Development of a catch and release mortality model for recreational steelhead fisheries

Kale Bentley & Dan Rawding
Washington Department of Fish & Wildlife
Steelhead Management Meeting
March 8th, 2016
WA State Steelhead Economic value

>$200 million/year

Scott and Gill (2008)
Balancing Act: Recreational & Conservation

Steelhead Distinct Population Segments
Catch and Release (C&R) Fisheries

- C&R allows for some catch of wild steelhead
- But C&R fish still susceptible to mortality
- Fisheries with ESA-species must monitor impacts
Monitoring C&R Fishery Impacts

\[ \text{Sport Fishery Impact Rate (SFIR)} = \frac{\text{C&R Mortalities}}{\text{Run Size}} \times 100 \]

\[ \text{C&R Mortalities} = \text{Catch} \times \text{Hooking Mortality Rate} \]

\[ \text{Hooking Mortality Rate} = \frac{\# \text{ died}}{\# \text{ caught}} \]

- Independent study
- Literature value(s)

C&R mortality: 0 – 11%
Goal of Study

Develop a predictive C&R mortality model for recreational steelhead fisheries
C&R Assessment Framework

• Q1. What are the most important factors that effect steelhead C&R mortality?
• Q2. How can we incorporate these factors into a predictive model?
• Q3. What are the results when we apply this predictive model to WA fisheries?
• Q4. What is the influence of fishing regulations on C&R hooking mortality?
Q1. What are the most important factors that effect steelhead C&R mortality?

C&R Literature Suggests...

- Water temperature
- Hooking location (critical v. non-critical)
- Angling duration (time from hooked to landing)
- Hook type (single/treble, barbed/un-barbed)
- Air exposure
Q1. What are the most important factors that effect steelhead C&R mortality?

Ashbrook et al. (*in press*)
- C&R 54 winter steelhead
- Water temperatures: 2 - 12°C
- Radio tagged fish and followed to spawning

Taylor and Barnhart (1996)
- C&R 126 summer steelhead
- Water temperatures: 14 - 25°C
- Block netted pool after release and snorkeled >36 after release to record mortalities
Q1. What are the most important factors that effect steelhead C&R mortality?

Posterior inclusion probability

- **High support**: Hook L.
- **Low support**: W. Temp., Duration, Hook T.
Q2. How can we incorporate hook location and temperature into a predictive C&R mortality model?

Steelhead C&R datasets

Chinook C&R datasets
(used as priors for hook location in Bayesian model)
Q2. C&R Hooking Mortality Model

![Graph showing C&R Mortality Rate (%) against Temperature (°C)]

- C&R Mortality Rate (%)
- Temperature (°C)
- Hooking Location:
  - Critical
  - Non-Critical
Q3. What are estimates of C&R Mortality for WA steelhead fisheries
Estimating Fishery C&R Mortality (FCRM)

• (1) Calculate proportion of steelhead that were critically or non-critically hook location by month \((q_{ij})\)

• (2) Estimate mortality using mean water temperature by month using predictive model \((m_{ij})\)

• (3) Fishery Catch & Released Mortality is weighted monthly mortality

\[
FCRM = \sum m_{ij} q_{ij}
\]
Q3. Estimated C&R Mortality for WA Steelhead Fisheries

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<th>Year</th>
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Q4. What is the influence of gear-type on C&R hooking mortality?

Steelhead creel surveys
- hooking location
- gear-type
Hook Locations

Non-Critical
- Roof of Mouth
- Jaw
- Floor of Mouth

Critical
- eyes
- esophagus
- gills
- tongue

Gear-Type
- Fly
- Lure
- Jig
- Bait
Q4. Hook Location by Gear Type (summer steelhead in lower Columbia R.)

- Bait: 3.5X higher
- Not significantly different
Summary and Conclusions

• Developed a predictive model to estimate steelhead C&R mortality
• Regulations that reduce/limit contact with critical sites will reduce C&R mortality
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• Regulations that reduce/limit contact with critical sites will reduce C&R mortality

• Model applicability
O. mykiss Diversity

Population-Specific Consequences of Fisheries-Related Stressors on Adult Sockeye Salmon

M. R. Donaldson
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G. D. Raby
D. A. Patterson
A. P. Farrell
S. J. Cooke

Differences in Thermal Tolerance Among Sockeye Salmon Populations

Erika J. Eliason, Timothy D. Clark, Merran J. Hague, Linda M. Hanson, Zoë S. Gallagher, Ken M. Jeffries, Marika K. Gale, David A. Patterson, Scott G. Hinch, Anthony P. Farrell

Maximum stream temperature and the occurrence, abundance, and behavior of steelhead trout (Oncorhynchus mykiss) in a southern California stream.

Matthew R. Sloot and Ann-Marie K. Osterback

[Map and graphs showing temperature and heart rate data for different salmon populations.]
O. mykiss C&R Mortality

C&R Mortality Rate (%) vs. Temperature (°C) for Gallatin, MT, Smith, MT, and Steelhead.
Summary and Conclusions

- Developed a predictive model to estimate steelhead C&R mortality
- Regulations that reduce/limit contact with critical sites will reduce C&R mortality
- Model applicability:
  - Appropriate for winter steelhead and is a reasonable start for some coastal summer steelhead
  - Need additional data for interior and northern summer steelhead
Questions?