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Sediment Removal as a Means of Stream Habitat Improvement[1]

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INTRODUCTION

Some consequences of the presence of substantial quantities of deposited sediment in streams have been well documented, especially the effects on reproductive success of salmonids. However, accumulated sediment may be equally detrimental in some streams by reducing both the amount of living space available for trout and the production of aquatic invertebrates. The resulting reduction in water depth may render the habitat unsuitable for fish, especially for larger individuals and for those species primarily relying upon water depth as cover. Fish populations potentially could be affected during both summer and winter.

Using a suction dredge, we sought to remove sediment from short segments of a stream choked with sediment to evaluate the response of fish, aquatic invertebrates, and aquatic vegetation. This technique has recently been used to improve trout habitat in Hot Creek, California (Parker 1981), but to our knowledge no previous study has systematically evaluated the response of the aquatic community to sediment removal from streams.

We worked on a tributary of Silver Creek (Blaine County, Idaho) holding rainbow and brook trout. The Silver Creek system has received large quantities of sediment from agricultural activities in the watershed (Manuel et al. 1979) but at present an active program of The Nature Conservancy to acquire land and secure riparian easements is reducing sediment inputs to the stream. It is largely a spring-fed system, and spring season flows are not great enough to naturally flush sediment. Because of a desire by The Nature Conservancy to maintain the stream in as natural a state as possible, sediment removal, if feasible, is preferable to the construction of in-stream structures to enhance trout habitat.

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METHODS

The tributary of Silver Creek that we studied was Mud Creek, a low-gradient stream (elevation 1490 m) with average width in the study area of about 4.5 m and summer discharge of approximately 0.3 m^3/sec. Sediment was removed from two 35 m-long sections, with sections of the same length immediately above and below the test sections studied as controls. One of the sections partially refilled with sediment after dredging and results from that section will not be included here.

A suction dredge developed by the US Forest Service Missoula Equipment Development Center for cleaning spawning gravel was utilized. The pump (Pacific Pumper Mark 3) is a lightweight unit designed for fire supression and has a capacity of 4.4 l/sec (70 gpm). A 7.5 cm-diameter suction nozzle was coupled to a Pardee eductor. Sediment was pumped onto the bank about 50 m from the stream where it was trapped and held by dense vegetation without problems of returning to the stream; separators are available to remove sediment from the water discharge, but we found them unnecessary in this instance.

Dredging was initiated at the head of a section and progressed downstream. Approximately 80 man-hours were needed for a two-person crew to dredge each 170 m^2 section. Average depths of water and sediment before dredging was accomplished on 9-15 June 1982 were 29 and 73 cm, respectively. After dredging an average of 25 cm remained over a firm clay bottom, although a substantial portion of the section had sediment depths of $<$ 15 cm. Water depth was doubled to 58 cm and average water velocity dropped from 19 to 12 cm/sec following sediment removal.

Fish populations were monitored in test and control sections by electroshocking with block nets in mid-October 1981 and mid-March 1982 preceeding dredging, on 8 June immediately before dredging, and then by electroshocking and snorkeling at approximately two-week intervals during the summer of 1982. At each of these dates a series of Hess net samples were taken to assess invertebrate abundance, and the composition and abundance of macrophytes was also monitored.

RESULTS

For trout longer than 13 cm, numbers in October 1981 were relatively consistent, with about 20 fish/section. Macrophyte growth, especially Chara, was heavy at this time, providing cover and increasing water depth. Most fish present were brook trout (Table 1). In the following spring (mid-March 1982), however, all sections were virtually devoid of fish, suggesting unsuitable overwintering conditions. Fish numbers increased somewhat before sediment removal in mid-June.

Table 1. Numbers of trout > 13 cm found in study sections of Mud Creek before and after sediment removal.

Date	test brook	test rainbow	upper control brook	upper control rainbow	lower control brook	lower control rainbow
17 Oct. 1981	16	3	12	4	18	3
15 Mar. 1982	1	0	0	1	0	2
8 June 1982	6	0	2	0	4	0
.... sediment removal						
25 June	7	0	0	0	2	0
13 July	10	0	1	0	2	0
29 July	8	0	0	0	4	4
9 Aug.	7	1	0	0	1	0
20 Aug.	5	1	0	0	0	0

Following sediment removal, numbers of trout > 13 cm increased in the test section to numbers several times greater than those found in either control section but not appreciably greater than in the test section before dredging.

Numbers of young-of-the-year (nearly all brook trout) declined in the test section following dredging. Immediately before dredging there were 24 present and this number dropped to 6 ± 2 throughout the summer. Young-of-the-year numbers remained relatively constant at about 20 and 10 in the upper and lower control sections, respectively.

Invertebrates in the area before dredging were low in abundance and diversity, with chironomids and oligichaetes heavily dominating. Analysis of post-dredging samples is not yet complete, but recolonization appears very slow.

All study areas are normally heavily vegetated with dense beds of Chara with scattered Potamogeton. After dredging, Chara was very slow to reestablish, reaching a height of 1-2 cm at the end of August.

EVALUATION

Although sediment removal may have potential in providing additional habitat for large trout in streams, more data must be gathered before judging the cost-effectiveness and feasibility of the technique. This study will continue to evaluate changes throughout the coming winter and summer, and additional areas will be dredged in 1983. Spring flows in 1983 may refill the dredged area with sediment, and this will be monitored closely.

In spring ponds in Wisconsin, hydraulic dredging was effective in tripling brook trout biomass, reducing aquatic vegetation by 90%, and increasing discharge of springs by 40%. At dredging costs of $0.50 - $2.00, it was viewed as economically feasible(Carline & Brynildson 1977). Its value under lotic conditions remains to be seen.

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