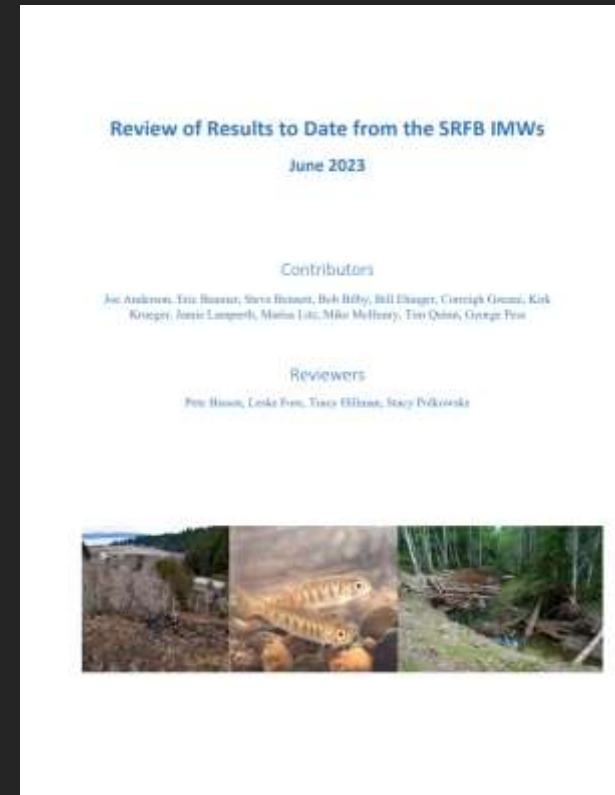
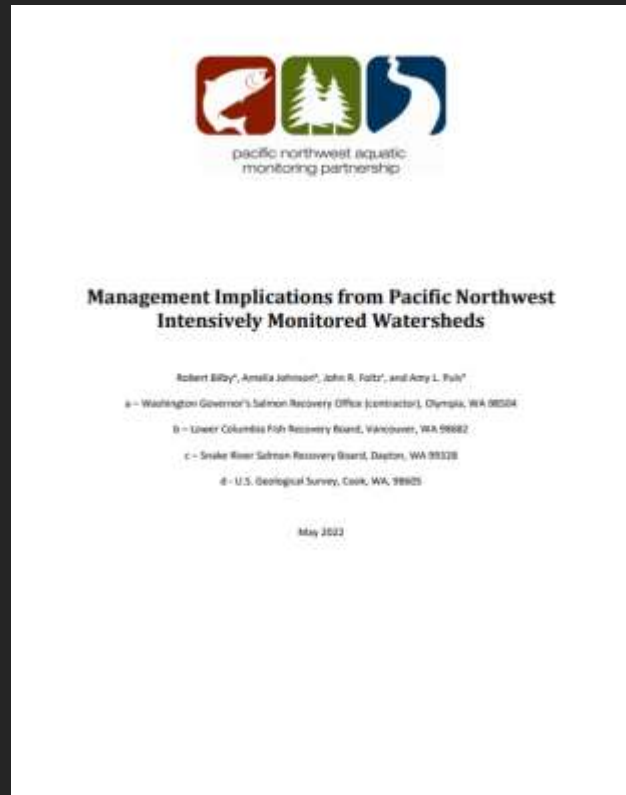


Management Applications from Intensively Monitored Watersheds

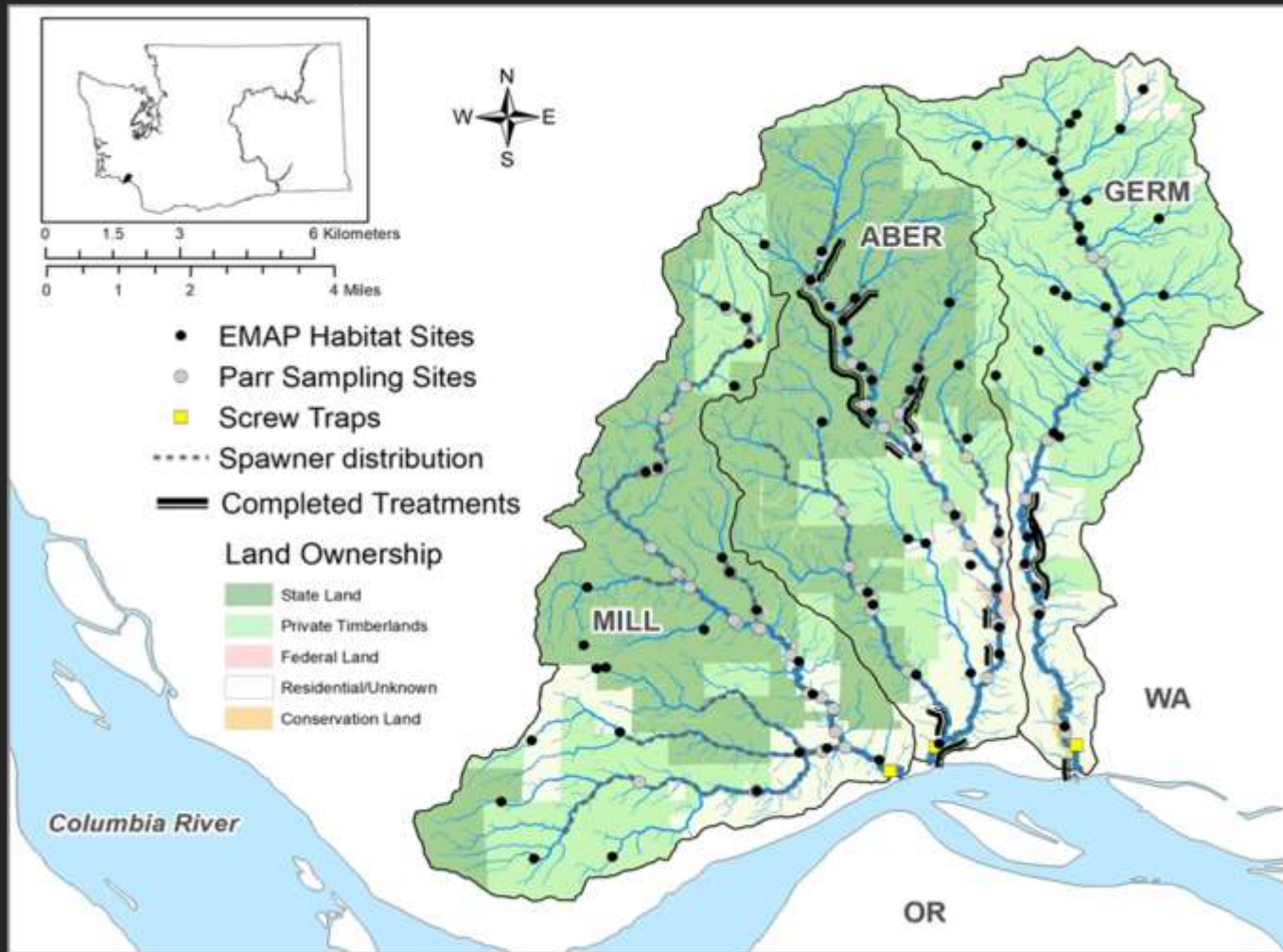
Review of recent IMW Synthesis Reports



Background - IMWs

- IMWs (Intensively Monitored Watersheds) initially established in early 2000s to develop a better understanding of the contribution habitat restoration could make to salmon recovery
 - IMW concept - concentrate restoration treatments and monitoring resources at a site to maximize the ability to detect and quantify fish and habitat responses
 - IMW approach still considered one of the few study designs capable of evaluating watershed-scale salmon and steelhead responses to habitat restoration
-

Illustration of IMW Design



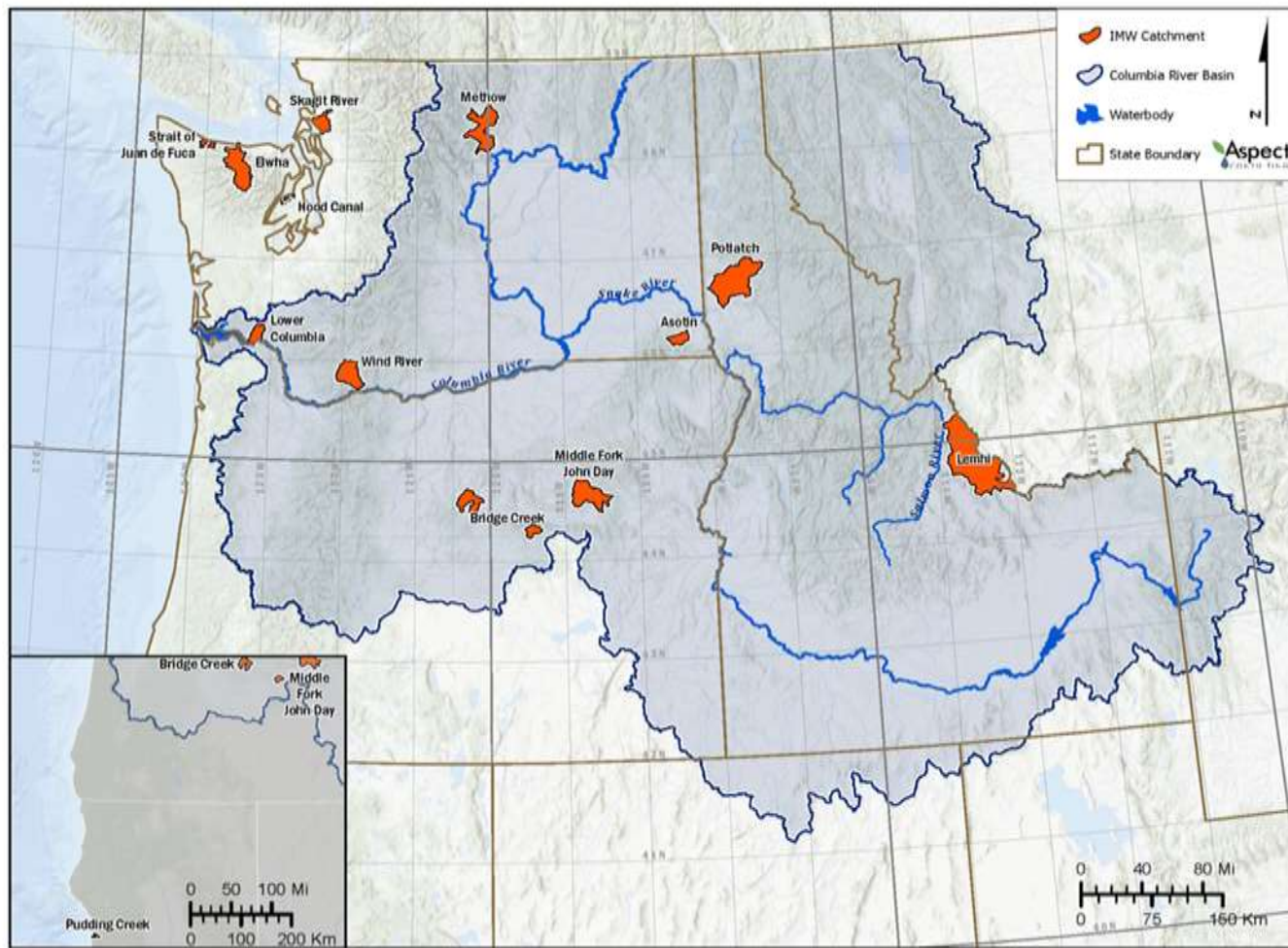
Common IMW Elements

- One reference watershed
- Ambitious restoration program
- Intensive monitoring of habitat and fish populations

IMW Reviews – 2022, 2023

- Two recent reviews of IMW results
 - 2022 – PNAMP review of 13 IMWs across the PNW
 - 2023 – Review of the IMWs supported by the SRFB
 - Purpose of both reviews identify management implications of IMW results to date.
 - Results in the IMW reviews are preliminary. Almost all the IMWs are still collecting data.
-

PNAMP IMW Review



- Survey sent to IMW PIs
- Information on restoration actions, habitat and fish responses, and results to date
- 13 IMWs responded
- Responses used as the basis for a series of workshops in late 2021
- Generated a series of key findings and management recommendations – published in 2022

Treatment Types and Species Monitored

Treatments	# of IMWs
LW or ELJ for instream complexity	11
LW or ELJ for lateral connectivity	11
Riparian restoration or protection	9
Longitudinal reconnection (e.g. dam removal, culvert replacement)	8
Beaver dam analogs	7
Lateral reconnection (e.g. removal of dikes, levees)	6
Road abandonment	6
Flow augmentation	3
Boulders	3
Fish protection screens	1
Nutrient addition	2
Hatchery supplementation	1

Targeted Species	# of IMWs
Steelhead	12
Chinook	8
Coho	7
Cutthroat	4
Bull Trout	3
Pacific Lamprey	2

PNAMP-Review-Habitat Responses

Habitat Response	Increased	Decreased	No Change
Riparian quality or quantity	4 (80%)	0 (0%)	1 (20%)
Channel quality or quantity	8 (89%)	0 (0%)	1 (11%)
Lateral connectivity	7 (100%)	0 (0%)	0 (0%)
Longitudinal connectivity	7 (100%)	0 (0%)	0 (0%)
Instream habitat complexity	6 (67%)	0 (0%)	3 (33%)
Sediment quality	4 (57%)	2 (29%)	1 (14%)
Sinuosity	4 (80%)	0 (0%)	1 (20%)
Stream width:depth	6 (100%)	0 (0%)	0 (0%)
Temperature improvements	2 (25%)	0 (0%)	6 (75%)
Flow improvements	2 (33%)	0 (0%)	4 (67%)
Water quality improvements	1 (25%)	0 (0%)	3 (75%)
Composite Habitat Response	68%	3%	29%

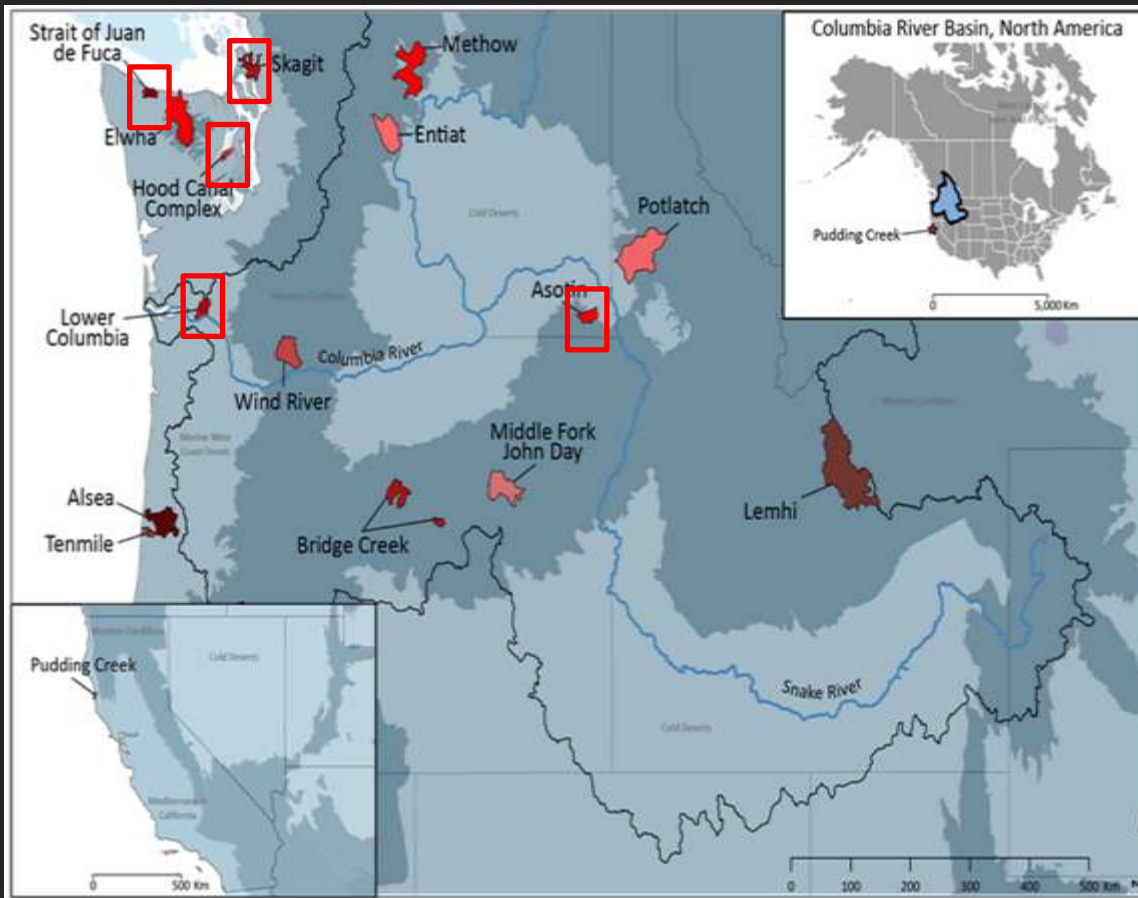
PNAMP Review- Fish Responses

Fish Response	Increased	Decreased	No Change
Adult returns	2 (22%)	1 (11%)	6 (67%)
Adult marine survival	0 (0%)	0 (0%)	3 (100%)
Redd numbers	2 (29%)	0 (0%)	5 (71%)
Juvenile density or abundance	6 (55%)	1 (9%)	4 (36%)
Juvenile survival	7 (64%)	0 (0%)	4 (36%)
Juvenile growth	2 (25%)	0 (0%)	6 (75%)
Smolt production	9 (75%)	0 (0%)	3 (25%)
Juvenile residence time	2 (40%)	0 (0%)	3 (60%)
Life history diversity*	3 (67%)	1 (33%)	0 (0%)
Composite Fish Response	46%	6%	52%

Key Findings

- Correction of barriers limiting longitudinal movement of fish (upstream-downstream) consistently produced positive responses
 - Removal of lateral barriers (enabling access to floodplain or delta habitats) generally produced positive fish responses – Beaver Dam Analogs proved to be particularly effective in improving floodplain connectivity
 - Responses to wood placement varied – some positive, some with no response
 - Fish response to habitat actions is impacted by out-of-basin factors (e.g., fishing, hatcheries, hydropower, variable ocean conditions, climate change)
-

SRFB IMWs



- IMWs established in early 2000s
- 4 freshwater IMWs
- 1 estuary IMW
- All SRFB-funded IMWs are ongoing
- Synthesis provides an interim look at what we are learning – focus on management implications
- Address uncertainties surfaced in the PNAMP IMW review

Synthesis Elements

- Review of results from each IMW
 - Use of combined data from multiple IMWs
 - Is low spawner escapement limiting fish response to habitat restoration?
 - Can we better define the attributes of wood placement projects with the greatest probability of generating a positive fish response?
 - What are key elements for successful delta habitat restoration?
 - Can we better identify the factors that are controlling fish populations?
-

Fish Response at IMWs

Asotin IMW – Steelhead

- Positive response in juvenile abundance and biomass at all sites
- Increase in smolt production at 2 of 3 sites
- No response in growth or survival

Straits IMW-Coho and Steelhead

- Increased Coho survival in 1 of 2 treated watersheds
 - Possible increase in Coho adult returns in 1 watershed
 - No response in Coho smolt production
 - No evidence of a Steelhead response
-

Fish Response at IMWs

Hood Canal IMW – Coho

- Increase in parr-smolt survival in 1 of 3 treated watersheds
- No response in smolt production or adult returns to date
- Density dependence is weak

Lower Columbia IMW-Coho, Steelhead and Chinook

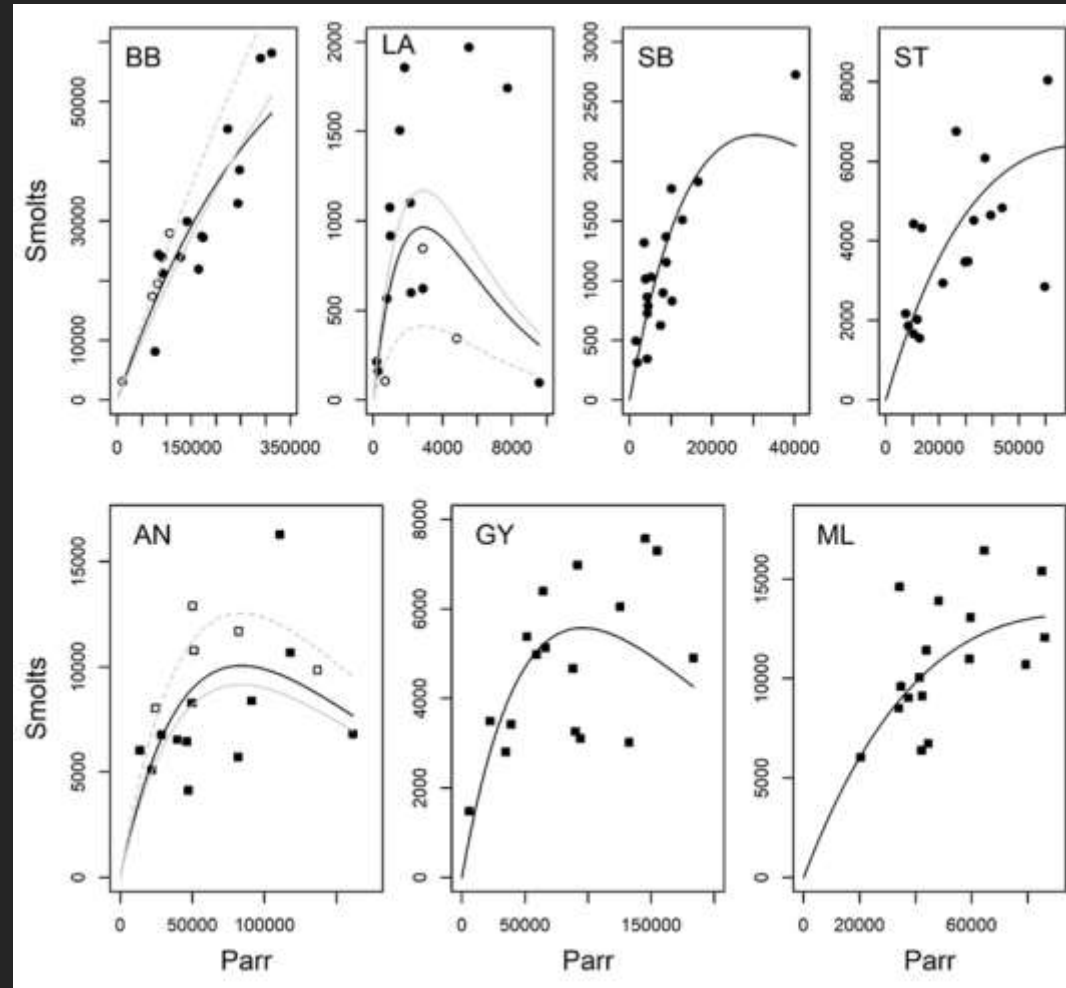
- Increased Coho survival and smolt production at 1 of 2 treated watersheds
- Possible increase in Coho adult returns in 1 of 2 treated watersheds
- No increase in Coho survival
- No apparent response in any parameter for Steelhead or Chinook
- Strong density dependence

Skagit IMW - Chinook

- Decreased fry density
 - Increase in juvenile growth rate
 - Increased time of delta residency
 - Possible increase in adult returns
-

Is Low Escapement Impacting Restoration Response?

- If no evidence of density dependence focus on actions that impact density independent mortality factors
- If density dependence is evident, focus on increasing habitat availability



Effective Wood Projects

- Successful wood treatment projects all included:
 - Concertation of wood placement
 - Repeated wood applications
 - Treated sites that trap and retain transported wood and sediment
 - Enhanced connection between channel and floodplain
- Apply wood treatments in watersheds with clear evidence of density-dependence



Abernathy Creek Project



Photos: Cowlitz Indian Tribe; Eli Asher

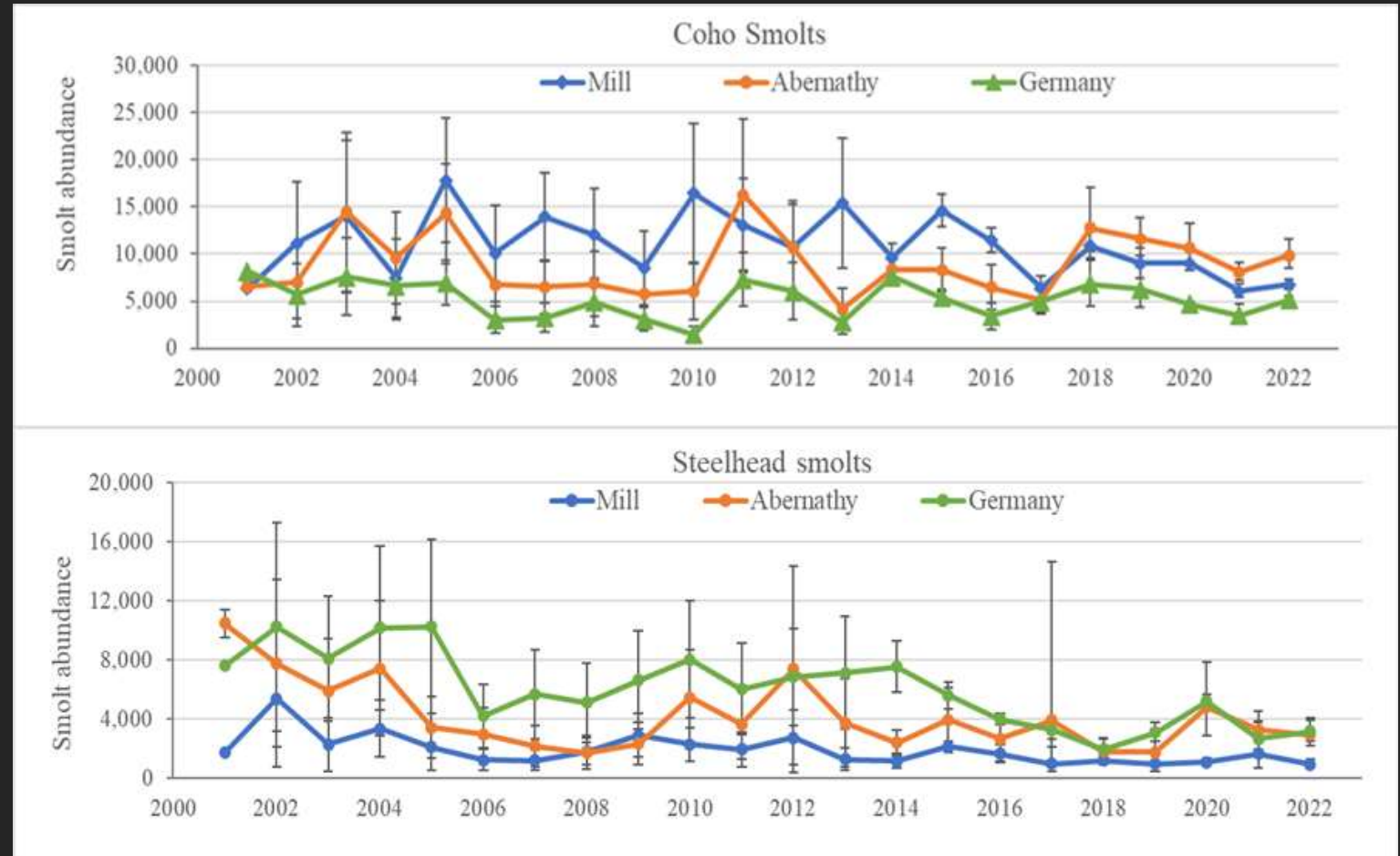


Post-Treatment Channel Response

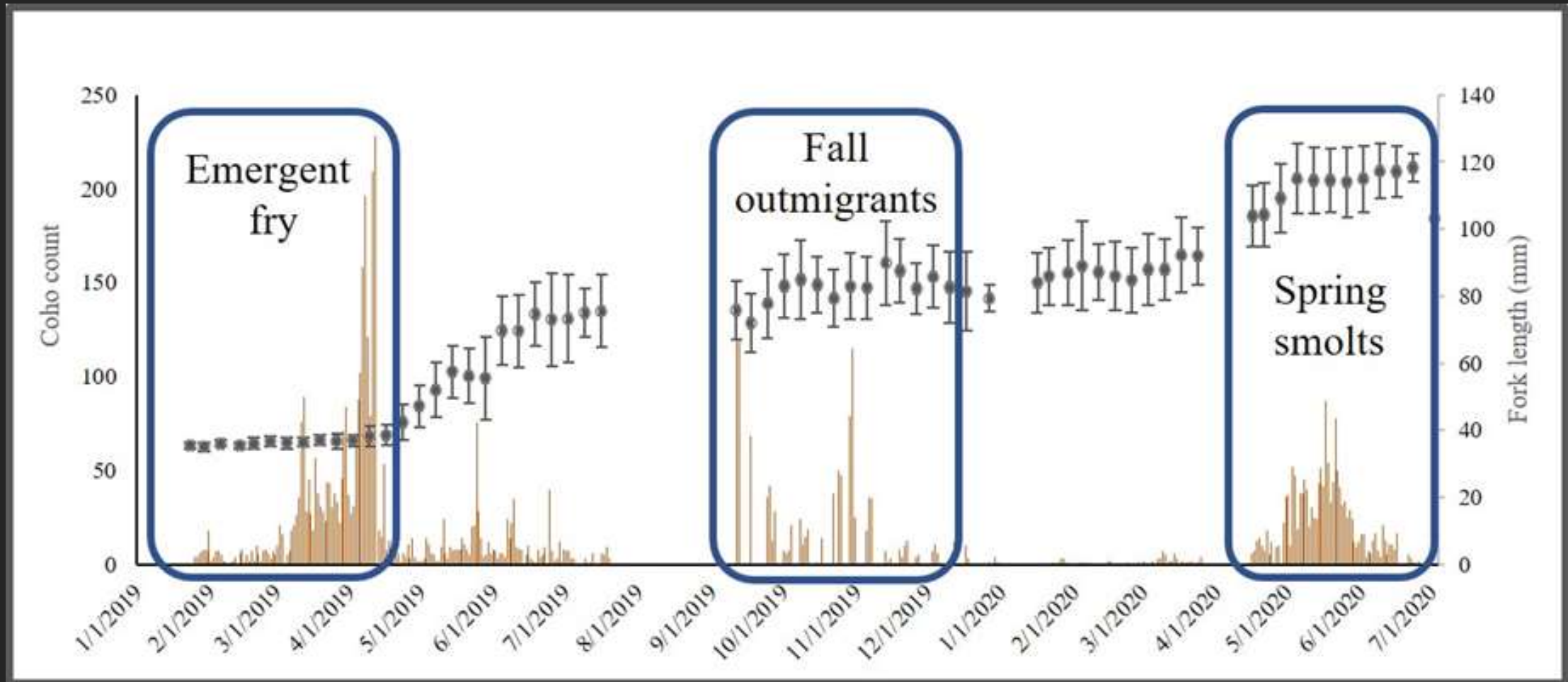


Abernathy Creek Coho Response

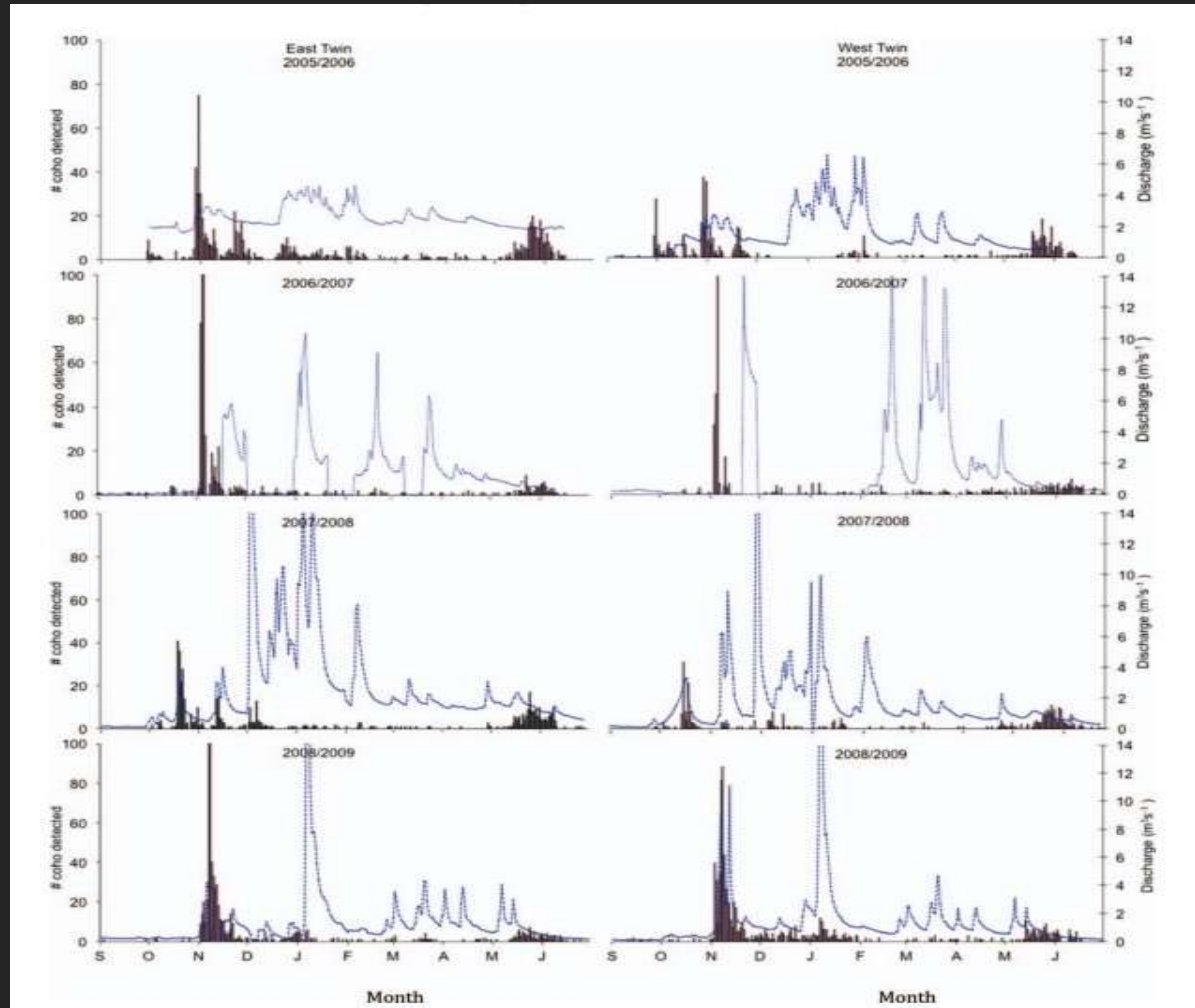
- Coho smolt production increased posttreatment
- No Steelhead response



Juvenile Coho Emigration – Abernathy Creek



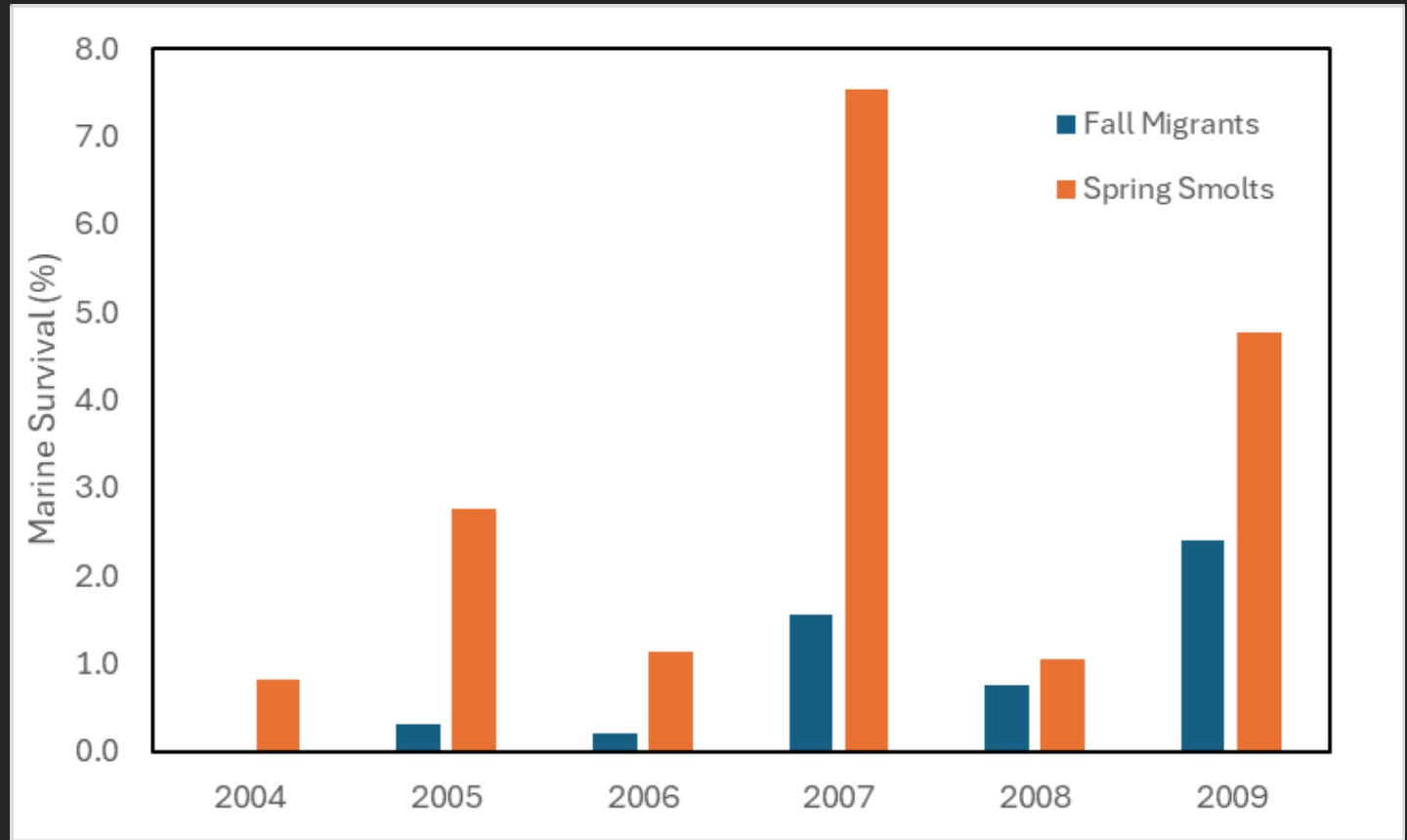
Juvenile Coho Emigration- East and West Twin R.



Roni et al. 2012

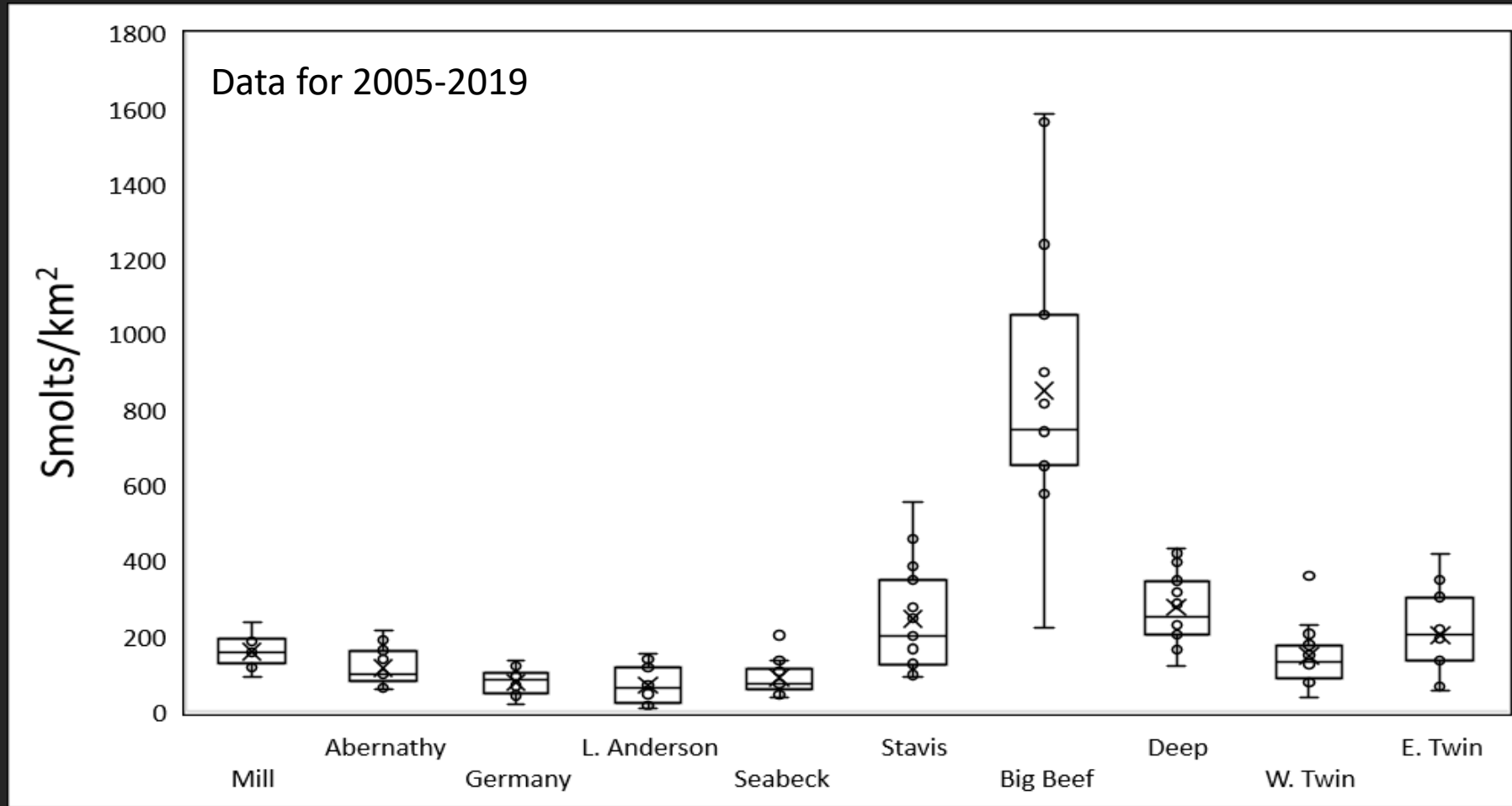
Migration Timing and Marine Survival

- Both Spring and fall migrants contribute to adult returns
- Survival of spring migrants is more than 3X higher than fall migrants



(Bennett et al. 2014)

IMW Watershed Coho Smolt Production



Key Conclusions/Questions

- Habitat restoration contributes to salmon recovery
 - Some restoration treatments are consistently effective
 - Fish response expected to be greater with strong density-dependence
 - Questions remain about the habitat factors that have the greatest influence on salmon populations:
 - What causes emigration of Coho fry and parr?
 - What causes the spatial variation in Coho production?
 - Why was there no detectable Steelhead response in the western WA IMWs?
-