Alberta Conservation Association
2008/09 Project Summary Report

Project Name: *Road Developments and Habitat Fragmentation of Sportfish and Non-Sportfish Species in the Athabasca River Basin*

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Partnerships: Alberta Sustainable Resource Development, University of Alberta

Preliminary Findings:

- In the Freeman River watershed, 46% of stream crossings with culverts were hanging (n=33 total), while 69% surveyed in the Sakwatamau River watershed were hanging (n=118 total).
- Hanging culverts have higher upstream (versus downstream) catch rates for the strong-swimming salmonid fish species (rainbow trout, mountain whitefish, Arctic grayling).
- Stream crossings appear to affect fish distributions (i.e., abundance differed between upstream and downstream transects), but the effect is dependent on fish type (i.e., sportfish versus non-sportfish) and crossing type (i.e., bridge versus non-hanging culvert versus hanging culvert).
- Electrofishing efficiency (or detectability) for Arctic grayling in wadeable streams appears to be very low.

Abstract

Recent reports on the status of Arctic grayling in Alberta suggest that populations have declined by as much as 50 to 90%. Habitat fragmentation caused by stream crossings and the cumulative effects of roads may be contributing to declines. Our primary objective was to examine the effects of stream crossings on sportfish, including Arctic grayling, and non-sportfish by comparing abundance above and below crossings on wadeable stream sections in Freeman and Sakwatamau River watersheds. Based on preliminary results, 46% of culverts in the Freeman River watershed (n=33 total), and 69% of those surveyed in the Sakwatamau River watershed (n=118 total) were hanging (i.e., having a physical drop from the culvert outlet to the stream below). These crossing structures have the potential to impede upstream fish passage. Based on backpack electrofishing, all crossing types appeared to affect fish distributions, but the effect on fish abundance was dependent on fish species and crossing type (i.e. culvert versus bridge). Analyses are on-

going and additional field sampling combined with GIS work being planned for 2009-2010 will clarify trends. It is important to note that low electrofishing detectability combined with low numbers of Arctic grayling precluded a rigorous statistical analysis. A more detailed evaluation of sampling methods for Arctic Grayling in wadeable stream will be a component of our 2009-2010 work plans. Results from this study will draw attention to the importance of appropriate mitigation measures that should be used by industry and regulated by governmental legislation.

Introduction

In Alberta, Arctic grayling populations have experienced severe declines in the past 50 years, and it is believed that improperly-installed culvert crossings may be a major contributing factor (ASRD 2005). Previous road-fish studies in Alberta have focused solely on crossing inventories (see Park et al. 2008). This project combined a crossing structure inventory with intensive fish sampling in the Freeman and Sakwatamau River drainage basins near Whitecourt, AB. The purpose of our project was to not only determine the extent of stream crossing problems through an inventory of crossing structures, but to also determine whether stream crossings were impacting Arctic grayling (ARGR) populations, as well as fish communities. We predict that stream fish will be unaffected by bridge and non-hanging culvert structures (i.e., abundance will be similar above and below these crossing structures). In contrast, we predict stream fish to be affected by hanging culverts, where there is a physical drop from the culvert outlet to the stream below (i.e., abundance will be lower at upstream versus downstream locations). We also predict that non-sportfish will be more influenced by crossing structures than sportfish, because non-sportfish are weaker swimmers. Another (secondary) objective of our 2008 field work was to evaluate electrofishing as a method for sampling ARGR in wadeable streams. The results of our research will have management implications, and provide valuable information on the landscape-level effects of road development on fish populations in Alberta. Work summarized below builds on studies conducted during 2007-2008 and is an on-going project with additional work being planned for the 2009 field season.

Methods

During the 2008 field season we conducted stream crossing inventories in the Freeman River and Sakwatamau River drainages. For more information regarding inventory protocols see McCleary et al. (2006). In the Freeman River drainage, we assessed 22 stream crossing sites. Because some culvert crossings sites can consist of multiple culverts, these 22 sites had 7 bridges and 27 culverts. In the Sakwatamau River, we assessed 105 crossing sites consisting of 19 bridges and 99 culverts. Culverts were classified as hanging if there was a physical drop of >0.01 m from the outlet to the pool below. We primarily used single-pass electrofishing to sample fish along 300-m sections that were located both upstream and downstream of crossings. We surveyed for fish at 22 sites in the Freeman River and 34 sites in Sakwatamau River. This method was supplemented with angling, as well as multiple-pass electrofishing at a sub-set of sites (*n*=5) for estimation of ARGR detectability (*q*) in wadeable streams. At electrofishing sites, we collected biological information (weight, total length, species identification) and habitat data (stream width, substrate type, temperature, water chemistry data). We also recorded electrofishing seconds for later calculations of catch-per-unit effort. To identify recaptured fish the adipose fin of ARGR was clipped on sites that were electrofished multiple times (*n*=5). We preserved this tissue in ethanol for possible genetic work. After measurements were taken, we returned fish to their respective capture locations. For analyses, fish were divided by swimming ability. Weak-swimming fish species were burbot, brook stickleback, lake chub, pearl dace, longnose dace, northern redbelly dace, trout perch, white sucker, and longnose sucker. Strong-swimming fish species were ARGR, rainbow trout, and mountain whitefish.

Preliminary Results

Of the culvert crossings inventoried in the Freeman River (*n*=33 in total), 46% were hanging. Of the Sakwatamau River culverts (*n*=99), 69% were identified as being hanging.

Both bridges and non-hanging culverts (i.e., those without a hang height) resulted in lower (by 62 to 68%) downstream catch rates of weaker swimming, non-sportfish species compared to upstream catch rates (see Figure 1a). In contrast, the trend in non-sportfish abundance at hanging culvert locations was not as strong, but as predicted, catch rate was lower at upstream sites (by 37%) than at downstream sites. For stronger swimming sportfish (salmonids), we observed lower downstream catches at bridges and hanging culverts (52 to 75% decrease; Figure 1b) compared to upstream sites. There were minimal influences of non-hanging culverts on salmonid catch (only 27% decrease in upstream catch).

Arctic grayling occurred at 41% of the Freeman River sites and 24% of the Sakwatamau River sites. We failed to capture high numbers of ARGR for the identification of possible trends in abundance (Figure 1c).

Based on three passes of electrofishing, we captured a total of 158 ARGR. Of these, we marked 104 (no fish were marked during the third pass). We recaptured only 16% of marked fish during subsequent passes suggesting that detectability (*q*) is low. Future work will quantify detectability using mark-recapture methods.

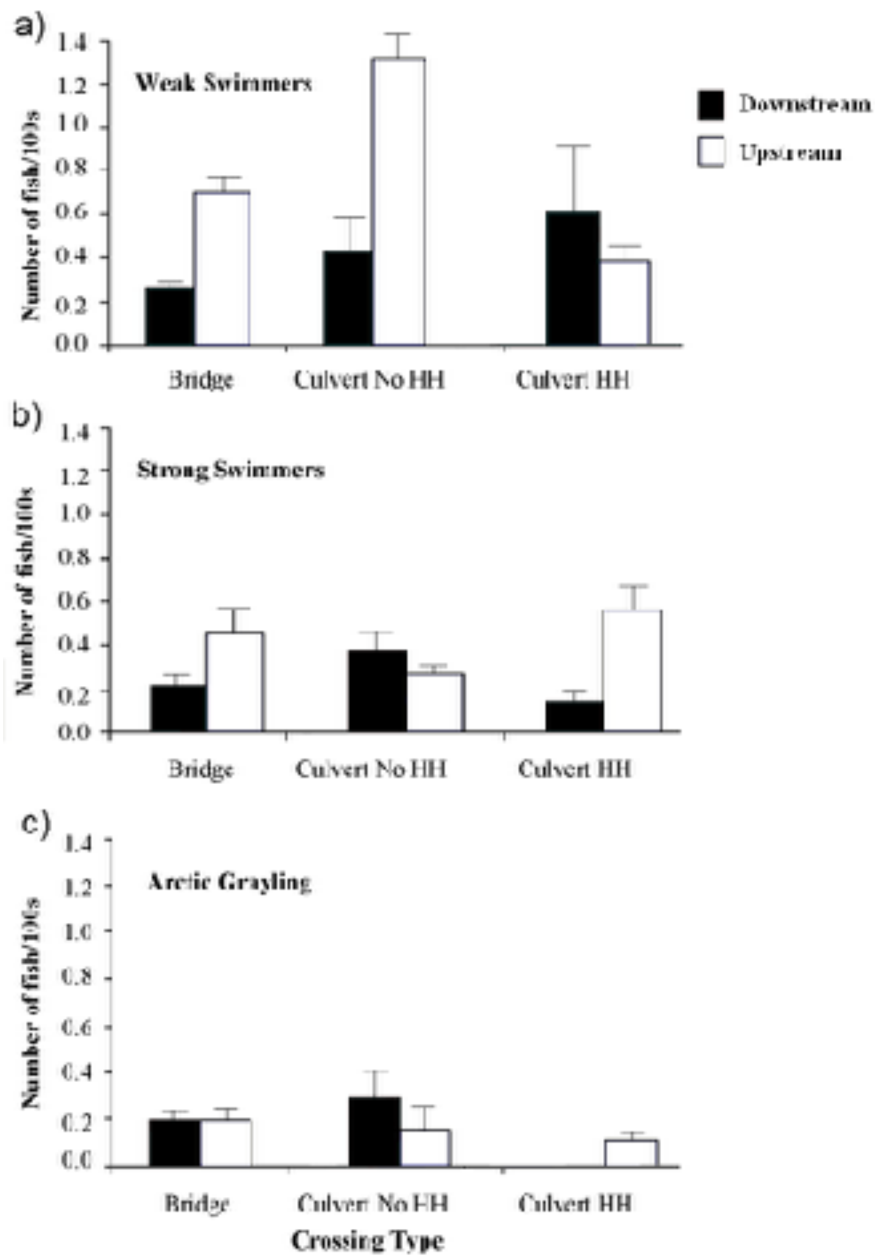

Figure 1. Comparison of mean number (±SE) of fish caught upstream and downstream of bridge and culvert crossings with (HH) and without ((No HH) hang height. Fish were divided by swimming ability: a) weak swimming fish species (burbot, brook stickleback, lake chub, pearl dace, longnose dace, northern redbelly dace, trout perch, white suckers, longnose suckers), and b) strong swimming fish species (Arctic grayling, rainbow trout, mountain whitefish); Arctic grayling catch rates are in a separate figure (c).

Conclusions

Under the federal *Fisheries Act*, stream crossings must allow safe passage to all fish species at all life stages. Our inventory of stream crossings in the Freeman River and Sakwatamau River watersheds indicates that road crossings influence the distributions of fish. Preliminary analysis indicates that fewer fish are at downstream locations, which is contrary to what was expected. Analyses are on-going and additional field sampling combined with GIS work being planned for 2009-2010 will help clarify trends and cumulative influences of roads. It is important to note that low electrofishing detectability combined with low numbers of Arctic grayling precluded a rigorous statistical analysis. A more detailed evaluation of sampling methods for Arctic grayling in wadeable stream will be a component of our 2009-2010 work plans.

Communications

N/A

Literature Cited

Alberta Sustainable Resource Development. 2005. Status of the Arctic grayling (*Thymallus arcticus)* in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, and Alberta Conservation Association, Wildlife Status Report No. 57, Edmonton,AB. 41pp.

Haskins, W., and D. Mayhood. 1997. Stream crossing density as a predictor of watershed impacts. Proceedings of the Seventeenth Annual ESRI User Conference Paper 457.

McCleary, R., C. Spytz, H. Schindler, and R. Anderson. 2006. Stream crossing inspection manual. Version 1. C.R. Bamsey, ed. Clear Lake Ltd. Edmonton, AB.

Park, D., M. Sullivan, E. Bayne, and G. Scrimgeour. 2008. Landscape-level stream fragmentation caused by hanging culverts along roads in Alberta's forest. Canadian Journal of Forest Research 38: 566-575.

Warren, Jr., M.L., and M.G. Pardew. 1998. Road crossings as barriers to small stream fish movement. Transactions of the American Fisheries Society 127: 637-644.

APPENDIX

Photographs from the 2008 field program.

Photo 1. Laura MacPherson electrofishing a stream in the Sakwatamau River drainage.
Photocredit Troy Furukawa

Photo 2. Hanging culvert in the Sakwatamau River drainage. Photocredit Laura MacPherson

Photo 3. Typical sampling site in the Sakwatamau stream. Photocredit Laura MacPherson

Photo 4. Typical sampling site in the Freeman stream. Photocredit Laura MacPherson