Bulkley River Wild Steelhead Catch-and-Release Project
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Rationale

Steelhead trout are one of the most iconic salmonid species. Their spawning migrations often span several hundred's of kilometres resulting in considerable energy expenditure during their spawning cycle (Penney and Moffitt, 2014). This severe energy depletion as well as a change in feeding behaviour during their reproductive cycle may make steelhead particularly susceptible to human-induced stressors that result in fish incurring additional energetic costs. Previous research has highlighted the influence of warm water temperatures (Wade et al., 2013), habitat degradation (NRC, 1996), water pollution (Suttle et al., 2004) and fisheries interactions (Andrews and McSheffries, 1976; Stewart and Lewysnky, 1988) on steelhead populations. Although commercial fisheries for salmon have been associated with significant by-catch mortality of steelhead (J.O. Thomas & Associates LTD., 2010), little is known about the impacts of recreational angling practices on steelhead physiology, behaviour, and survival (but see Nelson et al., 2001 for example with hatchery steelhead).

Given the widespread decline of wild steelhead populations, recreational fisheries for steelhead are primarily catch-and-release, including in the famed run of the Bulkley River, BC. The success of catch-and-release as a conservation tool is based on the premise that released fish survive and do not suffer fitness consequences following the capture event (Cooke and Schramm, 2007). Differences in morphology, life-history strategies, and metabolism can result in inter-specific responses to catch-and-release, emphasizing the need for species-specific evaluations of catch-and-release (Cooke and Suski, 2005). Given that angler behaviour can have dramatic influences on the outcome of catch-and-release angling opportunities, research specifically focused on wild steelhead has the potential to identify opportunities for refining handling practices to ensure the best outcome for the fish.

Our Approach:

We worked along-side volunteer anglers on the Bulkley River to tag and blood sample wild steelhead. The duration of the angling event was accurately timed, and we measured where the fish was hooked, how difficult the hook was to remove, as well as other relevant site variables (see below for full list). After hook removal, fish were held out of water for 10 sec, 30 sec or kept submerged (0 sec), creating three different air exposure groups. These fish were then either blood sampled (~0.4mL of blood) to measure physiology or tagged with a radio telemetry transmitter to monitor movement and survival after release. Blood was sampled for glucose, lactate, and pH as indicators of stress related to the angling event. We also blood sampled steelhead from Witset Falls immediately after they were caught via dipnet (<3 min). Since blood samples were obtained quickly, the stress of the

Taking a small blood sample from the underside of the tail (top left), a radio telemetry tracking receiver being used to detect fish movement (top right), and a radio telemetry transmitter (tag) attached to a steelhead prior to release (lower)

dipnet capture was not reflected in the blood glucose, lactate, or pH levels, and ultimately those values are considered "baseline" or the natural levels of free-swimming fish. All fish that had blood samples taken also had a reflex assessment done immediately after capture (equilibrium/righting reflex). To assess the presence of this reflex, fish were turned upside down in the river and were scored as positive for the reflex if it regained normal orientation in <3 seconds. Radio tagged fish were monitored for their location 20 min following release, and then relocated regularly by manual tracking between Sep 17th-Nov 8th, 2016. We also surveyed the Bulkley and Morice Rivers in early April, 2017 to determine the location of tagged steelhead, at or near putative overwintering/spawning grounds.

Summary of Results:

- 67 steelhead were tagged and tracked, while an additional 59 steelhead were blood sampled
- Catch rates for males and females were similar, and sizes were not different among treatments

Fight time

- There was a direct correlation between the size of fish and fight time, and fight times were longer in faster flowing water
- Fight times were 27% longer when fish were landed by tailing compared to netting
- Males were slightly larger (27.6 inches) than females (26.9 inches),and took longer to land (5 min 19 sec vs. 4 min 41 sec)
- Fight time or landing method had less of an influence on the short-term stress response values and movement measures.

Air exposure

- Air exposure of 10 and 30 sec increased reflex impairment (equilibrium loss) and immediate downstream movement of steelhead compared to fish air exposed for 0 sec that moved upstream
- Angled fish had greater lactate values than those captured by dipnet and sampled immediately to obtain baseline levels

Temperature

- Blood lactate and pH (acidity) were not closely related to air exposure but had a strong positive correlation with water temperature
- Stress genes responsive to oxygen availability increased expression at warmer water temperatures

Survival and movement

- 2.3% of fish were deeply hooked
- Steelhead survival was high at 95.5% by November, 2016
- The furthest movement upstream after capture was 61km
- Only 3 steelhead moved up to the Morice River as of April, 2017
- Estimated total pre-spawn mortality was 15.0% (13.5-25.0)

Dip net capture (different capture gear 35 steelhead tagged)

- Intermediate term (2-week) migration rates of steelhead captured by dip net were negatively correlated with air exposure durations at the time of capture
- Dip net fish captured in warmer water temperature were more likely to drop back below Witset Falls

Microbes and disease

- In the lab we screened steelhead tissue for 47 microbes known to cause disease in salmon species. We found about 10 of these microbes in Bulkley River steelhead, 3 of which were detected in over 50% of individuals
- Most pathogens were at low prevalence and did not seem to influence the physiology of steelhead (immunity, metabolism, or stress), suggesting they have only a small impact on steelhead during September and October when temperatures are cool

We also completed a survey of recreational anglers on the Bulkley River to provide some insight into recreational anglers' perception of threat during the angling event, communication and information channels, as well as their beliefs about science-based C&R best practices. In total, 197 recreational anglers completed the survey.

Social science

- 44% of anglers reported knowing 'a great deal' deal about C&R best practices for Steelhead. Respondents also reported that they think that only 50% of other recreational anglers actually know what best practices are, as well as actually use them (49%).
- Respondents generally supported the use of and need for science and research to identify C&R best practices for steelhead, and believed that the use of C&R best practices can help protect Steelhead populations.
- Respondents agreed (30.5%) and strongly agreed (27.4%) that there is a need for science and research to identify C&R best practices for steelhead. Furthermore, most respondents were either fairly (22.2%), very (17%) or extremely confident (10%) that science-based C&R best practices could help protect Bulkley River steelhead populations.
- Respondents also reported how threatening they perceived different aspects of the angling event is to the welfare of an angled and released steelhead. Respondents viewed air exposure as the most threatening aspect of the angling event, followed by fight time, handling (landing), gear type, and hook damage.

Relevance for Steelhead Conservation:

This research evaluates the role of various angling practices on the physiology, behaviour, and survival of wild steelhead following catch-and-release. Findings from this research will be relevant to fisheries managers attempting to balance the recreational value and conservation needs of the species. We recommend that anglers minimize air exposure to less than 10 sec as fish air exposed for 10 to 30 sec had immediate reflex impairment and immediate downstream movement following release. We also advise anglers to take special care when angling at warmer water temperatures earlier in the season, as water temperature was closely linked with measures of stress in steelhead. Further, this research has identified the main microbes present in Bulkley River steelhead and will provide an important baseline when looking at changes in steelhead microbes in the future.

Media:

For a brief video introduction to the project, check out the following video submission in the NSERC, Science-Action Research Video Contest.
"Angling Steelhead – William Twardek – Carleton University"

https://www.youtube.com/watch?v=6g59nfpLPtw&index=39&list=PL6ox0GB7vXYn-jN-ICu540E1xKalUxyr6

Partners and Supporters:
A special thank you to all organizations and individuals who have provided support for this project. Through funding and in-kind support our research on the Bulkley River was very successful. We are excited to have provided more information about the species' long term-movement in the Bulkley River and how this relates to angling practices. We thank you for your continued collaboration and for sharing our goal of conserving this remarkable fish species for generations to come.

Literature

Andrews, TR., and McSheffrey, HM. 1976. Commercial interceptions of steelhead trout stocks in British Columbia: a preliminary review. B.C. Marine Resources Branch, Fisheries Management Report No. 1, Victoria.

Cooke, SJ., Schramm, HL. 2007. Catch-and-release science and its application to conservation and management of recreational fisheries. Fisheries Management and Ecology 14: 73–79.

J.O. Thomas and Associates Ltd. 2010. Steelhead byatch and mortalities in the commercial Skeena net fisheries of British Columbia from observer data: 1989 to 2009. Report prepared for the Pacific Salmon Foundation and British Columbia Ministry of Environment, Skeena Region

National Research Center (NRC). 1996. Upstream: Salmon and Society in the Pacific Northwest. National Academies Press, Washington, D.C

Nelson, TC., Rosenau, ML., Johnston, NT. 2005. behavior and survival of wild and hatchery-origin winter steelhead spawners caught and released in a recreational fishery. North American Journal of Fisheries Management 25: 931–943.

Penney, ZL., and Moffitt, CM. 2013. Proximate composition and energy density of stream-maturing adult steelhead during upstream migration, sexual maturity, and kelt emigration. Transactions of the American Fisheries Society 143: 399-413.

Stewart, RWJ., and Lewynsky, VA. 1988. Report: Interception of steelhead trout (*Salmo gairdneri*) in the Indian fishery of the Fraser River, September through November, 1986. Ministry of Environment and Parks, BC.

Suttle, KB., Power, ME., Levine, JM., McNeely, C. How fine sediment in riverbeds impairs growth and survival of juvenile salmonids. Ecological Applications 14: 969-974.

Wade, AA., Beechie, T.J., Fleishman, E., Mantua, NJ., Wu, H., Kimball, JS., Stoms, DM., Stanford, JA. 2013. Steelhead vulnerability to climate change in the Pacific Northwest. Journal of Applied Ecology 50: 1093-1104.