DO FISH RESPOND TO HABITAT IMPROVEMENTS?

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EXTENDED ABSTRACT ONLY - DO NOT CITE

In earlier work, one of us showed that wild coho salmon (*Oncorhynchus kisutch*) showed significantly greater increases in gill Na^+,K^+-ATPase activity during the spring than their hatchery-reared counterparts (Shrimpton et al. 1994). This translated into lower perturbations in plasma sodium and greater survival during saltwater challenge tests for wild compared to hatchery coho. Rearing environment, therefore, has a profound effect on growth, performance, and ultimately survival of fish. Even in natural habitat, however, disturbances have the potential to impact the aquatic ecosystem and affect fish. An example of habitat disturbance is the construction of roads which often run parallel to many large rivers, and intersect the numerous tributaries that feed into these rivers. In the past little attention was given to the changes in fish habitat caused by these stream crossings and effect of these changes on fish populations. At many of the stream crossings, culverts were installed that prevented or restricted movement of fish above the road, reducing fish populations through a loss of habitat that may be important for juvenile rearing and / or spawning. We have conducted a number of studies to determine where habitat important for spawning is located, characterize factors that make this habitat suitable for spawning, assess how available area for spawning is related to population size, and determine whether fish utilize newly created habitat.

From a radio telemetry study on bull trout (*Salvelinus confluentus*) in the Morice River watershed, we determined areas selected for spawning. Spawning locations were identified during helicopter tracking flights and confirmed by visual

observation from the ground. Entry to the spawning grounds was variable, and spanned from June to September in the two years of the study. The locations for spawning of the radiotagged bull trout, however, were limited to specific reaches of only seven tributaries within the watershed in both years. Fish that spawned in both years, were found to utilize the same area for spawning, indicating bull trout home to natal streams similar to other salmonids (Quinn 1993).

We examined factors associated with habitat selection for spawning by bull trout in rivers that flow into the Finlay Arm of the Williston Reservoir. Microhabitat factors including stream flow, depth and substrate size were qualitatively similar between the spawning and non-spawning areas within these rivers; yet redds were only found in reaches of these streams with high intragravel flow and thermal regimes representative of moderate groundwater input. In an incubation study we found that slight elevations in water temperature significantly advanced the time for both hatch and button-up, but the number of degree days to reach these stages of development were significantly increased. Groundwater may contribute to the stability of the incubation environment and potentially incubation success, as measured by survival. Baxter and McPhail (1999) hypothesized that spawning sites with appropriate characteristics for successful incubation were limited and fish were actively seeking and spawning in areas with groundwater flow.

To assess the importance of size of spawning area, we examined genetic diversity in five populations of spawning chinook salmon (*O. tshawytscha*) from the upper Fraser River watershed (British Columbia, Canada). Eleven microsatellite loci were examined over 20 years using DNA extracted from archived scale samples. We tested for changes in genetic diversity, calculated the Effective Population Size (N_e) from the temporal change in allele frequency (Waples 1990), and compared this statistic to annual census estimates. Over the last two decades, population size has increased in all five populations of chinook examined; however N_e calculated for each population was low (87 - 329). Large scale historic barriers to migration and development activities do not appear to account for the low values of N_e; however, available spawning area is positively correlated with N_e. This positive correlations suggests that maintaining or enhancing spawning area is important for preventing declines in N_e.

Given the specific habitat requirements and homing tendency of salmonids, we investigated whether modifications that provide access to new habitat will be utilized by fish. Five stream improvement projects were conducted to increase fish passage in tributaries of the Torpy River, BC. Historically, culverts were installed at the road crossings for all five tributaries; all culverts were Ahanging@ on the

downstream side of the road creating a water drop of up to 1.39m. We sampled these streams for fish abundance prior to installation of bridges. Only two species of fish were found in any of the streams examined; rainbow trout (*O. mykiss*) and bull trout. Abundance of fish was greater below the road than above for all streams. In two of the streams, the vertical drop from the hanging culvert was more than 1.15 m and fish were not found above the road. In streams where fish were captured above the road, many young-of-the-year were captured indicating spawning by adults above the road.

Fish sampling conducted the year following habitat improvements found fish above the road on four of the streams, but no fish were found above the road in stream 19 (Figure 1). The sampling effort in the summer two years following culvert removal, however, was successful in finding bull trout above the road. Sampling proved that the gradient and water velocity were not too great for fish movement to occur above the road. Young-of-the-year (bull trout <5.0 cm) were observed above the road in stream 19 and it appears that there was spawning activity the previous fall above the road. The small fish observed above the road would likely not be able to migrate above the road due to water velocities measured at several locations. In addition a 25 cm bull trout was caught at the end of August above the road in stream 19 displaying spawning colouration and morphological characteristics. Milt was also easily expressed from this fish.

Culverts likely restricted access to upstream tributary habitat for Torpy River fish populations. The habitat restoration projects conducted appear to have been successful in improving availability of fish habitat. This work shows that bull trout will move into newly created habitat despite the high level of spawning site fidelity observed and specific habitat requirements needed by this species.

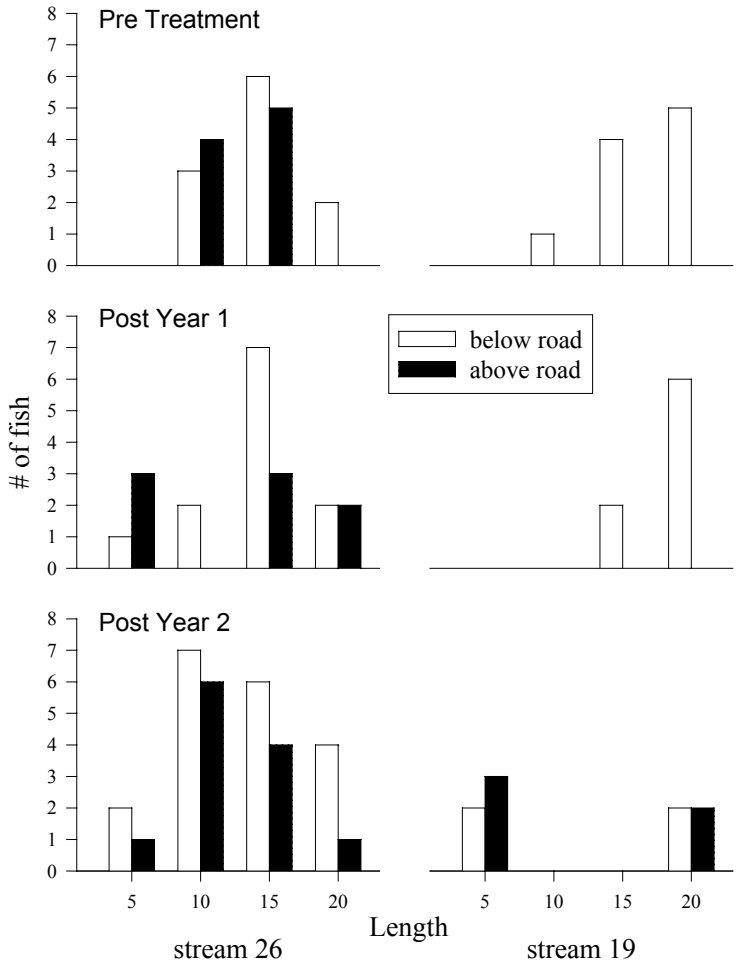

Figure 1. Abundance of different size classes (length in cm) of bull trout captured above and below the road in two tributary streams to the Torpy River, BC. Streams were sampled prior to culvert removal and for two years following the installation of bridges.

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