

The Effects of the Fish Ladder on Waughs River, Nova Scotia

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Abstract

An Alaskan steeppass fish ladder was installed at The Falls, an impassable cascade on Waughs River, Colchester County, Nova Scotia, in 2009, providing passage to anadromous fish which had been excluded from the habitat above The Falls for 140 years. The fish population above The Falls was also augmented with hatchery-reared fish from broodstock collected below the barrier. This thesis assessed the success of the fish ladder and the effects of re-introduced salmonids on upstream communities and ecosystem processes. I expected that the addition of anadromous fish to the habitat above The Falls would result in a restructuring of the resident fish community, that the abundance and diversity of benthic invertebrates would decline, and thus, the rate of litter decomposition would decrease.

Capture-mark-recapture electrofishing was used to estimate populations of salmonids at three sites above and three sites below The Falls, before and after the fish ladder was installed. Yearly redd counts were conducted to confirm spawning above the fish ladder. Benthic invertebrates were sampled at five locations above and below The Falls on three occasions. Litter decomposition at two sites upstream from the fish ladder was measured before and after salmon were introduced above the fish ladder using litter bags of coarse (5 mm) and fine (0.25 mm) mesh, installed in the river for up to six weeks. Invertebrates from coarse mesh litter bags were collected and identified.

In 2010, salmon spawned above The Falls for the first time in over 140 years. Furthermore, the number of salmon redds above The Falls increased from 16 in 2010 to 33 in 2012. The ladder was successful at allowing anadromous fish to ascend, but salmon did not become the dominant fish species above The Falls. In 2011, the estimated population of brown trout fry at the most upstream site was the largest at 809.5 fry per 100 m² and there were significantly more brook trout at the most upstream site than at any other study site. Even though the number of brook trout fry increased, the number surviving to parr stage decreased. The number of juvenile brown trout and brook trout increased with distance upstream after the ladder was installed. It is likely that tributaries were important habitat in the recolonization of the river.

The average density of benthic invertebrates was 2156 ± 1115 m⁻² and average Shannon diversity was 3.1 ± 0.6. Newly colonizing salmon had no effect on invertebrate communities above The Falls; however, diversity of invertebrates was lower at the site below The Falls with the largest juvenile fish population. Fish density at other sites was likely too low to affect invertebrate diversity.

The litter decomposition rate was fast ($k = 0.016 \text{ day}^{-1}$) but did not vary with the change in fish abundance. The fish density applied here (0.5 fish m⁻²) may be too low to affect the decomposition rate. The mean number of shredders per litter bag was 12.0 ± 13.3, and 70% of these were the cased caddisfly, *Lepidostoma*. The number of shredders on litter bags varied significantly between years and sites, but there was no difference attributable to a change in the fish population. Approximately 10% of mass loss from decaying litter was due to the effects of shredders; the addition of fish did not alter their contribution. It is likely that the addition of fish has not yet had an effect on the upstream ecosystem due to an abundance of unoccupied habitat above The Falls.