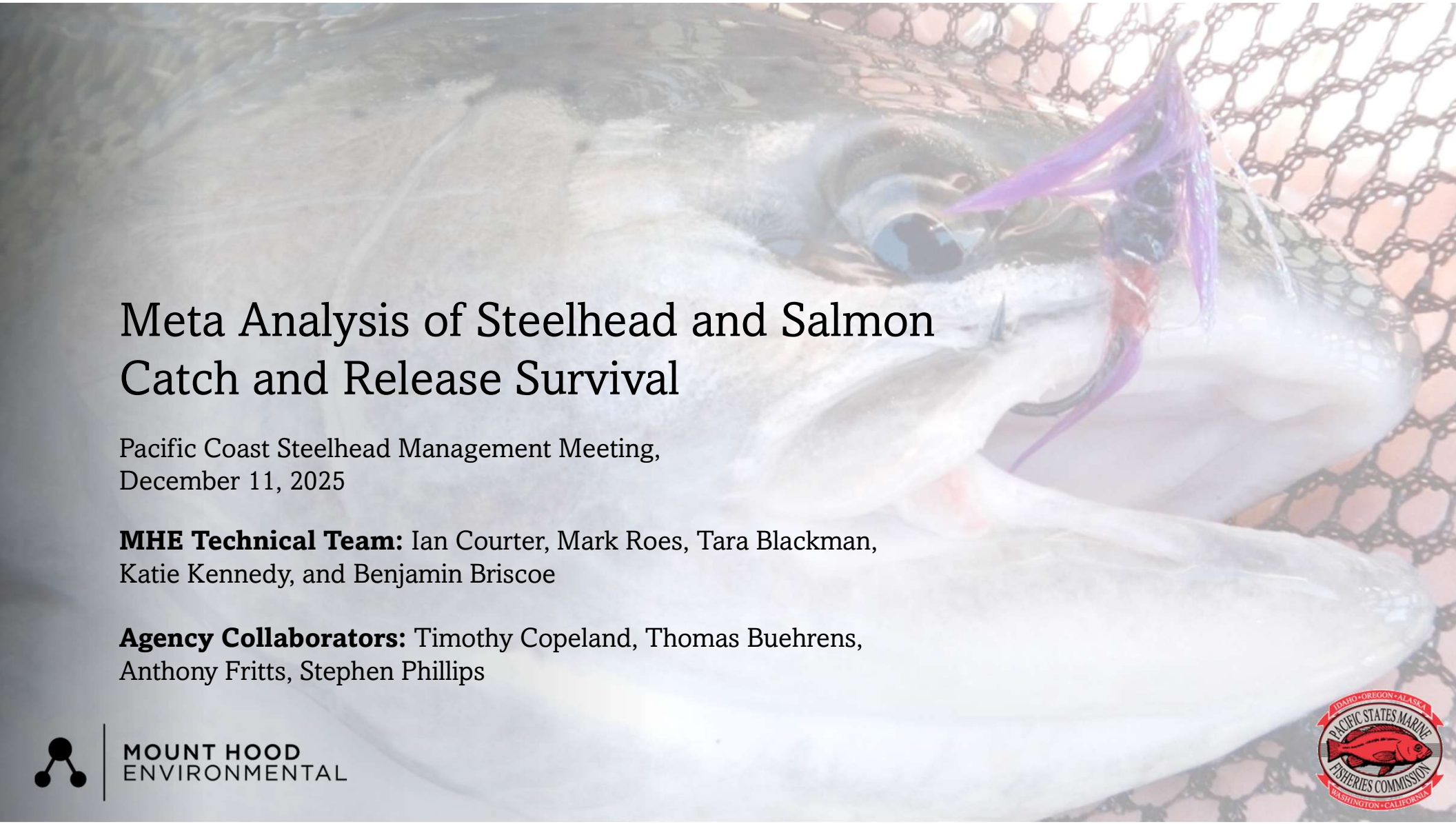

# Meta Analysis of Steelhead and Salmon Catch and Release Survival

Pacific Coast Steelhead Management Meeting,
December 11, 2025

**MHE Technical Team:** Ian Courter, Mark Roes, Tara Blackman, Katie Kennedy, and Benjamin Briscoe

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Fisheries Research 268 (2023) 106848

Contents lists available at ScienceDirect

Fisheries Research

journal homepage: www.elsevier.com/locate/fishres

Full length article

# Influence of angling methods and terminal tackle on survival of salmon and steelhead caught and released in the Cowlitz River, Washington

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ARTICLE INFO

Handled by A.E. Punt

*Keywords:*
Catch and Release
Mark-Selective
Angling
Salmon
Steelhead
Survival
Hooking Mortality

ABSTRACT

Efforts to recover depressed stocks of salmon and steelhead trout in North America include implementation of mark-selective recreational fisheries, whereby anglers are allowed to harvest hatchery-origin fish but must release natural-origin fish. Catch and release angling (C&R) is generally thought to be an effective tool for conservation relative to traditional retention fisheries due to high survival of released adult salmon and steelhead in freshwater. Studies designed to estimate C&R mortality have produced highly variable results among species and size classes of fish, gear types, and environmental conditions. Therefore, crude approximations of C&R mortality are commonly used to quantify impacts to natural-origin salmon and steelhead. In addition, managers often restrict use of certain angling methods and terminal tackle that are assumed to result in higher mortality, leading to a multiplicity of different regulatory requirements with limited empirical support. We conducted a novel three-year mark-recapture study in the Cowlitz River, Washington to estimate effects of a variety of factors hypothesized to influence salmon and steelhead C&R survival using a control-treatment design. Three species of anadromous salmonids were captured and released as treatments using various angling techniques and terminal tackle. Fight time, handling time, and water temperature were recorded during each capture event. Non-angled fish were captured in a trap and released back into the fishery to serve as controls. Recovery rates of Coho Salmon differed less than a percent between angled and non-angled fish across multiple gear types, indicating negligible effects of C&R. Angled Spring Chinook Salmon experienced 3.6–10.2 % C&R mortality relative to non-angled control fish, depending on terminal tackle. Barbless hooks were associated with higher survival than barbed hooks for both Chinook and Coho Salmon, although differences were small for Chinook and negligible for Coho. In contrast, steelhead trout angled on barbed hooks were recovered at slightly higher rates than those caught on barbless hooks. We also found evidence for a reduction in landing rates when angling using barbless hooks. Finally, use of bait increased the probability that salmon would be hooked in a critical location such as the esophagus or stomach. Our findings are useful for assessing trade-offs between conservation measures and harvest opportunity when defining fishing regulations in mark-selective salmon and steelhead fisheries.

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# Cowlitz Study Results

- Spring **Chinook** experienced **3.6-10%** C&R mortality based on gear and hook type
- C&R mortality for **Coho** was **<1%** regardless of gear or hook type
- Small benefit of barbless hooks for Chinook and Coho Salmon, but not for steelhead
- Higher landing rate for barbed v. barbless hooks

# Meta Database

- Near-comprehensive collection of currently available data for salmon and steelhead C&R in freshwater.
- An open access data resource to inform specific concerns about angling impacts.
- Reveal data gaps and provides study design guidance.

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# Data acquisition


6 Publications

4 States/provinces

3 Salmon and Steelhead species

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# Unique Study features

- Research questions
- Angling methods, gear types
- Control methods
- Survival definition
- Angling & trap efficiency
- Censoring %
- Biotic & abiotic conditions


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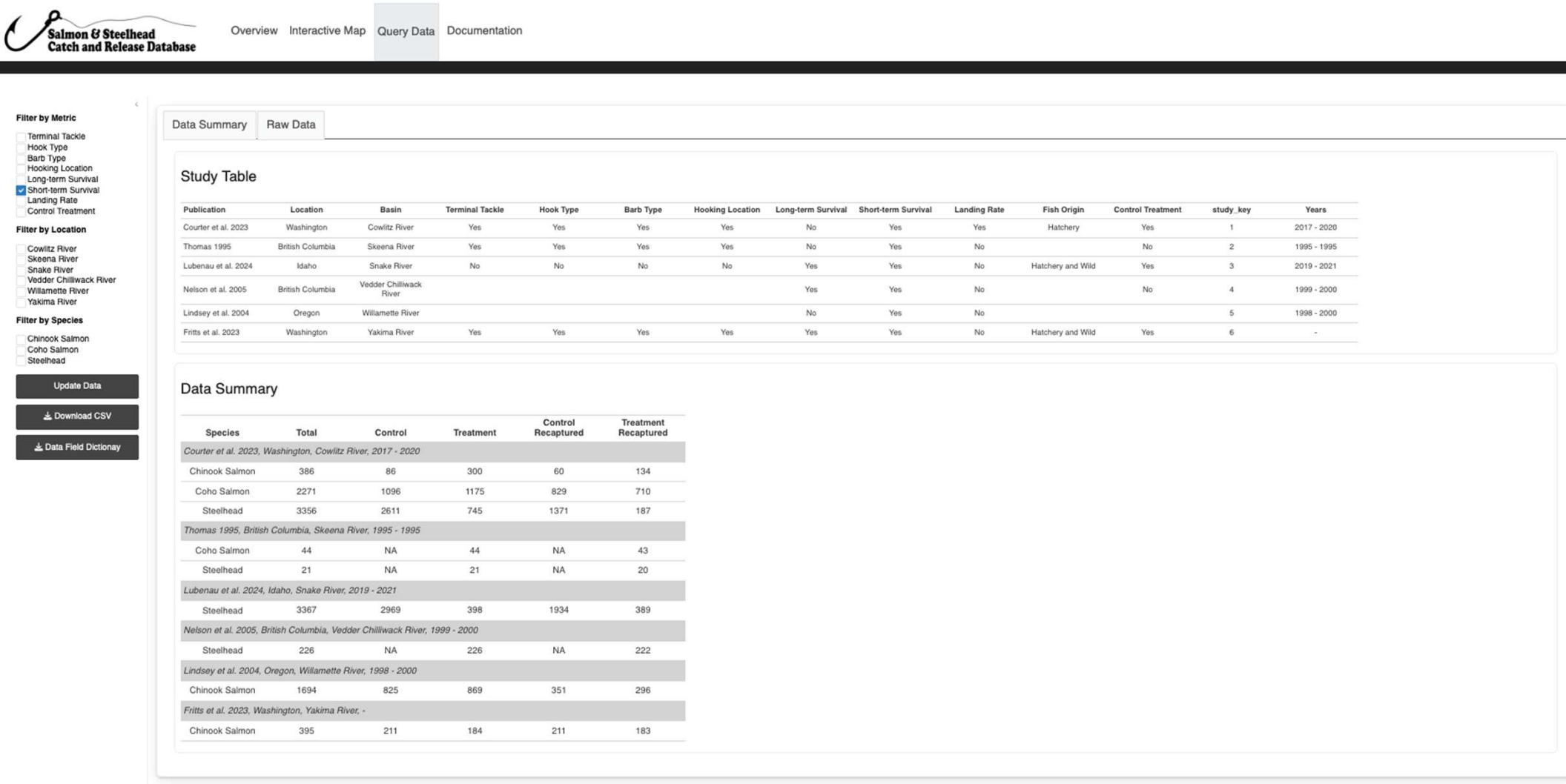


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https://mounthoodenvironmental.shinyapps.io/CatchReleaseDatabase

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# Meta analysis approach

- Pool data with minimal assumptions
- Limit research questions to study scopes
- Standardize study endpoints (detection after 48 hrs)
- Account for differences in studies and populations with hierarchical random effects

# Management relevant questions

How do the following effect survival:

- ✓C&R for each species
- ✓Barbed hooks
- ✓Bait
- ✓Hook location

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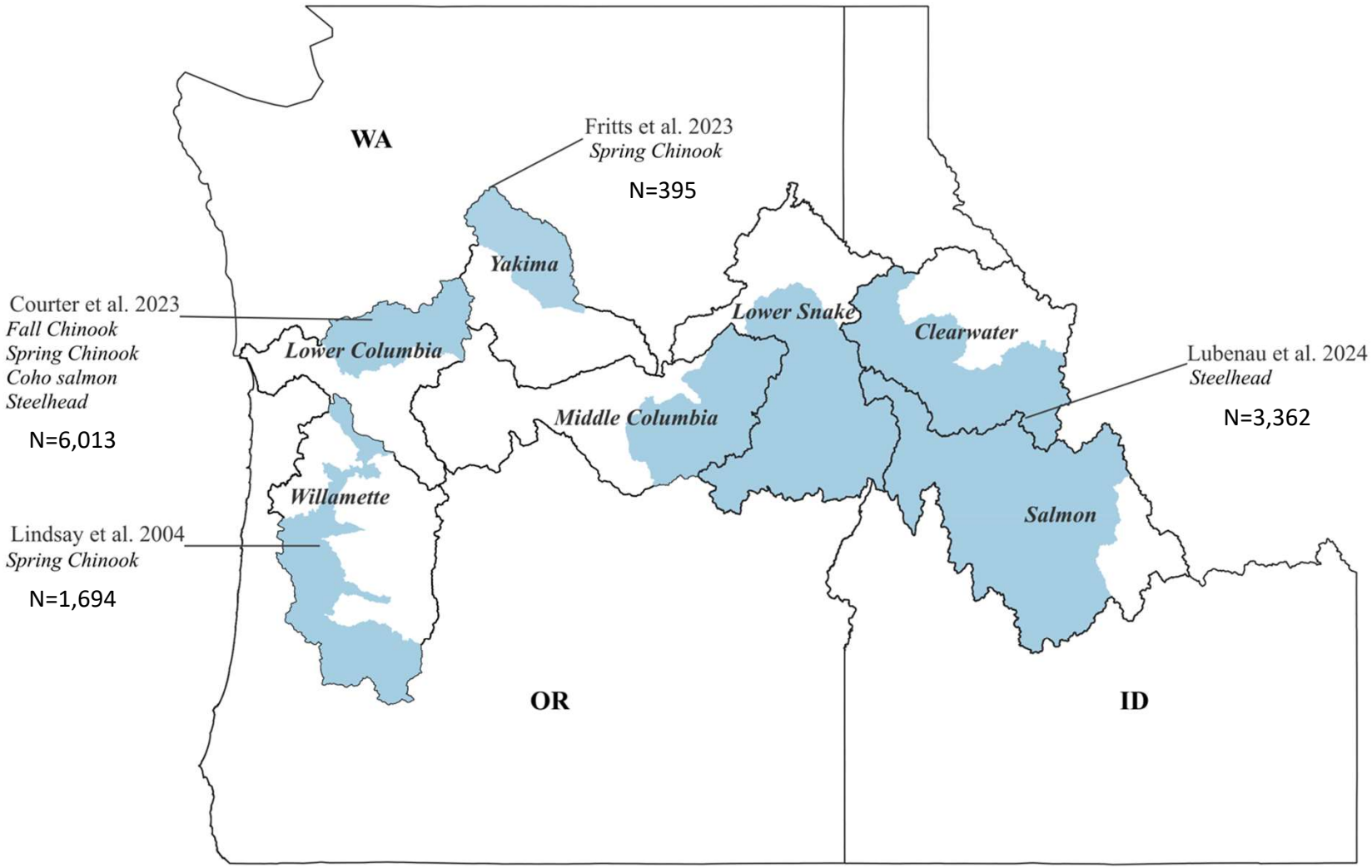


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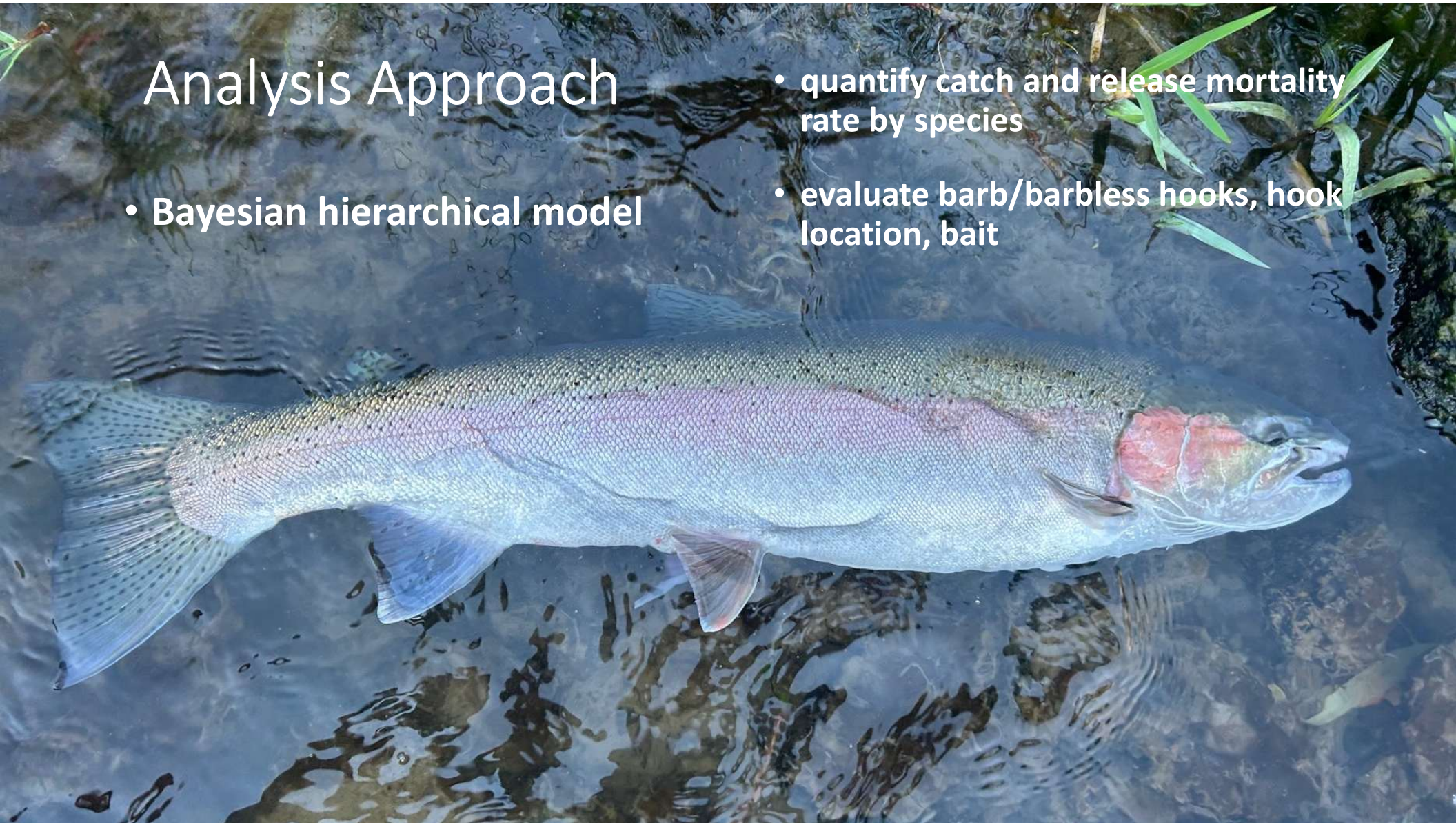
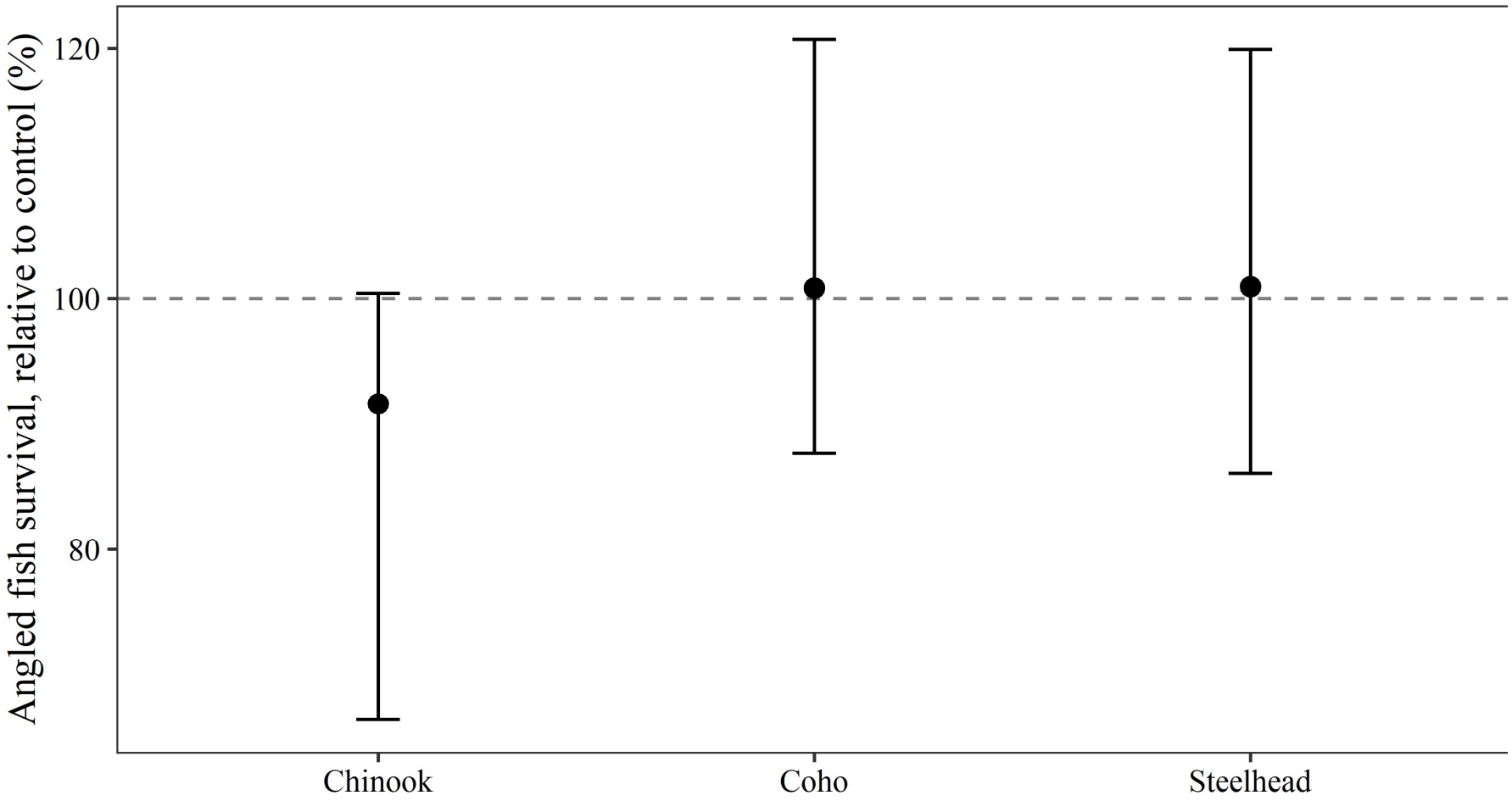
# Analysis Approach

- **Bayesian hierarchical model**
- **quantify catch and release mortality rate by species**
- **evaluate barb/barbless hooks, hook location, bait**



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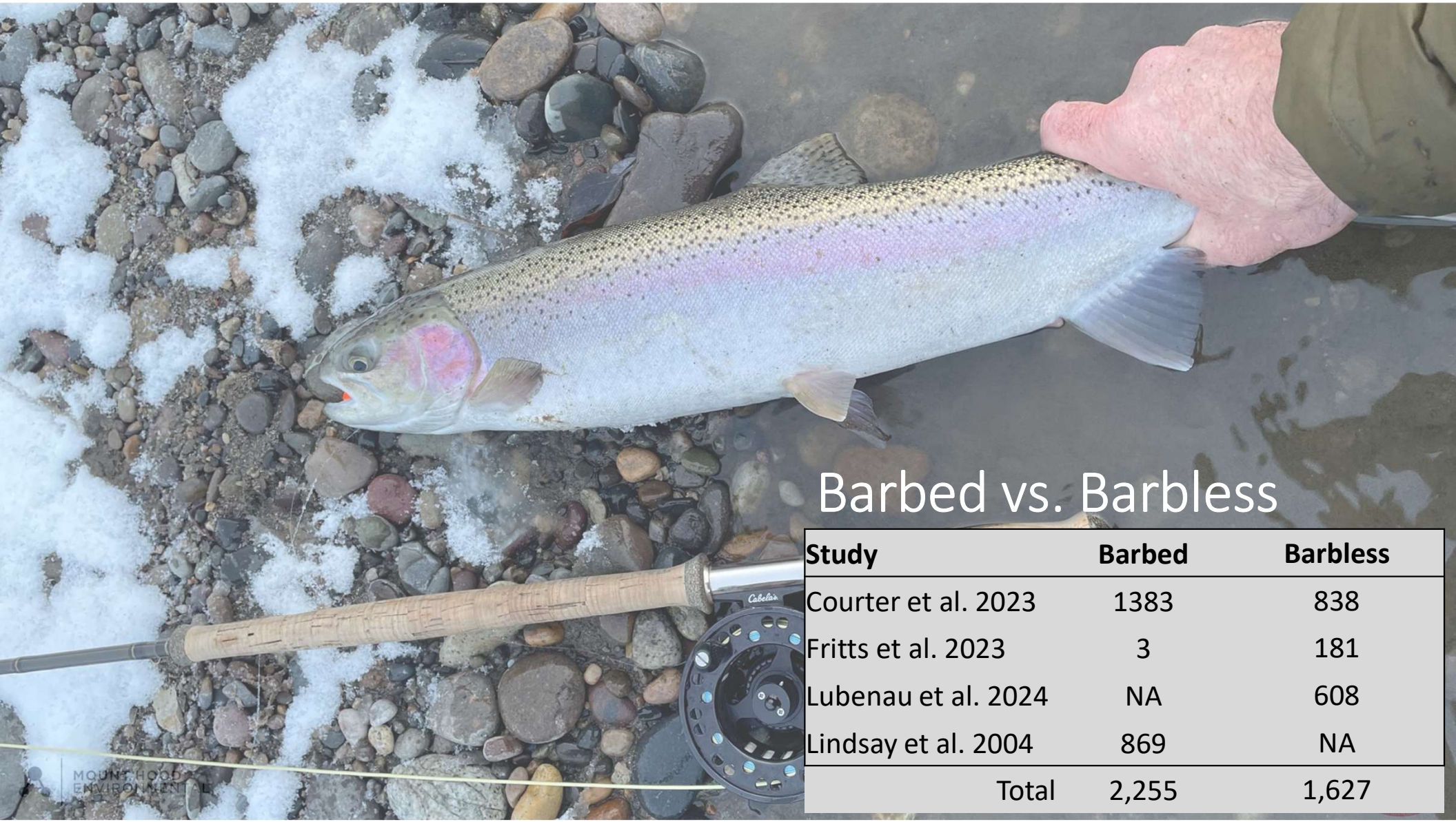
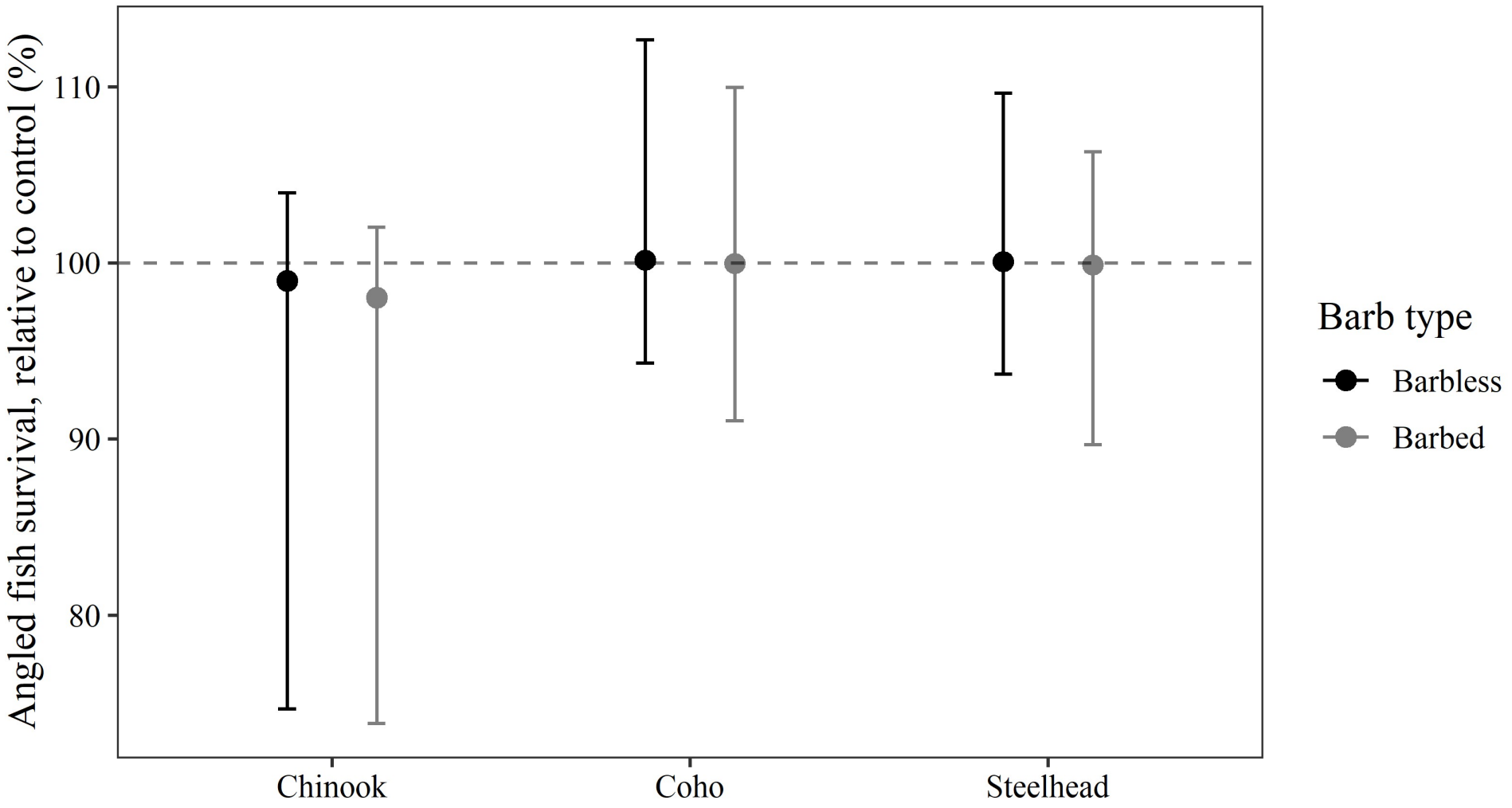


# Barbed vs. Barbless

| Study | Barbed | Barbless |
|---|---|---|
| Courter et al. 2023 | 1383 | 838 |
| Fritts et al. 2023 | 3 | 181 |
| Lubenau et al. 2024 | NA | 608 |
| Lindsay et al. 2004 | 869 | NA |
| Total | 2,255 | 1,627 |

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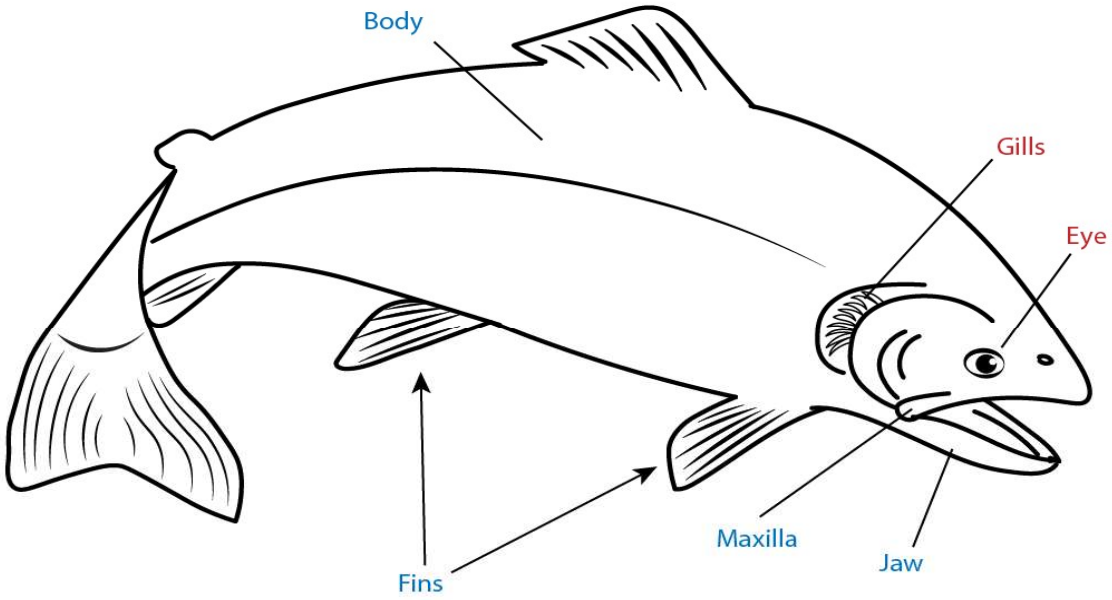


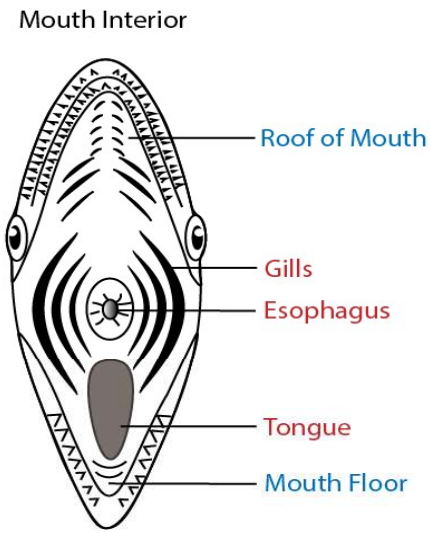


**Critical vs Non-critical**
Hooking Locations

# Hook Location

| Study | Critical | Non-critical |
|---|---|---|
| Courter et al. 2023 | 131 | 628 |
| Fritts et al. 2023 | 31 | 131 |
| Lindsay et al. 2004 | 236 | 633 |
| Total | 398 | 1392 |

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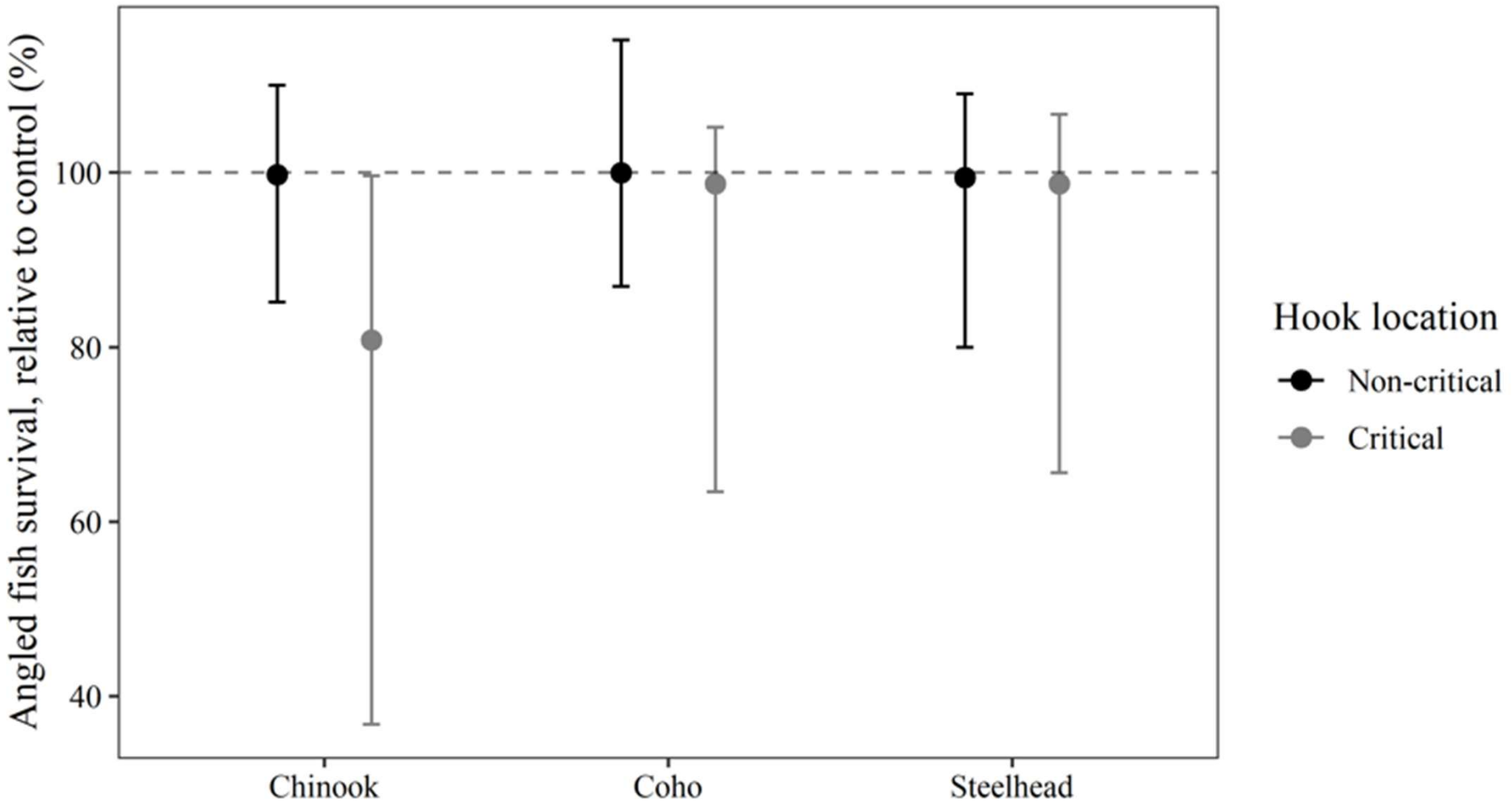


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