



Cowlitz Hooking Mortality Study Update

Fish Program, Washington Department of Fish & Wildlife

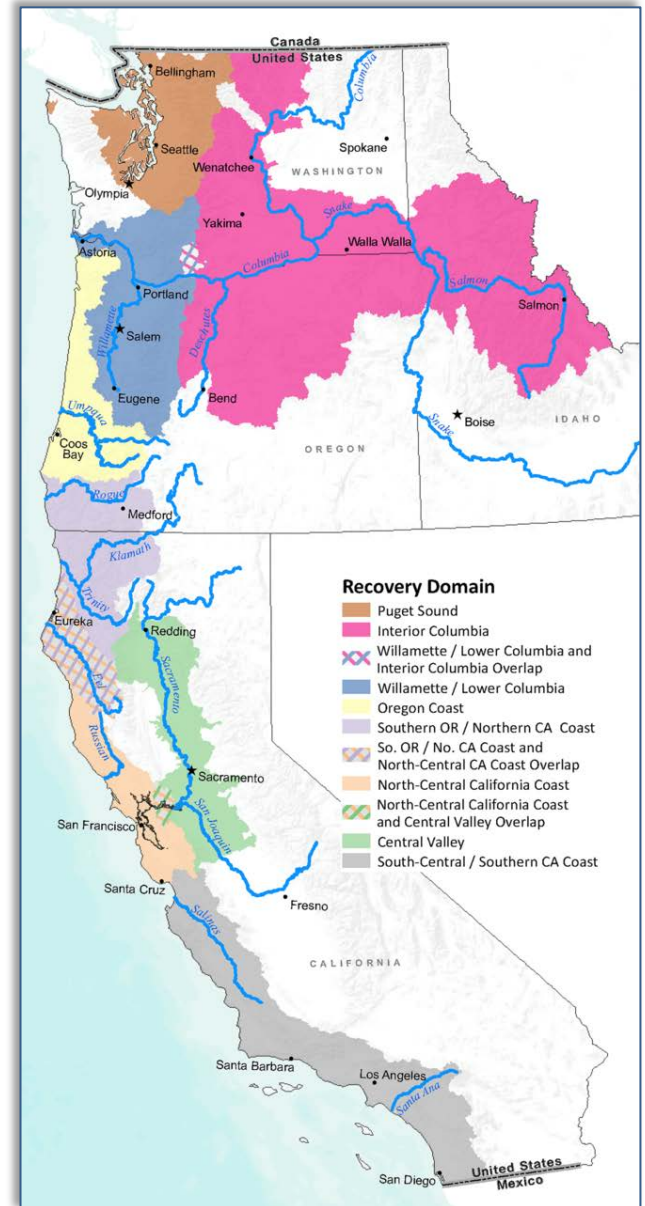
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Background

- Listed and declining populations have in many cases necessitated mark-selective fisheries
- Need to carefully quantify impact of these fisheries
- Mortalities = encounters * *hooking mortality rate*

ESA Listed Salmon & Steelhead



Past Hooking Mortality Studies

Author	Location	Species/life-history	Mortality Rate
(Cowen et al. 2007)	Nicola River, BC	Summer-run Chinook	0.9%
(Bendock and Alexandersdottir 1993)	Kenai River, AK	Early and late-run Chinook	7.6%
(Lindsay et al. 2004)	Willamette River, OR	Spring Chinook	12.2% (total) 3.2% (wild only)
(Fritts et al. 2016)	Yakima River, WA	Spring Chinook	10-12.2%
(Nelson et al. 2005)	Chilliwack River, BC	Winter steelhead	3.6%
(Donaldson et al. 2011)	Fraser River, BC	Sockeye	<5%, 16%
(Vincent-Lang et al. 1993)	Little Susitna River, AK	Coho	11.7%
(Thomas 1995)	Skeena River, BC	Coho, steelhead	2.27%, 4.55%
(Taylor and Barnhart 1999)	Mad & Trinity Rivers, CA	Summer steelhead	8.3%
(Hooton 1987)	Keogh River, BC	Winter and summer steelhead	3.4%
(Lirette and Hooton 1988)	Salmon River, BC	Winter and summer steelhead	5.7%
(Twardek et al. 2018)	Bulkey River, BC	Steelhead	4.5%
(Twardek et al. 2019)	Bulkey River, BC	Steelhead	0-32%
(Whitney et al. 2019)	Clearwater River, ID	Steelhead	3%
(Stubby 2002)	Unalakleet River, AK	Coho	15%



Limitations of past studies

Most studies on adult salmon and steelhead have been narrowly focused or limited by:

- Species
- Gear types
- Hook types
- Angling methods
- Variable environmental conditions (water temp)
- Use of controls
- Duration of post-release monitoring
- Sample size

Without accurate information on post-release mortality rates, fisheries might be unnecessarily constrained, or conversely, imperiled populations might be subjected to higher than intended exploitation rates



Project Objectives

- Address limitations of past studies through a more all-encompassing effort with larger sample sizes
- Quantify the effect of environmental factors, angling methods, and gear types on salmon and steelhead hooking mortality rates (and landing rates)
- Develop a model that can be used to predict hooking mortality rates for fishery-specific conditions (species, gear, environment)



Project History

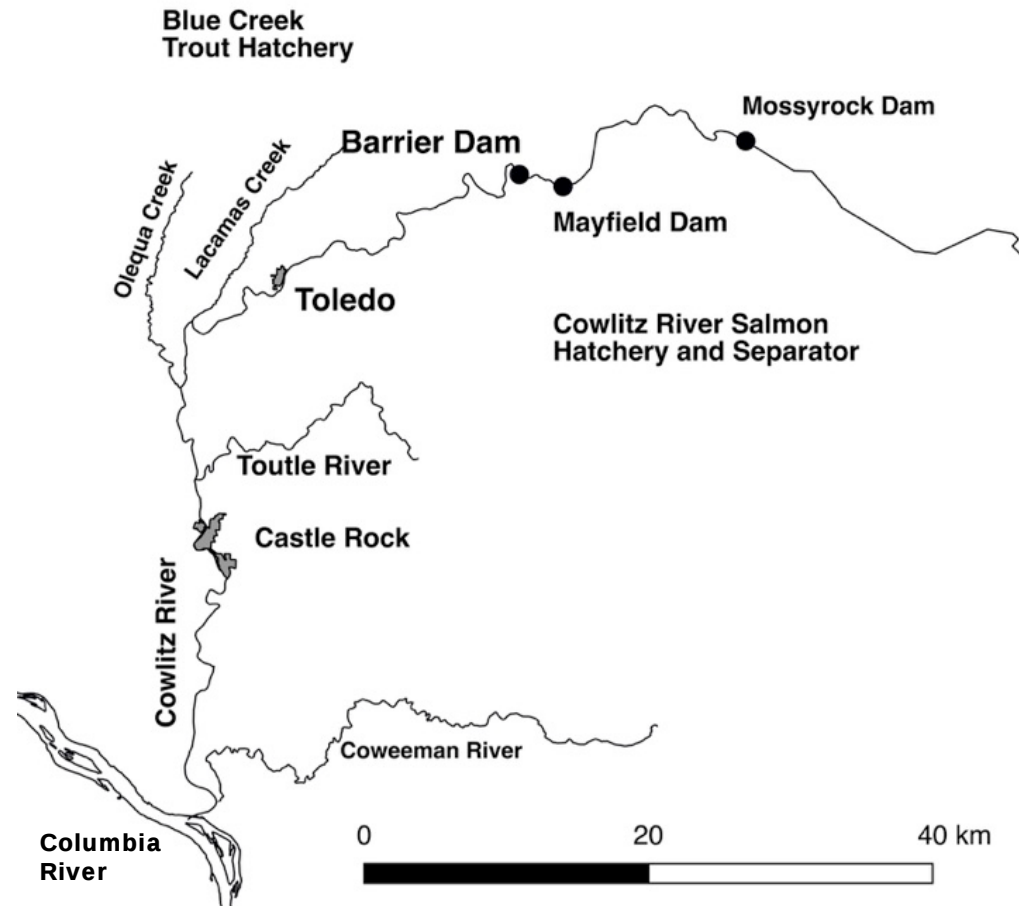
- Project developed collaboratively by WDFW and Mount Hood Environmental
- Funded by Columbia River Salmon and Steelhead Endorsement
- Field work for 3 years from late 2017- late 2020
- Analysis & final reporting delayed by lack of funding initially
- 2021 Legislative proviso to complete the analysis & reporting
- Analysis has occurred over the last year and we are preparing results for submission to a peer-reviewed scientific journal



Methods



- Dates: 2017-2020
- Species:
 - o Coho
 - o Chinook (spring, fall)
 - o Steelhead (summer, winter)
- Treatment-Control Study Design
 - o Treatments angled, tagged, released, recovered
 - o Controls tagged, released, recovered
 - o Hooking Mortality = $1 - (\text{Treatment Recovery Rate} / \text{Control Recovery Rate})$
 - o *Assumes angling capture is ONLY difference affecting recovery between treatment and control*



Treatment Fish

1. Angled in Lower River

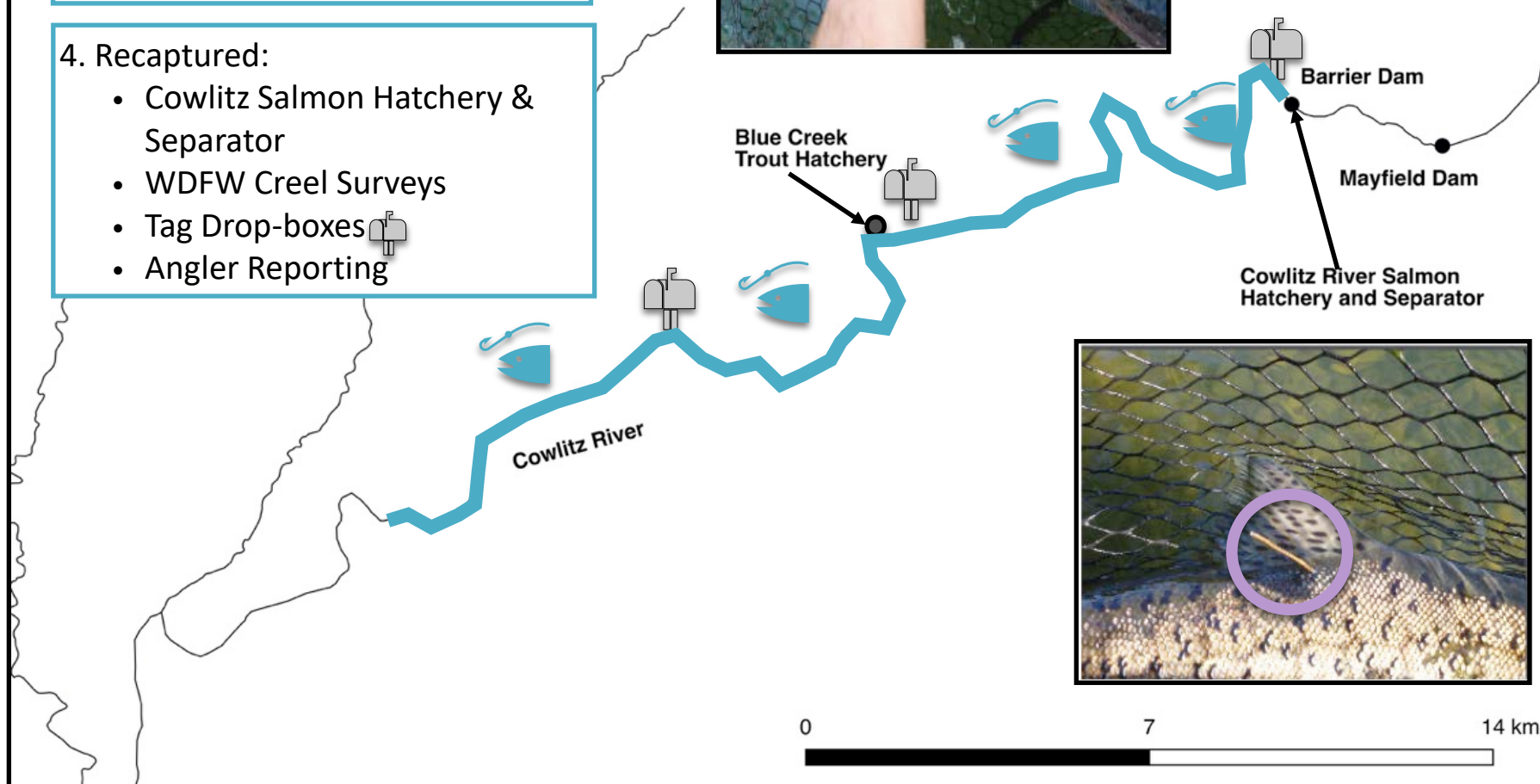


2. Double Floy Tagged

3. Released back into Lower River

4. Recaptured:

- Cowlitz Salmon Hatchery & Separator
- WDFW Creel Surveys
- Tag Drop-boxes
- Angler Reporting



Control Fish

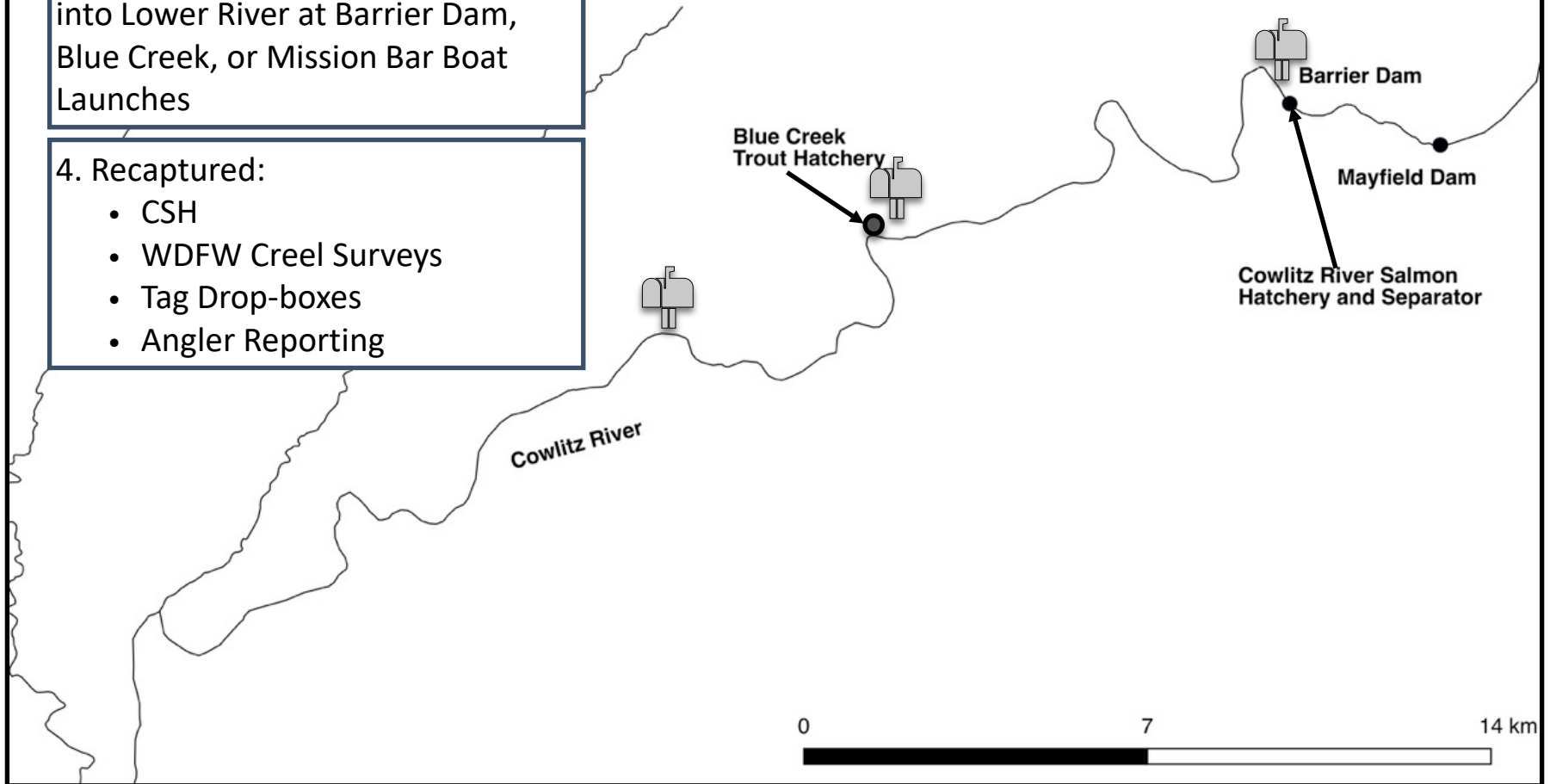
1. Collected at Barrier Dam

2. Double Floy Tagged

3. Transported and released back into Lower River at Barrier Dam, Blue Creek, or Mission Bar Boat Launches

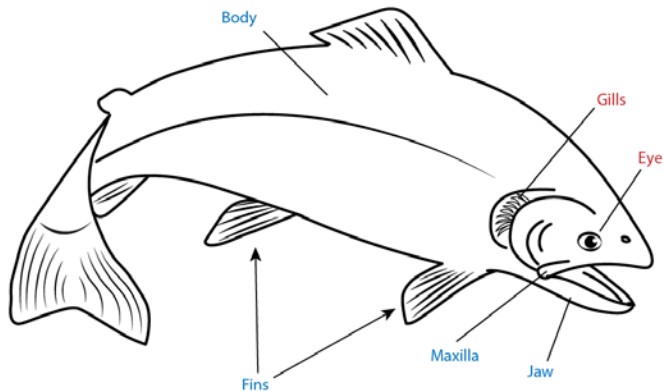
4. Recaptured:

- CSH
- WDFW Creel Surveys
- Tag Drop-boxes
- Angler Reporting



Study Design Variables

Type		
Fish	Anglers	Environment
Species	Angler Experience	Water Temperature
Sex	Method & Gear Type	Date
Fork-length	Fight Time	Location
Fish Condition	Handling Time	
Anatomical Hook location	Knotted vs. Knotless nets	
	Hook Size	
	Hook Type	
	Barbed/Barbless	



Fly

Lure

Jig

Bait



Results

- Study impacted by low runs resulting from low marine survival 2017-20
- As a result, NO controls were available for Fall Chinook, and controls were only available in 2018 for Spring Chinook
- Low sample sizes of treatments for steelhead, Spring and Fall Chinook
- Steelhead study design appears to have been impacted by different location of steelhead hatchery (Blue Creek) relative to salmon hatchery (adjacent to Barrier Dam)
- Nonetheless, good results for coho and spring Chinook



Results

Coho Raw Data

Treatment	Gear	Barb	Non-Recapture	Recapture
Control	Control	Control	267	814
Treatment	Bait	No	8	22
Treatment	Bait	Yes	24	46
Treatment	Baited Lure	Yes	NA	1
Treatment	Fly	Yes	1	4
Treatment	Jig	No	49	159
Treatment	Jig	Yes	78	249
Treatment	Lure	No	23	76
Treatment	Lure	Yes	49	149



Results

Summer Steelhead Raw Data

Treatment	Gear	Barb	Non-Capture	Capture
Control	Control	Control	880	940
Treatment	B	No	19	9
Treatment	B	Yes	39	32
Treatment	L	Yes	9	9



Results

Winter Steelhead Raw Data

Treatment	Gear	Barb	Non-Capture	Capture
Control	Control	Control	360	420
Treatment	Bait	No	4	6
Treatment	Bait	Yes	14	6
Treatment	Fly	No	11	12
Treatment	Fly	Yes	41	35
Treatment	Jig	No	11	20
Treatment	Jig	Yes	17	42
Treatment	Lure	No	1	1
Treatment	Lure	Yes	2	9



Results

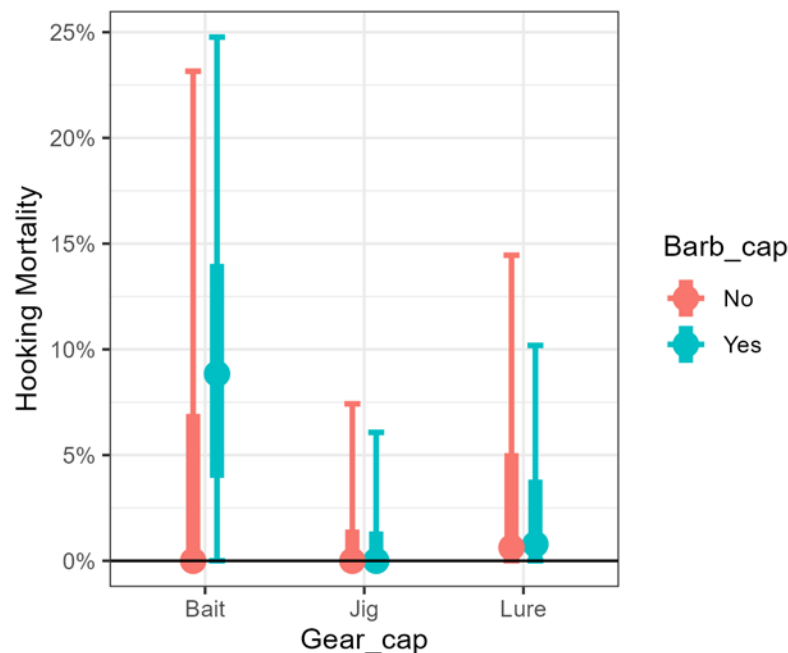
Spring Chinook Raw Data

Treatment	Gear	Barb	Non-Capture	Recapture
Control	Control	Control	15	56
Treatment	Bait	No	19	31
Treatment	Bait	Yes	30	37
Treatment	Lure	Yes	9	4



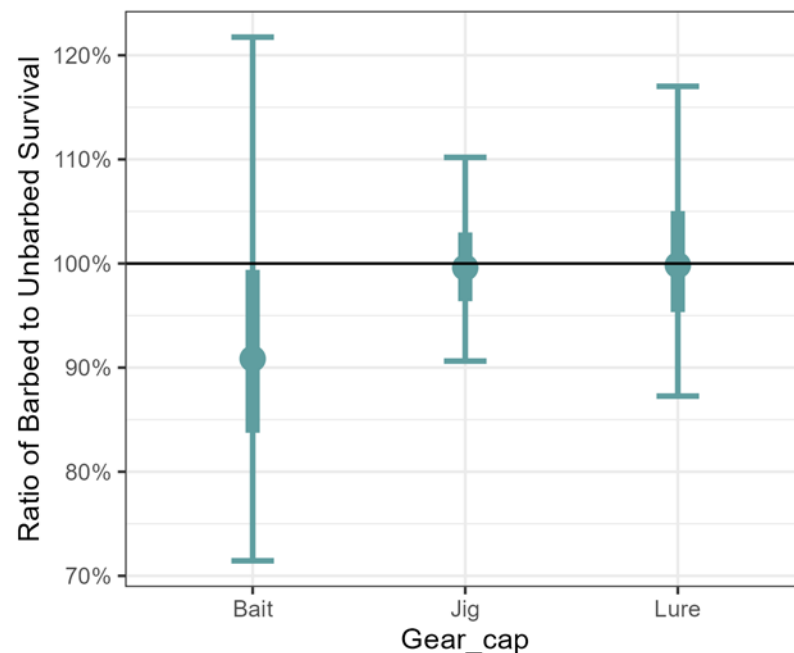
Results

Coho Salmon



Hooking Mortality Best Estimate

Gear	Barb	2.5%	25%	50%	75%	97.5%
Bait	Yes	0%	3.9%	8.8%	14.00%	24.8%
Jig	Yes	0%	0.0%	0.0%	1.40%	6.1%
Lure	Yes	0%	0.0%	0.8%	3.80%	10.2%
Bait	No	0%	0.0%	0.0%	6.90%	23.2%
Jig	No	0%	0.0%	0.0%	1.50%	7.4%
Lure	No	0%	0.0%	0.6%	5.10%	14.5%



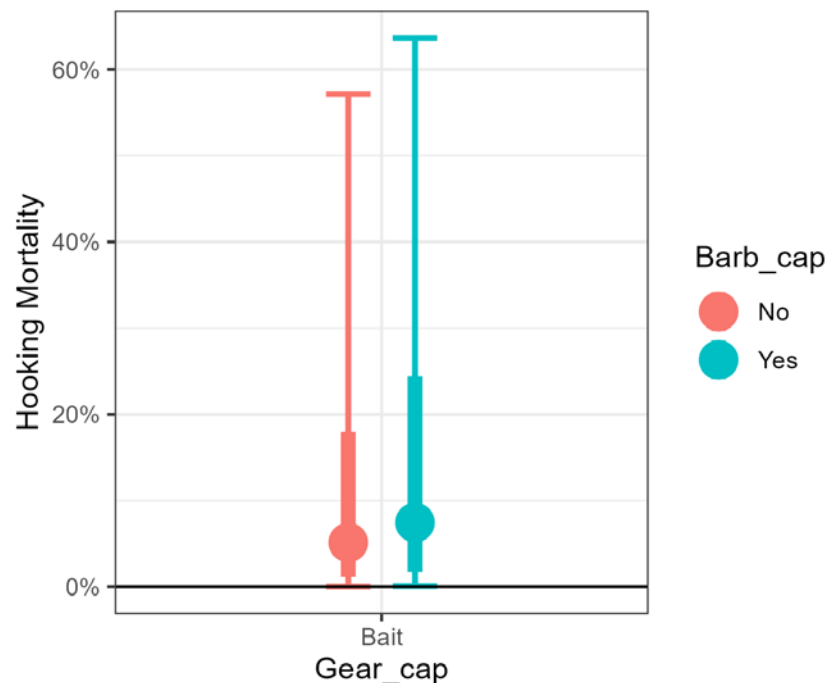
Barbed/Barbless Survival Best Estimate

Gear	2.5%	25%	50%	75%	97.5%
Bait	71.4%	83.7%	90.9%	99.4%	121.7%
Jig	90.6%	96.4%	99.6%	103.0%	110.2%
Lure	87.3%	95.3%	99.8%	105.0%	117.0%



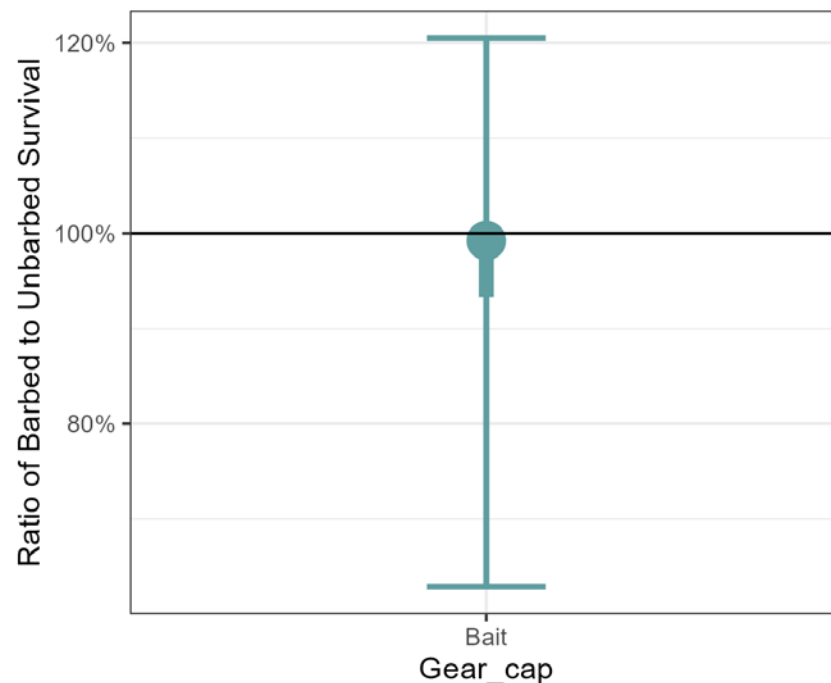
Results

Spring Chinook Salmon



Hooking Mortality Best Estimate

Gear	Barb	2.5%	25%	50%	75%	97.5%
Bait	Yes	0.1%	1.7%	7.4%	24.4%	63.7%
Bait	No	0.0%	1.1%	5.1%	18.0%	57.2%



Barbed/Barbless Survival Best Estimate

Gear	2.5%	25%	50%	75%	97.5%
Bait	63%	93%	99%	100%	120%



Results

Barbed vs Barbless Landing Rates

	Barbed		Barbless		Ratio
Species	Total Bites	Percent Landed (%)	Total Bites	Percent Landed (%)	Barbed/Barbless % Landed
Coho	812	89.3	452	82.3	109%
Fall Chinook	107	85.6	56	87.5	98%
Spring Chinook	111	91	56	73.7	123%
Summer Steelhead	91	79.8	34	57.6	139%
Winter Steelhead	191	76.1	74	63.2	120%
Total	1427	79.6	773	68.4	116%



Possible Barbed Hook Management Considerations

Do Barbs Have a...?		COST	
		Negative Effect on Release Mortality	
		No	Yes
BENEFIT Positive Effect on Landing Rate	No		
	Yes		



Possible Barbed Hook Management Considerations

Do Barbs Have a...?		COST Negative Effect on Release Mortality	
		No	Yes
BENEFIT Positive Effect on Landing Rate	No	Benefit: NO Cost: NO	Benefit: NO Cost: YES
	Yes	Benefit: YES Cost: NO	Benefit: YES Cost: YES



Possible Barbed Hook Management Considerations

- Results support both hypotheses, but bigger effect on landing
- Suggests need to identify when benefits outweigh costs
- “Boundary Cases” easy; examples:
 - C&R fishery (benefits of barbs hard to identify?)
 - Retention fishery with no conservation constraints (why not allow barbs?)
- “Middle Cases” hard example:
 - Some species open to retention but tight mortality constraints on species requiring release (does allowing barbs improve opportunity through more fish landed or reduce it because conservation limits reached faster?)

Do Barbs Have a...?		COST Negative Effect on Release Mortality	
		No	Yes
BENEFIT Positive Effect on Landing Rate	No	Benefit: NO Cost: NO	Benefit: NO Cost: YES
	Yes	Benefit: YES Cost: NO	Benefit: YES Cost: YES



Summary

- Mortality results in line with previous literature (generally <10%)
 - Higher for bait (likely as a result of more lethal hooking locations because fish were more likely to swallow bait)
 - Slightly higher mortality for barbs
- Lower landing rate for barbless
- Suggests policy tradeoff between possible “benefits” and “costs” of barbed vs. barbless hooks
- Future work to reconcile control-treatment designs for steelhead



Questions?

