Does the Fish release strategy based on Life stage matter for juvenile survival and Adult returns?

Shubha Pandit, Todd Newsome, Melinda Goudy, Mark Johnston, Charles Strom, Daylen Isaac, and Joe Blodgett

June 17, 2025
Yakima Science Conference

Background and Goals

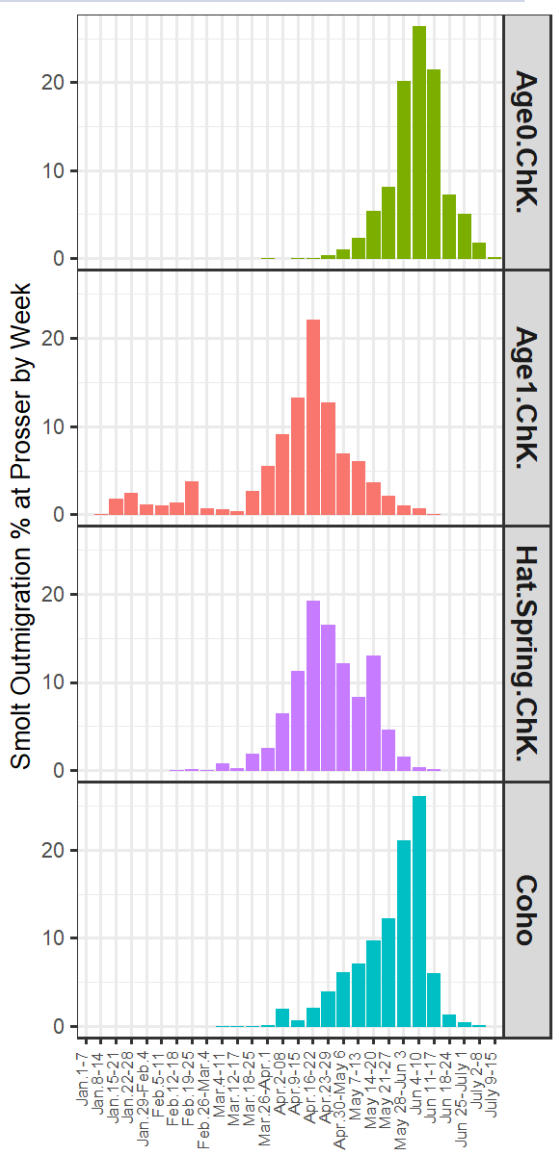
- Reintroduction program has used multiple release strategies
- Guided by long-term monitoring and adaptive management
  - Continued use of PIT tags and detection arrays
  - Performance monitored: survival, travel time, adult returns etc.
  - Findings have been used to refine future strategies
- Goals:
  - Improve Juvenile survival
  - Enhance adult returns
  - Adapt to changing habitat and environmental conditions

Progress on Releasing strategies

- Initially smolt releases in Yakima river mainstem
- Diverse release location across basin to understand how different habitat and hydrology influence survival and adult returns
- Mobile and permanent acclimation sites
- Multiple Broodstocks used (Yakima, Eagle Creek, Washougal etc.)
- Early vs. late season
- Photoperiod experiment on reducing the proportion of minijacks
- Effect of feed deprivation on in-hatchery survival, juvenile growth rate, size at release, SAR rates and age composition
- Life stage (Parr vs Smolts or sub-yearling vs yearling)

Life stages

Species	Outmigration
Spring Chinook • Parr (Nov. and Dec.)- • Smolts (February –May)	
Summer Chinook • Sub-yearling (April and May) • Yearling (April and May)	
Coho • Parr (June & July) • Smolts (March -May)	



In general, Coho parr overwinter in tributaries prior to emigration as smolts the following spring; smolt releases were more immediate emigrants (within a few weeks after being PIT-tagged).

Life stages (Pros and Cons)

A. Subyearling or Parr (Coho)

Pros	Cons
• **Lower rearing cost:** No need to overwinter in hatcheries, saving on feed, space, and labor—allows release of more juveniles into the river.	• **Predation risk:** Underdeveloped predator avoidance and longer freshwater residence increase vulnerability.
• **Stronger imprinting:** Extended freshwater residence may enhance homing cues and improve adult returns.	• **Need for overwinter habitat:** Sufficient habitat must be available to support juvenile survival.
• **Growth variability:** Uneven smolt development creates more diverse out-migration timing.	• **Potential competition:** Higher densities in natural habitats may lead to density-dependent effects.
• **Behavioral adaptation:** Early exposure to natural conditions may improve foraging and swimming skills.	
• **Use of natural habitats:** Enables use of tributaries and side channels for rearing, promoting more fish distribution across the basin.	

Life stages (Pros and Cons)

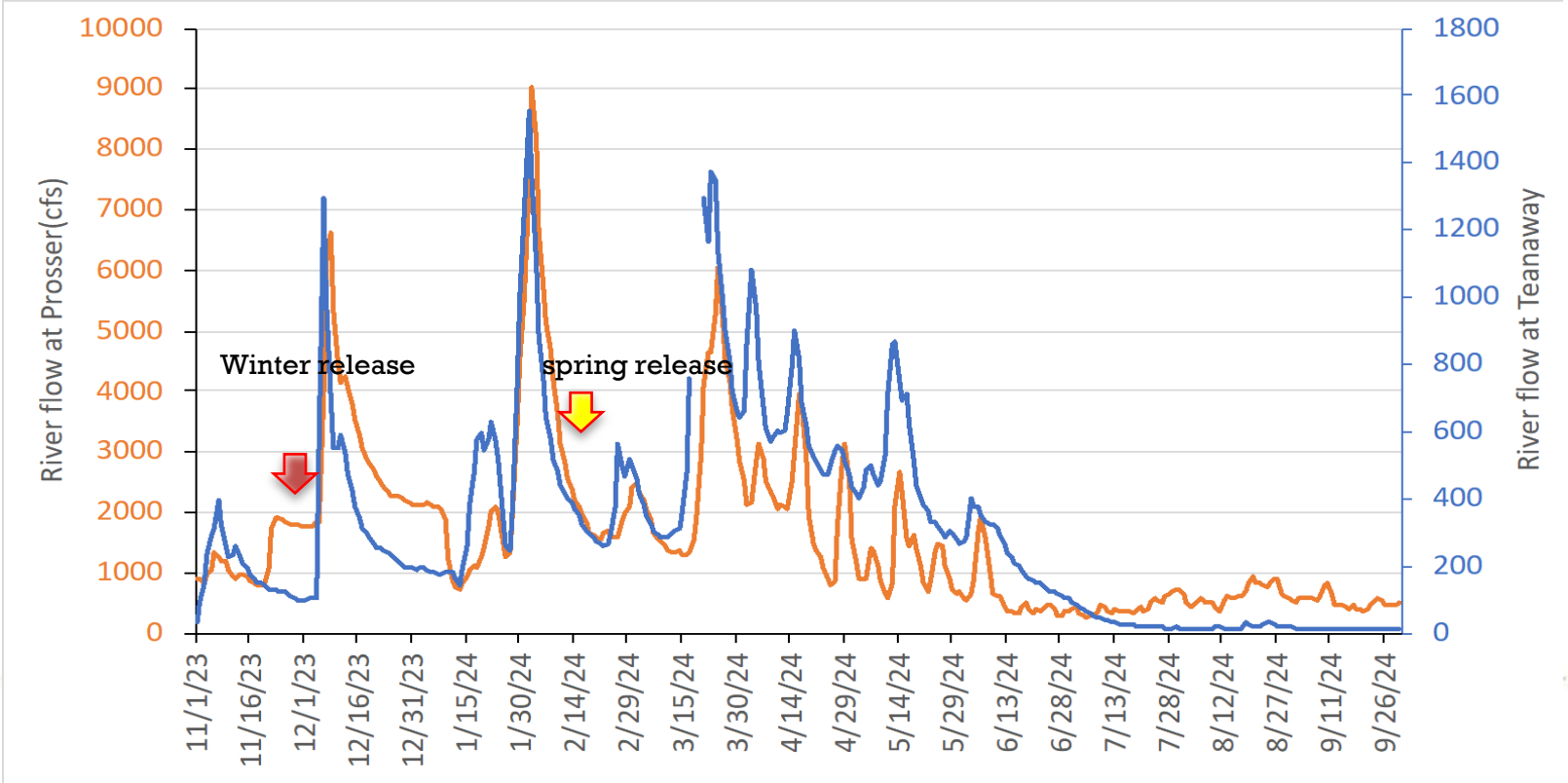
B. Yearling or Smolt

Pros	Cons
• **Synchronized** with peak river flows	• **Higher hatchery rearing costs**
• **Lower overwinter mortality** (due to hatchery rearing)	• **Fewer juveniles can be reared due to space/resource limits**
• **Higher survival rates** — less time spent in open water compared to parr.	• **Less diversity in their sizes.** Risks: out-migrate all of them in the same period. If drought or less river flow occurs, whole population can be impacted.
• More habitat remains available for wild/natural-origin juveniles	

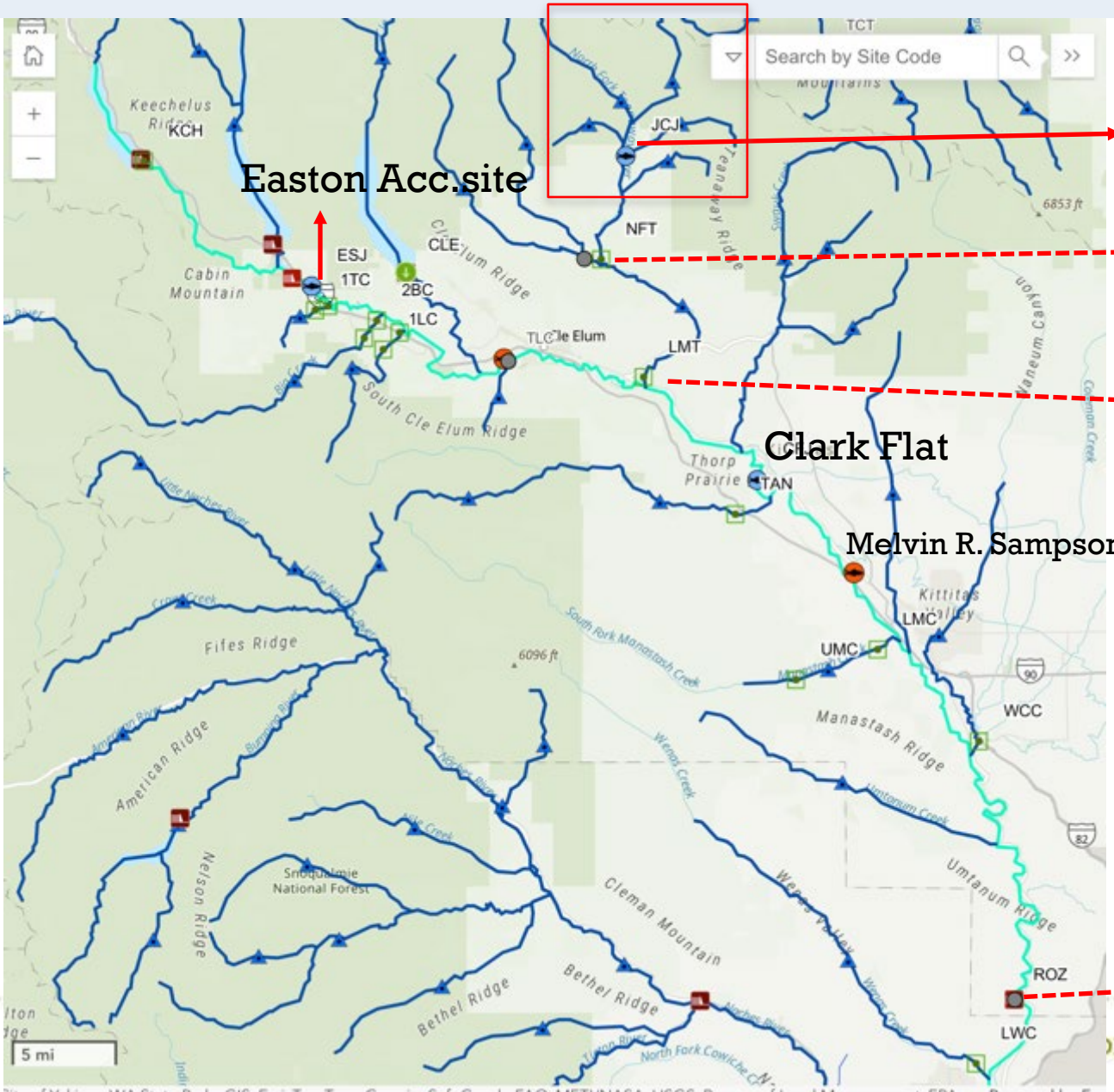
Spring Chinook (Parr and smolts)

Background

AccSite	Release.Site.Code.Value	Release.date	Freq
NFT Above Jack Cr	JACKC	2023-11-28	2000
NFT Fiesta Site	NFTEAN	2023-11-29	2000
NFT New Bridge	NFTEAN	2023-11-30	2000
NFT Yellow Bridge	NFTEAN	2023-12-07	2001
ClarkFlats	CLARFP	2024-03-14	11999
Easton	EASTOP	2024-03-14	11999
JackCreek	JACKCP	2024-03-14	7998



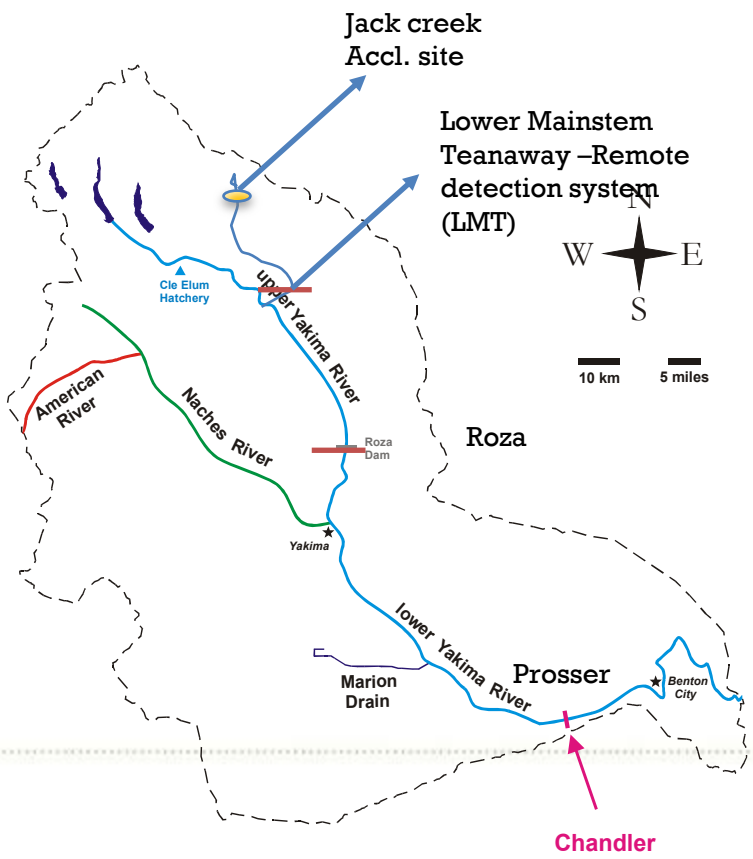
Spring Chinook (Parr and smolts)

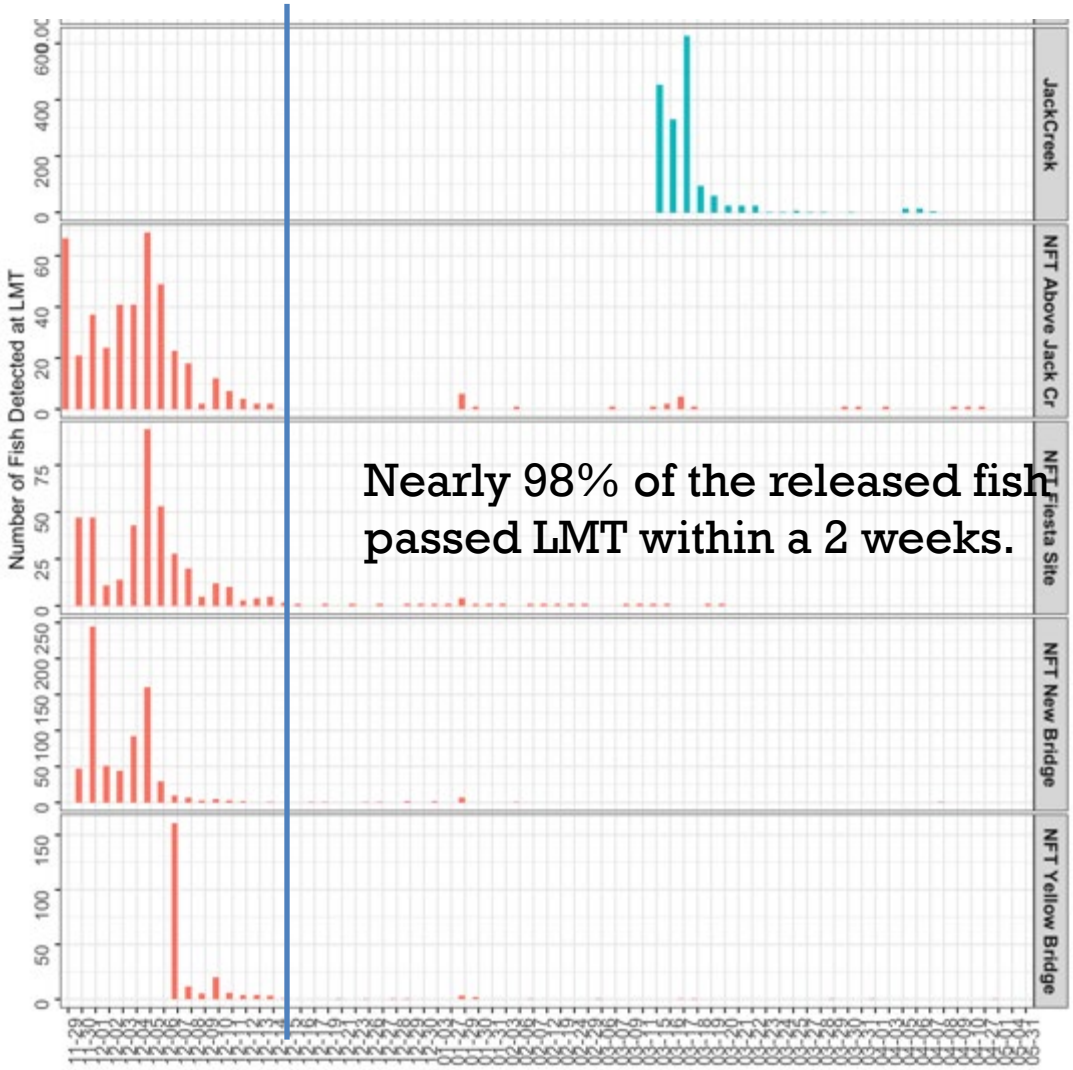


Spring Chinook (Parr and smolts)

Detection at L.mainstem Teanaway (LMT)

AccSite	Release.Site.Code.Value	Release.date	Freq
NFT Above Jack Cr	JACKC	2023-11-28	2000
NFT Fiesta Site	NFTEAN	2023-11-29	2000
NFT New Bridge	NFTEAN	2023-11-30	2000
NFT Yellow Bridge	NFTEAN	2023-12-07	2001
ClarkFlats	CLARFP	2024-03-14	11999
Easton	EASTOP	2024-03-14	11999
JackCreek	JACKCP	2024-03-14	7998

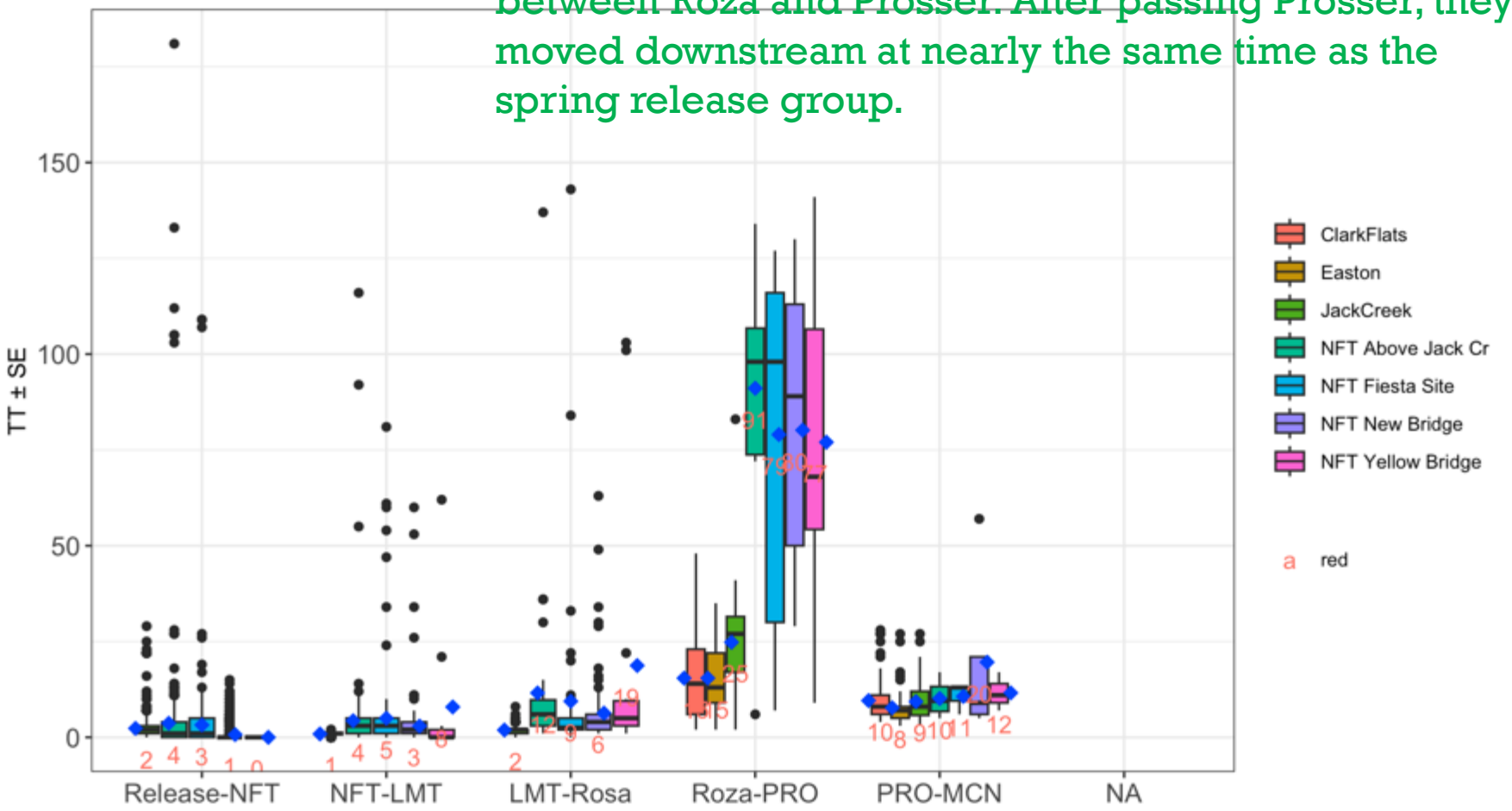




Spring Chinook (Parr and smolts)

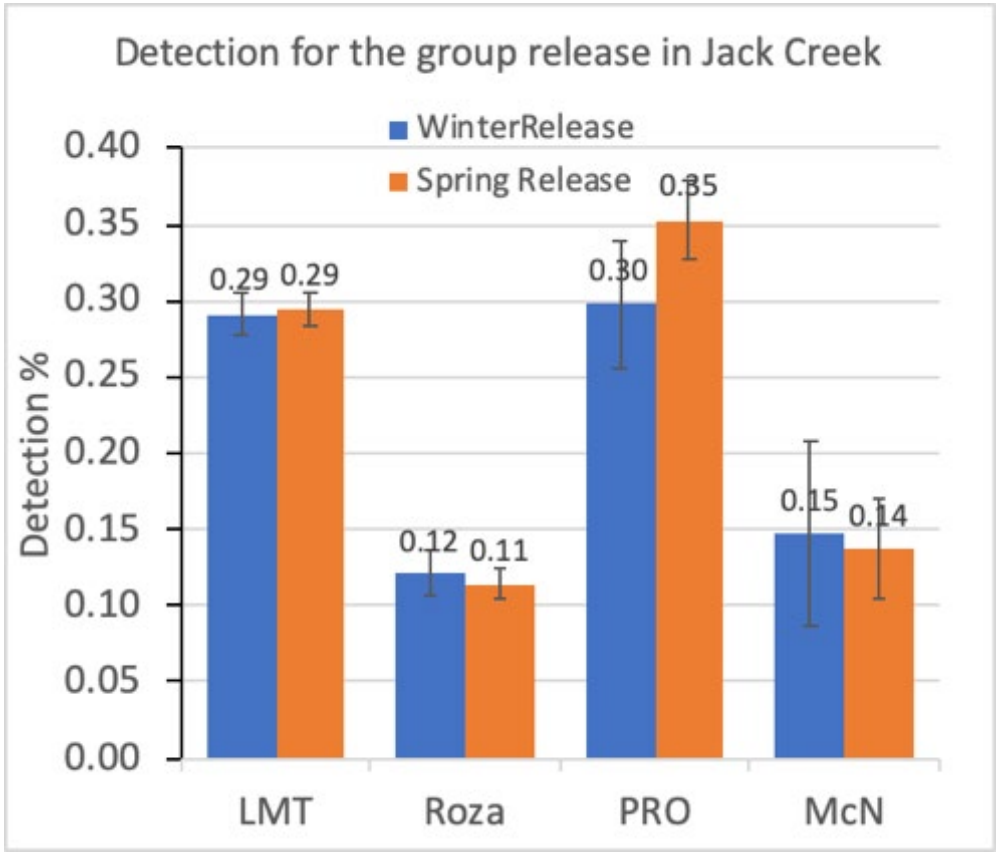
Travel time

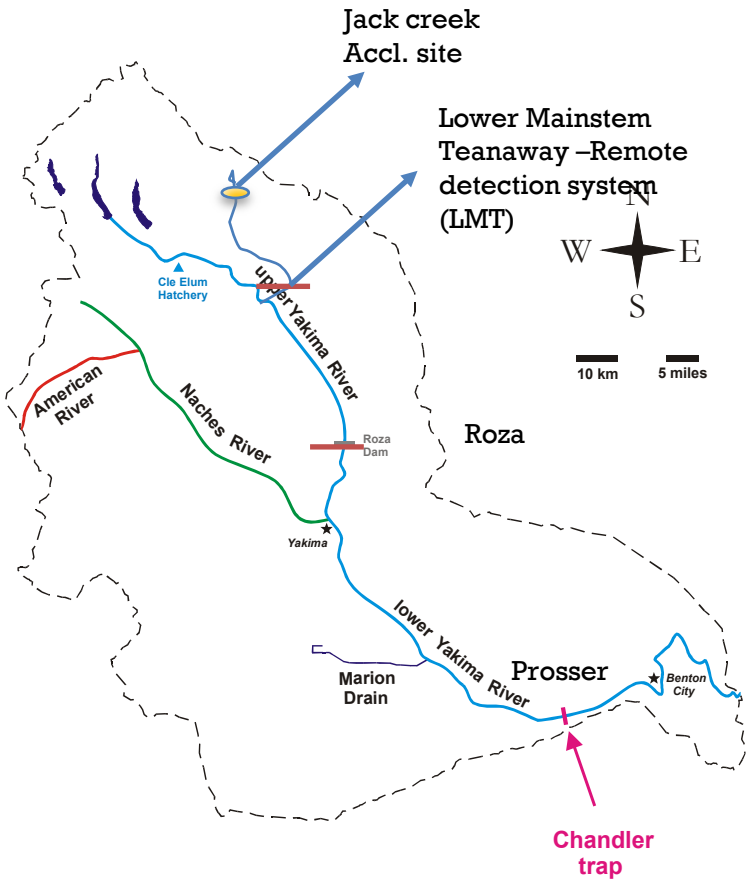
They reached downstream at Roza Dam within 2 to 3 weeks after release, but spent a couple of weeks between Roza and Prosser. After passing Prosser, they moved downstream at nearly the same time as the spring release group.



Spring Chinook (Parr and smolts)

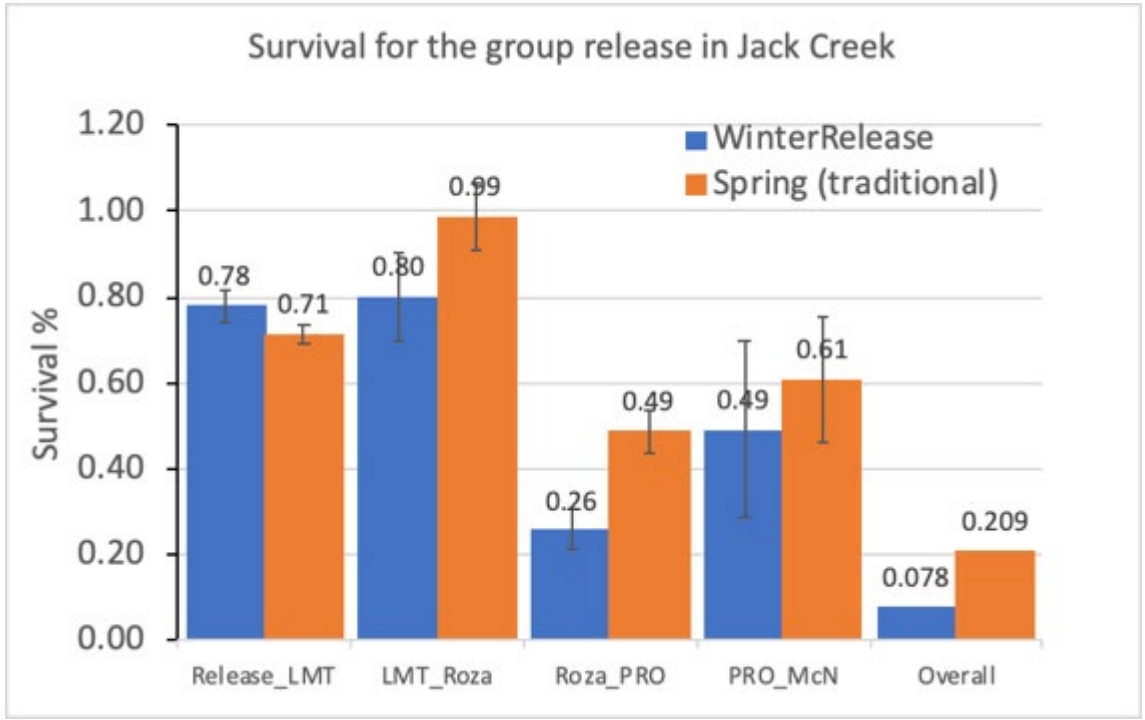
Detection Rate

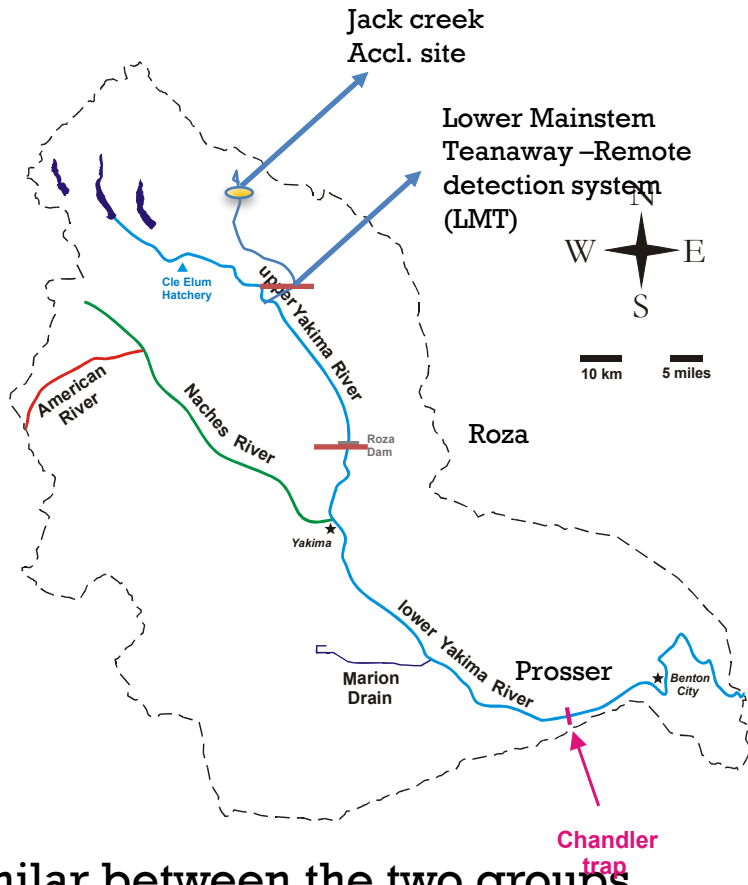




Spring Chinook (Parr and smolts)

Survival rate





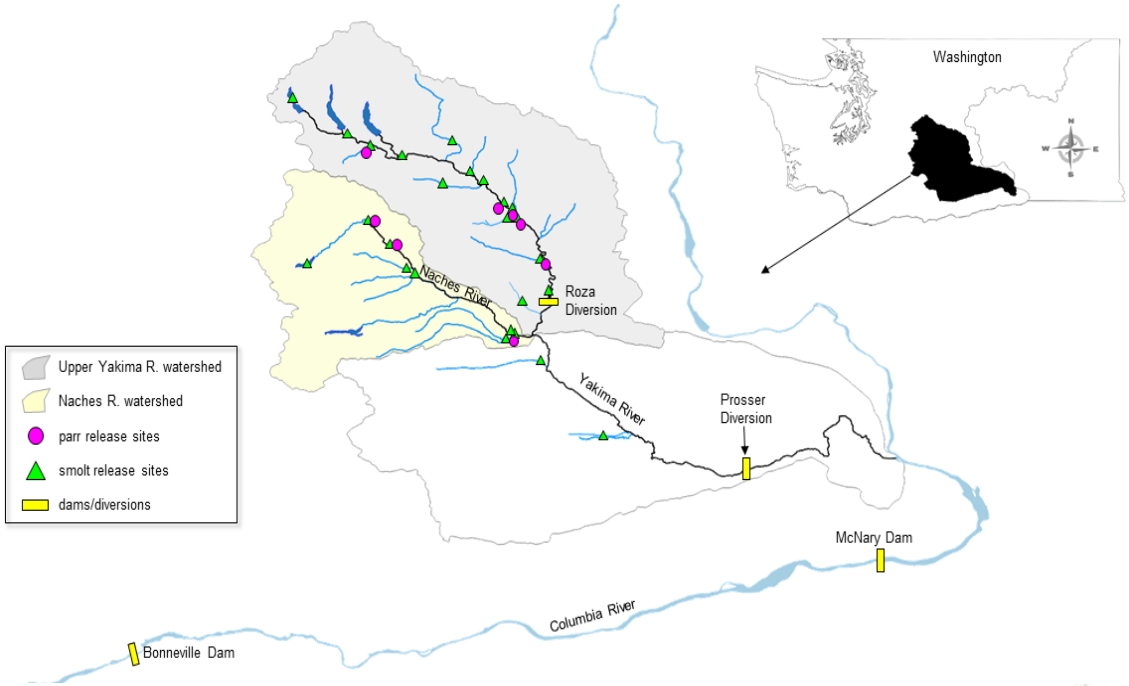
- In general, the survival rates up to Roza were similar between the two groups. However, the winter release group had nearly 50% lower survival compared to the spring release group in the section between Roza and Prosser.
- Overall, the survival rate from release to McNary was approximately 8% for the winter release and 21% for the spring release.

Coho (Parr and smolts)

Emigration and Survival of Hatchery-Reared Coho Salmon Released as Parr and Smolts in a Reintroduction Program; *River Research and Applications*, 2025.

Objectives

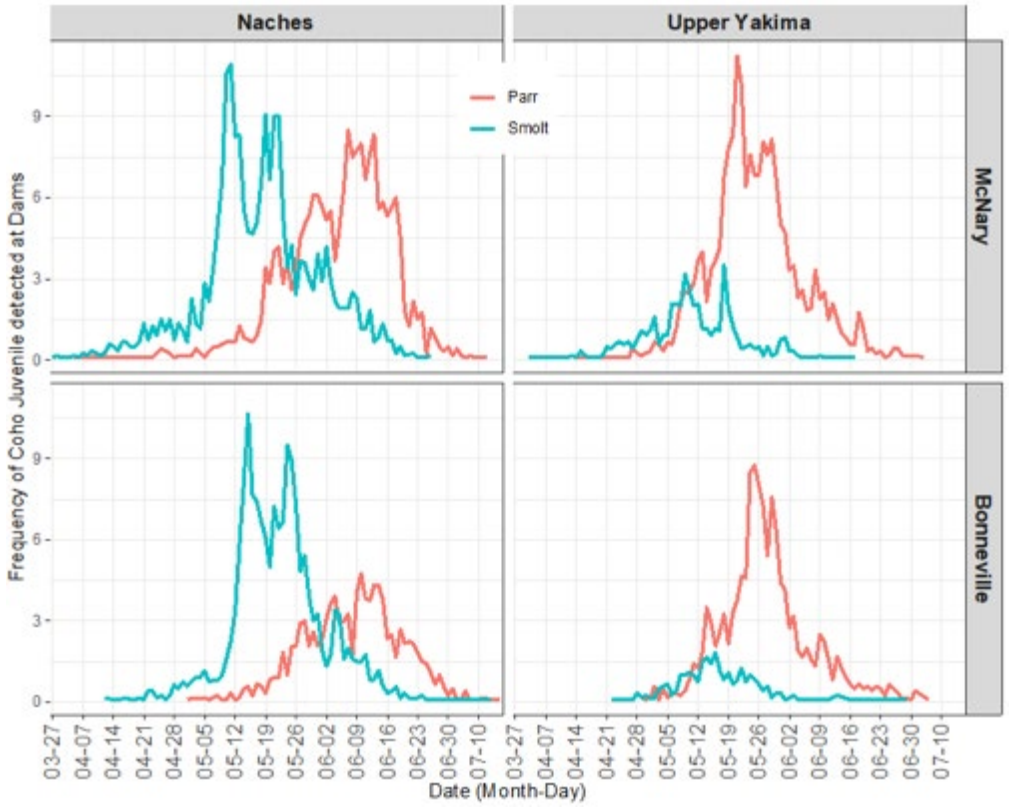
- to identify which release location and what life stage perform better, especially:
  - Are juvenile run timing, juvenile survival, adult returns, and age structure different between the groups and sub-basins (Naches and Upper Yakima)?



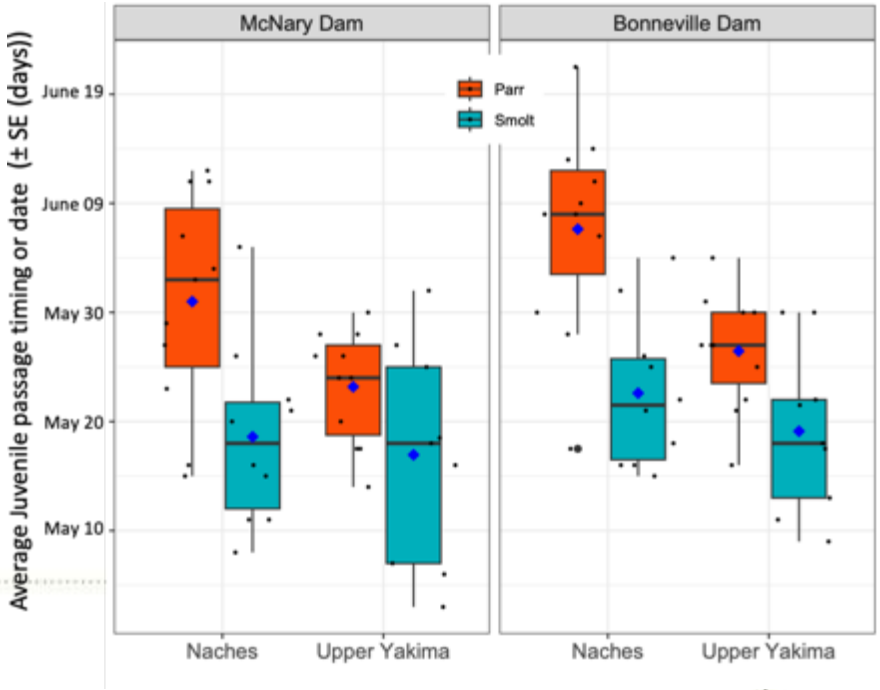
Data

Brood Year	Total Releases		Mean FL (mm)		Mean Release Date	
	Parr	Smolt	Parr	Smolt	Parr	Smolt
2006	20,507	9,983	85.0	81.7	7/27/2007	4/5/2008
2007	26,986	8,352	91.0	114.5	7/30/2008	4/14/2009
2008	24,271	9,914	98.4	146.1	8/5/2009	4/8/2010
2009	24,225	7,566	84.9	118.1	8/1/2010	4/11/2011
2010	29,654	5,059	92.0	124.1	7/18/2011	4/5/2012
2011	30,156	10,013	75.2	113.2	7/6/2012	4/4/2013
2012	27,236	6,826	82.6	128.4	7/16/2013	4/10/2014
2013	27,258	8,772	72.8	115.6	6/22/2014	3/22/2015
2014	24,166	10,006	102.0	129.9	7/28/2015	4/1/2016
2016	18,235	2,501	88.8		8/1/2017	3/8/2018
2017	36,821	1,273	76.3		7/20/2018	4/9/2019

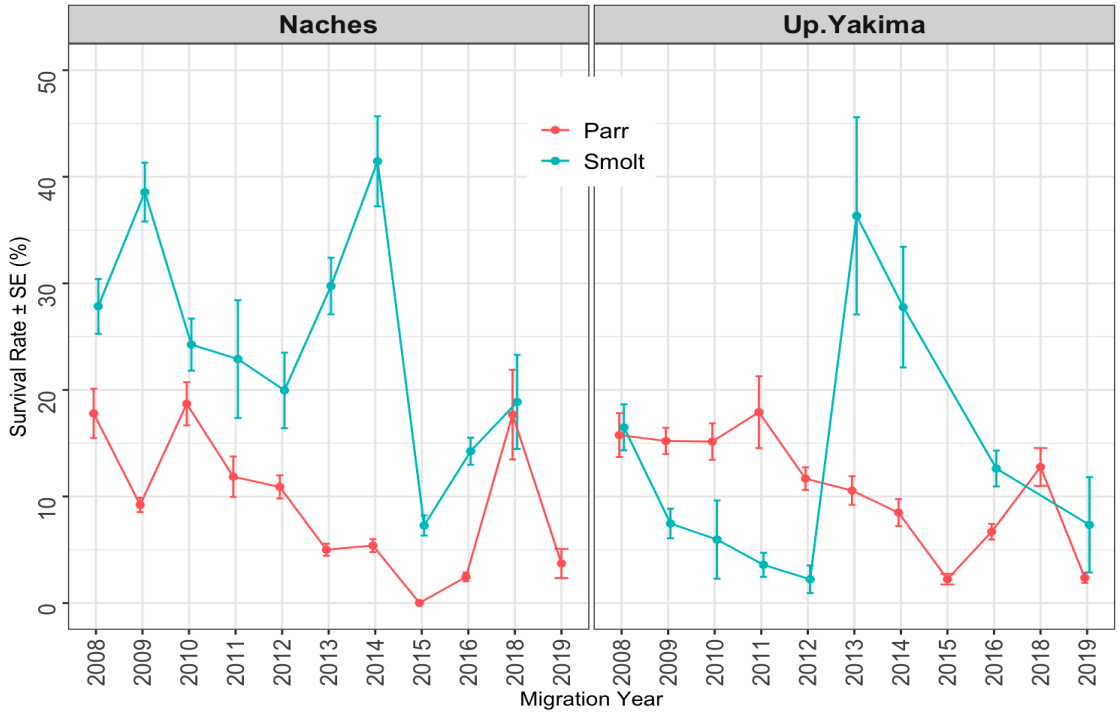
Passage timing

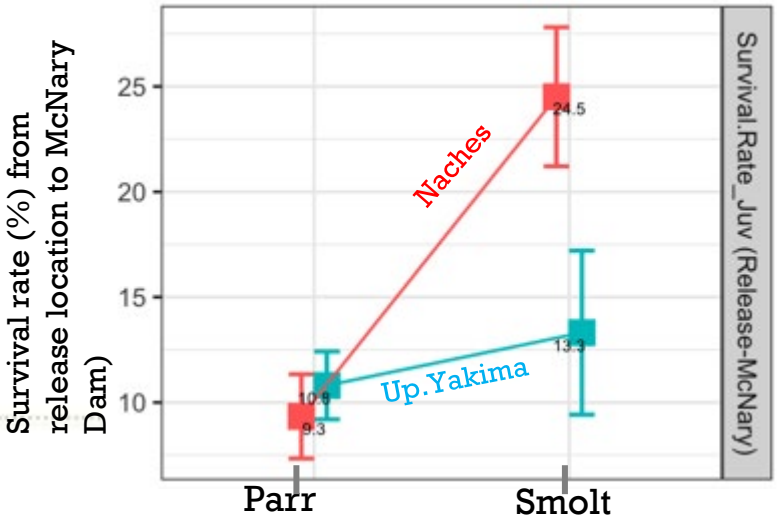


Smolts out-migrate earlier than Parr



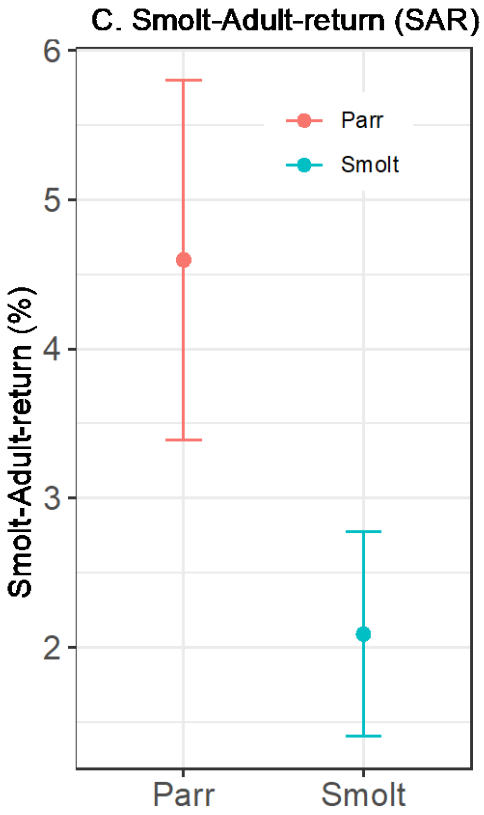
Survival rates





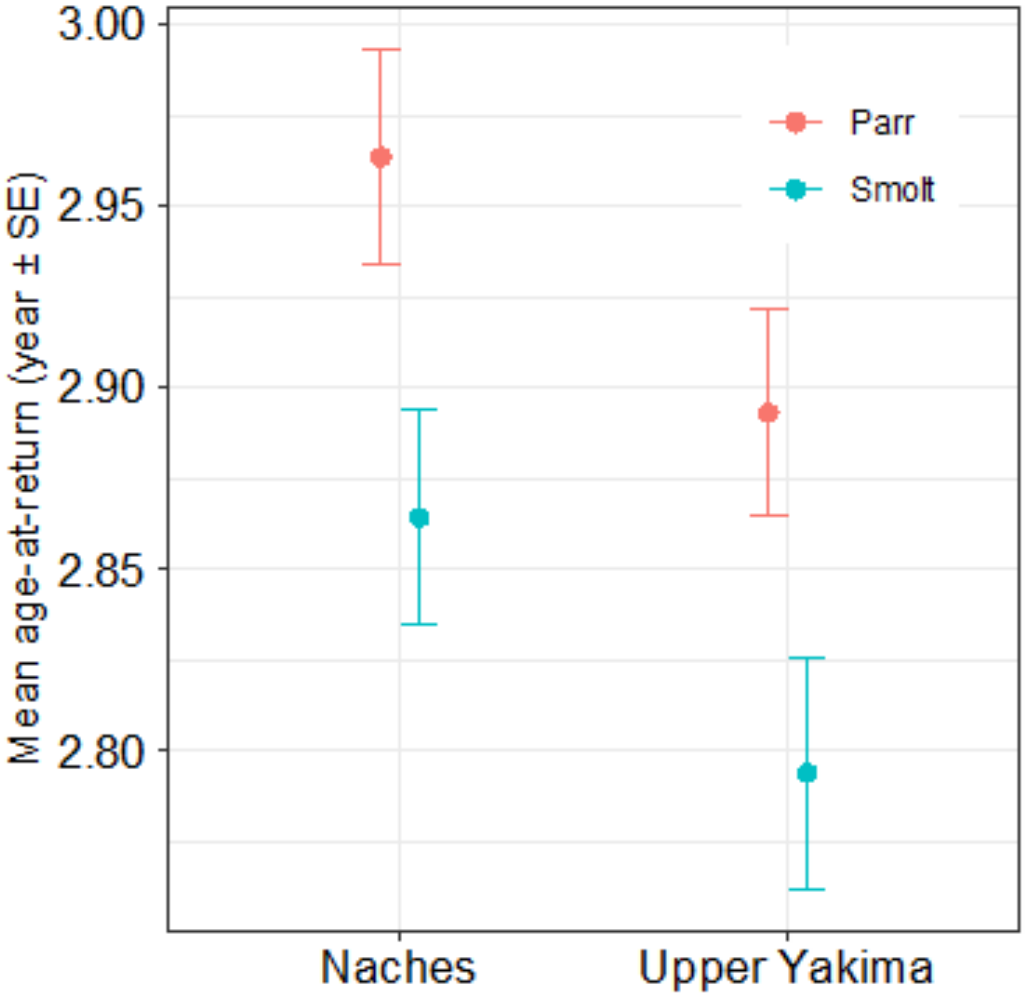
- Smolt releases performed better in the Naches watershed while parr releases had a survival advantage in the Upper Yakima River tributaries.
- The Naches is a colder river system and does not provide overwintering conditions as favorable to juvenile rearing, growth, and survival as conditions in the Upper Yakima subbasin.

Smolts-Adults-Returns (SAR)



- The Naches is a colder river system and does not provide overwintering conditions as favorable to juvenile rearing, growth, and survival as conditions in the Upper Yakima subbasin.
- Slower expected growth in the Naches system may have led to delayed smoltification and emigration for fish released as Parr and lower survival.

Age returns



In both sub-basins, smolts tend to return as adults earlier than the parr groups. However, the Parr group released in the Naches returned relatively later than the other three groups.

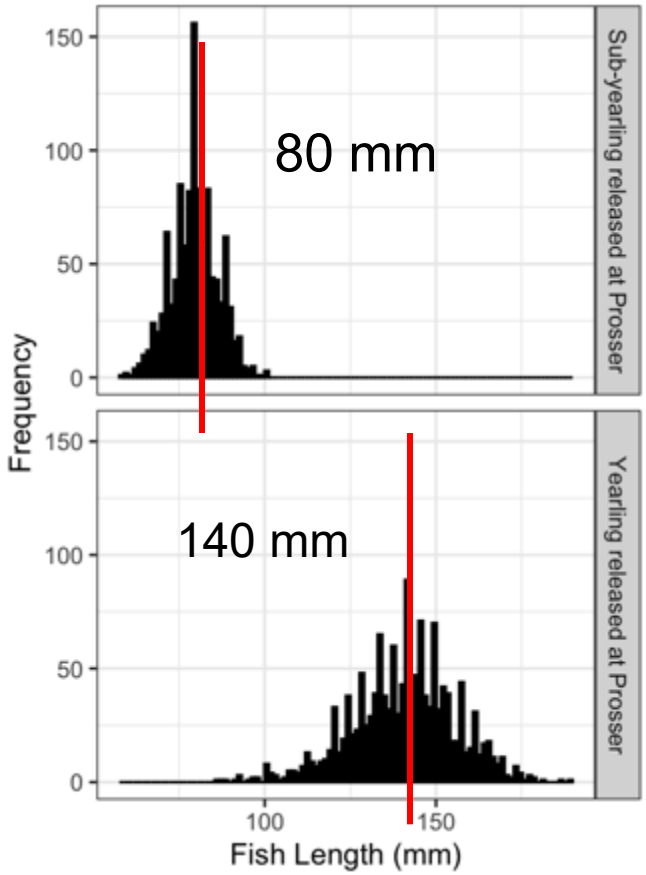
Summer Chinook (Parr and smolts)

Released number

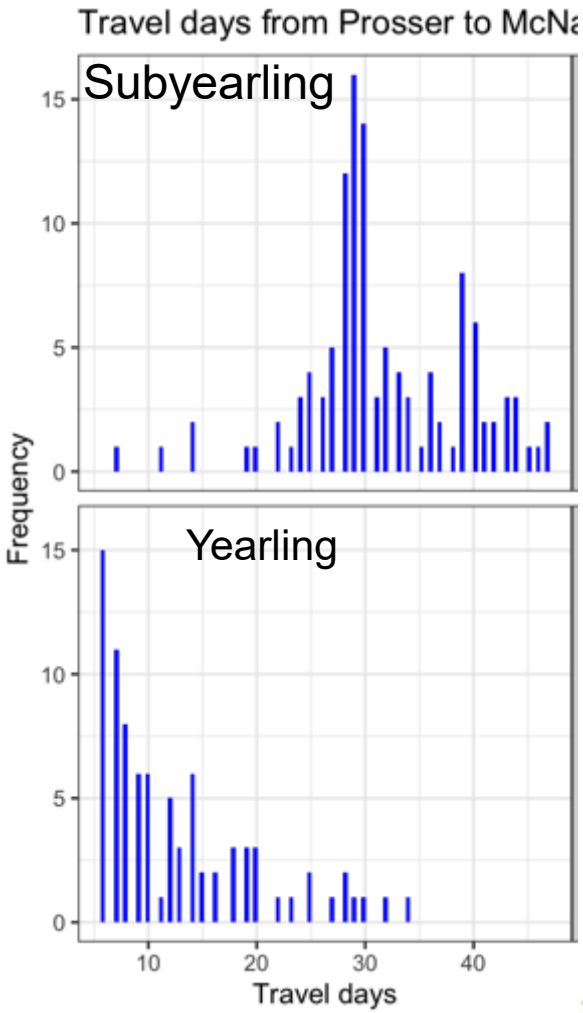
Mig.Year	Release.Date	Run	Species	Release site	Life stage	N (PIT tags)
2021	04/24/2021	Summer	Chinook	PROH	Yearling	20642
2021	05/27/2021	Summer	Chinook	PROH	Sub-yearling	14990
2023	03/24/2023	Summer	Chinook	PROH	Yearling	20498
2023	5/12/2023	Summer	Chinook	PROH	Sub-yearling	5580

Fish Length

Type	N	Median	Mean	se	min	max
Subyearling PRO	1117	80	79.61	0.20	58	100
Yearling PRO	1418	141	140.55	0.40	86	189

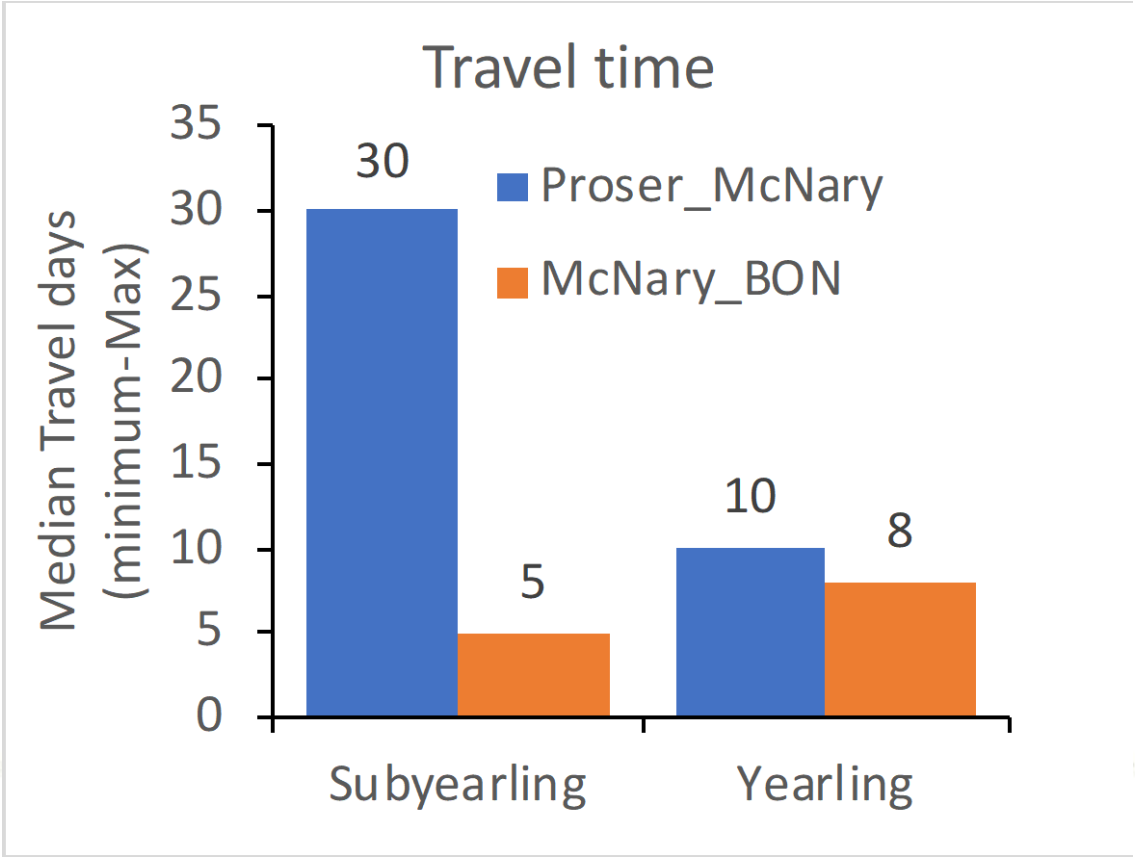


Travel Time

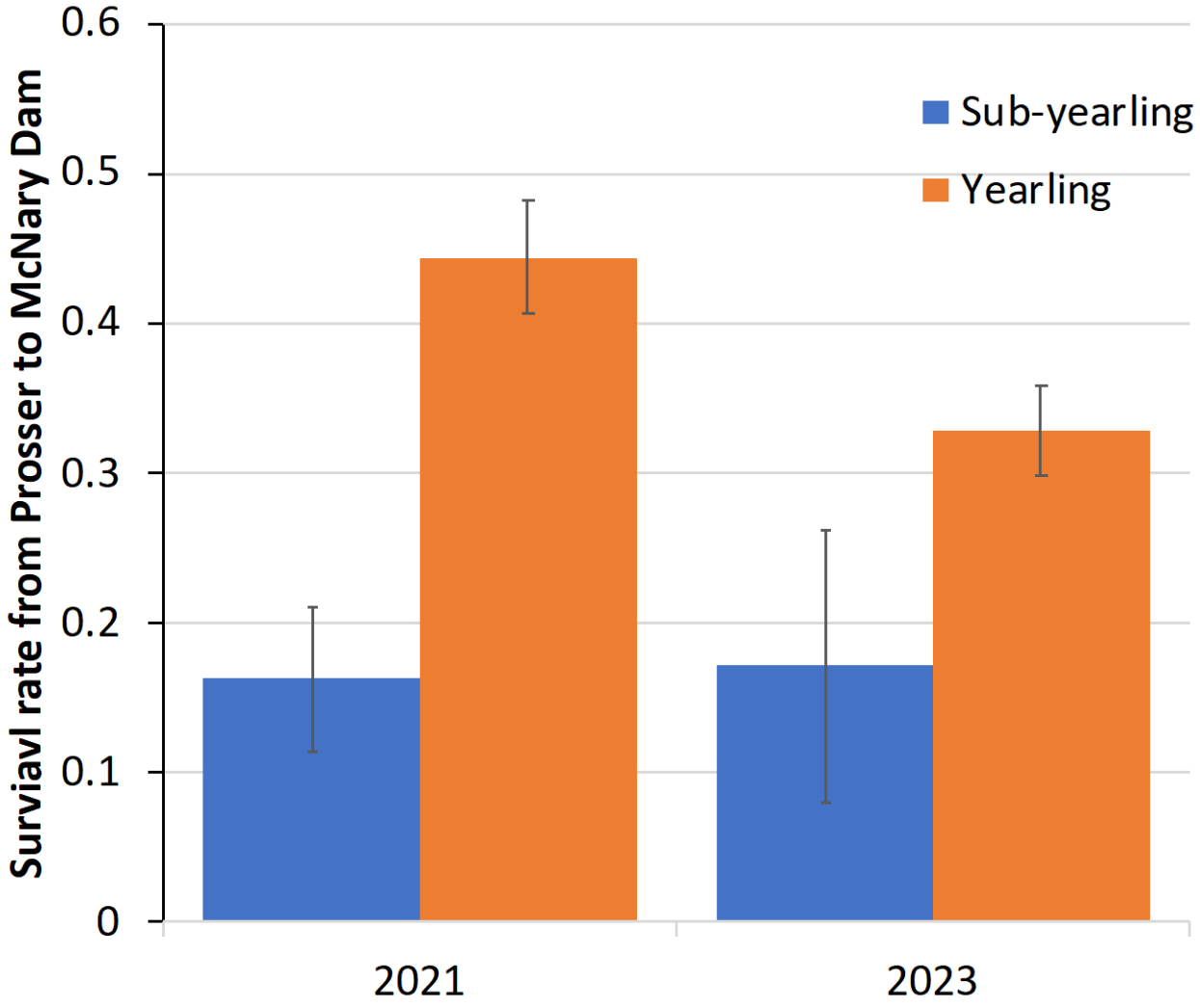


Median Travel days (minimum-maximum)

Type	Group	Release date	Pro-McN	McN-Bon
Subyearling	Subyearling	27-May-21	30 (7-47)	5 (4-8)
Yearling	Yearling	24-Apr-21	10 (6-34)	8 (6-14)



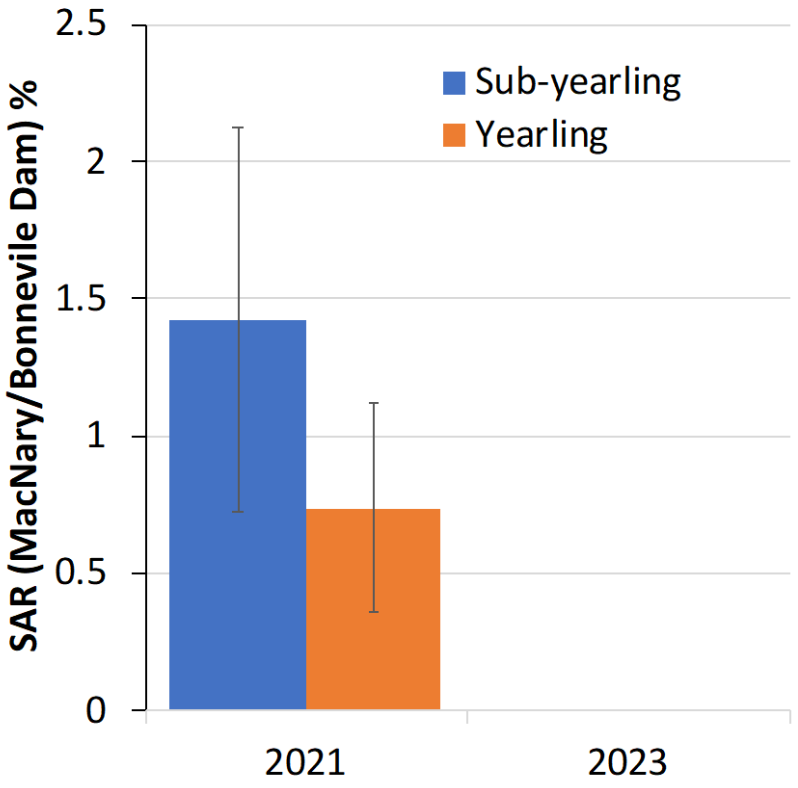
Survival Rate



Smolt-Adult returns (SAR)

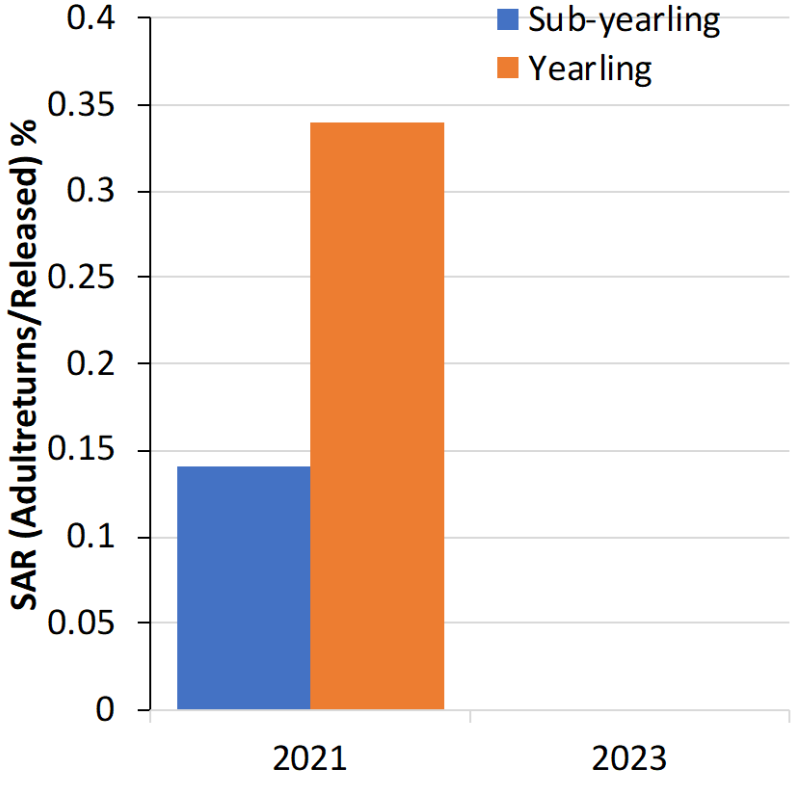
A. SAR based on McNary/Bonneville

Adult returns at BON/Juvenile at McNary



B. SAR based on released at Prosser

Adult returns at BON/Released at PRO



How Many Parr Are Needed to Match Adult Returns from Smolt Releases?

If 0.34% of smolts and 0.14% of parr released at Prosser return as adults, how many parr would need to be released to achieve the same number of adult returns as from the smolt releases?

Migration Year	Lifestage	Released number	Survival	SAR (BON|McN)	SAR (BON|released number)	Total Adult at BON
2021	Sub-Yearling	10000	0.16	1.42	0.14	1401
2023	Sub-Yearling		0.17			
2021	Yearling	10000	0.44	0.74	0.34	3391
2023	Yearling		0.33			

Migration Year	Lifestage	Released number	Survival	SAR (BON|McN)	SAR (BON|released number)	Total Adult at BON
2021	Sub-Yearling	24000	0.16	1.42	0.14	3362
2023	Sub-Yearling		0.17			
2021	Yearling	10000	0.44	0.74	0.34	3391
2023	Yearling		0.33			

Parr:Smolts=2.4:1;

If releasing 1,000 smolts results in 10 adult returns, you'd need to release **2,400 parr** to also get 10 adult returns — because parr survival is lower.

Summary

- In general, subyearlings or parr have lower survival rates than smolts. However, habitat conditions strongly influence growth, smoltification, and outmigration timing, which can increase diversity in migration patterns.
- Releasing both life stages can help maintain or enhance population size—if one group is impacted by a stochastic event, the other may still survive and support population stability.
- Before releasing parr, especially for Coho, it's important to assess habitat conditions, including overwintering habitat availability and carrying capacity.

Yakama Nation Fisheries

Questions?