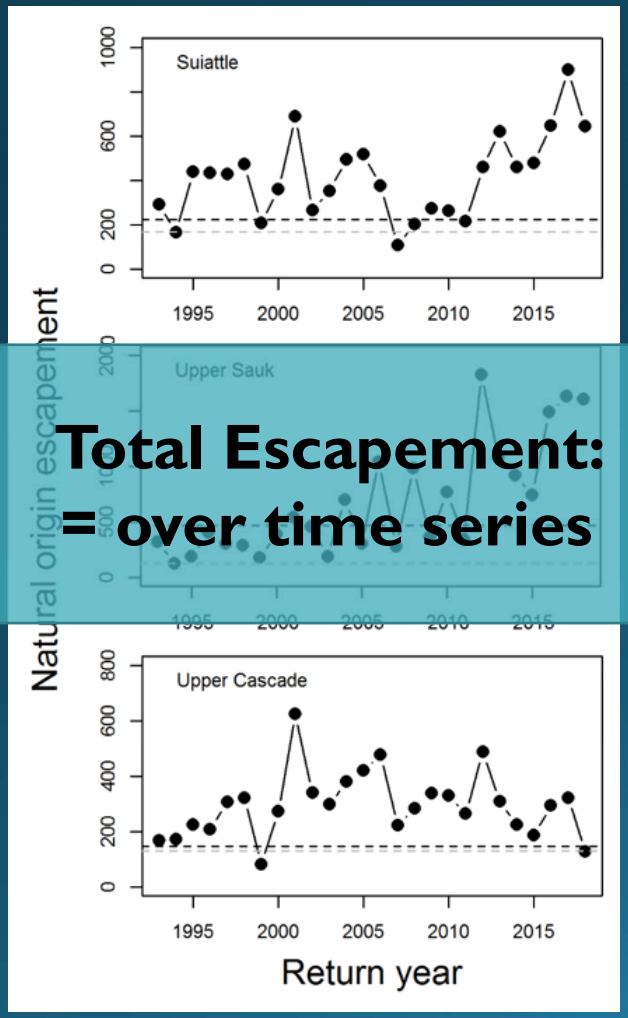
- Low Abundance Threshold (LAT) – triggers additional conservation measures in fisheries. Methods to derive LAT vary across management units (MU's). Provide increased responsiveness in fisheries to reduce risk to population

- Exploitation Rate – Percent of total mortality (i.e., in fisheries and on spawning grounds) that occurs in fisheries, including landed and non-landed fishery mortality components
  - Exploitation Rate ceiling – maximum allowable exploitation rate for management unit

Skagit Summer/Fall Example:
Preseason forecast: 13,825
> LAT (9100): up to 48% total allowable ER

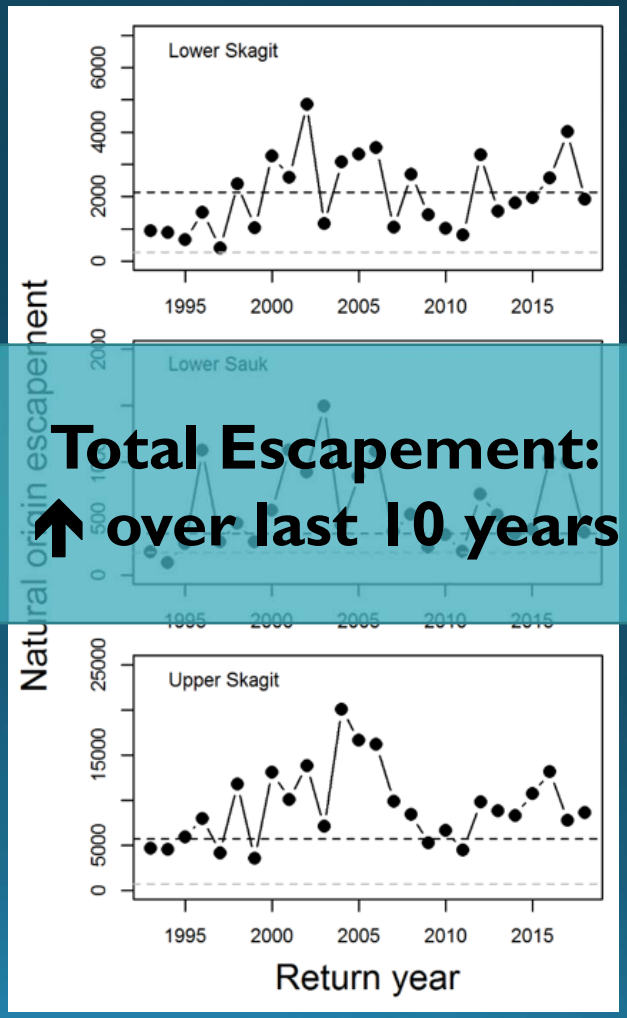
Skagit Chinook Escapement Trends

Spring Chinook



Total Escapement:
= over time series

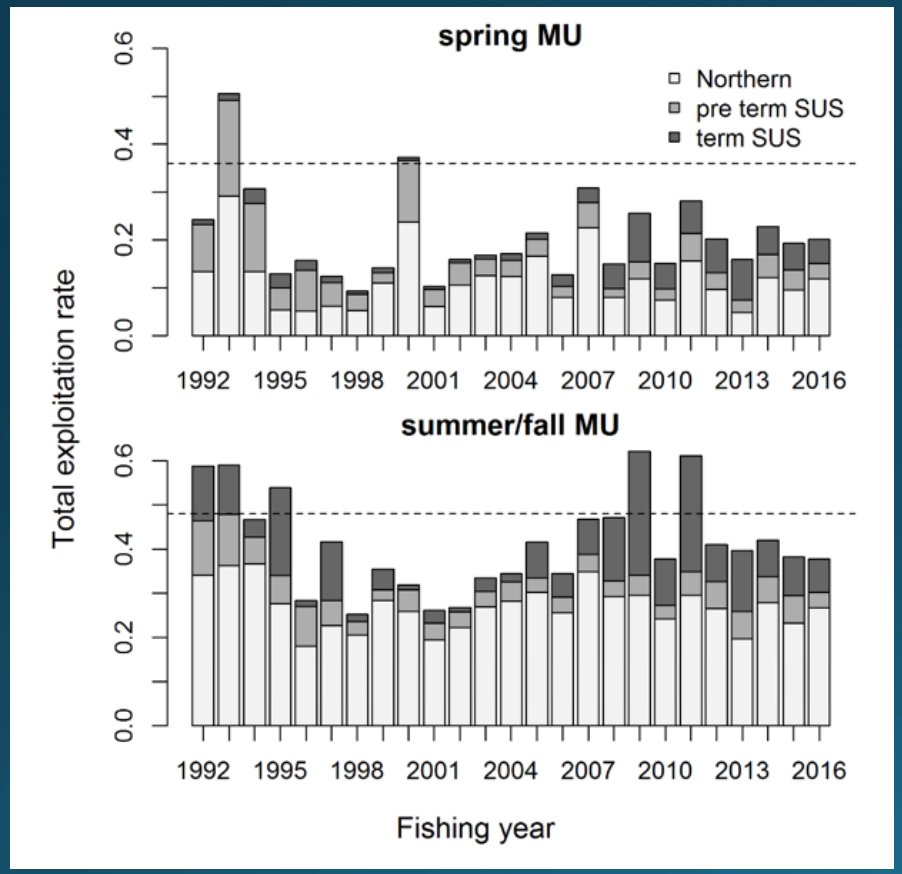
Summer/Fall Chinook



Total Escapement:
↑ over last 10 years

Skagit Chinook Exploitation Rates (ER)

Dashed lines – Exploitation Rate Ceiling



Spring ER

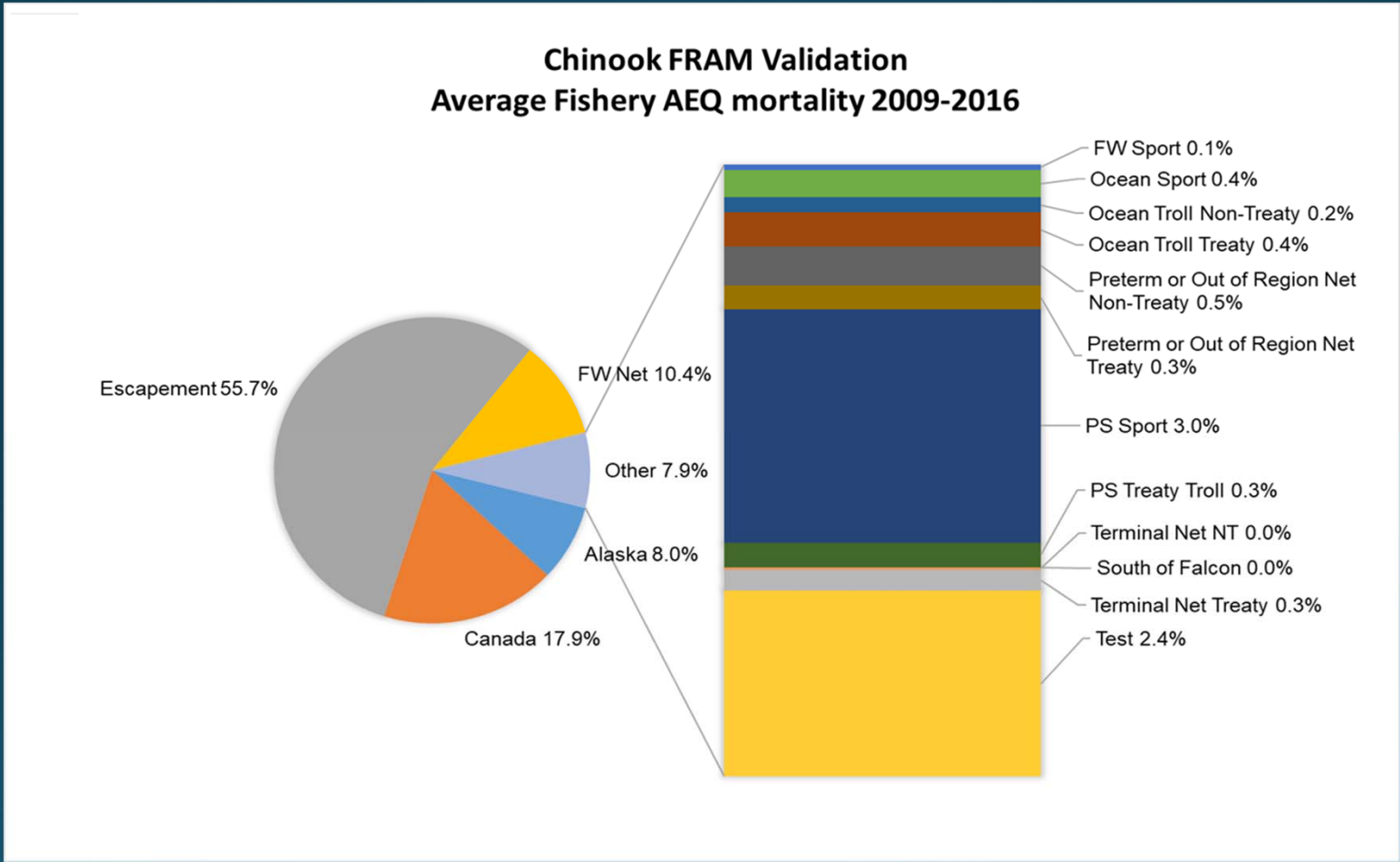
- Northern (Alaska/Canada) and Southern US (WA/OR) ER's similar (2007-16)
- On avg. 21% of return impacted by fisheries (ERC 37.5%

Summer/Fall ER

- Northern fisheries avg. 27%, SUS 18%
- On avg. 45% of return impacted by fisheries

Fisheries management successful in achieving conservation objectives

Skagit ER's Cont. – Who's catching what?



AEQ – adult equivalents – juvenile fish are also impacted by fisheries but not all of these fish would have returned to spawn – apply natural mortality rates

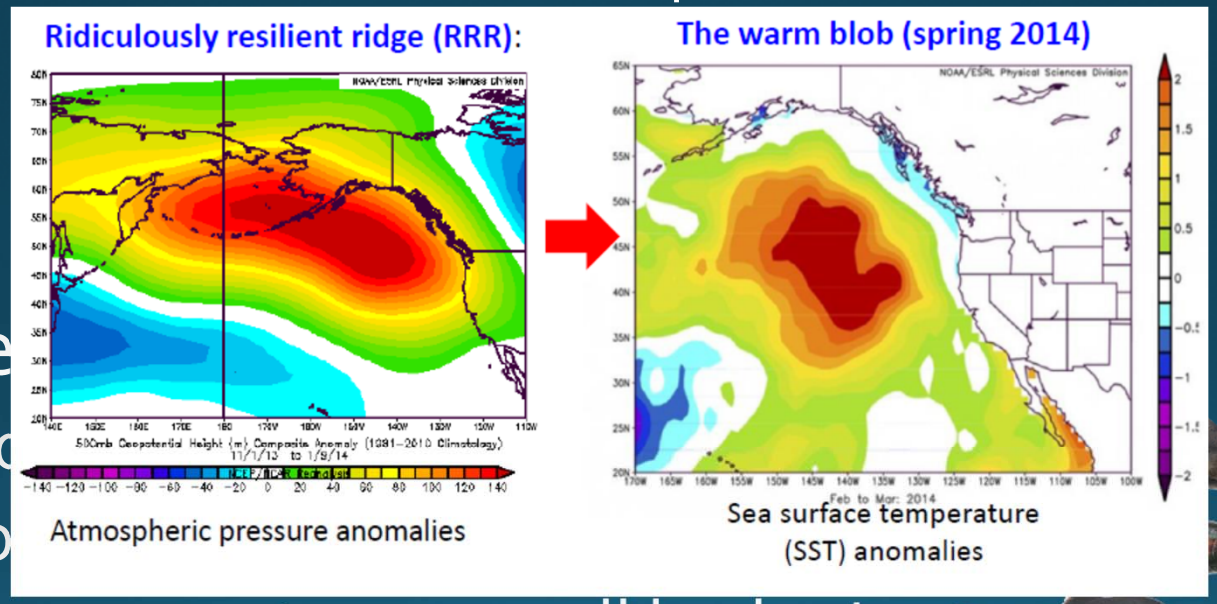
Outline

- Salmon Harvest Management
  - Mgmt Framework
  - NOF
- Data Collection
- Skagit Chinook
- **Climate Change Impacts**
- Summary

Climate Change and Salmon – 2014/15 Blob the future?

Majority of heat from climate change has gone into the ocean

Warm blob –what to expect in the future?



2015 Re

- Chino
- Coho
- Pink – poor returns, small body size
- Chum – average returns
- Sockeye – mixed returns

Climate Change and Salmon: Marine Impacts

- High seawater temperatures → altered copepod composition

- In warm years - Dominant copepod species are less lipid (fat) rich – indirect effect = less productive food web for salmon

- Environmental datasets used to predict marine survival in forecasts

Healthy →

Skinny →

Summary

Chinook Harvest Management

- Management of coast-wide fisheries coordinated by multiple federal and state entities and treaty tribes
- NOF - Annual pre-season harvest planning must stay under exploitation rate ceilings
- ESA – fisheries package approved by NOAA (BiOp) – fisheries not likely to jeopardize ESA-listed species

Data collection is crucial to successful fisheries management

- Fisheries monitored for harvest and harvest-associated impacts (eg release mortality in MSF)
- In-season management actions taken to ensure conservation objectives are met

- Puget Sound/Skagit Chinook
  - PS Wild Chinook down 30% since listing
  - Skagit population stable
- Salmon face a challenging future with climate change
  - Increasing ocean and river temps, altered river hydrology, etc are all expected to affect salmon negatively