CHANGES IN FISH POPULATIONS AND HABITAT AT A RECLAIMED MULTIPLE RIGHT-OF-WAY STREAM CROSSING[1]

by
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Abstract. Between 1964 and 1973, two large diameter pipelines and a power transmission line were constructed across the Raven River in western Alberta. The stream channel within the right-of-way after construction was wider, shallower and had little cover for fish, and the streambanks lacked a stable riparian vegetation community. Little natural recovery of the fish habitat within the disturbed channel has occurred since the last disturbance in 1973. In 1984, a project to reclaim the channel and evaluate the effect of the reclamation on habitat and fish populations was initiated. Bank overhang, logs, stumps and woody debris and aquatic vegetation were measured during the spring and summer from August 1984 to August 1988. Reclamation measures used were vertical log wall, artificial plank overhang, stumps, log deflectors and tree revetments. Reclamation measures increased the amount of available log and stump cover by an average of 146%, and bank overhang cover increased by an average of 245%. Fish populations were investigated by electrofishing to obtain data on abundance, age, growth and habitat utilization in the reclaimed section and in a control section. Trout numbers exhibited a general increase over the study period. The young-of-the-year cohort of the brook trout population and the one-year-old-and-older cohort of the brown trout population showed moderate increases in abundance in response to the reclamation. Increases in the abundance of the one-year-old-and-older cohort of the brook trout population attributed to the reclamation measures exceeded 350%.

Additional Key Words: streambank reclamation, fish populations, right-of-way reclamation.

Introduction

Between 1964 and 1974, two large diameter underground pipelines and an overhead power transmission line were constructed across the Raven River in western Alberta (52°02'50"N, 114°53'30"W). Twenty years after the first disturbance at this site, visual comparison with adjacent undisturbed reaches of the river revealed that in-stream fish habitat within the right-of-way had recovered only marginally. The stream channel through the right-of-way was shallower and more exposed, with less cover, and had

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a less diverse riparian vegetation community than the undisturbed channel.

In 1984, a program of reclamation and research was initiated at this site to evaluate changes in fish populations and habitat as a result of reclamation.

Study Area

The Raven River is a foothills trout stream with stable flow regimes such that stable, high-quality habitat for cold water fish species has evolved. Both eastern brook trout (Salvelinus fontinalis) and brown trout (Salmo trutta) were introduced and have subsequently established self-reproducing populations. The study used two sections; Section A encompassed the multiple right-of-way, and Section B was an undisturbed portion of the Raven River immediately downstream of Section A.

Methods

Fish populations were sampled with backpack fish shockers. Population estimates were determined using the Chapman modification of the Peterson mark/recapture formula (Ricker 1975). Criteria for validity of the estimates were taken from Robson and Regier (1968). Ranges were calculated using the 95% confidence interval and a "t" test (P = 0.05) was used to determine the significance of differences between parameters. Correlation analyses were used to examine the relationships of a number of parameters (Robson and Regier 1968).

Electrofishing was conducted in Section A in August 1984 and in both sections in both April and August from 1985 to 1988.

Habitat conditions prior to and after reclamation in Section A were measured using two methods, both involved the use of line transects established at right angles to the flow. At each transect the extent of aquatic vegetation, logs, stumps and woody debris and overhanging bank was measured. These measurements were then used to calculate the area (m^2) of each habitat component. In addition, six permanent transects were established where data on channel width, water depths, substrate and cover was collected and compared to transects established in Section B.

Reclamation was done in May 1985 and July 1988. A total of 120 metres of anchored vertical log wall were placed along those sections of bank deemed most unstable and offering the least cover. Portions of two of the log wall sections included an artificial underwater plank overhang, and portions of two sections incorporated an above-water deck overhang. Nineteen stumps with root wads were anchored at various locations along the log walls. A tree revetment was placed upstream of one log wall and two log deflectors were placed in the stream channel. The areas backfilled behind the log walls were revegetated by seeding a grass/legume mixture, transplanting native shrubs and fertilizing. The configuration of the reclamation measures is summarized in Figure 1.

Results

Habitat

The reclamation completed in 1985 increased the amount of log and stump cover by 17.3 m^2 (132%), and bank overhang cover by 16.5 m^2 (175%) over

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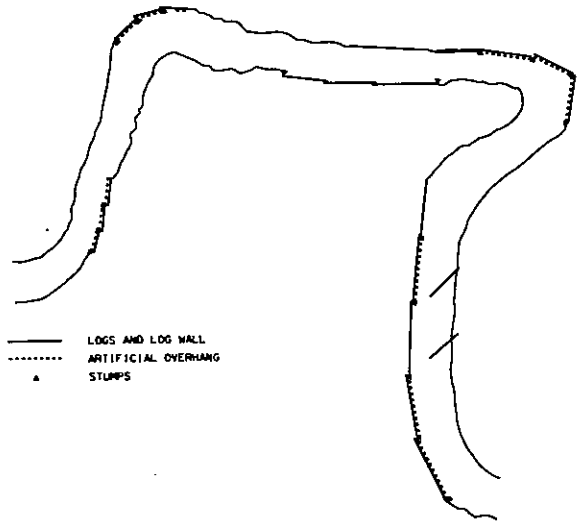

Figure 1. Configuration of Reclamation Measures

1984. The reclamation completed in 1988 increased log and stump cover by an additional 5.67 m^2 (24%) and bank overhang cover by 17.42 m^2 (79%). A major flood in the summer of 1986 substantially reduced the amount of naturally occurring logs, stumps, and bank overhang in the study section. In Section A there was greater than 50% reduction in log and stump cover and nearly a 50% reduction in natural bank overhang as a result of the flood. However, the flood had little effect on the artificial structures.

Fish Populations

Fish populations varied over the study period. The number of young-of-the-year brown trout in the reclaimed section varied from a low of 43.8/100 m in 1985 to a maximum of 2523.8/100 m in 1987. The number of young-of-the-year brown trout was correlated with the discharge in the previous spawning season ($P<0.05$), and was not related to habitat availability. The number of one-year-old-and-older brown trout ranged from a minimum of 40.2/100 m in 1986 to a maximum of 322.8/100 m in 1988. The abundance of the one-year-old-and-older cohort in the reclaimed section was dependent on both area of available cover and year class strength. This relationship was so strong that the effects of year class strength and habitat could not be separated (Multiple Correlation Analysis).

Young-of-the-year brook trout numbers in the reclaimed section ranged from 39.8/100 m in 1984 (before reclamation) to a high of 302.5/100 m in 1988. Young-of-the-year brook trout numbers were consistently higher in the reclaimed section than in the control section. These differences were statistically significant ($P = 0.05$) in three of four years. Although the relationships between a number of environmental and biological variables and young-of-the-year brook trout numbers were consistently poor. The abundance of the one-year-old-and-older cohort of the brook trout population in the reclaimed section ranged from 23.9/100 m in 1987 to a maximum of 42.2/100 m in 1988. The area of available cover was strongly correlated to the abundance of this cohort ($r = 0.83084$, significant at $P = 0.05$). The one-year-old-and-older segment of the brook trout population was consistently more abundant in the reclaimed section than in the control section.

Discussion

Young-of-the-year brown trout increased in abundance in the reclaimed section of the stream channel, but not in response to the reclamation measures. The one-year-old-and-older cohort of the brown trout population responded positively to the increased cover resulting from reclamation. However, their numbers were also positively related to year class strength. Lowry (1971) suggested that increasing abundance of young brown trout might be affected more by other environmental variables than by

habitat enhancement, whereas the positive response of older brown trout in enhanced streams is largely directly due to habitat improvements.

Saunders and Smith (1962), Hunt (1971, 1976) and Latta (1972) noted that one-year-old-and-older brook trout exhibited a greater positive response to habitat improvements than did the age 0 (young-of-the-year) cohort. In the Raven River, both the age 0 and the one-year-old-and-older cohorts of the brook trout population responded positively to the reclamation measures. The one-year-old-and-older segment of the brook trout population exhibited the strongest response of any cohort, although the magnitude of the changes was less than that demonstrated by the brown trout population.

Literature Cited

Hunt, R. L. 1971. Responses of a brook trout population to habitat development in Lawrence Creek. Wisconsin Department of Natural Resources, Technical Bulletin No. 48, 35 pp.

Hunt, R. L. 1976. A long-term evaluation of trout habitat development and its relation to improving management related research. Transactions of the American Fisheries Society 105:361-364.

Latta, W. C. 1972. The effects of stream improvement upon the angler's catch and standing crop of trout in the Pigeon River, Otsego County, Michigan. Michigan Department of Natural Resources, Research and Development Report No. 265, 57 pp.

Lowry, G. R. 1971. Effect of habitat alteration on brown trout in McKenzie Creek, Wisconsin. Wisconsin Department of Natural Resources, Research Report No. 70, 27pp.

Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Fisheries Research Board of Canada, Bulletin 191, 382 pp.

Robson, D. S. and H. A. Regier. 1968. Estimation of population number and mortality rates. pp. 124-158 in Ricker, W. E. (ed.). Methods for Assessment of Fish Production in Fresh Waters. IPB Handbook No. 3, Blackwell, Oxford.

Saunders, J. W. and M. W. Smith. 1962. Physical alteration of stream habitat to improve brook trout production. Transactions of the American Fisheries Society 91:185-188.